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**GUIDE TO SPECTRE
AND MELTDOWN:**
**STAY SAFE WITH
OUR TIPS**





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Meltdown and Spectre troubleshooting guide

BRAD CHACOS and MICHAEL SIMON explain how the critical CPU flaws affect PCs and Macs



Massive security vulnerabilities in modern CPUs are forcing a redesign of the kernel software at the heart of all major operating systems. Since the issues – dubbed Meltdown and Spectre – exist in the CPU hardware itself, Windows, Linux, Android, macOS, iOS, Chromebooks, and other operating systems all need to protect against it. And worse, plugging the hole can negatively affect your

PC's performance. Everyday home users shouldn't panic too much though. Just apply all available updates and keep your antivirus software vigilant, as ever.

Here's a high-level look at what you need to know about Meltdown and Spectre, in plain language. If you like diving deep into technical details read Google's post on the CPU vulnerabilities – fave.co/2DoKeKV.

What's the issue?

Again, the CPU exploits in play here are extremely technical, but in a nutshell, the exploit allows access to your OSes sacrosanct kernel memory because of how the processors handle 'speculative execution', which modern chips perform to increase performance. An attacker can exploit these CPU vulnerabilities to expose extremely sensitive data in the protected kernel memory, including passwords, cryptographic keys, personal photos, emails, or any other data on your PC.

Meltdown is the more serious exploit, and the one that operating systems are rushing to fix. It "breaks the most fundamental isolation between user applications and the operating system," according to Google. This flaw most strongly affects Intel processors because of the aggressive way they handle speculative execution, though a few ARM cores are also susceptible.

Spectre affects AMD and ARM processors as well as Intel CPUs, which means mobile devices are also at risk. There may be no permanent hardware solution to Spectre, which 'tricks other applications into accessing arbitrary locations in their memory'. Processor firmware updates can mitigate the issue to some degree. Software also needs to be hardened to guard against it.

Even new Intel chips like the Core i7-8700K are affected by Meltdown and Spectre



What's a kernel?

The kernel inside your operating system is basically an invisible process that facilitates the way apps and functions work on your computer, talking directly to the hardware. It has complete access to your operating system, with the highest possible level of permissions. Standard software has much more limited access.

How do I know if my PC is at risk?

Short answer: It is. Yes, even if it's a Mac. Google says "effectively every" Intel processor released since 1995

is vulnerable to Meltdown, regardless of the OS you're running or whether you have a desktop or laptop.

AMD processors aren't affected by the Meltdown bug. But chips from Intel, AMD, and ARM are susceptible to Spectre attacks. AMD says its hardware has "near zero" risk to one Spectre variant because of the way its chip architecture is designed, but AMD CPUs can still fall prey to another Spectre flaw.

How do I stay safe?

Update all the things. The entire computer industry is moving as quickly as possible to patch in Meltdown and Spectre protections. Right now, you should update your operating system, CPU firmware (if available), and web browser as soon as possible.

Make sure you are running security software as well – advice that Intel also stresses. No known Meltdown and Spectre attacks have been seen in the wild, but that's sure to change now the details are public. Triggering the attacks requires hackers to have access to your PC. An antivirus suite keeps bad guys off your PC. And as always, only download software and apps from reputable sources to reduce the risk of infection.

What patches are already available?

Microsoft pushed out a Windows update protecting against Meltdown on 3 January, the day that the CPU exploits hit headlines. Updates issued outside of Microsoft's monthly 'Patch Tuesdays' are rare, underlining the severity of this issue. Unfortunately, the emergency patch renders some AMD computers unbootable – mostly ones with older Sempron

and Athlon processors, judging by initial reports. Microsoft halted the roll-out of the patch on affected systems until the fix is fixed.

Intel is also publishing firmware updates for its processors. You'll need to snag them from your PC, laptop, or motherboard maker (like HP or Gigabyte) rather than Intel itself. At the time of writing, Intel expected to have released firmware updates for 90 percent of processors released in the past five years to its partners, though it will take longer for PC makers to actually push those fixes out for their devices. Firmware updates for all CPUs released in the past five years will roll out by the end of January, at which point Intel "will then focus on issuing updates for older products as prioritized by our customers," CEO Brian Krzanich said.

Intel revealed on 11 January it had received reports some users who owned Haswell or Broadwell systems were seeing "higher system reboots" after applying firmware updates. Intel's working to fix the issue.

AMD plans to release firmware updates to protect against Spectre, with patches for Ryzen, Threadripper, and Epyc CPUs coming first, and older architectures later. They're classified as optional because AMD says its CPU architecture has 'near-zero' risk against the Spectre variant that requires a firmware update.

Apple quietly protected against Meltdown in macOS High Sierra 10.13.2, which released on 6 December, as well as in iOS and tvOS 11.2. Kernel patches are also available for Linux.

Chromebooks received protection in Chrome OS 63, which released on December 15. You can find a detailed list of how individual Chromebooks

Macs are affected by Meltdown and Spectre, too



are affected at fave.co/2Drr8Uo. Furthermore, the Chrome web browser itself was updated to include an opt-in experimental feature called “site isolation” that can help guard against Spectre attacks. Site isolation is trickier on mobile devices; Google warns that it can create “functionality and performance issues” in Android, and since Chrome on iOS is forced to use Apple’s WKWebView, Spectre protections on that platform need to come from Apple itself. Chrome 64 will include more mitigations.

Other browsers are battenning down the hatches against Spectre as well. Firefox 57 released in November with some initial safeguards, and Edge and Internet Explorer received an update alongside Windows 10. On 8 January, Apple pushed out updates

to iOS 11 and macOS with 'security improvements to Safari and WebKit to mitigate the effects of Spectre'.

Nvidia swiftly released graphics card drivers containing initial protection against Spectre as well – a crucial fix since GPU display drivers sink deep hooks into your kernel. Grab the latest Nvidia drivers [here](#).

Will these fixes slow down my PC or Mac?

It's complicated, and highly dependent on your hardware, operating system, and workloads.

More recent Intel processors from the Skylake (6th-gen Core 6xxx series) era onward have a technology called PCID (Process-Context Identifiers) enabled and suffer less of a performance impact, according to Microsoft. Your version of Windows makes a difference as well. Plus, some applications – most notably virtualization and data centre/cloud workloads – are



affected more than others. Intel confirmed that the performance loss will be dependent on workload, and ‘should not be significant’ for average PC users.

Microsoft offers a slightly different and more nuanced opinion. Windows chief Terry Myerson says they “don’t expect most users to notice a change” on Windows 10 systems running Intel 6th, 7th, or 8th-generation Intel processors.

Intel published some post-patch benchmark results on best-case PCs like this on its blog (fave.co/2Dte3tJ). The tests showed an average performance loss of between 2- and 7 percent in the SYSMark 2014 SE benchmark, which simulates productivity tasks and media creation. Its responsiveness score – which Intel says measures “‘pain points’ in the user experience when performing common activities” – plummeted by a whopping 14 percent, though. In web applications that use heavy amounts of JavaScript, Intel saw a 7- to 10 percent performance loss post-patch. These tests were performed on SSD-equipped systems; Intel reports the performance loss is less noticeable if you’re using a traditional hard drive.

Those are the best-case scenarios, though.

If you’re running older processors, including 5th-gen Haswell chips, “some benchmarks show more significant slowdowns, and we expect that some users will notice a decrease in system performance,” Microsoft reports. Finally, Microsoft says for PCs running one of those older Intel CPUs and the older Windows 7 or 8 operating systems, “we expect most users to notice a decrease in system performance.” As far as business use cases, Windows Server “shows a

Benchmark	Workload Description	8th Generation Desktop Intel® Core™ i7 8700K Processor	8th Generation Mobile Intel® Core™ i7-8650U Processor	7th Generation Mobile Intel® Core™ i7 7920HQ Processor	8th Generation Desktop Intel® Core™ i7 6700K Processor		
CPU Code Name		Coffee Lake	Kaby Lake	Kaby Lake	SkyLake	SkyLake	SkyLake
OS		Windows 10	Windows 10	Windows 10	Windows 10	Windows 7	Windows 7
Storage		SSD	SSD	SSD	SSD	SSD	HDD
Introduction Date		Q4'17	Q3'17	Q1'17	Q3'15	Q3'15	Q3'15
Relative Performance (Fully Mitigated System / Non Mitigated System at 100%)							
SYSmark 2014 SE Overall	Windows Application-based Office Productivity, Data/Financial Analysis and Media Creation.	94%	95%	93%	92%	94%	100%
SYSmark 2014 SE Office Productivity		95%	95%	95%	90%	93%	96%
SYSmark 2014 SE Media Creation		96%	97%	96%	96%	97%	97%
SYSmark 2014 SE Data/Finance Analysis		97%	98%	98%	103%	99%	106%
SYSmark 2014 SE Responsiveness		88%	86%	86%	79%	89%	101%
PCMark 10 - Overall	Windows application based benchmark covering essentials, content creation and productivity	96%	96%	97%	96%	96%	96%
PCMark 10 - Essentials		96%	96%	97%	96%	93%	95%
PCMark 10 - Productivity		96%	94%	95%	94%	97%	97%
PCMark 10 - Digital Content Creation		98%	98%	98%	99%	97%	97%
3DMark Sky Diver - Overall	DX11 Gaming performance	100%	99%	100%	101%	100%	100%
3DMark Sky Diver - Graphics		100%	99%	100%	101%	100%	100%
3DMark Sky Diver - Physics		99%	98%	100%	99%	97%	99%
3DMark Sky Diver - Combined		100%	99%	100%	101%	100%	101%
WebXPRT 2015 Note: Windows 10 on Edge Browser Windows 7 on IE Browser	Web applications using six usage scenarios: Photo Enhancement, Organize Album, Stock Option Pricing, Local Notes, Sales Graphs, Explore DNA Sequencing.	92%	90%	93%	90%	95%	92%

Source: Intel
Note: The data above is based on multiple runs and expected system benchmark variation is assumed to be +/- 3%

Intel's post-patch performance results on 'best-case' PCs

more significant performance impact when you enable the mitigations to isolate untrusted code within a Windows Server instance.”

Early consumer benchmarks conducted using the Windows patch alone showed the most performance impact in storage speeds, but Microsoft’s Myerson stresses, “many of the benchmarks published so far do not include both OS and silicon updates,” which he deems a crucial part of the performance puzzle. Intel’s benchmarks include both OS and firmware updates.

“Obviously it depends on just exactly what you do,” Linux creator Linus Torvalds wrote in the Linux Kernel

Mailing List. "Some loads will hardly be affected at all, if they just spend all their time in user space. And if you do a lot of small system calls, you might see double-digit slowdown."

Will my games get slower?

Not according to the limited testing performed so far, though these sources didn't test the Meltdown and Spectre patches with updated CPU firmware.

Phoronix tested Dota 2, Counter-Strike: Global Offensive, Deus Ex: Mankind Divided, Dawn of War III, F1 2017, and The Talos Principle on a Linux 4.15-rc6 machine with a Core i7-8700K and Radeon Vega 64. None saw a frame rate change outside the margin of error range.

Hardware Unboxed tested a handful of DirectX-based Windows games in the video linked above. With DirectX hooking so deeply into Windows, gamers were worried about a potential performance degradation there. Fortunately, Hardware Unboxed observed virtually no frame rate loss in Ashes of the Singularity, Assassin's Creed: Origins, or Battlefield 1.

Are AMD processors affected?

Much, much less than Intel chips. All modern CPUs are vulnerable to Spectre attacks, but AMD says that its CPUs have "near zero" risk to the variant causing performance slowdowns in Windows PC due to the way they're constructed. Nevertheless, AMD is releasing CPU firmware updates to protect against it, though they're classified as optional. Operating system and software updates will protect against the other

Spectre variant. There is “zero AMD vulnerability” to Meltdown thanks to chip design, AMD says. If operating system patches exclude AMD CPUs from the new Meltdown-related performance restrictions – and Linux definitely is – the performance war between Intel’s chips and AMD’s new Ryzen CPUs may get even tighter.

Unfortunately, the emergency Windows patch renders some AMD PCs unbootable, which prompted Microsoft to halt its installation on potentially impacted systems. It appears mostly older Sempron and Athlon CPUs are affected. The security patches will resume once AMD and Microsoft correct the issue.

Best new products

These are the products we at TECH ADVISOR are still talking about when everything else has blurred together



CES 2018 is over, and we have a chance to pause and reflect on what we saw that was actually great. Products that advanced their category, or broke new ground. Things that leaped ahead of the competition, Or maybe they just looked cool.

It's easy to hit saturation at CES, but these are the products we're still talking about when everything else has blurred together. We start with the product that was so innovative, two of us raved about it.

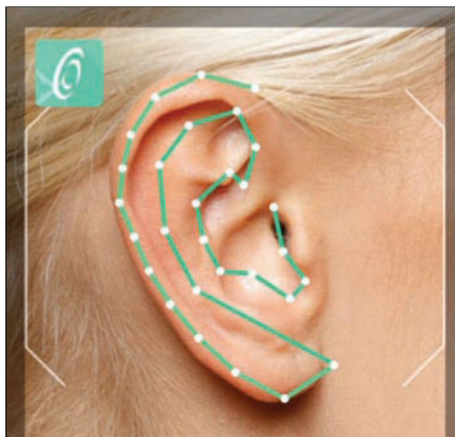
1. Creative Super X-Fi headphone holography

Hands down, this was the best demo at CES – and it's the product I'm most looking forward to reviewing this year. Creative's DSP chip and software analyses how your ears perceive sound, based on photos of each of your ears and your face. It then synthesizes this data with information about the headphones you indicate you're using and the acoustics of the room you wish to emulate, and builds a custom audio model for processing the sound passing through the chip.

The results simply must be heard to be believed. In my demonstration, I could barely tell the difference between Dolby Atmos demo tracks and movie soundtracks played through a conventional high-end home cinema system and a pair of headphones, even though the headphones had just two drivers. The device also made straightforward stereo music tracks sound magical, as if you were in the room with the musicians playing live. Creative told me Super X-Fi will be available later this year in several form factors, including a USB dongle that you'll use with your own headphones.

Michael Brown

As an audio engineer I readily claim that most 'virtual' surround



Creative's app contour-maps your ears and face to analyse how your ears hear sound

sound applications are rubbish – until now. Creative Labs' Super X-Fi blew me away. The company's technology makes a stereo headset sound like a surround sound speaker set up in the room with you. This is an important technology used by professional applications, made into an easy-to-use consumer product. This demonstration stole the show for me, and had my colleagues floored as well. *Adam Patrick Murray*

2. Intel Kaby Lake G

Though its launch was overshadowed by Spectre/Meltdown security questions, Intel's Kaby Lake G was no less exciting. The new CPU, which combines an AMD Vega M GPU and an 8th-generation quad-core Core i5 or Core i7, promises to deliver more performance in slimmer laptops.

Thus far, we've only seen two: HP's Spectre x360 15t and Dell's new XPS 15 2-in-1. Both laptops basically promise to give you the graphics performance of a laptop that would likely have been likely twice as thick before. *Gordon Mah Ung*

3. Digital Storm Project Spark

We're suckers for squeezing performance into tiny boxes, but Digital Storm's Project Spark is truly something to see. Not only does it get a 6-core Core i7 and GeForce GTX 1080 into a machine smaller than a tissue box, but it does it with custom liquid cooling too.

Digital Storm does it all by building a custom chassis using a MicroSTX motherboard and an MXM module. It all adds up to a lot of performance in a stunningly tiny PC. *Gordon Mah Ung*

4. Acer Predator Orion 9000

Wheels seem like such a little thing, but in this case it shows the attention to detail on Acer's Predator Orion 9000 gaming desktop. They nestle discreetly in the lower rear corner, so your rig won't look like a child's wagon when you lift up a bit on one of the dual handles atop the PC and roll the entire rig into your next LAN party.

Acer is hoping it will solidify its place in the burgeoning gaming PC sector. It's hard to follow an act like CES 2017's over-the-top Predator 21 X laptop, but this desktop offers a similar level of care.

It includes five fans: two on the top, two in front, and one more to help cool the available dual GeForce GTX 1080 Ti cards in SLI. The power supply has a slick

Predator-branded cover and its own ventilation. There's a neat hanger for your headset that pops out of the front panel. Clearly the company knows how to make a nice, thoughtfully designed rig.

Melissa Riofrio

5. Nvidia BFGD

The concept for Nvidia's Big Format Gaming Display (BFGD) must have been stupidly easy: Just make one big giant



External details on the Predator Orion 9000 include two top handles and a clear side panel

monitor. The result is the Big Format Gaming Display (BFGD). Note that the BFGD is not, repeat, not a TV, as it has no tuner. Instead, it's the display we might all want if we were designing our next nerd-cave. If you're saying a £499 Costco special large display would be "just as good", that's probably not true. Although no specs were released, the BFGD promises to be optimized for lower latency than you can get on a TV, as well as 120Hz G-Sync. Oh, and they're HDR too.

The big questions are how much, and when. We don't know, but Nvidia said Asus, Acer and HP have plans to offer the BFGD. For further details see [page 45](#). *Gordon Mah Ung*

6. Razer Project Linda

Razer loves to show off something wacky at every CES. While this year the surprise was a bit more subdued, I thought it was still an awesome prototype. I'm talking about Project Linda, which is essentially a laptop dock for the Razer Phone.

At first glance Project Linda looks like a Razer Blade Stealth sans trackpad and any sort of processing but that's where the Phone comes into play. While using a phone as the brains of a laptop/desktop isn't a new idea, I haven't seen a more elegant solution than Project Linda's, where the phone becomes the trackpad, tucking neatly into the laptop's profile rather than sitting in some dock.

Even though most Razer prototypes never make it into peoples hands, Project Linda felt pretty far along. I wouldn't be surprised if we saw a final version before summer. For details see [page 40](#). *Adam Patrick Murray*

7. Asus Bezel-Free Kit

It's the little things in life that mean the most sometimes, and nothing proves that more than the Asus Bezel-Free Kit, an entirely low-tech solution to a high-tech problem. Problem: Bezels when running a triple-monitor set-up. Solution: plastic lenses and bezels to bend light around those bothersome borders.

Is it perfect? No, and it won't magically turn three cheap panels into a pricey super-wide monitor, either. But it does work surprisingly well. Asus didn't announce a price, but it's expected to be well under £100 when released. *Gordon Mah Ung*

8. Hogar Controls' Milo and Pebble

Milo is a \$150 (around £110) Google Assistant smart speaker with a built-in smart-home hub and all the wireless tech one could hope for, including Wi-Fi, Bluetooth, ZigBee, and Z-Wave Plus. It can do everything a Google Home can do, plus it can control all your smart home devices, eliminating the need to buy something like a separate SmartThings or Wink hub

Milo has a glass touchscreen that you can tap and slide your fingers across to play music and control the on-board amplifier's volume. You can also use this surface to summon lighting scenes and perform other commands if you won't wish to use voice.



Milo Controls Pebble

Hogar will offer a second device called Pebble that offers the same touch controls as Milo, but it doesn't have mics or a speaker. It operates on battery power, so you can easily move it from room to room. Pebble will cost \$50 (around £36). Both it and Milo are expected to be available before the end of the second quarter. *Michael Brown*

9. Google Assistant

Amazon humiliated Google at 2017's CES. Its Echo smart speakers and Alexa digital assistant were everywhere on the show floor and on everyone's lips. It was almost as if the world had already forgotten about Google Assistant and Google Home. I wouldn't say Google turned the tables this year, but the company has clearly become much more serious about the smart home. Smart devices powered by Google Assistant, including a whole new class of smart speakers with touchscreen displays, were everywhere. Google representatives, meanwhile, uniformly dressed in white coveralls and wearing knit ski caps, were stationed in dozens of companies' booths ready to explain how Google Assistant was being used in various products. This battle is far from won. *Michael Brown*

10. D-Link AC2600 Wi-Fi router

In a world of malware, hacking and botnets, most smart home devices represent a huge vulnerability on your network, so it's great to see D-Link's AC2600 Wi-Fi router. It includes a firewall from McAfee that can stop unauthorized access to devices on your network, alert you to hacking attempts or peculiar Internet traffic from

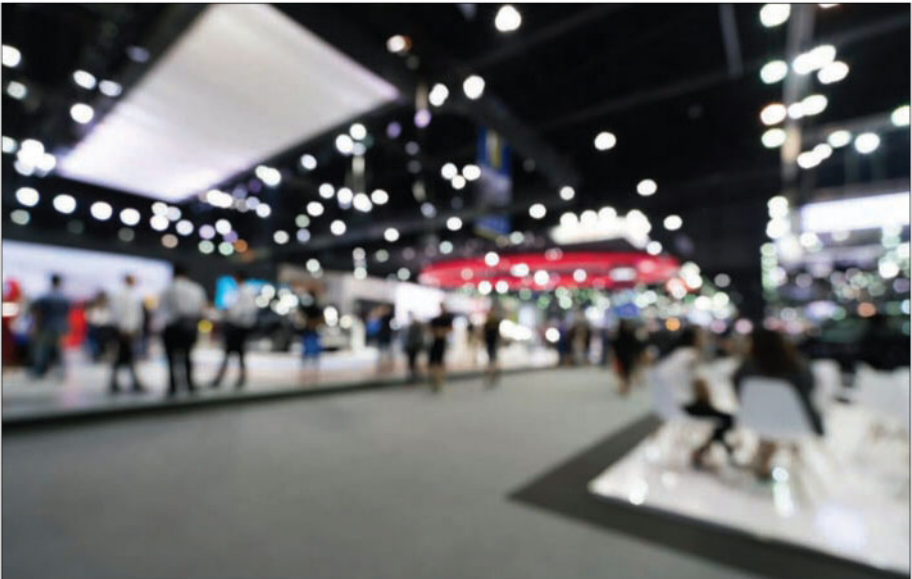


gadgets. It will also scan your network to notify you of insecurities and for parents, there's also a filtering system that can block websites and restrict web time.

And best of all, you're not locked into an expensive subscription. Included in the router's \$250 (around £180) price is five years of updates for the router's security software plus two years of McAfee protection for an unlimited number of PCs, phones and tablets. *Martyn Williams*

Biggest launches for PC enthusiasts

BRAD CHACOS offers an insight into the future of the PC

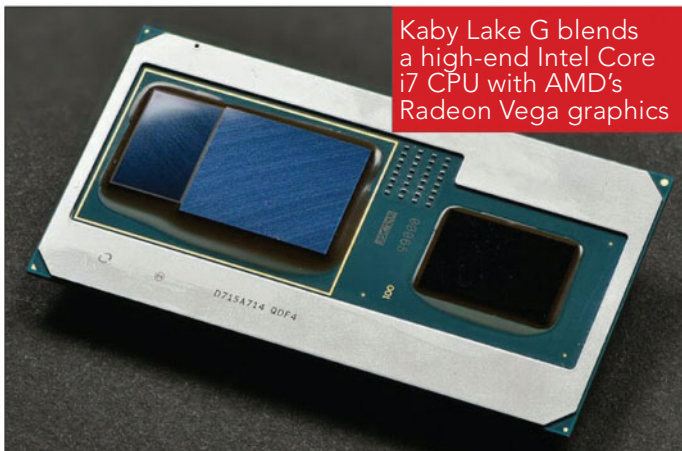


An ominous Spectre hung over CES 2018's PC announcements, as the industry grapples with how to protect against devastating CPU exploits that melt down security on almost every computer on the planet ([see page 4](#)). But put all that aside for now: 2017 was one of the best years for PC hardware ever, and at CES 2018, the PC kept the pedal firmly planted to the metal.

Intel and AMD joined forces on a powerful chip. Nvidia pushed gaming displays way past the limits of what we've seen so far. Next-generation routers, while Asus used an optical illusion to make multi-monitor set-ups even more immersive. Let's dig into the big CES reveals that PC enthusiasts need to know about, starting with a big one.

1. Intel <3 AMD

As we touched upon earlier, Intel and AMD are working together on a chip. Okay, okay, we've known this collaboration was coming since November, but at CES 2018, Intel pulled the full curtain back on five Intel Core processors shipping with Radeon Vega graphics on board. You'll find both Core i5 and i7 CPUs represented in the 'Kaby Lake-G' line-up, as well as differing Vega configurations. But getting down to brass tacks Intel expects the chips with slower Radeon graphics to beat Nvidia's GeForce GTX 1050 in gaming performance.



That translates to decent 1080p gaming performance with Medium graphics settings, roughly. And Intel says the full-force 100W chips should outpunch even the GTX 1060 Max-Q, a GPU that demands few compromises at 1080p resolution.

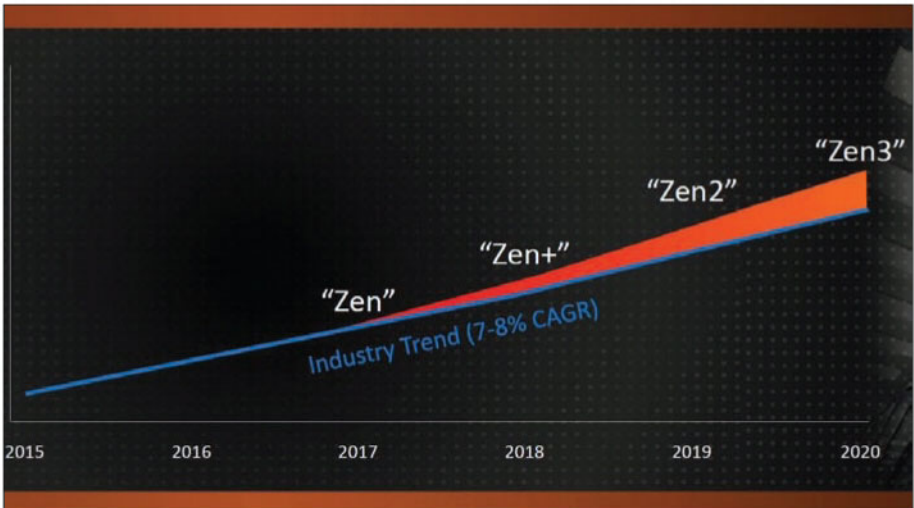
And, you know, Intel and AMD are working together.

These radical Kaby Lake-G chips will appear in actual PCs sooner than later. Intel showed off mean-looking 'Hades Canyon' NUCs that should blow our beloved previous version of the small PC out of the water – albeit for noticeably higher prices.

HP's updated Spectre x360 15 also marries Intel with Radeon, as does Dell's new MacBook Pro rival, the XPS 15 2-in-1. Look for those gaming-ready, yet super-thin laptops to land this spring.

2. The future of AMD

AMD didn't settle for being Intel's plus-one. At CES, the company dropped the proverbial kitchen sink, giving us a far-reaching look at the future of its CPU and GPU line-ups. The firm plans on launching a pair of affordable desktop APUs in February. They'll marry Ryzen CPU cores with Vega graphics cores, negating the need for a discrete graphics card – one of the few glaring issues in the original Ryzen line-up. Shortly thereafter, AMD's launching a new Ryzen generation based on 'Zen+' cores that use a more advanced 12nm manufacturing process, compared to original Ryzen's 14nm transistors. Officials unofficially told us to expect at least a 10 percent boost in performance over today's Ryzen chips. New X400-series motherboards will be released to support the new



chips, though existing Ryzen motherboards will support them as well after BIOS updates.

AMD also provided a product road map showing Zen 2 releasing in 2019, and Zen 3 in 2020, each providing performance upgrades that exceed the typical 7- to 8 percent uplift found in recent Intel generations (see above graph).

3. New routers

Futuristic routers were out in droves at CES. The most notable might have been D-Link's AX6000 and AX1100 Ultra – two routers so cutting edge that the next-generation 802.11ax Wi-Fi standard they're built around isn't even an official standard yet.

802.11ax routers will get a speed boost over today's 802.11ac routers, sure, but the technology's big draw is the ability to handle large amounts of network traffic



much more efficiently. With so many web-connected devices clogging up the pipes in modern homes, 802.11ax hopes to make it so none of your device ever find themselves starved for bandwidth.

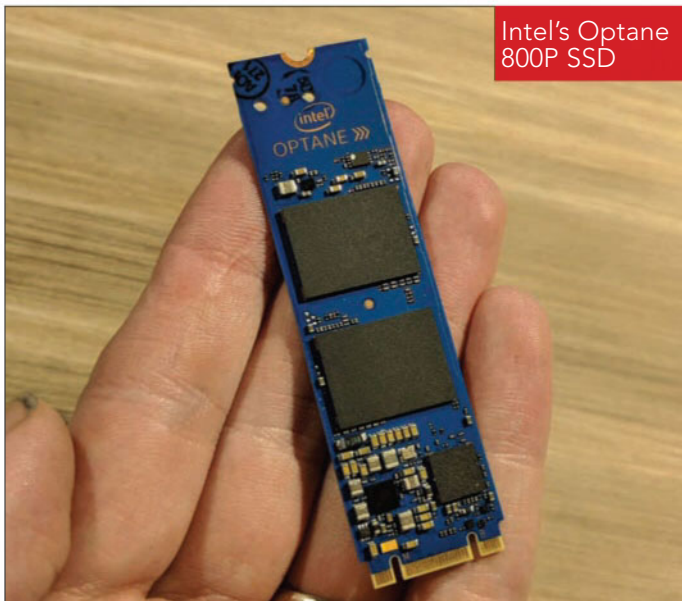
D-Link also announced the boringly named DIR 2680, which looks like an Overwatch loot box and bakes McAfee's Secure Home Platform right into the router itself, protecting every device on your network from PCs to swanky smart light bulbs. That's not new, per se – Symantec has its Norton Core router, and Bitdefender is onto the second iteration of its Bitdefender Box – but we saw more of the trend at CES.

Netgear's version takes a different angle: Netgear Armor is an optional firmware update for existing routers that adds in Bitdefender antivirus at the network level for \$70 (around £50) per year. Unfortunately, the only hard details provided were plans for Armor to first

appear for the Netgear Nighthawk AC2300 Smart Wi-Fi router (model R7000P) at some point in the future. CES isn't, however, about fine details. It's about the big picture. It's about the future. It's easy to hit saturation at CES, but these are the products we're still talking about when everything else has blurred together. We start with the product that was so innovative, two of us raved about it.

4. Intel's quantum processors and bleeding-edge SSD

Intel unveiled a potential glimpse of the future of computing during its blockbuster CES keynote, which was surprisingly light on news about traditional PCs. Instead, CEO Bryan Krzanich showed off a 49-qubit chip



Intel's Optane 800P SSD

for quantum computing. "This 49-qubit chip pushes beyond our ability to simulate and pushes towards quantum supremacy, the point at which quantum computers far and away surpass the world's best supercomputers," Krzanich said.

The company also pushed its bleeding-edge 3D XPoint technology, which blends the performance of DRAM and the non-volatility of traditional NAND storage to create SSDs with insanely good latency, insanely good low que depth performance, and endurance in spades.

The new Optane 800P SSD is the first Intel Optane (read: 3D XPoint) drive pitched at the masses, coming in a bootable M.2 form factor and 58GB and 118GB capacities. Intel's first two Optane drives, the enthusiast-focused Optane 900P and Optane Memory caching solution, targeted much more niche use cases.

5. **Wireless charging mice**

Wirelessly charging mice are officially a trend now. Following in the innovative footsteps of Logitech's PowerPlay mousepad and its G703 and G903 mousepad, Mad Catz and Razer revealed wireless charging mousepad/mouse combos at CES 2018 in the form of the RAT Air and HyperFlux Mamba, respectively. The mousepads plug into your PC and wirelessly charge your mouse while you use it.

The newcomers take a slightly different approach than Logitech, though. The PowerPlay mice include batteries and a wireless mouse dongle, which means you can also use them as standard wireless mice away from the PowerPlay mousepad. The Razer and



Mad Catz versions don't include batteries though. That helps bring down the weight, but means you'll need to plug them in on other systems. But more crucially, how will the newcomers perform when your mouse isn't firmly settled on the mousepad? As resident mouse guru Hayden Dingman mused in his HyperFlux Mamba coverage:

"For instance, there are certain areas of Logitech's Powerplay mousepad where my mouse doesn't receive a charge – mostly along the extreme edges and in the corners. The charging field also extends only a few millimetres at most above the mousepad, so I lose power whenever I lift and adjust the mouse. And that's fine, because there's a battery to fall back on.

“What happens in the same scenario with HyperFlux? Does the mouse lose power entirely? Or has Razer managed to extend the powered field across and significantly above the entire Firefly mousepad? An important question, and one I probably won’t solve until I’ve had some time with HyperFlux.”

Either way, mousepads wirelessly charge mice now. We’re officially living in the future.

6. ARM-powered laptops

Stop us if you’ve heard this one before: Microsoft and Qualcomm are trying to make ARM-powered Windows laptops a thing.

Windows RT wound up being an unmitigated disaster, quickly cast aside by Microsoft and PC vendors alike. But this renewed attempt at always-connected, long-lasting ARM laptops learned from its past. Where Windows RT laptops were restricted to Windows Store apps alone, the new batch of Qualcomm Snapdragon notebooks will be able to run the full-blown version of Windows 10 – though they’ll need to emulate traditional desktop software, which slows performance compared to Intel- and AMD-based Windows laptops.

Now for the disappointing news. The Snapdragon-powered 2-in-1 we handled at CES, Lenovo’s Miix 630, can’t run desktop software by default. Instead, it runs Microsoft’s gimped Windows 10 S, a made-for-education version of the operating system that’s – wait for it – locked to the Windows Store. Other Qualcomm Windows PCs we’ve seen do the same. Fortunately, you can upgrade to Windows 10 Pro through the

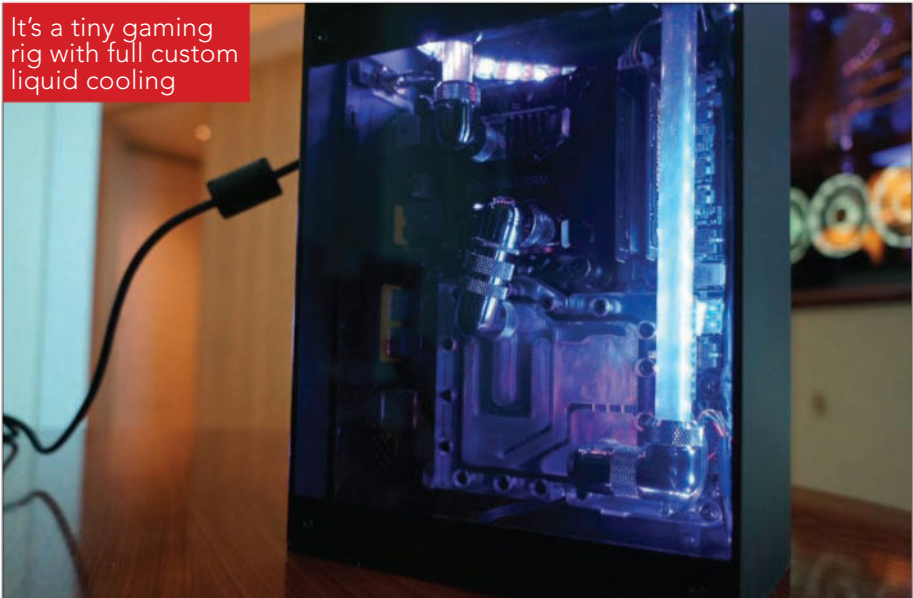
Microsoft store if you want a thin, light laptop with up to 20 hours of endurance – but doing so will cost you, both in upgrade fees and (likely) in battery life.

Is this Windows RT all over again? We'll find out when ARM-based Windows laptops start hitting the streets at, uh, some point. Nobody's said when yet.

7. Digital Storm Project Spark

One of my favourite parts of CES is finding PC hardware that's just plain cool. Digital Storm's stunning Project Spark fits the bill admirably. It uses the all-too-rare Micro-STX form factor to cram a Core i7-8700K and GeForce GTX 1080 into a custom-made case measuring just 6x4x12in. That's a lot of firepower in a tiny space. Digital Storm pulls it off by outfitting those heavy-

It's a tiny gaming rig with full custom liquid cooling



hitting components with fully custom liquid-cooling the likes of which you normally only see in gigantic boutique rigs.

And did I mention that it's drop-dead gorgeous? Just see the opposite photo.

Digital Storm will start shipping Project Spark sometime later this year, with prices that start at \$1,300 (around £950) for a GTX 1060-equipped system.

8. **Asus ROG Bezel-Free Kit**

Triple-monitor set-ups provide ultimate gaming immersion when you're playing a shooter, racer, or a space sim like *Elite Dangerous*. Well, until your eye shifts to one of the side panels and stumbles across monitor bezels creating dark seams in the action. Enter the Asus ROG Bezel-Free Kit, which makes those ugly monitor edges disappear using an optical illusion rather than advanced technology tricks.

The Asus ROG Bezel-Free Kit



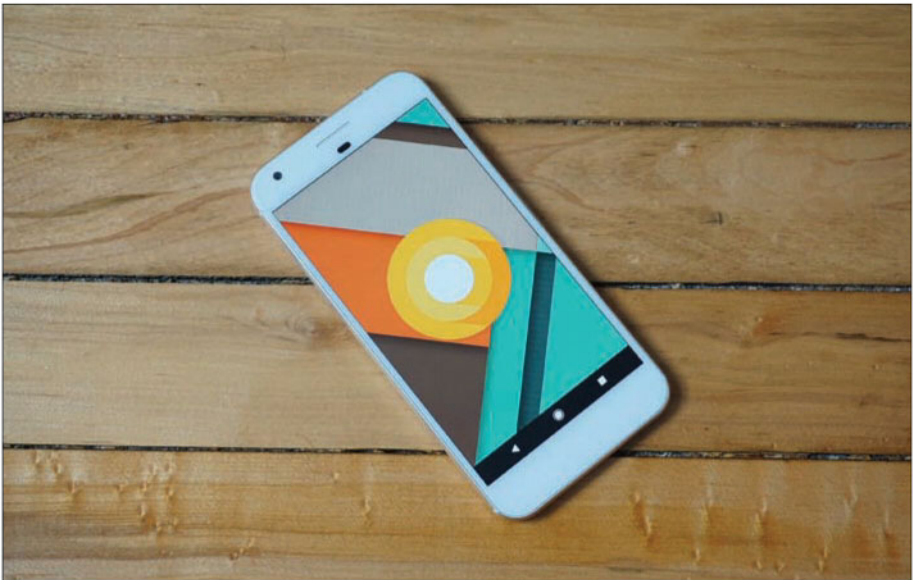
Simple plastic clips clamp acrylic strips over the bezels. They're set at a precise 130-degree angle to make those bezels fade away. The image coming through the kit still looks distorted and low-resolution, but the illusion ramps up the immersion factor.

The kits need to be designed for specific monitors to ensure the proper alignment of the lens. The version Asus revealed was created for the ROG Swift PG258Q (£559 from fave.co/2DevFtp) and Strix XG258Q (£455 from fave.co/2DifqLL) gaming monitors, though Asus says the kit can work with thin-bezel displays from other manufacturers as well. The ROG Bezel-Free Kit may launch later this year, or maybe not; Asus said the CES preview was to gauge interest.

Well, Asus, I never knew I wanted this, but now that I've seen it, I need it.

Android announcements you may have missed

PDA's, TVs, and watches. MICHAEL SIMON reports



CES may be all about consumer electronics, but sadly that doesn't really include phones. Most companies hold off until the spring to unveil their newest handsets, and there hasn't been a big Android splash at CES since Google unveiled the Nexus One back in 2010.

But that doesn't mean there wasn't any Android news coming out of Las Vegas in January. While the

Intel-AMD love affair and Google Assistant-powered speakers might have snagged most of the headlines, Android fans still found enough cool things on the show floor to entertain them. Here's a look at seven things you might have missed:

1. **Moto Mods**

Moto Mods were all the rage a year ago, but the fad isn't completely over. During its keynote, Lenovo showed off two new magnetic Moto Mods for its Z2 Force and other Z phones: a long-awaited keyboard and a health monitor.

The Livermorium Slider Keyboard Moto Mod is based on the winner of the Transform the Smartphone Challenge and adds a fully Qwerty keyboard with a 60-degree screen tilt. The Lenovo Vital Moto Mod is designed to keep you healthy, measuring your heart rate, respiratory rate, Pulse Ox, core body temperature, and for the first time, accurate systolic and diastolic blood pressure when you pop your finger into a slot on the back. The \$99 (around £70) keyboard mod will be available soon, while the \$395 (around £285) Vital Mod will ship later this year.

2. **Android Wear watches**

The state of Android Wear is anything but solid, but that's not stopping companies from making new watches. At CES this year, there were two that caught our eye. The first is from Kate Spade, and it joins a long line of fashion-first smartwatches from the Fossil company. Called the Scallop, the 1.2in watch has a decidedly feminine aesthetic, with gold accents and an

etched spade logo on the crown. There's no GPS, NFC, or heart-rate sensor, but you will get 24-hour battery life and Google Assistant. Two versions will launch next month: a bracelet for \$325 and a leather strap for \$295 – UK prices to be announced.

Danish watchmaker Skagen has also announced its first Android Wear watch. It's called the Falster, and while it too lacks GPS, NFC, and a heart-rate sensor, its simple aesthetic could appeal to casual watch wearers. It will cost \$275 when it launches – UK price to be announced.

3. Android TV screens

The last thing we expected to see at CES were new Android-powered screens, but no less than five companies unveiled new Android TVs this year: Nvidia,

Philips 7703



Westinghouse, Philips, Haier, and Hisense. Nvidia takes the crown, with the coolest name (BFGD, which stands for big format gaming displays) and radical design (for further details see [page 45](#)), but the 24in Philips 7703 is pretty good too, doubling as a Bluetooth speaker and made to look great in any room of the house. But really, we're just stoked to see Android TV get some love.

4. Google Assistant on Android Auto

Google made a slew of Assistant announcements at CES this year, but you might have missed this one: it's coming to Android Auto. Of course, Android Auto has had voice commands since its debut, but now Google is bringing the full Google Assistant to our cars. And that's probably where it'll be most useful.

5. Razor Phone's 'Project Linda' laptop

Okay, Razer's Android phone-powered laptop is not a real product just yet, but it is cool. Razer has taken Samsung's Galaxy S8 and Note 8 DeX dock and turned it up to 11 with Project Linda, a full-on laptop that does nothing until you slide your Razer Phone into it. For further details see [page 40](#).

6. In-screen fingerprint reader

We've been hearing about under-the-display fingerprint tech for a few years, but it's been theoretical until now. At CES, Chinese phone maker Vivo showed off the Synaptics-made tech in a working prototype, and it works. Vivo says it's secure and battery-efficient enough to make it into the company's next handset, so it could be the first of many phones that showcase the tech.



7. An Android PDA

Personal digital assistants may be a thing of the past, but we still have a soft spot for them. UK-based Planet Computers showed off the Gemini phone, which is straight out of the 1990s. The firm started taking orders for the device via Indiegogo ([fave.co/2D6HdeF](https://www.indiegogo.com/projects/planet-computers-gemini)) in 2017, but this is the first time we've seen it in public. With a 5.9in screen, integrated keyboard, clamshell design, and two weeks of stand-by time, it might be the best Android phone of the year. We joke, but we're not not considering buying one.

Project Linda turns Razer Phone into a laptop

Razer's big CES 2018 prototype was an Android phone dock done right. ADAM PATRICK MURRAY reports



Another CES, another Razer prototype. Unlike last year's three-screened laptop Project Valerie, Razer's Project Linda is something that might actually make it to market. Project Linda is a dock for your Razer Phone in the form of a laptop.

Razer's approach might have taken inspiration from the clamshell-like Lap Dock (originally called the Mobile Extender) that shipped as an option for HP's Elite x3 Windows phone. That phone is dead, though, so Razer has an opportunity to reincarnate the idea on a more successful phone platform. I'm optimistic: Project Linda is only a prototype, but it's the best I've seen from Razer.

Hybrid hardware

Because it uses the processing power of the Razer Phone, there isn't much inside Project Linda. The form factor mimics the Razer Blade Stealth with a 13.3in screen, CNC aluminium chassis, and a full Razer Chroma keyboard. In order to match the screen of the phone, the display is 120Hz, 16x9, and (hopefully) Quad HD resolution. I say hopefully because the unit we saw in our meeting was only full HD. Razer said 120Hz QHD displays at that size are hard to come by right now.

Inside the base of the laptop is a 53.6Wh internal battery, good for charging the Razer Phone up to four times. The included power brick is small and connects via one of Project Linda's USB-C ports. Project Linda also has one USB-A port and a 3.5mm headphone jack.

Razer Phone as the brains

The Razer Phone docks into Project Linda where a trackpad would traditionally be and is cushioned by felt. Once in place, you hit a docking button in the top right corner of the keyboard and you hear the USB-C port move into place. From there the keyboard and screen light up, with a quick Razer animation playing while it

transitions. From this point on, the glass screen of the Phone turns into a trackpad for Project Linda. When you want to take the phone out, you simply hit the docking button again, wait for the click, and pull it out.

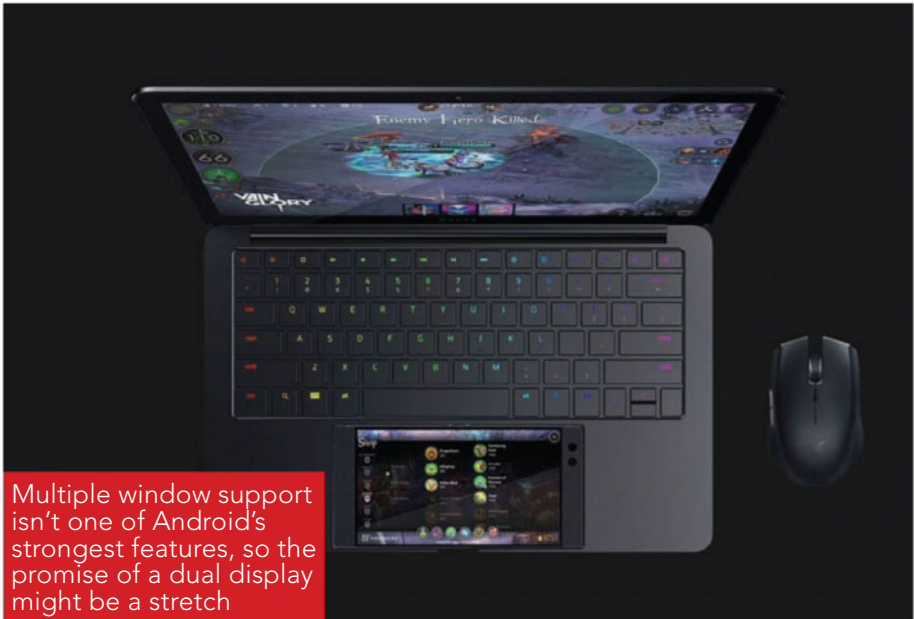
Everything in the laptop uses the Razer Phone's beefy Snapdragon 835 processor with 8GB of RAM. In our hands-on, the experience felt smooth and snappy, and it was great having the option to pair a Bluetooth mouse for finer controls.

Running Android on such a large screen takes a bit of getting used to, though. It's also worth noting that you don't have the flexibility of a traditional desktop experience, as you do with Samsung's DeX.

Project Linda's shortcomings

Even though Razer's Project Linda promises an intriguing twist on the smartphone-PC relationship, there is still plenty to iron out before it can come to market. Project Linda doesn't have any built-in speakers, so it uses the dual amps and front-firing speakers of the Razer Phone instead. I didn't get a chance to listen to anything while using it, so we'll have to see if your hands get in the way enough to make it a problem. There's also a notch carved out of the front of the laptop to reveal the fingerprint reader that's on the side of the Razer Phone. It wasn't the most natural way to unlock the laptop, but luckily the reader is fast and reliable.

Project Linda also packs 200GB of on-board storage, which mounts like an SD card in Android. In theory it's nice to have that extra space if you need it, but I'm worried about the security risks if the laptop gets



Multiple window support isn't one of Android's strongest features, so the promise of a dual display might be a stretch

stolen. I'd personally jump for a version without it, knowing that if I were to lose Project Linda, I wouldn't be risking any valuable info at the same time.

Another interesting prospect is dual-display support. At our CES demonstration, the Razer Phone screen was turned off and only mirrored what was on the display, but Razer had another unit playing a concept video of how it would look if both displays were treated separately. I love the idea of being able to see extra information on the touchpad screen, which has more practical applications than something like Apple's TouchBar. It also added to the visual flair of Razer's design, given that most laptop trackpads are typically solid colours and blend in.

Quite possibly the best Android phone dock

Over the years we've seen plenty of promises of docking a phone and using it like a traditional laptop or desktop. Everyone from tech giants Samsung and Lenovo to small kickstarter projects have tried to tackle this concept to various degrees of success. I've always been intrigued by the idea, especially lately, as mobile processing has become powerful and power-efficient.

Razer might have a winning formula on its hands, with great hardware on the laptop side, and all the raw power in the Phone. Docking the phone in place of the trackpad is the perfect location, far more user-friendly than Samsung's external DeX dock. Sure, I would never be able to do serious professional work in Adobe Premiere Pro on this laptop, but most of the time I just need something to write on, check my emails, and watch a couple of YouTube videos.

Will Project Linda ever come out?

Like I mentioned at the beginning, we all knew Project Valerie didn't make sense and would never come out. And while there is more for Razer to work on with Project Linda, I sense a real drive behind this product. It offers something unique to the die-hard fans who've already bought the Phone. Who knows: maybe in the future Razer will team up with Nvidia and offer GameStream on the laptop, making it an even better gaming set-up. But until then I feel confident that Razer can deliver on its promise of a laptop dock sooner than you might expect.

Nvidia unveils giant 65in gaming display

Nvidia sneaks into the TV business with its Shield-powered Big Format Gaming Displays, reveals JARED NEWMAN



Technically, Nvidia did not announce any smart TVs at CES. Instead, the company announced a set of 65in monitors that it's calling Big Format Gaming Displays (BFGD). Built by Acer, Asus, and HP – but all using the same 4K HDR panel – they're supposed to bring high-end PC gaming into the lounge.

But if you look past the gaming elements, Nvidia's BFGDs could become the best smart TVs that money

can buy when they arrive in the second half of this year. Their display quality rivals some of the best televisions from companies like Samsung, they use a fancy variable refresh rate technology that no other television has yet, and they have the guts of an Nvidia Shield TV – arguably the best media streamer on the market today – built in.

The only thing missing is a TV tuner for pulling in over-the-air TV broadcasts, which precludes Nvidia from using the term ‘television’ to describe its new creations. That doesn’t mean you should overlook BFGDs next time you need a new living room display.

It’s all about that panel

Although Acer, Asus, and HP use different industrial designs and might offer some minor distinguishing features – such as more HDMI inputs or better built-in speakers – all three BFGDs use the same panel, manufactured by AUO. It’s a stunning display, using the same kind of quantum dot filtering that appears on high-end LED TVs from Samsung and others. It also has a peak brightness of 1000 nits, which is what the UltraHD Alliance recommends to see the full benefits of 4K HDR.

Perhaps more importantly, the BFGDs will be among the first TV-sized displays to support variable refresh rates, in this case using Nvidia’s proprietary G-Sync technology. This allows the BFGDs to avoid screen tearing and stuttering by matching the display’s frame rate on the fly to whatever’s happening on screen.

While variable refresh rate is obviously useful for matching the ups and downs of video game frame

rates, it also comes in handy for video, whose refresh rate can vary depending on the source. The BFGDs can switch between 60fps YouTube videos and 24fps movies without having to flash a blank screen like today's TVs do.

The Shield factor

Granted, Nvidia won't be the only company offering those features in a television this year. Samsung plans to support variable refresh rate in some of its new high-end televisions, which also offer 4K HDR with quantum dot technology. Variable refresh rate should also come to more televisions in the future through the HDMI 2.1 connector.

What really helps Nvidia's BFGDs stand out, then, are its smarts. As a smart TV, the BFGDs function identically to an Nvidia Shield TV streaming box, which runs on Google's Android TV platform. It can run apps from the Google Play Store and uses the Google Assistant for voice controls, and it can turn



the television into a Plex server, SmartThings hub, or over-the-air DVR box. Performance be much smoother and faster than your average smart TV, since the BFGDs and the Shield TV share the same Tegra X1 processor.

As for the lack of a TV tuner, that's not a major problem seeing as you can plug a tuner into one of the BFGD's USB ports (or use a networked tuner, such as HDHomeRun or Tablo). This allows you to watch and record over-the-air channels through an app within the Shield's interface.

There's just one problem: Neither Nvidia nor its hardware partners are talking prices yet, and these displays aren't likely to come cheap. If you're enamoured with the Nvidia Shield, but don't want to pay through the nose for a television, you can still buy the streaming box on its own for £179 from fave.co/2DmfFFG, or £189 with a bundled game controller from fave.co/2D9ghLs.

The Shield TV lives on

If you're worried that all this means an end to the Shield TV as a standalone product, Nvidia says it's still committed to the streaming box, and to the Shield hardware line in general. Nvidia's director of Shield product management Chris Daniel says the set-top box will be available in more countries this year.

"We're really excited about Shield, and it's doing well," Daniel said. (Nvidia has never provided any sales figures for the Shield line.)

Daniel also said to expect an upgrade to Android 8.0 Oreo for the Shield TV sometime in 2018, although he wouldn't get any more specific than that.

Android 8.0 Oreo for the Shield TV in 2018



"We're sending a lot of changes back to Google that we want to see, so we're making changes with Google," Daniel says.

Part of the hold-up is Oreo's new interface, which lets each app advertise a row of content on the home screen, and offers a 'Watch Next' section where users can quickly catch up on favourites from different streaming service. Right now, most app makers haven't bothered to support those new features; Nvidia has been trying to get them on board.

"That's the whole interface, right? And if you release a whole new interface, and the apps aren't supporting it, then we don't feel like it's a good launch for us," Daniel says. "So we're working hard on that."

Samsung Galaxy A8



There weren't many interesting new smartphones at CES 2018 but Samsung has got a pocket rocket in the form of the Galaxy A8. We were lucky enough to get our hands on what can be described as a better late than never Galaxy S8 mini.

Before CES, there were a few rumours flying around that we'd see the Galaxy S9 unveiled at the show. It's not a big shock those were no more than tales, but

Samsung did at least have a new handset to keep us occupied. The Galaxy A range of devices has come a long way in a relatively short space of time and now effectively offers a cheaper and slightly lower spec version of the flagship S range, while keeping some of the key features and design traits.

Price

UK pricing has not yet been confirmed for the Galaxy A8, though we expect it to be somewhere around the £499 of the A7 (2017). It will be released in April.

Design

We're glad Samsung ditched plastic in favour for a combination of glass and metal on the A range back in 2016 and that hasn't changed here. The Galaxy A8 is not far off the S8 in terms of look and feel.

It's easy to confuse the A8 with its premium brother apart from a few small things. The display doesn't have the curved dual edge but does have tiny bezels so most of the front is take up by the screen.

It has a 75 percent screen-to-body ration compared to the S8's 83 percent. This means that like the S8, the home button is no longer and the fingerprint scanner is on the back of the phone. It's much easier to reach and use underneath the camera rather than beside it, though.

A small difference compared to the S8 is that there's no dedicated Bixby button on the side. We're not particularly fussed about this.

It is a little thicker than both the S8 and 2017's A7 at 8.4mm but it doesn't feel chunky at all. It's not the

lightest phone at 172g, but again this isn't a handset that gives a sense of being overly heavy.

Samsung continues to do a good job by offering IP68 waterproofing (up to 1.5m of fresh water for up to 30 minutes) and a headphone jack. There's no wireless charging despite the glass rear cover that, like most, is a little slippery.

It will be available in black, gold and orchid grey.

Display

The screen is the main upgrade since the Galaxy A7 as Samsung has, for the first time, brought the Infinity Display to the A range.

The A8 has a 5.6in 18:9 screen and as mentioned earlier, this means most of the front is the display and the home button is gone. It looks great and somewhat helps justify the inflated price.

It might not have the dual edge feature of the S8, but Samsung has to keep something for the flagship.



Also, the resolution is slightly lower at 2220x1080, but that's still an impressive 441ppi.

You don't get the edge panel then, but you do get the always-on feature, so the A8 displays some information even when the phone is locked – without using much power.

Processor, memory and storage

Inside the Galaxy A8 is Samsung's own Exynos 7885 processor. It's a small upgrade on the 7880 found in the A7, still with eight cores but at higher clock speeds. It also has the Mali-G71 GPU found in the Galaxy S8.

As before, there's 32GB of storage and a microSD card slot for adding up to 256GB more. However, there's now 4GB of RAM which is welcome.

Connectivity and battery life

These days, there's nothing overly exciting about connectivity on a phone. We've essentially reached a status quo of features, following gimmicks like infrared transmitters to control TVs and the like.

So the Galaxy A8 has the usual array of things including Bluetooth 5.0, dual-band 11ac Wi-Fi, GPS, NFC and offers Cat 11 LTE.

As you'd expect, the phone has USB-C but retains the headphone port. The battery size is still 3,000mAh so we're expecting a battery life of around a day.

Cameras

When it comes to photography, it appears that the A8 is doing things backwards to most other phones. Instead of having dual rear cameras and a single at the



front, it has the reverse. On the front are 16- and 8Mp cameras, both f/1.9, and the main reason for this is so you can use Live Focus. This gives you a bokeh effect blurring the background and you can adjust the amount of blur afterwards.

You can also switch between them to 'take the type of selfie you want' – either blurred background or not, but really they are pretty similar in terms of how much you can fit in the frame. Sadly they don't offer autofocus and are limited to 1080p video recording. Preliminary results look good, though.

On the rear is a lone 16Mp with a Galaxy S8 matching f/1.7 aperture. It offers phase detection autofocus and a single LED flash.

Software

The Galaxy A8 doesn't ship with the latest version of Android, but comes with 7.1.1 Nougat instead. We imagine an upgrade to 8.0 Oreo will arrive at a similar time to Samsung's other Galaxy phones. Samsung's interface is simple and clean these days, and although

there's no dedicated Bixby button on the side, it's a swipe away from the main home screen.

Verdict

The Galaxy A8 is by far the best A-range device to date and effectively the Galaxy S8 mini we always wanted. Samsung has brought the flagship design into a cheaper phone while keeping key features such as the Infinity Display and waterproofing. It's an attractive offering, but there are some amazing phones available at lower prices such as the OnePlus 5T. **Chris Martin**

Specifications

- 5.6in (2220x1080, 441ppi) Super AMOLED display
- Android 7.1.1 Nougat
- Octa-core Exynos 7885 processor
- Octa-core (2x 2.2GHz Cortex-A73, 6x 1.6GHz Cortex-A53) CPU
- Mali-G71 GPU
- 4GB RAM
- 32/64GB storage, microSD up to 256GB
- Fingerprint scanner (rear mounted)
- 16Mp rear-facing camera, f/1.7, phase detection autofocus, LED flash
- Dual front-facing cameras: 16- and 8Mp, f/1.9, 1080p
- 802.11ac Wi-Fi
- Bluetooth 5.0
- A-GPS, GLONASS, BDS
- USB 2.0 Type-C
- Non-removable lithium-ion 3,000mAh battery
- 149.2x70.6x8.4mm
- 172g

Dell XPS 15 2-in-1



Dell has doubled down on its successful XPS laptop line-up this year, using CES 2018 to launch not only a revamped version of the ever-popular XPS 13, but also a brand-new XPS 15 2-in-1.

There's a lot more to the new convertible than just a larger screen size though. It also boasts an impressively slim profile, a new 'Mag-Lev' keyboard design, and is one of the first laptops to market boasting the new Intel Core processor with integrated Radeon graphics.

Price

As with just about everything announced at CES, we don't have a firm release date and pricing details, but

Dell has announced some details of the US launch at least. The XPS 15 2-in-1 will go in sale in the US in April, with prices starting from \$1,299 (around £935), though we don't know yet just how much it will cost to buy a top spec model. At the time of writing there was no news on when it will be released in the UK yet.

Design

The first thing you notice about the XPS 15 2-in-1 is that it's impressively light and slim for its size. Dell claims it's the smallest and thinnest 15.6in 2-in-1 around, and while we haven't personally measured them all to check, we can believe it (not least because there aren't all that many 2-in-1s at this size, but there you go).

Still, make no mistake, this is not an ultraportable machine. It's light for its size, but still weighs a good chunk more than its smaller XPS 13 2-in-1 sibling, and this isn't the sort of device you'd want to carry around with you everywhere you go.

Part of the reduced form factor is down to the bezel-less InfinityEdge touchscreen display, which leaves as little wasted space as possible (except a chunk at the bottom), but the biggest changes are to the main chassis, where Dell has saved space thanks to a combination of the Intel-AMD chip, and a new 'Mag-Lev' keyboard design. The mechanism uses opposing magnets underneath the keys, rather than switches or membranes, with the intention of making the keys feel deeper than their 0.7mm travel suggests.

It's a design destined to prove divisive, feeling not too dissimilar to Apple's butterfly keyboard. It's far from the worst keyboard around, but it's not the



best either – it suffers from a direct comparison to the keys on the new XPS 13, which offers one of the better keyboards around, leaving us wondering if the fractional reduction in weight and depth really justifies the Mag-Lev mechanism.

Finally, ports – as you’d expect with a slimmed down design, this is USB Type-C only, but you get four of them (including two with Thunderbolt 3 support), along with a headphone jack and microSD card slot.

The model we tested boasted a silver aluminium casing with a black carbon fibre interior, and Dell hasn’t announced plans for any other colour options. Still, the one available finish looks slick and modern, and will feel familiar to anyone who’s used any recent XPS laptop.

Hardware

If the Mag-Lev keyboard is one half of the XPS 15 2-in-1's compact body, the other is the brand-new Intel Core Kaby Lake chip with a built-in Radeon Vega GPU.

The chip – the first partnership between Intel and AMD in decades – promises the sort of performance you'd normally expect from a discrete graphics card without having to take up all that space. That means thinner, lighter laptops that still have the necessary power for gaming or, more likely in the case, demanding creative work. The chips are just 1.7mm thin and also include 4GB of HBM2 RAM and power optimizations – though Dell hasn't announced any estimates for the XPS 15 2-in-1's battery life. Configuration options include a Core i5 or i7, 8GB or 16GB RAM, 128GB to 1TB SSD storage, and the option of either a 1080p or 4K display. The model we tested included the 4K option, which seemed crisp and bright, with a great range of colour reproduction.

There's also support for Dell's Active Pen stylus (sold separately) cementing that this is a device that has professional creatives in mind, who might benefit most from the combination of processing power, convertible form factor and relatively portable design.

Verdict

We're not convinced by the Mag-Lev keyboard, and haven't yet been able to fully test the new Intel-AMD chip, but the XPS 15 2-in-1 promises a lot of power in a sleek design. A big-screen convertible still feels like an undeniably niche product, but for the right user, Dell's design could be hard to beat. Dominic Preston

Specifications

- 15.6in UltraSharp 4K Ultra HD (3200x1800) InfinityEdge touch display/15.6in Full-HD (1920x1080) InfinityEdge touch display
- Windows 10 Home/Work (64-bit)
- Quad-core Intel i5-8305G processor/quad-core Intel i7-8705G processor
- Radeon RX Vega M GL GPU
- 4/16GB DDR4 RAM
- 128/256GB PCIe, 512GB PCIe, 1TB PCIe SSD
- 802.11b/g/n/ac
- Bluetooth 4.1
- 2x USB-C 3.1
- 2x Thunderbolt
- 1x DisplayPort
- microSD slot
- Single mic
- 3.5mm headset jack
- Mag-Lev keyboard
- 75Whr non-replaceable battery
- 354x235x9-16mm
- 1.97kg

Lenovo Miix 630



The Lenovo Miix 630 2-in-1 is one of the first three Windows 10 devices to be released that are powered by Qualcomm's Snapdragon 835 processor – rather than an Intel chip. Qualcomm revealed the HP Envy x2 and Asus NovaGo late in 2017, but Lenovo waited until CES 2018 to unveil its Miix 630.

The upshot of using the Qualcomm chip is that the Miix 630 enjoys always-on LTE connectivity along with a mammoth battery life of 20 hours.

Price

The laptop is expected to go on sale some time in Q2 2018, but Lenovo hasn't been any more specific than

that, or confirmed if that release window is just for the US, or other markets as well.

In terms of price, the base configuration will be \$799 (around £575), though we don't know UK pricing yet. That's much more than the Asus NovaGo, which starts from \$599 (around £430), and similar to what we expect for the HP Envy x2 – though that pricing hasn't been announced yet.

Design

The Miix 630 is a standard 2-in-1 with a detachable keyboard. It's attractive enough in an understated way, but it's clearly not a design-driven device.

The core of the device is a 12in tablet bordered by some thick bezels. Most of the time though, you'll probably use it with the included keyboard cover and kickstand, which does a pretty good job of replicating the laptop experience. With a full-size backlit keyboard and touchpad, the keyboard cover is



a respectable substitute for a proper laptop. The key feel is surprisingly impressive, without the mushiness you often find on detachable keyboards, and the grey finish is attractive and avoids looking cheap. There's also a small strap on the edge to attach the Lenovo Pen, a stylus that comes included with the device.

As for ports, you get one USB-C port, one SD card slot, a Nano-SIM slot, and a 3.5mm audio jack. That single Type-C slot could prove limiting, but the SD slot is welcome, and missing from its Snapdragon rivals.

As you'd hope, the Miix 630 is impressively lightweight. At 7.3mm thick and 770g without the keyboard, the Miix 630 is slightly chunkier than HP's Envy x2, but still comfortably portable. Adding the keyboard takes it up to 15.6mm and 1.33kg.

Hardware

The big selling point for the Miix 630 is that Snapdragon 835 chipset lurking inside, which promises a few big benefits over Intel's equivalents.

Arguably the biggest benefit is to battery life, with Lenovo promising up to 20 hours use. That's reportedly from tests involving continuous video playback though, so we'd expect most users to get even longer life than that in typical usage, with as much as a month of standby time. That could be a huge benefit to many users, and Lenovo envisions it as an always-on device – like your phone, which could well have the exact same processor inside it, you'd just leave the laptop on all the time, topping the battery up every few days.

The other part of that is that this is an always-connected device, with Qualcomm's X16 modem

offering Gigabit LTE through either the Nano-SIM slot or the optional eSIM, though don't expect serious eSIM support in the UK.

Access to 4G Internet on a laptop-style device could be a huge boon for some users, freeing you from the need to track down Wi-Fi everywhere you go, but it will likely come with the additional ongoing cost of a data plan, so bear that in mind.

The improved battery life and LTE connectivity sound like big benefits, but there's still the question of performance hanging over this and similar devices. The Snapdragon 835 is a powerful chip, capable of silky smooth performance on a flagship phone, but can it manage the same running Windows 10?

The Miix 630 will run Windows 10 S out of the box, but Lenovo is offering users a free upgrade to Windows 10 Pro within 180 days of activation, which will offer more functionality, but at a likely hit to performance and battery life. Our time with the device wasn't enough to seriously stress-test it, but navigating the operating system was slick and smooth.

As for the rest of the specifications, you get a choice of 4GB or 8GB of RAM, and 64GB, 128GB, or 256GB of flash storage, which should be plenty for most.

The display is a 1920x1280 touchscreen, which seemed crisp and bright, and is about what you'd expect from a device at this price.

Verdict

If it can run Windows smoothly and consistently, the Miix 630 could be a great option for users who want a 2-in-1 laptop that's easy to use on the go, without

worrying about battery life or Wi-Fi connections. The big question marks right now are just how well it handles Windows, and whether HP's similar Envy x2 – which is lighter and more attractive – can match it on price. Dominic Preston

Specifications

- 12.3in (1920x1280) WUXGA+ display
- Windows 10 S
- Qualcomm Snapdragon 835 CPU
- Qualcomm Adreno 540 GPU
- 4/8GB RAM
- 64/128/256GB storage
- 802.11b/g/n/ac
- Bluetooth 4.1
- 1x USB-C
- 1x Nano-SIM
- microSD slot
- 3.5mm headset jack
- 48Whr non-replaceable battery
- 770g (1.33kg with keyboard)



Lenovo Smart Display



Amazon has brought put a screen on an Echo device in June last year, with the Echo Show (though it took a few months longer to reach the UK). Now, more than half a year later, Google has finally caught up, partnering with third-party manufacturers to build its own Echo Show rivals powered by Google Assistant.

LG, JBL, and other manufacturers are all working on Google Assistant devices with displays, but the most

impressive so far is the Lenovo Smart Display. We went hands-on with the new device at CES 2018, and here's what we thought.

Price

The Lenovo Smart Display doesn't have a firm release date yet, but it's expected to arrive – in the US at least – in "early summer". We're not sure yet if other markets will get it at the same time, but we'll update this when the release date is more definite.

As for pricing, the Smart Display will cost \$199 (around £143) or \$249 (around £179), depending on whether you opt for the 8in or 10in model. Again, we don't have specific UK pricing just yet, but will update this when we do. Either way, the pricing is in line with the Echo Show, which Amazon sells for £199.

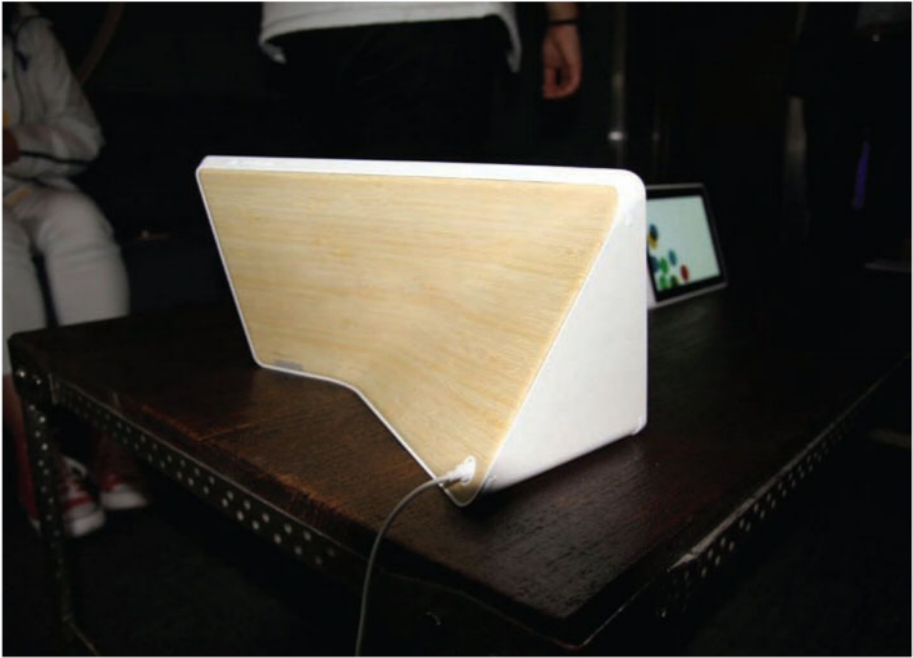
Design

At first glance, the Lenovo Smart Display looks a lot like a tablet with an oversized speaker grille at one end – either the left-hand side or the bottom, depending on which orientation you choose.

From the back, though, there's an angular wedge shape to the base to help keep it upright.

As we said above, the Smart Display comes in two different sizes of display: 8- or 10in. There are a few other differences between the two models though – the most obvious being the finish.

While both models are white on the front, the 8in comes with a muted grey on the rear while the larger device comes with a bamboo finish instead. Both look attractive enough, but since they're on the rear of the



device it's easy to imagine that many users will never even see the colour of the rear – so we'd encourage picking your model based on the screen and price, not the finish.

The smaller model measures 263x142x111mm, while the 10in is larger in every respect, at 311x174x136mm. Weight is unlikely to matter much for a device you're not expected to move very much, but they weigh 1- and 1.2kg respectively.

As for buttons, both devices keep it simple. Beyond the touchscreen, camera, and microphone, the only inputs are volume buttons and separate mute controls for the microphone and camera. The latter is particularly

interesting – the button physically blocks the camera shutter, so the privacy-conscious can guarantee that the camera can't be hacked to record them.

Hardware

So what does the Smart Display actually do? In essence, it's just a Google Home device with a screen. Driven by the Google Assistant, it can be used as a digital assistant to listen to music, check your calendar, ask about the weather, set alarms, and more.

The introduction of the screen adds some obvious features such as YouTube support and video calling, but also just a simple visual aid for checking the weather or seeing the recommended route to work.

Both devices use IPS displays, though the resolution differs significantly between the two. The 10in display runs at 1920x1200, while the smaller screen is just 1280x800, so anyone worried about crisp video calls or HD video should make sure they spring for the \$50 (around £36) extra for the larger screen, which looked bright and colourful during our hands-on time.

Naturally, everything works neatly through your Google account, pulling through contacts from your phone and video recommendations from your YouTube account. Video calling is handled by Duo, which means it should be easy to reach people – most Android phones come with it preinstalled, though you may have to persuade iPhone owning friends and family to visit the App Store first.

YouTube support is also handled intuitively, recognizing contextual prompts to help you out – in our demo, asking Google how to prepare the

rosemary in a recipe it was reading out prompted it to automatically pull up a relevant YouTube tutorial.

It's worth noting that despite appearances, this isn't tablet, and it isn't running Android. While the display is a touchscreen, the Smart Display is really built around voice commands, and will live or die by how well the Google Assistant handles a variety of requests.

What we have seen is impressive though. This is a much more attractive device than the Echo Show (or the other Google Assistant equivalents announced at CES 2018), and offers similar functionality. The user experience seems smooth, with great integration of the display and video options, and Google Assistant remains the virtual assistant to beat.

Verdict

Ultimately, as with most smart home hubs, much of the choice right now depends on whether you'd rather be part of Amazon's Echo family or the Google ecosystem. But if you want to go Google, the Lenovo Smart Display looks like a great choice, making a solid case that a smart speaker might just be better with a screen. **Dominic Preston**

Apple iMac Pro

Entry-level model £4,899 inc VAT from fave.co/2COcC5s

Review unit £9,039 inc VAT from fave.co/2D0cCTy ★★★★★



We're still waiting for the new Mac Pro (and don't even know which year it'll be launched in), but in the meantime Apple is placating its pro users with this high-powered slab of processing muscle.

It's available with anywhere from eight to 18 cores, and from 32- to 128GB of RAM. The thermal architecture, so problematic on the Mac Pro, has been redesigned with 'dual blowers' for a claimed 80 percent increase in thermal capacity. And the machine looks

great too, with the current 'pregnant iMac' design given a new and rather lovely Space Grey finish, and matching peripherals.

Design

Picture the 2017 27in iMac (the i7 model – we'll be making comparisons with this machine); now imagine it in Space Grey. That, in most external respects, is what you get with the Pro.

It's an attractive, classic design. There are razor-thin edges around the monitor, giving the illusion of a flat screen device, but most of the innards are concealed within a gently bulging belly on the back.

We like the reassuring heft and minimalist look of the stand, too, which is made from a single bent piece of aluminium of subtly varying thickness (thickest at the bend and tapering away as it approaches the user) and featuring a cleverly simple cutout to keep your power cable tidy and tucked away. And while it could never be described as lightweight (it's 9.7kg) or mistaken for a portable device, the iMac Pro's balance and shape are such that it's surprisingly easy to pick up and lug to another room.

This is all old news, of course, since we've had this design in the iMac range for several years. So is the new colour worth talking about?

Colour finish

We're going to be drilling down into hardcore processing performance in this article so it's tempting to disregard cosmetic changes like colour finish; but this would be a mistake. The Space Grey finish looks



superb, and given that you're going to be looking at this object for multiple hours a day that isn't an unimportant factor. It looks modern, and classy, and still unmistakably Apple. It will look great in a studio.

The Space Grey Magic Keyboard, Magic Mouse 2 and Magic Trackpad 2 that are available with the Pro are also stunning to look at, although the mouse in particular is a little less stunning to use; it's so prone this reviewer collecting fingerprints that our art director made us work with a substitute until we'd finished doing photography.

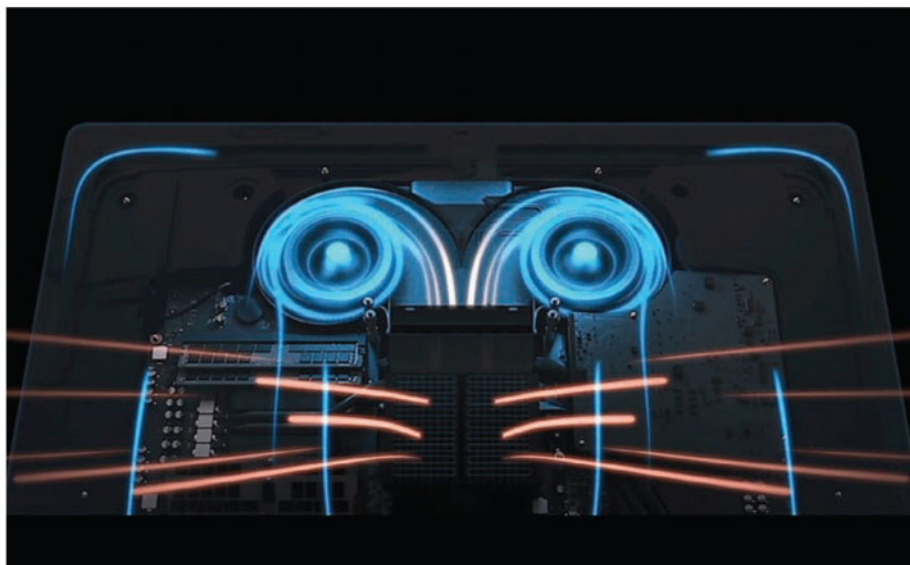
And hilarious though it might seem to normal people, the bundled black Lightning cable that you use to charge the peripherals has tickled the fancy of Apple fans.

Thermal design

In its mea culpa to the creative and design community who depend on the Mac Pro, Apple admitted that machine's thermal design was unsatisfactory, making it next to impossible to upgrade. The company expected the industry to move in the direction of multiple GPUs, whereas the trend was actually towards larger single GPUs, which generate more heat and which the Mac Pro's trash can design is unable to deal with thermally.

The iMac Pro should have no such problems. Apple says it offers 75 percent more airflow than the 27in iMac (thanks to the 'dual blowers') and 80 percent more system thermal capacity.

The significance and success of this redesign is hard to estimate at launch, since the Mac Pro seemed fine initially and the problems emerged only later. Looking



at the matter subjectively, however, we can report that when using the Unigine Valley graphics test on a loop (with Extreme HD settings) the GPU topped out at 91°C. That's a little on the high side for what we're used to, and a touch warmer than the iMac 2017, which peaked at 87 degrees while admittedly pumping out significantly lower frame rates. But it didn't cause any detectable slowdowns, and there was very little noise from the fans. All the parts of the casing that are reachable from the front remained cool to the touch, although naturally there was a decent flow of hot air pumping out of the vent.

Ports

The Pro has a solid bank of ports round the back: four each of USB 3 and Thunderbolt 3/USB-C. In this respect



it sits neatly between the 27in iMac (which has four and two) and the trash can Mac Pro (four and six, although the latter are only Thunderbolt 2).

There are four microphones on the Pro's chassis: one on the top edge, just above the FaceTime camera (like on the 2015 iMac), one either side of the camera, and one on the back. The 2017 iMac has only one, on the bottom edge.

Display

The display is the same Retina 5K 27in unit you get with the larger of the 2017 iMac range. That means a whopping resolution of 5120x2880, claimed support for a billion colours, and 500 nits brightness. Subjectively it's beautiful to look at: crisp, vivid and bright.



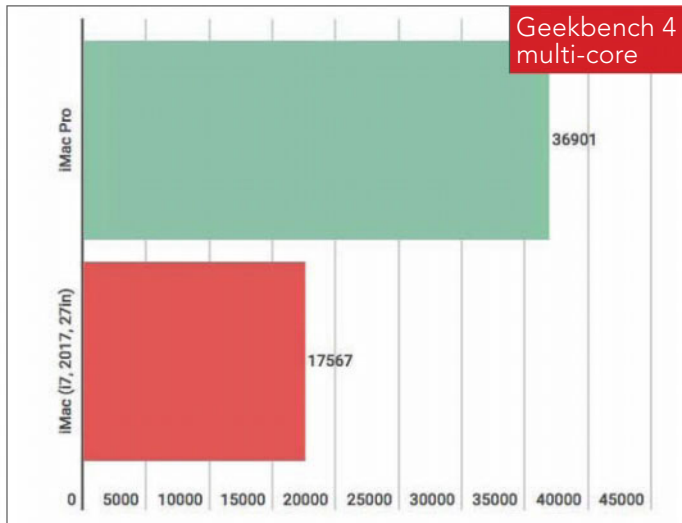
Performance

The iMac Pro is a powerhouse of a system. We reviewed the 10-core model with 128GB RAM and the Vega 64 GPU with 16GB of memory; Apple has been keen to stress that in terms of both processor and GPU chips the new iMac Pros are the fastest machines it's released.

With all this power at our fingertips, we were excited to put it through our battery of tests. Here's what we found out.

Geekbench 4.2 (64-bit)

The iMac Pro averaged 5,424 in the single-core segment of Geekbench 4.2's CPU test, and a monstrous 36,901 in multi-core. This is a test of pure processing speed, and higher scores are better. The Pro's results dwarf the numbers we saw with the 3.4GHz version

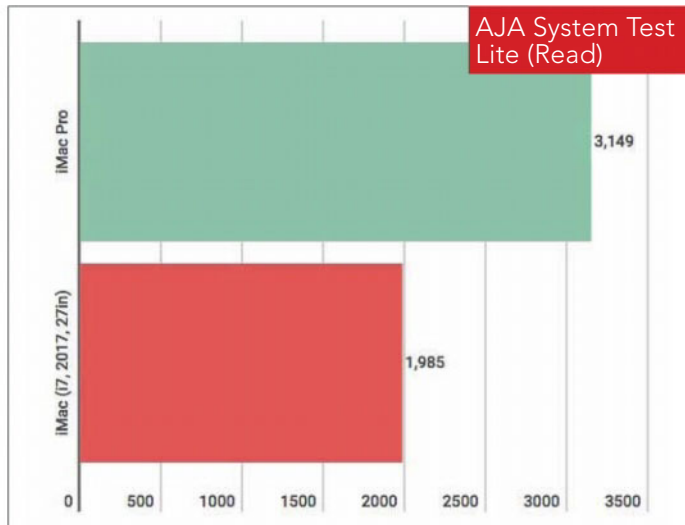


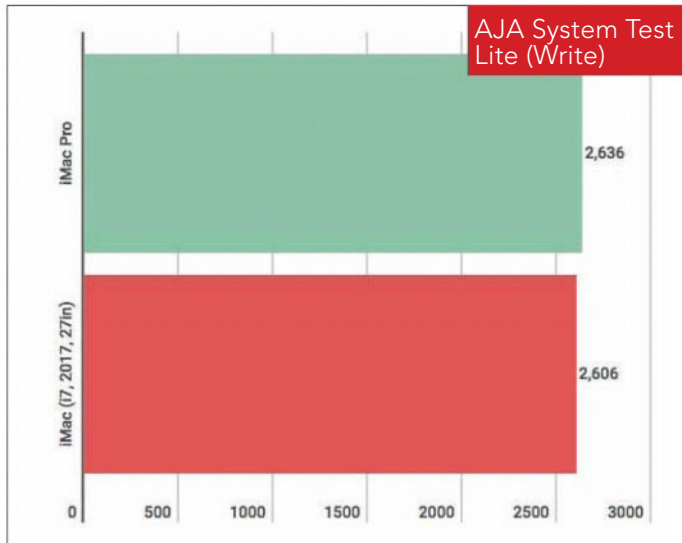
of the 27in iMac (2017) in the multi-core segment, although that device managed a shade more in single-core: it scored 5,507 and 17,567 respectively.

This category of performance is niche to say the least, and you're unlikely to see much difference between those two machines in anything but the most processor-intensive applications - although the gap will become more readily apparent in the years to come. But even now video editors, visual effects artists and 3D illustrators, among others, will appreciate the extra processing welly.

AJA System Test Lite

We used AJA System Test Lite next. This benchmark evaluates drive performance, and again higher scores are better. (We tested using the settings 5K RED, 4GB, single file and disk cache disable.)





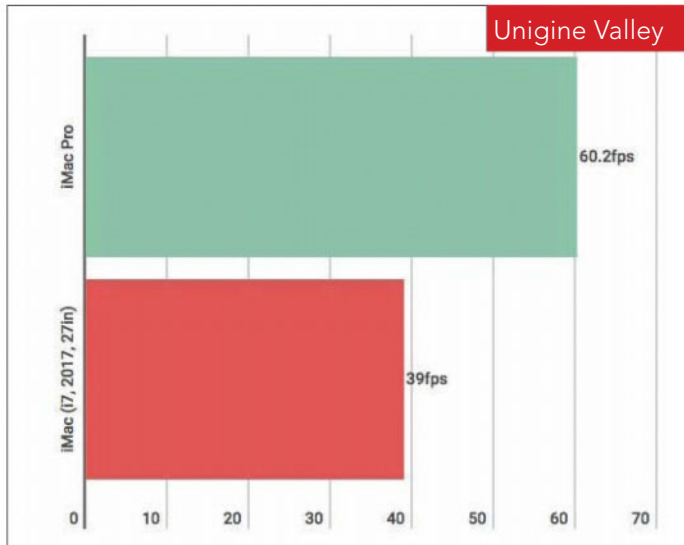
The iMac Pro recorded an average of 3,149MB/s write speed (an exceptional result, and far higher than the iMac's 1,985MB/s) and 2,636MB/s read speed (roughly the same as the iMac's 2,606MB/s).

Apple predicted impressive drive performance for the iMac Pro partly because it's split into two drives (512GB each in the starting configuration) for greater throughput. You're also automatically given an SSD: there's no option for a moving hard drive.

Unigine Valley

We ran the iMac Pro (and 2017 iMac) in Unigine Valley Benchmark 1.0, which evaluates performance and stability under high graphical workloads.

Using the Extreme HD presets, it recorded an impressive average frame rate of 60.2fps (maximum

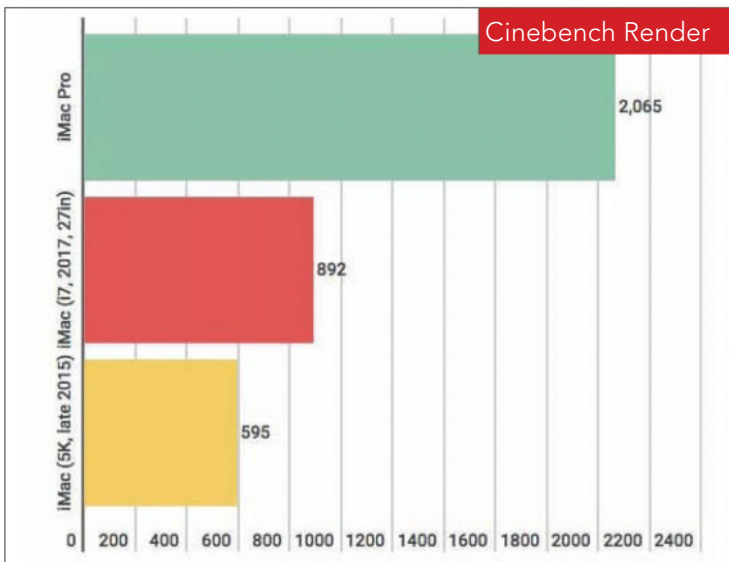
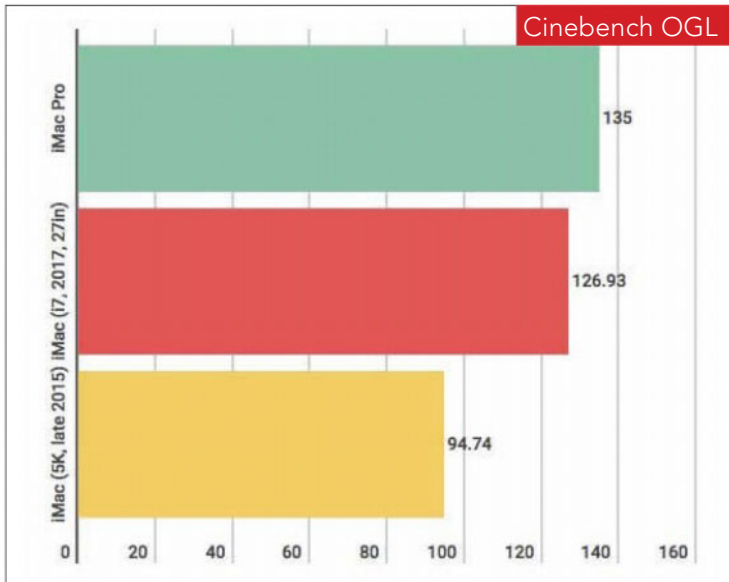


106.8fps, minimum 30.5fps) and scored 2,520 points. That compares to the iMac's average 39fps and score of 1,633. You should note that while it's capable of high frame rates, this isn't a gaming machine, and won't provide value for money if that's what you're looking for.

As mentioned above in the thermal design section, the Pro's GPU got pretty warm during this stress testing, peaking at 91°C, but didn't display any signs of distress or slowdown. The thermal system coped fine.

Cinebench

Our colleagues at *Digital Arts* ran the iMac Pro in Cinebench, a benchmark suite which tests a system's ability to render 3D scenes and stresses both CPU and GPU. They used the test, in which higher scores are

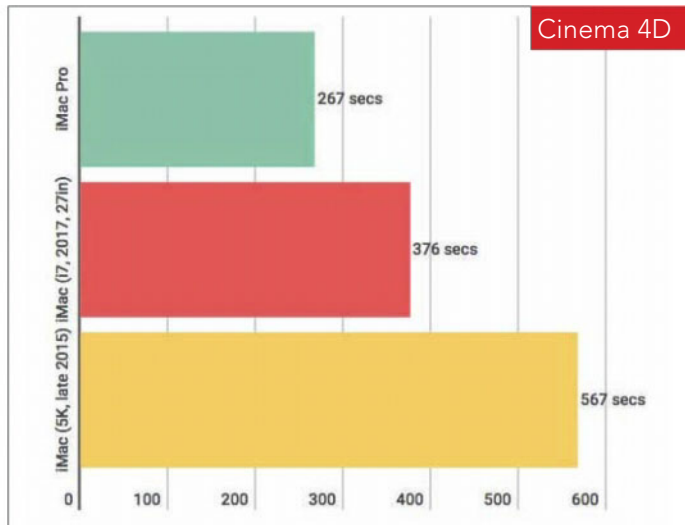


better, to compare against the iMac 2017 and the late-2015 iMac 5K, too.

The Pro scored 135 in the OGL test, and 2065 in the render: both very high scores, albeit not the highest we've seen (the Lenovo ThinkStation P900 tops that particular list). The iMac 2017 scored 126.93 and 892 respectively, and the late-2015 iMac 5K 94.74 and 595.

After Effects

Again, our thanks to Digital Arts for this set of test results, using Adobe After Effects 2018 (and in most cases using the CineWare plug-in) to evaluate the iMac Pro's ability to complete complex graphical processing tasks. These are times taken to finish the tasks, so in this case lower scores are better. In seven out of eight tests, the iMac Pro recorded a time less than half that of the iMac (which was noticeably faster in turn than



the iMac 2015, as you'd expect), but we'd like to focus on the eighth test, Cinema 4D. This stresses the GPU, processor, disk input and output and RAM, and provides the clearest overall assessment of a system's capabilities. In this test, the Pro took four minutes 27 seconds; the iMac 2017 took six minutes 16 seconds and the iMac 2015 took nine minutes 27 seconds.

Verdict

The iMac Pro is an exceptionally powerful and stable system, but that was never in doubt. The real question is whether you need its power and can justify its cost. This isn't a gaming rig you'll get similar specs at a fraction of the cost elsewhere. This is targeted at the niche of users in the creative, design, visual effects and illustration fields who need the ability to process major graphical and 3D rendering and editing tasks at a decent speed. Those involved in music production may find it ticks their boxes, too, but this is likely to be expensive overkill for the rest of us. We love the Space Grey finish, incidentally, and the matching peripherals look fantastic. David Price

Specifications

- 27in (5120x2880) Retina 5K display
- macOS High Sierra
- 10-core, 3GHz Intel Xeon W, Turbo Boost up to 4.5GHz, 23.75MB cache
- Radeon Pro Vega 56 graphics processor, with 16GB of HBM2 memory
- 128GB of 2,666MHz DDR4 ECC RAM
- 2TB SSD



- Wi-Fi 802.11ac
- Bluetooth 4.2
- 1080p FaceTime camera
- Stereo speakers
- Four microphones
- 3.5mm headphone jack
- SDXC card slot with support for UHS-II
- 4x USB 3.0 ports
- 4x Thunderbolt 3 (USB Type-C)
- Space Grey Magic Keyboard with Numeric Keypad
- Space Grey Magic Mouse 2
- 650x516x203mm
- 9.7kg

Razer Phone

£699 inc VAT from fave.co/2DkqeZJ ★★★★★☆



Following its acquisition of Nextbit, gaming brand Razer has entered the smartphone market with a handset aimed at gamers. It's called the Razer Phone and offers incredible tech not found on any other smartphones on the market including a 120Hz Quad HD display capable of offering double the frame rate of the likes of the iPhone X, Pixel 2 and more. It's a great concept, but has Razer done enough to cement its place in the smartphone market? Read on to find out.

Design

Let's be honest, the Razer Phone won't be winning any smartphone design awards when compared to the

likes of the iPhone X, Samsung Galaxy S8 or OnePlus 5T. The rather angular, blocky design that the Razer Phone employs is oddly reminiscent of the Xperia range (which is also considered rather unattractive) but with a distinctly Razer feel.

In terms of specifics, the handset measures in at a rather thick and broad 778x8mm and weighs in at a hefty 197g, making it one of the heavier flagship smartphones currently available.

These figures are immediately noticeable when you pick the smartphone up but that's not necessarily a bad thing. It makes the phone feel sturdy and more secure in the hand. It is a fingerprint magnet though, especially on the aluminium rear.

It looks like a solid block of aluminium, with nearly invisible antenna lines at the top and bottom, with the Razer logo on the back. It's the only noticeable design feature of the smartphone, as it has been engraved and coloured, and this can be felt by running your finger over the logo.

The issue is that the logo is right where your finger rests on the rear of the smartphone, and the slightly jagged edges of the engraving constantly catch your fingers. It's not painful, but it's a little annoying (a



thought shared by several of the *Tech Advisor* team). Apart from the Razer logo and display, the only physical feature of the phone you might notice are the front-facing speakers above and below the display, which is half the reason the phone feels so tall in the hand. We investigate the audio prowess on [page 92](#).

There are also circular volume buttons on the left of the smartphone, though these are placed further down than on other smartphones. The placement, while it looks odd initially, makes sense for gamers – they always in the way when gaming in landscape. Not with the Razer Phone!

It's a similar story with the power button, but it's flush on the right-side of the display, so placement doesn't matter as much. It's still easy enough to reach to lock and unlock the smartphone without adjusting your grip though, don't worry!

The real deal-breaker? It features a 16:9, 5.7in display. While that may sound okay, many manufacturers already employ bezel-less 18:9 displays in their smartphones. This allows for a larger display in a smaller body and for some is easier to use. The decision means that compared to bezel-less smartphones, the Razer Phone looks a little dated – on the surface, anyway.

Plus, Razer decided to follow Apple's example and ditched the 3.5mm headphone jack on the phone, featuring a solo USB-C port instead. Admittedly, like Apple, the Razer Phone does come with a USB-C-to-3.5mm adaptor for use with existing headphones, but most users will likely need to make the switch to wireless headphones sooner or later.

So, it's not the best-looking smartphone on the market by any means, but there's a reason for some of the slightly odd design choices. Let's take a look at why.

Hardware

As should be obvious by the manufacturer, the Razer Phone was designed with one focus in mind – mobile gaming. It's why the phone is slightly chunkier and taller than competitors – it features unique tech to make it the ultimate gaming smartphone.

Display

The most impressive feature of the Razer Phone is undoubtedly the 5.7in IPS LCD display. It offers a Quad HD (2560x1440) resolution and an eye-watering pixel density of 515ppi. Far more important here, though, is that the display offers the highest refresh rate of any smartphone on the market – 120Hz. For comparison, most high-end smartphones available at the moment are capped at 60Hz, meaning the Razer Phone can display double the number of frames in a single second – 120fps, up from 60fps.

In the real world, this means the smartphone provides a better mobile gaming experience than anything else available at the moment. The graphics are buttery smooth – so smooth, in fact, that you'll struggle to play games on any other smartphone once you adjust to the improved refresh rate.

Even in relatively basic games such as Pokémon GO, the experience is instantly improved – the difference in performance even when compared to flagships like the Google Pixel 2 is day-and-night.



It's not only games that get the buttery-smooth treatment either – you can head to the Settings menu and enable the 120Hz refresh rate throughout the operating system, making swiping between screens, browsing through your library of apps and surfing the web as smooth as can be.

Backing up the 120Hz refresh rate is a Wide Colour Gamut. This provides the display with a wider breadth of colours than what's provided on standard displays. It doesn't only improve the general look of your favourite Android games, but makes everything – from YouTube videos to the Google Play UI – look bright, accurately represented and vibrant.

Gaming

This, of course, is the main focus of the smartphone. The combination of impressive internals, an incredible

display, front-facing stereo speakers and software enhancements provide something close to the PC gaming experience on a mobile. Believe us – that’s not something we thought we’d ever say.

The 120Hz display provides up to 120fps on supported games – and although it’s an impressive feat, it’s also where the biggest issue currently is.

While there is admittedly a fast-growing list of Android games that offer support for the Razer Phone’s impressive UltraMotion display, the vast majority of popular games don’t offer support at the time of writing. You can see a list of supported games on the Razer website at [fave.co/2DoSSsR](https://www.razer.com/fave.co/2DoSSsR) to give you an idea.

The difference between supported and unsupported games is immediately noticeable, especially in terms of how smooth supported games look on-screen. Even when accessing in-game menus or watching the same battle animations you’ve seen thousands of times before, it looks smoother and frankly better on the Razer Phone than most smartphones on the market.

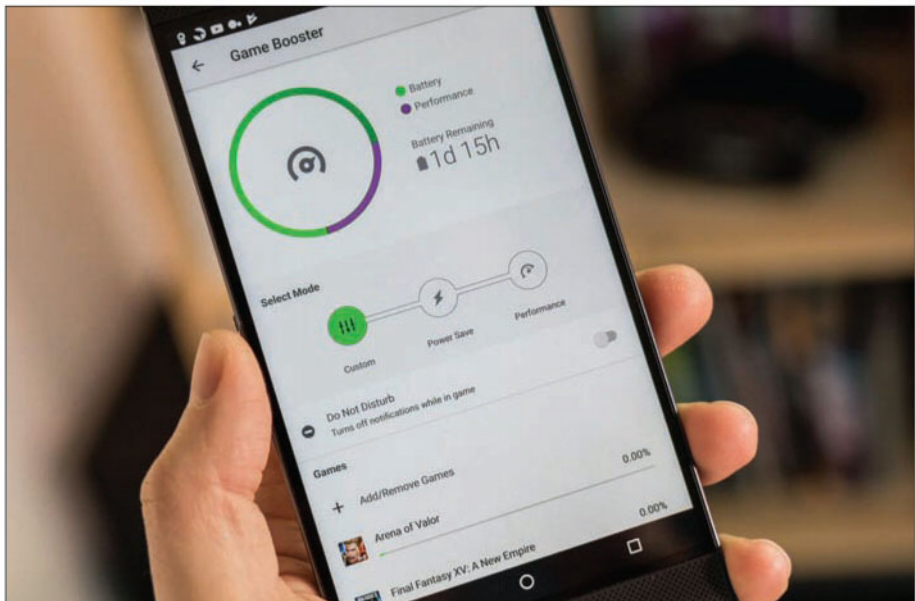
It definitely makes a difference to the overall gaming experience too; rather than being something that you play for five- to 10 minutes at a time, the Razer Phone’s impressive display and speaker set-up keep you coming back for more – if for nothing more than to marvel at how amazing games look on the smartphone.

The experience is improved with the introduction of Game Booster, an app found exclusively on the Razer Phone. The app provides both granular control over the performance of individual games and the ability to generally favour game performance or battery life on the smartphone.

It's the granular control over individual games where Game Booster really shines. Unlike with any other smartphone, you can customise not only the resolution but frame rate, anti-aliasing and even how much CPU power is dedicated to the game.

The higher you crank it, the more your battery will drain – but it's also true of the opposite. If you regularly play a mobile game that doesn't need flashy graphics, you can turn the performance down and use less battery life than usual. That way, you can enjoy the best games at 120fps and text-based games at 720p/30fps and help you game for longer.

It's essentially as close to configuring a PC game's Graphics settings on Android as you'll get for a while, and it's incredibly impressive.



Audio

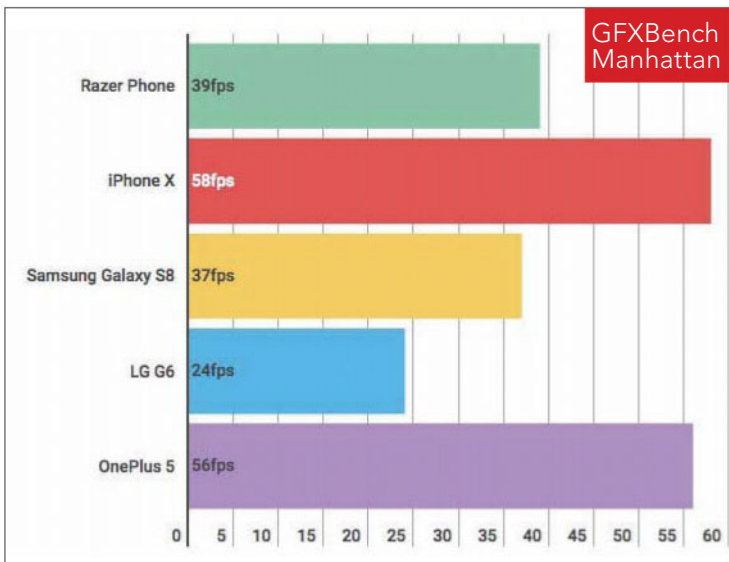
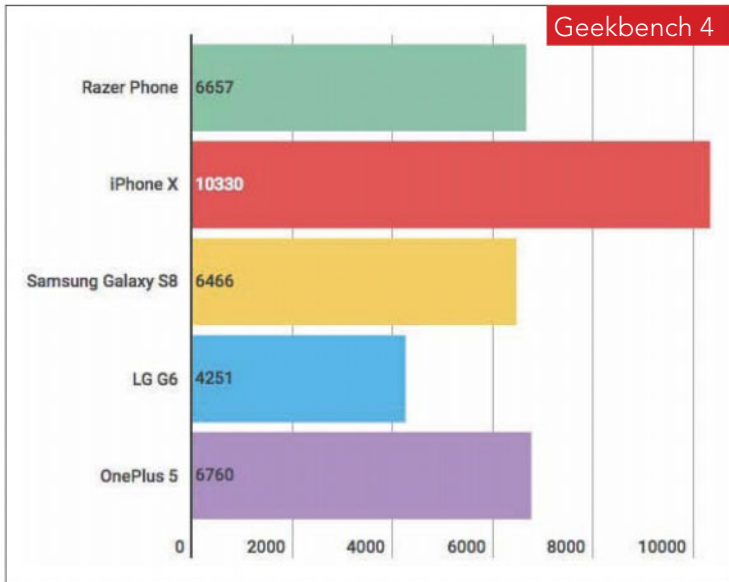
Alongside the stunning display, you'll find two front-facing stereo speakers. While most smartphones offer a single mono speaker or combine it with the phone earpiece to provide still poor stereo audio playback, the Razer Phone provides amazingly clear stereo audio with two dedicated directional speakers.

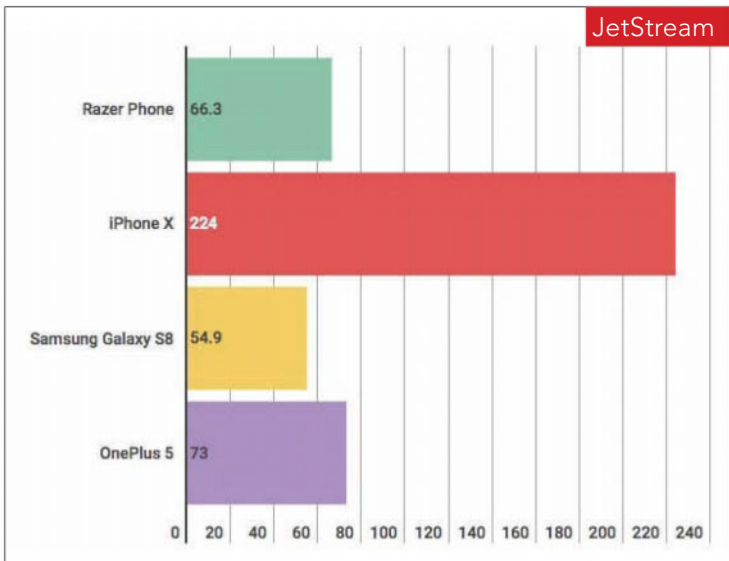
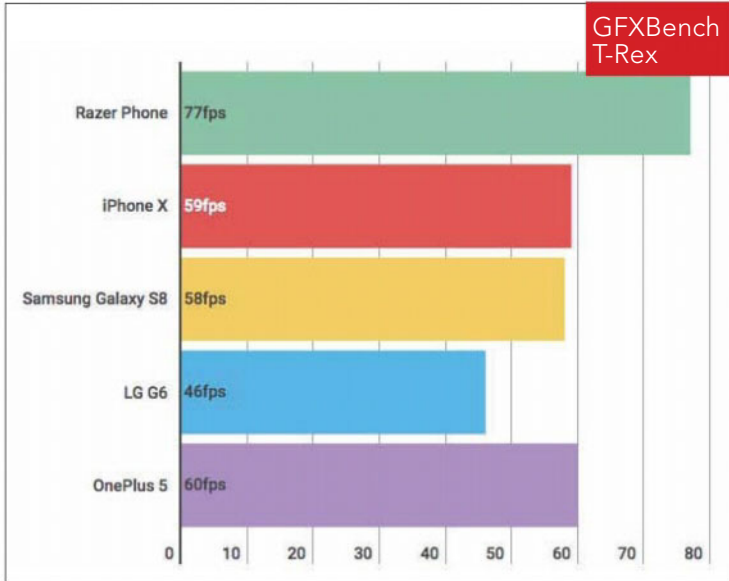
They aren't random speakers either – they've been Dolby ATMOS tuned and you're provided with several audio profiles (Movies, Games, and soon) to enhance your audio experience depending on what you're doing. They're easy to select too, as the toggle is accessible from the Notification Shade on the smartphone. The audio is powered by a THX-certified DAC, which provides impressive audio quality when listening to music via headphones. The overall audio quality is impressive for a smartphone, but the lack of a 3.5mm headphone jack may put some users off. As mentioned, there's an adaptor in the box but Bluetooth headphones may just be the way forward in 2018.

Processor, memory and storage

Of course, just because a display offers the ability to display 120fps when gaming, it doesn't mean it always will – any PC gamer will tell you that! So, how did Razer make sure its inaugural smartphone had enough oomph to power a Quad HD display at 120fps?

The Razer Phone features an octa-core Snapdragon 835 processor, the most powerful chip available right now from Qualcomm, alongside an Adreno 540 GPU and a whopping 8GB of LPDDR4 RAM – the most (and fastest) RAM in any smartphone on the market.





There's also 64GB of built-in storage with the option to expand it by up to 2TB via a Class 10 microSD card slot. This means the Razer Phone provides a decent bang for its buck, especially when you consider that lower-specified flagship smartphones cost £100 to £200 more than Razer's option. The smartphone is incredibly responsive when opening apps, swiping between menus and scrolling through Twitter, and it's equally as impressive in the gaming department. Even when rendering games at 120fps at 1440p, the Razer Phone barely breaks a sweat.

We've got some numbers to back up the impressive performance of the smartphone, which can be seen in the below chart. Though the numbers aren't chart-topping, the real-world difference isn't noticeable when compared to other smartphones – and thanks to the 120Hz display, apps, games and menus often look nicer just because they're a lot smoother.

Battery life

That 120Hz display and high-end internals must have an effect on overall battery life, right? Essentially, yes, but it's not as simple as that.

The Razer Phone has an impressive non-removable 4,000mAh battery, one of the largest of any smartphone on the market at the moment. But despite the high capacity, the display and internals draw more power than the average smartphone.

In real-world use, we've found the Razer Phone to last comfortably all day when using social media, replying to texts and reading emails, but when you add gaming to the mix (which, let's be honest, is the whole

point), the battery drain is more noticeable and chances are you'll need to top it up before the end of the day.

The good news is that if it does require a top-up, the Razer Phone features Qualcomm QuickCharge 4.0+, which can charge the battery in next to no time. It's one of the first phones we've seen to move beyond version 3.0. It features Dual Charge technology and Intelligent Thermal Balancing to eliminate hot spots, provide lower thermal dissipation and an overall reduced charge time.

The down side is that this is only provided by the official Razer plug and the USB-C to USB-C cable included in the box. That means that if you use a non-branded USB-C charger to top up the smartphone, chances are you'll be waiting for quite a while, especially with such a high-capacity battery inside.

There's also a Game Booster app that allows granular control over the performance of the smartphone generally and when playing specific games. It allows users to change the priority from performance to battery life with a tap.

Connectivity

The Razer Phone offers fairly standard connectivity options including Wi-Fi 802.11 b/g/n/ac, Bluetooth 4.2 and NFC. It also boasts 4G LTE activity for all UK-based networks. We've already mentioned the lack of a headphone port and the lone USB-C port.

Cameras and photography

In terms of cameras, the Razer Phone has an impressive – but not perfect – camera set-up. On the rear of the device you'll find a dual camera set-up comprised of

two 12Mp cameras – one standard lens with f/1.8, while the other is a telephoto lens with f/2.6. This is coupled with phase detection autofocus and a dual-LED flash that should in theory provide well-lit, perfectly focused images.

In testing we had mixed results. Take a look at the below photo of St. Pancras Hotel – while it captures decent detail and light on the whole, when you zoom in you start to notice ‘soft’ patches, especially on the hotel brickwork. Whole patches of brickwork are featureless blurs, thanks to slightly over-aggressive noise cancellation, an issue suffered by many flagship smartphones. It’s not completely lacking in detail



though, as you can still easily make out things like street signs and road markings pretty well.

Like other dual-camera smartphones, the Razer Phone opts for a telephoto lens to offer 2x optical zoom on-the-fly. The toggle in the camera app looks and works much like what's offered by the iPhone 8 Plus, but the degradation in quality is more noticeable than with Apple's offering. We found images to be more washed out and noisy than those taken with the standard lens, as can be seen with a zoomed image of St. Pancras hotel below taken directly after the image on the previous page was taken.

There's also the option to record at up to 4K at 30fps on the rear-facing camera, although the recording



options are limited to 4K, 1080p and 720p, with no option to change the frame rate. We've recorded some 4K sample footage, which can be seen below, but we're not too impressed – especially at how dramatically the colour changes towards the end of the video.

On the front of the smartphone, you'll find a rather standard 8Mp front-facing camera that provides decent quality for the likes of Skype, Snapchat and taking selfies for social media. It's also capable of shooting up to 1080p video if required.

It's worth noting that Razer is constantly updating the camera app to improve the quality of images and add new features, so it's possible that our complaints could be somewhat alleviated by a future update.

Software

The Razer Phone comes with Android 7.1.1 Nougat installed, with no upgrade to Android 8.0 in sight – for now. Though it hasn't been confirmed by Razer, we imagine that it (which will likely be the flagship for most of 2018) will get some Android 8.0 love at some point in order to keep it competitive, especially as other 2018 flagships are announced and released.

It's very much stock Android, but with a few design tweaks. In addition to the plethora of Google apps, you'll find the Razer Store. While you may think this is the place to find games, you'd be wrong. Instead, it's where you can browse from a variety of game- and Razer-related themes for your smartphone.

While the designs vary, the themes change more than your background – they'll change the icon style and the colour scheme used throughout the operating



system. Some could argue that it's gimmicky, but we think it's a nice way for users to personalize the phone without spending too much time in the Settings menu.

Verdict

The Razer Phone is the perfect smartphone... if you're a gamer. While it doesn't feature the sleek, bezel-less design of other flagship smartphones, no other device on the market can come close to matching the stunning 120Hz refresh rate. It makes a huge difference to gaming on mobile, especially when combined with stereo front-facing Dolby ATMOS-certified speakers and an app that lets you tweak the performance of games on a per-app basis.

But while the display is perfect, we can't really say the same about the camera set-up. Admittedly, the rear-facing dual-camera set-up isn't bad, but the quality

of images captured isn't enough to compete with the likes of the iPhone X or Google Pixel 2 XL.

But hey, if you're a dedicated gamer on the market for a new smartphone that can provide the best Android gaming experience possible, the Razer Phone is the ideal candidate – and it's much cheaper than other flagships too. Lewis Painter

Specifications

- 5.7in (2560x1440, 515ppi) display
- Android 7.1.1 Nougat
- Qualcomm MSM8998 Snapdragon 835 processor
- Octa-core (4x 2.35GHz Kryo, 4x 1.9GHz Kryo) CPU
- Adreno 540 GPU
- 8GB RAM
- 64GB storage, up to 2TB with microSD
- Fingerprint scanner
- Dual rear-facing cameras: 12Mp (f/1.8, 25mm) and 12Mp (f/2.6), 2x optical zoom, phase detection autofocus, dual-LED dual-tone flash
- 8Mp front-facing camera (f/2.0)
- 802.11ac Wi-Fi
- Bluetooth 4.2
- A-GPS
- NFC
- USB 3.1, Type-C 1.0
- Non-removable lithium-ion 4,000mAh battery
- 58.5x77.7x8mm
- 197g

Honor View 10

£449 inc VAT from fave.co/2CClrCE



Hot on the heels of the mid-range 7X, Honor has announced the View 10, a flagship device that starts 2018 with the 2017's biggest smartphone trend, an 18:9 display.

The phone was expected to be called the Honor 9 Pro as per its usual naming conventions, but the company have chosen View 10 thanks to its similarities to the Huawei Mate 10 Pro.

It's the first time the View branding has been used outside of Asia.

The device has premium build, and while is not exactly the same dimensions as either Huawei's Mate 10 or Mate 10 Pro shares many of the traits of the two.

For a company trying to break into the UK mainstream at the same time as its parent company Huawei, this affordable high-end flagship makes a decent case for itself so long as you're looking to buy a handset outright – Honor phones are not always easily available from UK operators.

Design

The View 10 looks like a lot of other premium phones this year, sporting an 18:9 display. First seen on the LG G6 and then the Samsung Galaxy S8, the form factor keeps the View 10 slim and manageable in the hand while adding some height to the screen.

This is the same aspect ratio as the Huawei Mate 10 Pro, yet there's a front-placed fingerprint sensor and headphone jack like on the Mate 10. Confused? It means you get the better 18:9 display size with the familiar fingerprint sensor and headphone jack. This means the View 10 has an excellent mix of features from both versions of Huawei's recent flagship.

The front of the phone is visually similar to the OnePlus 5T, though the View 10 has a more uniform, straight edged feel to it and has a front facing fingerprint sensor in a long pill shape not often seen.

The back of the phone is less exciting, with iPhone-esque antenna lines at the top and bottom, with a solitary Honor logo and dual rear cameras. Squint, and the View 10 resembles an iPhone 7 Plus with a taller screen running Android.

Two cameras are good to see, two ugly camera bumps are not, and it is a shame when Huawei's flagships manage to bring design that keeps the lenses flush with the body.

With no glass back, there's no chance of wireless charging, though that is still a non-essential feature that would have increased the price.

The Honor View 10 is alarmingly thin at 6.97mm and recalls the Apple of a few years ago that became obsessed with this measurement, to the detriment of build quality and Bendgate. In our time with the phone, though it hasn't exhibited much sign of wear at all, even without a case.

If you're on a budget, this is as premium a device as you'll get for the price – the same £449 asking price as the OnePlus 5T while pretty much matching that phone's specifications.

We like the matte back in comparison to smeary glass, and the View 10 has attractive shiny edges running around the display, sandwiching the matte rim that helps you hold it. It only adds to the premium feel of this decidedly mid-range price phone.

The View 10 is available in navy blue, but isn't as notably stunning as other flagships this year, or even compared to the older glass-backed Honor 9. It looks very similar to the 8 Pro that we reviewed last year.

Despite its upsides, the design isn't particularly inspiring, and reeks of a phone whose features you'll have to love way more than the hardware to shell out for it. Perhaps the black version we haven't used fares better, but we still aren't convinced many people actually want a blue phone.

Display

The display on the View 10 is a vibrant 5.99in LCD with a 2160x1080 resolution. It is pleasingly punchy for an LCD, but is not as vibrant as a Samsung or OnePlus OLED panel, even when you have the settings on Honor's 'vibrant' mode.

But the size of the screen and its high brightness capabilities means video streaming and gaming on the View 10 is more than acceptable, and easily good enough for long sessions.

Honor is leading with the AI features that Huawei pushed on the Mate 10 Pro and Honor had on its Asia-only Magic phone, and in theory they are impressive. There's an argument to be had that it's not really AI at all and rather a prominent assistant-style layer to the software, but we'll let them have it for now.



Processor, memory and storage

The Kirin 970 processor allows for language translation in the preloaded Translator app, while the AI smarts also allow the camera to intelligently select the right parameters of a certain shot, without you having to go into a confusing pro mode.

It's worth noting that you still need a data connection to use the translation features, much like Google Translate, so if you are planning on going abroad then you will have to download the relevant language pack.

Really what the NPU (neural processing unit, what Huawei calls its Kirin 970 chip) does is learn your behaviours to better enhance the day to day use of your phone. From sleeping background processes of unused apps to prioritizing certain functions at certain times, supposedly the View 10 learns you better than other phones.

But on use there is no proof of that in the short term, and we doubt there will be in the long term either. Many Android phones are intelligent enough to prioritize processes, and face recognition functions and vague claims like 'AI enhanced translation' are fairly vacuous.

Cameras

The dual 20- and 16Mp cameras are more impressive, and offer portrait mode for a depth effect on photos, as well as a monochrome lens for excellent black and white photography. The 20Mp sensor is monochrome, and gives a natural effect compared to phones whose software simulate black and white.



Detail in landscape shots such as the one above shows excellent detail and light balance

An AI feature that proved genuinely good is the built-in object recognition in the camera app. Point the camera at something, and an icon appears. Tap it, and the phone runs a search of what it thinks is in frame. When it works, it works really well, identifying landmarks and even specific products like a Rough Trade mug. But frustratingly, the feature often disappears from the camera app with no way to recall it. And of course, it doesn't always work. Honor also claims AI helps reduce blur in photos of moving objects.

It also says AI helps you get better selfies with the 13Mp front camera. In reality, this is not AI at all but post-processing software. Honor's insistence of having the awful beauty mode on by default is also annoying, but at least you can turn it off. Selfies still look fairly washed out to us, even though there are some fun AR masks in the native camera app.

Performance

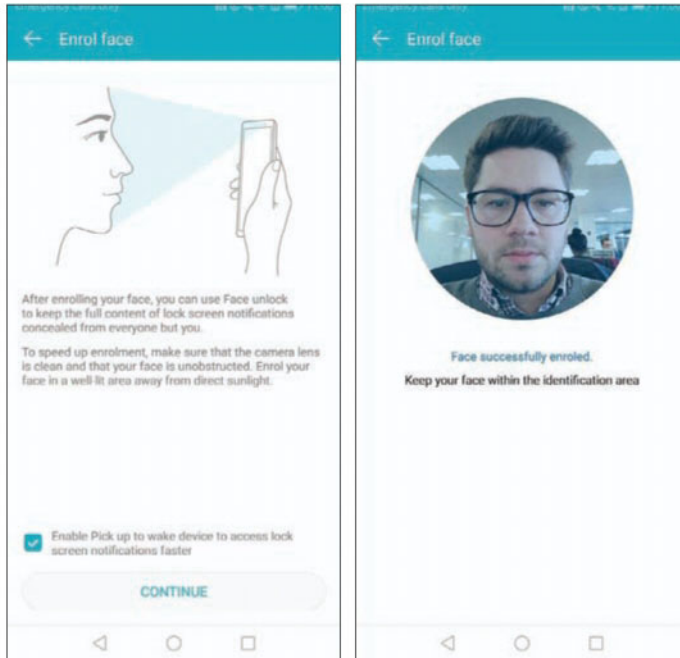
In its razor thin body, Honor has packed a whopping 3,750mAh battery with fast-charge the company claims can get you to 50 percent from dead in half an hour. In our testing, it proved good on that promise.

It's also great to see the octa-core Kirin 970 processor carried over, as it is Huawei's latest chip and a powerful alternative to the Qualcomm Snapdragon 835 in most other high-end Android phones this year. The pure processing power and speed of this chip is a better sell for Honor than the half-baked, half-functional 'AI' capabilities.

Unlocking the device

The View 10 has what the company describes as 'fast and secure facial recognition', but its only functionality is to reveal lock screen notifications when you look at the screen. The phone still falls back on its fingerprint sensor for secure app activity like banking, and it's odd that the facial recognition is reserved for notifications only and not even unlocking the screen.

The phone is dual SIM active (the best kind) and has a headphone jack, mercifully, though no headphones in the box. If you didn't like the omission of the jack on



the Huawei Mate 10 Pro, here's a way to get the same basic specs, a headphone jack, and save over £200.

Software

Software could be what lets this phone down if you're not a fan of Honor (and Huawei's) EMUI skin. Granted, EMUI 8.0 is a lot better than previous iterations, but the changes it makes to stock Android don't always make a lot of sense. Intuitive actions from stock Android are overlaid with different actions and icons, while the notification shade is still a bit of a mess.

Huawei and Honor's changes to the basic look and function of Android is off-putting if you are used to

Google's version. OnePlus' OxygenOS is a much better example of refined change to Android, where EMUI is the definition of change for change sake. Having said this, it doesn't restrict use, it's just a lot to adjust to if you're coming from another Android device.

Yet the View 10 ships on Android Oreo 8.0, still one of the first handsets worldwide to do so, and remains an excellently affordable way to get your hands on an OS running Google's latest software – even if it is masked by the massive changes EMUI brings.

You can add the preferable app drawer where EMUI by default displays all app on the home screens iOS style, or you could just add the Google or Nova launchers from the Play Store to change the vibe.

In fact, Honor includes probably the most granular customization settings of any widely available Android manufacturer, from screen resolution to accessibility features, secure enclaves and file encryption. If you are looking for a phone you can make your own, this is a great option. But if you want a clean, straight forward Android experience out of the box, you are best off looking at a OnePlus 5T or Pixel 2.

Verdict

The Honor View 10 is another flagship device from a company that promises a lot with high specs and low prices. The phone is much more similar in look and feel to the Honor 8 Pro than the recent Honor 9, and loses the attractive glass back in favour of AI software perks and Android Oreo. At £449 you could opt for the same-price OnePlus 5T which has more attractive software design, but it could turn out that the Honor View 10 is

an intelligent choice with Android Oreo out the box, promising if unrefined AI features and strong dual cameras. Henry Burrell

Specifications

- 5.99in (2160x1080, 403ppi) display
- Android 8.0 Oreo
- Hisilicon Kirin 970 processor
- Octa-core (4x 2.4GHz Cortex-A73, 4x 1.8GHz Cortex-A53) CPU
- Mali-G72 MP12 GPU
- 4/6GB RAM
- 64/128GB storage, up to 256GB via microSD
- Fingerprint scanner
- Dual rear-facing cameras: 16Mp (f/1.8) and 20Mp, phase detection autofocus, LED flash
- 13Mp front-facing camera (f/2.0)
- 802.11ac Wi-Fi
- Bluetooth 4.2
- A-GPS, GLONASS, BDS
- NFC
- USB 2.0, Type-C 1.0
- Non-removable lithium-polymer 3,750mAh battery
- 157x75x7mm
- 172g



