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ZENBOOK PRO DUO
REVIEW

ASUS'S DUAL-SCREEN LAPTOP OF THE FUTURE

CES 2020: THE BIG RELEASES FROM THE WORLD'S LARGEST TECH SHOW

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Credit: Getty Images/gorodenkoff

The chips, laptops, and PC gear enthusiasts need to know about

A glimpse into the future. BRAD CHACOS reports

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.
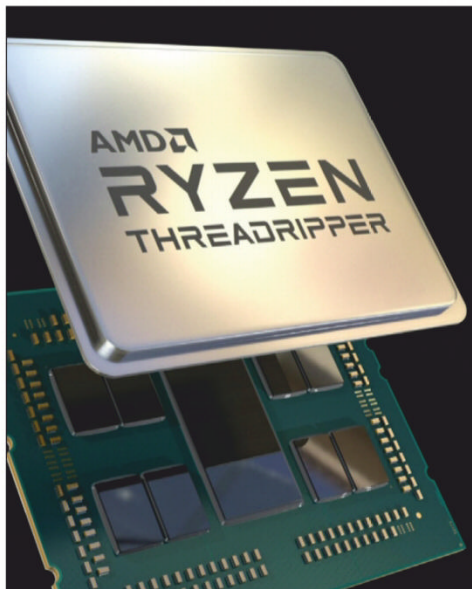
AMD vs Intel vs Nvidia

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

After claiming desktop dominance from Intel 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 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.

AMD also revealed pricing, speed, and release date info for its monstrous 64-core Threadripper 3990X. It'll cost $3,990 (£around £3,000), appropriately enough, when it launches on 7 February. We also chatted with Ryzen development leader David McAfee for further insights into Threadripper 3990X and Ryzen 4000, as well as Anandtech's Dr. Ian Cutress for how Ryzen 4000 squares up against Intel in laptops.

Laptop makers are already lining up to deploy the latest Ryzens, a stunning turnaround from the norm

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

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 will serve as a showcase for AMD's mobile efforts, with both Ryzen 4000 and Radeon 5000M chips inside. The Asus ROG Zephyrus G14, meanwhile, taps into the energy efficiency of AMD's new CPU and Nvidia's Max-Q GeForce technology to offer the world's first 14in RTX laptop. This thing looks badass. Acer's Swift 3, 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 during its keynote as well. It's basically a lower-clocked version of the Radeon RX 5700 with 6GB of memory and a $279 (around £210) price tag. Look for it to take on Nvidia's GeForce GTX 1660 series for PC gaming's

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

1080p sweet spot. In a small round table with press after the keynote, AMD CEO Lisa Su revealed what's next for Radeon: 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 and laptop form, based on the company's Xe graphics architecture. DG1 products are scheduled to launch in 2020.

Things were quieter on the CPU front. Intel confirmed that 'Tiger Lake' is the next CPU code name you need to care about, but didn't say much beyond that, though a Thunderbolt 4 tease quickly devolved into a mess. (But hey, USB 4 logos will actually make

Intel confirmed 'Tiger Lake' as its next CPU code name

sense.) On the brighter side, the company said that Comet Lake H mobile processors will hit 5GHz 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 showed off its NUC 9 mini PC

Intel also showed off its much-leaked 'Ghost Canyon' NUC, which is basically a mini-PC-in-a-mini-PC that revolves around a replaceable Intel Compute Element

AMD showed off its 360Hz
G-Sync Esports displays at CES

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.

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 360Hz G-Sync Esports displays, and new mini-LED G-Sync Ultimate monitors 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 monitors, 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, and Nvidia will toss in three free months of Adobe's Creative Cloud if you buy one.

Desktops gone wild

Desktop builders always bring their craziest concepts to CES, and 2020 was no exception. Razer's Tomahawk N1 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 buy one.

Razer Tomahawk N1

Corsair's Project Orion, 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 above.

Then there's the Big O, a revival of a decade-old oddity by 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

Origin Big O PC
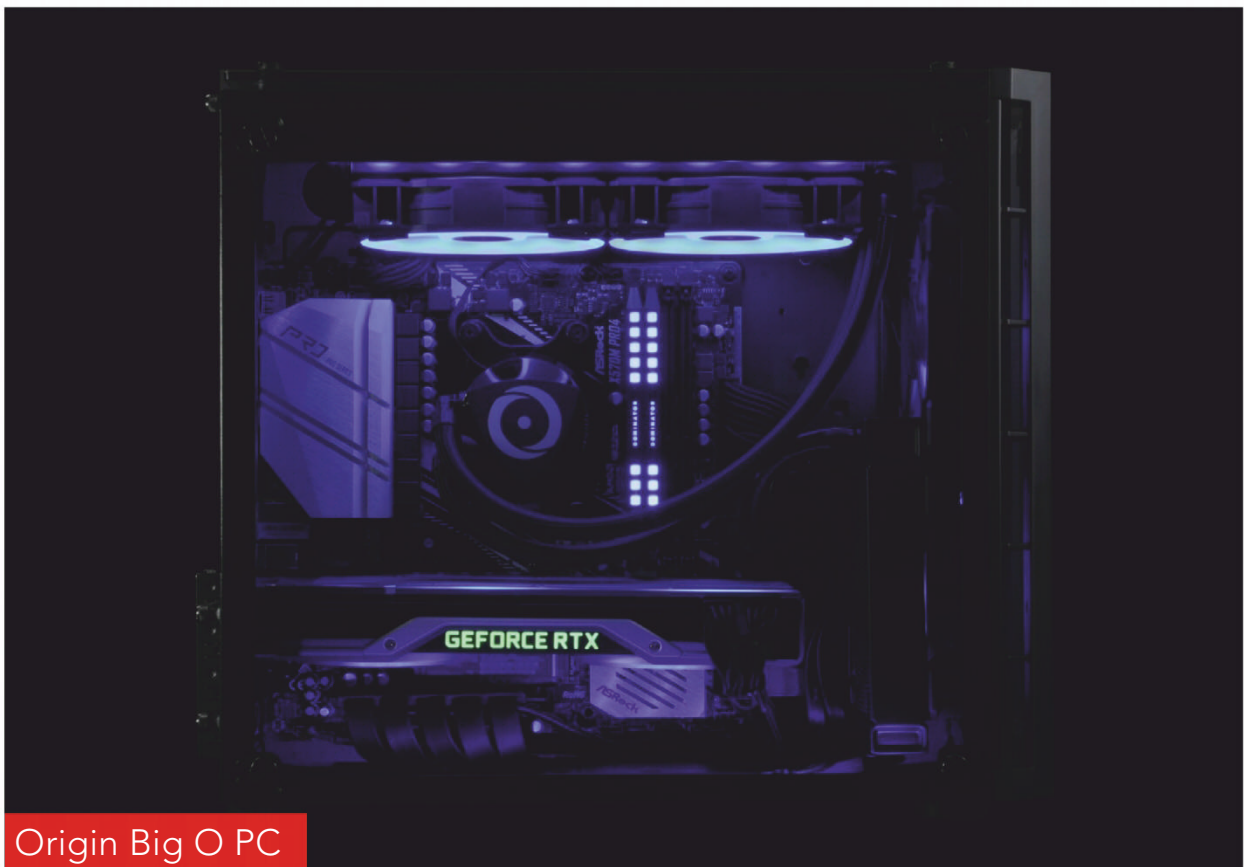
streaming box. Who says console and PC gamers can't get along? You'll be able to heavily customize the components and aesthetics of the Big O, as you would expect from an Origin PC product.

Dell blended console and PC in its own way with the Alienware Concept UFO, 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 are 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 amazing.

iBuyPower's Project Snowblind CL

Finally, it might not be as outwardly exotic as the other desktops shown above, but iBuyPower's Project Snowblind CL 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's ThinkPad X1 Fold in clamshell mode

Lenovo showed off a foldable tablet of its own, a $2,500 (around £1,900) machine dubbed the ThinkPad X1 Fold. Another oddity? The ThinkBook Plus, which plops a secondary e-ink displays to the outside of the laptop's lid, ostensibly to help you focus. Weird. But maybe cool? But weird.

Lenovo also revealed the Yoga 5G, based around Qualcomm's Snapdragon 8cx chip and touted as the first 5G PC, complete with a nano-SIM card slot. It promises all-day battery life, unlike the Microsoft Surface Pro X built using a Qualcomm variant, though app compatibility will still be something to watch. For gamers, there's the Lenovo Legion Y740S, a gaming laptop with no discrete graphics, as it's made to

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

pair with the Legion BoostStation – Lenovo's debut external graphics card dock.

The Acer ConceptD 7 Ezel and Ezel Pro bring a funky, yet useful dual-hinge configuration as well as even beefier hardware to our favourite content creation laptop of 2019. 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, with your choice of Intel or Ryzen 4000 chips inside.

The HP Spectre x360 15t is getting even thinner and smaller, with a battery that just won't quit even with a 4K display in tow. The company says a special
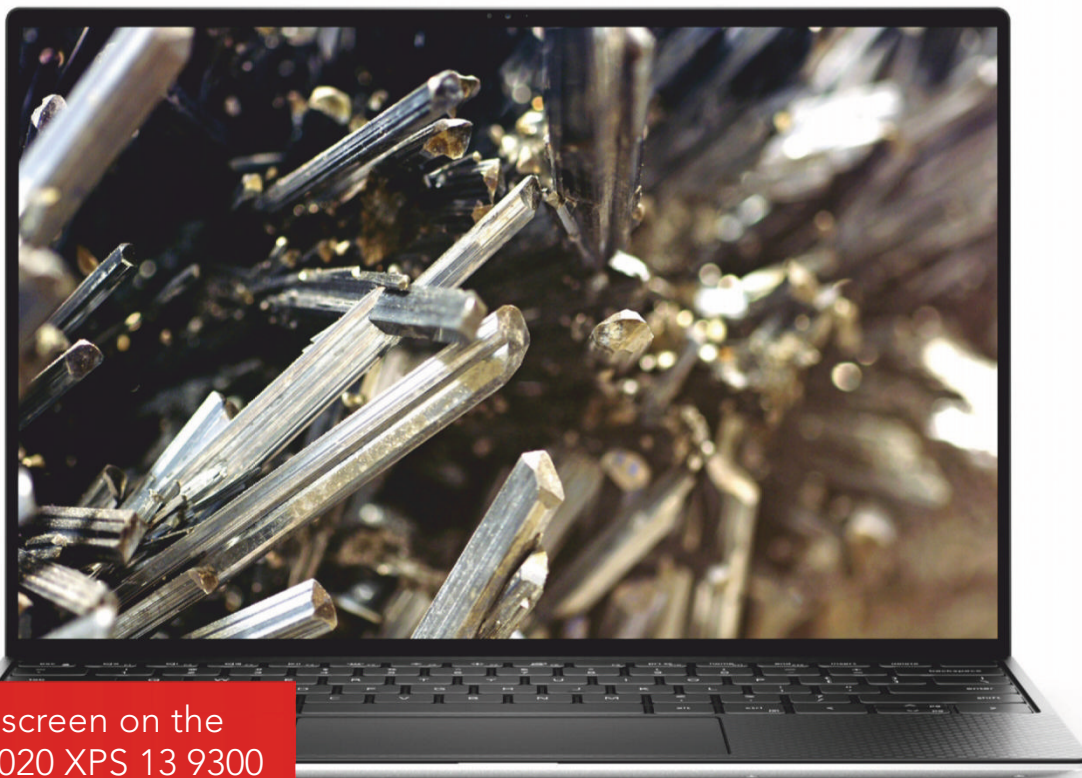
It's all screen on the new 2020 XPS 13 9300

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, while the HP Envy 32 is an all-in-one PC that actually kicks ass with a 4K HDR display, RTX graphics, and speakers that get loud. (It still packs a mobile processor though.)

Dell's XPS 13, 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 appears ready to shake things up for business types, with an ultra-compact design, 5G integration, and Dell Optimizer software that analyses your usage patterns and tries to save you time with routine tasks. Interesting!

There's more where those came from. The Asus ZenBook Duo takes a second stab at the company's dual-screen concept, shrunk down and equipped with more modest hardware (read our review on **page 30**). Samsung's vivid red Galaxy Chromebook is a daring bet on premium Google laptops. Dynabook, essentially the rebranded rebirth of Toshiba laptops, rolled out an ultralight rival for HP's Elite Dragonfly, as well as a

Comet Lake business laptop… with a DVD drive? That's not something you see very often these days.

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 a pair of mesh routers based on Wi-Fi 6. Netgear, meanwhile, added 4G LTE capabilities to its wonderful Orbi mesh router, and expanded its popular Nighthawk line into mesh routing as well – though the MK62 Nighthawk Mesh Wi-Fi 6 System ditches the series'

One of the two Wi-Fi 6 (802.11ax) mesh products Linksys showed off at CES this year

iconic aggressive design for a boring 'black box' look in the transition.

External storage also impressed, with Samsung adding fingerprint security to the blazing-fast T-series SSDs we love and Seagate blending portable performance with pretty looks.

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.

8 exciting Android announcements you might have missed

All the fast, folding, and futuristic things. MICHAEL SIMON reports

Another year, another CES in the books. Once again, the halls of the Las Vegas Convention Center were filled with folding PCs, helpful smart home gadgets, and futuristic AI dreams. But among all the hype that may or may not ship, we

found some truly useful and exciting Android-related things at CES this year:

1. Wacom One

In the age of tablets, styli, and Bluetooth pencils, a dedicated drawing tablet might seem unnecessary, but Wacom has other ideas. The newest member of its family of computers, displays, and tablets is the Wacom One (£359), which brings the usual Wacom accoutrements: a 13in display, pressure-sensitive stylus, an integrated stand, handwriting recognition. There's one thing this tablet has that the others don't, though: Android support. It's somewhat limited (supported handsets include a handful of Huawei models and the Samsung Note 9 and Galaxy S8 and later), and

you'll need to hook up a labyrinthine set of cables and dongles for it to work. But once it's ready to go, your Android phone will get the full Apple Pencil treatment. And when you're not using the Wacom One, you'll even be able to use the Wacom One pen on your phone. Try doing that with an iPhone.

2. TCL phones

Android fans should be familiar with TCL through its BlackBerry and Palm phones as well as Roku-powered smart TVs, but for the first time, the China-based company is going to be making its own smartphones. At CES, the company showed off three models: the 10 Pro, 10L, and 10 5G. The high-end 10 Pro model, which TCL says will sell for less than $500 (around

TCL will be launching its own phones this year, including an affordable 5G model

£375), has an infinity display like the Galaxy S10, four rear cameras, and an in-display fingerprint sensor. The 10L has a rear fingerprint sensor, and the 5G model is powered by a Snapdragon 7 Series processor, likely the upcoming 5G-integrated 765 chip. TCL even demoed a folding phone prototype, one of several the company says it is experimenting with.

We don't know much in way of availability (frankly we'd be surprised if TCL launched in the UK), but consider our interest piqued.

3. Razer Kishi

Razer made a push into Android gaming last year with the Nintendo Switch-inspired Junglecat controller, but there was just one problem: it worked only with

The Razer Kishi controller uses USB-C and promises to be compatible with way more phones than the Junglecat

a handful of high-end phones. The upcoming Kishi controller fixes that. Similar in theory and design to the Junglecat, the Kishi controllers "provide clickable analogue controls and thumbsticks on both sides of the phone with a universal fit created in partnership with Gamevice for compatibility with most smartphones". Rather than Bluetooth like the Junglecat, the Kishi uses your Android phone's USB-C port, and even includes pass-through ports on the controller for charging.

We're not sure why anyone would buy the Junglecat now, and we can't wait to check out the Kishi when it arrives in a couple of months.

4. Google Assistant

Google likes to save its biggest announcements for its own stage, of course, but it always brings something new to CES. This year, it was all about Google Assistant. The biggest news is the obverse addition scheduled actions, which lets you ask Google to turn on the coffee pot on at 6am the following morning, but there are numerous others, including:

Digital sticky notes for Smart Displays: If you want to remind yourself or someone in your home to do something, you can add a sticky note to your Google Nest Hub display just by asking Google to leave a note.

Read aloud: If you've ever wanted Google Assistant to read a news article on your phone, you'll soon be able to ask it to do so. What's more, it can translate the content it reads into 42 languages.

Google brought some new Assistant features to CES this year

Interpreter mode: Speaking of languages, businesses will now be able to use Google Assistant as a live translator in hotels, airports, sports stadia, and other places to help bridge language barriers.

Privacy: In addition to new commands that let you clear your activity, you'll be able to say, "Hey Google, that wasn't for you," if your phone or speaker accidentally triggers to forget what it heard.

More devices: Google Assistant is set to blow up in 2020, with support for smart displays, speakers, headphones, and soundbars from Acer, Anker, Belkin, JBL, Lenovo, Philips and LG, among others, all on the way.

The TiVo Stream 4K runs Android TV and stole out hearts

5. TiVo Stream 4K

Every time we think Android TV is ready for the Google Graveyard, something comes along and gives it new life. At CES that was the TiVo Stream 4K. A massive departure for the DVR pioneer and a bid to reclaim its position as an industry leader, the TiVo Stream 4K is exactly what its name suggests: a media streamer. But while it won't record your favourite programmes or let you skip commercials (at least not yet), it will collect all of your subscribed services into a cohesive menu so you can discover new shows and continue watching the ones you love. It comes with an actual remote with actual buttons, too.

The proof of the pudding will be in how many services TiVo can get on board before it ships in April. Even if it's half as good as we hope, it'll be the answer to our streaming prayers.

Samsung's Selfie Type prototype lets you use your selfie cam to type on an invisible keyboard
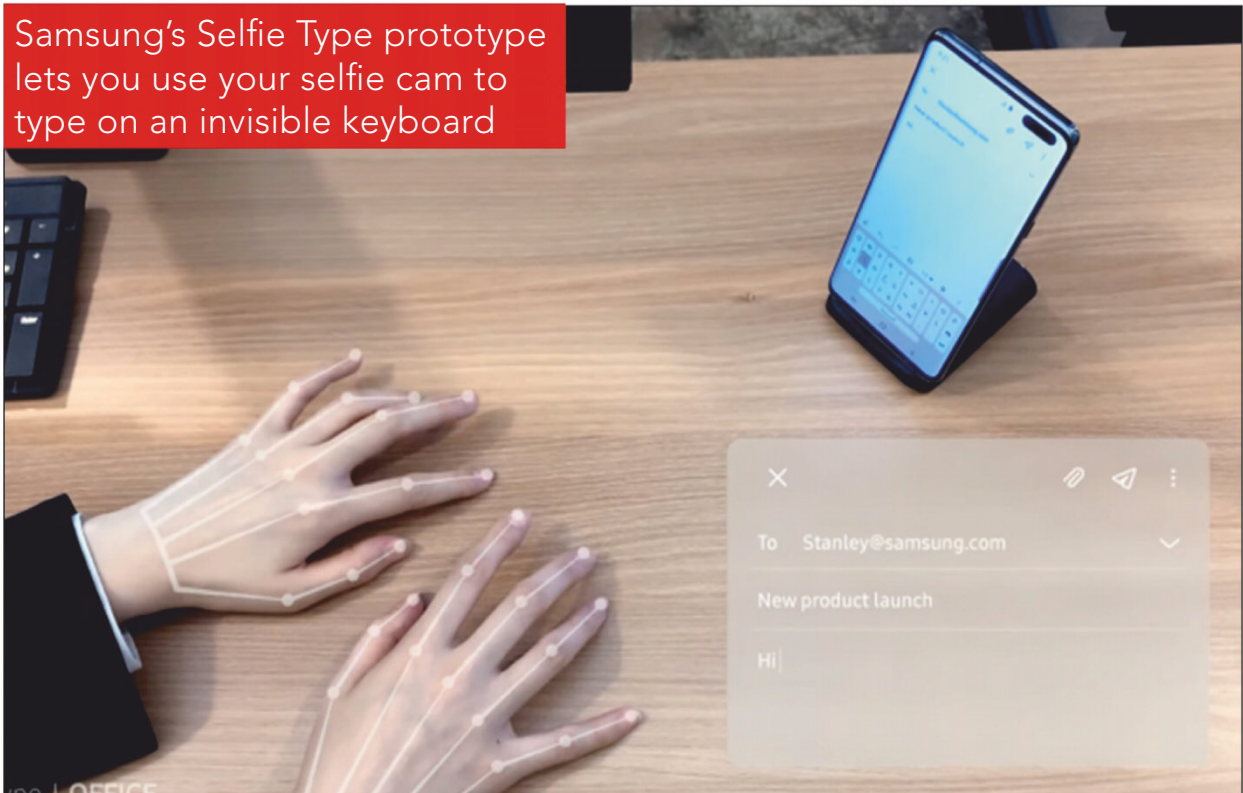
6. Samsung Selfie Type

Samsung spent CES dreaming big, but one of the more practical moon shots is something called Selfie Type. As its name suggests, it uses your Galaxy phone's front camera to 'project' a keyboard onto any flat surface and use AI to figure out what you're trying to type. We're sceptical, especially because Samsung wouldn't let anyone actually try it out for themselves, but it's definitely an intriguing idea. We're not expecting it to ship on the next Galaxy phone, but if it does, we'll be stoked.

7. Aukey Omnia Chargers

We can never have enough chargers in our gear bags, especially when they can stake the claim of

The Aukey Omnia chargers come in 61-, 65-, and 100-watt varieties

bringing incredibly fast charging speeds in a tiny package. Aukey's Omnia chargers check off every box. The gallium nitride, power-delivery mini bricks are 'up to 66 percent smaller when compared with stock MacBook 13in chargers' and should be able to power basically anything that uses USB-C for charging (though the top speeds will be reserved for USB-C Power Delivery-capable phones, specifically the Google Pixel).

Available in 61-, 65-, and 100-watt varieties with either one or two USB-C ports, the plugs promise to be safe, speedy, and smaller than most of the ones we have now. Pricing hasn't been announced, though Aukey's chargers are usually very affordable. Look for the Omnias in the second quarter of 2020.

8. Belkin Soundform Elite

Smart speakers powered by Google Assistant are a dime a dozen, but the Belkin Soundform Elite (£279) is something different. For one, the audio comes from Devialet, so you're getting the company's patented Speaker Active Matching technology that "ensures radically high fidelity so you can experience music as the artist intended". (That means it sounds good.) For another, you can pair it with any Google Assistant speaker to play multi-room audio. But the best part? It's also a wireless charger and a fast one (9 watts for Galaxy phone, 10 watts for Pixels). Let's see Apple's HomePod do that.
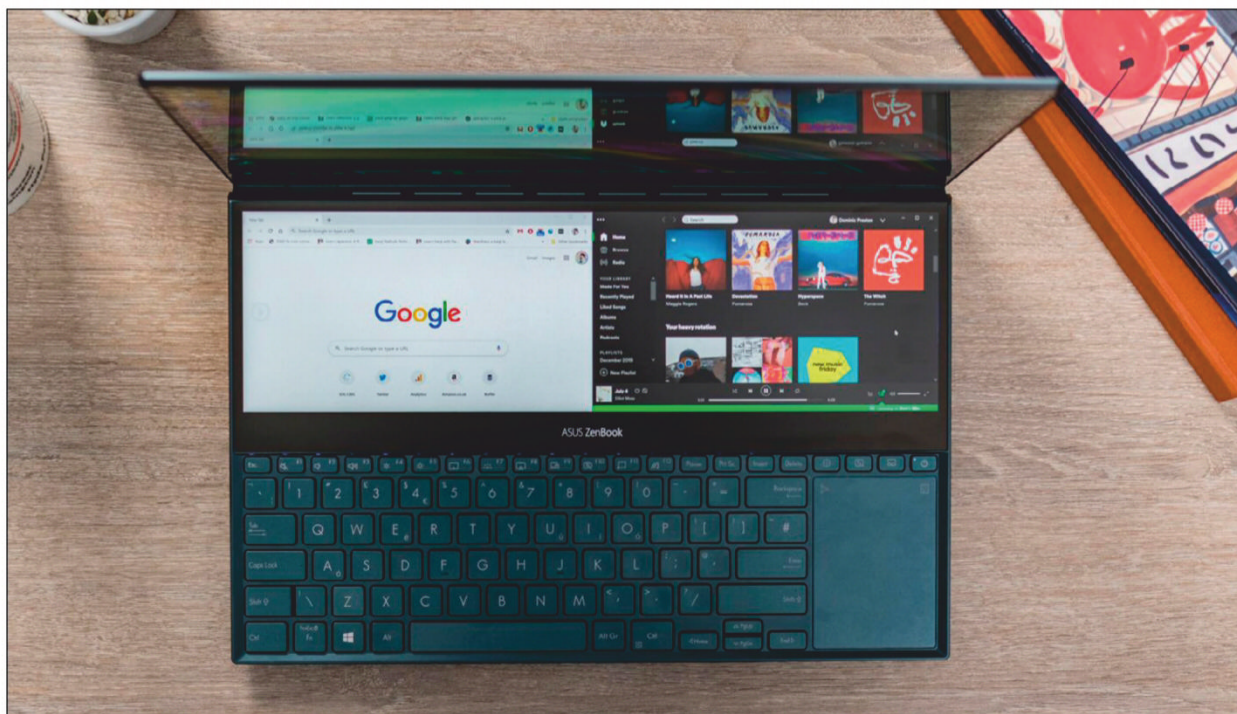
Asus ZenBook Pro Duo

Price: £2,499 from **fave.co/2NOBuBO** ★★★★☆

You can usually rely on Asus to come up with something a little different for its laptops, and Computex 2019 was no different: the company unveiled what it calls the future of laptops: the ZenBook Pro Duo, a high-end creative device that boasts not one, but two 4K displays.

Thanks to a 4K OLED main panel and RTX 2060 GPU backed by up to 32GB of RAM and a Core i9, the specs are about as premium as it gets, making this a veritable portable powerhouse. With a secondary display built into the main body, the ZenBook Pro Duo is built for multitasking and heavy duty creative

work – think Apple's MacBook Pro Touch Bar on steroids – but that brings with it design changes and compromises that you're likely to either love or hate.

Price

It should probably come as no surprise that the ZenBook Pro Duo isn't exactly cheap. There are two models available, which differ in processor, RAM and storage. The cheaper model has a Core i7, 512TB SSD and 16GB of RAM, and is available for £2,499.

Jump up to a Core i9, 1TB storage and 32GB RAM and the price will also shoot up to £2,999. That'll be overkill for most people, but then the whole laptop is overkill really, and the extra processing power and RAM could make the difference for serious creatives. Both models feature the same RTX 2060 GPU at least.

Asus itself also sold another model that dropped the RAM way down to 8GB and the storage to 256GB, but this is sold out on the company's own site and I haven't seen it for sale elsewhere – and with those specs is likely to be unattractive to most potential Pro Duo buyers in any case.

It's worth noting that there's also a cheaper 14in model – the ZenBook Duo – which drops the 'Pro' moniker but boasts roughly the same design. Beyond the smaller screen it caps out at an i7 processor, 512GB storage, and 16GB RAM, but more importantly drops down to HD on the display and an MX250 GPU.

Displays

Here's a choice you didn't used to have to make when buying a new laptop: how many displays do you want it

to have? Secondary displays have been around in some form for a few years, seen in the likes of the MacBook Pro's slimline Touch Bar or Asus's own ScreenPad, which replaced the traditional laptop trackpad with a small touchscreen. The ZenBook Pro Duo takes this to the next level, with a full-width 4K display built into the body of the laptop, right above the keyboard.

If that sounds either mad or pointless to you, then you're probably not alone. Still, it's remarkable how quickly I got used to the second screen once I started using it, and while I never quite felt it was indispensable, I definitely miss it when I'm back on a regular ultrabook.

The lower screen sprawls across half of the laptop's body, starting at the edge of the main display and running down to the top edge of the slightly smushed
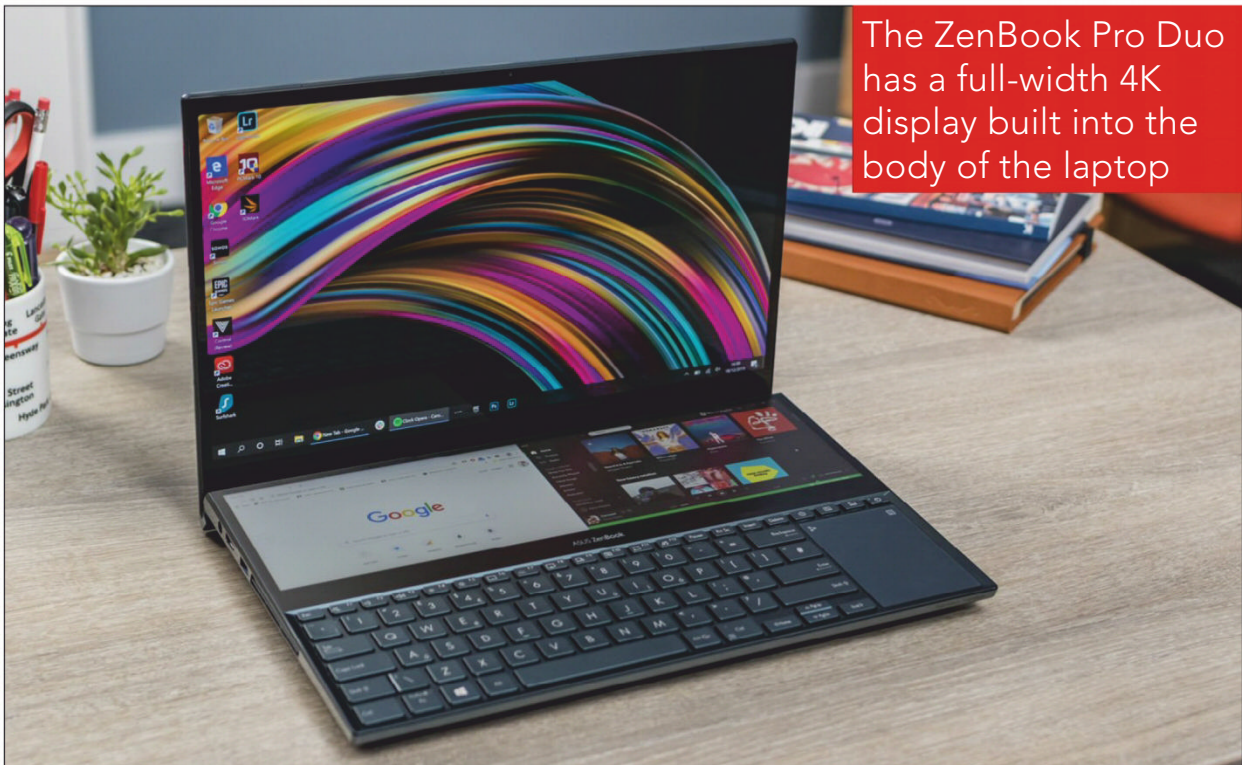
The ZenBook Pro Duo has a full-width 4K display built into the body of the laptop

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in keyboard and trackpad, and most of the way to the edges of the body too.

In terms of raw specs, it's a 14in IPS LCD with an aspect ratio of 3,840x1,100 – so it's just about half the size of the main OLED panel, which is 15.6in and 3,840x2,160. Asus touts the secondary display as 4K, which isn't technically true, but is accurate in the ways that count: it's the same pixel density as the top panel, so there are no awkward resolution shifts between the two panels.

You might have noticed that the screens differ in more than size. While the top panel is OLED the secondary screen is only an LCD. That's a compromise presumably driven mostly by cost, but one that shows in side-by-side comparisons – the only kind of comparisons that are really possible, given the two screens are basically touching. The second screen is dimmer and less rich, even with brightness cranked up to the max, and has a more matte finish – I got used to the difference eventually, but never totally stopped noticing it.

The difference makes sense when you consider that Asus still intends you to use the bigger display for the main part of creative work, which bears out in the display quality. While that big screen covers 100 percent of the colour gamut in both sRGB and AdobeRGB, the lower panel drops to 97 percent and 78 percent respectively – enough to still look nice in use, but not quite there for full-on editing work, which it really isn't designed (or needed) for.

From a software perspective things mostly work well. Mostly. You can fit up to three different app windows in

The top panel is OLED the secondary screen is only an LCD

the bottom panel side-by-side, dragging them around to suit whatever multitasking you want to do at the time – whether that's keeping the file explorer open while you work on a project, keeping an eye on Google Maps and a calendar while you book hotels on the main screen, or just running Spotify and Slack while you get on with your work up top (guilty). You can switch between apps quickly on the fly, set app shortcuts to open some programs straight to the second display, and save certain combinations of programs, letting you quickly access your favourite setups.

There are headaches, though. Reopen the laptop after letting it go to sleep and it forgets the screen layout of all your apps, instead tucking all your apps back behind each other on the main display. Both displays are touchscreens, which is convenient until

Switching between apps is easy on the Asus
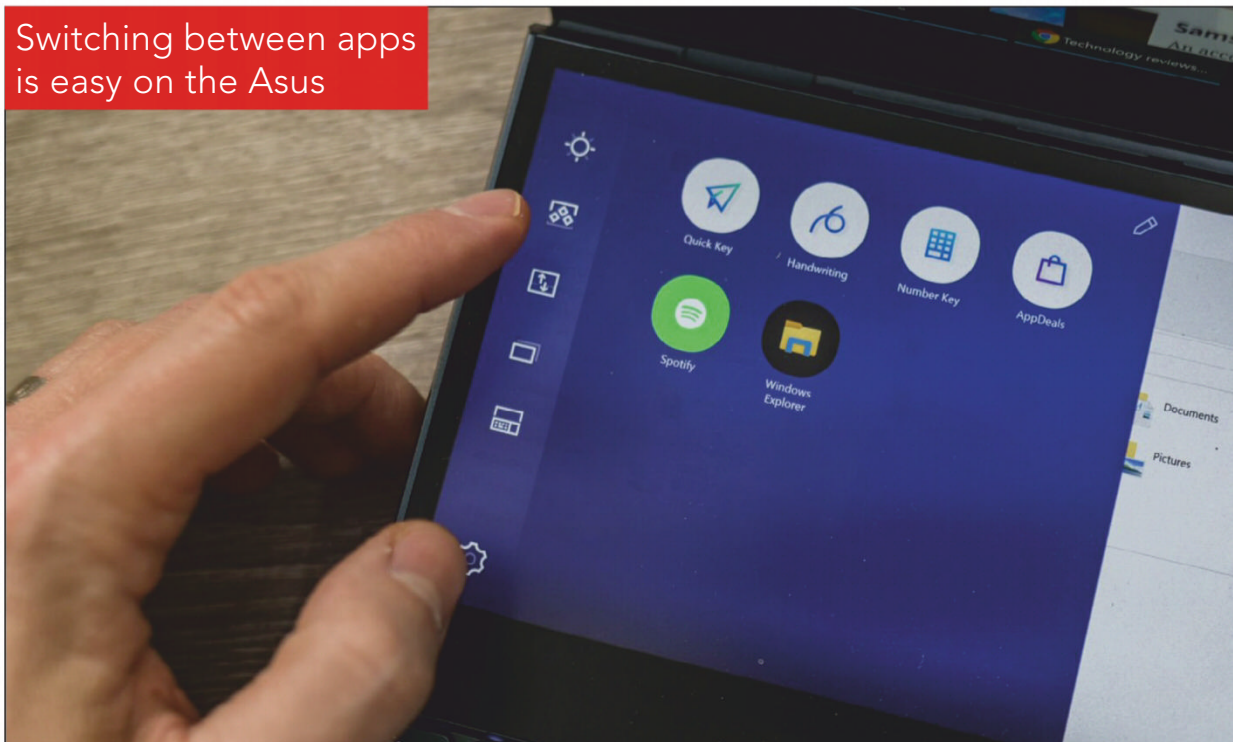
you have the instinct to drag windows between the two panels and forget there's a gap between that basically stops it working.

If you'd rather focus on one task at a time that's an option too. You can let one program sprawl across both screens, ideal for programmers who want extra vertical real estate, or complex creative apps where you can move certain controls down to the bottom display – keeping the project timeline on the lower screen while editing video, or dragging a couple of Photoshop's three million tools down and out of the way.

The average user will, in all honesty, not get a whole lot out of this unless they really, really hate switching windows – though it is admittedly great getting to drag distractions down to a secondary display. But for anyone used to working on a desktop with multiple

monitors who wants the same experience on the road, it's clear to see why the Pro Duo might appeal – so long as you can put up with the impact that second screen has on the rest of the laptop's design.

Design

So here's the downside: it's tricky to fit a 14in display into the body of a laptop. For what it's worth, Asus has done a good job of it, with minimal bezels around the screen and not a lot of wasted space: mostly just a thin black bar that has the ZenBook logo between the screen and the keyboard.

But in another sense, that's exactly the problem: with no wasted space there's also no free space, and the whole design is inevitably cramped and squeezed. There's still a full-size keyboard, but the trackpad has had to shift to the right-hand side of it, squeezed into the corner, and doubling as a numpad thanks to LED strips you can activate to illustrate the number keys.

There's almost no unused space at all on the main body, which means there's nowhere to rest your hands while you type. Asus also includes a detachable palm rest, but that's just another thing that you have to carry around with you in order to use the laptop comfortably, and either way you'll probably find that the Pro Duo is tricky to use in cramped conditions.

The keyboard itself is pretty comfortable to use at least, with a tactile, responsive feel, good-sized keys (no compromise for space there), and a comfortable 1.4mm travel distance. The trackpad is great too, and I quickly adapted to having it next to rather than below the keyboard, but you just can't get away
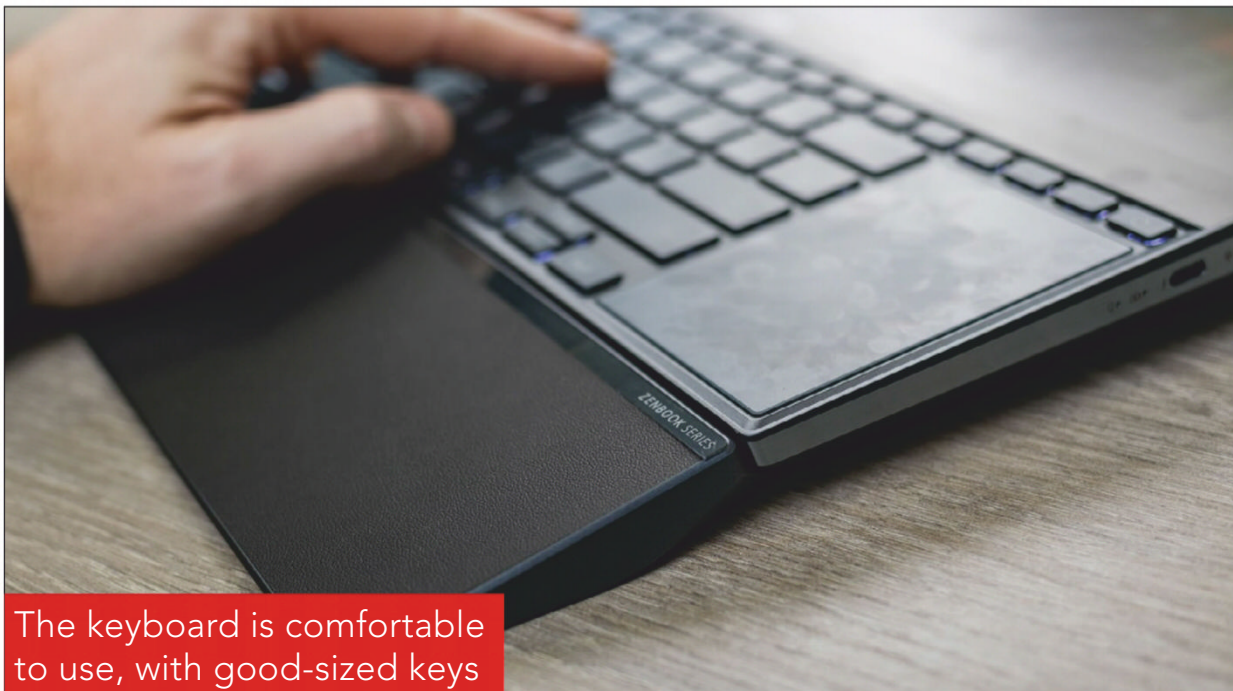
The keyboard is comfortable to use, with good-sized keys

from the fact that it's seriously small, and that may be a compromise too far for some. I'd recommend investing in a portable mouse.

The Pro Duo is hefty too. Between the top-end specs and the extra display, this thing is thick, and it's got the weight to match at 2.5kg – an ultrabook this isn't. Portability clearly wasn't the priority here, and while it's still just shy of the biggest gaming devices out there, there are plenty of other premium creative laptops from the likes of Apple or Dell that offer similar performance with a slimmer build.

One advantage of the heft is that it does leave Asus space for plenty of ports, though the potential does feel a little wasted. You get two full-size USB ports, one USB-C and one HDMI, along with a dedicated power port – Asus still hasn't jumped onto the USB-C charging bandwagon, sadly. Still, given the intended use case

it's odd that there's not even a microSD card slot, let alone full SD, while limiting it to a single USB-C slot and no ethernet at all means you might still need to cart a dongle round anyway.

As is standard for Asus laptops these days, sound is provided by Harmon/Kardon, though I found it unexpectedly weedy. The tone of the audio is strong, with a nice balanced sound profile, but maximum volume is actually a little lower than I'd have thought, and I found myself cranking things up higher than I usually ever would.

The Asus ErgoLift hinge design returns, naturally propping the base of the body up at a slight angle – ideal for both cooling and comfortable typing – and beyond the silly screen the rest of the design is actually very restrained. It's available in dark blue ('Celestial

Blue') finish with pretty minimal detailing, with both the Asus logo and its concentric circle finish offset slightly on the aluminium body.
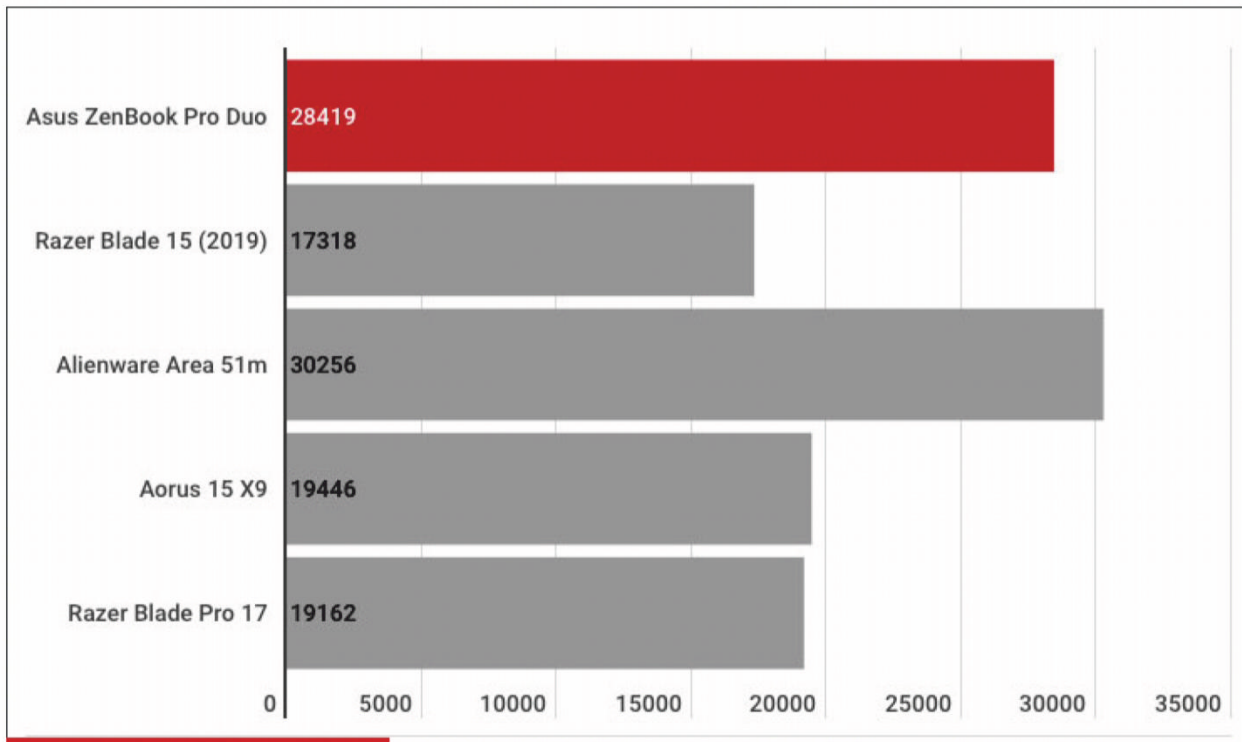
Performance

So it's a bit of a brute and the second screen (mostly) works, but does the ZenBook Pro Duo deliver where it counts? Yes, but not without downsides. I reviewed the top-of-the-range model with a Core i9-9980HK backed up by 32GB of RAM, which is more than enough for even fairly demanding work, and unsurprisingly it pretty much breezed through our benchmarking.
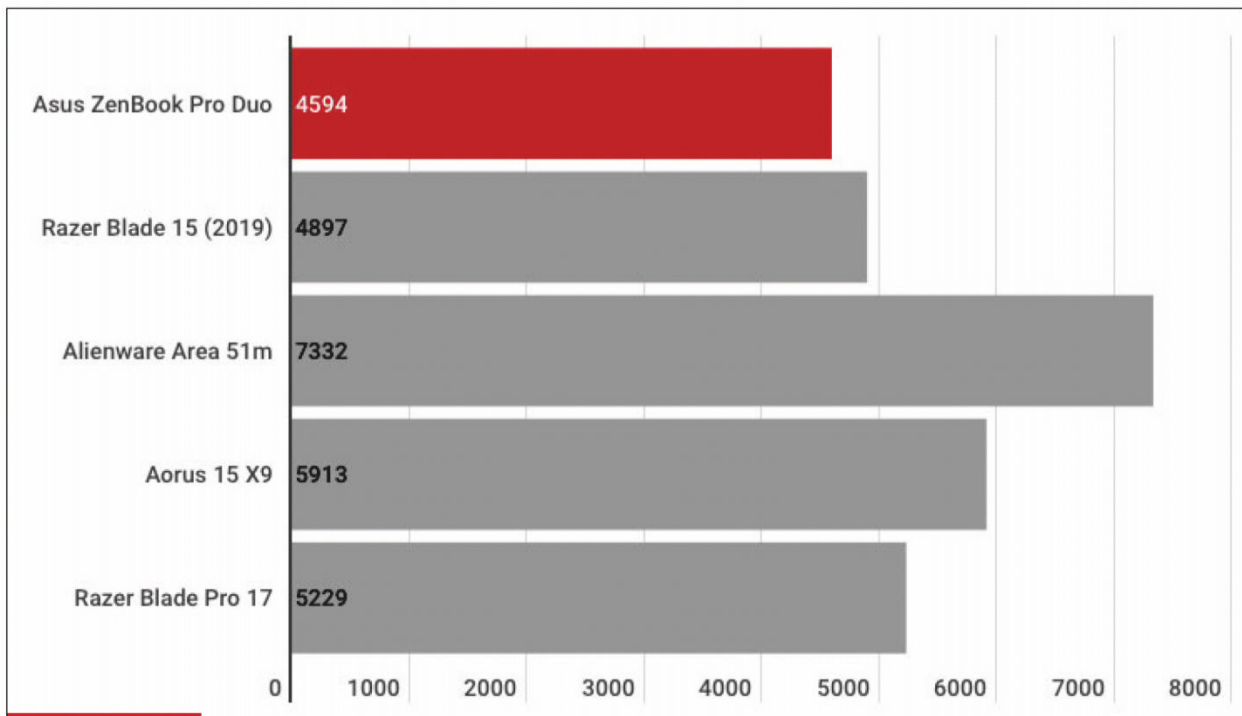
Battery is an issue, though. All that power doesn't come easy, and I found that even simply using the device for writing in Chrome, with Spotify, Slack and Twitter going on elsewhere, I'd be lucky to get three or four hours of continuous use unless I cut the display brightness right down. Do anything more demanding and that runtime will naturally drop further. That means you'll always want the power brick nearby, and that's big and hefty in its own right.

There's cooling too. Asus has gone all out, with much of the side chassis occupied by large vents which spew out hot air pretty much continuously. It's another reason you won't want to use this thing on your lap, but you'll even want to avoid keeping any cold drinks in the way of the exhaust – they won't stay cool for long.

With all that oomph and cooling power, you might think this would be a capable gaming laptop too. And it sort of is, with the RTX 2060 in particular letting you tap into the latest ray-tracing tech. There's not quite enough oomph to power the full 4K display at

Geekbench 4 multi-core

Laptop	Score
Asus ZenBook Pro Duo	28419
Razer Blade 15 (2019)	17318
Alienware Area 51m	30256
Aorus 15 X9	19446
Razer Blade Pro 17	19162

PCMark 10

Laptop	Score
Asus ZenBook Pro Duo	4594
Razer Blade 15 (2019)	4897
Alienware Area 51m	7332
Aorus 15 X9	5913
Razer Blade Pro 17	5229

respectable frame rates, but drop down to 1080p and this thing should run.

The downside is that it's hard to really make the most of the second screen while playing. You can leave Twitch, YouTube, or other apps open on the lower display, but because of how Windows handles full-screen games you'll end up minimizing your game window the moment you tap on anything else. You can work around this by playing in windowed mode, and I'm sure there are other hacks to make the most of it, but it's not quite a smooth, flawless experience yet.

One final up note – alongside the usual wireless connectivity options this also includes support for Wi-Fi 6. Not every router will make the most of the new tech anyway, but under the right conditions it should help you get noticeably faster connection speeds.

Verdict

Don't write the ZenBook Pro Duo off as a mere novelty without trying it. This may or may not be the future of laptops, but for creatives, multitaskers, and the attentionally challenged, the second display quickly makes a case for itself.

The question isn't really whether you need an extra display, then, it's how much you're willing to compromise elsewhere to get it. Disappointing battery life and a giant chassis are the immediate downsides, but the cramped keyboard, teeny trackpad and excessive heat will all irritate more or less in their own way, and that's before we even get to the price tag.

The thing is, after a few days of working with two screens, dragging apps around and saving different

preset layouts, most of those headaches fall to the wayside, and the Pro Duo is an easy laptop to love. It's not perfect, and no doubt future dual-screen devices will find better ways to make the form factor work, but this is one hell of a first attempt. Dominic Preston

Specifications

- 15.6in 4K OLED (3,840x2,160) touchscreen display
- 14in 4K LCD IPS (3,840x1,100) touchscreen ScreenPad Plus secondary display
- Windows 10
- 8th Generation Intel Core i7-9750H or Core i9-9980HK processor
- Nvidia GeForce RTX 2060 GPU
- 16/32GB RAM
- 512GB/1TB SSD
- 2x USB-A 3.1

For creatives and multitaskers, the second display quickly makes a case for itself

- 1x USB-C 3.1
- 1x HDMI
- 1x 3.5mm headphone jack
- Wi-Fi 6
- Bluetooth 5.0
- IR webcam with Windows Hello
- Full size, backlit chiclet keyboard
- Numpad built into touch pad
- Audio system from Harman/Kardon
- 359x246x24mm
- 2.5kg

Microsoft Edge

Price: Free update ★★★½☆

The new Edge browser is here. Microsoft is pushing it out to Windows 10 PCs, a complete revamp built on the Chromium technology of Google Chrome. This review, based on a late beta version available via the Windows Insider program, is a solid, mainstream browser with a few tempting features. But it's facing a real uphill battle.

By any estimate, Microsoft's Edge – new or old – won't make a splash. That's because, at least where market share is concerned, it's Google Chrome's world, and we're just living in it. As of December

2019, Chrome commanded over 67 percent of the browser market, as measured by NetMarketShare. Firefox, currently the second most popular browser, captured just 9 percent.

Edge's thin market share is an opportunity for Microsoft to switch horses midstream. Because the new Edge is built upon the Chromium open-source engine (earning it informal monikers such as 'Edgium' and 'Chredge'), Edge is now closer to Chrome than ever before, and can tap into Chrome's vast library of extensions. Microsoft may have painstakingly gathered around 100 productivity extensions for Edge, with more for ad blockers and other utilities, but it still can't hold a candle to the hundreds (thousands?) of extensions available via the Chrome Web Store.

Beginning 15 January, Microsoft began replacing the old Edge with the new Edge on consumer PCs with Windows 10 Home and Windows 10 Pro, though Release Preview Insiders will be the first to get it. Businesses will have a choice of whether to accept the new Edge, but consumers won't. Like the old Edge, the new Edge is integrated into Windows 10, though versions will be available for Windows 8/8.1 and even Apple's macOS.

Setup: Quick and easy

Virtually every browser available minimizes the setup and installation process as much as possible. The new Edge is no different.

Until Microsoft actually begins replacing the 'old' Edge with the 'new' Edge, we don't know exactly how the process will work. But simply downloading
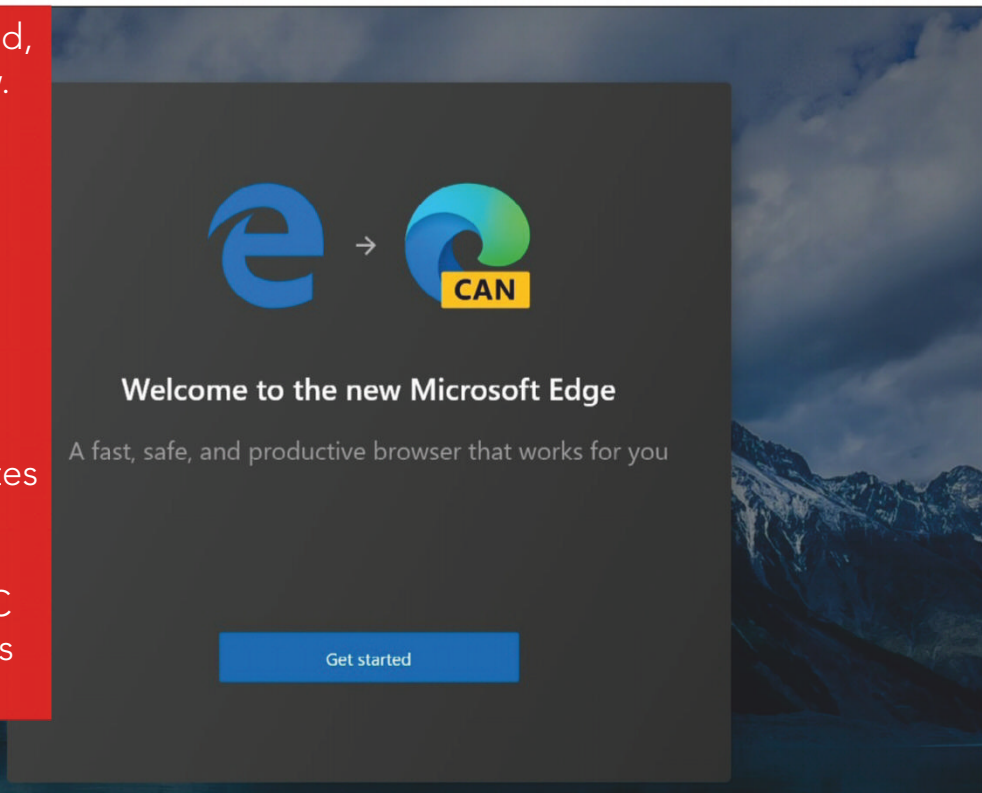
the 'Canary' build, as we did, and installing it showed that Microsoft was more interested in migrating users from Chrome rather than shifting from the old Edge to the new.

Setup, in fact, proceeds extremely quickly. Your choices essentially entail whether you'd like the new Edge to import Favourites, passwords and the like from Chrome or another browser; how you'd like to set up your new tab screens; and whether to accept targeted advertising to 'improve your browsing experience'. Rest assured that last choice is optional.

In selecting a new tab layout, you'll have a choice between layouts defined as 'Focused', 'Inspirational' and 'Informational'. The former choice offers little more than a search bar and a few shortcuts to

The new Microsoft Edge assumes you use Chrome (or did on my machine), and offers to import your data by default as part of the setup process
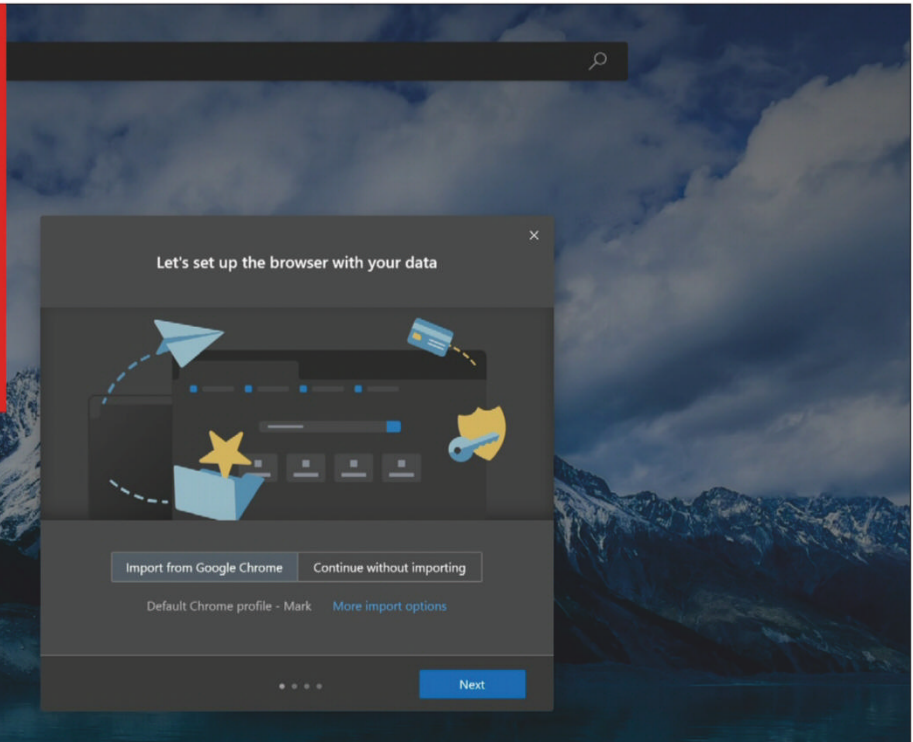
The brief setup process for the new Edge asks you to pick a new tab setup

I prefer the 'Informational' layout within the new Edge, but I'm a bit of a news junkie
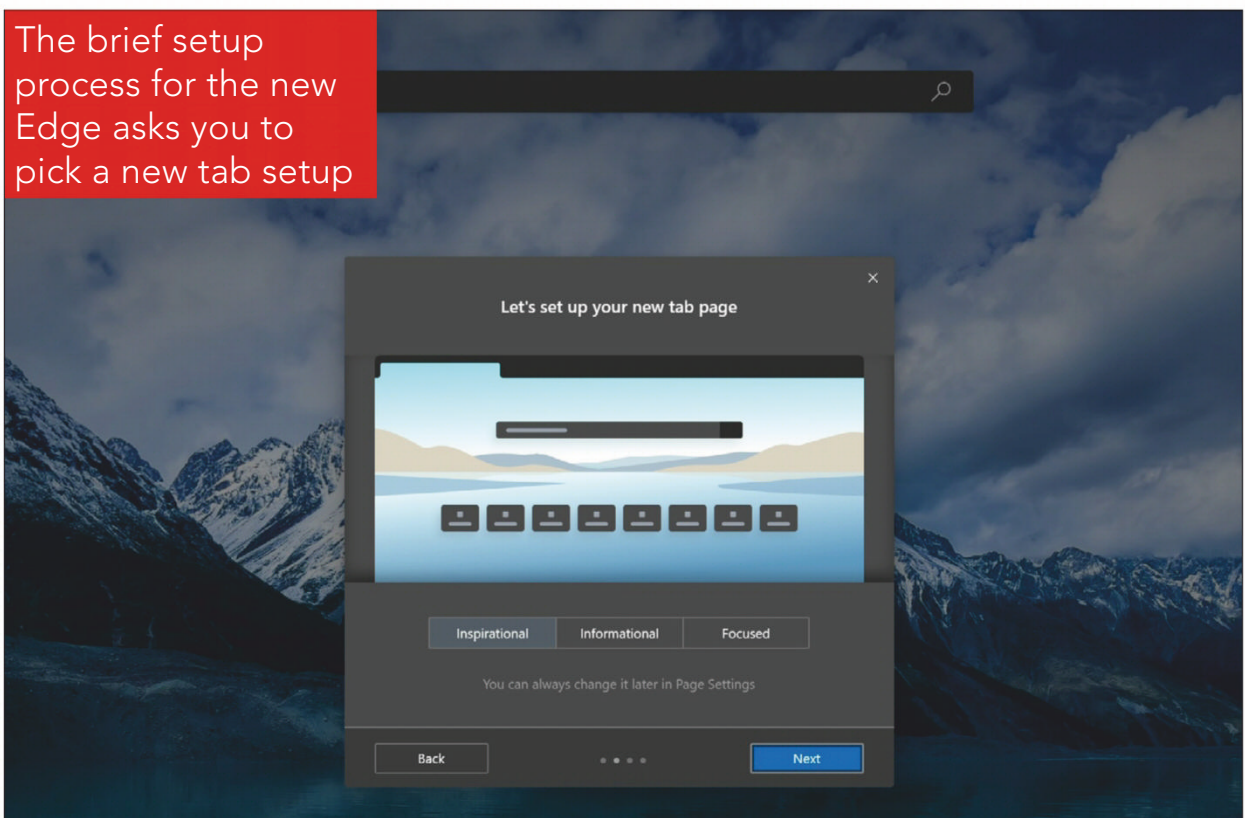
your most frequented web pages. Inspirational is essentially the same, but with the addition of Bing's nature photography.

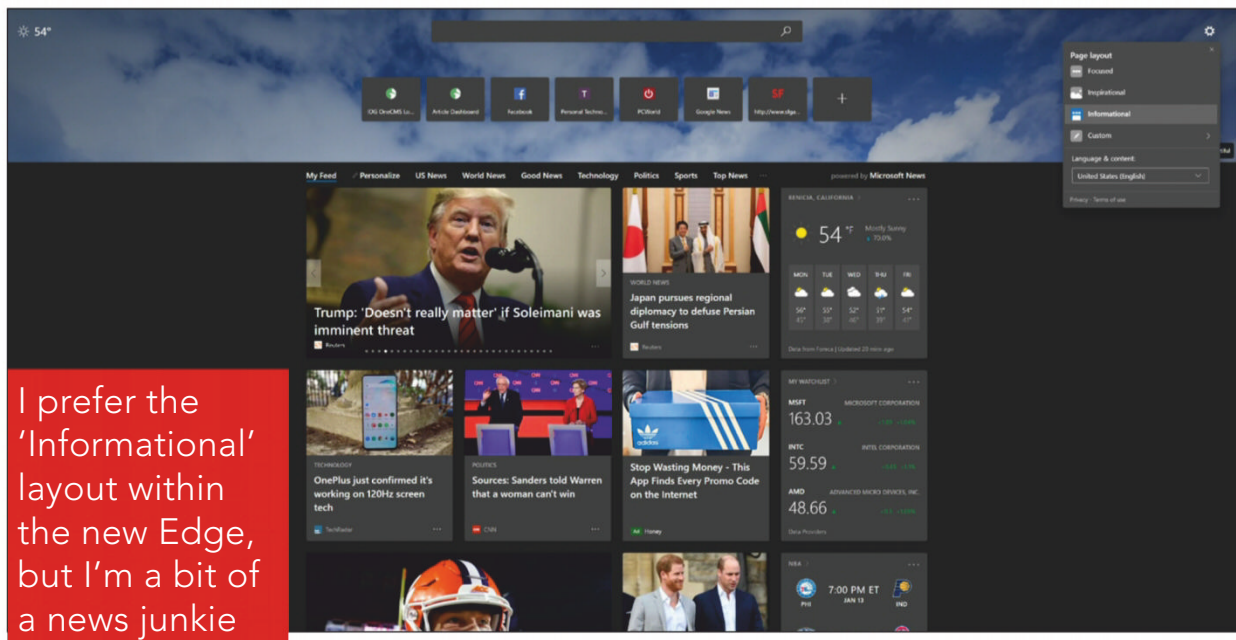The Informational option is the most crowded of all them, with a dozen or so headlines from Microsoft's news service cramming the page. (Both the Inspirational and Focused options also allow you to explore those news headlines; they're just hidden below the 'fold' of the page.)

In all, the setup process took about 30 seconds, though you're free to explore drop-down menus and other options that explain your setup choices in more details.

What you won't see in the setup process, however, is the ability to select a search engine. Like virtually every browser on the market, the URL bar doubles as a search box. Queries go to Microsoft's own Bing search engine by default. If you'd like to change the search engine

Settings
← Search results / Address bar - 19 results

Show me search and site suggestions using my typed characters
If you turn this off, you'll only see suggestions from your favorites and history. Typed characters won't be sent to the search engine used in the address bar.

_____ used in the address bar   Bing (Recommended, default) ∨

Manage search engines   >

Search
🔍 search
▢ Profiles
🔒 Privacy and services
🎨 Appearance
⏻ On startup
⊞ New tab page
🗂 Site permissions
↓ Downloads
⚧ Languages
🖨 Printers
🖳 System
↻ Reset settings
● About Microsoft Edge

Microsoft makes it quite difficult to figure out how to use any search engine besides Bing

to Google or DuckDuckGo, you can go to the Settings menu and click through menu after menu. Seriously, if the option to change the search engine is there, it's nearly impossible to find without a targeted search.

Only after I typed 'search' into the Settings search box could I find the option to change the search engine – and only by clicking though a related link. (I later found it under the Privacy and Services tab, at the very bottom.) I couldn't help but think that if this were 15 or 20 years ago, when Microsoft's Internet Explorer reigned, the company might be receiving a pointed letter from the DOJ right about now.

Using the new Edge
In practice, the new Edge looks... fine? With other browsers, such as Firefox, the page layout is visually distinctive, with sidebars and other ways of rearranging the content that identify that browser.

With the new Edge, there's little to distinguish visually between the new Edge and a browser such as Chrome. It has much the same back, forward, home and page refresh controls, plus a star at the end of the URL bar to set the current page as a favourite. Edge saw that I had a favourites toolbar enabled from within Chrome, and added it to my Edge browsing experience.

The new Edge also allows you access to both Microsoft's curated Edge extensions as well as the Google Chrome Web Store, though you'll have to enable content from other web stores to access and load them.

One plus in my book: Edge keeps what it calls the 'immersive reader mode'. A small book with a speaker icon superimposed over it may appear in the URL bar when you're viewing a web page. That opens the page on a paper-like background, eliminating all superfluous content like ads. Unfortunately, that also currently includes embedded images, which can be helpful to illustrate a story.

What's different, though, is the ability to add a web page to a Collection – a collection of bookmarks, yes, but with a powerful enhancement. Collections, introduced last year as part of the 'old' Edge, allow you to gather a number of web pages into a group of links that can live in your sidebar. (You'll find the Collections icon just to the right of the URL bar.)

Though you can collect just about any web page, Collections is most effective as a shopping tool for comparing products, using data that Edge 'scrapes' from the page. When you export the Collection to

If you import data from Google Chrome, extensions carry over as well
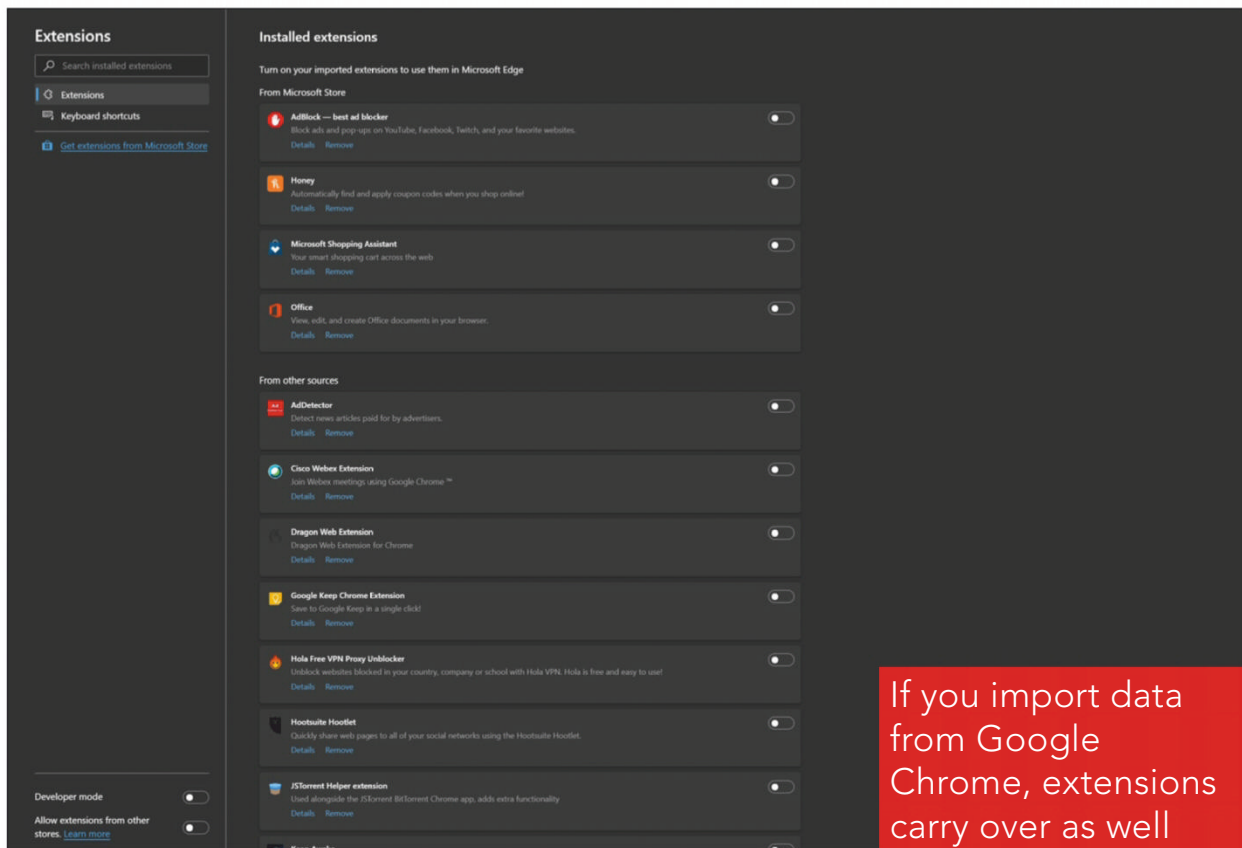
Excel (via the small ellipsis tool within the Collections sidebar), Edge creates an Excel spreadsheet on a new web page, then populates it with a summary of the metadata it collects: the price, the product's rating, the store, and a link, among others. Although it's a little late for the holidays, Collections is still a powerful shopping research tool.
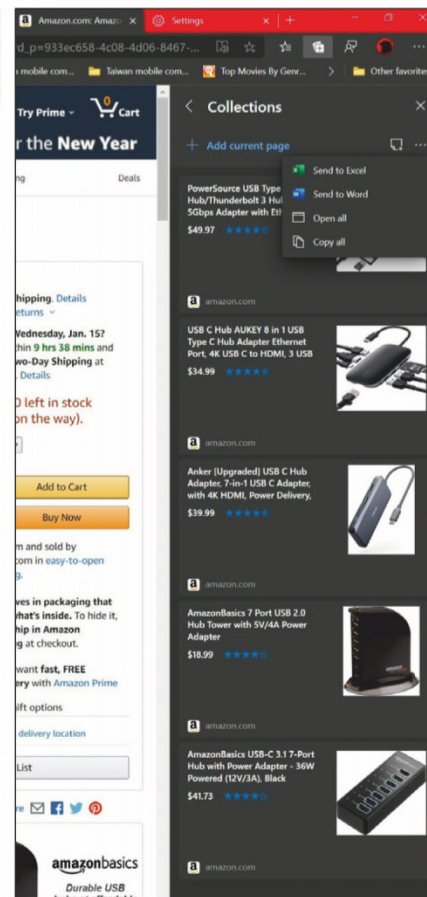
Edge also supports Progressive Web Apps, though chances are you'll miss them entirely. If you visit a site like Google News using Edge, a wispy '+' sign will appear in the URL bar. Clicking it will download the Google News site as an HTML-based web app, allowing you to 'bookmark' it in your Start menu as an actual app. In reality, this probably won't make a lick of

difference to your everyday browsing habits, but the option is there.

Otherwise, the new Edge still has some tasks left on the to-do list – or at least it did on the beta versions we used just two days before launch.

While the old Edge allows you to set per-site media permissions, allowing you to block autoplaying videos and sound, the new Edge doesn't – or, at least, I couldn't easily find the option among the laundry list of permissions Edge threw up when I right-clicked the 'padlock' option

next to the URL bar. I finally found the feature after scrolling all the way down to the end of Edge's Settings > Site permissions – but for now there's only the ability to either universally allow or 'limit' media playback. In the latter case, the new Edge will try to determine intelligently what media should or should not be played, based on your behaviour in the past.

The new Edge also benefits from Chrome's ability to 'cast' a tab to a device such as a Chromecast, via the ellipsis menu in the upper right-hand corner, then dropping down to More Tools > Cast Media to Device. Edge didn't seem to want to do that, however, reporting that the 'source wasn't supported'. We tried it with an ordinary web page as well as a YouTube stream.

The new Edge also supposedly supports Internet Explorer mode, though we're told that it's an enterprise feature, and one that has to be turned on via a group policy.

Edge's development is more evolved where security is concerned. JavaScript is allowed, but Flash is off by default, and will ask for your permission only when necessary.

Privacy and syncing

While other browsers require you to sign in to ensure that favourites, passwords, and your browser history are saved across various devices, Microsoft's new Edge benefits from 'knowing' your Microsoft account password, and syncing that information with other Windows devices you're signed into. Microsoft already had saved information like my address from prior browser sessions, so it can store that information,
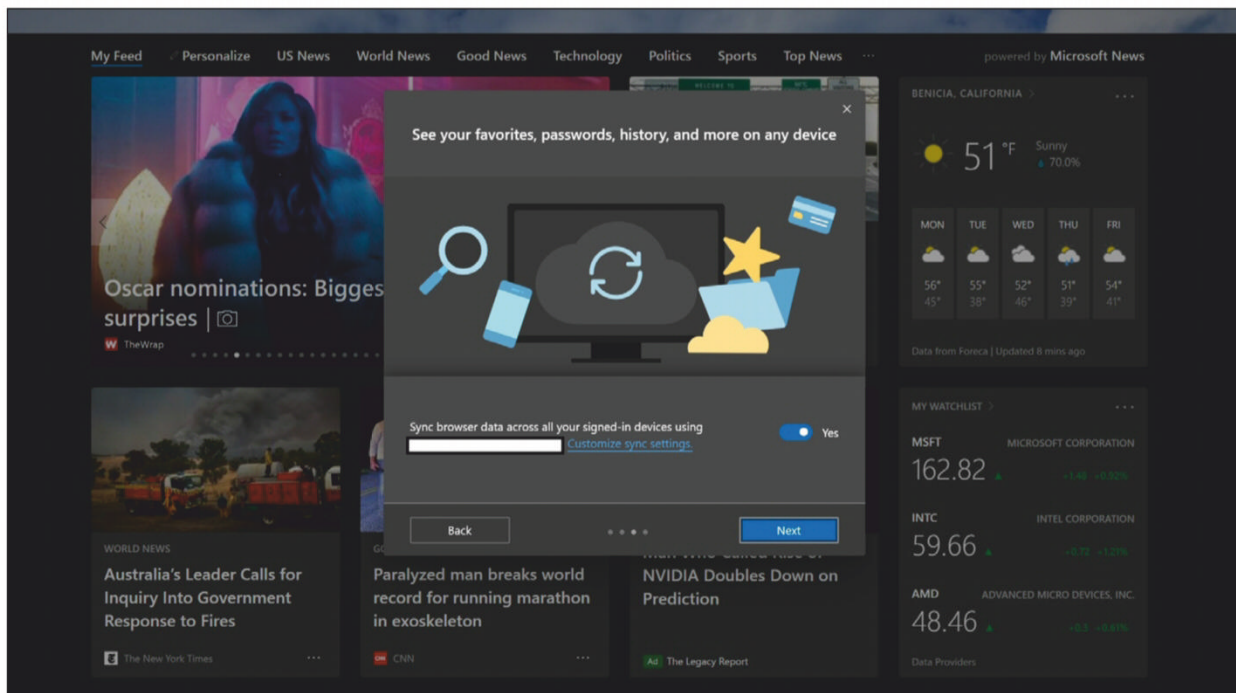
as well as any debit/credit cards or other payment information you enter into a field. You can also turn off syncing.

Unfortunately, it appears that Edge isn't quite ready to save all your information from device to device. Using the test 'Canary' build we downloaded, Edge said that syncing your browser history, open tabs, and extensions were 'coming soon'. And although the Edge browser for Android now uses the swirling Edge logo of the desktop version, it doesn't seem to 'pick up where you left off' or sync the history of pages you accessed on the mobile browser. That's a feature that's undoubtedly in the works.

Performance

Against Chrome's dominance, competing browsers take what small advantage they can. Opera has its free, unlimited VPN, and Brave, its searing focus on privacy and its BAT token for paying creators with virtual currency. Microsoft's new Edge doesn't really seem to offer any particularly compelling angle – Collections, maybe? Convenience? Speed? The latter two may be the attributes that lure users over time, though it's a difficult topic to sell to a friend over coffee.

Still, here's what we can say about Microsoft's new Edge: It's as fast or faster than the current version of Chrome, and among the leaders in terms of overall speed. Obviously, the new Edge remains a work in progress, and will see fluctuations in performance over time. We tested using the Canary build downloaded on 13 January – technically a beta, but close to what should be the final version. (On the graphs below, the Canary build is erroneously labelled as version 84, when it should be version 81. The stable version that will be pushed to your PC is version 79.) It's enough to characterize the new Edge as a solid effort.

We used the recent Surface Laptop 3 as a test platform, downloading the most recent versions of the Brave browser; Google Chrome; what we'll call the 'old' Microsoft Edge; the new, Chromium-based Edge; Mozilla Firefox; Opera; and Vivaldi.

We carved out our testing into a number of different browser tests. The first group, which encompasses JetStream, MotionMark, and Speedometer, are published by Browserbench.org. JetStream 2 uses a variety of JavaScript and WebAssembly tests focused

Brave 79.0.3945.117
- Speedometer: 113
- MotionMark: 300.33
- JetStream: 120.947
- WebXPRT: 176

Google Chrome 79.0.3945.117
- Speedometer: 102
- MotionMark: 286.63
- JetStream: 123.547
- WebXPRT: 185

Microsoft Edge (new) (Edge 84.0.392.0)
- Speedometer: 113
- MotionMark: 296.19
- JetStream: 114.661
- WebXPRT: 185

Microsoft Edge (old) (Edge 44.18362.449)
- Speedometer: 65
- MotionMark: 415.52
- JetStream: 0
- WebXPRT: 199

Mozilla Firefox 72.0.1
- Speedometer: 87
- MotionMark: 60.68
- JetStream: 85.058
- WebXPRT: 222

Opera 66.0.3515.27
- Speedometer: 102
- MotionMark: 309.93
- JetStream: 117.008
- WebXPRT: 174

Vivaldi 2.10.1745.26
- Speedometer: 118
- MotionMark: 346.28
- JetStream: 131.21
- WebXPRT: 187

Larger numbers are better

■ Speedometer ■ MotionMark ■ JetStream ■ WebXPRT

Microsoft's new Edge delivers solidly middle-of-the-road performance. Note that the 'old' Edge failed to run a test, and received a '0' as a result

on advanced web applications. MotionMark tests the browser's ability to render graphics. Speedometer runs tests over and over to determine how responsive a browser will be in web apps.

We're not highlighting any one test in this group, but you can see that the new Edge performs on par with the competition.

We used a separate test, Basemark Web 3.0, to measure how well the browser performs using JavaScript and WebGL graphic content. We've also included the results of HTML5test, which measures how well the browser conforms to the HTML5 specification.
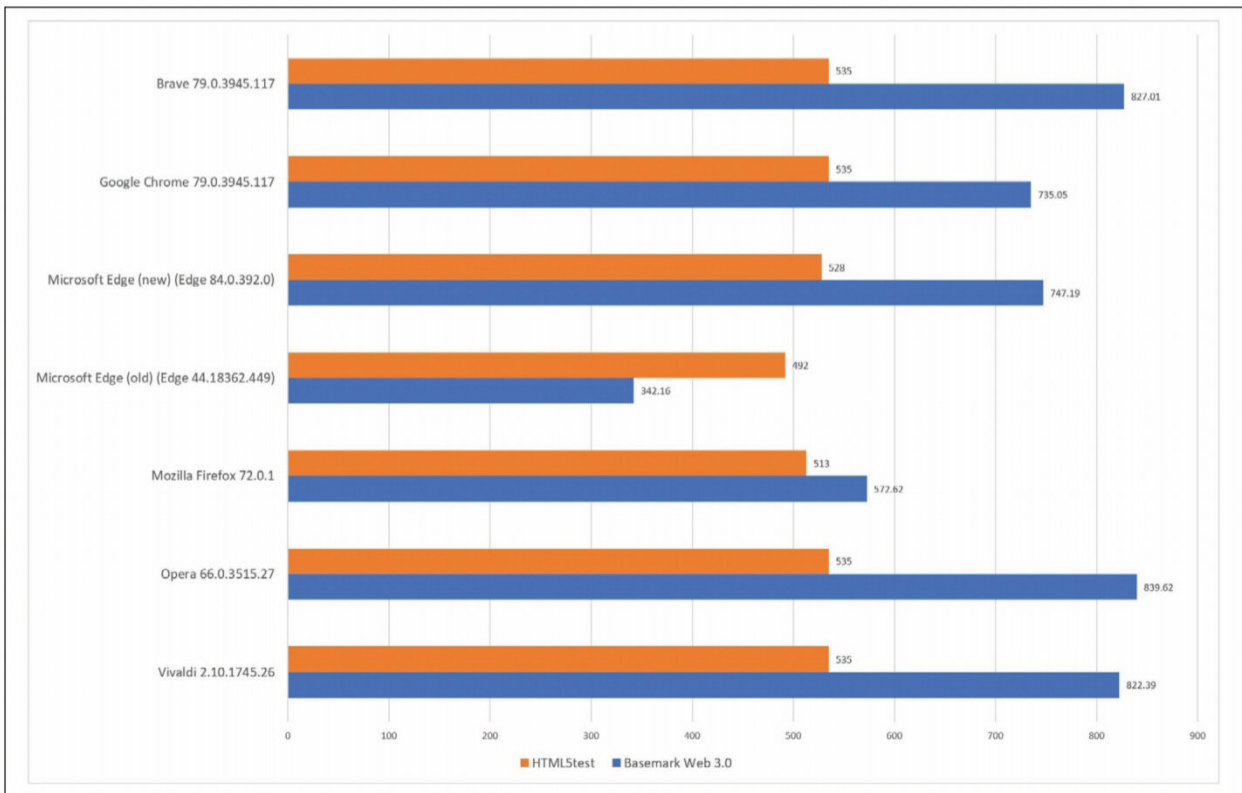
The Basemark Web 3.0 test indicates that Microsoft's new Edge performs on a par with its competition

In the latter, the test reports that the new Edge doesn't yet support Web Authentication/FIDO 2, as well as some web elements (custom elements, HTML imports) that other browsers do.

Finally, we took a real-world look at how well each browser did in terms of memory usage and CPU utilization. Because this is a real-world test, it's not repeatable. We used 30 tabs of media-rich sites, including our own, loaded each, then waited for 60 seconds to let the system 'settle down' and measured the results. Ads will vary, the content will vary – what we hoped to achieve was to load the sites within the
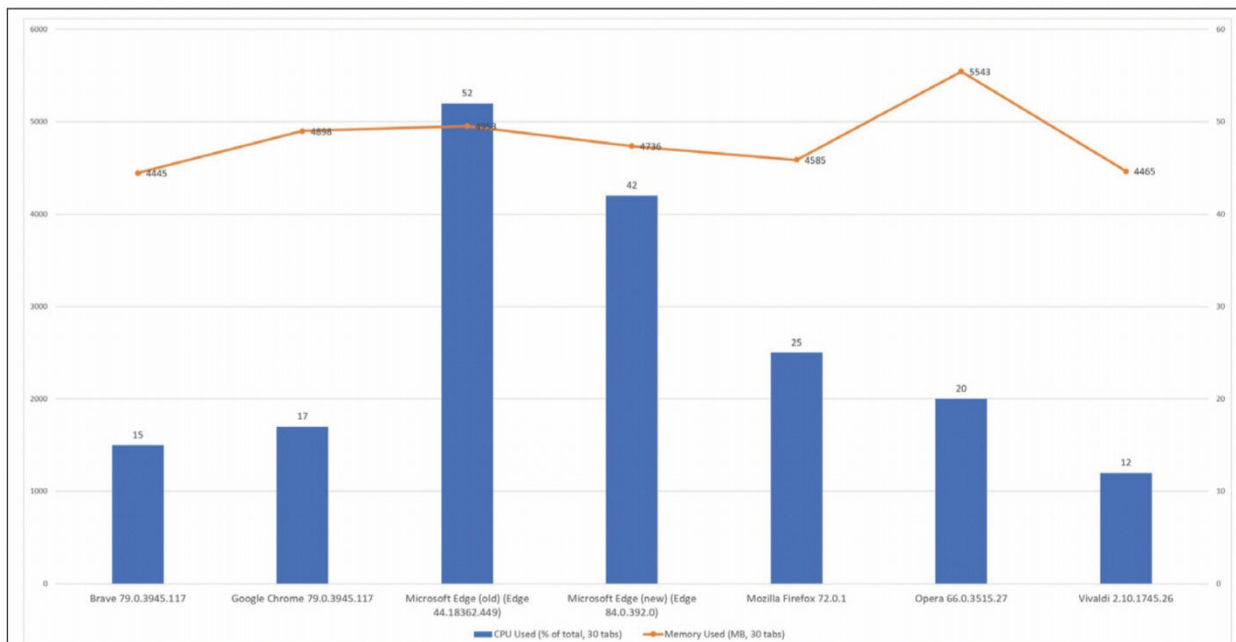
CPU usage is highlighted in blue, with memory usage represented by the secondary orange line. The new Edge's memory usage is just fine, but it's still a bit of a CPU hog

same window to hopefully minimize variation, but this is a very subjective, content-dependent test. We ran the tests without any extensions or plug-ins enabled, and turned off the 'Shields Up' ad-blocker within Brave.

What we saw here was that while memory usage was on a par with that of other browsers, there's still room for improvement as far as CPU utilization was concerned. In this case, it's probably fair to allow Edge a little leeway as Microsoft's developers fine-tune it.

Verdict

Although Edge hadn't quite been finalized by the time of our review, our impression can be summed up by one word: okay. Over time, I suspect Edge will be defined by its convenience, and how well it worms its

way into the desktop and smartphones as well. Features like Collections, which encourage you to use Edge as a shopping tool, may motivate some users to give up on other browsers entirely.

For now, Edge has one big advantage. For all of the praise we've lauded on Firefox, Opera, or Brave, none come anywhere close to Chrome's market share. Each also requires users to seek them out, download, and install them. The new Edge will land on your home PC whether you like it or not. That hasn't stopped the 'old' Edge from being passed over, of course, but maybe the second time's the charm.

Convenience, ubiquity and moderate power make the new Edge a solid if somewhat uninspiring browser right now. If nothing else, the new Edge will be worth checking out, as it stares at you from your PC's taskbar. Mark Hachman

TECH ADVISOR

March 2020

SECURITY SPECIAL

BEST ANTIVIRUS
SOFTWARE REVEALED

PLUS
- BEST PASSWORD MANAGERS
- **REVIEWED:** WINDOWS SECURITY
- HOW TO REMOVE MALWARE FROM A PC
- AND MUCH MORE ...

Google Stadia

Price: £119 from **fave.co/2uFG6Dn** ★★⯪☆☆

With Stadia, there are no easy answers. Every compliment I want to pay Google's game streaming service – and there are quite a few actually – is shackled to a caveat, a complication, or a complaint. Sometimes all three.

That's a problem. The biggest problem, really. Google intended Stadia to simplify the way people consume games. No hardware. Play your games

anywhere, at any time. And yet the reality, at least for now, is a labyrinth of potential pitfalls. Does Google Stadia work? Sure, under the right circumstances and with the right game. Will it work for you, though? That's a harder question, or rather a hundred questions, any one of which could prove fatal to Stadia's chances.

Let's dig in.

The best case scenario

Those who purchase the Google Stadia Founder's Edition, or functionally identical Premiere Edition, will receive a Stadia controller, a 4K-ready Chromecast Ultra, and three months of the £8.99 per month Stadia Pro subscription. This is the only way to get access to Stadia right now and for the foreseeable future.

And there's a reason for that: it's the only use case that feels finished. Google Stadia arrives with a litany of missing features, especially on PC and phones. As such, the Chromecast is the only device that supports 4K streaming at release, as well as 5.1 surround sound and the wireless Stadia controller. Those features won't hit other platforms until 2020.

Consider the Chromecast Ultra the 'Best Case Scenario' for testing, then. Specifically, a Chromecast Ultra wired directly into your router, with solid download speeds (500Mb/s in my case) in a home near one of Google's Edge Nodes. I've conducted most of my Google Stadia review in this manner, and you know what?

That's a loose term, of course – and therein lies the problem. Google Stadia is bound to be divisive because the definition of what's 'Good Enough'

Mmmm, glorious Edge Nodes

varies person to person. Are we comparing Stadia to the streaming services that came before, to OnLive and to PlayStation Now? Or are we comparing it to consoles and PCs? Hell, I find myself torn between these different lines of thought.

If we're comparing against the standards of other for-pay game streaming services, Stadia is a rousing success. I'm particularly shocked how responsive it feels. Even the games I was most sceptical of at first proved surprisingly playable in an ideal network environment. Google provided access to Destiny 2 and Mortal Kombat 11 during our review period, and I found I could consistently (with a slight muscle memory adjustment) line up headshots and tap in combos, respectively. It looks good, too. Not great. Not on par with a high-end PC. But only the occasional compression artifact gives away the

gambit, provided your connection's good enough to stream at 4K.

So much of Google's messaging is aimed at holding Stadia to an impossible standard, though. The way Google's pitched it, Stadia is The Future, and The Future can't just be 'pretty good for a streaming service'. The Future can't be 'playable'. It has to be indistinguishable from running a game locally. Better, even. It's not, and might never be. But if that's Google's end-goal, then every stutter is a letdown. Every blurry background or compression artifact becomes an indictment of the entire platform. The thrill of 'Wow, I'm running Destiny 2 off a server 40 miles away and it works surprisingly well' is no longer enough.

And I'd be perplexed how to handle this duality in a review, except it's the least of Stadia's issues.

Scaffolding

A baffling amount of the Stadia experience is still a work in progress. So much, in fact, I'm hard-pressed to explain why Google didn't simply lock off the rest until a later date.

A PC is probably the best setup after the Chromecast, and if you participated in Google's tests last year then it will feel familiar. Games are accessed through Chrome, popping a full-screen window over your browser. It's slick, basically indistinguishable from running a game natively in borderless windowed mode.

Trouble is, 4K streaming is locked to the Chromecast at launch, as I said. The PC is limited
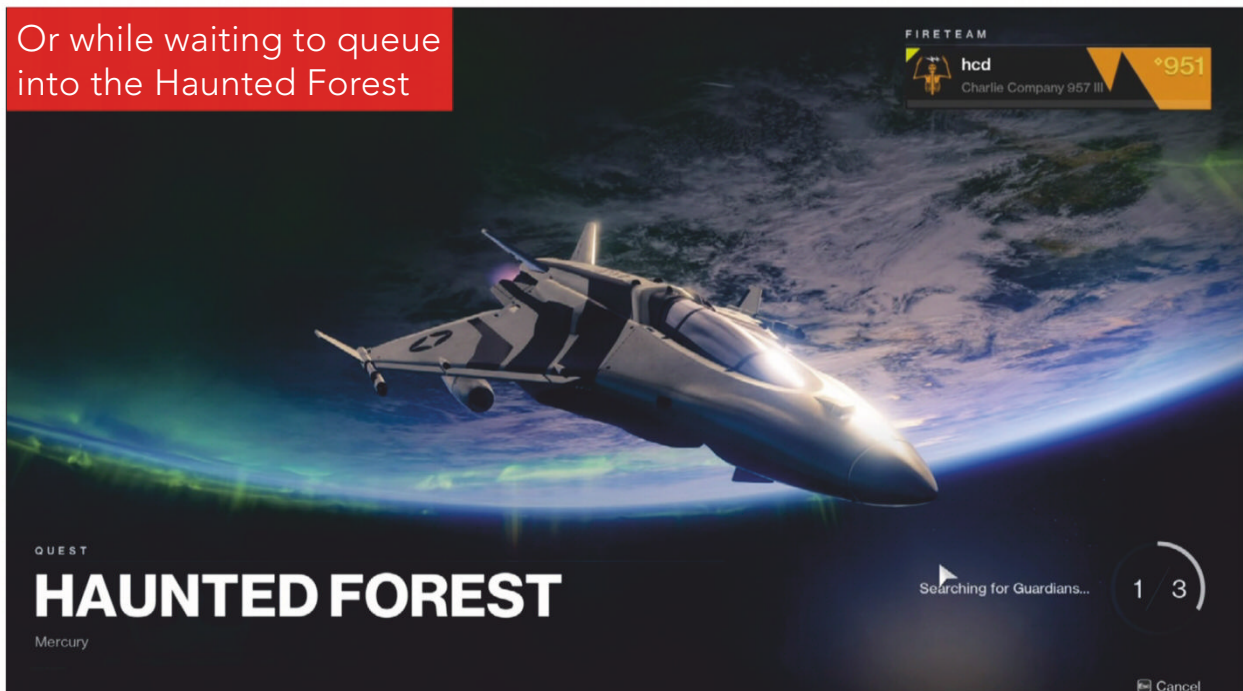
to 1080p, and it's an ugly 1080p. The compression artifacts, already noticeable on a Chromecast at the maximum streaming quality, are omnipresent on PC. It's a definite issue in dark environments, and can even be spotted on Destiny 2's 'Destination' menu.

Still, there's a novelty to running these games on devices that shouldn't be able to run them. Got a cheap laptop at home? Hook it up to an ethernet cable, pop open Chrome, plug in a mouse or the Stadia controller (or an Xbox controller for that matter) and you could be running a pretty good facsimile of Destiny 2 or Red Dead Redemption II or Assassin's Creed Odyssey. That's the real promise of Stadia, and when 4K support is added to the Chrome version in 2020 it could prove pretty interesting.

Phones are a disaster, though. Even if you've purchased the Founder's Edition, at launch Stadia only

supports Pixel 2, 3/3a and 4 devices. That's it, so… I hope you own one. Given how many phones run Android, I cannot believe Google didn't even prep the 2019 flagships for release day.

The phone is also the weakest Stadia environment, which is a shame because it has the most promise. Who doesn't want to play Red Dead Redemption II on a phone, right? Or take Destiny 2 with them on vacation by packing just a controller in their bag? Performance is inconsistent though, even on Wi-Fi. Half a second latency was the norm, and while I didn't have any serious connection issues with a laptop, the phone dropped frames, stuttered, even displayed a 'Lost Connection' symbol at times.

To make matters worse, many games are unplayable at phone size. People complain about Nintendo Switch games and unreadable text, but just try and play Red Dead Redemption II on a 5in screen. I dare you. It's not just text either. Interactive items, button displays, it's all microscopic.

And the controller barely works as advertised. That's probably the weirdest part of this whole mess. When Google announced Stadia, a highlight was that you could switch between devices on-the-fly. Say you're playing on your Chromecast, you could seamlessly transition to your phone at the push of a button. In theory, this can still occur. The Stadia app lets you change which screen the game is displayed on, and I've pushed Mortal Kombat 11 from my TV to my phone mid-fight before. Neat.

The controller doesn't go with it, though. It's supposed to connect not to any single device but

Grab your reading glasses, and good luck
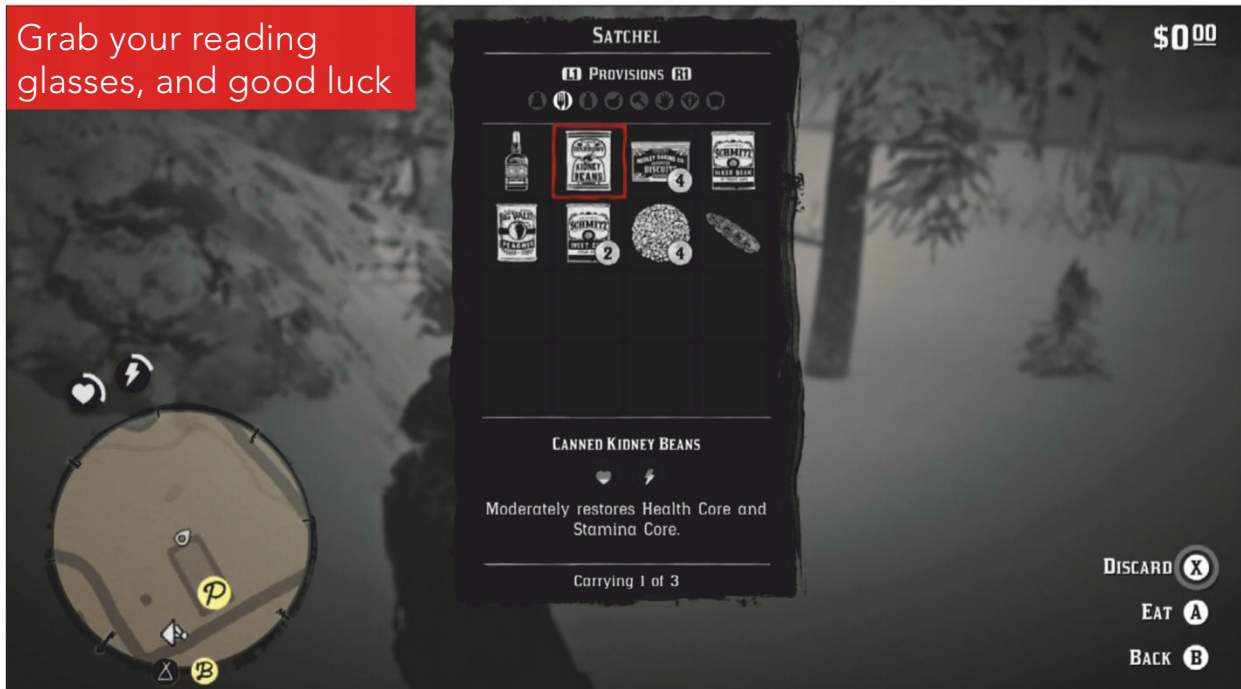
to your Wi-Fi, then relay commands directly to Google's servers to cut latency. That happens when you're connected to the Chromecast, but phones and PCs need to be connected to the controller directly with a USB-C cable. The PC, whatever. I'm just sitting at my desk anyway. The phone situation is absurd though, requiring you first attach a mount to the Stadia controller, then put your phone in the mount, then wire the two together. It's an unwieldy hydra, and made more confusing because – again – Google intentionally limited the hardware pool to its own line of phones.

It's a shame because the controller itself is great. The design is a hybrid of the PlayStation 4 and Xbox One controllers, marrying horizontal sticks to sculpted grips and the A/B/X/Y buttons. Battery life is better than a DualShock 4, the battery charges fast over

USB-C, and I've generally enjoyed using it. For a first attempt? Great.

But why is it only half functional?

Game selection

Google initially announced that Stadia would launch alongside a dozen games. A week later, the number was upped to 22. Neither list is all that impressive, with only a single exclusive: Gylt, developed by Tequila Works. Given we're at the end of the release season, that means most of Stadia's line-up is old – either a few months, or in some cases a few years. I don't have much to say about that situation, but it's not making me want to rush out and buy anything for Stadia.

And you have to. I think that's worth reiterating, because there is a Stadia Pro subscription and I get the feeling most people still expect some sort of Netflix-for-Games. That's not Stadia. Stadia Pro does get you copies of Destiny 2 and Samurai Shodown at launch, with more free games teased for the future. It also gets you the occasional discount.

It does not get you an Xbox Game Pass-style line-up though. Many games, like Red Dead Redemption II, are the same price (or more) on Stadia as they are elsewhere. You are buying a version that is locked to Google's servers, and could conceivably disappear entirely if Stadia shuts down.

I remain incredulous that Google took this approach. Microsoft's already said its competing streaming service, Project xCloud, is coming to Xbox Game Pass (which includes PCs) next year. That's 100-plus games available for £10.99 per month. Stadia's subscription

is paltry by comparison – required at launch, but only because there is no free version yet, and then at some point it'll be the only way to get 4K streaming and 5.1 surround sound. Those are worthwhile, but £11 a month worthwhile? Meh.

Anyway, we had access to about a half-dozen games during our test period and I have a few thoughts that haven't already been covered elsewhere.

Destiny 2: As I mentioned, Destiny 2 is surprisingly playable – at least in theory. What I haven't gotten around to discussing yet is that it's cross-save compatible, but not cross-play. In other words, you can bring your existing Destiny 2 characters over to Google

Stadia but it's a sandboxed version of the game that only exists for Stadia players.

It's no wonder Google's gave away free copies of Destiny 2 to everyone who pre-ordered the Founder's and Premiere Editions, because if they didn't there would be nobody playing. And indeed, that's how our review period has gone. I've spent the past week running around empty planets and visiting an empty Tower and trying to complete the Haunted Forest on my own and it has been very weird. I'll be curious whether the population picks up after Stadia's released, but it's hard to imagine it ever being as vibrant as the existing console or PC versions.

Red Dead Redemption II: I was particularly curious to try out Red Dead Redemption II given that we struggled to run it at 1080p on an Nvidia GeForce RTX 2080 Ti. Unshackled by local hardware constraints, could Google Stadia run Red Dead better than a high-end PC? And the answer is, not really. It's hard to do an A/B comparison given the variables at play, but the Stadia version's lighting seemed flatter, and the otherworldly fog effects that left me slack-jawed on PC were undercut by omnipresent compression artifacts.

Load times were faster, though. And besides, it was Red Dead Redemption II streamed to a £69 Chromecast Ultra. That's impressive in its own right.

I also think games like Red Dead are a better proof-of-concept for Stadia because they're not as reliant on tight timing windows as shooters, fighting games, and the other genres Google seems hell-bent on proving

it can conquer. Red Dead's shooting suffers still, but its movement is so heavy and momentum-based that a delay of a few milliseconds barely registers. It's the same reason Assassin's Creed Odyssey worked so well for those early Stadia tests.

Kine: Another genre that fares great in streaming: puzzles games. Kine isn't a great puzzle game, but I spent a lot of time playing it this week because it didn't matter how well Stadia performed.

It's basically a block-moving puzzler, locked to a grid, with a catchy soundtrack. Playing it local on my PC or on my phone via Stadia provided precisely the same experience. More of this, please.

Gylt: Lastly, the lone Stadia exclusive. I like Tequila Works. I like Gylt. From what I played, it seemed like

Gylt
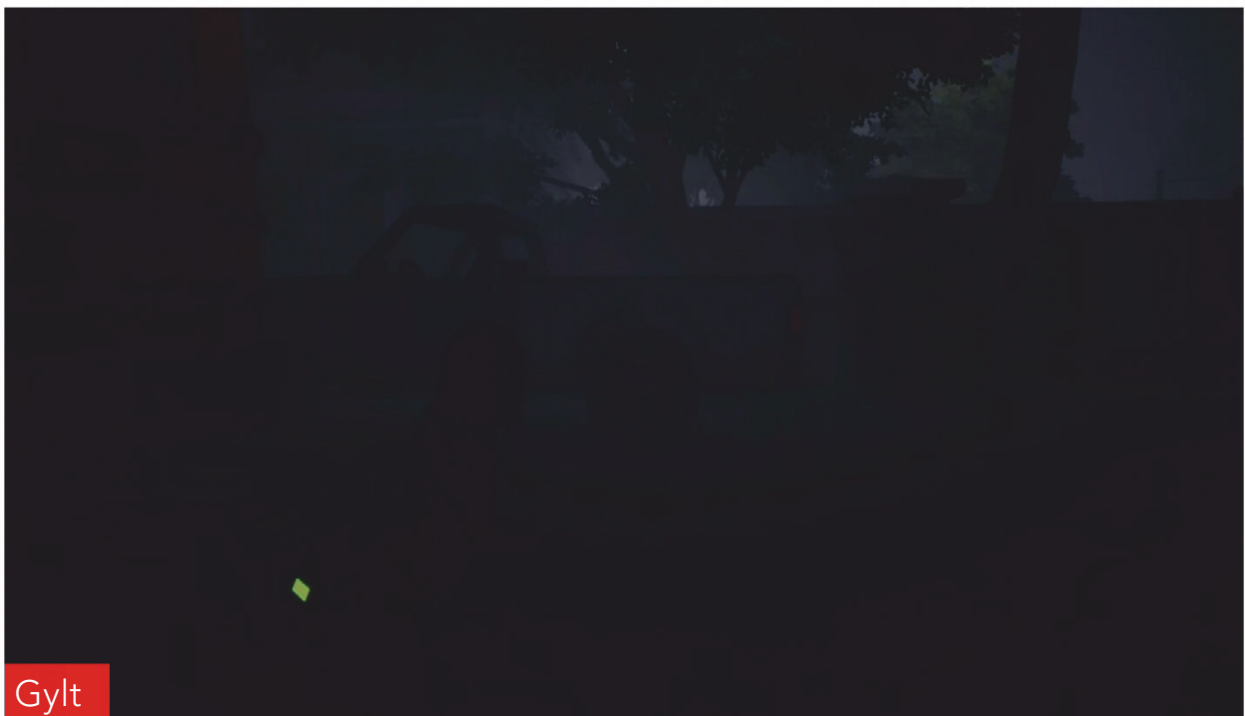
a brave attempt to tackle bullying and other weighty themes within the confines of a stealth game.

But I cannot imagine who decided to make the lone Google Stadia exclusive a game that takes place almost exclusively in the dark. Blotchy shadows almost completely ruin the experience, even on the Chromecast where I had the most luck avoiding compression artifacts. I want to play it, but not like this.

Data caps

Before we end, a word on data caps. That's the other part that gives me pause about Stadia. Many people, myself included, have a 1TB cap on our monthly Internet. Go over that twice in a year, you get a warning. Go over it again, and you'll need to pay an extra on top of your standard Internet bill.

It's a problem even for standard game downloads nowadays. Red Dead Redemption II came in around 150GB, I think. That's huge, and publishers should absolutely be lobbying against these punitive measures by Internet providers.
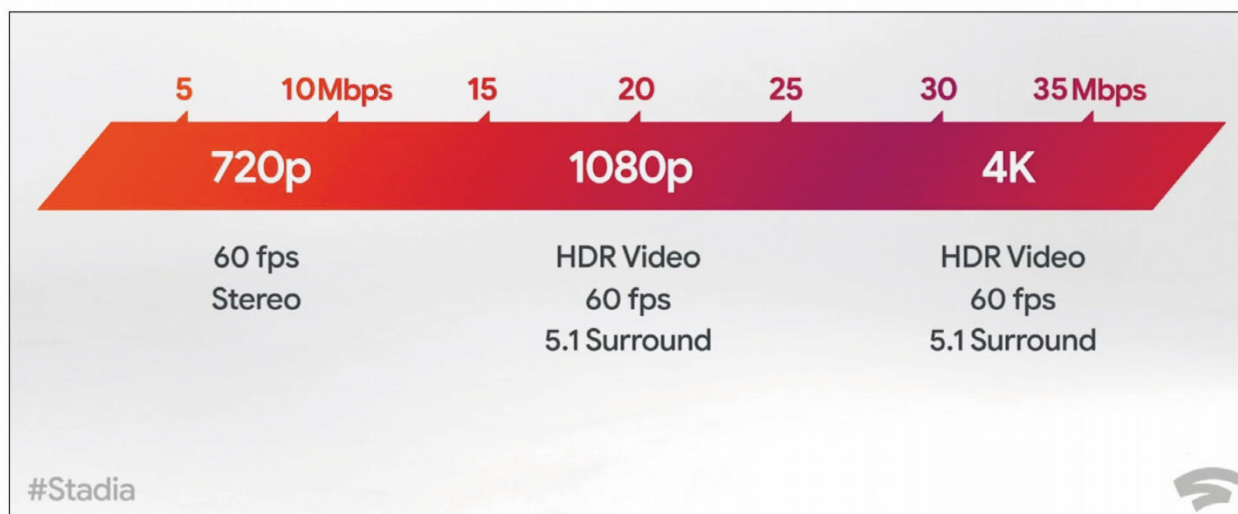
But Google should be even more worried. By Google's own calculations, 4K streaming requires up to 20GB of data per hour. If we take the average Red Dead Redemption II playthrough of 75 hours, Stadia would burn through up to 1.5TB of data before the end. Stadia simply isn't a good choice for most people with metered Internet, especially those with multiple players under one roof. 10 hours here, 10 hours there, it adds up incredibly fast – and that's before you factor in Netflix, BBC iPlayer, Spotify, or any other streaming services you might use.

Verdict

Is Google Stadia the future? That's really two questions, I guess. First, 'Is streaming the future of gaming?' Possibly. It's convenient, and even exciting at times. But if you're asking whether Stadia is the platform to get us there? I have my doubts.

Whether or not Google turns Stadia into a long-term success, it's hard not to feel they botched the launch. The underlying tech is great, but everything else half-works, or works only in specific situations, or it's 'coming soon'. I can't imagine this is what Google had in mind when it put on that splashy unveiling event at GDC. If it is, then that raises even more questions. Mark Hachman

Specifications
Stadia controller
- Google Assistant button and microphone
- Capture button
- Dual-band 802.11ac Wi-Fi
- Bluetooth 4.2

- 3.5mm headset jack
- USB-C port
- Internal rechargeable Li-ion battery
- 65x105x163mm (2.56 in)
- 268g

Google Chromecast Ultra

- Dual-band 802.11ac Wi-Fi
- HDMI plugs directly into the TV
- Micro-USB for power and data
- Ethernet port on the power adaptor for hard-to-reach Wi-Fi spots in your home
- Supported operating systems: Android 4.2 and higher; iOS 9.1 and higher; macOS X 10.9 and higher; Windows 7 and higher
- 58.2x58.2x13.7mm
- Device 47g; adaptor 101g

17 new PC games we're excited for in 2020

With Cyberpunk, Dying Light 2 and more already on their way, it's going to be a busy year. HAYDEN DINGMAN reports

There's a massive hole in 2020. A blind spot, if you will. Next autumn, 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 impressive. These are exciting times.

1. Ori and the Will of the Wisps
Release date: 11 March

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 watercolour 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. 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: 20 March

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.

4. **Resident Evil 3**
Release date: 3 April

The Resident Evil 2 remake was one of our favourite 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
Release date: 16 April

When we saw the first Cyberpunk 2077 demo at
E3 2018, 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 the same about
The Witcher 3 and it's one of my favourite games this
decade. Maybe the favourite.

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 story lines 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: 19 May

Five years after Wasteland 2 took home our sister publication *PCWorld*'s Game of the Year prize, 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.

Other bosses in Chicago have tried, but you might have better luck.

I ain't like the other bosses in this city cause I ain't from here. I'll give Ronnie a taste of how we did things back in New York.

9. Empire of Sin

Release date: To be confirmed

Brenda Romero's reportedly 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 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 situations will present themselves outside a demo.

10. **Humankind**

Release date: To be confirmed

Humankind is a direct challenge to Civilization, a historical 4X that starts at the dawn of human civilization and takes it up through the present day. It's 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. Interesting ideas, and brave. Exactly what I'd expect from Amplitude.

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 and my continued devotion to Google Earth VR. 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 or even a Hat in 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. 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, 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.

17. Halo Infinite

Release date: November

Halo Infinite is the only game I can safely say will ship alongside the new consoles. It's slated as an Xbox Series X 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 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.

ANDROID
ADVISOR

XIAOMI
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REVIEW

WORLD'S FIRST
5-LENS
CAMERA PHONE

PLUS
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ALL THE BIG ANNOUNCEMENTS

Android's best vs Apple's iPhone 11

The iPhone 11 is an incredible phone, but there's one I like a little better. MICHAEL SIMON reports

It's time to compare Apple's iPhone to the leading Android handsets, and it should be a close race. From the launch of the first folding phone to the rise of 5G, dual screens, waterfall displays, and cameras, cameras, cameras, 2019 has delivered a dizzying array of new features. Apple may have surprised everyone with a price cut to its entry-level handset, but can it stack up to the best Android has to offer? Let's go through the major specs and find out.

The phones

Three phones compete against the iPhone 11 this year:

Samsung Galaxy S10+: I chose this model because it's cheaper than the official flagship Note 10+. Also, compared to the S10, it's a) only £100 more, and b) equipped with a much bigger battery.

Google Pixel 4 XL: The newest Pixel phone has a laundry list of issues, but it's Google so it gets the nod. Plus it has a better screen and bigger battery than the smaller one.

OnePlus 7T: OnePlus is on a roll. The two phones released in the UK in 2019, the 7 Pro and the 7T, raised expectations for what an affordable model can deliver. The newer 7T offers killer specs and a price that undercuts the iPhone 11's.

Design

While Samsung pushed design boundaries with an impressive reimagining of the Galaxy S10, the iPhone is starting to feel a little stale. It's more symmetrical than the other phones here, but the notch, the thickish bezels, and the screen-to-body ratio leave much to be desired. It's also the thickest of the bunch at 8.3mm.

The giant square camera is a polarizing look, and it makes the iPhone 11 wobble when it rests on a table. The camera bump matches your chosen handset colour, and while the new purple and green are nice, the glossy back picks up fingerprints early and often. Rumours suggest that Apple may dump the notch and make other changes for the iPhone 12. I hope that's the case.

The Pixel 4 XL (left) and iPhone 11 have very similar camera stylings

If the iPhone 11 is bland, the Pixel 4 XL is just plain blah. It loses last year's notch for a sizable forehead, a small chin, and chunky side bezels. Like Apple, Google has added a square camera array in the upper left corner, but the Pixel 4 XL's bump is black regardless of body colour.

I do like Google's choice of materials, however. The luxurious frosted glass now covers the entire back of the phone, and it resists fingerprints, scratches, and smudges. The brushed-aluminium sides echo the frosted look, and the colour options – which adds orange this year to the classics black and white – are appealing. I love the coloured accent button. If Google ever decides to get serious about smartphone design, it should start with the materials and work backward.

The Pixel 4's orange power button remains my favourite feature about Google's design

Samsung's S10+ continues to refine the Galaxy look. The top and bottom bezels are barely-there slivers, bringing the screen-to-body ratio close to 90 percent, but it feels like more because the edges of the screen drape over the sides. The back of the S10+ is just as pleasing, with a horizontal camera array set against a glass available in fantastic colours. Yes, it's a fingerprint magnet, but so is the iPhone's back. And unfortunately the lack of bezels brings visual and functional problems that Samsung isn't yet prepared to address.

The oddball is the selfie camera. Lacking enough bezel to hide sensors, Samsung opted for a 'hole-punch' camera literally embedded in the display, peering through a black circle in the upper right corner. Its off-centre placement and funky design make it an eyesore.

The OnePlus 7T may lack the pop-up selfie cam and edge-to-edge screen of the OnePlus 7 Pro, but

Surprisingly, the iPhone 11 (far right) is slightly thicker than the other phones here, but only by a tenth of a millimetre

its tiny 'teardrop' notch, slim bezels, and thin body steal the show. Like the iPhone, the metal sides match your chosen colour (blue or silver), setting off the all-black front nicely. The bezels aren't much thicker than those on the S10+, and I prefer the flat look over the S10+'s infinity screen.

If the new trend is to spotlight the camera bump rather than try to hide it, the advantage again goes to OnePlus. The 7T's giant circular camera array is unique, plus it's the only phone here that can lie on a table without wobbling. I hope it remains a design element on future OnePlus phones.

Winner: OnePlus 7T

The OnePlus 7T (bottom) has the smallest camera cutout

Display

With such skinny bezels on all except the Pixel 4 XL, the display commands all of your attention. All of the OLEDs here are supplied by Samsung, while the iPhone 11 uses an LG LCD. They all feature HDR10 and Dolby Vision, and are impressively calibrated out of the box.

But they're not created equal, especially in refresh rate. The standard is 60Hz, which is the default for all four phones, but the OnePlus 7T and Pixel 4 XL both feature 90Hz options. The extra 30 frames per second means scrolling and swiping feel faster, especially on the 7T. Google hamstrings the Pixel 4 XL somewhat by limiting this feature to screen brightnesses above

The iPhone 11, OnePlus 7T, Galaxy S10+, and Pixel 4 XL (left to right) all have top-notch displays

75 percent, though an upcoming software update will allegedly fix it.

Screen speed isn't the only area where the 7T excels. The quad HD Galaxy S10+ may win for crispness and vividness, but the 7T is still bold, bright, and easy on the eyes. Like the iPhone 11's, the OnePlus 7T's display is something of a testament to how much you really need in a phone. It's 'only' full HD, doesn't have curved edges, and lacks ambient and always-on options, but it still makes a strong showing.

As the only LCD of the bunch – and a 720p one at that – the iPhone 11 loses when it comes to depth. The blacks of an LCD can't match those of an OLED, which is particularly evident when switching on the new iOS dark mode.

The OnePlus 7T (right) bested the iPhone 11 when it came to brightness
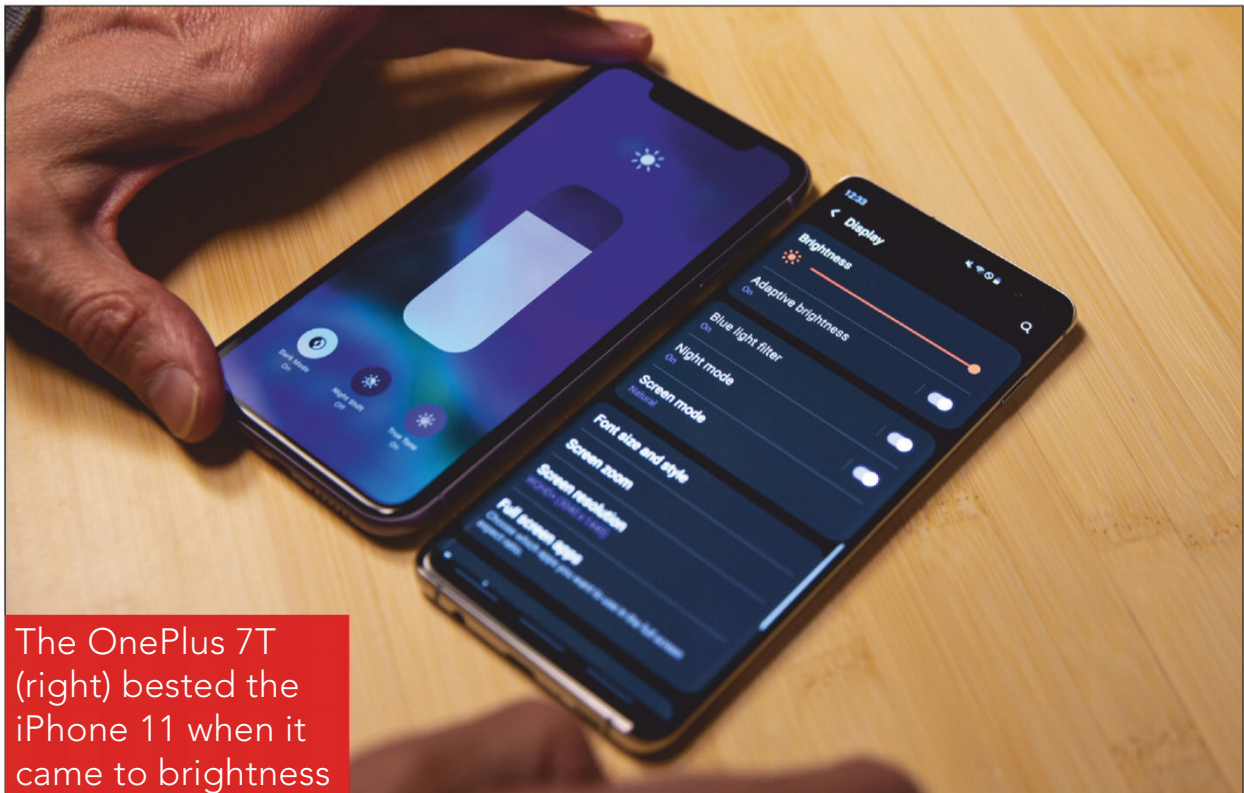
Apple has done a fantastic job with the calibration on the iPhone 11's display. Colours are rich and vibrant, though I would like an always-on or ambient option, especially at night when the whole display needs to light up to check the time.

When it comes to brightness, the iPhone 11 shines, though the 7T was just a little better. However, in my testing with a simple white background, the 7T was also the most inconsistent.

Max brightness (nits)
Google Pixel 4 XL: 650
Samsung Galaxy S10+: 715
Apple iPhone 11: 765
OnePlus 7T: 825

I'm confident in saying Google has delivered its best display in the Pixel 4 XL, but that's mainly because the ones that came before were so disappointing. It still has Google's trademark dullness, and an overall lack of punch when left in Natural mode. But even when switched to Boosted, the Pixel 4 XL just has a flatter feel when compared to the other phones here.

The Pixel 4 is particularly lacklustre when placed next to the Galaxy S10+. But to be fair, most phone displays are. The Galaxy S10+ pretty much set or broke every display record there is. There aren't enough adjectives or superlatives to describe just how gorgeous the S10+'s screen is. My only want is a higher refresh rate – and I have to assume that's coming with the S11.

Winner: Samsung Galaxy S10+

Battery

Each phone has a respectable battery, but the S10+ is the clear standout on paper:

Samsung Galaxy S10+: 4,100mAh
OnePlus 7T: 3,800mAh
Google Pixel 4 XL: 3,700mAh
Apple iPhone 11: 3,142mAh

The real-world results don't quite match up, however. In my testing and real-world use, the S10+ bested its competitors, but not by much, while the iPhone 11 vastly outperformed its capacity. The only one that consistently struggled to make it through a full day of use was the Pixel 4 XL. The iPhone 11 and

The iPhone 11 (left) has the best battery life, but not by much

7T benefit from their lack of an always-on display, but some (including me) will miss that feature.

The Pixel 4 XL was the most disappointing. The same OS ownership that gives Apple a ridiculous edge should propel the Pixel 4 XL to heights unseen by other Android phones, but the reality doesn't deliver. The lack of optimization is extremely frustrating.

For example, I played a two-hour movie at maximum brightness with all ambient and adaptive brightness toggles turned off, and this is how much battery each phone used:

OnePlus 7T: 17 percent
Apple iPhone 11: 19 percent
Samsung Galaxy S10+: 19 percent
Google Pixel 4 XL: 21 percent

The results are pretty close, but those percentage points add up over the course of a day, especially because most people won't be using their phones to watch videos for 10 hours straight. And look what happened when I ran the same video a second time with auto- and adaptive brightness turned on for all three phones, tracking the battery drain:

Apple iPhone 11: 13 percent
OnePlus 7T: 18 percent
Samsung Galaxy S10+: 19 percent
Google Pixel 4 XL: 20 percent

Apple's advantage comes into play when iOS starts working its magic. Even with a significantly smaller

With giant screens and lots of pixels, the OnePlus 7T (left), Galaxy S10+ (centre), and Pixel 4 XL (right) all have giant batteries

battery, the iPhone 11 is able to last longer than any of the phones here. All four handsets have lots and lots of pixels to power here, so lower brightness is definitely your friend. At the end of the day, the iPhone 11 consistently had the most juice left – and the Pixel 4 XL was always closest to the red – but every phone should get you through a normal day of use.

It's hard to crown a champion here, so I'll say this: the iPhone 11 and the Galaxy S10+ will last the longest, the OnePlus 7T is just a tick below, and the Pixel 4 XL will constantly worry you. But if battery life is your deciding factor for any phone, go with the iPhone 11.
Winner: Apple iPhone 11/ Samsung Galaxy S10+

Charging

We no longer need to wait hours to charge our phones – assuming you have the right charger. With a dead phone and the charger that's included in the box, here's how much juice you'll have after an hour of charging:

OnePlus 7T: 100 percent
Google Pixel 4 XL: 77 percent
Samsung Galaxy S10+: 74 percent
Apple iPhone 11: 33 percent

Two things here: the OnePlus 7T's incredible Warp Charging, and the iPhone's not-incredible 5-watt charger. While Apple's 'Pro' phones enjoy a swift 18-watt USB-C charger, the iPhone 11 is still saddled with a Lightning-based 5-watt plug. So if you buy one, you'll want to pick up a way bigger third-party charger.

Speaking of big, the OnePlus 7T's Warp Charge 30T is easily the biggest of the bunch, taking up the better of two outlets when plugged in – and you'll be using it every day, because the OnePlus 7T is the only phone here that lacks wireless charging. The other three phones all offer it, though the top speeds vary slightly:

Samsung Galaxy S10+: 12 watts
Google Pixel 4 XL: 11 watts
Apple iPhone 11: 7.5 watts

Ironically, the iPhone 11 wirelessly charges faster than it does with its bundled charger. Some people might scoff at wireless charging as a reason to buy a phone, but I'd have a hard time without it. So the OnePlus 7T loses major convenience points, even with the stellar Warp Charge.
Winner: Samsung Galaxy S10+.

Performance

All of the phones include very fast and very efficient processors. Obviously the iPhone uses Apple's silicon, while the Android phones are powered by Qualcomm's Snapdragon chipset.

Both the Galaxy S10+ and the Pixel 4 XL use the Snapdragon 855 processor, while the OnePlus 7T sports the newer Snapdragon 855+. It would take a serious user with equally serious benchmarks to discern any difference, but OnePlus buyers can boast that they have the technically faster Android phone.

Something's not quite right with the Pixel 4. It should be the fastest of the bunch, with the purest

Android skin and Google's hardware-software integration, but in test after test it performed slower than the others. It's gotten worse since I wrote my review. Apps hang (including Google's own utilities), system features lag, and even scrolling feels sluggish at times with Smooth Display turned on. It's the only phone where I need regular restarts to keep things humming. I can only hope the performance issues will be fixed with an update. Just check out these BrowserBench Speedometer scores, which measure the responsiveness of web apps:

Apple iPhone 11: 153
OnePlus 7T: 69.1
Samsung Galaxy S10+: 53.8
Google Pixel 4 XL: 34
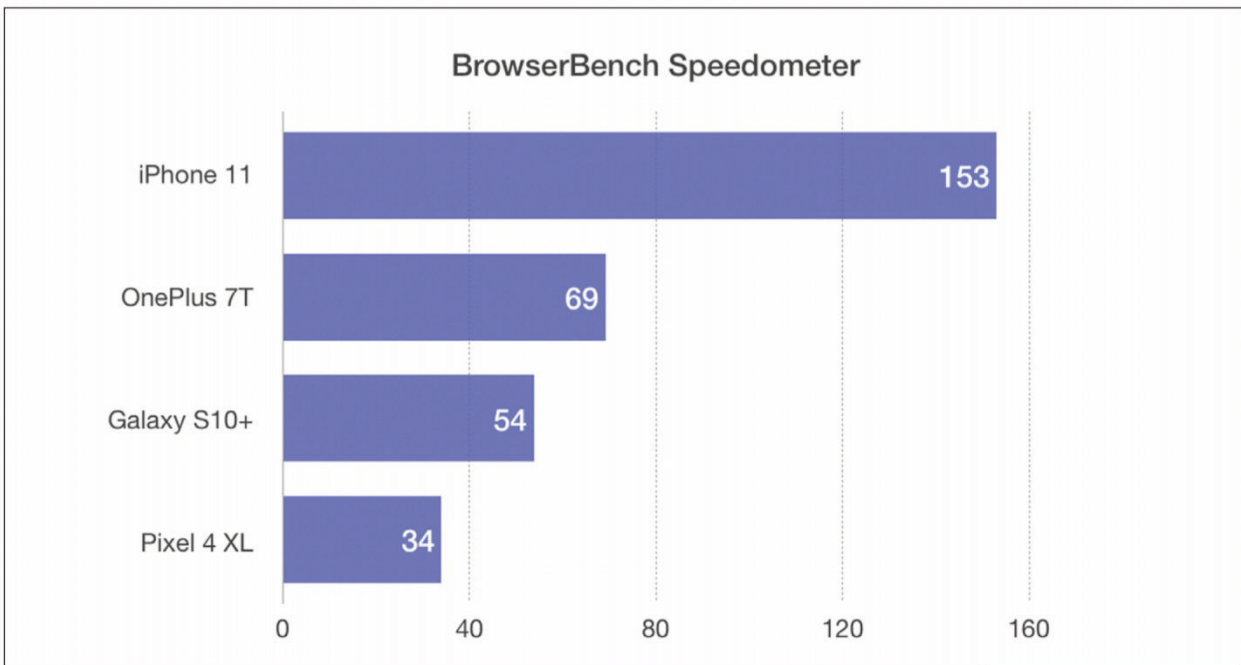
The iPhone 11 performs more than twice as many browser tasks as the closest top-of-the-line Android phone

I ran this test several times on the Pixel 4 using Google's own Chrome browser, and it never topped 35. Meanwhile, the A13 Bionic chip in the iPhone 11 is on another level – faster than its predecessor and the fastest of the bunch here, including in real-world results. Even the fastest Android UI here feels sticky when compared to the iPhone 11, and that's without a 120Hz ProMotion display.

The harmony Apple creates between the silicon and software is second to none, as evidenced by these Geekbench benchmark score (where once again the Pixel 4 seriously lags):

CPU (Single-Core/Multi-Core)
Apple iPhone 11: 1,330/3,531
OnePlus 7T: 791/2,789
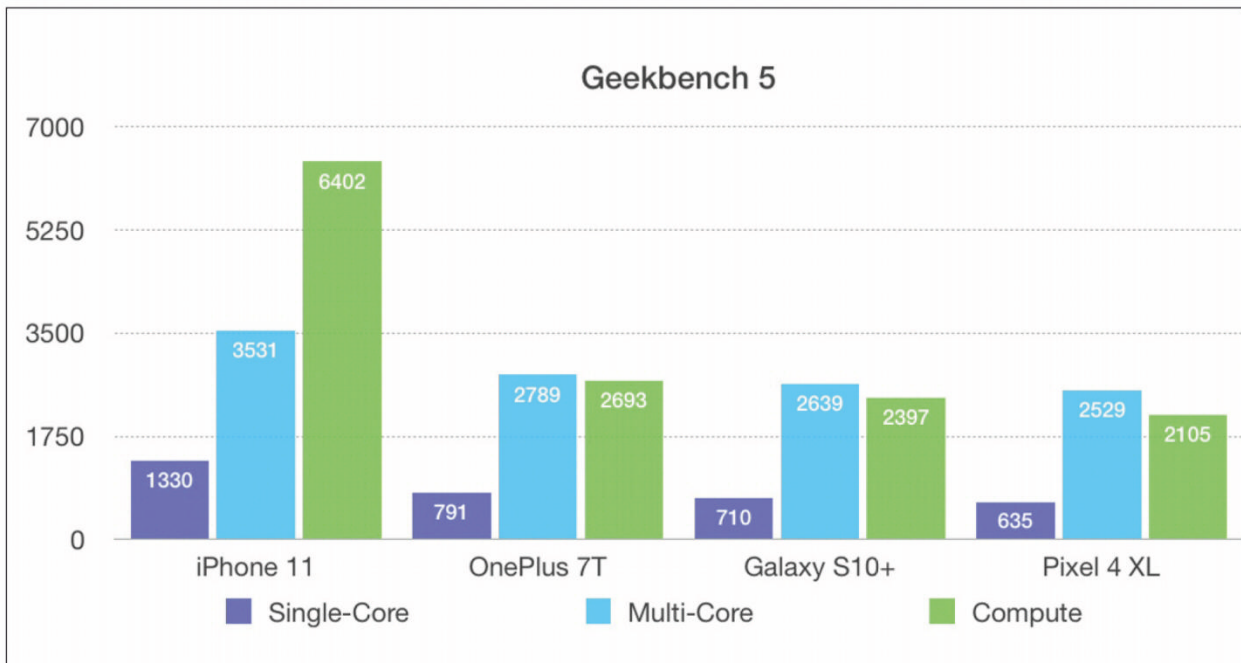
The A13 Bionic processor in the iPhone 11 simply smokes the competition

Samsung Galaxy S10+: 710/2,639
Google Pixel 4 XL: 635/2,529

Compute
Apple iPhone 11: 6,402
OnePlus 7T: 2,693
Samsung Galaxy S10+: 2,397
Google Pixel 4 XL: 2,105

One area where Apple can improve, however, is startup time from a full shutdown. The Pixel 4 XL obliterated the other phones, and the iPhone consistently came in last place, even if only by a second or two:

Google Pixel 4 XL: 11 seconds
Samsung Galaxy S10+: 19 seconds
OnePlus 7T: 20 seconds
Apple iPhone 11: 21 seconds

Granted, we rarely restart our phones – and the iPhone needs it even less often than the Android phones here – but I'd still like to see Apple get closer to the Pixel with the iPhone 12.

The results here underscore my frustrations with the Pixel 4 XL: if Google can optimize start-up time, why can't it do the same with the rest of Android? The Galaxy S10+ and OnePlus 7T basically run circles around the Pixel 4, but neither can touch the iPhone's crazy speeds, even if you won't notice them much.

Winner: Apple iPhone 11

Sound

After Apple famously dumped the headphone jack with the iPhone 7, the rest of the industry has slowly followed suit. First Google took it away from the Pixel 2, then OnePlus removed it with last year's 6T. And once it's gone, it's not coming back.

The Galaxy S10+ is the sole phone in the bunch that retains a 3.5mm headphone jack. You even get a very decent pair of AKG-tuned earbuds in the box. But Samsung axed the headphone jack from the Note 10 and Galaxy Fold, so you can see the writing on the wall. You'll get a pair of Lightning EarPods with the iPhone 11, but neither the OnePlus 7T nor the Google Pixel 4 XL includes a pair of buds, nor a USB-C-to-3.5mm dongle. The phones' own speakers also deliver solid

The headphone jack is going away, but the Galaxy S10+ still has one

volume (the Pixel 4 loses its front-firing speakers, which gave it a serious sound boost last year).

Max decibels
Samsung Galaxy S10+: 100
Google Pixel 4 XL: 98
OnePlus 7T: 97
Apple iPhone 11: 94

Along with their loudness, every handset but the Pixel 4 boasts Dolby Atmos spatial sound. While it's debatable that you actually need Dolby Atmos support on a phone, it's nice to have. Supported music and movies definitely feel slightly fuller (though you're not going to forget you're listening on a pair of smartphone speakers).
Winner: Samsung Galaxy S10+

Biometrics

We're at something of a transitional period when it comes to biometrics. OnePlus and Samsung replaced the physical fingerprint sensor with an in-display scanner, while the iPhone 11 and Pixel 4 XL both use 3D facial recognition. The Galaxy S10+ has a better scanner than the OnePlus 7T, and the iPhone tops the Pixel 4 XL with facial recognition, but there's more to the story than that.

The Galaxy phones used to have an iris scanner in addition to a fingerprint reader, so the in-display sensor feels like a step backward, especially because it's neither as fast nor as reliable as the physical scanner. Meanwhile, the OnePlus 7T's scanner is faster than

Samsung's when it works – especially when paired with the 2D face unlock. But on the whole I struggled with it more than I did with the S10+. Both phones have continuously improved their sensors through software updates.

Apple's had two years to refine Face ID. It's speedy, secure, and simple, with smart features that help keep your data locked down.

That's not the case with Google's face unlock. It's very fast and will even work if you're holding your phone upside down, but it's missing a key feature: attention, both in the literal and figurative sense. Google has opted against including eye tracking in the initial version, so if your eyes are closed, someone could still hold your phone up to your face to unlock it.

Winner: Apple iPhone 11

Storage

We've kind of reached the point where no one should ever run out of space on their phones, but just for the fun of it, let's break down the pound-to-gigabyte ratio:

OnePlus 7T (128GB): £4.28
Samsung Galaxy S10+ (128GB): £7.02
Apple iPhone 11 (64GB): £11.39
Google Pixel 4 XL (64GB): £12.95

That's a pretty big disparity, and you don't need to be a math whiz to figure out that more gigabytes for less money equals better value. The same goes for the step-up models:

Apple iPhone 11 (64GB upgrade, £50): 78p
Samsung Galaxy S10+: N/A
Google Pixel 4 XL (64GB upgrade, £100): £1.56
OnePlus 7T: N/A

It's disappointing that OnePlus isn't offering a storage upgrade option for the 7T in the UK, but even so, it delivers the best internal storage value. It's also disappointing that Google continues to sell 64GB of extra storage for £100, and no other Android phone here other than the S10+ offers an expandable memory card slot. But pounds-to-gigabytes, the OnePlus 7T takes this category.
Winner: OnePlus 7T

Operating system

I could spend the whole of this section debating the differences between iOS and Android and trying to convince you why the iPhone 11 has stronger app support and better gesture navigation, or why Google Assistant is superior to Siri and notifications are actually quite good on Android.

But the fact of the matter is, for every point I make about one, an equally salient point could be made about the other. The scale of iOS has lead to widespread bugs and issues that Apple struggles to squash, while Android's fragmentation and generally slow update schedule is continuously frustrating. The two operating systems are extremely close now – heck, they both even have dark mode.

So let's talk about Android vs Android instead. We often refer to Android as a universal OS, but each

phone brings a very different interpretation, affecting the overall experience as much as the specs and the hardware. Here's what you get with the phones here:

Samsung Galaxy S10+: One UI
Google Pixel 4 XL: Android 10
OnePlus 7T: OxygenOS 10

The One UI Android skin on the Galaxy S10+ is the most unique of the bunch, as far away from stock Android as a Galaxy phone has ever been. It's also the smartest interface Samsung has ever designed, with intuitive controls, thoughtful layouts, and powerful apps. As the first Galaxy to ship with One UI, the

Whichever phone you choose, you're getting a great, modern OS

S10+ easily delivers the best end-to-end Samsung experience in years. Major updates are still an issue – One UI 2 based on Android 10 likely won't arrive until 2020 – but Samsung has done a fantastic job with crafting an OS that's all its own.

The OnePlus 7T is one of the very few phones to ship with Android 10. Its Oxygen OS skin is every bit as light and airy as its name suggests. It sticks close to Google's vision of Android and even feels like an Android One phone at times. However, powerful customization and smart features, plus a healthy dose of speed, give Oxygen OS its own character while still giving Android purists enough to love.

The Pixel 4's main reason to exist is as a showcase for the latest Android build, so like the OnePlus 7T, it ships with Android 10 on board. But unlike the iPhone 11, which runs iOS 13 like it was tailor-made (because it was), I encountered more issues with Android 10 on the Pixel 4 than I have with any other Pixel phone. App crashes and hangs, laggy scrolling, and general slowness has plagued my time with it. Worse, the November update that should fix things has been slow to reach my phone. Software problems with new phones are hardly uncommon – Apple certainly has its share of them each year – but the Pixel is supposed to represent the best of Android, and so far the Pixel 4 doesn't.

Winner (Android): OnePlus 7T

Miscellaneous features

Each phone offers apps and features that are unique to the experience. The Galaxy S10+ has its Edge

shortcuts, which let you swipe from the curved area of the screen to access apps. The OnePlus 7T has a Reading Mode that desaturates the screen to make it easier on the eyes. The iPhone 11 has Animoji and FaceTime. They also all have some form of water resistance, though the OnePlus 7T isn't IP-rated, so we don't know how deep you can dunk it. On paper, the iPhone 11 is the most resistant, letting you submerge it in 2m of water for up to 30 minutes. (The Pixel 4 XL and S10+ guarantee a depth of only 1.5m).

The Pixel 4 XL brings something that you won't find on the other phones here. Called Motion Sense, it lets you control parts of your phone by waving your hand above the screen. It's limited to snoozing alarms, skipping tracks, and silencing calls for now, but it works extremely well and has incredible potential. In a world of near-homogeneity when it comes to smartphones, I commend Google for thinking and engineering out of the box with the Pixel 4 XL.
Winner: Google Pixel 4 XL

Camera

The camera is probably the main thing people research when buying a new phone, and I'm just going to say it here: each of these phones' default cameras will take fantastic pictures out of the box without adjusting a single setting, despite some differences and deficiencies, as you'll see here.

All have multiple cameras, but you're getting only two with the Pixel 4 XL (standard, telephoto) and the iPhone 11 (standard, ultra wide), while the S10+ and 7T have three apiece (standard, ultra wide, telephoto).

The iPhone 11 (left) and Pixel 4 XL (right) don't have a ton of manual controls, but they still take the best pictures

The unique placement of the iPhone 11's cameras have a purpose: it's the only camera where you don't have to adjust your shot when switching from standard to ultra-wide. It's a small but meaningful attention to detail.

If you're looking for the fastest, most accurate, most versatile, then the iPhone 11 is your champ, just barely beating out the Pixel 4 XL. Neither Google nor Apple offer users the manual controls in the stock camera app that the OnePlus 7T and the Galaxy S10+ do, but you wouldn't need them if they did. The photo processing on the iPhone 11 and Pixel 4 are far enough ahead of the other phones here where you can be absolutely confident that you're getting the best possible picture

when you tap the shutter, no matter the subject, mode, or lighting condition.

The bigger jump over last year can be seen in the iPhone 11's Night Mode. While it will be criticized by some as merely playing catch-up to Google's Night Sight, which debuted to wows on the Pixel 3, Night Mode is a revelation for nighttime photography, with a mind-blowing algorithm that produces better results than the Pixel 4 in some instances.

The iPhone excels in its understanding of what's being shot. Other night modes simply amp up the brightness and exposure with varying results, while the iPhone 11 does a better job of preserving the shadows and overall integrity of the scene.

While both the iPhone 11 and the Pixel 4 XL usually snuffed the competition, more often than not, I preferred the nuance in the iPhone 11's shot. Where the Pixel 4 XL's Night Sight shots often seem like a Photoshop brightening filter had been applied, which affected clarity and sharpness, the iPhone 11's shots had deeper blacks, crisper details, and less overall noise and graininess.

Small details aside, at times the iPhone 11 simply floored the competition. As you can see in the comparison shots opposite, all four phones did well with pulling out the colour of the darts, but the board on the wall is another story. The OnePlus 7T struggled mightily with white balance (a constant issue when shooting in low light with white backgrounds), and the numbers in the S10+'s shot are barely visible. The Pixel 4 XL handled the colour well, and illuminated the colours in the board and most of the bottom numbers,
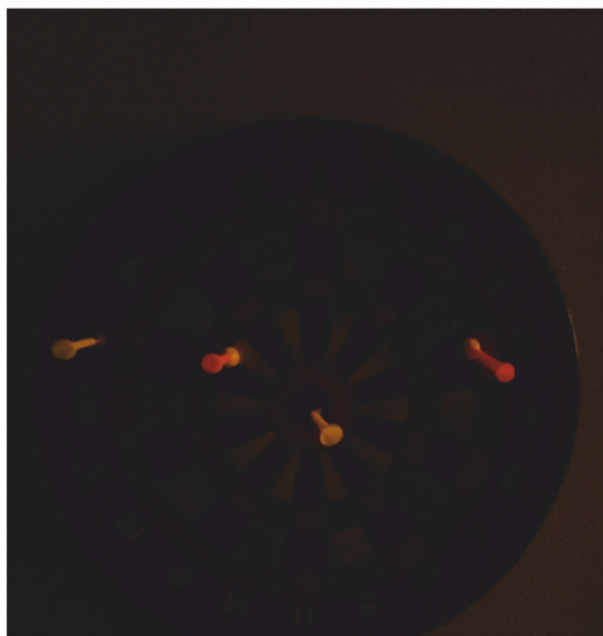
The iPhone 11 (top left) handled this extremely dark scene better than the Pixel 4 XL (top right), the Galaxy S10+ (bottom left), and OnePlus 7T (bottom right)

The Galaxy S10+ (bottom left) handled my son's messy hair slightly better than the others in this portrait shot, but it's hard to find fault with the iPhone 11 (top left), Pixel 4 XL (top right), or OnePlus 7T (bottom right)

The iPhone 11 (top left) nailed the colour and captured more detail in this shot of a tree trunk, but the Pixel 4 XL (top[right), Galaxy S10+ (bottom left) and OnePlus 7T (bottom right) weren't far behind

but the iPhone 11 was the only one of the bunch to illuminate all of the numbers (even if some aren't legible) and properly brighten the wall.

When shooting in normal light, however, the differences aren't nearly as extreme. In the portrait examples on **page 120**, each camera handles the background blur (and my son's messy hair) very well. You can quibble with skin tone and saturation (I personally prefer the Pixel 4 XL's), but for the most part they all handle portraits very well.

Everyday shots come down to little details as well. Take the shots of a plant on **page 121**, above. Good bark, contrast, and colour detail are present in all four pictures, but you can see how the OnePlus 7T lags a bit compared to its higher-priced peers, mainly due to autofocus issues. The iPhone 11 and Pixel 4 XL captured the deep maroon best, but again, I'm splitting

The OnePlus 7T might not be on the same level as the iPhone 11 or Pixel 4 XL, but it's capable of taking mind-blowing pictures

hairs. For example, if you had to guess which camera took the photos opposite, you'd probably guess the iPhone 11 or Pixel 4 XL, but they were actually snapped with the OnePlus 7T. Granted they were taken in ideal lighting, but they underscore just how far OnePlus has come with its smartphone photography.
Winner: Apple iPhone 11

Price

While you'd expect to pay about the same price for any of four smartphones with the best processor, screen, design, and cameras you can buy, that's not the case:

OnePlus 7T: £549
Apple iPhone 11: £729
Google Pixel 4 XL: £829
Samsung Galaxy S10+: £899

That's a £350 gap between the Galaxy S10+ and the OnePlus 7T, and well, if you've gotten this far, you know that the S10+ isn't £350 better than the 7T. Quite frankly it's not £170 better than the iPhone 11, either. Apple shocked the world by lowering the price of the iPhone 11 compared to its iPhone XR predecessor, but for all you're getting with the 7T, the other phones here just can't compete.
Winner: OnePlus 7T

Verdict

With all due respect to the Pixel 4 XL, this is a three-phone race. Tally the category winners, and it's a close call between the iPhone 11, Galaxy S10+, and OnePlus

The rear of the phones have even more character than the front

7T. You won't regret buying any of them, but the one you'll feel just a little better about is the OnePlus 7T.

OnePlus phones have long been our pick for best value in a smartphone, but it's time to recognize the 7T for what it is: a legitimate flagship that costs hundreds of pounds less than it should. Where things like the camera, design, and network compatibility used to drag down its predecessors, the 7T is a milestone for OnePlus, putting every other Android phone on notice – and the iPhone 11.

Yes the iPhone does some things better – and the lack of wireless charging on the OnePlus 7T is frustrating – but as a full package that's £180 cheaper,

it's easy to recommend the OnePlus 7T to anyone in the market for a new phone, no matter which operating system they want.