

**PLUS:** CHECK YOUR CHROMEBOOK'S EXPIRATION DATE

# PCWorld

OCTOBER 2020

FROM IDG

I SWITCHED FROM THE **iPHONE SE** TO THE

# GOOGLE

# PIXEL 4A



9 THINGS  
I LEARNED  
IN THE  
PROCESS



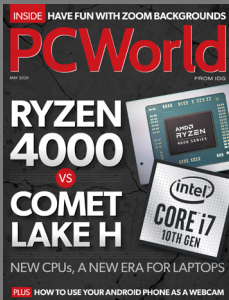


# PLEASE ENJOY THIS FREE ISSUE OF PCWORLD DIGITAL MAGAZINE.

Subscribe through this special issue and unlock **12 months for just \$13.98** (a 30% discount).

**SUBSCRIBE NOW!** 

Click the button or visit:  
[go.pcworld.com/freeissue30](http://go.pcworld.com/freeissue30)



# PCWorld

OCTOBER 2020

## » DEPARTMENTS

## » FEATURES



**7** News



**35** Reviews & Ratings



**89** Here's How



**118** Tech Spotlight



**77** 9 things I learned switching from the iPhone SE to the Pixel 4a



**82** Is your Chromebook about to die?

# PCWorld

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

## **EDITORIAL**

EXECUTIVE EDITORS Melissa Riofrio, Gordon Mah Ung  
SENIOR EDITORS Michael Brown, Brad Chacos, Mark Hachman  
COPY EDITOR Sue Voelkel

## **DESIGN**

DESIGNER Rob Woodcock

## **ADVERTISING**

SALES INQUIRIES [idg.com/contact-us/](https://www.idg.com/contact-us/)

## **FOUNDERS**

FOUNDER David Bunnell  
FOUNDING EDITOR Andrew Fluegelman

## **INTERNATIONAL DATA GROUP, INC.**

CHAIRMAN OF THE BOARD Walter Boyd  
US PRESIDENT, IDG COMMUNICATIONS Charles Lee



### REPRINTS AND PERMISSIONS

You must have permission before reproducing any material from *PCWorld*. Send email requests to [permissions@pcworld.com](mailto: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](http://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](http://pcworld.com/customer)

**EMAIL** [support@pcworld.zendesk.com](mailto: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](mailto: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 38, number 10 *PCWorld*<sup>™</sup> (ISSN 0737-8939) is published monthly at \$24.95 for one year (12 issues) by IDG Communications, Inc. Copyright 2020, IDG Communications, Inc. All rights reserved. *PC World* and *Consumer Watch* are registered trademarks of International Data Group, Inc., and used under license by IDG Communications, Inc. Published in the United States.



# B

is for

building on your  
retirement savings  
every year.



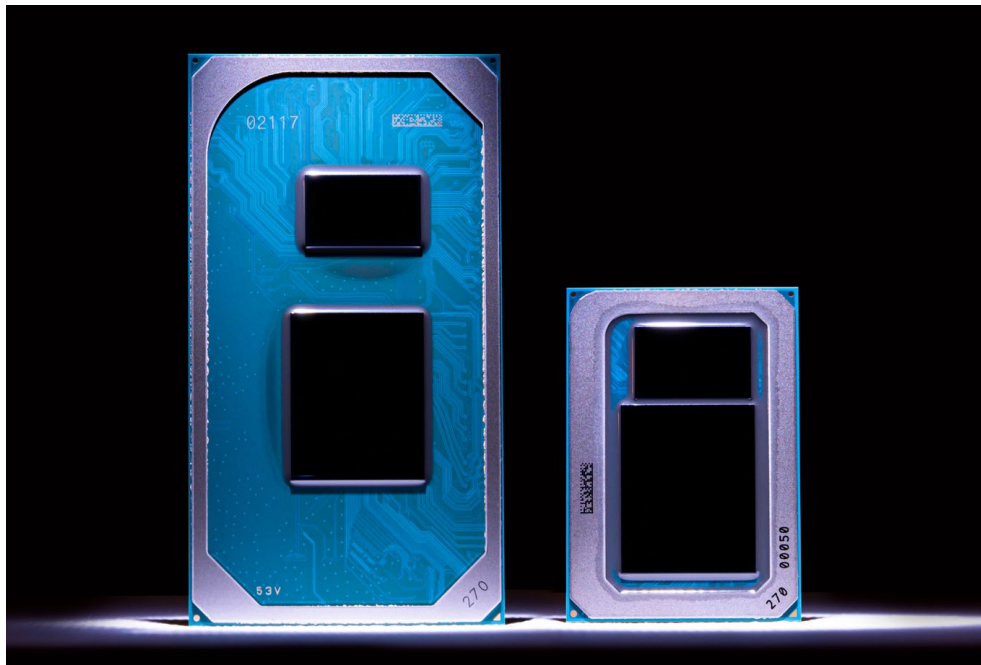
Get more tips from your Retirement Coach **AVO**<sup>SM</sup> at:

***[AceYourRetirement.org](https://www.aceyourretirement.org)***



# Intel launches 11th-gen Tiger Lake CPUs, with blazing-fast clock speeds

But can they topple AMD's Ryzen Mobile parts? **BY MARK HACHMAN**



Intel promised “dramatic” clock-speed increases ([go.pcworld.com/prom](https://go.pcworld.com/prom)) in its 11th-gen “Tiger Lake” Intel Core CPU. It delivered.

In August, Intel surprised us by promising that its new SuperFIN transistor would push Tiger Lake to a greater-than-generational improvement in CPU performance. While that claim will have to wait for actual testing, the numbers help bolster its case: The base clock

speed of the top four-core, eight-thread Core i7-1185G7 reaches 3GHz—far above that of Intel’s flagship 10th-gen Ice Lake chips ([go.pcworld.com/1011](https://go.pcworld.com/1011))—with single-core turbo speeds hitting 4.8GHz.

All told, Intel is launching nine new Tiger Lake processors for notebooks, five of which include the new Xe integrated graphics core. More than 150 designs based on the new 11th-gen Intel Core processors are expected from partners

including Acer, Asus, Dell, Dynabook, HP, Lenovo, LG, MSI, Razer, Samsung, and others, Intel says. Twenty will be “Intel Evo” notebooks ([go.pcworld.com/inev](https://go.pcworld.com/inev)), the new name for Intel’s ongoing Project Athena lineup of collaboratively designed premium notebook PCs. They’ll begin shipping in October (see page 13).

Intel’s making ambitious performance claims, including that Tiger Lake is 2.7 times as fast as “competitive products” in video editing, and that it can add an hour or so of battery compared to Ice Lake. Keep in mind, however, that the current landscape favors AMD’s mobile Ryzen, especially notebook processors like the 8-core, 16-thread Ryzen Mobile 4800U ([go.pcworld.com/480u](https://go.pcworld.com/480u)) that easily compete with Intel’s 10th-gen “Ice

Lake” H-series processors for gaming laptops. Intel hasn’t announced a gaming-class Tiger Lake processor yet, though it’s made the case that Tiger Lake enables thin-and-light gaming performance ([go.pcworld.com/1011](https://go.pcworld.com/1011)) where none existed before.

## TIGER LAKE LOOKS SIGNIFICANTLY FASTER

Intel has talked at length about the architectural details underlying Tiger Lake, but it’s said little about the actual clock frequencies of the chips themselves. Until recently, when Intel unveiled them. The higher-power UP3 series of chips (previously known as the “U” series mobile CPUs for laptops) will include five chips ranging from the dual-core, 3GHz Core i3-1115G4 on up to the quad-core, 3GHz Core

## UP4

Processor number	Intel Core i7-1160G7	Intel Core i5-1130G7	Intel Core i3-1120G4	Intel Core i3-1110G4
Graphics	Intel Iris X	Intel Iris X	Intel UHD Graphics	Intel UHD Graphics
Cores/Threads	4/8	4/8	4/8	2/4
Graphics (EUs)	96	80	48	48
Cache	12MB	8MB	8MB	6MB
Memory	LPDDR4x-4266	LPDDR4x-4266	LPDDR4x-4266	LPDDR4x-4266
Operating range	7-15W	7-15W	7-15W	7-15W
Base Freq (GHz)	1.2	1.1	1.1	1.8
Max Single Core Turbo (GHz, up to)	4.4	4.0	3.5	3.9
Max All Core Turbo (GHz, up to)	3.6	3.4	3.0	3.9
Graphics Max Freq (GHz, up to)	1.1	1.1	1.1	1.1
Intel DL Boost/Intel GMA 2.0	Yes	Yes	Yes	Yes

**Intel’s 11th-gen Tiger Lake processors for thin-and-light notebooks and tablets. It looks as if Intel may differentiate between the UP4 and UP3 chips via model number: A final “0” for UP4 tablet chips, and a final “5” for UP3 notebook processors.**

i7-1185G7. The lower-power UP4 series chips for tablets and thin-and-light PCs (designated in prior generations with the “Y” suffix) includes four processors, ranging from the 1.8GHz dual-core Intel Core i3-1110G4 up to the 1.2GHz quad-core Core i7-1160G7.

In a presentation, Intel quietly amended its product list by saying that the Core i3-1125G4 and Core i3-1120G4 would be available in 2021.

Compared to Intel’s first 10th-gen Ice Lake processors ([go.pcworld.com/1011](https://go.pcworld.com/1011)), several differences stand out with Tiger Lake. Top to bottom, the base clock speeds as well as the single-core turbo speeds are all higher, even significantly so in some cases. The max

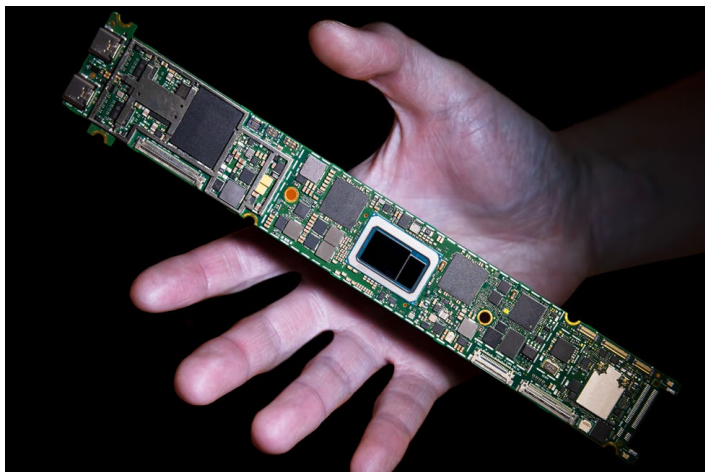


**Acer’s Swift 5 will feature Intel’s 11th-gen Tiger Lake CPU and Xe graphics.**

all-core turbo speeds are higher, too. The closest generational comparison is Ice Lake’s Core i5-1035G1 (1GHz base, 3.6GHz single-core turbo, 3.3GHz all-core turbo) and Tiger

### UP3

Processor number	Intel Core i7-1185G7	Intel Core i7-1165G7	Intel Core i5-1135G7	Intel Core i3-1125G4	Intel Core i3-1115G4
Graphics	Intel Iris X	Intel Iris X	Intel Iris X	Intel UHD Graphics	Intel UHD Graphics
Cores/Threads	4/8	4/8	4/8	4/8	2/4
Graphics (EUs)	96	96	80	48	48
Cache	12MB	12MB	8MB	8MB	6MB
Memory	DDR4-3200 LPDDR4x-4266	DDR4-3200 LPDDR4x-4266	DDR4-3200 LPDDR4x-4266	DDR4-3200 LPDDR4x-3733	DDR4-3200 LPDDR4x-3733
Operating range	12-28W	12-28W	12-28W	12-28W	12-28W
Base Freq (GHz)	3.0	2.8	2.4	2.0	3.0
Max Single Core Turbo (GHz, up to)	4.8	4.7	4.2	3.7	4.1
Max All Core Turbo (GHz, up to)	4.3	4.1	3.8	3.3	4.1
Graphics Max Freq (GHz, up to)	1.35	1.30	1.30	1.25	1.25
Intel DL Boost/Intel GMA 2.0	Yes	Yes	Yes	Yes	Yes



Last year, Intel showed a Tiger Lake motherboard at CES.

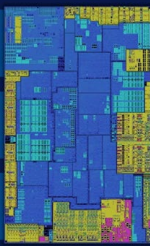
Lake's Core i3-1125G4 (2GHz base, 3.7GHz single-core turbo, 3.3GHz all-core turbo). Actual performance will vary, and will need to be established via testing.

Intel isn't offering as much processor choice as in Ice Lake, as there are five UP3 Tiger Lake processors (versus six Ice Lake-U chips) and four UP4 Tiger Lake processors (compared to five Ice Lake Y-series chips). Intel may identify the lower-power UP4 chips with model numbers ending in zero.

There's a possibly significant difference in operating power. Ice Lake's U-series chips offered a 15W nominal TDP and a 25W "up" TDP, allowing for higher frequencies and performance differences. The information Intel released doesn't make that distinction. Intel hasn't said whether the 12W-28W UP3

processors indicate a nominal TDP of 12W, or whether they're 15W parts with a TDP "down" option of 12W. Intel could be offering laptop makers the option of buying a single processor, and running it in either an unlocked,

**LIVE** 11<sup>th</sup> Gen Intel® Core™ PCH Processor

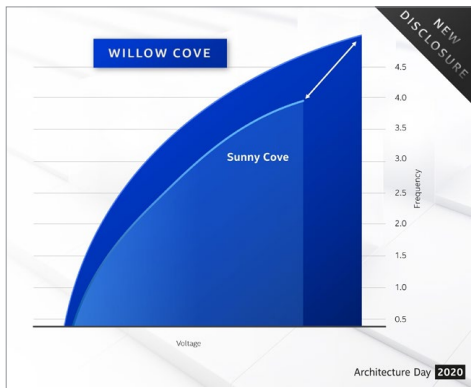
<p><b>Integrated Wi-Fi 6 (Gig+)</b> Integrated 802.11ax MAC (CNVi 2) Discrete RF (Intel® AX201)</p>		<p><b>Audio DSP</b> Programmable Quad Core DSP Low Power Wake-on-Voice USB and BT Audio Offload</p>
<p><b>Integrated Power Delivery</b> Fully Integrated Voltage Regulators CPU and PCH</p>		<p><b>I/O</b> x4 USB3 (x10 USB2) x12 Gen3 PCIe x2 SATA 6 Gbps OPIO x8 Gen3.0</p>
<p><b>4<sup>th</sup> Gen CSME</b> Improved Crypto, Side Channel Resiliency Power and EM monitoring</p>		<p><b>Touch Host Controller (THC)</b> Lower Power, More Responsive Simultaneous Pen + Touch</p>

For more complete information about performance and benchmark results, visit [www.intel.com/11thgen](http://www.intel.com/11thgen) (configuration details in section 3).

intel

Here's the Platform Controller Hub, or chipset, for Tiger Lake notebooks. It will enable the peripheral I/O and other options seen here.





**Intel believes that Tiger Lake offers a wider range of performance-versus-power options than Ice Lake ever did.**

downclocked, or nominal (stock) configuration.

We knew a bit about Intel’s plans for its Xe integrated graphics, because Intel said last month that Tiger Lake would include up to 96 EUs. That’s a bump up from the 64 EUs Ice Lake offered, before any performance improvements from Intel’s new Xe Core (now dubbed Iris Xe) are factored in. Graphics frequencies are higher, too. Tiger Lake’s Xe GPU supports 8K HDR displays and up to four simultaneous 4K HDR displays, as well as Dolby Vision.

Interestingly, Intel is not making any distinction between the graphical capabilities of processors like the Core i7-1185G7 (96EUs, 1.35GHz GPU frequency) and the Core i5-1135G7 (80EUs, 1.3GHz). Both are identified with the same G7 suffix, and both include the Intel Iris Xe branding. There will likely be some differences in graphics

performance between the two that the branding and model numbers won’t disclose.

Otherwise, Intel’s product matrix tells us that the cache sizes will vary among the different processors, affecting performance somewhat. The memory options include the same DDR4-3200 as Ice Lake had, plus a faster LPDDR4X-4266 option that Ice Lake didn’t have. Tiger Lake is also Intel’s first CPU line to support PCI Express Gen4. Tiger Lake notebooks will have up to four ports of Thunderbolt 4 and Wi-Fi 6 (Gig+), too.

## ACTUAL PERFORMANCE REMAINS UNKNOWN

Intel’s recent Intel Architecture Day ([go.pcworld.com/prom](https://go.pcworld.com/prom)) revealed one reason why Tiger Lake represents a greater-than-generational leap in performance: its SuperFIN transistor. According to Ruth Brain, an Intel fellow specializing in technology development and interconnects, the sum total of all of the intranode improvements made in the 14nm generation would be equaled by one intranode performance increase from Ice Lake to Tiger Lake. That’s a generation’s worth of “++” improvements, wiped off the table by the SuperFIN transistor.

That might help explain the greater range in Tiger Lake’s operating power, too, as the “Willow Cove” CPU within Tiger Lake is designed for a broader range of operating power and frequency than the “Sunny Cove” CPUs inside of Ice Lake.

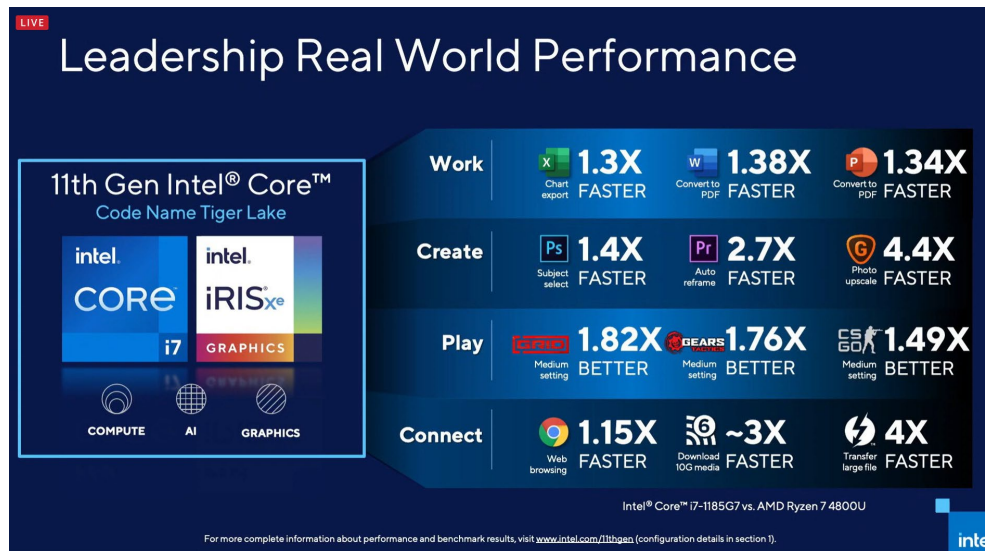


For now, however, there's still a mishmash of somewhat vague performance comparisons. Intel claims the integrated Xe core outperforms "90 percent of the discrete graphics in the segment," and that the chip can play games twice as fast as the integrated Ice Lake GPU. (The latter claim is based on a comparison between the Core i7-1065G7U and the Core i7-1185G7, using Gears Tactics at 1080p, Medium settings. Intel had also made some initial performance claims about Tiger Lake [[go.pcworld.com/tgcl](https://go.pcworld.com/tgcl)] last year.)

Intel also says that Tiger Lake offers video editing that's twice as fast, and photo editing that's 2.7 times as fast, compared to rival products. Last month, Intel released video ([go.pcworld.com/ivid](https://go.pcworld.com/ivid)) explaining how Tiger

Lake would perform in games ranging from *Battlefield V* to *Grid*—but without frame rates to back it up. Still, being able to play *Borderlands 3*, *Far Cry New Dawn*, and *Hitman 2* on integrated graphics, and on a thin-and-light PC, is noteworthy. After this story was printed, however, Intel held further sessions and offered a deluge of benchmarks ([go.pcworld.com/inbn](https://go.pcworld.com/inbn)) to back up its Tiger Lake claims. Here's one summary:

Until we have laptops in house to test, it's all academic. It's probably fair to say that until Intel announced its SuperFIN transistor, the comparison between AMD's mobile Ryzen and Intel's Tiger Lake looked pretty bad for Intel. Now, the landscape could be much more competitive. 🔌



This is how Intel sees Tiger Lake shaping up with the AMD Ryzen Mobile 4000.

# Intel Tiger Lake laptops will begin shipping in October

Consumers will still have to wait a bit. **BY MARK HACHMAN**



**L**aptops and notebook PCs using Intel's first Tiger Lake chips will begin shipping in October, an Intel representative confirmed in early September.

Up to that announcement, Intel had been cagey, stating that the first laptops using its new Tiger Lake chips (see page 7) would be available this fall in time for the holiday season. Its latest presentation also clarified a fact that was left out of its press release: Two

of the nine new Tiger Lake chips, the Core i3-1125G4 and Core i3-1120G4, won't be available until 2021. Some observers grumbled that Intel should have waited to launch Tiger Lake until PC makers were ready to ship.

At the presentation, though, Intel somewhat nailed down the initial shipping date to October. That means we have to wait a little longer before reviewers and consumers begin putting Intel's boatload of

benchmark claims ([go.pcworld.com/inbn](https://go.pcworld.com/inbn)) to the test, and determining whether they should buy a notebook with an Intel 11th-gen Core (Tiger Lake) or an AMD Ryzen Mobile chip inside.

MSI was among the first to reflect the new shipping date, by confirming that its Stealth 15M gaming laptop ([go.pcworld.com/m15m](https://go.pcworld.com/m15m)) will ship in October, complete with a blazing-fast PCIe 4.0 SSD. That's important, because Tiger Lake is Intel's first notebook platform—and, in fact, the world's first—to use PCI Express 4.0 as part of the infrastructure. And that's important, because Nvidia and Microsoft are working to eliminate SSD compression latencies ([go.pcworld.com/cmlt](https://go.pcworld.com/cmlt)) by routing them directly from the GPU to the CPU via PCIe. (While Intel's quite proud of its Xe GPU

architecture inside Tiger Lake, gaming laptops will use discrete graphics from either AMD or Nvidia.)

Hand in hand with the Tiger Lake launch, Intel has introduced Evo, the rebranding of its Project Athena ([go.pcworld.com/inev](https://go.pcworld.com/inev)) laptop design initiative. Many of the new Tiger Lake laptops will be Evo graduates

as well, including Acer's Swift 3 and Swift 5 ([go.pcworld.com/sw35](https://go.pcworld.com/sw35)) laptops—the latter, Acer says, is the first verified member of Intel's Evo family. In all, twenty Evo designs are expected by the end of the year, Intel executives said, including the Lenovo Yoga 9i ([go.pcworld.com/yg9i](https://go.pcworld.com/yg9i)), the Asus Zenbook Flip S, and the Samsung Galaxy Book Flex 5G, among others.

In total, more than 150 designs based on the new 11th-gen Tiger Lake Intel Core processors are expected from partners including Acer, Asus (which announced new ZenBook and ExpertBook laptops [[go.pcworld.com/zbeb](https://go.pcworld.com/zbeb)]), Dell, Dynabook, HP, Lenovo, LG, MSI, Razer, Samsung, and others, Intel said. Now, we'll know a bit more about when you can buy them. 🔌



**Asus's new range of ZenBooks and ExpertBooks are the firm's first to come with Intel's Tiger Lake chip.**

# AMD sets October 8 date for next-gen Ryzen 'Zen 3' launch

It looks like AMD's Ryzen 4000 is arriving soon. **BY MARK HACHMAN & GORDON MAH UNG**



**A**MD chief executive Lisa Su said recently that her company will be launching its next-generation Zen 3 microprocessors on October 8.

"It's going to be an exciting fall for gamers...time to start a new journey with @AMDRyzen ([go.pcworld.com/aryz](https://go.pcworld.com/aryz)) Zen3 and @Radeon ([go.pcworld.com/ardn](https://go.pcworld.com/ardn)) RDNA2," Su tweeted ([go.pcworld.com/lstw](https://go.pcworld.com/lstw)), with a small promotional video that advertised the October 8 launch date.

(AMD also confirmed the October 28 launch of its "Big Navi" Radeon RX 6000 series cards [[go.pcworld.com/bgnv](https://go.pcworld.com/bgnv)] to take on Nvidia.)

The announcement comes after some speculation that AMD would delay the launch of its next-generation Zen 3 cores ([go.pcworld.com/z3cr](https://go.pcworld.com/z3cr)), the basis of its Ryzen chips for desktop and mobile. Those desktop and mobile chips are expected to include the Cezanne APU, with mainstream and high-end desktop parts codenamed Vermeer. An



**AMD also confirmed that its “Big Navi” Radeon RX 6000 GPUs will be released on October 28.**

enthusiast and workstation version is reportedly codenamed Genesis Peak. AMD had denied a report that the company was essentially planning to milk the current Ryzen 3000 generation for another few months, pushing the launch date into 2021.

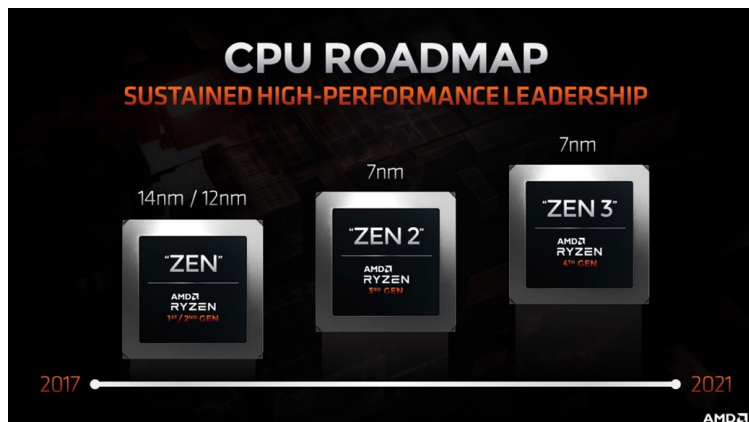
Respected site Wikichips.org ([go.pcworld.com/wkch](https://go.pcworld.com/wkch)) says the new Zen 3 architecture will be based on a 7nm+ process, offer 20 percent more density, and 10 percent power reduction compared to Zen 2.

AMD has said that ([go.pcworld.com/am4p](https://go.pcworld.com/am4p)) it will

continue to use its AM4 processor socket straight through its next generation of Zen 3 processors, fulfilling the pledge it made to continue the socket through 2020. AMD did say in May, however, that any chipset before the “500 series” generation—basically, everything but the X570 and B550—will not be supported by AMD’s

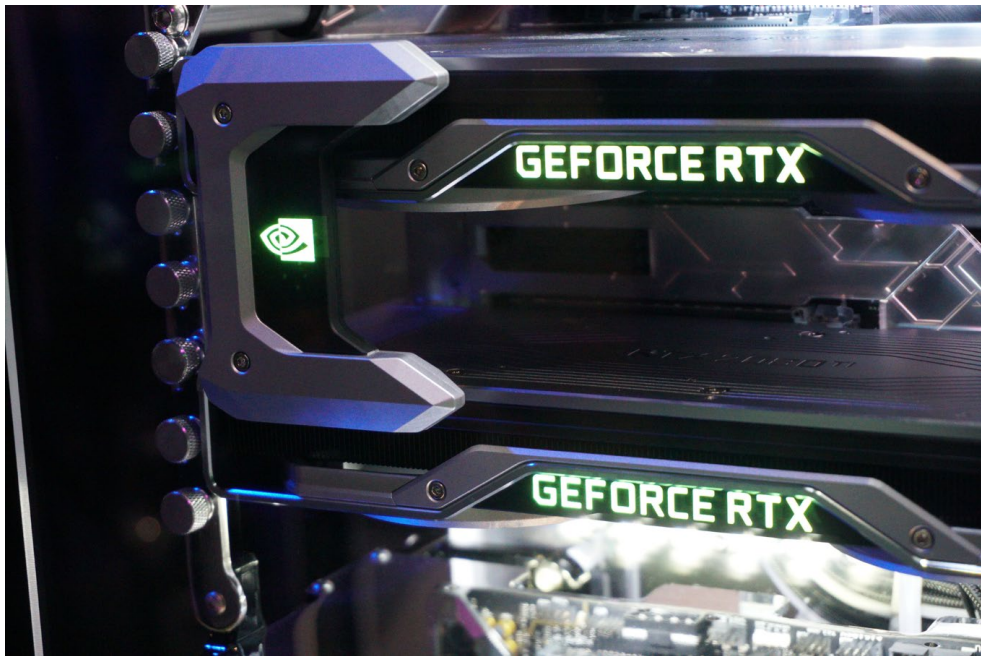
Zen 3.

Besides confirming the manufacturing process, AMD has said little more about what consumers can expect for the Zen 3 / Ryzen 4000 series, or when the first processors based on the new architecture will actually ship. It looks like we’ll have some answers in a few weeks’ time. 📺



# RIP, SLI: Nvidia GeForce RTX 30-series slams the final nail in multi-GPU's coffin

Unless you have a \$1,500 GeForce RTX 3090, that is. **BY BRAD CHACOS**



**P**our one out, enthusiasts. Nvidia's beastly new GeForce RTX 30-series graphics cards ([go.pcworld.com/rt30](https://go.pcworld.com/rt30)) just slammed the final nail into SLI's coffin. Well, almost.

A glaring fact jumped out at me while I was sifting through Nvidia's product pages for our GeForce RTX 30-series vs. RTX

20-series spec comparison ([go.pcworld.com/32cm](https://go.pcworld.com/32cm)): Only the monstrous \$1,500 GeForce RTX 3090 includes support for



**VIDEO: SHOULD YOU PREORDER NVIDIA'S GEFORCE RTX 30-SERIES?**

Watch now at [go.pcworld.com/r30](https://go.pcworld.com/r30)



NVLink, the proprietary connector that enables SLI multi-GPU configurations. Even the \$800 GeForce RTX 3080 lacks it, and Nvidia calls that graphics card the 30-series flagship. (The RTX 3090 is a “BFGPU” [[go.pcworld.com/bfgp](https://go.pcworld.com/bfgp)] above and beyond the rest.) Given that Nvidia controls 80 percent of the graphics card market ([go.pcworld.com/80pc](https://go.pcworld.com/80pc)), it seems clear that the days of slapping multiple graphics cards into your PC to boost frame rates is effectively over.

That said, it’s been effectively over for a while. Nvidia reduced SLI support to just two graphics cards ([go.pcworld.com/slis](https://go.pcworld.com/slis)) during the GTX 10-series generation four long years ago. Rival AMD phased out CrossFire multi-GPU support for its Radeon GPUs ([go.pcworld.com/xfre](https://go.pcworld.com/xfre)) soon after. But even

that reduced support has stuttered in recent years, as graphics cards became powerful enough to drive 1440p and 4K displays by their lonesome.

Making matters worse, multi-GPU support has become increasingly wonky in games themselves over the years. Such setups were always a niche consisting of deep-pocketed enthusiasts, making it hard for developers to justify supporting SLI. SLI also slowly lost its reason for being, first because many games tied physics to frame rates, and inevitably because of the rise of ultra-powerful GPUs. Even if you invested in an SLI setup, it flat-out wouldn’t work in many of today’s games. In the ones that did support it, it didn’t work well—technically implementing it was always a nightmare for devs. Game developers can

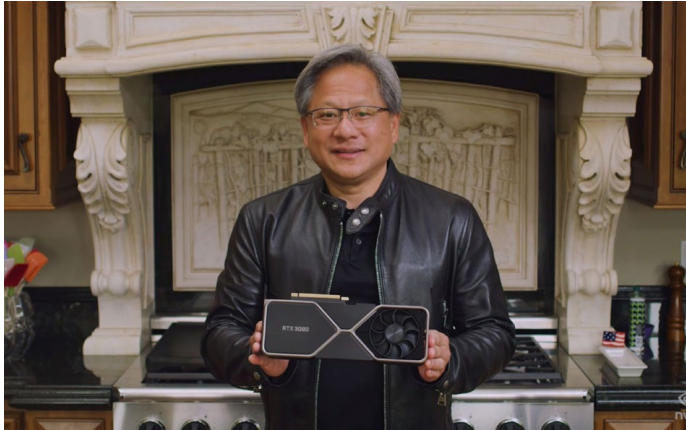
use DirectX 12 to implement multi-GPU ([go.pcworld.com/dr12](https://go.pcworld.com/dr12)) without a connector, but it’s telling that virtually none of them have.

We’ve warned would-be buyers off multi-GPU configurations for years now.



**Nvidia controls 80 percent of the graphics card market.**





**The GeForce RTX 3080 lacks SLI connectors.**

could still use more help to hit smooth frame rates at such a ludicrous resolution. If you thought pushing pixels at 4K resolution was rough, check out these Nvidia performance metrics at 8K (see bottom graph).

An NVLink connection can also help with compute and content creation workloads for this

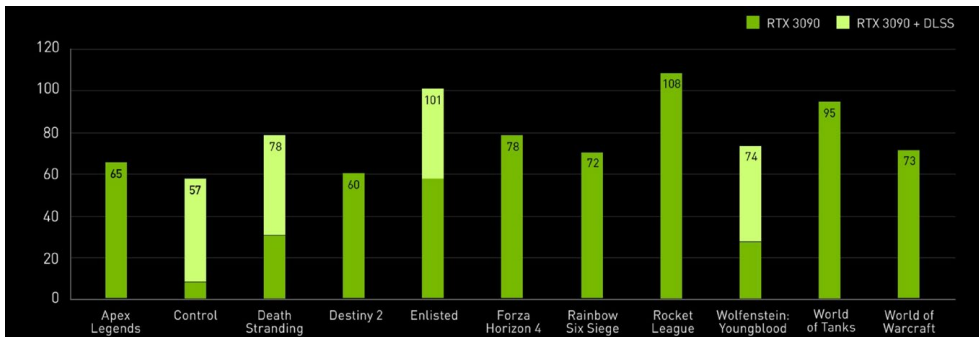
Nvidia just sealed the deal.

Well, almost, like I said. The GeForce RTX 3090 still supports it, but that's because it's the only card that still needs it to meet its intended use. Nvidia's pitching this beast as the first-ever 8K-capable graphics card, and that's with the company's fantastic DLSS 2.0 technology enabled. Not many games support DLSS yet, and even the ones that do

pricey Titan-in-all-but-name.

So yeah, SLI isn't technically dead, but it's effectively dead for all but the top 0.1 percent of us. If you've got \$3,000 to drop on a pair of RTX 3090s, by all means feel free to lord it over your geeky pals. Just don't expect developers to spend much time making sure it works great in your games.

Farewell, SLI. We hardly knew ye. 🛑



**An Nvidia-supplied chart showing the GeForce RTX 3090's performance at 8K resolution.**



## Samsung Galaxy Z Fold 2: Killer specs in search of killer purpose

All dressed up with no place to go. **BY MICHAEL SIMON**

**T**he original Samsung Galaxy Fold never really got a chance to make a name for itself. While it launched to a ton of fanfare, by the time it landed on shelves following a months-long delay ([go.pcworld.com/fldy](https://go.pcworld.com/fldy)) due to design and manufacturing deficiencies, the Galaxy Note 10+ ([go.pcworld.com/nt1p](https://go.pcworld.com/nt1p)) and iPhone 11 Pro

([go.pcworld.com/a11p](https://go.pcworld.com/a11p)) were stealing the limelight and the wow factor had long faded. But Samsung persisted and now the follow-up has arrived with a new name (Galaxy Z Fold 2), a new price, and a new lease on life.

Unsurprisingly, Samsung is sticking with a very similar form factor as the one introduced with the original Fold, but every aspect of the

Galaxy Z Fold 2 has gotten an upgrade, from the outside cover display to the inside screen ratio. But while the hardware is certainly improved, it's still missing a compelling reason to spend \$2,000 on a folding device.

First, let's take a look at the specs:



**The Galaxy Z Fold 2 is available in gorgeous Mystic Bronze with an array of customizable hinge colors.**

## Galaxy Z Fold 2

**Dimensions (closed):** 68.0 x 159.2 x 16.8mm

**Dimensions (open):** 128.2 x 159.2 x 6.9mm

**Display (outside):** 6.2-inch HD+ Super AMOLED, 2260x816, 386ppi

**Display (inside):** 7.6-inch QXGA+ Dynamic AMOLED 2X Infinity Flex Display (2208 x 1768), 373ppi

**Processor:** Snapdragon 865+

**RAM:** 12GB

**Storage:** 256GB

**Front/Inside camera:** 10MP, f/2.2

**Rear camera (triple):** 12MP wide, f/2.4, OIS + 12MO Ultra Wide, f/2,2 + 12MP telephoto (2X), f/2.4, OIS

**Battery:** 4,500mAh

**Network:** 5G (mmWave and sub-6Ghz)

That's not *quite* on the level of a flagship like the Galaxy Note 20 Ultra ([go.pcworld.com/n20u](https://www.pcworld.com/n20u)), but it's close. You get the same processor, RAM, battery, 5G support, and base storage, and a very good triple-camera system that comes with a new trick that automatically frames your subject and zooms while recording video. That's a nice upgrade on the original Fold's dual-camera system.

The biggest improvements on the Fold 2's predecessor are with the displays. The outside display gets the biggest boost, jumping to 6.2 inches from the prior-gen's barely useable 4.6-inch display. The Galaxy Z Fold 2's resolution is only HD quality, but you can use it just as comfortably as you would a regular phone. Plus it looks a lot better than the odd small screen floating in the center on the outside of the original Fold.

When you open the Samsung Galaxy Z Fold 2, you'll be met with a slightly larger 7.6-inch display with a squarer 3.74:3 ratio (versus 4.2:3 on the first Fold) that's got a 120Hz adaptable refresh rate and a hole punch camera that looks way better than the ugly notch on the original model. The Fold 2 also borrows Flex Mode from the Galaxy Z Flip ([go.pcworld.com/fl1p](https://www.pcworld.com/fl1p)) with a redesigned "hideaway hinge" that lets the Fold be used at any angle.

It still doesn't quite close as flush as the Z Flip, but all in all, the Galaxy Z Fold 2 looks every bit as premium as its \$2,000 price tag. The outside screen takes away the awkwardness of the original, and the move to a hole-punch camera on the inside screen does wonders for its appearance as do the thinner bezels. And the new Mystic Bronze color looks as good as it does on the Note no matter which of the new customizable hinge colors you choose (silver, gold, red, or blue).

## ALL DRESSED UP WITH NO PLACE TO GO

However, while the Galaxy Z Fold 2 is a very compelling device, it still lacks a compelling reason to exist. While Samsung touted optimized apps from Google (Duo, YouTube) and its own apps (Camera, Gallery, Clock) as well as the ability to launch three apps at



**The Galaxy Z Fold 2's outside screen is way larger than that of the original model.**

once, drag-and-drop, and stream to a larger display via wireless DeX, it's harder than ever to justify the Galaxy Fold's existence, especially with a higher price tag (that doesn't include Galaxy Buds or a case this time around). Multitasking is still more for short tasks than serious work, and there isn't much you can do that you can't already do on other large-screened phones.

That's compounded by what Samsung dubbed "the new normal" at its last Unpacked event. With more people working at home than ever before and millions still unemployed, a luxury phone that doubles as a tablet seems less likely to appeal to people

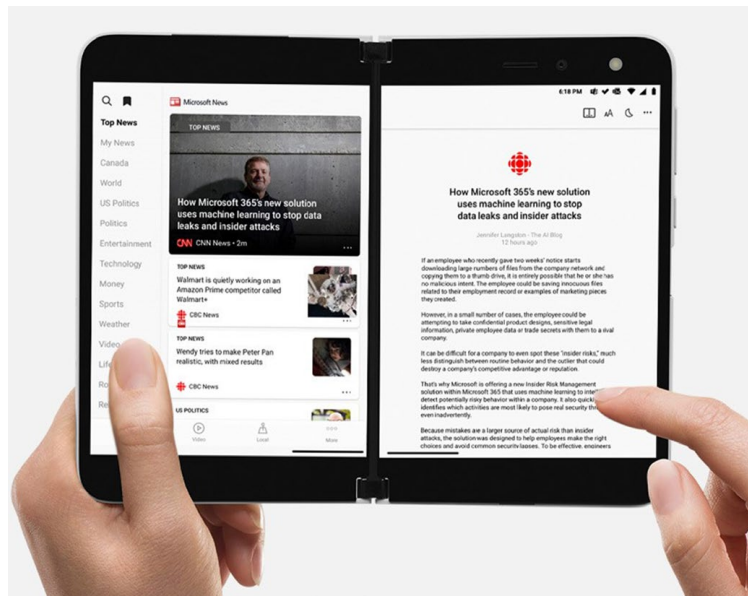
with a couple thousand bucks to spend on a phone. In my briefing, Samsung touted the Galaxy Z Fold 2's versatility as an entertainment and productivity device, which is definitely true, but it's decidedly less compelling when you're traveling from the kitchen to the living room rather than to and from the office.

Even the Surface Duo ([go.pcworld.com/5duo](https://go.pcworld.com/5duo)), which has an equally high price tag and uphill fight to lure customers, has a better selling point. Microsoft makes no attempt to hide the fact that the Duo is a phone second and a productivity device first. For better or worse, it's embraced its flaws—like the lack of a cover display and gigantic bezels—to deliver a device that gives on-the-go Office users something they can't get on other Android phones.

That might be the biggest obstacle the Galaxy Z Fold 2 faces, even more than the luxury smartphone slump: a lack of identity. It's as if the first Galaxy Note didn't have an S Pen or the iPhone

3G didn't introduce the App Store. High-end specs are great, but ultimately it needs something to convince people that a \$2,000 folding phone with a 7.6-inch folding screen is more valuable than a \$1,300 one with a 6.9-inch screen that doesn't fold.

Even if Samsung has adequately fixed the first-gen problems as it claims, the Fold 2 needs to do more than just not break. Foldable phones are no longer the novel, trailblazing devices they were just 18 months ago, and while the Galaxy Z Fold 2 is definitely a major improvement on the first model, it still doesn't have a unique use-case. Maybe by the third-gen, Samsung will figure out what to do with it. 🔌



Even the Surface Duo has a better selling point.

# Android 11 is here, bringing minor changes to Pixel phones

A few other phones are getting previews and betas though. **BY MICHAEL SIMON**



If you own a Pixel 2 or later, your phone can get some new features. After months of betas, Google has begun rolling out Android 11 to “select Pixel, OnePlus, Xiaomi, Oppo and Realme phones,” but if you don’t own a Google phone, you won’t see the full version yet.

OnePlus, Oppo, and Realme have announced that some customers will be getting access to public betas and previews while the full version is still being developed.

That’s better than usual, but it’s still a far cry from iOS 14, which has already been made available on hundreds of millions of iPhones.

Still, if your phone isn’t on that list, you’re not missing out on all that much. Android 11 is very much a maintenance release, and as such, it has few new features that you’ll notice. The most obvious is Bubbles, which lets you respond to a message and see whole conversations without needing to launch




Android Messages or other supported messaging apps. Small circles will appear on the screen when a new text arrives and you'll be able to expand it and reply without leaving the app you're working in.

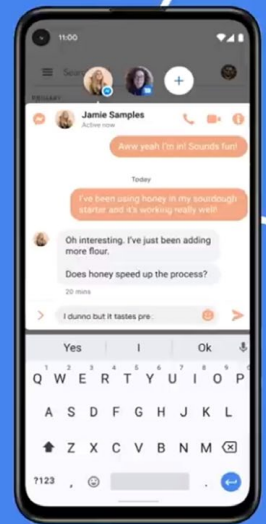
Additionally, conversations will now get their own cluster in the notification panel so they're easy to see. And people you often chat with will show up on your lock screen and override do-not-disturb so you won't miss an important message. And the power menu has new functionality, like Home buttons and Google Pay cards.

Otherwise, the changes in Android 11 are extremely minor. You'll be able to record your

screen without needing to download a third-party app, quickly switch between Bluetooth audio devices and access media controls, and connect to Android Auto without plugging in. And privacy controls, permissions, and protections have been enhanced and upgraded to better safeguard your data.

If you own a Pixel, you'll be getting a few extra features as well ([go.pcworld.com/xftr](https://go.pcworld.com/xftr)), such as app suggestions on your home screen and easier text selection, and smart folder names. The update for Pixels and other eligible phones should now be available. 

**Bubble conversations  
to multitask and  
respond to messages  
without having to  
open your chat app**



**Android 11 changes the way message notifications are received and organized.**



# How Microsoft and Nvidia plan to kill game-loading times on PCs

A game changer, literally. **BY BRAD CHACOS**



**T**hat blisteringly fast storage technology found in the next-gen consoles is coming to PCs too, debuting first with the RTX IO technology in Nvidia's new GeForce RTX 30-series graphics cards ([go.pcworld.com/8090](https://go.pcworld.com/8090)). Microsoft just pulled back the curtain a bit more on how it works.

Yes, the creator of Windows is explaining how SSD technology works in a graphics card. No, it's not as bizarre as it sounds.

Both the Xbox Series X ([go.pcworld.com/xboxx](https://go.pcworld.com/xboxx)) and Nvidia's RTX IO tap into Microsoft's DirectStorage, a new DirectX API. Microsoft teased that it would be coming to PCs ([go.pcworld.com/c2pc](https://go.pcworld.com/c2pc)) after the Xbox Series X

announcement.

This week, the company revealed ([go.pcworld.com/dcst](https://go.pcworld.com/dcst)) a bit more about how the technology helps your SSD and GPU work more closely together to reduce (and possibly eliminate) loading times—though you'll need a speedy NVMe drive to take advantage of it.

"With Nvidia RTX IO, vast worlds will load instantly. Picking up where you left off will be instant. This is a very big deal for next-generation gaming," Nvidia CEO Jensen Huang said while introducing the technology. Instantaneous loading is also a key selling point for the Xbox Series X and PlayStation 5 ([go.pcworld.com/sp15](https://go.pcworld.com/sp15))

launching later this year.

## HOW MICROSOFT DIRECTSTORAGE AND RTX IO WORK

“Games have pushed PC IO and file systems to the breaking point,” Huang said. DirectStorage was built to smash past that. Traditionally, CPUs have both called game assets from your storage and decompressed them, passing the data through the system memory over to your graphics card. Microsoft’s Andrew Yeung explained why that worked well before, but not in an era of blazing-fast PCIe 4.0 NVMe drives:

*“Previous gen games had an asset streaming budget on the order of 50MB/s which even at smaller 64k block sizes (ie. one texture tile) amounts to only hundreds of IO requests per second. With multi-gigabyte a second capable NVMe drives, to take advantage of the full bandwidth, this quickly explodes to tens of thousands of IO requests a second. Taking the Series X’s 2.4GB/s capable drive and the same 64k block sizes as an example, that amounts to >35,000 IO requests per second to saturate it.*

*Existing APIs require the [game] to manage and handle each of these requests one at a time first by submitting the request, waiting for it to complete, and then handling its completion. The overhead of each request is not very large and wasn’t a choke point for older games running on slower hard drives,*

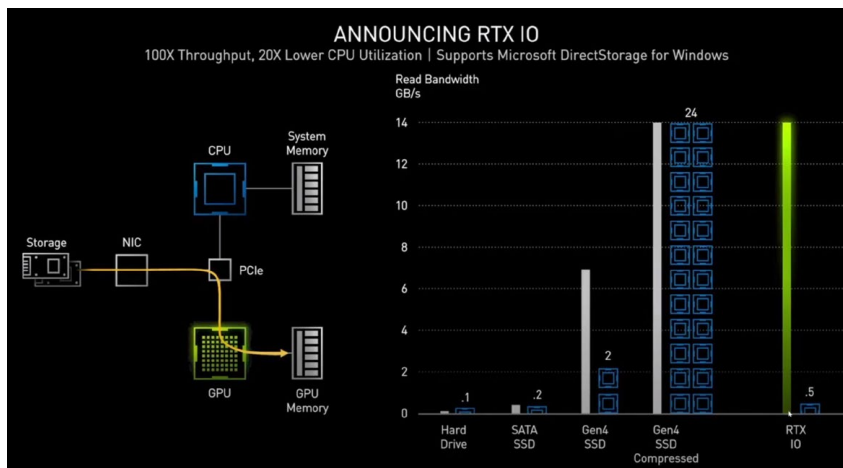


**The Xbox Series X uses Microsoft’s DirectStorage.**

*but multiplied tens of thousands of times per second, IO overhead can quickly become too expensive preventing games from being able to take advantage of the increased NVMe drive bandwidths.”*

In today’s world of 100GB-plus games with massive file textures and ludicrously fast PCIe 4.0 SSDs, that traditional CPU handoff has become the bottleneck.

But while CPU threads need to complete a task before moving onto the next one, GPUs excel at executing many tasks in parallel. DirectStorage takes advantage of that by letting ultra-fast NVMe SSDs send data directly to the ultra-fast dedicated VRAM on



An illustration of RTX IO's potential benefits.

your video card. It's essentially cutting out the pokey middle-man, while also freeing up your CPU to do other work.

Yeung says DirectStorage offers multiple tools for developers to maximize storage performance: "by reducing per-request NVMe overhead, enabling batched many-at-a-time parallel IO requests which can be efficiently fed to the GPU, and giving games finer grain control over when they get notified of IO request completion instead of having to react to every tiny IO completion."

Nvidia's Huang said that RTX IO offers "APIs for fast loading and streaming directly from SSD to GPU memory"

and GPU lossless decompression. It's unclear yet whether that's a special sauce, or just Nvidia glomming onto the benefits of DirectStorage itself. Nvidia's marketing did a killer job of tying real-time ray tracing to its RTX



**Nvidia's marketing did a killer job of tying real-time ray tracing to its RTX branding.**

branding ([go.pcworld.com/rtxb](https://go.pcworld.com/rtxb)), but the technology is actually built on Microsoft's underlying Direct Raytracing API, which is why you'll be seeing it in the Xbox Series X and AMD's RDNA 2-based "Big Navi" graphics cards ([go.pcworld.com/bnav](https://go.pcworld.com/bnav)) later this year.


## THE NEED FOR NVME SPEED (AND SMARTS)

Microsoft's post makes it clear that you'll need an NVMe drive to tap into DirectStorage's benefits, however. That's because NVMe drives offer both extremely high bandwidth compared to traditional SATA-based storage, as well as multiple "NVMe queues" that can contain multiple IO requests, making them "a perfect match to the parallel and batched nature of modern gaming workloads"—and GPU capabilities.

That's great for PC enthusiasts who have invested in one. Until this point, the benefits of a blistering NVMe drive have largely been constrained to large file transfers or editing 4K/8K video. Games haven't been noticeably faster on an NVMe drive than a standard 2.5-inch SATA SSD, even with a ludicrously capable PCIe 4.0 SSD like the Corsair Force MP600 pictured above.

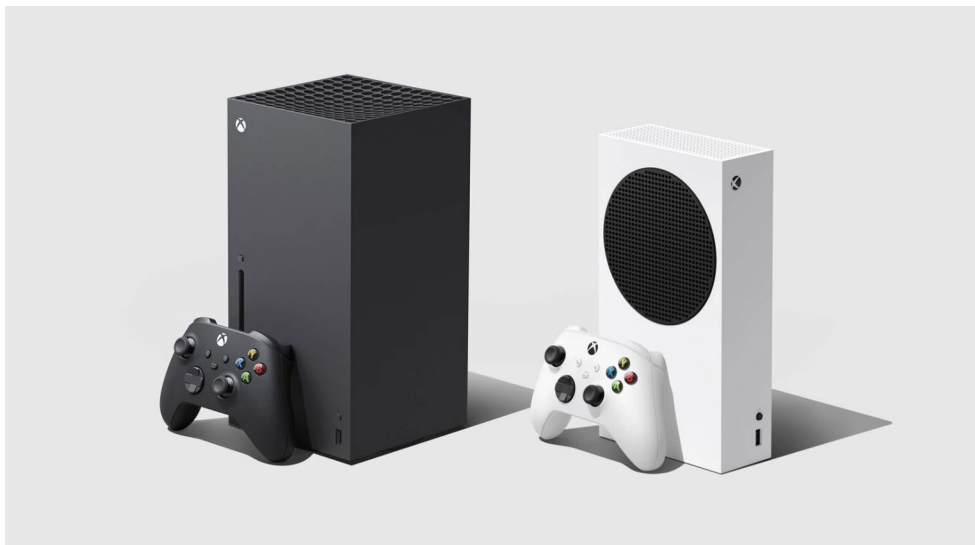
DirectStorage looks like it'll change that—when it arrives on PCs, that is. While the technology will be part of the Velocity Architecture inside the Xbox Series X this fall, Microsoft says it's hoping to get a DirectStorage preview in the hands of PC developers sometime in 2021. If the dream of instantly loading worlds turns into a gaming reality, the wait will be worth it.

Check out our guide to the best SSDs ([go.](https://go.pcworld.com/sdbt)

[pcworld.com/sdbt](https://go.pcworld.com/sdbt)) if you're thinking of snatching up a shiny new NVMe SSD in the meantime, or our NVMe SSD explainer ([go.pcworld.com/nvmx](https://go.pcworld.com/nvmx)) if you want to learn more about the tech inside this ultra-fast storage. 



The Corsair Force MP600.



# Microsoft's \$499 Xbox Series X and \$299 Xbox Series S launch November 10

The next generation finally gets a price and a start date. **BY BRAD CHACOS**

**A** mere day after leaks forced the sudden reveal of the previously unrevealed \$299 Xbox Series S ([go.pcworld.com/xsrs](https://go.pcworld.com/xsrs)),

Microsoft has drawn the curtain fully back on its next-gen console. The company announced ([go.pcworld.com/x499](https://go.pcworld.com/x499)) in early September that the flagship Xbox Series X console will cost \$499 when it launches alongside the Series S on November 10. Preorders opened on September 22. That's

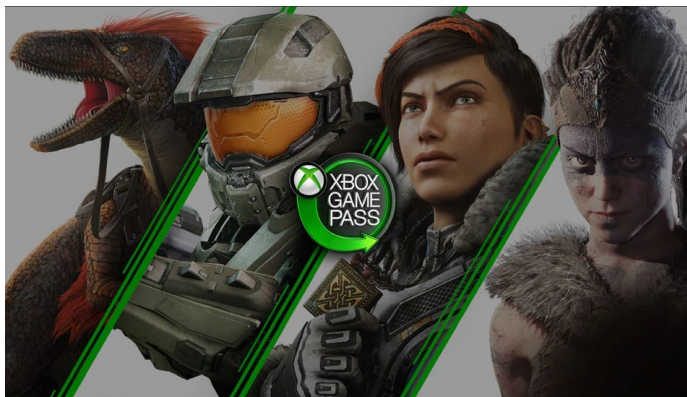
an insanely good price for a backward-compatible console that probably puts your PC to shame ([go.pcworld.com/shme](https://go.pcworld.com/shme)), but Microsoft's optional payment plans make the price even more affordable in an uncertain world.

In addition to the flat \$299 and \$499 sticker prices for the Xbox Series S and Xbox Series X, respectively, Microsoft is offering both consoles via its Xbox All Access payment plans. These plans require no money down,

and Microsoft's offering the Xbox Series S for \$25 per month for 24 months, or the Xbox Series X for \$35 for 24 months.

Paying \$35 a month for what looks to be the world's most powerful console doesn't feel bad on the surface, but a little back-of-napkin math reveals you'll wind up paying far more with these plans than you would if you buy the consoles outright. Multiplying the monthly costs by 24 months brings the Xbox Series S's total to \$600, and the Xbox Series X's total cost to \$840. Oof. Then again, \$25 or \$35 a month is a lot more doable for a lot of people than dropping \$500 up front, especially in today's world.

To sweeten the deal, Microsoft is throwing in monthly access to both Xbox Game Pass Ultimate and EA's rival EA Play subscription, following Microsoft's announcement ([go.pcworld.com/2srv](https://go.pcworld.com/2srv)) that the two services are merging at no additional cost. Xbox Game Pass Ultimate gives you all of Xbox Live Gold's benefits (like free games and multiplayer support) and unlocks the deep, excellent Xbox Game Pass library ([go.pcworld.com/xlbr](https://go.pcworld.com/xlbr)) on both PCs and your shiny new Xbox. The EA Play subscription



**The best deal in PC gaming just became a sweet deal for Xbox Series X gamers who don't want to pay upfront.**

likewise works on both Xbox and Windows 10 PCs and gives you all-you-can-play access to over 60 EA games, including heavy-hitters like *FIFA 20*, *Battlefield*, *Mass Effect*, *Titanfall 2*, *Need for Speed Heat*, and more.

Xbox Game Pass Ultimate and EA Play cost \$15 a month, which suddenly makes those \$25 or \$35 Xbox All Access payments for the next-gen consoles look much more palatable, especially since the dual services offer well over 160 games that you can play immediately. Factoring in the subscription cost of \$360 over two years, you're saving \$60 on the Series S and \$20 on the Series X by opting for the payment plan.

It's a bold move from Microsoft. With all the fierce hardware inside the Xbox Series X, I expected the console to cost closer to \$600 or even \$700 at launch. Sony has yet to reveal pricing for its rival PlayStation 5, which will



also be powered by AMD chips and ultra-fast storage ([go.pcworld.com/ufst](https://go.pcworld.com/ufst)) when it launches this holiday season.

**CPU:** 8x Cores @ 3.8 GHz (3.66 GHz w/ SMT) Custom Zen 2 CPU

**GPU:** 12 TFLOPS, 52 CUs @ 1.825 GHz Custom RDNA 2 GPU

**Die Size:** 360.45 mm<sup>2</sup>

**Process:** 7nm Enhanced

**Memory:** 16 GB GDDR6 w/ 320mb bus

**Memory Bandwidth:** 10GB @ 560 GB/s, 6GB @ 336 GB/s

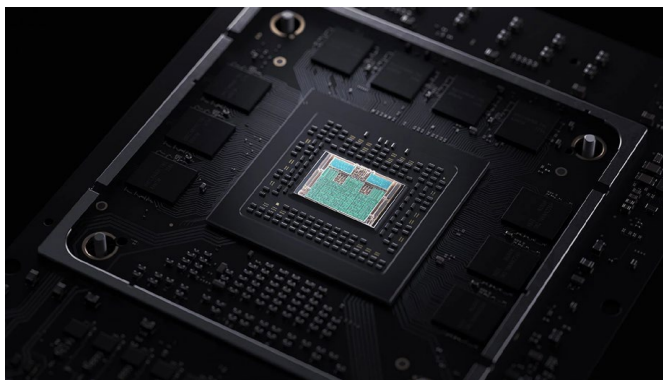
**Internal Storage:** 1 TB Custom NVME SSD

**I/O Throughput:** 2.4 GB/s (Raw), 4.8 GB/s (Compressed, with custom hardware decompression block)

**Expandable Storage:** 1 TB Expansion Card (matches internal storage exactly)

**External Storage:** USB 3.2 External HDD Support

**Optical Drive:** 4K UHD Blu-Ray Drive




The AMD chip at the heart of the Xbox Series X.

**Performance Target:** 4K @ 60 FPS, Up to 120 FPS

In a post published the day of the announcement, Microsoft revealed more Xbox Series S details ([go.pcworld.com/xsdt](https://go.pcworld.com/xsdt)) as well. The “smallest Xbox ever” includes the same 3.6GHz AMD Ryzen CPU as its bigger brother, along with a 512GB custom SSD powered by Microsoft’s Xbox Velocity Architecture and an RDNA 2-based AMD GPU that still supports real-time ray tracing and variable rate shading. It’s targeting 1080p and 1440p gaming experiences at 60 frames per second, with support for up to 120fps, thanks to this new GPU offering 3x the performance of the one inside the original Xbox One.

Console players aren’t the only gamers with something to look forward to this fall. Nvidia just revealed its next-gen GeForce RTX 30-series graphics cards ([go.pcworld.com/30sr](https://go.pcworld.com/30sr)) and they look like monsters. Better yet, they’re swiping a trick from the next-gen

consoles by letting your SSD talk directly to your GPU to eradicate game-loading times (see page 26).

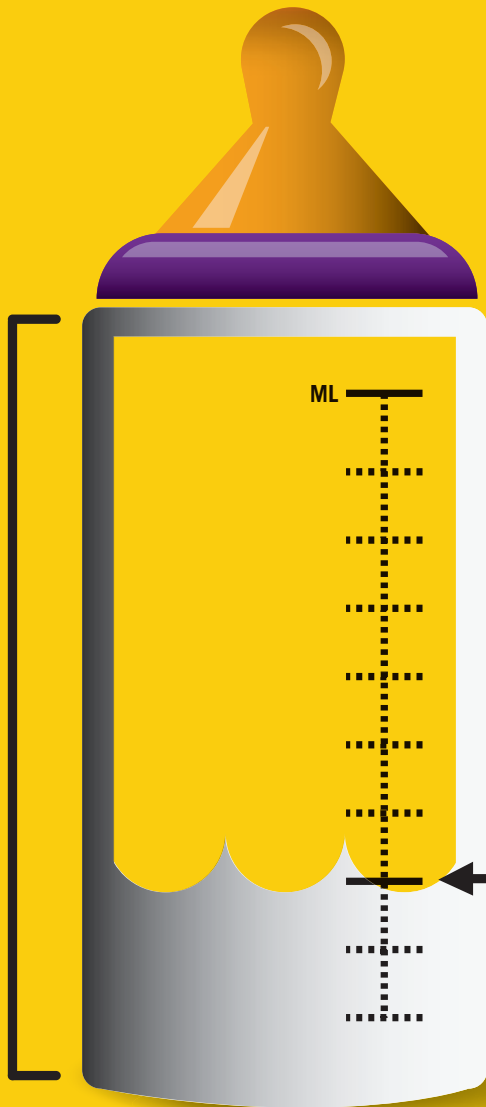
Likewise, AMD promised that its “Big Navi” RDNA 2-based Radeon GPUs will launch sometime before the next-gen consoles, so expect to hear more about those soon. 



THE NUMBER  
OF PEOPLE

**WHO**  
**THINK**

THEY HAVE  
THEIR CHILD IN  
THE RIGHT  
SEAT.



THE ONES  
**WHO**  
**ACTUALLY**  
**DO.**

---

# KNOW FOR SURE

---

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.

---



VISIT [SAFERCAR.GOV/THERIGHTSEAT](http://SAFERCAR.GOV/THERIGHTSEAT)



# THE NEW



# CONVERTER

There are career paths that you might not know about. Whether you're making a change or just starting out, you have more options than you think. Get started at [FindSomethingNew.org](https://FindSomethingNew.org)





## Google Pixel 4a: Android's affordable answer to the iPhone SE

And that battery life. **BY MICHAEL SIMON**

**L**ike Apple's \$400 iPhone SE ([go.pcworld.com/ifse](https://go.pcworld.com/ifse)), the \$349 Google Pixel 4a isn't a want phone, it's a need phone. Apple made certain sacrifices with its budget iPhone to keep the price low, and Google has done the same with its own cut-rate Pixel, dropping features like wireless charging, 90Hz Smooth

Display, Face Unlock, and a dual camera that pushed the Pixel 4 XL to \$900 ([go.pcworld.com/p4xl](https://go.pcworld.com/p4xl)).

You might think you need those features, but you probably don't. You only want them. With just 6GB of RAM and a 60Hz display, the Pixel 4a still delivers an Android experience that's as smooth and speedy as any premium



phone. Night Sight and Live HDR+ bring a high-end feel to photo-taking that rivals anything Apple brings with the iPhone 11 Pro ([go.pcworld.com/i11p](http://go.pcworld.com/i11p)). And while I'll admit that I miss wireless charging, wired charging is plenty fast out of the box.

For a third of what Samsung charges for its new Galaxy Note 20 Ultra (see page 42), the Pixel 4a nails the bare necessities: a lightweight phone with a nice design that'll take great pictures and last all day. Put it all together, and you're getting the most practical Android phone ever made and the easiest buying decision you'll ever make. You don't even need to pick a color—it only comes in black.



**And Pixel 4a is Android's yin to the iPhone SE's yang.**

## A GOOGLE PHONE THAT ACTUALLY LOOKS GOOD

I've never been a fan of Google's overly utilitarian design language, but it's done an admirable job with the Pixel 4a. The giant bezels around that have been present on nearly every other Pixel have been dramatically thinned around its screen to give the phone a high screen-to-body ratio (83 percent). The Pixel 4a's small size means it has a relatively small display as well—5.8 inches, which is smack dab in the middle of the 5.6-inch Pixel 3a and 6-inch Pixel 3a XL.

The 2340x1080 display is essentially the same one you get in the Pixel 4, so the same frustrations are present. Colors will be muted

even in Boosted mode and system text has an ever-so-slight glow around it. Still, it's a good size for a phone in this price range that's basically in the sweet spot for whatever you want to do. Videos and games look good, text is plenty big, and apps have plenty of room to operate. And since it's basically all screen on the front with nicely rounded corners that match the contours of the body, the screen feels even bigger than it is.

Part of that optical illusion is due to Google's use of a



**Compared to the iPhone SE, the Pixel 4a has a more modern design and much bigger screen.**

hole-punch camera on the 4a, a first for a Pixel phone. It's left-aligned rather than centered, so the status bar will be pushed out of place, but it's a giant step forward for Google's phone design and blows away Apple's four-year-old iPhone SE.

However, there's no mistaking the Pixel 4a for a premium Android phone. It's made of plastic and only comes in black, so there's no must-have color or shimmery effects to catch your eye. In the top left corner, you'll find a replica of the square camera array on the Pixel 4, but the smaller size and black color set against the matte black body of the phone helps it blend in. Compared to the iPhone SE's glass back, the Pixel 4a feels a

little cheap, even if it is incredibly light at 143 grams (versus the SE's 148-gram body).

That plasticky feel extends to the buttons, which have a stickiness like a case that hasn't been broken in. But the mint green-colored power button looks great, especially against the all-black enclosure, and the trademark curved sides fit perfectly in your hand. It's the first Android phone I've used in a long while that's truly comfortable using with one hand, and anyone who's looked longingly at the iPhone SE's stature will be very pleased with the Pixel 4a.

The Pixel 4a joins the iPhone SE as one of the few remaining phones that have a circular fingerprint sensor, and also like Apple's Touch ID, it's surprisingly great. Unlocking is quicker than any phone I've used



**The Pixel 4a's 5.8-inch screen takes up nearly the whole front of the phone.**

with an in-display sensor, and it makes me wonder why phone makers moved away from them in the first place. If Google can fit one on a phone this size, then Samsung and OnePlus can certainly fit one on their larger phones, not to mention a headphone jack, which the Pixel 4a also has.

## IT'S NOT FAST BUT IT'LL LAST

With a Snapdragon 730G and 6GB of RAM, the Pixel 4a isn't going to win any speed or performance awards. But Google makes the best of a slower chip with a finely tuned Android 10 that feels more capable than it should.

But for a processor that produced some of the lowest benchmark scores I've seen in years, the Pixel 4a really isn't bad. It can't hold a candle to the A13 chip in the iPhone

SE, but it's also not nearly as slow as its benchmarks indicate:

### Geekbench 5

**Single:** 552

**Multi:** 1646

**Compute:** 1027

### PCMark

**Work 2.0:** 8225

Those numbers are somewhat comparable to the Snapdragon 845 in the Pixel 3, and the performance is roughly in line with a two-year-old flagship phone. That is to say, it's not terrible, but you can feel it struggle when running games and intensive apps, and animations and transitions were visibly laggy at times.

But thanks to Google's Android optimizations, the Pixel 4a belies its processor's capabilities. It's still nowhere near as fast as the iPhone SE's top-of-the-line A13 processor, but the Pixel 4a occasionally felt as fast as my Pixel 4 XL. Even without a high refresh rate, scrolling is very smooth, and the Snapdragon 730G rarely feels frustratingly slow, even as someone who regularly uses the



**The G logo on the back means you'll get a smooth-as-silk Android experience, even with a Snapdragon 730G processor.**



top-of-the-line processors.

You're getting a robust 128GB of storage with the Pixel 4a, more than the 64GB you get with the base iPhone SE and the Pixel 4. The Pixel 4a's battery is also bigger—3,140mAh versus 1,821mAh (iPhone SE) and 2,800mAh (Pixel 4)—and Google squeezes every bit of juice from it. Benchmarks topped 11 hours and I comfortably made it

through a full day, with sometimes more than 50 percent of my battery remaining. Both phones are doing a lot with a little, but I've never made it through a full day with my iPhone SE without at least a quick charge.

## ONE CAMERA WITH A TOOLBOX OF TRICKS

The Pixel line has always preached camera processing over camera hardware, so as expected the 4a doesn't wow you with lenses. It has a single rear 12.2MP dual-pixel camera with an f/1.7 aperture and 77-degree field of view. That's very similar to the 12MP, f/1.8 camera you get with the iPhone SE and functionally identical to the main lens on the Pixel 4 XL, which costs more than twice as



**It might look big, but the camera array on the back of the Pixel 4a only houses one lens.**

much, so Google isn't cutting corners here.

You don't get the secondary telephoto lens that comes with the Pixel 4, but you do get nearly all of the fringe benefits: Night Sight with astrophotography, Top Shot, Portrait Mode, HDR+, Dual exposure controls, Motion Auto Focus, even Super Res Zoom, some of which aren't available on the Pixel 3. That's an impressive set of camera features for a \$349 phone, but even more impressive is how well they work on a \$349 phone.

Even without the Pixel Visual Core ISP, the Pixel 4a takes incredible low-light photos. Photos that are otherwise unusable are nicely brightened without being blown out, and the results consistently challenged what I got from the iPhone 11 and Pixel 4—and it



**When it comes to low-light shots, the Pixel 4a (left) absolutely smokes the iPhone SE.**

completely blew away the iPhone SE. For example, while you can see some color and detail in the low-light photo above snapped by the iPhone SE, the Pixel 4a version looks like it was taken in completely different lighting.

In bright light, the Pixel 4a performs extremely well, with robust colors, excellent clarity, precision focus, and incredible shutter speed. The 4a always handled movement well, but the new Motion Auto Focus

feature shows no signs of blurring. Portraits are also as good as they've ever been on a Pixel, and the Pixel 4a is also quite good at zooming, with full 7x shots producing clear images with surprisingly good white balance. It even has a handy digital level that helps keep your shot straight.

And the iPhone SE simply can't compete. While it certainly takes good pictures, basically none of the Pixel 4a's features are available on

the iPhone SE, most notably night mode and zooming. While you can download third-party apps that replicate the functionality



**The baseball crossing home plate in the Pixel 4a shot (left) doesn't look like it's moving but it is. But the iPhone SE handled motion extremely well too.**



The Pixel 4a can take incredible shots in all kinds of light with very little fuss.


somewhat, the results from the stock camera aren't anywhere near as good as they are on the Pixel 4a, and there's a lot to be said for getting a ready-made, out-of-the-box experience.

## BOTTOM LINE

Whether you're budget-conscious, feature-conscious, or are just tired of paying too much for phones that barely fit in your pocket, the Pixel 4a is a fantastic option that won't make you feel like you cheated out.

And quite frankly, even if you do think you need premium features like gobs of RAM or 100X zoom, the Pixel 4a might just convince you otherwise. Its performance is the only sticking point, but for a \$349 phone, it definitely exceeds expectations even if it's a far cry from the A13 chip in the iPhone SE. In every other area, the Pixel 4a excels, so much

so that you won't even miss a glass back or wireless charging.

So if you want a phone that looks great, lasts all day and then some, and takes incredible pictures, get the Pixel 4a over the iPhone SE or Galaxy A71 or any other phone in its price range—and maybe even a few that aren't. 

### Google Pixel 4a



#### PROS

- Surprisingly nice design with lots of screen.
- Incredible results from just a single camera.
- Amazing price with more storage than the Pixel 4.

#### CONS

- Performance can be pokey at times.
- No color or storage options.

#### BOTTOM LINE

The Google Pixel 4a is Android's answer to the iPhone SE and it gets everything right.

**\$349**



## Samsung Galaxy Note 20 Ultra: A love note to Note lovers

If you want it all and can afford it. **BY MICHAEL SIMON**

**O**ur Samsung Galaxy Note 20 Ultra review found three clear reasons to make the jump to this new flagship phone: Mystic Bronze, laser autofocus, and the S Pen's new 8ms latency. And if you're looking for any reasons not to, well, there are plenty of those in this review too—namely, it's gigantic,

expensive, and not a huge upgrade over the S20 Ultra.

But if you're a Note fan, you know exactly what you're getting and you know you want it: the biggest, fastest, and most powerful Android phone you can buy. For everyone else, it's not so simple.

Samsung's flagships have gotten so good





**The 6.9-inch screen on the Galaxy Note 20 Ultra definitely needs two hands to operate.**

that reviews of them are all basically the same: Yes, they have the best specs, but they're also the most expensive (although the Note 20 Ultra actually costs \$100 less than the S20 Ultra). The math is brutally clear: Even with trade-ins and carrier offers, you're still going to be paying more for this phone than for any other Note that came before it ([go.pcworld.com/10pl](https://go.pcworld.com/10pl)).

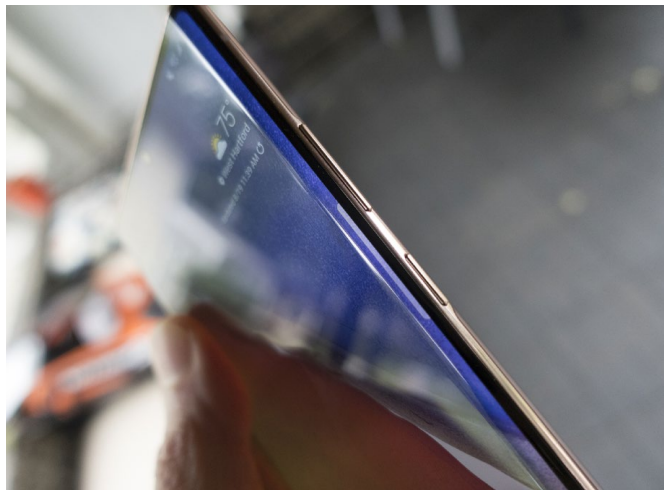
There's no doubt that you're getting a lot for your money with the Note 20 Ultra. But Samsung has raised the bar so high, the best might not be worth the price of admission anymore.

## **BIG, BOLD, BRIGHT, AND BEAUTIFUL**

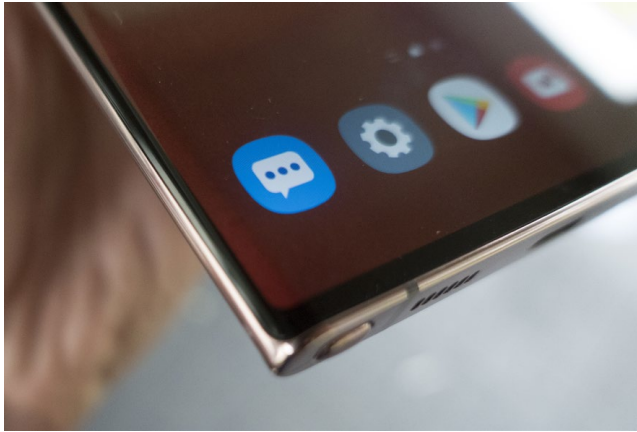
There's no nice way to say it: The Note 20 Ultra is the most unwieldy phone I've ever used. Granted, it's about 15 grams lighter than the S20 Ultra, three-quarters of a millimeter thinner, and only a couple of millimeters wider, but that phone was already at the upper limit of what my hands and pockets could handle. The extra width on the

Note 20 Ultra, along with its very boxy shape, makes it feel incredibly uncomfortable to handle and carry.

The unwieldiness is due in no small part to



**Sorry, Bixby lovers, the dedicated button is gone for good.**



**The bezels aren't completely gone on the Note 20 Ultra, but they're not very visible.**

the camera bump. You've seen it in photos, and it's every bit as obtrusive as it looks. The Note 20 Ultra's impressive thinness actually works against it here, making the bump feel much thicker by comparison. The size also means it's tough to use when resting on a table. I even encountered some issues with charging pads. A case would help, but you wouldn't want to use one.

Why? Because the Note 20 Ultra is flat-out gorgeous. Samsung's new colors are dubbed "Mystic," and they give the Note a refinement and dignity that contrasts with the pop-culture vibe one gets from the S20 Ultra's ([go. \[pcworld.com/s20u\]\(https://www.pcmag.com/roundup/the-best-smartphones\)](https://www.pcmag.com/roundup/the-best-smartphones)) bright,

iridescent "Cosmic" colorways.

The Note 20 Ultra has a luscious matte finish that's nicer than what I've seen on any Galaxy phone I've ever used. It doesn't need to grow on you like the iPhone 11 Pro's Midnight Green, or wait for the right light like the Note 10's Aura Glow. It repels fingerprints like it was made of plastic, and it has a better grip than the glossy S20 does. The new bronze color's

matching, stainless-steel sides add a touch of sophistication, accentuated by the slivers of color that peek out above and below the display. You'd be nuts to get any other color and even more nuts to put a case on it, even a clear one.



**The Note 20 Ultra's matte finish is a massive improvement to the glossy S20 Ultra.**



The front of the phone is equally fabulous. The bezels around the enormous 6.9-inch screen are about as thin as they can get without disappearing completely. The curved edges contrast nicely with the flat top and bottom.

Because it's a Samsung flagship, it goes without saying that the display is big, bright, and breathtaking. But I'll say it anyway. Samsung somehow manages to top itself with each new flagship. If you go deep enough in the comparison with the S20 Ultra, you'll see a more consistent white balance and a higher max brightness (a whopping 1,500 nits using adaptive brightness), but all you'll notice are the vibrant colors and deep blacks.

The Galaxy Note 20 Ultra has the same 120Hz display that Samsung introduced with the S20, so unfortunately, you still need to drop the resolution to Full HD to use the 120Hz setting, but it's a small sacrifice. Once you try it out, you won't want to go back, but here it has an adaptive refresh rate to conserve battery life. So if you're reading an article, the rate will drop to 60Hz, but if you're playing a game or watching a movie, it'll increase to 120Hz. It's a great battery-saving feature and one that looks to be

exclusive to the Note. Samsung has announced the One UI 2.5 features that are coming to the S20 ([go.pcworld.com/tktk](https://www.pcworld.com/tktk)) and the adaptive refresh isn't one of them.

## POWER TO SPARE WITH SOME SPARING PARTS

The Note 20 Ultra might not be a true "gamer" phone like the Asus ROG Phone 3 or the Lenovo Legion Duel ([go.pcworld.com/Intl](https://www.pcworld.com/Intl)), but it packs just as much of a punch. The Snapdragon 865+ combined with 12GB of LPDDR5 RAM produced the best scores I've ever seen on an Android phone:

### Geekbench 5

**Single:** 966

**Multi:** 3,067

**Compute:** 3,652



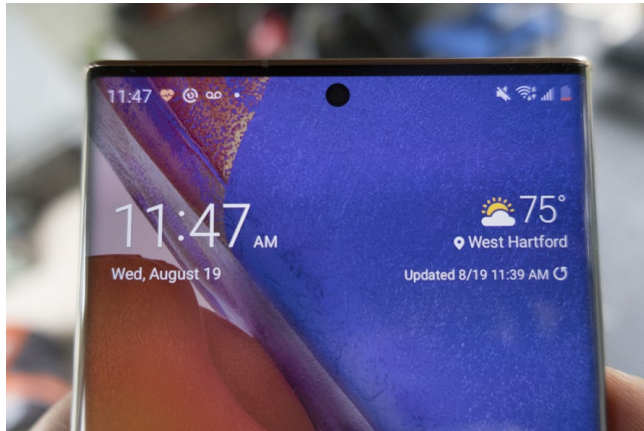
**The Galaxy Note 20 Ultra (top) is only about three-quarters of a millimeter thinner than the S20 Ultra, but the difference is noticeable.**

**PCMark****Work 2.0:** 12,298

So you're getting a phone that'll run everything at tip-top speed, including Microsoft's new xCloud Xbox gaming service. I'm no gamer (my *Candy Crush* obsession notwithstanding), and my *Minecraft Dungeons*-loving son was too young to try out the preview with his account, but Xbox fans will surely be happy with the performance.

You'll also be able to download *Fortnite* without side-loading, an unexpected benefit of Epic's recent war with Google and Apple. Because Samsung runs its own App Store and doesn't have terms as strict as Apple's for developers, the new Epic Store with discounted V-Bucks is available at a tap. My son reports that while the on-screen controls were a little confusing at first, gameplay on the Note 20 Ultra is "OP" (that means good), and he was able to snipe some sweets.

The Snapdragon 865+ chip gets a little hot, however. In *Fortnite* and other graphically intensive apps, the back of the phone became noticeably warm to the touch, often topping 100 degrees Fahrenheit during the heaviest loads (per an infrared thermometer). It might become an issue on hot days. That's probably why the Asus ROG Phone 3 and



**The bezels are thin, the camera is centered, and the screen is gorgeous on the Note 20 Ultra.**

Lenovo Legion Duel have specialized cooling systems.

One thing gamers will need to bring to the Note 20 is a pair of earbuds. Samsung has quietly decided to nix them as freebies from versions of the Note 20 sold in the United States. That probably won't matter to most users who have long dumped the in-box buds for something better, but on a \$1,300 phone, it feels a little stingy. As does the 128GB of storage, which is half of what the Note 10+ starts at.

Also a little on the skimpy side is the Note 20 Ultra's 4,500mAh battery. While that's bigger than what you'll find on most phones, it's smaller than the 5,000mAh battery in the S20 Ultra. But don't worry: Your Note Ultra is still going to make it through the day, even with heavy users who want to keep 120Hz

motion smoothness turned on.

Note 20 Ultra users will have to settle for second-best when it comes to battery life, however. In benchmarks, I got better than 12 hours with 120Hz turned off, but only around 9 hours with it on. My real-world experiences were similar: Even with the new adaptive refresh rate, the Note's battery drained significantly faster when motion smoothing was on, which is just going to be a fact of life until it evolves. It's the main reason why the iPhone 12 probably won't include a ProMotion display—it kills battery life.

When you need to charge it, you'll get 25W fast charging, but not the 45W charging on the Note 10+ and Galaxy S20 Ultra. It won't make a huge difference—the Note 20 Ultra will still fill up in less than 90 minutes using the 25W charger—but it's strange that

Samsung removed support after just a year.

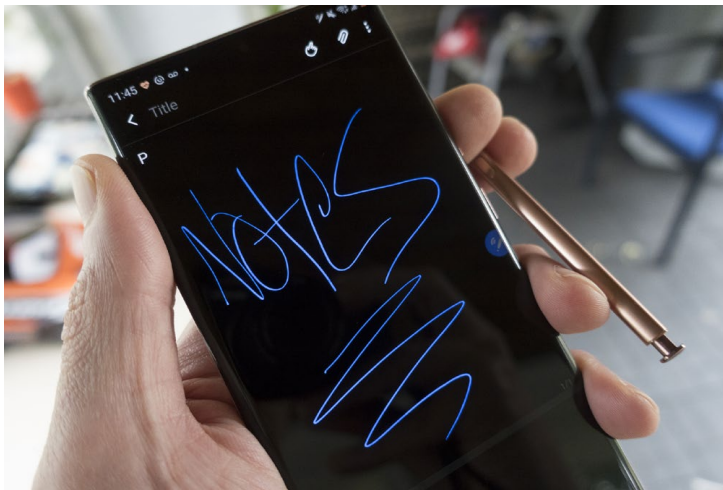
The camera bump also caused some issues with charging pads. More than once my phone didn't charge because the camera lifted the phone up enough where the coils weren't touching.

## A MIGHTY NOTE-TAKER

Because this is a Galaxy Note phone, it has an S Pen on board, though it's not like the styli of Note past. For one, it's been moved to the left side of the device after living its whole past life on the right side.

The placement isn't the only thing that's new. Samsung has accelerated the S Pen's latency from 45ms to 8ms, which has a dramatic effect on writing and drawing. I never had an issue with the old pen's performance, but the new S Pen feels as

natural as writing on an actual piece of paper. That latency is the same as the Apple Pencil's, and it makes a huge difference when taking notes, marking up documents, or just scribbling on the screen. It's even better with the higher refresh rate. Samsung's Notes app has been



**You'll want to take more notes with your Note 20 Ultra's S Pen.**



**The camera bump on the Note 20 Ultra is very bumpy.**

upgraded as well, with better handwriting support and annotated audio. I suspect you'll be using your Note to take notes more often than with previous Notes.

The rest of the S Pen's tricks aren't nearly as impressive. Samsung turned its stylus into a Bluetooth remote with the Note 9 and added app gestures last year. Now the Note has even more "air actions" that let you control all aspects of the phone with back, recents, home, and screenshot gestures. I could somewhat see the appeal of using the S Pen as a remote for the Camera or Gallery, but the use case for the new air actions is extremely limited.

And that's if you can get them to work. While I was able to complete the handy tutorial that forces you to practice each of the new gestures, getting them to work while using the phone wasn't so simple. I often triggered the wrong gesture or none at all.

I struggled to find a reason to use them. Even when I was using the S Pen, it was just as easy to tap the phone than wave my hand

to go back a screen or switch apps.

The new S Pen is joined by a new version of One UI (2.5) that brings minor camera and interface tweaks, as Samsung continues to refine one of the best Android skins this side of the Pixel. Samsung has specifically



**The Note 20 Ultra is impressively thin at 8.1mm, but the camera bump adds some girth.**

designed One UI to be friendlier to giant phones. The menus, navigation, and layout all make the Note 20 a little easier to handle. You'll still need two hands, but One UI is a pleasure to use.

## A MORE RESERVED, MORE REFINED CAMERA

The Galaxy Note 20 Ultra has a camera system rivaling that of any smartphone out there, but it's not quite as extravagant as the S20 Ultra's. That's a good thing. The 100X Space Zoom that was plastered across the camera array on the S20 Ultra has been lowered to 50X, and the DepthVision lens has been replaced by laser autofocus.

Both changes serve the Note 20 Ultra well. While the 108MP lens is still largely unnecessary—I couldn't tell the difference between 108MP pictures and 12MP "binned" images—the Note 20 Ultra is definitely Samsung's best smartphone camera. It's no coincidence that it's also the least gimmicky, eschewing features like Dual Exposure on the Note 9 for the things that matter: improved night mode, lightning-fast focus, and realistic zoom.

The zoom has its limits. When pushed to 50X, the Note 20 Ultra still produces noisy shots. Drop to 30X and they're useable, but 10X yields the best results. If I were in charge of the Note 30's camera, in fact, I'd make 30X the upper limit and work on perfecting it. Samsung's zoom is its biggest advantage over Google and Apple (for now). Even with fewer megapixels in its telephoto lens (12MP versus



**The Galaxy Note 20 Ultra has impressive zoom, seen here at 1X (top left), 10X (top right), 30X (bottom left), and 50X (bottom right).**





**The laser zoom is so fast and precise, the center of subjects are often too in focus, leaving blurry edges.**

48MP on the S20 Ultra), the Note 20 Ultra takes better zoom shots.

The other big improvement is with autofocus. Focusing was an issue with the Galaxy S20 Ultra that has never been satisfactorily resolved. For the new

generation, Samsung added a laser autofocus sensor to the Note 20 Ultra. It makes a huge difference over the S20 Ultra and is a far more useful fourth lens than a macro or depth one. I've never used a phone that focused this quickly without

needing to tap the screen, and it helps all aspects of the Note.

However, at times it works a little too well. When the foreground is similar to what's behind it, the Note 20 occasionally locked onto the wrong part of the picture. Other cameras were smarter. When it got it right, photos often had an aggressive bokeh effect even without using Live Focus. In the photo of the flower above, for example, the back petals are



**Even without a dedicated time-of-flight sensor, the Note 20 Ultra (left) takes portraits that are as crisp as the S20 Ultra's.**



out of focus. The same shot with the Pixel 4a has everything in focus.

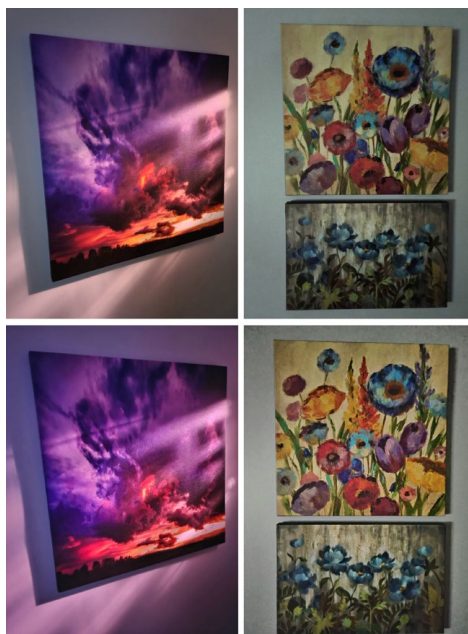
Night mode also improves on the Note 20 Ultra, pulling it close to equal footing with the iPhone 11 and Pixel 4. Shadows and lowlights aren't blown out as they are on other Galaxy phones. Pictures have less noise than on the S20 Ultra. It's a great improvement and puts the Note 20 Ultra on firm footing with the night mode champ.

Hands down, the Galaxy Note 20 Ultra is Samsung's best camera phone. You'll still get a healthy serving of Samsung's trademark oversaturation, and the app is still a bit more confusing than it should be. But more often than not, you're going to take your phone out of your pocket and snap a great pic with very little fuss, whether you're far away or shrouded in darkness.

## BOTTOM LINE

Nothing I write here is going to convince you about a Note 20 Ultra either way. If you have \$1,300 to spend on a phone and want the very best of Android, you've probably already decided to order one. And if you're a Note lover, it's likely already on the way.

For everyone else, however, it's a tough recommendation. It's undeniably the best phone you can buy, but it's also probably more screen and power than most people need. No matter how you slice it, \$1,300 is a ton of money to pay for a phone, even one as beautiful as the Note 20 Ultra. 🔌



**The Note 20 Ultra (top) takes sharper, more balanced, and less over-exposed photos in Night mode compared to the S20 Ultra. (It was very dark when I took these shots.)**

### Samsung Galaxy Note 20 Ultra



#### PROS

- Giant, gorgeous screen, fast processor, and great battery life.
- Mystic Bronze is the new pinnacle in phone colors.

#### CONS

- Extremely expensive with less storage than the Note 10+.
- Might be too big for some pockets.

#### BOTTOM LINE

The Galaxy Note 20 Ultra is a phone for Note lovers, but it might be too expensive and overloaded for anyone else.

**\$1,300**

# Lenovo IdeaPad Slim 7 performance preview: The Ryzen laptop we've been waiting for

AMD's Ryzen 7 4800U is insanely fast. **BY GORDON MAHUNG**

**L**ike a prize fight weigh-in, the AMD Ryzen 7 4800U in Lenovo's IdeaPad Slim 7 just flexed like no other ultrabook CPU we've ever seen.

It's almost as though the Ryzen 7 4800U snatched the mic from the podium and started hurling insults at Intel's upcoming Tiger Lake CPU ([go.pcworld.com/prom](https://go.pcworld.com/prom)). If there was a folding chair, we're sure it would've been thrown at Intel's entourage while the flash bulbs popped.

While we're still in the process of finishing our testing, the early results we're seeing are gobsmackingly impressive. How impressive? When we started hunting in our spreadsheet for how other laptops performed against the IdeaPad Slim 7's results, we kept scrolling, and scrolling, and scrolling to find something comparable. At that point, any hardware reviewer worth his or her salt questions whether they're "doing it wrong." Did I run the wrong test? Am I in the wrong row? Do I need more coffee?

No. Not at all. The Ryzen 7 4800U in the IdeaPad Slim 7 is just that stupidly fast.

Peep the scores from Maxon's older Cinebench R15 benchmark, which uses all cores to measure a CPU's performance at rendering a 3D image. We're not kidding either. We initially thought we ran the wrong test or simply recorded it wrong, but the IdeaPad Slim 7 and the Ryzen 7 4800U is just that fast in this short, all-core performance test.





**The Ryzen 7 4800U in the IdeaPad Slim 7 is stupidly fast.**

As you look at the chart, you should note the two laptops that are even remotely close to the IdeaPad's performance aren't even the same class of notebook. Both the Dell XPS 15 7590 with an 8-core Core i9-9980HK ([go.pcworld.com/xp75](https://go.pcworld.com/xp75)) and the new Dell XPS 15 9500 with an 8-core Core i7-107850H CPU ([go.pcworld.com/xp95](https://go.pcworld.com/xp95)) are basically 4.5-plus-pound, content creation laptops with discrete GPUs and beefy cooling.

Intel's 6-core Comet Lake are next up, but the 4-core laptops aren't even eating dust compared to the IdeaPad Slim 7, because the shock wave from the Ryzen 7 4800U has sucked the dust with it.

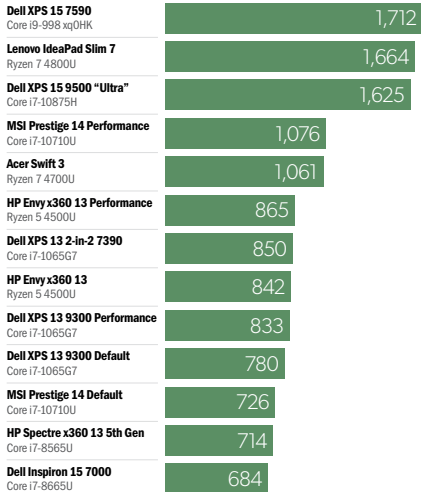
Even more interesting is the performance

of the Ryzen 7 4700U in the budget-priced Acer Swift 3 ([go.pcworld.com/aswf](https://go.pcworld.com/aswf)). It's also an 8-core CPU, but AMD leaves simultaneous multi-threading (a.k.a. its version of Hyper-Threading) off. SMT is enabled on the IdeaPad Slim 7 and we're looking at a huge performance bump.

One issue with Cinebench R15 is its short runtime—maybe a minute, if that. Modern laptops are all limited by thermals and a short test doesn't really tell you how well a laptop can handle a really long task. For that, we run HandBrake and encode a 30GB 1080P file using the Android Tablet preset. On an ultrabook, it used over an hour to run, and was really just a test to see how well laptops

### Cinebench R15.038

Multi-core performance



LONGER BARS INDICATE BETTER PERFORMANCE

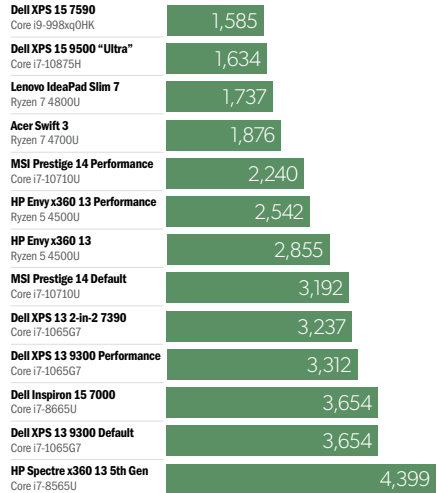
**We thought we ran the wrong test, but nope. The Ryzen 7 4800U in the Lenovo IdeaPad Slim 7 is that fast.**

handled heat over a long test. With today's notebooks though, actually running a CPU encoding task on a 3-pound laptop is realistic.

The result is still pretty amazing, but we do see that the Lenovo IdeaPad Slim 7 doesn't leave its Ryzen 5 siblings in the dust. It still eats the lunch (and dinner) of the Intel 10th-gen Comet Lake U and 10th-gen Ice Lake U laptop, but the thermal limitations of a thin and light laptop are at play. And yes, it's really not that much slower than an 8-core Core i7-10875H

### HandBrake 0.99 Encode

Seconds



SHORTER BARS INDICATE BETTER PERFORMANCE

**On a longer workload, the thermals come back into play and the Slim 7 comes back to earth. It's still enough to basically make us wonder just what Intel's H-class laptops are doing with all that power they have though.**

in the Dell XPS 15 9500 either. Phew.

Besides CPU performance, AMD's graphics matter too. With the Ryzen 7 4800U, you get one more graphics core over the Ryzen 7 4700U, and you get slightly higher clock speeds: 1,750MHz versus 1,600MHz. The Lenovo IdeaPad Slim 7, however, also sports LPDDR4X RAM clocking as high as 4,267MHz. Most of the Ryzen laptops we've seen feature dual-channel DDR4/3200 memory that's slower, but lower cost.

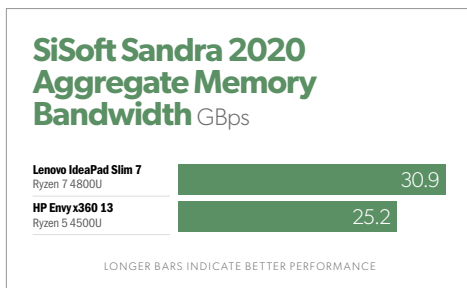
Graphics performance can typically use all

the memory bandwidth it can get so we suspect the IdeaPad Slim 7 gets a boost from both the additional graphics core and the clocks plus the faster LPDDR4X/4267 RAM.

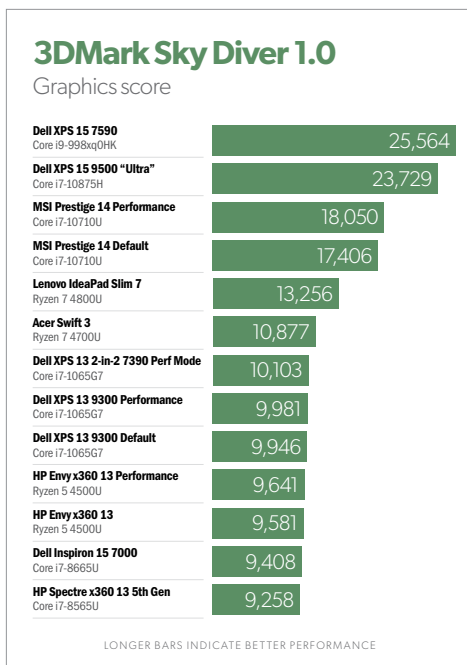
To see how much more memory bandwidth you'd get, we compared the HP Envy x360 13 ([go.pcworld.com/x313](http://go.pcworld.com/x313)) with its Ryzen 5 and DDR4/3200 to the Lenovo IdeaPad SlimPad 7 and its LPDDR4X/4267. Don't take this as a repudiation of the HP because we're really focusing on the main memory subsystem here, and we suspect most other DDR4 laptops would perform the same. When we get a chance, we'll also look at the memory bandwidth of LPDDR4X/3733 common in Intel Ice Lake laptops use. Just to note: Intel's Tiger Lake will support LPDDR5X at even higher clock speeds.

Ryzen desktop CPUs typically benefit from increased memory clocks, but we expect the integrated Radeon graphics in mobile Ryzen to see an even more substantial boost. Let's look at how the Ryzen 7 4800U does with its faster LPDDR4X RAM. We'll use the synthetic 3DMark Sky Diver as a way to gauge performance.

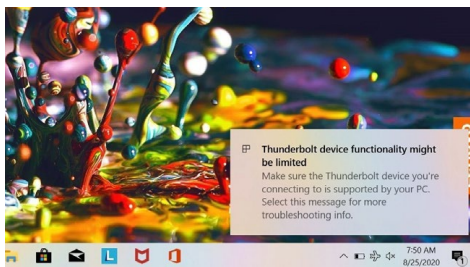
The result is a very healthy bump in performance over the seven Radeon cores in the Ryzen 7 4700U, but some of that is the increased number of graphics cores, the increased clock speeds, and also the increase in CPU thread count, as the score is the overall result. Delving into just the graphics score for 3DMark Sky Diver, it gets a little closer. Lenovo's IdeaPad Slim 7 and its Ryzen



**Dual-channel LPDDR4X/4267 offers about 23 percent more bandwidth over a dual-channel DDR4/3200 configuration.**



**The additional CPU, higher clocks and faster main memory gives the Ryzen 7 4800U in the IdeaPad Slim 7 a very healthy increase in graphics performance.**



The notification in the bottom-right corner of this screenshot appears when you plug a Thunderbolt device into the Lenovo IdeaPad Slim 7.

7 4800U gave us a score of 13,083; the Ryzen 5 4500U in the HP Envy x360 13 got 9,547; and the Acer Swift 3 and its Ryzen 7 4700U finished with 10,888.

## AND NO: THERE IS NO THUNDERBOLT 3

Despite some early reports that the IdeaPad Slim 7 has the Holy Grail of features in an AMD laptop—Thunderbolt 3—it doesn’t. After reading those reports, we got giddy with our Thunderbolt 3 accessories, only to end up with the same Charlie Brown football we’ve seen on Ryzen 4000 laptops for the last five months.

## WHAT THIS MEANS

So what does this all matter? Well, the main take away is that the Ryzen 7 4800U has finally arrived just in time for the main fight.

When Intel unwraps its 11th-gen “Tiger Lake” CPUs, we’ll witness an epic battle for the soul of thin and light laptops unlike any we have ever seen before. Our earlier prediction that Tiger

Lake will lose against Ryzen 4000 in multi-threaded tasks ([go.pcworld.com/tgrz](http://go.pcworld.com/tgrz)) stays the same. Well, kind of. After seeing the Ryzen 7 4800U’s results, we actually think it’ll be a total blowout in multi-threaded performance now. Graphics, however, might just be closer than we expected. And one area Tiger Lake is likely to win big is single-threaded performance, which is actually probably more important for most of what it is done in a small laptop.

Stay tuned for our full review of the Lenovo IdeaPad Slim 7, and for more information about Intel’s imminent Tiger Lake counterpunch. 🔌

### Cinebench R15.038

Single-core performance

Dell XPS 15 9500 “Ultra” Core i7-10875H	203
Dell XPS 15 7590 Core i9-9980HQ	200
Dell Inspiron 15 7000 Core i7-8665U	190
MSI Prestige 14 Performance Core i7-10710U	189
Dell XPS 13 9300 Default Core i7-1065G7	184
HP Spectre x360 13 5th Gen Core i7-8565U	184
Lenovo IdeaPad Slim 7 Ryzen 7 4800U	183
Acer Swift 3 Ryzen 7 4700U	183
Dell XPS 13 9300 Performance Core i7-1065G7	183
Dell XPS 13 2-in-2 7390 Perf Mode Core i7-1065G7	179
HP Envy x360 13 Performance Ryzen 5 4500U	177
HP Envy x360 13 Ryzen 5 4500U	177
MSI Prestige 14 Default Core i7-10710U	177

LONGER BARS INDICATE BETTER PERFORMANCE

**Tiger Lake is likely to clean Ryzen 4000’s clock in single-threaded performance and that might just matter more.**





**END  
FAMILY  
FIRE**

8 kids a day are accidentally killed  
or injured by **FAMILY FIRE**.

**FAMILY FIRE** is a shooting involving an  
improperly stored gun, often found in the home.

[ENDFAMILYFIRE.org](http://ENDFAMILYFIRE.org)

**Ad  
Council**

# Mullvad vs. NordVPN: Two popular VPNs do battle

We break it down, feature by feature. **BY IAN PAUL**



Choosing a VPN is a challenge when there are so many available—as our comprehensive roundup of VPN reviews demonstrates ([go.pcworld.com/vpnr](https://go.pcworld.com/vpnr)). Everywhere you look online, some service is offering to help obfuscate your location and protect your browsing habits from internet service providers (ISP) and anyone else lurking around the web.

Before plunking down your cold hard credit card number, however, there are many questions to ask. Can you trust the company? What are the speeds like? Is there a desktop app and is it easy to use? How many country locations are there, and can you still watch Netflix while connected?

Let's take a look at two of the most popular VPN choices—Mullvad ([go.pcworld.com/mv18](https://go.pcworld.com/mv18)) and NordVPN ([go.pcworld.com/](https://go.pcworld.com/)

[nrvp](#))—the former is our current top pick for a VPN ([go.pcworld.com/vpnr](https://go.pcworld.com/vpnr))—to understand how they differ and figure out which one is right for you.

## THE WINDOWS APP

The primary way we interact with a VPN is through its desktop app. A bad app may not be a deal breaker, but something that's easy to use just makes things simpler.

NordVPN on Windows uses an interactive map to help you connect to the location you want. This can be a little overwhelming from the zoomed-out view (especially if you're looking at Europe), but zoom in and everything becomes clearer. NordVPN also provides a list view of locations, as well as the ability to drill down into specific servers.

Mullvad offers a single-pane app with a non-interactive map. It's a vast improvement on what the company had before, but it doesn't quite rise to the level of NordVPN's excellent mix of simplicity and power-user complexity.

**Winner:** NordVPN

## SPEED

A VPN is useless if your internet connection slows to a crawl. In our tests, both VPNs busted out high-speed performances, with

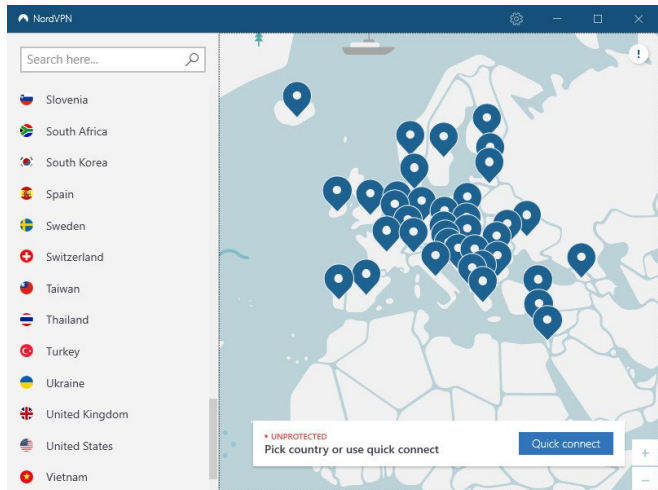
NordVPN recently pulling in a resounding victory: NordVPN kept 60.40 percent of the base speed across five different country locations, while Mullvad retained 52 percent.

**Winner:** NordVPN

## PRIVACY AND ANONYMITY

Both Mullvad and NordVPN are big on not tracking you. NordVPN says it doesn't log any of your activity, though it does maintain a timestamp of your last session status, which is deleted within 15 minutes of you terminating a connection. Mullvad also has a no-logs policy and says all data is sent to dev/null, a nonexistent directory on Linux machines.

When it comes to protecting your identity, Mullvad really excels. NordVPN only requires an email, which is already pretty good, and you can easily use a throwaway address to



**NordVPN's default view.**

manage your account.

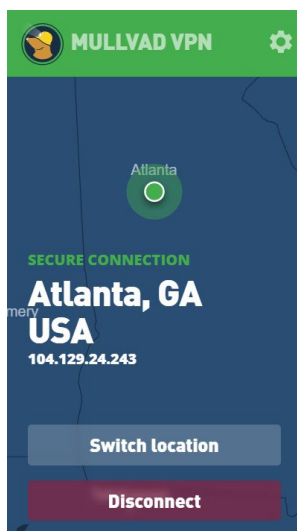
Mullvad, however, doesn't even want that much information. When you sign up it assigns a random account number that is your only way to access your account. No passwords that might accidentally reveal identifying information, no email address, nothing.

**Winner:** Mullvad

## TRUST

A key component to trusting a company with your data and privacy is identifying who runs the company and where they are in the world. That's easy with Mullvad, but until recently it was harder with NordVPN.

The company is finally starting to be transparent about who's in charge over there,



Mullvad VPN.

with company co-founder Tom Okman going public. NordVPN also tries to improve trust with third-party audits of its no-logs policy. The reports validate most of the company's claims;

however, the audits were contracted in such a way that NordVPN is prevented from publishing them in full for the public—though NordVPN customers can read them online from their account dashboard.

**Winner:** Mullvad

## PRICE

When it comes to price, NordVPN has the cheaper plan, if you pay for three years upfront. The company's three-year plan costs a little less than \$108, or just under \$36 per year.

If you choose to pay year-by-year instead, it comes out to about \$84 per year; a per-month plan is \$12 per month.

Mullvad's pricing scheme is much simpler. The company charges you €5 per month, which at this writing is about \$5.70.

So where does that leave us? Overall, NordVPN has the cheapest plans, but if you need a month-to-month VPN at a reasonable price it's hard to beat Mullvad, as most VPNs charge \$10 to \$12 for a single month.

**Winner:** Tie

## NETFLIX

A popular use for a VPN when you're overseas or just securing your connection away from home is watching Netflix. Mullvad doesn't make any promises about being able to view Netflix, but NordVPN does. The last time we checked, NordVPN was making good on its promise. Mullvad users may occasionally find



they can connect to Netflix, but it's more of a happy accident than a guaranteed feature.

**Winner:** NordVPN

## COUNTRY CHOICES

Mullvad runs its own network of servers and offers 33 country locations and more than 300 servers. NordVPN is closer to double that at 58 countries and more than 3,000 servers.

**Winner:** NordVPN

## PLATFORMS

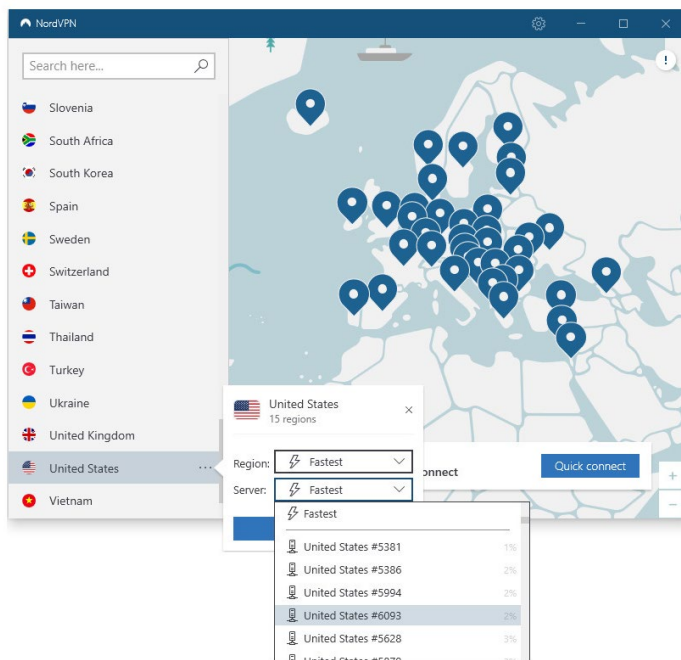
Mullvad offers apps for Windows, Mac, and Linux. There are also apps for Android and iOS.

NordVPN also has apps for Windows, Mac, Linux, Android, and iOS.

**Winner:** Tie

## BOTTOM LINE

If you do a straight count of the categories above, NordVPN is ahead by two (three if the call on pricing upsets you). The speed, privacy, and trust categories are weighted more heavily since they are the key components of a VPN in our book. For that reason, we're recommending Mullvad,



**NordVPN's server lists are easily accessible.**

which should come as no surprise since it's the top pick in our VPN roundup ([go.pcworld.com/vpnr](https://go.pcworld.com/vpnr)).

The bottom line is that Mullvad checks almost every box including speed, trust, and security. There are numerous reasons to trust its service with your data. NordVPN has a long track record of service, and has an amazing product. Still, we want even more transparency about leadership and the team running the operation before reconsidering.

By our calculation there's just no question. When it comes down to NordVPN vs. Mullvad, the latter is the clear winner. 🔌



# Norton 360 Deluxe: Good protection with added features make it an excellent value

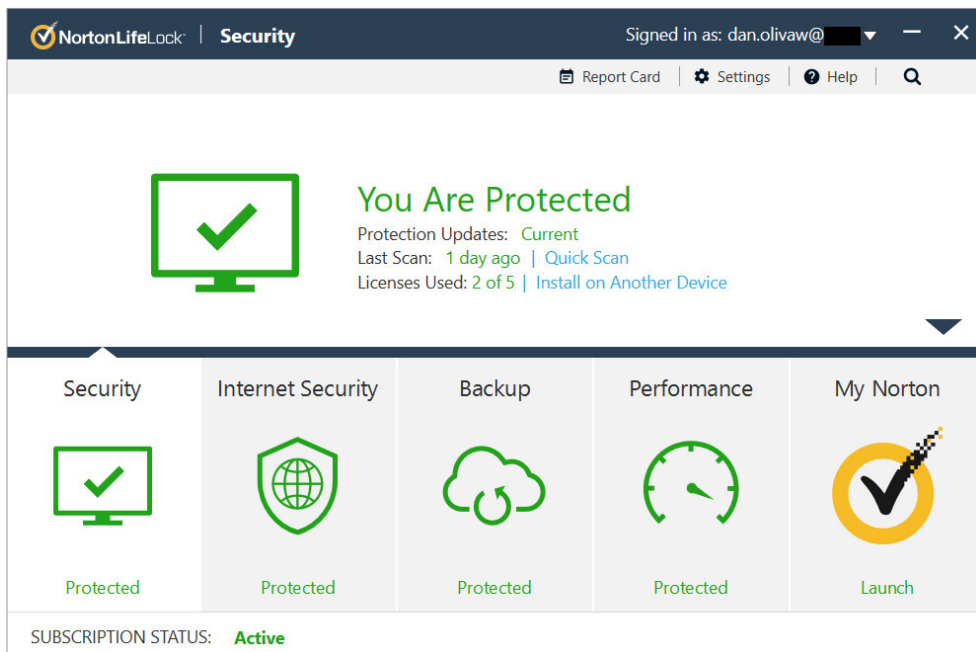
Norton 360 Deluxe offers excellent value with solid protection, and a good amount of extra features. **BY IAN PAUL**



**N**ortonLifeLock, formerly Symantec, has changed up its security suite lineup. Norton Security Premium, the suite we've reviewed several times, is no more. Now it's all about the Norton 360 brand that combines Norton's protection with services from identity-theft protection company

LifeLock, which Symantec acquired in 2016.

By our reckoning, the best choice in terms of value and capabilities in the current lineup is Norton 360 Deluxe. There are two other suites above that with extra LifeLock features, but for most people 360 Deluxe hits the sweet spot at \$50 for the first year for new users and \$100 for returning users, covering



### The Device Security app in Norton 360 Deluxe.

five devices.

Norton 360 works with two primary apps. The first is My Norton, a launcher for the actual antivirus program known as Device Security. My Norton is home to other features that come with 360 Deluxe such as Dark Web Monitoring from LifeLock, a secure VPN, 50GB of cloud backup, a password manager, and a link to the Norton website for parental controls.

Device Security looks the same as Norton's other antivirus apps have for years now. The app has five sections: Security, Internet Security, Backup, Performance, and My Norton. The latter is just a launcher for the

My Norton app.

Security is where most of the action happens. Here you can initiate a scan with a wide number of options including a quick scan (the default), full system scan, a custom scan, and a custom task.

The custom scan can check for protection updates, remove temporary files in the system, run disk optimization, and erase Internet Explorer temporary files.

The Scans section can also run Norton Power Eraser for eliminating threats that regular scans can't deal with, as well as diagnostics, and Norton Insight—the

program that determines which files should be scanned during a quick scan.

While most people will just need the quick scan and full system scan options, it's great that all these tools are easily accessible by the user. Beyond scans, the Security section also houses the SafeCam settings for keeping rogue programs away from your webcam. There isn't much to do with SafeCam, but if it's ever giving you issues, this is where you can turn it off.

Internet Security features access to the password manager, password generator, and Norton's browser extensions. As we've noted before, Norton doesn't bother you too much with notifications about its features; however, it does love to notify you from time to time if you don't have all of the Norton browser extensions installed.

The essential one is Norton Safe Web,

which warns you about malicious sites, and puts a green check mark next to safe sites in your Google results and a red "x" next to bad ones.

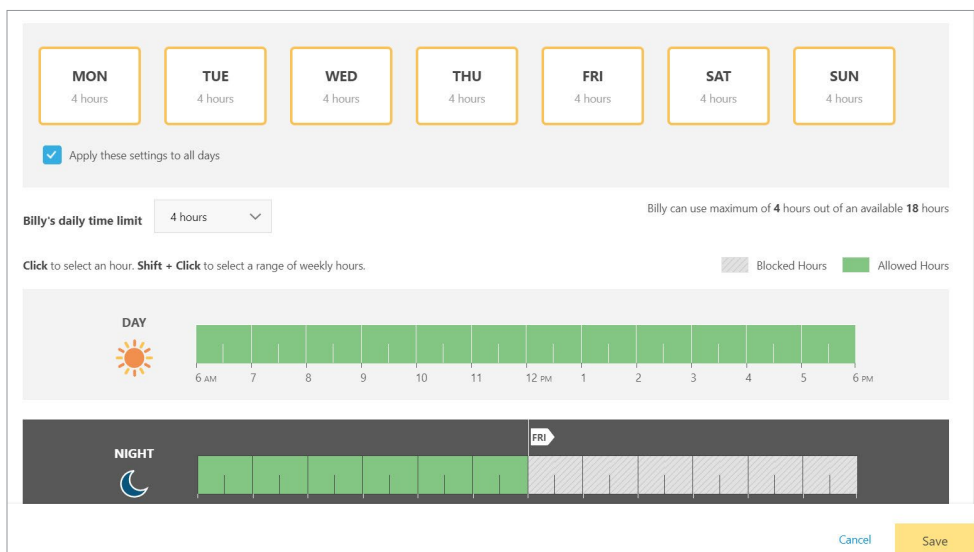
In our opinion, the other extensions are less important. Norton Home Page and Norton Safe Search are particularly unimpressive and essentially do the work that one extension could. Safe Search makes Norton Safe Search your default browser search engine, and Home Page redirects your browser's new tab pages and the Home button to Norton Safe Search. In our experience, these two extensions just get in your way. There's also a Norton Password Manager extension, which is essential if you use this program for storing all your passwords.

Backup is pretty straightforward. Setting it up allows you to keep copies of essential files in Norton's Secure Cloud Storage. If you don't want your files in Norton's cloud there's also an option for saving it to local storage.

Norton Deluxe also includes some system optimization features including disk optimization, file cleanup, a startup manager, and a graph showing performance history. You can find a lot of these features in Windows itself



**The Internet Security section of Norton 360 Deluxe.**



### The parental time controls for Norton 360 Deluxe.

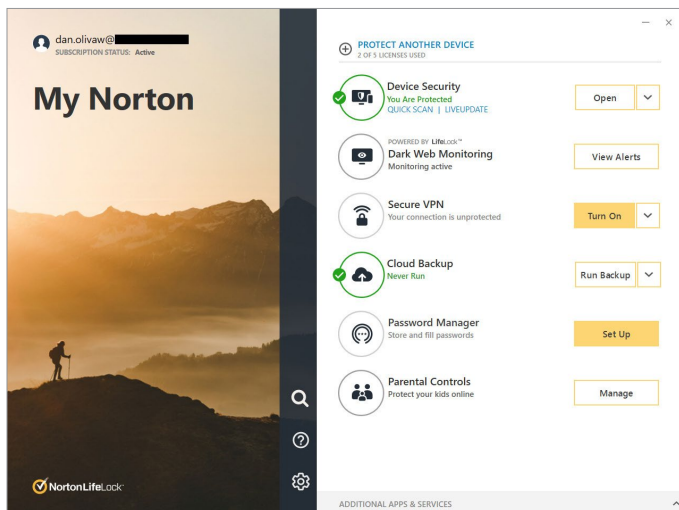
or in free third-party programs, but if you're getting Norton 360 anyway it's nice that they're there.

The Dark Web Monitoring runs off Norton's website and lets you add key information such as a bank account or credit card number, phone number, address, insurance policies, and up to five email accounts. If any of this data shows up in a hacked database being traded on the so-called Dark Web, NortonLifeLock will alert you to it.

It notably doesn't track your social security number, which I assume is part of NortonLifeLock's Fictitious Identity Monitoring available only in Norton 360 with Ultimate Plus.

We tried testing out Norton 360's parental controls and they were pretty good once they started working. We added a child profile, and then followed the instructions to install the Norton Family App on the test PC to monitor the child user account for Windows 10.

Norton's defaults will monitor the child's account quite aggressively for younger children. Time is limited, all searches are logged and more; however, it took several hours before we could see the PC reflected in the child's profile on the web interface. That's just too long, because you need to be able to tweak the protection settings to your liking—especially the time limits. If your child is doing homework and gets suddenly locked out of



The My Norton app on Windows 10.

their PC due to aggressive parental controls, well, that can get annoying. Parents can extend the child's computer time manually by entering their Norton account password, but it'd be preferable to have full control much sooner.

## PERFORMANCE

In AV-Test's round of testing from May and June 2020 ([go.pcworld.com/mj20](https://go.pcworld.com/mj20)), Norton scored 100 percent on the 0-day malware attacks test, as well as the widespread and prevalent malware test.


Over at AV-Comparatives ([go.pcworld.com/avlf](https://go.pcworld.com/avlf)), Norton blocked 100 percent of samples in the real-world protection test from May 2020 with 27 false positives. In the malware protection test, it also scored

a 100 percent, with 25 false positives. All in all, the protection results are excellent.

For our in-house performance tests, we saw no significant changes in performance between the PC with and without Norton 360 Deluxe installed.

## BOTTOM LINE

Norton 360 is a very good suite with a good price. If you're looking

for excellent antivirus protection that won't get in your way with a good amount of features then Norton 360 Deluxe is the suite to buy. 

### Norton 360 Deluxe



#### PROS

- Many extra features.
- Very good protection.

#### CONS

- Parental control device linking was a little slow.
- Pricing now covers 5 devices, down from 10.

#### BOTTOM LINE

Norton 360 Deluxe is the new suite we recommend from NortonLifeLock, as Premium Security is now retired. There aren't a lot of fundamental changes to the suite compared to previous iterations. The pricing now covers fewer devices, but you do get a good number of extra features such as Dark Web Monitoring and VPN access.

**\$40**



# Flight Simulator: Hands on with Microsoft's breathtaking virtual, real world

Downloading, installing, and loading Microsoft Flight Simulator is a slog, but in the end it's more than worth it. **BY MARK HACHMAN**

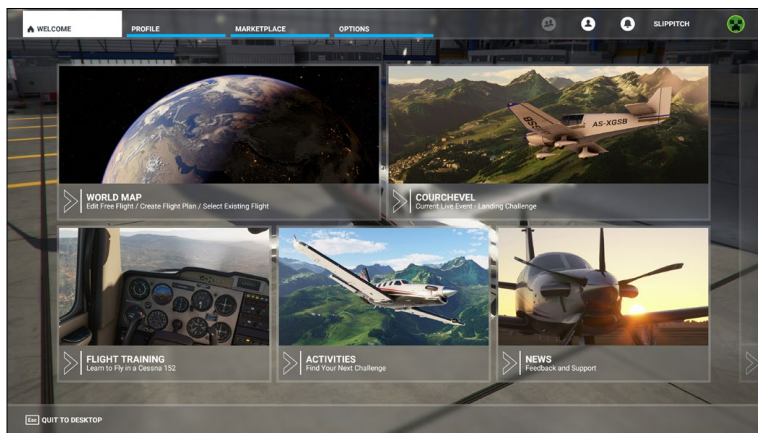


It's 8 a.m. on a clear, sunny day in Oakland, California. No, it's a rainy afternoon in Hong Kong. Or is it evening in Paris? Microsoft *Flight Simulator* doesn't care.

At a time when gorgeous "open world" games are the norm, *Flight Simulator* helps set the bar even higher. Yes, it offers a stunning recreation of a virtual world, with weather and realistic landscapes, real-world traffic and

ocean waves, and even, apparently, animals. But the virtual world is our world, our planet, and you can go anywhere in it.

For me, that's the whole point of *Flight Simulator*. Even if we weren't severely limited in our movements by the current pandemic, most of us will never see the entirety of our planet. Travel to exotic locales also comes with costs—not just the price of a flight and hotel and food, but the pollution spewed by



Flight Simulator's home screen.

the planes, trains, and motor vehicles used to get there. Microsoft's *Flight Simulator* allows me to be that happy noob simply exploring the world, without worrying about all those other considerations.

## HURRY UP AND WAIT

Microsoft's *Flight Simulator* ships in three editions ([go.pcworld.com/3edt](http://go.pcworld.com/3edt)):

Standard Edition (\$60 from Microsoft [[go.pcworld.com/60ms](http://go.pcworld.com/60ms)])

Deluxe Edition (\$90 from Microsoft [[go.pcworld.com/90ms](http://go.pcworld.com/90ms)])

Premium Deluxe Edition (\$120 from Microsoft [[go.pcworld.com/12ms](http://go.pcworld.com/12ms)])

All three will be available

when the game launches. Xbox Game Pass for PC subscribers will receive the Standard Edition for free.

Note that *Flight Simulator* requires an incredibly intensive process to install and play it—the virtual equivalent of

driving to the airport, parking, checking in, and more. Our installation (of the Premium Deluxe Edition, Microsoft confirmed) required about 70GB of files to be downloaded. Unpacking them all filled up about 110GB total. The whole process took about two hours over a broadband connection.

The system requirements are worth



	Min Spec	Min Spec	Recommended Spec	Recommended Spec	Ideal Spec	Ideal Spec
	OS	OS	OS	OS	OS	OS
OS Version	Windows 10 Nov 2019 update (19H2)	Windows 10 Nov 2019 update (19H2)	Windows 10 Nov 2019 update (19H2)	Windows 10 Nov 2019 update (19H2)	Windows 10 Nov 2019 update (19H2)	Windows 10 Nov 2019 update (19H2)
CPU	Ryzen 3 1200	Intel i5-4460	Ryzen 5 1500X	Intel i5-8400	Ryzen 7 2700X	Intel i7-9800X
GPU	Radeon RX 570	NVIDIA GTX 770	Radeon RX 590	NVIDIA GTX 970	Radeon VII	NVIDIA RTX 2080
VRAM	2 GB	2 GB	4 GB	4 GB	8 GB	8 GB
RAM	8 GB	8 GB	16 GB	16 GB	32 GB	32 GB
HDD	150 GB	150 GB	150 GB	150 GB	150 GB SSD	150 GB SSD
Bandwidth	5 Mbps	5 Mbps	20 Mbps	20 Mbps	50 Mbps	50 Mbps

Here are Microsoft's minimum, recommended, and ideal system requirements for Flight Simulator.



**You'll see this screen quite often.**

studying. While they reach back far enough to accommodate many generations' worth of PCs, you do need Windows 10 version 18362.0 or higher; at least 8GB of RAM; and discrete graphics with dedicated memory. The minimum, recommended, and ideal system requirements are in the screenshot at left.

Actually playing the game takes even more time. My PC—a Surface Book 3 that falls somewhere between Microsoft's "recommended" and "ideal" system requirements for *Flight Simulator*—required a few seconds to show me that the game was

being loaded, and a whopping three to four minutes to move past the introduction to the main menu. In a world where Windows PCs are almost immediately responsive, it all feels excruciatingly slow. The 15-second audio loop the game plays will soon drive you insane. You may as well go fetch a coffee

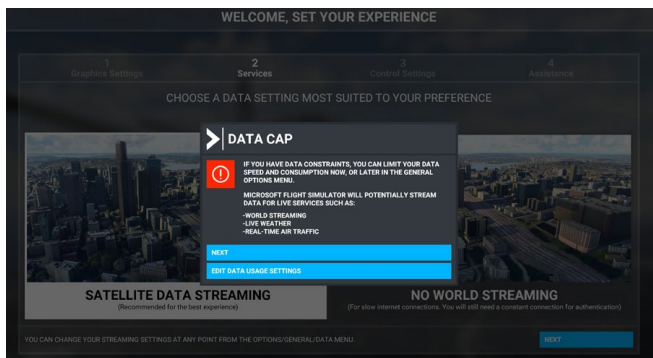
while the game's being loaded.

## ALL THE DETAILS

While *Flight Simulator* offers everything from tutorials to challenges (such as landing at a particular airport), most people will want to jump right into *Flight Simulator's* virtual world. The game pulls data from Microsoft's



**Flight Simulator is accessible to mice, keyboards, and even controllers.**



**Keep an eye on your data usage in Flight Simulator, especially if you live in rural areas or are subject to bandwidth caps.**

real-world services, including Bing Maps and its weather forecasts, promising that you'll have the option of experiencing the actual, current weather as it happens.

Our limited review time meant that I didn't have a chance to chase down a hurricane, but the oddly hazy skies outside my Bay Area home were replicated in the virtual space when I took flight above San Francisco.

What it does mean, though, is that in addition to opening your wallet for *Flight Simulator*, you'll also need to keep track of how much data the game uses. Over a couple of days' use, *Flight*

*Simulator* sucked up 2GB of data on my account. There are controls to limit bandwidth as well as the total available data the game uses over the course of a month. If you live in a rural area with limited bandwidth, you may have to dial down the live, real-world features a bit.

Early on, you'll be asked to select a difficulty level, ranging from "easy" to a

"middle ground" to a more hardcore sim experience. This choice matters. Damage to the aircraft can occur not just from an outright crash, but from undue stress on the airframe and engine. Catastrophic damage ends your flight—and forces you go back through the prolonged loading process to try again. You



**Flight Simulator offers a wide variety of assistive features to make gameplay more fun...or more realistic.**



**It's just so much fun to fly around the world in Flight Simulator.**

might want to toggle on unlimited fuel, too. Like *Flight Simulator's* graphics options, however, there's opportunity to tweak and adjust to your heart's content—or just skip all that and jump in.

Gamers who grew up with *Wing Commander* and *X-Wing* probably learned how to use a joystick, and perhaps a throttle—and then, if you're like me, you buried them in a box for the next twenty years. Fortunately, *Flight Simulator* plays smoothly with just an Xbox controller, along with the option to use a mouse or keyboard for supplementary commands.

## A MAGICAL EXPERIENCE

Flights begin with a bit of scene-setting, showing your aircraft on the tarmac from a

variety of angles. With a controller, one joystick simulates the airplane's controls, with yaw and pitch; the other governs your view of the instrument panel and outside the windows. Just taking off can be a challenge to first-timers who are unfamiliar with the controls, but Microsoft helpfully provides a toolbar which exposes itself if you move the mouse to the top of the screen. An AI control (the "head" icon) will automatically check off your pre-flight checklist and remain in contact with Air Traffic Control—and will even fly the plane for you, if you want. Tips will occasionally pop up, such as a reminder to stow the landing gear after takeoff.

*Flight Simulator* implicitly understands that there are hobbyists and enthusiasts who





The interiors of the aircraft are as detailed, or more, than the outside world.

enjoy tinkering with aircraft systems, and there are those who are just there for the ride. (Our earlier story [[go.pcworld.com/3edt](https://go.pcworld.com/3edt)] details all the aircraft within the game, from a Cessna 152 to a Boeing 78710 Dreamliner.)

I absolutely fall within the latter camp. I recall playing the original *Flight Simulator* when it came out in the late 80s, and immediately giving up on it—it simply wasn't the real world. With the *Flight Simulator* reboot, it comes pretty darn close.

Once in the air, all of the technical wizardry fades away. You simply can't help but marvel at the graphical detail... everywhere. The

golden hills of the East Bay, the deep green of the Northern California coastal forests. The traffic on the roads as you swoop down. Diving in a 747 doesn't lend itself to close examination of textures and structures, but it appears that many buildings in urban centers are, in fact,

buildings, rather than just textures overlaid onto terrain. Naturally, one of the first things I flew over was my own house, just to see if the nearby schools and shopping centers looked as I imagined them to be. They certainly did.

*Flight Simulator* includes a number of "handcrafted" airports, which include more than the usual level of detail. While I'm not



The detail in Microsoft's *Flight Simulator* is simply amazing.



**The only thing Microsoft Flight Simulator needs is a dedicated photo mode, though the “Showcase” feature as part of the external camera mode helps do the job, Microsoft says.**

sure how much you’ll notice taking off or landing, the baggage carts and other details scattered around the recreation of LAX, for example, certainly add validity to Microsoft’s recreation of the world.

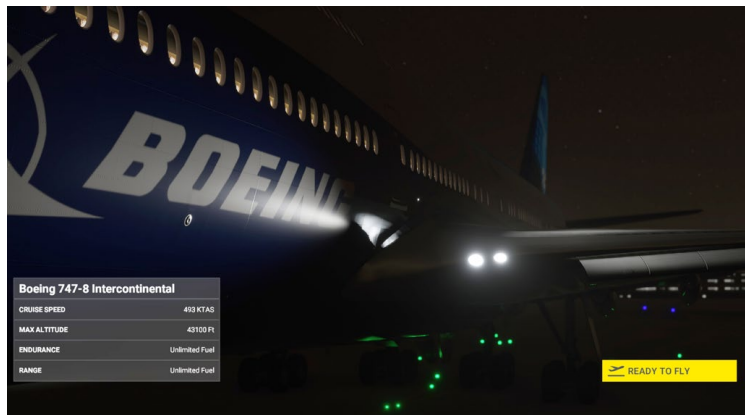
Clouds...look like clouds. I really want to go hunting for some big, lazy thunderheads, but I haven’t had time quite yet. Are Ayers Rock, Machu Picchu, and the Pyramids all visible from the air? What’s the weather like flying through a hurricane? Are there updrafts over the

Sahara? I don’t know, but the world’s there for me to find out.

I can’t really speak to performance, as Microsoft doesn’t appear to make a frame counter available. Microsoft recommended that I play the game on “high” settings, though I turned down the resolution to 1080p for the

gameplay stream. I played on a Surface Book 3 (Core i7-1065G7/32GB RAM/GTX 1660Ti Max-Q), and I’d have preferred a faster GPU.

Recording video does rob a few CPU cycles from gameplay, but you’ll probably want a desktop or a dedicated gaming PC to



**Flights begin with a closeup of the aircraft.**




play it. (I would hate to ask you to turn down the graphics options, however, as for me that's why you'd want to own the game!) *Flight Simulator* employs a "rolling cache" that seems to store recently-used textures and objects, but it seemed to have the most influence when I circled around and flew over the same terrain twice.

The "reload" penalty for crashing makes landings that much more nail-biting, especially if you're winging it, so to speak. The helpful "window" that guides you to your destination is *Flight Simulator's* equivalent of the Forza driving lines, but (at least to me) far more useful.

About the only thing I could have done without was the constant chatter between my AI copilot and the tower, which added realism but just became annoying after a while. And is

there a photo mode? Microsoft's settings helpfully provide a search box, but other than the usual methods of taking screenshots, there didn't seem to be an easy way to play tourist. (I asked Microsoft about this, but received no response.)

One of my favorite sites on the Internet is MapCrunch ([go.pcworld.com/mcrn](http://go.pcworld.com/mcrn)), which has a very simple, similar premise: It "teleports" you to a random point within the vast network of Google Maps images. (Recently, it opened with a view of Vestfjarðavegur, Ísafjarðarbær, Iceland.) Random.earth does the same, but within Google Earth.

For me, *Flight Simulator* is a hybrid of the two: a chance to explore our vast, beautiful world without ever leaving my desk. One day maybe I'll be able to do the same in real life. 





LUNG CANCER WON'T QUIT,  
EVEN IF YOU DID.

Thanks to a new scan, lung cancer can be detected early when it's more curable. If you smoked, get scanned.

Talk to your doctor or visit [SavedByTheScan.org](http://SavedByTheScan.org)



You good?



Reach out to a friend about  
their mental health.

Find more ways to help at [SeizeTheAwkward.org](https://SeizeTheAwkward.org)

SEIZE THE AWKWARD



American  
Foundation  
for Suicide  
Prevention





# 9 THINGS I LEARNED

SWITCHING FROM THE  
APPLE iPhone SE TO  
THE GOOGLE PIXEL 4A



GOOGLE  
GETS  
A LOT  
RIGHT.

BY

MICHAEL SIMON





**W**hile you can spend a thousand bucks or more on a phone if you want, you don't actually need to anymore. In the past few months, Apple and Google have both released impressive midrange phones that cost less than \$400 and bring many of the features usually reserved for premium handsets, including wireless charging, all-screen designs, and impressive battery life.

But as with all things Apple and Google, the iPhone SE ([go.pcworld.com/ip20](https://go.pcworld.com/ip20)) and Pixel 4a (see page 35) are not created equal. But I wanted to see just how different they are.

I had been using the iPhone SE since receiving it in early June, so when the Pixel 4a arrived on my doorstep, I popped out the SIM and jumped back into the world of Android. Here's what I learned:

## **SPEED ISN'T ALL THAT IMPORTANT**

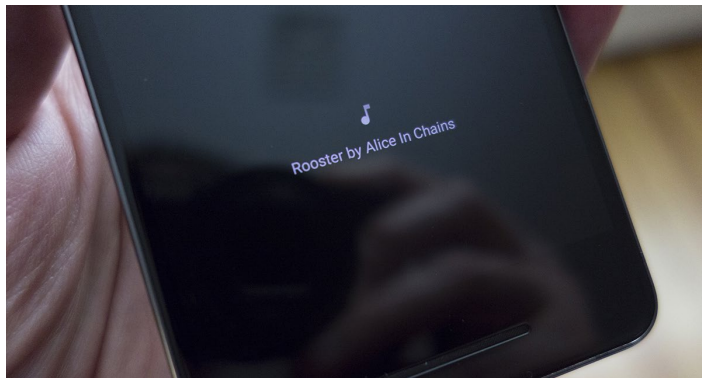
The biggest selling point of the iPhone SE is its processor. Apple gave its low-cost SE the same A13 chip that's inside the flagship iPhone 11 Pro, and you can definitely feel the power when launching apps and multitasking. It's a whole lot faster than the Snapdragon 730G inside the Pixel 4a. But

while using both, the Pixel 4a didn't really feel that much slower during day-to-day use thanks to Android 10. Frankly, the people buying these phones aren't going to be looking for flagship-level speeds anyway. It's nice for sure, but not necessary.

## 64GB OF STORAGE ISN'T GOOD ENOUGH

The iPhone SE might start at \$399, but most people should opt for the \$449 model with 128GB of storage. System files and formatting take up 5GB-10GB or more, and when you factor in photos, videos, and apps, 64GB can fill up very fast.

I didn't really notice how conservative I was being with my space until I started using the Pixel 4a, which comes with 128GB of storage, twice as much as the \$899 Pixel 4 XL. Where I was judicious about photos and apps on my iPhone SE, I didn't hesitate to install or download anything on the Pixel 4a.



The Now Playing notification has been a staple feature since the Pixel 2.

## APPLE IS WASTING SHAZAM

Ever since the Pixel 2, Google has included a cool Now Playing feature that automatically scans the surrounding area for music and identifies what it hears. It's a fantastic feature that Apple could easily mimic, and it wouldn't even have to build its own database or algorithm as Google did. Apple already owns the Shazam song identification service ([go.pcworld.com/szam](https://go.pcworld.com/szam)), and could use it to build a speedy, private, and delightful feature for the iPhone that's just as good as it is on the Pixel 4a. Instead, the only feature it's added to Shazam is an automatic Apple Music playlist. Yawn.

## GOOGLE OUT-DESIGNED APPLE FOR ONCE

While the iPhone SE is certainly a well-built phone, there's no getting around its 2016 design, with giant bezels, lots of wasted space, and a home button. The Pixel 4a, on

the contrary, looks a lot like the iPhone 11, with a near-all-screen design, rear fingerprint sensor, and rounded corners on the display. It looks better and more modern than the iPhone SE and doesn't feel cheap, either. But Apple wins with colors. Sadly, you can only get



The Pixel 4a is Android's yin to the iPhone SE's yang.

the Pixel 4a in black (though I really like the mint-green power button.)

## NIGHT MODE IS ESSENTIAL

Google revolutionized nighttime shots with Night Sight on the Pixel 3, and Apple followed suit with its own Night mode on the iPhone 11. You can quibble over which produces better results, but there's no denying that both represent a huge leap for low-light smartphone photography. If you buy a Pixel 4a, you get it—and even without a dedicated image signal processor, it's nearly as good as it is on the flagship Pixel 4 XL. Apple has inexplicably left Night Mode off

the iPhone SE, and the camera suffers as a result.

## WIRELESS CHARGING IS, TOO

When Apple finally released an iPhone with wireless charging in 2017, the Android world scoffed. After all, most flagship phones had enjoyed the convenience of wireless charging for years. Fast-forward three years and nearly every phone has it, for good reason.

Wireless chargers are cheap

and a great way to make sure you never run out of juice. But sadly, you'll need to plug in the Pixel 4a to charge it. I lost track of how many times I mindlessly placed it on one of my wireless chargers before remembering I needed to plug it in.



It might look like the Pixel 4a has more cameras, but they actually both have one rear lens.

## THREE YEARS OF UPDATES AREN'T ENOUGH

Google famously promises Android version and security updates “for at least 3 years from when the device first became available on the Google Store.” That means anyone who buys a Pixel 4 will be guaranteed to get Android 13 when it arrives in 2022.

Apple makes no such assurance because it doesn't have to. iOS 14 has been released, and it's available to both new and old iPhone SE users, even those who bought their phones in 2016. That's a huge advantage for Apple that Google should match.

## APPLE'S LCDS ARE BETTER THAN GOOGLE'S OLEDS

You don't need to be a pixel purist to see that the screens on the iPhone SE and Pixel 4a are quite different. First, there's the size, which is 5 inches for the iPhone SE versus 5.8 inches on the Pixel 4a. You also get a higher resolution on the Pixel 4a (1080p vs. 720p), with a higher ppi density (443 vs. 326). Google uses OLED compared to Apple's LCD, which means blacks are deeper on the Pixel 4a.


Despite all the Pixel's display advantages



**The Pixel 4a and iPhone SE are very similar in size, but the Pixel has a way bigger screen.**

by spec, I prefer the iPhone SE's display to the Pixel 4a's. Whites are brighter, colors are richer, and True Tone does a fantastic job of keeping whites balanced. On paper, I want the Pixel 4a's screen, but my eyes prefer the iPhone SE's.

## PLASTIC ISN'T SO BAD

The Pixel 4a is the first plastic-backed phone I've used in a while, and I'm smitten. It feels good, looks good, doesn't pick up fingerprints, won't break when it drops, and shaves several grams off the weight (143 grams, versus the iPhone SE's 148 grams). Apple hasn't made a plastic phone since the “unapologetically plastic” iPhone 5c way back in 2015, but it might be time to give it another shot. 

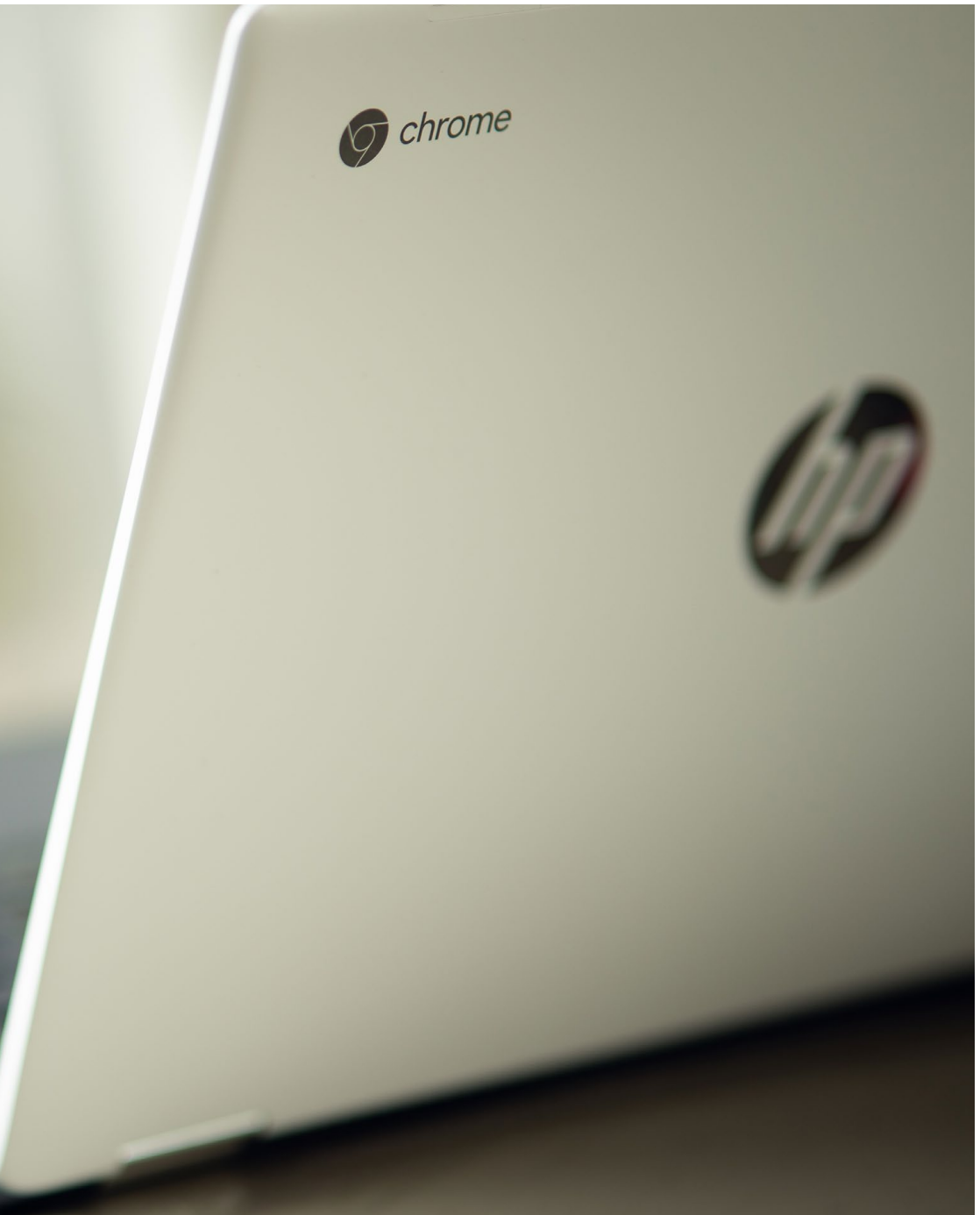


# IS THIS CHROMEBOOK ABOUT TO DIE? WHY GOOGLE'S EXPIRATION DATES MATTER

DON'T GET STUCK WITH A SHORT-LIVED LEMON.

BY GORDON MAH UNG

IMAGE: ROONZ-NL / PIXABAY



If you're the kind of person who looks at the milk carton expiration date or squeezes the bread before you buy it, then you probably don't want to buy these 77 Chromebooks. That's because after examining every single Chrome OS device listed in Google's database, we've found a healthy amount of them that are about as fresh as a three-day old donut.

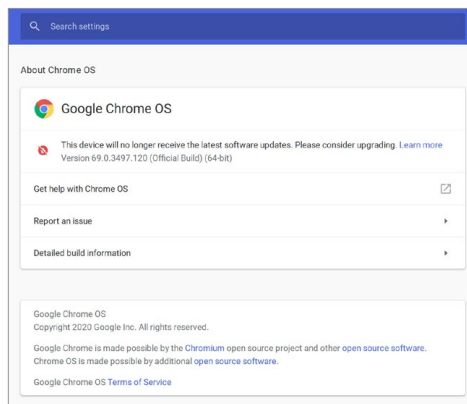
Google publishes expiration dates for Chromebooks on its support site here ([go.pcworld.com/xpdt](https://go.pcworld.com/xpdt)). But rather than drill down into each Chrome OS device maker's page to find out if just one particular Chromebook was expiring, we compiled a list of every single device and then sorted it by expiration date.

We found 51 expired devices, another 35 with just one year left of support. Another 29 had two years of "life" left, and another 13

## PCWorld Milk Rating For All Chromebook Devices In The World

	Update Years Left	Number Of Chromebooks And Chromebox Models
<b>Spoiled</b>	0	51
<b>About To Spoil</b>	1	35
<b>Close To Spoiling</b>	2	29
<b>Not Fresh</b>	3	13
<b>Fresh</b>	4	45
<b>Very Fresh</b>	5	39
<b>Just Left Dairy</b>	6	51
<b>Just Came From Cow</b>	7	12

**As of Aug. 2020, here's how many ChromeOS devices are about to expire and when.**



**With a Chromebook, the OS doesn't expire—the actual Chromebook does and you no longer get updates at all.**

with less than three years. Frankly, that's a lot of Chromebooks you could potentially purchase that will no longer get updates very soon after you buy it. All told, not counting the already expired Chromebooks, there's 77 we think you may want to avoid right now. We'll list those laptops below.

## WHAT IS A CHROMEBOOK'S LIFESPAN?

The concept of an expired computer itself isn't new, but Chrome OS has taken heat ([go.pcworld.com/tkht](https://go.pcworld.com/tkht)) for years over it. Since Chromebooks are essentially low-cost hardware running a very lightweight Linux operating system as a vessel for the Chrome browser, few expected them to expire ([go.pcworld.com/fwwxp](https://go.pcworld.com/fwwxp)).

What's a bit different with Chromebooks is that the hardware itself expires. With an "expired Windows 7 laptop," for example, you can simply

buy Windows 10 and keep using the laptop rather than buying a new one. With a Chromebook there is no option to buy an updated version of ChromeOS — the only answer to continue getting updates from Google is to buy a new one.

(See our article comparing Chromebooks to laptops [[go.pcworld.com/clap](https://go.pcworld.com/clap)] for a comprehensive discussion of the differences between the two, as well as buying recommendations.)

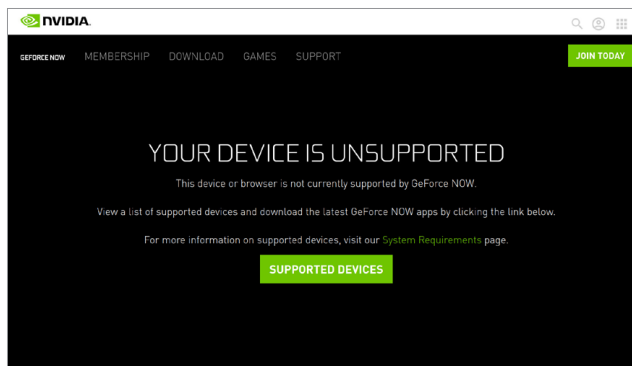
Google's End of Life Policy (as it was called before the less terminal-sounding "Auto Update Policy") first offered 5 years of OS and security updates. Google later changed it to 6.5 years, and now it's 8 years.

Kind of.

## IT'S NOT REALLY '8 YEARS' ON NEW CHROMEBOOKS

Even the "8 years" the newest Chromebook is supposed to last isn't necessarily 8 years in your actual hands. The lifeclock ([go.pcworld.com/lgcl](https://go.pcworld.com/lgcl)) of every Chromebook is tied to an introduction window and, like milk on a shelf, it's running even if no one has bought it.

For example, a Lenovo Chromebook Duet ([go.pcworld.com/lndt](https://go.pcworld.com/lndt)) announced in May and released in June has an expiration date of June 2028. If you bought it today, you'd get about 8 years. If you bought that same Chromebook



**Nvidia's GeForce Now streaming game service has come to Chromebooks but it requires version 77 and up of ChromeOS, which abandoned Chromebooks may not have.**

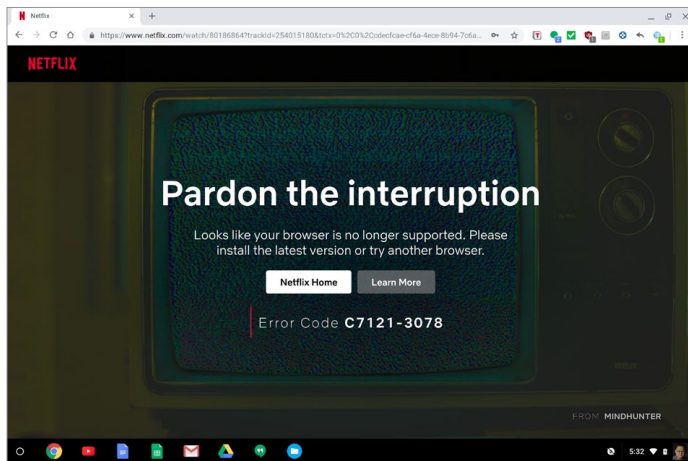
Duet in June of 2021, you'd get 7 years of updates. Buy a brand-new, never-touched Duet in 2025 and you'd get only 3 years.

We suspect the June 2028 deadline will hold for the majority of Chromebooks announced over the next 12 months. Looking at Google's list of Chrome OS devices, they tend to also expire in June or August.

## WHAT HAPPENS TO AN EXPIRED CHROMEBOOK

Once a Chromebook expires, you no longer get updates. Period. Ever. That's different from Microsoft, which updated Windows 7 on its last day. Intel even recently issued a security update ([go.pcworld.com/insc](https://go.pcworld.com/insc)) for PCs running Windows 7, 8, and 10, so you do get some support.

The most important reason to keep your PC, Mac, or Chromebook updated today is security. All computers are under constant attack and



**The original Google Pixel Chromebook is still a very capable laptop, but because its last OS update was in 2018, it can't even watch movies on Netflix anymore.**

updating it is the first line of defense. With an expired Chromebook, you lose that defense.

For people used to Windows and macOS, that could be enough to make you think an expired Chromebook should be crossed off the list. But to be fair, Chromebooks are still one of the most secure consumer laptops around, and you could argue that an expired Chromebook might even be more secure than updated Windows or macOS laptops. In 10 years, only 55 security exploits ([go.pcworld.com/55xp](https://www.pcmag.com/uk/news/55-security-exploits)) have been documented for ChromeOS. Apple's OS X has 2,212 ([go.pcworld.com/22xp](https://www.pcmag.com/uk/news/os-x-vulnerabilities)) listed vulnerabilities from 1999 until today and Microsoft Windows has 6,814 ([go.pcworld.com/68xp](https://www.pcmag.com/uk/news/microsoft-windows-vulnerabilities)) since 1999.

Security risks are just one problem. An

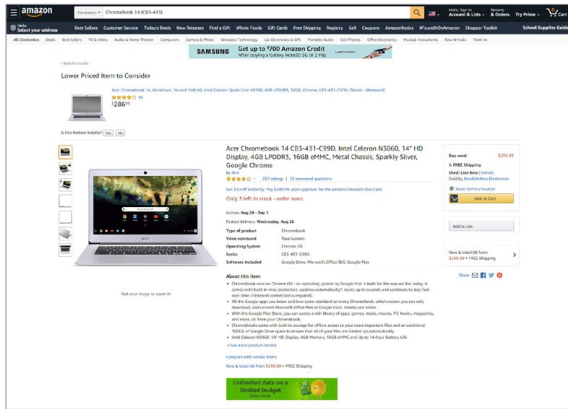
unsupported browser means you get left behind by websites, too. For example, on the original \$1,300 Google Chromebook Pixel (which expired in 2018), the version of Chrome it runs will no longer let you watch Netflix. For a typical consumer who isn't going to open the laptop up, unlock the OS write protect, and install CloudReady ([go.pcworld.com/incr](https://www.pcmag.com/uk/news/cloudready)), the

only way to watch a Netflix movie is to buy a new Chromebook. Disney+ also rejected the 2013 Pixel. Eat your heart out, because you can still watch Netflix or Disney+ on a 2013-era Windows PC or MacBook. Meanwhile, Nvidia's nifty GeForce Now game streaming service ([go.pcworld.com/gefn](https://www.pcmag.com/uk/news/geforce-now)) requires ChromeOS 77 and up, which was released late last year. If you're on an older version, you can't use GeForce Now, full stop. As time goes on, you can bet more Chromebooks on the list will also be abandoned.

## NEARLY EXPIRED CHROMEBOOKS ARE STILL BEING SOLD

The unstated mess in all this is that you can still buy many Chromebooks that are





**We found many used Chromebooks for sale with less than two years of OS support left.**

nearing the end of their lives. We did spot-checks of older models and found that it's pretty hard to buy a very old (five years or older) Chromebook. What you will find, however, are a lot of used Chromebooks we'd consider to be on the "close to spoiling" list being sold. Many Chromebooks with expiration dates of June 2022 can still be found in online stores.

For example, we found the Acer Chromebook 14 CB3-431-C99D selling for \$300 or more. The high price is likely due to parents and even school districts rushing out to buy any Chromebook to prepare for remote learning ([go.pcworld.com/rirm](https://go.pcworld.com/rirm)). We know it's hard times for Chromebook buyers, but \$300 would mean just 18 months of updates before being pushed overboard by Google.


## HOW TO BUY A FRESH CHROMEBOOK

To get a Chromebook that you know will get longer term support, you should first look at our list on the second page of this article and determine just how "fresh" you want it. If, for example, \$300 for a Chromebook with three years of updates left is fine with you, you can pick out one like the Asus Chromebook Flip C101PA and buy that specific Chromebook with the confidence that you have August

2023 before the OS gets visited by Valkyries (the Norse mythology kind [[go.pcworld.com/vlky](https://go.pcworld.com/vlky)], not the Tom Cruise [[go.pcworld.com/vlfm](https://go.pcworld.com/vlfm)] kind). We wouldn't advise buying a Chromebook with less than three years of updates left on the clock if you can help it.

You can check any Chromebook on your shopping list against Google's official support page ([go.pcworld.com/ofsp](https://go.pcworld.com/ofsp)) to see how long it will last. Our list (see below) was compiled in late August of 2020, and more will be added over time. It's a good idea to visit the official list once you have an idea of the Chromebook you want.

## CHROMEBOOK EXPIRATION LIST

For our in-depth list of Chromebooks, go to ([go.pcworld.com/xpch](https://go.pcworld.com/xpch)). 

In 30 states,  
it's legal to  
fire, evict or  
deny service  
to LGBT  
people.

Get the facts at [Beyond I Do.org](https://www.beyondido.org)



## How to turn an old laptop into a Chromebook

Not only will you save money, but some older laptops have better hardware than cheap Chromebooks—making this project a double win. **BY ALAINA YEE**

**N**ot everyone needs a computer with a full set of bells and whistles. A Chromebook's simplified interface makes it popular with schools—and those of us who serve as IT support for less tech-savvy relatives. You don't need to worry about

managing irritating updates or avoiding malware on a Chromebook, like you do if you simply install Chrome on an old Windows laptop, and the lightweight operating system feels much snappier than Windows on modest hardware. Chromebooks can cost less than a budget PC, too.

You might not even need to spend anything if you have an older laptop already lying about. Installing the equivalent of Chrome OS onto aged hardware takes less than an hour's worth of elbow grease, and the final result often feels snappier than today's dirt-cheap Chromebooks. Woot!

Here's how to do it.

## CONVERT A LAPTOP INTO A CHROMEBOOK

For this project, we'll be using Neverware's CloudReady operating system, which is based on Chromium OS—the same open-source code that Google built Chrome OS on. You can read more about the basic differences between the two if you're curious ([go.pcworld.com/dif2](http://go.pcworld.com/dif2)), but all you need to know is that Neverware has made the experience of using CloudReady all but

identical to Chrome OS.

**Note:** CloudReady lacks access to the Google Play Store—so if support for Android apps (like Minecraft) is integral to your needs, you'll have to buy an official Chromebook.

### STEP 1: CHECK THAT YOUR LAPTOP WILL MEET THE REQUIREMENTS

Like Chrome OS, CloudReady's system requirements ([go.pcworld.com/clrd](http://go.pcworld.com/clrd)) are very minimal. The laptop must have 2GB RAM, 16GB storage, and full BIOS access, as well as have been manufactured after 2007, ideally. You will still need to check your CPU model, though, as Neverware says that processors with Intel Graphics Media Accelerator (GMA) 500, 600, 3600, or 3650 graphics hardware don't meet CloudReady's performance standards. (In other words, Atom processors

from the Silverthorne [[go.pcworld.com/slvt](http://go.pcworld.com/slvt)], Lincroft [[go.pcworld.com/lncr](http://go.pcworld.com/lncr)], and Cedarview [[go.pcworld.com/cdvw](http://go.pcworld.com/cdvw)] families, which were found in low-end laptops between 2008 and early 2012.)

Your best-case

+ TPM	
✕ TECHNICAL DETAILS	
My Neverware Portal	
Minimum RAM Requirements	<h4>Minimum RAM Requirements</h4> <p>Due to performance limitations, only machines with 2 GB RAM or more are certified for use with CloudReady. Even if a machine is certified for use with CloudReady, it must have 2 GB RAM to be officially supported.</p>
General Hardware Recommendations	<h4>General Hardware Recommendations</h4> <p>Only <b>officially certified models</b> are guaranteed to work with CloudReady, but many other models will work fine. Neverware recommends the following minimum hardware requirements</p> <p><b>RAM:</b> 2GB or greater</p> <p><b>Storage space:</b> 16GB or more</p> <p><b>BIOS:</b> Full administrative access, in order to boot from the CloudReady USB installer</p> <p><b>Processor and Graphics:</b> Components made prior to 2007 will likely result in a poor experience. Additionally, the following graphics hardware does not meet performance standards on CloudReady: Intel GMA 500, 600, 3600, 3650</p>
Dual-boot	
Enrollment Notes	
Admin Notes	
Network and Proxy Settings	

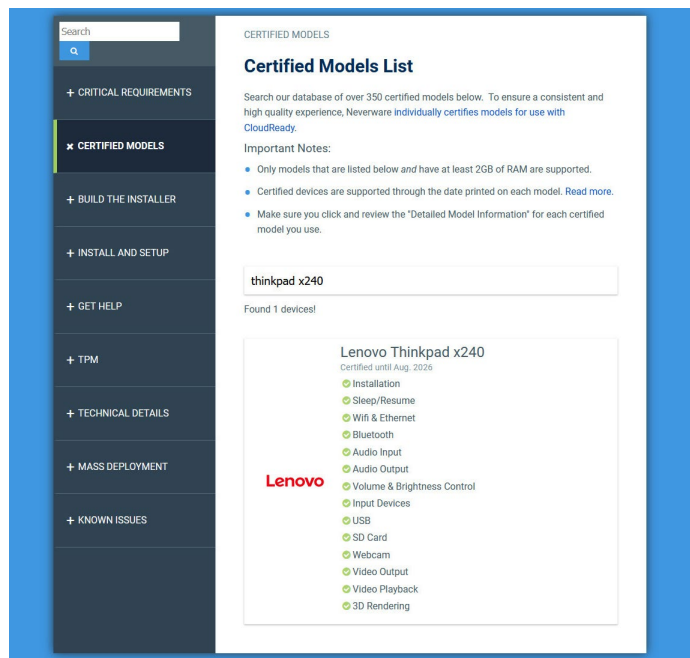
**CloudReady's system requirements are very minimal: Just 2GB RAM, 16GB storage, full BIOS access, and manufactured after 2007.**

scenario is to find your laptop on Neverware's list of certified devices ([go.pcworld.com/crde](http://go.pcworld.com/crde)), which clearly outlines support for features like a webcam or touchscreen. (Click on the model's name to see those details.) We lucked out that our test model, a 2013 Lenovo ThinkPad X240, had full feature support across the board.

**Note:** On the compatibility list, you'll see desktop systems like iMacs and NUCs listed as well—so if you have a spare monitor, mouse, and keyboard, you can instead spin up a Chromebox. Systems running integrated graphics work best.

If your laptop meets the hardware requirements but isn't on the certified devices list, don't worry. You can try out CloudReady from the flash drive you'll create next, which will allow you to test out how well it works without having to nuke your system.

**FRIENDLY REMINDER:** Before you begin installing CloudReady, back up any files within your existing OS! The process is the same as a clean install of Windows, Linux, or macOS and will completely wipe your drive.



**We lucked out with our test machine, a Lenovo ThinkPad X240: All of its major features are supported.**

## STEP 2: PREPARE THE FLASH DRIVE FOR INSTALLATION


To install CloudReady, you'll need an 8GB USB drive (at minimum) and a PC, Mac, or Chromebook to create the installation media. The process takes about 20 minutes.

We'll be using CloudReady Home edition ([go.pcworld.com/chme](http://go.pcworld.com/chme)), which is free and will work even if you plan to use this Chromebook for school. You can ignore any notes or warnings about restrictions related to management licenses—they're for the CloudReady Enterprise and Education



### 1. Build your CloudReady installer

There are two ways to do this:


**Download the USB Maker** 

If you have access to a Windows 7 or newer computer, we recommend you download the CloudReady USB Maker. It's a wizard-based tool that will guide you through the process of making a CloudReady USB installer. The USB Maker will prevent issues and save time.

[DOWNLOAD USB MAKER](#)

Approx. download size: 48MB

**Note:** The machine you use to create your USB installer does not need to be the computer you plan to install CloudReady on, so even if you are a Mac or Chrome OS user, we recommend temporarily switching to a Windows computer to create your CloudReady USB installer.

**Create a USB installer manually** 

If you don't have a Windows 7 or newer computer, download the 64-bit CloudReady image below to your Downloads folder (**not to the USB stick**) and then click the appropriate OS link below for instructions on how to manually create a USB installer.

[DOWNLOAD 64-BIT IMAGE](#)

Approx. download size: 1.12GB

64-bit Checksums:  
MD5SUM SHA1SUM SHA256SUM

**Next: Finish Building Your Installer**

If you're using a Mac, [click here to proceed](#) →

If you're using a Chromebook, [click here to proceed](#) →

If you're using Windows, [click here to proceed](#) →

**The easiest way to prepare a CloudReady installation flash drive is with a Windows PC.**

versions, which would be purchased by an institution.

Using a Windows PC to create the flash drive installer is easiest, as you can download the USB Maker and let it take care of the whole process. For Macs, Linux PCs, and Chromebooks, you'll need to download the CloudReady Home Edition image first, then follow Neverware's instructions for manually building your installer.

## STEP 3: BOOT TO FLASH DRIVE

In order to boot to your newly created flash drive, you must bypass your laptop's automatic boot order, which usually defaults to the primary storage drive. You'll do this by

hitting a key on your keyboard when your PC first powers up, similar to entering the BIOS. Search online for how to access the boot priority menu for your particular laptop, since

it's not universal. For example, our Lenovo ThinkPad X240 required mashing F12 right at startup, while for our HP Spectre x360, it was F9. CloudReady even provides a list of boot keys for major laptop makers ([go.pcworld.com/mjlp](http://go.pcworld.com/mjlp)).

An alternative method is to enter your laptop's BIOS (again, you will need to search for which key to press when powering on your laptop) and rearrange the automatic boot order, then undo that change after your CloudReady install.

In either case, you should be able to choose the USB drive as your boot device. A white screen with the CloudReady logo will appear shortly thereafter.

**Tip:** Did you end up in your laptop's

default operating system after booting, despite repeated button mashing? You likely waited too long to start pressing the key, or you aren't pressing the right combination of keys. (Example: Function keys may require also holding the Fn key—or not.)

## STEP 4: INSTALL CLOUDREADY

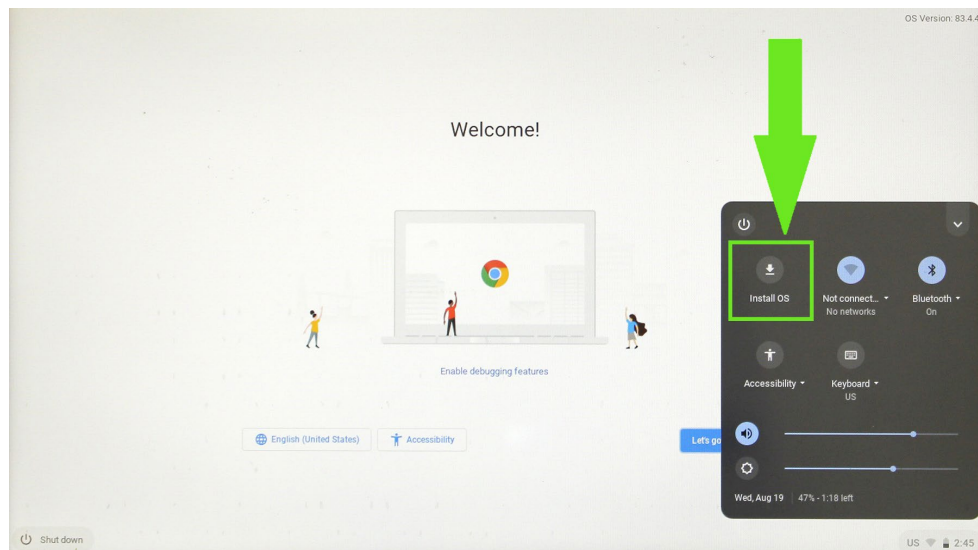
When the welcome screen appears, you can take one of two routes: Immediately wipe your laptop's drive and install CloudReady, or configure CloudReady on the flash drive. Choose the latter if you'd like to test drive CloudReady for a short while—doing so allows you to try out Neverware's OS without any destructive changes to your system.

**Note:** Neverware does not recommend running CloudReady indefinitely from a USB drive due to performance and storage limitations, as well as a lack of OS updates.

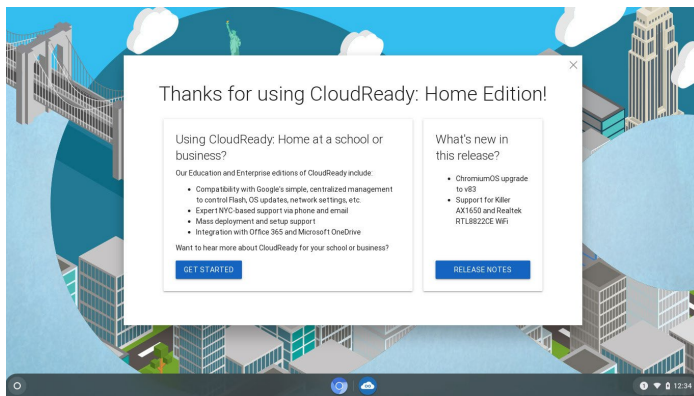
### Option 1: Installation

After booting to the flash drive, wait for the welcome screen to appear, then click on the bottom right-hand part of the screen where the time shows. In the menu that appears, choose Install OS.

Confirm you've backed up your data, and then proceed with the hard drive wipe and CloudReady installation. Neverware says the process will last between 5 and 20 minutes, depending on the speed of your flash drive and the size of your laptop's hard drive.



**You'll find the option for installing CloudReady to your laptop within this menu.**



Unless you wish to read the release notes, you can close out of this desktop start screen right away.

Upon completion, your laptop will shut down. Remove the USB drive, then power the system back on (and undo any changes to your BIOS's automatic boot order, if applicable). You'll see a welcome screen once again, now running from your laptop. Click on Let's Go to begin setup.

### Option 2: Try out CloudReady from the flash drive

When the welcome screen appears, click on Let's Go to start setup. After passing through configuration screens for Wi-Fi, data sharing, and Google account login, you'll reach the desktop. Close out of the pop-up window that shows info on the paid editions and current release notes to begin using CloudReady.

You can later install CloudReady locally by clicking on the time in the bottom right-hand

part of the screen. Choose Install OS in the menu that appears. After completion, your laptop will shut down. Remove the USB drive, then power the system back on (and undo any changes to your BIOS's automatic boot order, if applicable). You'll see the welcome screen once again, now running from your

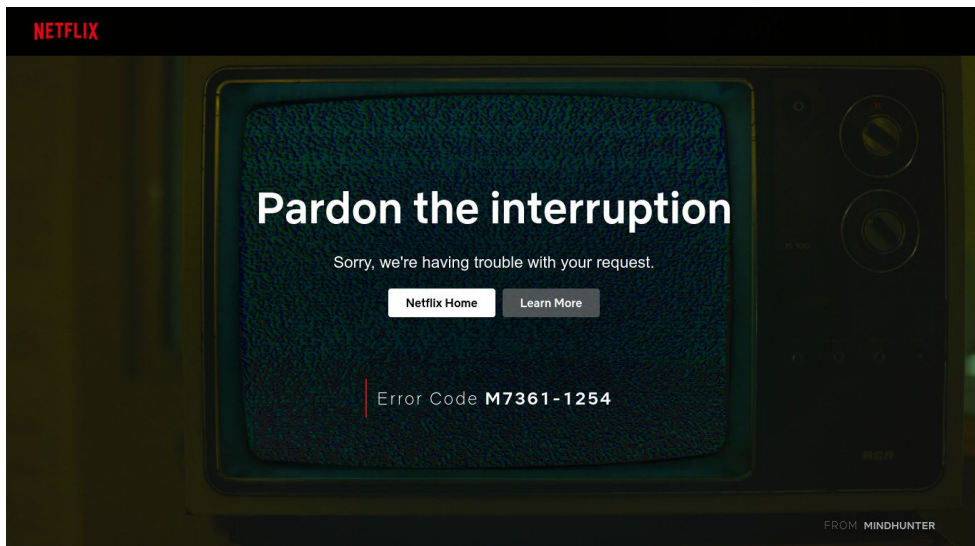
laptop; begin setup by clicking on Let's Go.

## STEP 5: ENABLE PROPRIETARY MEDIA COMPONENTS

In order for CloudReady to function just like Chrome OS, you'll need to take one extra step. Paid video streaming services that rely on DRM protection (like Netflix and Hulu) won't work until you enable a set of proprietary media plugins. It's the only thing that doesn't work right out of the box.

Access the system settings by typing **chrome://os-settings** into a Chromium browser window. (You can also click on the time in the bottom right of the screen, and then on the gear icon.) Choose Media Plugins, then install Proprietary Media Components.

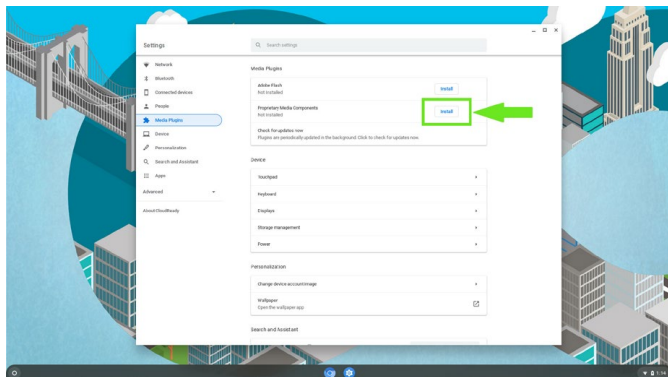
You can also choose to install Adobe



**Avoid running into Netflix's M7361-1254 error by enabling Chromium's Proprietary Media Components.**

Flash now, too, though it will still remain off by default. You'll need to finish enabling Flash afterward by opening Chromium and navigating to Settings > Site Settings > Flash,

then clicking the toggle next to Block sites from running Flash. That will change the setting to Ask first, allowing you to activate Flash on a case-by-case basis.



**Unlike Chrome OS, you have to take one extra step to make both DRM-protected streaming video and Adobe Flash work in CloudReady.**

## HOW WELL DOES IT RUN?

For this article, we used a 2013 Lenovo ThinkPad X240, borrowed from our IT department's stash of decommissioned laptops. This 12.5-inch touchscreen laptop is long in the tooth by today's standards, mostly due to a spinning-platter hard-disk

drive—when working within Windows 8.1, I could feel delays in response during mundane use.

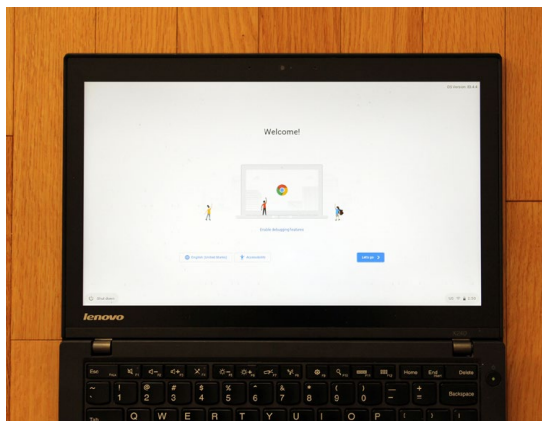
But our X240's Intel Core i5-4300U processor, 8GB RAM, and 500GB drive absolutely crushes today's budget Chromebooks. It hangs pretty well with midrange models, too, despite its 1366x768 resolution display. When we tried CloudReady off the flash drive, the touchscreen worked immediately and the system ran buttery smooth; even when installed on the hard-disk drive, CloudReady had a much faster response time than Windows 8.1.

Normally I'd swap in an SSD on a semi-older laptop to prolong its life, but I found I could use CloudReady on the X240's existing hardware without yearning for that upgrade.

Standby battery life also improved, allowing us to go from a day of use between charges in Win 8.1 to a couple of days in CloudReady.

## IF YOU DON'T HAVE AN OLD LAPTOP


Try hunting for gently used notebooks among reliable friends or family. Local universities sometimes also have surplus departments, which offload older computer equipment by selling it to the public. On occasion, you can find good refurbished computers through Amazon Warehouse ([go.pcworld.com/amwh](http://go.pcworld.com/amwh)) or Woot ([go.pcworld.com/woot](http://go.pcworld.com/woot)), too.



**As a Windows PC, our Lenovo ThinkPad X240 was starting to get long in the tooth. As a Chromebook, its hardware automatically made for a smooth, pleasant experience.**

## FINAL TIPS

If your older laptop has low-end hardware (or very old hardware) paired with a hard-disk drive, you'll get better performance by swapping in an SSD ([go.pcworld.com/swsd](http://go.pcworld.com/swsd)). Make sure to find out the height of your existing hard drive before buying, so that it'll fit the space.

Though CloudReady functions all but the same as Chrome OS, one small difference is that the keyboard layouts don't match exactly. Most keyboard commands ([go.pcworld.com/kcmd](http://go.pcworld.com/kcmd)) carry over, but a few are a little different. Our Lenovo ThinkPad X240 didn't even match Neverware's suggestion of Ctrl + F5 for taking a screenshot ([go.pcworld.com/tscr](http://go.pcworld.com/tscr)); for some reason, Ctrl + F11 worked instead. You may also need to experiment to find the right key combos. 





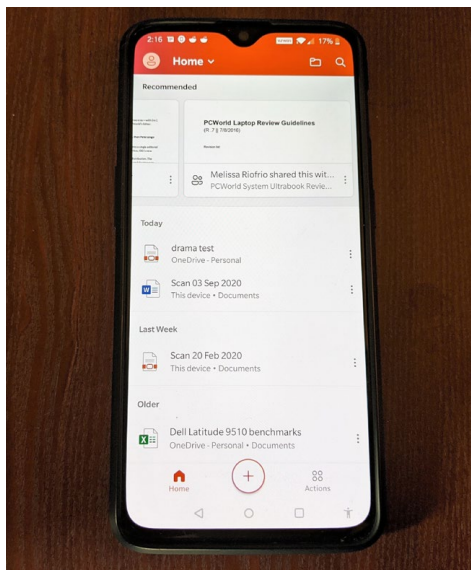
# How Microsoft's Office app helps with schoolwork, PDFs, signatures and more

Fill out worksheets, sign permission slips, make PDFs and more, all from your phone. **BY MARK HACHMAN**

If your child is tired of endless Zoom calls and typing on screens, Microsoft's Office app for iOS and Android offers a respite: kids can work on paper, and you can submit their work electronically.

Microsoft launched its Office app for iOS and Android ([go.pcworld.com/ofap](https://go.pcworld.com/ofap)) in

February, a few weeks before the pandemic drove us all indoors. Who knew, as my family hunkered down to work and study from home, that the Office app would quickly turn into an indispensable tool for managing day-to-day document tasks for my kids as well as myself.



**Microsoft's Office app for Android stores a list of your frequently-accessed Office documents, but its list of powerful tools are hidden within the Actions menu.**

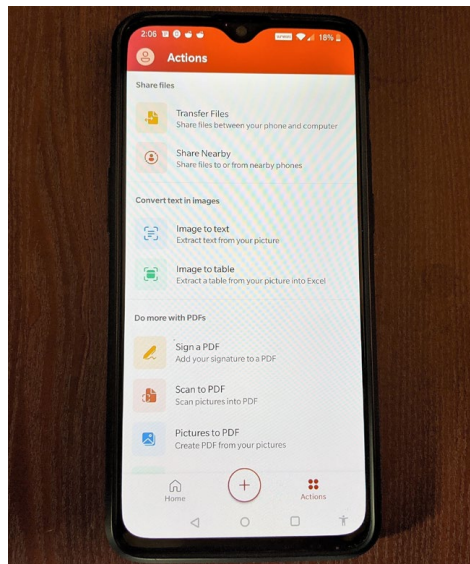
Here, you'll find a few quick tutorials on how to get things done with the Office app. But it's amazing how much it can actually do! You can take a picture of a page of a book and use the Office app to extract the text automatically using optical character recognition. You can turn a photo into a PDF. You can sign a PDF that you've already created. You can take a photo of a spreadsheet and turn that into an Excel table, or turn a document into a PDF, or vice versa. Don't underestimate those last features, either, as PDF-to-Word conversion tools can be hard to come by. And, of course, unlike

most of the PDF editors we've reviewed ([go.pcworld.com/pdrv](https://go.pcworld.com/pdrv)), all these Office app functions are free.

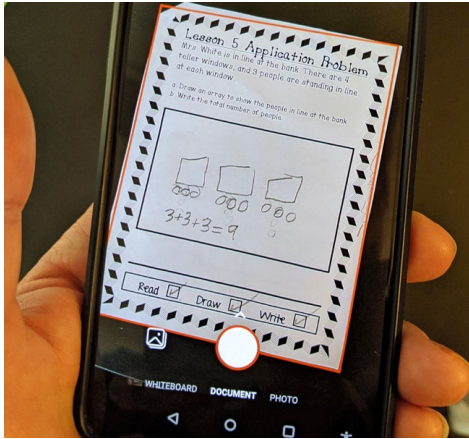
## USE THE OFFICE APP TO SCAN IN YOUR KIDS' HOMEWORK

Your child's teacher has probably already told you one way of entering hand-drawn work: using the camera on the PC or Chromebook. At our school, the students are asked to open their Google Doc, navigate to the Insert Image icon on the toolbar, and snap a photo from the user-facing camera. It's easy, effective, but not always that clear.

If you'd like, you can use the mobile Office app to do the same thing, and it will look



**The Office app's Actions menu.**



**The Office app may be hypersensitive to boxes drawn on the page—it will sometimes think that a box, such as the middle one, is the entirety of the page. Note the “stacked photos” icon to the lower left: You can use that to make a multipage PDF using multiple images.**

nicer. Open the Office app on Android, and navigate to the Actions icon at the bottom of the screen.

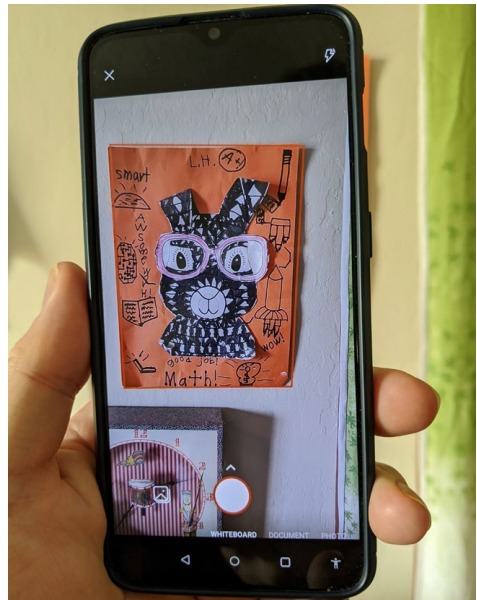
You'll see a whole list of interesting menu items. Tap Scan To PDF, a somewhat confusing name.

This will bring you to a pretty conventional photo screen with some interesting options at the bottom. By default, the Document option is highlighted. If you place your child's worksheet on a table or bed, you'll see a small ghostly rectangle surrounding it. This is the Office app's AI magic at work: It will sense the document's borders and align them so that your PDF will look nice and neat. In other words, don't spend a lot of time aligning the

document's borders within the frame, as the app will do it for you.

Choosing the Whiteboard option allows you to take a photo of a piece of artwork that's hanging on the wall—and again, Office will make it nice and neat. Office will save the file as a PDF, and it will be accessible from the main screen.

Office does have an option to turn an existing photo (from your camera roll) into a PDF, but all it does is turn the image into a PDF, with none of the AI snipping that the app otherwise offers. I find it's simply more effective to snap a new shot if the original document is available.



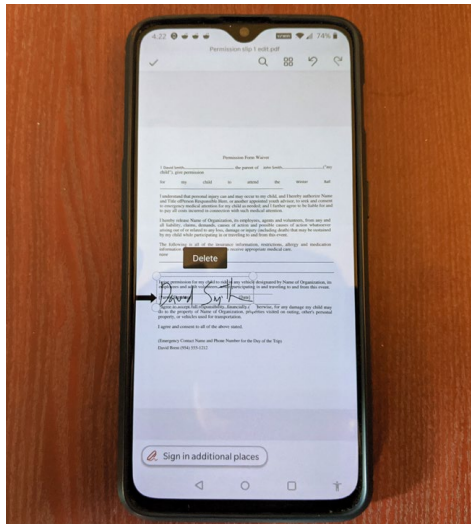
**Here, you can see how the Office app has extracted the artwork from the rest of the scene.**



The Sign With PDF tool allows you ample space to input your signature, as well as the option to save it.

## HOW TO SIGN A PDF FROM YOUR PHONE

If your child receives a permission slip either in email or in person, and you want to send it back electronically, the Office app makes this easy, too.



You then have the option to resize and move the signature as you'd like.

**Do you have a printed document?** Use the Scan To PDF function to turn it into a PDF document.

**Do you have an electronic document, such as a Word or Google Docs file?** If it's a Google Docs file, save it in Word. Word files can be opened with the Document To PDF conversion tool, which

is part of the mobile Office app you're using.

Once you have a PDF of your file, you should see a Sign A PDF option in the Actions heading, under the Do More with PDFs subheading.

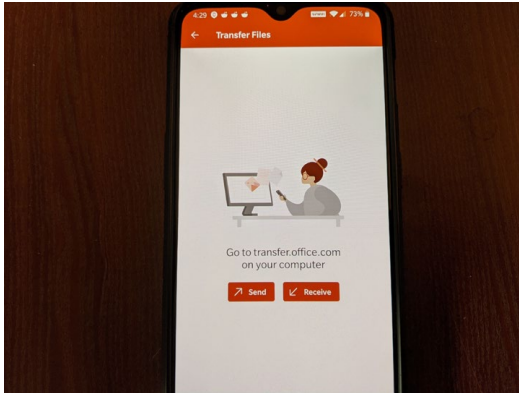
The app will open your PDF, and you'll select an approximate spot to add a signature. Don't worry if the location's not precise. Once you've tapped the location, an entirely different window will open, where you can add your signature. You can save your signature as well.

Once you've entered your signature, the PDF will reopen again, with a mammoth overlay of your signature superimposed upon it. Pinch and zoom the signature to shrink and fit it to the space, then save the PDF.

## HOW TO SEND A PDF FROM THE OFFICE APP

The Office app's main screen allows you to share a document (via text or email), including the PDFs you just created. But what if you





**The Office app will direct you to this intermediary site to facilitate sending files between your phone and your computer. You're free to use email or another app, too.**

need to move the file to your computer, or your child's computer, to upload it? Again, the Office app has anticipated that.

The Transfer Files option at the top of the Actions page will direct you to [transfer.office.com](https://transfer.office.com), a website where you'll be asked to scan a code with your phone to authenticate a transfer. Because it's web-based, you should be able to transfer the PDF regardless of whether the laptop is a Chromebook or a Windows PC. On your phone, you'll need to select Send or Receive to make sure the file is going in the right direction. Find the file in File Explorer and save it where it needs to be.

## HOW TO USE YOUR PHONE AS AN OCR TO SCAN TEXT


There's another fun trick that may benefit older kids working from a printed textbook who need to take notes: Turn your phone into

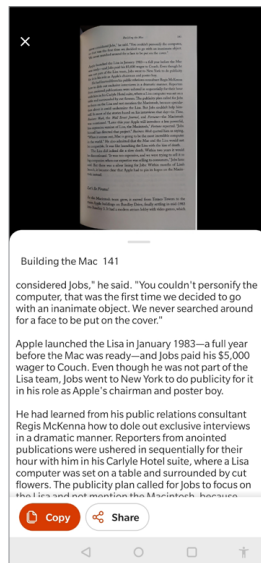
an OCR (optical character recognition) device. We're not scanning a page as your scanner would—we're reading and copying the text on the page.

To begin the process, go to the Actions page once again and select the Image To Text option. This will work on a live photo or a stored image.

Office does this fairly well, though you'll always want to proofread it. You'll get better results if the page is flat and well-lit.

We're all trying to manage the pandemic, working from home, and distance learning if we have school-age kids. Microsoft's Office app for Android and iOS is a handy way to save a little time and effort.

Use it! 



**Microsoft's Image To Text feature in action within the Office mobile app, transcribing a page from Walter Isaacson's biography of Steve Jobs.**





## How to speed up your home Internet and Wi-Fi on the cheap

I doubled our home Wi-Fi performance and saved hundreds. **BY GORDON MAH UNG**

**Y**ou can speed up your home Internet connection and Wi-Fi for cheaper than you'd think. It's a need many homes are facing now, when the pandemic traps both students and parents under one roof, all trying to work online at the same time.

Wi-Fi range becomes an especially painful issue. In our tiny home, spreading out meant we needed solid signal even in corners of the

house, deck, or yard that never mattered before. While an Internet drop-out while surfing the web was no big deal a year ago, a drop-out during a Zoom call is about as embarrassing today as showing up to work with your shirt on inside-out.

Here's how I sped up our home Wi-Fi and even coaxed more speed out of our main Internet connection (with an assist from our ISP). It takes some smart shopping and DIY

can-do spirit, but my cash outlay was minimal—and could have been less, if I'd known everything I know now.

## MESH ROUTER (ASUS AIMESH) TO THE RESCUE

When our current troubles first hit, my first step to improve our Wi-Fi was to purchase a used Asus RT-1900P Wi-Fi router. One of the cooler features of Asus routers has been support for a feature called “AiMesh” ([go.pcworld.com/aims](http://go.pcworld.com/aims)). This is basically the company's take on node-based mesh routers ([go.pcworld.com/mshr](http://go.pcworld.com/mshr)) that you place around your home to fix wireless dead zones.

Asus AiMesh is a little different. Most mesh networks ask you to buy only matching nodes, or to buy them in sets of two or more—and to be fair, that is the best way to do it. AiMesh gives you an alternative, though, allowing you to mix and match different Asus router models. This can lower your initial cost, or let you build on a conventional setup you already have (provided your existing router is from Asus and supports AiMesh).

Even better, Asus backdated many of its older routers with AiMesh support via a simple firmware update. My original dual-band RT-AC88U MU-MIMO 4x4 could get the firmware update, so I decided to pair it with a 2015-era Asus RT-1900P router. The RT-1900P also supports Wi-Fi 5 (802.11ac).

My main reason for buying the RT-1900P was cost. Not just because I can be a



**In March, the run on routers was so bad, I was happy to get a five-year-old Asus RT-1900P for \$70 on eBay.**

cheapskate, but in March when there was a run on hand sanitizer and toilet paper, there was also hot demand for wireless routers. The situation was so desperate that I was happy to pay \$70 for a five-year-old used Asus RT-1900P router on eBay.

## MESH ROUTER VS. WI-FI RANGE EXTENDER

The other, even lower-cost option (assuming you could find one) was to use a Wi-Fi range extender, also called a repeater. Wi-Fi range extenders basically take a Wi-Fi signal and rebroadcast it on a neighboring Wi-Fi channel. It works, but it can be inelegant, creating multiple repeat Wi-Fi SSID's (like [Your network name] and [Your network



**My dual-band Asus RT-AC88U is a 4x4 MU-MIMO that I recovered from an eWaste bin . It's very fast and features integrated gigabit ethernet.**

name]\_Repeater), and broadcasting the same packets regardless of need.

With AiMesh and Mesh, you can have just one SSID, and the traffic is handled more intelligently. Management of the network is also done from one device, rather than having to run around the house resetting the range extender or hauling a laptop to it with an ethernet cable to update firmware. In my anecdotal experiences setting up extenders for friends and family, performance has also been sketchy, so it wasn't my first choice.

## SETTING UP AIMESH

The first step in setting up AiMesh is to bring both routers to the same room, and update the firmware to the latest versions available that support AiMesh. You then factory-reset

the node, connect it to your PC directly using ethernet, and tell it to set up as an AiMesh node. Finally, you connect your PC to the AiMesh router via ethernet, and tell it to set up the AiMesh network.

It didn't go as smoothly for me as it did in the Asus YouTube videos, but if you can find your router's IP address (check the manual, or the bottom of the router) and roll up your sleeves, you can get it done. It may require resetting both routers to default states, but if one router is already set up, you can save the configuration file, which can be uploaded to the router after it is reset and paired.

For the five months I've had the RT-1900P, Asus has pushed no fewer than three firmware updates for it. That many updates suggests that there might be lots of

bugs to fix, but the fact that Asus is actively pushing out firmware for a five-year-old router (when other vendors might ask you to buy a new one) is overall a strength rather than a weakness.

One other advantage of AiMesh and a mesh system is the single SSID, which in theory means more seamless roaming between nodes. I say in theory because depending on the firmware, roaming has sometimes meant a 3- to 4-second disconnect as the hand-off is done. Other systems have a better reputation for handling it more seamlessly, but I wasn't expecting commercial-grade Wi-Fi.

This setup got us through spring and summer, but with virtual schooling the likely plan for the fall, it was time to get more bandwidth.

I called my provider and asked what could be done to keep me from defecting to cable (my only alternative). My ISP cut the price in half and doubled our speed. The speed, though far from gigabit fiber or coaxial cable, should be enough to get us through the next hump.

## WHEN DUAL-BAND IS NOT ENOUGH

With double the broadband performance, my cheap-skate

router setup was no longer up to the job for our laptops. While our wired desktops were fine, the laptops farther out on the RT-1900P node did not benefit as much.

The reason? In AiMesh, as with many mesh systems built on dual-band nodes, some of the wireless speed is provisioned for the "backhaul"—the conduit through which the routers pass network traffic to each other. With just two bands—2.4GHz and 5GHz—and some of it congested by passing traffic between the routers, we definitely had poor broadband throughput in the 15 to 30Mbps range, even with our very moderate broadband.

In more expensive systems from Asus and



**Using a 125-foot Cable Matters CAT6 cable run as your wired backhaul, is far cheaper than buying a new router setup.**

others, this is alleviated with tri-band routers. These routers feature a 2.4GHz band and two 5GHz bands. When set up as a mesh system, this allows for, say, one of the 5GHz bands to be completely dedicated to the wireless backhaul, leaving more bandwidth for PCs or other devices.

The problem for me is these systems aren't that cheap. When paired with the latest Wi-Fi 6 or 802.11ax, they're downright painful to buy, though a delight to use. You can read about my colleague Michael Simon's experience putting down a lot of scratch for a tri-band Netgear Orbi system ([go.pcworld.com/ntob](https://go.pcworld.com/ntob)).

While 802.11ax is pretty awesome and we do have one 802.11ax/Wi-Fi 6 laptop in use,

the vast majority of our hardware is Wi-Fi 5/802.11ac or older. Looking for a way to eke out more performance without plunking down \$600 to \$700 on a set of high-end 802.11ax tri-band mesh routers, I went with the counter-intuitive idea of running a wired backhaul.

## WIRED BACKHAUL

Yes, it may make no sense to build out a wireless mesh setup to avoid wires—and then actually end up running wires. But creating a wired backhaul was definitely the cheapest way to get more performance.

Mesh networks can either eat wireless bandwidth to talk amongst themselves—or they can eat wired bandwidth. By stringing an ethernet cable between my two routers, I

would essentially get many of the benefits of a tri-band mesh system without the cost. For \$26 (for a 125-foot ethernet cable), I was able to double and triple the speeds on laptops connecting to the RT-1900P.

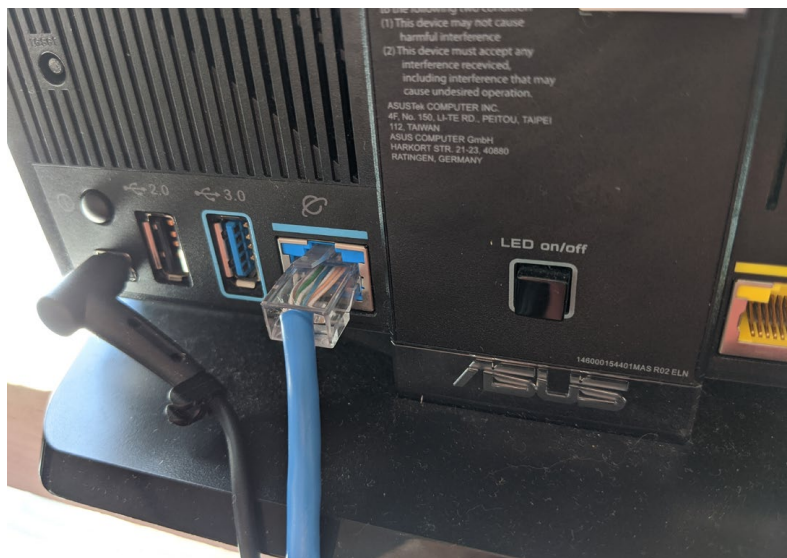
## AND THEN I GOT CHEAPER

In fact, rather than spend \$26 on a



**For \$17, I was able to get a crimper, CAT5 connectors, and a cable checker.**





In an Asus AiMesh, you plug one end of your LAN cable into the WAN port (where your internet modem would normally go) and the other end goes into an open Ethernet port on the primary router.

125-foot CAT 6 cable, I was able to get a box of drywall-dust-coated bulk CAT5e cable from a friend, and buy a crimper, connectors and cable tester for \$17 ([go.pcworld.com/crmp](http://go.pcworld.com/crmp)), so I could return the \$26 CAT 6 cable.

Yes, this meant running a cable through the floor (where the coax for the long-gone cable system had run) under the house, and then along the garage ceiling and up a heater vent, but in the end, I ended up with far better performance than running an AiMesh network on just two bands.

With demands—and high performance routers—still quite high, you may want to consider this option if you have a newer AiMesh Asus router. Most router experts, in

fact, recommend running a wired backhaul for that dual-band mesh setups for the best performance.

## BEING CHEAP CAN COST YOU, TOO

While I'm generally happy with my \$17 speedup, and it did increase node performance to the Internet from 30Mbps to 60Mbps, I was pretty disappointed by the performance of my five-year-old RT-1900P node. I do think getting a stable 60Mbps on the 5GHz band was a marked improvement from 30Mbps—but that was sitting three feet from the node. For those near that node, it was great, but in my garage and in a bedroom kitty-corner to the node, performance was only 30Mbps even with

the hardwired backhaul.

Clearly, the \$70 investment in the RT-1900P was a mistake, as a more modern router would give me better performance. So back to Amazon I went to look for a newer router with better performance and a reasonable cost. Asus had recommended its Blue Cave router, which is a dual-band, 802.11ac, MU-MIMO router with a 4x4 antenna configuration. Beyond the alphabet soup of network specs, it features an Intel Lantiq dual-core processor and 512MB of RAM, which most network nerds say will help in packed households.

It also generally gets high marks from reviewers ([go.pcworld.com/himk](https://go.pcworld.com/himk)). To stick with my cheapskate ways, I picked up a refurbished Blue Cave for \$75. This replaced the \$70 RT-1900P as the wired node, and it indeed increased performance greatly: PCs in the bedroom and garage hit the limit of our Internet at 100Mbps.



**To squeeze more performance out of my AiMesh network, I replaced my ancient RT-1900P with an Asus Blue Cave router.**

The total cost for our pandemic routers has been about \$162. That's still a fair cost, especially since a decent mesh tri-band Wi-Fi 6 system would cost more—and probably wouldn't make a difference with our current ISP.

If I could do it over again, I would have skipped the original RT-1900P completely. Instead, it'll be handed down so someone else will benefit from it. 

# How to use Photoshop Blur Gallery for Bokeh effects and more

Blur Gallery tools offer many options to transform your images. **BY JD SARTAIN**

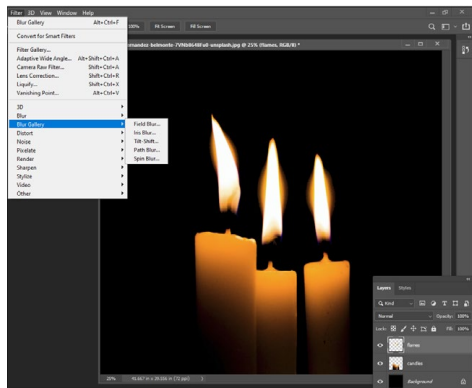


**T**he Blur Gallery in Adobe Photoshop is different from the Blur Filters ([go.pcworld.com/blrf](http://go.pcworld.com/blrf)) we've covered previously (both are found in Photoshop's Filter menu). When you select Blur Gallery, Photoshop displays another drop-down menu with five Blur options: Field, Iris, Tilt-Shift, Path, and Spin Blur. These filters are much more interactive than regular Blur Filters, with live previews

and on-image controls, including options to create Bokeh effects.

## BLUR GALLERY TOOLS

To use Blur Gallery features, open a file, then use the Lasso tool or the Magic Wand to select the area you want to smooth or soften. It works best if you cut out the selected area, paste it back in as a new layer, then ensure that this layer is active in the Layers panel. The



Using the blur features in the Blur Gallery.

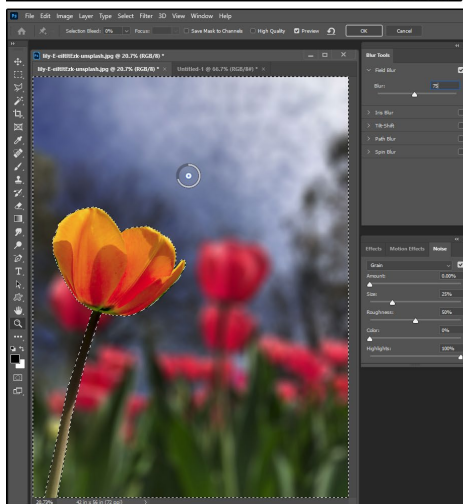
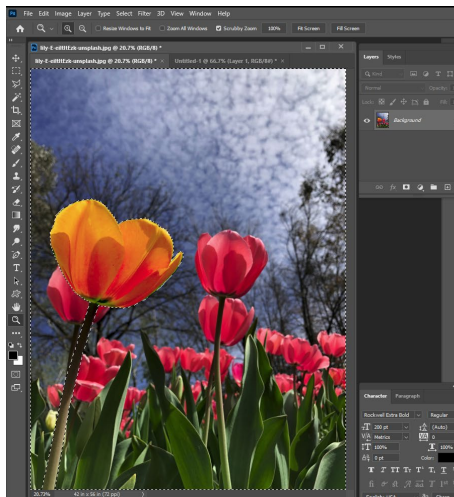
blur will affect the entire selected area unless you use the Pins to select specific sections.

Choose Filter > Blur Gallery > Path Blur (or any of the other four Blur options) to open the Blur Gallery panel, which displays all five of the Gallery Blurs mentioned above, plus three Effects tabs that provide options for Bokeh, Motion, and Noise. Each Gallery Blur and each of the three Effects offer different adjustment tools to fine-tune the special effects on your images.

With the on-screen controls, you can see what the effects are doing to your image as they happen. For example, the main control is a circle with a dot inside called a Pin (the cursor looks like a pin). Click different areas on the image to create multiple Pins, which are potential blur areas. Click the dark line inside the circle and drag it around the circle to increase or decrease the blur effect. You can also use the slider bar for this same function.

## FIELD BLUR

Use Field Blur effect to illustrate a graduated blur effect (similar to a gradient, but using only the colors in the selected area).



Use the Field Blur to soften the graduated levels of color in the blurred background.

Select the layer in the Layers panel that you want to affect. Choose Filter > Blur Gallery > Field Blur. Click the location or locations where you want to blur the image. Use your cursor to select each Blur Pin individually, then drag the spinner inside the circle to blur the different areas.

We chose an image of a field of tulips, deciding to create one different from the rest by changing its color, then blurring out the rest. We colored one of the tulips a bright coral-orange. We outlined it with the Lasso tool, then inverted the layers: Select > Inverse to make the background the active layer. We moved the Pin up into the sky area, then dragged the line inside the circle until the background was fuzzy but still recognizable.

NOTE: Press the Delete key to remove individual pins, or click the checkbox to toggle the check on and off. Off cancels the current blur effect. The Escape key cancels the Blur Gallery.

## IRIS BLUR

Use the Iris Blur effect to blur out everything on the canvas except the selected area.

Choose Filter > Blur Gallery > Iris Blur. Position the blur Pin

on the section you want to highlight so the focus is clear and sharp. Use the handles to drag the ellipses around, change its shape, increase or decrease its size. You can place multiple Pins on the canvas to “stop” the blur in all the selected areas and just blur what’s left of the background.

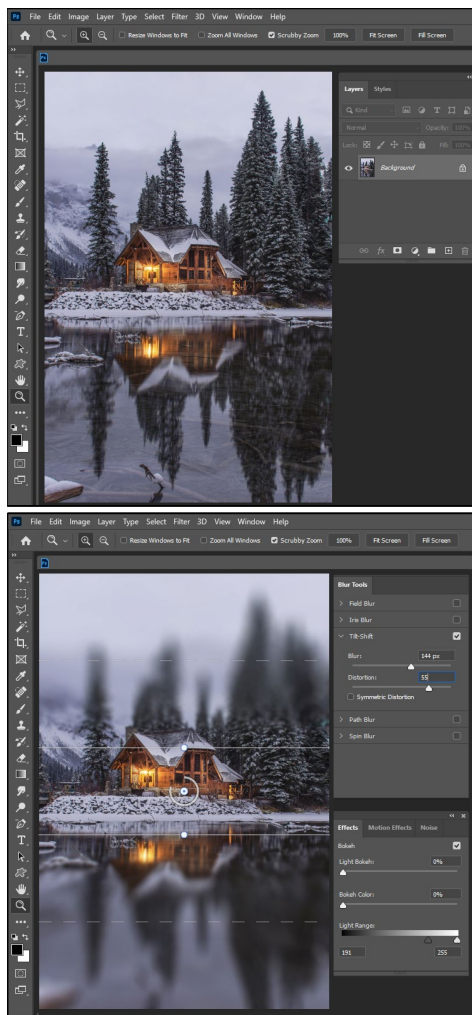
We chose a photo with seven candles on a table, then used the Iris Pin selector to create an ellipse around the center candle. We set the blur effect to 100, which faded



**The Iris Blur effect blurs out everything except the selected area.**



and hazed out everything except the selected center candle. Unlike the Field Blur, which works best with multiple Pins or multiple layers, the Iris Blur reacts to everything not Pinned.



**Tilt-Shift Blur alters perspective.**

## TILT-SHIFT BLUR

Photographers use tilt-shift lenses to photograph panoramic views, to modify the scale of an area so it appears miniature, to correct vertical lines that converge, and to blur specific areas of an image.

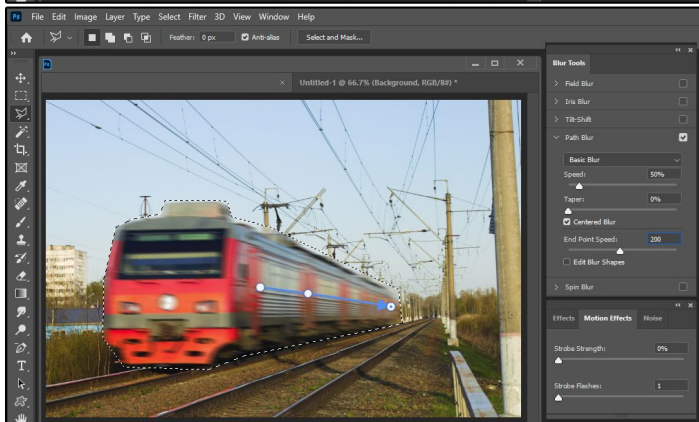
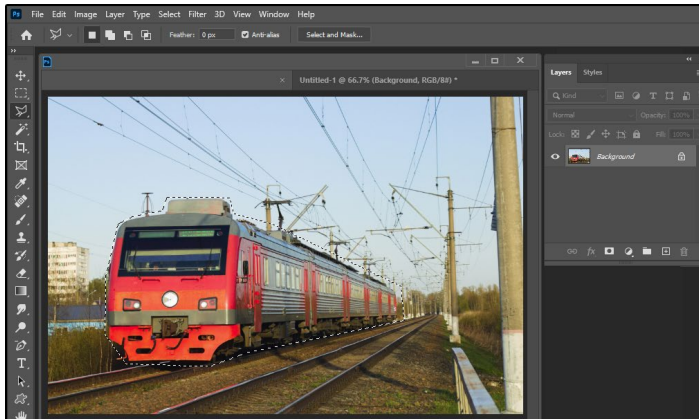
In Photoshop, the effect is much the same. A tilt-shift lens alters perspective. It looks like it adds a rectangular window (or strip) of sharpened focus to a blurred photo. But, in fact, it maintains the sharp focus inside the window and blurs out the rest in a graduated fade.

In our example, we decided to focus on the cabin and make the trees, mountains, and sky on top gradually fade from sharp to hazy; then phase out the water and reflections on the bottom to simulate an eerie, ghostly feeling. We divided the image into five sections, maintained the sharp center, and fuzzed out the rest. We chose 144 pixels for the Blur and 55 for the Distortion.

## PATH BLUR

The Path Blur does the obvious: It creates a blurred area along a selected path that simulates motion. When you select Filter > Blur Gallery > Path Blur, a line with an arrow and a large pin dot appear on the right, a small pin dot appears in the center, and another large pin dot appears on the left.

If you drag the pin dots in any direction, the line that connects them bends and arcs up, down, left, right, or in and out of spirals,



**Path Blur create a blurred path of motion.**

hooks, and loops. If you click the pin dot first (a smaller dot appears inside the pin dot), then you can drag a straight line in any direction. You can also use the pin tack cursor to add more pin dots to the image, which creates multiple blur paths.

For our example, we moved the line of pin dots down to the side of the train, then stretched it out from the engine to the

caboose, following the line of the tracks to simulate a fast-moving train soaring down the tracks at high speed. We set the Basic Blur Speed to 50 percent, the Taper to 0, checked the Centered Blur box, and chose an End Point Speed of 200 pixels. This provided an illusion of a speeding train, which is the effect we wanted.

NOTE: If the Basic “Path” Blur doesn’t provide the effect you seek, try the Rear Sync Flash Blur, which emulates that flash effect that fires at the end of an exposure.

## SPIN BLUR

The Spin Blur is, basically, the same as the Radial Blur, except the Blur Angle is measured in degrees from 0 to 360. When you choose Filter > Blur Gallery > Spin Blur, a circle appears in the middle of your image with tiny dots at north, south, east, and west; and pinpoints appear just inside the circle at the same locations.

Use the dots to reshape and rotate the

outer circle. Use the square handles to size it, and the pinpoint dots to reshape the inside, which is the area that spins.

We chose to spin a couple of tires. We selected a Blur Angle of 20 degrees for the first and a Blur Angle of 55 degrees for the second to illustrate the different angles and the precise control one has over manipulating the spinning radius.

## GALLERY EFFECTS TOOLS

### Bokeh Effects

As described in the second paragraph, the Bokeh effects in our example create smooth, silky circles of light with soft, glowing edges.

Notice that the background lights around the ornament in our Christmas photo are gold and white only, and appear as confetti-like dots on the tree. After we applied an Iris Blur of 102 pixels, with 69 percent of Bokeh Light, 56 percent of Bokeh color, and a Light Range of 210, the ornament now glows on a background of soft, colorful lights.

### Motion Effects

These effects work only on Spin Blur and Path Blur. There must be a path or radius of motion to get Motion Effects.

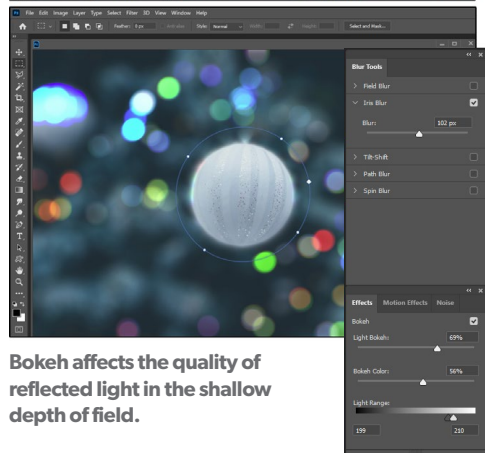


Spin Blur is measured in degrees.

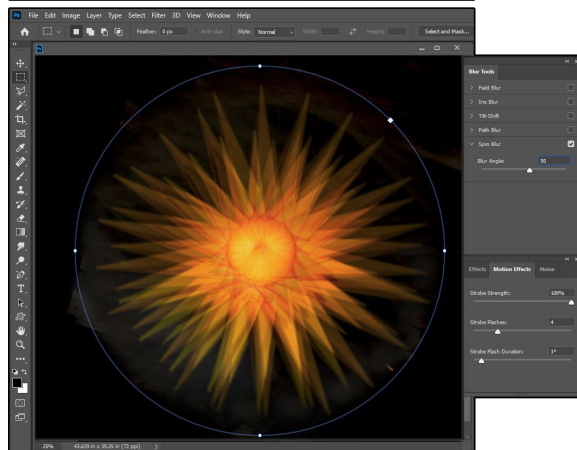
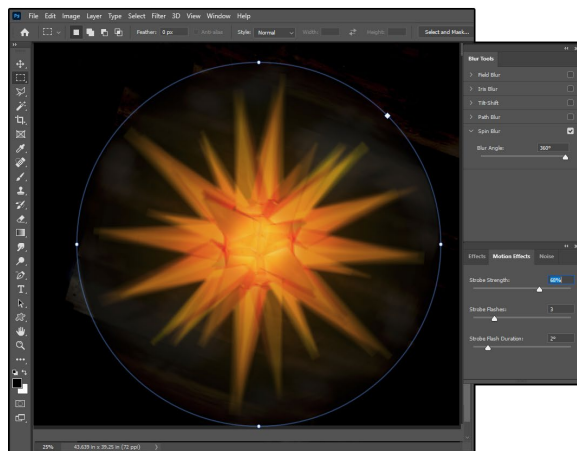
The process is simple. Open a file, choose Filter > Blur Gallery > Path Blur or Filter > Blur Gallery > Spin Blur. Use the Pinpoints, the dots, and the handles to size and position your path or radius around your object (or across the entire image). Select a Blur Angle, then use the Motion features to create some amazing effects.

We used a 22-point star to create two very different Motion effects.

We started with a Spin Blur. The first one has a Blur Angle of 360 degrees with 68



**Bokeh affects the quality of reflected light in the shallow depth of field.**



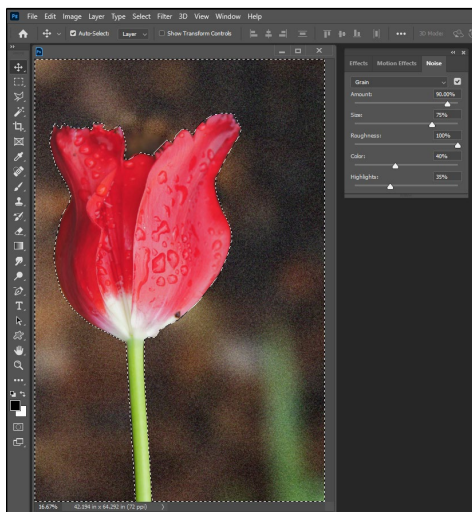
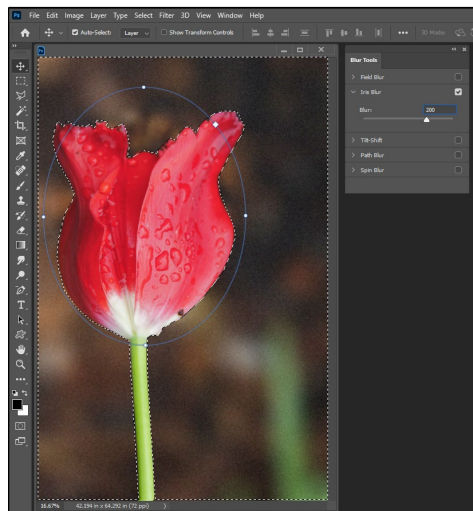
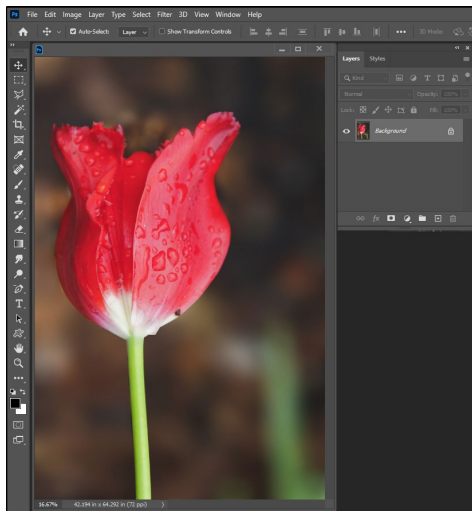
### Motion Effects.

percent Strobe Strength, three Strobe Flashes, and a Strobe Flash duration of two degrees.

The second image has a Blur Angle of 50 degrees with 100 percent Strobe Strength, four Strobe Flashes, and a Strobe Flash duration of one degree.

Both designs look amazing, but so






### Noise Effects.

different. One looks like a flaming star, and the other looks like a sunburst. The Motion Effects completely change from one setting to another.

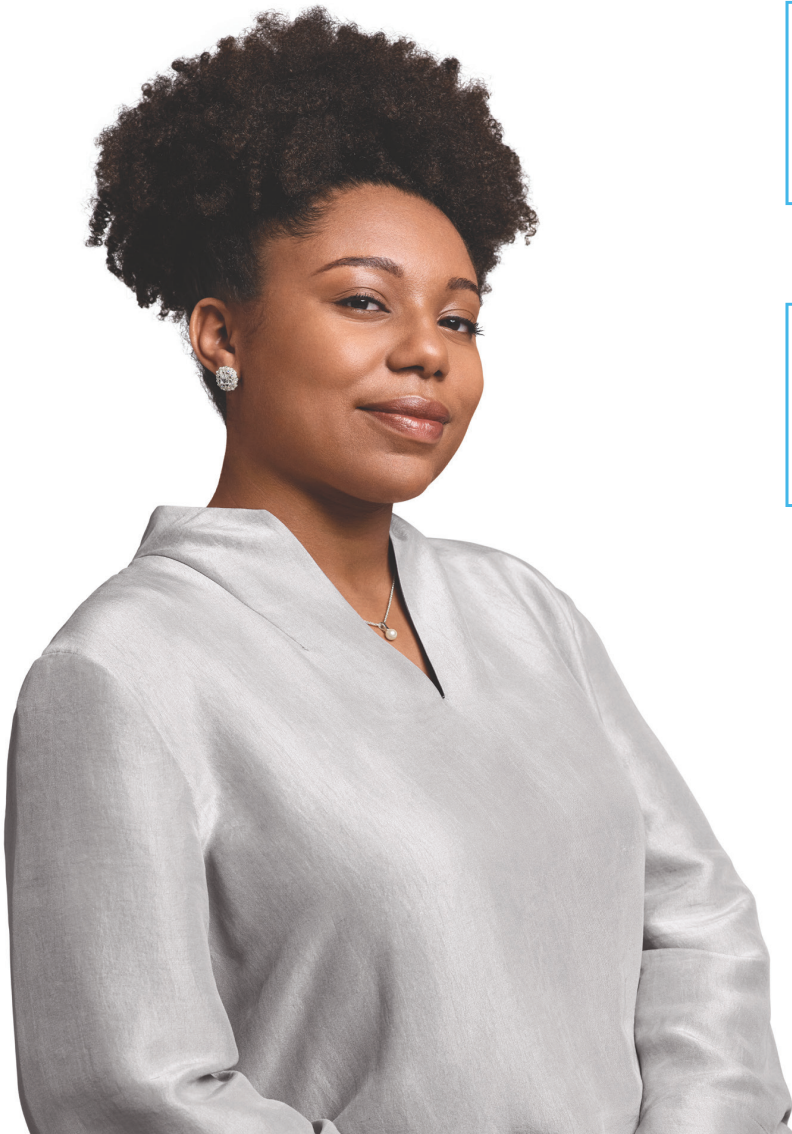
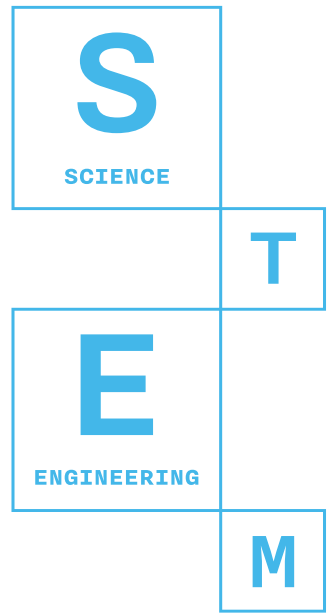
### Noise Effects

Noise is another word for grain, or a grainy effect. You can add noise anywhere on your photos, and there are several ways to do it. This effect is used with the Blur Gallery effects so you can add back some detail or texture to a blurred section.

We first used the Iris Blur (set to 200) to blend out the background of a red tulip. There was nothing essentially wrong with this result, but after a few days of looking at it, we decided to give the image more depth.

We used the Noise Effect in the Blur Gallery to add some needed texture to the background. We added 90-percent grain at a size of 75 percent with 100-percent roughness, 40-percent color, and 35-percent highlights. The dull, flat background was transformed to a finely textured finish. 





**YOU ARE THE GENERATION THAT  
WILL BE STEPPING FOOT ON MARS.**

**TIERA FLETCHER  
STRUCTURAL ANALYSIS ENGINEER, BOEING**

GIRLS IN STEM BECOME WOMEN WHO CHANGE THE WORLD.  
LEARN MORE @SHECANSTEM ON INSTAGRAM

# Tech Spotlight

A video showcase of the latest trends



## Windows 10 October 2020 Update: 5 biggest changes

➔ With the Windows 10 Fall 2020 Update, Microsoft refines the experience with changes to the taskbar, Edge browser, Start menu and more. *PCWorld's* Mark Hachman hits the highlights.