PCWorld

FEBRUARY 2020

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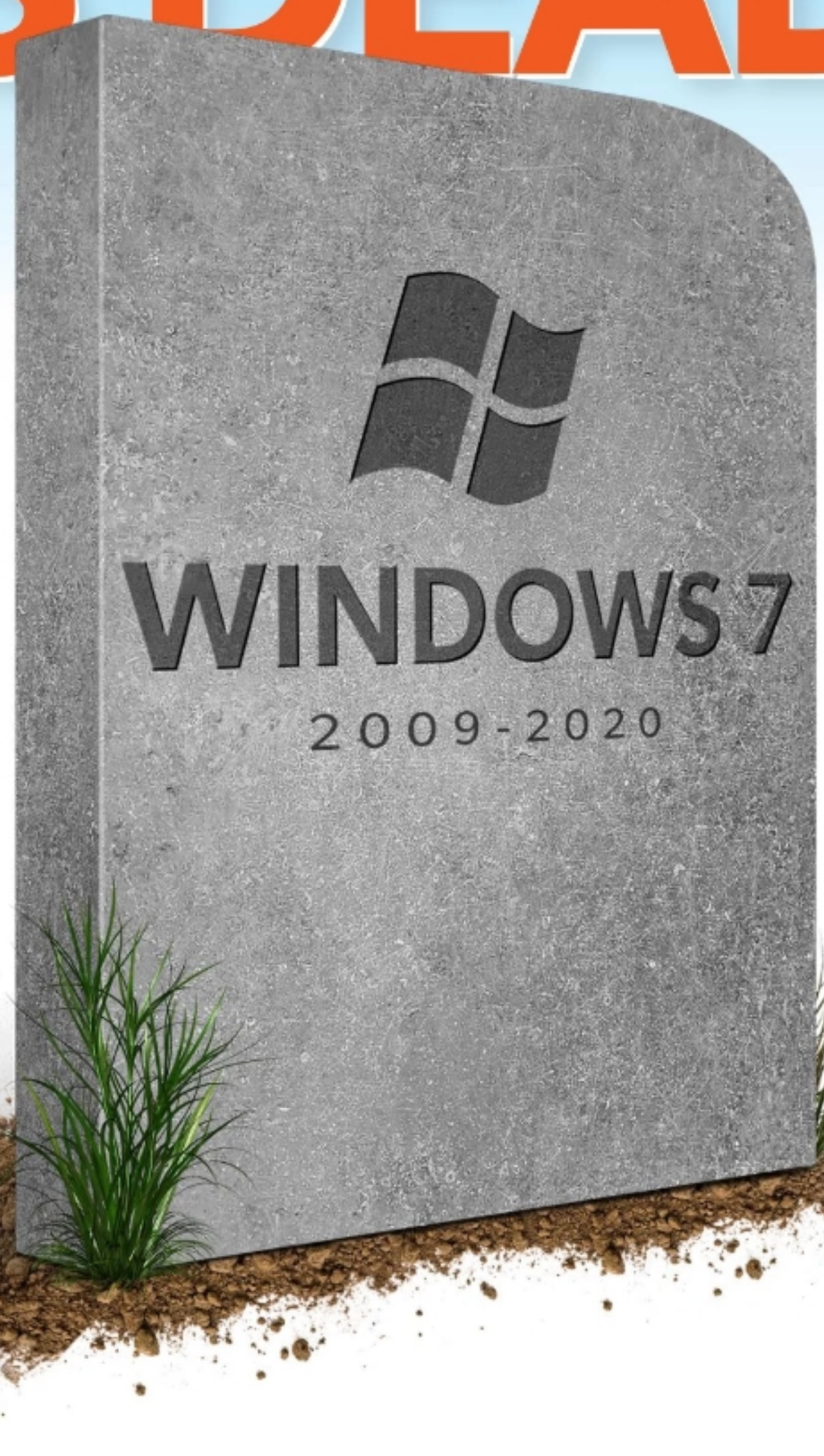

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THE COOLEST HARDWARE WE SAW AT CES

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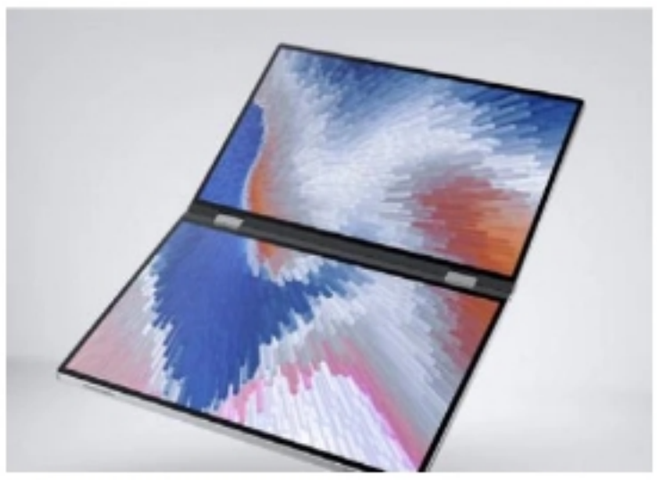

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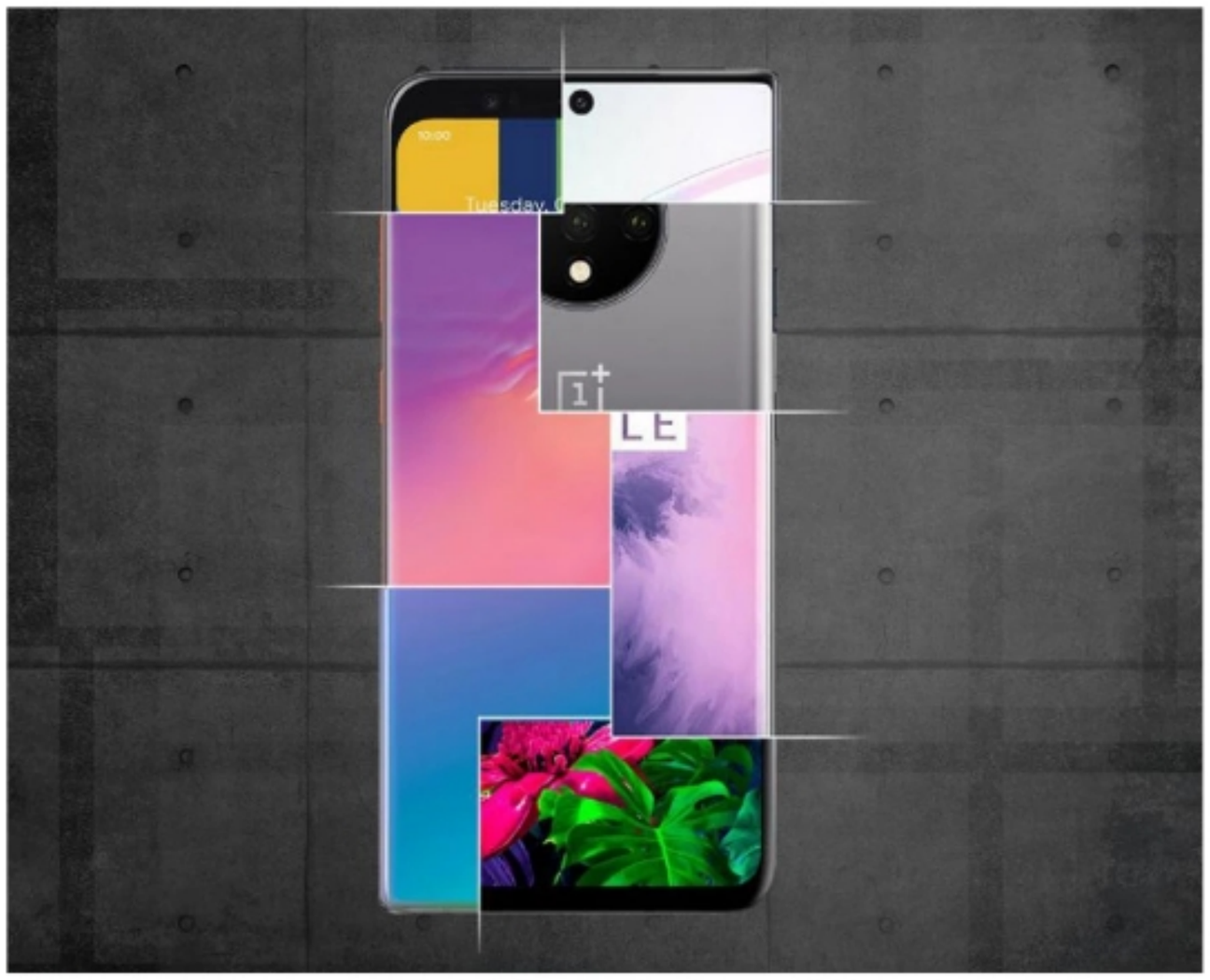

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PREVENT WILDFIRES, FOR THE LOVE OF THE OUTDOORS.

ad COUNCIL

Dell Concept UFO, Concept Duet, and Concept Ori are intriguing peeks at future PCs

Dell shows its Concept UFO modular gaming PC, Concept Duet dual-display laptop, and Concept Ori folding PC at CES in Las Vegas. **BY MELISSA RIOFRIO AND GORDON MAH UNG**

Dell's Concept UFO, Concept Duet, and Concept Ori offer a rare peek at future products from the usually tight-lipped PC maker. *PCWorld* got an advance look at these concepts ahead of their announcement at CES in Las Vegas.

Because they're concepts, we don't know whether they'll ever make it to market. So, think of them as hints of what Dell's working on for future PCs, and who knows—you may see something like it someday at your local electronics store.

CONCEPT ORI: IT FOLDS!

The Concept Ori is a folding PC that looks a lot like the ThinkPad X1 Fold (go.pcworld.com/thx1) that Lenovo revealed at CES 2020.

Dell's Concept Ori folding PC is a single display that folds in the middle.

IMAGE: DELL

The Concept Duet can be used like a clamshell or a book.

It's a single display that folds in the middle, offering options for using it as a display, a tablet, or a clamshell laptop. A small Bluetooth keyboard would likely come with it for maximum versatility.

CONCEPT DUET: A LAPTOP THAT'S ALL SCREEN

The Concept Duet is a laptop with two displays—that's right, no keyboard tray. You can use it like a clamshell or like a book. The Bluetooth keyboard can be used separately, or it can stick to one of the displays to act more like a regular laptop. You can even create an onscreen trackpad below the keyboard when it's stuck to the display.

VIDEO: **DELL UNVEILS CONCEPT PCS**
Watch now at go.pcworld.com/dcn

CONCEPT UFO: IT'S A PC! IT'S A GAME CONTROLLER!

The Concept UFO might as well be coming from space, as it shows something unlike anything Dell's done before. It's a full-fledged mini-PC with modular parts that can turn it into a game controller. Sure, it may look a lot like a Nintendo Switch, but remember, this is a full PC, offering a lot more functionality than a boring old dedicated game controller.

The Concept UFO is a mini PC that can be turned into a game controller.

HP's Envy 32 AiO busts out with HDR 600 4K, RTX graphics and very loud speakers

This may be the first bad-ass All-in-One. **BY GORDON MAH UNG**

HP's Envy 32 AiO claims the title of being the first with an HDR600 4K display, the first with GeForce RTX graphics, and for those who want the noise: the world's loudest speakers on an AiO, too. Announced at CES in Las Vegas, it's also arguably the first all-in-one PC that's bad-ass instead of boring. You can configure the Envy 32 right now on HP.com (go.pcworld.com/cn32).

Calling it a "personal creative studio," HP says the all-in-one PC is the first to feature a 32-inch 4K UHD screen that can hit HDR600 requirements. HP says the panel offers a 6000:1 contrast ratio, 600 nits of brightness, and 98 percent of the DCI-P3 color space.

IMAGE: HP

HP opted not to offer touch support on the screen. Officials said their research indicates touch is preferred on laptops, but many consumers don't care for it on desktops.

THIS RTX GPU IS NOT FOR GAMING

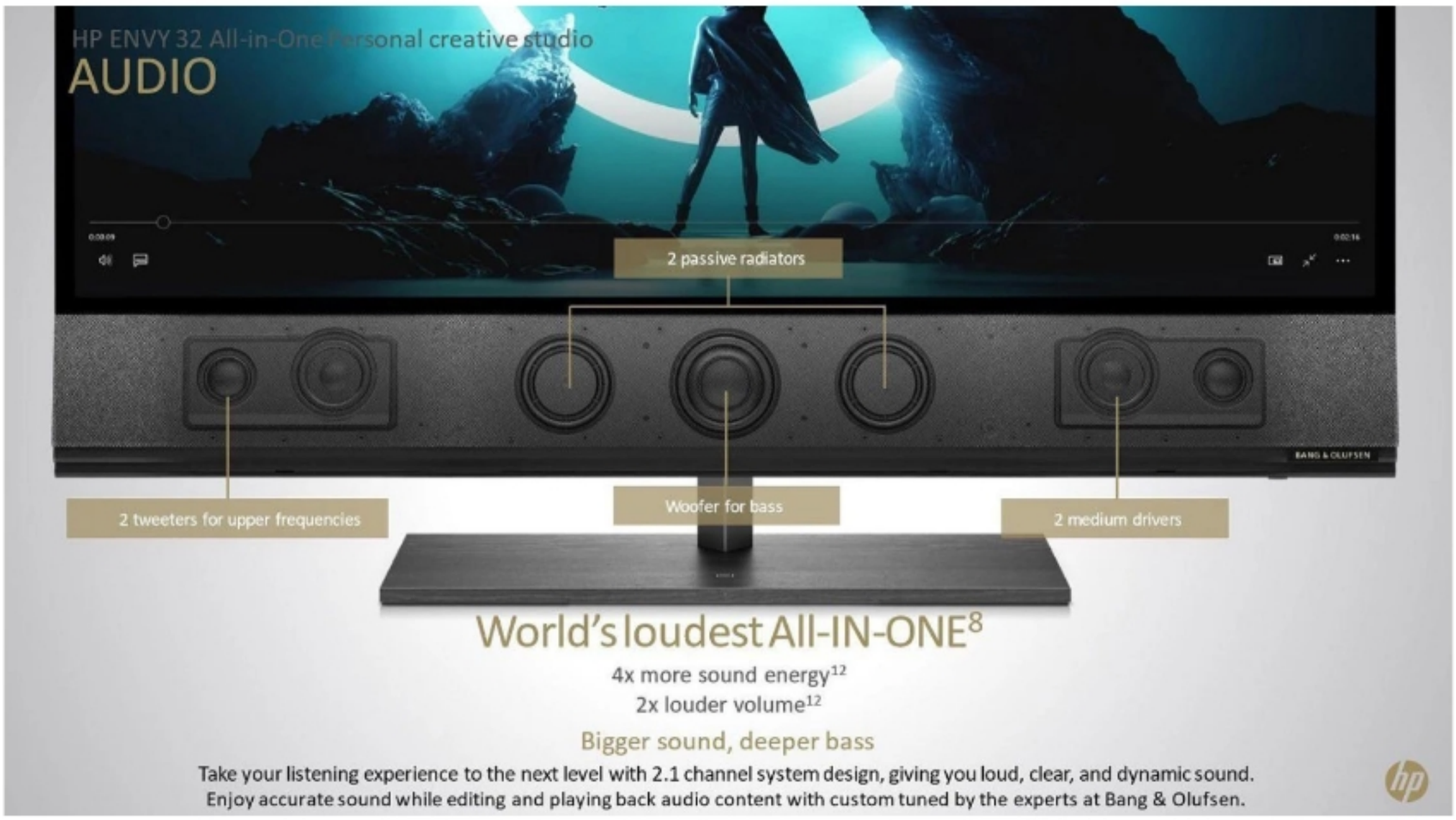
The second "first" is HP's use of Nvidia's GeForce RTX graphics, with options from RTX 2060 to RTX 2080. Despite this GPU firepower, the company said the Envy 32 AiO is not a gaming-focused PC. Instead, it caters to creative types who need access to the state-of-the-art RTX GPUs, which feature Nvidia's newest encoding cores and hardware support for ray tracing. The Envy 32 AiO is actually part of Nvidia's RTX Studio program (go.pcworld.com/stio), which helps PC vendors develop hardware optimized for the company's highest-end graphics technology.

Given that HP reaches for the stars in graphics, the company's choice of CPU is interesting. You'd think HP would use the top-end, 95-watt 9th-gen Core i9 "K" parts (go.pcworld.com/kprt) introduced in late 2018 and actually positioned for creators. Instead, HP took CPUs from the second round of 9th-gen Core desktop chips (go.pcworld.com/9gen) announced last April, mostly 65-watt parts, and most without Hyper-Threading (including the ones used by the Envy 32 AiO).

HP hasn't said why one was chosen over the other. For most creative uses, however, an 8-core is usually plenty even if it lacks Hyper-Threading. While an AMD Ryzen 7 3000-series of CPUs would be a nice option, HP's Envy 32 AiO was likely too far along when AMD introduced the CPUs last summer.

BRING THE NOISE

All-in-One PCs usually have inadequate to average audio. HP reverses the trend by basically tucking a soundbar into the chin of



Get loud: HP says its new Envy 32 AiO is the loudest around town.

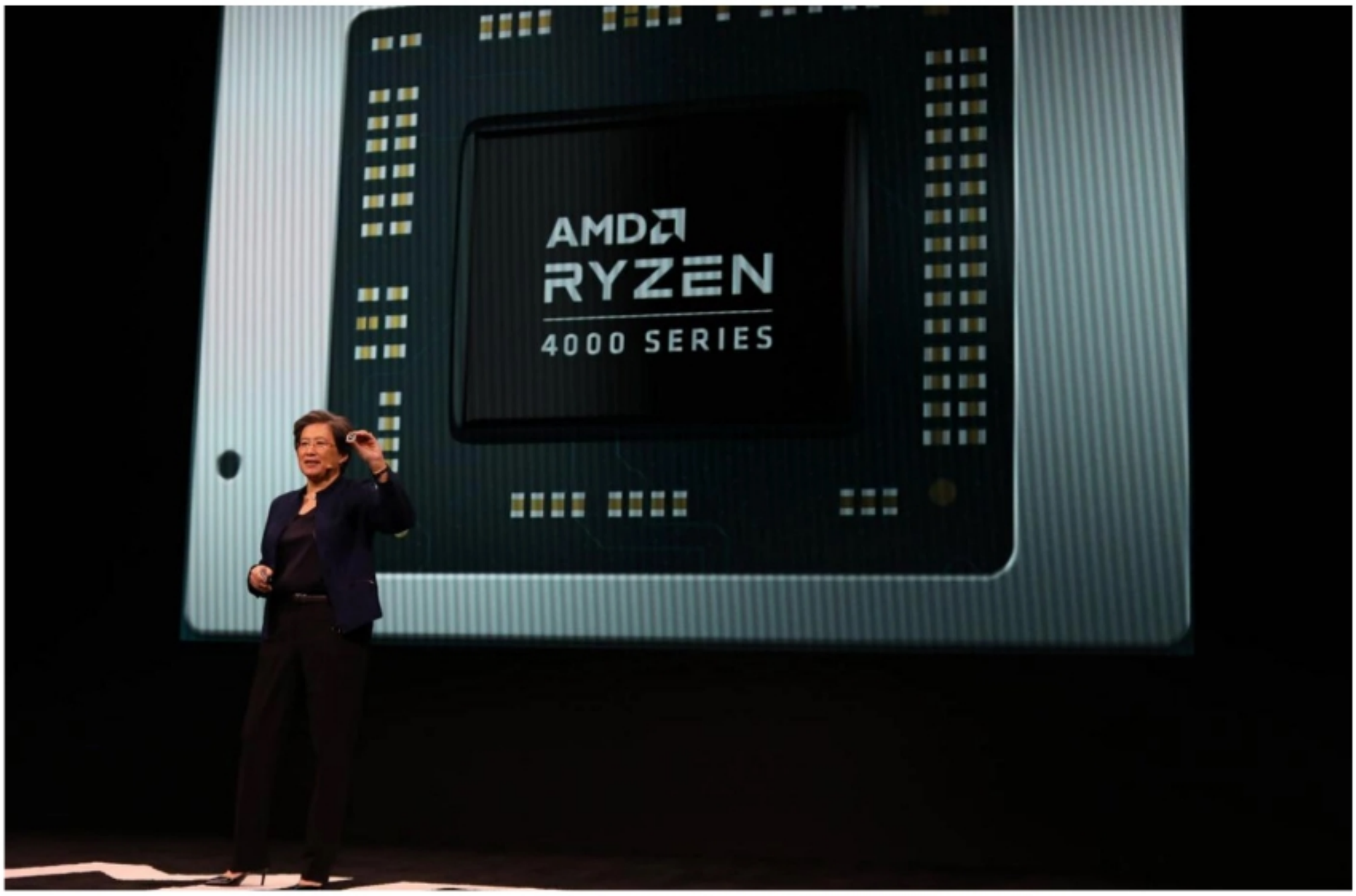
the Envy 32 AiO. In person, the Envy 32 AiO can fill a typical home office with significant volume. HP said it actually measured the noise other All-in-One's could make, and the Envy 32 AiO prevailed.

Sure, you'll say "loud" doesn't mean good. The Envy 32 AiO's soundbar aims to create fuller sound by including one woofer and two passive radiators, two medium drivers, and two tweeters. Given that the speakers and even the acoustic material are tuned by audio experts Bang & Olufsen, there's some reassurance for quality as well as quantity.

HP said the Envy 32 AiO is expected to be available in January, with prices starting at $1,600 with a Core i5-9400, 16GB of RAM, and a 1TB hard drive. For $300 more, HP throws in a 256GB SSD and GeForce GTX 1650. At $2,300, the CPU ticks up to a Core i7-9700, the GPU is upgraded to a GeForce RTX 2060, and along with the hard drive, you'll also get a 512GB Optane hybrid SSD. You can find full configurations options for the Envy 32 AiO on HP.com (go.pcworld.com/cnop).

HP didn't list out higher-end specs for the Envy 32, but those with GeForce RTX 2080 and 32GB of RAM will obviously cost more.

VIDEO: **HP'S ENVY 32 AIO ALL-IN-ONE**
Watch now at go.pcworld.com/e32



AMD's 7nm Ryzen 4000 laptop CPUs aim to steal Intel's performance crown

AMD will release seven Ryzen 4000 mobile CPUs with claims of performance leadership and more than 100 laptop models coming. **BY GORDON MAH UNG**

After snatching the performance crown from Intel on the desktop (go.pcworld.com/pfcr), AMD officially opened up a second front in the war at CES 2020, with a series of Ryzen 4000 laptop CPUs that look to outperform Intel's best and brightest.

"In 2020, we will be introducing the best laptop processor ever built," said AMD CEO Dr. Lisa Su during the unveil.

The company detailed no less than seven consumer Ryzen 4000 processors, based on its 7nm Zen 2 cores. The new CPUs will come in both 15 watt "U-class" ultra-low power

IMAGE: GORDON MAH UNG

versions in thin and light laptops and "H-class" 45-watt gaming and content creation laptops.

The Ryzen 7 4800U is the top-end low power version, packing 8-cores and 16-threads. It will hit boost clock of 4.2GHz and have a base clock of 1.8GHz. The chip will feature eight compute units in its Radeon graphics cores, which—surprisingly—use an optimized version of the company's 7nm Vega cores rather than being based on the company's newest RDNA architecture.

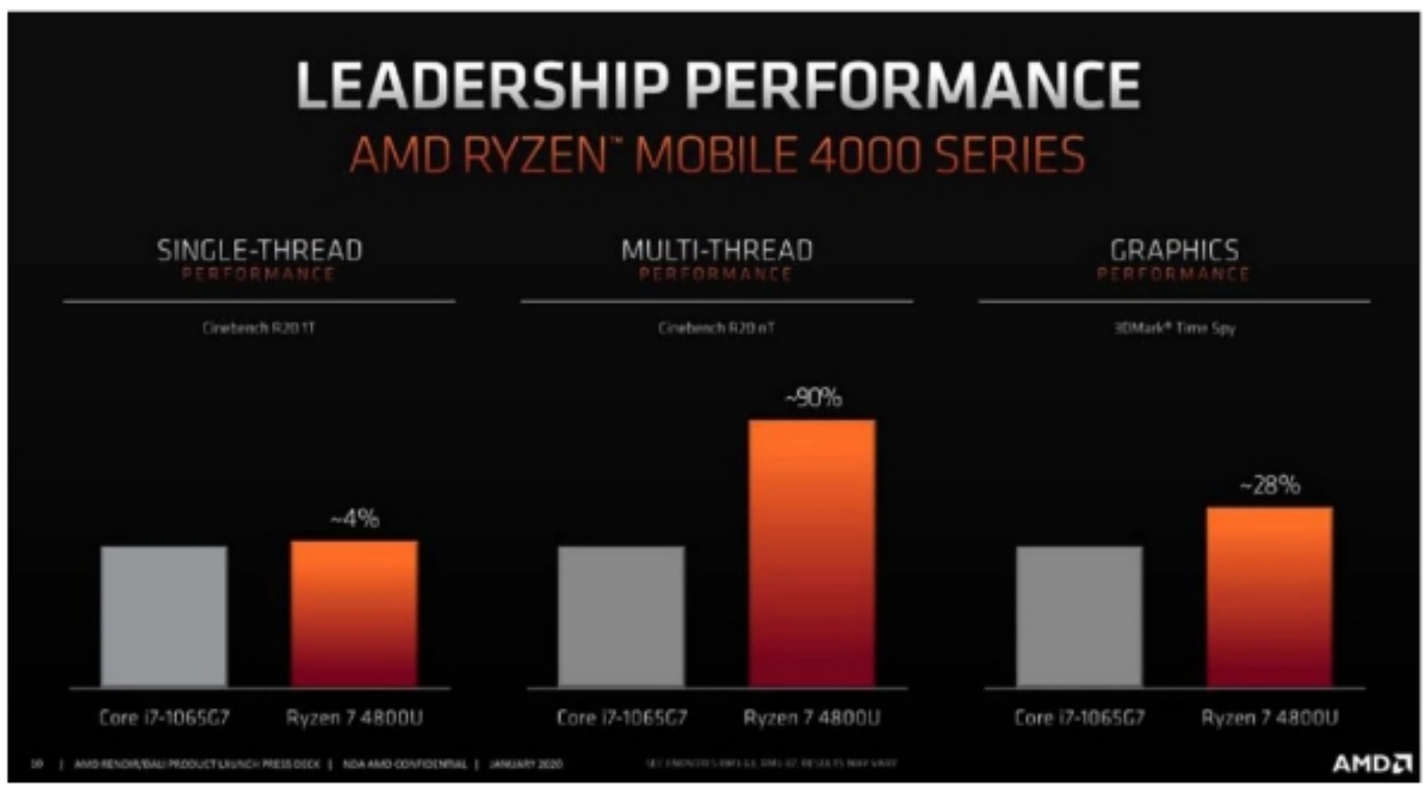
AMD said a Ryzen 7 with 8 compute units actually outperforms its previous Ryzen 7 3000 mobile chips, which had 11 compute units. The newer Ryzen 7 4000's graphics cores actually offer 59 percent more performance per compute unit over the older Ryzen 7 3000 offerings, the company stated.

AMD isn't aiming at older Ryzen 7 3000 though. It's finally hoping to dethrone Intel's mobile chips, and if what AMD claims is true, it's happening.

AMD said the Ryzen 7 4800U, for example, will offer about a 4 percent advantage over Intel's most advanced 10nm-based Ice Lake Core i7-1065G7 in single-threaded performance. But single-threaded performance is just part of it.

RYZEN 7 HAS MORE CORES

As Intel's "Ice Lake" 10th-gen Core chip tops out at four cores, it's no surprise that the



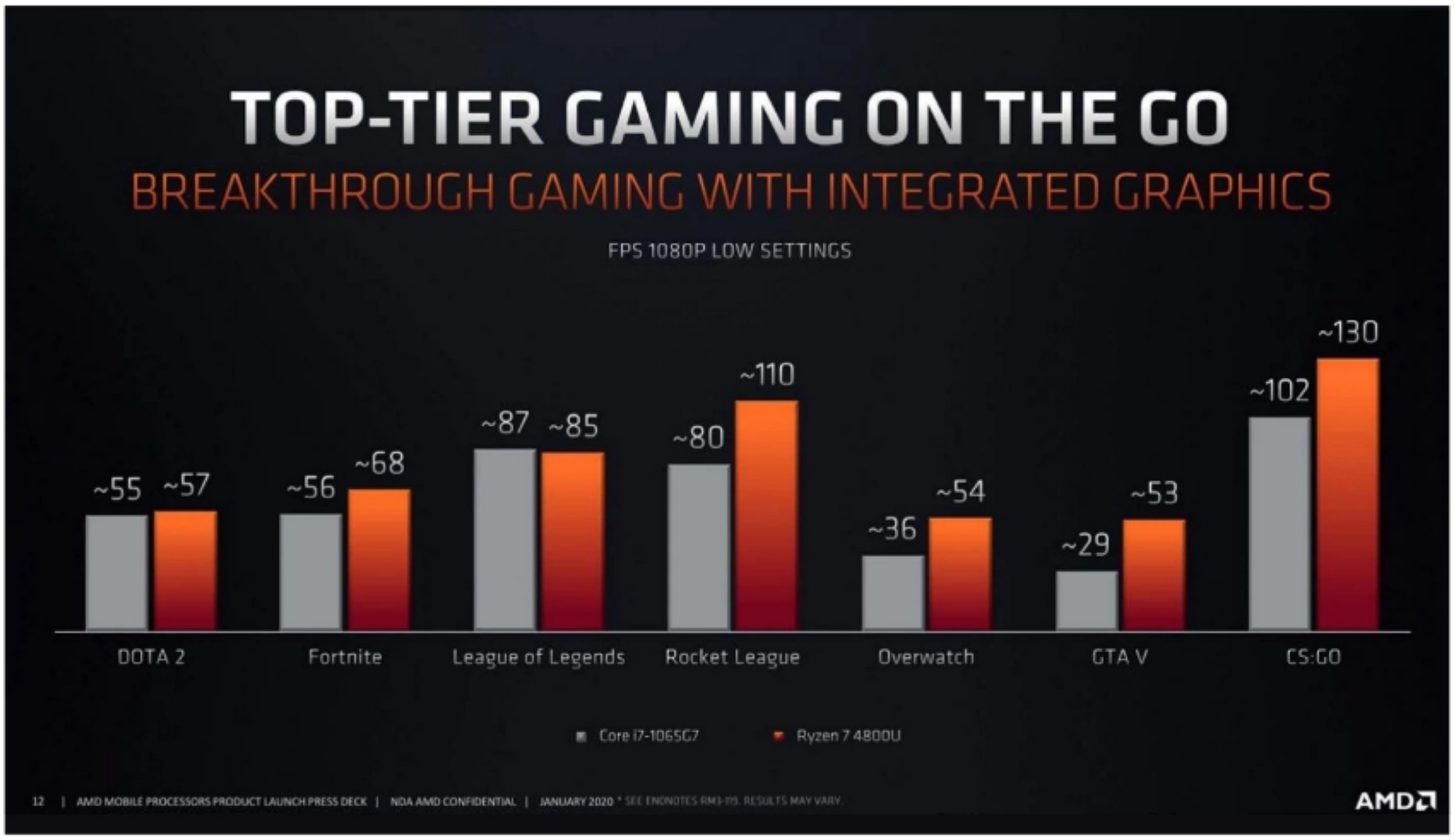
Ryzen 7 4800U will outrun the Core i7-1065G7 to the tune of 90 percent in multi-threaded performance using Maxon's Cinebench R20 benchmark. Although Intel has looked down on using 3D modeling as a measuring stick for thin and light laptops, AMD's performance in multi-threading likely means big wins elsewhere too.

In a video encode using HandBrake, for example, AMD said it has a 40 percent advantage over the Core i7-1065G7, with Adobe Premiere CC giving the Ryzen 7 4800U the advantage by 49 percent.

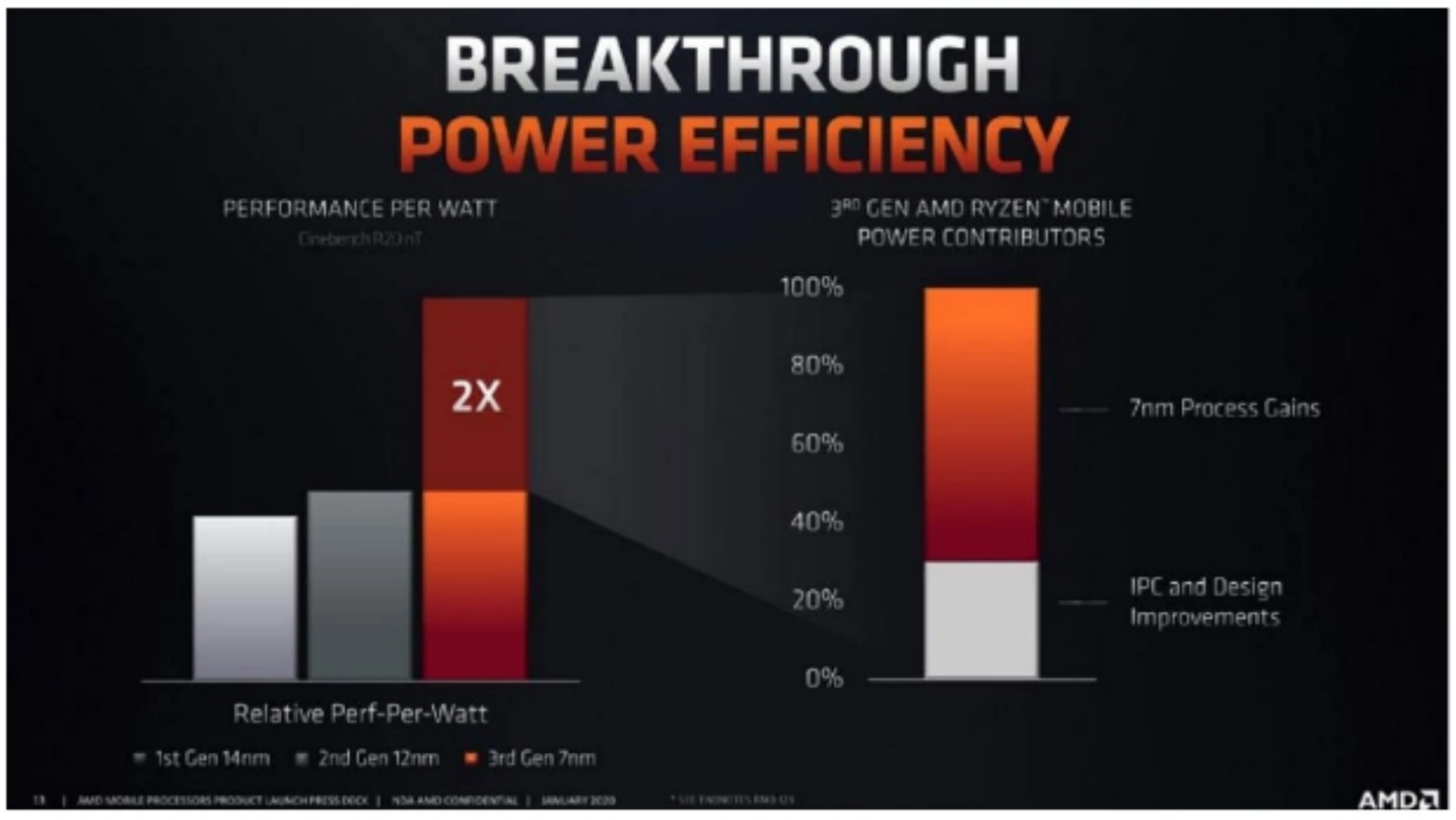
With Ice Lake, Intel greatly improved the graphics performance of its mobile chips but AMD claims that won't help it here, as the Ryzen 7 4800U's integrated Radeon cores will outperform the top-end Core i7-1065G7 by 28 percent using 3DMark Time Spy as a benchmark. The company also highlighted games such as Rocket League and Fortnite giving the Ryzen 7 the advantage too.

FASTER THAN COMET LAKE U TOO? YUP.

But Ice Lake isn't the end all and be all. Intel currently has two architectures available under the 10th-gen Core banner, with the second being its 6-core Comet Lake U Core i7-10710U chip, built using the long-established 14nm process technology. AMD said single-threaded performance is closer between the two, but the two-core advantage of the Ryzen 7 4800U still puts it ahead by about 30 to 40 percent in multi-threaded tasks.



The Achilles heel of the Core i7-10710U is its pedestrian UHD graphics, which offers half the performance of the Ice Lake Core i7-1065G7. Intel's current offerings basically force consumers to choose between the superior graphics of the Core i7-1065G7 or the superior multi-core performance of the Core i7-10710U.



With the Ryzen 7 4800U, AMD said, consumers can have their cake and eat it too by getting better graphics performance and better multi-core performance.

RUH ROH: BATTERY LIFE IS TBD

All out performance isn't the only factor in laptops though—battery life matters too. Unfortunately, AMD didn't disclose hard details on just how well Ryzen 4000 chips compare to Intel's designs. That's a particular sore point, as the Ryzen 3000-series hasn't adjudicated itself here (go.pcworld.com/msl3). Although we have seen some early Ryzen 4000 battery life specs from laptop vendors that don't look particularly good, we've also seen some that look reasonable.

For its part, AMD said we're in the early stages of new laptops based on Ryzen 4000 chips and a lot more tuning has to be done before judgment should be passed. So take any vendor numbers with a grain of salt as they're likely to change, company officials said.

The new Ryzen chips do support LPDDR4X RAM which should greatly help the platform's performance with greater memory bandwidth, better battery life, and improved standby times. AMD claims performance per watt has basically doubled over Ryzen 3000 chips.

RYZEN GAMING LAPTOPS LOOK PRETTY AWESOME

AMD's second set of Ryzen 4000 CPUs play in the heavier gaming and content creation arenas. Typically labeled as "H-class," these laptops have far more powerful 45-watt chips and tend to slot into heavier laptops.

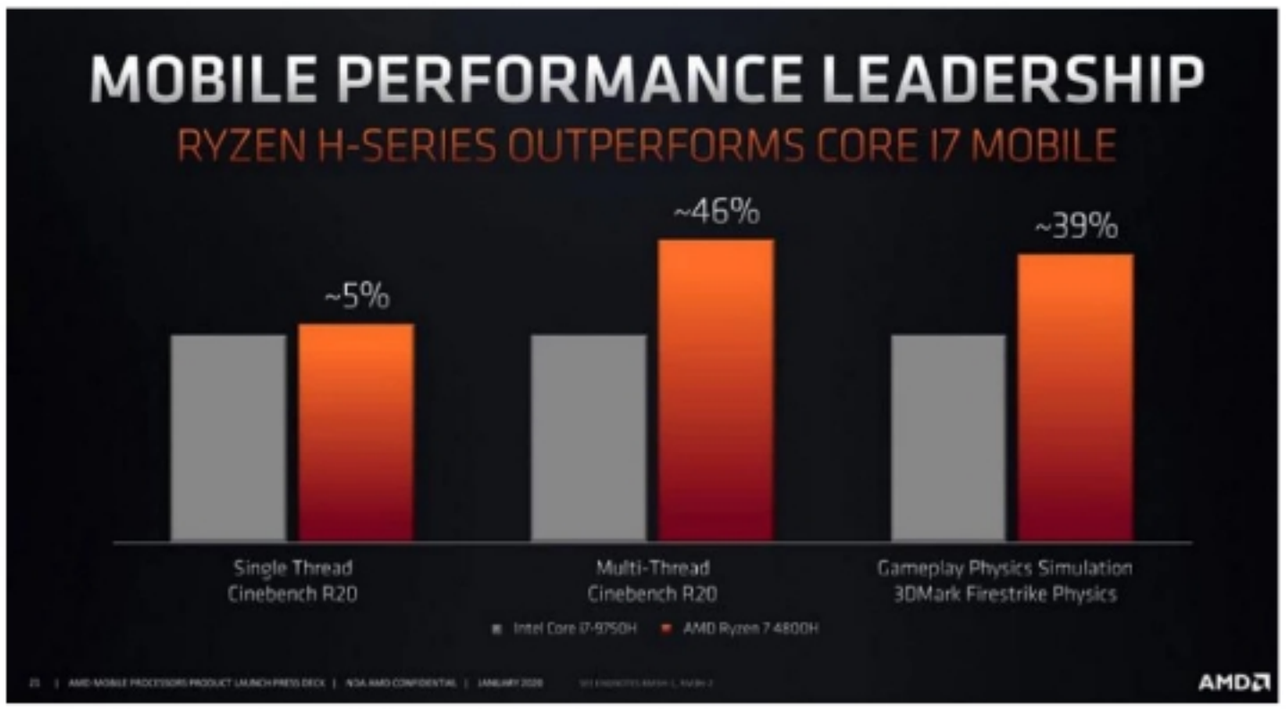
AMD is only offering two CPUs in this category today: An 8-core, 16-thread Ryzen 7

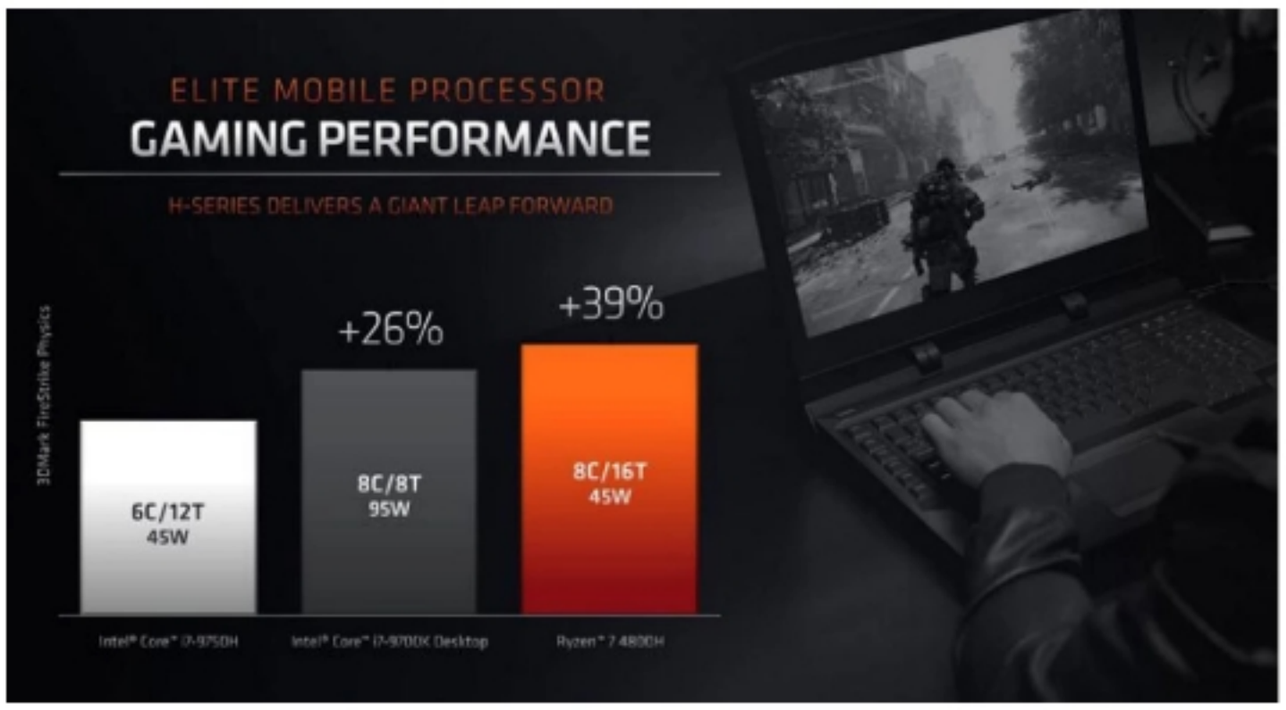
4800H with a boost clock of 4.2GHz and base clock of 2.9GHz, and a 6-core, 12-thread Ryzen 5 4600H with a boost clock of 4GHz and base clock of 3GHz. Both also feature optimized Vega-based Radeon graphics cores.

AMD said the Ryzen 7 4800H's eight cores let it easily outperform Intel's Core i7-9750H by 46 percent in multi-threaded performance, as that chip only has six cores. Single-threaded performance closes up, but AMD claims it has about a 5 percent advantage over the popular Core i7-9750H. In other performance tests, AMD said Ryzen 7 4800H leads Core i7-9750H by 25 percent in Adobe Premiere CC, 32 percent in POV-Ray, and 31 percent in Blender.

Even crazier: AMD said its laptop Ryzen 7 4800H can actually outperform Intel's desktop Core i7-9700K in multi-threaded performance. How? Intel's Core i7-9700K has 8-cores at fairly high clocks, but the company doesn't offer Hyper-Threading on it. These Ryzen mobile H-series chips, on the other hand, do offer simultaneous multi-threading.

There are some indications of just how impressive Ryzen 4800H might be though. One of the new laptops is Asus' ROG Zephyrus G14 laptop (go.pcworld.com/zg14). It's a 14-inch laptop with a GeForce





RTX 2060 GPU and 8-core Ryzen 4800H chip. On paper, that doesn't sound like a big deal, but the Zephyrus G14 weighs just 3.5 lbs. which is far lighter than any GeForce RTX 2060 laptop we've ever seen. It's also the first 14-inch RTX laptop ever.

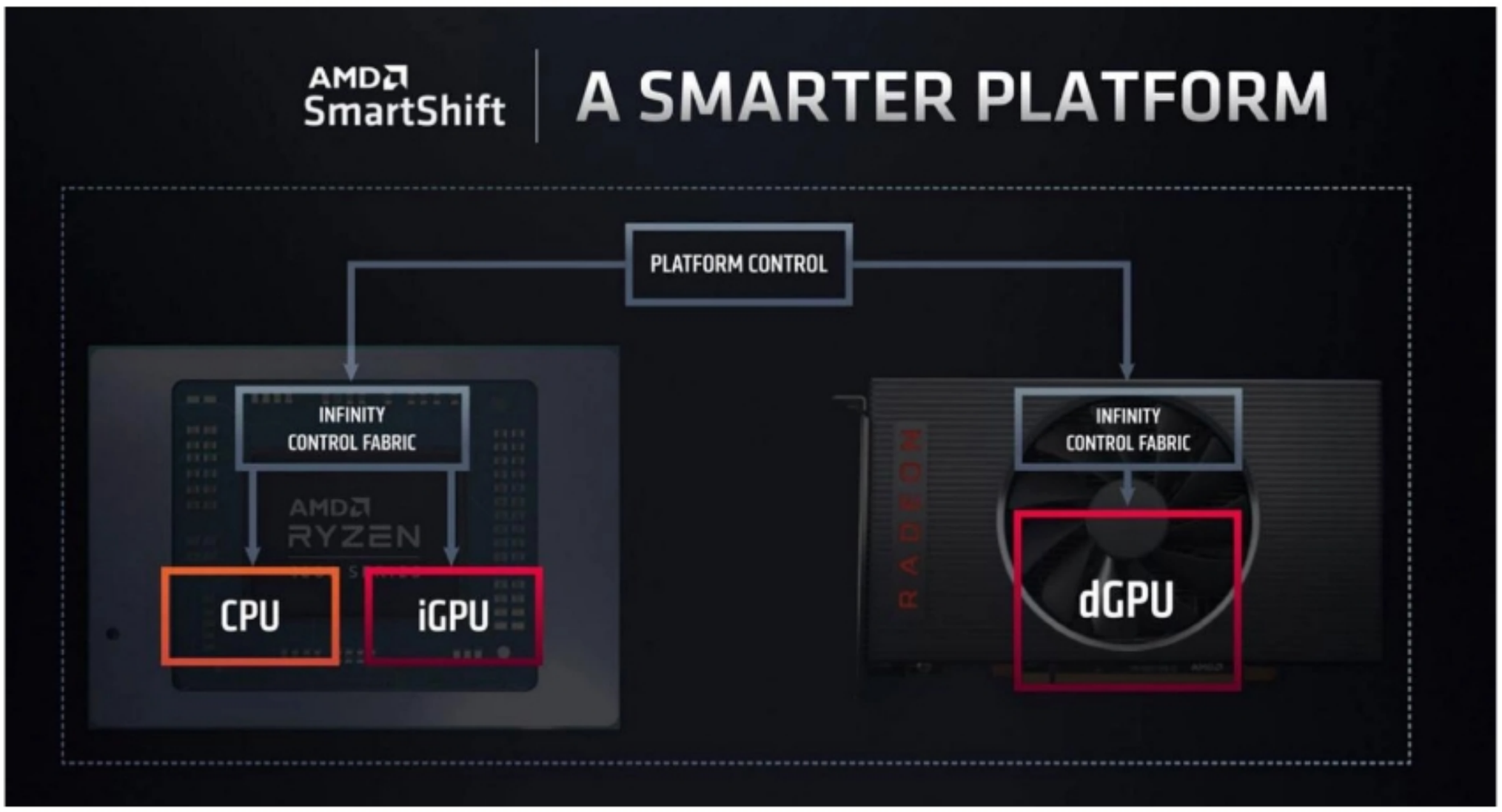
We should also add that most lightweight gaming laptops with beefy gaming GPUs tend to skip Intel's 8-core Core i9 chips in favor of the 6-core Core i7 chips. The reason? It's likely due to the thermals. Although you can shoehorn an 8-core Intel chip into a 4.5-lb. Dell XPS 15 (go.pcworld.com/x759) or a 4-lb. MacBook Pro 15, the performance of the Core i9 typically suffers compared to say, shoving the same CPU into an 8-lb. Acer Predator Helios 700 (go.pcworld.com/h700).

The fact that Asus, AMD, and Nvidia feel comfortable shoving an 8-core CPU into a 3.5-lb. gaming laptop just might mean the 7nm Ryzen 7 4800H is far more power efficient than an Intel 14nm Core i9. That said, Asus is tuning the Ryzen 7 4800H to 35 watts and using the nomenclature of Ryzen 4800HS, rather than the full-blown chip.

Obviously, we'll have to wait for final products to make a final judgment.

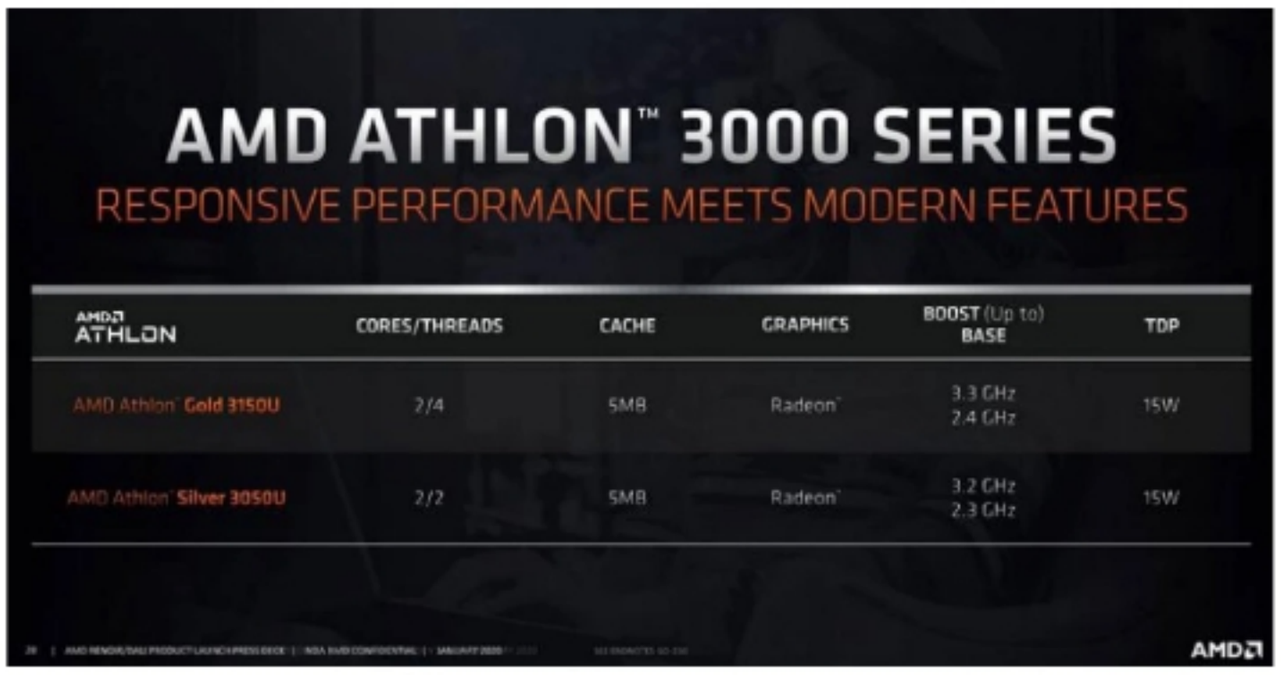
SMART SHIFT: ALL AMD LAPTOPS GET A SPECIAL BOOST

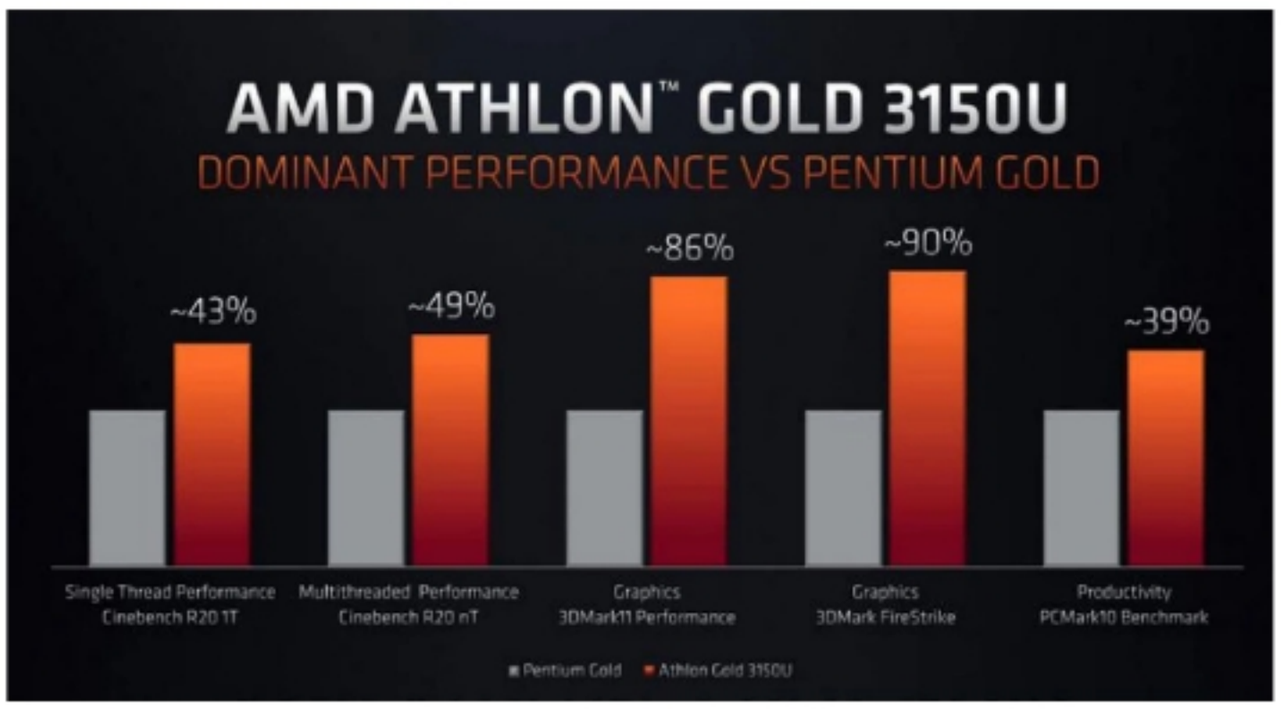
One feature AMD is implementing with Ryzen 4000 H-class chips is an intelligent way to shift power around a system. AMD said laptops Ryzen CPUs and Radeon GPUs can talk to one another over the company's Infinity Fabric and if the CPU isn't being driven hard, more power can be allocated to the GPU, or vice-versa.



AMD said this can result in a 10 percent boost in performance in games like *The Division 2* or a 12 percent bump in Cinebench R20 results.

If this sounds familiar, that's because Intel implemented something similar with its Kaby Lake G chip (go.pcworld.com/klkg) that was built with a 7th-gen Intel Core CPU and custom Radeon graphics.





ATHLON 3000

AMD also announced a pair of new Athlon 3000-series processors for budget laptops, promising modern computing features on the cheap.

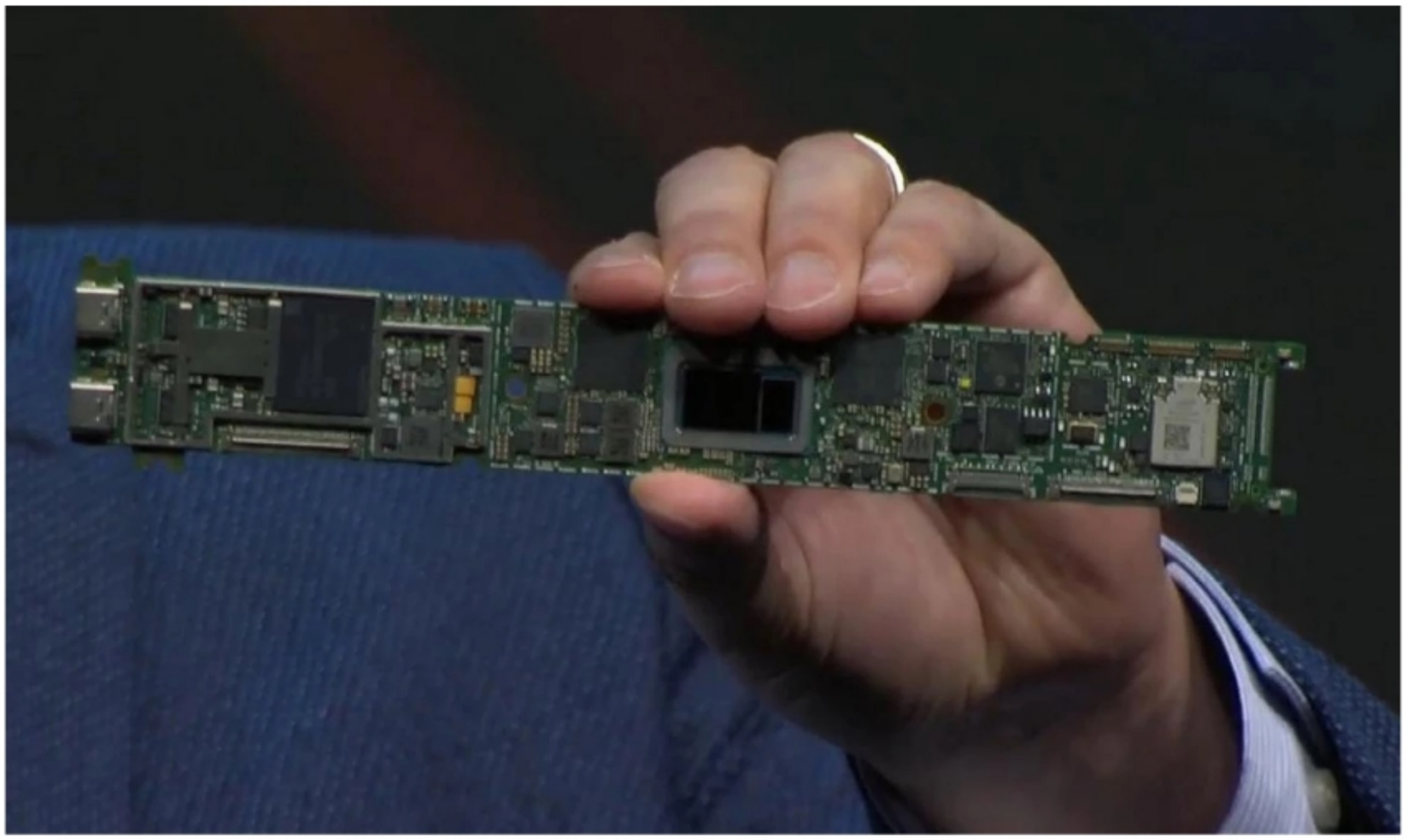
A LOT OF RYZEN 4000 LAPTOPS COMING

Despite the surprising success AMD has with Ryzen CPUs in desktops (go.pcworld.com/3ryz), it would be an understatement to say the company's momentum has been underwhelming in laptops. The Ryzen CPUs available thus far have been mostly budget options and typically far outnumbered by Intel-based laptops.

With Ryzen 4000, AMD said, momentum is finally swinging its way. There will be no fewer than 100 laptops based on Ryzen chips coming out throughout the year. Even better for AMD: Many of them will be premium laptops, where the company has frankly never had any success outside Microsoft's Surface Laptop 3 (go.pcworld.com/msl3) and Lenovo ThinkPads.

Combine good CPU performance, good GPU performance, and at least 100 new Ryzen 4000 laptop designs, and you can imagine this year will shape up to be an exciting one for consumers. AMD's bringing it to Intel.

VIDEO: **AMD'S 7NM RYZEN 4000 CPUS**
Watch now at go.pcworld.com/ry4



Intel confirms 'Tiger Lake' is the next Intel Core processor you need to care about

We still don't know much about Tiger Lake, but it's the next CPU on Intel's road map, to replace Ice Lake and Comet Lake. **BY MARK HACHMAN**

Intel used CES in Las Vegas to offer a further glimpse, though little detail, of its next-generation chips due in 2020. 'Tiger Lake' is its next CPU, and Intel proved that its next GPU, code-named DG1, is up and running.

Before its press conference began, Intel had already made several announcements, some arguably more interesting: its new Core i9-based modular NUC, "Ghost Canyon," (go.pcworld.com/gost) plus new details concerning its 10th-gen Comet Lake chips, including the fact that they'll run above 5GHz (go.pcworld.com/abv5). Intel also revealed earlier that its upcoming Tiger Lake CPUs will have improved AI performance, though the company didn't say how much.

Intel is—or should be—worried about

IMAGE: INTEL

AMD's barrage of CES announcements, including the Ryzen 4000 (see page 12) 7nm/Zen 2 mobile chips expected to take on Intel, and the ridiculously powerful 64-core 3rd-gen Ryzen Threadripper 3990WX (go.pcworld.com/39wx).

PROJECT ATHENA GAINS MOMENTUM

The press conference began with segments on Intel's enterprise businesses, which we've summarized at the end of this story. Finally it was time for some consumer PC news.

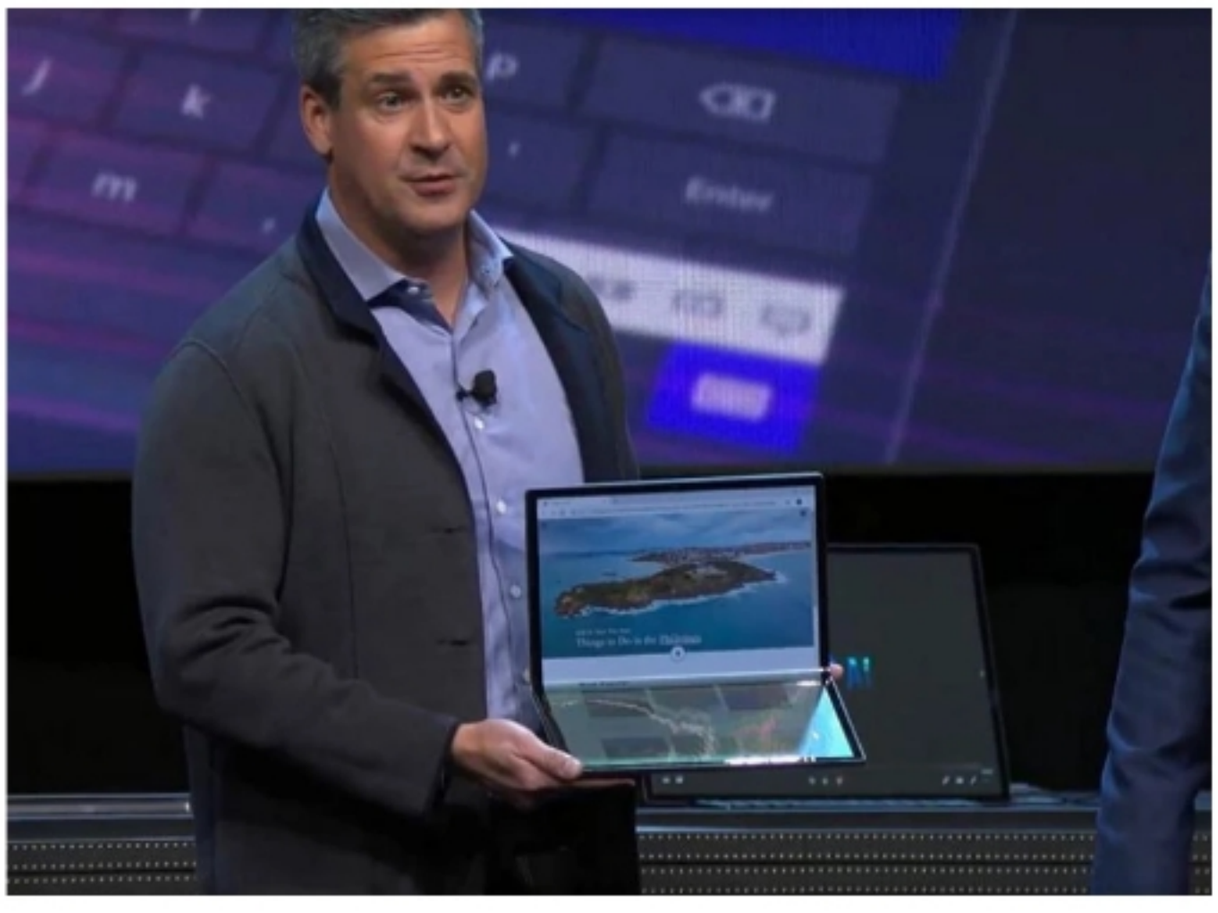
Greg Bryant, executive vice president of its Client Computing Group, came onstage to update the audience on Project Athena (go.pcworld.com/pran), the thin-and-light specification that Intel helped develop. In less than a year, Intel has verified 25 Project Athena devices, Bryant said. In 2020, that number will be doubled to more than 50, Bryant continued—including a new dual-screen specification.

Intel representatives showed off two Project Athena laptops: the Acer Swift 3 (go.pcworld.com/3swf) and the HP Elite Dragonfly (go.pcworld.com/drfl). Bryant also highlighted the Project Athena partnership with Google for Chromebooks, including the Asus Chromebook Flip C434 and Samsung Galaxy Chromebook (go.pcworld.com/glcb) announced at CES.

Lenovo's Christian Teismann, senior vice president for the commercial business at Lenovo, came onstage to show off the ThinkPad X1 Fold (go.pcworld.com/x1fl), a dual-screen PC that can be a 13.3-inch display or tablet, or a small laptop. Intel followed that with a demo of the Dell Concept Duet (see page 7, a larger dual-screen laptop prototype.

Intel's Chris Walker made a surprise entrance with another concept: the "Horseshoe Bend," a full 17-inch foldable PC. Like the Lenovo ThinkPad X1 Fold, the Horseshoe Bend can be a single-screen

The Samsung Galaxy Chromebook is part of Intel's Project Athena program, partnering with Google. Intel showed off the new model at CES in Las Vegas.



Intel's Chris Walker shows "Horseshoe Bend," the company's prototype of a 17-inch foldable PC.

display or tablet, or a dual-screen device, and it's a lot bigger than Lenovo's offering.

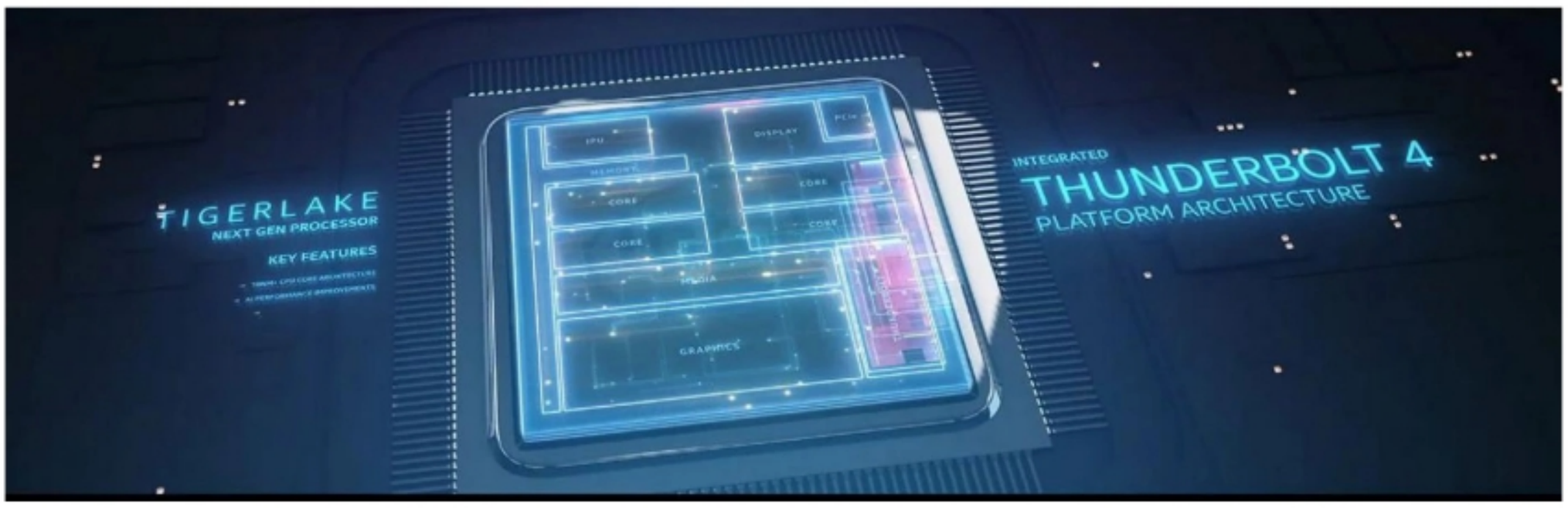
Bryant also pledged 5G support for PCs, with a partnership with Mediatek (go.pcworld.com/inmd), with samples available in the third quarter of 2020. Originally, Intel had claimed that the partnership wouldn't yield fruit until 2021.

TIGER LAKE AND DG1

Bryant then switched gears to the silicon inside the devices themselves, with an emphasis on AI. Adobe's Jason Levine appeared briefly and entertainingly to show the ability to pull out objects from the background within Adobe Photoshop or Adobe's Sensei app, a feature that Intel emphasized within Ice Lake and other 10th-gen chips.

Intel's 10th-gen parts have been split between Comet Lake and Ice Lake, but the next code word to pay attention to is Tiger Lake. That chip, reportedly a 10nm offering, popped up on road maps in mid-2019 (go.pcworld.com/rdmp), and is "coming soon" to laptops, according to a promotional video Intel played.

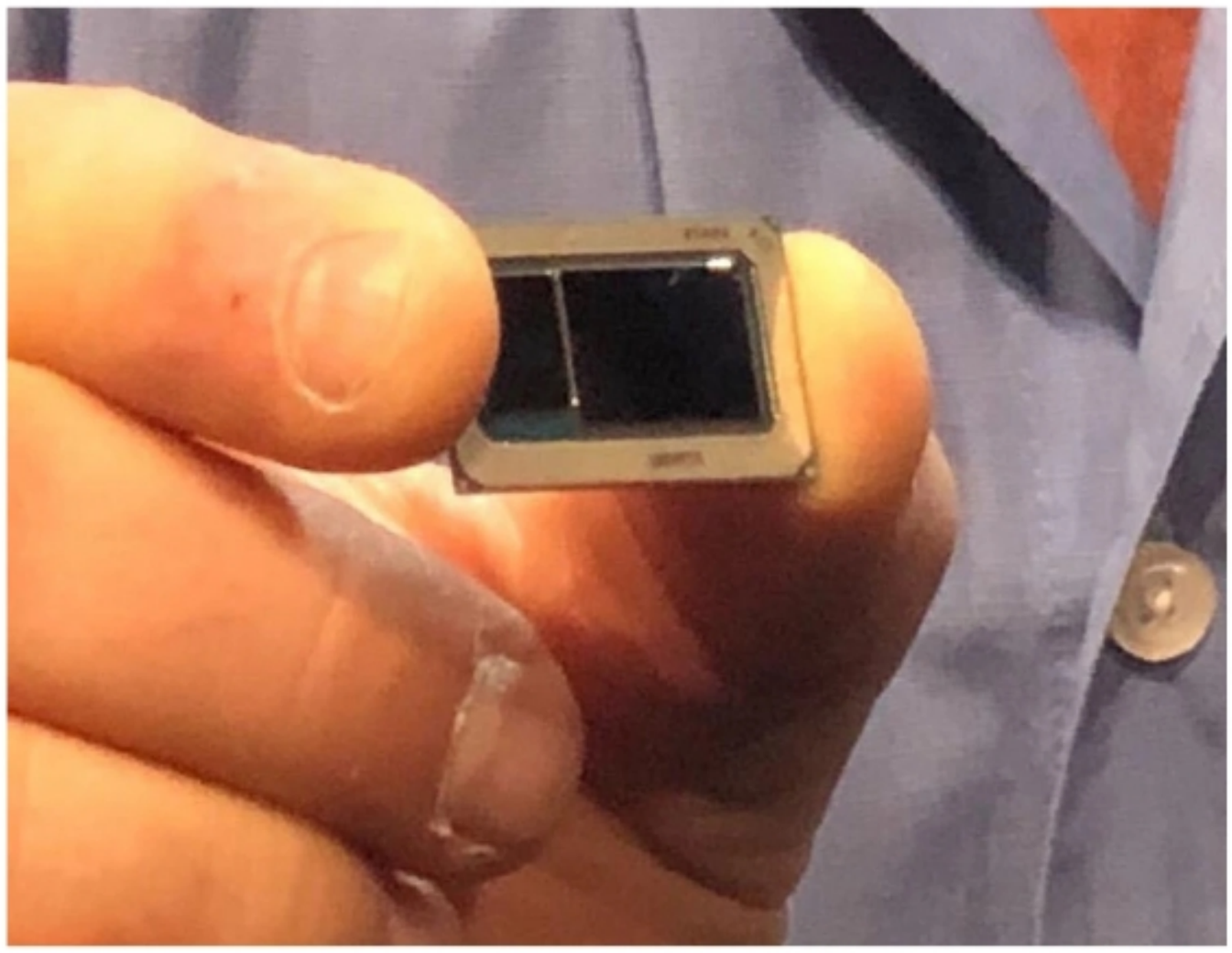
It's not clear what performance advantages Tiger Lake will offer, and over which chips. Bryant appeared to claim that



It's not clear whether Tiger Lake will be a 10th- or 11th-gen part, but at least we know it's next on the road map. A new "Thunderbolt 4" is apparently one of the I/O features.

Tiger Lake would offer a "double-digit" performance increase over the prior generation. Lisa Pearce, vice president of Intel architecture, graphics and software, who joined Bryant onstage, claimed there would be a "huge leap" in graphics performance, presumably due to the inclusion of Xe graphics cores.

Intel's Greg Bryant showed off the company's Tiger Lake CPU and a prototype motherboard at CES in Las Vegas.



Intel unveiled DG1, its first discrete GPU for consumers, at its press conference January 6 at CES in Las Vegas.

Intel closed out its CES presentation with a "proof of life" demo of the Xe core, showing it running part of the presentation as well as playing Destiny 2. The first implementation, which may be just a prototype, is known as DG1. Intel executives offer no actual details, but an Intel representative did show the chip to media for photography.

It's not known when Intel expects Tiger Lake and Xe to arrive. By the end of 2020, however, we should expect to see both chips on the horizon.

OTHER NEWS FROM THE PRESS CONFERENCE

Most of the press conference focused on other areas of Intel's business. The theme was "Innovation through Intelligence," representing the addition of AI from the edge to the cloud. Intel chief

executive Bob Swan walked through a series of announcements focusing on the enterprise.

The message? Data, and the need to process it. In 2019, there were 38 billion devices connected to the network, expected to increase to 56 billion devices by 2025, Swan said. Roughly 75 percent of those devices will fall into the IoT category, he said. About 7 devices will be owned by one individual, collectively generating 175 zettabytes of data in 2025. Of that, half of the data will be generated by devices at the edge—wearables, cash registers, connected cars, and the like.

Intel chief executive Bob Swan.

Three emerging technologies are key to managing that data, Swan said: 5G-speed networks, artificial intelligence, and the intelligent edge (or intelligent devices at the edge). "How do we embed intelligence into everything we make to enrich the opportunities for consumers and our partners?" Swan asked rhetorically.

Intel's acquisitions in recent years of Movidius, MobilEye, Nervana, and more represent the company's desire to address those needs. Swan showed off examples of several in-house Intel technologies from those subsidiaries that, for example, helped the Red Cross create better mapping data for areas it was serving.

Navin Shenoy, Data Platforms Group executive vice president, brought out Anne Aaron, director of encoding technologies for Netflix, to explain how the royalty AV-1 codec, which the company will deploy this year, offers 60 percent more data savings versus the previous technology. Intel's SVT-AV1 codec, the next generation, will be deployed at Netflix and other companies in 2020.

Unfortunately, just a fraction of that data, about 5 percent, is processed by artificial intelligence, Swan said. One way Intel hopes to overcome that is through the Intel Neural

Network Processor for Inference, announced last year at CES. Shenoy said that the NNPI is delivering up to 1.6X improvement on natural language workloads and 3.7X on system level performance, within a 75W envelope.

Intel also said that an athlete-tracking technology will be deployed at the 2020 Olympic Games, powered by its 2nd-gen Xeon Scalable chips—the fastest growing Xeon part in its history. In sports training, a similar technology is used to analyze how athletes use the various parts of their body during workouts.

Similarly, James Carwana, vice president and general manager of Intel sports, showed off the progress with Intel's volumetric video, which captures a three-dimensional image of sports action using cameras trained on the playing field from all around the stadium. In 2017, the company could capture a volumetric "frame" that could be manipulated as an object in 30 seconds. The company spent two years working on improving the processing speed, and in 2019, Intel's Xeon helped spur a massive increase in performance to 30 frames per second, Carwana explained.

"We figured out the speed portion of the puzzle, and now have to figure the quality part," Carwana said. That requires 67GB per second of data right now, and will need more in the future. The next goal is six times more computing power to improve the resolution even further.

Volumetric video treats video as objects, which can be tracked, manipulated and viewed as users wish.

CES 2020: The chips, laptops, and badass gear PC enthusiasts need to know about

A glimpse into the future. **BY BRAD CHACOS**

Another CES is in the books, and this time around, the annual techstravaganza served as a harbinger for the disruption aimed at PCs in 2020. Things are about to get funky, friends.

AMD opened a new front in the war against Intel, Intel fired shots at AMD and Nvidia, and monitors were being pushed to blazing-fast new limits left and right. Laptops embraced newfound form factors. Desktops got weird. Heck, we even saw a détente in the battle between consoles and PC gamers in bold, badass fashion.

We were there to capture it all. Here's a recap of the CES 2020 reveals that PC enthusiasts need to know about. Hit those links for deeper details throughout.

IMAGE: CES

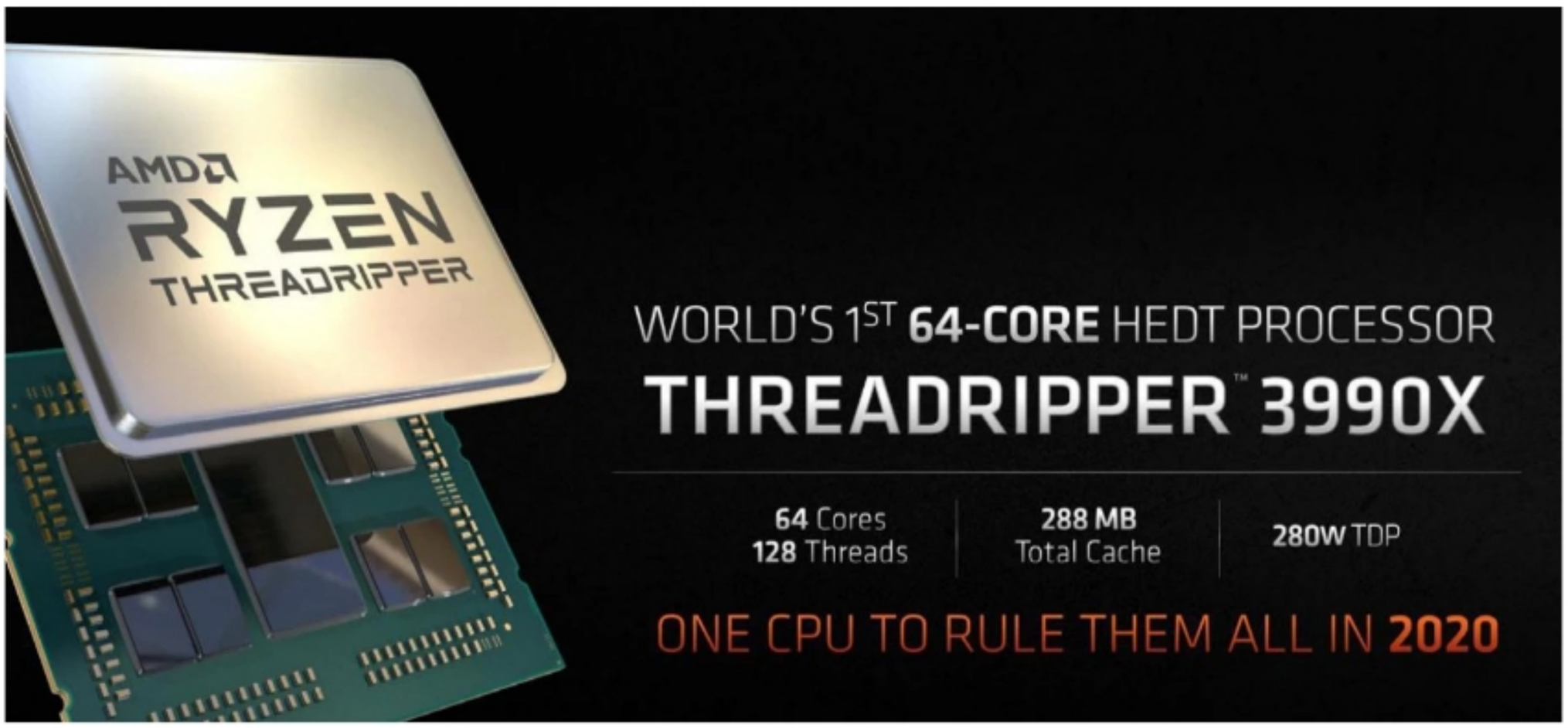
AMD VS. INTEL VS. NVIDIA

Let's start with the heavy hitters powering the chips inside the PCs you buy.

After claiming desktop dominance from Intel (go.pcworld.com/dkdm) for the first time in a long time in 2019, AMD came out swinging at laptops at CES 2020. The company revealed Ryzen 4000 laptop processors (see page 12) at its keynote, built using the same 7nm process that made 3rd-gen Ryzen and Threadripper CPUs so great, with both energy-efficient U-series and gaming-ready H-series processors planned. Get this: AMD says it's introducing "the best laptop processor ever built," and claims that its top-tier H-series chip can outpunch even Intel's desktop Core i7-9700K in some scenarios. Hot damn.

AMD also revealed pricing, speed, and release date info for its monstrous 64-core Threadripper 3990X (go.pcworld.com/64cr). It'll cost $3,990, appropriately enough, when it launches on February 7. We also chatted with Ryzen development leader David McAfee for further insights into Threadripper 3990X (go.pcworld.com/390x) and Ryzen 4000 (go.pcworld.com/mb40), as well as Anandtech's Dr. Ian Cutress for how Ryzen 4000 squares up against Intel (go.pcworld.com/squp) in laptops.

Laptop makers are already lining up to deploy the latest Ryzens, a stunning turnaround from the norm for AMD. The company says over 100 laptops will ship with Ryzen 4000 inside, with several flagship models on display at CES. Dell's G15 SE (go.pcworld.com/15se) will serve as a showcase for AMD's mobile efforts, with both Ryzen 4000 and Radeon 5000M chips inside. The 3.5-pound Asus ROG Zephyrus G14 (go.



AMD announced details of its monstrous 64-core Threadripper 3990X processor.

Dell's G15 SE will ship with a Ryzen 4000 inside.

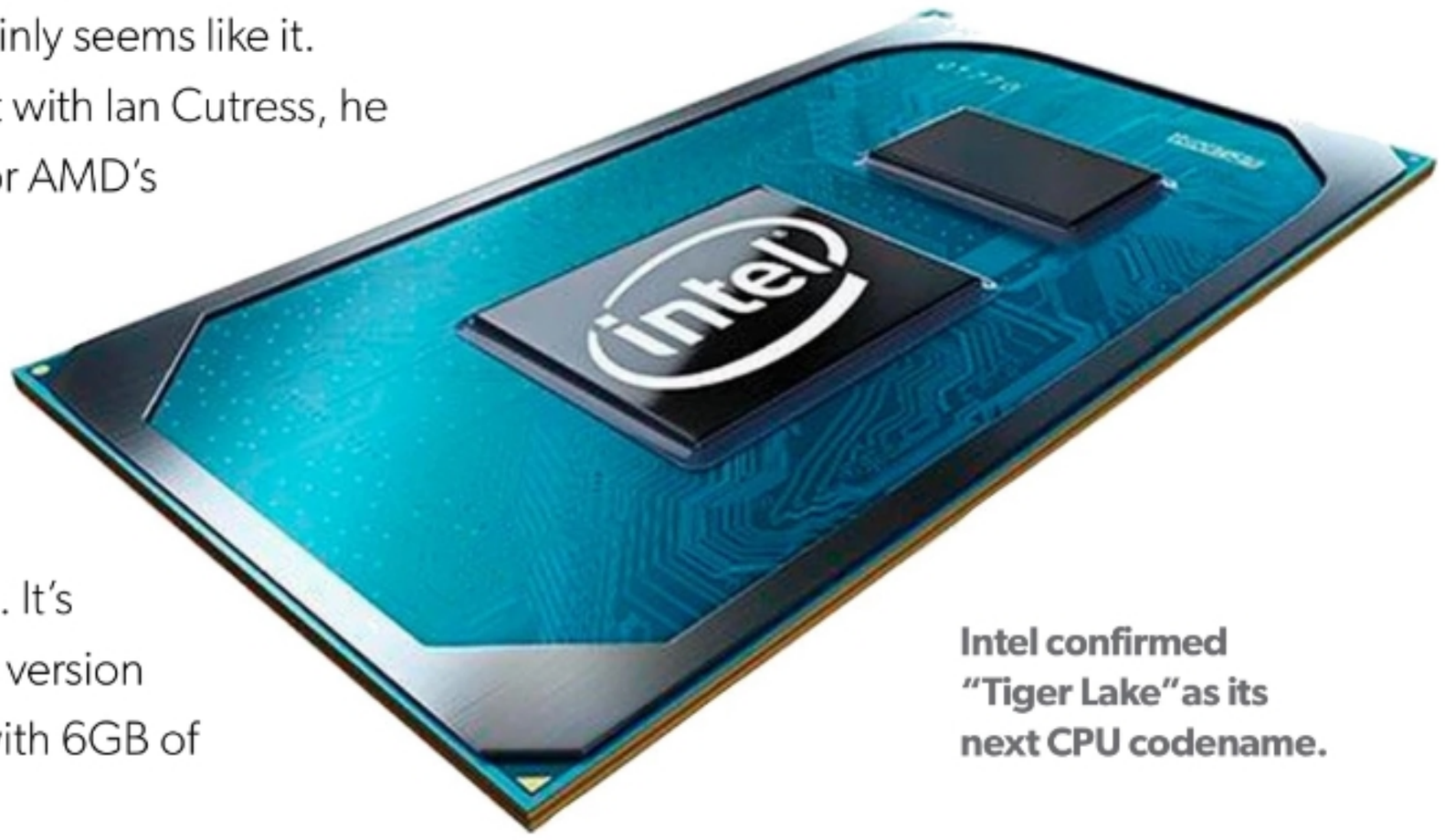
pcworld.com/zphr), meanwhile, taps into the energy efficiency of AMD's new CPU and Nvidia's Max-Q GeForce technology to offer the world's first 14-inch RTX laptop. This thing looks badass. Acer's Swift 3 (go.pcworld.com/3swf), meanwhile, will come with either Intel or AMD inside.

Are the tides finally turning for AMD's notebook efforts? It certainly seems like it.

At the end of our chat with Ian Cutress, he muses about the future for AMD's Radeon graphics cards, because AMD revealed the Radeon RX 5600 XT (go.pcworld.com/56xt) during its keynote as well. It's basically a lower-clocked version of the Radeon RX 5700 with 6GB of memory and a $279 price tag. Look for it to take on Nvidia's GeForce GTX 1660 series for PC gaming's 1080p sweet spot when it launches January 21. In a small roundtable with press after the keynote, AMD CEO Lisa Su revealed what's next for Radeon (go.pcworld.com/lisu): high-end Navi GPUs and real-time ray tracing.

Intel isn't taking the threat lying down, naturally. It revealed an array of news at CES 2020, the most interesting being the grand unveiling of early versions of its discrete DG1 graphics in both desktop (go.pcworld.com/dx1e) and laptop (go.pcworld.com/d2xe) form, based on the company's Xe graphics architecture. DG1 products are scheduled to launch sometime this year.

Things were quieter on the CPU front. Intel confirmed that "Tiger Lake" is the next CPU codename you need to care about (see page 19), but didn't say much beyond that, though a Thunderbolt 4 tease quickly devolved into a



Intel confirmed "Tiger Lake" as its next CPU codename.

Intel showed off its NUC 9 mini PC.

mess (go.pcworld.com/thn4). (But hey, USB4 logos will actually make sense! [go.pcworld.com/u4lg].) On the brighter side, the company said that Comet Lake H mobile processors will hit 5GHz (go.pcworld.com/clkh) when they launch later this quarter, and showed off several big wins in radical laptops thanks to its Project Athena initiative and its investment in innovative form factors. We'll cover laptops more extensively later.

Intel also showed off its much-leaked "Ghost Canyon" NUC (go.pcworld.com/gnuc), which is basically a mini-PC-in-a-mini-PC that revolves around a replaceable Intel Compute Element card stocked with the mobile CPU, RAM, chipset, and storage. There's PCIe x4 and x16 slots next to the Compute Element, too, ready to accept discrete graphics and storage add-in cards—handy preparation for when Xe launches later. Watch Alaina rip inside Ghost Canyon in the video at the link.

Nvidia had a lower profile at CES 2020. It didn't release updated graphics cards, show off a new Shield console, or (finally) launch GeForce Now out of beta. But the company brought it when it came to monitors, showing off face-melting 360 freakin' Hz G-Sync Esports displays (go.pcworld.com/espt), and new mini-LED G-Sync Ultimate monitors (go.pcworld.com/mnld) with 1,152 backlight zones capable of a blazing 1,400 nits. We called the first wave of G-Sync Ultimate displays the Holy Grail of gaming

AMD unveiled its 360Hz G-Sync Esports displays at CES.

monitors (go.pcworld.com/gsul), and these look even better.

The GeForce software team also released a feature-laden Game Ready driver for the show, introducing real-time ray tracing in Wolfenstein: Youngblood and much more. It also announced that boutique PC builders can now offer RTX Studio-validated systems for content creators (go.pcworld.com/rtst), and Nvidia will toss in three free months of Adobe's Creative Cloud if you buy one.

Razer Tomahawk N1.

DESKTOPS GONE WILD

Desktop builders always bring their craziest concepts to CES, and 2020 was no exception. Razer's Tomahawk N1 (go.pcworld.com/tmn1) blends the design of the company's Razer Core external graphics card dock with Intel's new card-based NUC technology to create a dead-simple, damned sleek DIY PC. It's pretty appealing, though Razer's been more miss than hit when it comes to actually launching the wild concepts it shows off at CES, so we'll see if you're ever able to actually buy one.

Corsair's Project Orion (go.pcworld.com/orin), on the other hand, leans heavily on the revolutionary Capellix LEDs that Corsair introduced at last year's CES. Project Orion's a modified Corsair Crystal 465X case with the Capellix LEDs lining the inside of its glass panels. Embedded into a transparent film, the ultra-bright LEDs illuminate the exterior of the case without interfering with the clarity of the view of the internal components. Behold its dazzling beauty in the video at the link.

Then there's the Big O (go.pcworld.com/bigo), a revival of a decade-old oddity by

Origin Big O PC.

recent Corsair acquisition Origin PC. Big O pairs a high-end PC with a liquid-cooled console in a single Corsair Crystal Series 280X case, then tosses in an optional Elgato 4K60 capture card for the ultimate streaming box. Who says console and PC gamers can't get along? You'll be able to heavily customize the components and aesthetics of the Big O, as you'd expect from an Origin PC product.

iBuyPower's Project Snowblind CL.

Dell blended console and PC in its own way with the Alienware Concept UFO (see page 7), which looks like a Nintendo Switch but runs full-fledged Windows 10. Cool stuff. The company also showed off Concept Ori, a folding PC built around a single large screen, and Concept Duo, a laptop that replaces the usual keyboard with a second large display. Because they're concepts, we don't know whether they'll ever make it to market, so think of them as hints of what Dell's working on for future PCs rather than actual product announcements. That being said, Concept UFO looks sick.

Finally, it might not be as outwardly exotic as the other desktops highlighted here, but iBuyPower's Project Snowblind CL (go.pcworld.com/snwb) could make custom loop cooling easier and cheaper, and that's a welcome development for PC enthusiasts. Custom loop cooling for CPUs and GPUs in a pre-built PC has long been recognized to be more beautiful, more efficient—and more expensive. Project Snowblind CL may change all that. It turns what is normally a five-hour process into a ten-minute process, essentially putting custom water loop cooling within reach of normal budgets.

LAPTOPS GALORE

Most of the PCs sold today ship as laptops, not desktops, so it should come as no surprise that laptops could be found in every nook and cranny of the CES 2020 show floor. While many of the models on display were thinner, better versions of standard form

factors, built to accommodate new hardware from the big-name chip vendors, we also saw a surprising amount of form factor innovation this year.

Lenovo showed off a foldable tablet of its own, a $2,500 machine dubbed the ThinkPad X1 Fold (go.pcworld.com/thx1). Another oddity? The ThinkBook Plus (go.pcworld.com/thpl), which plops a secondary e-ink display to the outside of the laptop's lid, ostensibly to help you focus. Weird. But maybe cool? But weird.

Lenovo's ThinkPad X1 Fold in clamshell mode.

Lenovo also revealed the Yoga 5G (go.pcworld.com/yg5g), based around Qualcomm's Snapdragon 8cx chip and touted as the first 5G PC, complete with a nanoSIM card slot. It promises all-day battery life, unlike the Microsoft Surface Pro X (go.pcworld.com/srfx) built using a Qualcomm variant, though app compatibility will still be something to watch. For gamers, there's the Lenovo Legion Y740S (go.pcworld.com/y74s), a gaming laptop with no discrete graphics, as it's made to pair with the Legion BoostStation—Lenovo's debut external graphics card dock.

The Acer ConceptD 7 Ezel and Ezel Pro (go.pcworld.com/ezel) bring a funky, yet useful dual-hinge configuration as well as even beefier hardware to our favorite content creation laptop of 2019 (go.pcworld.com/fv19). It can flip and rotate its display into five different modes, from traditional clamshell to tablet, and it's touch/pen friendly as well.

Acer also showed off the Swift 3 thin-and-light mentioned earlier (go.pcworld.com/3swf), with your choice of Intel or Ryzen 4000 chips inside.

The HP Spectre x360 15t (go.pcworld.com/s15t) is getting even thinner and smaller, with a battery that just won't quit even with a

The Lenovo 5G is a 360-degree convertible PC.

Acer's Swift 3 SF313-52/G, which uses Intel's mobile Ice Lake chip, looks virtually identical.

4K display in tow. The company says a special two-watt—two-watt—4K panel helps the laptop achieve up to a whopping 17 hours of endurance. Yes, please! HP's impressively sleek Elite Dragonfly business laptop, meanwhile, is getting easy-peasy device tracking thanks to Tile integration (go.pcworld.com/tlin), while the HP Envy 32 is an all-in-one PC that actually kicks ass (go.pcworld.com/en32) with a 4K HDR display, RTX graphics, and speakers that get loud. (It still packs a mobile processor though.)

Dell's XPS 13 (go.pcworld.com/9300), the laptop that kicked off the narrow-bezel revolution, took it to another level at CES 2020 with, well, even narrower bezels, along with a move to a 16:10 aspect ratio. The laptop also upgrades to Intel's latest 10th-gen "Ice Lake" processors, a replaceable M.2 SSD, an infrared Windows Hello biometric camera, and an overhauled cooling design.

The ultra-premium Dell Latitude 9510 (go.pcworld.com/9510) appears ready to shake things up for business types, with an ultra-compact design, 5G integration, and Dell Optimizer software that analyzes your usage patterns and tries to save you time with routine tasks. Interesting!

There's more where those came from. The Asus Zenbook Duo (go.pcworld.com/zduo) takes a second stab at the company's dual-screen concept, shrunk down and equipped with more modest hardware. Samsung's vivid red Galaxy Chromebook (go.pcworld.com/glcb) is a daring bet on premium Google laptops. Dynabook, essentially the rebranded rebirth of Toshiba laptops, rolled out an ultralight

The Acer ConceptD 7 Ezel's display has two hinges, one at the bottom and one at the middle, so it can work as a clamshell or "float" at a number of angles for viewing or drawing.

It's all screen on the new 2020 XPS 13 9300.

rival for HP's Elite Dragonfly (go.pcworld.com/dnbk), as well as a Comet Lake business laptop…with a DVD drive? That's not something you see very often these days.

MK62 Nighthawk Mesh WiFi 6 System ditches the series' iconic aggressive design for a boring "black box" look in the transition.

External storage also impressed, with Samsung adding fingerprint security (go.pcworld.com/fnsc) to the blazing-fast T-series SSDs we love and Seagate blending portable performance with pretty looks (go.pcworld.com/sgxd).

And to think, this bounty of gadget-y goodness was unveiled at the very start of the year. PC enthusiasts have a lot to look forward to in 2020!

NETWORKING AND STORAGE

Wrapping things up, we also saw some new networking and storage gear revealed at the show.

On the networking front, Linksys unveiled (go.pcworld.com/lnks) a pair of mesh routers based on Wi-Fi 6. Netgear, meanwhile, added 4G LTE capabilities (go.pcworld.com/4lte) to its wonderful Orbi mesh router, and expanded its popular Nighthawk line into mesh routing (go.pcworld.com/nhwk) as well—though the

The Netgear Nighthawk AX6 is designed for medium to large homes and can handle as many as 25 clients accessing the network at the same time.

Samsung teams up with Microsoft to sell a weirdly practical phone that means business

A Galaxy phone with a removable battery is the last thing we expected. **BY MICHAEL SIMON**

While we're all waiting for the Galaxy S20 to arrive in San Francisco on February 11, Samsung isn't resting on its laurels. After announcing the budget-friendly Galaxy S10 and Note 10 Lite models (go.pcworld.com/s10l) ahead of its recent CES appearance, Samsung has turned its sights to a new kind of Galaxy phone, and it's getting a little help from Microsoft.

The Galaxy XCover Pro (go.pcworld.com/xcvr) is something of a return to the "Active" phones that Samsung made from the Galaxy S4 to the S8, but it's more than just a rugged, IP68 water-resistant, MIL-STD 810G certified handset that doesn't need a

IMAGE: SAMSUNG

case. You're also getting something that was long thought to be extinct. No, I'm not talking about a headphone jack (though it has one of those too). I'm talking about a removable battery.

It's been many years since Samsung released a phone with a removable battery, but when you run out of juice in the XCover Pro's 4,050mAh battery, you'll be able to pop off the back cover and snap in a new one (which are obviously sold separately). It also features 15W fast charging, which can be done over USB-C or a pogo pin-compatible charger.

Since the Galaxy XCover Pro is a "field" device, you won't find a glass back or an Infinity screen, and the bezels are quite large. However, there's more than meets the eye. The 6.3-inch display has "an enhanced touchscreen able to work in any condition, including rain or snow," as well as the ability to work even when the user is wearing gloves. The back of the phone features a grippable plastic cover, while the rest of the specs are fairly unremarkable:

Dimensions: 159.9 x 76.7 x 9.94mm
Display: 6.3-inch Full HD+
Processor: Exynos 9611
RAM: 4GB
Storage: 64GB
Front camera: 13MP. f/2.0
Rear camera: 25MP, f/1.7 + 8MP, f/2.2
Battery: 4,040mAh

On the side of the phone you'll find a power button with an embedded fingerprint sensor, as well as a pair of programmable keys that can boil tasks down to just a single click. But Samsung hopes one of them will be used as a walkie-talkie. Just like the canary-colored Motorola i530, you can use your XCover Pro as an old-fashioned walkie talkie thanks to integration with Microsoft Teams. As announced last week (go.pcworld.com/mstm), Microsoft is building push-to-talk Walkie Talkie mode into its Teams software, letting you push a button to instantly contact a team member or a group.

Additionally, Samsung is building a point-of-sale system into the XCover Pro that lets customers make payments by tapping their contactless card, phone or watch to the phone. It's unclear how seamless Samsung's POS platform is, but it specifically spotlighted approval by Visa's Tap to Phone pilot program (go.pcworld.com/vtap).

Samsung says the XCover Pro will ship in the first half of 2020 for $499.

This Firefox vulnerability is so bad, the U.S. government is urging users to patch it immediately

Seriously, go update your browser before you even read this. **BY MICHAEL SIMON**

We're just barely into 2020, and already we have our first critical security flaw. It comes from Mozilla's popular Firefox browser, and it's so dangerous, the Homeland Security Cybersecurity and Infrastructure Security Agency is warning users about it.

The good news is that it's already been patched. The bad news is that it's already being exploited in the wild. And it's about as bad as it can get. In technical terms, as Mozilla

IMAGE: MOZILLA

explains (go.pcworld.com/mzxp), "Incorrect alias information in IonMonkey JIT compiler for setting array elements could lead to a type confusion." That means that an attacker could exploit the Javascript code to surreptitiously hack a user's PC and install malicious code outside of Firefox. Mozilla says it is "aware of targeted attacks in the wild abusing this flaw," but doesn't give any information about how widespread the attacks are.

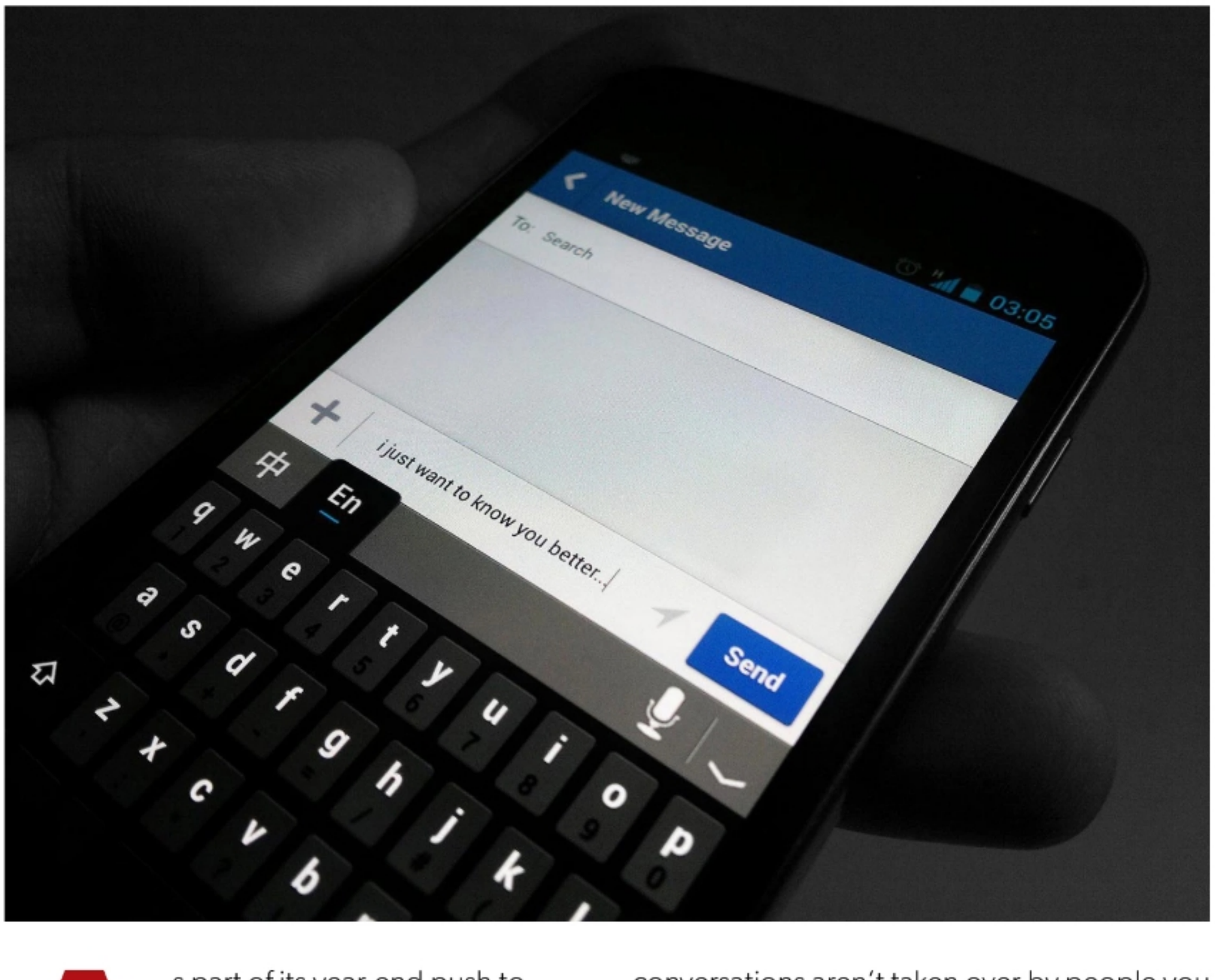
The Department of Homeland Security echoed that warning (go.pcworld.com/exwn) and urged users to "apply the necessary updates." The government regularly tracks malware and vulnerabilities, but rarely do consumer apps rise to the level of a cyber alert.

The bug was first detected by Chinese security company Qihoo 360 just two days after the initial update was released, according to TechCrunch. The vulnerability is patched in Firefox 72.0.1 and Firefox Extended Support Release (ESR) 68.4.1. Firefox should check for updates immediately upon launch, but if you've disabled that setting, you can update your browser in the General tab inside settings.

Firefox users are urged to update their browser as soon as possible.

Google makes it safer to text on Android phones, but end-to-end encryption is still MIA

Verified SMS and spam protection rolling out now. **BY MICHAEL SIMON**



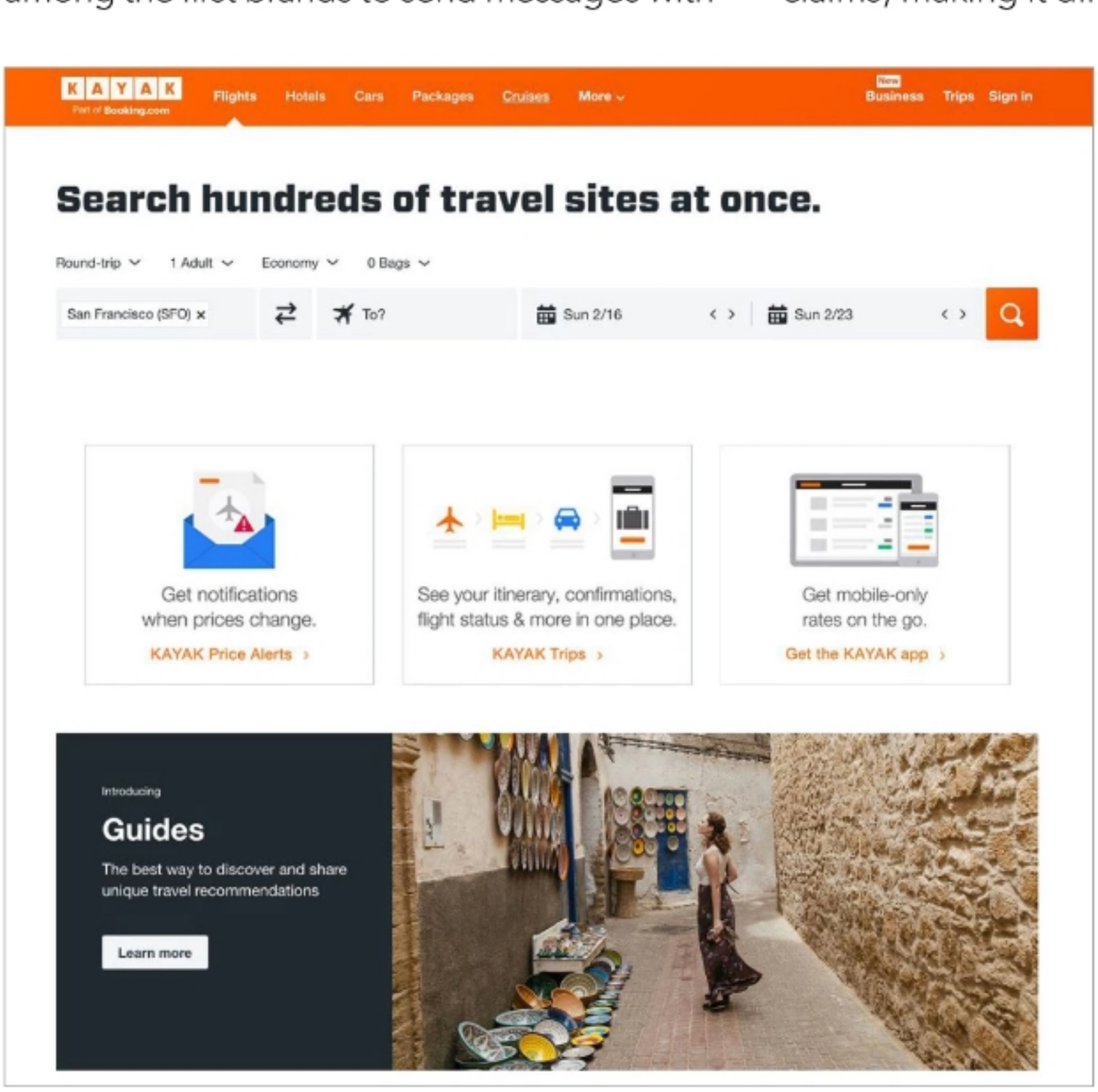
As part of its year-end push to bring Android Messages up to speed, Google has rolled out two new features: Verified SMS and spam protection (go.pcworld.com/vsms). Together, they help make sure your conversations aren't taken over by people you don't want to talk to.

Like the phone app, Google won't automatically filter out suspected spam messages, but it will warn you when it suspects one has arrived. You'll be able to

IMAGE: JUSTIN TAANNIX/PIXABAY

let Google know whether it got it right and also report spam texts, all of which will be used to improve the detection engine.

In addition to flagging spam, Google will also verify whether you're indeed chatting with the brand you think you're chatting with. If so, Google will add a verification badge alongside the business name and logo in the conversation. Google says 1-800-Flowers (go.pcworld.com/18fl), Banco Bradesco (go.pcworld.com/bnco), Kayak (go.pcworld.com/kyak), Payback (go.pcworld.com/pybk), and SoFi (go.pcworld.com/sofi) are among the first brands to send messages with Verified SMS, with more being added daily.



Kayak is among the first sites to send messages with Verified SMS.

While both of these features are certainly excellent additions to Android Messages—especially on the heels of the recent launch of RCS—it also underscores the biggest security safeguard that's still MIA: end-to-end encryption. While messages are indeed encrypted while being sent, there's no guarantee that they're encrypted by the carrier, which means someone could be reading or intercepting messages along the way. Google promises that it doesn't save messages, but most providers make no such claims, making it difficult to fully trust that your messages are for your eyes only.

But at least you'll know that they're coming from verified sources, which is a step in the right direction. Verified SMS is rolling out in nine countries, starting in the U.S., India, Mexico, Brazil, the UK, France, Philippines, Spain, and Canada, while spam protection is rolling out in the U.S. following a broader launch earlier this year.

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Dell XPS 13 2-in-1 vs. HP Spectre x360 13t: Which premium laptop is best?

We compare them on features, performance and more. **BY GORDON MAH UNG**

Dell's XPS 13 2-in-1 7390 and HP's 5th-gen Spectre x360 13t embody the intense rivalry of the two top American PC vendors. Locked in a constant fight for market share, the companies seem to pour every technological advance they have into these two premium convertible laptops. With each iteration, one seems to challenge the other, "can you top this?"

VIDEO: **DELL XPS 13 2-IN-1 VS. HP SPECTRE X360 13T**
Watch now at go.pcworld.com/d13

IMAGE: GORDON MAH UNG

Both companies recently released new models, so it's time to pit Dell's XPS 13 2-in-1 7390 against HP's 5th-gen Spectre x360 13t in an epic battle, which we'll recount blow by blow as we talk specs, features, performance, and more.

Dell (left); HP (right).

SPECS

On specs, both rivals are very similar. Both are based on Intel's new 10nm, 10th-Core i7-1065G7 chip. The RAM is similar, too, with LPDDR4X/3733 in both. The Dell does, however, offer a higher optional maximum of 32GB of LPDDR4X.

Both have 4K screen options, so there's a tie. The technologies differ, though: IPS with the Dell XPS 13 2-in-1, and AMOLED with the HP Spectre x360 13t.

The only internal spec that varies is storage. Our XPS 13 2-in-1 7390 features a Kioxia BG4 TLC SSD NVMe PCIe drive. If you've never heard of Kioxia, it's just the new name for Toshiba. Our Spectre x360 13t featured an Intel Optane H10 drive, an option sold at Best Buy at the 512GB capacity. Both laptops offer larger capacities on their websites, but the Dell stops at 1TB, while HP offers up to a 2TB NVMe PCIe drive.

You can argue the merits of the technologies and the capacities, but we're going to declare this a tie, as each has specs the other doesn't offer.

Winner: Tie

STORAGE

There's more to the storage story on these laptops, what you might call two schools of thought, so we're giving it a dedicated category.

Dell's storage philosophy with the XPS 13 2-in-1 suggests that consumers are willing to think of their laptops as phones. Because 99 percent of users never replace SSDs, Dell solders it in place and takes the dividends to make the laptop thinner and smaller. Indeed, between the two laptops, the Dell is thinner by about 1.5mm to 2mm.

HP, on the other hand, sticks with the tried-and-true M.2 standard for storage, though it's not meant to be upgraded by

the consumer.

Which is right? Again, Dell (and others who do the same, such as Apple) aren't doing it to anger you. They're taking that space from the M.2 slot and using it for, say, better cooling, or shrinking the motherboard.

We, however, like to think long-term. While 512GB seems like more than anyone will ever need today, in three years when you pick up a 4TB SSD for $25 on Black Friday, you (or some authorized person) can crack open the Spectre x360 13t and replace the 512GB one that the HP came with. Dell's SSD will be there for eternity.

We should also mention that the Intel Optane hybrid drive option is available only on the HP. There are times when Intel's fancy new storage is a huge advantage, and times when it doesn't help—you can read more on that here in our Optane H10 review (go.pcworld.com/oh10).

We suspect the Optane hybrid SSD greatly contributes to just how crazy-fast the HP is at booting. You can see this captured on slow-motion film in the video attached to this story. Note: Our video was shot at a high frame rate, so it'll appear these laptops are cold-booting slowly. In real time, the HP boots in about 8 seconds, while the Dell boots in about 13. The HP is so fast, it gets to the desktop using Windows Hello facial recognition before the Dell even hits the login screen prompt.

Both laptops include microSD slots, which let you add cheap 1TB memory cards for additional storage. We tested both and found the card readers performed about the same, with read speeds in the 77MB range and write speeds in the 70MB range.

Winner: HP Spectre x360 13t

SIZE AND WEIGHT

Both laptops are pretty darn close in size. While it's a little difficult to tell from the perspective in the picture above, the Spectre x360 13t is basically about a half-inch wider, while the XPS 13 2-in-1 is about a half-inch

The Spectre x360 13t is slightly wider, while the XPS 13 2-in-1 is slightly deeper. That's no surprise as the Dell has a 16:10 aspect ratio, while the HP's screen is 16:9.

deeper. In weight, our postal scale put the Spectre x360 13t in front at 2.7 pounds without AC, with the XPS 13 2-in-1 slightly heavier at 2.9 pounds without AC. Adding power bricks and pens for both, the gap basically vanishes, as both the Spectre and XPS 13 end up at about 3.4 pounds, with the Spectre only an ounce lighter.

The reason? Dell runs the XPS 13 2-in-1 off of a smaller 45-watt PSU, while the Spectre comes with a larger, heavier 65-watt PSU. Overall, once both laptops are in your shoulder bag, it's a wash.

Winner: Tie

CHARGERS

Both laptops come with very small, USB-PD spec power bricks. The Dell's is smaller and lighter and puts out less power at just 45 watts, but it features a nifty LED at the end of the cable. While the LED doesn't indicate the charge condition of the laptop like Apple's older Magsafe bricks, the LED does confirm it's plugged in properly, so you don't wake up to a dead laptop. The HP lacks the LED, but its cable features a classy cloth braid, and it puts out 65 watts, or 45 percent more power output, than the Dell.

We had no issues with interoperabiilty. Both laptops charged off OEM USB-PD chargers from Dell, HP, and Apple, as well as a third-party Delta USB-C charger.

The only problem for the Dell is that tiny 45-watt charger. With brightness cranked and as decent load on the GPU or the CPU, we found it often consumed right up to the limits of the brick. Dell did its homework, and the laptop did not use so much power that it discharged the battery. However, performance will occasionally suffer as the laptop prioritizes either charging the dead battery or running the CPU hard. Dell lets you mitigate this by changing the charge priority, but on auto we found performance dipped when the battery capacity was under about 20 percent.

We also looked at the charge rates of both by discharging both to zero, then tasking

The HP's (left) power brick is 65 watts and features braided cabling. The Dell's (right) is smaller and puts out only 45 watts. It does have a cool LED indicator top to let you know it's actually plugged in.

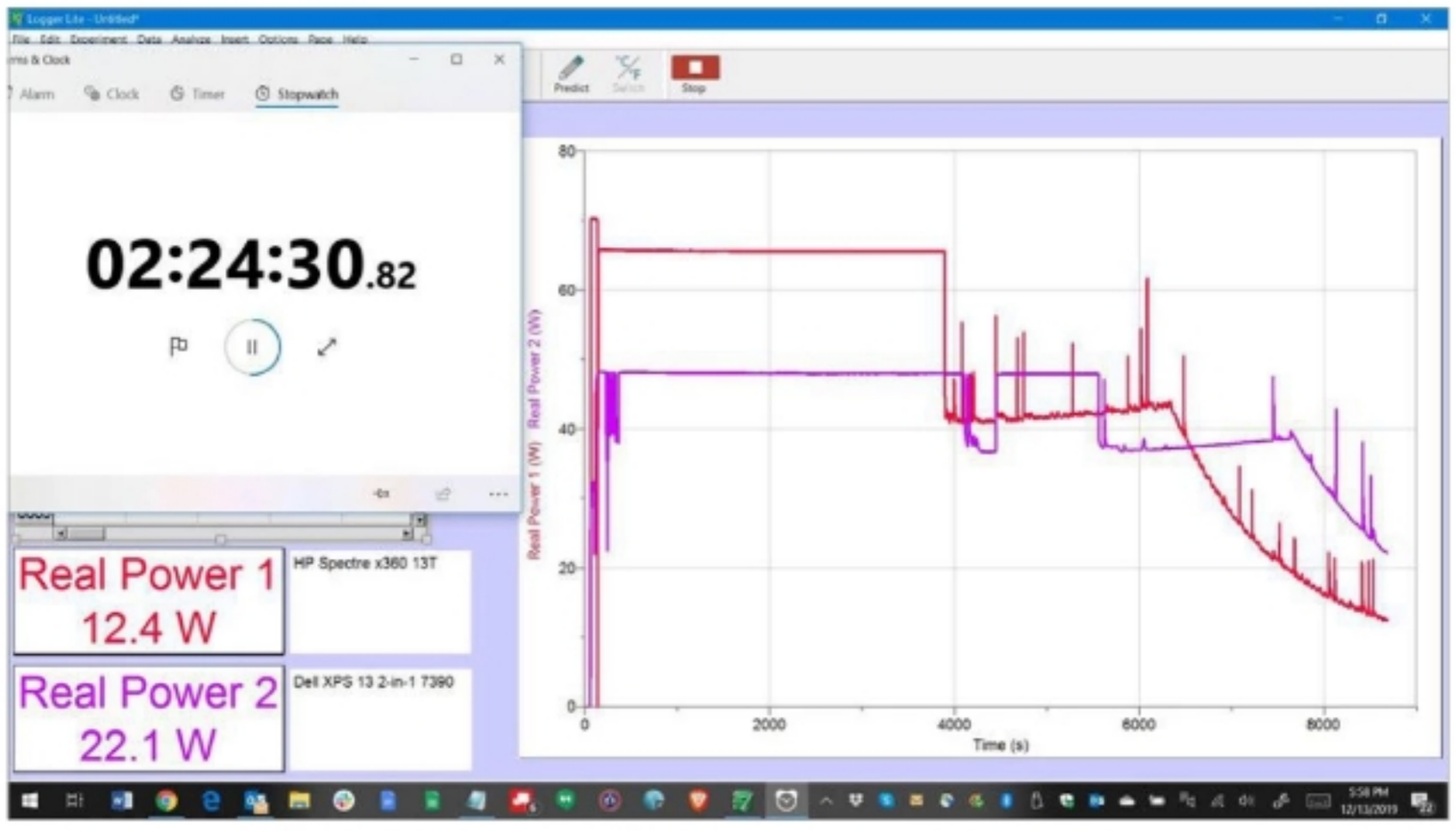
each with an hour-long encode before letting the laptops continue charging, with the systems idling at the desktop.

To show the disparity between brick sizes, we recorded power consumed at the wall using a pair of watt meters.

In the graphic belong, you can see the HP's power output in red and the Dell's in purple. The HP used 65 watts until HandBrake completed and then dropped down to about 45 watts as it continued to charge quickly. Once the battery was filled beyond 90 percent, the charge rate gradually tapered off.

With its smaller brick, the Dell ran at a maximum of 48 watts and then dropped off once Handbrake was done. It continued to charge harder until it also reached above 90 percent, where it tapered off to preserve battery longevity.

Based on our test, the HP has a big advantage in charge rates and performance with a dead battery, but it comes at the cost of a little more weight. The Dell is at a disadvantage, but still charges up reasonably fast despite the smaller brick. In the end, you get a lighter brick as well. One last word: The Dell's charging system does support using a larger power brick, and with the HP's USB-C in place used up to 65 watts.



The HP's larger 65-watt power brick let it run and charge faster than the Dell's 45-watt brick. Beyond about 20 percent though, the Dell's performance lead comes back, and it charges to 93 percent in about 2.5 hours.

While we'd prefer a more powerful brick, we understand that this probably isn't something most people would prioritize above having less weight in their bag. We'll just call it a tie.

Winner: Tie

PORTS

This one is fairly easy. The Dell XPS 13 2-in-1 offers two Thunderbolt 3 ports, a microSD slot and a combo headset jack. The HP also offers two Thunderbolt 3 ports, a microSD slot and a combo headset jack. The thing that pushes it over to the HP is the inclusion of a USB Type-A port. You know, the good old rectangular slot you can't live without.

The newest HP Spectre x360 13t (top) features a USB Type-A port using a drop-down latch. The Dell XPS 13 2-in-1 7390 (middle), throws USB Type A under the bus. On the bottom is an older Spectre x 360 13t with the fully exposed USB Type-A port.

Sure, Dell gives you a dongle, and it has Thunderbolt 3 ports on both sides (which means you can charge from either side), but we can't quit USB Type-A just yet. We know what it's like to be on the road and have to go dongle-begging from others just to access a USB memory stick.

DISPLAY

The Dell's 13.4-inch Sharp SHP14AF IPS panel is simply spectacular. It puts out a blazing 550 nits, and text is perfectly crisp. The display also includes EyeSafe technology (go.pcworld.com/isfe), which purports to lower sleep-stealing blue light emissions without making it look like you just put on a pair of brown-tinted sunglasses.

The Spectre x360 13t's panel is a very good 13.3-inch AU Optronics "IPS-like" panel that can use as little as 1 watt under many conditions. Its maximum brightness is a good 350 nits. Overall, however, it's just not quite as lovely as the Dell's.

The other point in Dell's column is the use of a 1920x1200 resolution, which results in an aspect ratio of 16:10. That makes it slightly taller than the 16:9 displays used in most other 13-inch laptops, and better for actual work with open windows.

While the Spectre's panel is fine and commendably power-efficient, panel aficionados will prefer the Sharp screen in the Dell.

Winner: Dell XPS 13 2-in-1 7390

KEYBOARD AND TRACKPAD

Keyboards and trackpads are truly personal experiences for most people, so it's always a little difficult to pass judgment. We will say that Dell's decision to go with a low-travel "Maglev 2" keyboard continues to be polarizing. Certainly not as polarizing as Apple's unreliable and now-abandoned Butterfly series of keyboards, but it's not what you're used to.

The Maglev 2 uses magnets to repel the keys, which just sounds louder. When everyone in the conference room gives you

We prefer the "full" travel of the HP Spectre x360 13t's keyboard (right) to the loud, low-travel, MagLev 2 "I'M TYPING AN ANGRY LETTER TO MY SENATOR!" keyboard of the Dell (left).

the stinkeye because it sounds like you're firing off an angry email to your cable company, you just might have a problem.

The HP's keyboard, meanwhile, offers the experience everyone is used to and has come to expect. Let's just say we prefer the luxurious 1.4mm travel of the HP over the 0.7mm of the Dell.

The other aspect is the trackpad. Although the HP features a good experience, we prefer the glass-smooth Dell trackpad. The Dell's is also centered closer to the Y key, instead of centered on the U key like the HP. That puts less of your palm on the trackpad during use.

In the end, the keyboard matters more than the trackpad, so we're giving this one to the HP.

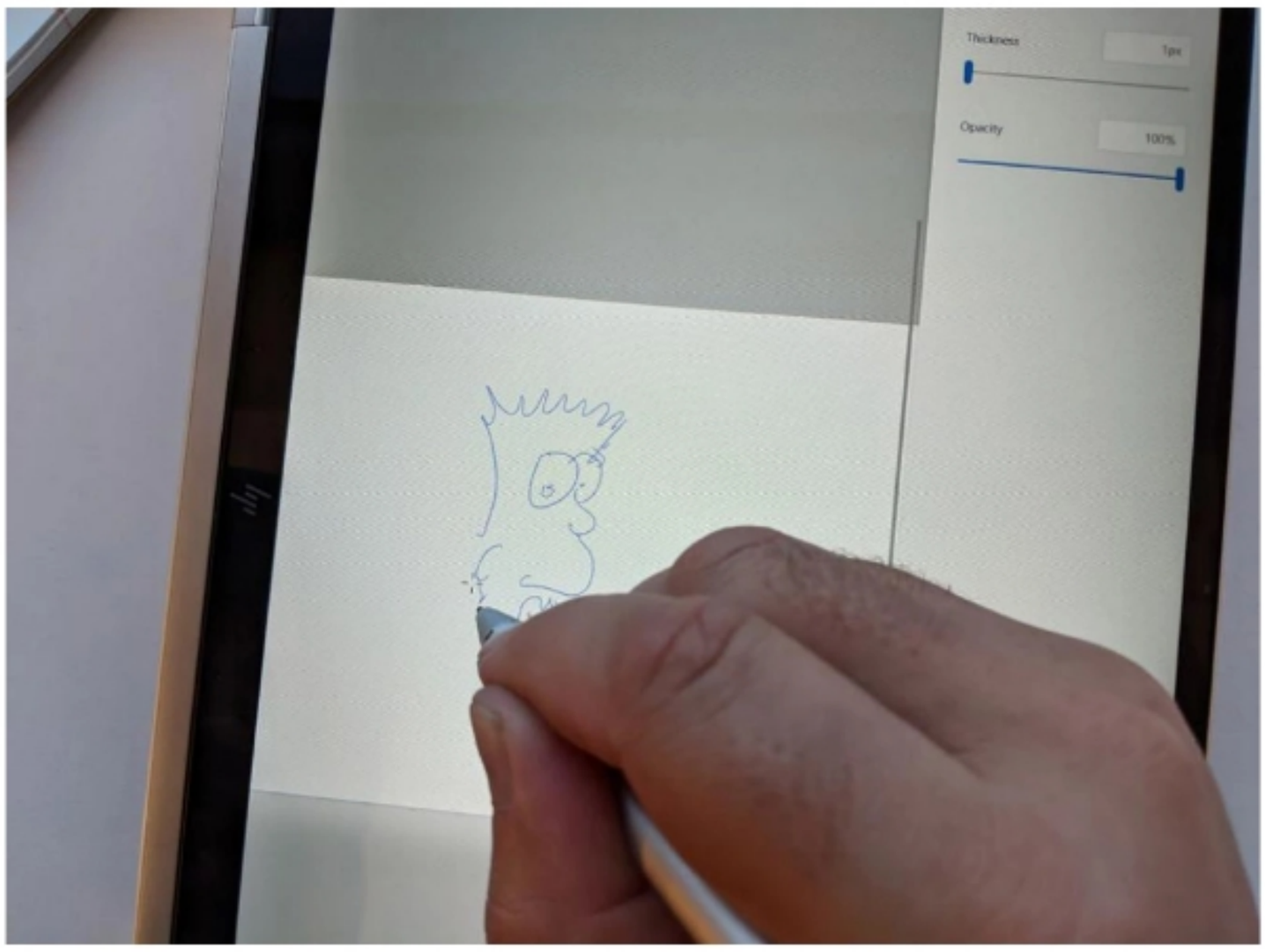
Winner: HP Spectre x360 13t

PEN SUPPORT

Laptop vendors seem to switch laptop pen technology constantly, and that doesn't change here. The current XPS 13 2-in-1 features Wacom Active ES 2.0 technology, while the current Spectre x360 13t features Microsoft's N-trig. We compared Dell's Premium Active Pen PN579X (which is an extra-cost option) vs. HP's included base-level Pen.

Which is better? We asked *Macworld* associate editor and pen aficionado Leif Johnson (go.pcworld.com/lfjn) to rate them. He gave the Dell's Wacom AES pen and digitizer the edge in use, even though it occasionally misregistered during a fine-dotting technique test. The HP didn't miss any dots, but its latency and "pen feel" put it just a step behind the Dell. And if you had to pry Johnson's precious iPad Pencil 2 out of his hands, he said he would reach for Dell's Wacom system.

Over? Not necessarily. Note that the Dell Premium Active Pen is optional and $100, while the HP Pen is included. Even if the Dell pen supports both MPP and AES pen



Macworld's **pen expert Leif Johnson thought precision dotting on the 5th-gen Spectre x360 13t was better than the Dell XPS 13 2-in-1's, but overall responsiveness went to the Dell.**

protocols (which is nice if you want to move it between, say, a Microsoft Surface and the XPS 13 2-in-1), it's still an extra cost. So somewhat better vs. "comes free with the laptop" likely neutralizes it for most consumer use, which will largely involve signing documents and playing Hangperson during boss meetings.

Winner: Tie

BATTERY LIFE

The Dell XPS 13 2-in-1 features a 51-watt-hour battery. In our video rundown test in airplane mode with ear buds, it cranks out a very respectable run time of 707 minutes, or just under 10 hours.

The HP, with its power-efficient "1-watt" panel and larger 61-watt-hour battery, takes it out to 969 minutes, or almost 4 more hours of video run time over the Dell. The HP's battery life is basically annoyingly long—for reviewers who need to run it all the way down to finish their testing.

We kind of wished Dell had integrated a larger battery, but maybe it chose to use that space for more cooling instead.

Winner: HP Spectre x360 13t

PERFORMANCE

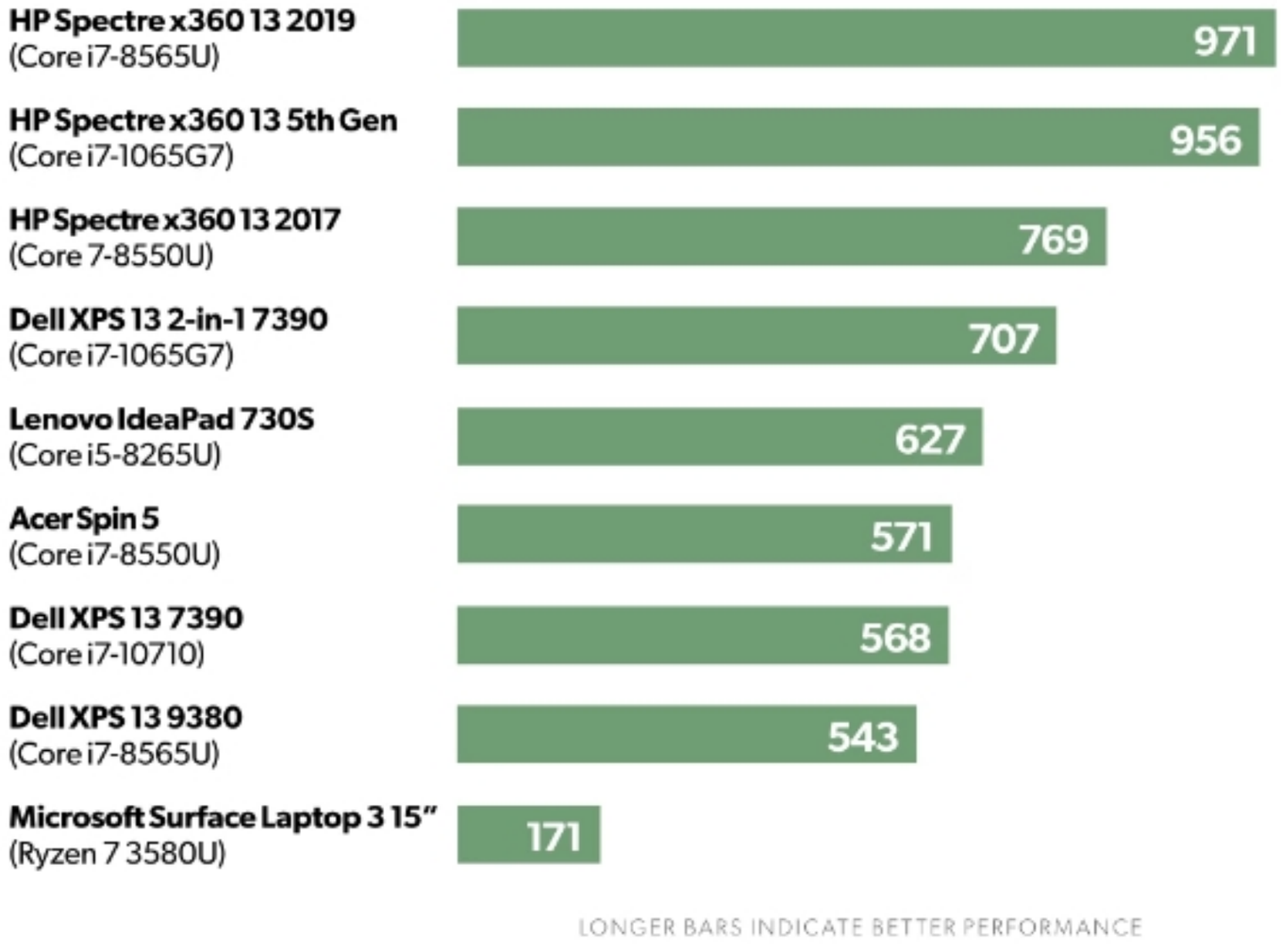
Some have argued that performance doesn't matter as much on small laptops. It's a fair point, given that pushing Outlook, Chrome, and PowerPoint is basically the same experience on any premium laptop.

Still, when push comes to shove, you want to know that the money you paid for your Core i7 is actually getting you Core i7 performance. In that case, the winner most of the time is the XPS 13 2-in-1 7390. There are times when the Spectre x360 13t comes pretty close, but the edge goes to the Dell, which pushes its 10th-gen Core i7-1065G7 far harder.

How much harder? We recorded the clock speed, temperature, and TDP of each

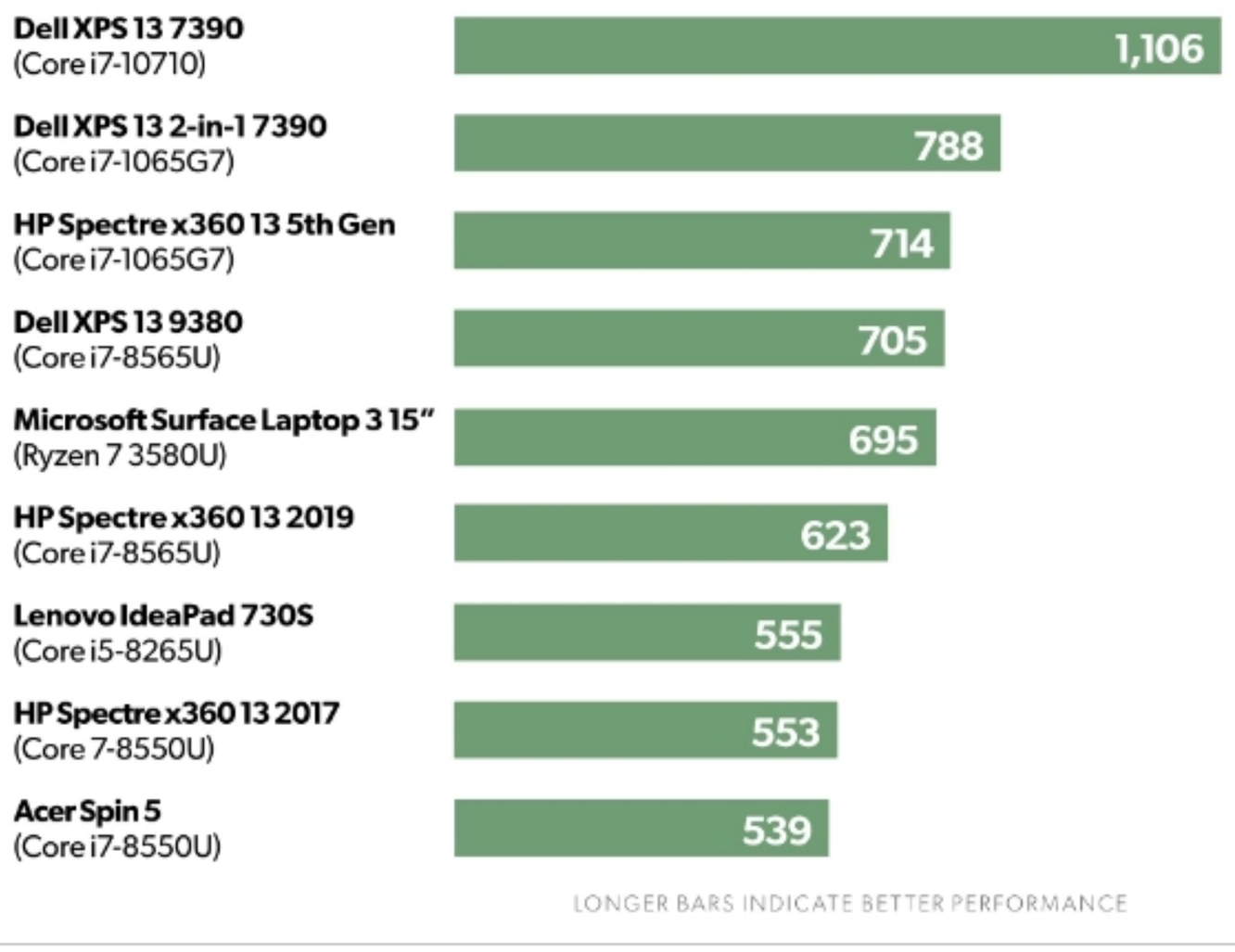
4k Video Playback Battery Life

(Minutes)



Cinebench R15.038

(Multi-core performance)

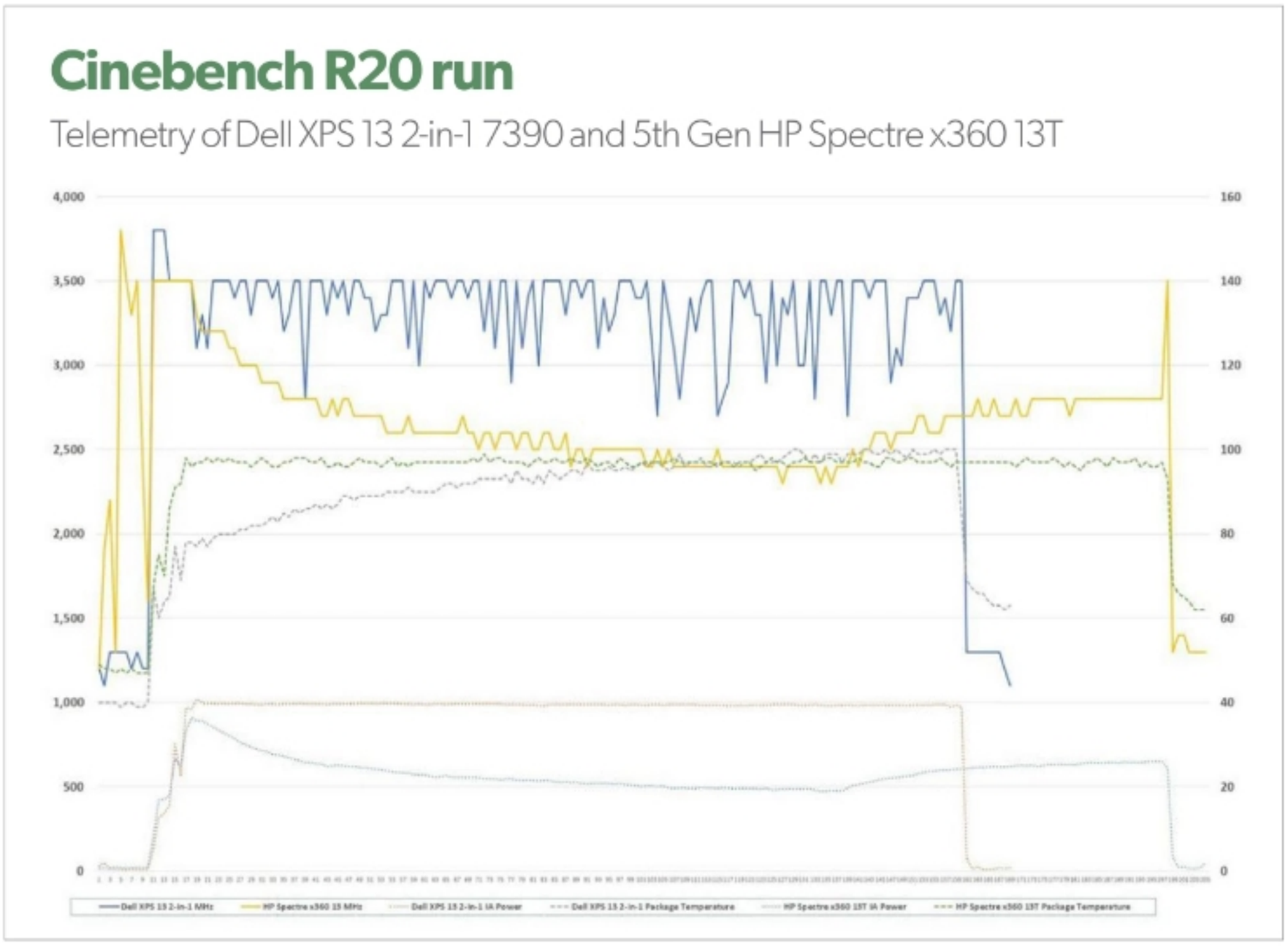


Battery life on the HP Spectre x360 13T clocks in an impressive 16 hours or run time. You can thank the larger battery and "1 watt" screen.

laptops during a Cinebench R20 run, each set to their performance setting.

You can see the solid blue line of the Dell constantly pushing up to 3.5GHz as much as possible. The HP, meanwhile, maintains a solid, consistent clock speed—albeit lower than the Dell's. Basically, the Dell takes the "15-watt" CPU and pushes it to 46 watts most of the time, while the HP is more conservative at 28 watts to 35 watts (although it will boost

The Dell XPS 13 2-in-1 and its aggressive profiles makes it the fastest quad-core ultra portable laptop in town most of the time.



We recorded the vitals of both laptops during a Cinebench R20 run and it's clear Dell is far more aggressive with its clock speeds.

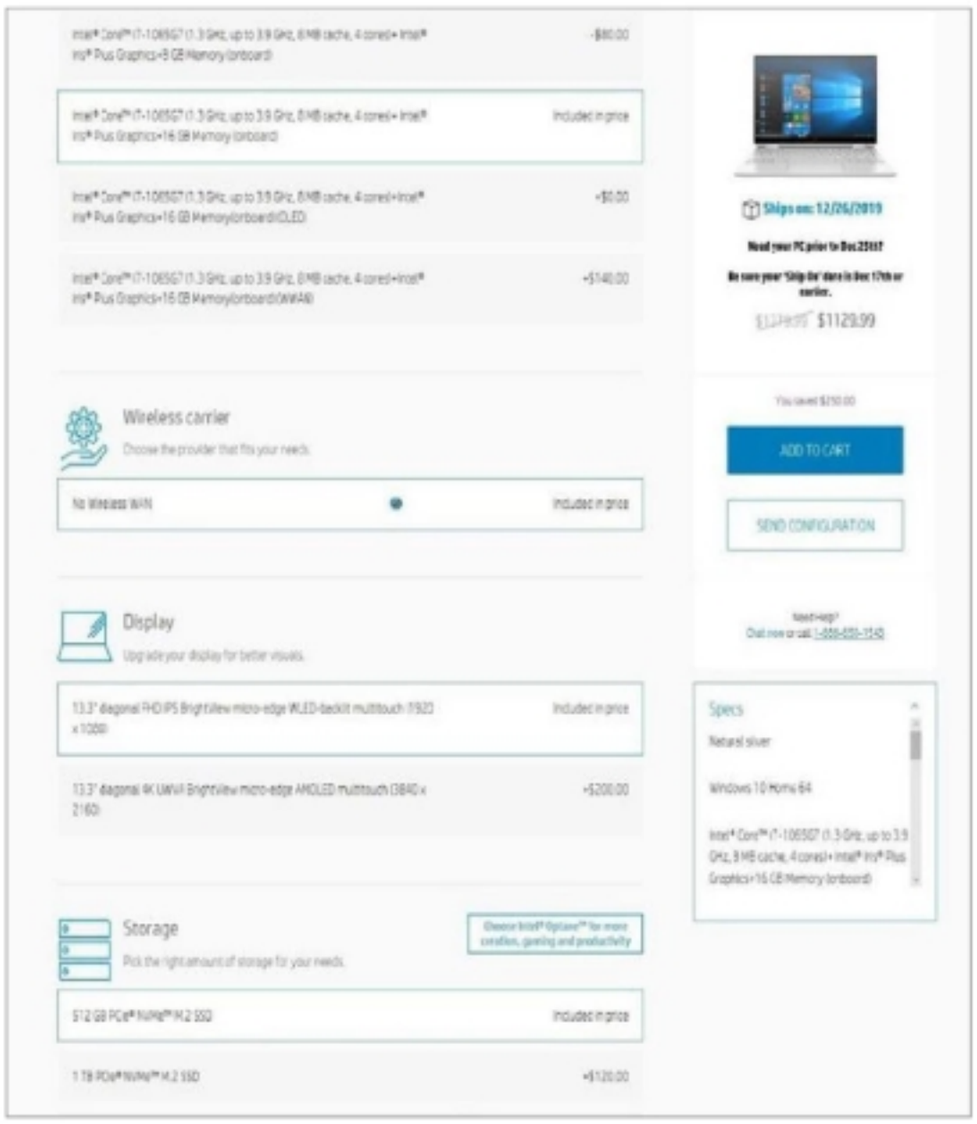
to 51 watts briefly).

The Dell is plain faster most of the time. There is a cost, though: The Dell was far quicker in triggering its fans, while the HP tried to keep the fans silent longer.

The other bill for all this performance is thermals at the keyboard deck. Below you can see a thermal image of both laptops after running the CPU near 100 percent for 40 minutes. The Dell's keyboard temps on the left are definitely toasty compared to the HP's on the right. HP also says its newest Spectre features small air inlets below some of the keys to allow cool air to be sucked in from the keyboard and exhausted out the back. We suspect they may have contributed to the cooler keyboard on the HP as well.

All of this performance testing is on AC, which is how most people will use their

The Dell XPS 13 2-in-1 7390 pushes harder when set to performance but that also means a higher keyboard deck temperature over the 5th gen HP Spectre x360 13T when also set to its performance mode.



The Spectre x360 13T's value is impressive.

laptops during intensive modes. When running off of the battery, both laptops significantly throttle performance, by about 50 percent.. It actually ends up being a tie when running on battery between the two.

In the end, we have to give it to the Dell for this category because in a drag race, the first one across the finish line wins. By a huge margin? No, but there can be only one winner here.

Winner: Dell XPS 13 2-in-1 7390

VALUE

To compare prices, we configured the XPS 13 2-in-1 7390 and a Spectre x360 13t with a 10th-gen Core i7-1065G7, 16GB of LPDDR4X/3733, 512GB SSD, Windows 10 Home, and standard-res screens (1920x1080 for the HP, and 1920x1200 for the Dell.) The Dell had a list price of $1,699 and was on sale for $1,599 in early December when we priced it out. The HP had a list price of $1,379 and was on sale for $1,129. When you remember that HP bundles an active pen and a leather carrying case, the easy winner is the HP Spectre x360 13t.

Winner: HP Spectre x360 13t

BOTTOM LINE

We tallied up the wins, losses and ties, and we can only conclude the overall winner to be the HP Spectre x360 13t. The Dell XPS 13 2-in-1 gets some very critical wins in display quality and performance, so if those are your priorities, go ahead and pick the Dell. But big-picture, the wins in storage, ports, keyboard, battery life, and value easily push the HP to the front for us.

Winner: HP Spectre x360 13t

Bottom of Dell's XPS 13 2-in-1 7390 (left) and HP's Spectre x360 13T (right.)

HP Pavilion x360 14m-dh0003dx: A sturdy 2-in-1 with dependable quad-core performance

This sleek convertible laptop has what it takes in terms of day-to-day performance, although we wish it had a bigger battery. **BY BEN PATTERSON**

The HP Pavilion x360 14 2-in-1 laptop comes in many flavors, and ours (14m-dh0003dx) should please productivity-minded professionals with its smooth quad-core performance and a keyboard that feels great. Given that it's $700 from Best Buy (go.pcworld.com/pvbb) before discounts (though we've recently spotted it for just $560), we would have liked a bit more battery life, though.

CONFIGURATION

HP offers a dizzying array of Pavilion x360 models in 11-, 14-, and 15-inch sizes, with the 14-inch configurations ranging from 8th-gen

IMAGE: BEN PATTERSON

dual-core Intel Core i3 systems up to 10th-gen Core i7 quad-core Comet Lake CPUs. Here's what's under the hood of our middle-of-the-road 14-inch Pavilion x360 14m-dh0003dx):

CPU: Quad-core Intel Core i5-8265U

RAM: 8GB DDR4

GPU: Integrated Intel UHD Graphics 620

Display: 14-inch 1920 x 1080 IPS touchscreen

Storage: 128GB SSD

At first blush, we've got the makings of a solid productivity workhorse here, with a quad-core Core i5 Whiskey Lake CPU that should be able to breeze through most daily computing and Office tasks and tackle some CPU-intensive tasks, such as video processing and database work. The 8GB of RAM, typical for a laptop in this price range, should help smooth out multitasking kinks (although 16GB of RAM would be even better), and the full-HD IPS touchscreen should offer reasonably sharp resolution with solid viewing angles.

The 128GB solid-state drive is on the small side, however, leaving you with only about 90GB of storage once Windows, Office, and other miscellaneous apps and utilities are accounted for. Given the cramped SSD, you'd probably want to lean on cloud storage or an external drive.

A similar Pavilion x360 14 is officially $900 on HP.com (go.pcworld.com/14dh) with 12GB of RAM and a 256GB SSD, but only $590 with discounts as of press time.

DESIGN

HP has been adding more and more snazzy design elements to its Pavilion x360 series. This particular 2-in-1 bears many of those hallmarks, particularly the "hourglass" edges that allow you to open the Pavilion from the front, left, or right sides, as well as the shiny aluminum trim and the matte lid stamped with the HP logo.

The 14-inch, 16:9 "micro-edge" display does indeed have reasonably thin bezels along the top and sides, although the bottom bezel is pretty chunky. Below the hinges sits an attractive, diamond-cut grille for the Bang & Olufsen speakers (more on them in a moment), along with the silver-colored palm rest and keyboard. An understated Pavilion

The HP Pavilion x360 boasts a sleek profile and a nifty "hourglass" edge.

As a 2-in-1 laptop, the HP Pavilion x360's lid can bend all the way around, perfect for tablet use or for tenting on a desktop.

logo sits near the bottom-left edge of the keyboard.

As a 2-in-1 system, the Pavilion x360's lid can swivel all the way around for tablet use. You can also tent the laptop on a desk, or place it keyboard-down with the display tilted back in kiosk mode. The Pavilion x360's reassuringly sturdy hinges did a solid job of keeping the lid in place, although the stiff motion of the lid means that opening the laptop requires a fair amount of effort.

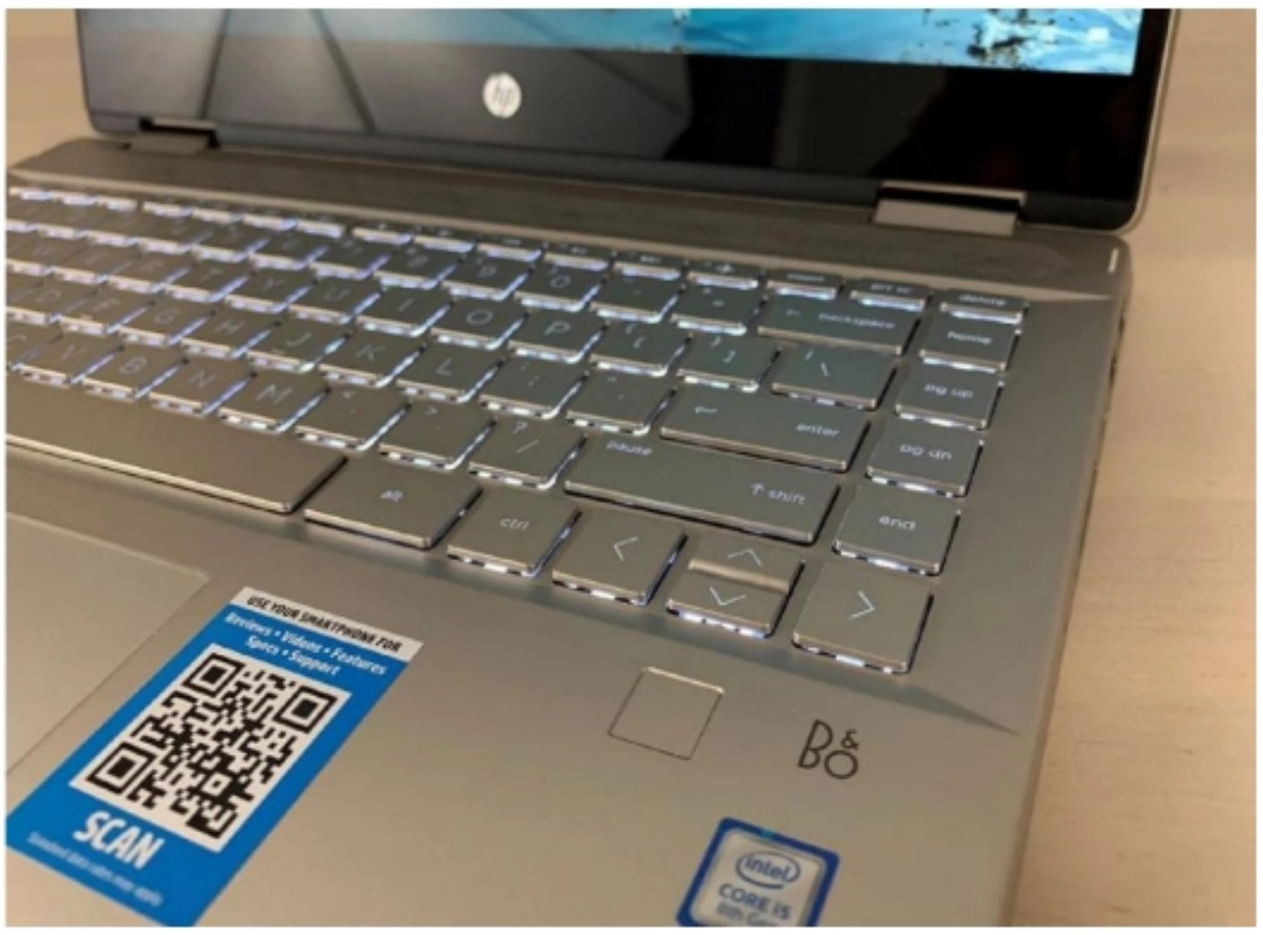
One design element I didn't love on the Pavilion x360 was the power button on the left edge of the laptop, near the middle. More than once, I accidentally put the Pavilion to sleep by inadvertently pressing the button as I was moving the laptop on my desk. A smarter move would have been to position the button farther away from the middle—or, better yet, put it just above the keyboard on the inside, where you're much less likely to press it by accident.

Measuring 12.7 x 8.8 x 0.8 inches, the Pavilion x360 is reasonably thin for a convertible-style laptop. Weighing in at 3.62 pounds (or 4.19 if you include the power brick), the Pavilion feels a bit on the heavy side, and you'll definitely notice the weight when you're toting it around in a backpack.

DISPLAY

The Pavilion's 1920x1080 display looks as sharp and vivid as we'd expect from a full-HD screen. With its IPS (in-plane switching) display technology, the panel boasts impressive viewing angles, dimming only slightly when viewed from the sides, top, or bottom.

The screen is a tiny bit dimmer than we'd like, measuring about 245 nits (or candelas), when our low-water mark for comfortable indoor viewing is 250 nits. Then again, we've seen dimmer displays on laptops in this price range, and I was able to view the Pavilion's display comfortably in my office. Outdoor viewing would likely be a different story.



The HP Pavilion x360's backlit keyboard is a pleasure to type on, with plenty of travel and solid, tactile key caps.

KEYBOARD, TRACKPAD, SPEAKERS, AND EXTRAS

The Pavilion x360's keyboard is a cut above those you typically see in midrange laptops. The square, flat keys feel solid rather than squishy, with a fairly generous amount of travel and a satisfying mid-stroke bump that feels almost clicky. Indeed, I found typing on the Pavilion to be an unexpected pleasure.

The Pavilion's trackpad is a bit on the wide side, which meant that my palms frequently dragged over it while I typed. That wouldn't be a big deal if the trackpad were better at rejecting accidental inputs; alas, the Pavilion's cursor occasionally jittered across the screen as my palm brushed the trackpad, particularly on the right side. The accidental trackpad inputs weren't so bad that they interrupted my work, but they happened enough to be noticeable.

Back on the plus side, the Bang & Olufsen-designed stereo speakers are actually pretty good. We generally expect very little from laptop speakers, but the Pavilion's top-firing drivers actually evinced some subtle detail and even a bit of bass. While I couldn't crank the speakers very loud, at least I didn't notice any distortion when I dialed the volume all the way up.

This particular configuration of the Pavilion x360 comes with a fingerprint reader sitting just beneath the bottom-right corner of the keyboard.

PORTS

The Pavilion x360 has a solid selection of ports given its size and price range. Starting on the left side, there's a USB 3.1 Gen 1 Type-A port (5Gbps), a combo audio jack, and a laptop security slot. Also on the left side is a good-sized cooling vent, along with the aforementioned power button.

On the right side you'll find a media card reader, a USB 3.1 Gen 1 Type-C port, a second USB 3.1 Gen 1 Type-A port, a full HDMI port, and a barrel-shaped charging connector.

There's no ethernet port, but given that Pavilions generally don't have one, that isn't much of a shock.

On its left edge, the HP Pavilion x360 features a USB Type-A port, a combo audio jack, a large cooling vent, and a laptop security slot. Also on the left side: the power button, which makes it a little too easy to press by accident.

Right-side ports include HDMI, USB Type-A, USB-C, and a media card reader.

PERFORMANCE

For our performance charts, we've grouped with HP Pavilion x360 with a mix of laptops, ranging from a 8th-gen, dual-core i3 model to a system with Intel's latest six-core Ice Lake CPU, along with a series of quad-core laptops in the middle. Obviously, that Ice Lake chip is going to dust the Pavilion's less powerful Whiskey Lake CPU in some cases. But as we'll see, the Pavilion gets a few chances to shine even compared to the latest and greatest laptops, particularly when it comes to day-to-day productivity. We'll also see how much of a difference a quad-core CPU makes compared to a dual-core chip like Intel's Core i3.

PCMark 8 Work 2.0 Conventional

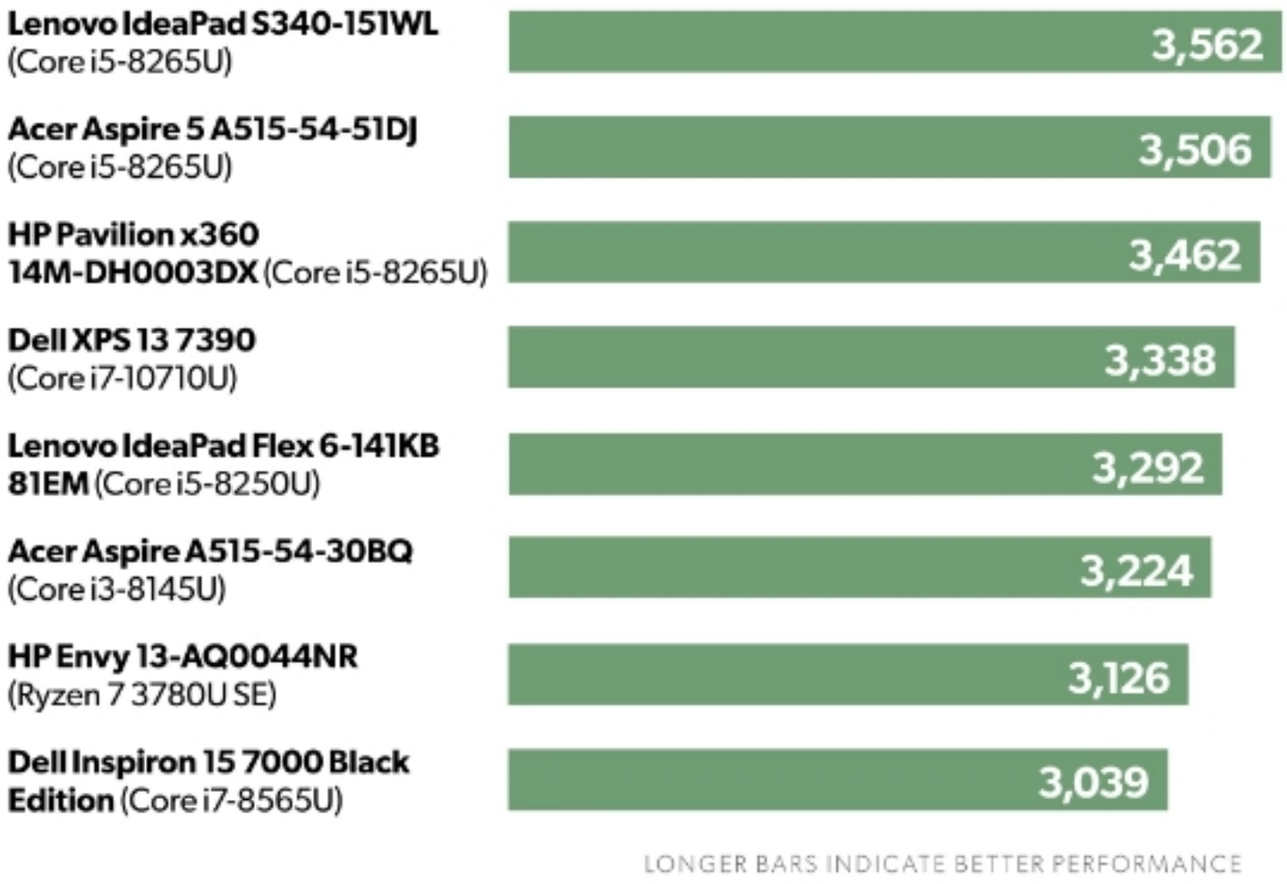
Our first benchmark simulates such daily computing tasks as web browsing, spreadsheet work, video chat, and other common desktop chores. Given that the HP Pavilion x360 should appeal most to productivity mavens, PCMark 8 is a great place to start with our testing. Generally speaking, a PCMark 8 score above 2,000 means you can expect smooth Office performance.

A quick glance at the chart reveals that the Pavilion handled the PCMark 8 benchmark like a champ, and it even edged the Dell XPS 13 7390 with its six-core Ice Lake CPU. To be fair, though, the core count doesn't really matter so much with PCMark 8, which focuses mostly on single-core applications. It's also worth noting that the Dell is much thinner and lighter than the Pavilion, which means it must pump the brakes to keep its slim chassis cool.

In the end, which laptop finished where in our chart really doesn't matter given that they all notched scores north of 3,000. In other words, all of these laptops are great Office machines.

PCMark 8 Work 2.0 Conventional

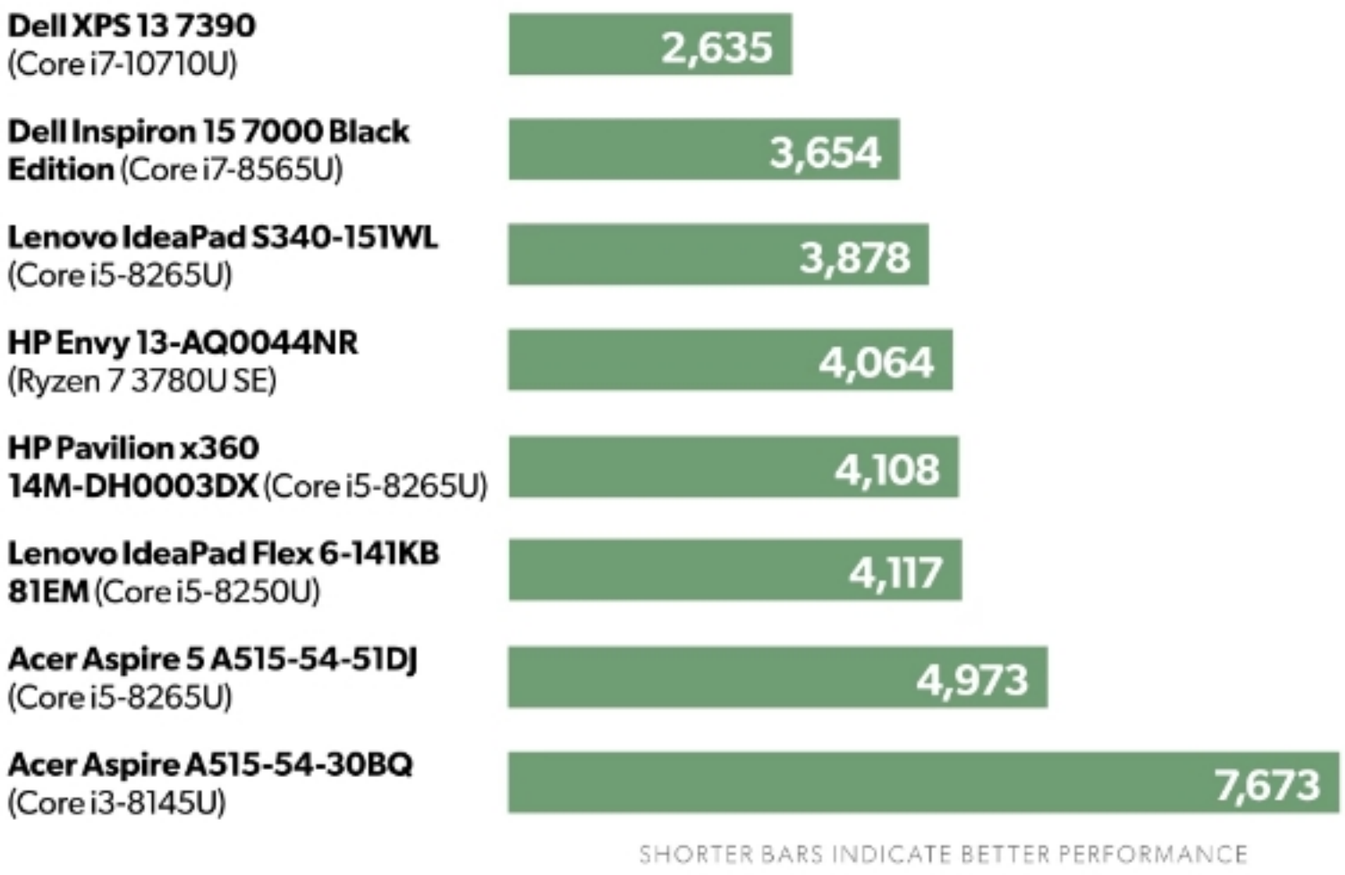
(Native resolution)



With its solid PCMark 8 score, the HP Pavilion x360 should handle day-to-day computing tasks with ease.

HandBrake Total Encode Time

(Seconds)



With its quad-core i5 CPU, the HP Pavilion x360's HandBrake performance sits right where it should, with the six-core Dell XPS 13 at the top of the heap.

HandBrake

A benchmark that involves converting a 30GB MKV file into a format suitable for an Android tablet, our HandBrake test pushes even the beefiest CPUs to their limits. It also tells us a lot about how a given laptop balances cooling and performance over a relatively lengthy period, given that our HandBrake test often takes more than an hour to perform.

Checking our chart, the HP Pavilion x360 lands where we'd expect, right in the mix with other quad-core Core i5 Whiskey Lake laptops. The Pavilion is also neck-and-neck with the HP Envy 13, a Core i7 Whiskey Lake

laptop. That's actually not as surprising as it sounds, as the main difference between the i5 and i7 chips is that the i7 boasts a higher boost clock, an advantage that's most apparent during short, intense bursts of CPU activity.

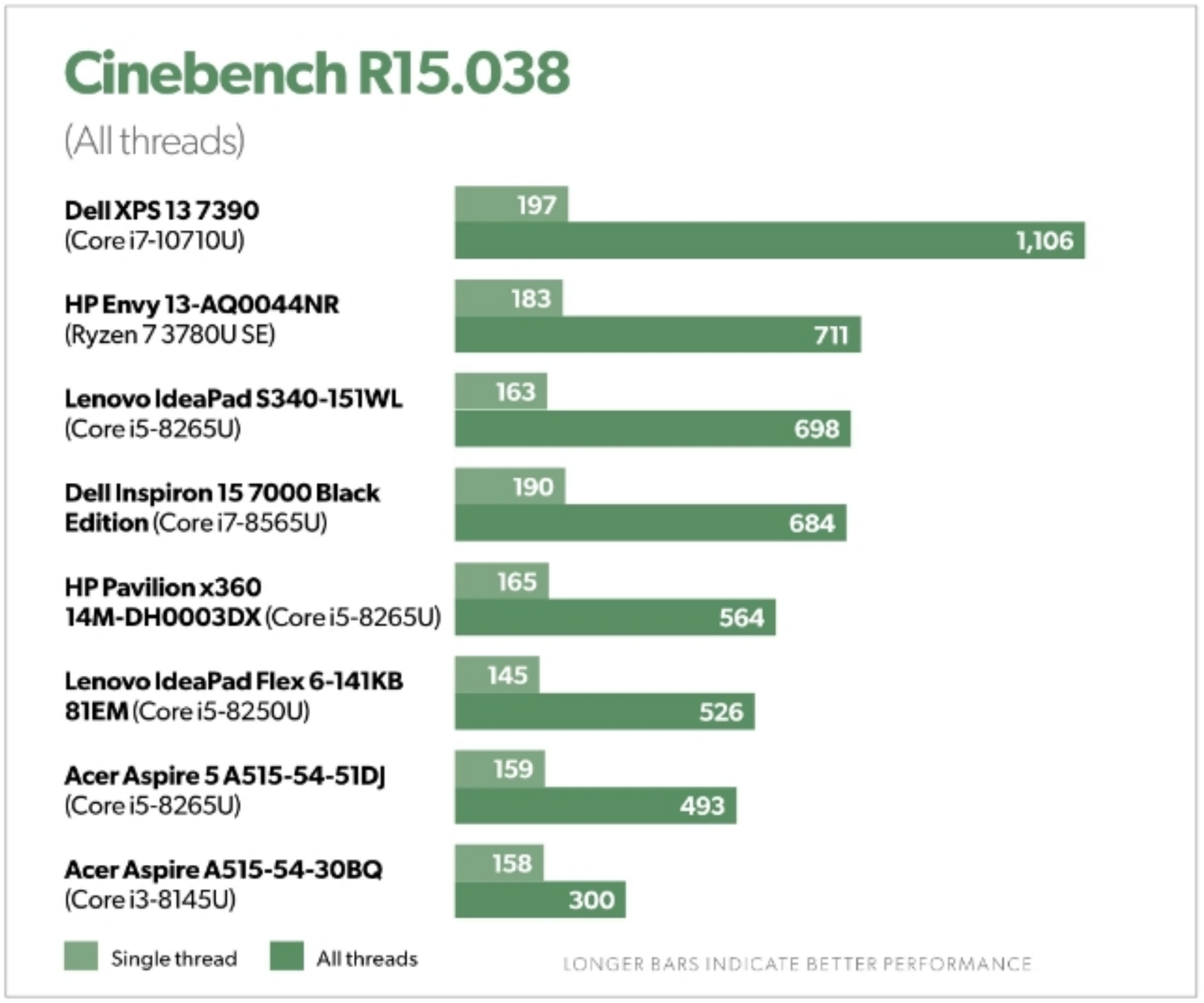
The chart-topping Dell XPS 13 and its Ice Lake CPU illustrate the substantially superior performance of a (far pricier) six-core processor compared to a quad-core system, although you generally don't need that kind of horsepower unless you're dealing with, say, 4K video workflows. On the other end of the spectrum is the dual-core Acer Aspire 5, which lags well behind the pack but does just fine (and for a lot less) when it comes to daily, single-core productivity tasks.

Cinebench

Remember what we said a moment ago about short bursts of CPU activity? That's what our Cinebench test, which involves rendering a 3D image in real time, is all about. Unlike the lengthy HandBrake benchmark, which can take an hour or more, Cinebench is typically all over within five minutes or so.

Once again, the HP Pavilion x360's Cinebench score was bunched up with its fellow i5-packing laptops, albeit nearer to the bottom. The Pavilion's so-so performance can be partly blamed on its 2-in-1 form factor, which is tougher to keep cool than a traditional clamshell laptop is. Still, we should note that the Pavilion x360's all-threads Cinebench score is respectable given its CPU, while its solid single-thread Cinebench result (which is all that matters when it comes to day-to-day computing tasks) brings it up a notch.

Looking at the competition, we see the six-core Ice Lake-powered Dell XPS 13 way ahead of the pack (no surprise there), while



Again, no surprises with the HP Pavilion x360's Cinebench performance. If you consider its single-thread score, the Pavilion actually moves up a notch.

the quad-core HP Envy 13 and its Core i7 CPU gets an expected speed bump thanks to its faster boost clock. At the bottom of the list, once again, is the dual-core but bargain-priced Acer Aspire 5.

3DMark Sky Diver

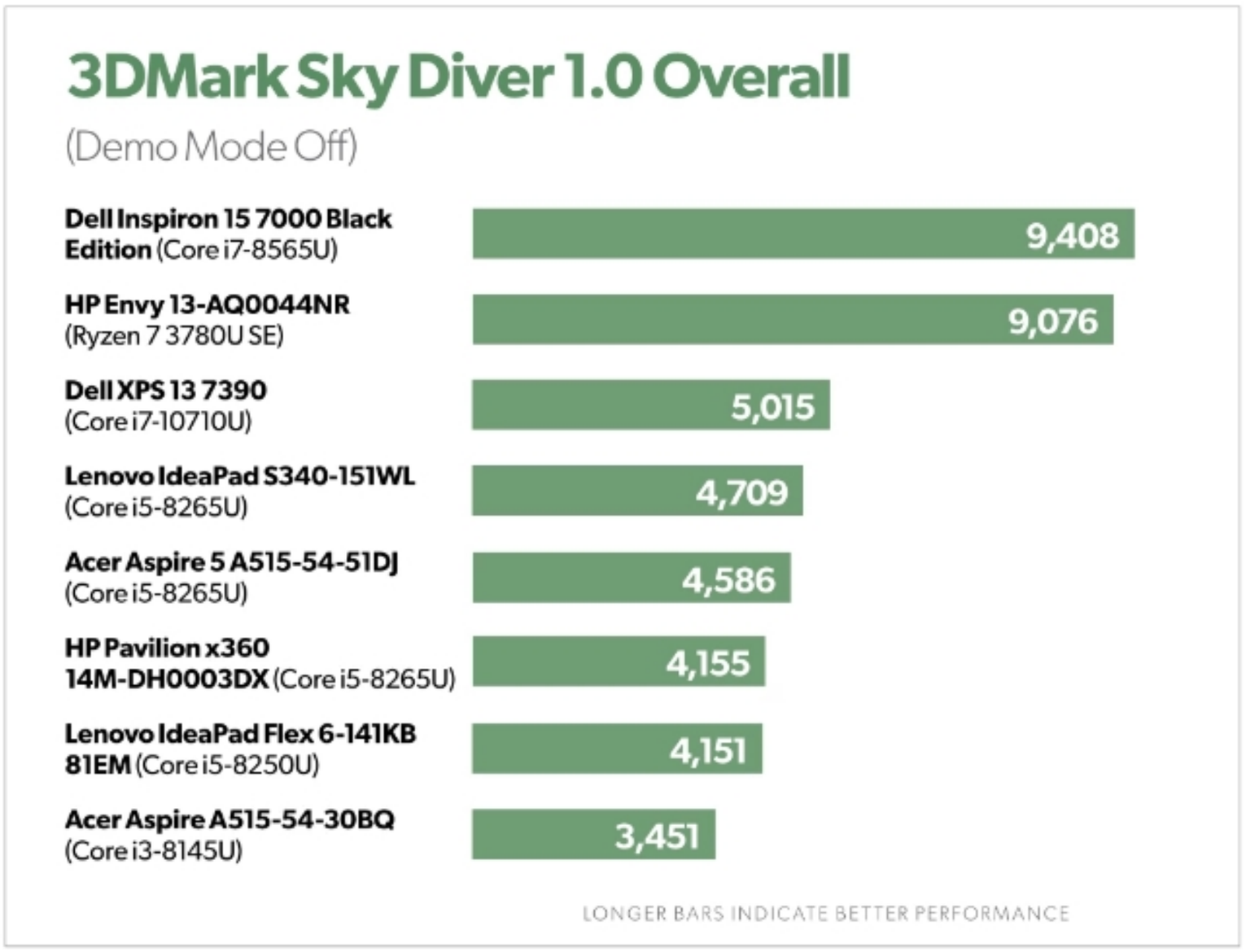
Like many midrange, productivity-minded laptops, the HP Pavilion x360 isn't much of a gaming machine, although its integrated graphics core is designed to deliver enough adequate performance for light photo editing and similar tasks. As a rule, laptops with discrete graphics cards will score much higher in our graphics-oriented 3DMark Sky Diver benchmark, and our results bear that out.

As expected, the HP Pavilion x360 sits right alongside similar laptops with integrated Intel UHD Graphics 620 cores. While it's nearer the back of the pack, you're not going to see any of these integrated graphics systems deliver even close to 30 fps while playing, say, *Fortnite*. For smooth gaming performance, you'd need a laptop with discrete graphics, such as the two laptops at the top of our chart, which both boast entry-level Nvidia GeForce MX250 graphics cards.

Battery life

We test a laptop's battery life by looping a 4K video using the stock Windows Movies & TV app. We set screen brightness set to about 250 nits (which means cranking the brightness all the way up on the HP Pavilion x360) and with the volume set to 50 percent, headphones on.

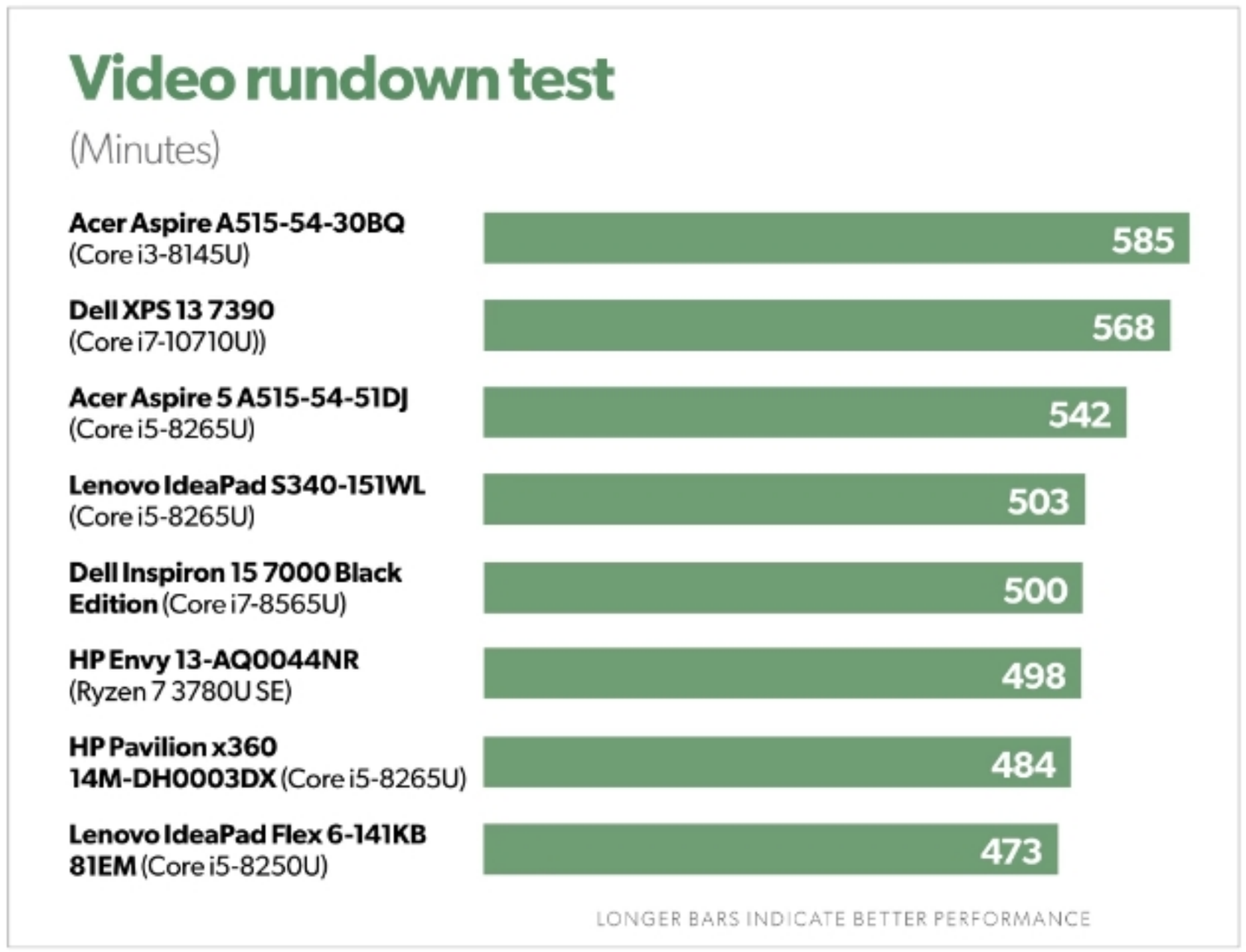
At first glance, the Pavilion's position near the bottom of the chart doesn't look so great, but its 484-minute battery drain result (a sliver over 8 hours) isn't bad considering its



Without discrete graphics, the HP Pavilion x360 isn't much of a gaming machine, but that likely won't matter to productivity-minded users.

40-watt-hour battery, which is the smallest of the bunch. It even beats out that of the 14-inch Lenovo IdeaPad Flex, a 2-in-1 laptop with a larger 48-watt-hour battery.

Still, if you're looking for a system that'll last you more than a long afternoon on battery power (and keep in mind that our eight-hour battery drain result won't hold up if you're doing anything remotely demanding on the Pavilion), you should consider a device with a bigger battery. The relatively low-priced Acer Aspire 5's 48Wh battery managed to last 100 minutes longer during our battery drain test. It's also a good three-quarters of a pound heavier than the Pavilion.



The HP Pavilion's battery life isn't bad considering its smallish battery, but we still wish it had a bigger one.

HP Pavilion x360 14m-dh0003dx t

★★★½☆

PROS
- Solid quad-core performance.
- Sleek, sturdy design.
- Great keyboard.

CONS
- So-so battery life.
- Display is a bit dim.
- Side power button is easy to press by accident.

BOTTOM LINE
This sleek convertible laptop has what it takes in terms of day-to-day performance, but its small battery won't last all day.

$559

BOTTOM LINE

While its battery life and display are mediocre, the HP Pavilion x360 remains a solid, well-built 2-in-1 that will speed you through everyday computing tasks as well as moderately tough video-processing or number-crunching chores. Better still, its comfy keyboard will keep your fingers happy, and the surprisingly decent-sounding speakers will keep you humming. For the price (especially at current discounts), it's a solid deal.

WD SN550 NVMe SSD: Good performance, very good price

An improvement on WD's own SN500 in every way, the SN550 is also only 10 cents per gigabyte in the 1TB capacity. **BY JON L. JACOBI**

WD's new Blue SN550 is a nice improvement on the older SN500 (go.pcworld.com/s500), though it still isn't going to worry the competition with its performance. However, other vendors sure won't be happy that it's 10 cents per gigabyte at the 1TB capacity.

DESIGN AND FEATURES

The WD Blue SN550 is a x4 PCIe 3.0, M.2 NVMe SSD in the 2280 form factor. That is, 22mm wide and 80mm long. The NAND is 96-layer TLC (Triple Layer Cell/3-bit) with an unspecified percentage utilized as SLC (Single Level Cell/1-bit) cache. More on that later.

The 1TB SN550 we tested is $100 on Amazon (10 cents a gigabyte; go.pcworld.com/s1tb), while the 500GB is $70 on Amazon (go.pcworld.com/b500), and the 250GB flavor costs $50 on Amazon (go.pcworld.com/b250). While I didn't find any better deals on a 1TB drive, I did find several cheaper 250GB and 500GB drives, so it's the highest capacity where you'll get the best bang for the buck.

The SN550 carries a five-year warranty and is rated for 600 TBW for every 1TB of capacity. That means you can write 600 terabytes to the 1TB drive before you'll start losing capacity, or things will otherwise go wonky. Note that TBW ratings are estimates, and likely conservative ones at that, formulated with legal and other concerns in mind.

IMAGE: WD

PERFORMANCE

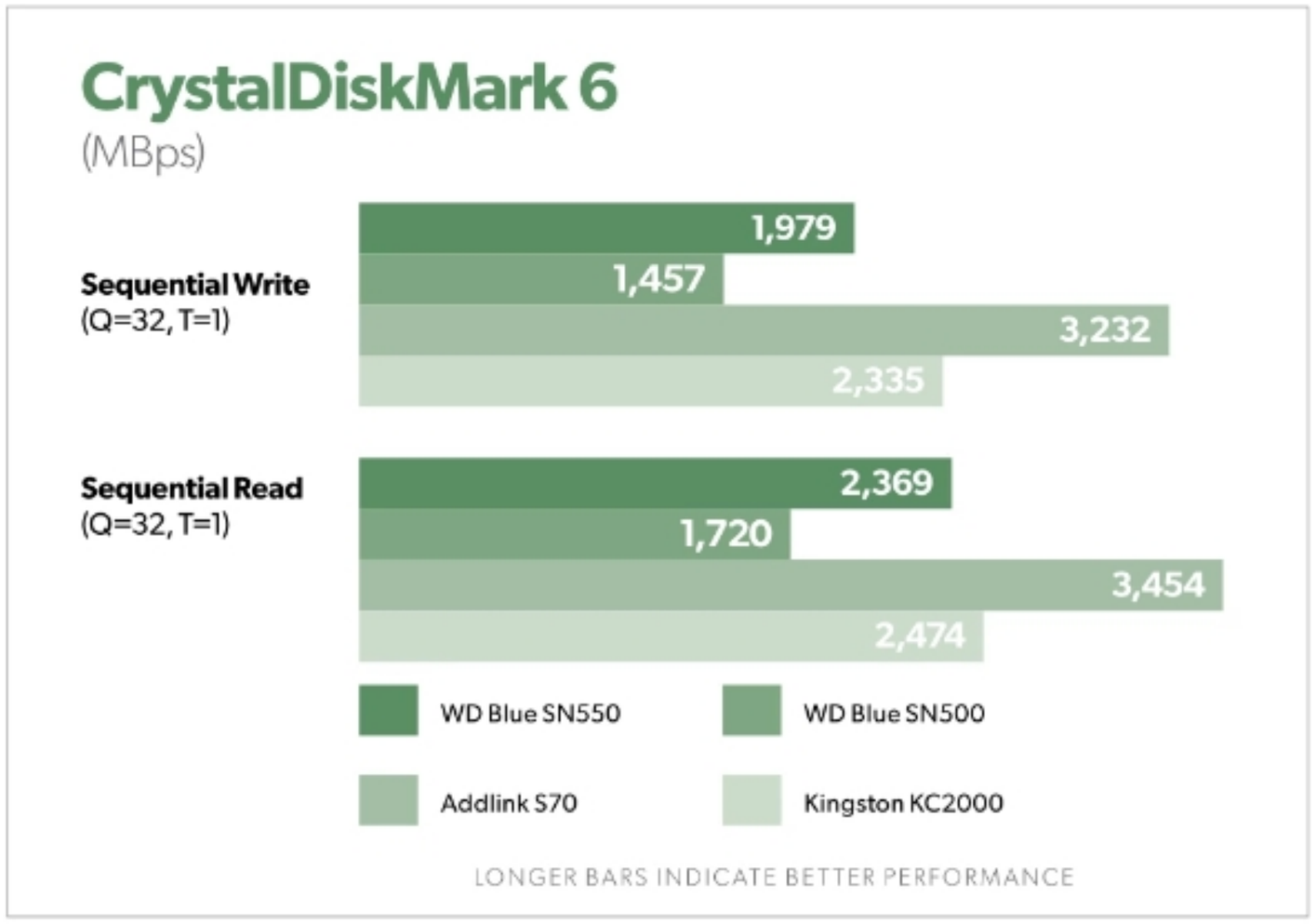
While the 1TB Blue SN550 I tested didn't excel at any one task, it handily outpaced the older SN500 and was competitive with its peers throughout. The synthetic CrystalDiskMark and AS SSD benchmarks rated it as average for its class, as did our 48GB/450GB copy tests.

I've seen TLC-NAND based NVMe SSDs plummet to SATA III speeds during long writes. While the SN550 dipped to 835MBps rather rapidly, that's as low as it went and still what I'd consider decent performance. Better than SATA, at any rate, and considering you'll see 1.75GBps during normal, shorter writes, perfectly livable.

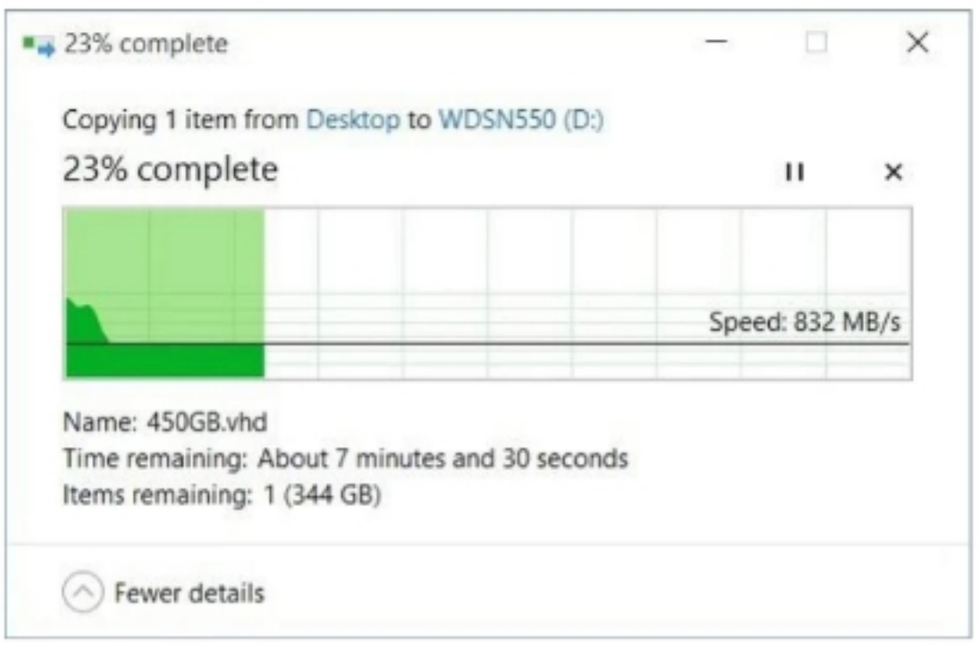
I did not test the 500GB SN550. If WD is assigning secondary cache as a fixed percentage of total capacity, as it seems, the 500GB drive will drop to around 835MBps even sooner than the 15GB mark at which the 1TB capacity slowed.

The 250GB version of the Blue SN550 is rated for a little more than half the write speed (950MBps max), as it has fewer channels for transferring data. It likely has less cache as well, so you will not get nearly the same write performance. Reads, which are not cache-dependent, nor so reliant on multiple channels, will be every bit as fast as the 500GB and 1TB capacities.

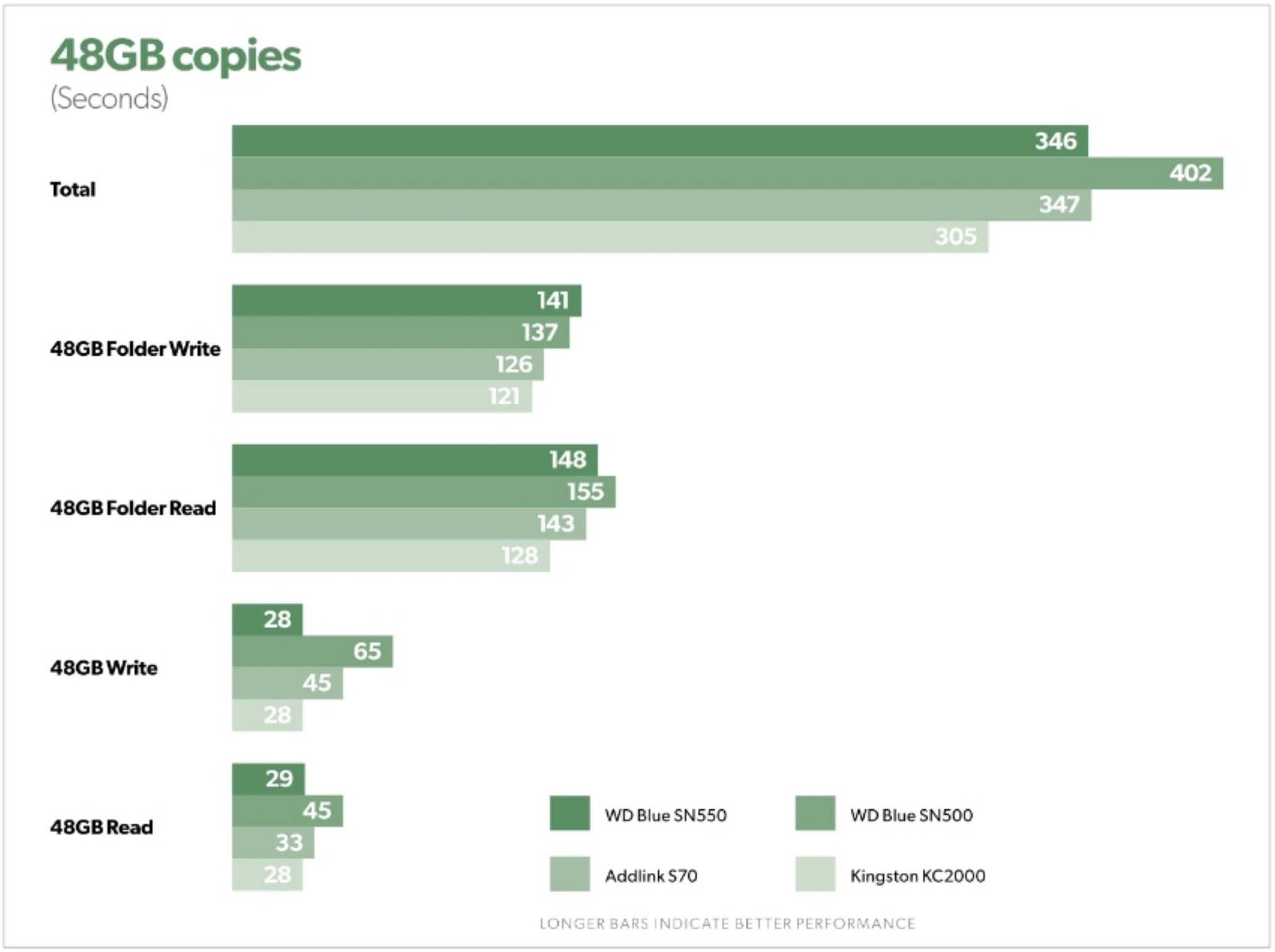
The Kingston KC2000 (go.pcworld.com/kc20) led real-world performance in our



While the Addlink S70 is a standout in this test, this is a very short burst of data and the SN550 bested it in real world copies.



The 1TB SN550 runs out of cache after only 15GB or so, but the sustained 850MBps write speed is still quite good for a budget TLC NVMe drive.



In real-world copies, the SN550 matched the Addlink S70, but was off the pace of the Kingston KC2000.

48GB tests, but the SN550 is a compelling improvement on its predecessor—and considering the price, plenty fast enough.

BOTTOM LINE

The WD Blue SN550's price, and its suitability for the average user, are undeniable. It's definitely one of the top options in the bargain NVMe market and from a trusted brand name. Compare to the Kingston KC2000 and the Addlink S70 (go.pcworld.com/as70).

WD Blue SN550 NVMe M.2 SSD

★★★★☆

PROS

- Extremely affordable at the 1TB capacity.
- Good everyday performance.

CONS

- Drops to 835MBps during long copies.

BOTTOM LINE

A 1TB drive for $100 is easy to like, and we were nearly all smiles with this notable improvement on the Blue SN500. Only the slightly skimpy amount of SLC cache wrinkled our brows. Note that the 250GB capacity maxes out at 950MBps writing, rather than the 1.75GBps at which we clocked the 1TB version.

$124

Sennheiser GSP 370: A wireless headset that lasts for 100 hours—that's all you need to know

Sure, it's kind of ugly—but Sennheiser's new GSP 370 wireless headset sounds great, and it lasts for weeks on a single charge. What else do you need, really? **BY HAYDEN DINGMAN**

PCWorld EDITORS' CHOICE

The battery lasts for 100 hours. That's all Sennheiser needed to say to pique my interest in the GSP 370. Charging various wireless devices is the bane of my existence, and I'm constantly looking for ways to mitigate the problem. Some are creative, like Astro's A50 headset and its unique charging stand (go.pcworld.com/aa50). But I'm all for Sennheiser brute-forcing the

IMAGE: HAYDEN DINGMAN

problem and just cramming a whopping big battery inside.

Whatever gets the job done, right?

BOXCAR RACER

And surprisingly, a whopping big battery doesn't mean a whopping big headset.

Listen, the GSP 370 is by no means small. Sennheiser's gaming headsets tend to be boxy, with more than a hint of the dreaded "Air Traffic Control" silhouette, and the GSP 370 is no exception. But it also isn't noticeably larger than Sennheiser's previous efforts like the GSP 600 (go.pcworld.com/sgsp) we reviewed earlier this year.

Nor is it heavier. Quite the contrary. The GSP 370 is shockingly light, weighing in at a mere 0.62 pound. That's less than both the Astro A50 and Logitech G Pro X (go.pcworld.com/gprx), which weigh in at 0.83 and 0.70 pound, respectively. Larger batteries usually mean heavier headsets, but Sennheiser has kept the GSP 370 fairly trim.

Unfortunately, it's done so (at least in part) by compromising on build quality. The GSP 370 is plastic to its core—plastic headband, plastic joints, plastic earcups, plastic microphone sheathe. You get the idea.

Plastic is wonderful in that it's both lightweight and relatively durable. It doesn't exude "luxury" like other materials though. Does that matter? Objectively, no. Subjectively? Well…it's a $200 headset. That's not the absolute pinnacle of wealth but it is on the higher end for a gaming headset nowadays, and the GSP 370 looks underwhelming next to peers like the Corsair Virtuoso RGB (go.pcworld.com/cvrt) and the aforementioned Logitech G Pro X.

That said, comfort is surprisingly good. I say "surprisingly" because the GSP 370 seems spartan at first glance. There's a scant half-inch of padding on the headband, and the same around the ears. Donning the headset, I expected my cartilage to press against the GSP 370's drivers.

But its looks are deceptive. The GSP 370's drivers are recessed deep into the plastic

frame, so the earcups are almost twice as deep as the exterior indicates.

I don't know why Sennheiser settled on that design but it works. I complained that the GSP 600 held my head in a vice grip, even after I played with its proprietary "contact pressure" adjustment sliders. The GSP 370 needs a short break-in period—give it a few good flexes—but after that you get an excellent seal without any unnecessary squeezing. Passive noise cancellation is top-notch, and while my ears did get a bit warm with prolonged use, I was still pretty impressed by the fit.

As for the built-in controls, Sennheiser had an easy time of it. The wired GSP models already included a flip-to-mute microphone on the left ear and a volume knob surreptitiously built into the right ear. The GSP 370 duplicates those elements, adding only a MicroUSB charging port and a power toggle on the bottom of the left ear. The power toggle is a bit small and finicky, but whatever, you only have to touch it once or twice a day.

Oh, and there's an RGB LED power indicator on the left face, right below the microphone. It's a gaming headset, and don't you forget it. (Kidding, mostly. The LED turns off after a few seconds.)

AUDIOPHILES ASSEMBLE

Per usual, Sennheiser's built a cheap-looking headset that sounds great. Consistency where it matters, I guess.

The GSP 370, like the GSP 600, is on a par with comparably priced Sennheiser headphones. The tuning is different, as Sennheiser tends to give its gaming headsets a bit of a midrange boost, the better for making certain sounds like gunshots and dialogue pop. But it's not as overbearing as the high-end boosts applied

to Corsair's headsets, and I find Sennheiser's default sound listenable across music, games, and movies.

And the GSP 370 is the first Sennheiser headset we've reviewed in a while that connects through USB. That means it's easy to rectify one of the more obvious issues, which is the lack of bass presence. Sennheiser's bass implementation is very clean and precise, but lacks the oomph some might want when gaming. Luckily Sennheiser added a five-band EQ to its software since last time we tested it, making it easy to add a bit more low-end without damaging the overall clarity. It's a welcome addition, and I eventually settled on a 3dB increase in the 80Hz band and a 2dB increase in the 300Hz band.

I'd stay away from Sennheiser's EQ presets though. Both the "Music" and "Movie" presets significantly increase the treble (or "scooping the mids" in guitarist parlance), which ends up sounding like a telephone to my ears.

Sennheiser's 7.1 functionality leaves a lot to be desired as well, crushing the GSP 370's wide 2.0 soundstage in service of a crummy-sounding faux-surround. Sennheiser is unrivaled when it comes to crafting a beautiful stereo environment, especially as far as gaming headsets are concerned, so I'd stick to that and consider the 7.1 forgotten.

There's also a software tab for the microphone. Reviewing the GSP 600, I commended Sennheiser for making a microphone that was "crisp, clean, and flattering even without the software tricks most USB-powered headsets lean on." Turns out, those software tricks can make a great mic even better. I didn't notice much difference between the default recordings and the "Warm" or "Clear" voice enhancers, but the addition of a noise gate can be extremely helpful in even moderately noisy environments. I was able to dial in the GSP 370 to cut any and all keyboard noise, something I'm sure my teammates appreciate.

LIVE LONG AND PROSPER

Lastly, the vaunted 100-hour battery life. What can I say? It's almost impossible to test that number with any real degree of certainty. Hell, I have trouble verifying claims of 20-to-30 hour batteries. Anything longer than a day strikes me as "Pretty solid," especially given that use rarely lasts for an entire day straight. People usually take the headset off occasionally, or sit with it on but silent, and so forth.

The best I can say for the GSP 370 is that it lasts a long time. Like, a really long time. Theoretically the battery indicator in Sennheiser's software should drop one percent per hour, but even that isn't consistent. I've gone upwards of a week without charging it, or even getting to that "Hmm, I should think about charging this" stage.

My only concern is that because the battery lasts so long, when it does die it'll inevitably take you by surprise. When you get in the habit of plugging in your headset every night—or in the case of the A50, setting it on the charging stand—you're always certain it's ready to go. The GSP 370 won't engender those same habits.

When that is my biggest concern, however, you can surmise that I have no complaints. Hopefully others can follow Sennheiser's lead, because the bar for battery life was just raised significantly.

BOTTOM LINE

End of the day, I still wish Sennheiser would rethink its design language. Boring, boxy, and corporate. These are the charges I've leveled at the GSP line for years now, and nothing's changed. Sennheiser's certainly got the audio chops to challenge Corsair, Razer, and even Logitech. But the GSP line is bland, if not outright ugly, and a far cry from Sennheiser's more mainstream headphones like the Momentum 3 or many of its HD-branded models—or even its alternative gaming headset, the all-but-abandoned Game Zero.

The GSP 370 scores major points for its battery life. Hell, it's a minor miracle. And it sounds great too! I only wish the aspects I liked came in a more attractive package. Alas, maybe next time.

Sennheiser GSP 370

★★★★½

PROS

- Battery life blows the competition out of the water.
- Offers Sennheiser's typically excellent audio.
- Lightweight and comfortable.

CONS

- Bulky and drab.
- Software is still a bit rudimentary.
- Mediocre 7.1 implementation.

BOTTOM LINE

Sure, it's kind-of ugly—but Sennheiser's new GSP 370 wireless headset sounds great, and it lasts for weeks on a single charge. What else do you need, really?

$199

Logitech Ergo K860: This ergonomic keyboard delivers a comfortable typing experience

BY MICHAEL ANSALDO

PCWorld EDITORS' CHOICE

I'm usually skeptical about split keyboards. Because I don't have any of the ergonomic-related aches and pains they purport to help, I find it hard to evaluate the efficacy of their science-backed designs. It doesn't help that most of the ones I've used have introduced more typing discomfort than they've relieved.

Logitech's Ergo K860 has made me a believer. Announced recently and due to ship later in January, it showed me that just because my usual typing posture doesn't cause pain doesn't mean it can't be improved. In the few weeks I used the K860 I noticed increased typing comfort, reduced muscle tension, and all without sacrificing productivity to a steep learning curve.

IMAGE: LOGITECH

DESIGN

The K860 is big: almost 18 inches across and just over 9 inches from the top of keyboard to the bottom of the wrist rest. No, it won't save you any desktop space and may even require you to clear a little more. But if you're looking into an ergonomic keyboard, you're more interested in comfort than convenience, and the K860 offers plenty.

The keyboard has a curved, split keyframe designed to improve your typing posture. Specifically, the slope that divides the alphanumeric keys roughly in half puts your arms, and by extension your neck and shoulders, in a more relaxed posture. A pillowed cushion made of high-density foam, memory foam and coated fabric follows the same slope as the keyboard. Logitech says this cushioning offers 54 percent more wrist support while reducing wrist bending by 25 percent.

A unique palm lift feature provides wrist support. Under the wrist cushion is a pair of flip-down legs. The larger pair tilts the keyboard 7 degrees, while the smaller pair raises it four degrees. You can flip both of them up to sit the keyboard flat. This flexibility allows you to get your wrists into a comfortable position at both conventional and standing desks.

In addition to its full slate of alphanumeric keys, the keyboard has plenty of space for hotkeys for media playback and volume control, search, lock, and other functions, plus a full number pad.

CONNECTIVITY

Like other Logitech keyboards we've tested, the K860 connects to PC or Mac via an included USB receiver. All you need to do is plug the dongle into your computer's USB port, turn the keyboard's power switch on, and it connects instantly.

Alternately, you can connect the keyboard to your computer or mobile device via Bluetooth. The K860 supports up to three paired devices, which you can toggle between using their assigned Easy-Switch buttons.

The K860 can be raised up to 7 degrees with its unique palm lift feature.

The K860's keys are quiet and produce satisfying tactile feedback.

TYPING FEEL

I've often had a tough time acclimating to split-and-sloped keyboards. The unconventional hand positions usually feels awkward. Groping for keys on the split layout invariably introduces a bunch of typos. Time and patience would probably relieve both these issues, but I always give up long before I can find out.

I encountered neither of those problems with the K860. I'm not going to say the new hand position felt natural at first, but it definitely felt more relaxed, and that was enough for me to persevere. After a few days of use, I found my hands craved the more relaxed position the keyboard offered. The wrist cushion is one of the most comfortable I've used, providing a pillowy feel without compromising firm support.

The slightly concave keys are responsive and very quiet, but have nice tactile thump and a springy rebound. Despite the curved, split layout, I had no problem with key discovery and was able to touch-type as usual.

BOTTOM LINE

Logitech's K860 has done the unprecedented: It has made me adopt a split keyboard as my daily driver. Whether you need some relief from an ergonomic affliction or just want a more comfortable typing experience, the K860 is well worth a look.

Logitech Ergo K860

★★★★½

PROS

- Curved and split ergonomic design.
- Comfortable wrist support.
- Palm raise feature lets you adjust height for sitting or standing.

CONS

- Requires some time to get used to split design.
- Expensive.

BOTTOM LINE

Most ergonomic keyboards require some getting used to, but the K860 delivers on its promise of more comfortable typing. If you have typing aches and pains or just want a more relaxed typing posture, try this keyboard first.

$129

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BY MICHAEL ANSALDO

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Kindle Unlimited is a subscription service that's been likened to Netflix for eBooks. For a

IMAGE: AMAZON

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The beloved *Harry Potter* and *Hunger Games* series are here, though, as is Margaret Atwood's *The Handmaid's Tale*, and a host of books by popular thriller author Dean Koontz. But these seem to be the exception rather than the rule, and popular titles and authors take a considerable amount of poking around to uncover.

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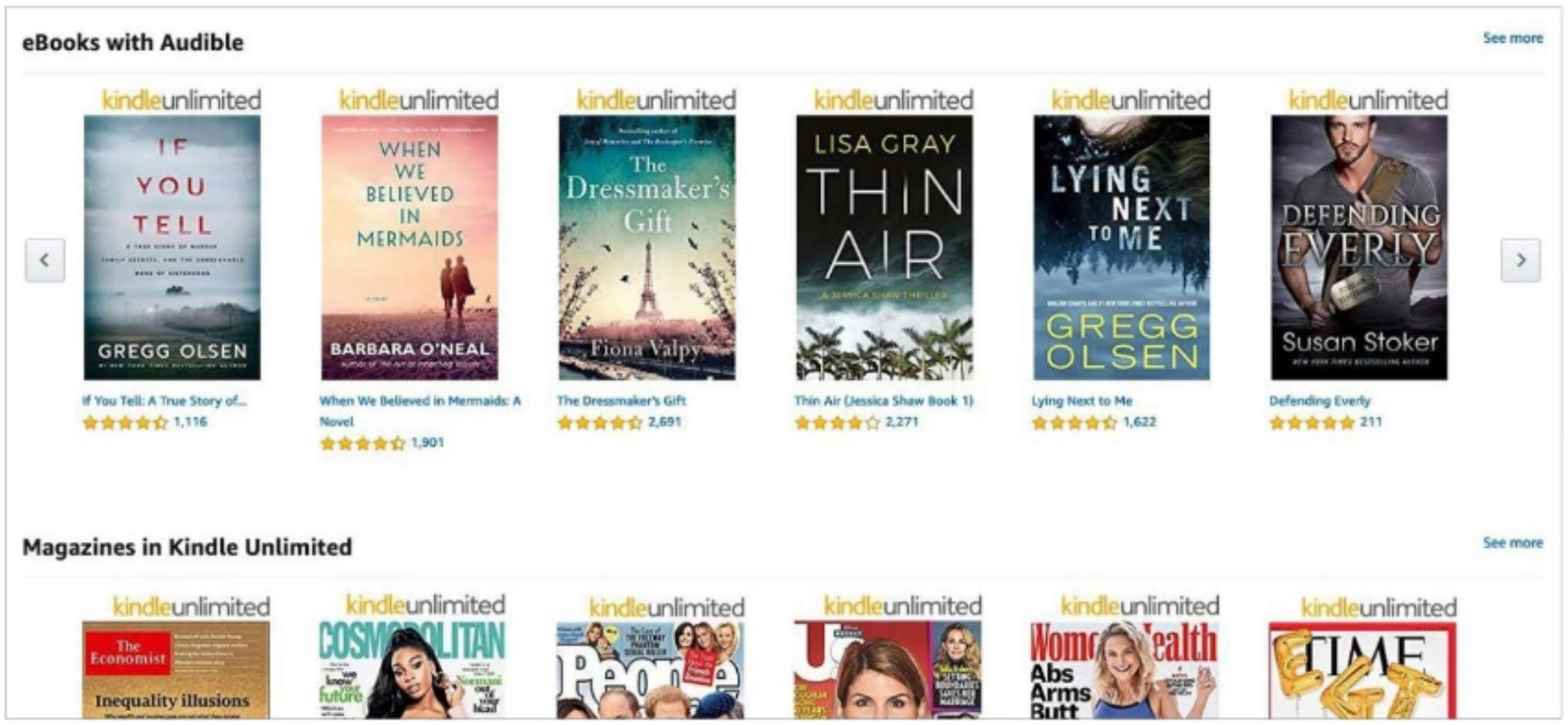

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BOTTOM LINE

If you're a voracious reader, Kindle Unlimited is pretty compelling. The ease with which you can stock up on reading material is pretty addictive, and the number of titles is dizzying. The service puts its best foot forward, though—most of the big, popular books like those mentioned earlier were prominently displayed on my Browse page, but once I dug deeper I found a dearth of major authors and titles.

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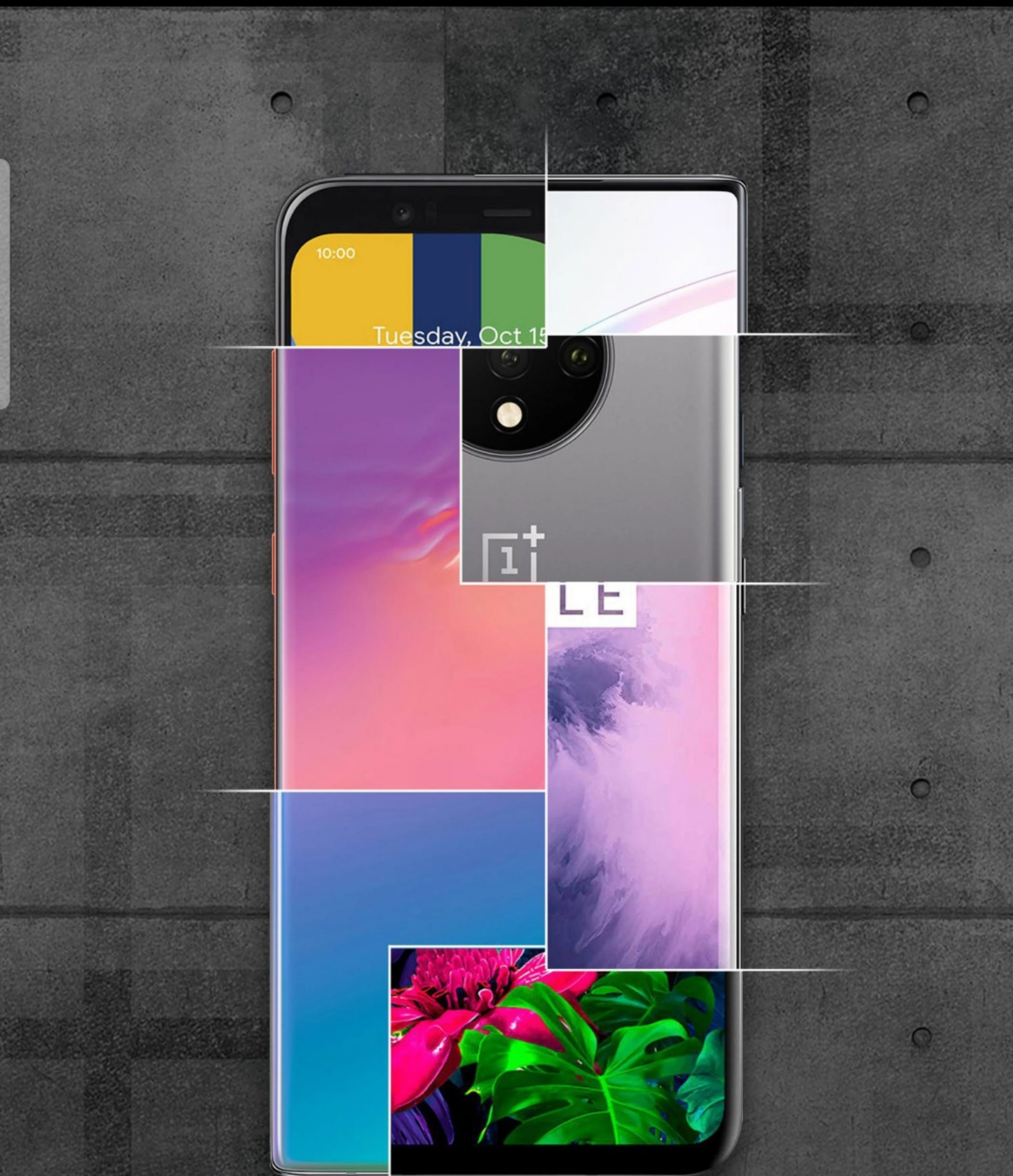
BUILDING THE PERFECT ANDROID FRANKEN-PHONE

THE BEST PARTS OF THE BEST PHONES OF THE YEAR

A CUP OF GALAXY, A DASH OF ONEPLUS, A PINCH OF PIXEL. **BY MICHAEL SIMON**

IMAGE: ROB SCHULTZ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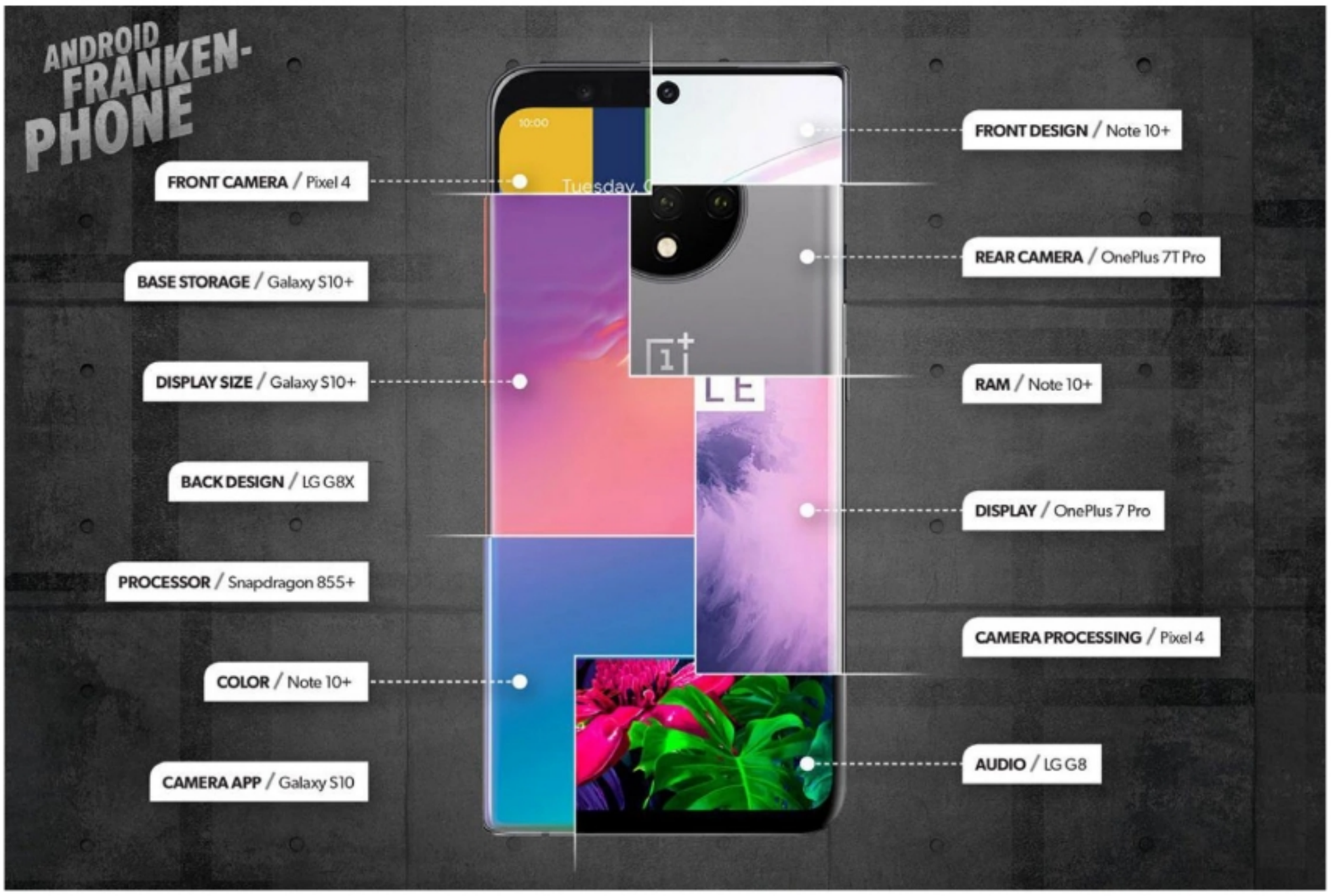

You can build a killer Android phone with a piece of every great handset released in 2019.

Android phones didn't just break the bank in 2019, they also broke speed, photography, and display records. Samsung and OnePlus delivered handsets that were as groundbreaking as they were gorgeous; Google pushed the limits of smartphone photography; and LG continued to march to its own drum, crafting some truly unique beats along the way.

But for all their strengths, there's no perfect Android phone. So this year, I decided to build one. Well, on paper. Without further ado, here's the 2019 Android Frankenphone, built using the best parts of the best phones of the year.

DISPLAY: ONEPLUS 7 PRO

You can't have a great phone without a great display, and the OnePlus 7 Pro had it this year—even better than the Galaxy S10+ and Note 10+. Samsung might supply the display OnePlus uses, but the 7 Pro does it better. Why? Because of its 90Hz refresh rate, which makes scrolling super speedy. It's not just that the 7 Pro is one of only a handful of phones that offer a refresh rate higher that 60Hz, it's that OnePlus has delivered it in a display

that's so perfect, it's like a cherry on top. And now it's Samsung that needs to do the catching up.

DISPLAY SIZE: GALAXY S10+

While the OnePlus 7 Pro has the best display, it's a little too big for my tastes. At 6.7 inches, it's one of the biggest phones ever made and pretty much impossible to use with one hand. But at 6.4 inches, the Galaxy S10+ is basically the Baby Bear of phones: just right. It's smaller than the Note 10+ and the iPhone 11 Pro Max, and easily fits in my pocket, yet it's still big enough to get serious work done.

FRONT DESIGN: NOTE 10+

The biggest story of 2019 was the ever-shrinking bezel, and the race to the first full-screen phone is truly underway. But until we get there, the Note 10+ is the phone that does itty-bitty bezels best. Its camera cutout is centered (unlike in the Galaxy S10+) and its receiver is the tiniest of holes along the top edge. The rounded corners of the display match the rounded corners of the phone, the chin is nearly as thin as the forehead, and the side bezels are nonexistent thanks to the infinity display. Lots of phones claim to have all-screen designs, but the Note 10+ is the only one that's actually almost there.

REAR DESIGN: LG G8X

As the fronts of our phones have become overtaken by screens, it's become easier to distinguish them from the backs of phones, from the Pixel 4's square camera to the OnePlus 7T's circular bump. But LG made the prettiest one of all, with a camera that's entirely encased under glass. It's the only phone with a rear case that's completely smooth and flat, and it feels downright luxurious to hold. And it's not too shabby to look at either. I've become so accustomed to bulbous bumps, and I can appreciate how the Pixel 4 and OnePlus 7T fully embrace them as

The Galaxy S10+ (center) hits the sweet spot when it comes to screen size.

Why have one color when you can have all the colors.

part of their designs. But when I run my finger along the surface of the LG G8x and feel nothing but smooth glass, it makes all those camera bumps feel ancient.

COLOR: NOTE 10+

A whole bunch of cool colors debuted this year including Flamingo Pink (S10), Oh So Orange (Pixel 4), Cosmic Purple (Mate 30), and Martian Green (Galaxy Fold), but my favorite is the one that captured them all: Aura Glow on the Galaxy Note 10+. A virtual chameleon that's constantly shifting its hue as you use it, Aura Glow might be the first phone color that truly needs a clear case—or none at all.

PROCESSOR: SNAPDRAGON 855+

With all due respect to the Snapdragon 855 that powers the Galaxy S10 and Note 10, Google Pixel 4, LG G8, and a slew of other high-performing premium handsets, the Snapdragon 855+ in the OnePlus 7T is a little faster and a little better at rendering graphics. The extra speed is particularly noticeably with 90Hz displays, which is probably why OnePlus is one of the only phones to use it.

RAM: NOTE 10+

There was a time when I questioned whether phones needed more RAM than most Chromebooks, but the Note 10+ convinced me. With 12GB of RAM, apps launch

Performance on the Note 10+ is stellar thanks to its 12GB of RAM.

incredibly quickly, Recents is loaded with screens, and hooking it up to a monitor via DeX doesn't slow it down at all. I hear your groans—no phone needs that much RAM—and that may be true today. But I expect most people will keep their $1,150 phones for at least three years, and in 2022, a little extra RAM will go a long way.

BASE STORAGE: S10+

The past few years have seen rapidly declining storage costs, so much so that now even Apple is offering a minimum of 64GB of space in all iPhones. But while you can get up to a terabyte of internal storage inside some phones, I'm still a bit more practical. The sweet spot is the base Galaxy S10+, with 128GB of storage and an expandable memory card slot. Its one of the few remaining phones to still feature a storage slot (even the smaller Note 10 ditched it), and like the headphone jack, I'm going to miss it when it's gone for good.

FRONT CAMERA SPECS: PIXEL 4

Front cameras don't usually get a lot of attention, but with so many selfies floating around Instagram, it's just as important as the rear camera. They're all very similar, but the Pixel 4 ekes out a win here. Even without the dual-cam setup of the Pixel 3, the Pixel 4's front camera excels, with a wide 90-degree field of view, f/2.0 aperture and 8MP sensor. That's slightly narrower than the Pixel 3's 97-degree FOV, but wider than most other phones out there, including the dual-selfie-cam S10+, which maxes out at 80 degrees.

REAR CAMERA SPECS: ONEPLUS 7T PRO

Before we get into the ability to take good pics, let's talk about camera hardware. Triple cameras are officially a thing after 2019, and no other phone embraced it quite like the

OnePlus went all out with its camera sensors this year.

OnePlus 7T Pro. There's a Leica-branded lens, as always, but I'm much more interested in the specs:

Camera 1: 48MP, f/1.6, OIS

Camera 2: 8MP 3X telephoto, f/2.4, OIS

Camera 3:16MP ultra-wide, f/2.2

That's about as good as it gets in a smartphone, with a better optical zoom than the Pixel 4 or the Galaxy S10, and an impressive 117-degree ultra-wide FOV. You're also getting 4K video at 30 or 60 fps and Super Slow Motion (720P video at 960 fps, and 1080P video at 240 fps).

CAMERA APP: GALAXY S10

How you shoot is as important as what you're shooting with, and stock camera apps run the gamut from minimal to overloaded with options. Samsung nails the sweet spot, with an excellent interface, super-fast switching between the lenses and modes, and fantastic manual controls.

CAMERA PROCESSING: PIXEL 4

Smartphone camera hardware doesn't really matter if the processing engine behind it isn't up to snuff. That's been the Pixel's mantra since day one and even with just two cameras, the Pixel 4 continues to dominate thanks to its stellar AI and processing engine. There aren't enough superlatives to describe how incredible Google's behind-the-scenes mojo is. From Night Sight to portraits and every possible tricky lighting in between, the Pixel 4 is a veritable masterclass in photo processing, and basically every other phone is playing catchup.

You won't find an Android phone that takes better pictures than the Google Pixel 4 (right).

BIOMETRIC UNLOCKING: PIXEL 4

In a vacuum, the Pixel 4 has the best biometric on any Android phone. It's one of the few to offer secure 3D face unlock and it's extremely fast and accurate, even working upside down if you happen to pick your phone up the wrong way (which happens more than you'd

think). It might not be all that useful beyond unlocking, but I'll still take it over an in-display fingerprint sensor any day.

AUDIO: LG G8

As the assault against the headphone jack continues—Samsung removed it from the Galaxy Fold and the Note 10 this year—audio continues to be a bright spot on LG phones. And the G8 has it in spades: Crystal Sound OLED, which uses vibrations and the display to create an all-over sound without a visible speaker, Boombox audio, and a 32-bit Quad DAC headphone jack, not to mention top-notch equalizer presets and noise filters.

OS: ONE UI

I can't believe I'm saying this, but the best implementation of Android in 2019 didn't come from Google, it came from Samsung. With its One UI overhaul update, Samsung radically changed the way it approached its interface, bringing bold changes that departed from stock Android while still respecting Google's vision. In it, we got a stellar dark mode, excellent gesture navigation, an emphasis on one-handed operation, and an overall beautification of the interface, with bold fonts, clean menus, and smart controls. Android 10 on the Pixel 4 is great, but One UI is smarter, bolder, and more modern.

CASE: LG G8X

This is more of an honorable mention pick, but after a year of folding phone hype that's only going to grow, I felt it needed some attention. You won't find any folding displays on this list because I'm not yet sold on their value proposition, but the LG G8X convinced me that a dual-screen smartphone could work. The Dual Screen case made exclusively for the G8X is literally that: a second display for your phone. So you can write an email on one side and watch a video on the other. It's the kind of thing that feels like a gimmick but actually works, and I'd love to be able to pop any phone I wanted into one.

One UI on the S10+ is one of the best Android skins I've ever used.

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17 NEW PC GAMES WE'RE EXCITED FOR IN 2020

WITH NEW CONSOLES DUE TO ARRIVE IN NOVEMBER, THERE'S A SIZABLE GAP IN THE 2020 RELEASE CALENDAR AT THE MOMENT—BUT WITH CYBERPUNK, DYING LIGHT 2, AND MORE ALREADY ON THEIR WAY? IT'S GOING TO BE A BUSY YEAR.

BY HAYDEN DINGMAN

1.

There's a massive hole in 2020. A blind spot, if you will. Next fall, new consoles arrive. That doesn't affect us much on the PC side, but it does mean everyone's playing cards close to their chest at the moment. Holding onto surprises. Keeping quiet about quite possibly the biggest games of 2020.

So as we look towards the coming year, keep in mind we're only seeing half the picture—if that.

And yet it's still pretty damn impressive, with *Cyberpunk 2077, Doom Eternal,* and *Dying Light II* headlining one of the most packed spring lineups I've ever seen. Oh, and lest we forget, there's a new *Half-Life* game releasing in March.

These are exciting times, friends.

1. ORI AND THE WILL OF THE WISPS

Release date: March 11

When Microsoft announced *Ori and the Will of the Wisps* at E3 2017, I don't think I ever imagined it would take until 2020 to release. Here we are though, and at least it's early 2020.

Regardless, the second *Ori* outing looks every bit as beautiful as the original. It's got that same soft watercolor look, lots of dark blues specked with pink and green and red highlights. I'll be curious how the sequel ups the challenge for veterans without making it unapproachable for newcomers—the original struck a tight balance. But either way, I can't wait to play it finally. It's more about the spectacle for me anyway.


2.

2. HALF-LIFE: ALYX

Release date: March

No, it's not *Half-Life 3*. After more than a decade, Valve's finally putting out a new *Half-Life* game though, one where you play as Alyx in the events leading up to *Half-Life 2*. A pre-sequel, to borrow a phrase from *Borderlands*.

The catch? It's VR exclusive, a showcase for Valve's Index headset—and for Oculus, the Vive, or any other PC VR setup you might own. That's undoubtedly frustrating for anyone who hasn't made that investment yet, but perhaps *Half-Life: Alyx* can be as groundbreaking for VR as *Half-Life 2* was for physics engines all those years ago. We'll see.

3. DOOM ETERNAL

Release date: March 20

Doom Eternal was supposed to unleash hell last November, but fell victim to a last-minute delay. Now it's ripping and tearing its way through March instead.

As we've said before, *Doom Eternal* is just "More Doom," and that's not a bad thing. With nearly four years separating the reboot and its sequel, I certainly haven't tired of semi-mindless run and guns, especially ones that play this slick. Hopefully it's been delayed for the last time, and we can all get to murdering demons in the near future.


3.


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4. RESIDENT EVIL 3

Release date: April 3

The *Resident Evil 2* remake (go.pcworld.com/res2) was one of our favorite games of 2019. Using the core story beats of the 1998 original, the updated *Resident Evil 2* reimagined Claire and Leon's adventure with a proper over-the-shoulder camera, a more grounded tone, and an ingenious map. It's the first Resident Evil game I've ever truly loved.

For 2020, Capcom will try to work the same trick again and resurrect Resident Evil 3. I didn't expect it this soon, but nor am I complaining.

5. CYBERPUNK 2077 - APRIL 16

Release date: April 16

When we saw the first *Cyberpunk 2077* demo at E3 2018 (go.pcworld.com/cy20), I doubted it could run on current console hardware. I still doubt it, honestly.

CD Projekt is determined to prove me wrong though, scheduling *Cyberpunk 2077* to release in April. It seems impossible it could live up to the hype, seven years after the original teaser trailer and five years after *The Witcher 3*. But then again, I would've said


5.

the same about *The Witcher 3* and it's one of my favorite games this decade (go.pcworld.com/wit3). Maybe the favorite.

6. DYING LIGHT 2

Release date: April

We haven't seen nor heard much from *Dying Light 2* since E3 2019. That's...worrisome. It's an ambitious game, and when ambitious games go radio silent I assume they've been delayed.

I wouldn't be surprised, either. *Dying Light 2* is doing branching storylines on a massive scale. The demo we saw at E3 2019 ended with an entire district emerging from underwater, a section of the city you'll only see if you make certain choices along the way. As Techland put it, "It's not about which ending you get, but how the city looks when you finish the game," claiming you'd only see 50 percent of the content in any given playthrough. Pretty cool, but it sounds like a lot of work.

7. WASTELAND 3

Release date: May 19

Five years after *Wasteland 2* took home our Game of the Year prize (go.pcworld.com/gy14), the sequel's almost ready. What we've played so far seemed very cold, with the Desert Rangers trading out sweltering Arizona for the frozen wastes of post-apocalyptic

Colorado. It's still very much *Wasteland* though, with satisfying turn-based combat and skill checks galore. And given InXile's track record, I'm sure the writing will be solid. My only hope is that the Microsoft acquisition gave InXile time not only to add more content, but to polish what was already there. I don't want to wait for the inevitable Director's Cut this time to get the game as InXile originally intended it.

8. BALDUR'S GATE III

Release date: To be confirmed

Will *Baldur's Gate III* release in 2020? I have my doubts. Google announced it as part of the Stadia launch lineup though, and Stadia has…technically launched. Theoretically that means Baldur's Gate III will also arrive in the near future. Theoretically.

If it does make it out, it'll be fortuitous timing. *Baldur's Gate II* turns 20 next year, a nice round anniversary worth celebrating with a long-awaited sequel. That said, I'm happy to give Larian as much time as it needs. Following up one of the most beloved CRPGs of all time can't be easy.

9. EMPIRE OF SIN

Release date: To be confirmed

Brenda Romero's apparently waited decades to make *Empire of Sin*, a hybrid real-time strategy/turn-based tactics game set in the Prohibition Era. I'm glad it's finally getting made, because it has some really neat ideas.

Foremost among them is what *Empire of Sin* calls RPCs or "recruitable player characters." These are your gang members, and they're not just faceless grunts. They have personalities, relationships with other characters, dreams and desires. You might recruit a character only to find out her lover's in a rival gang, and then be able to exploit that—or have it come back to haunt you when she refuses to fire at her lover at a crucial moment. It's an interesting wrinkle to consider, though I'm curious how often these


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situations will present themselves outside a demo. We'll see.

10. HUMANKIND

Release date: To be confirmed

If you shoot at the king, you better not miss. For years Amplitude's taken potshots at Civilization's 4X hegemony, with the unique and innovative *Endless Legend* (go.pcworld.com/enlg) and then *Endless Space 2* (go.pcworld.com/ens2). But there's a real battle brewing in 2020, when Amplitude is due to release Humankind.

It's a direct challenge to *Civilization*, a historical 4X that starts at the dawn of human civilization and takes it up through the present day. *Humankind* is no *Civilization* clone though. Amplitude's upending the formula, rethinking a lot of the ideas *Civilization* is so loathe to abandon. Victory, for instance, doesn't entail outlasting your opponents. "Fame" is the metric for success, and past glories can be as important to securing a legacy as present-day ones. Think of the Roman Empire, the Egyptians, or the Khans.


10.

Interesting ideas, and brave. Exactly what I'd expect from Amplitude.

11.

11. MICROSOFT FLIGHT SIMULATOR - 2020

Release date: To be confirmed

I never expected a flight sim to be one of my most-anticipated games. *Microsoft Flight Simulator* is what I've always wanted though, drawing upon Bing Maps and Azure to realistically render the entire world. Every city, every town, every mountain or river, every notable landmark and monument, all visible from the cockpit of whatever plane you choose to pilot.

I don't care much about the flight aspect, but I'm fascinated by digital tourism—as evidenced by my love-hate relationship with *The Crew* (go.pcworld.com/crew) and my continued devotion to *Google Earth VR* (go.pcworld.com/gevr). I can't wait to hop in a Cessna and fly over the town I grew up in. Bonus points if I can pick out our old house.

12. PSYCHONAUTS 2

Release date: To be confirmed

All the attention's on *Baldur's Gate III*, *Vampire: The Masquerade - Bloodlines 2*, *Half-Life: Alyx*, and other long-awaited 2020 sequels. But *Psychonauts 2* is due to release next year as well, and I'm...well, maybe not excited but intrigued, sure. It's been 15 years since the original came and went, and at least 10 since it started being discussed as a cult classic. Mascot platformers were dated even in 2005 though, and in 2020? It's tough being a *Yooka-Laylee* (go.pcworld.com/ykly) or even a *Hat in*


12.

Time. I'm confident in Double Fine's ability to surprise people, but I do wonder if *Psychonauts 2* will actually appeal to those who waited on a sequel for so long.

13. SKATEBIRD

Release date: To be confirmed

Skateboarding games are in a bit of a renaissance at the moment, but none have captured my attention as much as *SkateBird*. They're birds! That skate! It's not the most realistic of skateboarding sims (obviously), nor is it the *Tony Hawk* successor I really want. But you know what? Sometimes originality counts for more than execution, and *SkateBird*'s managed to hook me where more serious games like *Session* and *Skater XL* have not.

14. WATCH DOGS LEGION

Release date: To be confirmed

This console generation opened with an ambitious *Watch Dogs* and it will close with one too. Hopefully Legion lives up to the hype more than the original.


13.


14.

It sounds incredible in theory. Set in modern-day London, there's no central protagonist. Instead you can recruit and play as anyone in the world. Cab driver? Cop? Beloved grandma? Those guards who wear the tall hats? Any of them could be the main character in your version of *Watch Dogs Legion*. Or all of them, because when characters die they stay dead. I had a great time shuffling around as an old lady at E3 (go.pcworld.com/oldy), and am disappointed *Legion* got delayed later into 2020, if only because I'm curious to test the limits of such a unique system for myself.

15. VAMPIRE: THE MASQUERADE - BLOODLINES 2

Release date: To be confirmed

Vampire: The Masquerade - Bloodlines 2 is another game that was originally slated for spring only to slip into late 2020. I'd be disappointed, but we waited 15 years for a sequel. A few more months can't hurt, especially given the original was notoriously broken at release and required fans to fix it up. Hopefully the delay helps avoid a similar fate this time around.

Like *Baldur's Gate III* and *Half-Life: Alyx*, I'll be curious how *Bloodlines 2* fares. It's hard following up a cult classic, even when you have some of the original talent involved. What we've seen so far looks promising, but can it ever meet people's expectations? I hope so.

16. CRUSADER KINGS III

Release date: To be confirmed

Crusader Kings III is another game I doubt releases in 2020, but that's what Paradox claims and so it goes on the list. After eight years and a dozen expansions, Paradox is finally hitting the reset button and making a proper sequel to the beloved *Crusader Kings II*. The core is the same, taking over any Medieval ruler and trying to expand their influence across multiple generations through warfare, marriage, strategic heir selection, and religion. But a clean slate allows Paradox to delve deeper into what made the game a breakout hit, expanding on courtly intrigue,

dynastic traits, and random events—plus making the map a bit more attractive. If Paradox has learned anything in the last eight years, it's UI design.

16.

17. HALO INFINITE

Release date: To be confirmed

Halo Infinite is the only game I can safely say will ship alongside the new consoles. It's slated as an Xbox Series X (go.pcworld.com/xbxs) launch title in November. While *Halo Infinite* will also appear on the Xbox One it's really Microsoft's poster child for next-gen. And it sounds like an ambitious sequel, far more so than *Halo 4* and *5*. Developer 343 Industries is reputedly ditching the old formula, adding in RPG mechanics and telling IGN (go.pcworld.com/sprb) it's a "spiritual reboot" of what's traditionally been a straightforward shooter series.

Best of all: It's the first *Halo* to debut day-and-date on PC ever. Hopefully they picked a good one to do it with.


17.

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Windows 7 is dead: How to stay as safe as possible after the security updates stop

RIP to a legend. **BY BRAD CHACOS**

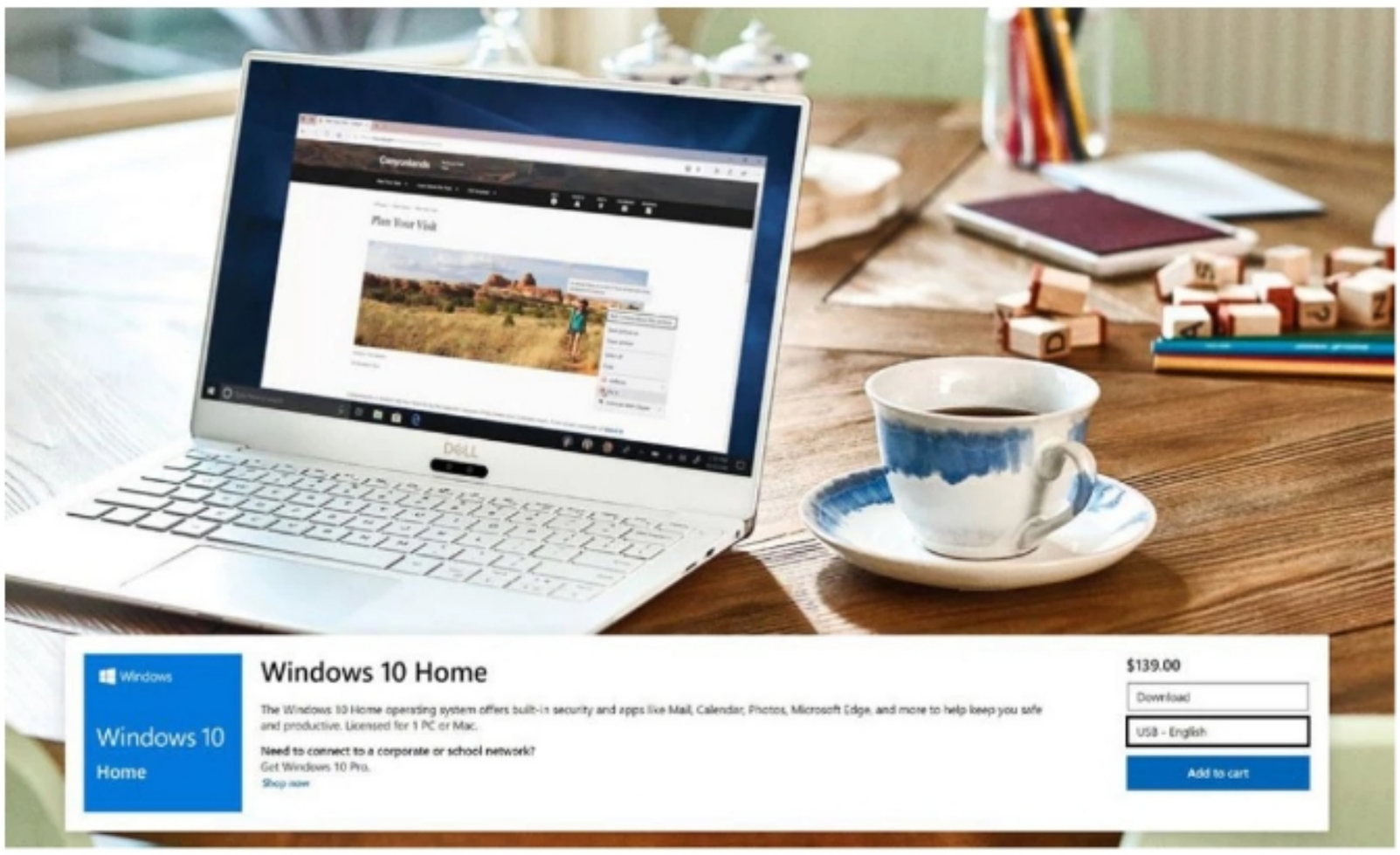
Windows 7 is one of the best things Microsoft ever released. The much-adored operating system wooed back users who reviled the disappointing Windows Vista, and it remained a comfortable refuge during the even bleaker Windows 8 era.

Even today, with Windows 10 fixing Windows 8's worst mistakes and standing as a superb desktop operating system of its own, a legion of vocal PC enthusiasts swears

IMAGE: PAN XIAOZHEN MODIFIED BY IDG COMM./MICROSOFT (CC0)

by Windows 7. Why? Because it stays out of your way, and it just works.

Until January 14, 2020, when Microsoft ends Windows 7's extended support. Windows 7 is dead.



Upgrade to Windows 10 or Linux if you can.

Your PC will keep operating, of course. Microsoft isn't literally pulling the plug on your devices. But Windows 7 won't receive any more updates or security patches, meaning your PC will also be very vulnerable to all those nasty malware programs garnering headlines seemingly every day. If you keep using Windows 7—and over a quarter of all computers run it, per NetMarketShare (go.pcworld.com/nmkt)—you're on your own, and the Internet can get nasty.

We can help you stay as safe as possible, though.

STICKING WITH WINDOWS 7 IS NOT AN OPTION

Seriously: Switch away from Windows 7 by whatever means necessary. That's our underlying recommendation. Sticking with Windows 7 was understandable before; now it's a liability. With no security updates and a still-vast market share, Microsoft's operating system will be a big, juicy target for hackers.

We recommend migrating to Windows 10 if you're able to, and have a guide explaining your Windows 10 upgrade options (go.pcworld.com/10up). If you perform only basic tasks on your PC—email, web surfing, and documents—then Linux is a viable, user-friendly option these days. We've got a Linux beginner's guide (go.pcworld.com/lnxg), too, and better yet you can try it for free with no risk to your main Windows 7 installation. You can probably still upgrade to Windows 10 for free (see page 103), too.

But if you need to bide some time before

making a switch, here's how to keep Windows 7 as safe as possible.

DON'T USE INTERNET EXPLORER

A lot of malware gets delivered via browser vulnerabilities, and a lot of those will be aimed at Windows 7 now that it's wide open to attack. Microsoft's ending support for Internet Explorer too, and you definitely don't want to run an insecure browser on an insecure operating system.

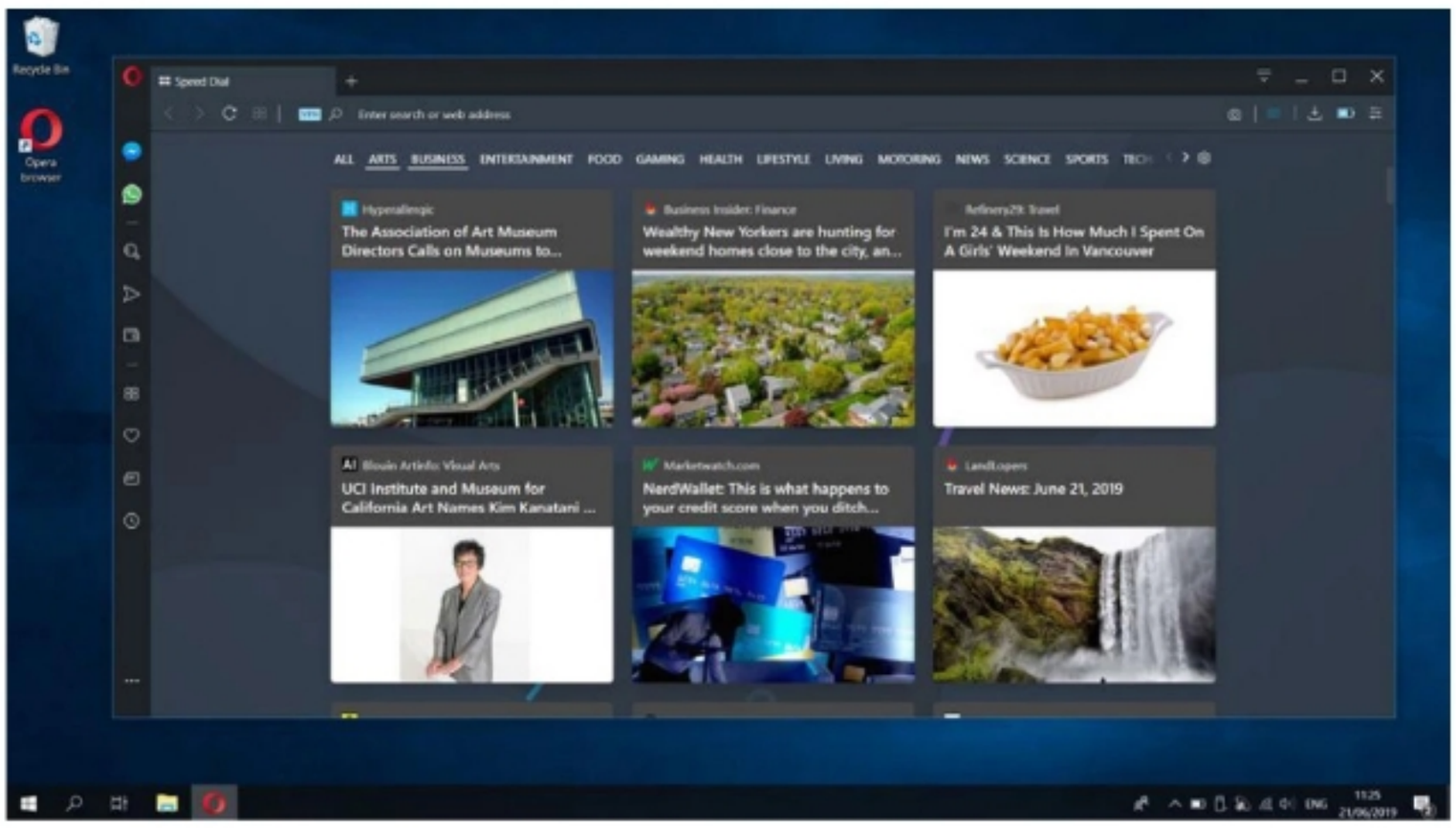
The other top browser vendors will continue to support Windows 7, however. Google's Chrome is popular, but Opera beat it out in our best web browser comparison (go.pcworld.com/wbrw), and Firefox is great, too [remember to update Firefox to avoid a recently revealed vulnerability (go.pcworld.com/frfx]). Switch to one of those—any will do, honestly—and make sure to enable automatic updates to keep those hatches battened down. This should be a top priority.

CHOOSE YOUR SOFTWARE WISELY

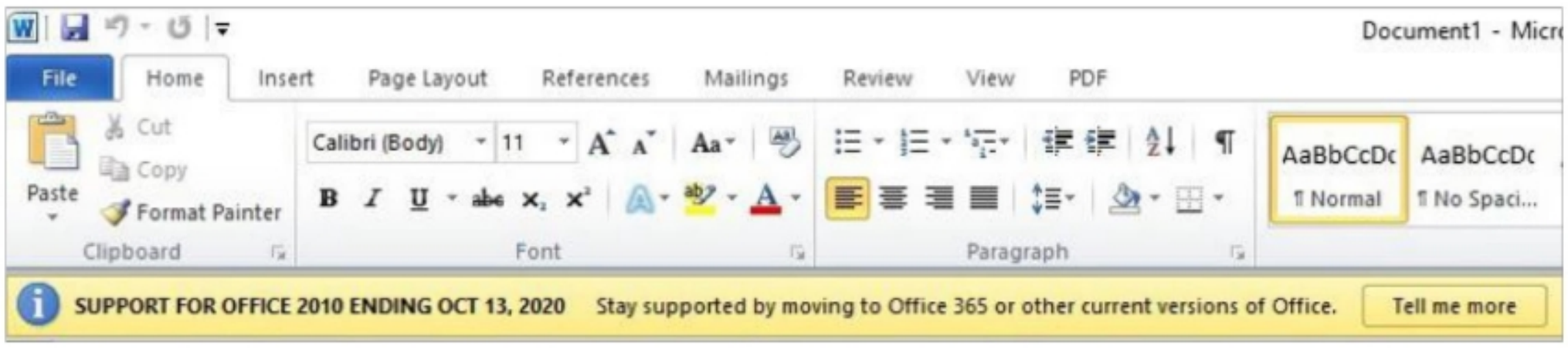
That segues to a key point: Make sure the software you're using still supports Windows 7, so that any potential security holes still get patched.

After browser vulnerabilities, poisoned Office documents are another frequent attack vector. If you're still using Office 2007, stop—its support ended years ago. Office 2010 will continue to receive security updates through October 13 (go.pcworld.com/oc13), so you have a little time there. Microsoft will actually continue to support Office 2010 for the next three years (until January, 2023) if you subscribe to Office 365. If that's not in your budget, check out our list of the best free Microsoft Office alternatives (go.pcworld.com/ofal) for other no-cost options, such as LibreOffice and Google Docs.

Java, Flash, and Adobe Reader are commonly targeted as well, so make sure they're up to



Opera is our favorite web browser and still supports Windows 7.



"Support for Office 2010 ending October 13, 2020," says the message popping up on Office 2010 screens everywhere.

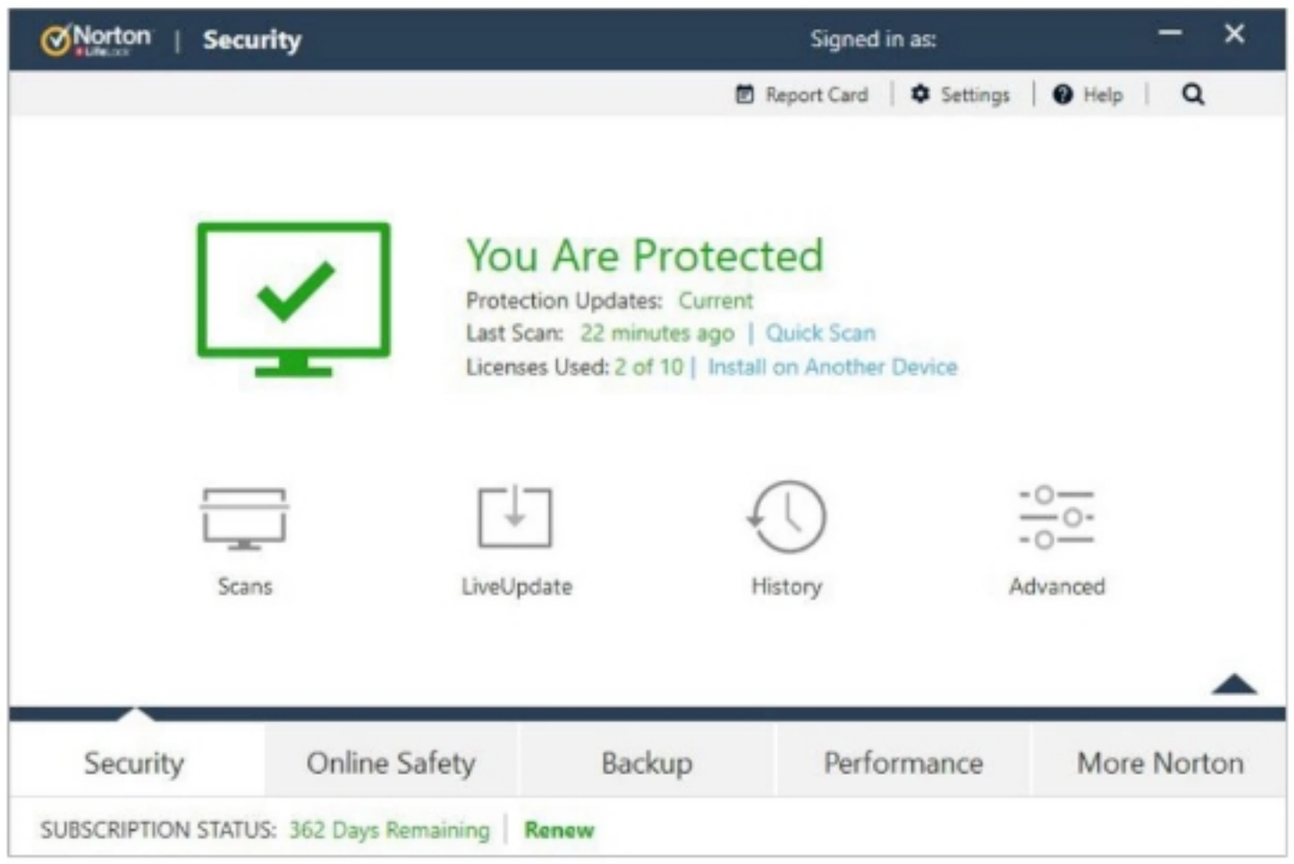
date if you need them. You might not, though. I was able to live my online life surprisingly well (go.pcworld.com/lvwl) without them seven long years ago, and it's even easier today, though it's hard to replace some of the meatier features in Reader (go.pcworld.com/rder). Kick Flash and Java to the curb and only install them if needed. They're in their twilight years.

Audit all your installed software, including browser plug-ins. If you don't use it, ditch it. Many standalone programs offer an option to update automatically to newer versions as they're pushed out. Activate it.

INSTALL ANTIVIRUS SOFTWARE

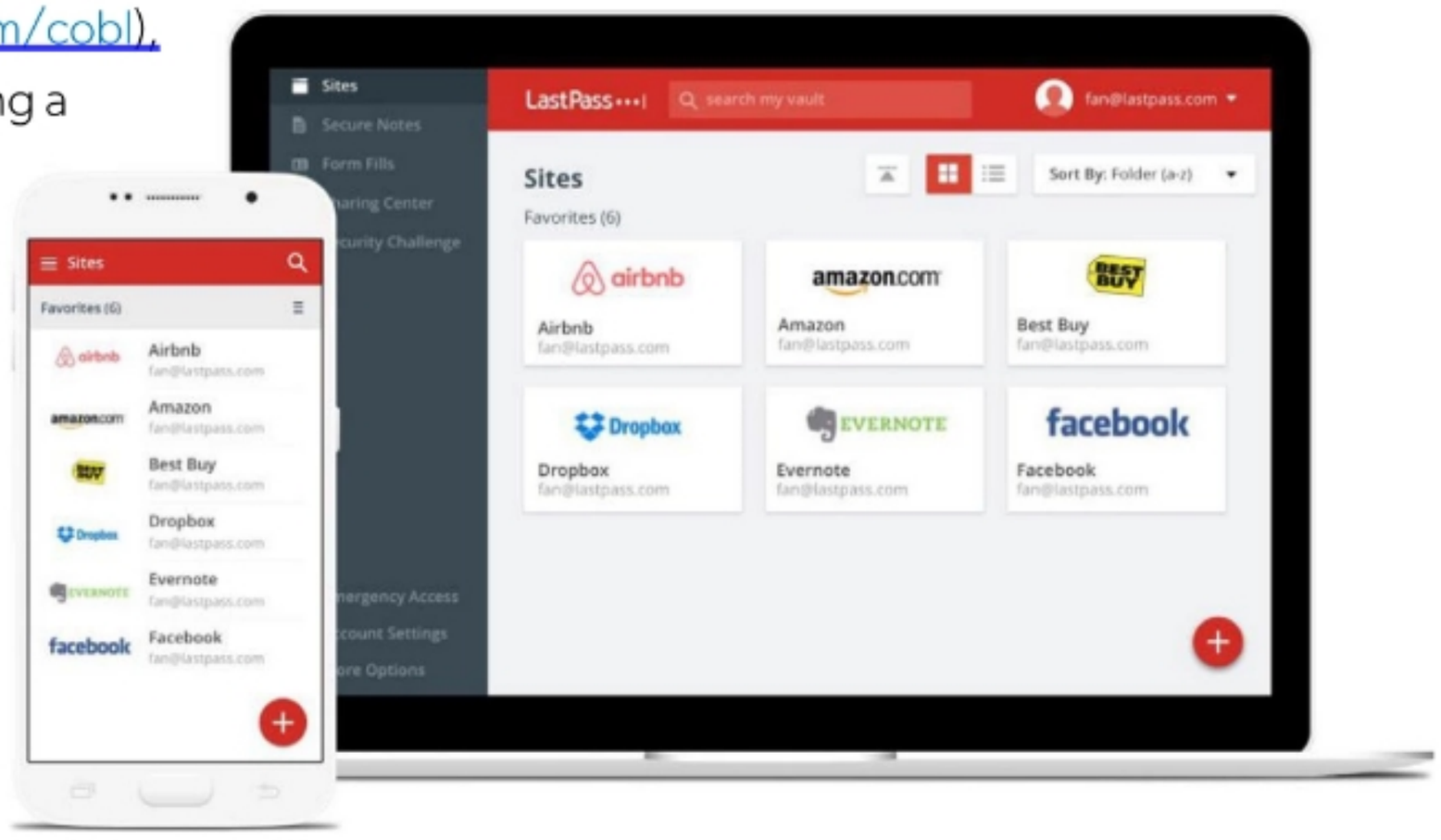
The free antivirus that Microsoft offers for Windows users works great for most users, but it won't receive updates now that Windows 7 is end-of-life. Yes, Windows Security Essentials is dead too (go.pcworld.com/sees). Now that your operating system won't receive security patches it's even more crucial to run protection on your PC. That expired version of McAfee that came with your computer isn't going to cut it.

An activated version might, though there are better options. Most security suites will continue to support Windows 7 for a while, and our guide to the best antivirus suites for Windows (go.pcworld.com/anvr) can help you find your best option. While you can cobble together an arsenal of free security



Norton Security Premium will help keep a Windows 7 PC safe.

tools (go.pcworld.com/cobl), we recommend buying a premium version if you're still running Windows 7. Modern security suites do much more than antivirus alone, protecting you against phishing, malicious ads, browser and email attacks, and more. If you're running an unsupported operating system, investing in a rounded-out security suite is money well spent.



LastPass makes password protection effortless.

Norton Security Premium (go.pcworld.com/nprm) is the best pick for most people right now, but you have options. Again, check out our guide to the best antivirus software (go.pcworld.com/anvr) to see all the security product's we've tested. Be sure to check your chosen program's Windows 7 support cycle before you buy, though. (Norton still works with Windows XP, even!)

BATTEN DOWN THE HATCHES

Hackers can't hack what they can't touch. Follow this pro tip from our old Windows XP safety primer (go.pcworld.com/xprm):

"Barring being purely disconnected, if there's a single tip that could make any Windows PC more secure, it's this: Stay away from administrator accounts [go.pcworld.com/admn]. If you're blasted by malware, it can only do as much damage as the account it infects. Admin accounts give baddies the keys to your computing kingdom.

"Once [Windows 7] stops being patched, stick to using a Standard account for your day-to-day activities if at all possible. Use an admin account to create the locked-down login and stock it with the software you need—keeping our previous program advice in mind—and then don't stray from Limited land unless you need to install or update software. (And even then, only stick in the admin account for as long as is absolutely necessary to get the installation done.)"

You can go even further though. If your Windows 7 computer doesn't need to

connect to the Internet, physically disconnect it from the Internet. Pull the ethernet plug right out, or disable Wi-Fi.

Alternatively, if you only need legacy Windows 7 support for a program or two, you can run Windows 7 in a virtual machine on a modern, supported operating system, be it Windows 10 or some flavor of Linux. (Again, moving off of Windows 7 as much as possible should be the goal.) If the virtual machine gets compromised, you can just wipe it and start over, with no harm to your main installation. Just make sure you're backing up the Windows 7 data so you can replace whatever's lost.

Even with all these precautions in place, your PC can get pwned (go.pcworld.com/pwnd) if you tell malware to come in. Use safe browsing practices (go.pcworld.com/sfbr) to avoid being fooled into downloading malware by phishing attempts, malicious emails, fake updates and error warnings, drive-by downloads, or other tomfoolery.

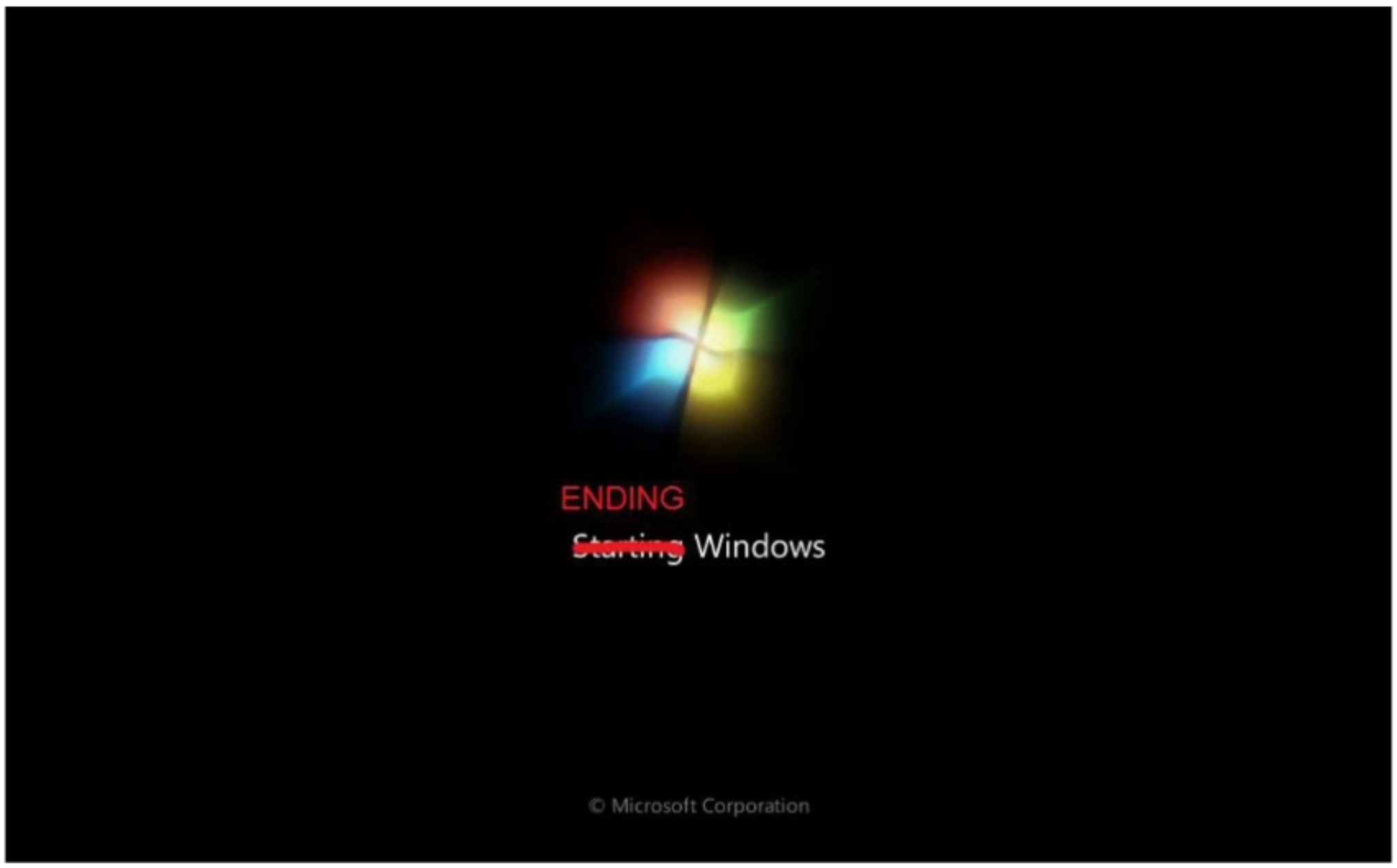
It's not specific to Windows 7 security, but make sure you're backing up your data (go.pcworld.com/wbak) and using a password manager (go.pcworld.com/pman), too.

MAKE PLANS TO MOVE ON

Windows 7 was great while it lasted, but now it's gone. While these tips will help you keep using the operating system for longer, running an insecure OS in today's hyper-connected world is inviting trouble. Start thinking about your future options, whether it's snagging a free Linux distro (go.pcworld.com/lnxd), trying for a free Windows 10 upgrade (see page 103), or straight-up buying a new Chromebook or Windows laptop (go.pcworld.com/blpt). When the next catastrophic bug rears its head, you don't want to be left in the lurch.

Be careful out there.

You may want to consider migrating to Linux.



Tip: You can still upgrade from Windows 7 to Windows 10 for free

Ditch that dead OS, officially unofficially. **BY BRAD CHACOS**

It was a great ride, but it's over. On January 14, 2020, Microsoft ended the life of one of its greatest operating systems ever. Windows 7 is dead.

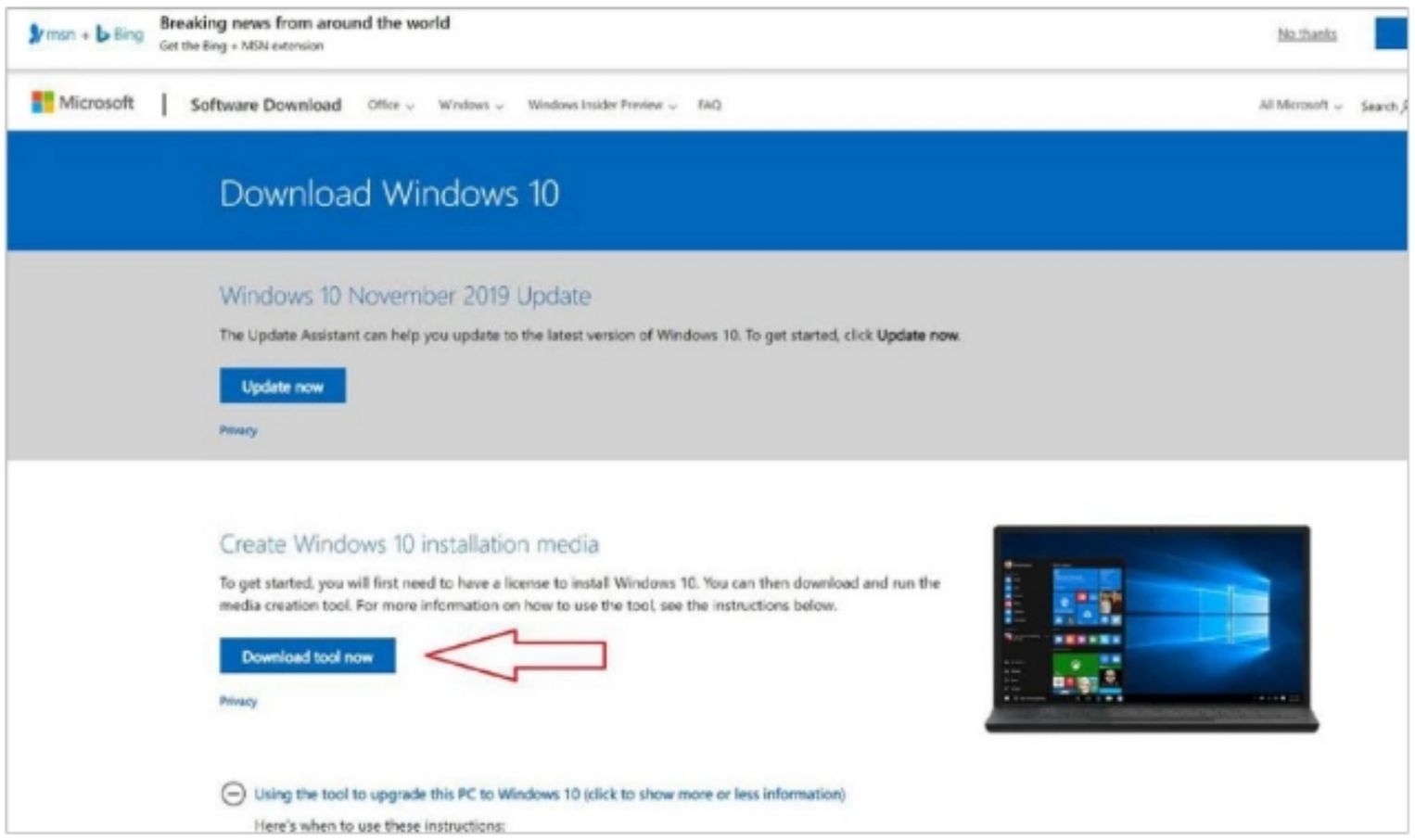
Your computer will still power on, but it won't receive any more security updates, and any bugs found won't get fixed. Bottom line: It's dangerous to keep using Windows 7, especially if you shop online or store any personal information on your PC. We've got tips on how to stay as safe as possible on Windows 7 (see page 97) now that security updates are done, but your best bet is migrating to a more modern operating system. Good news! Remember Microsoft's offer of a free Windows 10 upgrade, the one that ostensibly ended years ago (go.pcworld.com/yrag)? It's quietly still available.

Yes, if you're running a valid, licensed Windows 7 Home, Pro, or Ultimate computer, you can still upgrade to Windows 10 for free, as confirmed by How To Geek

IMAGE: MICROSOFT

(go.pcworld.com/hwgk), ZDNet (go.pcworld.com/znet), and Bleeping Computer (go.pcworld.com/blcm).

It's unclear how long this will continue to be available, as the upgrade offer was officially yanked in 2016, so consider doing it sooner than later if you're interested. That said, since it still works, we're inclined to believe Microsoft doesn't mind this unofficial upgrade method and simply wants as many people off Windows 7 as possible. Now that Windows 7 is dead it's even more critical.



Microsoft's Windows Media Creation Tool page.

HOW TO UPGRADE FROM WINDOWS 7 TO WINDOWS 10 FOR FREE

First, you'll want to have your Windows 7 product key in hand in case things go awry. If you're using a prebuilt PC bought at a store—the usual tower computers by Dell, HP, etc.—then it should have a sticker somewhere that includes the product key. If not, free tools like Belarc Advisor (go.pcworld.com/blrc) or NirSoft's ProduKey (go.pcworld.com/nsft) can scan your system and find it for you. Jot it down and keep it handy.

With that done, back up your data. Upgrading to a new operating system is a major task, and you don't want to lose your precious photos and files if things go wrong. We've got guides to the best Windows backup software (go.pcworld.com/wbak) and online backup options (go.pcworld.com/onlb), but even stashing your most valued files on a USB key or external drive works. Whatever method you use, just make sure your data's backed up somewhere safe.

Next, head to Microsoft's Windows Media Creation Tool page (go.pcworld.com/mdcr) and click the Upgrade Now button. The Media Creation Tool will download to your computer. Run it, select the Upgrade This PC Now option when prompted—not Create Installation Media—and choose to keep your apps and files.

Click Install and wait for the tool to work its magic. After several reboots (and potentially a long wait), you'll be on Windows 10, which is still being supported for years to come. Yay!

If you want to take a more complicated route, you can also use the Create Installation Media option to clean-install Windows 10, inputting the Windows 7 product key you dredged up earlier when you were asked for your Windows 10 license. How To Geek's article walks you through the process step by step. Most people should stick with using the much simpler Upgrade This PC Now option, though.

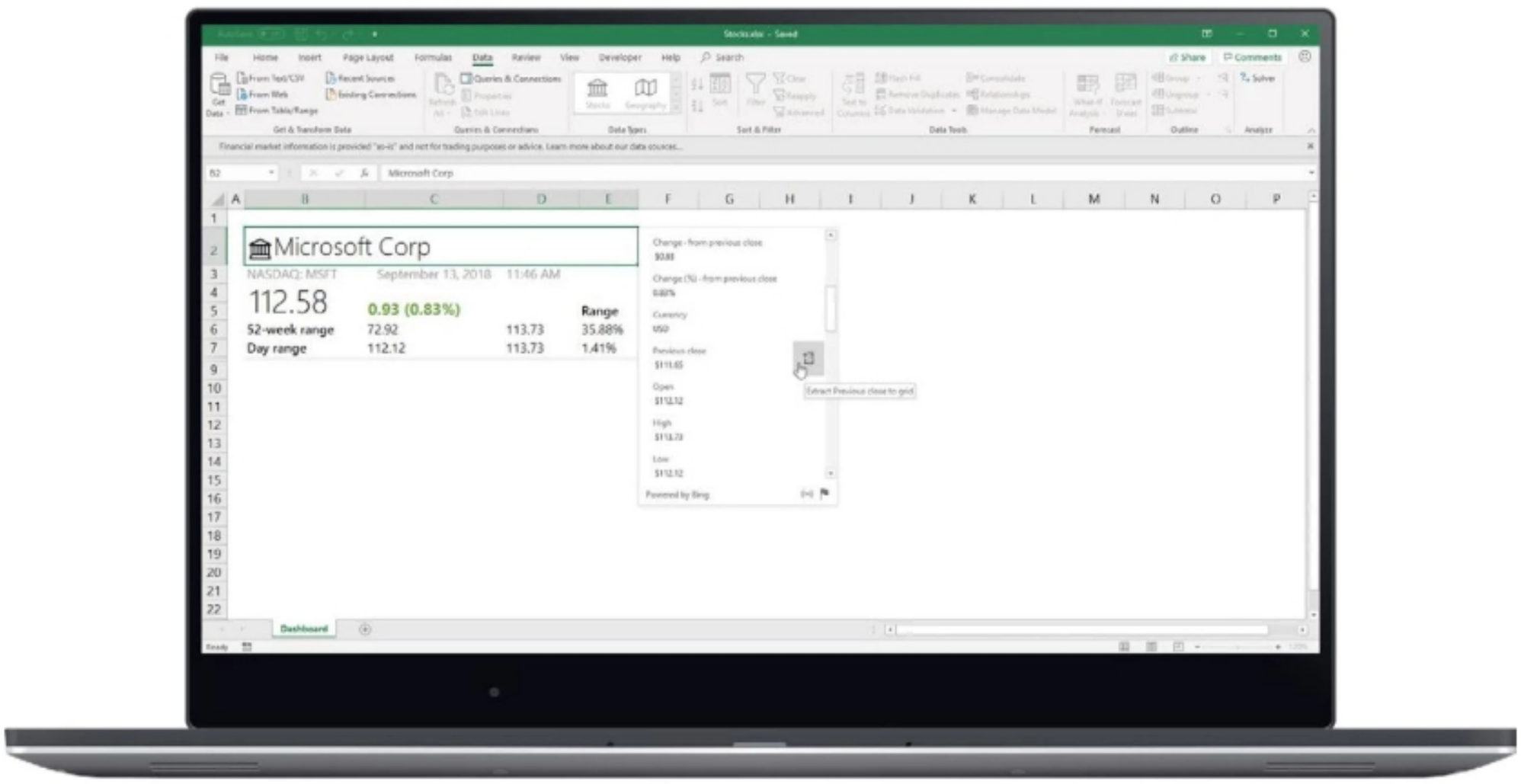
Sometimes, Microsoft will prevent the upgrade from occurring because of compatibility errors with your hardware or software. If so, you'll be dumped back into Windows 7 after a reboot. Troubleshooting those errors gets hairy and far beyond the scope of this article. Consider checking if there's a BIOS or firmware update available for your system if you run into an issue, though. Find one? Install it and run Microsoft's upgrade tool again.

If you're still out of luck, check out our guide to running Windows 7 safely (see page 97), and consider migrating to Linux (go.pcworld.com/lnxd) or buying a new Chromebook or Windows PC (go.pcworld.com/blpt) to hop back on the security update bandwagon. Seriously: You don't want to be running an unpatched, insecure operating system in today's world. Linux is much more user-friendly than it used to be and should handle most people's basic needs with minimal headaches.

Now may be a good time to buy a new Windows laptop.

Your Excel formulas cheat sheet

22 tips for calculations and common tasks. **BY JD SARTAIN**



Many of us fell in love with Excel as we delved into its deep and sophisticated formula features. Because there are multiple ways to get results, you can decide which method works best for you. For example, there are several ways to enter formulas and calculate numbers in Excel.

5 WAYS TO ENTER FORMULAS

1. Manually enter Excel formulas:

Long Lists: **=SUM(B4:B13)**

Short Lists: **=SUM(B4,B5,B6,B7) or =SUM(B4+B5+B6+B7)**. Or, place your cursor in the first empty cell at the bottom of your list (or any cell, really) and press the **+** sign, then click B4; press the plus sign again and click B5; and so on to the end; then press **Enter**. Excel adds up this list you just "pointed to" as =+B4+B5+B6+B7.

2. Click the Insert Function button

Use the Insert Function button under the Formulas tab to select a function from Excel's menu list:

=COUNT(B4:B13) Counts the numbers in a range (ignores blank/empty cells).

=COUNTA(B3:B13) Counts all characters in a range (also ignores blank/empty cells).

IMAGE: MICROSOFT

3. Select a function from a group (Formulas tab)

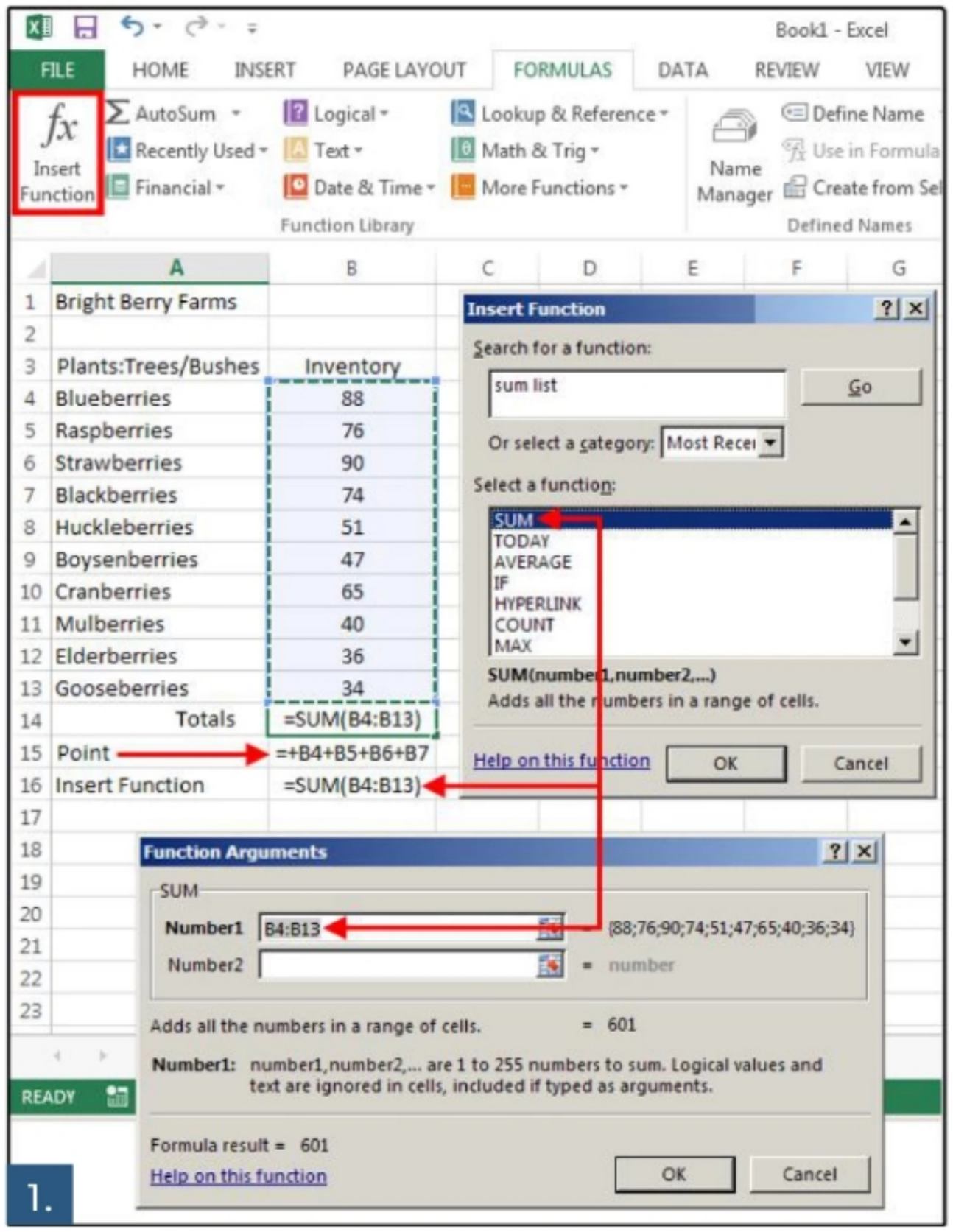
Narrow your search a bit and choose a formula subset for Financial, Logical, or Date/Time, for example.

=TODAY() Inserts today's date.

4. The Recently Used button

Click the Recently Used button to show functions you've used recently. It's a welcome timesaver, especially when wrestling with an extra-hairy spreadsheet.

=AVERAGE(B4:B13) adds the list, divides by the number of values, then provides the average.



5. Auto functions under the AutoSum button

Auto functions are my editor's personal favorite, because they're so fast. Select a cell range and a function, and your result appears with no muss or fuss. Here are a few examples:

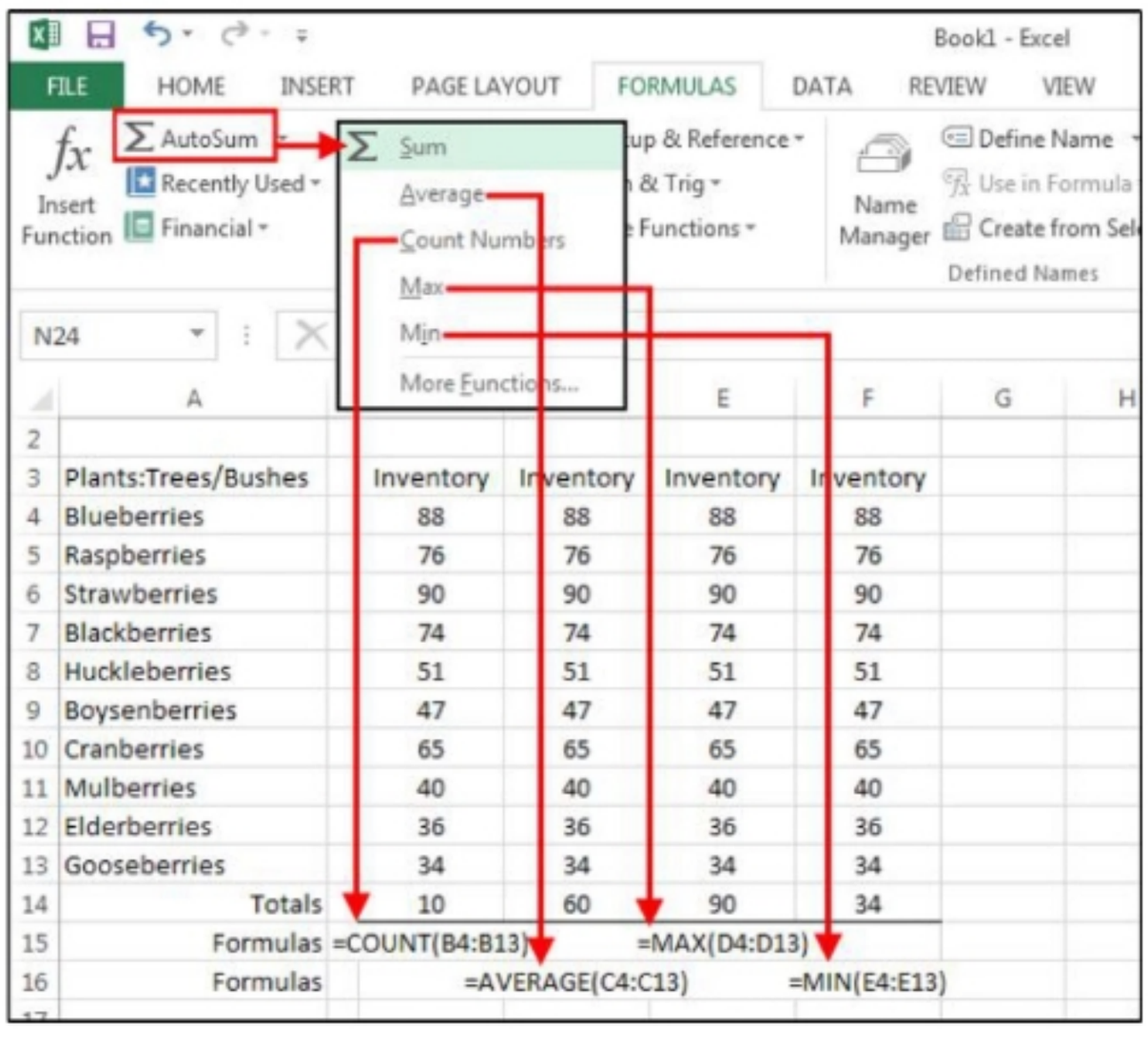
=MAX(B4:B13) returns the highest value in the list.

=MIN(B4:B13) returns the lowest value in the list.

Note: If your cursor is positioned in the empty cell just below your range of numbers, Excel determines that this is the range you want to calculate and automatically highlights the range, or enters the range cell addresses in the corresponding dialog boxes.

Bonus tip: With basic formulas, the AutoSum button is the top choice. It's faster to click AutoSum > Sum (notice that Excel highlights the range for you) and press Enter.

Another bonus tip: The quickest way to



Use the AutoSum button to calculate basic formulas such as SUM, AVERAGE, COUNT, etc.

add/total a list of numbers is to position your cursor at the bottom of the list and press Alt + = (press the Alt key and hold, press the equal sign, release both keys), then press Enter. Excel highlights the range and totals the column.

12 HANDY FORMULAS FOR COMMON TASKS

The five formulas below may have somewhat inscrutable names, but their functions save time and data entry on a daily basis.

Note: Some formulas require you to input the single cell or range address of the values or text you want calculated. When Excel displays the various cell/range dialog boxes, you can either manually enter the cell/range address, or use the cursor and point to it. Pointing means you click the field box first, then click the corresponding cell over in the worksheet. Repeat this process for formulas that calculate a range of cells (e.g., beginning date, ending date, etc.)

1. =DAYS

This is a handy formula to calculate the number of days between two dates (so there's no worries about how many days are in each month of the range).

Example: End Date October 12, 2015 minus Start Date March 31, 2015 = 195 days

Formula: **=DAYS(A30,A29)**

2. =NETWORKDAYS

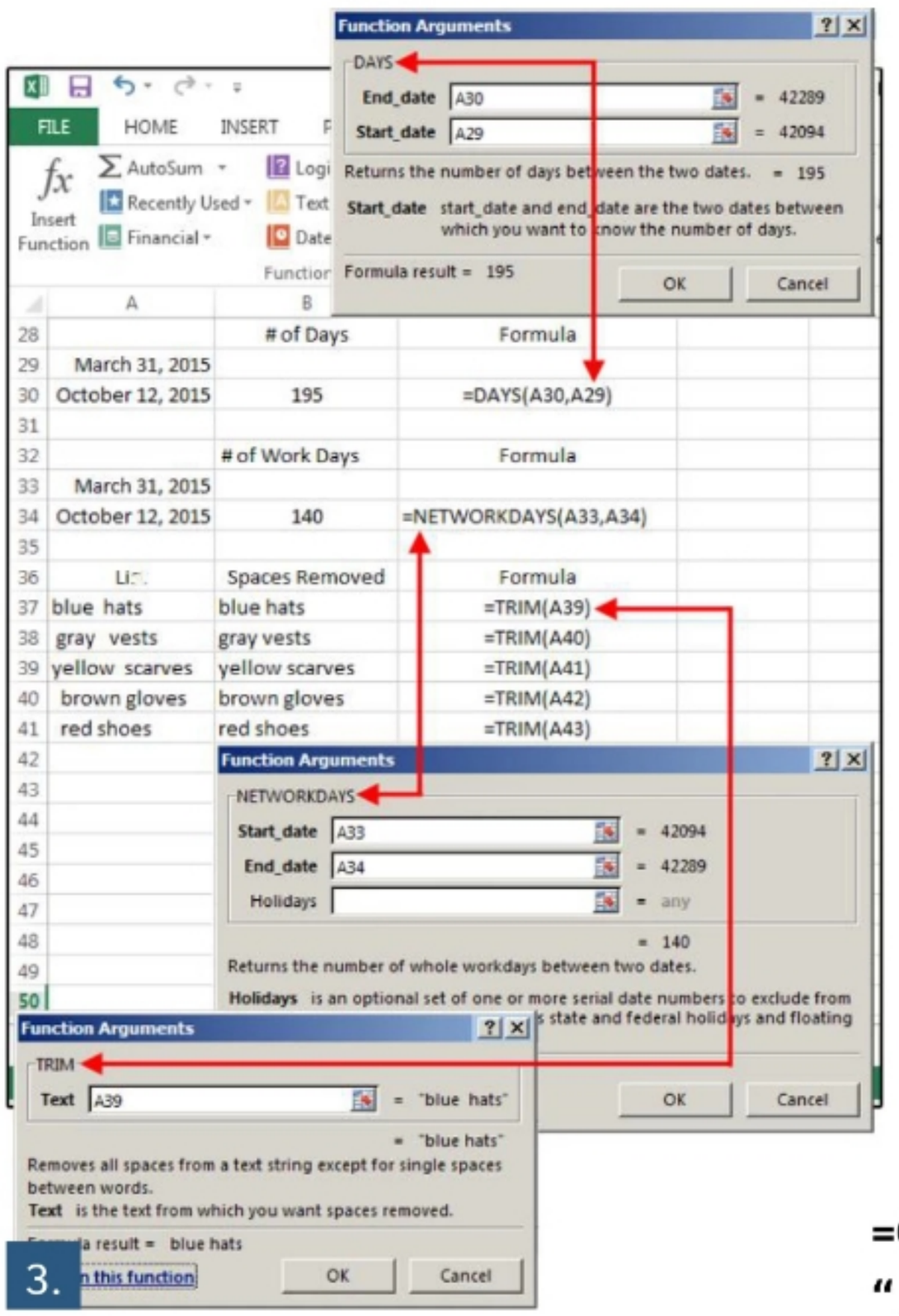
This similar formula calculates the number of workdays (i.e., a five-day workweek) within a specified timeframe. It also includes an option to subtract the holidays from the total, but this must be entered as a range of dates.

Example: Start Date March 31, 2015 minus End Date October 12, 2015 = 140 days

Formula: **=NETWORKDAYS(A33,A34)**

3. =TRIM

TRIM is a lifesaver if you're always



importing or pasting text into Excel (such as from a database, website, word processing software, or other text-based program). So often, the imported text is filled with extra spaces scattered throughout the list. TRIM removes the extra spaces in seconds. In this case, just enter the formula once, then copy it down to the end of the list.

Example: =TRIM plus the cell address inside parenthesis.

Formula: **=TRIM(A39)**

4. =CONCATENATE

This is another keeper if you import a lot of data into Excel. This formula joins (or merges) the contents of two or more fields/cells into one. For example: In databases, dates, times, phone numbers, and other multiple data records are often entered in separate fields, which is a real inconvenience. To add spaces between words or punctuation between fields, just surround this data with quotation marks.

Example: **=CONCATENATE** plus (month,"space",day,"comma space",year) where month, day, and year are cell addresses and the info inside the quotation marks is actually a space and a comma.

Formula: For dates enter:

=CONCATENATE(E33," ",F33,", ",G33)

Formula: For phone numbers enter:

=CONCATENATE(E37,"-",F37,"-",G37)

5. =DATEVALUE

DATEVALUE converts the above formula into an Excel date, which is necessary if you plan to use this date for calculations. This one is easy: Select DATEVALUE from the formula list. Click the Date_Text field in the dialog box, click the corresponding cell on the spreadsheet, then click OK, and copy down. The results are Excel serial numbers, so you

must choose Format > Format Cells > Number > Date, and then select a format from the list.

Formula: **=DATEVALUE(H33)**

6. =FORMULATEXT

Use this function to display the "text" of a formula in a given cell. For example, the actual formula in cell E2 is **=SUM(C2*D2)**; but all you see is the answer, which is $164.25. Sometimes it's helpful, even necessary, to see the actual function, especially if you're editing a macro or tracking down a circular reference. So enter this formula into a cell off to the side of your spreadsheet matrix (such as cell F2): **=FORMULATEXT(E2)** and Excel displays the actual formula of E2.

7. =AVERAGE

Averages are used every day to determine the median or midpoint of a set of numbers; for example, average grades for a group of students; average temperature of a region; and/or average height of sixth graders. Before functions, to get an average, you would add a column of numbers; for example 10 numbers; then divide by that total (10). The AVERAGE function does that for you. So typing **=AVERAGE(E2:E6)** adds those five numbers, then divides by 5.

8. =COUNT & =COUNTA

These simple functions count the total number of digits or text in a column of data. COUNT only counts numbers and formulas, while COUNTA counts everything—that is, alpha and numeric characters plus punctuation, symbols, and even spaces.

Why use the COUNT function? Imagine that your friends pay dues for membership into several different clubs. The spreadsheet adds the dues for all clubs in column G, so each individual knows how much he/she owes in dues a month. Use the COUNT function to total the number of people in each club (without having to create a column full of ones). For example; **=COUNT(B13:B22)** tells us there are six people in the Garden Club.

9. =COUNTBLANK

The COUNTBLANK function does exactly what is says: It counts the number of blank cells in a column or range. In column B of our spreadsheet example, there are four blank cells (and six cells with numbers). Note that anything in a cell, even a space, will register as a non-blank cell. In other words, if you put a space in cell B13, the total blank cells changes from 4 to 3.

10. =COUNTIF & combined functions

This formula combines the COUNT and the IF functions to count the number of cells in a range that meet a specific condition.

For example, say that you want to count

the number of members in the Music Club (column C), but only the members who receive the discounted price of $18.00 a month. First you count the cells, then set the condition; for example: **=COUNTIF(C13:C22, "<19")**. In this case, the answer is 2. Note: Don't forget to put the conditions inside double quotes, or else you'll receive an error.

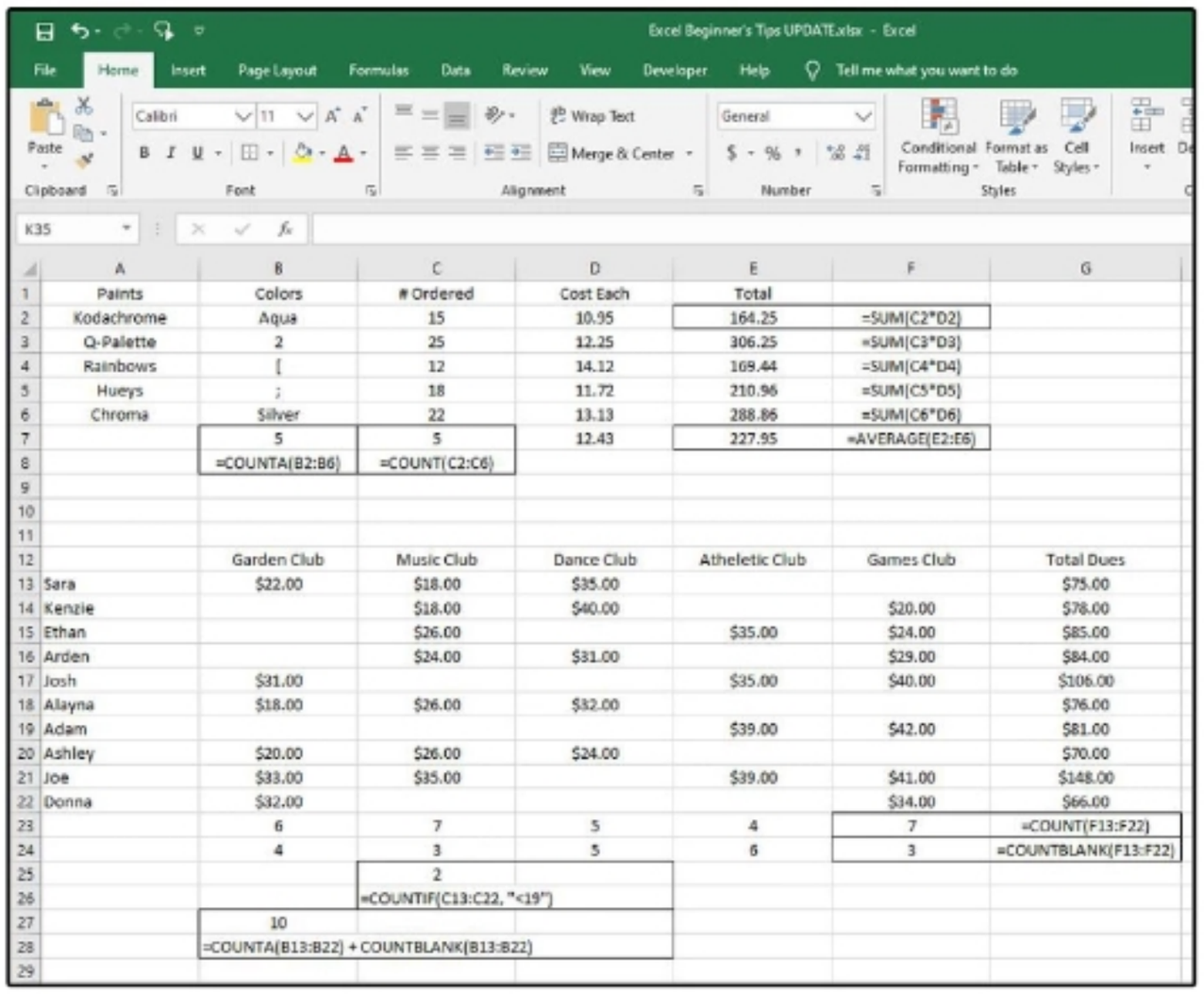
You can also combine multiple functions to get the results you need, so you don't have to use multiple cells or columns, which wastes valuable spreadsheet real estate. For example, imagine that you need to know how many cells are in a column or range with numbers (or text) plus the blanks.

For the numbers plus the blanks, enter this formula:

=COUNT(B13:B22) + COUNTBLANK(B13:B22)

For all characters (alpha and numeric) plus the blanks, enter this formula:

=COUNTA(B13:B22) + COUNTBLANK(B13:B22)



	A	B	C	D	E	F	G
1	Paints	Colors	# Ordered	Cost Each	Total		
2	Kodachrome	Aqua	15	10.95	164.25	=SUM(C2*D2)	
3	Q-Palette	2	25	12.25	306.25	=SUM(C3*D3)	
4	Rainbows	[	12	14.12	169.44	=SUM(C4*D4)	
5	Hueys	;	18	11.72	210.96	=SUM(C5*D5)	
6	Chroma	Silver	22	13.13	288.86	=SUM(C6*D6)	
7		5	5	12.43	227.95	=AVERAGE(E2:E6)	
8		=COUNTA(B2:B6)	=COUNT(C2:C6)				
9							
10							
11							
12		Garden Club	Music Club	Dance Club	Atheletic Club	Games Club	Total Dues
13	Sara	$22.00	$18.00	$35.00			$75.00
14	Kenzie		$18.00	$40.00		$20.00	$78.00
15	Ethan		$26.00		$35.00	$24.00	$85.00
16	Arden		$24.00	$31.00		$29.00	$84.00
17	Josh	$31.00			$35.00	$40.00	$106.00
18	Alayna	$18.00	$26.00	$32.00			$76.00
19	Adam				$39.00	$42.00	$81.00
20	Ashley	$20.00	$26.00	$24.00			$70.00
21	Joe	$33.00	$35.00		$39.00	$41.00	$148.00
22	Donna	$32.00				$34.00	$66.00
23		6	7	5	4	7	=COUNT(F13:F22)
24		4	3	5	6	3	=COUNTBLANK(F13:F22)
25			2				
26			=COUNTIF(C13:C22, "<19")				
27		10					
28		=COUNTA(B13:B22) + COUNTBLANK(B13:B22)					
29							

Check out the Average, FormulaText, and four Count functions.

11. =TRANSPOSE

A very useful function if you decide to change the spreadsheet fields (columns) to rows and vice versa. Why would anyone do this? Sometimes when spreadsheets are created, we aren't absolutely certain which data should be the fields and which should be the records and, sometimes, the situation changes and requires a redesign. This is where the Transpose function comes in.

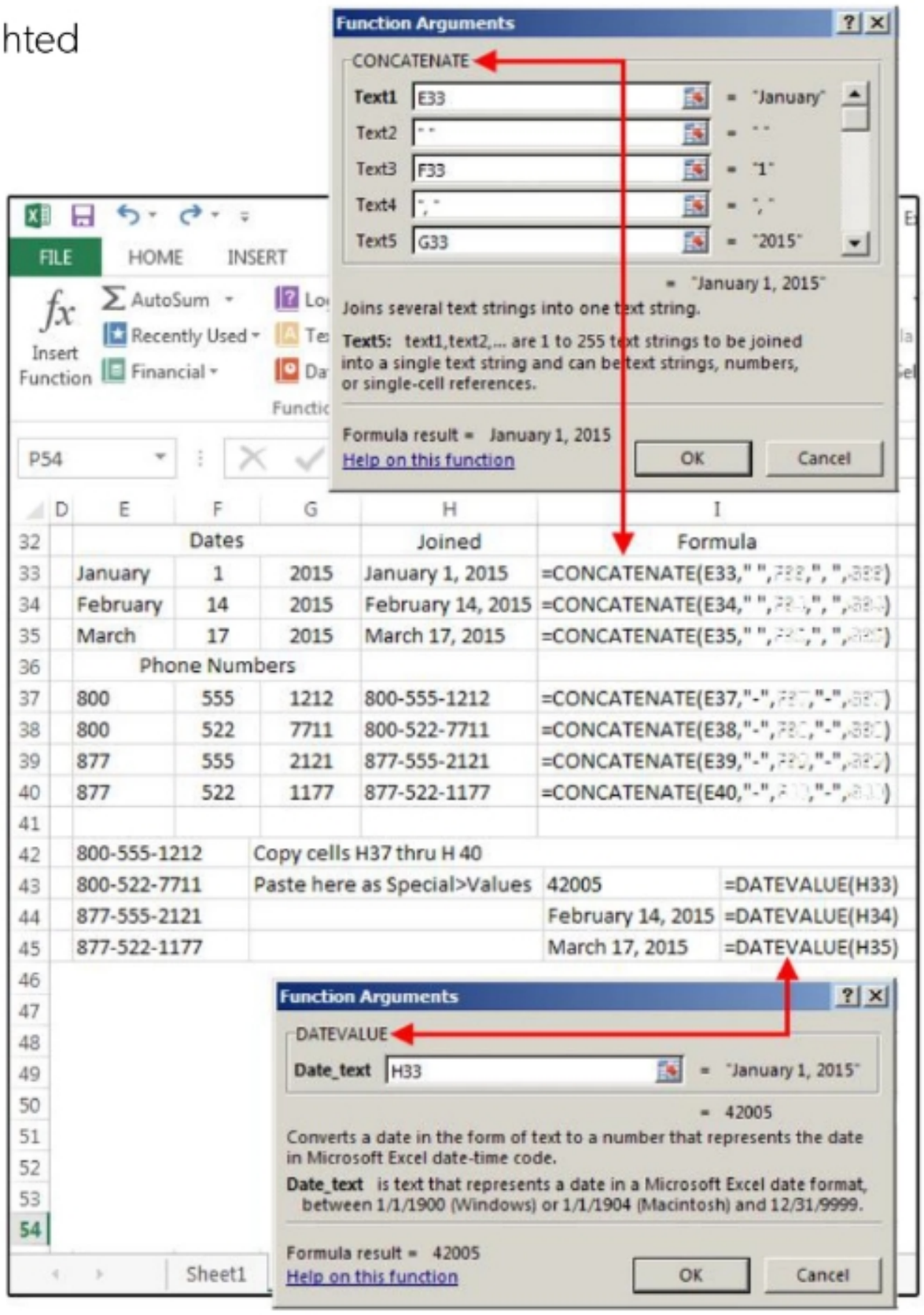
First, select a range of blank cells beneath (or on another sheet) that's the same size as the original range. Note that the original number of columns/fields may be five, while the rows/records are six. When you transpose the data, you'll have six columns and five rows; so be sure your blank cells reflect that. The original range may be A32:E37, but the new range of blank cells highlighted should be A40:E44.

Once the new range is highlighted, type

=TRANSPOSE(A32:E37) in the highlighted section and use the original range coordinates. Once the function and range are entered, press Ctrl+Shift-Enter and the range changes right before your eyes.

12. =MAX & =MIN

These two are simple, but useful. If you need to find the maximum or minimum number of items in a column or list, position your cursor somewhere outside the matrix and enter this function for Maximum: **=MAX(E33:E37)** or this for the Minimum: **=MIN(D33:D37)**. Excel returns the highest or lowest number in the column list.



THREE MORE FORMULA TIPS

As you work with formulas more, keep these bonus tips in mind to avoid confusion:

Tip 1: You don't need another formula to convert formulas to text or numbers. Just copy the range of formulas and then paste as Special > Values. Why bother to convert the formulas to values? Because you can't move or manipulate the data until it's converted. Those cells may look like phone numbers, but they're actually formulas, which cannot be edited as numbers or text.

Tip 2: If you use Copy And Paste > Special > Values for dates, the result will be text and cannot be converted to a real date. Dates require the DATEVALUE formula to function as actual dates.

Tip 3: Formulas are always displayed in uppercase; however, if you type them in lowercase, Excel converts them to uppercase. Also notice there are no spaces in formulas. If your formula fails, check for spaces and remove them.

7 free GIMP scripts and plug-ins for filters, brushes, textures, and more

Collect 'em all! **BY JD SARTAIN**

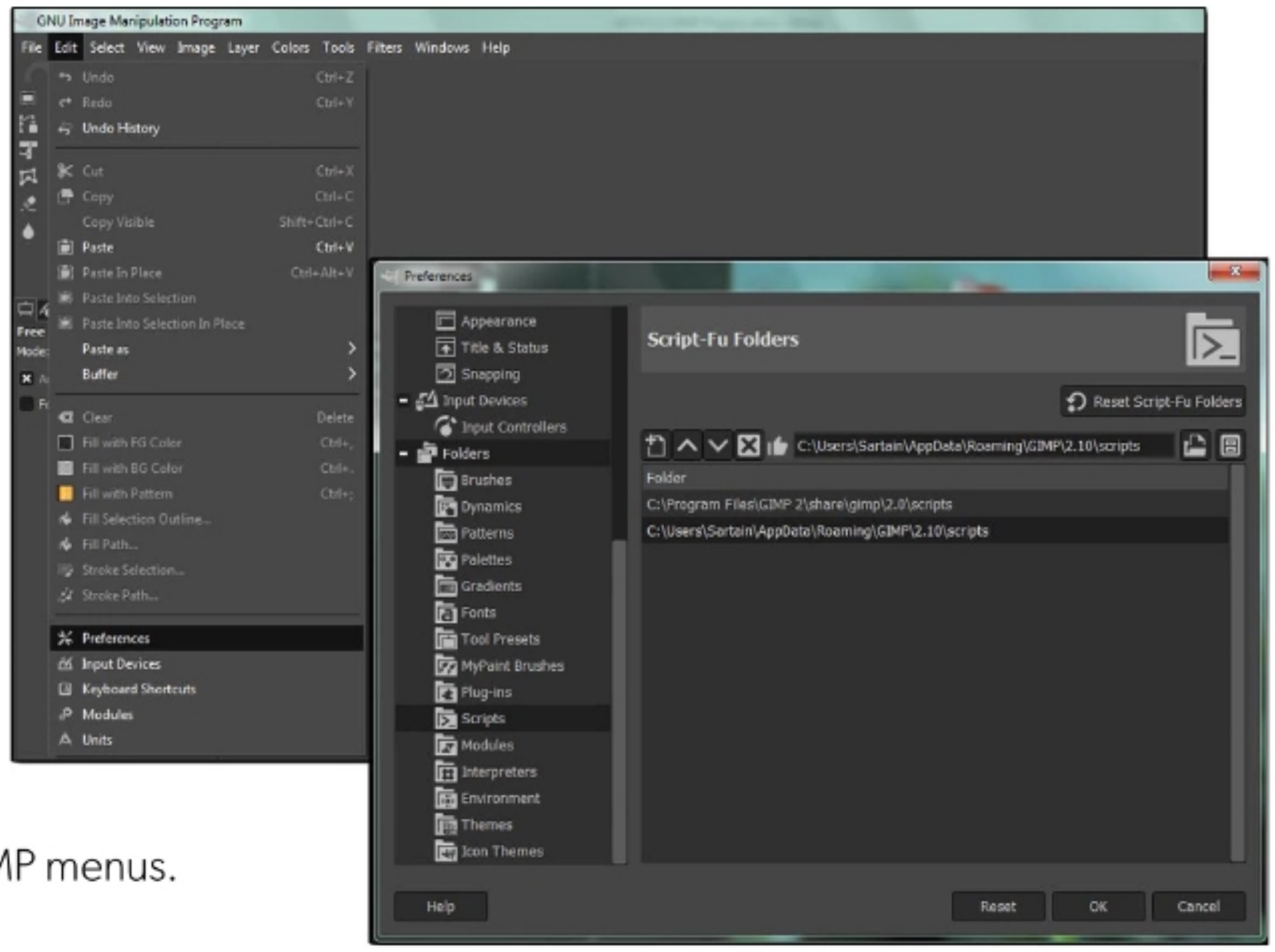
The free and open source photo-editing program called GIMP (GNU Image Manipulation Program) is a nice alternative to the subscription-based or boxed versions of its competition (including PhotoShop). Whether you're a beginner with GIMP (go.pcworld.com/gbsc) or a seasoned pro, there's lots to love.

Some of GIMP's greatest assets are the plug-ins and scripts created by numerous independent programmers. At one time, there was a massive collection called the GIMP Plugin Registry, but that resource is no longer available. Consequently, you must search the Internet for GIMP plug-ins and scripts.

To start you on the right track, we've

IMAGE: DUSAN PETKOVIC / GETTY IMAGES

selected our favorite plug-ins and scripts for you to try, with a brief description of each, and a link to the resource location. First; however, we should explain the complicated process of how to install these treasures and where to find them on the GIMP menus.



File locations of the Scripts and Plug-ins used in GIMP.

HOW TO INSTALL AND USE GIMP PLUG-INS

Notice that plug-ins in GIMP are called plug-ins and scripts. Scripts (Script-Fu) have .scm extensions, while Python-Fu scripts have .py extensions. The .scm extensions are copied into the Gimp scripts directory, while the .py extensions are copied into the Gimp plug-ins directory.

The complicated part is determining where your system copies these files. The easiest way to find out is to access the *Edit > Preferences > Folders > Plug-ins* or *Edit > Preferences > Folders > Scripts* path information from the GIMP menus. Notice there are two folders listed:

A. For 2.10 Scripts—*C:\Users\Your User Folder Name\AppData\Roaming\GIMP\2.10\Scripts*

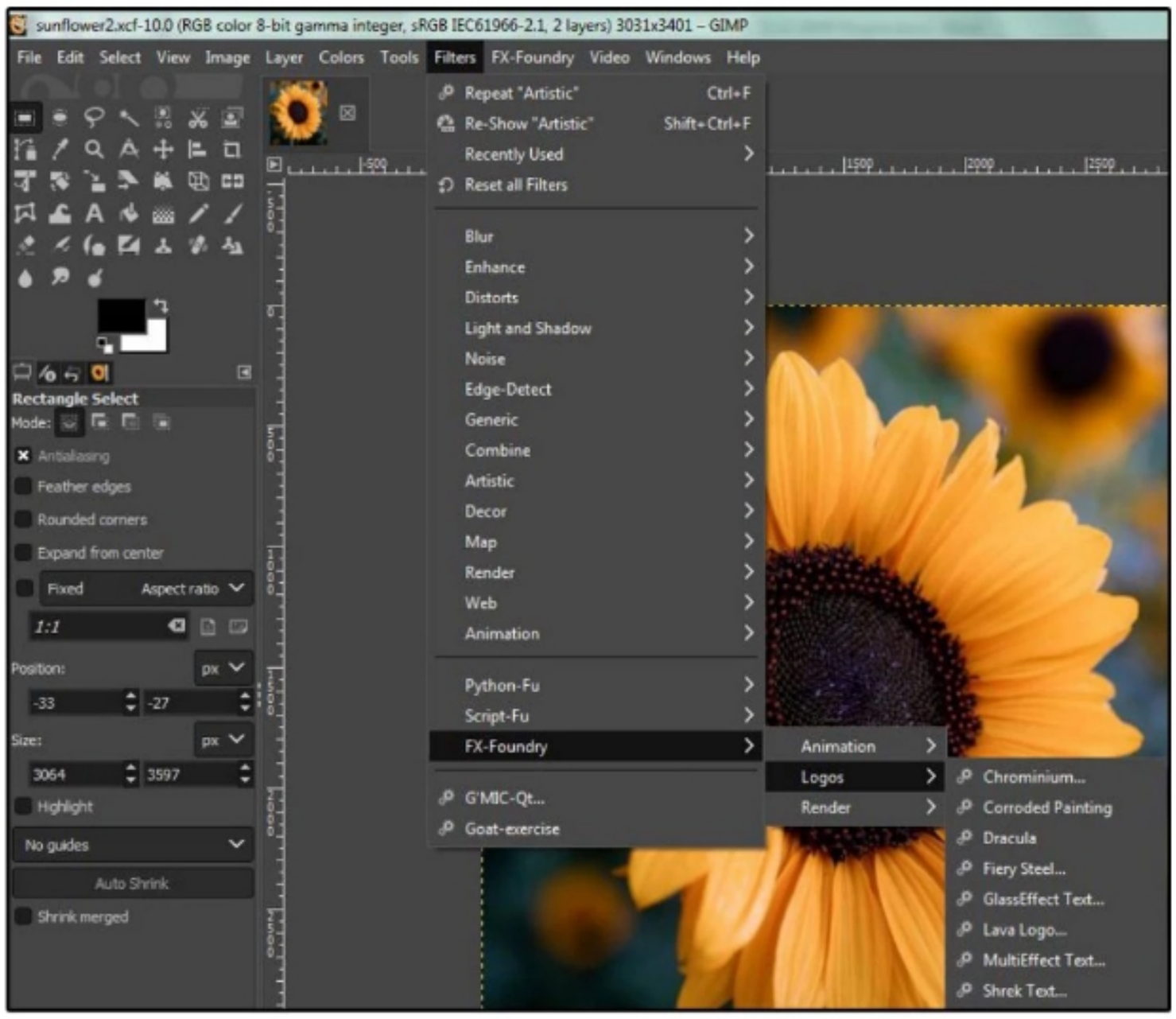
B. For 2.8 Scripts—*C:\Program Files\GIMP 2\Share\2.0\Scripts*

C. For 2.10 Plug-ins—*C:\Users\Your User Folder Name\AppData\Roaming\GIMP\2.10\Plug-ins*

D. For 2.8 Plug-ins—*C:\Program Files\GIMP 2\lib\gimp\2.0\plug-ins*

Once you know the location, you can Unzip the downloaded file(s). Copy (or Move) the scm files to the folder location indicated in "A" for GIMP 2.10, or "B" for GIMP 2.8. Copy (or Move) the py files to the folder location indicated in "C" for GIMP 2.10 or "D" for GIMP 2.8. When finished, restart GIMP.

Note: Plug-ins and Scripts are platform-specific, so ensure that the files you choose to download are written for Windows (not



Plug-ins and Scripts are accessed through multiple GIMP menus.

Linux or Mac, unless you have Linux or Mac).

Once downloaded into the correct folders, the Plug-ins and Scripts are accessed through various locations on the GIMP menus such as a New Tab on the main menu (e.g., Script-Fu, FX-Foundry, Video, etc.); or under the Image, Layer, or Filters tabs; or, sometimes, under multiple tabs. Generally, the instructions or description will specify the location on the menus.

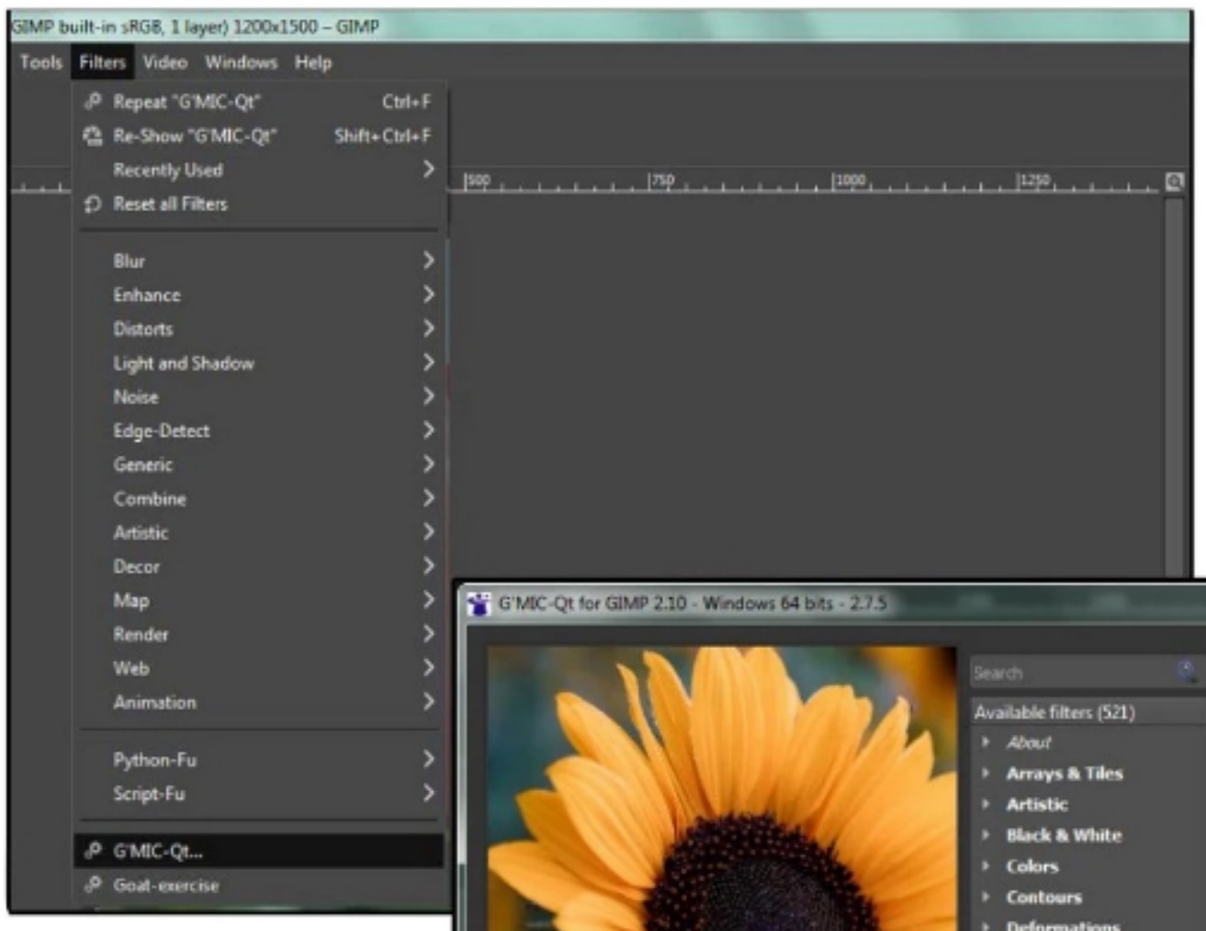
Below are seven of our favorite GIMP Plug-ins and Scripts (with over 800 filter effects, 400+ brushes, and 63 papers [aka textures]).

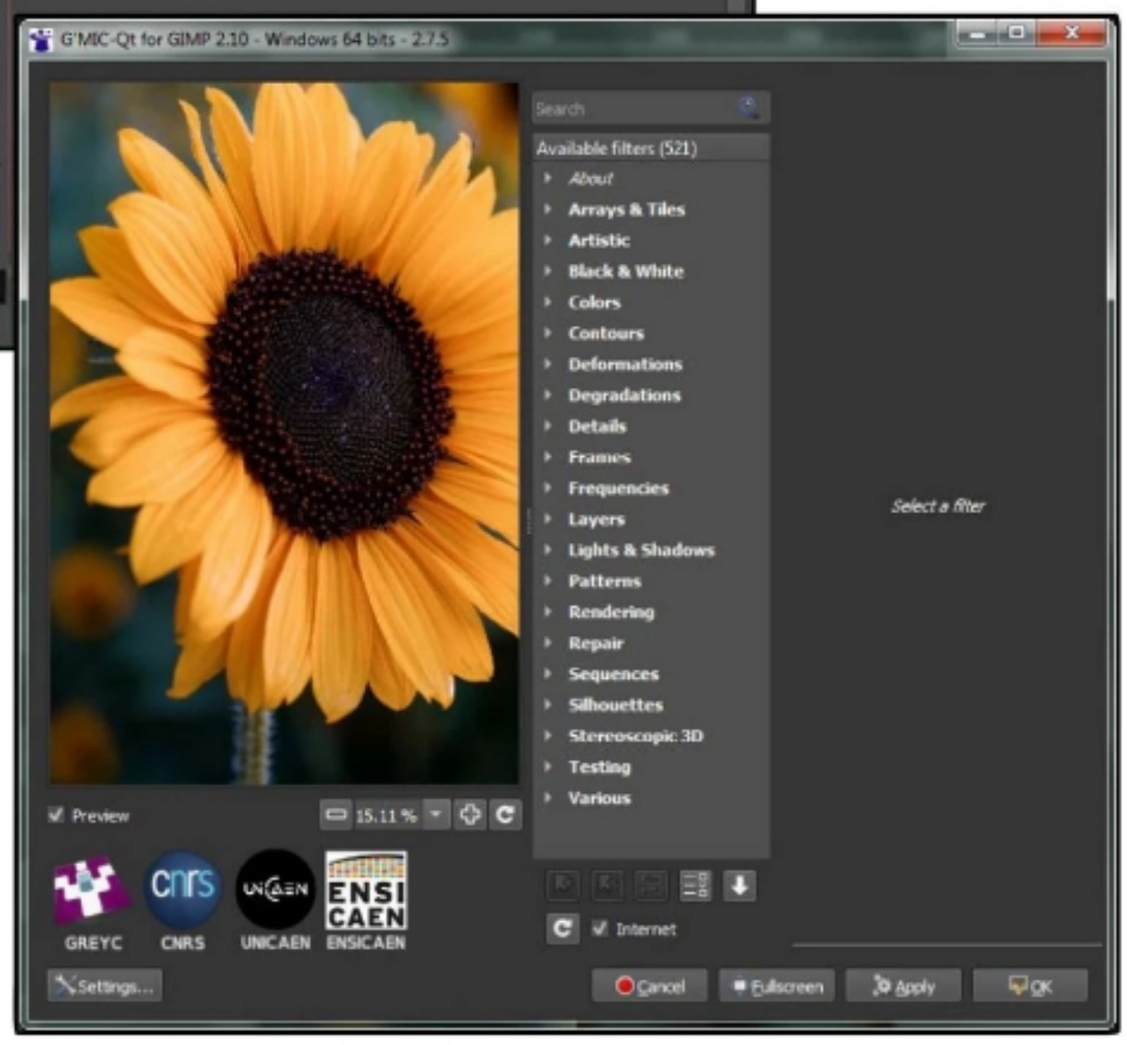
G'MIC (GREYC'S MAGIC FOR IMAGE COMPUTING)

This amazing resource (go.pcworld.com/gryc) provides 521 filter effects within its own menus, which are accessed through the Filters tab. From the webpage linked above, cursor down to G'MIC plug-in for GIMP. Select for GIMP 2.10: Windows: installer or .zip archive.

If you'd like to experiment with some of these filters before you download the plug-ins, select this link for the G'MIC online user version (go.pcworld.com/gmic). Open a file (from your computer), click the Select A Filter button, then choose filters from the menu list and watch the magic unfold.

GIMP comes preloaded with 71 of its own filter effects, so there may be some duplicates. Don't delete any of them until you've tried them on your photos, because the same filter effect (with the same name)—if developed by two different individuals—may produce very different results. You can keep the one you like best or keep them both.





G'MIC has 521 filter effects within its own menus, accessed through the Filters tab.

selections, heals transparencies, uncrops an "Oops, didn't mean to do that," removes undesirable objects; repeats and/or transfers styles and textures from one object to another; maps objects to spheres, boxes, cylinders; renders and enhances dozens of special effects to objects; and more.

Access Resynthesizer features from *Filters > Enhance*, *Filters > Map*, or Filters > Render, then select effects from the submenus.

QUICK SKETCH

Quick Sketch is a plug-in used to convert an image into a sketch/illustration/line drawing. Every photo-editing program I have ever used provides a "Sketch" filter. This one is better than most. Download here: go.pcworld.com/qksk. Note that it adds a tab to the GIMP menu called Script-Fu with *Artistic > Quick Sketch* under that tab.

RESYNTHESIZER

This one (go.pcworld.com/rsyn) heals

FX-FOUNDRY

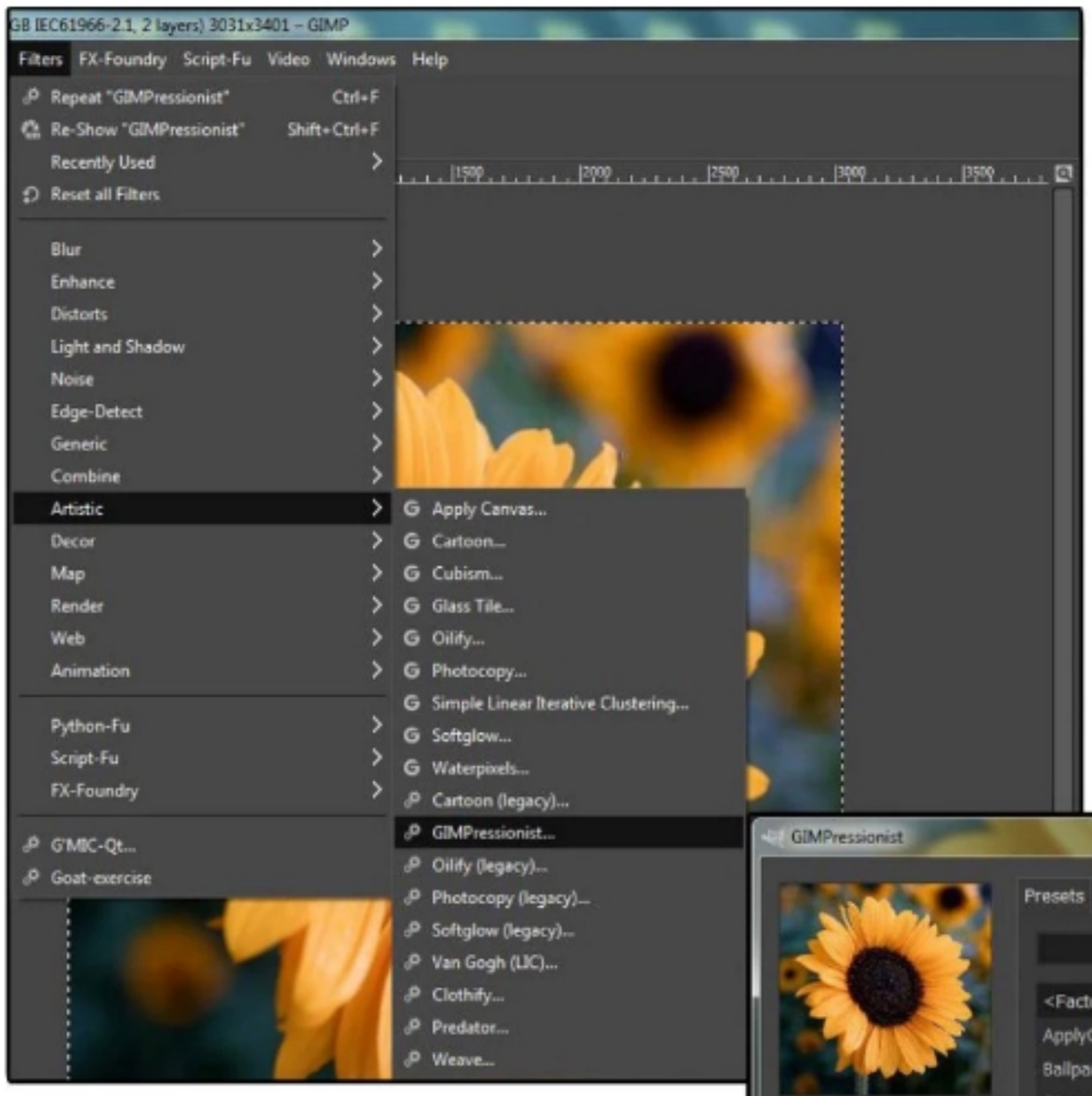
Another remarkable script, with 155 filter effects under its own main menu tab called FX-Foundry (go.pcworld.com/fxfn). Note that some additional scripts are located under the Filters > FX-Foundry, including Animation, Logo, Render). This collection has some filter effects that I have never seen or used before, such as Corroded Painting, Bercovich Lovo, Aquarel, and dozens more.

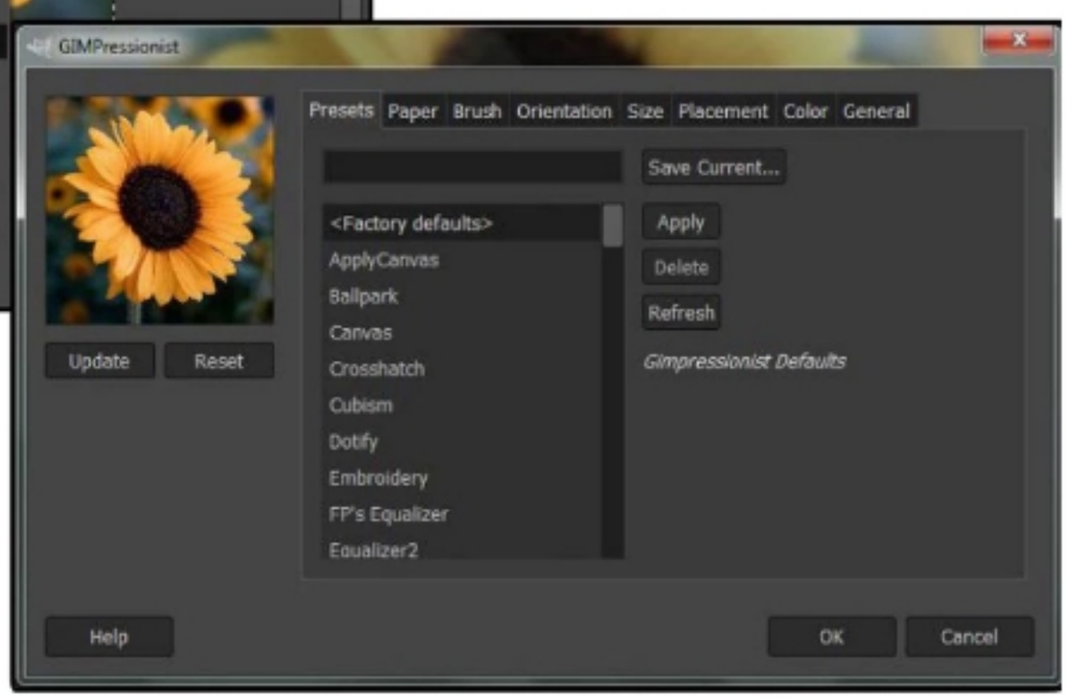
The FX-Foundry script has 155 filter effects.

GIMPRESSIONIST

This is a unique collection of scripts/plug-ins because in addition to the 77 filters, it also provides 461 brushes and 63 papers, which are actually textures. It has its own menus with eight tabs: Presets, Paper, Brush, Orientation, Size, Placement, Color, and General. The Orientation, Size, Color, and other tabs provide options for customizing the Presets (filters), Papers, and Brushes. Click this link to download GIMPressionist (go.pcworld.com/gmpr).

This submenu displays a copy of the current image in the upper left corner, with Update and Reset buttons below. You can scroll through the effects, see what they do, then click Reset to cancel. Nice feature. Like FX-Foundry, the Preset filters include some special effects that are new to me such as Embroidery, Flowerbed, Parquette, Rice, and Ballpark. I can't wait to try them.





GIMPressionist includes 77 filters, 461 brushes, and 63 papers/textures.

These filters are located under Filters > Artistic > GIMPressionist. Copy all three of the unzipped folders into the GIMP > 2.10 > GIMPressionist folder (see "A" from earlier).

For samples of the effects and detailed instructions, try this link: go.pcworld.com/dtin.

CARTOONIZE

Another really fun plug-in/script that converts your photos into cartoons. If you download all the scripts/plug-ins covered in this article, you'll have five "cartoon" effects. Although similar, they each have a slightly unique quality. Click this link to download CarTOONize: go.pcworld.com/crtn.

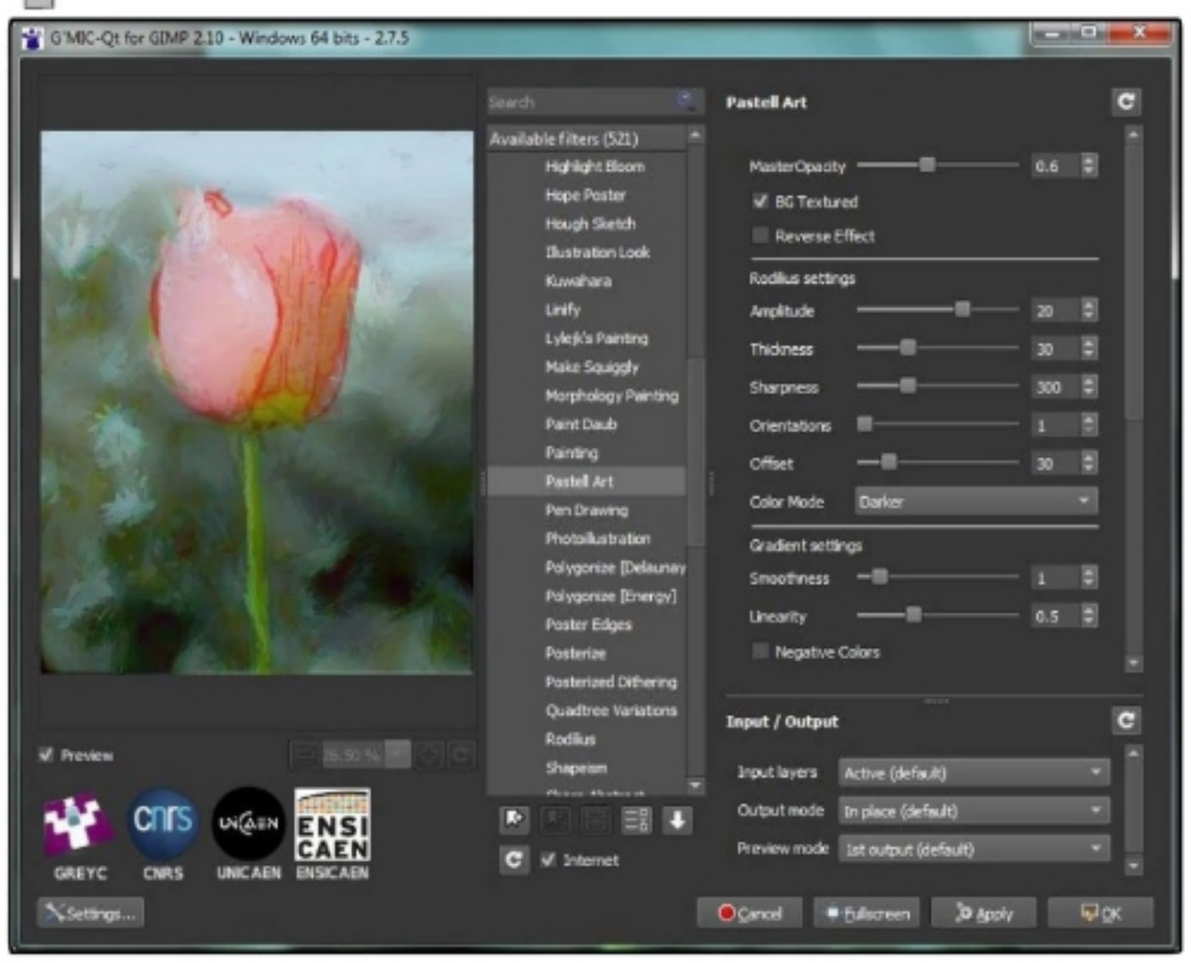
This filter effect is located under the Script-Fu tab > Effects > Cartoonize. Note that you can combine additional filters to enhance the cartoon effect.

A GIMP-2.10.10 SCRIPTS BUNDLE

There are 114 scripts in this bundle (go.pcworld.com/gm14), a collection shared on the internet by a long-time GIMP user named Paul Sherman. He does not claim to be the programmer, but he has continually updated many of the older scripts to make them compatible with the new 2.10 versions. In addition to the scripts, the downloads include gradients, patterns, and some images.

The link above provides detailed installation instructions, a list of all the scripts, how and where to copy the files, the download links, and a project history. Because the scripts are all placed in the scripts folder and the presets are in the GIMPressionist folder, the bundled files are all mixed in with the other scripts and presets under Filters and Filters > Artistic > GIMPressionist. If you download this bundle, you will have duplicate files. Try them all, keep the ones you like, and delete the rest.

The filters/effects included with GIMP are marked on the menus with a capital "G." The independent programmers' scripts and plug-ins are marked with a symbol of double gears.



Free Scripts/Plug-ins double-gears symbol, and a picture of the G'MIC "Pastel" filter effect.

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Tech Spotlight

A video showcase of the latest trends

ThinkBook Plus & ThinkPad X1 Fold hands-on

Lenovo showcased two intriguing PCs at CES: The ThinkPad X1 Fold, which will be the first foldable PC available, and the ThinkBook Plus, which has a second screen on the cover so you can glance at notes without opening your laptop.