

# PC

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## Which smartwatch?

**NEW** Apple, Fitbit and Huawei watches on test **p70**



## The Psion style phone

**EXCLUSIVE** First review of the Cosmo Communicator **p46**



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HIGHLIGHTS THIS MONTH

Full contents overleaf



PRODUCT OF THE MONTH  
Cosmo Communicator

p46

Still yearn for a Psion Series 5? You're not alone, with Planet Computers shipping tens of thousands of the Gemini PDA, its first attempt to fuse the Psion's DNA with a modern Android phone. Now it's back with a second-generation device, except this time there's an external OLED screen so you can make and take calls without flipping open the lid and looking like the world's most foolish yuppie. And that's not the only improvement, with a faster processor, backlit keyboard, fingerprint recognition and a 24-megapixel camera - in essence, everything you need to usurp a regular phone. So is it a winning recipe? Find out in our editor's in-depth review, starting on p46.



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LAPTOP OF THE MONTH

Out of four laptops on review, we choose the Lenovo ThinkBook 13s - and that isn't a typo. This is our first test of a ThinkBook, an attempt to bring ThinkPad quality to small businesses.



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Windows is still shockingly poor at searching for documents, but we have the answer. Some free add-ons and a bit of nous are all you need to become a true search wizard.

OLD COMPUTER OF THE MONTH

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Regular RWC columnist and repair shop owner Lee Grant explains why he couldn't, in all good conscience, allow one client to keep using a Windows 98 machine.

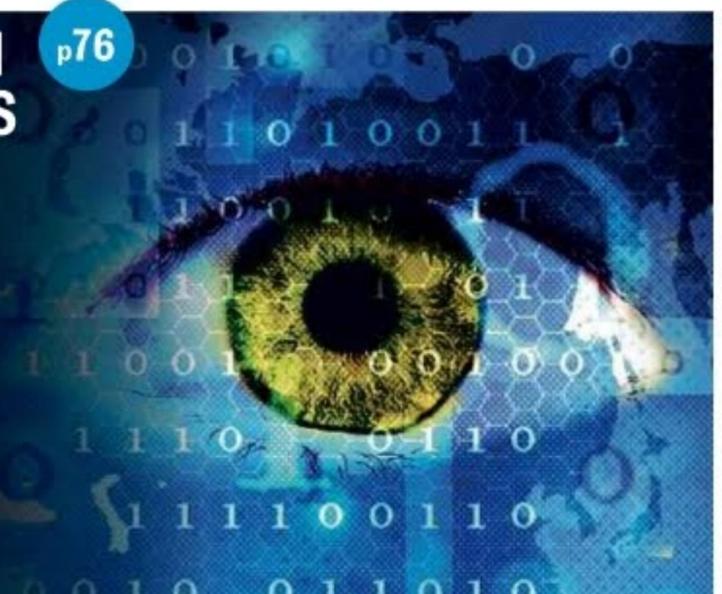


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Big Brother

While Big Brother is watching you, there is a chance others are sniffing your data in the hope of finding your credit card details. We test 16 VPNs that will help keep your details safe.





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- Shield your identity
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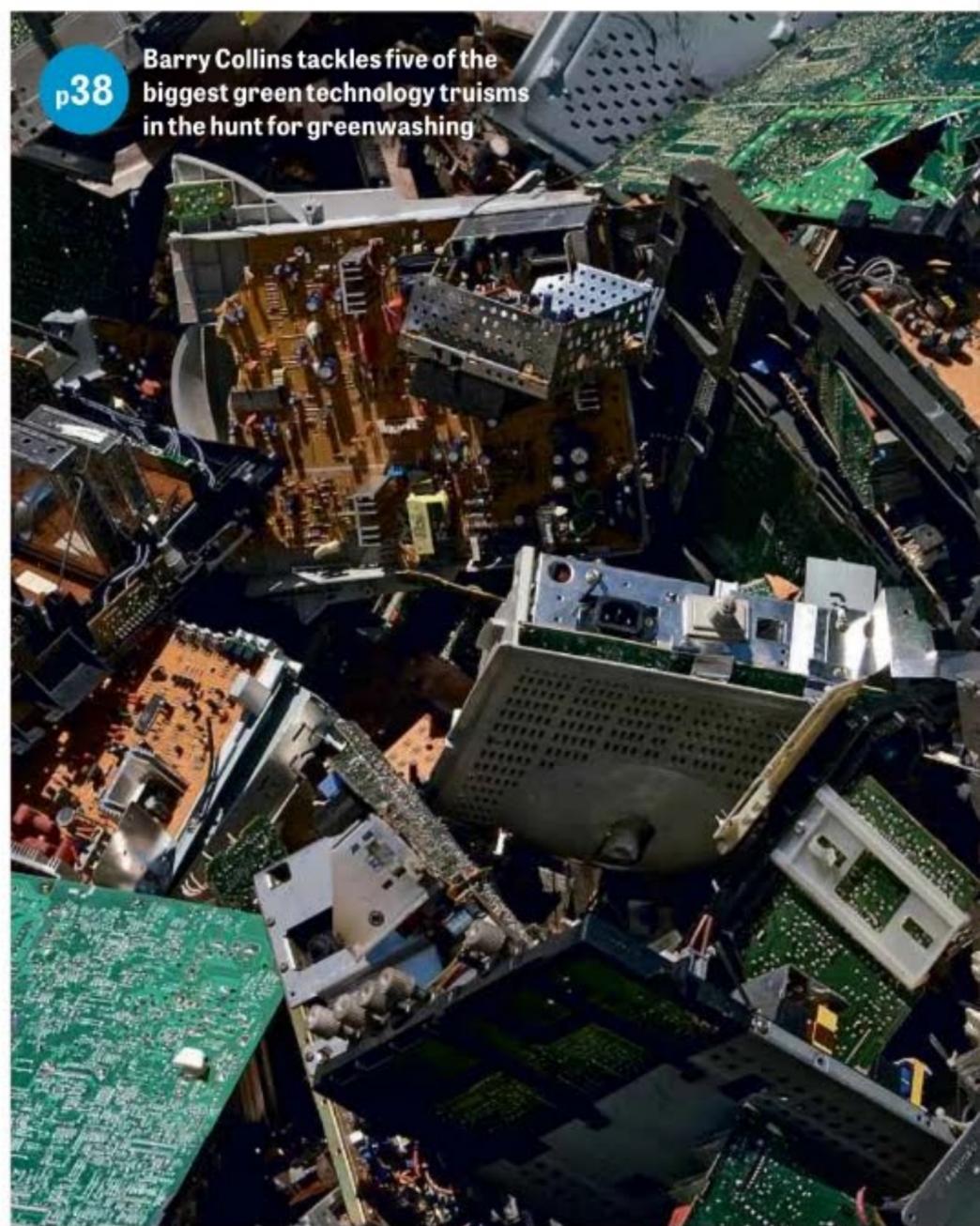
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**The Psion style phone**  
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## Editor's letter

# The VR dream is over, but its memory lives on

**THANK YOU, EVERYONE**, for gathering here today. I know that Virtual Reality, or VR as he liked to be called, lives on in all our hearts. I would like to celebrate what might have been. You soared too close to the stars, young VR, but my how you soared.

Some of you will know that I was a friend of VR's almost since the beginning. When others pointed, even laughed, I jumped to his defence. "Too heavy," you taunted, "too sweaty, too demanding". And while I would never have said this to his face – VR had feelings too – there were elements of what you said that were impossible to deny.

Let us tackle those criticisms one by one. Too heavy. Yes, it's true. He demanded we cover our eyes with weighty headsets, which meant that after 20 minutes of play, the ridge of one's nose became rather sore. Too sweaty? Well, that's a little personal, but you have a point: to enclose your face in any mask is always going to have side effects.

Too demanding? That is the most telling blow, particularly on headsets designed for computers. To make him reach his full potential, he needed power well beyond what most of us could give. VR had expensive tastes.

Even when he made sacrifices and reimagined himself in a phone, there were obvious drawbacks. While lighter and more accessible – any half-decent phone could play VR games, provided you had a headset to drop it into – the challenges proved insurmountable, even for Google.

"We saw a lot of potential in smartphone VR – being able to use the smartphone you carry with you everywhere to power an immersive on-the-go experience," Google told Engadget in a statement. "But over time we noticed some clear limitations constraining smartphone VR from being a viable long-term solution. Most notably, asking people to

put their phone in a headset and lose access to the apps they use throughout the day causes immense friction."

I assume "friction" refers to the fact people couldn't send Snapchat messages while battling aliens, rather than the Daydream headset rubbing against people's noses.

"There also hasn't been the broad consumer or developer adoption we had hoped, and we've seen decreasing usage over time of the Daydream View headset," it continued. "So while we are no longer selling Daydream View or supporting Daydream on Pixel 4, the Daydream app and store will remain available for existing users."

It's easy to see why Google couldn't support our friend VR: it dared to Daydream, but not enough people were willing to join in. Within a week, the BBC announced it too was distancing itself from him. "After [one final] project... the VR Hub will be wrapping up its commissioning and production work," wrote Zillah Watson, head of said Hub, in a BBC blog.

But, my friends, we are gathered here today to celebrate, not commiserate. VR has failed in his ultimate ambition, but he lives on. In businesses, where he will be used for many years to train people in scenarios impossible for real life to match. And in his second cousin once removed, AR, who may yet prove to be his ultimate legacy.

And to all those who are here to snigger, to cast stones at VR and yet have never tried *Beat Saber*, I say shame on you! In his memory, before it's too late, absorb yourself in a world of glowing objects, pumping music and swordplay that would make the Three Musketeers weep.

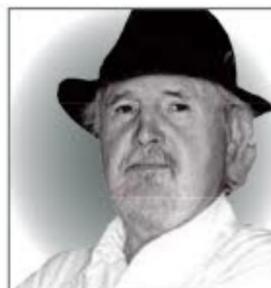
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**Davey Winder**

While it's easy to blame service providers for playing fast and loose with our data security, Davey sets out the steps we can take ourselves. See **p118**



**Dick Pountain**

Think you make your own decisions? Dick examines the larger forces that guide our decisions through "nudges", and why it's only going to get worse. See **p22**



**Nik Rawlinson**

Things people never say #77: "Windows is brilliant at finding the files I'm after". Luckily, Nik provides the tools to make us all search wizards on **p42**



**Jon Honeyball**

If you have a slow laptop then Jon has some useful advice – but unless you're a friend from his local pub, he won't fix it for you. Find out why on **p130**

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## SOFTWARE DOWNLOAD TECHNICAL SUPPORT

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We review the Psion 5-style Cosmo Communicator on p46, which comes as Microsoft announced the Duo concept phone (see p12). Are either the future of phones or will we be stuck with slabs of rectangular glass forever?

"I still have Psion 3, 3a, and 5 that work but are useless because no software and no phone. If the Cosmo Communicator drops to a sensible price, I might be tempted."

"The future of phones is gesture, speech and, eventually, some sort of instant neural link. Until then, though, the iPhone form factor will reign because it's perfectly simple and shiny."

"The Communicator and the Duo will be in museums in 20 years' time, under the banner: 'Do you remember when someone thought these were the future?'"

"If you could leave it in your pocket or bag, and interact with it via Edith-style specs, the design starts to work. If you have to haul it out all the time, people outside the nerd group won't go there. And I speak as an owner of two working and much-loved Psion Series 5s."

"The issue is thickness and the value-add of either a physical keyboard or second screen. I think the Cosmo is a dead end, but the folded dual screen has potential if the battery life/thickness issues are handled well."

"Phones with physical keyboards were needed when onscreen keyboards were still rubbish. They no longer are. As for the Duo phone – stupid idea. You have to open it to even glance at notifications. It'll die."

"Foldables might work, if someone gets the tech right, but one screen, not two. I'm waiting for the direct-to-brain implant smartphone..."



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# Briefing

Background and analysis on all the important news stories

**Unveiled: hot hardware releases**  
A first peek at the Microsoft Surface Duo and a fanless PC [p12](#)

**Two-factor authentication**  
Abuses by Twitter and Facebook could put users off 2FA [p13](#)

**PC Probe**  
Why does life end at 40 in the tech industry? [p14](#)



## BT set for new broadband windfall

### BT's Openreach is primed for yet more government handouts

BT IS SET for another major cash injection from public funds as it sits in pole position for £5bn earmarked for nationwide fibre broadband.

A week after the government set out plans for "full fibre Britain" with a £5bn fund, BT announced a series of 13 provincial areas where it will run trials to cost rural connections.

BT's dominant position as owner of the UK's legacy infrastructure saw it land almost all of the £540m allocated under the previous rural broadband rollout (known as BDUK) and industry experts expect a repeat performance.

"I suspect that it will be a similar model to the BDUK money," said Matthew Evans, CEO of the Broadband

Stakeholder Group. "The challenge for the sector and government is that the more competitive the process they set up, the longer it will probably take, so I'd be surprised if the government went too far away from that as they want it done 'as soon as possible'.

"The government will go with what was ultimately a pretty successful model, with local authorities taking part," Evan added.

Sticking with a system that saw BT as the only supplier in almost all local authority regions would be bad news for rival networks. "It is generally accepted that BDUK funding resulted in only one real winner," said a spokesperson for CityFibre, which

elsewhere has won funding for several urban projects. "Funding allocation must be both fair and effective."

BT laid out a series of plans and projects that it hopes will show its strengths, alongside commissioned research that showed the economic benefits of fibre, if only public funding was made available.

The 13 trials amount to an audition for BT, which it will use as evidence of costs when going to local authorities tasked with allocating the funds.

"With the 13 villages it's still with

**“The trials amount to an audition for BT, which it will use as evidence of costs when going to local authorities”**

commercial money," said Andrew Ferguson, network expert at [thinkbroadband.com](#). "BT is saying 'if we can do those

villages for that much then we have the mathematics to say we can do other villages that you want us to do, but it will cost you x thousand or x million pounds'."

A spokesperson for the networking arm of BT, Openreach, told us that the announced investment has given the company the incentive to explore new tech to reach outlying customers.

"It's a competitive process," Openreach told us. "We've been calling for public support in the form of subsidies for the most rural areas of the UK for a long time.

"We know that around 10% of the country will need the support of public subsidy, and these trials will help us test a bunch of new techniques that could help us in other rural areas."

### Enough money in the pot?

The cost of rolling out to remote areas can be enormous, and analysis suggests £5bn may not go very far.

"In Scotland [where BT is the sole supplier in two of three projects] they are spending £600 million to reach 200,000 premises, or £3,000 each," said Ferguson. "It has larger distances, but it suggests £5bn for the rest of the UK may not be enough.

"For full fibre, you're talking 2.6m to 2.7m premises left to go and a £5bn pot is less than £2,000 each – for some places it just won't work out."

With that in mind, the government already appears to be rowing back on its initial plans for "full fibre" and has said it is aiming for a universal "gigabit capable network," which would mean 5G fits the remit.

"The other element is the 'gigabit capable' side of this so I think that will bring in 5G in some of the hardest to reach areas," said Evans, adding that BT or other contract winners might partner with smaller players to complete such workarounds.

"We'll see fixed wireless come into play and it will be interesting to see how [companies that supply it] take part in that bid," he said. "It might be they wouldn't be best suited to doing a whole county, but they might partner with an Openreach or Gigaclear."

The idea of 5G, however, is seen as a cop out by alternative fibre companies that have been rolling out fibre through community action.

Broadband for the Rural North (B4RN) believes the government supporting 5G would let contract winners off the hook in terms of laying fibre to the remotest areas. "BT will do the bits that look interesting to them and then they will use something else," said Barry Forde, founder of B4RN. "It will make noise about 5G, it will come up with tricks and treats, but I would be very surprised to see BT build any fibre in the last 5%." ●

## Five stories not to miss

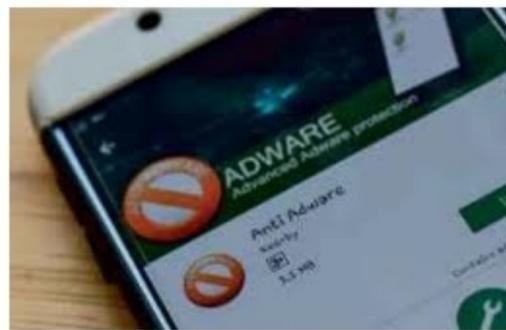


### 1 Google reveals updated Pixels

Google took the lid off its latest box of hardware toys, with the company announcing the Pixel 4 and Pixel 4 XL phones (see p62), Pixel Buds 2 earphones, the Pixel Go Chromebook as well as smart home devices. At its Made by Google event in New York City, the company also announced that its Stadia gaming platform would launch on 19 November and be supported by the Pixel 4 handsets.

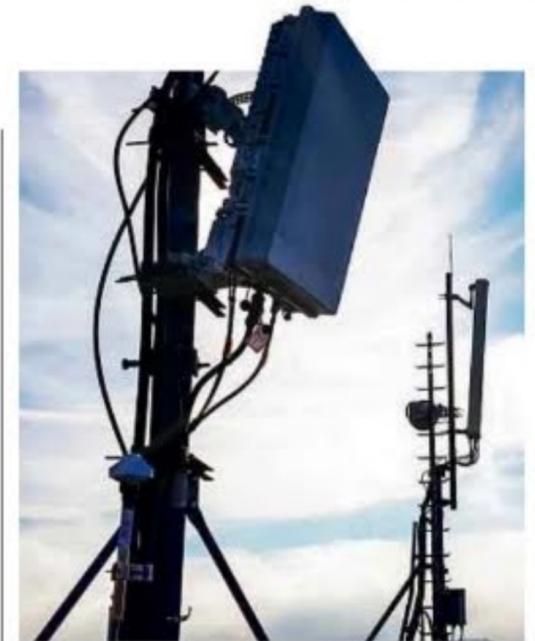
### 2 Bogus adware plaguing Google's Play store

Adware is thriving in Google's Play store, with research from security firm ESET spotting 172 malicious apps in the shopfront and 335m installations in September, despite Google's efforts to reduce harmful software. According to the research, revenue-generating code hidden in apps meant ads were served even when the apps were closed.



### 3 Tech firms dragged into Hong Kong dispute

Companies as diverse as Apple, Blizzard and Google became embroiled in the ongoing democracy protests in Hong Kong, highlighting the strained relationship between consumers, technology firms and authorities globally. While Amazon and Microsoft have faced criticism over working with heavy-handed border agency ICE in the US, Apple, Blizzard and Google saw a storm of complaints over decisions to block pro-democracy apps and commentators from their services.



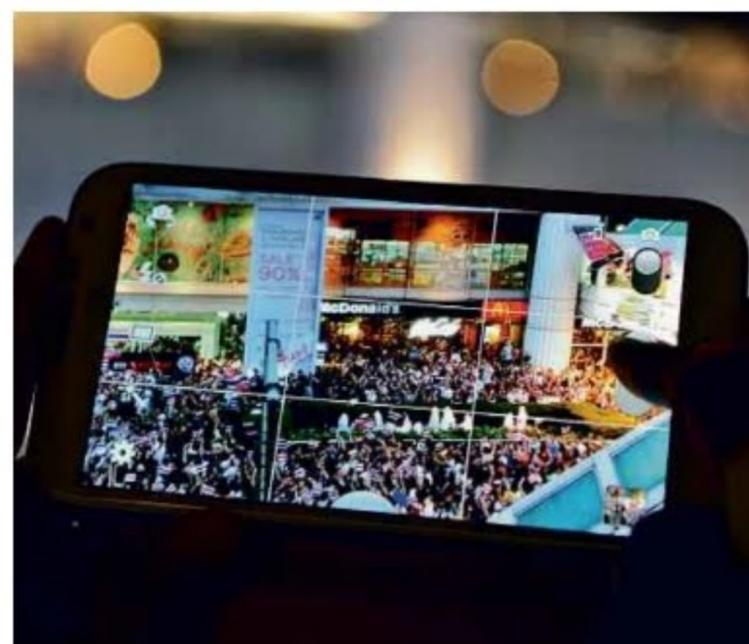
### 4 5G held up amid unproven health fears

5G sceptics and critics have halted plans to roll out the wireless internet services in areas of the UK, with dubious health concerns and planning permission thwarting progress, despite multiple research papers declaring the technology safe. Councillors in Totnes became the latest to ban masts over health fears, while Brighton and Hove blocked three masts branded as "visual clutter".



### 5 Apple facing storm over Catalina

Apple came under fire over what many believed to be a botched and rushed update to macOS. Critics pointed out that many independent apps failed to work properly on Catalina due to the end of 32-bit support and that Microsoft Office users may be forced to repurchase the suite in its 64-bit format.





# Unveiled

The key details of this month's hot hardware releases

## ► Microsoft Surface Duo

Microsoft's record with smartphones is roughly akin to Donald Trump's record with international diplomacy, but the company is giving it yet another go. The latest Microsoft phone is the Surface Duo, a clamshell device that will run on Android.

The Surface Duo is a foldable phone, in a similar vein to Samsung's recent Galaxy Fold. But instead of using a folding screen, the Surface Duo has two distinct 5.6in panels linked by sturdy-looking hinges.

Microsoft foresees the two screens displaying separate features or apps, a different take from other foldable handsets that double the screen size of a single app. APIs will allow developers to tailor apps to the dual displays.

The company believes it is creating a device that's better for productivity than a standard phone, and envisages people carrying a Duo instead of a



phone and a tablet/laptop. However, the hybrid device does have some notable shortcomings – for example, there's no rear-facing camera in the model the company showed off.

The phone won't arrive until the back end of 2020, with Microsoft giving developers due warning of what's to come. A failure to have developers on side was a killer blow for Windows Phone.

The current prototype device is built around Snapdragon 855, although this could be upgraded by the time the Duo reaches production.

### KEY DIGITS AND DETAILS

**Availability** Late 2020

**Price** TBA

**OS** Android

**Processor** Qualcomm Snapdragon 855

stripped back the bezels to achieve an impressive screen-to-body ratio. The top bezel, for example, is only 5.8mm wide, yet still manages to squeeze in a webcam.

The Spectre x360 is HP's first convertible featuring a quad-core 10th Gen Intel Core processor with Iris Plus graphics, while the company is still quoting a 22-hour battery life, although the usual caveats apply.

Security features include dedicated controls for the webcam.

### KEY DIGITS AND DETAILS

**Availability** Now

**Price** From \$1,099

**Processor** Intel Core i5-1035G1

**Memory** 8GB (up to 32GB)

**Storage** 256GB SSD (up to 2TB)

**Display** From 1080p

**Ports** microSD reader, USB-C, combo audio jack, USB 3.1 Type-A

**Weight** 1.27kg



## ► Cirrus7 Incus A300

German manufacturer Cirrus7 looks to be targeting the living room and bedroom with a fanless mini PC that uses the machine's own body to dissipate heat. The heavily finned aluminium chassis is threaded with copper cores, meaning that there's no need for noisy fans.

The PC is based on an ASRock A300M-STX motherboard and there are two main options for consumers, depending on their power requirements. The 35W models can be furnished with AMD Athlon 200GE/240GE, Ryzen 3 2200GE or Ryzen 5 2400GE processors, while buyers seeking more grunt can opt for the 65W model that features Ryzen 3 3200G or Ryzen 5 3400G chips.

The PC can be configured with up to 32GB of RAM, although the base configuration ships with a meagre 4GB. The storage options are also flexible, with a single M.2 SSD slot and two 2.5in SATA SSD bays, which

customers can furnish with a cocktail of drives either bought from Cirrus7 or from their own supplier.

Wireless connectivity is another optional extra, with Cirrus7 adding €40 for Intel's Wireless-AC 9260 module, which adds dual-band Wi-Fi and Bluetooth 5 to an acceptable range of wired ports.

### KEY DIGITS AND DETAILS

**Price** From €418

**Availability** Now

**Memory** Up to 32GB

**Storage** Up to 10TB

**Ports** USB 3.1 Gen 1 Type-A and Type-C ports, HDMI, DisplayPort, VGA, Ethernet

**Dimensions** 178 x 195 x 108mm

**ABOVE** The base model of the A300 ships with just 4GB of RAM, but users can choose from a host of upgrades

**LEFT** Microsoft envisions the Duo's two screens being used for different features and apps – and replacing a tablet or laptop



**ABOVE** The A300's "fins" are threaded with copper cores, which dissipate the heat – meaning no fans are required

**LEFT** The 2019 version of the Spectre x360 has HP's first 13in 4K OLED display

# “Foolish” Twitter sells users’ security details

## Misuse of data will put people off supplying two-factor authentication details

**DATA ABUSES FROM** Twitter and Facebook could damage the uptake of important security protocols such as two-factor authentication (2FA), experts have told *PC Pro*.

Twitter has been criticised after admitting it used phone numbers provided by customers for 2FA security for marketing purposes. “The result is likely to be a reduction in 2FA adoption and, consequently, more users having accounts compromised, more revenge photos stolen and posted on the internet, and ultimately maybe even real physical harm,” said Matthew Green, an associate professor in the Department of Computer Science at Johns Hopkins University. “It’s impossible to overstate how foolish this practice is.”

Twitter admitted in a statement that email addresses and phone numbers collected “for safety or security purposes (for example, two-factor authentication) may have inadvertently been used for advertising purposes”.



Twitter would not say how many users were affected, but confirmed that advertisers could use the details to target adverts to audience lists provided by third-party partners.

In an era of growing mistrust surrounding social media, Green believes that blurring the lines between authentication features and marketing is a serious problem. “Convincing users to adopt 2FA systems means that social networks have to be above reproach when it comes to keeping their data private,”

**ABOVE** Twitter has admitted to inadvertently using users’ 2FA details for advertising

he said. “They simply don’t have the technical capability or self-control to avoid that kind of abuse.”

Although there are several methods of 2FA, the fact that the vast majority of people carry smartphones makes SMS a convenient option.

“Twitter and Facebook’s behaviour is the sort of thing that drives people away from using this very effective protection, and makes them take greater risks online,” Green said.

Rights groups echoed the concerns, reflecting that Facebook had admitted to committing the same indiscretion only months earlier. “Facebook has history when it comes to the blurring of lines between contact information provided for security, and contact information provided for other purposes,” said Privacy International in a statement.

“Earlier this year, it emerged that Facebook was making mobile phone numbers (which users believed to be) provided for the express purpose of 2FA both searchable, and a target for advertising by default. Disclosing or using information provided for security purposes for any other purpose, including advertising, is unacceptable.”

# HP combats refills with higher printer prices

**HP IS SET** to shake up its ailing printer business by increasing the price of its hardware.

At a meeting with investors, HP’s new printer president Tuan Tran explained that the company would change its focus to put more emphasis on upfront revenues from printers, which had previously been subsidised by ink sales.

This would be a stark change from the cheap-printer-expensive-ink model that has been undermined by the arrival of third-party ink providers, despite technical efforts to thwart the grey market.

“We rebalance the system profitability by monetising innovation through increased hardware prices,” Tran said. “Customers can pay for the full value of the HP printer up front, gaining the flexibility for supplies... like buying an unlocked cell phone and then choosing your own wireless carrier.”

**RIGHT** Certain industry experts argue that HP’s shift in focus is too little, too late

Alternatively, HP said that users could commit to using HP inks in formats such as “Smart Tank” and “never stop” supplies in return for cheaper hardware.

Whether HP will be able to prevent third-party ink suppliers working out ways to get around controls in such systems after an initial contract period remains to be seen, but there are doubts that a model that mirrors mobile phones will appeal.

“HP has been experimenting with services for a while,” said Carolina Milanese, principal analyst with research firm Creative Strategies.

“But, from a consumer perspective, printers are those things you buy and use until they break, so I am not sure if two years with ink is something people will think they need. This is not a phone where tech



improves over those 24 months in a way to make a new model attractive.”

With overall print volumes reducing, experts believe the measures may come as too little, too late. “We worry that printing may be facing greater structural headwinds from the shift to digital, people printing less and increased pressure from cloned/remanufactured supplies,” Toni Sacconaghi of finance firm Bernstein told investors in a company post.

“In short, there is a higher likelihood the printing business is a ‘melting ice cube’.”



# PC Probe

## Life ends at 40 in the tech industry

Hiring managers favour enthusiasm of youth over expertise, **Stewart Mitchell** discovers

Technology as an industry has long faced criticism over its white, male-centric population. Now it appears ageism can be added to list.

In the ever-changing and demanding tech industry, hiring managers prefer young candidates with recent qualifications and a perceived willingness to work longer hours for the cause, recruiters have told *PC Pro*.

"Ageism is absolutely an issue and while the HR departments might say 'Oh no, we're not ageist', they are for the most part," said Graham Martin, founder of recruitment firm Orchard Jobs. "There's an unwritten set of criteria.

"There are a few enlightened firms that are more open, but when you talk to the hiring manager they'll say, 'Well this guy's not quite right' and it might be that it's just because he's got a few silver hairs."

### The legacyware lifeline

If new technologies and techniques block older workers from some environments, they can thrive in areas where younger rivals simply don't have the skills.

Legacy software and networking tools, for example, are too niche for many people to take the trouble to learn, but still play a major role within many organisations.

"I worked mainly with Cobol for most of my career and it lasted me through until retirement last year," said Peter Daniels, a contractor who serviced legacy systems for financial services companies. "In the last few years it was difficult to get a full-time role, but companies with systems that needed maintenance were always looking for contractors."

The work wasn't as glamorous as designing apps for mobiles, but Daniels said he didn't need to constantly update his skills. "It wasn't at the cutting edge and, yes, it was repetitive, but it paid the mortgage,"

he said. "A lot of customers didn't know anyone else that could do it either, so there was normally enough work."

According to experts, legacyware provides older professionals with a common pasture for where they face little competition. "There is some tech which is the preserve of those in their 40s, 50s or 60s," said Martin. "I've got a client that runs a small IT consultancy and he's always looking for someone with experience of legacy software and the young kids just don't know it."



With laws in place to punish ageism, companies are never going to admit to such bias but there are plenty of figures to back up the theory. According to research from HR analyst company Visier, the average age of workers in the tech industry is five years lower than in non-technical industries and workers from the "baby boomer" generation (which it defined as born between 1946 and 1964) are significantly underrepresented.

The Visier research found that "millennial" workers between 20 and 33 made up 42.6% of tech staff, but only 26.1% in other areas. Baby boomers accounted for only 11.7% of tech staff compared to 26.7% in the wider world. Gen X workers between 34 and 51 were on near parity.

The bias can't be brushed aside as a reflection of the demographic of the job applicants, because the talent pool includes people of all ages. "If I have all these people I might hire and if I am looking for 100 people, it might be split equally in many industries between millennials, Gen X and baby boomers," said Dave Weisbeck, chief strategy officer with Visier. "In tech, for that same 100, it's proportionately shifted and they hire much younger - that shows that there's something going on there."

### Age barriers

Despite laws that prevent ageist recruitment policies, there are plenty of job postings that, reading between the lines, also suggest a bias. "We want to hire people who have their best work ahead of them, not behind them," reads an advert for Silicon Valley software developer MobiChord, using a phrase that appears often in adverts.

Studies show the issue is widespread, with employment consultancy Dice finding in its 2018 Diversity Survey that "ageism in tech is clearly an issue, with 76% of all respondents saying it exists in their industry".

According to the research, "one in every four boomers reports having been refused a promotion solely because of their age," while 29% of respondents had experienced or witnessed age discrimination based in their office.

Firms occasionally face censure for discriminatory practices - Google, for example, recently agreed to pay \$11m to settle a lawsuit brought by 200 job applicants over 40 that had been declined work in engineering positions. But, according to experts, tech giants such as





Amazon, Facebook and Google are more age diverse than many smaller companies, particularly startups.

The theory is that young companies need staff that are willing to dedicate themselves round the clock to growing the company. “When you join a startup, you’re a small group of people that are going to burn the candle at both ends to create a brand new company, hopefully with stock options and other incentives,” said Weisbeck.

“That environment favours those that can sacrifice the rest of their life for this dedicated focus to work – they talk about ‘blue flames’, the workers that burn the hottest.”

Workers in their 20s are less likely to have family responsibilities that would get in the way of late nights in the office or impromptu business trips. “If you have older people, they have other commitments – such as ageing parents and kids, so it’s coming from both sides,” said Weisbeck. “How ‘blue flame’ can you be when life is forcing that many commitments on you? So, companies are predisposed to get the younger ones who are willing to do the crazy hours and hard work of blue flames.”

According to research from developer forum Stack Overflow, of 100,000 respondents to its 2018 Developer survey, 71% had no children or dependents, and more than 75% of developers were under 35.

### ■ Generation games

There are multiple reasons behind the preference for younger staff, many of them based on the idea that because under-35s were born into a digital world they are more capable of working in tech, especially mobile apps.

“The tech industry changes so quickly – you get down into programming languages and what was needed five years ago might be less relevant now,” said Weisbeck. “If you’re going to go mobile and completely web based, you might be looking for younger workers because there’s a perception they will be better.”

While languages go out of fashion, at least part of the problem is a cultural clash between generations. Do bosses really want staff that are twice their age? “Once you find

**ABOVE** Research in the US shows that salaries plateau at 40, meaning many older tech workers leave the industry

egalitarian, where developers who dedicate their free time and energy to constantly grow become the most successful,” said Howard Williams, managing director at communications tools developer Parker Software.

“In development, it is not quite so easy as to simply train older staffers on new skills. They must train themselves, or risk a gradual erosion of skillset value.”

How much ageing workers will benefit from putting in the extra effort is a moot point as research from [Hired.com](#) shows that the average tech worker’s salary plateaus at 40 in the US, leading some to leave the industry altogether.

Experienced staff also face competition from younger workers who take short courses and seek low-paying work to gain their first real-world experience.

**“ Older developers have pushed through complex problem solving and know when a proposed solution won’t work ”**

“Bootcamp graduates – people who have spent three months on a programming course – have flooded the market and created a large pool of junior developers desperate to get a foot on the ladder,” said Williams. “These software developers will likely work for a lower salary to gain the real work experience they need.”

### ■ Lost labour

The frustrating aspect of tech’s ageism problem is that the victims often have much to offer. All the recruitment professionals we spoke to believed the industry was self-harming by discarding people with decades of experience.

“Older developers have valuable insight from experience,” said Williams. “They have pushed through complex problem solving and know when a proposed solution won’t work. It might have been in a different language, but problem-solving experience is transferable.”

“They’re likely to have a more responsible attitude, because they’ve seen the consequences of careless errors.”

There’s something very 2019 about rejecting collective expertise and embracing less-experienced workers who know little of the industry outside their immediate role. ●



# The A-List

The best products on the market, as picked by our editors



## PREMIUM LAPTOPS

NEW ENTRY

### HP Envy 13 (2019)

Sleek ultraportable for a price that's right, £1,150

from [johnlewis.com](http://johnlewis.com)



Last year's top bargain buy becomes this year's top all-round choice thanks to a high-quality Full HD screen, Nvidia MX250 graphics and a stylish design. This includes a Core i7, 16GB of memory and a 1TB SSD, but you can save £400 by buying the Core i5 model with 8GB of RAM and a 256GB SSD direct from HP's website. **REVIEW Issue 303, p57**

## ALTERNATIVES

### Apple MacBook Pro 15in (2018)

A machine for true power users with amazing specifications, including that infamous Core i9 CPU and up to 4TB of SSD storage. **From £2,399 from [apple.com/uk](http://apple.com/uk)**  
**REVIEW Issue 288, p48**

### Razer Blade 15 Mercury White

A beautifully made gaming laptop with a Max-Q RTX 2070 and powerful Core i7 chip inside, along with 16GB of RAM and 512GB SSD. Add a 240Hz 15in screen and it's pure class. **REVIEW Issue 301, p52**

### Lenovo ThinkPad T490s

Lenovo updates its T series with this thin yet powerful laptop. With battery life over 11 hours in our tests, it's truly business class. **From £1,080 from [lenovo.com](http://lenovo.com)**  
**REVIEW Issue 301, p46**

## SMARTPHONES

### Samsung Galaxy Note 10+

Android phablet, 256GB, £999

from [samsung.com](http://samsung.com)



With a ludicrously fast processor, 256GB of storage as standard – you can upgrade to 512GB and 5G for £100 apiece – and a glorious 6.8in AMOLED screen, the Galaxy Note 10+ screams luxury. While this is a huge amount to spend on a phone, it lifts itself well above the budget competition thanks to unique features such as the bundled S Pen stylus. **REVIEW Issue 302, p68**

## ALTERNATIVES

### Google Pixel 3a

Not the cheapest, nor the fastest, but a well-rounded phone that offers premium features for a great price. **£399 from [store.google.com](http://store.google.com)**  
**REVIEW Issue 298, p68**

### Apple iPhone 11 Pro

Apple's latest flagship phone is fast, chock-full of new features and has an unbelievably good set of cameras. **64GB, £1,049 from [apple.com](http://apple.com)**  
**REVIEW Issue 302, p52**

### Motorola One Action

Another excellent budget Motorola, with this feature-packed, high-quality phone defying its low price. **£220 from [pcpro.link/301moto](http://pcpro.link/301moto)**  
**REVIEW Issue 301, p70**

## TABLETS

NEW ENTRY

### Apple iPad (2019)

9.7in tablet from £349

from [apple.com/uk](http://apple.com/uk)



Is this the world's most exciting upgrade? No, it isn't. And we still balk at the cost of the Smart Keyboard (£159) that turns this into a true laptop rival. However, nothing else can match the 2019 version of the iPad for usability, especially with the advent of iPadOS and grown-up features such as multiple instances of apps and a full-blown web browser. **REVIEW Issue 303, p50**

## ALTERNATIVES

### Apple iPad Pro 10.5in

Add a Pencil and Smart Keyboard and the Pro is pricey but – for mobile workers – it's definitely worth it. **64GB, £500 from [currys.co.uk](http://currys.co.uk)**  
**REVIEW Issue 278, p89**

### Amazon Fire HD 8

If you're just looking for entertainment on the go, there's no need to spend more: the Kindle Fire HD 8 is superb value. **£60 from [pcpro.link/290fire8](http://pcpro.link/290fire8)**  
**REVIEW Issue 290, p87**

### Microsoft Surface Go

We weren't expecting much from the Surface Go, but the £509 version is a highly portable work companion. **128GB, £509 from [microsoft.co.uk](http://microsoft.co.uk)**  
**REVIEW Issue 290, p80**

## EVERYDAY LAPTOPS+CHROMEBOOKS

### HP Envy 13 x360

Slim convertible, £800

from [johnlewis.com](http://johnlewis.com)



We're simply amazed by the high quality of this £800 ultraportable, which includes a screen that can flip round 360 degrees so you can use it as a giant tablet. Battery life is highly respectable at 8hrs 22mins, and the AMD Ryzen 5 processor is quick enough to keep Windows 10 running smoothly for years. HP's Envy range is rapidly becoming our new favourite. **REVIEW Issue 302, p61**

## ALTERNATIVES

### Lenovo Yoga Chromebook C630

This 15.6in Chromebook is still surprisingly portable, and boasts a Core i5, 8GB of RAM and 128GB of storage. **£700 from [lenovo.com/uk](http://lenovo.com/uk)**  
**REVIEW Issue 299, p87**

### HP Pavilion x360

Need a 14in screen? The Pavilion x360 lacks the all-aluminium chassis of the HP Envy 13 x360 above, but remains a pleasure to use thanks to its keyboard. **£679 from [pcpro.link/300hp](http://pcpro.link/300hp)**  
**REVIEW Issue 300, p81**

### Asus VivoBook S432F

Asus has just updated its VivoBook range with this highly portable laptop, with a strong core specification married to a long-lasting battery. **£799 from [asus.com](http://asus.com)**  
**REVIEW Issue 300, p80**

## ENTHUSIAST PCs

### Chillblast Fusion Akula RTX 2060 Super Gaming PC

RTX 2060 Super PC, £1,230

from [chillblast.com](https://www.chillblast.com)

With an overclocked Ryzen 7 3700X processor, 16GB of RAM and Nvidia's new RTX 2060 Super graphics, this PC blasts through demanding tasks and 1080p games. **REVIEW** Issue 302, p62



### Palicomp AMD Impulse RYZ7

Against tough competition in our bargain PCs Labs, this Ryzen 5 system impressed thanks to the sheer power inside it – including a discrete Radeon RX 560 graphics card. With a 512GB PCIe SSD and room for expansion, it's a great choice. **£500 from [palicomp.co.uk](https://www.palicomp.co.uk)** **REVIEW** Issue 302, p89

### PC Specialist Vulcan S1

A great-value PC based on Intel's six-core i7-8700 CPU and the new mid-range Nvidia graphics card, the 1660 Ti. With a classy chassis, quiet running and plenty of power, it's a great buy for people who don't want to pay over a grand. **£999 from [pcspecialist.co.uk/reviews](https://www.pcspecialist.co.uk/reviews)** **REVIEW** Issue 297, p54

## WORKSTATIONS

### Scan 3XS WA4000 VR

Ryzen 9 3000 series workstation, £3,700 from [scan.co.uk](https://www.scan.co.uk)

Taking full advantage of the capabilities of AMD's new Ryzen 9 3900X, the Scan 3XS WA4000 VR is an impressive all-round workstation that offers phenomenal image editing, video encoding, rendering and 3D modelling. There's a 16-core version on the horizon, too. **REVIEW** Issue 300, p58



### Armari Magnetar S32T-RD1300G3

Armari takes advantage of the power of AMD's Threadripper 2990WX, keeping it company with 64GB of 3,200MHz DDR4 memory and Nvidia's new Quadro RTX 5000 graphics. No wonder it blasted through our benchmarks with ease. **£5,994 from [armari.com](https://www.armari.com)** **REVIEW** Issue 296, p86

### Scan 3XS WI4000 Viz

The latest iteration of Scan's Intel-based workstation includes a Core i9-9900K, Quadro RTX 4000 graphics and 32GB of 3,000MHz DDR4 RAM. The result is an affordable content-creation workstation that can turn its hand to all tasks with equal aptitude. **£2,500 from [scan.co.uk/3xs](https://www.scan.co.uk/3xs)** **REVIEW** Issue 296, p88

## MONITORS

### NEC MultiSync EA271U

27in 4K monitor, £792

from [bechtle.co.uk](https://www.bechtle.co.uk)

The NEC can display almost 100% of the sRGB colour gamut with tremendous accuracy – and it's designed to give your eyes an easy ride. **REVIEW** Issue 293, p62



### Eizo ColorEdge CG319X

Is this the best 31in monitor that money can buy? Almost certainly. Designed for creative professionals who need to move between all forms of media, from print to web to creating HDR video, it's a stunning display. **£3,989 from [wexphotovideo.com](https://www.wexphotovideo.com)** **REVIEW** Issue 301, p82

### Iiyama ProLite X3272UHS-B1

Looking to kit out an office with 4K displays? This 32in screen is a perfect option, with image quality and value for money taking precedence over features you may never use. **£350 from [box.co.uk](https://www.box.co.uk)** **REVIEW** Issue 288, p72

## ENTHUSIAST/SMB NAS DRIVES

### Synology DS918+

Four-bay NAS, £505

from [laptopsdirect.co.uk](https://www.laptopsdirect.co.uk)

All Synology NAS drives share the same great OS, with all its attendant apps – but the DS918+ took the top spot in our Labs thanks to its horsepower, its four drive bays and the sheer number of roles it can perform. **REVIEW** Issue 284, p81



### Qnap TS-453Be-4G

Qnap markets the TS-453Be-4G at businesses rather than home users – but, in our opinion, it's equally at home in both of those situations. An extremely versatile NAS appliance that's both straightforward to use and a very solid performer. **£474 from [pcpro.link/284qnap](https://www.pcpro.link/284qnap)** **REVIEW** Issue 284, p80

### WD My Cloud EX4100

If you're looking for a solid, speedy NAS – particularly for a small office – then take note of the affordable WD My Cloud EX4100. Despite the low price, it offers four bays and its mid-range specification is more than up to handling office duties. **£274 from [pcpro.link/284wd1](https://www.pcpro.link/284wd1)** **REVIEW** Issue 284, p83

## WIRELESS NETWORKING

### Asus RT-AX88U

802.11ax router, £294

from [pcpro.link/300ax](https://www.pcpro.link/300ax)

When testing the RT-AX88U, the reality of 802.11ax (or Wi-Fi 6) proved even better than we dared hope for: it provided blazingly fast speeds throughout even the trickiest areas of our house. The design is surprisingly understated, too – only the gold cutouts hint at this router's winning performance. **REVIEW** Issue 300, p62



### Linksys EA9500 Max-Stream

If a mesh network isn't for you, this feature-packed router is an excellent choice. It's packed with eight Gigabit Ethernet ports and can work as DLNA server. Most importantly, the Max-Stream delivers very fast speeds. **£250 from [pcpro.link/288link](https://www.pcpro.link/288link)** **REVIEW** Issue 288, p82

### Tenda Nova MW3

Don't want to spend over £200 on a Wi-Fi upgrade? The Nova MW3 is our bargain choice, killing off "not spots" and spreading Wi-Fi throughout your home. It may not be as fast or wide-ranging as the Zyxel Multy X, but it wins on value. **£70 from [pcpro.link/288tenda](https://www.pcpro.link/288tenda)** **REVIEW** Issue 288, p69

**WORKGROUP PRINTERS**

**NEW ENTRY**

**NEW ENTRY**

**Xerox VersaLink C405DN**

**Colour laser, £369 exc VAT**  
from [printerland.co.uk](http://printerland.co.uk)

ConnectKey apps make this colour laser versatile – but it's an excellent choice even if you have little need for them, combining fast, sharp output with great security and mobile printing services. **REVIEW Issue 303, p101**



**Brother MFC-J6945DW**

Small businesses that want affordable A3 colour printing won't find a better alternative to Brother's MFC-J6945DW. High-resolution prints are slow but colour quality is very good, running costs are remarkably low and cloud support is outstanding. **£272 exc VAT from [printerbase.co.uk](http://printerbase.co.uk)** **REVIEW Issue 295, p96**

**Kyocera Ecosys P6235cdn**

The Ecosys P6235cdn hits all the important notes. It's expandable and easily maintained, with good print performance and strong, fine-grained security, as well as very low running costs – all of which make this sturdy colour laser ideal for busy offices. **£358 exc VAT from [printerland.co.uk](http://printerland.co.uk)** **REVIEW Issue 303, p100**

**HOME OFFICE PRINTERS**

**Canon Pixma TS6250**

**All-in-one inkjet, £85**  
from [pcpro.link/298can](http://pcpro.link/298can)

Nigh-on the perfect all-rounder for home use, with speedy output (12.7ppm for black text, 3.9ppm for complex colour layouts), excellent image quality on plain paper and competitive running costs. Add an easy to use touchscreen and we have a winner. **REVIEW Issue 298, p83**



**Epson EcoTank ET-2710**

Epson's EcoTank concept lets you refill the huge ink reservoirs yourself for super-low running costs – and this solid all-in-one is cheap to buy, too. It's not the fastest printer in the world, and photo-printing is a weakness, but for cost-effective home printing, it can't be beaten. **£242 from [lambda-tek.com](http://lambda-tek.com)** **REVIEW Issue 298, p84**

**HP Tango X**

The Tango X is the size of two hardback books piled on top of one another – yet it has all the features of a full-size all-in-one. 100% wireless, it pairs with your phone for "scans" and "copies", and produces great-quality (and free) photo prints. A fresh and likeable take on home printing. **£180 from store.** [hp.com](http://hp.com) **REVIEW Issue 293, p58**

**VIDEOCONFERENCING**

**Poly Studio**  
**4K meeting room**

**solution, £752 exc VAT**  
from [lambda-tek.com](http://lambda-tek.com)

Poly's Studio is a hassle-free videoconferencing solution that's a cinch to set up and use. The audio-enhancing and video-tracking features really help remote meetings go smoothly, and for a 4K VC solution it's seriously affordable. **REVIEW Issue 300, p97**



**Lifesize Icon 700 and Phone HD**

A superbly easy-to-deploy videoconferencing system with great management features. Businesses that want 4K VC without complex configuration or bandwidth worries will find it an excellent solution. **£6,150 exc VAT from [onedirect.co.uk](http://onedirect.co.uk)** **REVIEW Issue 300, p94**

**Logitech Rally**

Not a racing car but Logitech's latest professional videoconferencing solution. Designed for medium-to-large meeting rooms, it's a modular system that can be expanded with extra accessories, allowing it to grow along with your demands. **£1,800 exc VAT from [onedirect.co.uk](http://onedirect.co.uk)** **REVIEW Issue 300, p95**

**BUSINESS WI-FI**

**Ubiquiti Networks UniFi nanoHD**

**Access point, £137 exc VAT**  
from [broadbandbuyer.com](http://broadbandbuyer.com)

You'll need to factor in the cost of extra UniFi hardware to get the most from it, but the nanoHD is perfect for SMBs seeking the best wireless performance. It's a cinch to deploy and great value, with on-premises and remote cloud management included in the price. **REVIEW Issue 297, p99**



**Draytek VigorAP 903**

This Wave 2 access point brings self-healing mesh networking within reach of an SME budget. It's very easy to deploy – you can quickly create a wide-ranging wireless network using up to eight APs – and is a clear winner for value compared to rivals. **£114 exc VAT from [broadbandbuyer.co.uk](http://broadbandbuyer.co.uk)** **REVIEW Issue 298, p100**

**WatchGuard AP325**

An ideal choice for SMBs seeking Wave 2 Wi-Fi performance, strong security and remote management on a modest budget. It's quick to set up, and has a superb spread of features, including an intrusion prevention system that blocks rogue APs. **£468 exc VAT from [watchguardonline.co.uk](http://watchguardonline.co.uk)** **REVIEW Issue 293, p99**

**SCANNERS**

**Fujitsu fi-7300NX**

**Network scanner, £758 exc VAT**  
from [tradescanners.com](http://tradescanners.com)

This 802.11ac scanner delivers performance that lives up to its 60ppm claims, and with a huge range of options it's the perfect choice if you want to streamline your scanning processes. **REVIEW Issue 301, p98**



**Brother ADS-2800W**

A great choice for businesses that need a desktop scanner with a finely tuned balance of features, speed and value. It includes an excellent software package, provides good cloud support and makes light work of walk-up scan operations. **£330 exc VAT from [lambda-tek.com](http://lambda-tek.com)** **REVIEW Issue 301, p96**

**Epson WorkForce DS-970**

The DS-970 may only offer a USB port as standard, but it delivers 85ppm scan speeds at a very competitive price. Combine this with Epson's scan automation software and you have a great choice for SMEs with high-volume scanning requirements. **£806 exc VAT from [ebuyer.com](http://ebuyer.com)** **REVIEW Issue 301, p97**



**CCL COMPUTERS**



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**Bitdefender Internet Security 2019**

Not the fuss-free offering of last year, but the Autopilot mode still rarely interrupts – and protection remains absolutely top-notch. **1yr, 3 devices, £25 from [bitdefender.co.uk](http://bitdefender.co.uk) REVIEW Issue 291, p84**

**Panda Free Antivirus**

Forget about Windows Defender; if you want protection that you can rely on, won't kill your resources and won't cost you a penny, Panda Free Antivirus is the one to go for. **Free from [pandasecurity.com](http://pandasecurity.com) REVIEW Issue 291, p87**

**BACKUP SOFTWARE**

**Acronis True Image 2019 Acronis**

This comprehensive backup solution does it all, from cloud storage to disaster recovery and app rollback. If you take data protection seriously, this is a great investment. **1 PC, Advanced edition, 250GB cloud storage, £35 per year from [acronis.com](http://acronis.com) REVIEW Issue 295, p82**

**IDrive**

It might be IDrive's free 5GB of cloud backup that first attracts you, but the paid-for plans are cost-effective, too – and the service, which supports hybrid backup and disk imaging, is very flexible. **Free, 5GB; £52/yr, 2TB from [idrive.com](http://idrive.com) REVIEW Issue 295, p84**

**O&O DiskImage Professional 14**

Focused on protecting your hard disk, and with no subscription costs, O&O's offering could be exactly what you need to bring a bricked PC back to life. That's well worth the asking price. **1 PC, £36 from [oosoftware.com](http://oosoftware.com) REVIEW Issue 295, p86**

**CREATIVITY SOFTWARE**

**Adobe Creative Cloud**



Adobe entrenches its position as an indispensable resource for creative professionals, with useful upgrades to the core print-orientated apps such as Photoshop, and exciting new additions for digital designers, too. **Complete plan, £50/mth from [adobe.com/uk](http://adobe.com/uk) REVIEW Issue 268, p72**

**Affinity Publisher**

Showing that Affinity Photo, its Photoshop rival, was no fluke, Affinity Publisher is another brilliant Adobe alternative (this time to InDesign) that works superbly on low-power hardware. **£49 from [affinity.serif.com](http://affinity.serif.com) REVIEW Issue 299, p75**

**CyberLink PowerDirector 16 Ultra**

An excellent tool for 360-degree video production, and also a fine choice for normal video, with powerful plugins that boost it yet further. Not cheap but worth it. **£52 from [pcpro.link/278cyb](http://pcpro.link/278cyb) REVIEW Issue 278, p73**

**RACK SERVERS**

**Dell EMC PowerEdge R340**

A versatile Xeon E rack server with good upgrade potential, plenty of storage choices and the best management features around. It's good value, too: the price shown here includes the iDRAC9 Enterprise upgrade, which enables full OS remote control and virtual media services. **£1,579 exc VAT from [dell.co.uk](http://dell.co.uk) REVIEW Issue 298, p97**



**Lenovo ThinkSystem SR250**

Despite its modest proportions and low price, this Xeon E server has the credentials to handle a wide range of business applications, with big storage potential, great features and remote management. **£1,155 exc VAT from [uk.insight.com](http://uk.insight.com) REVIEW Issue 298, p99**

**PEDESTAL SERVERS**

**Fujitsu Server Primergy TX1320 M4**

Don't judge this server on its size. It may only be 405mm tall and cost £847 exc VAT, but it packs in a quad-core Xeon E-2134 processor, 16GB of DDR4 memory and you can specify up to eight hotplug SFF drive bays. It's great value and can be configured to a wide range of demanding workloads. **Model T1324SC120IN, £847 exc VAT from [lambda-tek.com](http://lambda-tek.com) REVIEW Issue 302, p103**



**HPE ProLiant ML350 Gen10**

A perfect expression of HPE's "buy now, upgrade later" mantra, you can upgrade every part of the ProLiant ML350 Gen10. Our review model (877621-031) is a fine start for a growing business. **£1,799 exc VAT from [ebuyer.com](http://ebuyer.com) REVIEW Issue 288, p96**

**SECURITY**

**SonicWall TZ300P**

A competitively priced desktop UTM appliance with abundant security measures and a wealth of management features. It's loaded with features yet easy to deploy, and with remote management and zero-touch provisioning it will be particularly appealing to businesses with multiple offices. **£1,085 exc VAT with 1yr TotalSecure Advanced from [sonicwallonline.com](http://sonicwallonline.com) REVIEW Issue 298, p101**



**DrayTek Vigor 2620Ln**

Don't expect cutting-edge Wi-Fi speeds, do expect a strong set of security measures and WAN connection options. Excellent value for a small business that needs always-on internet access. **£197 exc VAT from [broadbandbuyer.com](http://broadbandbuyer.com) REVIEW Issue 300, p100**

**NAS SERVERS**

**Synology DiskStation DS2419+**

With a monstrous maximum capacity of 168TB, the DS2419+ is the perfect backup vault for small to medium-sized businesses. The fully loaded app store meanwhile opens up a huge range of additional roles, including video surveillance. **Diskless, £1,226 exc VAT from [span.com](http://span.com) REVIEW Issue 296, p101**



**Qnap TS-983XU-E2124-8G**

It may be pricey, but this 1U rack NAS is in a different class to most rivals, thanks to a Xeon E-2124 CPU, 10GbE support out of the box and highly flexible storage choices. **Diskless, £1,758 exc VAT from [span.com](http://span.com) REVIEW Issue 296, p99**

**BACKUP**

**Veritas Backup Exec 20.4**

Simply the best on-premises backup and data recovery solution for SMEs. It can easily manage a hybrid backup strategy, it offers great security features and the choice of licensing schemes makes it very affordable. **£370 per TB exc VAT from [span.com](http://span.com) REVIEW Issue 299, p99**



**Iperius Backup Full**

Iperius Backup presents an impressive range of features in a well-designed system, and its low price makes it an excellent solution for budget-conscious businesses. Even the extras are nicely priced. **£222 exc VAT from [iperiusbackup.com](http://iperiusbackup.com) REVIEW Issue 299, p97**

**VOIP SERVICES**

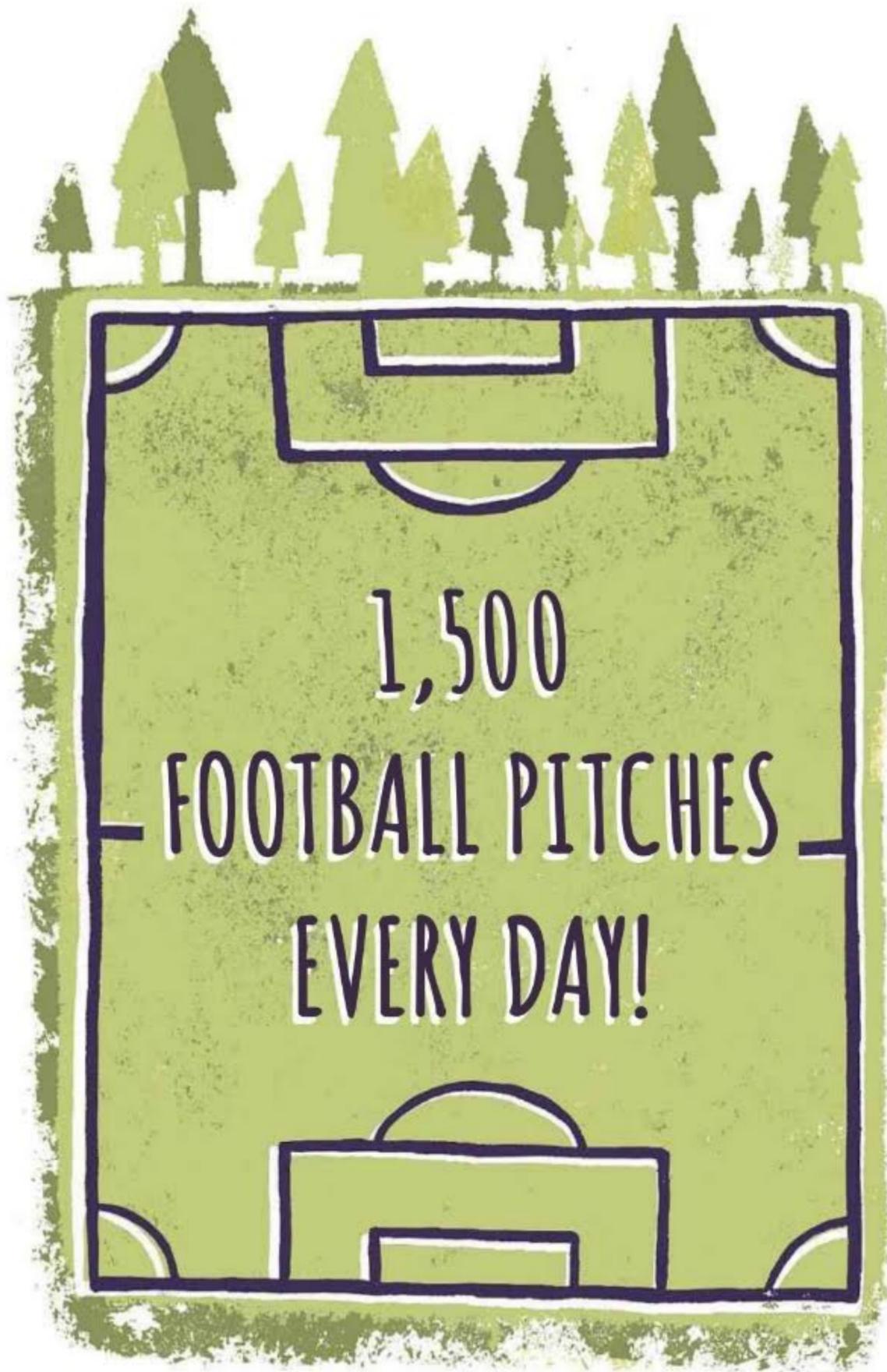
**3CX Phone System 15.5 Update 6**

This self-hosted phone system does everything you need for a great price – and because it's licensed by the number of simultaneous calls, rather than the number of physical extensions, you don't have to agonise over who gets a phone and who doesn't. A super choice for SMBs. **16SC Standard, £536 exc VAT from [3cx.com](http://3cx.com) REVIEW Issue 294, p96**



**RingCentral Office**

If you're looking for an easier alternative to an on-site IP PBX, RingCentral Office is the answer – an affordable and powerful cloud-based service with a great set of call-handling features. **From £8 exc VAT per month from [ringcentral.co.uk](http://ringcentral.co.uk) REVIEW Issue 294, p98**



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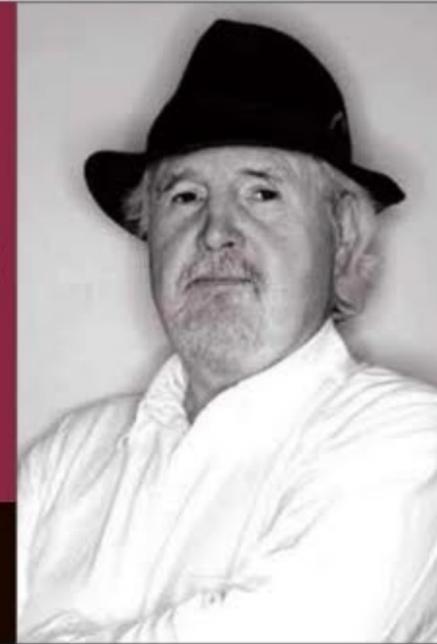
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# Your thoughts and desires are no longer your own



Dick Pountain is editorial fellow of *PC Pro*. The only Skinner Box he might consider is that one where you press a button for a shot of cocaine.

As societal nudges edge closer to super-nudges, Dick wonders if our “free” society is starting to lose control of its own decision making

**W**e live in paranoid times, and at least part of that paranoia is being provoked by advances in technology. New techniques of surveillance and prediction cut two ways: they can be used to prevent crime and to predict illness, but they can also be abused for social control and political repression. Which of these one sees as more important is becoming a matter of high controversy. Recent protests in Hong Kong highlight the way that sophisticated facial recognition tech, when combined with CCTV built into special lampposts, can enable a state to track and arrest individuals at will.

But the potential problems go way further than this, which is merely an extension of current law-enforcement technology. Huge advances in AI and deep learning are making it possible to refine the more subtle means of social control often referred to as “nudging”. This means getting people to do what you want them to do, or what is deemed good for them, not by direct coercion but by clever choice of defaults that exploit people’s natural biases and laziness (both of which we understand better than before, thanks to the psychological research of Daniel Kahneman and Amos Tversky).

The arguments for and against nudging involve subtle philosophical principles, which I’ll try to explain as painlessly as possible. Getting people to do “what’s good for them” raises several questions: who decides what’s good? Is their decision correct? Even if it is, do we have the right to impose it?

Liberal democracy – which is what we still do just about have, compared

to Russia or China – depends upon citizens being capable of making free decisions about matters important to the conduct of their own lives, but what if advertising, addiction or those intrinsic defects of human reasoning that Kahneman uncovered so distort their reckoning as to make them no longer meaningfully free? What if they’re behaving in ways contrary to their own expressed interests and injurious to their health? Examples of such behaviours, and the success with which we’ve dealt with them, include compulsory seatbelts in cars (success), motorbike crash helmets (success), smoking bans (partial success) and US gun control (total failure).

Such control is called “paternalism”, and some degree of it is necessary to the operation of the state in complex modern societies, wherever the stakes are sufficiently high (as with smoking) and the costs of imposition, in both money and offended freedom, are sufficiently low. But there are libertarian critics who reject any sort of paternalism at all, while an in-between position, “libertarian paternalism”, claims that the state has no right to impose but may only nudge people toward correct decisions. An example might be opting in versus opting out of various kinds of agreement, from mobile phone contracts to warranties, from mortgages to privacy agreements. People are lazy and will usually go with the default option, a careful choice of which can nudge rather than compel them to the desired decision.

Advances in AI are amplifying the opportunities for nudging to a paranoia-inducing degree. The nastiest thing I saw at the recent AI conference was an app that reads shoppers’ emotional states

“That non-invasive approach might be extended with even deeper learning to predict your speech intentions, the voice in your head”

using facial analysis and then raises or lowers the price of items offered to them on the fly. Or how about Ctrl-Lab’s app, which non-invasively reads your intention to move a cursor (Facebook just bought the firm). Since vocal chords are muscles too, that non-invasive approach might be extended with even deeper learning to predict your speech intentions, the voice in your head, your thoughts...

**I** avoid both extremes in such arguments about paternalism. I do believe that the climate crisis is real and that we’ll need to modify human behaviour a lot in order to survive, so any help will be useful. On the other hand, I was once an editor at *Oz* magazine and something of a libertarian rabble-rouser in the 1960s. In a recent *Guardian* interview, the acerbic comedy writer Chris Morris (*Brass Eye*, *Four Lions*) described meeting an AA man who showed him the monitoring kit in his van that recorded his driving habits. Morris asked if he felt that was “creepy” but the man replied: “Not really. My daughter’s just passed her driving test and I’ve got half-price insurance for her. A black box recorder in her car and camera on the dashboard measures exactly how she drives and her facial movements. As long as she stays within the parameters set by the insurance company, her premium stays low.” This sort of super-nudge comes uncomfortably close to China’s punitive social credit system: Morris called it a “Skinner Box”, after the American behaviourist BF Skinner who used one to condition his rats.

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“People will usually go with the default option, a careful choice of which can nudge rather than compel them to the desired decision”

# Google is actually getting worse as it does more



Nicole Kobie is PC Pro's Futures editor. She feels nostalgic for the early days of the web, which probably means she's getting old. Remember GeoCities? Ah, the good old days. [@njkobie](https://twitter.com/njkobie)

Search is Google's heart, but the algorithms that run it are clearly struggling to keep up with the web

The internet is broken, though that's hardly news. Facebook doesn't bring the world closer together, as Mark Zuckerberg once hoped, but drives people with slightly divergent opinions further apart. Twitter was designed to share news and information instantly and across borders, but it's much better for sharing abuse. As for Google's goal, to "organise the world's information and make it universally accessible and useful"? Searching for anything specific is nigh on impossible.

Don't believe that Google is useless? Here's an example. Try to find out the date and time of your local Bonfire Night fireworks display. The first result I see when I search "Walthamstow Bonfire Night 2019" is a Google-made "Events" box informing me that Bonfire Night is the fifth of November, a fact I very much remember. Next in the results is a list of questions that other "people also ask", which includes the suggestion "what time are the Crystal Palace fireworks" – while I'm sure they're lovely, I live in northeast London.

Both of those results were generated automatically by Google's systems, and both are useless to me. But after that algorithmic garbage, we finally have some actual results from the web, namely a series of articles and blog posts finely tuned to ride the SEO train to advertising profit. The first result says there's no fireworks in Walthamstow this year; that is not true. The second and the third results don't feature the "Walthamstow" anywhere on the linked page – so why are they ranking for that term? If my

editor would let me use emoji in my columns, there'd be a "shrug" here.

The fourth website in the ranking does include all the key terms, but only in a photo caption; it's an explainer about what Bonfire Night is, rather than where I might partake. The fifth result is the local council's Bonfire Night listing on Facebook... for last year's event. Bing, on the other hand, had an accurate result second in the list. It's enough to make anyone want to chuck Google on the bonfire; the only fireworks are my temper.

The cause of those fruitless Google results is twofold, and both are issues Google needs to address. First, the article results are there because sites are trying to game Google's ranking algorithm, the dark art known as search engine optimisation (SEO). It's easy to blame publishers, but if sites are ranking for "Walthamstow" without using the word at all, we need to dole out some blame to Google's clearly broken algorithm, too.

The second cause of those terrible results is also to do with Google's algorithm: data ages, it erodes and goes out of date. It's much easier to find information about Bonfire Night displays from 2018 and before than it is this year, but that isn't of much use for those of us without time machines.

Don't get me wrong; I haven't forgotten what life online was like before Google. Hotmail, Yahoo and Ask Jeeves all pale in functionality and utility compared to Gmail and Google Search. But that leap forward hasn't been maintained. The web isn't what it was back in 1997 when Google Search launched, and plenty of that

change and added complexity is down to Google itself. Back then, it was easy to dig out the link to the council's web page about Bonfire

Night, but now that same system must also define Bonfire Night, sort through the many SEO-designed pages gaming the system and sift through social posts. Google's search algorithm is creeping under the weight.

All of this is important. Under its wider Alphabet umbrella company, Google is building driverless cars, with Waymo running trials in

**“ We hear a lot about avoiding bias in algorithms and AI, but we also need to make sure systems actually work – and keep working ”**

Arizona. In Toronto, its subsidiary Sidewalk Labs is designing a new neighbourhood from the ground up as a smart city lab. It bought British machine-learning startup DeepMind to expand into AI healthcare and Nest to shift into smart homes. And that's just Google. Algorithms are slipping into our homes via voice-activated assistants, into our cities via automated traffic lights and dynamic transport timetables, and touching every aspect of our lives. Your bank processes your salary via algorithms. Your medical scans are examined by machine learning systems.

Many of those algorithms aren't fit for purpose. Others may be today, but won't be in the near future. They must learn how to evolve with change and spot the erosion of data quality. We hear a lot about avoiding bias in algorithms and AI, and that's vital, but we also need to make sure systems actually work – and keep working.

After all, if I can't trust Google's famously powerful search algorithm to find such basic information, why would I trust its systems to drive me, organise my city, or keep me healthy?

[work@nicolekobie.com](mailto:work@nicolekobie.com)

**“ The web isn't what it was back in 1997 when Google Search launched, and plenty of that change and added complexity is down to Google ”**

# We may not be hip, but our grey matter matters



Barry Collins has more grey hairs than share options. You can send your headhunters to [barry@mediabc.co.uk](mailto:barry@mediabc.co.uk).  
[@bazzacollins](https://twitter.com/bazzacollins)

**The IT industry may treat experience as a burden, but those years on the clock translate into valuable knowledge that it's foolish to ignore**

**S**poiler alert: editing this month's PC Probe (see p14) was a depressing job. Not because Stewart Mitchell's writing was anything less than his brilliant best, but because of the topic. At the age of 42, I am pretty much washed up when it comes to pursuing a career in IT.

It's not that those already in the IT industry should consider themselves pensioned off as soon as they hit their forties – although Stewart does find strong evidence that the industry casts aside experienced staff. It's that my chances of getting a foot in the door are about as high as my chances of eloping with the Queen.

This is particularly true should I wish to join a startup. These fledgling companies aren't interested in what someone with a couple of decades of experience could bring. They're looking for twentysomethings with the willingness to work until their fingers bleed all over the keyboards. The job ads almost say it explicitly: those with family lives need not apply.

There is a degree of hypocrisy in this polemic. I joined this magazine 21 years ago, on the cusp of my 21st birthday, when the average age of the staff was around 25. In my twenties, there's no doubt my ability to work harder and longer hours than some of my colleagues helped me progress to senior levels of national newspapers.

However, that doesn't make the situation any less problematic. Ignoring experience in favour of eagerness to sleep on the office floor doesn't make good business sense. In fact, more experience in the office might prevent regular all-nighters.

**“The message to the next generation: work until you drop, take no prisoners, take the riches that come with it”**

Tech's workaholic culture is nothing new. The Netflix mini-series *Inside Bill's Brain* is a fascinating, if hagiographic, biography of Bill Gates. It spends a while focusing on young Bill, when he was falling asleep at the controls of primitive computers, programming the early systems at Honeywell or the Microsoft code that went on to make him serious money.

Young Gates is relentless. Too relentless for co-founder Paul Allen, who quits early on. Too relentless for his wife, who bemoans living in a mansion with a young child and feeling totally isolated. Too relentless for the staff who suffer from one of his infamous tirades because they “never understood the first thing” about a piece of software he's critiquing. You can see him half-wince as he watches back that footage in the documentary, but he stops short of wishing he had done things differently. The message to the next generation: work until you drop, take no prisoners, take the riches that come with it.

It's hard to argue that Gates's attitude did him or Microsoft any great harm, but does it make for a better industry, a better society? Women undoubtedly suffer in relentless work cultures, getting left behind when the time comes to raise a family and they bear more than their fair share of the parenting burden.

The reason the traditional pipelines into these industries – technology, media and public office – work best for men is that, intentionally or not, they were designed that way. We need to create new pathways into these industries

that will open more entry points for women from all backgrounds. And those aren't my words, they're the words of Melinda Gates – the woman

who largely sacrificed her own Microsoft career to bring up Bill's children – who's just pledged a billion dollars of their joint foundation's money to “expanding women's power and influence in the United States”.

A better age balance would help some of these companies as much as a better gender balance will. The

**“When they needed a new laptop, he went down to a nearby PC World and bought whatever was on offer at the time”**

mistakes some startup companies make are terrifying. A few years ago, I was asked to visit an up-and-coming recipe box company – now very much a household name – and troubleshoot their IT in a Gordon-Ramsay-pitch-up-at-the-restaurant-and-start-shouting-at-people kind of way.

They had millions of venture capital in the bank and a central London office crammed with staff, all the right side of 30. The kid running the IT was 22, and it showed. When they needed a new laptop, he went down to a nearby PC World and bought whatever was on offer at the time. The printers weren't big enough to print the A3 menus they needed. Backup was practically non-existent. Yet they were taking tens of thousands of orders every week.

The firm made it in the end, but it was sheer good fortune that saved it from an IT disaster – the kind of data loss that finishes companies. The kind of mistake a more experienced IT director wouldn't make, even if they refused to sleep amongst the pizza boxes. Us experienced heads add value. Startup billionaires-to-be, you know where to find me.

[barry@mediabc.co.uk](mailto:barry@mediabc.co.uk)

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# Readers' comments

## Your views and feedback from email and the web

### Shhh...

I was struck by the tone of your recent review of the Quiet PC Nofan (see issue 302, p92) in which I noted, to my mind, a huge misunderstanding of the purpose of quiet or silent computing as a distinct branch of the IT world.

To every family and every user there are competing needs (and desires) in IT, one of which is quiet or silent running. I say this particularly because I never really knew it before my own experience. If it is a branch of IT surely it can command some respect; your review seems to imply that performance is the monarch and noise levels some quaint frippery to be mocked. Just putting on headphones is not the answer when the need for quiet is from the non-users in the room, not the user, who is probably quite happily immersed in their work.

My experience was trying to solve a problem: one living space, three teenagers, a TV/dining/working area and a gaming and workstation PC that sounded like a helicopter. Living together in cramped conditions is not so unusual, and maybe headphones are a good idea, but rather than put everyone in them, we needed the aid of Quiet PC, an immensely helpful UK-based company.

The Nofan is an easily upgradeable, premium product. There's no fan on the graphics card, CPU or power unit, and it's impossible to put a price on that as a solution to the problems caused by my family's conflicting needs and stages of education.

I believe your reviewer could have been more even-handed and open-

## Star letter

With all the excitement regarding Wi-Fi 6 (802.11ax), it's worth considering the support router manufacturers provide for existing kit. Recently, Netgear published an R7000 firmware update, which I quickly installed to keep Davey Winder happy. However, it not only broke my Google Chromecast Ultras, but also removed half a dozen features (such as DLNA). Thus, I can't update my router to fix security issues if I want the router to keep the features I paid good money for. The strong suspicion is that Netgear dropped these features to

make space for new subscription services (antivirus and parental controls) that I just don't want. Your shiny new Wi-Fi 6 router may have a shorter shelf life than you think. Or am I being too cynical?

**Stewart Sim**

**Darien Graham-Smith replies:** We raised this issue with Netgear, but the company's only response was that users wanting to keep their existing router functions should skip the update. With new security threats emerging all the time, that's hardly a satisfactory answer. We will be keeping a close eye on this situation and calling out any manufacturers who put their customers in such an unfair position.

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minded in their review of the Nofan, since it answers perfectly the needs of many an IT nerd and novice alike. Domestic life is not one-dimensional and rarely does one standard meet the needs of all. **David Cutler**

**PC Pro replies:** Thanks for getting in touch and giving us your perspective. As you say, plugging in a set of headphones only solves the problems of fan noise for the user, not anyone in the surrounding area, and we'd be interested to hear from other readers if that's also a reason why they have specified a silent PC. As we made clear in the Nofan's review, it "makes absolutely no noise whether it's switched on or switched off". In that respect, it's a triumph. However, when grading PCs in a Labs test, we need to consider more than just one element of their specification, and we felt that, when you lined up the Nofan's component list against some of its rivals, it was difficult to justify the price.

### The cons of a cashless society

Nicole Kobie's view of the future (see issue 302, p25) was glimpsed through the wrong kind of glasses: the rose-tinted ones that don't correct for short sightedness. As a result, she's described the appealing upside of a cashless society while ignoring two very unappealing downsides.

First, the chip in a piece of payment plastic only works if the machine with which it connects is working - which it may not be. It might be failure of the card reader, local electricity supply, the grid or data links. Worse, the more we depend on physical infrastructure, the more it becomes a target for the bad guys; from a ransomware attack to invasion. What degree of infrastructure failure is acceptable?

The retailer may have a sign saying "card only", but I bet they'd accept a

physical fiver for your lunch, rather than throw the food in the bin.

Second, if all your money is in a bank from which it can't be withdrawn (only moved to another bank), those institutions can charge you for the pleasure of looking after it. Currently, if you don't like the idea of paying interest on your credit balance you have the option of withdrawing all your money and placing the cash in your own secure storage.

Less cash is reasonable, no cash is unwise. **Alan Wheatley**

### What, where, who?

I found your article comparing what3words and AML (Advanced Mobile Location) very interesting (see issue 302, p16). I don't really know about AML works, but I assume it provides the same location that Google Maps tells me I'm in. However, I'm a great fan of w3w.

For instance, how does AML tell the emergency services that I'm not in the house next door, as Google Maps consistently positions me, and that my front door is round the other side of my building? With w3w and Google Maps in satellite view, I can correct the location that my phone offers. I can also use this if I am reporting an emergency from a location further away.

For non-emergency functions, how do I use AML to tell someone, without using coordinates, where to meet me, if neither of us is already there? **David Coull**

**PC Pro replies:** Thanks for your email, David. You raise some excellent points and you're quite right that what3words has some clear advantages, but in answer to your last question, AML isn't designed for domestic

**BELOW** The Quiet PC Nofan could prove a godsend in communal rooms



users but for the emergency services. The main essence of the article was that, while what3words is great at what it does, the built-in nature of AML (and the fact it didn't require users to install an app at a time of potentially great pressure) means that it should be the first port of call for UK emergency services, and right now that isn't always the case.

### Kicked out of orbit

Well, Paul you were right! I'm not an expert, but I was annoyed (see issue 302, p118). The model of the atom you describe - with a nice picture - is a little out of date. Well, actually 100 years out of date. It's the Bohr atomic model (1913), and while it does explain some of the atomic properties neatly, it completely ignores what we know about the electron; that it can behave as a wave or a particle, and in an atom is better treated as a wave. That is why we refer to the energy levels as orbitals, NOT orbits. **John Errington**

**PC Pro replies:** First, we'll leap to Paul's defence, as he didn't select the picture.

### “The retailer may have a sign saying ‘card only’, but I bet they’d accept a physical fiver for your lunch”

However, we would point out that Paul explained right at the start of his excellent piece about SSDs that he was going to simplify the physics. If Paul ever decides to explain quantum computing but insists on using Copernican heliocentrism as his basis, then we'll definitely stop him in his tracks.

### Correction

In issue 302 of *PC Pro* we published an article that included inaccurate statements about the website MoneySavingExpert, and its comparison tool Broadband Unbundled. On p43 of the article it said: "MoneySavingExpert even admitted to stealing exclusives from other sites!". Further to additional information provided by MoneySavingExpert, we accept this is untrue and we apologise for this statement. [MoneySavingExpert.com](https://www.moneysavingexpert.com) has clarified that when it becomes aware of an exclusive offer from another site that may help users save money, its editors get in contact with them and always ask for their permission before featuring it on their tool. See **broadband.moneysavingexpert.com** for full details. We would also like to clarify that MoneySavingExpert always selects deals based on what is best for users, and not on whether the site receives payment.

## Readers' poll

We asked you what you thought about Microsoft's decision to split up Cortana and Windows Search in the latest build of Windows 10. You said:

I preferred things how they used to be  
**0%**

Did it? I hadn't noticed  
**82%**

I know - great isn't it?  
**18%**

Awareness of the change wasn't great, but at least those who spotted what had happened were happy. It "works as I expect it to work," said one anonymous respondent who also wanted to see better antivirus and malware built into the OS. However, another anonymous voter said they "don't bother using it, unless it's to find programs in the Start menu". They would prefer better performance, "particularly around desktop graphics and the file system".

"Just bin it" said a third voter - again anonymous - who, when asked what other changes they would have made if they had been in charge of Windows 10 development, said they would have "made it Windows 7".

“With the growth of smart speakers, it's obvious all search will be voice-based one day” **PB**

“Windows Search is almost entirely passive - just press the Windows button and start typing. That's exactly what it should be like” **Pete**

“It's obvious why Microsoft invested so heavily in Bing now. It wasn't so much a Google killer as a plugin for a future (now present) version of Windows” **Amy Riches**

“It's only a matter of time before we're all working online the whole time and OS-level search will be irrelevant” **Mark Dale**

### Join the debate

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# Gifts for grown-ups 2019

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What do you buy the technical person in your life?  
Particularly if that's you. We ask our own techies, and  
*PC Pro* readers, what they want this Christmas

**CONTRIBUTORS** Tim Danton and Max Figgett





# HOME & OUTDOORS



## Asus RT-AX88U AX6000

PRICE £261 from [amazon.co.uk](https://www.amazon.co.uk)

There's only one problem with testing the latest technology: once the tests are complete, you have to send it back to the manufacturer. So have some sympathy for Darien Graham-Smith, who's reviewed all the latest Wi-Fi 6 (802.11ax) routers and has thus seen the future. "I want an 802.11ax router and adapters for all my devices," he said. "Having seen how great the technology is, I'm impatient to switch as soon as possible!"

When we pinned Darien down on which exact 802.11ax router he wanted, the Asus was his top pick. "It's not the fastest for last-gen devices, but 802.11ax performance is simply fantastic." Now to let him down gently that we're not actually going to buy it for him this Christmas. He'll get *PC Pro* socks like everyone else.

## Alexa Smart Oven

PRICE \$249 (US only)

As a keen cook and all-round foodie, it's no surprise that Monica Horridge – editor of our sister site [expertreviews.co.uk](https://www.expertreviews.co.uk) – has her eye on the just-announced Alexa Smart Oven. This is a four-in-one microwave, with the extra three functions being convection oven, food warmer and air fryer. "I don't know why I want one," admitted Monica, "but it's cool that it's an air fryer and I'm about to buy a convection oven so it would have been perfect timing... if it was out in the UK."

And there is the catch, because for now this oven is US only. So all of us in the UK, including Monica, will have to wait awhile until we can use the Alexa app to scan Whole Foods produce and then pop it into the oven, safe in the knowledge it will use just the right settings.

## Google Nest Hub Max

PRICE £219 from [store.google.com/uk](https://store.google.com/uk)

Google's chunky Nest Hub Max is at the top of reader Mike Webster's Christmas list – and we can see why, having awarded the impressive smart screen five stars in last month's review (see *issue 301*, p97). The Nest Hub Max is 3in larger than its Home Hub predecessor, with a 10in 1,280 x 800 display, and Google has beefed up the speaker, as well as adding a camera for facial recognition and Google Duo voice calls.

Think the screen is a gimmick? Think again. You can link the Hub Max to a Nest Hello doorbell to see if carol singers are knocking, pull up YouTube for a hands-free Brussels sprouts tutorial and connect it to a Google Photos account to show off family snaps. You can even control it via the Jedi-like Quick Gestures: put your hand in the stop position in front of the camera and the Nest Hub Max will pause your music. It means you won't have to shout over the thousandth rendition of *I Wish It Could Be Christmas Everyday*...



## Tesla Powerwall 2

PRICE Around £11,000 via local reseller

If you're a frequent reader of Paul Ockenden's Real World Computing column (see p113), you won't be surprised by his choice of gift. "I'd like a Tesla Powerwall 2," he said, without even a "please". His parents really should have told him that it's rude to ask for an £11,000 present – about £8,000 will go to Tesla, a further £2,000 to £3,000 to the local reseller – without the appropriate Ps and Qs.

While the price is undeniably steep, the benefits of this domestic battery are obvious once it's in place – providing you have your own solar panels to supply the energy, you'll hugely reduce your electricity bill and could even create a zero emissions home. So with all this money saved, you can imagine that Paul will have plenty of cash to splash on presents for his loved ones. What would he buy them? "Toys R Us vouchers."



## Fitbit Inspire HR

PRICE £90 from [fitbit.com](https://www.fitbit.com)

Can't quite stretch to £11,000 for the Tesla Powerwall 2? Well here's a cheaper way to keep loved ones warm for a much more attractive price: send them out running. You can buy the cheaper Inspire for £70, but we prefer the HR version with its 24/7 heart-rate monitor, accurate sleep tracking and 50m water resistance so it's safe to use in a pool.

In truth there are much cheaper trackers, but the Inspire HR still wins our vote thanks to the community of like-minded fitness freaks – there's nothing quite like a family leaderboard to motivate you – and Fitbit's proven customer service.

## BioLite CampStove 2

PRICE £130 from [amazon.co.uk](https://www.amazon.co.uk)

"I'd desperately love to have one of those camp stoves that also charge devices," wrote reader Harry Monmouth. Well, we've got good news for Harry in the form of the £130 BioLite CampStove 2. Despite looking like Wall-E's long-lost cousin, it's an invaluable tool for staying in contact when you're out in the wild.

Simply feed the BioLite CampStove 2 twigs you find around the campsite and, thanks to an internal fan, it will produce an almost smokeless flame that you can use to boil water or cook meals. A thermoelectric generator then converts the heat into 5V of electricity, which charges the battery. Plug your smartphone or other device into the BioLite CampStove 2 via a USB cable and you won't ever have to worry about running out of juice. An LED dashboard also means you can check the battery level and strength of the fire at a glance.



## iRobot Roomba 960

PRICE £577 from [amazon.co.uk](https://www.amazon.co.uk)

"This probably means I'm aging into someone sensible, but I really want a Roomba – one of the expensive ones that actually works," explained Nicole Kobie, PC Pro's Futures editor. "Never needing to vacuum ever again seems like the gift that keeps on giving."

1950s science fiction writers imagined a future stuffed with robot butlers, but we'll have to make do with vacuum cleaners for the time being. The hockey-puck Roomba 960 is an excellent example, using an infrared camera to map its surroundings and sensors to avoid a fatal plummet down the stairs.

It cleans the floor methodically and goes over particularly dirty areas multiple times before returning to its charging station for a well-earned nap. You can also block off no-go areas using a "virtual wall" and use the app to schedule cleaning times or rescue the Roomba if it gets stuck. A slight downside is a tiny 100ml or 200ml dust bin, which means you'll have to empty the Roomba 960 after every vacuum. Still, that's a small price to pay for not having to lift a finger.





# MUSIC & AUDIO



## Ruark MR1 Mk2

PRICE £329 from [johnlewis.com](http://johnlewis.com)

PC Pro's editor-in-chief Tim Danton thought he had expensive tastes when putting the Ruark MR1 Mk2 Bluetooth speaker on his Christmas wish list. "I tested them earlier this year and the sound they produce, especially considering their size, is just fantastic – a huge upgrade on any desktop speakers I've used before," he said. "I know that they're a luxury, and that frankly none of my friends or family is going to buy them for me, but you can dream, right?"

You can indeed. And you can also hook up a subwoofer for even more bass, add a battery pack to use them on the move, and control them from afar thanks to a bundled remote control (there's no built-in smarts, but you can add that easily enough via an Echo Dot). If only they weren't made to look so awfully downmarket by the B&W Formation Duo speakers chosen by Jonathan Bray.

## Sony WF-1000XM3

PRICE £219 from [johnlewis.com](http://johnlewis.com)

PC Pro's features editor Barry Collins has a problem. Earlier this year, he bought the over-the-ear Sony WH-1000XM3 headphones, which means he can benefit from Sony's astonishingly good active noise cancelling when he's commuting and travelling – or just needs to escape from the kids in his home office. "Having now been won over by the Sony cans," he explained, "I'd like a matching pair of Bluetooth buds for dog walking."

Having tried the WF-1000XM3s at this year's IFA trade show, we can understand Barry's wishes. It's an almost surreal experience to slot in a pair of earphones, activate noise cancelling and sweep almost all of the background hubbub away. Naturally for a piece of Sony kit, music sounds great, too. There's only one piece of bad news for Barry: we're not buying them for him as Jonathan Bray has used up all our budget.

## Qobuz Studio subscription

PRICE £250 per year from [qobuz.com](http://qobuz.com)

Let's just suspend our disbelief for a second and imagine that we go along with Jonathan Bray's wishes and buy him a pair of B&W Formation Duo speakers. He'll need a pretty decent audio source, and while those speakers do support Spotify Connect, that seems like a waste. Luckily, audiophile Jon Honeyball has the answer in the Rolls-Royce of music subscription services, Qobuz. So, what's the appeal? "A wide range of interesting music," kicked off Jon. "Support for high-def purchasable downloads at sensible prices. And no MQA nonsense." (We'll let you into a trade secret: Jon's actual word wasn't "nonsense".)

The promise of MQA is to deliver compressed music files with CD-quality audio, but as you can tell Jon isn't impressed. He just wants hi-fi quality streaming and doesn't care a jot for bandwidth: Qobuz's Hi-Fi and Studio tiers promise just that, albeit at £20 per month or £25 per month – discounted if you pre-buy for a year. You can get a "free trial", but it asks for your credit card details during registration so be careful...



## Vifa City

PRICE £125 from [vifa.dk](http://vifa.dk)

The biggest compliment we can pay the City is that you can close your eyes while listening to it and believe it's a full-blown speaker, not a tiny ice puck of a thing. Sure, it's a tad treble-heavy, but it offers truly incredible sound quality for its size: it isn't far off an Echo in terms of punch. If you travel often then the Vifa City will soon become an essential companion thanks to a battery that lasts for up to 12 hours, its ability to act as a speakerphone for conference calls, and a trifling weight of 320g.

## B&W Formation Duo

PRICE £3,500 from [johnlewis.com](http://johnlewis.com)

"How cheap." So we replied when Jonathan Bray, head of reviews at our sister site [expertreviews.co.uk](http://expertreviews.co.uk), declared what he wanted for Christmas. And would you believe that Jon ignored our implicit sarcasm and agreed? "They sound like a system that costs four times the price, so you're right. Relatively speaking."

Here's what you get for your miserly £3,500. A pair of Bluetooth stereo speakers, sure, but these are full-size speakers to sit either side of your desk. They feature an "innovative carbon dome tweeter" that "delivers a precise soundscape". Plus the same Continuum cone featured on B&W's 800 Series speakers. *What Hi-Fi?* was certainly impressed, giving the Formation Duo a five-star rating when it reviewed them earlier this year.





## Sega Saturn

PRICE Around £80 from [ebay.com](https://www.ebay.com)

Former *PC Pro* writer turned professional photographer Dave Stevenson clearly has a yearning to relive his childhood evenings. "Sega Saturn and whatever rats nest of cables I need to connect it to my TV please and thanks," he wrote on Twitter when we asked people for their Christmas wishlist.

So, Dave, why? "When I was a teenager I was DESPERATE for a Sega Saturn. I'd missed out on the Mega Drive and Sega did a brilliant job of trailing its 32-bit wonder-console in the gaming magazines I obsessively hoarded. When Sega Saturn-specific magazines started coming out I bought those too, despite not having the money to get the console itself. If Father Christmas could find a working model on eBay – perhaps with a copy of *Sega Rally* and *Virtua Fighter* thrown in – it would probably inspire me to stay on the nice list for the whole of 2020."



## Raspberry Pi 4 Model B

PRICE £34 from [thepihut.com](https://www.thepihut.com)

How could we write a Christmas gift guide and not mention the Raspberry Pi? This past year saw the release of the excellent Pi 4 Model B (see *Paul Ockenden's verdict on p113*), which brings the promise of working as a full desktop PC. Not bad for under £50. Michael Dear, who features regularly in our letters pages and the podcast, specifically requested a Pi 4 for Christmas this year, but when – like all good parents – we pushed him for a reason, he was coy. "Do you need a reason for another? Not sure what I would do with it... play probably." Go on then, Michael. But you'd better come downstairs when it's time for lunch.

## Amstrad CPC 464

PRICE Around £100 from [ebay.com](https://www.ebay.com)

"Would love to have an Amstrad CPC 464!" wrote Dan on Twitter, who still had fond memories of "Mode 0" making the text huge and "typing in code to play *London Bridge Is Falling Down*". And Dan is not alone. There are huge numbers of Brits (and Europeans, with the Amstrad also selling well in France and Germany) who remember the CPC fondly. And if you somehow lost yours in the past 35 years, we have excellent news: there are plenty of high-quality units on sale if you look hard enough. There's also a lively forum on Facebook where people occasionally post about games and accessories they're looking to sell, and even refurbished units – visit [pcpro.link/303cpc](https://www.pcprouk.com/303cpc) for details.



# RETRO & HOBBIES

## The C64

PRICE £110 from [amazon.co.uk](https://www.amazon.co.uk)

While you can shop around for original Commodore 64 computers – and, to be absolutely clear, that's what *PC Pro* reader Jeremy Verity asked for on Twitter – those of us with a retro bent but who also like the easy life may be tempted by the upcoming The C64. Unlike the C64 Mini (which sells for around £45), this replica console includes a working keyboard and full-size joystick.

The C64 goes on sale in December and has the huge benefit of connecting to your TV via HDMI, and naturally includes a plethora of original Commodore 64 games preloaded. Take your pick from *Impossible Mission*, *Paradroid* and *Winter Games*, to name but three. However, if, like Jeremy, you're a purist, then you should be able to find refurbished original models on eBay for around £100.





# PRACTICAL

## Tile Pro

PRICE £28 from [amazon.co.uk](http://amazon.co.uk)

"Have you seen my keys? They were right HERE!" you cry as you topple tables, tear apart the sofa and treat every family member with extreme suspicion. It's a problem that the simple Tile Pro instantly solves: attach it to your keyring and you'll never lose it again.

How? If your device is within the 300ft range, tap "Find" in the app and your Tile Pro will produce a loud and catchy ringtone until you're reunited with it. If it's not nearby, the app will show you when and where it was last detected so you can go on the hunt. And, if that doesn't work, you can mark your Tile as lost, which means you'll get a notification when anyone with the app walks near it. The sizable Tile community becomes your personal search party.

And it's not just for keys: you can buy accessories that turn your Tile Pro into a stick-on tracker for your laptop or even a luggage tag. Even better, Tile has ditched the environmentally unfriendly and expensive non-replaceable battery for a removable one.



## PWER Slim RFID blocking credit card holder

PRICE £11 from [amazon.co.uk](http://amazon.co.uk)

Dastardly criminals will stop at nothing to get your personal information – including "skimming" your data, stealing your identity or pinching your money by reading the cards in your pocket remotely via RFID (radio-frequency identification). Think of it as invisible pickpocketing.

Luckily, you can protect yourself by slotting a credit card, driving licence or ID card into PWER's holder, which makes use of dual-layer RFID blocking tech that stops cards operating at a frequency of 13.56MHz from being read. Best of all, PWER claims that it's 100% effective.

There's space for seven cards in the holder, as well as a separate pocket for banknotes and a PVC window for your work pass. And it's not a case of substance over style: the stitches give it a handcrafted look and there are attractive carbon fibre, light brown, dark brown or orange stitched options on offer.



## Anker wireless charger

PRICE £15 from [amazon.co.uk](http://amazon.co.uk)

If waiting for your smartphone to charge sets your teeth on edge, Anker is here to help. Its affordable wireless charger is compatible with all of the big Qi handsets, including iPhones (from the iPhone 8 onwards) and promises an uninterrupted 5W supply. However, if you're the owner of a recent Samsung Galaxy phone (such as the S9, S9+, S8 or S8+), you get a whopping 10W, meaning that a full charge will be 30 minutes faster than with a normal charger.

You don't even need to remove your case, as long as it's under 5mm thick and not made of metal, and a handy LED indicator gives you an indication of the charging status (solid blue means everything's working perfectly, flashing blue less so). Oh, and it will look good on your bedside table or desk.



## YubiKey 5 NFC

PRICE £41 from [amazon.co.uk](http://amazon.co.uk)

No guessing which *PC Pro* writer suggested this for a Christmas present. While he humbly wants an LG Z9 88in 8K OLED TV, a snip at £30,000, Davey Winder would give "YubiKeys for everyone". This makes a lot of sense, as Davey has been banging the two-factor authentication drum for quite some time and nothing does it better than a dedicated key that will lock down all your online accounts, and access to your PC, unless you slip this USB stick into the slot. "The question is less would they like them," said Davey, "and more would they use them? I suspect, mostly, the answer is probably not..."



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## GAMING

### Ring Fit Adventure

PRICE £70 from [game.co.uk](http://game.co.uk)

"I actually want that weird fitness ring for the Nintendo Switch," said Expert Reviews' Nathan Spendelow. "It's basically a flexible ring that you slot your controllers into. And your workout depends on what happens in the game. It's stupid, but I like the look of it. Probably the only way to get me to do exercise." At £70, it's probably cheaper long-term than the gym, too, suggested Nathan. "Especially where I live. Canary Wharf prices are absurd. One of the gyms is £150 a month."

Nintendo's *Ring Fit Adventure* involves players using "that weird fitness ring", also known as the Ring-Con controller, to battle an evil dragon called Dragaux in Adventure mode or play other minigames in a brightly coloured universe – all while getting a workout. Simply attach one Joy-Con to the ring and the other to a strap on your leg to get started.



### SCUF Prestige

PRICE £130 from [scufgaming.com](http://scufgaming.com)

Tom Bruce, also from *PC Pro's* sister site [expertreviews.co.uk](http://expertreviews.co.uk), has his eyes firmly set on the SCUF Prestige Xbox One controller. The price might have your wallet cowering in fear, but the Prestige is built for serious competitive gamers. The design backs that up: the top plate is made of soft, rubbery plastic and the grips are textured to make it more comfortable to use for up to 30 hours on a single charge – although we wouldn't recommend that, even in the endless "Twixmas" between Christmas and New Year's Eve.

The four paddles on the underside can be custom-mapped to the controls on the top side – ideal for when you don't have enough time to take your thumbs off of the sticks. It's also very customisable: you can opt for long-throw or domed sticks and remove the rumble packs for an extra fee, and two switches underneath the controller allow you to shorten the travel of the triggers to get a shot off more quickly.

### Nintendo Switch Lite

PRICE £198 from [amazon.co.uk](http://amazon.co.uk)

*PC Pro's* very own Kris Kringle, Tim Danton, asked Adam Shepherd, of our sister site [itpro.co.uk](http://itpro.co.uk), what he would like for Christmas. "The Switch Lite is pretty neat, I'd have one of those. I've already got a full-fat Switch, but I wouldn't mind one of the Lites..." But why would he want a second Switch? "Well, [my fiancée] Laura quite often asks me to leave it at home if she's got a day off, so it'd be handy to have a spare to take out and about. Plus the Lite looks much snazzier."

It's a wish that's likely to be shared by millions around the world, especially given the attractive price, new, longer-lasting battery life and ever-expanding library of Switch games. However, before you make the jump, bear in mind that the Lite is only for handheld play – you can't connect it to a screen – and the Joy-Cons are attached, meaning certain games that rely on IR, rumble and motion can't be played.



### Razer Blade 15

PRICE £2,880 from [razer.com](http://razer.com)

When we sent out the bat signal to the Expert Reviews team, asking them for their nominations for the perfect Christmas gift, laptops editor Tom Bruce and head of reviews Jonathan Bray replied with the exact same words: "A top-spec Razer Blade 15." (Although Jon got greedy and then asked for the £3,500 B&W speakers on p34.)

We wouldn't actually recommend the most expensive version of the Blade 15, which includes a 4K OLED touchscreen and adds £270 to the price, but let's see how this set of specs appeal: GeForce RTX 2080 Max-Q graphics, 240Hz Full HD screen, Core i7-9750H processor, 16GB of RAM and a 512GB PCIe SSD. We admit that the price is juicy at almost £3,000, but as we saw in our review of the Mercury White version (see issue 301, p52) this is a beautifully made gaming laptop. At that price, though, Jon and Tom will definitely need to play nice and share.





# SMASHING GREEN TECH MYTHS

**W**e're living in something of a post-truth age. Things are stated as fact, with little or no evidence to back them up. Claims about products and technologies are made without being challenged. And few areas are subject to the pulping of the truth more than so-called green technology.

Innovations, ideas and schemes arrive that are meant to make the planet greener. But when you start chipping away at the veneer of these claims or truisms, there's often little to back them up.

Here, I'm going to investigate five common claims about "green" technology to see if there is any truth behind them and whether you're doing any good for the environment by adhering to them - or whether you're simply being hoodwinked.

## Dark mode saves battery life

Dark mode is currently *de rigueur*. Android, iOS, Windows and macOS all now have their own dark modes, turning the background to menus and apps to a dark shade of charcoal.

## Environmentally friendly or snake oil? Barry Collins tackles five of the biggest green technology truisms

Dark mode reportedly has two plus points. The first is a health benefit: dark mode spares your eyes from the strain of looking at bright screen, reducing the so-called blue light that can keep you awake at night. That said, hard medical evidence that darker screens reduce eye strain or improve sleep is difficult to find.

The other benefit is that dimming the screen with dark backgrounds puts less strain on the device's battery, meaning your smartphone, tablet or laptop should last for longer between charges. While that may sound perfectly logical, it's not necessarily true.

Dark mode's ability to preserve battery life depends on the type of

screen your device uses. LCD screens light all their pixels from the edges, so it makes no difference in terms of battery life whether your phone is showing an all-white image or an all-black one.

Only on high-end devices with OLED screens could dark mode offer battery-saving benefits. OLED displays have each pixel lit individually, so if the image is jet black, the pixel will simply switch its backlight off. That's why the so-called always-on screens on devices such as Samsung Galaxy handsets have a black background - only a tiny proportion of the overall pixels need to be switched on to display the time and notifications, making a small dent in overall battery life.

While the display is one of the big drains on battery life, it's not the only factor. Background processing, the strength of your mobile signal and the various wireless radios all take their toll too, so it's unlikely that switching on dark mode is going to make a substantial difference to your battery life. It falls into the "every little helps" rather than "game changer" category.

## It's greener to run a laptop on batteries when fully charged

This one comes from the energy supplier, Octopus Energy. When I was browsing its website a little pop-up appeared: "Carbon emissions from electricity are currently high," it read. "Your battery is at 97%, so you might like to unplug for a few hours."

Once I'd got over the mild shock of websites being able to read the current state of my laptop's battery without any permission ever being granted (to the best of my knowledge, at least), it got me thinking. Is it really more eco-friendly to run the laptop on battery power until it needs a charge, much like a phone?

First, let's consider how much energy a laptop would chomp through. In my case, it's a three-year-old Lenovo ThinkPad Yoga X1 first generation, which consumes between 20W to 35W when in use, according to the readings from my TP-Link smart plug. That's about 0.2kWh of electricity over the course of an eight-hour working day (excluding any peripherals plugged in).

In other words, the laptop isn't a massive energy sump. If I stuck my 1,800W dishwasher on for an hour, it would consume almost ten times the energy of running my laptop all day.

Still, if we're going to stop Birmingham becoming a seaside town in the next few years, every little helps. So, what are the energy pros and cons of unplugging the laptop and letting it cruise on battery power for a few hours?

The laptop is obviously sucking nothing out of the grid when it's unplugged, but it's not going to be as efficient on battery power as it is when chained to the mains. Windows and Mac laptops will automatically drop into a power-saving mode when the cord is pulled, which chokes processor performance and dims the screen to maintain battery life. The performance dip probably won't make a tangible difference if you're word processing or browsing the web, but it's going to slow things down if you're doing heavy lifting: Photoshop work, video editing and so on. If your Windows laptop dips below 20%, it will enter Battery Saving mode, where background app activity and notifications are limited.

You can override the automatic power saving and plough on at full pelt, but that will obviously crimp your battery life, maybe giving you only an hour or two off the mains, instead of three or four. Either way,



If I stick my dishwasher on for an hour, it consumes almost ten times the energy of running my laptop all day



### Stocks 4 October

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### Top Stories



**BP lifer Bernard Looney named new CEO as Bob Dudley retires**

Looney joined BP as a drilling engineer in 1991 and has worked his way up to lead the company's upstream business.

**Bloomberg**

**Boris Johnson Gets One Week to Improve His Brexit Offer or Face Delay**

**UK business morale slides, especially in manufacturing: BCC**

**John Lewis seeks discounts from some landlords**

**BUSINESS INSIDER**

**6 international airports that are an extremely long way from the city they ar...**



regularly unplugging the laptop and running on batteries – even when you have mains available – is going to increase the number of charge cycles you put the battery through.

Most laptop batteries are designed to last for around 400 to 500 charge cycles. As mine is plugged into the mains most of the time, my three-year-old battery has only been through 167 charge cycles at the time of writing, but if I was following Octopus' advice and unplugging when fully charged, the battery would by now need replacing. That means more raw materials, such as the lithium the battery is made from, as well as the environmental costs of manufacture, shipping and the repair

**TOP** The energy footprint of cloud gaming is often higher than laptops, consoles – and even PCs

**ABOVE** Dark mode may help to save battery life, but only if your device has an OLED display

itself (it's a sealed unit laptop, so I couldn't replace the battery myself).

It's even dubious if there's any energy saving to be made by unplugging the laptop for a few hours in the first place, because when you plug it back in and the battery needs charging, the power drain shoots up to around 45W – around double the energy that it was using when merely plugged into the mains. If it takes a couple of hours to fully recharge the laptop, that's going to be, at best, a negligible power saving.

To be fair, Octopus' message was arguably aimed at reducing energy consumption at peak times, when there's not enough renewable energy to satisfy the grid. Still, unplugging



your laptop for a few hours when there's a socket available doesn't seem a smart environmental move.

## Cloud desktops use less energy than client PCs

There is a growing shift towards desktop as a service (DaaS). Microsoft recently launched Windows Virtual Desktop for enterprise customers, joining long-established firms such as IBM and VMware with DaaS services. Meanwhile, in the gaming world, Shadow hosts virtual Windows desktops from its data centres in France, replicating the performance of a dedicated gaming PC on any Windows, Mac or mobile device. Google is launching Stadia and Microsoft is pushing ahead with Project xCloud to let you stream Xbox games over the internet.

The idea behind all of these services is that you don't need to buy powerful new client hardware to sit in your home or office. Simply stream the content from the data centre to pretty much any internet-connected device in the home. That's got to be good for the environment too, right? No need to build and ship expensive, power-hungry PCs and consoles to people any more. Just use low-powered client devices and let the more efficient data centres take the brunt. Well, it's not quite as clear cut as you might think.

A study published last year into "Green Gaming" by researchers from the Lawrence Berkeley National Laboratory found that the overall energy footprint of cloud gaming services was often higher than consoles, laptops

and even desktop PCs. "Media streaming devices are by far the least energy intensive gaming technology locally," the researchers found, "although when running cloud-based gaming services a far larger workload manifests in data centres and intervening networks."

"We have estimated that a 10W local media streaming device can entail an additional 520W of power (more than most local PCs) in the upstream network together with the data centre hosting the servers performing the graphics processing."

All told, cloud gaming "adds approximately 40 to 60% to the otherwise total local annual electricity use for desktops, 120 to 300% for laptops, 30 to 200% for consoles, and 130 to 260% for media streaming devices". So while your personal energy consumption might drop if

you use a cloud desktop, the overall energy impact could be much greater.

That's potentially bad news for the environment, because cloud gaming in particular is expected to grow hugely in popularity over the next decade, as ultrafast broadband connections become more common and consumers grow ever-more accustomed to the model of buying hardware on subscription.

"Gaming already represents one-fifth of the total miscellaneous residential energy use, and is expected to rise significantly due to the overall growth and the shift to both higher-end PC gaming and cloud gaming," Gary Cook, a spokesperson for Greenpeace told *PC Pro*.

"While some of this additional energy demand could be transitioned to renewable energy if the data centre is in a location/run by a company who is buying renewable energy to

However, those vast data centres also need feeding with new servers, graphics chips, cooling equipment and so forth. As the interest in cloud gaming and DaaS expands, so will those data centres.

The fact that Microsoft, VMware, Shadow and IBM all failed to respond to our questions about the environmental impact of their cloud services should at least give consumers pause for thought.

## Electronics retailers must take back old kit for recycling

It's been a while since we've written about the WEEE regs in *PC Pro*, but one common misperception about the WEEE Directive is that electronics producers and retailers have a duty to take back and recycle your old equipment. They don't, at least not directly. And despite the WEEE



## A 10W streaming device can entail an additional 520W of power in the upstream network

power their data centre, the growth in energy demand associated with cloud gaming regardless of the hardware is an indication that much greater attention to the environmental footprint of the gaming sector is needed going forward."

Energy consumption is, of course, only one part of the overall environmental impact of a piece of technology. As Greenpeace's own *Guide to Greener Electronics* states: "Upwards of 70 to 80% of the carbon footprint during the lifespan of personal computing devices occurs during manufacturing". If, therefore, fewer gaming PCs, laptops and consoles are being manufactured and shipped thousands of miles around the world because consumers are running cloud services on existing equipment, that's an unquestionable environmental benefit.

**ABOVE** If I followed Octopus Energy's advice to unplug, my battery would need to be replaced...

**ABOVE RIGHT** ...and recharging a laptop drains more power than when it's simply plugged into the mains

Directive being in place for more than a decade now, the recycling of electrical waste is still falling well short of targets.

Electronics producers and retailers who put more than five tons of electrical goods on the market each year must join a producer compliance scheme (PCS). As the Department for Environment, Food & Rural Affairs (Defra) website explains: "The PCS takes on your obligations to finance the collection, treatment, recovery and environmentally sound disposal of household WEEE collected in the UK". In other words, retailers pay the recycling firms and they take care of business. At least, in theory.

Let's take Amazon, for example. At the time of writing, Amazon's WEEE recycling page stated that it has decided to fulfil its recycling obligations by joining a government-approved takeback scheme operated by a company called Valpak. "As part of this scheme we ask that you take your old piece of equipment to a designated collection facility (DCF) run by Valpak in your area".

That's actually a little misleading. Amazon customers don't have to go to Valpak-run facilities – they can drop

off their unwanted electrical goods at any of 1,100 collection points run by local authorities across the country. "For clarification, Valpak itself does not run any DCFs [designated collection facilities] and we have brought this to the attention of Amazon to change their wording on this point," said Duncan Simpson, director of Scottish business development and relations at Valpak.

Who pays for the electric waste at these public sites to be recycled? The companies do, based on how much electrical equipment they sell into the market each year. Initially, the majority of producer compliance schemes ganged together to organise collections and share the costs of collecting electrical waste from remote sites, but some of the compliance schemes refused to join. Now that's been made mandatory by the government, so there should no longer be some hard-to-reach local authority sites sitting on piles of electrical equipment that nobody wants to collect.

That might help the government reach its WEEE recycling targets, because it's not done a great job of hitting targets so far. In 2018, the UK collected just shy of 493,000 tons of household WEEE – only 91.7% of the target. The target was missed by 100,000 tons in 2017. The target for this year has been increased to 550,577 tons, so that the UK can meet European targets, although there seems to be precious little extra money going into WEEE recycling and widespread reports of online retailers dodging their obligation to join compliance schemes.

Valpak's Duncan Simpson told us the UK's entire WEEE system is up for review in 2020, in which he expects the government to put a greater emphasis on reminding us to send our electrical waste to collection points and not leave it to rot in cupboards, garages or landfill. If and when the UK leaves the EU, however, the entire scheme could be called into question.

### You need to leave a computer on to access it remotely

If you're one of those people who is constantly remote desktoping (yes, we're using it as a verb, live with it) into the office to get files to work on at home, you'll probably leave that office PC running – after all, it's not you paying the electricity bills. Even if you are paying the bills, you might leave a



In 2018, the UK collected just shy of 493,000 tons of household WEEE – only 91.7% of the target

**TOP** There are now alternatives to leaving your work PC running around the clock

**ABOVE** Does your supplier really have a responsibility to take back your old equipment?

computer running at home so you can access it at work. But neither of these options are helping to prevent glaciers turning to mush. Is having to leave a PC running to access it remotely another myth we can bust?

Well, sort of. There's no doubt wake-on-LAN has improved, but it's not as simple as you might like. It needs to be enabled in BIOS, assuming the system even supports it in the first place, and even then there's a fair few hurdles to overcome before you can fire up your work PC from home.

First, if your PC is not connected to the network via an Ethernet port, you will need to go into the Windows Device Manager, find your wireless network card, click Properties and check if it has the option to Wake on Magic Packet. That feature is a lot less exciting than it sounds – it's simply a means for the wireless card to listen

out for a broadcast packet on a certain IP address to tell it to rouse from sleep.

Even if your card does support this feature, there are all sorts of firewall, port forwarding and other challenges that must be overcome. You will certainly want to engage the support of your in-house IT team if you're planning to remotely access an office PC, and you may well need to do some router configuration at home if you're planning to wake a PC there.

The question today is whether remote desktoping is the right way to crack this particular nut. Cloud storage services such as Dropbox, Google Drive and OneDrive are much easier ways of moving/sharing files between work and off-site devices, although they potentially come with the same energy-consumption caveats as the cloud gaming services.

If you're trying to access files from home, a NAS drive – which is likely to consume much less energy (typically around 30W) when on than a desktop PC – is more environmentally friendly and easier to manage than that remote desktop/wake-on-LAN.

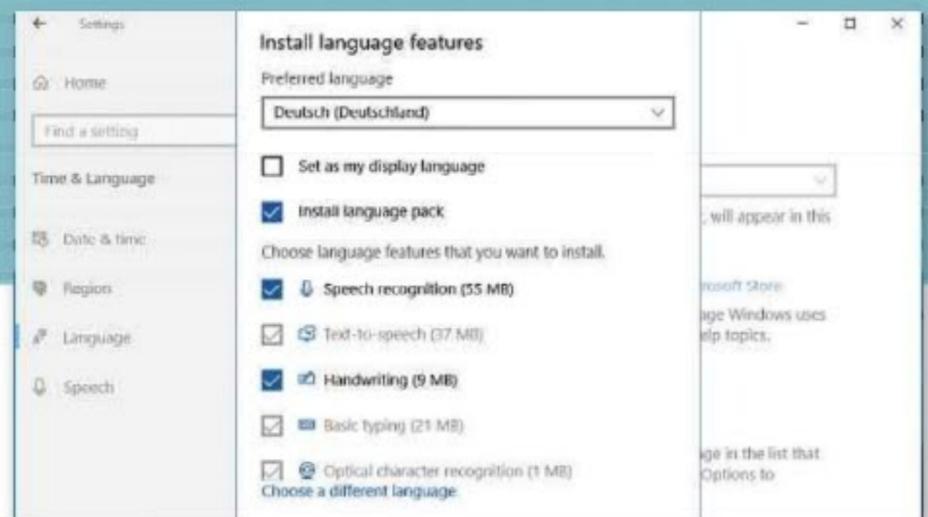
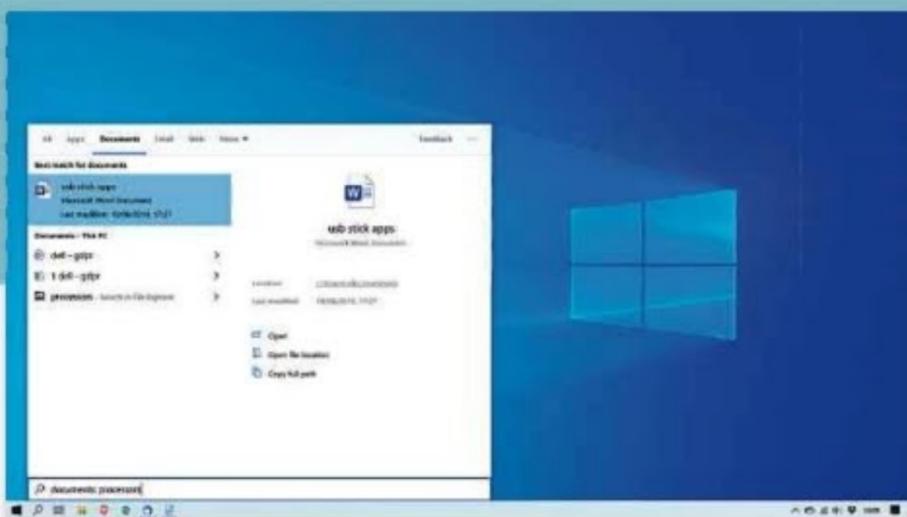
Leaving a computer running around the clock may be convenient, but it's not really necessary now. ●



# NEVER LOSE A FILE AGAIN

## How to become a search wizard

Fed up of trawling for documents you know you saved somewhere? **Nik Rawlinson** comes to the rescue



**S**earching in Windows is a bit of a mess. To be fair, though, it's less messy than it used to be: until earlier this year, the Start menu's search functionality was mixed into the Cortana voice assistant. The May 2019 Update split Cortana and search into separate functions, which made things clearer, and means those who prefer not to use Cortana can disable her entirely without forfeiting search capabilities.

Improvements have been a long time coming, though. As far back as 1991, Microsoft was working on a smarter file system that would extensively index both the metadata and content of every file, making it quick and easy for users to find whatever they wanted with just a few keystrokes. By the early 2000s, this idea had evolved into a project called WinFS (short for "Windows Future Storage"). This was to have been part of Longhorn, the nascent operating system that became Vista – but, sadly, WinFS never saw the light of day.

Its abandonment may have had something to do with Apple. In 2004, several of the Longhorn team attended the Apple Worldwide Developers Conference, where Steve Jobs unveiled Mac OS X 10.4 Tiger, featuring Spotlight – a fast, system-wide search tool that seemed to do everything WinFS was designed for. Internal emails, later released, reveal how the Longhorn team felt about what they'd seen: "I did system-wide queries against docs, contacts, apps, photos, music, and my Microsoft email on a Mac," admitted Microsoft developer Lenn Pryor: "It was **■**ing amazing. It is like I just got a free pass to Longhorn land today."

Jim Alchin, who headed up Vista development, agreed: "It's hard to take. I don't believe we will have search this fast."

The good news is that, while WinFS may be defunct, Microsoft hasn't given up on search performance, and today you don't need a Mac to enjoy lightning-fast, system-wide searches. You just need to know how to effectively harness

**ABOVE LEFT** The tabs at the top of Windows' search results let you filter content

**ABOVE** Windows Search can index content in multiple languages

the search capabilities built into Windows 10.

### Search basics

The simplest way to search is just to hit the Windows key, or click in the taskbar field that helpfully says "Type here to search". This interface is designed primarily for launching apps, and as you start to type you'll see links to installed applications appear at the top of the list. However, files of other types will be listed below these results – and if you're running the latest version of Windows 10, you can click on the links along the top of the pane to focus on documents, settings, web results and other types of content. You can also type into the search field at the top-right of any File Explorer window to search for files and folders in the current location and all subdirectories.

To come up with its results, Windows doesn't just match documents by filename. It also tries to index the content of files, emails and so forth to help it return the most relevant hits. By default, however, it

# ERROR

## file not found

### WINDOWS SEARCH FILTERS

When searching from a File Explorer window, you can narrow down your search by including what Microsoft calls “Advanced Query Syntax” keywords. Type one of these, followed by a colon, and a dropdown menu will appear showing available filter options, which you can pick from – or simply carry on typing to specify whatever parameters you want. Here are some examples of how you might use them:

#### kind:docs

Other valid file types include “music”, “pics”, “spreadsheets” and “programs”.

#### size:>500MB

You can use the “..” operator to mean “between”, as in “size:10MB..100MB”.

#### date:June

The greater-than and less-than symbols mean “since” and “before”, so “date:>2018” will return all files modified since the start of last year.

You’ll find a complete rundown of the (extensive) syntax options at [pcpro.link/303aqs](https://pcpro.link/303aqs).

does this only in English: if you have been sent a large number of French or German files, you’ll need to install the appropriate language packs to have them indexed.

To add new language packs to your PC, open the Settings app and click “Time & Language”, followed by “Language”. Click “+ Add a preferred language”, then select the language you require and click “Next”. Make sure “Install language pack” is ticked – but not “Set as my display language”, unless you want to completely change the system interface – and click “Install”.

Working in multiple languages raises an issue that we anglophones don’t usually have to worry about, and that’s how to deal with accented characters. Windows comes configured to ignore diacritical marks, but, for example, in French the words *cote*, *coté*, *côte* and *côté* all have distinctive meanings and, depending on context, you may want to distinguish between them. To enable this feature, open the Settings app again and click “Search”, followed by “Searching Windows”; then click “Advanced Search Indexer Settings” at the bottom of the main panel. Click “Advanced” to open another dialog box, and in this tick “Treat similar words with diacritics as different words”.

### Modify your search parameters

Effective system searching relies on a thoroughly indexed PC. However, such an index takes time to build and takes up disk space. Your search index will normally be stored at C:\ProgramData\Microsoft\Search; inside that folder you’ll find a Data folder. You may not have access rights to this folder, but if you’re logged on as an administrator you can get in by simply double-clicking and clicking the “Continue” button. You can then right-click and open the Properties window to see how much space your index is taking up. Microsoft claims that the search index will normally take up around 10% of the space of the files it catalogues.

This raises a question, though: which files are catalogued? Not everyone needs every byte of data indexed, and by default Windows 10 implements what’s known as Classic search, which scans only your Desktop and personal libraries (Documents, Pictures, Music and so on). For most users this will be fine, but it means that if you routinely store documents in a custom location they might not appear in the results.

To extend the index to cover your whole drive, open the Settings app, go to “Search” and again click “Searching Windows” in the sidebar.

Click the radio button beside “Enhanced” and Windows will start cataloguing all available locations.

Bear in mind that a bigger index will take up more disk space and, if you’re on a laptop, keeping it up to date will eat up more battery life: for this reason, the initial indexing process won’t start until you’re connected to the mains.

A complete index of your hard drive will also include thousands of files you’re very unlikely to be searching for, such as system configuration files – which could actually make it harder to find what you’re looking for. For this reason, Windows offers a search exclusion list, which is prepopulated with various system folders. You can add other folders you want to ignore to this list, and remove items from the exclusion list by selecting a folder and clicking the “Remove excluded folder” button that appears.

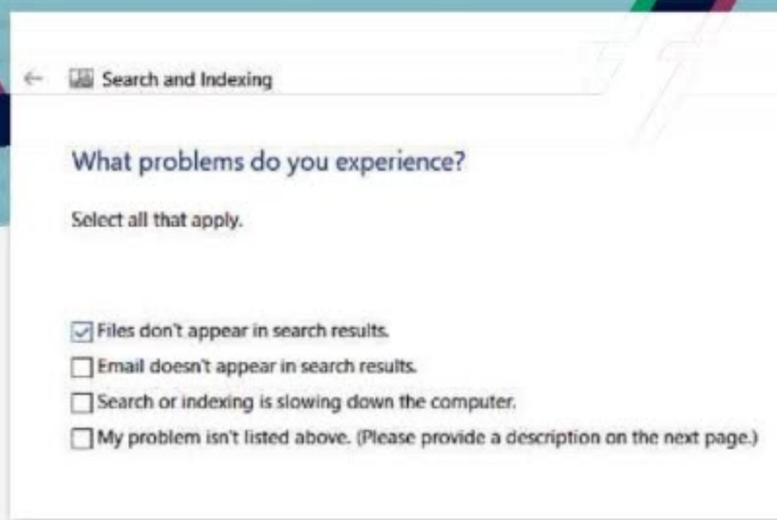
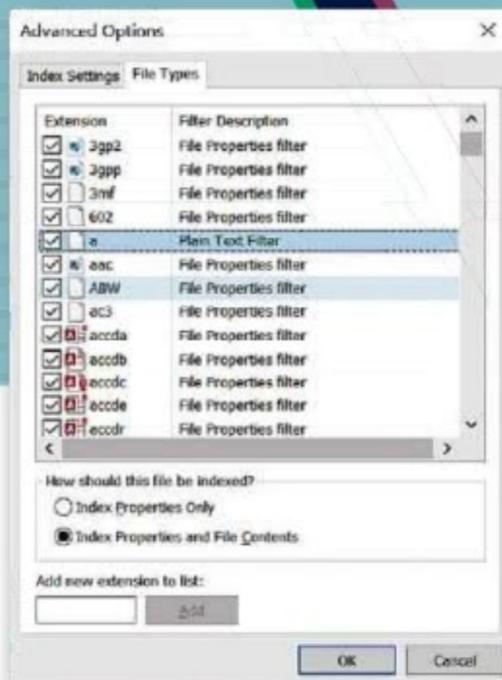
### Digging deep

Even with exclusions, a full-system search is normally overkill; you’ll



# ERROR

## file not found



often just want to add a few specific locations to the standard search folders. You can do so directly from the “Searching Windows” Settings page by clicking the “Customise search locations here” link that’s tucked away under the Classic search option. This will open a new window showing available locations: click “Modify” to open the Indexed Locations window, then navigate through the directory tree and add a tick beside any folders that you want to add to the catalogue.

Here’s where you can also set up how Windows catalogues different types of file. When you install a new application, its file types are registered with Windows, and the operating system normally does a good job of identifying which sorts of file are human-readable and fully indexing their content, while storing only the name and metadata for pure binary files. However, if you’re routinely searching for file contents and turning up a blank, you can easily

check whether Windows is only indexing files of that type by name.

To do this, go back to the “Indexing Options” window, click Advanced and click the File Types tab to view a very long list of recognised file extensions. Scroll down and click on the file type you’re interested in, then check the radio buttons below the list: if “Index Properties Only” is selected then a click is all it takes to switch it to “Index Properties and File Contents”. If the file type doesn’t appear on the list at all, you can use the “Add new extension to list” box to add it.

These actions won’t fix your problem immediately, though: it may take hours or even days for Windows to revisit your files and fully index their contents. If, after this, it still fails to recognise the contents of your files, your next stop should be the Search troubleshooter, which checks for incorrect permissions and other problems that may prevent some content being included in the index. You will find the link towards the

**ABOVE LEFT** You can tweak exactly which file types are indexed

**ABOVE** The built-in troubleshooter fixes common search problems

**ABOVE RIGHT** You can disable Windows’ indexing service and use another search tool

bottom of the “Searching Windows” Settings page, and to help narrow down its focus you can specify whether the issue is with missing files, missing emails or slow performance.

If even the troubleshooter can’t solve your problem, there’s always the nuclear option – rebuilding the index from scratch. You’ll find this tool by opening the “Indexing Options” window again and clicking the “Advanced” button to open the Advanced Options dialog. On the first pane, you’ll see a button labelled “Delete and rebuild index”. This is a slow, intensive process, so you might want to leave it running overnight.

### Finding remote content

Not all of the content you want to index will reside on your PC. Some of it might sit on Microsoft’s OneDrive servers, or in a webmail account. You can easily ensure that these locations are included in the index as well. First, in the Settings app, click “Search”, followed by “Permissions & History”,

## SEARCH ALTERNATIVES

Configured correctly, Windows Search can be a powerful tool, but it's not your only option: there are several third-party alternatives to choose from.

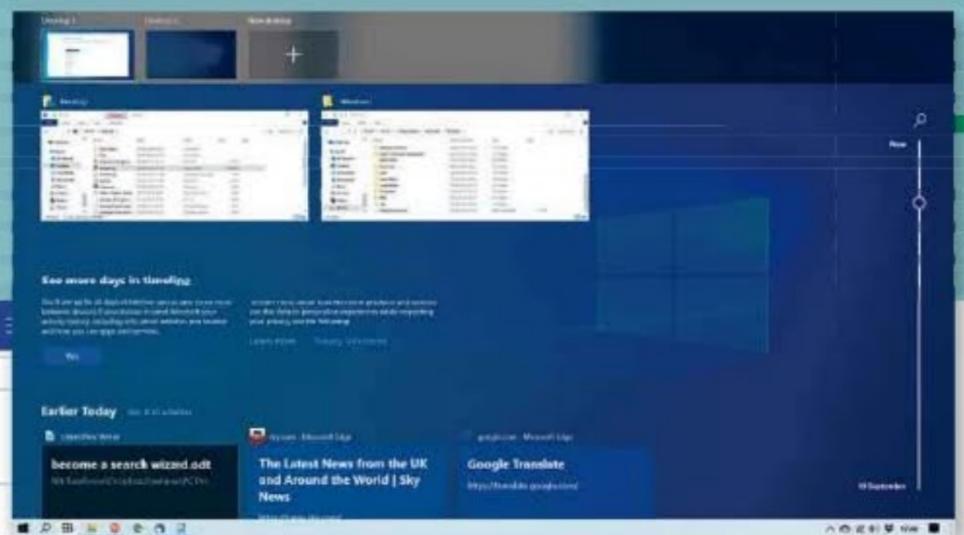
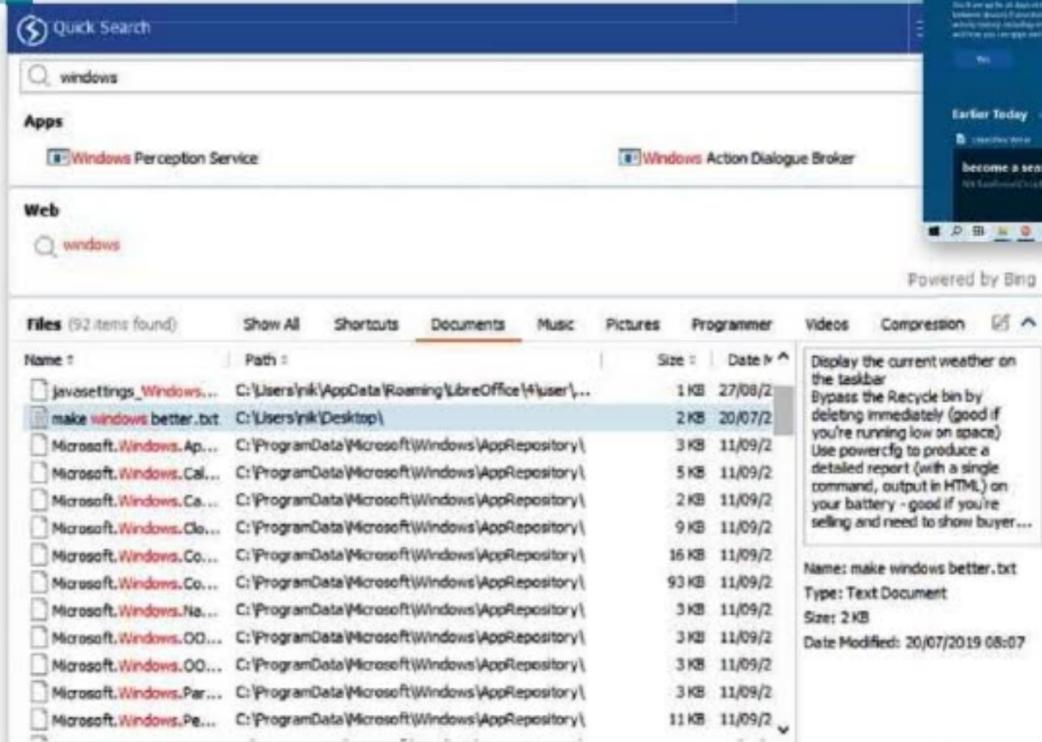
Everything ([voidtools.com](https://voidtools.com)) is free, lightweight and very fast: it indexed almost 400,000 items in a couple of seconds on our test PC and delivered live results instantly, narrowing down the list of matches in real-time as we continued to type. You can search inside files by preceding your search string with "content:" – so, for example, you might type "content: processors" – but file contents aren't indexed, so this is considerably slower than merely searching by name.

Quick Search ([glarysoft.com](https://glarysoft.com)) is free, fast, and better looking than Everything. Again, it offers live searching, and features tabs that you can use to narrow down your results to documents, music and so on. There's also a preview pane to the right of the results so you can easily browse your search results to find the file you're after. Its major shortcoming is that it doesn't offer in-document searching, delivering results solely on the basis of filenames.

Copernic Desktop Search ([copernic.com](https://copernic.com)) is a real heavyweight when it comes to local search. Its Desktop Search tool is free for home users, but it's restricted to 10,000 files and won't search for Office files, nor index the contents of other document types. Paid subscriptions with more features start at \$15 a year and deliver extremely fine-grained results, covering contacts, appointments and internet history alongside the usual documents, emails and photos. You can filter results by date and, if you use several browsers side by side, you can target just one when performing an internet history search.

## FINDING RECENT FILES AND SITES

If typing is a drag – or if you can't remember the name of the file you're looking for – you can quickly reopen recent files and websites using Windows 10's Timeline view: it can be accessed by swiping up with three fingers on a trackpad, clicking the icon on the taskbar (it looks like a film strip), or by simply pressing Windows+Tab. The Timeline gives an instant overview of your active desktops, open applications, recently used documents and recently visited sites – and if you're happy to upload your usage history to Microsoft, you can extend the results to cover the previous 30 days. While not strictly a search tool, the Timeline provides a quick, visual way to find recently used items without having to trawl through the file system.



**ABOVE** The Timeline lets you quickly skip back to recent documents and websites

**LEFT** Quick Search is an attractive alternative to native search

and check that the switches for "Microsoft account" and "Work or School account" are both on (blue) in the Search Permissions & History dialog (open Settings and click Search, followed by "Permissions & History").

Then, if you haven't already, you will need to connect the accounts you wish to be searched to Windows 10. You can do this from the "Email & accounts" page in the Settings app; a good range of providers is supported, including Google, iCloud, [Outlook.com](https://www.outlook.com) and Yahoo, as well as POP and IMAP email servers.

Back at the Permissions & History page, you can also control how strict Windows is about filtering adult content in Bing-driven search results. Moderate filtering is enabled by default, which doesn't censor language but aims to strip out potentially offensive videos and images. The other settings – "Strict" and "Off" – speak for themselves.

## Disabling indexing

What if you want to disable Windows Search altogether? This isn't necessarily as silly as it sounds: if

you're using a third-party search tool (see "Search alternatives" above), there's no point having Windows waste time and energy maintaining its own index. Searching in real-time also means there's no risk of files being missed out of your results because they haven't yet been catalogued.

Remember, though, the whole point of the index is to speed things up. If you're using a mechanical hard drive, disabling indexing is likely to make search operations extremely slow and laborious. However, if you're running from a fast SSD then performance may be acceptable, especially if you can narrow down the locations you want to search within.

To disable indexing, you'll need to open the Services console (just search for it in the Start menu). Scroll down through the list to find the Windows Search service, then double-click to open its properties and change the Startup type to "Disabled": this stops the service restarting when you next reboot Windows. Now click the Stop button below to turn off the indexer and click OK to finish. ●

# Reviews



The biggest, best, most exciting products in tech – tested, evaluated and reviewed

## Cosmo

Still a niche product, but this second attempt to resurrect the Psion Series 5 could conceivably replace your laptop and your phone

# Communicator



SCORE ★★★★★

PRICE £666 (£799 inc VAT)  
from [store.planetcom.co.uk](http://store.planetcom.co.uk)

The Cosmo Communicator is a curious thing. In an age of sleek smartphones and excellent Swype-style software you may wonder what the point of it is at all. Well, keep your snorts of derision at bay for the moment. Yes, this is a device with niche appeal, but it's also strangely brilliant. If it matches your needs, it could replace your phone, your laptop and your tablet when you're travelling.

Sceptical? You're right to be and, as you'll see in this review, the Cosmo Communicator has many niggles.

But there's also much to celebrate in this UK-designed machine.

### History lesson

The Cosmo Communicator isn't the first of its kind. This is actually the successor to the Gemini PDA (see issue 285, p58), which I reviewed back in April 2018. The Gemini borrowed heavily from the Psion 5 series of PDAs, right down to the original designer Martin Riddiford helping Planet Computers (the makers of the Cosmo and Gemini) recreate that original, brilliant keyboard.

While the Gemini PDA wasn't designed to replace your phone, however, the Cosmo Communicator is. This time there's a secondary OLED screen on the front, a fingerprint

**ABOVE** The keyboard still doesn't quite reach Psion levels, but it's much improved

**"Keep your snorts of derision at bay for the moment. Yes, this is a device with niche appeal, but it's also strangely brilliant"**

reader and a 24-megapixel camera. The keyboard now benefits from an adjustable backlight, too.

The most important change is the front panel. This operates separately from the main Android system – it

even has its own processor – but hooks into the OS so that you don't need to, for example, dismiss a notification twice.

On the whole, Planet Computers' technicians

have done an excellent job of providing all the functions you need access to on such a tiny panel. It's detailed enough to make the first few lines of emails readable, for instance, so you can take the decision whether

to reply or not without opening up the device. If you do press Reply, when you open the Cosmo the email client will be sitting there waiting for you.

Once you get used to the activation buttons – “OK” sits to the left of the fingerprint reader, “Back” to the right – it becomes intuitive to navigate the menu system, too. You even get colour coding to assist. For example, if a call comes through then a green LED lights up next to the OK button and a red one appears on the Back button. Press green and you can start talking.

The screen provides notifications too. There’s signal strength for Wi-Fi and your phone network, date and time, a battery indicator and icons to show if a message has come through, whether that’s Twitter, text or email. Click on the icon to read what it has to say. In essence, it acts as a triage service, so you can make a decision on whether or not to respond.

You can make a call direct from the front screen, too. If you’re precise enough with your fingers, you can manually plug in the number, but it’s easier to go through your recent call history or address book, both of which are a button press away.

Inevitably, there are a couple of annoyances. The first is that it’s so easy to accidentally activate something when you’re putting the Cosmo into your pocket: I once slipped it into Flight mode without realising. I soon trained myself to press the silver on/smart button before shoving it in my pocket, as that switches the front screen off.

The mini screen’s processor is also too slow to do anything demanding. For instance, in theory you can use it to frame shots using the 24-megapixel camera. However, it lags behind by about a second, reminding me of the early generations of digital cameras with passive matrix screens.

The final annoyance, and I’m hoping this is an early bug that can be squished, is that the phone app sometimes sends the audio to the wrong earpiece (it works in both orientations), so you end up hurriedly turning it the other way round to hear what people are saying. Note that you can only adjust volume by pressing the keyboard shortcuts, too. Those irritations aside, making calls is absolutely fine on the Cosmo. You just look a bit of a 1980s doofus putting something so bulky against your ear.

### ■ Talking of bulk

Which brings us to the topic of size, and there’s no hiding from the fact that the Cosmo is bulky. In fact,



there’s not much chance of hiding it at all: whether you put it into a trouser or jacket pocket, you and your companions will notice its presence. That’s inevitable with something that is both twice the depth and weight of a normal phone.

Physically, the chassis is almost identical to the Gemini PDA. Planet Computers has tweaked the hinge to improve its reliability and stability, while it’s now much easier to add a SIM. Whereas previously you needed to remove part of the top lid via a supplied tool, now it uses an ejectable SIM drawer. You can use this to add a second SIM or a microSD card, and note that the Cosmo supports eSIMs, too. World travellers will also appreciate that it supports all the US bands, unlike the Gemini.

There are two USB-C slots, one on either side. You can use the left one to charge it quickly, for attaching a single peripheral, adding Ethernet, or hooking up a USB-C hub (Planet recommends its own for £45). The right port can be for outputting to HDMI via a converter, or for attaching a peripheral.

That’s an incredibly versatile set of ports for a phone – and yes, there’s a 3.5mm audio jack too but the Cosmo has the capability to operate as a full-blown PC thanks to its support for Debian Linux. Having said that, the installation process involves jumping many hurdles and some original Gemini buyers have been disappointed by the lack of updates and support for its Debian implementation. This is an area where the relatively small installed base of the Gemini/Cosmo becomes evident.

### ■ That keyboard

I was critical of the original Gemini PDA’s mechanical keyboard. It wasn’t simply that it lacked the tactile feel of the original on the Series 5, but that it suffered from frustrating problems

**ABOVE** The Cosmo is equipped with its own email app, Airmail, and the Agenda planner, which will appeal to Psion devotees

**“That’s an incredibly versatile set of ports for a phone, but the Cosmo has the capability to operate as a full-blown PC”**



**ABOVE** A SIM drawer lets you add a microSD card or a second SIM

that slowed down my typing and caused errors. While the Cosmo still hasn’t reached the insanely brilliant heights of the Psion, I’m pleased to say that it’s a big improvement.

The biggest jump forward in quality is the responsiveness of the spacebar. Previously, you had to hit it precisely right to avoid either the dreaded double space or the yet more annoying not-being-recognised-at-all. Nothing stops the flow of words quite like needing to correct mistakes every five seconds. Inevitably, you won’t hit the same typing speed as on a full-size keyboard, but it’s possible to reach high, error-free rates.

At this point, you may be questioning the point of a physical keyboard. As I said right at the top, it isn’t for everyone, but there’s a reason why almost 4,000 people backed the Cosmo on Indiegogo (and why over 10,000 Gemini PDAs have been shipped to date). There’s an active Gemini community in a Facebook group, so I asked members why they preferred a physical keyboard. There were common themes: hating onscreen keyboards, having a full screen to work with (this makes a big difference when using Word, for instance), making notes in meetings without looking at your phone, cursor key navigation in spreadsheets. One user (thanks Kevin!) also pointed out how useful it was in emulators, “especially 8-bit machines that never supported touch”. Other uses included clinical notation, inserting special characters and coding.

While it’s true that many of those examples would be even better served by an iPad and a keyboard – see p50

– it's much trickier to slip an iPad into your jeans pocket. If you just want to carry one device, and love the idea of a physical keyboard, your options are limited. Fundamentally, only you will know if you find this form factor of value.

### The software experience

To take advantage of the keyboard, Planet supplies a few interesting apps. The one with immediate appeal to Psion lovers is Agenda, which provides the year-at-a-glance view that many people grew to love. It syncs perfectly with Google Calendar, too.

There's a Data app that you can use to create new apps on the device, or to import data from other sources.

Planet Computers also offers its own email app, dubbed Airmail, but Gmail works just as well with the keyboard. Finally, there's Notes. Nothing to do with Lotus, this is for quickly tapping in notes or recording them by voice.

Before you buy, bear in mind that the mobile world is tuned for portrait screens, not landscape. Many apps simply aren't usable in landscape, yet that's the default view as Android knows you're viewing sideways on. This is when you need to resort to the "force rotate" option or turn the Cosmo awkwardly into portrait view.

Another niggle is that the Cosmo isn't great at switching between Wi-Fi networks. During my testing, I often moved between my "home" and "office" networks, and I frequently had to force it to recognise the correct option (despite choosing the auto recognise option in Android 9).

### Life and speed

The Cosmo has enjoyed a speed bump over the Gemini PDA, as the graphs above reveal. That boost comes courtesy of the MediaTek P70 chipset, which features four "big" 2GHz Cortex A73 cores and four "small" 2GHz A53 cores. It's a midrange offering but that's fine: Android 9 ran smoothly during testing, and while the gaming results show that it will never rival the flagships, it's quick enough for most.

Battery life is more important, and is something heavy users should be wary of. Planet includes the same 4,220mAh battery that it supplied in



ABOVE The front OLED screen gives you an at-a-glance view of notifications and the first few lines of emails

the Gemini, and while that's enormous for a standard phone, it's merely sufficient for a device that you could use all day. To give an idea of real-world usage, I've been tapping away for two hours now and it's dropped from 80% to 58%. That's with the screen at two-thirds brightness.

I suspect that Planet's power-management skills aren't quite up to the standards of the likes of Huawei and Samsung either, because over the course of my week with the Cosmo it needed charging every night – and sometimes a quick

top up during the day. I also tested it using our video rundown test, where it lasted for a lowly 10hrs 38mins.

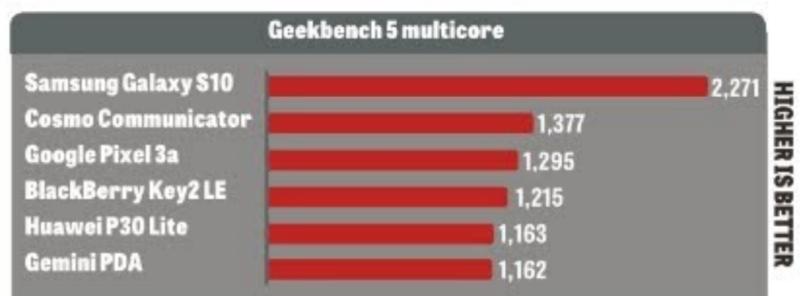
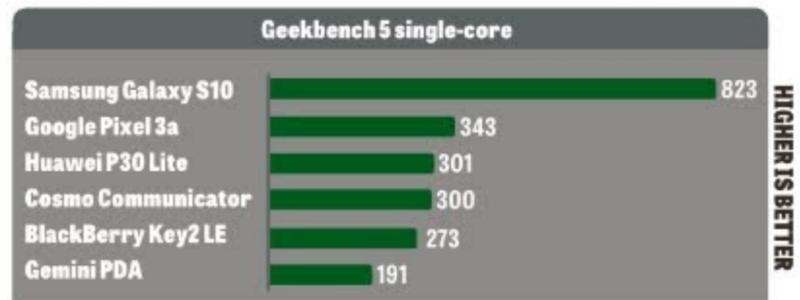
One bit of good news is that Planet Computers has designed the battery to be replaceable; this is meant to be a device with a lifespan of years, rather than months. But if you send the Cosmo to Planet Computers they will replace the battery for you – for \$79. You'll need to look after the Cosmo if you want it to last: while it can cope with light rain, it isn't water resistant, so beware coffee spills and don't use it near a swimming pool.

### Screen and camera

One thing hasn't changed: the screen. It's a 6in IPS display that doesn't quite sit in the middle of the frame, with a 2,160 x 1,080 resolution. I would call it Championship quality, helped along by a top brightness of 558cd/m<sup>2</sup>. It covers 87.6% of the sRGB gamut and has a Delta E of 2.39, where most top-end phones are near 100% and under one. It's fine, but won't blow you away.

The same applies to the external camera. This is a huge upgrade on the Gemini, principally because it didn't have one – you either needed to use the mediocre 5-megapixel internal camera or buy a camera add-on. Neither were satisfactory. Here, though, you're getting a camera that can take decent images.

Keep your expectations realistic, however. There's nothing fancy such as optical zoom or video stabilisation,



BELOW The external camera can capture decent photos, but don't expect iPhone-level results



and the controls are limited to HDR on/off... and that's about it. Zoom into images and you can expect plenty of compression. Still, it's capable of taking snaps and, as long as you don't zoom in too much, they're fine.

### Back the Cosmo?

The Cosmo is being shipped to backers on Indiegogo, where it costs \$750. That translates into around £580. Soon, however, it will only be available to buy via the Planet Computers website – and will cost £799 inc VAT. That's a meaty sum. Despite this, the Cosmo is well worth buying if it hits all your buttons. It's a more rounded product than the

Gemini PDA and may be enough to persuade you to leave your laptop at home or in the office. **TIM DANTON**

### SPECIFICATIONS

Octa-core MediaTek Helio P70 processor (4 x 2.1GHz Cortex A73, 4 x 2GHz Cortex A53) • Mali-G72 graphics • 6GB RAM • 128GB storage • 6in IPS screen, 2,160 x 1,080 resolution • external 1.91in AMOLED touchscreen • microSD slot • 24MP/5MP rear/front camera • 802.11ac Wi-Fi • Bluetooth 4.2 • 2 x USB-C connectors • 3.5mm jack • 4,220mAh battery • Android 9 • 171 x 79.3 x 17.3mm (WDH) • 326g • 1yr warranty

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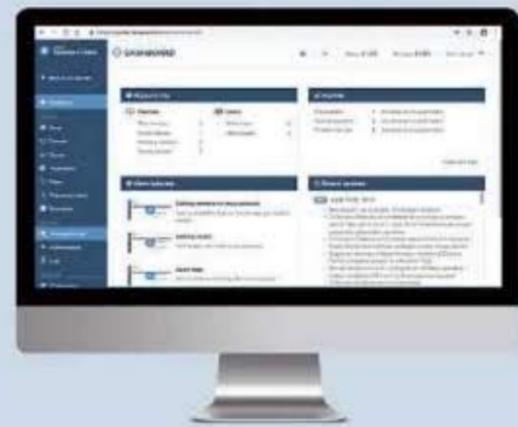
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# Apple iPad 10.2in (2019)

The best entry-level tablet just got better, but the killer new feature – a Smart Keyboard – costs half as much again



**SCORE** ★★★★★

**PRICE** 32GB, £290 (£349 inc VAT)  
from [apple.com/uk](https://apple.com/uk)

I have a simple answer when friends ask, “What laptop do you recommend for around £300 to £400?” That answer: “Why don’t you buy an iPad and keyboard instead?” Good battery life, great performance and a top-quality screen go together to make for a product that, in most instances, will be far superior to a Windows 10 laptop at a similar price. All they need to do is add that keyboard and they’re good to go.

As if in acknowledgement of the iPad’s rising status as an all-round productivity tool, Apple has made this easier with the addition of its “Smart

Connector” keyboard interface. This three-pin magnetic connector means you can add Apple’s Smart Keyboard for a laptop-like experience. It’s the first time you’ve been able to do this on Apple’s cheapest, non-Pro tablet. (Note it supports the first-generation Apple Pencil, too.)

As with all add-on keyboards, the iPad’s can’t match a “proper” laptop for feel; if I was going to type thousands of words, I wouldn’t use the Smart Keyboard. However, it’s a great choice for quick emails and the keys have a surprisingly nice feel considering their shallow depth.

## ■ Usability to the fore

Probably the biggest improvement to the newest iPad, somewhat ironically, is one you don’t have to

**ABOVE** The new “Today View” brings lockscreen widgets onto the homescreen

**BELOW** The bright screen is as good as you’ll get for this amount of money

buy new hardware to experience: iPadOS. To use the marketing term, this is iOS “reimagined” for the world of productivity. In other words, it’s a version of iOS that has been liberated from the shackles that Apple previously imposed upon it.

Much centres around the revamped Files app, which allows you to connect to an external hard disk drive and transfer files back and forth. Not only photos and videos, but any kind of file; this facility even extends to network drives. Other niceties include a Column View, just like the one you’ll see in the macOS Finder, allowing you to drill down folder by folder quickly and efficiently.

A host of “quick actions” mean you can perform common tasks with files simply by



long-pressing and selecting the option. In this way, you can quickly annotate files, create PDF files from images or compress a file into a ZIP.

Small beer, you might think, but it turns the iPad into something that can now be used for most day-to-day tasks. Something that you can use to spit out a file and easily send it to a colleague.

Elsewhere, the improvements continue. There's now full desktop web browser capability in iPadOS, where previously it was a more limited mobile browser (despite improvements in recent years on iOS). For most browsing tasks, you won't notice much of a difference, but there have always been web apps that demanded a full browser and didn't play nice in iOS Safari. This update will make a huge difference.

Other grown-up features include the ability for apps to spawn multiple instances. I also like the fact that MacBook, iMac and Mac mini owners can now use the iPad as a second screen using the Sidecar feature. This only works with MacBooks and Mac minis running the latest macOS Catalina, though.

There are some minor improvements, too. It's now possible to squeeze more app icons onto the homescreen and there's something called "Today View", which brings iOS' lockscreen widgets – Apple News, stocks, calendar notifications and so on – directly onto the desktop.

Of course there is still the odd irritation. For instance, if you're using a web form to upload images to a website, it's only possible to select one file at a time. There is a workaround to this, but it involves saving them into Photos and uploading from there instead.

### ■ Bigger thinking

Then there's the benefit of a slightly larger screen. At 10.2in, it's half an inch larger across the diagonal than the previous iPad, albeit with the same 2,160 x 1,620 resolution. That's fine by me: when it's held at normal viewing distances, you won't be able to see the pixels.

The display uses the same technology and method of construction as the previous model. So, unlike Apple's Pro tablets, the touchscreen isn't laminated to the LCD beneath it, which means there's a small gap between the two layers. You can see this for yourself if you look at the edges from an oblique angle. This can have an adverse effect on perceived contrast in bright ambient light. Another advantage of iPad Pro tablets is True Tone, where the screen senses and matches



the colour tone of light in your immediate surroundings.

Still, the screen on the iPad is as good as it gets at this price. It's bright, peaking at 492cd/m<sup>2</sup> in our tests, ensuring good readability in most conditions. The contrast ratio is a decent 1,060:1 and, as ever with Apple's devices, it's fully calibrated in the factory and colour-accurate. When tested against the sRGB colour space, I measured an average Delta E of 1.01, which is very good indeed.

### ■ Battery boost

One area where Apple hasn't made big changes is the power within. It uses exactly the same dual-core A10 Fusion chip as the previous 9.7in iPad, coupled with 3GB of RAM and 32GB or 128GB of storage. That's the same chip that was first used in the iPhone 7.

**ABOVE** We wouldn't write a novel on the Smart Keyboard, but it's fine for tapping quick emails

**“Battery life rose from the 8hrs 43mins of the previous iPad to 12hrs 29mins. That's despite a bigger screen and the same size battery”**

### ■ Final thoughts

There are many things to like about this updated iPad, but there isn't much that's new and exciting – unless your idea of exhilaration is adding a

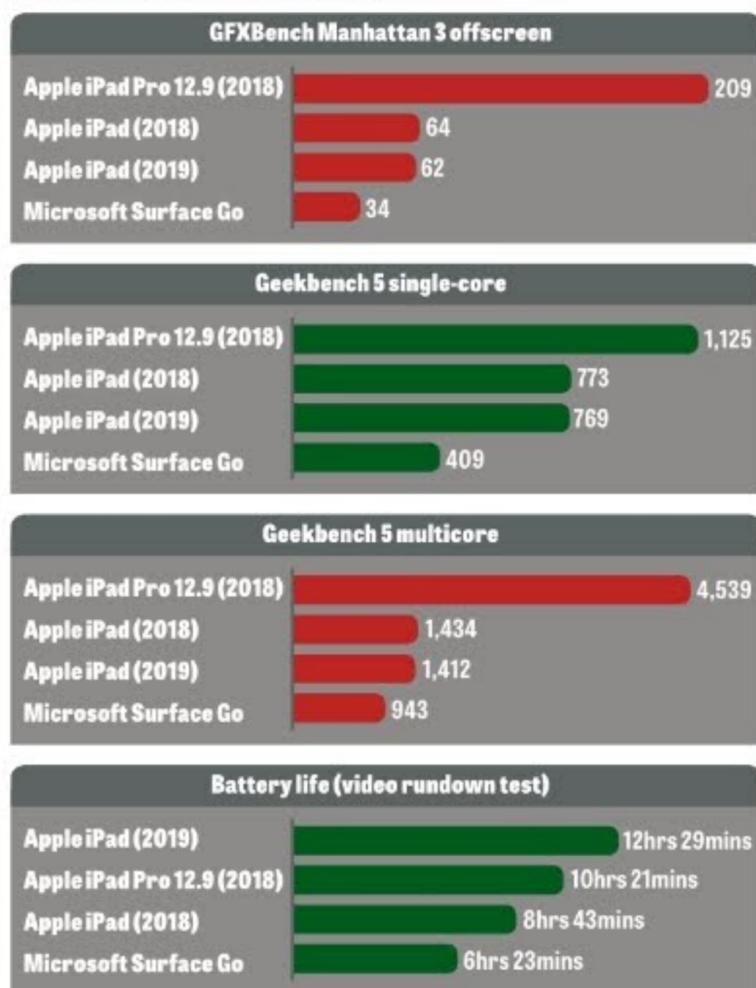
keyboard connector and making the screen fractionally bigger. For instance, by modern standards those bezels are broad, while the 8-megapixel rear camera and 1.2-megapixel front-facing camera are the same underwhelming units as found on the previous iteration.

We've also seen a slight price rise, going up from £329 to £349 for the 32GB model, while the 128GB model costs £449 rather than £429. Add the Smart Keyboard at £159, and you're looking at £588 for a decent specification laptop replacement. Sure, you can buy Bluetooth keyboards, but you'll still need to fork out for a cover if you want to take the iPad on your travels.

It is, however, impossible to deny the quality of this device. The 10.2in iPad is still the best tablet you can buy for under £500 and, with the addition of a keyboard and iPadOS, it's an even better lightweight laptop alternative than before. **JONATHAN BRAY**

### SPECIFICATIONS

Quad-core 2.34GHz Apple A10 Fusion processor • 3GB RAM • 10.2in IPS screen, 1,620 x 2,160 resolution • 32/128GB storage • 12MP/1.2MP rear/front camera • 802.11ac Wi-Fi • Bluetooth 4.2 • Lightning connector • 32.9Wh battery • iPadOS 13.1 • 174 x 7.5 x 251mm (WDH) • 483g • 1yr warranty



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Scan Recommends Microsoft Windows



# Lenovo ThinkBook 13s

It doesn't have all the ThinkPad trimmings, but Lenovo is offering small businesses a bargain

SCORE ★★★★★

PRICE £567 (£680 inc VAT) from [lenovo.com/uk](http://lenovo.com/uk)

If you've always longed for a ThinkPad but been put off by the high asking price, Lenovo is dangling this tempting carrot: a 13in business-focused laptop with much of the ruggedness found on ThinkPads, yet at a remarkably low price. The switch from black to industrial grey is no coincidence, as Lenovo is hoping to woo a younger audience of buyers who consider the traditional ThinkPad as too unfashionable to go with their topknot and almond-milk latte.

What's most impressive about the ThinkBook, though, is that Lenovo retains so much of the ThinkPad heritage while keeping the price down. For instance, it still feels rugged, with an aluminium chassis that's reassuringly cool to the touch. There's no military-standard testing to back up this feeling, though, so you would be well advised to extend the warranty from the initial one year.

Lenovo has trimmed a millimetre or two of travel from its usual keyboard, so it doesn't have the luxurious feel of a ThinkPad. But it's still significantly better than most keyboards on a sub-£1,000 laptop, so don't be put off. It should survive if you spill some of that latte onto it, too, as the keyboard is designed to be spill-proof. Including a precision



ThinkBook 13s lasts longer on the road. A battery life of 8hrs 30mins is more than respectable, beating the Acer by 90 minutes, and you can always use the single USB-C port to supply power. Lenovo's power supply plugs into a proprietary port, next to which you will find a full-size HDMI output. Old-style USB isn't forgotten either, with two ports on the right side, meaning that the only obvious omission is a microSD/SD card slot.

There's no infrared webcam, so

touchpad is another nice touch.

The matte Full HD screen isn't one of the platinum-grade, super-bright panels you can specify in the best ThinkPads, but it reached a peak brightness of 324cd/m<sup>2</sup> in our tests and covered 90.1% of the sRGB gamut. With an average Delta E of 1.06, you can trust the colours it produces, while a contrast ratio of 1,827:1 means you won't miss out on details when watching films.

Where it shows its budget leanings are moderate viewing angles and a slight grain effect.

Looking for more compromises? One is management.

You still get Lenovo's full suite of Vantage tools to help

keep your PC protected and in peak condition, and note the inclusion of Windows 10 Pro, but there's no vPro certification for the Intel Core i5-8265U. In truth, that won't matter to most small businesses, who will care more about speed – and the ThinkBook 13s has a fine turn of pace. An overall score of 86 is excellent for a Core i5 with 8GB of RAM in support, and that's made possible because Lenovo backs it up with active cooling: you'll often hear the low pitch of its fans kicking in.

This isn't the slimmest of laptops as a consequence, but 15.9mm isn't fat. Compared to the Acer Travelmate X5 (see issue 302, p60) it's heavy at 1.3kg – the Acer weighed 960g – but Lenovo can rightfully point out that the

**ABOVE** The chassis feels high-quality – as does the keyboard for a sub-£1,000 machine

Windows Hello support is limited to the fingerprint reader integrated into the power button, but to save potential blushes there's a privacy filter for the webcam. This takes the usual desultory 1,280 x 720 photos and videos. Audio playback is typical of a modern laptop too, making music

bearable at a push, so don't get too excited by Lenovo's "audio by Harman" claims.

The 13s is the first ThinkBook to go on sale, and it's notable that there's only one

**"If there's any justice in the world, the Lenovo ThinkBook 13s should be popular: at £680, this machine is a real bargain"**

specification available in the UK. Considering the aggressive price, I can live with the 256GB SSD, and note that it's meant to be a "quick ship" model – as long as Lenovo has stock, it will ship in one to two days. If it proves popular, higher-specified models will no doubt be released, along with a 14in version. And if there's any justice in the world, it should be popular: at £680, this machine is a real bargain. Sure, it trims back on a few luxuries, but when you're paying Ford prices you can't expect a Porsche. **TIM DANTON**

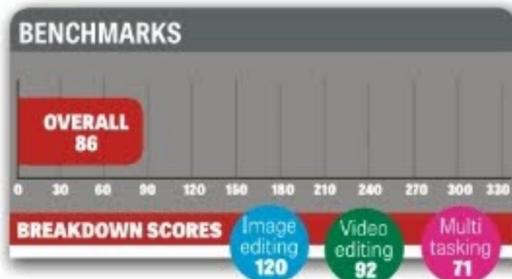
**LEFT** Two old-style USB ports are in place on the right-hand side of the ThinkBook



**ABOVE** The ThinkBook 13s may be flexible, but it weighs a not-so-skinny 1.3kg

### SPECIFICATIONS

Quad-core 1.6GHz Intel Core i5-8265U processor • 8GB 2,400MHz DDR4 RAM • Intel UHD 620 Graphics • 13.3in non-touch IPS display, 1,920 x 1,080 resolution • 256GB M.2 PCIe SSD • 720p HD webcam • 2x 802.11ac Wi-Fi • Bluetooth 5 • USB-C 3.1 (with data transfer, charging and DisplayPort support) • 2x USB 3.1 • HDMI 1.4 • combo 3.5mm mic/headphone • 45Wh battery • Windows 10 Pro • 308 x 216 x 15.9mm (WDH) • 1.4kg • 1yr RTB warranty





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## HP Envy 13 (2019)

Last year's top bargain buy has become this year's top all-round choice thanks to upgrades in the right places

SCORE ★★★★★

PRICE £958 (£1,150 inc VAT)  
from [johnlewis.com](http://johnlewis.com)

At any one time, there's a sweet spot for computers. A big-selling product type where the major manufacturers are simultaneously dropping prices and improving quality in their quest to usurp rivals. That sweet spot, for the moment at least, is the 13in ultraportable.

While the Dell XPS 13 has been the 13in laptop to beat for some time, HP undoubtedly produced the bargain of 2018 with its Envy 13 (see issue 288, p61). At £849 for a Core i5/8GB/256GB spec, it was unbeatable value. This year, it's set its sights higher by boosting quality and dropping prices: the Core i5 version costs £749 direct from HP, while this version (the aq0003na) with a Core i7, 16GB of RAM and a 1TB SSD is a still-affordable £1,149. (Spend the extra pound and order from John Lewis, though, as this upgrades the warranty to two years.) To put those prices into perspective, the Dell XPS 13 starts at £1,149 – and that's with the same specification as the £749 Envy.

One reason to stick with the XPS 13 is speed: Dell still provides the best cooling setup in a 13in ultraportable, which enables it to make the most out of a Core i7-8565U processor. That chip, combined with 8GB of memory and a 256GB SSD, scored 95 in our benchmarks, while this HP Envy 13



only managed 85 with 16GB of RAM. In fairness, that's still respectable. It's just that the chip was typically running at 2.3GHz to keep its four cores comfortably below their 100°C threshold. HP doesn't include the fastest SSD around, but sequential read and write speeds of around 1,300MB/sec and 650MB/sec respectively will rarely hold you back.

The XPS 13 also lasts longer: 10hrs 35mins in our video rundown battery test, compared to the 8hrs 34mins of the Envy 13. But that's still an hour improvement over 2018's model, and it can charge from 0% to 50% in around 45 minutes.

Plus, HP has a trick unavailable to Dell: Nvidia graphics. While the GeForce MX250 sits closer to Intel's UHD Graphics than it does to a GTX 1060, it can still run many games that are beyond the reach of Intel's integrated chip. For instance, it averaged 56fps at 720p in *Dirt: Showdown*, and even managed 36fps in *Metro: Last Light* at 1080p.

Games and movies look fantastic on the bright 13.3in Full HD display, with a glossy finish that extracts every last ounce of colour from images. It helps that the display packs a 1,842:1 contrast punch. You can trust that the colours you see are accurate, too, with a stunning average Delta E of 0.39 and a maximum of one. Combine that with 98.6% coverage of the sRGB gamut

**ABOVE** The excellent 13.3in Full HD display squeezes every drop of colour from images

**“Colour accuracy plus 98.6% coverage of the sRGB gamut mean the best image quality results yet from a 13in ultraportable”**

**LEFT** HP has included a fingerprint reader, but note the lack of an infrared webcam

**BELOW** The sides boast a good selection of ports – and a button to disable the webcam

and you have the best image quality results yet from a 13in ultraportable. Its speakers aren't the same stellar quality, but they're still good partners for a film. Besides, there's a 3.5mm jack on the left edge, along with a USB-C and USB connector. Curiously, HP uses a tiny flap for the latter, as if the Envy 13 is so slim it couldn't squeeze in a normal slot;

in truth, it's quite slender at 14.7mm, but no one's jaw will drop when they see it in profile. The other side holds a second USB port, microSD slot and a button to turn off the webcam, and it produces such shocking results that it's best left unused.

When you lift the lid it also lifts the rear of the chassis, which supposedly helps both airflow and the typing angle. I'm sceptical about the latter – there isn't enough of a hike to notice

– but the keyboard is pleasant to type on with plenty of travel on the keys and a soft feel. The Enter key is only single height, while it's a standard touchpad so you don't get the smooth, glass

finish of higher-end laptops, but these are both easy concessions to live with.

The feature I miss more is an infrared webcam to log in. There's a fingerprint reader, and it worked every time, but it isn't as convenient.

But these are minor criticisms. HP already had the best “value” ultraportable around with last year's Envy, and all the upgrades – the superior screen, faster components, improved battery life – mean this isn't just our preferred budget machine but our 13in laptop of choice. **TIM DANTON**

### SPECIFICATIONS

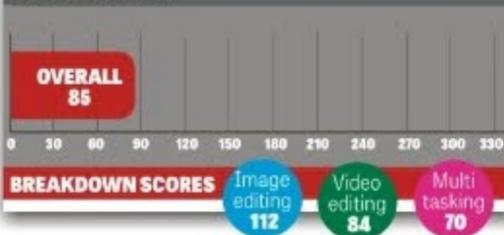
Quad-core 1.8GHz Core i7-8565U processor • 2GB Nvidia GeForce MX250 graphics • 16GB RAM • 13.3in touch IPS display, 1,920 x 1,080 resolution • 1TB M.2 PCIe SSD • 2x 802.11ac Wi-Fi • Bluetooth 4.2 • USB-C 3.1 (with data transfer, charging and DisplayPort support) • 2x USB 3.1 • microSD card reader • 53Wh battery • Windows 10 Home • 307 x 212 x 14.7mm (WDH) • 1.2kg • 2yr RTB warranty (via John Lewis)



BATTERY: video rundown, 8hrs 34mins



### BENCHMARKS





## Dynabook Portégé X30F-14U

Steady as she goes: the name may have changed, but all the core ingredients of a Portégé laptop remain

SCORE ★★★★★

PRICE Approx £1,800 (£2,160 inc VAT) from Dynabook resellers

The Toshiba brand is slowly disentangling itself from the all-new Dynabook, and this is the first true Dynabook laptop we've seen – complete with a substantial silver logo on the lid. While you'll still see a Tosh logo at [emea.dynabook.com](http://emea.dynabook.com), and it's embedded into the default wallpaper, this feels like the final goodbye. If you were hoping for a dramatic change to mark the event, though, you'll be disappointed.

To say this is business as usual is a statement with obviousness on a par with "Brexit is tricky, isn't it?" The Portégé X30F-14U is finished in Toshiba's trademark onyx blue, and if you've used any Portégé of the past five years then you'll know what to expect: slim dimensions, light weight, solid build quality.

The keyboard is, but for one irritation, an excellent affair. I'm a fan of its combination of a quiet sound with a deep travel; if you're a touch typist, or simply used to mechanical keyboards, this is as close as you can come to that same feel on a compact keyboard. The irritation is the spacebar, which should be positioned a fraction to the right: my thumb kept hitting the AltGr button, which sits directly under the M.

The touchpad is small, too, and that's partially because Toshiba has

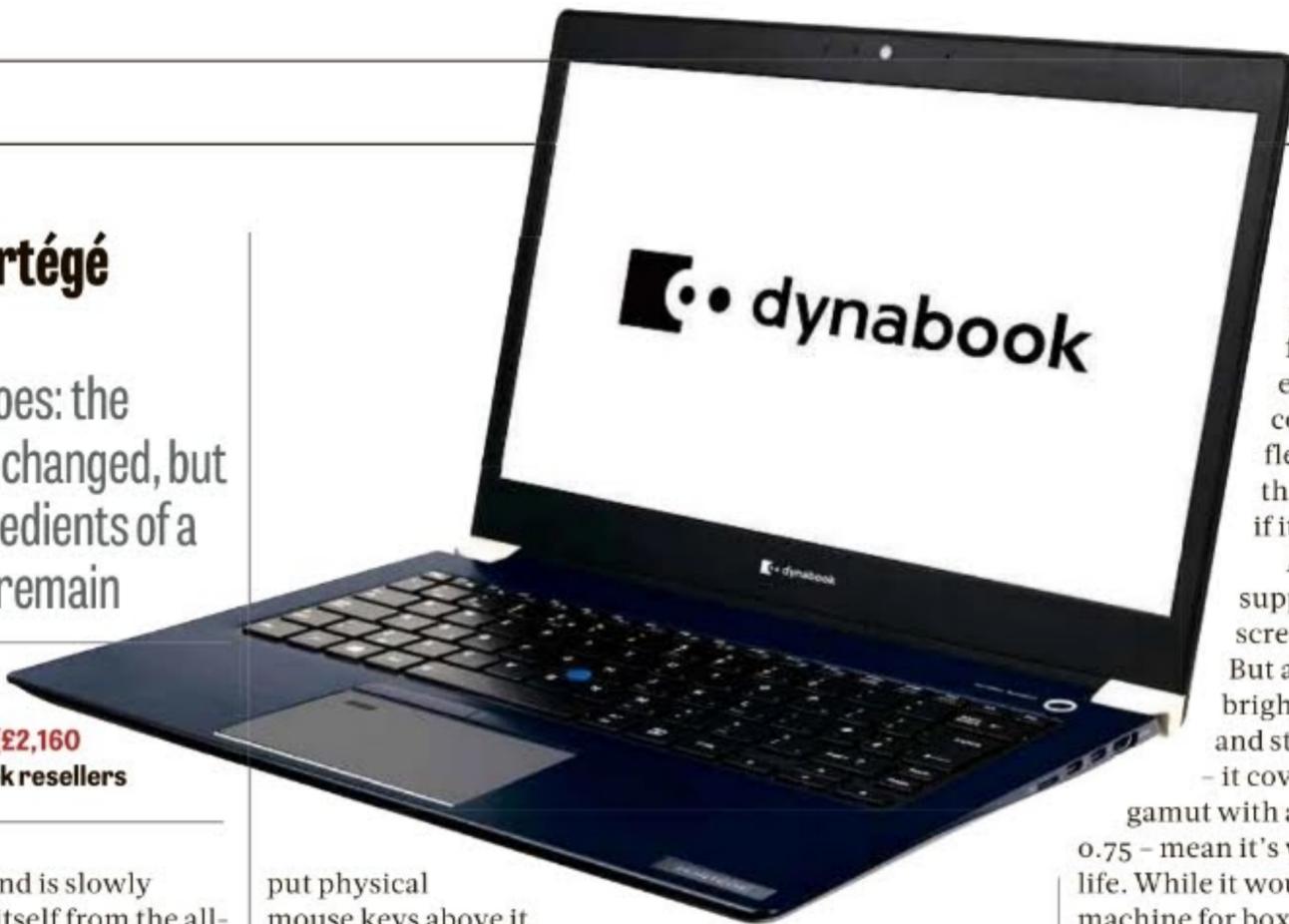
put physical mouse keys above it, with the idea that they will work in combination with the [trackpoint](#). It's a high-quality touchpad, with a glass finish to keep friction to a minimum and support for Windows' precision gestures.

Security comes in many forms, as I'd expect from a Portégé laptop. First the tiny fingerprint reader, which is integrated onto the touchpad, then infrared cameras for Windows Hello, and there's a smart card reader on the right-hand side. The Portégé supports Microsoft's modern standby function, too, which promises "instant" on. In reality, you'll have to wait a second or two while the infrared cameras scan your face, but that's far quicker than resuming from standby used to be.

Curiously for a laptop with enterprise aspirations, the X30F-14U doesn't include a vPro processor so you can't use Intel's active management technology (note there is a trusted platform module). The Core i7-8565U is a familiar chip in these pages, and while its overall score of 84 is respectable, I hoped for more bearing in mind the 32GB of RAM.

In truth, there is little point paying extra for a Core i7 rather than Core i5 in an ultraportable unless it has epic cooling to allow the processor to reach its full potential, and of the Dynabook's obvious competition only the Dell XPS 13 can claim that. Here, the X30F's chip was often stuck at around 2GHz rather than its Turbo Boost speed of 4.6GHz. The Dell was 14% faster with a score of 96.

I hoped for more battery life from the X30F, too. It's perhaps churlish to complain about 7hrs 44mins, but the Dell lasted for 10hrs 35mins in the same test. Where the Dynabook wins is portability, as its weight of 1.05kg is



excellent for a 13in business laptop. The magnesium chassis feels well built; as ever, don't be too concerned by the flexibility of the lid, as that can come in useful if it's bashed.

Aside from the fact it supports touch, the screen is nothing special. But a matte finish, a top brightness of 303cd/m<sup>2</sup> and strong colour accuracy – it covers 95% of the sRGB

gamut with an average Delta E of 0.75 – mean it's well suited to office life. While it wouldn't be my go-to machine for boxset binges, a contrast ratio of 1,030:1 means scenes look punchy, and the speakers are decent.

I was half-hoping for 802.11ax Wi-Fi, but Dynabook sticks with the Intel Wireless-AC 9560 offering. A lonely USB slot sits on the left-hand side – only a Kensington lock slot and 3.5mm jack keep it company. On the right are two Thunderbolt 3 ports, with support for data transfer, DisplayPort and power (there's no dedicated power input). There's even

full-size HDMI and a microSD slot.

Dynabook estimates this spec will cost between £1,599 and £1,999 exc VAT, depending on the quantity you buy from your reseller. To quote a

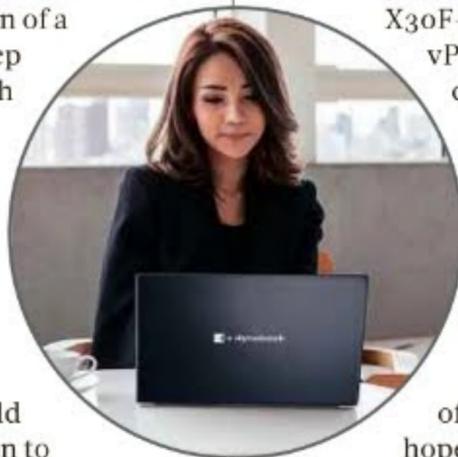
spokesperson: "X30F-14U is an ultra high spec laptop and we are only offering it on a build-to-order basis to those customers which have the budget." Given the 1TB SSD and 32GB of RAM, that's sensible.

However, there's no hiding from the value-for-money question. Last month, I reviewed the business-friendly 13in Acer Travelmate X5 (see issue 302, p60), which is 946g and feels just as well made; it cost £900 inc VAT. Toshiba loyalists will be happy with the Portégé X30F if they're lucky enough to receive one, but there's no opportunity for the new company to rest on its laurels. Dynabook will need to innovate, not simply follow the same route as Toshiba. **TIM DANTON**

**ABOVE** Toshiba's onyx blue finish? Check. Lightweight? Check. Great keyboard? Check

**"A matte finish, a top brightness of 303cd/m<sup>2</sup> and strong colour accuracy mean the screen is well suited to office life"**

**LEFT** The magnesium lid will flex, but that's a good thing when it comes to bumps



BATTERY: video rundown, 7hrs 44mins



BENCHMARKS



BREAKDOWN SCORES: Image editing 117, Video editing 84, Multi-tasking 72



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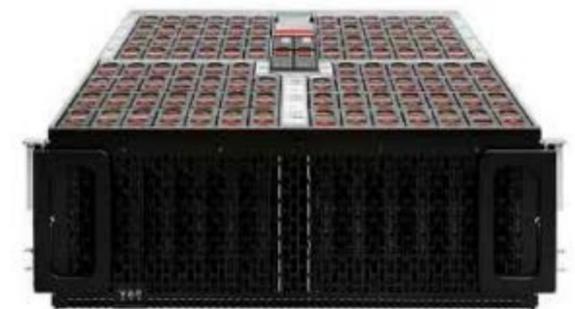
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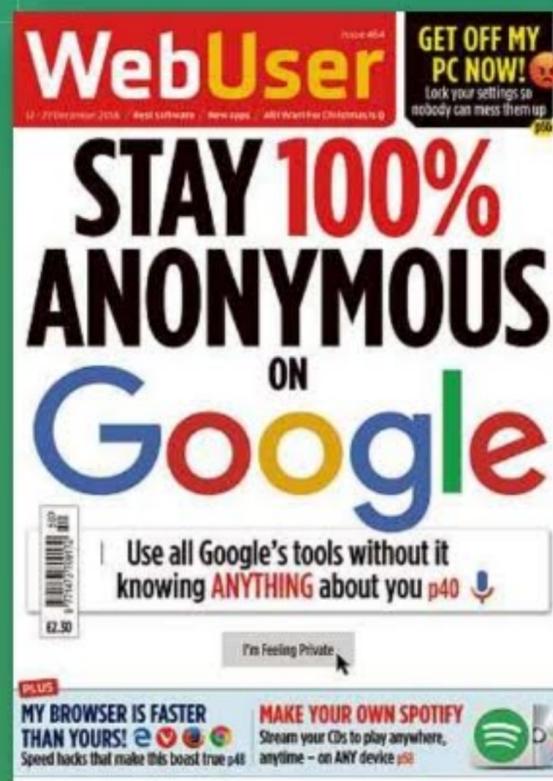
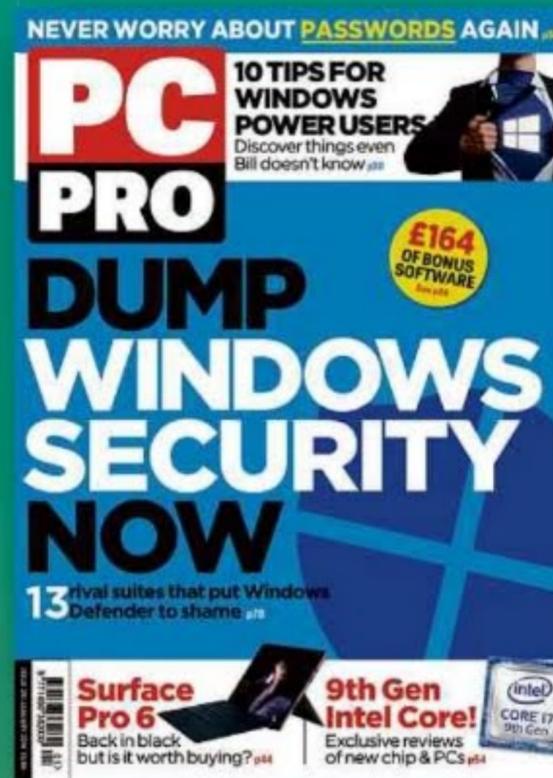
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## Acer TravelMate X3

A fast, solid laptop with excellent battery life that would make a fine choice for small businesses

SCORE ★★★★★

PRICE £658 (£790 inc VAT)  
from [uk-store.acer.com](http://uk-store.acer.com)

I was mightily impressed by the sleek Acer TravelMate X5 last month (see issue 302, p60), with Acer offering a high-quality 13in business ultraportable for £900. The X3 may sound like it's smaller still, but in fact this is a 14in and comparatively chunky machine. But that's fine. If power is more important to you than portability then there are advantages to going up in girth.

The most obvious is that a larger chassis gives more room for cooling, and that in turn means that you can expect the processor inside your machine to keep going at its maximum speed for longer. And so it proved here. While the X5 I tested last month included a Core i7-8565U processor that promised boost speeds of 4.7GHz, in reality it wasn't comfortable running faster than 2.7GHz for any length of time. The Core i5-8265U inside the X3 here, on other hand, kept churning away at over 3GHz without complaint even in heavy-duty benchmarks.

That resulted in an overall score of 81 to the X5's 75, and in reality few people will ever complain about this laptop's speed. The only exception, as ever for a machine that relies on Intel's UHD 620 Graphics, is if your task involves 3D acceleration. For example, it only managed 29.6 frames per second in the offscreen GFX Bench Open GL Car Chase test.

The other advantage of a bigger chassis is that manufacturers can include a larger battery, with the X3 featuring a 59Wh unit. That's almost twice the size of the X5's, and while

BATTERY: video playback, 12hrs 16mins



BENCHMARKS



BREAKDOWN SCORES  
Image editing: 118  
Video editing: 83  
Multi-tasking: 68



the smaller TravelMate stopped playing our video on repeat after 7hrs, the X3 carried on for 12hrs 16mins. Note that you can charge the laptop via the USB-C port on the left, but Acer provides a conventional, compact charger as standard.

The USB-C port can also be used for connecting an external monitor, but you may prefer to use the full-size HDMI output. There's even a D-SUB connector for hooking up older projectors. Another potentially useful inclusion is the Ethernet port, again sitting on the left-hand side, with a USB 3 slot to round things off. The right-hand side is similarly packed, with two USB 3 ports, a 3.5mm combo jack and an SD card reader.

As this plethora of ports hints at, this isn't the world's slimmest laptop: it measures 19.9mm from top to bottom, while it's an inch wider than an A4 sheet of paper at 328mm. I wouldn't describe it as bulky, though, and a weight of 1.53kg is perfectly respectable for a 14in laptop. (Note that Acer's website undersells its weight at 1.6kg.) It's well built, and Acer has reassuringly put the X3 through a number of MIL-STD 610 tests. With an all-aluminium chassis, I'm optimistic that it would survive three years of daily commuter abuse.

Acer backs up this capable design with a high-quality keyboard, with generously sized keys, a substantial feel and an absolutely huge touchpad. The only thing it may take you time to get used to is the column of keys to the right, where Acer has chosen to place Delete, Home, Pg Up, Pg Dn and End. I found the backspace key particularly difficult to locate while typing.

ABOVE The 14in matte display and generous array of ports are ideal for business use



**"The other advantage of a larger chassis is that it means a larger battery, and the X3 carried on going for 12hrs 16mins"**



ABOVE Not as compact as the X5, but the X3 is a portable system at 19.9mm thick and 1.53kg

You'll search in vain for a fingerprint reader next to the touchpad, but that's because it's integrated into the power key just above the keyboard. This makes perfect sense – you'll be pressing it anyway, after all – and by backing it up with an infrared webcam, Acer has all the Windows Hello bases covered. Note the processor isn't compliant with Intel's vPro platform, though. Acer claws back some

management favour by making the hard disk and RAM user-upgradeable, via slots on the bottom of the chassis. As this model only includes 8GB of RAM and a 256GB SSD, both of those options could be handy.

I'm also a fan of the 14in Full HD screen Acer supplies, with a matte finish that proved excellent at deflecting light. It peaks at 330cd/m<sup>2</sup> and scored top marks in our quality tests: 93.4% sRGB coverage and an average Delta E of 0.63 point to a colour accurate panel. The corollary is that it won't be a brilliant choice for streaming movies and the speakers are comically poor, so don't choose

this as your primary entertainment machine.

This laptop isn't without flaws, but considering that you're buying a Windows 10 Pro laptop with considerable battery life, plenty of

power and quality in all the most important places, it's hard to baulk at the £790 Acer is asking for it. The only caveat is that the one-year limited warranty isn't reassuring, but the £150 Acer wants for a three-year on-site warranty is reasonable.

Once again, Acer delivers an excellent value laptop that's well-tailored to small businesses.

TIM DANTON

### SPECIFICATIONS

Quad-core 1.6GHz Intel Core i5-8265U processor • 8GB 2,400MHz DDR4 RAM • Intel UHD 620 Graphics • 14in non-touch IPS display, 1,366 x 768 resolution • 256GB M.2 PCIe SSD • 720p HD webcam • 2x2 802.11ac Wi-Fi • Bluetooth 5 • USB-C 3.1 (with data transfer, charging and DisplayPort support) • 3 x USB 3.1 • D-SUB • Gigabit Ethernet port • HDMI 1.4 • SD card reader • combo 3.5mm mic/headphone • 59Wh battery • Windows 10 Pro • 328 x 236 x 19.9mm (WDH) • 1.53kg • 1yr RTB warranty



## Google Pixel 4

The Pixel 4 has an extra camera and a new design, but Google's Android crown is beginning to slip

SCORE ★★★★★

PRICE 64GB, £557 (£669 inc VAT)  
from [store.google.com](https://store.google.com)

My immediate reaction to the Google Pixel 4 was disappointment. While it offers a series of firsts for the Pixel range – two rear cameras rather than one, a Snapdragon 855 processor, a 90Hz screen, even radar-sensing gesture controls – there was still no immediate sense that it had jumped ahead of its rivals.

That's despite a new design. Google has ditched the two-tone look of its previous three generations of Pixels, instead opting for a simple single-tone colour scheme available in "Just Black", "Clearly White" and "Oh So Orange". Each is surrounded by a curved, textured black trim, with a coloured power button and volume rocker on the right edge. There's no notch, either; instead, the 8MP selfie camera and earpiece speaker are located inside a chunky forehead bezel.

The Pixel 4 is sandwiched between protective layers of Gorilla Glass 5, rated to the IP68 standard. The new rear camera module is distinctly iPhone-like, with the two cameras, infrared sensor and dual-LED flash arranged in a diamond pattern.

The dual front-facing speakers also reappear, and there's still no 3.5mm headphone jack. This isn't normally much of a problem, but miserly Google has decided not to include an adapter in the box this year. There's also no fingerprint sensor, but you can still unlock the Pixel 4 with your face, or with a PIN or pattern lock.

That would be bearable if it weren't for the security vulnerabilities of the face recognition. My review unit failed to register my face on several occasions, especially with my glasses off, and sometimes forgot the face data entirely, forcing me to go through the process of setting it all up again. But the biggest problem is that you can unlock the phone with your eyes closed. So someone could grab the phone while you're asleep – or unconscious – and access all your data. Google says



ABOVE The single-tone "Oh So Orange" model of the Pixel 4 is certainly striking

there's a fix in the works, but until then use a PIN, pattern or password lock instead.

### Screen size

On a happier note, the Pixel 4's 90Hz OLED screen is excellent. While an average Delta E of 1.4 and sRGB coverage of 90.5% aren't the best figures ever, they show you can trust the screen's accuracy in its Natural colour mode. I don't advise switching to Boosted or Adaptive settings, as these reduced accuracy and produced garish, candy-looking colours.

Screen brightness peaked at 430cd/m<sup>2</sup> in automatic brightness mode, promising readability in most sunny environments in the UK, although you might be squinting at your Facebook or Twitter feeds if you jet off somewhere more exotic. Suffice it to say, this is a screen that's very good for watching YouTube videos and playing games, although if HDR playback is your secret love then the iPhone 11 Pro's Super Retina XDR display is far superior: scenes in Netflix's *Marco Polo* series look dark in comparison when first played on the iPhone and then the Pixel 4.

If you want a larger screen, the Pixel 4 XL is the obvious choice. Aside from being larger – and benefiting

from a 3,700mAh battery – this is exactly the same phone as the Pixel 4, but with a larger chassis, 6.3in QHD+ screen and higher price: £829 for 64GB, £929 for 128GB.

### Good speed, poor battery

Inside the Pixel 4 you'll find a Qualcomm Snapdragon 855 processor and 6GB of RAM – up from the 4GB of last year. Both the Pixel 4 and 4 XL come with either 64GB or 128GB of internal storage, which you won't be able to expand via microSD.

Unsurprisingly, this new processor delivers barnstorming

benchmark results, and offers a slick, responsive experience all around. In the Geekbench 5 graphs opposite, you can see that the Pixel 4 performs better than its predecessor by quite a wide margin, and even better than the Galaxy S10's Exynos 9820 chipset in multicore performance.

It's a similar story for graphics speed, but I was most hoping to see a major improvement in the Pixel 4's stamina. It wasn't to be, and that's due to Google's bizarre decision to use

a smaller 2,800mAh capacity battery. As a consequence, it lasted a mere 12hrs 7mins in our video rundown test.

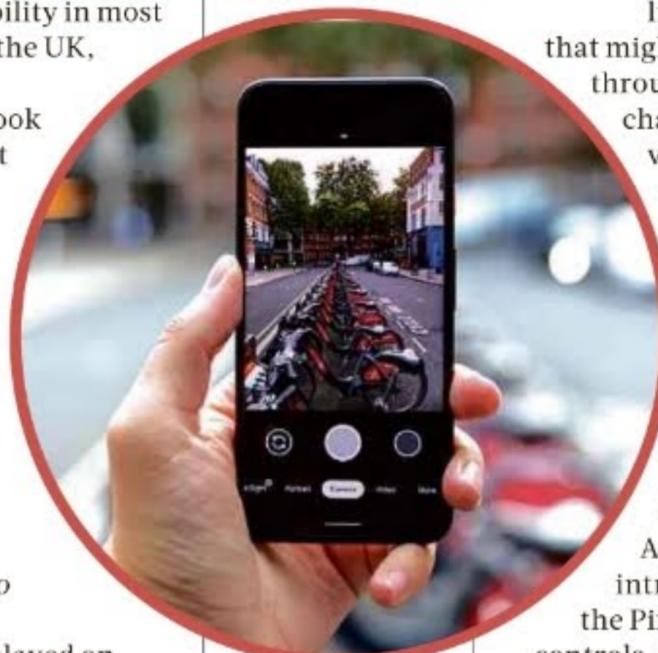
What does this mean for real-world battery life? Well, this is a phone that might just about make it through a day on a single charge, but you'll have to be very conservative with what you do with it, and there certainly won't be wiggle room to spare when you get home in the evening. Google needs to do much, much better next year.

### Gesture difference

Arguably the most intriguing new feature is the Pixel 4's gesture-based controls. Google says that it's been working on this technology for five years now. It essentially uses a motion-sensing radar powered by a small custom "Soli" chip embedded



**"This new processor delivers barnstorming benchmark results, and offers a slick, responsive experience all around"**



ABOVE The Pixel 4 captures colour-accurate images that are packed with detail

into the handset, which detects motion around the phone.

While gesture controls in phones aren't new, they have previously relied on the camera, which is restricted to a field of view of up to 180°. This Pixel's radar chip allows you to interact with the phone from seemingly any angle.

The most useful application is when it comes to unlocking the phone, with the screen lighting up whenever the Pixel 4 detects movement and swiftly turning off the screen when it's left alone. This should help speed up the unlocking process and, I'm told, improve battery life; that doesn't seem to be the case.

You can also snooze alarms, skip songs on Spotify and cycle through your YouTube playlists with a nearby waggle of your hand. All of which are particularly useful if you're cooking and your fingers are covered in brownie batter. Google is encouraging app developers to support the Pixel 4's gesture controls, but Spotify is the only third-party application to incorporate this feature so far.

The Pixel 4 runs Android 10 with its own Pixel launcher overlay. Android 10 is currently only available on a select few phones, and brings with it a handful of new features and software tweaks.

A system-wide dark mode is (finally) an option in Android 10, as well as a new "focus mode" that hides notifications from apps you deem distracting. UI navigation has also changed slightly – there's no more virtual navigation bar at the bottom of the screen, instead you move about with simple swipes. Swiping your thumb across from either side of the screen now acts as the back button, swiping up from the bottom of the screen brings you to the homescreen, while swiping up and holding your finger in the middle of the screen for a brief moment opens up a list of recent apps. It may sound complicated, but it quickly becomes intuitive: for my money, this is the best version of Android yet.

### ■ Double camera

For the past few years there's been an ace up Google's metaphorical sleeve: there's usually nothing better than a Pixel's camera. It's stuck with the same 12-megapixel camera unit, but that's been joined by a 16-megapixel 2x telephoto zoom camera. But what's particularly special is the processing that goes on behind the scenes, especially when it comes to the phone's impressive HDR+ algorithms.

In particular, Google's engineers have improved the quality of the excellent "Night Sight" mode. The colour balance of images captured in

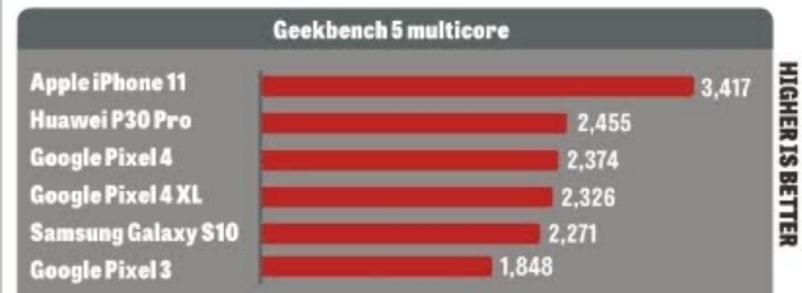
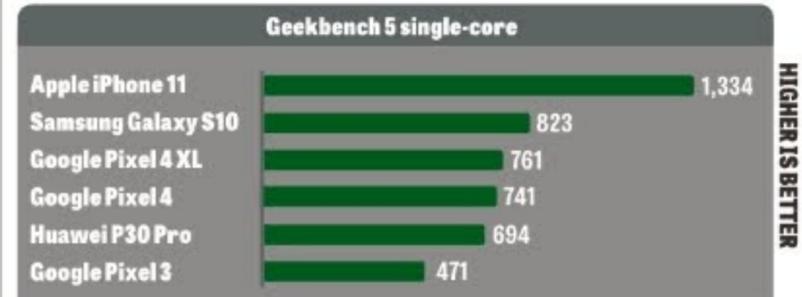
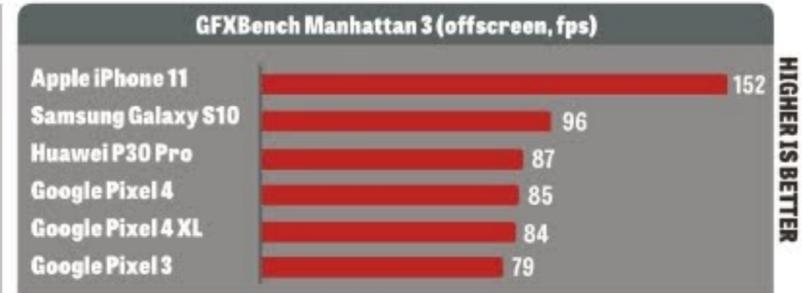
low light – particularly in sky scenes – is much improved, and there's now a dedicated astrophotography shooting mode. In this setting, Google explains that the Pixel 4 combines 15 long-exposure shots to create the best image possible, although you're advised to stay away from urban areas and to pop your smartphone in a tripod or gimbal.

You're no longer left at the mercy of the HDR+ algorithms working their magic after you capture an image, as you now get a rough indication of what the image will look like before you press the shutter button via the viewfinder. This also allows you to manually change the exposure of the foreground and background independently.

The end result? No matter the lighting conditions, you can rest assured that your pictures will be filled to the brim with intricate details, with well-judged exposures and accurate colour rendition. The Pixel 4 has the ability to seemingly capture colours as your eyes see them. Images aren't under or over-saturated, and there's also not much visual noise – even if you're worried that there isn't enough light in the environment.

The iPhone 11 Pro nudges ahead for sheer detail capture, especially if you compare the images taken using the 2x telephoto zoom cameras. Similarly, in medium to low-light, the Pixel 4 does a mighty fine job at brightening up shots without noticeably altering the colours, but the iPhone 11 Pro is better in near pitch-black environments.

The Pixel 4's camera suite is very impressive, but there's still room for improvement when it comes to video recording – it can shoot stabilised footage at 4K resolution, but if you slowly pan across the scene, the judder is visible.



**BELOW** The Pixel 4 XL (right) is more or less identical to the Pixel 4 – aside from the bigger chassis and higher price



### ■ Buying decision

The Pixel 4 lacks the Big New Feature that demands you upgrade; despite what Google may think, a second camera and gesture controls aren't life-changing. However, when you compile the long list of small changes that you might have otherwise dismissed, along with the addition of Android 10, you'll find they add up to something far greater.

Still, it isn't the high Android watermark I was hoping for. The lack of microSD support, lost fingerprint reader and question marks over its face unlock feature all count against it. Is it the best implementation of Android 10? Absolutely. Is it decent value at £669 for the 64GB model and £769 for 128GB? Yes. Is it currently the best smartphone on the market? For me, that remains the Samsung Galaxy Note 10. **NATHAN SPENDELOW**

### SPECIFICATIONS

Octa-core Qualcomm Snapdragon 855 processor (2.84GHz Kryo 485, 3 x 2.42GHz Kryo 485, 4 x 1.78GHz Kryo 485) ● Adreno 640 graphics ● 6GB RAM ● 64GB/128GB storage ● 5.7in P-OLED screen, 1,080 x 2,280 resolution ● dual 12.2MP/17MP rear camera ● 5MP rear/front camera ● 802.11ac Wi-Fi ● Bluetooth 5 ● 2 x USB-C connectors ● 3.5mm jack ● 4,220mAh battery ● Android 9 ● 171 x 79.3 x 17.3mm (WDH) ● 326g ● 1yr warranty

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HIGHER IS BETTER

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HIGHER IS BETTER



## Amazon Echo Dot with clock

The new Echo Dot takes a winning formula and adds a bright LED clock. What's not to like?

SCORE ★★★★★

PRICE £50 (£60 inc VAT)  
from [pcpro.link/303dot](http://pcpro.link/303dot)

The history of Amazon's own products – misguided attempt at a smartphone aside – is one of small iterations. Whether it's Kindles, Fire tablets or Echos, each new version brings small improvements that you weren't aware you needed until they arrived. The Echo Dot with clock is a great example of this.

Since I reviewed last year's third-generation Echo Dot, it's become a friendly nighttime ally. It can turn off the lights, saving me bumped knees trying to navigate the room in the dark, and play a series of sleep sounds to lull my unsettled mind to rest. But there's a problem. While it can tell the time, I have to ask it out loud and then it shouts back at me. Not ideal at 3am. The Echo Dot with clock solves this dilemma by displaying the time in LEDs across its side.

When switched off, the Echo Dot with Clock looks exactly like last year's model. It has the same chunky 99 x 99 x 43mm dimensions, while

Amazon sticks with the fabric wrap around the sides. It's a look that works well – it's certainly a lot nicer than the plastic puck of the previous Dots. It's only when you plug it in that the change becomes apparent.

Underneath that fabric is a segmented LED display capable of showing a digital clock and other things when required; timers, volume and even the outside temperature.

Cleverly, it adapts its brightness to meet the needs of the room.

Amazon clearly has two rooms in mind for the new Dot: the kitchen and the bedroom. The former is handy for cooking, due to the clock being replaced with a visual countdown when a timer is set. That's so much more useful than having to ask how much time is left whenever you want an update. In the bedroom, setting an alarm places a small circle next to the time and neatly lets you silence an alarm with a tap on the top, like the snooze functions of old.



ABOVE The clock can also display timers, volume and even the outside temperature



“The LED display is very welcome, offering little ‘glance details’ without detracting from the screen-free charm”

LEFT A tap on the top of the Echo Dot will silence alarms – just like the clocks of yore

BELOW The clock cleverly adapts its brightness depending on the environment

Sound quality is as we were, but that's good news. While the second-generation Echo Dot had a thin sound, which was good for audiobooks but not much else, the third generation fixed that with performance in line with what you can expect from a £50 Bluetooth speaker.

Putting last year's model and the clock version side by side, and alternating the same track between the two, they proved impossible to distinguish with surprisingly

resonant bass and reasonably rich music playback across the frequency spectrum. You can even pair a couple of Echo Dots for makeshift stereo sound. Note it retains the 3.5mm audio

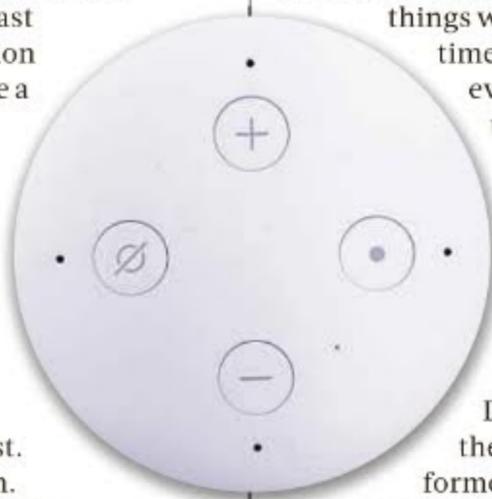
jack output, so you can always plug in a better quality speaker at a later date.

As for Alexa, it's business as usual, although she has a new, smoother sounding voice, closer to Google Assistant's. Oddly, this hasn't arrived on any of the other Echos dotted around my house, but hopefully they'll change to match eventually.

In short, the Echo Dot with clock is everything you'd expect it to be: an Echo Dot, with a clock. The LED display is very welcome, offering little “glance details” without detracting from the screen-free charm smart speakers were supposed to offer in the first place. Alexa still isn't as good as Google Assistant in terms of usefulness (see opposite for more on this), but as a piece of hardware the Echo Dot comfortably beats the Google Home Mini – until somebody puts Google Assistant in a dinky speaker with a 3.5mm audio jack, Amazon has this market sewn up. The clock is just icing on an already delicious cake. **JONATHAN BRAY**

### SPECIFICATIONS

Bluetooth speaker with Alexa • LED display • 802.11n • Bluetooth with A2DP • 3.5mm audio output • 99 x 99 x 43mm (WDH) • 300g • 1yr warranty



## Amazon Echo (3rd Gen)

The same sound quality as the Echo Plus for £50 less makes the all-new Echo a compelling buy

SCORE ★★★★★

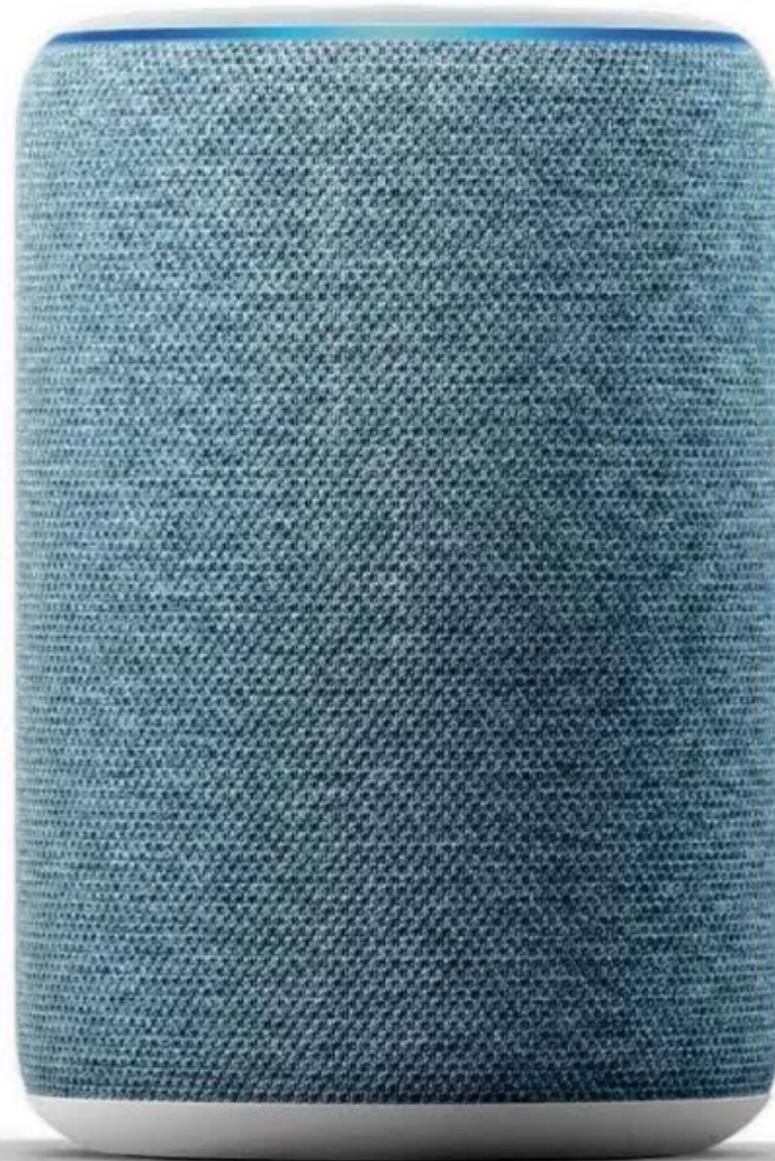
PRICE £75 (£90 inc VAT)  
from [pcpro.link/303echo](http://pcpro.link/303echo)

For those who have been following the smart speaker revolution, the third-generation Echo looks remarkably familiar. But it's not because Amazon has retained the shell from the second-generation Echo. Instead, it takes its design cues and innards from the second-generation Echo Plus (see issue 291, p64), only without the advanced smart-home connectivity that comes courtesy of its built-in hub.

In terms of audio credentials, they're identical, with the Echo 3 inheriting the 3in neodymium woofer and 0.8in tweeter from the Amazon Echo Plus 2. That's an excellent upgrade over the 2.5in woofer and 0.6in tweeter in the second-generation Echo.

This third-generation Echo (let's call it the Echo 3 for short) and the Echo Plus are also impossible to tell apart in real life. And I mean that in the literal sense: I sat the two side by side for testing and they're indistinguishable, barring the thin layer of dust on top of my Plus.

If you own a second-generation Echo, on the other hand, you'll probably notice the new version is bigger: specifically, it's 11mm wider and deeper. Unless you have both side by side, though, this growth isn't obvious. The overall effect is of an extra-large tin of beans wrapped in fabric. Said fabric comes in twilight



blue, charcoal, sandstone or heather grey colours. The cover can't be replaced like it can on the Google Home, so the shade you pick is what you're stuck with.

There's a slightly rounded top that houses the physical buttons: volume up and down, mic disconnect and a physical button to get Alexa's attention if you're playing music too loudly to be heard. I miss the twisting top for volume from the very first Echo, but that's clearly never coming back, and this is a more compact and aesthetically pleasing design. Near the base, there's a power input and 3.5mm jack, which supports output of audio to a beefier sound system or input from a smartphone, tablet or music player.

The first thing you'll notice when you play with the Echo 3 is that Alexa has had a voice lift. The speech on both this and the new Echo Dot with clock (see opposite) sounds far more natural and closer to the tones of Google Assistant.

The second difference you'll notice is the sound quality: the gap between the third-gen Echo and its predecessor is night and day. The sound profile is both richer and warmer, while the thin bass performance of the previous model has been replaced with something far more robust. Perhaps most importantly, it's a substantially better speaker than the £89 Google Home (see issue 273, p56),

which lacks bass and nuance compared to the Echo 3.

Amazon's speaker is also louder, but I don't recommend pushing it up to full volume as the higher frequency notes start to eclipse the bass. In short, this wouldn't be my go-to party speaker.

As I alluded to earlier, the Echo Plus does have a couple of things the Echo 3 lacks. First, there's the built-in smart home hub with ZigBee support, which allows it to talk directly to smart home devices such as Philips Hue bulbs without a separate hub. And second, the Plus has a built-in thermometer to measure the room temperature.

That's all very nice, but is it worth £50? Well, not to me, and I say that as someone with a couple of smart bulbs, a Nest thermostat and a Ring doorbell, so I'm well on the way to the kind of house the Jetsons might have given you dreams about in the 1980s. It's not only the extra cost, either: if you're the kind of person who has already invested in smart home kit, then surely you'll have set it all up already, including your own choice of hub?

On the subject of Alexa, Amazon's smart assistant still isn't the brightest (smart) bulb in the box. Asked simple questions, Google Assistant has always managed to come up with more complete or relevant answers, and the same is true here. Alexa is fine for controlling smart homes, playing music and telling jokes, but more advanced queries are often met by confusion or something unrelated.

That may not be an issue for you. Personally, if I want to find something out, then smart speakers aren't the

easiest way to get answers anyway, and the Echo range of speakers still has far better third-party hardware and software support than Google Home. Where would I be without being able to play

Pointless before bed? Aside from being asleep five minutes earlier.

Your choice boils down to the £89 Google Home - which hasn't seen an update since its debut in 2017 - and its lesser sound quality, or this Echo. If you want a new smart speaker, the third-generation Amazon Echo is the best all-round choice: nothing matches its sound quality at this price.

ALAN MARTIN

### SPECIFICATIONS

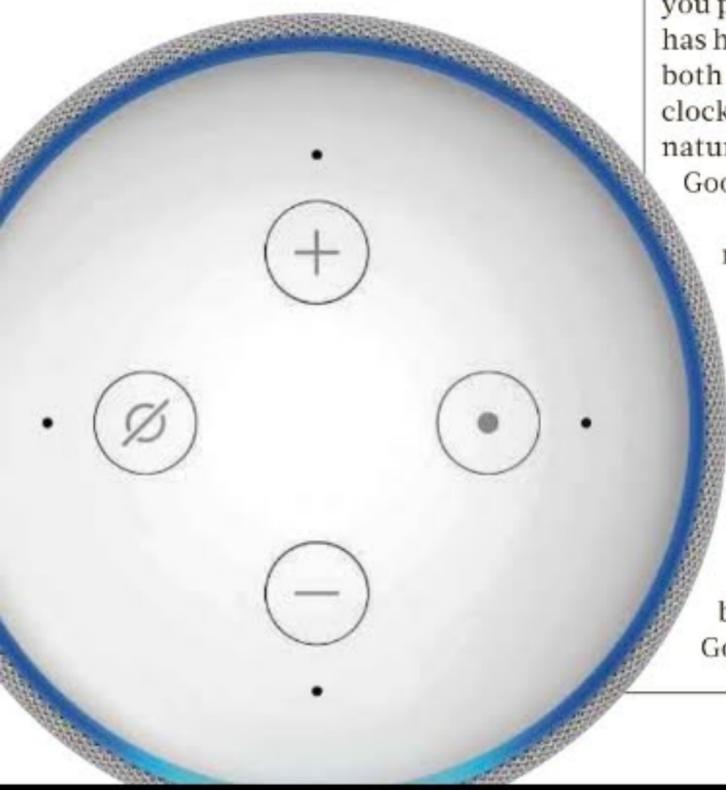
360-degree sound speaker with 3in woofer and 0.8in tweeter • far-field mic • 802.11ac Wi-Fi • Bluetooth (A2DP and AVRCP) • external power supply • 3.5mm audio jack • 99 x 99 x 148mm (WDH) • 780g • 1yr RTB warranty

ABOVE The fabric is available in twilight blue (pictured above), charcoal, heather or sandstone hues



**"Perhaps most importantly, it's a far better speaker than the £89 Google Home, which lacks bass and nuance compared to the Echo 3"**

LEFT The top is slightly rounded and there's a button to summon Alexa when you're blasting out music



# Your bonus software

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

Total  
value this  
month  
**£151**

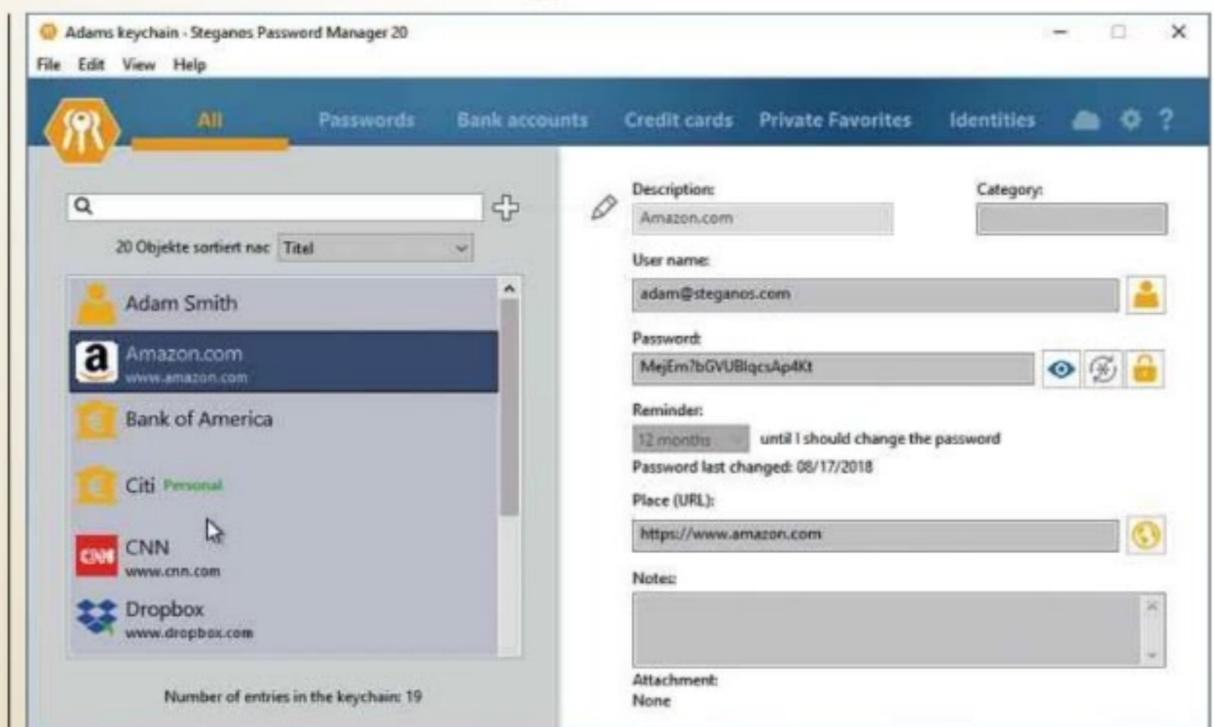
## Steganos Password Manager 20

- Full product worth £24
- [steganos.com](http://steganos.com)

IF YOU'RE OVERWHELMED with passwords, Steganos Password Manager can help you keep track. It stores your credentials in keychains: that is, secure password lists, of which you can create as many as you like, perhaps for use in different locations or by different people. Each one is protected by its own master password, so having access to one doesn't mean you can see any of the others.

Once you've authenticated, your credentials can be automatically entered when visiting a supported site in Chrome or Firefox, or you can simply drag and drop your password into the relevant field.

There's help if you need to use your passwords elsewhere, too. You can install Steganos Password Manager on another computer or on a USB flash drive for access on any convenient PC – or, add it to iOS and Android devices to make your logins available on the move via cloud synchronisation.



**REQUIRES** Windows XP or later; 75MB hard drive space; online registration

## How to claim your bonus software



**1** Visit the *PC Pro* download site at [pcprodownload.co.uk](http://pcprodownload.co.uk). You'll need to enter the coupon code printed on the card, along with your email address. We'll send you an email to confirm that your code has been registered. On subsequent visits, you'll be able to access the download area by entering only your email address.

**2** Once you're into the download area, you can access this month's bonus software by navigating to the relevant product page and clicking the red Install button. For trial software, freeware and other downloads, click the Install button below the product description, or follow the onscreen instructions (please read these carefully).

**3** If the software needs registering, click the purple Register button, or follow the instructions on the left of the product page (again, please read these carefully). In some cases, you may need to register for a *PC Pro* Software Store account – if you don't already have one – and you might be prompted to re-enter the coupon code on the card.

**4** Please be sure to install and register your bonus software before the date shown below. After this date, we can't guarantee that it will still be possible to download or register the bonus software. If you need assistance with the coupon code or registration issues, please contact us at [software@pcpro.co.uk](mailto:software@pcpro.co.uk).

**ABOVE** If you've bought the Bonus Software edition of *PC Pro*, it will include this card between the current pages

**Remember to claim your software by 31 December 2019**

**[pcprodownload.co.uk](http://pcprodownload.co.uk)**

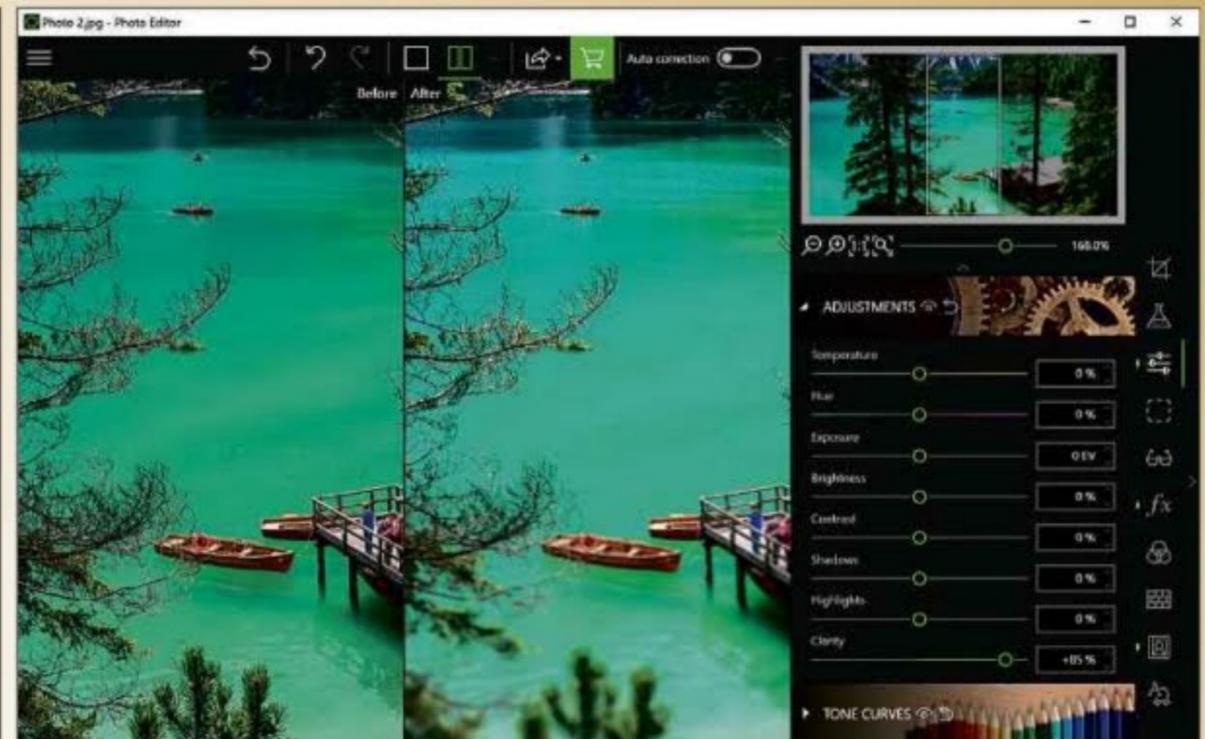
## InPixio Photo Editor 9

■ Full product worth £30  
 ■ [avanquest.com](http://avanquest.com)

THIS POWERFUL IMAGE-EDITING suite helps you make the best of your photos. It offers a range of automatic enhancement filters, with handy previews so you can quickly see how your photo will look with, say, the “Winter” filter applied – plus a split view tool that lets you compare versions side by side.

There are plenty of manual adjustments you can make as well, from altering the temperature of the image to enhancing its clarity. You can overlay a texture, frame or text, and if you need to process several photos at once, you can select them *en masse* and apply the same settings to each.

Once you’ve finished editing, you can export your photo to your hard drive, send it to friends via email or use the social media options built into Photo Editor to share it with the world.



**REQUIRES** Windows 7 or later; 200MB hard drive space; online registration

## KeyDepot 2019



■ Full product worth £28  
 ■ [abelssoft.com](http://abelssoft.com)

**REQUIRES** Windows 7 or later; 40MB hard drive space; in-application registration

- Create secure passwords, store them in an encrypted vault and optionally sync them across all your PCs.
- Organise your websites by categories and KeyDepot will double as a bookmark manager.
- Includes free cloud synchronisation and automatic clipboard clearing to avoid leaving passwords behind.

## Driver Booster 7 Pro



■ Full product worth £19  
 ■ [iobit.com](http://iobit.com)

**REQUIRES** Windows Vista or later; 70MB hard drive space; online registration

- Scan your system for outdated drivers, then download and install replacements with a single click.
- Drivers can be updated individually or all at once, giving you precise control of the process.
- This full product also includes six months of updates to Driver Booster 7 Pro.

## Kaspersky Total Security 2020

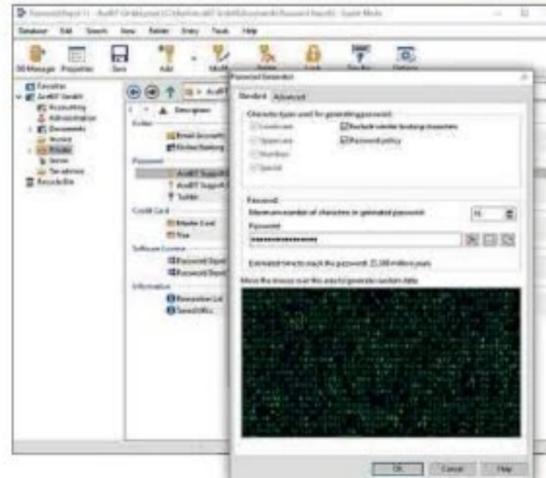


■ Full product with three months of updates worth £10  
 ■ [kaspersky.com](http://kaspersky.com)

**REQUIRES** Windows 7 or later; 250MB hard drive space

- A complete, powerful suite of malware-hunting, anti-hacker and web-safety tools.
- Includes webcam protection and tools to protect your online transactions.
- Software updater checks for patches to common applications and will optionally install them automatically.

## Password Depot 11



■ Full product worth £40  
 ■ [acebit.com](http://acebit.com)

**REQUIRES** Windows 7 or later; 100MB hard drive space; online registration

- This versatile password manager will safely store your passwords, credit card numbers and other confidential information.
- Its secure, encrypted folder can be stored locally, on a USB drive, or on a cloud server for easy access anywhere.
- A built-in password generator creates lengthy and effectively uncrackable passwords for each of your logins.

# Brother's secret of success



## Brother has won PC Pro's Printer Brand of the Year award for six years in a row. So what is it doing that rivals can't match?

It's been a long journey for Brother. Founded as a humble sewing machine repair company way back in 1908, it has become a byword for printer quality and innovation. But we hardly need to tell *PC Pro* readers that you have just voted it Printer Brand of the Year – for the unprecedented sixth year running.

After producing products as diverse as a home knitting machine and portable typewriter, Brother turned its attention to printers in 1971 with the launch of the M-101, a high-speed dot-matrix model. Built in collaboration with the Centronics Data Computer Corporation, it could only produce shapes and illustrations – a far cry from the lush graphics and crisp text the firm is renowned for today.

The turning point came in 1994. Not only was it the year of *PC Pro*'s birth, but Brother produced its first low-cost black-and-white laser printer for small or home office users. The HL-630 came with a price of \$399, making it the cheapest on sale in the US, and set Brother on a path to printer success. It hasn't looked back since.

### Secrets of its success

So what's Brother's secret? Why does it take home the *PC Pro* award year after year? Well, the word that came up time and again in relation to Brother in this year's Printer Brand of the Year survey (see issue 301, p36) was "reliable". Whether they were Brother devotees or first-time buyers, *PC Pro* readers praised the firm's price tags, the lifespan of its devices and, most importantly, the consistently high print quality. Here's a typical comment from a customer: "This is the second Brother I have bought within the last two years. That tells you how well I rate Brother. Both their online support and software are very comprehensive."

While Brother's overall score of 87% in this year's prize may be a drop from 2018's 92% (see chart below for a

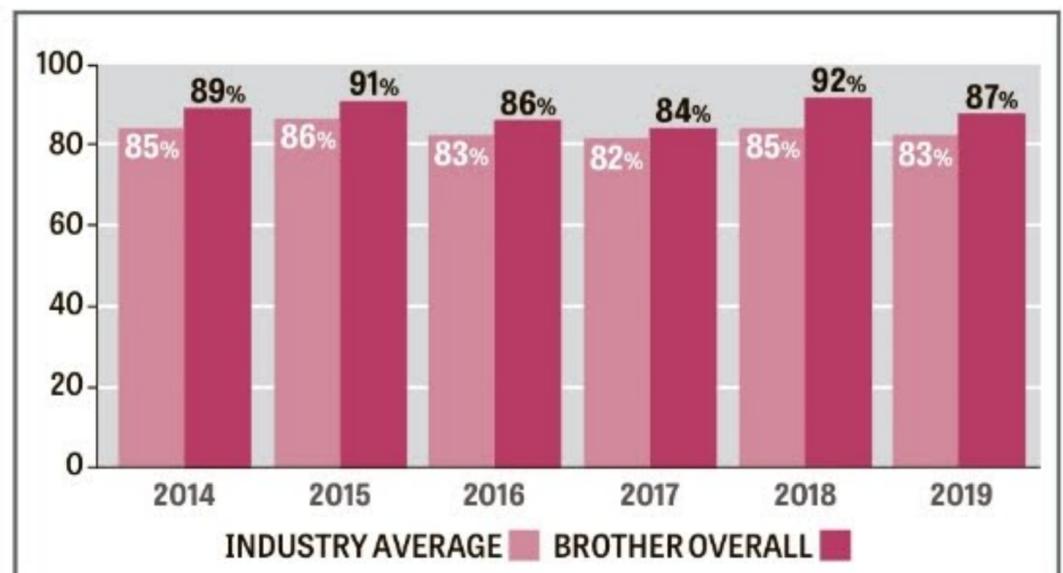
IN ASSOCIATION WITH  
**brother**  
at your side

BELOW Brother has outperformed the industry in *PC Pro*'s reader satisfaction surveys for years

breakdown of its winning totals over the past six years, compared to the industry average), it's still one of the highest any printer brand has ever achieved. This meant it surged well ahead of rivals such as HP, Canon and Xerox. In fact, it beat second-place HP across the board, including by a whopping 6% in the vital value for money category (87% to HP's 81%) – an area where Brother has always performed exceptionally strongly.

And it was a similar story across the other categories: 90% for print quality, making it the second year running that Brother has scored over 90% or over; 88% for reliability, a stellar result in an industry where faults can quickly develop; and 86% for speed, an essential ingredient for life in a fast-paced office. And its customer support score of 73% was the best of the bunch: generally its rivals posted results in the 50s and 60s, with one company scoring 38%.

All of this, along with the fact that its MFC-J6945DW proudly occupies one of workgroup printer berths on the *PC Pro* A-List (see p18), means that Brother consistently delivers the goods across the full range of its products – and should be a top pick for any company or home office looking for a cost-effective and reliable machine.



## Why scanners still rule OK

The scanner has been written off more often than Lewis Hamilton's test car, but those in the know ignore the naysayers.

There's a reason for this:

high-speed standalone business scanners allow you to scan documents, like bank statements or invoices, directly to cloud services such as Dropbox or Google Drive

– without clogging up the printer workflow.

One such option is Brother's ADS-1700W, which was the recipient of a five-star *PC Pro* review (see issue 296, p100) and a coveted Recommended award. With a desk footprint of just 300 x 103mm, the ADS-1700W produces scan speeds of up to 25ppm at 300dpi in both colour and mono, while a 7.1cm colour touchscreen makes setup a cinch.

*PC Pro's* tests found that the bundled optical character recognition (OCR) software did a stand-up job in producing fully searchable PDFs – even when the text was a minuscule size. Elsewhere, Brother has put privacy at the forefront: you can password-protect the touchscreen, limit access to scan functions and even require users to log in with a PIN. In short, "Brother's ADS-1700W packs a lot into its modest dimensions: it's easy to use, well-featured and competitively priced," wrote Dave Mitchell in his review.



**ABOVE** Brother's pint-size ADS-1700W is fast, user-friendly and well-priced

## Which Brother printer to buy

So which is the perfect Brother printer for you? Here are three inkjet, colour laser and multifunction picks that should suit any budget

### Brother MFC-J5730DW

If you're looking for a fast inkjet workhorse for your office, the Brother MFC-J5730DW is an excellent option. Not only does it produce the first page in a mere six seconds, it has a two-sided, 50-page automatic document feeder (ADF), as well as a 100-page multi-purpose paper tray, to ensure that prints are produced as quickly as possible. It can even print A3 pages, despite its compact size. Better still, depending on which of Brother's trusted partners you buy from, the MFC-J5730DW can be picked up for as little as £151, including VAT.



### Brother HL-L3270CDW

After a colour laser? Take a look at the Brother HL-L3270CDW, which is reviewed on page 98 this month. "This colour LED desktop unit offers a 24ppm print speed in both mono and colour, a built-in duplexer and both wired and wireless networking – not to mention top-notch mobile device and cloud support as well," expert reviewer Dave Mitchell explains. In *PC Pro's* tests, even 6pt text was pin-sharp and images were vibrant, backing up Brother's high print quality score in this year's *PC Pro* Awards. However, the headline is surely the price, which is a steal at £159 including VAT from [printerland.co.uk](http://printerland.co.uk).



### Brother DCP-L3550CDW

Need a fully fledged multifunction printer (MFP) for your office that won't cost the earth? Brother's DCP-L3550CDW, which was £186 including VAT on [printerland.co.uk](http://printerland.co.uk) at the time of writing, is just the ticket. It's packed with handy features such as wireless or wired networking, duplex printing and a 50-page ADF. Scans appear promptly, with low-resolution scans finishing in less than seven seconds and a 1,200dpi 10 x 15cm photo scan completing in just 44 seconds. Most impressively, the DCP-L3550CDW is a great multitasker: it can easily handle scanning to a PC whilst servicing a print job. It's a **wallet-friendly** option if you would rather not splash out on a separate scanner (see above left).



## ■ Buying the right consumables

"Cost-effective" is the operative phrase there. As we all know, the initial price of the printer can just be the start of the financial hit: while many third-party ink cartridge brands offer attractive prices, some are a false economy as they may not last very long – or even work at all. But why should you ignore those alluring deals and buy Brother's own, or "Genuine", supplies?

The main reason is longevity: not only are genuine supplies likely to last longer than third party offerings, there's also less risk to your printer. And because they've been developed by Brother, they will also produce higher-quality results.

While all this is common sense, it's backed up by independent testing by Buyers Lab in July 2018 (you can download the report from [pcpro.link/303brother](http://pcpro.link/303brother)). In its summary, the report stated that Brother Genuine supplies produced "more consistent page yields" and "superior performance from start to finish". In particular, it concluded that "most of the output from third-party brands was rated as being acceptable for internal use only".

Brother has also focussed on reducing its – and, therefore, your – environmental impact: aside from using less energy with Genuine supplies and replacing them less often, the company is accredited as "a zero-waste-to-landfill facility". This means that, when your ink or toner cartridges are finished, Brother recycles them at one of its centres for free, helping to achieve the demanding Blue Angel environmental standard. ●

Visit [brother.co.uk](http://brother.co.uk) for more information

# Apple Watch Series 5

The best smartwatch you can buy, but it's only worth doing so if you also own an iPhone



**ABOVE** The activity rings are still in place while the HR monitor is the best around



**BELOW** There's an Apple Watch Series 5 strap to suit any style - and budget

**SCORE** ★★★★★

**PRICE** 40mm, £333 (£399 inc VAT) from [apple.com/uk](https://apple.com/uk)

Apple is yet to make big changes to the Apple Watch with its annual iterations, but even by its standards the Series 5 is a small upgrade: the only major new feature is its always-on screen. How annoying for the competition, then, that it's still the best smartwatch you can buy.

## ■ Small change

As with the Watch 4, the Watch 5 can only be paired with an iPhone and comes in two sizes: 40mm and 44mm. With either you can pick between a GPS-only model and one that also has cellular connectivity, the latter of which is supported by EE, O2 and Vodafone in the UK.

While the always-on screen is the key new feature on the Apple Watch Series 5, it's not the only change to the hardware. It comes with 32GB of storage, up from 16GB, and it has a

built-in magnetic compass and an upgraded altimeter, which measures your actual elevation as well as overall changes in elevation. The cellular variant can also make emergency calls worldwide, rather than only in the country it was purchased.

The Series 5 has the same advertised 18 hours of battery life as the Series 4, despite having an always-on Retina display, and that's thanks to Apple's excellent low-temperature polycrystalline oxide (LTPO) screen. The screen can use different refresh rates to improve efficiency, switching between 60fps when in use to 1fps if not.

When you're not looking directly at the watch, the display dims and the data shown on watch faces and during workouts refreshes more slowly. Turn your wrist to look at the Series 5 and it brightens instantly. However, for now, this feature only works on the main watch face and Apple's Workout app. With other apps, the display blurs and a simple digital time is shown when not in use.

Other than the new screen, the design is the same as on the Series 4 with no difference in weight between the GPS and GPS+ Cellular variants. The aluminium watch weighs 30.8g for the 40mm model without a strap, and 36.5g for the 44mm, with both measuring 10.7mm thick - slightly slimmer than the 11.4mm Series 3.



## ■ Everyday use

If you ever use the Apple Watch to navigate your way around town, the new compass should prove a valuable addition. Instead of the simple blue dot showing your position in the Maps app, you can now see which direction you're facing, making following routes much easier.

The everyday activity tracking on the Apple Watch has always been excellent, with many owners hooked by the concept of filling three activity rings each day. The same system is in place on the Series 5 but a new feature in watchOS 6 is activity trends. This identifies patterns in your activity over long periods of time and takes 90 days to kick in.

Apple has also tweaked its Health app to better show information at a glance, with a new summary section of your day, and highlights of your recent activity, including workouts. I'd be keen to see some of this data make its way onto the Watch itself, though; it would be great to view recent workouts in detail from your wrist, for instance.

## ■ Sports track

When it comes to sports tracking, you can pick from basically any app you want: Strava, Nike+ Run Club, Endomondo and many more are all there. But, as the always-on screen is only available in the native Workouts app, that's the one most people will use, and it's far from perfect.

The GPS tracking, in particular, is where the Workout app stumbles, with corners being "smoothed" and sections of my runs being missed entirely at times. Indeed, during one 30km run that only included six turns, the Watch cut 0.8km from the total distance. But this only happened when the Watch was connected to my phone and presumably piggybacking off its GPS. When I turned off Bluetooth, or left my phone behind, the Watch's distance readings matched up well with a Garmin running watch linked to a calibrated foot pod.

Another complaint is that the Workout app still won't interface with other apps such as Strava natively. You can get around this through the use of a third-party app such as RunGap, which you have to pay for, but you really shouldn't need to.

The always-on screen works well, dimming and reducing the amount of info shown when you're not looking directly at it – the workout duration doesn't show milliseconds, for example. This is a big improvement because during exercise it's not always easy to turn and hold the screen in place for a second to wake it up. Whichever activity you're doing, being able to glance at the screen from any angle is a big plus.

Another major benefit is the accuracy of Apple's heart rate monitor. The Series 4 was the most accurate wrist heart rate monitor I've tested, and the Series 5 has matched it, logging readings within a beat or two of a chest strap throughout several runs and workouts.

Apple has expanded its health-tracking features with watchOS 6 by adding in both menstrual health tracking and a noise monitor. The latter is useful in showing the decibel level of the environment you're in, and whether it poses a risk to your hearing. It does make riding the London Underground a pretty terrifying experience, though; during my commute to work, sound levels were consistently above 80 decibels, which can lead to long-term hearing damage.

Alongside the noise and period-tracking features, watchOS 6 brings a dedicated App Store to the Watch, which allows you to browse and download apps without your phone, at least in most cases – some apps require your phone to be nearby. Having screenshots of the apps to view on the Watch itself makes it easier to visualise how they will look when installed, but it's still easier to hunt down new apps on a large screen with a keyboard rather than scribbling on a watch display or using dictation.

## ■ Smooth operator

The Series 5 has the same 64-bit dual-core processor as the Series 4 – although, confusingly, its been renamed as an S5 chip – and it's brilliantly smooth and fast to use at all times. Switching between apps is snappy, and even when tracking a run with music playing from the Series 5, there was no lag when jumping between apps.

Apple still promises all-day battery life from the Watch despite it now having an always-on screen, and I found that to be true, but it does drain quicker than the Series 4. With the latter I'd usually have 40% to 50% of juice left at the end of a day, using the watch to record outdoor runs and continuously play podcasts. Under the same conditions, the Watch 5 is normally down to 30% to 35% at the end of the day.

That's still enough to make it through a working day reasonably

comfortably, but you'll certainly need to charge it every night. That's nothing new – the Apple Watch 4 needs daily charging under fairly heavy use – but it's disappointing when you considering that the Fitbit Versa 2 (see p72) also includes an always-on displays and lasts up to five days.

## ■ Upgrade time?

The Series 5 starts at £399 for the 40mm GPS version, which rises to £429 for the 44mm Watch. If you want 4G, you can add £100 to that price, and more still depending on your choice of materials. The cheapest is aluminium, while Apple has reintroduced a white ceramic version of the Watch that starts at £1,299.

In a move that has no doubt set alarm bells ringing for its rivals, Apple has kept the Apple Watch Series 3 in its lineup, and reduced the price to only £199 for the 38mm (the 42mm watch starts at £229). The

Series 3 has a smaller screen than the Series 5, and a much less reliable heart-rate monitor, but it might be the most compelling competition for the latest model.

The Apple Watch Series

4 was the best smartwatch I'd tested until the Apple Watch 5 came along, so it's no bad thing that Apple has merely tweaked the blueprint for its new wearable. The always-on screen

is the key update and improves the user experience significantly, especially during workouts, although I'd like to see it extended to third-party apps soon.

Aside from that, the improvements are minor, but Apple has done enough to retain its top-dog status. It has the best range of apps, a gorgeous design and is exceptionally easy and fun to use.

Let's just hope the next generation can deliver an improvement in battery life.

NICK HARRIS-FRY



ABOVE The always-on LTPO screen dims when you're not looking directly at it

**“Switching between apps is snappy, and even when tracking a run with music playing from the Series 5, there was no lag”**



ABOVE Swapping out the watch strap remains a quick, hassle-free process

## SPECIFICATIONS

**40mm model:** 1.5in, 312 x 390 OLED touchscreen • 34 x 10.7 x 40mm (WDH) • 31g  
**44mm model:** 1.7in, 368 x 448 OLED touchscreen • 38 x 10.7 x 44mm (WDH) • 37g  
**Shared:** Dual-core Apple S5 processor • 32GB storage • 802.11n Wi-Fi • Bluetooth 5 • heart-rate sensor • altimeter • compass • gyroscope • GPS • water resistant to 50m • watchOS 6 • 1yr RTB warranty



## Fitbit Versa 2

A touch short of greatness, this excellent all-rounder only needs GPS and offline Spotify to make it a winner

SCORE ★★★★★

PRICE £167 (£200 inc VAT) from [fitbit.com](http://fitbit.com)

At the time of its launch, the Fitbit Versa proved to be a big money-spinner for a company that was struggling to keep up with the modern world of wearables. Fitbit was being squeezed from three directions: the expensive Apple Watch (see p70), cheap Chinese fitness bands such as the Xiaomi Mi Band, and by dedicated running watches from Garmin and Polar. The Versa almost single-handedly turned around the company's fortunes, giving it its first quarter of profit in ages. It's perhaps no wonder that it's hoping to repeat the trick with a sequel: the Fitbit Versa 2.

### ■ Don't break it

If it ain't broke, don't fix it seems to be Fitbit's main mantra with the Versa 2, as the company tries hard to make modest improvements that won't disrupt the watch's popularity. That means you're still looking at a device that bridges the gap between smartwatch and fitness tracker. Steps and activities take front and centre, and it all ties in nicely with the excellent Fitbit app, but it also has notifications and acts as a bridge from phone to wrist.

So what's new? Three things stand out. First, the screen is now OLED, rather than the LCD of old. This means deeper blacks and more vibrant



illusion. First of all, it's 12mm thick, which doesn't sound like a lot, but that's about 50% more than your average smartphone. Because of the way it tapers inwards, though, it looks much thinner than it actually is.

Second, if you look closely you'll see the Versa 2 has a thick bezel all the way around the screen – but because the background is black on every menu, you only really spot this in bright sunlight. In short, Fitbit has done a masterful job of hiding aesthetic imperfections in such a way that only a killjoy like me will go out of his way to find them. Bravo, Fitbit.

It's comfortable, too, with straps that can be replaced should you want to mix things up. I've been wearing the salmon pink and rose gold number Fitbit sent us, which has raised a few eyebrows from friends and family as it's somewhat out of step with my usual colour palette, but I could have swapped the strap easily enough.

Before we leave the watch design, it's worth labouring the point about the new OLED screen. It doesn't only improve battery life, but it's also an

always-on display – which means you don't need to move your wrist to read the time or see your steps at a glance. Note that it isn't switched on by default because Fitbit says it reduces battery life by a day.

It's a good screen, too. The 300 x 300 resolution is sharp enough to show off the watch's bright array of icons and you can always see what's on the screen at a glance.

### ■ Keeping up

Those good vibes continue into performance, with the Fitbit Versa 2 diligently tracking your activity as you go along. Steps are counted, notifications buzz through and if you want to interact more with it, then music, exercises, breathing and other apps are just a swipe away. The Versa 2 is generally seen and not heard, and that's absolutely fine.

Amazon's virtual assistant Alexa comes in courtesy of a microphone on the side of the watch. Hold down the button and the Alexa logo will pop up to show it's listening. Ask a question and then, after a short

colours but also likely contributes to the second improvement: battery life. Fitbit says the new Versa will last at least five days, rather than the four days plus of the older model. Thirdly, and I would argue least usefully, the Fitbit Versa 2 has a built-in microphone for chatting with Alexa.

Still missing in action: GPS. Instead, the Fitbit Versa 2 piggybacks off your phone. If you want a Fitbit with GPS, you need to buy the Ionic.

### ■ Sleek design

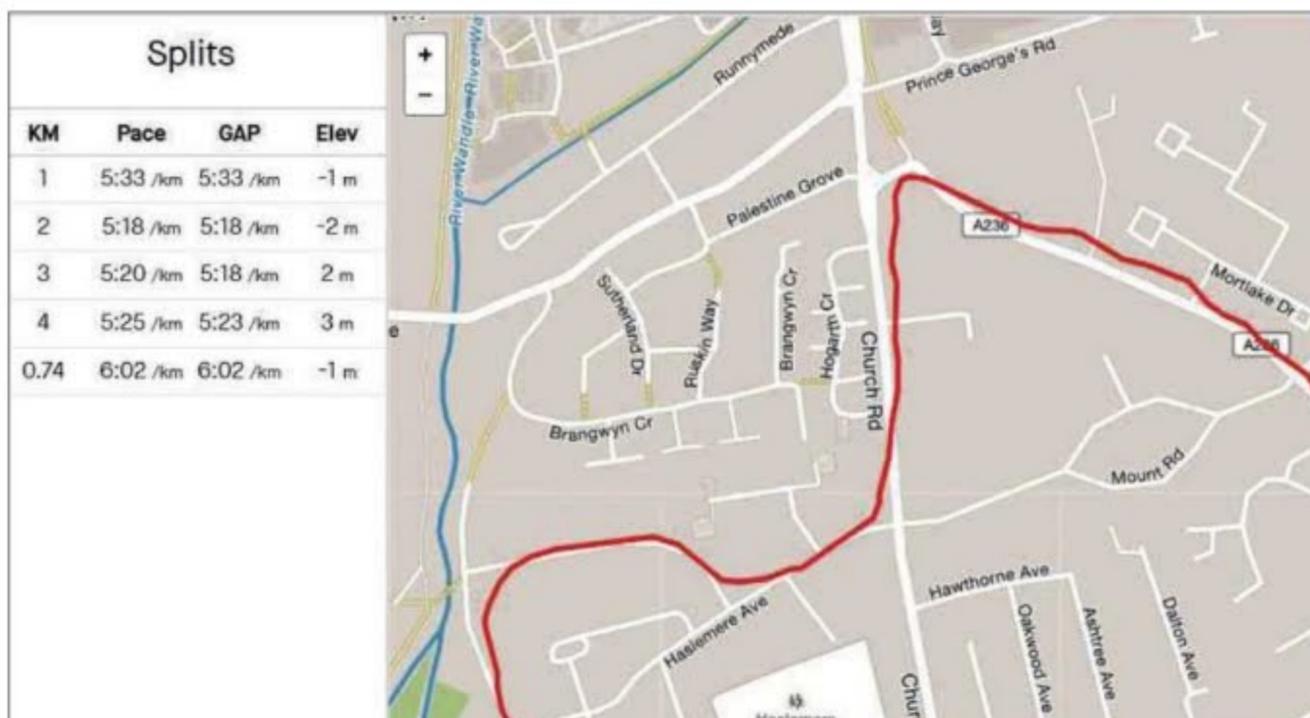
The Fitbit Versa's design was one of its strongest suits, and the new one is every bit as attractive – in fact, I think it's as stylish as the Apple Watch, with a sleek square face, gentle rounded edges and single, unobtrusive button.

It's quite remarkable how stylish it looks on the wrist, because to some extent its good looks are an optical

**ABOVE** The screen is OLED, rather than LCD, meaning deeper blacks and richer colours

**“Fitbit has done a masterful job of hiding aesthetic imperfections so that only a killjoy like me will go out of his way to find them”**

**BELOW** No, Fitbit, I kept to the roads and didn't run through people's gardens



“thinking...” message, the answer to your question will be written on the screen, not read aloud.

There are limitations to this. You can't ask Alexa to play music on Spotify, for example, even though the app is there on the watch. But you can get it to set timers and control smart home kit – I truly lived the dream by turning on and off lights from my wrist.

While Alexa works well, I don't think it's a game changer: the gap between asking a question and getting a very basic answer is long enough that most people would probably dig out their phone by preference anyway.

You also have the choice of making the button trigger Alexa or Fitbit Pay – whichever one you choose not to use is relegated to an awkward swipe when you want to use it. But the truth is neither is a killer feature. While the idea of paying for things from the wrist is tried and tested, Fitbit Pay has such weak support in the UK that the chances are you won't be using it (unless you bank with Santander).

App support is growing and it's good to see Fitbit bundling both Strava and Spotify alongside its own first-party apps, although the latter is a remote control for phone playback, rather than a fully built-in music player. Yes, you can add MP3s of your own, but in this streaming-first era, that's still a drawback. Although, given the lack of GPS, you may want to take your phone with you when you run or cycle anyway.

Which brings me to this watch's big weakness. Built-in GPS is a must for some and I'm sympathetic to this viewpoint, especially after the experience of piggybacking off my own Huawei P20 Pro. To be clear, Huawei's aggressive battery-saving tech has known issues with various wearables (pro tip: put the Fitbit widget on your Android homescreen to keep it alive) and it's worth noting that you are at the mercy of your phone here: if you know it has weak GPS then this may not be the watch for you.

A couple of cases in point. At the Sutton Coldfield 5K parkrun, the Versa 2 measured the course as 5.15km. Weirdly, it said 5.25km on the watch, but revised things to 5.15km when it synced to Fitbit's app. Both were wrong, anyway, and obviously this will cause problems if you use mid-run stats to adjust your pace. As a second test, I took the Versa 2 out running on a regular route around my neighbourhood that Mapometer measures as exactly 5km. Fitbit said I did 4.74km this time, giving me an average pace that was

slower than I actually achieved. The reason for this is clear when you dig into the mapping data (see the map screenshot opposite).

Suffice to say, I was strictly sticking to the pavement, yet the data has me cutting huge corners, running through houses and gardens.

This isn't necessarily Fitbit's fault, but it underlines the perils of relying on phone data rather than bundling a dedicated GPS chip.

### ■ Buy time

The Fitbit Versa 2 is frustratingly close to being amazing. However, I couldn't make it my main watch without a GPS chip. It's a shame the company doesn't make a Versa 2 Pro with GPS



**ABOVE** Hold down the button and Alexa will pop up, before replying with a short written message

built in, because it's far nicer to look at and use than the now ancient Fitbit Ionic (see issue 279, p74).

As it stands, the Versa 2 might still be perfect for you. If your phone's GPS is up to the task, then this is a wonderfully sporty smartwatch. It looks great, it lasts for days and it benefits from the superb Fitbit app. Although I question the need for Alexa on your wrist, the OLED screen makes it a worthy successor to the smartwatch that put Fitbit back on the map. **ALAN MARTIN**

### SPECIFICATIONS

1.34in OLED display, 300 x 300 resolution ● 802.11n Wi-Fi ● Bluetooth 4 ● accelerometer ● SpO<sub>2</sub> monitor ● heart-rate sensor ● altimeter ● ambient light sensor ● microphone ● NFC ● water resistance to 50m ● Fitbit OS ● 2yr RTB warranty

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## Huawei Watch GT 2

The Watch GT 2 offers heaps of fitness-tracking tools and unrivalled battery life, but app support is poor

SCORE ★★★★★

PRICE 46mm, £200 (£240 inc VAT) from [huawei.com](http://huawei.com)

Don't tell Donald Trump, but the Huawei Watch GT 2 is listening. It comes with a microphone and speaker, so you can answer phone calls on the Watch GT 2 when you're in range of your phone. The good news for Mr President? There's no cellular version of the watch, so probably no need to ban it.

This doesn't mean you have a shortage of options. Not only does the Watch GT 2 come in two sizes – 42mm and 46mm – but you can buy straps in an array of colours. The Watch GT 2's stainless steel and plastic casing looks great with sporty silicone straps and leather wristbands alike, and it's comfortable: it's 22g lighter than the equivalent-sized Samsung Galaxy Watch and 1.3mm slimmer. I never once woke with the urge to take it off.

One significant change from the original GT is the bezel-less design. That's more obvious on the smaller 42mm model, while the 46mm edition has second and minute markers printed around the edge of its glass front. Regardless of which size you choose, two crown-style buttons sit on the right edge; one of these opens the app list while the other can be mapped to a function of your choice.

At the centre of everything is the watch's always-on AMOLED screen. On the larger model, it's a 1.39in 454 x 454 resolution panel, while the smaller watch has a 1.2in 390 x 390 screen. Colours looked punchy with excellent contrast levels, and the resolution is such that you can make out every detail on the device's intricate heart rate graphs.

Where things start to fall down, however, is the watch's software. For



ABOVE The GT 2's screen is punchy, and the second and minute markers of the 46mm model are a nice touch

example, configuring the screen to be always-on requires you to open the Advanced menu in Display settings, then ignore the Screen on and Sleep options, instead tapping Lockscreen before selecting Digital or Analogue instead of the default option of None.

Notification delivery is another area where the Huawei Watch GT 2 could do better. Although alerts normally appear in a timely manner with a vibration, there's no option to interact with them in any meaningful way. Then there's the lack of an app store; the Apple Watch and Wear OS wearables provide endless options for expanding your watch's functionality.

Not everything about the software is bad, though. The smartwatch's accompanying Huawei Health app, for instance, works well. As with most such apps, it's here that you see all your important metrics at a glance, including step counts, exercise, heart rate and sleep data. Delve deeper and you'll uncover hidden depths. Sleep tracking is especially impressive, with a breakdown of time spent in deep, light and REM sleep.

Stress tracking is similarly detailed, showing charts for the last day, week, month or year, along with short canned summaries. Likewise, the Huawei Health app gives you no end of data to sink your teeth into

**“Sleep tracking is especially impressive, with a breakdown of time spent in deep, light and REM sleep”**

when reviewing workouts you have recorded from the watch, from pace and heart-rate information to average cadence and stride length.

This watch's appeal goes far beyond runners, too. With water resistance up to 50m, it's even suitable for open-water triathletes as well as keen cyclists. And note the 4GB of storage for up to 500 songs, so there's no need to bring your phone.

At the other end of the fitness spectrum, there's plenty of help for couch-to-5Kers. From the mobile app and the watch itself, you can browse a range of running plans that take you through structured workouts to help you improve your fitness.

Unlike the Fitbit Versa 2 (see p72), it does a fine job of tracking your location, while heart-rate tracking was even better: I paired the far more expensive Garmin Fenix 5 Plus with a chest strap and, whenever I glanced at my wrist, the two showed readings within a beat or two of each other.

After five days of using the watch with its “real-time” heart rate monitoring switched on, and the always-on lockscreen enabled, it showed 40% battery remaining. Switch the heart rate monitoring to “smart” and pick more conservative display settings, and it could last ten days between charges. According to Huawei, the 46mm Watch GT 2 will last for 30 hours of continuous GPS recording, while the 42mm model can keep going for 15 hours. In short, its battery life is far better than any Wear OS watch.

But there's a catch. Because the GT 2 runs LiteOS, there are none of the Google apps you'll find on, say, the Huawei Watch 2 (see issue 272, p65). You can link the watch with Google Fit and MyFitnessPal, but there are no apps from Strava,

Nike, Runkeeper or Runtastic. Also note the lack of NFC, which means you can't make contactless payments.

While it's great that you can use the Watch GT 2 with an Apple or Android phone, and I can't deny that it has superb sports-tracking credentials for its price, it's hamstrung by being unable to export your data to other platforms. As it stands, the Watch GT 2 is little more than an attractive fitness tracker. **EDWARD MUNN**

### SPECIFICATIONS

1.39in 454 x 454 AMOLED display • Kirin A1 processor • 4GB storage • GPS • Bluetooth 5.1 • heart-rate sensor • gyroscope • geomagnetic sensor • air-pressure sensor • ambient-light sensor • 5ATM water resistance • 1yr RTB warranty • LiteOS • 45.9 x 10.7 x 45.9mm (WDH) • 40g

LEFT Straps come in a huge range of colours – from sporty silicone to classic leather



## Logitech MX Keys

Yes, it's overpriced, but if you want a luxury keyboard to match your luxury MX Master mouse, you'll love it

SCORE ★★★★★

PRICE £83 (£100 inc VAT)  
from [logitech.com](https://www.logitech.com)

We all know that mice get lonely when left on their own, which is why Logitech has created the wireless MX Keys to accompany its excellent MX Master 3 mouse (see issue 301, p65). Finished in the same industrial chic grey, the moment you lift the MX Keys from its eco-friendly packaging it's obvious you've bought a top-quality device: its all-metal plate only adds to the feeling.

Most crucially, though, the MX Keys is lovely to type on. Concave key tops mean that your fingers sit comfortably in place whether you're mid-flow or sitting in "home" position, ready to start touch typing. And if you're used to a mechanical keyboard, it's pleasantly quiet, too. The keys don't have the same triumphant feel of a Cherry MX Red, but there's enough travel and



positivity that you know you've hit the right key.

There are no feet to adjust this keyboard's height, but I found the 8mm lift created by the battery/antenna unit at the rear to be sufficient. This battery keeps going for up to five months on a single charge via the USB-C connector, but note that drops down to around 500 hours of use if you switch on the backlight. However, this cleverly switches itself off if it detects that you've stepped away from the keyboard.

Other neat features tie in with the MX Master mouse, including the ability to flow between up to three computers: by using the same Logitech dongle, and its software, if you move the mouse to the edge of one window it knows you want to slide over to a neighbouring system. Or

ABOVE The industrial grey look and all-metal plate scream quality – and a high price



you can simply pair the MX Keys with three different computers (it supports Windows, Macs, Linux, iOS and Android) and manually select the one you want using the shortcut keys.

Note that you can buy an accompanying palm rest at the time of purchase by opting for the £109 version, but whichever you choose Logitech is asking for a lot of money. Even bearing in mind the two-year warranty and promised lifetime of ten million keystrokes, that's difficult to justify. Nevertheless, if you already own an MX Master mouse and love the design, you will enjoy using it long after the memory of its price has gone away. **TIM DANTON**

### SPECIFICATIONS

Bluetooth/RF wireless keyboard • 10m range • adjustable backlighting • USB-C • supports Windows, Linux, Android, iOS and macOS • 430 x 20.5 x 132mm (WDH) • 810g • 2yr warranty

## Canon Zoemini

It's tiny, fun and produces better prints than HP's Sprocket, but the Zoemini is still an indulgence

SCORE ★★★★★

PRICE £71 (£85 inc VAT)  
from [pcpro.link/303zoe](https://www.pcprouk.com/303zoe)

The Zoemini photo printer is Canon's answer to the HP Sprocket. About the size of a thick, small smartphone, it's highly portable yet contains everything you need to print 2 x 3in photos, beamed via Bluetooth. I reviewed the standalone printer, but the range includes the Zoemini C and Zoemini S, each of which combines a printer and digital camera in a single device.

Like the Sprocket family, the Zoemini uses Zink's specialised ink-free paper, available in packs of 20 or 50. Slide open the cover, load a bundle of ten sheets, and the printer

spits out the blue information page and is ready to go. You'll also need Canon's Mini Print app, available for iOS and Android phones; there are no PC or Mac drivers.

Links on the app homescreen cover the camera and gallery, and connected platforms including Facebook, Instagram, Google Photos and Dropbox. Elsewhere the app is overrun by icons for its various editing functions, and it takes time to understand what all of them do. You can apply a range of colour, border, sticker and text edits to photos, and experiment with augmented reality "enhancements" in the camera view. Mostly you can just add glasses, or borderline-unpleasant facial distortions.

Zink paper combines distinct yellow, cyan and magenta layers. Initially the dyes are in clear crystals, but by applying heat pulses of different length and intensity, the printer melts them, revealing the dyes to create a full-colour picture. Unlike dye-sublimation printers, it happens in a single pass. I timed a single print at 48 seconds, which is slightly faster than the HP Sprocket New Edition.



ABOVE You can add a whole host of stickers and borders to your photos via the app

Print quality isn't a strength of the Zink system – you'd get better results from an inkjet – but photos from the Zoemini were noticeably better than those from the Sprocket. The latter tends to overexpose prints, bleaching out lighter areas and adding a red tint for good measure, but prints from the Zoemini are more neutral, manifested most noticeably in natural-looking skin tones. There's a slightly darker bias, preserving more information in light skies and lightly exposed faces, but the flipside is a loss of shade detail in some prints.

The Zoemini isn't designed as a general-purpose printer: it's aimed at people who want to produce and share instant photos. While I could grumble about it being an indulgence, and how each print costs 44p, that would be missing the point. The Zoemini is a fun way to remember and share good times, and it's slightly better at it than HP's Sprocket. **SIMON HANDBY**

### SPECIFICATIONS

Portable Zink 2 x 3in photo printer • Bluetooth 4 • NFC • supports Android and iOS • lithium-ion 500mAh battery • 82 x 118 x 18.7mm (WDH) • 160g • 2yr warranty



NETFLIX

# Best VPNs

We test 16 affordable VPN services that promise to shield your identity and unblock the internet

**D**o you need a VPN? If you value your online privacy then yes, you do. Without a VPN, your ISP can track and record everything you're doing online. Connecting to a no-logs server through an encrypted VPN tunnel ensures that your activity can't be snooped on. Even the sites you're visiting won't be able to trace the connection back to you.

There are other benefits to using a VPN, too. Remote servers can give you access to sites and services that are normally blocked by your ISP – or by your network administrator, or even your government. And if you route your traffic through a different country, you can access geo-restricted sites, too: feel free to enjoy what Netflix or Amazon Prime have to offer in other regions or take your laptop abroad and access BBC iPlayer as if you were at home.

This month we put 16 VPNs to the test, comparing their performance through servers around the world, trying out their advanced features and picking apart their various pricing options. With subscriptions as low as £1.59 a month, a virtual private network could be the cheapest tech upgrade you have ever treated yourself to; read on to find out which one is right for you.

Contributor: Darien Graham-Smith

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BBC  
iPlayer



# BUYER'S GUIDE: YOUR VPN QUESTIONS ANSWERED

Ready to start protecting your privacy? Here are the key facts you need to know to make the right choice

## 1 What is a VPN?

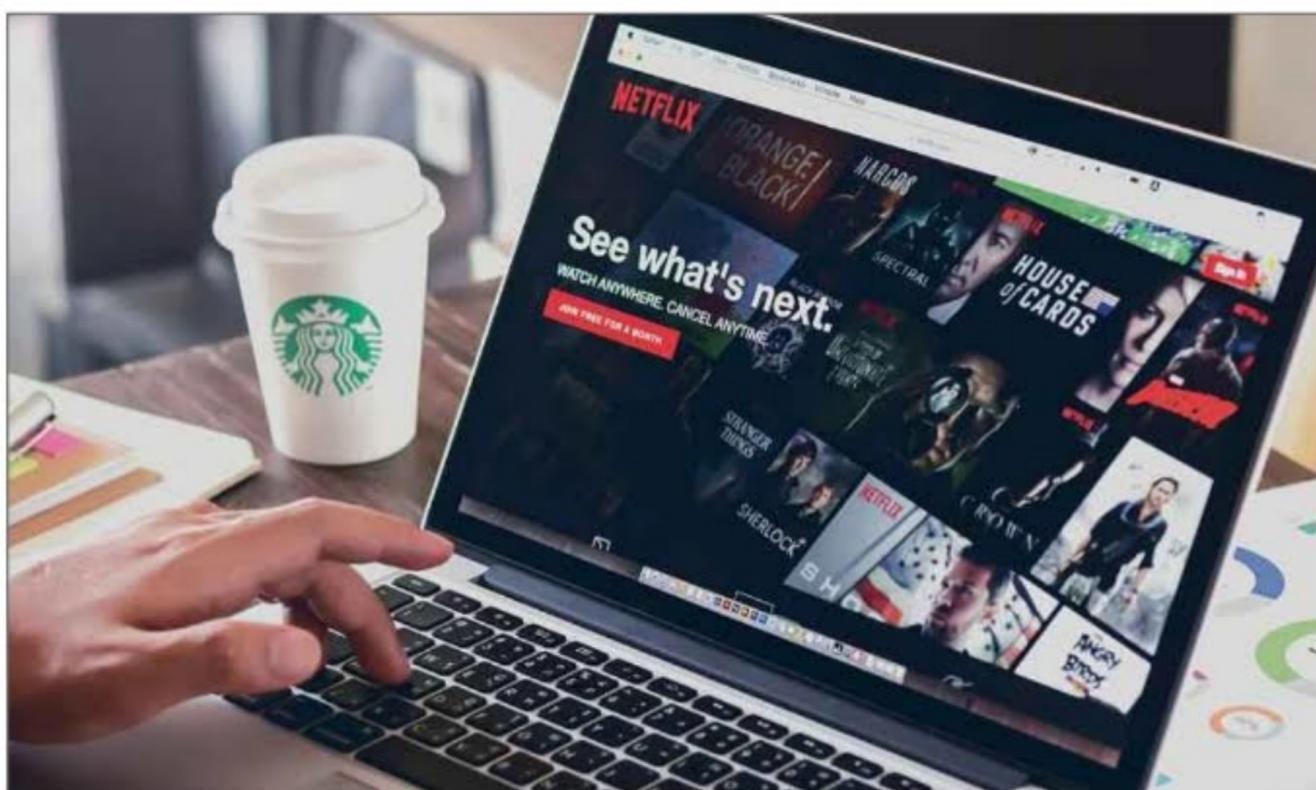
A virtual private network – a VPN, for short – is an encrypted data channel between your computer and a VPN provider. When it's active, all of your internet traffic goes through it and the VPN provider acts as a secure go-between, forwarding data back and forth between you and the servers and sites you want to access. This means that your ISP can't see what you're doing online, and the sites you connect to won't know who or where you are.

## 2 Why do I need a VPN?

There are several good reasons for using a VPN. In business, virtual private networking is used to provide secure access to internal servers from employees' homes or hotel rooms. As an individual, you might similarly use a VPN to ensure that no one can snoop on your connection when you're accessing banking or shopping sites over a public Wi-Fi hotspot.

Then there's the identity-protection aspect of VPNs. A VPN gives whistleblowers a safe way to post on public message boards: if the authorities demand access to the board's access logs, all they'll see is an anonymous connection from a VPN provider. And if you're not a political dissident, the technology can also defeat online surveillance and share files in a way that can't be traced.

Due to the roundabout way in which VPNs work, they can also defeat site-blocking technologies: for example, if Facebook is blacklisted on your university network, you can still access it via a VPN. Many VPNs are even able to get through the "Great



**ABOVE** A VPN can unblock streaming services that are normally blocked from the UK

**BELOW** Certain VPN providers offer servers that are specifically optimised for file-sharing

Firewall of China", opening up sites that can't normally be accessed via Chinese ISPs.

Finally, all VPNs allow you to access the internet from a wide range of virtual locations all over the world, so you can also get around geographic restrictions. Many VPN customers use their services to simulate a presence in the US, so they can access the Netflix US library or use BBC iPlayer when in other countries. This isn't always guaranteed to work as Netflix does periodically try to clamp down on location spoofing – but at the time of writing almost all of the VPNs in this month's Labs instantly unblocked the US library.

## 3 Why does it matter where my VPN is based?

If you can use a VPN to surf via any country you like, does it really matter where the service itself is located? Well, it might. All of this month's VPN operators promise that they don't store any information about your online activity – so no one can find out what you got up to last week.

However, a VPN necessarily needs to store some information about you, so that it can handle your connection and process your payments. That's information that it could be forced to give up by the local authorities. It's even theoretically possible that a VPN could be served with a court order requiring it to start recording details

of your activity. If you're serious about privacy, that's a possibility you should be concerned about.

You might, therefore, opt to steer clear of VPNs based in the so-called "Five Eyes" nations – namely Australia, Canada, New Zealand, the United Kingdom and the United States – which have agreements to cooperate on investigations and share intelligence. Choose a service based somewhere more obscure, such as the British Virgin Islands or Panama, and it will be much harder for the UK authorities to get their hands on your personal data.

## 4 Is it legal to use a VPN?

VPNs themselves are legal almost everywhere, including the UK. Regular travellers should note that they're banned in Turkey and Russia, while China places limits on their usage – but such laws are primarily intended to make life difficult for political dissidents and terrorist groups. We've yet to hear of a private individual being arrested anywhere in the world just for using a VPN.

Of course, it's possible to use a VPN for illicit purposes. Some VPNs actively encourage the use of BitTorrent over their networks, even though it's illegal to share copyrighted material in the UK; in practice that's a moot point, as the VPN connection makes it extremely unlikely that you'll be caught. As for accessing

For torrenting  
Choose from the list below and connect to one of the servers optimized for fast and safe downloads.

Name	Distance	Load	Favorite
Greece 138 users	2,388 km	25 %	☆
Russia 105 users	2,494 km	36 %	☆
Cyprus 28 users	3,212 km	10 %	☆
Greenland 40 users	3,241 km	14 %	☆
Egypt 31 users	3,332 km	11 %	☆
Georgia 28 users	3,529 km	9 %	☆
Armenia 44 users	3,607 km	15 %	☆
Iran 18 users	4,390 km	6 %	☆

Netflix US from the UK, technically this breaches the terms of your Netflix subscription – but again, we’ve never heard of anyone getting into trouble for this.

## 5 Will a VPN slow down my connection?

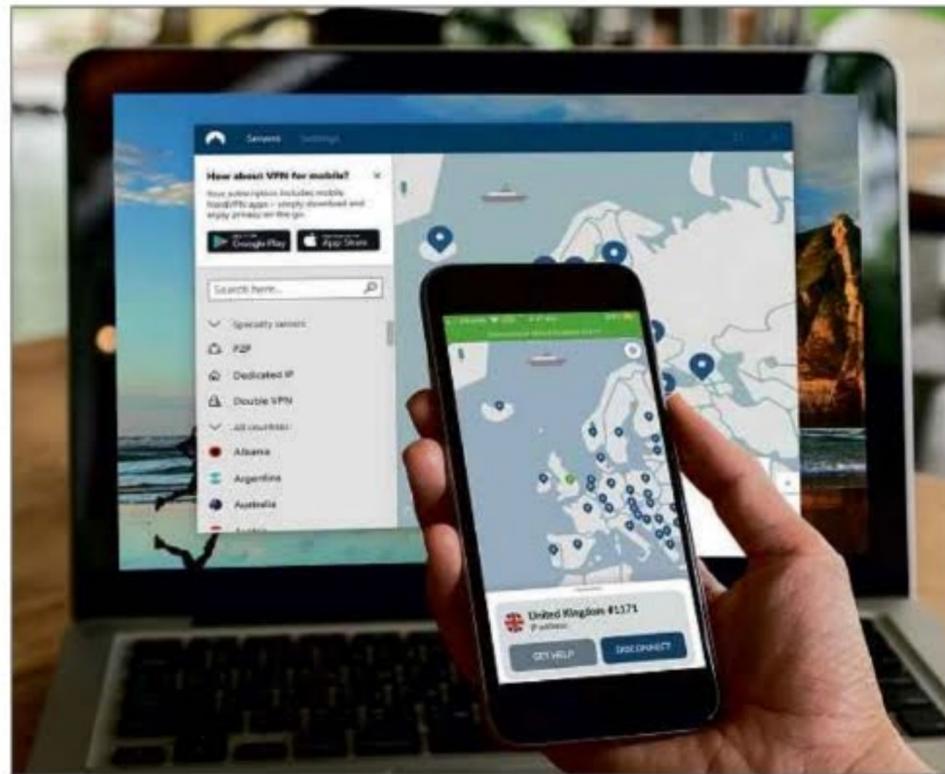
Yes, but if you connect to a nearby server the impact should be small. We tested this month’s VPNs using a 110Mbps/sec domestic fibre line, and regularly saw download speeds in excess of 100Mbps/sec when connected via the Netherlands. If you want to access Netflix US then you’ll need to open a transatlantic link, which tends to be slower, but many VPN operators have excellent lines either to the east coast or to Silicon Valley – we’ve seen downloads zoom along as fast as 98Mbps/sec all the way from California. For reference, Netflix recommends a connection speed of at least 5Mbps/sec for Full HD video and 25Mbps/sec for a 4K stream.

When browsing from a more distant locale, you can expect things to go more slowly. When we connected via Australia, different VPNs gave us speeds ranging from a maximum of 66.2Mbps/sec all the way down to just 10.8Mbps/sec.

## 6 Do I have to pay for a VPN connection?

Of this month’s crop, Hotspot Shield, TunnelBear and Windscribe all offer free VPN services – but these only let you transfer a certain amount of data within a certain period (and it’s naturally not enough to binge on video streams). For unlimited data, you’ll have to pay.

Many other VPNs offer time-limited free trials, however, so you can check performance and compare



**ABOVE** Mobile devices can be protected as well as your desktop PC; even smart TVs can get in on the act

**“Some services accept payment via Bitcoin, so you can sign up without your bank knowing anything about it”**

the software before you commit. Some services accept payment via Bitcoin and other niche currencies, so if you really want to keep your activities private, you can sign up without your bank knowing anything about it.

Pricing varies a lot, but as a rule you can expect to pay a steep rate for a monthly subscription, while annual and multi-year deals are much better value. Most operators offer a no-quibble money-back guarantee, so you can change your mind within

the first month or so if you realise you’ve made a mistake.

## 7 Will my chosen VPN work on all my devices?

All of this month’s VPNs offer apps for Windows, macOS, Android and iOS, but check how many simultaneous connections are allowed: most services only let you use the VPN on a limited number of clients at once.

You may also want to look into which other platforms are supported. If you have an Android TV or an Amazon Fire TV Stick, a native VPN client lets you use your remote control to switch regions for Netflix and other streaming services. Most VPNs also offer a browser extension that lets you conveniently control the secure connection while surfing.

If you want blanket protection for all the devices in your household, you might be able to configure your router to send all traffic through the VPN. This ensures that nothing slips through the net, and it’s a handy way around the limit on simultaneous connections. However, not all routers or VPNs support this feature, and sending all your traffic via the same virtual location could drag down your general internet speeds.

## 8 Do I need a kill switch?

Most VPN client apps include a “kill switch” feature, which freezes all internet traffic as soon as the secure connection is terminated. If you’re just using your VPN to unblock remote sites or video services then you probably don’t need this – but if you’re sharing sensitive information it’s a must. Without a kill switch, apps and web pages may continue to refresh or download data after you’ve disconnected from the VPN; these connections will now be routed via your ISP, instantly exposing what

you’ve been doing online.

A related concern is what’s called a DNS leak. Simply put, this is when domain lookup requests are sent to your ISP, even while the secure VPN tunnel is active. A leaky setup would let your ISP know when you were visiting (say) a particular political forum, although it wouldn’t know exactly what you had been reading and posting. The good news is that we’ve tested all of this month’s VPNs with the free leak-testing service at [doileak.com](http://doileak.com), and can confirm that no leaks were detected.

## 9 What other features should I look for?

Some VPNs keep it simple, but others come with optional features that can improve your overall experience. Split tunnelling is a handy one, allowing you to route only nominated apps or websites via the VPN, while everything else goes through your ISP – a great way to minimise the performance hit. Some VPN clients can also detect when you connect to an unsecured Wi-Fi hotspot, and automatically initiate a private connection to ensure you can’t be spied on. A few will even remember all the different networks you’ve used in the past, and automatically connect to a particular server or stand down, according to your preference.

Then there’s “Double VPN” – an extreme privacy measure, which routes your traffic out of one remote server and into another located somewhere else in the world, making it even harder for anybody to trace your activities. Finally, a static IP option allows you connect every time from a unique address, registered in the country of your choice. This costs extra, but makes it all but impossible for the sites you visit to identify that you’re using a VPN.

## How we test

Each VPN in this month’s Labs receives a star rating out of five, which takes into account performance, ease of use, features and value for money.

To test performance, we install each VPN client on a standard laptop running Windows 10 Professional, connected via Ethernet to a domestic fibre broadband line rated at 110Mbps/sec. We then connect to a selection of VPN servers in different parts of the world and run speed tests using the free Ookla Speed Test tool at [speedtest.net](http://speedtest.net). Our reviews focus on the single-connection testing mode, which measures downstream speeds for a single download or video stream; you’ll find the results in our graphs on p94.

We also try out all the features of each VPN, and rate each one for its versatility and usability. Value for money is calculated by comparing the effective monthly cost of each product’s monthly, annual and other subscription options – as again detailed on p94 – in light of its performance and feature set. All of these measures are combined together to arrive at a final star rating for each product.



	<b>Avast SecureLine</b>	<b>Buffered</b>	<b>RECOMMENDED</b> <b>CyberGhost</b>	<b>ExpressVPN</b>	<b>F-Secure Freedom</b>	<b>Getflix</b>	<b>HMA Pro</b>	<b>Hotspot Shield</b>
<b>Overall rating</b>	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
<b>Price (UK prices include VAT)</b>	£65/year, £120/2 years, £180/3 years	\$13/month, \$79/year, \$99/2 years	£10/month, £55/year, £74/2 years, £76/3 years	\$13/month, \$60/6 months, \$100/year	£25/year (3 devices), £50/year (7 devices), £70/2 years (7 devices)	\$4.95/month, \$13/3 months, \$23/6 months, \$40/year, \$55/2 years	£60/year, £96/2 years, £129/3 years	Free (500MB/day); £11/month, £120/year, £216/2 years
<b>Simultaneous connections</b>	5	5	7	5	3/7 (see above)	3	5	5
<b>Major payment methods</b>	Credit/debit card, PayPal	Bitcoin, credit/debit card, PayPal	Bitcoin, credit/debit card, PayPal	Bitcoin, credit/debit card, PayPal	Credit/debit card, direct transfer, PayPal	Credit/debit card	Credit/debit card, PayPal	Credit/debit card, PayPal
<b>Client platforms</b>	Windows, macOS, Android, iOS	Windows, macOS, Linux, Android, iOS	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Android, iOS	N/A	Windows, macOS, Linux, Android, iOS	Windows, macOS, Android, iOS
<b>Router support</b>	✗	✓	✓	✓	✗	✓	✓	✗
<b>Publisher's website</b>	<a href="http://avast.com">avast.com</a>	<a href="http://buffered.com">buffered.com</a>	<a href="http://cyberghostvpn.com">cyberghostvpn.com</a>	<a href="http://expressvpn.com">expressvpn.com</a>	<a href="http://f-secure.com">f-secure.com</a>	<a href="http://getflix.com.au">getflix.com.au</a>	<a href="http://hidemyass.com">hidemyass.com</a>	<a href="http://hotspotshield.com">hotspotshield.com</a>
<b>Headquarters</b>	Czech Republic	Budapest / Gibraltar	Romania	British Virgin Islands	Finland	Seychelles	UK	US
<b>Free trial</b>	7 days	✗	24 hours	✗	5 days	14 days	7 days	7 days
<b>Money-back guarantee</b>	30 days	30 days	45 days	30 days	30 days	✗	30 days	45 days

### Features

<b>Countries</b>	34	27	61	94	23	20	190	82
<b>Total servers</b>	55	40+	4,700+	3,000+	Not stated	91	970	Not stated
<b>Browser extension</b>	Chrome, Avast Secure Browser	✗	Chrome, Firefox	Chrome, Firefox	✗	✗	Chrome, Firefox	Chrome
<b>VPN protocol</b>	OpenVPN	Proprietary, OpenVPN	L2TP, IKEv2, OpenVPN	PPTP, L2TP, IKEv2, OpenVPN	OpenVPN	PPTP, L2TP, SSTP, IKEv2, OpenVPN	OpenVPN	Proprietary
<b>BitTorrent servers</b>	8	All	56	All	9	38	8	All
<b>Kill switch</b>	✓	✓	✓	✓	✓	✓	✓	✓
<b>Split tunnelling</b>	✗	✗	✓	✓	✗	✗	✗	✓
<b>Double VPN</b>	✗	✗	✗	✗	✗	✗	✗	✗
<b>Auto-activate for known networks</b>	✗	✗	✓	✗	✗	✗	✗	✗
<b>Auto-activate for insecure networks</b>	✓	✗	✓	✗	✗	✗	✓	✓
<b>Static IP option</b>	✗	✗	✗	✗	✗	✗	✗	✗

### Support

<b>Email support</b>	✓	✓	✓	✓	✓	✓	✓	✓
<b>Live chat</b>	✗	✗	24/7	24/7	Mon-Fri, 9-6pm	24/7	Mon-Sun, 9am-11pm CET	24/7
<b>Phone support</b>	Paid-for	✗	✗	✗	✓	✗	✗	✗



	LABS WINNER				RECOMMENDED			
	IPVanish	NordVPN	Norton Secure VPN	Private Internet Access	PureVPN	Surfshark	TunnelBear	Windscribe
	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
	\$10/month, \$27/3 months, \$78/year	£9.15/month, £64/year, £73/2 years, £82/3 years	£20/year (1 device), £30/year (5 devices), £70/year (10 devices)	\$6.95/month, \$36/6 months, \$40/year	\$11/month, \$70/year, \$80/2 years	£9.49/month, £57/year, £38/2 years	Free (500MB/month), \$9.99/month, \$60/year	Free (10GB of data/month), \$9/month, \$49/year
	10	6	1/5/10 (see above)	10	5	Unlimited	5	Unlimited
	Credit/debit card, PayPal	Amazon Pay, credit/debit card, PayPal	Credit/debit card, PayPal	Amazon Pay, credit/debit card, PayPal	Credit/debit card, PayPal	Bitcoin, credit/debit card, Google Pay, PayPal	Bitcoin, credit/debit card	Bitcoin, credit/debit card, PayPal
	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Android, iOS	Windows, macOS, Linux, Android, iOS	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Linux, Android, iOS, Fire TV	Windows, macOS, Android, iOS	Windows, macOS, Android, iOS
	✓	✓	✗	✓	✓	✓	✗	✓
	<a href="https://ipvanish.com">ipvanish.com</a>	<a href="https://nordvpn.com">nordvpn.com</a>	<a href="https://uk.norton.com">uk.norton.com</a>	<a href="https://privateinternetaccess.com">privateinternetaccess.com</a>	<a href="https://purevpn.com">purevpn.com</a>	<a href="https://surfshark.com">surfshark.com</a>	<a href="https://tunnelbear.com">tunnelbear.com</a>	<a href="https://windscribe.com">windscribe.com</a>
	US	Panama	US	US	Hong Kong	British Virgin Islands	Canada	Canada
	✗	✗	✗	✗	✗	✗	N/A	N/A
	7 days	30 days	60 days	7 days	31 days	30 days	✗	3 days
	75+	60	29	32	140+	50+	22	66
	1,300	5,500+	1,500+	3,394	2,070	800+	Not stated	480+
	✗	Chrome, Firefox	✗	Chrome, Firefox, Opera	Chrome, Firefox	Chrome, Firefox	Chrome, Firefox, Opera	Chrome, Firefox
	PPTP, L2TP, SSTP, IKEv2, OpenVPN	IKEv2, OpenVPN	OpenVPN	PPTP, L2TP, OpenVPN	PPTP, L2TP, SSTP, IKEv2, OpenVPN, proprietary	OpenVPN	IKEv2, OpenVPN	IKEv2, OpenVPN
	All	1,000+	Blocked	Not stated	86	21	Not stated	Not stated
	✓	✓	✗	✓	✓	✓	✓	✓
	✗	✗	✗	✗	✓	✓	✗	✗
	✗	✓	✗	✗	✗	✓	✗	✗
	✗	✗	✗	✗	✗	✗	✗	✗
	✗	✓	✗	✗	✗	✗	✓	✗
	✗	✓	✗	✓	✓	✓	✗	✓
	✓	✓	✓	✓	✓	✓	✓	✓
	24/7	24/7	24/7	Mon-Fri, 9-6pm MT	24/7	24/7	✗	✗
	✗	✗	✗	✗	✗	✗	✗	✗

# CyberGhost

Feature-packed yet easy to use, this versatile VPN is a great choice for beginners and experts alike

SCORE ★★★★★

PRICE £10/month, £55/yr, £74/2yr, £76/3yr (7 devices, all prices inc VAT) from [cyberghostvpn.com](http://cyberghostvpn.com)

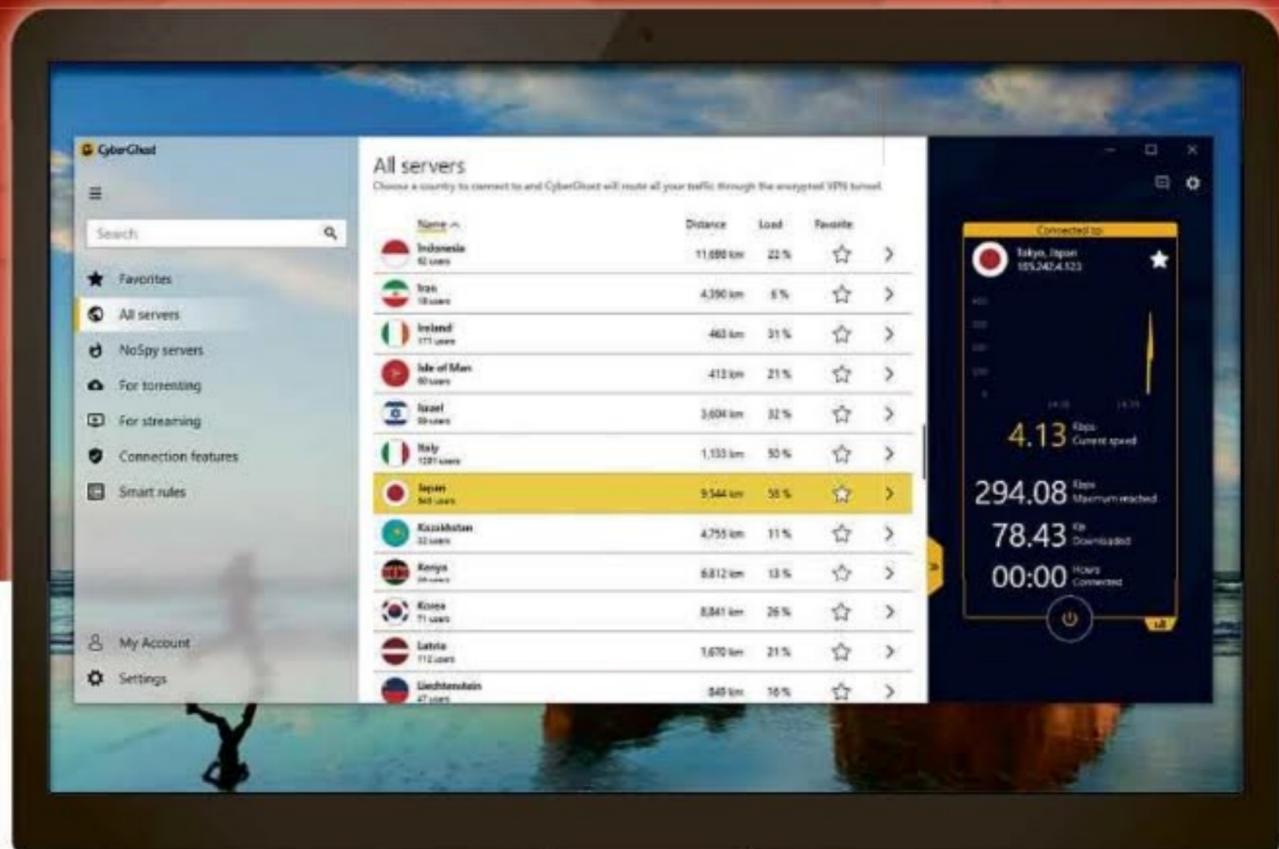
CyberGhost makes a low-key first impression, appearing as a simple black pop-up above your system tray. “Best server location” is preselected – a default option that automatically finds a fast, secure server in a nearby location – so all you need do to get connected is click the large yellow switch icon.

There’s a lot more to CyberGhost than this, though. Clicking the dropdown gives you instant access to popular servers in France, Germany and the US, plus one-click options to unblock Netflix US or BBC iPlayer.

Select “More servers...” (or click the tasteful yellow tab) and the interface expands into its full-sized, windowed form. From here you can browse servers across 61 countries, or pick one that’s optimised for a specific purpose. CyberGhost offers more than 50 servers worldwide on which BitTorrent is expressly permitted, plus 42 streaming servers across nine countries. Each one is optimised for a specific service: we had no problem enjoying Netflix US, but those looking for German YouTube or Fox Sport Brazil are equally well covered.

There’s also a third category of server called “NoSpy”. These are all located in CyberGhost’s own home country of Romania, outside of any formal intelligence-sharing agreements, and the company guarantees that they’re entirely inaccessible to any third party. Frankly, if your VPN provider is competent and trustworthy, these reassurances should be unnecessary, but if you’re looking for maximum peace of mind, here it is.

Servers of any type can be added to your favourites list by clicking the star icon, and each one comes with a helpful readout of geographic distance and load to give you a sense of how responsive it’s likely to be. CyberGhost wasn’t the fastest VPN overall in



this month’s tests, but it gave us a solid 10.4Mbps/sec via the Netherlands and around 50Mbps/sec from both New York and Tokyo. Only in Australia did speeds fall below the recommended 4K streaming standard, coming out at a dismal 14.6Mbps/sec.

What we love about CyberGhost is its versatility. Up to seven devices can connect to different servers at once, and client software is offered for all major platforms. That includes Amazon Fire TV devices, so you can switch the location settings for your living room television with just a few clicks of the remote. Alternatively, you can enter your settings into a compatible router and have all your household traffic tunnelled through a nominated server. There’s one quirk to be aware of, though: the browser extensions for Chrome and Firefox don’t control the main VPN, but rather act as free, standalone VPN gateways with a much more limited set of servers and features.

The feature set is impressive, too. As well as an automatic kill switch that cuts all internet activity if the connection drops, there’s an option to force all DNS requests to go via CyberGhost’s own servers, ensuring

ABOVE The location list includes load and latency information to help you pick a server



BELOW There’s a good set of specialist servers optimised for particular tasks



that misdirected connections can’t inadvertently clue your ISP into your activities. You can choose to use a random port to connect too, which can help you bust through blocks in public Wi-Fi services.

Alongside that, CyberGhost’s “Smart rules” offer some clever ways of automating your protection. You can set the software to engage the VPN as soon as it opens, and it remembers all the networks you’ve connected to, so it can automatically pick the appropriate server for wherever you happen to be.

Perhaps most usefully, CyberGhost can also connect you to a specific location whenever you open a particular application. And while you can’t configure split tunnelling on an app-by-app basis, specified URLs can be routed via your ISP rather than over the VPN, optimising performance for sites that don’t require location spoofing. The software can also strip out adverts, online trackers and known malicious websites, and compress images to reduce bandwidth usage on metered connections.

All of that might sound like a lot of features to get on top of, but the CyberGhost interface is clean and intuitive, with no option located more than a few logical clicks away from the main screen. If we’ve one slight grumble it’s to do with the pricing structure: month-by-month subscriptions are never great value, but at £10 this is one of the steepest deals around. Still, an annual licence is quite reasonably priced, and if you commit for three years you’ll pay just £2.10 a month – and your licence covers up to seven simultaneous connections, which is more than you’ll get from most rival VPNs.

## ExpressVPN

A fast service that combines an open-minded attitude with impressive privacy credentials

SCORE ★★★★★

PRICE \$13/month, \$60/6 months, \$100/yr (5 devices) from [expressvpn.com](https://expressvpn.com)

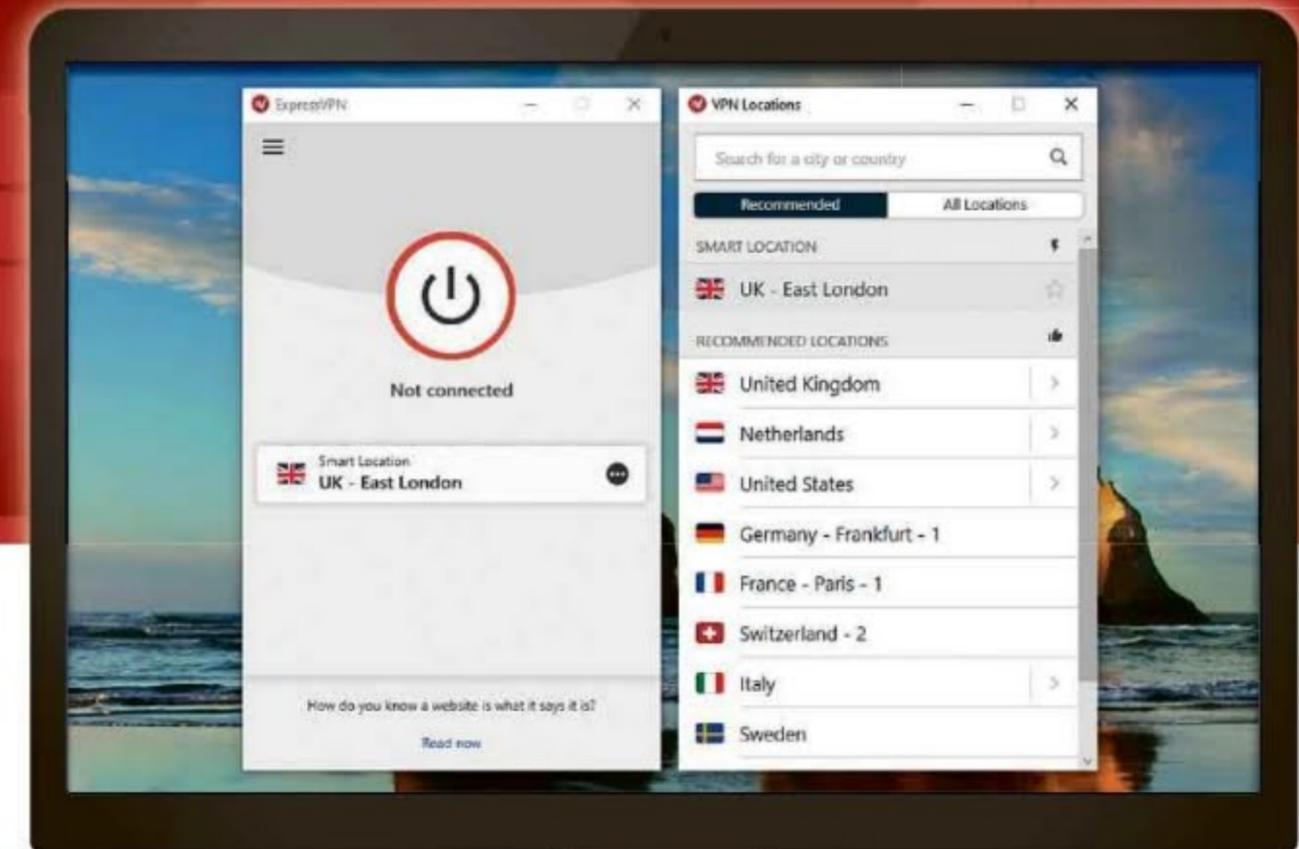
ExpressVPN is based in the British Virgin Islands – a tiny Caribbean nation that is, despite the name, blissfully unburdened by European surveillance agreements and legislation. You can't do much better when it comes to privacy and the ExpressVPN app itself opens up in a similarly small and unencumbered form. To help you hit the ground running, it immediately suggests a "smart location" and remembers two recent connections so you can easily restore a closed session.

If you wish to virtually wander further afield, clicking your currently selected location brings up a list of recommended servers, with a search box allowing you to jump straight to a particular location. Clicking on "All Locations" lets you browse a long list of the 94 countries where ExpressVPN operates, and in many of them you can click the little arrow to drill down to individual cities.

With so many servers on offer, it would have been nice to get an at-a-glance indication of relative speed. However, from the Settings menu you can open the Speed Test tool, which measures the latency and download speed from selected servers. This isn't exactly a swift process – it took us 1min 55secs to test all European servers – and it doesn't provide load statistics, which would have helped contextualise the results. Still, it's a good tool to have, and star icons let you instantly add the fastest servers to your favourites.

For the most part, ExpressVPN's performance is rather good. Our download speeds topped 100Mbps/sec via servers in Amsterdam and Zurich, with very creditable rates of 88Mbps/sec while browsing via New York and 71Mbps/sec in San Francisco. Connections via Japan weren't bad either, averaging exactly 50Mbps/sec – although, as with CyberGhost, speeds fell away to a less impressive 16.3Mbps/sec via Australia.

One thing you might find initially confusing is that the ExpressVPN app doesn't seem to offer any options for



BitTorrent or video streaming. That's because BitTorrent is permitted across all 3,000+ nodes – and, similarly, to use a geoblocked video streaming service, you simply connect to whichever server in the relevant territory is fastest for you. It feels a little strange to get no hand-holding at all, but connecting to ExpressVPN's New York server instantly unblocked Netflix with no fuss.

While ExpressVPN isn't overloaded with technical features, it ticks two important boxes: the obligatory kill switch is there, to ensure that nothing leaks when the connection goes down, and there's also a welcome split tunnelling feature for apps. Cleverly, this lets you set up either a blacklist or a whitelist, so you can determine that named programs should always or never be routed over the VPN. There's no option to do the same with websites, but convenient extensions for Chrome and Firefox let you turn the VPN on and off as you browse.

If you don't like to take things on trust, you'll also appreciate ExpressVPN's geo-IP address, DNS leak and WebRTC leak testing tools. These are free services, hosted on the

**ABOVE** ExpressVPN offers over 3,000 servers to choose from in 94 countries

**BELOW** The Speed Test tool helps you get the best performance



ExpressVPN website, but it's nice to have a link right there in the app. As you would hope, ExpressVPN itself achieved a perfect protection score across these tests, as well as in the independent [doileak.com](https://doileak.com) test – and a professional audit completed in July by PwC confirmed that ExpressVPN's servers and processes were in full compliance with its no-logging policy.

Although ExpressVPN has plenty of positives, it's pricey. Indeed, if you just want a rolling monthly service, it's one of the most expensive VPNs on test, the dollar price working out to around £10.50 a month. Paying annually brings the price down to around £7 a month, but that's still on the expensive side, and there's no option to lock in for a longer period. Sign up for three years with CyberGhost or NordVPN and you'll be paying around a third as much.

Still, all ExpressVPN subscriptions cover five connections, with native clients available for Windows, macOS, Android, iOS and Linux. The latter app has to be configured and controlled from the command line, but we suspect Linux fans won't mind that. Router installation is supported too, meaning you can send all traffic via a country of your choice, with a decent documentation library on the website to help you get set up. There's also a native app for quick region-switching on Fire TV and Android TV devices.

In all, ExpressVPN's solid performance and liberal approach to torrenting and streaming make it a persuasive choice. Privacy-conscious customers will appreciate its impeccable security credentials – and if you want to remain as anonymous as possible you can even pay for your subscription in bitcoins.



NETFLIX

BBC iPlayer



## NordVPN

A superb all-rounder, offering great performance and all the key features at a very reasonable price

SCORE ★★★★★

PRICE £9.15/month, £64/yr, £73/2yr, £82/3yr (6 devices, all prices inc VAT) from [nordvpn.com](http://nordvpn.com)

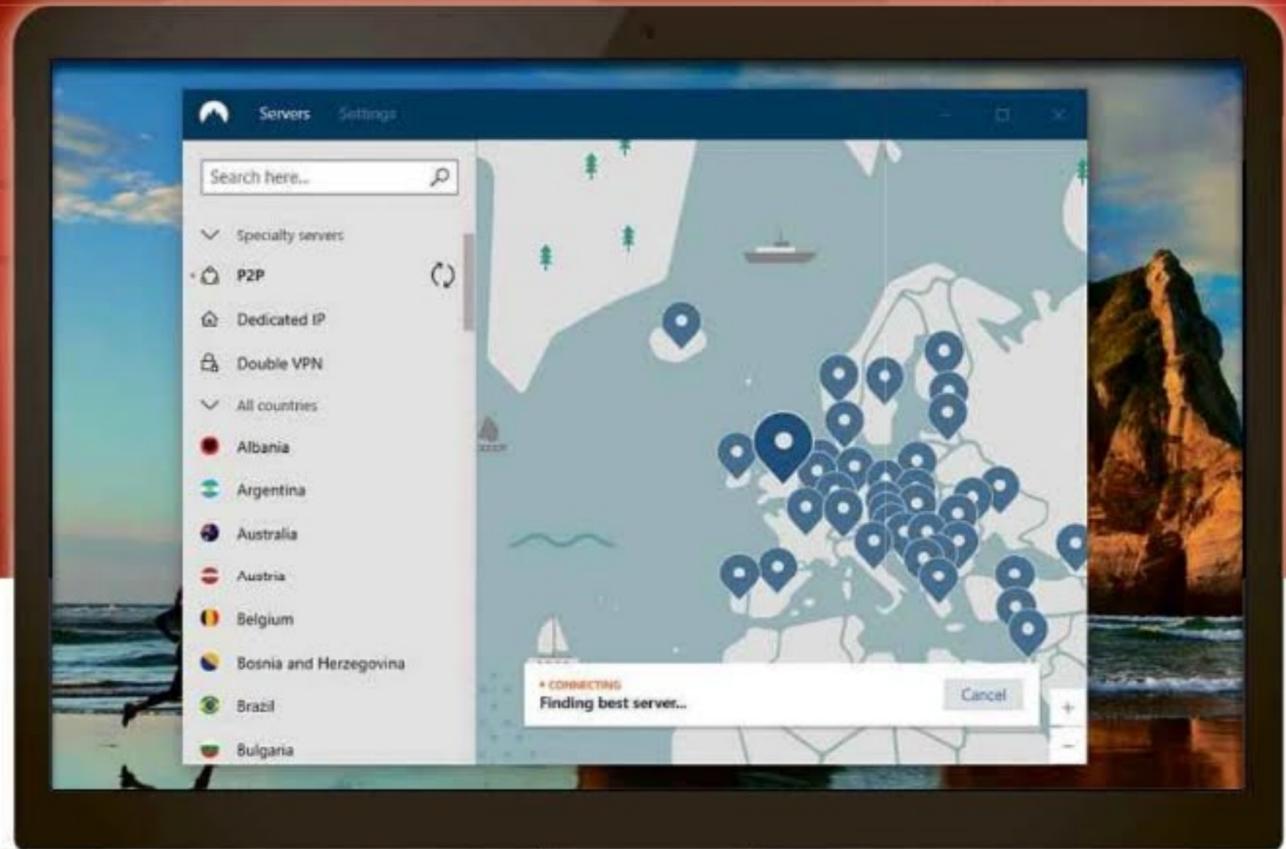
If you're looking for a VPN with plenty of servers, NordVPN takes the crown. Its geographic reach isn't quite as extensive as some rival VPNs – it has a presence in 60 countries, while HMA Pro boasts 190 – but within those nations it claims more than 5,500 exit nodes, so you should have no problem finding a fast connection that isn't overloaded.

Indeed, there's no need to hunt around at all if you don't want to. You're free to browse all the servers and compare their load estimates, but double-clicking on a country name instantly connects you to the fastest available server in that region.

And we certainly can't complain about the results. NordVPN gave us download speeds of more than 100Mbps/sec from servers in the Netherlands and Switzerland, and an excellent 80Mbps/sec from New York. Predictably, performance drops off as you reach out towards the Pacific rim, but we still got around 60Mbps/sec via California, Japan and Australia. That's enough bandwidth to stream two 4K videos at once from the other side of the world.

Alongside all its regular servers, NordVPN offers three types of "speciality" server. Peer-to-peer servers, as you'd guess, are ones on which BitTorrent is permitted. There are more than a thousand on offer, but once again you don't need to bother comparing their stats unless you want to: simply double-click on the main "P2P" heading and you'll be connected to the fastest peer-to-peer server available at that point in time, no matter where it happens to be.

Then there's a selection of double VPN connections, which route your traffic through two nodes in series. 29 such routes are available, including US to Canada, Taiwan to Hong Kong and UK to Netherlands. This is overkill for most users and predictably it has an impact on performance, so you won't want to use it for everyday browsing. Still, for the truly paranoid it's a good option to have.



Finally, there's a range of servers in the US, UK, Netherlands and Germany that can be used to browse from your own static IP address – although to get one you'll have to shell out an extra £54 a year. Again, most users won't need this, but for dealing with finicky services that don't like constantly changing IP addresses, it's a simple solution that few VPNs offer.

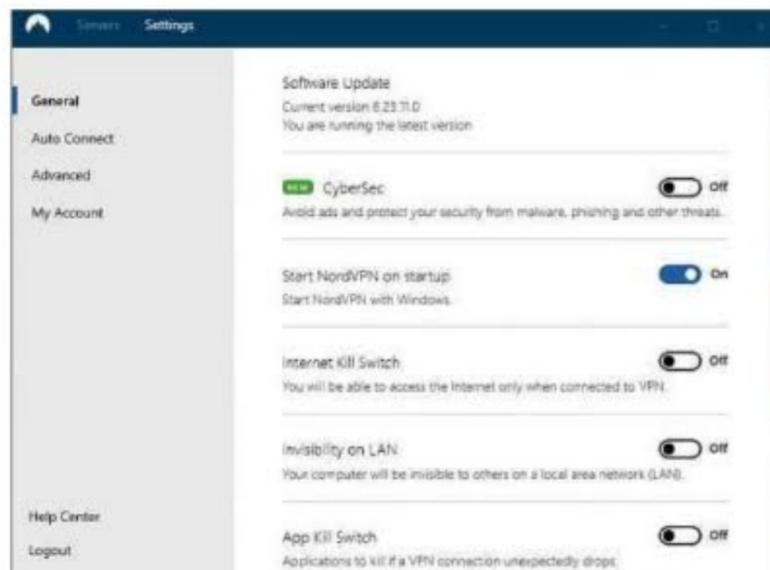
Like ExpressVPN, Nord doesn't explicitly promise access to specific video-on-demand services; to watch content from a different country, you're advised simply to connect to a server in that country. This worked perfectly for us, with Netflix US opening up in moments – and a native app for Fire TV devices is available on the Amazon Appstore, making it easy to switch regions at will on your smart TV. Other client options include a command-line tool for Linux, and configuration instructions for a wide range of routers and NAS appliances.

NordVPN's feature set is pretty good, with a granular kill switch that lets you freeze internet access for nominated applications when the VPN

ABOVE NordVPN has three handy "speciality servers", including P2P and double VPN



BELOW A smart kill switch lets you pause internet access for certain applications



### Stop press: hack update

As we went to press, it was confirmed that one of NordVPN's servers had been compromised by hackers in 2018. We're assured that the vulnerability has now been fixed, so we're happy to recommend this VPN – but see [pcpro.link/303nord](http://pcpro.link/303nord) for the company's full statement.

is disconnected, rather than taking the whole system offline. You can also set it to automatically engage when you connect to an insecure wireless network, though it doesn't remember per-network settings like CyberGhost does. There's no split tunnelling either, although it's no great hardship to route everything over the VPN.

Despite our update above, security looks strong. While its name suggests Scandinavian origins, NordVPN is based in Panama, a reassuringly long way from the usual authorities. It sailed through the [doileak.com](http://doileak.com) technical test with no red flags, and the app includes a simple web filter that blocks phishing attacks and intrusive pop-ups. Last year, the company also invited auditors PwC to inspect its servers and interview staff, receiving independent confirmation that no user activity is recorded.

There are simpler VPNs out there, and ones that give you more technical control. For our money, though, NordVPN strikes the perfect balance, offering all the key features and great performance, while making it as easy as possible to open a fast connection and get on with what you want to do. The price is persuasive too, working out to £5.36 per year for up to six devices – or just £2.29 a month if you sign up for a three-year commitment.

## Surfshark

This nippy VPN is unbeatable value, supporting an unlimited number of devices for a very low monthly price

SCORE ★★★★★

PRICE £9.49/month, £57/yr, £38/2yr (unlimited devices, all prices inc VAT) from [surfshark.com](https://surfshark.com)

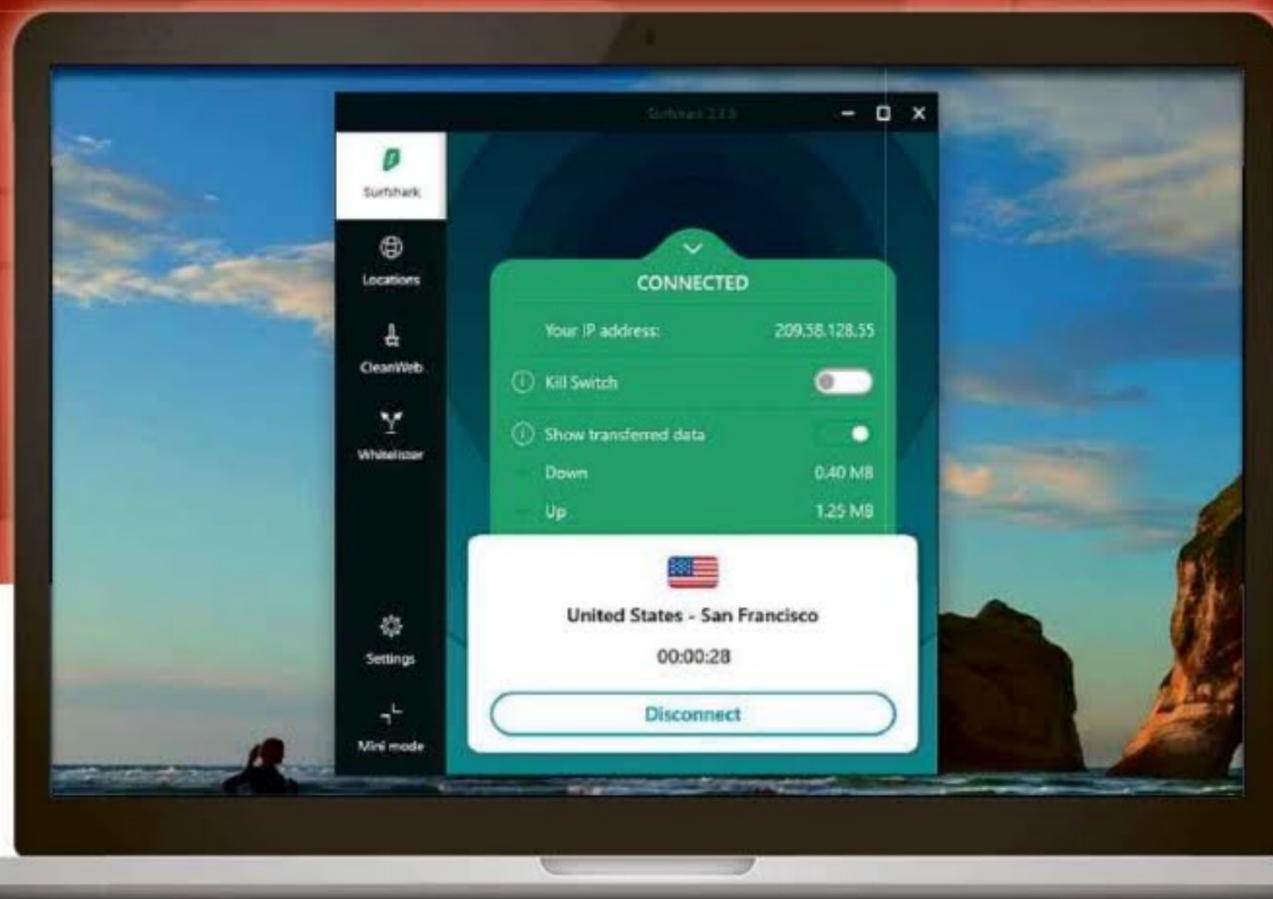
Most VPNs let you connect three, five or even ten devices at once; Surfshark lifts the bar completely and allows unlimited simultaneous connections. That makes it perfect for a busy household packed with computers, phones and smart appliances: you'll never need to worry about disconnecting device A so that device B can get onto the VPN.

You'd expect that freedom to come at a cost, but Surfshark's rates are very competitive. An annual subscription works out to £4.79 a month, but you would be daft to take that deal, because a two-year licence is actually cheaper, working out to just £1.59 a month – the lowest price you'll pay for any of the 16 VPNs on test this month.

One slight trade-off is that the Surfshark server network isn't as large as certain competitors'. The company claims to operate "800+" servers across 59 countries, but some of these are flagged up as virtual presences that spoof their own locations – so, for example, the server for Cyprus might actually be physically located in Greece. We haven't heard of any problem with this approach, but if you need your virtual location to look as authentic as possible, it's a potential concern.

It's also notable that the server presence is heavily concentrated in the US: 26 different American cities are represented, while Australia offers five locations and no other country gets more than three. A little circular icon gives an indication of relative load and a star icon lets you add selected servers to your favourites.

Surfshark isn't the fastest VPN overall, either. To be clear, it's capable of some very fast speeds: it topped 100Mbps/sec downstream from Switzerland and the Netherlands, and achieved a best-in-class 98Mbps/sec when browsing via Silicon Valley. It's not consistently on top, though: while its download speed of 50Mbps/sec from servers in Sydney was strong, we got just 27Mbps/sec from New York and 26Mbps/sec in Japan.



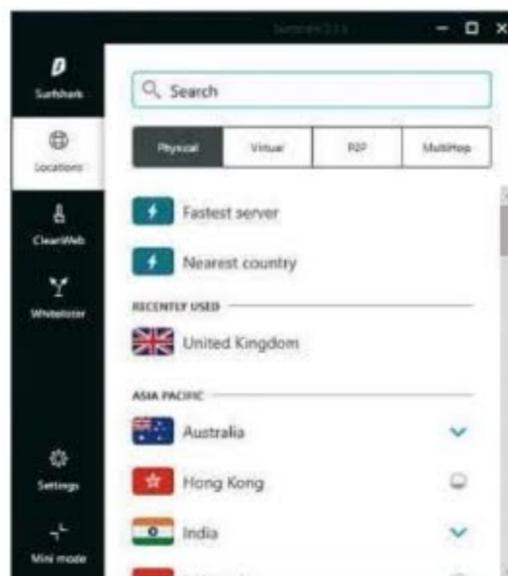
ABOVE The simple interface puts all the important information at your fingertips



Although they're not singled out in the interface, the company publishes a list of recommended locations for file sharing, and if you connect to a different one then you'll be redirected. Similarly, there's no specific provision for video streaming, but we had no problem accessing US Netflix when connected to the New York server.

Two specialist connection types are available, however. A selection of static IP presences in Germany, Japan, the Netherlands, the UK and the US let you access resources from the same address every time – though the address won't be unique to you, and could still be recognised as a VPN server. There's also a selection of "MultiHop" routes, some of which are impressively obscure: you can route your traffic to the Netherlands via Singapore, or to the US via Australia, which should be pretty tricky to trace.

A few advanced connection features round things off. You can set up either a whitelist or a blacklist of apps to specify that they should always or never be routed via the VPN – but you can't have both lists active



LEFT If you don't mind where you surf from, the client will pick the fastest server for you

at the same time. You can also whitelist URLs or IP addresses, so that specific websites and other resources bypass the VPN for maximum performance. The CleanWeb feature, meanwhile, strips out recognised ads, trackers and malware from the VPN stream: you can't configure this, or monitor exactly what it's doing, but it presumably can't hurt.

One last feature worth mentioning is "Mini mode", which – in the Windows client app – shrinks the interface down to a compact little rectangular window just showing the currently selected server and a switch to enable/disable the connection. It's a neat little convenience that makes me much happier about keeping the VPN to hand at all times: I just wish there were an "always on top" option.

As usual, there are also native apps for macOS, Android, iOS and Linux, plus a Fire TV app downloadable from the Amazon Appstore. Router installation is supported, but the documentation isn't as extensive as you'll find elsewhere, with hands-on guides provided only for routers running AsusWRT, DD-WRT and Tomato firmware. To be fair, though, it's not difficult to set up.

The last piece of the puzzle is security. Like ExpressVPN, Surfshark is based in the British Virgin Islands. That means the company has no obligation to store logs and it promises to keep no records of the sites you visit, the bandwidth you consume or other such information.

It may not top the table for speeds and server counts, but Surfshark does everything most people will want from a VPN – and, with unlimited connections from just £1.59 a month, it's fantastic value.

## Avast SecureLine

With limited platform support and disappointing performance, this VPN is hard to recommend

SCORE ★★☆☆☆

PRICE £65/yr, £120/2yr, £180/3yr (5 devices, all prices inc VAT) from [avast.com](https://www.avast.com)

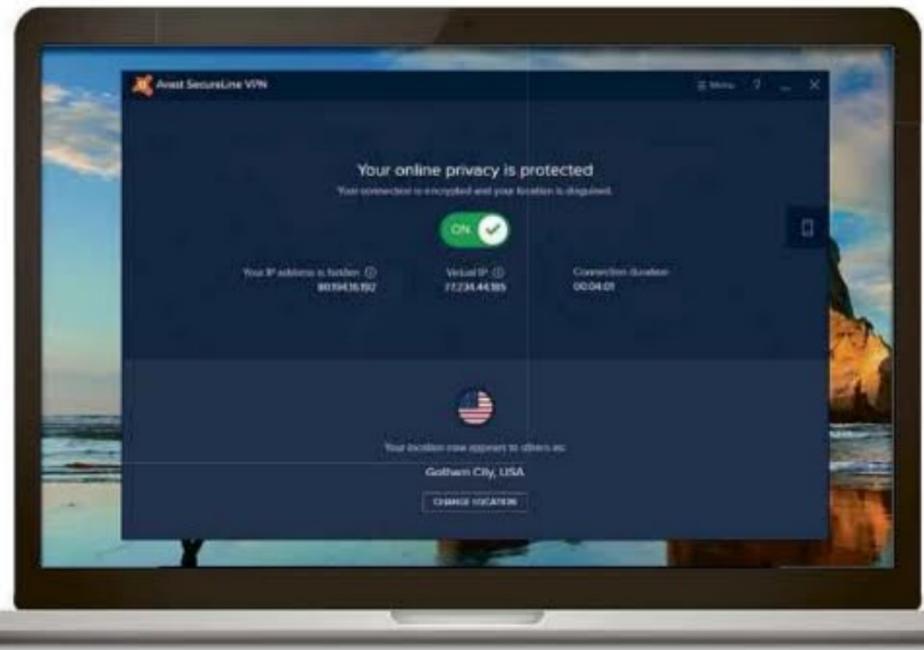
If you've used Avast's free internet security software lately then you'll already have seen in-program ads recommending the company's SecureLine VPN as an extra layer to your online protection. However, while this fuss-free VPN certainly can protect your privacy, it lags behind the competition in numerous ways.

Let's start with platform support. Client software is available for Windows, macOS, Android and iOS, but there's no support for Linux, Chromebooks or smart TVs. Nor can you configure SecureLine at the router level to protect all your traffic, so while your subscription covers five simultaneous connections, anything that doesn't run one of the four major

platforms is left out in the cold. There's an extension for Chrome, and for Avast's own Secure Browser (which is itself based on Chromium), but nothing for Firefox or other browsers.

Avast operates 55 servers across 34 countries, and while that's fine for most purposes, it feels mean when, for example, ExpressVPN boasts 50 times as many servers in nearly three times as many territories. To be fair, we found SecureLine's performance wasn't bad, consistently giving us enough bandwidth to stream 4K video from anywhere in the world. Highlights were a strong 54Mbps/sec connection via Sydney and a speedy 89Mbps/sec from San Francisco, second only to Surfshark – and we had no difficulty accessing US Netflix over the connection. There are also eight servers that support BitTorrent, if that's what you're into.

The feature set is quite basic, with no split tunnelling or double VPN options. You do get a kill switch, though, and while Avast isn't quite as clever as CyberGhost when it comes to remembering settings for specific



**ABOVE** The front-end is appealingly simple, but there's not much behind it

networks, you can set the VPN to automatically activate when you connect to a new network unless you've previously marked it as a trusted connection.

If Avast SecureLine were cheap it might still be a decent choice. Unfortunately, it's not: the publisher offers a seven-day free trial, but after that you'll pay £5.42 a month on a yearly contract, or £5 a month if you sign up for two or three years. There are a dozen cheaper alternatives in this Labs alone, and Avast doesn't offer live support chat either, making this one to miss.

## Buffered

The user-friendly client is a hit, but this VPN is far from the fastest – and it failed to unblock Netflix US for us

SCORE ★★☆☆☆

PRICE \$13/month, \$79/yr, \$99/2yr (5 devices) from [buffered.com](https://www.buffered.com)

Although Buffered operates out of Budapest, its VPN business is legally based in Gibraltar. That's because Gibraltar law prohibits any data about you from being transferred outside of the territory without your consent: reassuring stuff.

The service itself, however, is rudimentary. Buffered operates in just 27 countries and most countries appear to host just a single server – the exception being the US, which offers separate connections for the west coast, Midwest and east coast.

One thing we like about Buffered is all the information it provides about your connection, with large-print details of transfer speeds and total

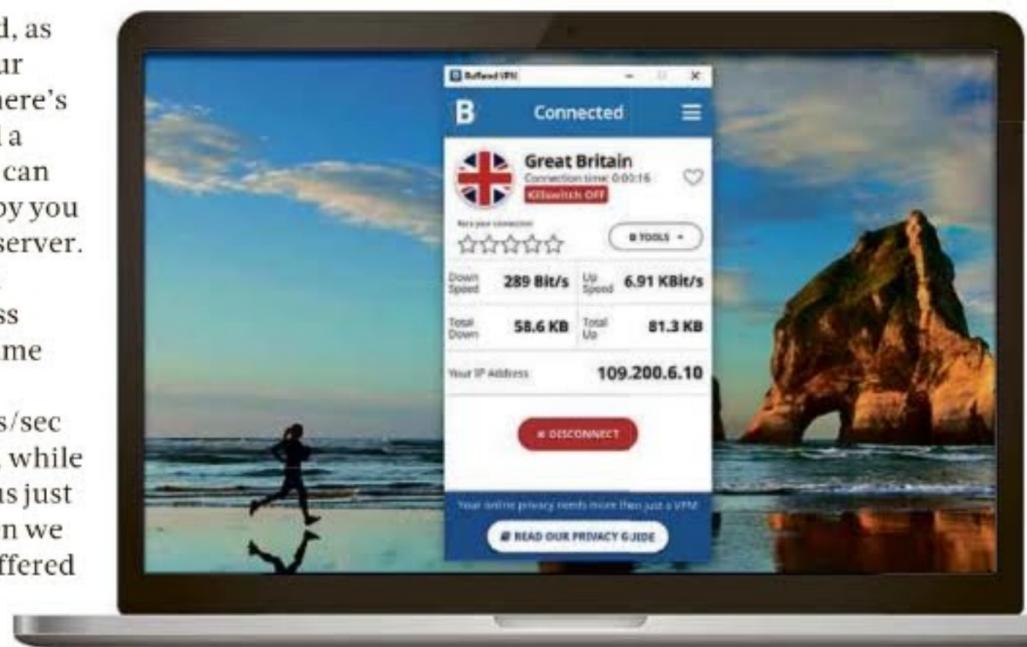
bytes sent and received, as well as a readout of your external IP address. There's a speed-tester tool and a rating widget that you can use to report how happy you are with your current server.

We had no problem using Buffered to access BitTorrent, but data came down the line at an unexceptional 56Mbps/sec from the US east coast, while the Swiss server gave us just 27Mbps/sec – and when we browsed via Japan, Buffered limped along at 10.1Mbps/sec.

Trying to access US Netflix meanwhile resulted in the dreaded "you seem to be using an unblocker" error.

Buffered is also distinctly stripped-down when it comes to features. A failsafe kill switch is included, but otherwise there's almost nothing to configure. You can't split traffic between the VPN and your ISP connection, you can't automatically engage the VPN when you connect to a new network and there are no extra obfuscation options for the nervous.

Supporting software is limited, too: Windows, macOS, Android and iOS enjoy graphical apps, but Linux users



**ABOVE** The Buffered software gives a clear overview of your connection statistics

get a barebones command-line client. There are no browser extensions at all and no support for smart TVs. On the upside, Buffered does provide setup instructions for routers running Asus, DD-WRT or Tomato firmware.

If you're willing to sign up for two years then Buffered is pretty good value, working out to £3.30 per month. Monthly and annual pricing are less tempting, though, and as with Avast SecureLine, your subscription doesn't include live phone or chat support. In all, there's not much reason to pick Buffered when other VPNs do so much more.

# REASONS TO TRY THE FREE FIREFOX VPN

Firefox users will find it worth jumping through hoops to get this free VPN service, but it's no rival to commercial services

If you want the protection of a VPN with an absolute minimum of extra software and subscriptions to think about, how about one that's completely free and built right into your web browser? Mozilla is currently trialling an official VPN extension for Firefox – dubbed Firefox Private Network – as part of its “Test Pilot” beta programme.

Before you get too excited, there are a few points to be aware of. First, although the free VPN is supported by a huge global network of servers operated by Cloudflare, it doesn't allow you to choose your own exit node: when you turn the VPN on, you'll be automatically connected to a server that's as close as possible to your actual location. This means that, while the VPN can get you into sites that are normally barred by your ISP, it won't unblock services that require you to be located in a specific country.

Second, the extension works only on the desktop browser, and it only protects web traffic – so you can't use



**Encrypt your browsing from eavesdroppers**

The Network encrypts the web addresses you visit. It also helps protect you from eavesdroppers on open, public Wi-Fi from spying on your browsing activity.

**Limit what websites and advertisers know about you**

The ads and prices you see online are often based on your location. Private Network hides your location from websites and ad trackers, making it tougher for them to target you.

it to secure other programs such as BitTorrent clients.

Third, at present the service is officially only available to users in the US – but then there's something laughable about the idea of trying to region-lock a VPN service. You can easily install the extension by using a different VPN to

**ABOVE** It's hard to quibble with the convenience of having a VPN integrated into your browser

spoof your location, then visiting the product page at [private-network.firefox.com](https://private-network.firefox.com). Once you've added the extension to Firefox, it will continue to work no matter where in the world you are.

## How fast – and how free?

As Firefox Private Network always uses the nearest server, it has very little impact on your bandwidth: we experienced only a tiny dip in download speeds, from 112Mbits/sec with the VPN off to 108Mbits/sec with it turned on. Online geographic lookup tools showed us as located in London in both cases, although enabling the VPN changed our external IP address to that of a secure Cloudflare server.

Clearly, Firefox Private Network is more limited than the 16 commercial VPNs on test this month, but it still unblocks sites, shields your browsing activity from your ISP and protects your data on unsecured wireless networks. What's more, unlike other free VPN offerings, it has no data cap. There's a good case to be made for leaving it on all the time.

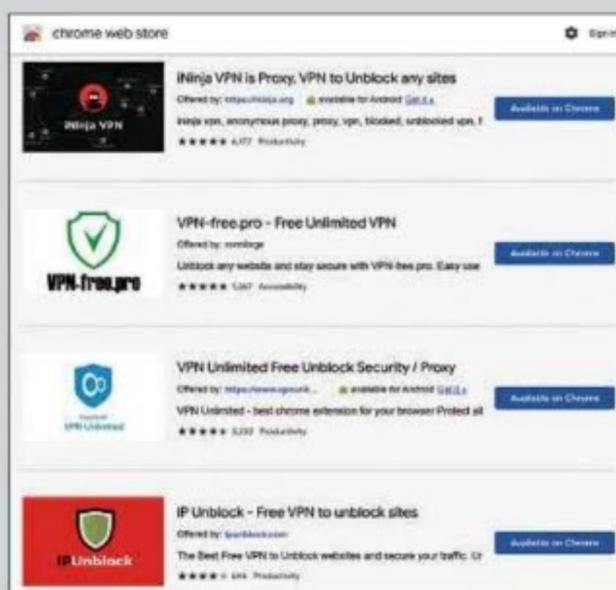
There's one last caveat, however: as we've mentioned, the service is officially still in beta and Mozilla describes it as free “for a limited time”. So far, it hasn't suggested when subscription fees might be introduced, or how much they'll be, but the implication is clear – enjoy this free VPN while you can.

## When free isn't free

Firefox Private Network isn't the first free browser-based VPN service. Search the Firefox Add-ons library (or the Chrome Web Store for that matter) and you'll find dozens of extensions promising to protect your online security. The Opera browser even ships with its own built-in VPN feature. So what makes Firefox special?

The short answer is trust. Operating a VPN costs money and most of these nominally free browser extensions will be taking something back in return for your patronage. Many (including the Opera VPN) reserve the right to track and analyse your data, and even share it with third parties. Others may use your computer as an exit node for other VPN users, or lease your bandwidth to others – slowing down your connection and potentially exposing you to liabilities. Browser extensions can also hijack your web traffic to insert their own adverts into the pages you visit.

Aside from all of that, there's the risk that a little-known extension from a no-name developer might contain bugs and loopholes that could expose your online activity – completely undermining the whole point of using a VPN. For all these reasons,



**ABOVE** There's no shortage of third-party VPN extensions, but, as the saying goes, there's no such thing as a free lunch

we're much happier to put our faith in a big name such as Mozilla, with a track record of championing user privacy and security.

## F-Secure Freedom

A competent VPN, but it simply doesn't excel for features, platform support or performance

SCORE ★★★★★

PRICE £25/yr (3 devices), £50/yr (7 devices), £70/2yr (7 devices) (all prices inc VAT) from [f-secure.com](http://f-secure.com)

F-Secure's Freedom VPN offers an attractive, flexible pricing structure. If you only need three connections then you can pay just £2.08 a month on an annual contract, while a seven-device subscription comes out at £4.17 a month on a yearly contract or £2.92 a month biennially.

However, not all types of device are covered. F-Secure offers apps for the main desktop and mobile platforms, but rather snippily declares on its website that it doesn't consider a Linux version "feasible". There's no support for using the VPN with a smart TV or router either, nor any browser extensions, making this one of the least versatile VPNs around.

It's not overloaded with features, either. The big, blue interface exposes plenty of buttons and settings, but you'll look in vain for advanced obfuscation options, split tunnelling or network rules. Actually, that last part isn't strictly true, as Freedom does remember trusted networks, but only to enable access to local network resources.

The location count meanwhile is one of the slimmest here, with just 23 countries to choose from. To be honest, though, we're almost glad there aren't more, as the menu is fiddly enough as it is, requiring you to click on a continent before you can browse the countries within it. F-Secure doesn't reveal how many actual servers it operates, and there's no way to browse the individual exit nodes, so you just have to pick a country and take what you're given.

That being the case, it's perhaps a tribute to F-Secure's load-balancing technologies that, across all the servers we tested, performance was uniformly average, with Freedom consistently ranking between eight



ABOVE Selecting a location via the big blue interface is quite a fiddly task

and eleventh place. In practice that means there's enough bandwidth for 4K streaming from anywhere – and yes, US Netflix did work for us – but those looking for fast BitTorrent downloads may be disappointed.

Alongside VPN duties, F-Secure Freedom offers browsing and tracking protection modules, which seek to remove any malicious or intrusive content from your VPN traffic. We can't really complain about that, but it hardly makes up for the lack of functionality in other areas, nor Freedom's generally unimpressive performance.

## Getflix

A smart and very effective way to unblock video sites – but we can't recommend it as a general-purpose VPN

SCORE ★★★★★

PRICE \$4.95/month, \$13/3 months, \$23/6 months, \$40/yr, \$55/2yr (3 devices) from [getflix.com.au](http://getflix.com.au)

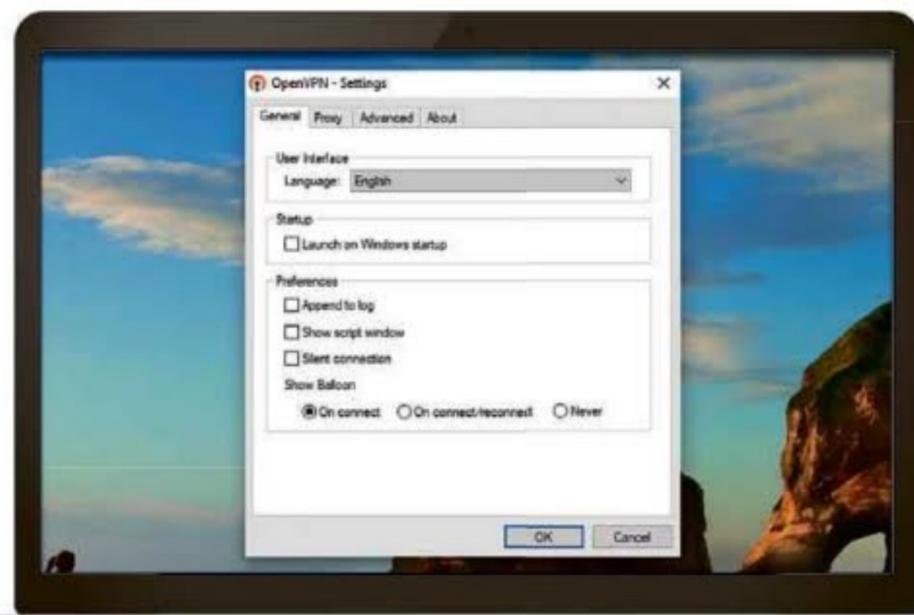
Most VPNs emphasise privacy and security, but Getflix makes no bones about it: this is a service that's primarily designed for unblocking video streaming sites. And it does so in a clever way, with the standard configuration operating purely at the DNS level. This means you can watch Netflix US, Amazon Prime and a wide selection of other international streaming sites without having to route all your network traffic via the country in question – and without having to deal with the performance implications that entails.

Getting set up is less user-friendly than with other VPNs, however. You have to go into the network settings of

the device you want to stream to, and manually change its DNS settings to point to the Getflix servers, before logging onto the Getflix website to set your virtual region. Still, this does mean that you can use Getflix on just about anything, from a router to a games console.

Let's be very clear, though: the DNS-based approach does nothing to protect your online privacy. And while Getflix does also offer a full-fat VPN option, it's one of the crudest offerings around. It doesn't even have its own client app: rather, you have to download the generic, open-source OpenVPN client and unzip the supplied configuration files into the installation folder. You can then connect to servers in 20 countries from an icon in your system tray – but as for advanced features, you can forget it.

Performance over the VPN is pretty dire, too. We got 70.6Mbps/sec downstream when connected via the Netherlands, but no more than 10.8Mbps/sec anywhere else; across all of our tests, the Getflix VPN never



ABOVE "Functional" is probably the best word for the Getflix VPN service

placed higher than fourteenth in a field of 16.

For these reasons we obviously can't recommend Getflix as an all-round VPN champion; however, if you're chiefly interested in US Netflix with the option of a bit of incognito browsing once in a blue moon, it's a tempting proposition. The price isn't at all bad, either: it only covers three devices, and they'll all have to share the same virtual region, but £4 a month is less than you'll pay for a more fully featured VPN – and if you commit for two years it works out to just £1.85 a month.

## HMA Pro

A huge global presence and support for a good range of devices make this a decent VPN, albeit not the cheapest

SCORE ★★★★★

PRICE £60/yr, £96/2yr, £129/3yr (5 devices, all prices inc VAT) from [hidemyass.com](http://hidemyass.com)

If you've a long memory you might recognise HMA as the VPN that, back in 2012, landed LulzSec hacker Cody Andrew Kretsinger in prison by sharing details of his online activity with the UK authorities. Since then, though, the company has been bought out by Avast and now boasts that it records no information about the websites you've been visiting, nor the data you've transferred.

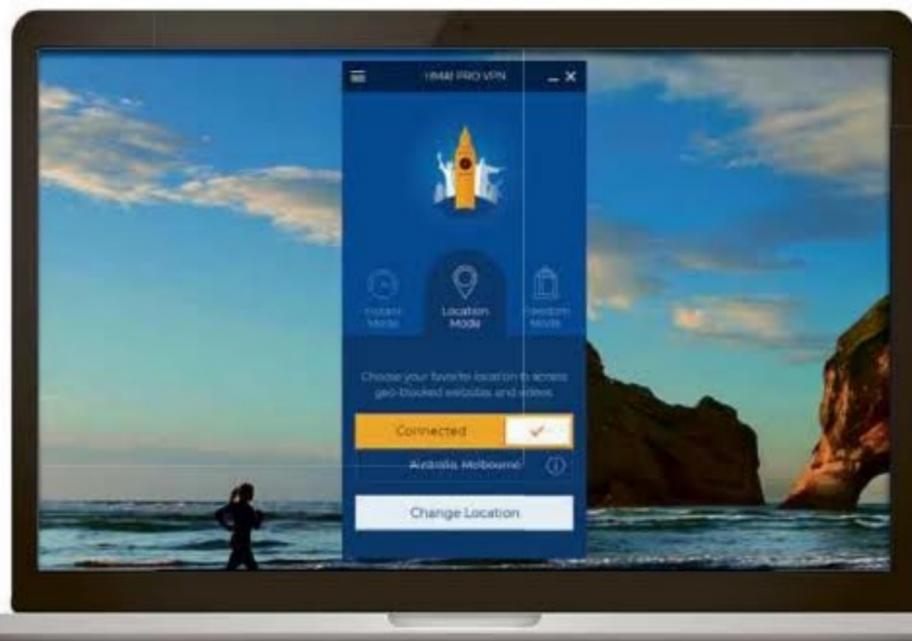
The service is completely separate from Avast's own-brand SecureLine VPN, however, and differs from it in several ways. One is the sheer global reach of the service: while SecureLine offers servers in 34 regions, HMA Pro can route you into a whopping 190

countries – more than any other VPN on test.

Another is a wider client ecosystem. As well as the main desktop and mobile platforms, HMA supports Linux and router-based installation; if your router isn't compatible, there's even a tutorial on the website for setting up a Linux VM as a VPN gateway. Browser extensions are offered for Chrome and Firefox, too; the only real disappointment is that there's no support for Fire TV devices,

There are a few clever features, too. There's no split tunnelling, but you can mark known networks as trusted to bypass the VPN and an app-specific kill switch lets you block only nominated apps when the connection goes down. If you really want to cover your tracks you can enable the ingenious IP Shuffle feature, which automatically changes your network address to a user-defined schedule (which can be as frequently as once every minute).

Perhaps HMA Pro's weakest suit is performance. It pulled a magnificent 66.2Mbps/sec down the line from Australia, but other servers were



ABOVE The client app looks simple, but it includes some smart advanced features

much less impressive, delivering a mediocre 60Mbps/sec from New York and just 31.8Mbps/sec from Switzerland. Still, that's more than fast enough to watch Netflix US, and if you want to use BitTorrent you can go via the Netherlands server, which gave us a solid 106.2Mbps/sec.

HMA Pro doesn't offer monthly subscriptions, but the deals on offer aren't bad, working out to £5 a month for a single year, £3.99 for two years or £3.59 for three years. It's not the fastest or most feature-packed VPN, but if you need a virtual presence in Aruba or Mali, HMA has you covered.

## Hotspot Shield

Some will be put off by the price, others by fact that it's based in the US – but this is a simply excellent performer

SCORE ★★★★★

PRICE Free (500MB/day, £11/month, £120/yr, £216/2yr (5 devices, all prices inc VAT) from [hotspotshield.com](http://hotspotshield.com)

If you just need a VPN for light usage – say, transferring the odd document – then Hotspot Shield could be just the thing. It offers a free service tier that lets you transfer 500MB of data a day, via more than 70 countries. Better yet, the free Chrome extension has no data cap and can route your web traffic through more than 25 virtual locations.

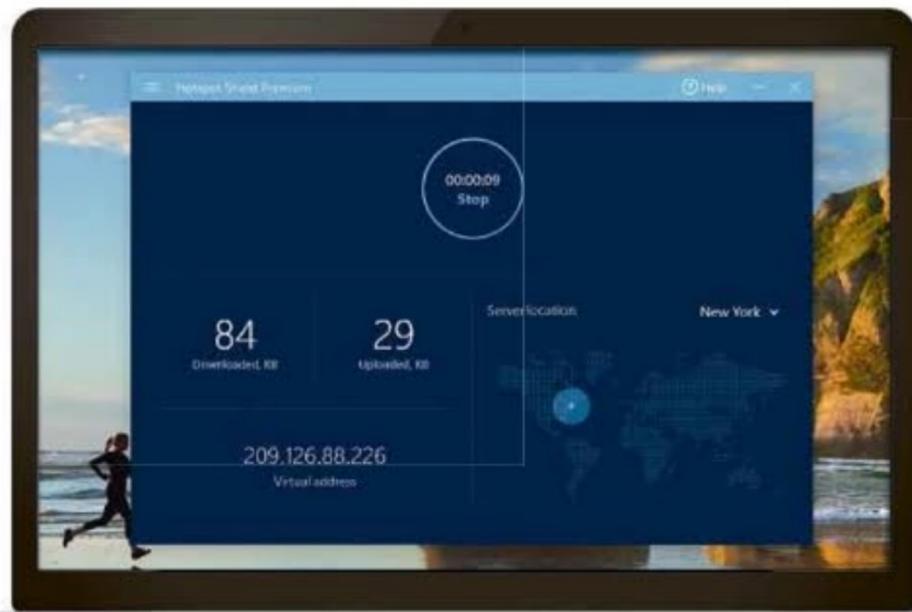
Sign up for the full service and Hotspot Shield is fairly expensive. Even a two-year deal works out to £9 a month, going up to £10 for the yearly package and £11 for a month-by-month subscription.

Still, what you get for that is best-in-class performance. Hotspot

Shield wowed us with download speeds of 110Mbps/sec in the Netherlands, and 109Mbps/sec in Switzerland. Even more remarkable, it managed 106Mbps/sec downstream all the way from New York. True, connection speeds from California, Japan and Australia were only around half that, but it's still an unbeatable set of figures.

You're free to do whatever you want with all that bandwidth, too. Hotspot Shield allows you to run BitTorrent from any location, and while it doesn't offer servers dedicated to video streaming, Netflix US worked first time for us – so there's a good chance that Hotspot Shield will unblock whatever international content you want.

The client includes a split tunnelling feature for websites, so specific domains can be routed via your ISP rather than the VPN, although there's no equivalent feature for applications. You can also choose to have the VPN kick in automatically when you connect to an unsecured network, or to all networks. Software



ABOVE The client looks rather bland, but download speeds make up for that

support is a little limited, though: if you want to use Hotspot Shield on Linux, you'll need to use the browser extension and there's no support for router or smart TV hardware at all.

One point to keep in mind is that Hotspot Shield is based in the US; if you want to be completely out of reach of the authorities, you would be well advised to pick a more out-of-the-way VPN. However, the service definitely has its plus points – and if you're wavering, there's a seven-day free trial, plus an unusually generous 45-day money-back guarantee, so you have very little to lose.

## IPVanish

Not the cheapest VPN, but the price gets you ten simultaneous connections to a good spread of servers

SCORE ★★★★★

PRICE \$10/month, \$27/3 months, \$78/yr (10 devices) from [ipvanish.com](http://ipvanish.com)

IPVanish is one of the more liberal VPNs when it comes to device support, allowing up to ten simultaneous connections. You can use it with most types of hardware, too: native apps are offered for Linux and Amazon Fire TV devices, and the website offers setup instructions for a variety of router models.

The Windows client can be used in a compact “Simple mode” – similar to Surfshark’s “Mini mode” – or as a full-size window. The latter includes a live graph of upload and download speeds, and while this may not be the most useful feature in the world, it’s quite pleasing to watch. We saw a creditable data rate of 106.5Mbps/sec

from the Netherlands, with 49.9Mbps/sec via Japan and 54.8Mbps/sec from servers in Australia. IPVanish did surprisingly poorly when we tried connecting from New York, giving us only 24.4Mbps/sec, but connecting via California proved twice as fast, allowing us to watch Netflix US without a blip.

For those wanting to venture further afield, IPVanish operates around 1,300 servers in more than 75 countries, which you can browse as either a list or a scrollable map. If you’re looking for the best performance you can sort and filter servers by load or latency, or simply select “Best Server” and “Best City” and let IPVanish make the call.

The software lacks a double-VPN option, but it can disguise your encrypted traffic so as to sneak through firewalls and proxy-blockers. Like HMA Pro, IPVanish can also periodically change your IP address – although it has a minimum interval of 45 minutes, so it won’t mix up your traffic quite as thoroughly. There’s also a smart kill switch that can optionally leave local connections



ABOVE You can pick a country using either a jazzy map view or this much more boring list

open while internet access is blocked. Our one frustration is that while IPVanish does have a split tunnelling feature, allowing certain apps to bypass the VPN, it’s only available on Android and Fire OS.

You can use BitTorrent over any server you wish, but bear in mind that IPVanish is based in the US, so in theory it could be forced to expose your activity. Value for money isn’t spectacular either, despite the ten-device allowance: an annual licence costs around £5.30 a month, while Surfshark or Windscribe give you unlimited connections for less.

## Norton Secure VPN

Performance isn’t dire, but compared to the competition this VPN package is almost embarrassingly basic

SCORE ★★★★★

PRICE £20/yr (1 device), £30/yr (5 devices), £70/yr (10 devices) (all prices inc VAT) from [uk.norton.com](http://uk.norton.com)

Norton isn’t the only security specialist that’s branched out into private networking: on previous pages you’ll have seen offerings from Avast and F-Secure. Norton Secure VPN undershoots both, though, to take the dubious title of this month’s worst VPN.

To be fair, the software does what it promises to. You can browse via servers in 29 countries, and picking a US server gave us fuss-free access to Netflix US. Performance wasn’t atrocious either: our Swiss connection was lightning-fast at 105Mbps/sec, and we got strong download speeds of around 68Mbps/sec from both New York and Japan. Norton doesn’t let

you pick a specific exit node in your chosen country, however, so we weren’t able to test speeds from the US west coast.

We’d also hesitate to trust this VPN with anything sensitive. That’s partly because the publisher is headquartered in the US, within easy reach of state surveillance programmes and potentially vulnerable to legal or political pressure. That’s probably the reason why BitTorrent is blocked on the service.

Another issue is that the software lacks a kill switch, so an accidental disconnection could completely expose all your online activity. You won’t find anything in the way of advanced options either, such as double VPN or split tunnelling; the Windows client doesn’t even have an auto-connect function, although this is available on Android. While we’re on the subject, note that Norton Secure VPN works on the big four platforms, but if you want to use it on a Linux system, set it up on a router or access it from your smart TV, you’re completely out of luck; there isn’t even a browser extension.



ABOVE The client app is attractively simple, but there’s nothing below its surface

The one semi-smart feature that Norton Secure VPN does offer is the ability to block tracking technologies when you’re browsing via the VPN. This may help protect your privacy, but it hardly makes up for everything else that’s lacking.

If you’ve five devices to protect then £2.50 a month isn’t a lot to pay, although bafflingly the ten-device deal costs more per device. There’s also a lengthy 60-day money-back guarantee, which is a decent gesture. Frankly, though, we suggest you skip Norton and go for a more capable VPN – you’ve plenty to choose from.

## Private Internet Access

The interface is a bit full-on, but this techie-friendly VPN has thousands of servers and good support for Linux

SCORE ★★★★★

PRICE \$6.95/month, \$36/6 months, \$40/yr (10 devices) from [privateinternetaccess.com](http://privateinternetaccess.com)

Private Internet Access – let’s just call it PIA – opens up as a floating window crammed with buttons and widgets. It’s daunting at first, but techies will appreciate all the information on offer, and you can customise the layout to hide the parts that aren’t important to you.

A certain technical bent is evident elsewhere, too. For example, although the client software doesn’t support split tunnelling, you’ll find a tutorial on the website showing you how to use PowerShell to configure it at the OS level. In the absence of an official client for Fire TV devices, there’s also a step-by-step guide to sideloading the standard Android app.

Linux fans meanwhile will be pleased to learn that PIA gives them a proper graphical client, rather than relying on a basic command-line interface. There’s a browser extension that lets you control the VPN within Opera too, in addition to the more usual pairing of Chrome and Firefox.

PIA’s VPN service extends to 32 countries; that’s not a huge number, but it’s served by more than 3,000 servers, so capacity shouldn’t be a concern. The connection list doesn’t indicate the load or bandwidth of individual servers, but it does show a latency estimate for each location, which gives you a clue as to what sort of performance you can expect.

In our download tests, PIA fared respectably. Servers in the Netherlands and Switzerland both topped 106Mbps/sec, and we got 75.9Mbps/sec downstream from Silicon Valley. New York was unusually slow, though, at 43Mbps/sec, and our Australian connection delivered just 25.5Mbps/sec.

As for Netflix US and BitTorrent, both worked perfectly over PIA – but



ABOVE Love or hate it, the Private Internet Access interface isn’t short on detail

note that peer-to-peer downloading isn’t officially sanctioned by the publisher. That may be because it’s based in the US, and has to be a bit more legally cautious than VPNs in breezier jurisdictions. The location also has an effect on support: live chat is available, but only during US office hours, which means between 4pm and 1am UK time.

Its US heritage might give you pause, but Private Internet Access is a tempting VPN for more advanced users, and the annual plan is good value too, coming out at around £2.70 a month for ten devices.

## PureVPN

An affordable do-everything VPN with fair performance and handy connection modes to suit different usages

SCORE ★★★★★

PRICE \$11/month, \$70/yr, \$80/2yr (5 devices) from [purevpn.com](http://purevpn.com)

PureVPN has servers in over 140 countries, but you might not discover them all at first. On opening the app you’re prompted to select an operating mode (options include “streaming”, “internet freedom” and “file-sharing”), which brings up a shortlist of servers deemed suitable for your purpose. They’re sorted by ping time, so you can just click on the top one and get on with whatever it is you want to do.

Indeed, if it’s video streaming you’re interested in, you can forget about virtual locations altogether, and simply scroll through a list of more than 80 video-on-demand services from all around the world. A click unblocks any one of them, and there’s

a Fire TV client too so you can easily hop between regions on your television.

Though PureVPN’s modal approach might appeal to beginners, we found the interface rather fussy, with a proliferation of links and views that can be confusing to navigate. There’s not much in the way of extra features, either: the most interesting one is the VPN Hotspot tool, which turns your laptop into an encrypted Wi-Fi gateway for other devices. You can also configure PureVPN on your router; you’ll find detailed instructions on the PureVPN website for more than a dozen popular brands.

As for performance, PureVPN didn’t disgrace itself, but didn’t stand out either. We saw strong speeds of 104Mbps/sec via Switzerland, 81Mbps/sec from San Francisco and 55Mbps/sec from Sydney. Our New York connection, however, was rated at just 54Mbps/sec, and we got only 26Mbps/sec from Japan.

PureVPN’s track record on privacy isn’t perfect. In 2017, it shared information with the FBI that led to the arrest and imprisonment of one



ABOVE Choose an operating mode and a list of suitable servers will appear

of its users. The company has since updated its practices, however, and proudly advertises that it now keeps no logs whatsoever.

While PureVPN isn’t especially cheap on a monthly or annual basis, there’s a steep discount on a two-year subscription, which comes out to around £2.70 a month: only Getflix and Surfshark are cheaper over the same period. And should you need a static IP address, you can add one for \$1.99, or \$2.99 with DDoS protection. That might make it a good choice for techies, while its one-click video streaming will appeal to telly addicts.

## TunnelBear

It's undeniably cute, but this VPN doesn't officially support BitTorrent and won't unblock Netflix US

SCORE ★★★★★

PRICE Free (500MB/month), \$9.99/month, \$60/yr (5 devices) from [tunnelbear.com](http://tunnelbear.com)

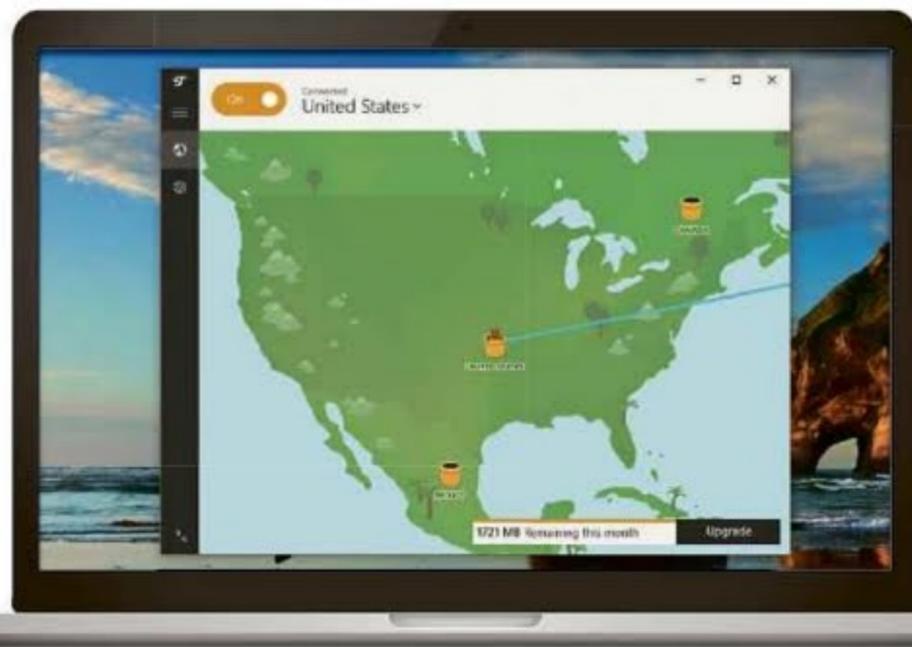
TunnelBear endears itself right away with its playful ursine theme – and it's one of the few VPNs to offer a free service, which will be music to your ears if you only need a secure connection every now and then. It's not exactly generous though, with a transfer cap of just 500MB per month; you can get an extra gigabyte by tweeting about the service, but that still feels rather mean when Hotspot Shield gives you 500MB for free every single day.

The selection of virtual locations is also one of the narrowest here, covering just 22 territories, with no option to pick a specific city within your chosen country. On the plus side,

TunnelBear gave us some very good download speeds: we averaged 92.1Mbps/sec from the US server and over 105Mbps/sec from both Switzerland and the Netherlands. More distant servers are much slower though, delivering 22.6Mbps/sec via Australia, and 20.9Mbps/sec in Japan.

And while there's bags of bandwidth available around the western hemisphere, you're limited as to what you can do with it. For one thing, TunnelBear doesn't explicitly support BitTorrent, probably because file sharing is illegal in Canada, where the company is based. In practice we had no problem downloading torrents over the VPN, and the company assures us it doesn't store details of what you're doing online, but be aware that there's no guarantee that torrents won't be blocked at some point.

Nor does TunnelBear unblock international Netflix libraries – which makes its lack of support for Fire Stick and smart TV devices somewhat moot. There's no support for router configurations either, and while TunnelBear does provide advice on



ABOVE The animated bear graphics are an undoubted highlight of this quirky VPN

getting the service working in Linux, this is strictly unofficial and limited to the command line.

Annual pricing works out to around £4 a month for five devices, which isn't out of line with the competition. However, while the free tier lets you put TunnelBear through its paces, the company doesn't offer trials of the full service, nor a money-back guarantee (the company considers refund requests "on a case-by-case basis"). Considering that this VPN does less than its rivals, and is based in a "Five Eyes" nation, we recommend you look elsewhere.

## Windscribe

Build-your-own packages and support for unlimited devices make this VPN a very tempting value option

SCORE ★★★★★

PRICE Free (10GB of data/month), \$9/month, \$49/yr (unlimited devices) from [windscribe.com](http://windscribe.com)

Windscribe is a generous VPN. It's one of only two services this month to permit unlimited simultaneous connections (the other being Surfshark), and it even lets you transfer 10GB of secure data per month for free.

Subscription terms are admirably flexible too. A standard annual licence comes out to around £3.30 a month, but if you don't need access to all 66 countries where Windscribe operates you can build your own plan. Each location costs \$1 per month for 10GB of data, with unlimited data across all your locations costing an extra dollar. This means you can get unlimited access to Windscribe's dedicated US

Netflix server for just \$2 a month, with no lock-in. You can also lease a static data centre IP address for \$2 per month, or a residential one for \$8 a month.

Platform support is a third feather in Windscribe's cap. Alongside clients for Windows, macOS, Android and iOS, you'll find instructions for setting up the VPN on routers, smart TVs, NAS devices and Kodi players. There's advice on getting the Chrome extension running in Opera too, and even a page on enabling proxy connections for BitTorrent clients – although a regular VPN connection is more secure.

Windscribe doesn't exactly scale the heights of performance: the fastest download rate we saw was 78Mbps/sec (via Switzerland), but New York came in a close second with 77Mbps/sec, and that's fast enough for 4K video streaming with bags of bandwidth left besides. The big disappointment was Australia, where speeds hit just 18.7Mbps/sec.

The feature set isn't huge, but there's a kill switch (confusingly referred to as a "firewall"), a secure



ABOVE Windscribe's no-nonsense front end belies the flexibility of the service

wireless hotspot feature and an ad-blocker called R.O.B.E.R.T. that can remove malicious or unsavoury content from your VPN stream. Finally, note that, like TunnelBear, Windscribe is based in Canada, so although it boasts a strict no-logs policy, government agencies could theoretically require it to share whatever it does know about you.

For the typical user, though, that might not be a serious concern – and Windscribe's easily customisable plans and unlimited device support make it excellent value for those with specific VPN needs.

# SEASON'S READINGS

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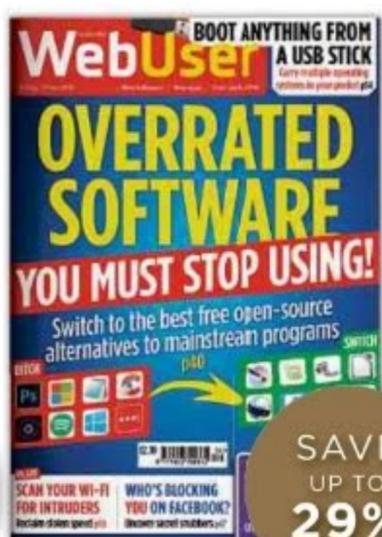


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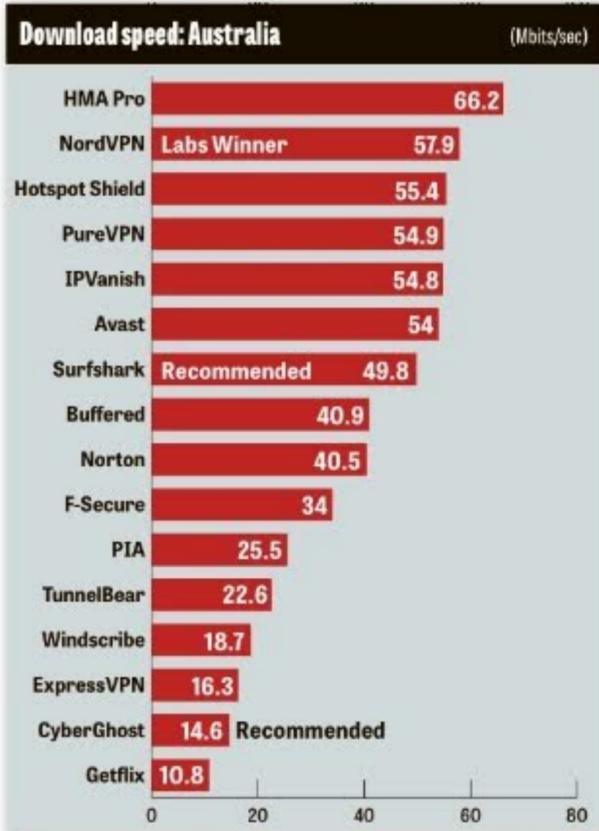
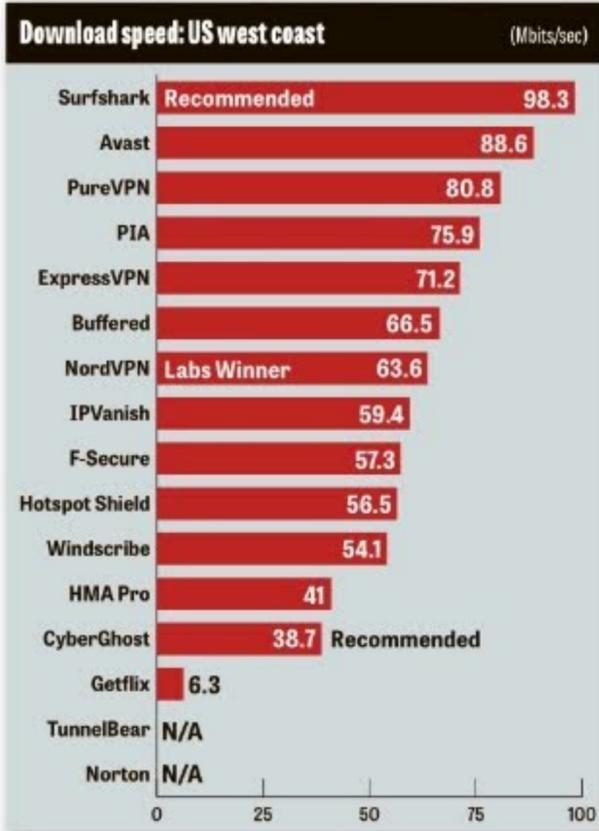
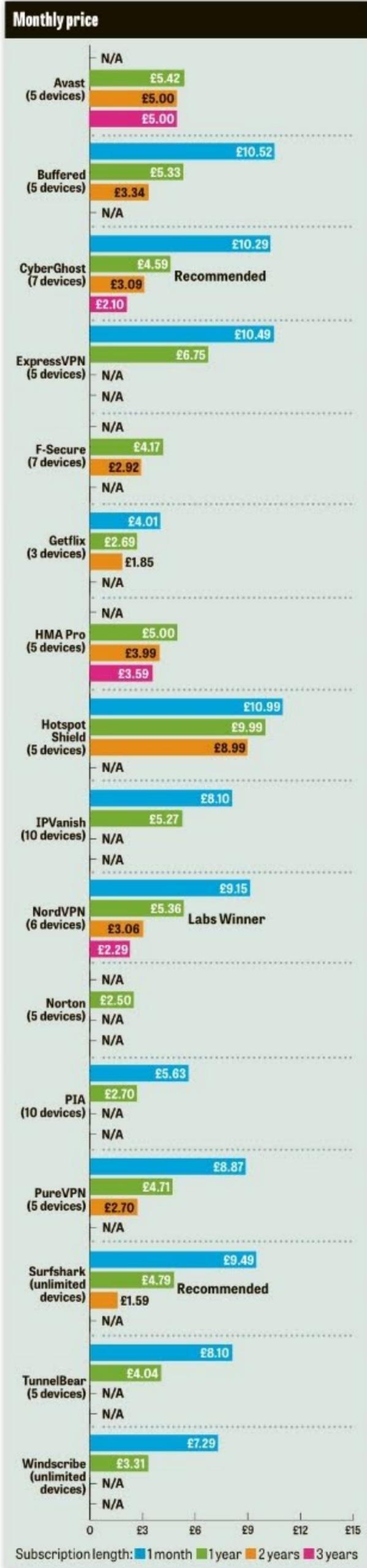
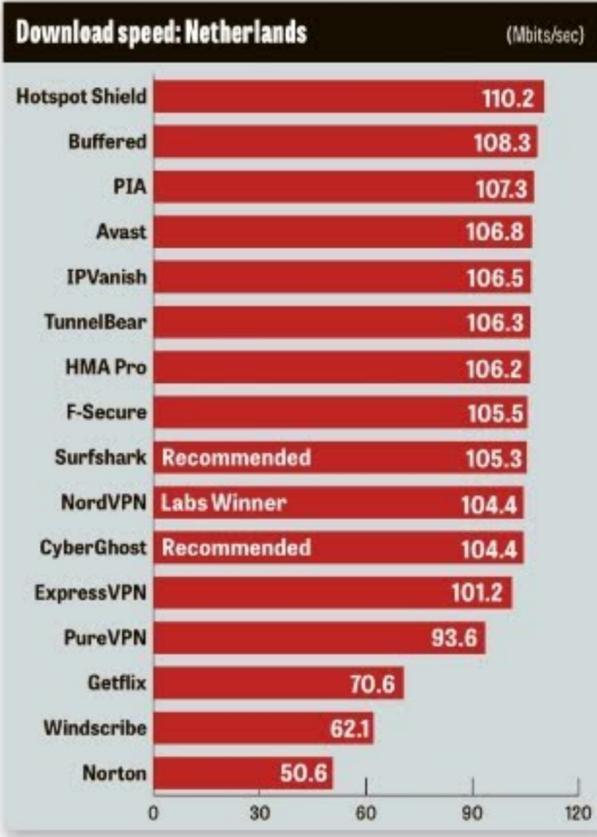


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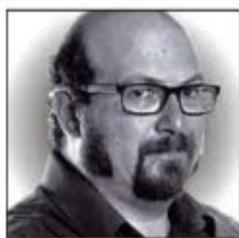
# VIEW FROM THE LABS

Using a VPN isn't just about protecting yourself – it could be a vital step towards safeguarding our nation's digital future

The Labs has been part of *PC Pro* since day one – yet believe it or not, we've never before carried out a full-scale Labs test of VPNs. To a casual observer that might seem odd, not least since the first mainstream VPN came with Windows NT 4, which means the idea has been around for almost as long as the magazine itself.

But it's only in recent years that the true value of virtual private networking has become apparent. Back in the 1990s, the focus was on businesses wanting secure LAN connections over the nascent internet. Today, thanks to the likes of Edward Snowden, we've belatedly come to recognise how important online privacy is in our personal lives as well as our professional ones.

Indeed, right now, we Brits find ourselves slap-bang in the middle of defining our relationship with online privacy. Sensitive communications are increasingly being carried out online, and ever-growing archives of personal data are being amassed. At the same time, the controversial "Snooper's Charter" continues to



**Darien Graham-Smith** is associate editor of *PC Pro*, and he's happy to share his views on VPNs with the world

rumble through legal challenges, and no one can say how those will end.

So, at a time like this, we need to ask ourselves a fundamental question. Do we want to live in a world where it's easy for government agencies, ISPs and – inevitably – hackers to sift through our communications? Or do we want to live in one where that's as hard as practically possible? If your answer is the latter, it's time to start establishing the idea of strong online privacy as a cultural default.

Happily, getting on board the VPN train is quicker and easier than you might fear. In the past I've been put off by the thought of having to set up client software on every machine, and fiddling about turning the VPN on and off as needed. But not only do today's VPN apps run unobtrusively in the background, many of them embrace router installation, so you can enter your credentials once and forget about the VPN altogether.

Then there's the price. Yes, no one loves the idea of yet another monthly

payment, but sign up for two years or more – and personally I'm happy to go as long as possible without having to think about renewals – and you can get a great, full-featured VPN service for less than three quid a month. That's pretty hard to gripe about.

Finally, there's performance. It's true that a VPN connection can slow things down, but the infrastructure on the other side of your modem is more awesome than you may realise. As the graphs opposite show, picking the right VPN (and the right server) can get you near enough to the full bandwidth of your local ISP that you won't notice the slightest difference.

In short, getting set up with a good VPN is cheap and convenient. As well as privacy protections, you get the option of unblocked streaming sites and unfettered BitTorrenting – and perhaps more importantly, you'll be helping to shape the way we use the internet for years to come. In decades past you might have questioned the need for a personal VPN; come 2020, the question will be how you can justify going online without one.

**“Do we want to live in a world where it's easy for government agencies, ISPs and hackers to sift through our communications?”**

## WHEN VPNs AREN'T ENOUGH

If you're looking for the ultimate in online anonymity, Tor could be the answer – but it's far from a magic bullet

We've hammered home the point this month that a VPN can safeguard your online privacy. But at the end of the day, if the police come knocking with a court order, your VPN provider has no choice but to cooperate. You can reduce that risk by choosing a service outside of your local jurisdiction, but you can't wholly eliminate it.

For the maximum protection, therefore, you might consider using Tor instead. Similar to a VPN, this technology routes your connection through remote servers to make it harder to trace. The difference is that Tor sends everything through (at least) three randomly selected servers in turn, and applies multiple levels of encryption so that no single server



**ABOVE** It's slow, but the Tor browser provides multiple layers of privacy protection

It also makes Tor connections all but untraceable. Even seizing one of the servers wouldn't reveal anything conclusive about the traffic it had been handling. And since Tor servers are mostly run by volunteer individuals, they're extremely hard to gain access to in the first place.

If you want to try Tor for yourself, the easiest way is by downloading the

ever knows both the origin of your connection and its content. This multilayered approach is what gives Tor its name: it's short for "the onion router".

dedicated Tor web browser from [torproject.org](http://torproject.org), which automatically routes all your traffic over the Tor network. Be warned, though, Tor can be very slow, depending on which servers are randomly chosen. The first time we tried connecting, we saw download speeds of 20.1Mbits/sec via an exit point in Ghana; on our second attempt we got just 6.4Mbits/sec from a virtual location in Azerbaijan.

Be aware too that, since Tor is completely opaque and anonymous, there's no way to be certain that your connection hasn't been compromised by criminals – or even governmental agencies. You'll find a discussion of the theoretical dangers at [pcpro.link/303tor](http://pcpro.link/303tor), along with advice on staying safe while using Tor. ●

# The Network



Practical buying and strategic advice for IT managers and decision makers

**Pick the perfect colour printer**  
We offer colourful advice before putting four options to the test [p96](#)

**Cheat Sheet**  
What businesses need to know about quantum computing [p105](#)

**The Business Question**  
How do I manage a departing employee's access to IT? [p106](#)

## BUSINESS FOCUS

# Pick the perfect colour printer

Some things never change – such as the choice between laser or inkjet. But, as **Dave Mitchell** explains, there are plenty of other issues to consider before buying

The promise of the paperless office has been dangled before us for more than 40 years – yet we're hardly any closer to it now than we were in the 1970s. True, a gradual move towards digitisation means we don't need to handle so many physical printouts in our everyday working lives, but businesses still need to produce hard copies of invoices and reports, documents for signing or proofing, sales pitches and more – which means the in-house printer still has a big and central role to play.

The good news is that there's a huge range of printers on the market that can handle your needs. No matter what your requirements when it comes to price, speed and printing technology, there's a model to suit every task – and costs for colour models keep on falling, to the extent that they're making mono printers all but obsolete.

The only downside is that the wide range of options means there's a lot to take into account when choosing a printer. This month, we review colour inkjets, lasers and LED models from the biggest names in the industry and put them through their paces in the lab to help you make the right choice.

### ■ Good technology

Lasers remain a popular choice for business printing: they're fast, they're reliable and they can deliver great results on cheap recycled paper. Even low-cost lasers can produce pin-sharp text, with colour quality that's good enough for professional reports.

LED printers work on a similar principle, but instead of beaming a laser across the page, they use a stationary array of LED emitters to generate the static charge that sticks the toner to the paper. Since they have fewer moving parts, LED printers are cheaper to manufacture, yet most can match lasers for speed and produce equally good results. They may, however, produce a slight cross-hatch pattern on large areas of colour.

Finally, there are inkjet printers. The old advice was to avoid inkjets, as they have historically suffered from poor reliability and high running costs. Today's business models are serious contenders, however, with high-capacity ink tanks and big duty cycles. Running costs are generally lower than for laser or LED printers too, although for the best prints you will need higher quality paper, which may increase overall costs.

### ■ Cut the costs

On that note, before purchasing a colour printer, make a serious effort to estimate your current and future printing needs, and calculate the resultant running cost. Cheap printers often use expensive consumables, and depending on your usage you could save a lot of money in the long run by choosing a pricier model.

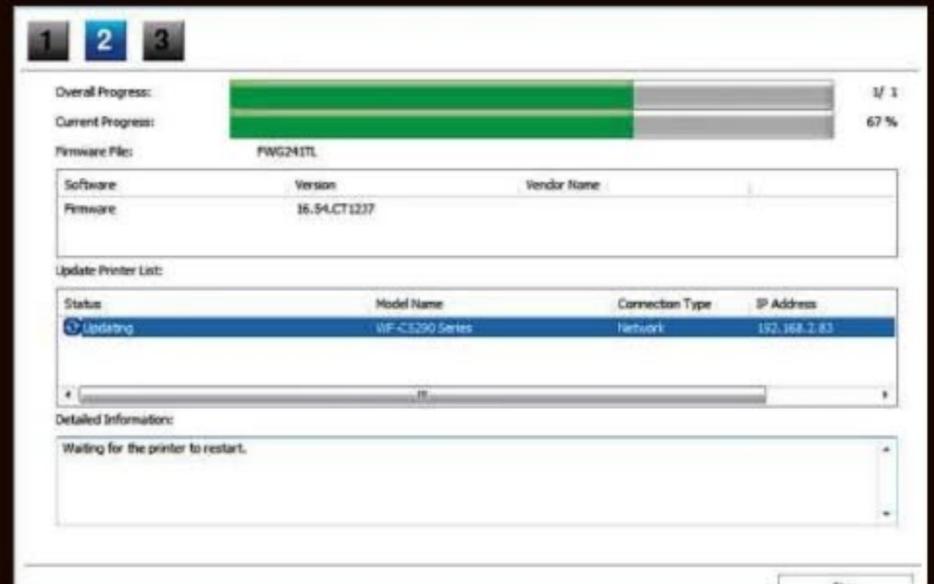
**“Cheap printers often use expensive consumables, and you could save a lot of money in the long run by choosing a pricier model”**

To illustrate this, let's compare running costs for some of the printers on test this month. The Brother HL-L3270CDW (see [p98](#)) costs just £132, making it a tempting choice for a low-volume role. However, if your staff print a total of 100 pages per day every working day for a year, you will end up paying a steep £754 for mono prints or £3,405 for colour.

Move up to the Kyocera Ecosys P6235cdn (see [p100](#)) and while you'll pay £358 for the printer itself, yearly



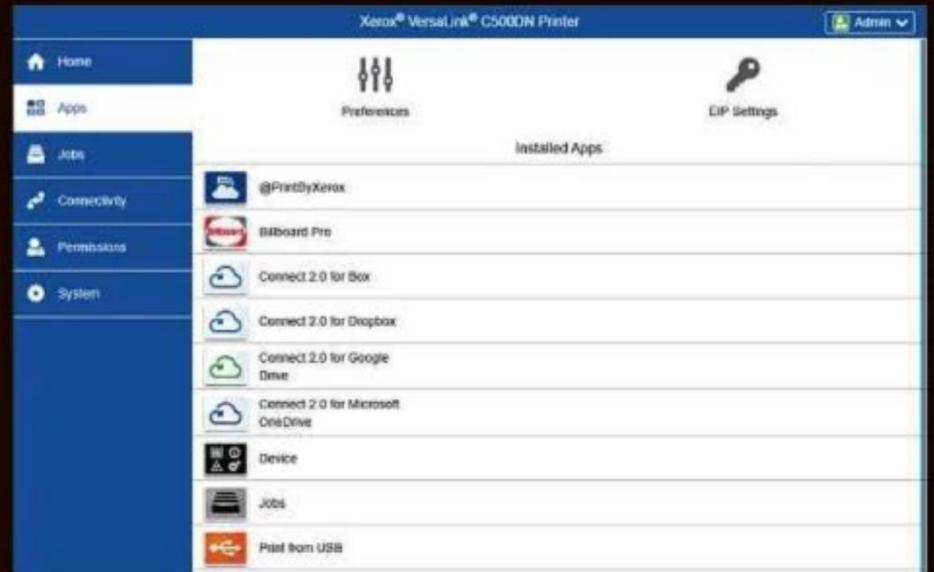
**ABOVE** Brother's Web Connect portal makes light work of linking its printers to cloud storage services



**ABOVE** For the sake of security, you should regularly check for and install firmware updates



**BELOW** Look for a printer that allows you to restrict access to colour printing and other expensive functions



**BELOW** Some printers – such as Xerox's VersaLink models – can run a wide range of apps for increased versatility

running costs fall to £266 and £1,300 respectively – a significant saving of £2,105 on colour prints in the first 12 months alone. The £175 Epson WorkForce Pro WF-C5290DW (see p99) delivers similar yearly mono costs of £296, but cuts colour costs even lower to £1,275.

As an extreme example, what if you printed 500 pages every day for a year? With Brother's printer, you'd pay a gobsmacking £17,027 for colour, while the Epson slashes your outlay to a slightly more reasonable £6,376.

**It's not easy being green**

Printing will never be great for the planet, but there are ways to reduce your impact on the environment. One is to use an inkjet where possible: the Epson inkjet we review this month consumed no more than 27W when printing, while the laser and LED models peaked as high as 1.17kW during their warm-up phase.

You can also save paper by encouraging staff to use the duplex setting in their printer driver, which can halve paper usage and reduce running costs. Many printer drivers these days make this the default, although it's always easy for users

to override it: we would really like to see one that gives you the option of enforcing double-sided printing.

Further savings can be made by using cheap recycled paper for draft documents. Rather than continually swapping paper over, look for a printer that can be expanded with multiple paper trays, so users can select a paper grade from the comfort of their desks.

You may also want to limit access to colour printing; this will help reduce wastage, and discourage users from printing personal documents and pictures. If that appeals, choose a printer that can block individual users from using colour or limit the number of colour pages each user can produce.

**Safety PIN**

A printer can be a security risk: it's all too easy for users to print out confidential documents and leave them sitting in the output bin for all to see. If that's a concern, look for a "walk up and print" feature that holds documents at the printer, releasing them only when you arrive at the local control panel and enter a PIN.

Certain printers also have the ability to reserve a portion of their

internal memory as a RAM disk, or use an SD card or internal hard disk to store frequently used forms and documents. Be warned that any personally identifiable information stored on the printer comes under the

**"Be warned that any personally identifiable information stored on the printer comes under the remit of the GDPR"**

remit of the GDPR – so make sure the storage device can be encrypted, and when the time comes to recycle the printer, remove the drive and have it professionally destroyed.

Remember too that if your printer is accessible over the internet, it's a potential target for hackers and needs to be locked down. Simple security measures include changing the default password for the management interface, keeping the firmware up to date and disabling any unneeded features such as SNMP management, FTP access or internal email services.

The four printers we have chosen for this buyer's guide are all worthy representatives of the available technologies. Whether you choose laser, LED or inkjet, they all offer an impressive range of features at low prices; so read on to see which one suits your printing needs best.



## Brother HL-L3270CDW

A wealth of features at an amazing price – although high colour costs mean it's best for occasional printing

SCORE ★★★★★

PRICE £132 exc VAT from [printerbase.co.uk](http://printerbase.co.uk)

From the price tag you would be forgiven for assuming that Brother's HL-L3270CDW was a simple consumer-grade printer. Yet this colour LED desktop unit offers a 24ppm print speed in both mono and colour, a built-in duplexer and both wired and wireless networking – not to mention top-notch mobile device and cloud support as well.

It looks the part too, with a flip-up 6.8cm colour touchscreen and an integrated NFC sensor for tap-to-print mobile operations. Capacity is spread across a single sheet multipurpose tray and a 250-sheet lower tray, which is long enough to take 14in legal paper as well as regular A4.

As usual, you can't use both wired and wireless networking at the same time, but whichever you choose the HL-L3270CDW is simple to configure. The printer connected to our wired network without a hitch, and immediately found and downloaded the latest firmware with a couple of button presses.

Driver installation is nicely handled, too. The Windows installer software loads Brother's iPrint&Scan desktop app for quick local printing, while the iOS mobile version expands printing facilities to cloud accounts, web pages and stored photos, and even allowed us to print directly from our iPad's camera.



Cloud support is a real strength: getting set up with Dropbox was a simple case of visiting Brother's Web Connect portal, registering our Dropbox account, entering the unique 11-digit code at the touchscreen and setting up a PIN. With this done, we were able to browse and print cloud documents directly from the printer's touchscreen, and Google Drive, OneDrive, OneNote, Evernote and Box are supported, too.

Another feature we've always liked is Brother's Secure Cloud Print portal, which lets you send PDFs, images and Office documents to the printer from any web browser. To use it, you simply visit a custom URL, select a file to print, upload it and release it within 24 hours at the printer using an automatically generated six-digit PIN.

For more general access security, Brother's Secure Function Lock 3 lets you create local user lists and decide which print services they can access. The printer supports 100 function profiles, with each covering permissions for mono and colour printing, page counts and access to online features.

**ABOVE** This low-cost LED printer looks and feels like a much more expensive model

**“Getting set up with Dropbox was simple... we were able to browse and print documents directly from the touchscreen”**

**BELOW** Software support includes good access security and printing controls, as well as free mobile apps

While the feature set is strong, print speeds are a mixed bag. Our sample Word document was turned out at 24ppm at both Normal and Fine quality – but switching to double-sided mode pulled that down to just 9ppm.

Performance was also erratic with our colour DTP

document: the printer paused several times while processing the job, delivering an overall print speed of just 8ppm. We've seen this before with Brother LED printers, and it seems to be down to a lack of onboard horsepower. When we switched from the standard PostScript driver to the GDI version (which relies on the host PC to do all the rasterising legwork), colour speeds shot up to the promised 24ppm in both quality modes.

And print quality is impressive for such a low-cost printer. Even 6pt text

is pin sharp, and mono photos come out with a fair amount of detail, even in the murkiest areas. Reports with large colour graphics were suitably eye-catching too, and our colour test

chart showed smooth transitions across complex colour fades. Photos show good contrast, vibrant colours and very little cross-hatching.

There's just one catch with the HL-L3270CDW: while the purchase price looks like a steal, running costs are relatively high. The drum units, belt and waste toner box will probably last the life of the printer, but even if you use high-yield cartridges, you're looking at 3p for a mono page and 13.5p for each side of colour print.

That makes the HL-L3270CDW printer best suited to small businesses that only need to run off the occasional print in colour. Still, it scores highly for output quality, access security is tight and it won't be beaten for cloud and mobile support.

### SPECIFICATIONS

600dpi A4 colour LED printer • 24ppm colour/mono • 800MHz CPU • 256MB RAM • 6.8cm colour touchscreen • 10/100 Ethernet • 802.11n wireless • USB 2 • NFC (Android only) • duplex • 250-sheet drawer • single-sheet manual feed slot • recommended monthly duty cycle: 1,500 pages • 439 x 461 x 252mm (WDH) • 18.3kg • 1yr limited warranty **OPTIONS** 2yr warranty extension, £61 exc VAT



## Epson WorkForce Pro WF-C5290DW

Great value for small workgroups, with plenty of connection choices and very low energy consumption

SCORE ★★★★★

PRICE £175 exc VAT from printerbase.co.uk

If you're looking to minimise your environmental impact, an inkjet is the way to go – and you won't do much better than Epson's WorkForce Pro WF-C5290DW. Throughout our tests, this small workgroup printer never consumed more than 27W, which is around 2% of the peak draw of an equivalent business laser.

It's cheap to run, too. With XXL black and XL colour ink cartridges, typical mono and colour pages work out to just 1.2p and 5p respectively. Be warned, though, that the printer is supplied with small starter ink bags; Epson doesn't quote a page life, but our testing suggests that they're only good for around 500 pages.

Despite all of this, there's very little in the way of technical trade-off. The WF-C5290DW comes with Gigabit Ethernet, 802.11n wireless and USB 2, along with AirPrint, Wi-Fi Direct and an integrated NFC sensor: for £175, it's a remarkable specification.

Initial installation takes a while, as once you have loaded the four ink bags in the lower tray, the printer has to spend around ten minutes priming its reservoirs. Things gets slicker from here on, though, as Epson's installer



software discovers the printer, loads the drivers and automatically updates the printer's firmware.

The installer also gives you a network status monitor and an E-Web browser plugin for printing web pages. Remote printing by email has to be set up separately, but this doesn't take long: a wizard registered the printer with our Epson Connect cloud account and instantly assigned it a customisable email address.

For an even more seamless experience, you can install Epson's free remote print driver, which appears as a regular printer in the Windows print dialog. Behind the scenes, it links up with the printer via your Connect account, allowing you to dispatch print jobs over the internet from anywhere in the world. Remote access can be secured with a global key, although if you have already installed the driver in unrestricted mode, you'll need to run the routine again after enabling this feature.

ABOVE This neat little inkjet is vastly more energy-efficient than any laser printer



“Our test charts revealed super-smooth transitions across complex colour fades, while grey shades were perfectly reproduced”

There are plenty of additional access security features, too: we were able to browse usage logs from the Connect web portal, choose who was allowed to print email attachments and optionally block photo printing altogether. You can also configure up to ten users and decide whether or not they're allowed to print from a PC and use colour. And for sensitive prints, the driver offers a walk-up-and-print option, which requires a four-digit PIN to be entered at the printer's control pad to release protected print jobs.

Although the WF-C5290DW claims a maximum print speed of 34ppm, this isn't achievable in the real world. The quoted ISO rating of 24ppm is a lot more realistic: our 34-page Word document emerged at 23.5ppm at Standard quality, which tumbled to 6.2ppm when we switched to High quality. Our 24-page colour DTP document was slower still, with Standard and High modes averaging 20.5ppm and 6ppm.

For a sub-£200 inkjet, output quality is really very good. Both driver modes produced sharp text with almost imperceptible dusting on cheap 75gsm paper, and colour reproduction was impressive, too: our test

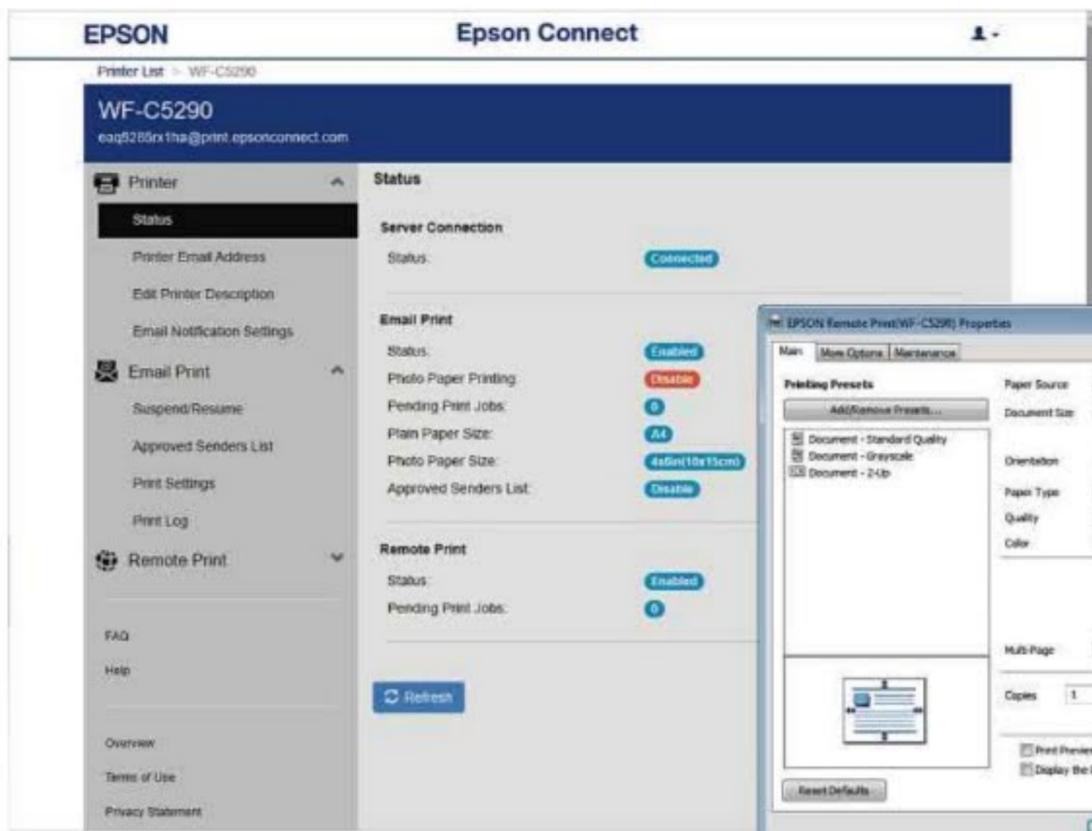
charts revealed super-smooth transitions across complex colour fades, while grey shades using equal mixes of C, Y and M ink were perfectly reproduced. Photos printed on heavier 100gsm paper showed plenty of detail, with no banding at all, and moving up to 160gsm semi-gloss paper yielded excellent results with not a hint of edge bleeding.

All of this makes the WorkForce Pro WF-C5290DW a superb choice for small workgroups with a keen eye on the environment. The starter ink bags aren't very generous, but Epson makes up for that with a low purchase price and running costs that no laser can match.

### SPECIFICATIONS

4,800 x 1,200dpi A4 inkjet printer • 34ppm mono/colour • 6cm LCD colour screen • USB 2 • Gigabit Ethernet • 802.11n wireless • NFC • duplex • 250-sheet drawer • 80-sheet MPT • recommended monthly duty cycle: 2,500 pages • 425 x 535 x 357mm (WDH) • 15.3kg • 3yr on-site warranty with registration

OPTIONS 500-sheet lower tray, £126 exc VAT



BELOW Epson's remote driver allows you to print from wherever you happen to be



# Kyocera Ecosys P6235cdn

Designed for high print volumes and fine-grained security, this sturdy laser is ideal for busy offices

SCORE ★★★★★

PRICE £358 exc VAT from [printerland.co.uk](http://printerland.co.uk)

Kyocera's Ecosys P6235cdn is no lightweight laser: it targets medium-to-large workgroups with serious printing needs. Its long-life print drum and developer are each rated for 200,000 pages and they come with a three-year warranty (whichever comes first), so there's a good chance you will only ever need concern yourself with replacing toner.

Even that's not something you will have to do very often. The starter mono and colour cartridges supplied in the box are good for 6,000 pages and 5,000 pages respectively – and replacements are rated at a massive 13,000 and 11,000 pages. That translates to low ongoing costs of just 1p per mono page and 5.1p for colour.

There's no need to be constantly reloading paper either, as the P6235cd's 500-sheet internal paper tray can be supplemented with up to three more 500-sheet feeders. And staff won't spend ages waiting around for big print jobs to emerge, thanks to a claimed 35ppm print speed.

In practice, we were pleased to see that our 35-page Word document was indeed delivered in precisely one minute at the standard 600dpi resolution. And switching to double-sided printing had an impressively



1,200dpi, while colour photos – which initially came out looking slightly dingy – were greatly improved by tweaking the driver's colour contrast and saturation settings to +4.

Management is handled via the printer's Command Center RX web interface, which allows you to configure user authentication and job accounting. Users can be set up with numerical account IDs, and each can have a total page limit assigned, as well as an optional limit on the number of colour pages they can print. Users can log into the web interface themselves with their account ID, to view their own page counts, check on the printer status and view job logs. Enabling these features requires a visit to each user's desk, however, as the driver needs to

be manually configured to use job accounting.

For frequently used or secure documents, it's possible to set aside up to 64MB of the printer's base 1GB of memory as a RAM disk – and if you

need more space, you can simply pop in an SD card. Kyocera also offers a good selection of optional add-in cards, although at £250, the IB-51 802.11n wireless adapter is expensive.

Finally, to complement the standard Windows software, Kyocera's Mobile Print iOS app brings a good range of features to mobile users, including PIN-protected prints and the ability to print from cloud accounts such as Dropbox. The free MyPanel mobile app also provides handy printer status details, including paper and toner levels.

While the 1,200dpi print mode is slow, the Ecosys P6235cdn hits all the important notes. It's expandable and easily maintained, with good print performance, strong security and very low running costs.

### SPECIFICATIONS

1,200dpi A4 colour laser printer • 35ppm colour/mono • 1.2GHz dual-core ARM Cortex-A9 CPU • 1GB RAM (maximum 3GB) • Gigabit Ethernet • USB 2 • duplex • 500-sheet tray • 100-sheet MPT • recommended monthly duty cycle: 3,000 pages • 390 x 532 x 470mm WDH • 29.5kg • 2yr on-site warranty  
**OPTIONS** IB-51 wireless card, £250 exc VAT

small impact on performance, causing speeds to dip only to 30ppm.

Unusually for a laser at this price, the Ecosys P6235cdn offers a high-quality 1,200dpi print option – but selecting this caused single-sided print speeds to fall to 13ppm. It was a similar story with our 24-page colour DTP document, which came out at 34ppm at standard resolution and 10ppm at 1,200dpi.

This isn't a big problem, though, as the higher resolution is superfluous for most business purposes. Output quality is excellent at 600dpi, with razor-sharp text that we couldn't fault at all. Colour quality was just as good, with no discernible stepping across complex colour fades in our test chart and faithful reproduction of grey shades using equal mixes of cyan, magenta and yellow.

The one scenario where you might want to tweak the settings is when printing photographs. Mono photos revealed slightly more detail at

**ABOVE** A 500-sheet internal feeder can be expanded with up to three additional trays

**“Users can be set up with numerical account IDs, and each can have a total page limit assigned, as well as a limit on colour pages”**

**BELOW** Kyocera's job accounting tools give you plenty of control over user access



# Xerox VersaLink C500DN

An expansive app library makes this affordable printer exceptionally versatile – and it's fast

SCORE ★★★★★

PRICE £369 exc VAT  
from [printerland.co.uk](http://printerland.co.uk)

Sitting in the middle of Xerox's VersaLink range, the C500DN is a colour LED printer aimed at workgroups of between five and 15 users. To that end, it offers fast 43ppm print speeds, built-in duplexing and a recommended monthly duty cycle of 10,000-pages. It also features a generous 700-sheet paper tray – which can be expanded hugely by adding up to four 550-sheet lower trays, or combining one with a high-capacity 2,000-sheet feeder.

Connection options are flexible, as the C500DN sports both USB 3 and Gigabit Ethernet ports, while simultaneous 802.11n wireless services can be added for £47 via a little box that snaps in at the back.

What really makes the VersaLink C500DN special, however, is Xerox's ConnectKey platform. This provides a tablet-like user experience via a 5in colour touchscreen, complete with downloadable apps to add useful print and cloud features.

On first contact, a wizard appears on the touchscreen to guide you through initial installation and get you started with the four preinstalled ConnectKey apps. These provide access to printer settings, job status and USB device printing; the fourth is the App Gallery, which you can use to



As if all this weren't enough, the C500DN is also the fastest printer on test this month, delivering our 43-page test Word document in 60 seconds at both standard and enhanced resolutions. And it's no slouch at duplexing, producing a double-sided copy of our test document at 41ppm. Our challenging 24-page colour DTP document didn't faze it either, with a 600dpi print averaging 43ppm, only dropping marginally to 41ppm at the enhanced resolution.

Quality meanwhile is top notch. Even on cheap 75gsm paper, the printer produced pin-sharp text and detailed mono photos. Colour printing is just as good: graphics came out with plenty of fine detail, with the driver's "Vivid RGB" setting making our reports really stand out.

Mobile users can get in on the act too, as the Xerox Workplace Cloud portal provides local and remote

printing services for iOS and Android devices plus desktops. Licensed by job credits or by device, with a 3,600-job credit costing £357 per year, this makes use of an agent discovery service loaded on one PC

on your LAN and includes strict remote access controls.

We've just one word of caution: avoid the standard toner cartridges, as these will send your running costs through the roof. The extra high-yield versions deliver far more palatable mono and colour costs of 1.3p and 5.6p per page.

Aside from that, the VersaLink C500DN is very hard to criticise. The ConnectKey apps make it supremely versatile – but even if you have little need for them, it's an excellent choice, combining fast, sharp output with great security and mobile printing services.

### SPECIFICATIONS

600dpi A4 colour LED printer • 43ppm mono/colour • 1.05GHz dual-core CPU • 2GB RAM • 5in colour touchscreen • Gigabit Ethernet • NFC • USB 3 • duplex • 550-sheet tray • 150-sheet bypass tray • recommended monthly duty cycle: 10,000 pages • 427 x 466 x 443mm (WDH) • 27.6kg • 1yr on-site warranty  
**OPTIONS** 802.11n wireless, £47 • Productivity kit, £181 (all exc VAT)

browse the cloud app store and add more (although you'll probably find it more convenient to log in from a desktop web browser).

There are plenty of apps to choose from, and some are free. One example is @PrintByXerox, which lets you email documents to the printer, view them from the touchscreen and decide which ones to release. Slightly disappointingly, the cloud print apps for Google Drive, Dropbox, OneDrive and Box all cost around £80 per device – but they work well, allowing users to conveniently log in, browse their accounts at the touchscreen and print directly from the cloud.

And if that idea makes you uneasy, fear not. You can restrict touchscreen access by user account – both local and LDAP user authentication are supported – and decide which specific apps that users are allowed to use. The printer driver also offers print and hold, and PIN-secured prints.

**ABOVE** A 5in colour touchscreen makes the C500DN a joy to interact with

**“The ConnectKey platform provides a tablet-like experience, complete with downloadable apps to add print and cloud features”**

**LEFT** There's a good range of apps on offer, and the web portal lets you control access to them





# Buffalo Technology TeraStation TS6400RN

Good storage performance and plenty of data protection features, all wrapped up in a powerful hardware package

SCORE ★★★★★

PRICE 16TB (4 x 4TB), £1,325 exc VAT from [span.com](http://span.com)

Buffalo Technology is upping its game in the SMB NAS market with the new TS6000 series of TeraStation appliances. Along with an updated hardware package, Buffalo has added support for NAS and iSCSI LUN snapshots, plus a service for securing IP SAN volumes to remote Buffalo appliances.

This month, we've tested the four-bay, 1U TS6400RN. There's no diskless option, but you can have the appliance prepopulated with 4TB or 8TB Seagate IronWolf drives. A 24-hour exchange service for failed drives is included in the standard three-year warranty, although this may be invalidated if you fit your own drives.

One key upgrade from the older TS5010 range is that the Alpine CPU has been replaced with a 2.1GHz Intel Atom C3538. You also get 8GB of faster DDR4 RAM, though this isn't upgradable. And besides dual standard Gigabit Ethernet ports, the TS6400RN offers a 10GBase-T connector with support for NBase-T 2.5GbE and 5GbE modes – so businesses wanting to go beyond Gigabit speeds won't have to replace their existing cabling.

The TS6400RN arrives ready to go, with its drives preconfigured in a



RAID6 array. Once we'd connected it to the lab network, the NAS Navigator 2 Windows utility quickly discovered it, offered options to change the RAID type and provided a direct link to the web-based management interface.

There's not a lot else to set up as, unlike Qnap and Synology, Buffalo doesn't let you install extra apps to its appliances. That might seem restrictive, but the reason is that the administrative account doesn't have root rights, which in turn closes off a lot of potential security risks.

Another notable security feature is Buffalo's unique Boot Authentication Tool. This lightweight service runs on a host PC on the same network as the NAS appliance, and you can set the TS6400RN to check in with it when it boots up. If it's not found, all access is completely blocked – a handy safeguard against data loss, should the appliance get stolen.

NAS access controls are flexible, too. Shares can be presented over selected protocols such as CIFS or FTP, and you can either use local user and group lists or link in with Active Directory. Snapshots are managed from the same section of the interface, and can be run on demand or as often as every five minutes.

If you need to recover a snapshot, it is a breeze to roll entire shares back to a specific point in time – such as just before a ransomware attack. You can

also mount snapshots as shares for drag-and-drop recovery, while Windows users with mapped shares can use the Explorer's Previous Versions tool to view shadow copies and revert to a specified point in time.



**“It is a breeze to roll entire shares back to a specific point in time – such as just before a ransomware attack”**

also mount snapshots as shares for drag-and-drop recovery, while Windows users with mapped shares can use the Explorer's Previous Versions tool to view shadow copies and revert to a specified point in time.

Buffalo also provides a Windows agent for managing application-consistent snapshots of VMware-hosted virtual machines. And for backing up client systems, the price includes the NovaStor NovaBackup 19 software, with licences for one server and ten workstations. We found this easy to use and had no problems backing up our Windows 10 clients to shares on the appliance.

To test network performance, we used the TS6400RN's 10GbE port to connect the appliance to a Dell PowerEdge T640 tower server running Windows Server 2019. This gave us raw sequential read and write

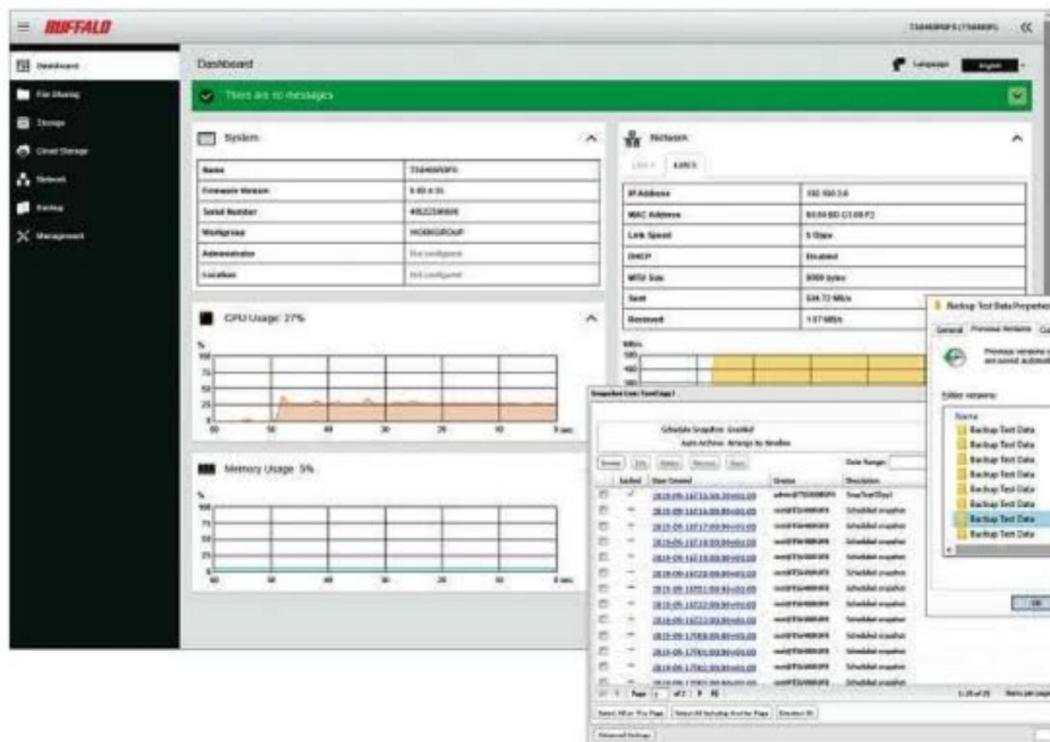
speeds of 9.3Gbits and 5.2Gbits/sec in Iometer. IP SAN speeds are equally good, with a 500GB target delivering read and write rates of 9.3Gbits/sec and 5Gbits/sec.

For those relying on an NBase-T connection, we also tried connecting the appliance to the 5GbE port on a Netgear ProSafe MS510TX multi-Gigabit switch; this gave us read and write rates of between 4 and 4.6Gbits/sec, for both our NAS share and iSCSI target.

If you're looking for the most expandable and feature-packed NAS appliance, something like Synology's four-bay RS818RP+ might be a better bet. However, the TS6400RN costs less than the Synology, while offering a faster CPU, superior DDR4 memory and a convenient NBase-T port. Businesses seeking a straightforward storage appliance with solid security and data-protection features will find it fits the bill nicely. **DAVE MITCHELL**

### SPECIFICATIONS

- 1U rack chassis
- 2.1GHz Intel Atom C3538
- 8GB ECC DDR4
- 4 x 4TB Seagate IronWolf hot-swap hard disks
- supports RAID0, 1, 10, 5, 6
- 2 x Gigabit Ethernet
- 10GBase-T (NBase-T)
- 3 x USB 3
- NASNavigator 2, NovaBackup Buffalo Edition (1 server, 10 desktops) software
- 3yr limited warranty



LEFT Buffalo's web console has support for storage snapshots and good data recovery features

## Qsan XCubeNAS XN5012RE

The app choice is basic, but this expandable NAS delivers enterprise-level data protection at an SMB price

SCORE ★★★★★

PRICE Diskless, £2,100 exc VAT from [span.com](http://span.com)

If data protection is your priority, you'll find that Qsan's XCubeNAS appliances have plenty to offer. The XN5012RE is the latest to join this burgeoning family, and like all its stablemates, it runs Qsan's QSM software, which is based on a robust ZOL (ZFS on Linux) architecture.

Snapshot services are excellent, with QSM's copy-on-write feature offering unlimited snapshots as standard. Data deduplication services are included too, along with real-time data tiering and optional WORM (write once read many) policies for long-term data protection.

Internally, the XN5012RE is powered by a dual-core 2.9GHz Celeron G3930 CPU and comes with 8GB of DDR4 memory (which can be expanded to 64GB). It presents 12 hot-swap SATA drive bays; if you need more, consider stepping up to Qsan's XN5012R, which adds a rear six-bay SFF drive cage for four standard SSDs and two NVMe drives.

Connection options are good, with four Gigabit Ethernet and four USB 3 connectors at the rear, plus a USB 2 port up front. There are two PCIe slots



available too, although these only support Qsan's own 10GbE, 40GbE, Thunderbolt 3 and SAS adapters.

Installation went without a hitch: we fitted four 16TB Seagate Exos X16 drives, visited the Qsan Finder web portal to install the latest QSM 3.1.7 software and set up a massive 44TB RAID5 storage pool. Next, to test performance, we installed Qsan's dual-port 10GbE fibre adapter and connected it as a mapped share to a Dell PowerEdge T640 Xeon Scalable server running Windows Server 2019.

With this done, Iometer reported impressive sequential read and write rates of 9.3Gbits/sec and 8.8Gbits/sec, while drag-and-drop copies of a 25GB file completed at average read and write speeds of 7Gbits/sec and 3.7Gbits/sec. The appliance is no slouch when it comes to backup performance, either: our 22.4GB folder of 10,500 small files was copied to the NAS share at a nifty 2.5Gbits/sec. And IP SAN speeds are tops, with a 1TB target delivering read and write rates of 9.2Gbits/sec and 9Gbits/sec.

The tidy QSM web console makes light work of storage management,

ABOVE A quartet of Ethernet and USB 3 connectors open up plenty of options



“Data deduplication services are included, along with real-time data tiering and WORM policies for long-term data protection”

BELOW The small app selection includes all the data-protection features you need

but it's short on apps, with just ten on offer. To be fair, though, these cover all the basic requirements, including backup, hardware monitoring, cloud syncing, antivirus, file and media management, VPNs, SQL databases, web services and virtualisation.

The backup app can run on-demand NAS share and iSCSI LUN snapshots, as well as scheduling

them as often as every five minutes. Data restoration is swift, and you can easily roll back entire snapshots or browse their contents and restore individual files or folders.

The Xmirror option lets you replicate shared folders or entire volumes to other Qsan appliances; it's possible to send backup jobs to other Qsan or rsync-compatible appliances too, or to the Alibaba Cloud OSS, Amazon S3 and HiCloud commercial cloud providers.

Virtualisation performance is held

back a little by the dual-core CPU, but the XN5012RE can host any OS you fancy, and QSM gives you options to download software directly from the VMware, Bitnami and

Turnkey app marketplaces. The Cloud Sync app meanwhile supports Google Drive, OneDrive and Dropbox, with the option to run sync jobs in real-time or periodically.

Lastly, as we mentioned earlier, QSM offers flexible WORM options. A choice of policies can be applied to NAS shares to prevent the deletion of important data: you can enforce a retention period of any length you like, or choose the “WORM forever” option to ensure that shares can never be modified or deleted. (Note that you won't even be able to remove the volume containing the shares.)

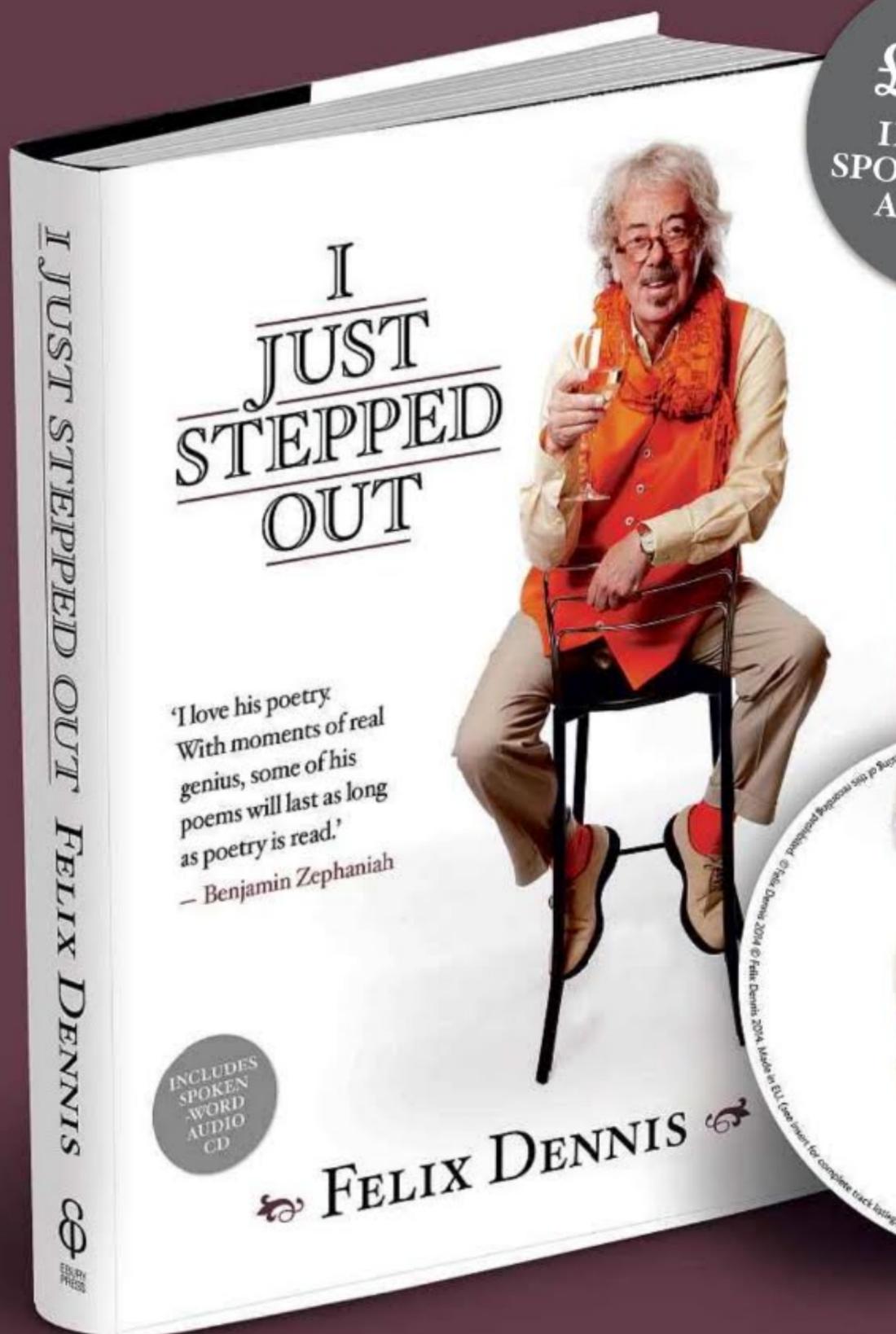
With its basic set of apps, the XN5012RE might not be the most exciting NAS appliance around. However, it does an excellent job of storing and protecting your business data, with great 10GbE performance at a good price. **DAVE MITCHELL**

### SPECIFICATIONS

2U rack chassis • dual-core 2.9GHz Celeron G3930 CPU • 8GB DDR4 UDIMM (max. 64GB) • 12 x LFF/SFF hot-swap bays • supports RAID0, 1, 5, 6, 10, Z3, JBOD • 4 x Gigabit Ethernet • 4 x USB 3, USB 2, HDMI • 2 x PCIe slots • 2 x 250W hotplug PSUs • web browser management • 3yr RTB warranty



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compute service for hire. And this is already starting, even before the technology is meaningfully mature: drop by [qiskit.org](https://qiskit.org) and you can learn the basics of quantum computing, and access the IBM Q Experience, which lets you run quantum workloads in the cloud right now – albeit, at this point, on simulators rather than real quantum computers.

■ **So quantum computing is going to be just another hosted resource?**

Well, yes – in the same way that CERN is “just another

hosted resource”, and the Hubble Space Telescope, and Elon Musk’s holiday snaps. Pretty much everything we do for the foreseeable future will have some cloud presence. Bear in mind, though, that this isn’t just another server to log into: the basic fabric of what you can do with a cloud server is rather broken by quantum’s apparent promise of a multiverse of computers, each doing only part of your computations.

■ **I suppose this new field will bring all sorts of new costs?**

Not necessarily. In the areas where QC is expected to have commercial applications, the push has mostly come from the business interests themselves; that means that many of the people you might imagine need training don’t, as they’re actually the ones in the driving seat. And, as we’ve noted, there are resources out there to help developers get started with quantum concepts. In terms of management, the main challenge you’re likely to face is just how to stop people exchanging woo-words with no meaning or value within your business. ●

**“The IBM Q Experience lets you run quantum workloads in the cloud right now – albeit, at this point, on simulators”**

## Does QC mean the end of cryptography?

Lots of excitable commentators want you to think it might. Even the terminology is over-excited; yes, as we’ve mentioned, Google may have achieved “quantum supremacy”, but that doesn’t mean it can now use the technology to do whatever it wants. QC lets you take advantage of some of the odd properties of a multiverse of quantum computers, and that’s it.

That said, code-breaking is one area where an array of superposed quantum machines can be very useful indeed. Barrelling through billions of possible permutations in

picoseconds and zeroing in on the ones that contain real words instead of random mush is a pretty perfect fit for this type of computing.

Make no mistake, though: we are talking about highly specific and demanding bits of coding and delivery here, and anyone using a public cloud resource for this sort of activity is likely to be spotted very quickly. For the foreseeable future, it’s likely that only nation states and supercriminals will be in a position to use QC to attack current cryptographic methods.

# Quantum computing

A futuristic buzzword or a game-changing paradigm?

Steve Cassidy gets to grips with an elusive concept

■ **Quantum computing? Isn’t that sci-fi stuff?**

Actually, it’s not. Hardly any science-fiction authors seem to have foreseen quantum computing: the envisioned future of computing tends to be all about more speed and ever-increasing knowledge. Quantum computing (QC for short) is something much more complex and, frankly, a lot less plausible sounding – which is perhaps why even the most imaginative writers have steered clear.

■ **So how is quantum computing different to regular computing?**

Regular computing is essentially about bashing electrons around a maze. QC makes use of the same building blocks, but instead of physical particles it relies on shadows cast by other universes, which may have equivalent devices in them: making the same computations at the same moment. No, seriously: for a detailed explanation, read David Deutsch’s *The Fabric of Reality*.

This extremely different way of working means that QC doesn’t address the same functions as traditional computing. It’s not an easy speed boost, or the next big thing for gamers. QC demands a completely new mindset on the part of both users and developers.

■ **So we’re a long way from mainstream usage, right?**

That depends on what you mean by “mainstream”. In September 2019, Google reported that it had achieved “quantum supremacy” – a milestone meaning that it had completed a calculation using a quantum computer that would have been effectively impossible using traditional computing methods (in this particular case, the computation would have taken an estimated 10,000 years to complete on a current supercomputer). So QC is here today.

However, right now it’s of very little benefit to present-day hot topics such as Big Data, blockchain or machine learning. Hopefully we’ll find ways to make QC systems more versatile over time, but any evolution could take years or even decades, and it will never displace traditional computing in all areas.

■ **And how will our business take advantage? I don’t see any quantum computers on the Dell website.**

For the foreseeable future at least, nobody is seriously proposing home or business quantum compute units. For one thing, the hardware is large and cumbersome, and needs to be supercooled. To dip a toe in the commercial outcomes of quantum computing, therefore, you’ll need to find someone offering a suitable quantum



## THE BUSINESS QUESTION

# How do I manage a departing employee's access to IT?

**Nik Rawlinson** talks to experts in access rights, data removal and human resources to navigate this most tricky of passages

Jobs for life are a thing of the past. Staff turnover has never been higher, in part because it suits employers to structure contracts that way – but more often because there's a skills shortage. Staff are a valuable asset easily lured away by rivals.

And then what? Do you revoke their access, both physical and digital, to keep them away from your infrastructure and data, or should it be business as usual while they work out their notice? A decision like this can only be made if the organisation has a clear picture of what exactly the employee can access.

"You need a complete understanding of the company assets employees use from their first day," said Fredrik Forslund, one of the part founders of the Blancco Technology Group, whose eponymous product is used by businesses to safely wipe used

kit for reuse or sale. "You need an asset management system that tracks the physical assets an employee's using, which can be simple to organise and incredibly helpful when reconciling assets following an employee's departure. Besides that, it's great to know all digital services used, which is easiest to achieve with single sign on. Simple tasks like changing passwords and logging out of online services is an important process that could protect your company from a potential data breach."

"An IT admin requires quick visibility into the scope of who has access to what within the organisation, including internal systems, cloud services and files," said Brandon Shopp, VP of product strategy for security, compliance, and tools at SolarWinds, whose access rights manager software helps IT

managers understand what a departing staff member had access to, beyond simply their Active Directory account. "Doing this manually is a time-consuming exercise, so having a tool that audits and provides it to you is an important resource. Before the employee exits the organisation, IT admin should revoke access to any information they don't need to complete their final assignments. Having a product in place to help with this not only provides visibility, but also an audit of changes to your infrastructure to help understand who is making changes and what they are."

### ■ Why, where and when?

It also depends on the circumstances under which the employee is leaving. Redundancy requires a period of

consultation, during which restricting an employee's right to work – and access to resources – may leave an organisation open to legal repercussions. Should an

**"Before the employee exits, IT admin should revoke access to any information they don't need to complete their final assignments"**

employee voluntarily hand in their notice, however, the situation is somewhat different.

“If the employee is leaving to go to a competitor, it’s still the situation in most cases that once they’ve handed in their notice they’ll probably be leaving that day, so won’t continue to have access to the [company’s] data – although that’s a bit of an outdated concept, to be honest,” Shaun Thomson, CEO of Sandler Training told us. “By the time someone puts their hand up and says they’re leaving, if they want to take that data, they already have it. They’d be silly to wait until the day after they’ve handed in their notice.”

Thomson says organisations should concern themselves with continuation of business at least as much as they think about the safety of their data and the hardware they have loaned an employee. Building multiple contact points for each client, effectively sharing internal data far and wide may, conversely, be the most effective solution.

### ■ Hardware and data jurisdiction

“Once the decision about letting someone go has been made, a collection date for assets should be set and when assets are collected, all data should be securely erased with an audit trail... before these assets are transferred to another user,” Forslund said. “There should be zero risk for data leaks in between users in a situation like this.”

Frequently, the distinction between corporate and personal hardware – and corporate and personal data – is blurred. BYOD can result in business-critical data residing on users’ own devices, while personal emails may linger in a corporate inbox. Should employees be allowed to export their mailbox and take their contacts with them?

“Generally, no,” said Forslund. “The personal emails must originate

from some other service where access to emails should still exist and remain. If employees are allowed to export their inbox, all locally saved work emails will come along, which is not okay.”

Shopp agrees. “Company email systems and the underlying data stored within belongs to the company, which makes it the company’s discretion to allow the employee to extract any personal items such as contacts and emails before they leave.”

It’s therefore essential that guidelines for the acceptable use of email are written into staff members’ contracts of employment, so that confusion – and conflict – can be avoided at the point of departure.

As Thomson points out, “when you employ people you’re looking for certain things, which you’re disdainful about when they leave. You expect them to come with contacts but don’t want them to leave with any.”

But contacts alone are less important than an established relationship once an organisation reaches a certain size.

“When we’re working with our client companies, we apply an acid test: do your clients have a relationship with you or just one person in your company?” Thomson asked. “If it’s the latter, when that individual moves the client is going to go wherever they go. As you grow – both your own company and a company you’re dealing with externally – it’s more about dealing organisation to organisation. We use Microsoft Dynamics as a CRM, but if our contact at Microsoft left that wouldn’t change: we’d still be using Microsoft software. The bigger a company is, the less likelihood that the employee will be able to take business with them.”

From a leadership point of view, then, and with succession planning in



**ABOVE** Certain software can notify you if an ex-employee is attempting to access a locked account

mind, only considering the risk to your data at the point an employee announces they’re leaving is probably too late. Data can be used as an insurance by staff who feel their position to be under threat. By cultivating multiple touch points between your organisation and its clients, this policy will be less effective, and have a less detrimental effect in-house if it was ever deployed.

### ■ You’re fired!

Special consideration needs to be given to staff leaving under a cloud, for whom you may wish to curtail access to mission-critical systems and sensitive data in short order.

In this case, SolarWinds’ Security Event Manager “alerts you if someone is still trying to use an account once they’ve been locked out” said Shopp. “It gathers logs that can tell you why someone is trying to authenticate with the account that you’ve shut down. Is it an application that was installed while the person was still at the company, which you need to go in and shut down, or is somebody actually trying to do something that they shouldn’t? Having visibility into that is something that every organisation should have.”

As Thomson explained, though, each situation must be considered on its own merits. There’s a wide choice of safeguards

that companies can choose from, depending on their philosophy, size, and the kind of assets – both physical and data-based – they’re dealing with. Key is understanding what staff have access to, and knowing what needs to be done as soon as it becomes clear their time with the business is drawing to a close. After all, the rate of staff turnover is unlikely to slow down any time soon, if ever. ●

**“If employees are allowed to export their inbox, all locally saved work emails will come along, which is not okay”**



### The expert view Jon Honeyball

If someone is leaving and you fear they might take all your data, then it’s time you had a serious look at your access policies

and data structuring. Every user should only have access to what they need to do their job. And logging access to that data is entirely proper. Handing out too much access is simply negligent behaviour.

On the flip side, there is no point being too paranoid. A travelling salesman will have all their business relationships in their head anyway, and that information goes when they leave. That’s just

the nature of business. But does the stores guy need access to accounts information? Of course not, but when was the last time that you did a proper information security audit?

As a rule, cut off access as soon as possible. Change all passwords and use remote cleaning tools to take out stuff that is on their work-supplied laptop and phone. Things get trickier when you’re dealing with BYOD, which can then turn into Brought Your Own Disaster from a data privacy point of view. But you took the choice of being a skinflint up front, and will now pay the cost down the line.

As for the wider HR issues, it’s imperative to get good advice. Lawyers are expensive, but they can save you a fortune in the longer term. In the end, pragmatic access to data is the most important issue. You can still layer in rights management and digital keys if you really want to, but few SMBs have the resources to manage that anyway. Oh, and allowing home devices onto the corporate Wi-Fi is a complete no-no too, so provide a “home” network SSID and VLAN for such traffic. Reducing the footprint to uncontrolled access is a key requirement.

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**JON HONEYBALL**

## “So this is a product that is sold almost certainly primarily for macOS, but requires a Windows box to update it”

**Jon hits an update roadblock when adding 10Gb Ethernet to an old Mac Pro, and gets angry with Google when he switches from one phone to another**

My recent experience with upgrading large Synology NAS (network attached storage) boxes to 10Gb Ethernet was sufficiently promising and useful that I decided to upgrade my “waste basket” Mac Pro, too. That’s because, every few months, it’s used for a specific project where I handle a multitude of large Windows virtual machines, hosted within Parallels VMs. I sometimes end up with 30 to 40 system state snapshots within the VM container, and the resultant file can be upwards of 500GB in size. Moving that around for backup purposes over Gigabit Ethernet is an exercise in frustration as the network itself is clearly the bottleneck.

How to add 10Gb Ethernet to the Mac Pro? The obvious way was to use a Thunderbolt 2 to 10Gb Ethernet adapter. I had already purchased an Atto unit for use on my 27in 5K iMac, but the cost was steep at around £500, excluding VAT. I had recently spotted that Sonnet, another Mac specialist, had released the Sonnet Solo 10G unit. This is a small box with a 10Gb port on one side and a short captive Thunderbolt 2 cable on the other. Sonnet now produces a Thunderbolt 3 version, which would be useful for a recent MacBook Pro, for example. Note that the iMac Pro has 10Gb built in, as does the forthcoming Mac Pro.

At £175 plus VAT, it seemed a much more friendly price than the otherwise excellent Atto unit. A purchase was made, and it arrived a few days later. In addition, I needed to upgrade the 10Gb network switch because I had run out of ports. Originally I bought the small but perfectly formed Netgear XS505M switch, which has four main ports (one of which is mirrored onto a fibre SFP port) and costs a trifling £228 exc VAT. The connection of two Synologies, one iMac and the uplink to the main Meraki switch had filled all the ports. Fortunately, Netgear does a bigger brother version, called the XS508M, which costs £340 exc VAT and frankly is the one I should have bought in the first place. This has eight ports, and hence solved my problem and gave me room for additional devices in the future.

Getting the Sonnet up and running was trivially easy. Plug it in, choose it in the Networks part of System Preferences, plug in an appropriate 10Gb-capable Ethernet cable, and hook it up to the switch. Everything worked, and I could move 600GB of data across to the NAS in around 25 minutes or so, compared to the multiple hours required before.

Before finishing, I decided to check for a firmware upgrade for the Sonnet. Aha, there was a newer firmware available, version 1.4.2\_3.1.90, dated



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**“Am I annoyed? Of course I am. The primary platform for Thunderbolt 2 was macOS”**

**BELOW** Sonnet’s box seemed an easy and relatively cheap way to add 10Gb Ethernet to the Mac Pro, but buyer beware

8 August 2019. I clicked on the download link, opened the ZIP file and looked in puzzlement at the contents. There were a bunch of CLX files, which I presume were firmware binary images. The usual README and licence files. An XML file for doing the updating. And an executable called ATLFLASHUPDATE.EXE. However, no macOS executable was to be found.

I returned to the download page only to discover in the small print the words: “This firmware fixes an issue using a grandmaster clock in multiple AVB domains, and other minor issues. At this time, the firmware updater runs only under Windows, but this firmware supports operation under Windows, macOS and Linux.”

So this is a product that is sold almost certainly primarily for macOS, but requires a Windows box to update it. Not only that, a Windows computer that has a Thunderbolt 2 port. For a Mac user, you are just straight out of luck and the product is effectively unsupported right from new. Now I have to hunt around and see if I have a Windows computer with Thunderbolt on it. I think that my Dell XPS 27 desktop has Thunderbolt 3, and thus I might be able to use the Apple Thunderbolt 2 to Thunderbolt 3 adapter to mount up the Sonnet so I can run the firmware updater.

Am I annoyed? Of course I am. The primary platform for Thunderbolt 2 was macOS. It’s only the integration of Thunderbolt 3 with USB-C that has brought it to wider acceptance on the Windows platform. And I didn’t expect to have to check not only that firmware was available, but that the updater was for the intended mainstream platform, too.

Lesson learned. Maybe it would have been easier to buy another Atto unit. At least it supports the main platform appropriately.

### The joy of swapping phones

iOS 13 has been released, and it’s the usual large scale annual update from





**Jon Honeyball**  
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Apple. Dozens and dozens of new features and facilities, some useful and some trivial tweaks.

It's been a couple of weeks since the initial release of iOS 13.0, and already we have had 13.1. And then 13.1.1. Maybe this week will bring 13.1.1.1 and next week we will have arrived at 13.1.1.1.1.

First, let me praise Apple for the way it is possible to transfer the contents of one phone to another. Simply place the new phone next to the old one, and it sends the entire contents across on a private Wi-Fi network – I presume it's Wi-Fi, given it has some 200GB of stuff to move in my case. Once done, the new phone is up and running and everything has been transferred.

You'd think that would be it. And it is... until you start running your third-party apps. At which point, you discover that many, maybe even most of them, are somewhat screwed up.

Now I am not particularly surprised that the Barclays Bank app has noticed that it is now sitting on a new phone, and that it needs to go through some re-authentication to ensure that it hasn't just been cloned by a fraudster. There is a means by which you can authenticate yourself to the app, and everything is up and running quite quickly. That is except for the Mobile PINsentry authentication system: this is disabled for "up to 4 days" during which "security checks are made". After waiting eight days, I reached out to Barclays support on Twitter to enquire how long these four days were, since they clearly stretched beyond the normal 24 hours. I was told it could take up to ten days for this functionality to be re-enabled. All I can do is sit and wait.

Microsoft Outlook had imploded and lost all of its account information. This really was the last straw for me with this app, and I have gone back to iOS Mail for all my Office 365 email accounts. The fact that Outlook on iOS still can't handle digital certificates for signing of emails tells me it is not a serious platform.

The biggest offender, however, was Google Authenticator. I use this to do two-factor authentication for the administrator accounts on the Synology servers. It turns out that there is no means of backing up and



restoring the account settings in this app. And they don't transfer when you do a phone upgrade either. Some idiot in Google has clearly decided it is better to just drop all the authentication on the floor instead. Which of course can be exciting when you are using this tool to do authentication into other services.

Fortunately, there is a fallback "email me an emergency code" facility on the Synology NAS boxes, so I was able to get back in, disable 2FA, and set it up again. I am now looking at alternatives including Authy and the Microsoft Authenticator app, both of which have some semblance of backup and recovery of the keys. My mind is still reeling at the concept of an authentication tool that cannot back up its keys, but I'm sure it makes sense to someone inside Google.

In terms of stability, iOS 13.0 was a bit of a wobbly jelly in a thunderstorm. I managed to cause repeated kernel panics by running the Synology DS-Cam remote camera app and scrolling back

**ABOVE iOS 13.0 was wobbly – to say the least – but issues are being ironed out**

**BELOW The iOS data transfer tool is nifty, yet it can play havoc with third-party apps**

through the timeline. This was still the case in 13.1, but 13.1.1 appears to have fixed the issue.

So now I am left with trying to find where things have been moved to. I use Find My Friends a lot to find out whether my husband has left work so I can make sure I have the kettle on for some tea. This app has now been renamed to "Find my" and integrates in the "find my computer/phone" functionality. A little birdy tells me that Apple is shortly going to launch a keyring location tracker device,

similar to the Tile devices that have been around for a while. Tile allows you to locate through the Tile use network. Just imagine if Apple's Tile-alike managed to locate, in a secure encrypted fashion, through the entire iOS device network worldwide. This would indeed be a game changer. Let's see if the rumours come true.

As for the phone, I actually had no intention of upgrading my year-old 512GB Xs Max. But the lure of the three-camera capability on the new iPhone 11 Pro Max was too strong, hence the



need to transfer my Xs Max to the 11 Pro Max. And hence all the issues I have just covered.

I have done a whole bunch of photography on the 11 Pro Max already and, frankly, it is astonishingly good. The likelihood of me ever taking my Leica cameras out again has been reduced to near zero. And the old adage applies – the best camera is the one you have in your pocket at the time. In truth, the upgrade isn't worth the money unless you need to be on the leading edge. It would have made more logical sense to wait until next year for the 5G version to come along, presuming that we have some 5G coverage outside of the major cities.

## Samsung web camera

I needed to replace one of the security cameras at the house, because the old one had died. It had managed to get its built-in OS into some sort of a firmware reboot lockup and didn't respond to determined poking. So I went hunting for a new one. The usual go-to name for security cameras is Axis and we have a number of them around the lab. They do a good job, although the purchase prices can be somewhat robust.

A little hunt on the intertubes showed that the Samsung Wisenet QNO-6010R could be just the ticket, giving 1080p resolution, infrared illumination and a price tag of a little over £100. Compare and contrast to the similar specified Axis M2025-LE, which is three times the price.

Fitting the Samsung was straightforward enough, once you realised that you need to take the entire mounting apart to rotate it to the orientation you need. And the documentation is heroically awful. But I soon got it up and running and feeding images into the Synology Surveillance Station engine on the network. The picture quality is a step up from



the thing that died, and so far I am happy. I have, of course, disabled all internet access, cloud support and all other unnecessary frippery, and made good use of VLANs. If you are in the market for some IP cameras, I would certainly give this a look – especially at the current price.

## Time to CarPlay

We have a rather nice little VW Caddy van that we use both for the lab and for ManFood (the company my husband I set up a few years ago to create a range of pickles, sauces and other fine condiments, which you can now find stocked on Ocado and

many other places, thanks for asking). The Caddy was ex demo at our local VW van emporium, and it ticked all the boxes for optional extras. So it has a very good built-in satnav with touchscreen and Apple CarPlay.

I have come to really like CarPlay, simply because it removes you from the byzantine and often baroque user

interfaces of the touchscreens of most cars. It allows access to Google Maps, and music from various streaming services. I like the voice control, and the ability to send and receive SMS simply using voice recognition. And my favourite app is Waze for traffic monitoring and route planning.

I'd probably pay a hundred pounds for it on a new car. Whether I would pay some \$4,000 for it on a new Ferrari is a moot question. But that market rationalises inordinate amounts of money to have different paint colour on the brake callipers, so I guess a normal sense of value doesn't really apply.

But BMW's move is interesting. If you have the full satnav touch interface, then you get CarPlay for free. Kind of. After a couple of years, BMW will charge you a subscription price to keep it running. Now £85 per year might not sound a lot (and you can pay £255 for three years or £295 for a lifetime subscription)

**ABOVE** While Axis is my preferred security camera at work, this £110 Samsung unit is proving a great choice for home

**BELOW** Apple CarPlay in my VW Caddy gets rid of the frustrations that bedevil many car touchscreens



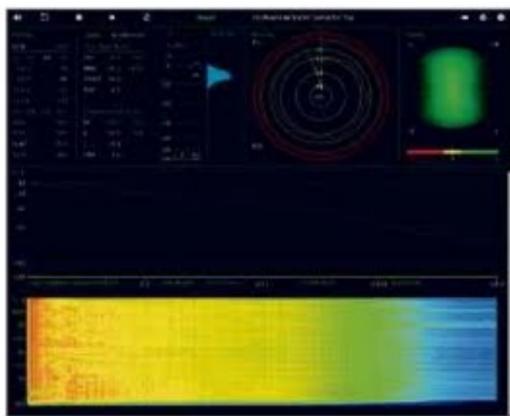
but it still opens BMW up to criticism about ongoing subscription costs for capabilities.

I can see why BMW would want to make this charge. But it will require it to actively offer a software upgrade path. This is something that Tesla has nailed completely, and for which most car manufacturers are stuck in the Stone Age. My little Audi A1 could do with a maps upgrade but it runs from an SD card and the cost is ludicrous.

It's easy to see why these manufacturers want to monetise CarPlay: otherwise they would be missing out on lots of massively overpriced updates and ongoing fixes. And if you think that's bad, think about what will happen in the longer term with autonomous cars. What will we do when we don't have to drive the car? The answer is simple – use the car systems for shopping, watching TV and so forth. Allowing the user to move to some other platform shifts the fundamental financial basis of that customer relationship, and not in a way that benefits the car manufacturer.

### Audio analyser

I discovered a nice piece of audio analysis software. Called MusicScope from Xivero ([xivero.com/musicscope](http://xivero.com/musicscope)) it does a fine job of doing spectrum analysis of a music track you feed into it. It also does all the average level calculations, crest factor and so forth.



**ABOVE** Xivero's MusicScope is an excellent spectrum analysis tool – and the price is right

It's a really useful little tool for seeing what is going on. Cost is trivial at under £30, and you can install it onto three devices at once. And it supports Windows and macOS too. It's clever, it's useful and provides great insight.

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### PAUL OCKENDEN

# “I reckon that, for many people, the Raspberry Pi 4 would actually be okay as a desktop replacement”

**Paul gives the latest Raspberry Pi a real-world workout, finding its strengths and exposing its weaknesses**

I've been playing with a Raspberry Pi 4 – in fact several of them – for a few months now, so I've reached the point where I can start to write about them here. This being a real-world column, I never like to write about products when they're brand new; it's good that they get a thorough workout first.

So what's the Raspberry Pi 4 like? Or the Raspberry Pi 4 Model B to give it its full name – I'll return to the significance of the “Model B” moniker towards the end of the column.

Well, if I had to sum it up in a trite soundbite, I'd have to describe it as powerful but flawed. Let's start with what's good, and there's lots of it. First, it's fast. Not fast like your laptop or desktop computer, but it's probably as fast as the phone in your pocket. This really opens up the range of tasks that you can use it for. While previous generations of Pis were often used as local data loggers, for example, forwarding on readings from sensors to be crunched on a “proper” computer, the Pi 4 means it's quite realistic to do that processing locally. In fact, I reckon that, for many people, it would actually be okay as a desktop replacement. For things such as email, web browsing, social media and watching videos, it's perfect. It will even play basic games. Of course if you want to edit videos or play the



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@PaulOckenden

latest games then it's really not the right bit of kit!

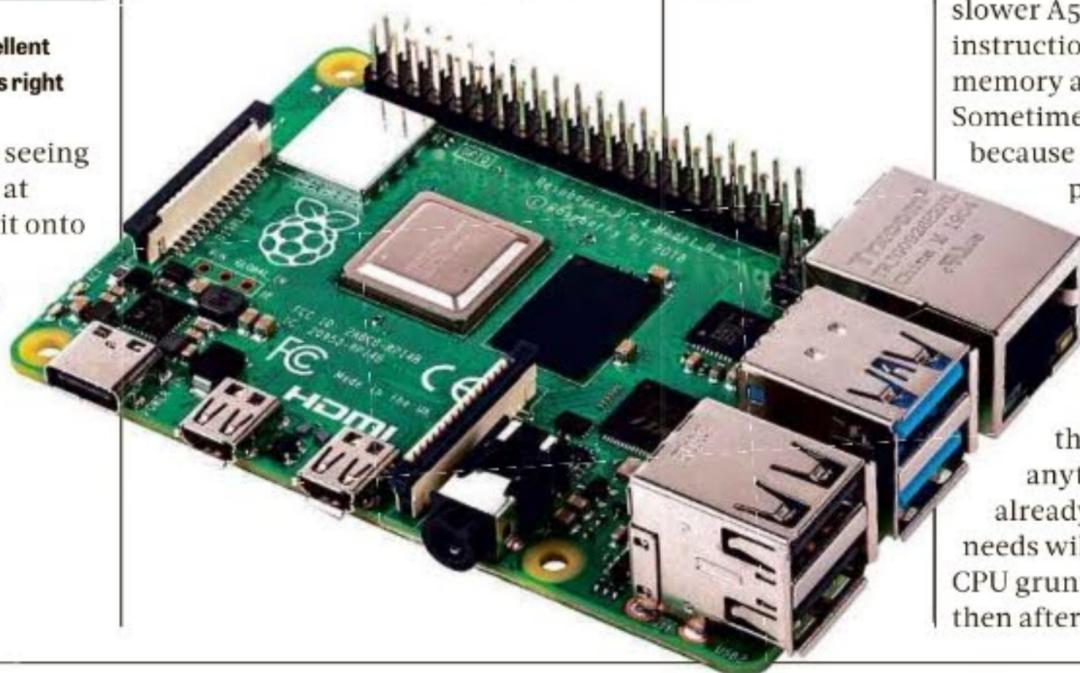
Pretty much everything soldered onto the Pi 4 circuit board has been revamped and upgraded. The CPU is actually part of a SoC, or system on a chip. That means that the metallic chip that you can see in the middle of the board doesn't just contain a traditional processor: there's a GPU in there too, as well as various bits of electronic glue that would normally be needed to interface a processor to the circuitry that sits around it. The CPU is a four-core design, just like its predecessor. And the clock speed has only jumped from 1.2GHz to 1.5GHz, so at first glance you would expect any gains to be quite modest.

Those four cores are now Cortex A72, though, and that's a huge boost over the A53 cores in the Raspberry Pi 3. The A72 and A53 are both ARMv8, so there's no real difference with the instruction set, but the differences lie in the way the processors work. The A53 was designed primarily for efficiency and frugality, whereas the A72 is all about performance. It has more onboard cache for starters, and that always makes a big difference with any CPU.

The differences go way beyond that, though. The A72 supports out-of-order execution (sometimes written as OoOE). In simple terms, the slower A53 will just grab program instructions sequentially from memory and execute them in turn. Sometimes there might be a delay because not everything needed to perform the particular

instruction is ready yet, and so those CPU cycles effectively get wasted. With OoOE, the incoming instructions are placed into a buffer and, whenever there's a spare CPU cycle, anything in the queue that already has all the inputs that it needs will be executed so that the CPU grunt doesn't go to waste. And then afterwards, in an output buffer,

**BELOW** The Raspberry Pi 4 is the fastest Raspberry Pi yet, but it does have some niggles



the results are placed back into the original execute order. It's not easy to do this, requiring much more logic and circuitry within the CPU, but it pays handsome dividends.

## Cooking with breadcrumbs

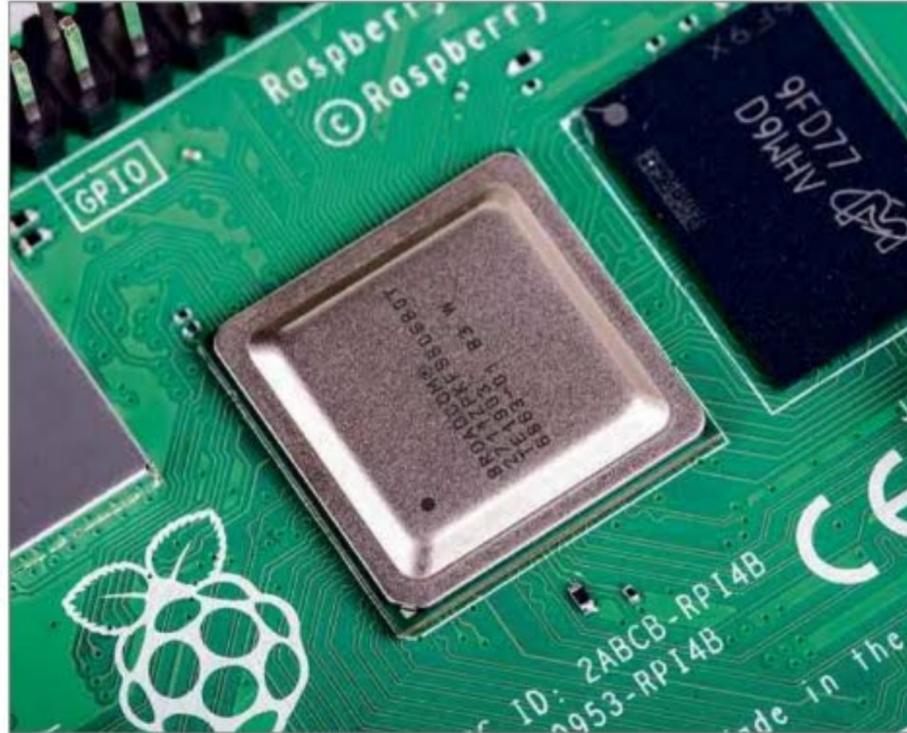
The A72 also has a bigger pipeline and better branch prediction than the A53. These are two things that work hand in hand to optimise performance.

Imagine you're about to cook a meal and the recipe asks for dried breadcrumbs. As you follow the steps you'll find one that says "if the breadcrumbs are a little soft then heat up the oven to 200°C and then put the crumbs in for five minutes". Now that obviously means you'll be sitting around waiting for the oven to heat up. With branch prediction, the processor assesses the chances of needing the oven at this point, and the time it will waste, and so heats it up anyway. If the breadcrumbs are already dry then there's no harm done and no time wasted – you just carry on with the recipe. But if the crumbs do need drying, you no longer have to wait for the oven to heat.

The better the branch prediction, the more the CPU is able to weigh up the likelihood and consequences of these decisions, and the longer the pipeline the further ahead the processor can look for these possible optimisations. In terms of pure CPU grunt, I reckon the Raspberry Pi 4 is around four and a bit times faster than the Pi 3. Much more than the jump from 1.2GHz to 1.5GHz would suggest.

The onboard graphics have also received a boost. Previous Pis used the Broadcom VideoCore IV GPU as part of their SoC, but with the Pi this jumps to the VideoCore VI. Hard to see the difference perhaps in Roman numerals, but it's gone from four to six. So what does that mean? Well, the new VC6 GPU is faster, naturally, but it now also supports 4K video and two separate HDMI outputs. For day-to-day operations you might not even notice the speed difference between VC4 and VC6, but if you fire up a GPU-intensive game you'll find a frame rate that's anywhere between 50% and 100% faster on the Pi 4 than the Pi 3. This is a key reason why some games actually become playable on the Pi 4.

So far, all of this has been inside the SoC – the little 1cm square metal thing



that sits near the middle of the circuit board. But there's much more that's been improved with the Raspberry Pi 4 Model B. With earlier Pis, much of the interfacing was done via a single 480Mbps/sec USB lane. If you used the Ethernet port the USB slowed down, and vice versa. If you used one USB port the other slowed down. And so on. That's all been revamped with the Pi 4. The USB ports are now all fully independent, and two of them support USB 3. The Gigabit Ethernet port is now actually capable of reaching Gigabit speeds, too.

The memory has also had a big boost. It's been upgraded from LPDDR2 to faster LPDDR4, with a throughput around twice that of the Pi 3, and it's no longer limited to 1GB – you can buy the Pi 4 in 2GB and 4GB configurations if you wish. Unless you're on a really tight budget, I advise going for the 4GB variant.

Despite all these upgrades, the Pi 4 is backwards compatible with earlier Raspberry Pis. It still has the same set of pins so will work with add-on boards that adhere to the HAT standard (which actually stands for "hardware attached on top", but nobody ever calls it by the full name). So if you've invested in displays, sound cards or fancy DACs, they will all still work with the Pi 4.

## So what's wrong?

I mentioned that the Pi 4 is flawed – what are the gotchas? Well, first off, Raspberry Pi made a really stupid mistake with the power input on the board. It's powered by USB-C this time, rather than the micro-USB of earlier generations. And the USB-C spec has two pins called CC1 and CC2. CC stands for configuration channel,

and the purpose of the two CC pins is to manage which is the source and which is the sink end of the cable. USB-C cables are unidirectional – they can have the same plug on each end. You just don't get that with previous versions of USB such as micro-USB, where it's always obvious which end of the cable is the giver and which is the receiver, whether it be power or data. The CC lines also signal what type of device is connected. It's called the source-sink

relationship. The Silicon Labs FAQ will give you more detail if you're interested: [pcpro.link/303usb](https://www.siliconlabs.com/faq/usb-c).

In an application such as powering a Raspberry Pi 4, these two pins are used to detect things like which way round the cable is, and whether either end has been inverted (don't forget that, unlike other USB variants, USB-C plugs can be inserted either way up). And also how much power the PSU needs to supply.

To enable this detection both pins are supposed to be floated to ground using a resistor – a separate resistor for each. But the Pi 4 designers cut corners and didn't use the reference USB-C design that's printed in the spec – instead they just used a single resistor connected to both pins.

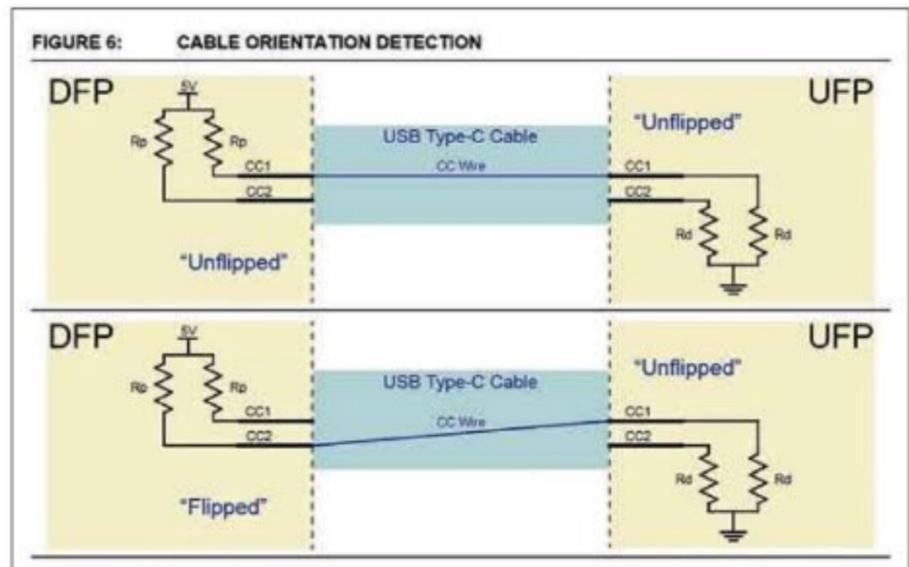
The result is that many power supplies will see the device as a low power accessory, and so won't supply the full current that the Pi 4 needs. I tested various USB-C power supplies and battery packs that I have here and around half of them work and the other half don't. It seems to be hit and miss even across particular manufacturers such as Anker.

Thankfully, and unsurprisingly, the official Raspberry Pi 4 power supply works just fine, so my advice

**ABOVE** The metal chip in the centre of the Pi 4 doesn't just contain a processor – it also houses a GPU

**"The Pi 4's USB ports are now all fully independent, and two of them support USB 3"**

**BELOW** The USB-C spec shows separate resistors pulling down the CC1 and CC2 lines, but the designer of the Pi 4 skimped and only used one



is to stick with that. It's not expensive and it works well.

The other problem with the Raspberry Pi 4 is that, if you ask it to do anything taxing, it gets very hot. This won't damage the silicon – it just throttles back its internal clock and runs very slowly until it cools back down again – but the whole point of buying the Pi 4 is because you want something that runs nice and fast. If you didn't, you'd have bought the cheaper Pi 3.

Now there are ways to deal with this excess of heat, but they all involve third-party add-ons. I can't help thinking that, given just how much of a problem heat is with the Pi 4, perhaps the Raspberry Pi Foundation should have designed something in from the start.

There are two ways to deal with excess heat: passive and active. Passive essentially means using a heatsink. With the Pi 3 you could buy heatsinks (because it too would throttle back, but this time only under extreme load). With the Pi 3, the heatsinks tended to be tiny, but with the Pi 4 you're probably best off looking at a wraparound heatsink case. Be warned that, although these should stop the Pi 4 from slowing down under medium to heavy loads, the case itself will get quite warm. So that might not suit everyone.

Active cooling means you'll be using a fan. You can actually buy variants of the big aluminium heatsink case with a fan attached. They work well, dispersing the heat nicely and everything stays nice and cool. It's a bit clunky, though. A much better option is the Fan Shim from UK Pi specialists Pimoroni (which, incidentally, stands for Pirate, Monkey, Robot, Ninja – what a brilliant name!). It's an incredibly small and slim fan that you attach to the Pi 4 by sliding a "shim" PCB over the first few IO pins.

If you've ever played with fans in PCs, laptops or servers, you'll know that as a rule smaller fans tend to be much noisier. In fact, a 1U server in a rack will often scream because its tiny little fans are working so hard – many server rooms sound like there's a 747 taking off. So I was worried when I ordered the Fan Shim that it would turn out to be irritatingly noisy.

I needn't have. It's pretty much silent, even when running at full pelt. I actually leave mine running all the time, but there's software available on Pimoroni's website that will control the fan speed as needed to keep an optimum temperature. You might want to do this, for example, if you're concerned about the 0.6W or so additional power requirement of the fan at full speed.

There's a slight downside to the Fan Shim inasmuch as it uses pin BCM18 for controlling the fan, and that's the pin used by some I2S audio HATs – in fact, Pimoroni says that I2S devices are incompatible. However, I've found that if you don't use the software to regulate the fan and just leave it running uncontrolled then some audio HATs will work just fine, including some of Pimoroni's own.

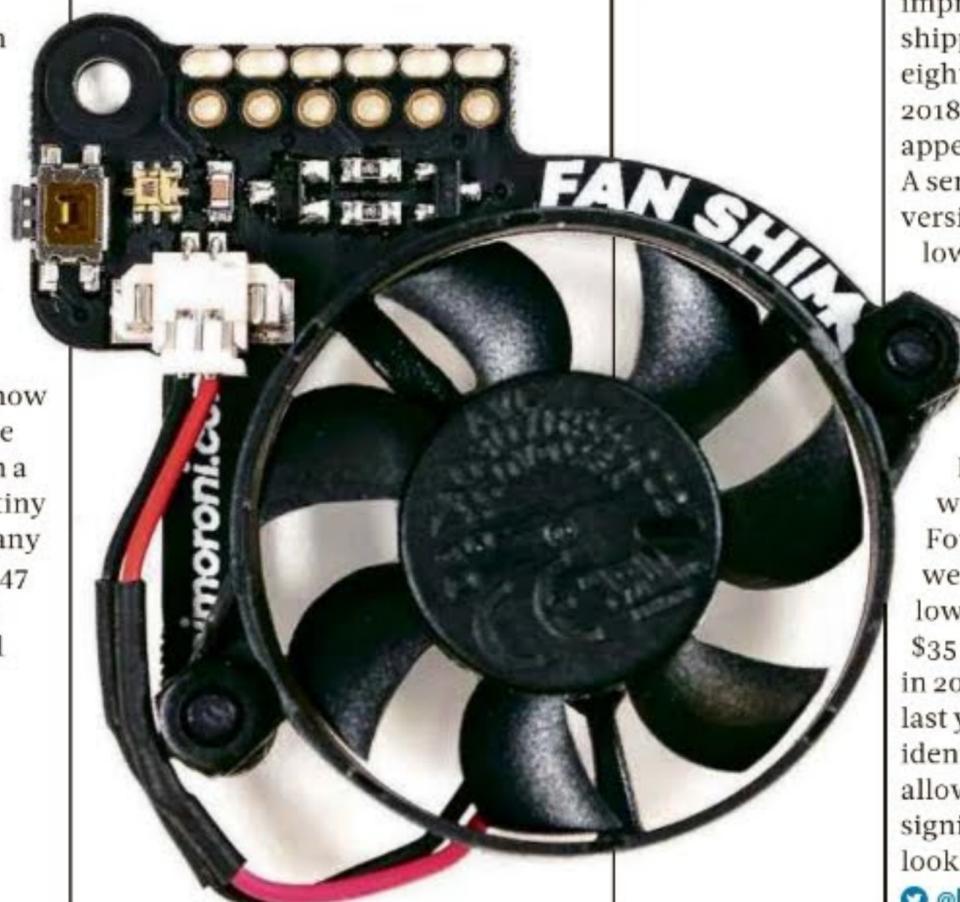
You can't use a Fan Shim inside a traditional "sealed box" case – or rather you could, but it would be a waste because it will just recirculate the hot air. The good news, though, is that it has been designed from the outset to fit together with Pimoroni's own Pibow Coupé 4 cases. Well, it calls them cases but they aren't really – at least not in the traditional sense. I think of them more as board protectors. They're neat things, built



**ABOVE** The Fan Shim is designed to work with the colourful Pibow Coupé case

**"The Pimoroni Fan Shim is pretty much silent, even when running at full pelt"**

**BELOW** Pimoroni's Fan Shim is effective – and a steal at £9.60



from several layers of stacked plastic. Putting one together the first time is a bit like doing a puzzle, but very satisfying. They come in all different colours, but because of the layered construction they are able to produce a rainbow version, where every layer is different – it looks great.

As you can tell, I'm a fan of this fan. But I've saved the best 'til last – the wonderful little Fan Shim costs less than a tenner. At the time of writing it's £9.60, which I think is an absolute bargain.

### What about the A?

Right at the start I mentioned that the full title of this board is the Raspberry Pi 4 Model B. So what happened to the Model A? Did that come before the Model B? Well, that's not how Raspberry Pi naming usually works. If you look at the Raspberry Pi 3, the Model B arrived first, in February 2016. The next to arrive was the Pi 3 Model B+ which had a slightly improved specification – it started shipping in March 2018. But it was eight months later, in November 2018, that the Model A+ put in an appearance. The Raspberry Pi Model A series is effectively a cut-down version of the Model B, designed to be lower cost and with a reduced power consumption. It has a smaller form factor, only one USB port and no Ethernet.

So when will we see a Raspberry Pi 4 Model A (or A+)? Maybe never. In a blog post on its website, the Raspberry Pi Foundation stated: "Historically, we've produced cut-down, lower-cost, versions of some of our \$35 products, including Model 1A+ in 2014, and Model 3A+ at the end of last year. At present we haven't identified a sensible set of changes to allow us to do a 'Model 4A' product at significantly less than \$35. We'll keep looking though."

[@PaulOckenden](https://twitter.com/PaulOckenden)

LEEGRANT

## “I passed through increasingly decayed rooms, loaded with PCs, printers and rotary dial phones”

**How do you convince someone that it's time to upgrade from Windows 98? Lee attempts the impossible, before setting up a VM for a beloved game**

My real-world computing involves a real-world shop. This means calls from sales reps trying to persuade me to stock new widgets and wonders. That is their job of course: to push the latest and greatest with a chirpy swagger intended to soften me psychologically so I'll order ten pallets of USB-C fondue sets. I'd love to see one of them chat with Neville.

He is an accounts clerk for a small local business and his work machine was the suspect in the boatload of racy emails that was received by the company's entire address book.

We had spoken on the phone and I'd advised him to change his email password immediately. As he didn't know how to do this, I suggested a call to his ISP would be useful. According to Neville, the ISP refused the password request as he hadn't virus-scanned his machine. This seems odd but we've all got stories of bonkers ISP conversations that make PR departments weep. If you consider that in this paragraph, the one you are reading right now, I've written Neville's password in full three times, then I'm sure you'll agree that this is shoddy customer service.

The machine is a Windows XP Dell Dimension V400 dating back to 1998. It's never seen internet security, but then it functions purely for a dribble of Office 97 and a smattering of county cricket results. It's quiet, perky and still in daily use. It was also devoid of all gremlins, so the ISP finally crumbled and changed the password.

I instigated “the chat”. Trying to explain that what appears to be a functional machine needs replacing with something more secure. Neville went away to talk with his boss.

A week later, I was summoned to sort out a printer. Neville's business is



Lee Grant and his wife run Inspiration Computers, which has been supporting home users for 15 years in Kirkheaton, just outside Huddersfield @userfriendlypc

BELOW The venerable PC was more or less a Minesweeper-playing electronic typewriter

based in an old textile mill and I'm not talking about refurbished and trendy open-plan pods with baristas and executive ball pits. This is the “Marley was dead” type of mill. I passed through increasingly decayed rooms, loaded with PCs, printers and rotary dial phones, then punch-card generators next to dumb terminals that connected to an abandoned mainframe that Neville hadn't visited for years. One room was kitted out with 286s, waiting for the return of their users who had popped out to buy the new Frankie Goes to Hollywood single and hadn't been seen since. This was a technological mortuary.

In a corner of an office was the secretary with her Dimension V400 chugging away on this month's invoices, exactly as it had done for the past 15 years. Forget cloud computing, this PC was running Windows 98.

I struggle in these situations. Part of me is delighted that old machines are still being used whilst another bit is beyond concerned that this business has not had a successful backup since the tape drive on the 98-machine went pop over 12 years ago. I cautiously explained my concerns, but Neville's boss

gave me his version of “the chat”, which revolved around not seeing any reason to make a “capital expenditure” as the current system fulfils all requirements. He added that, being a man in his 80s, he has no desire to learn something new.

I admire the brazen two-fingers to obsolescence and I'm a fully signed-up member of the keep-it-going club, but only if it's safe to do so. Apart from the backup issue, the 98 machine is offline, it doesn't understand USB sticks and functions as an electronic typewriter that can play Minesweeper. It works.

I was introduced to the printer that I'd been summoned to resuscitate. It was a Canon and probably weighed the same as a real one due to the volume of water that cascaded out of the scanner unit when I picked it up. That's the thing about draughty mills, not terribly watertight. A recent flood on the first floor added to the antediluvian panache of the place. I condemned the Canon immediately and was asked to seek a replacement that would work with Windows 98. A sharp reader like yourself has probably spotted the problem.

A week later, I was on my way back with a new laser printer and two Windows 10 boxes. I'll tell you how I shifted from Windows 98 to Windows 10, including the DOS software from 1993, in a future column. You do subscribe to PC Pro, right?

This scenario isn't as rare as you may imagine. Last month a local firm was bought out by its international rival. The rival's UK boss has been a customer for years and he mentioned that the buyout involves migrating the new acquisition from Office 365 to IBM Lotus SmartSuite, which was last properly updated in 2002. Head office prefers it apparently.

### Yearning for retro

Being a system builder is more than nailing PCBs together. We specialise in consumers and many, by their own admission, do not have a high level of technical literacy as they're just not interested. Life is too brief to ponder if the current i3 will outpace its AMD rival. What is always important is that the machine performs a certain task – games, spreadsheets, vinyl encoding, HMRC



returns. Usually the requests are run-of-the-mill, but we're frequently asked to come up with something not available on the high street.

Andre had dropped by a few weeks earlier, enquiring about buying a new laptop that came with Windows XP. He left somewhat disappointed, but I tried my best to explain why it wasn't possible. What I wouldn't discover until he returned to the shop was why he needed XP.

His poison is an old game. *Command & Conquer Red Alert 2: Yuri's Revenge*. "He can play it online", I hear you shout, but I wouldn't be wasting your time if it was that easy. Andre is a C&C purist and this new laptop had to play the original DVD versions. The online editions, it turns out, are rather resistant to change and Andre wished to run specific game mods and updates. Though I'd been unable to supply the XP machine, he said he was convinced that I could find him a solution. Me and my mouth.

He pushed a bumper pack of DVDs into my hand then requested that the machine should also be able to play *Mental Omega*. Not knowing what *Mental Omega* was, I fought the confused expression, last seen when my daughter decreed that Old MacDonald had a unicorn. I said I would investigate.

C&C echoes back to 1995 and I spent things blowing things up on my 66MHz 486DX2. Many of the original 16-bit versions are now freeware and a vibrant modding community keeps the game alive and invigorated with new content. *Mental Omega* ([mentalomega.com](http://mentalomega.com)) is an expansion pack that runs very nicely on modern hardware without much intervention.

The same cannot be said for the DVDs, which have a few snags when introduced to anything post-Vista. The 16-bit versions are scared by current, 64-bit OSes and take a lot of persuading to get anywhere near the merest hint of an installation. The machine we've sourced for Andre, an HP Omen, has a lovely 1,920 x 1,080 Full HD screen which, if the game would run, would make C&C's 800 x 600 window look rather silly.

The solution involved a lot of hacking and a small amount of law breaking. I needed to create a virtual machine capable of running the game.

Andre's previous laptop was an old Acer Aspire running XP. By the time it got to me, the motherboard had failed but the drive still worked. I made a few attempts to make a VM from this drive, but it was too unstable. I used VirtualBox ([virtualbox.org](http://virtualbox.org)) to create a new XP VM on our test rig, recycling the licence from the underside of his laptop. Normally I'm a stickler for applying Redmond's directives but on this occasion, I was happy to let the activation wizard be my Judge Judy. The software activated without a hiccup, which I like to believe is Microsoft nodding in an approving way, but is more likely because it's beyond caring.

I converted Andre's game DVDs to ISOs and then placed them in a folder that was accessible to the virtual machine. Installation was smooth and blisteringly fast, but the graphics proved tricky. Trying to find the balance between the VM's resolution, C&C's resolution and the Omen's Full HD loveliness was a headache. This element is critical to a successful C&C setup as the quickest way to move objects around is to fling your mouse pointer at the screen border. This is useless if the game's border sits in the middle of the screen: once the pointer goes too far, the VM switches focus and you're no longer in control.



**ABOVE** After a lot of tweaking, the classic *Command & Conquer* was up and running on an XP VM

**"It's nice to see life in old games where credit cards aren't needed to make them playable"**

**BELOW** Fancy a good chuckle? Watch my attempt to win a *Nascar 2003* race



The solution was to set the virtual machine to always be full screen and then modify C&C's RA.INI and RA2MD.INI files. Tweak the Video section with "ScreenHeight=1080" and "ScreenWidth=1920". This works well, but I warned Andre that certain mods may manipulate these settings.

*Mental Omega* is a simple download and will run natively in Windows 10. If you enjoy a bit of C&C, and many do, this is a great option. Andre arrived to collect the Omen which he put through its paces. Let this be a warning to all: the only thing worse than playing a 25-year-old game is watching someone else play it. He certainly was an aficionado, rattling off keyboard combinations that sent little tanks around the screen with ease. After an hour of testing, tweaking and tuning, Andre gave the machine the thumbs up.

He's not the only retro gamer on our books. Last year I built a new machine to play *Nascar 2003*. Like C&C, this game has a huge community of modders who update the tracks, repaint the cars and play online in prize leagues. I've put some test footage online for you to laugh at here: [pcpro.link/303nascar](https://www.pcpro.link/303nascar). This was sent to the client to assess certain tweaks I was making. I'd like to

highlight that the flailing wheel action is caused by using a keyboard in one hand and, if the timestamp is correct, probably a cheese sandwich in the other.

I love the ethos behind these communities and it's nice to see life in old games where credit cards aren't needed to make them playable. This wonderful magazine is full of the latest and greatest technology on the planet, but don't forget the old stuff too; some of it is still pretty awesome.

[lee@inspirationcomputers.com](mailto:lee@inspirationcomputers.com)

DAVEY WINDER

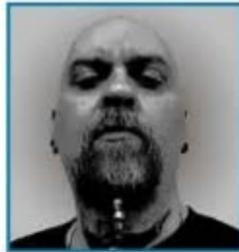
## “The vastness of the attack surface demands that all of us make better choices and put in more effort”

This month, Davey explains why misconfiguration is the (not so) hidden infosecurity Achilles heel

One of the many professional hats that I wear happens to have senior contributor at *Forbes* written upon it, and one of the subjects that comes up time and time again in my reports is that of misconfiguration. Sure, you can think of this as subset of the “people problem” if you like, or maybe a result of a lack of true visibility into your networks and data. However, hiding the misconfiguration issue behind the veneer of these common infosecurity tropes is dangerous. Why? Because misconfiguration, be that of a product or service, is increasingly emerging as the root cause of many security incidents I see.

And it’s not just me. A recent report from McAfee, looking at risk in the infrastructure as a service (IaaS) sector, suggested as many as 99% of misconfigured cloud instances that lead to data being exposed aren’t picked up by the organisation that owns the data. That research, of some 1,000 representative enterprises across various geographies, found that there was an average of 37 unsecured instances (think cloud storage buckets or databases) every month per enterprise.

That was just the number that the enterprises themselves put on it when asked, of course. McAfee reckons it’s far short of the actual number: it thought 3,500 was nearer the mark because most enterprises don’t have enough visibility to see when data is exposed like this. In fact, McAfee put the number of organisations with the ability to properly audit cloud configurations as low as a quarter of those asked. This lack-of-visibility issue is further demonstrated in the number of enterprises that “thought” they used multiple cloud vendors (76%) compared to the actual figure



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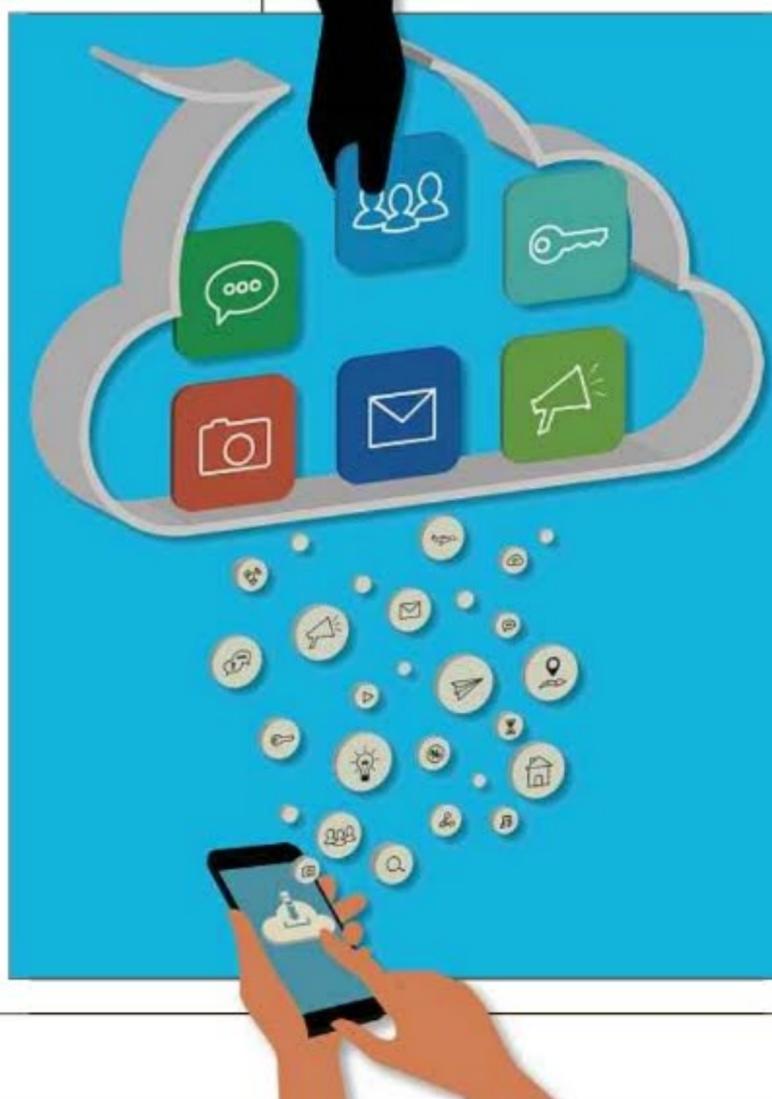
determined by McAfee researchers of 92%.

I’m not suggesting that weak credentials, password reuse, a lack of security awareness training and poor code don’t play their part in the overall cybersecurity threatscape. Of course they do; but unsecured servers and databases in the cloud are an increasingly common theme for me during my reporting. These are usually unsecured simply because they had not been properly configured, not that there are bugs in code, vulnerabilities waiting to be exploited or password reuse.

The consequences of a configuration cock-up can be catastrophic. How catastrophic? I’m glad you asked, and I can answer by way of just a trio of recent headlines that have recently spawned from my

BELOW Misconfigured cloud instances can lead to it raining data cats and dogs

keyboard for *Forbes*. Perhaps the most shocking being that data relating to pretty much the entire



population of Ecuador – that’s some 16.6 million adults and children – was leaked online by an unsecured database. There were 20.8 million records contained within 18GB of data in that particular breach.

And I do consider “data leakage” of this sort, where researchers have gone looking for unsecured databases and find them, a data breach. What else can it possibly be? The leaky database in this example contained data obtained from what appears to have been Ecuadorian government registries, an Ecuadorian bank and even an automotive association. As Ian Thornton-Trump, head of cybersecurity at Amtrust International, told me at the time: “Criminals of both the cyber non-cyber varieties will be smiling like an evil raccoon.” Less so the general manager of the company that owned the misconfigured database, who was arrested by the Ecuadorian police.

Or how about a car buyer marketing database that was found to be at the root of a 413GB dataset that another security researcher kept coming across online? This one contained loan and finance information, vehicles for sale, names, addresses, phone numbers and so on. In all, some 198 million records had been leaked by another unsecured, non-password-protected, database. Because the data included IP addresses, this meant ports, pathways and storage info could be exploited by cybercriminals to navigate the network further. More cloud-based data sitting there for anyone with the skills to go looking for it, and truth be told, it doesn’t take a “L33T” player to find this stuff: simple searches are all that’s required.

The vastness of the attack surface demands that all of us make better choices and put in more effort to get the basics right. And configuring an internet-facing database so that it isn’t publicly accessible is pretty damn basic. Often the blame seems to be laid at the door of the service or software provider, and there’s some merit in this as ensuring out-of-the-box defaults are secure, and configuration options readily understandable, isn’t a lot to ask. However, the people doing the configuring can’t escape their responsibility either; whether it’s a lack of time or training is open to debate, but getting the right people for the job, even if it costs a little more, has to be preferable to exposing data online. Especially as GDPR will take a very dim view of “oops, I didn’t know how to configure that properly”

when it comes to demonstrating every effort was made to prevent data from being breached.

To mitigate the risk of misconfiguration requires several strategies being in play at the same time. Visibility of your data is key, so that you know where that information resides and who else has access to it. The latter point, third-party access, being just as important your own – maybe more so. Ensure any third party that can access, process or store your data is acting in a secure manner. This extended due diligence is the kind of visibility that’s required if you’re really going to “see” the data exposure before you.

As many of the misconfiguration issues that come across my desk involve databases that have either scraped, paid for or otherwise obtained data from external sources, there are three big questions that need to be asked before commencing on a big data(base) path: is that level of data storage necessary, can it be secured properly and is it legal? If the answer to any of those is either no or “err” then there’s your red flag telling you to stop before you begin.

Case in point: another unsecured database, this time containing details of about 419 million Facebook users. 18 million of those users are in the UK, so chances are that includes you. And that data included phone numbers associated with the account ([pcpro.link/303forbes](https://www.pcpro.link/303forbes)). This incident likely has a bigger impact on Facebook in reputational damage terms than it will the owner of the leaked database itself, if they’re ever traced. People read the story and see that it’s Facebook data; the fact it isn’t a Facebook database or stored on a Facebook server isn’t relevant. The ripple-in-the-pond, negative-rep effect hits hardest in the centre and the Facebook brand is right there in the middle. Which is why Facebook was quick to make a statement that the dataset was old and appeared “to have information obtained before we made changes last year to remove people’s ability to find others using their phone numbers”.

Again, that important mitigation point about visibility into third party access to data, albeit by data-scraping, rises to the surface. Make it hard for anyone to get eyes on your data who shouldn’t have, and you make it easier on yourself to avoid the fallout from leaky databases floating around.

## Sextortion scams

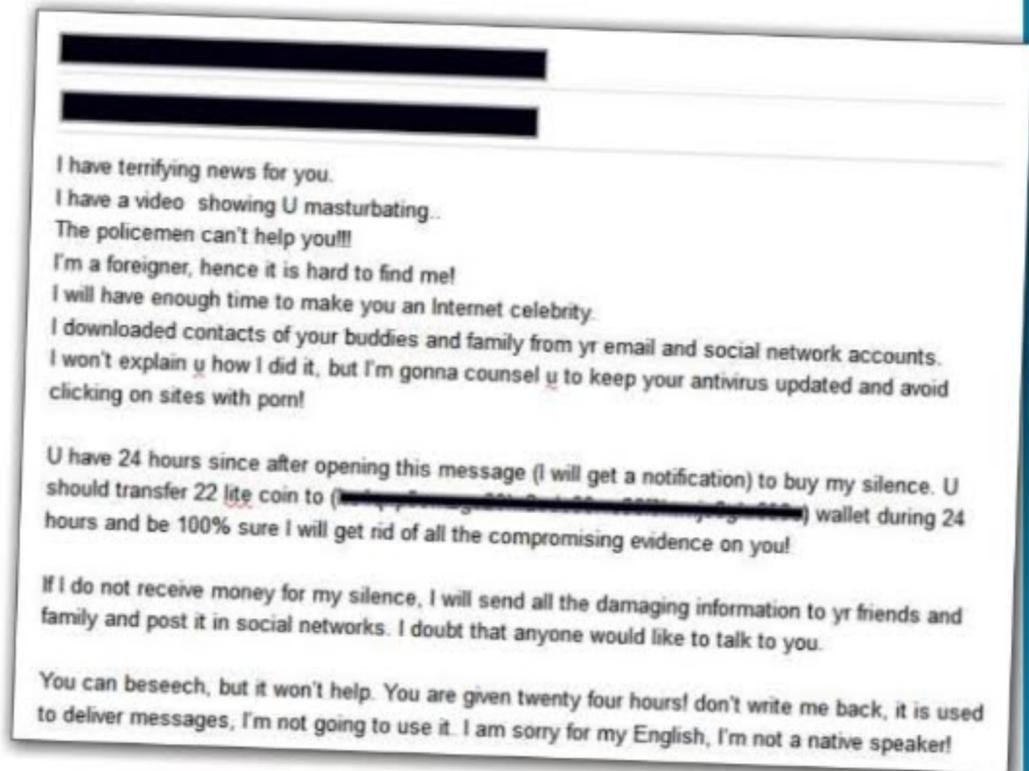
I’m going to toss in a warning about an old threat that has experienced

something of a revival lately. I would like to think most *PC Pro* readers wouldn’t fall for this one, but the numbers suggest that plenty of people do. The reason being that it combines two psychological triggers: fear of being caught, and fear of being exposed and embarrassed. Yes, I’m talking sextortion.

These scams take two forms. There’s one that has fooled many folks I would have thought better of, and the reason is simple: it includes one of your actual passwords. The blackmailer, and let’s call them what they are, sends a threatening email purporting to have accessed your computer and files, including some photos or video of a very personal nature. By way of proof, rather than attaching a clip or an image (which they don’t actually have), they quote your password.

This is, indeed, one of your passwords. How do they know that if they haven’t hacked your device? Because they use one of the many databases of leaked credentials that circulate around the dark web which have been compiled from various breaches. You might not even be aware your password for a given service was compromised; as ever, check [haveibeenpwned.com](https://www.haveibeenpwned.com). Chances are that each hacked password has been reused across multiple services. Hence the success rate that this scam, which demands a cryptocurrency payment, achieves.

The other sextortion scam that’s doing the rounds – note that Symantec blocked 350 million extortion emails in the first five months of 2019 – doesn’t bother with a password. Instead it goes straight for the embarrassment jugular by claiming to have hacked your webcam or smartphone camera.



**ABOVE** If you receive a “terrifying” email like this, report it to Action Fraud and block the sender

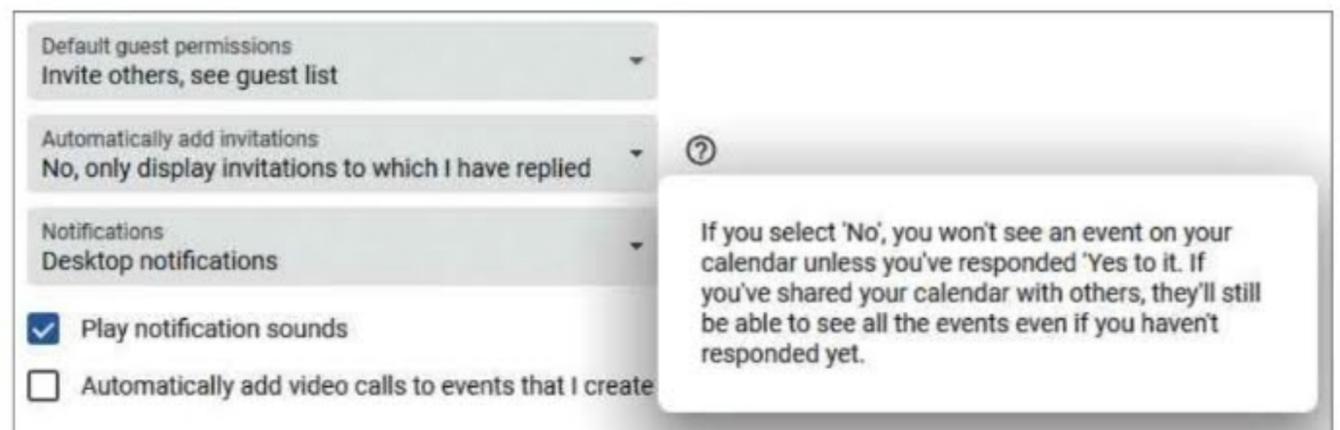
The same advice applies to both, of course: report it as a phishing attempt if your email provider has that option, report it to Action Fraud ([actionfraud.police.uk](https://www.actionfraud.police.uk)) and block the sender. Above is an example of such a sextortion email I received a day before writing this column.

**“Is that level of data storage necessary, can it be secured properly and is it legal?”**

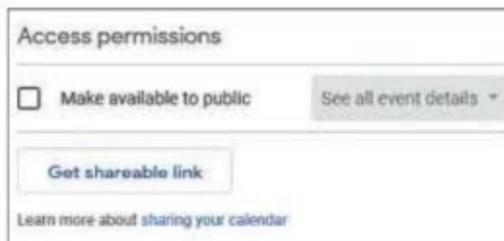
## Google Calendar misstep

Here’s another misconfiguration problem. Actually, it’s probably more accurate to call it a misunderstanding problem, but one with serious consequences nonetheless. With so many people now using Gmail and Google Calendar to run their home and working lives, there are a remarkable number of security and privacy problems that can arise. The first being a straightforward security risk that isn’t widely understood: unsolicited calendar invites with malicious payloads. The tight integration between Gmail and Calendar makes it easy for threat actors, especially those of the phishing variety, to craft a calendar invite sent to your Gmail account that can then pop up as a notification within your calendar app. By leveraging the trust of the recipient, especially those who are short of time and long on business meetings, links to events in these invites are easily clicked upon and these can then lead to credential grabs.

**BELOW** Reduce the risk of calendar invite spam, and reduce the risk of malicious payloads



Continued from previous page



**ABOVE** Make Calendar public? Don't do that...

It's what is known as a non-conventional attack vector and is proving very popular indeed amongst the criminal fraternity. To prevent this, you can turn off "automatically add invitations" in the event settings options and enable "only show invitations to which I've responded". Don't enable the "Show declined events" (under View Options) either. Of course, this disables much of the functionality that the home and office juggling user demands. In which case, your only hope is a better awareness of the risk and to be on the watch for these malicious invites instead.

Which brings me another doozy of a non-misconfiguration misstep. There are times when you may want to make a calendar public to share an event. Google Calendar allows this; after all, it's a common requirement for people wanting to organise meetups or share an event reminder.

However, there are two problems: first, that public calendar is then searchable using Google with a relatively simple query that doesn't require any knowledge of the event link itself; second, once you make a calendar public, that remains the default for all new events. Unchecking the "public" option reverts back to privacy but can take hours to be applied. You'd have thought that this wouldn't be a problem seeing as Google does throw a big warning box up into your face that says "Making your calendar public will make all events visible to the world, including by way of Google search. Are you sure?" However, researchers have found all sorts of private information left accessible through public calendars using that Google search method I didn't, deliberately, explain in detail earlier. That would suggest this "non-misconfiguration misstep" is more common than it should be.

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STEVE CASSIDY

## "This is one of those moments when I feel like apologising for my entire profession"

**More thanks to a car park attendant than an audience with Ellen DeGeneres, Steve explains why training staff can't be left to an unthinking computer**

Sensitive to the accusation of living a bit high off the hog, I begin this month with a story that could not be physically closer to home. We are separated from the outside here by a car park, which has yet to fall victim to the dead, Terminator-like hand of unattended operation. There's a guard's room, with a neat little cooker, a loo (mostly these days used by Ubers) and a PC for internet access and email. Following some recent shenanigans, we've had a literal changing of the guard, and the new boy has proved to be a fast learner and natural diplomat. Cups of tea in the guard's booth are now quite a frequent mid-morning thing, and it was during one such that the new boy unburdened himself. "Bloody training courses!" he exclaimed. "First it was GDPR, now something to do with benefit fraud... I'm a garage guard, not Sherlock bloody Holmes."

He was pointing angrily at his computer. It displayed what looked like a multipart questionnaire, with some long sentences in place of the questions. Evidently, the way this works is that there is no option to flunk out. If you don't go all the way through the test, or score less than 85%, then there is no escape – cycle round, start again, figure out what you got wrong. Abject and repeated failure gets you a frank conversation with HR.

Most of the questions weren't about the work of a garage guard: they were about people's mail and how the addressing of that mail might give away a benefit fraudster. This seemed to be a high priority matter in the administration. So high priority, indeed, that my new friend was obliged to go through the computer testing, despite the twin facts that his job did not



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart @stardotpro

**BELOW** My car park guard friend had to finish a completely unnecessary online questionnaire – and not for the first time

demand handling of post and that anyone who had understood and absorbed the earlier module on GDPR would realise that the rules laid out there prohibit any employee probing in records outside their job remit.

This is one of those moments when I feel like apologising for my entire profession. The idea that computers could be used to monitor, step by step, exact choices and responses to leading questions, is an exceedingly uncomfortable realisation. Top that with the broad-brush approach of putting everyone through a lot of administrative training without matching up jobs and skills, and a dystopia begins to take shape.

### Pluralsight and Azure

So I was definitely in the mood for a different approach when an invite crossed my desk that was too unusual to ignore. Come and listen, it said, to Ellen DeGeneres. In Salt Lake City. Or, if she's not your cup of tea, then how about Adam Savage from the popular nerd culture show, *MythBusters*? All courtesy of Pluralsight.

I couldn't imagine a subject further away from grey, dull, bludgeoning



local government questionnaires and, as it turned out, I was pretty much 100% wrong when it came to what those speeches would deliver.

At this point you may be wondering what Pluralsight does. In short, it specialises in training and accreditation packages for both IT skills and real-world training behaviour. Immediately I saw an opportunity to understand what on earth has been going on in that field. It couldn't all be about mistargeted bureaucratic over-enforcement by computer, could it?

Definitely not. Pluralsight's *metier* and complete *raison d'être* is not about the software tool it has developed: it's about the subject

of the courses that these tools are presenting. To be sure, they have a lot of fashionable technology in there, with hints of AI and lots of attractive web browser layouts – but for an old developer like me, with some COBOL in my personal history, I have all sorts of trouble getting used to the idea that what's being “developed”

here isn't a runnable, clickable application. It's more like a YouTube video, only one that's partly smart and partly multibranching. Quite a lot of the meetings and breakouts were for “Authors” – a job that Pluralsight clearly feels it has reinvented, because here it means authors of these sophisticated questionnaires.

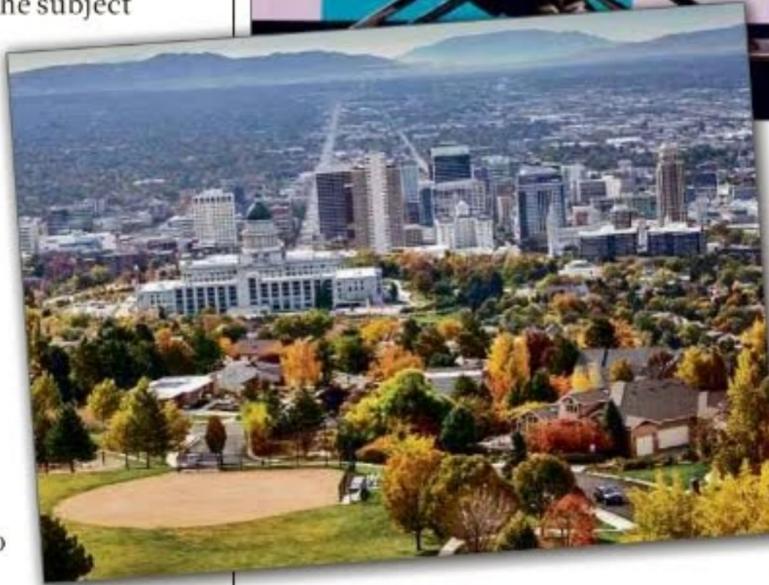
The best way to understand this part-programme, part-training platform is to consider the case of Microsoft Azure. The big announcement of the show for the technical faithful wasn't about Ellen DeGeneres or Adam Savage: it was about Azure wanting to adopt the authoring and display tools that Pluralsight's content producers have been using on other cloud platforms, such as Amazon's EC2.

The point of this is that cloud management has frankly turned into a bit of a monster, and some of that monster's worst behaviour is found in the click-heavy, decision-rich procedures expected of regular, ordinary humans.

When an expert tells you that Azure has been “taken over by wizards”, this does not mean those nice old beady-eyed men with



**ABOVE** Pluralsight brings big-name speakers like Ellen DeGeneres to Salt Lake City (left)...



pointy hats and wands; it is a reference to the fact that you can't really manipulate your portfolio of cloud machines, objects and structures like you might a cell-range in a spreadsheet, or a series of code modules in a compile project.

Quite a lot of the daily work in Azure is starting over from scratch, sometimes several times, to get the wizards to do the work in the background that Microsoft doesn't want you messing up. Wizards can be asynchronous in Azure, too, which means you don't necessarily get a fully disclosed progress bar. It's a matter of coming back later and surfing the reports interface. Which is fine if that's all you're doing that morning, not so good if you have half a dozen project architectures to spin up and test.

So far the industry fix for this type of problem is to essentially give up on the mouse and join the ranks of the wizards. Management platforms provide machine-written, cloud-executed scripts for starting, stopping and otherwise controlling your cloud machines – but you then run

the risk of not really understanding what those scripts are doing.

The approach Pluralsight is proposing has two layers of response. One is to be able to write procedural training materials that run your cloud DevOps team through the scenarios your business has to cope with, and shows them the approved ways of achieving some response that the alleged load-management and automatic scale-up can't handle. The other layer of response is to make the steps of daily activity familiar and well understood enough that you can trust the job will be done without complex orchestration.

The second scenario is, of course, a lot cheaper and quicker to get results.

**“Cloud management has frankly turned into a bit of a monster”**

**RIGHT** ...as well as cult figures such as Adam Savage from the ever-popular *MythBusters*



While there's not yet a well-defined job hunter's market in Azure skills or architecture awareness, when such a thing does arise it will be a lot easier to put people through standardised training and indeed testing, to establish whether they have the right skills and experience.

Which, I know, is going to be just what you might expect the management of my curmudgeonly car park guard thought they were getting into back in London. The truth is very different. Words on a screen are just that: using this approach, there's no more subtlety to using computers to train humans than a set of bullet points neatly separated by exhortations to pay attention.

This is where Pluralsight's aforementioned redefinition of "author" is so useful, and the shift away from valuing the code to valuing the portfolio of courses delivered by the code is so remarkable. Azure has long moved away from local, Windows-based management suites and steadily become more web-driven, using the latest tools and designs to put the interface together. That's an awfully long time effectively trapped in the world of self-teacher and easy learners.

One symptom of this type of convention are what's called "birds of a feather" (BoaF) breakouts. I can remember going to such things in 2003, at a Lotus Notes show, and finding the room packed out with exasperated, philosophically resigned ubernerds, bemoaning this or that strange behaviour in some obscure corner of the product. The need for BoaF sessions arose because the ability to encompass the whole of a massive product containing millions of lines of code in a single, sequentially ordered PDF file of dry functional definitions was a poor match to the audience of developers.

Somewhat later I remember jerking awake while reading an immensely complex, tiny font slide presented by the Jenkins team, in the middle of about 60 other slides. The bit that woke me up was the phrase "high cognitive load" listed as a disadvantage of its product. Lotus Notes, it confessed, was something of an intelligence test, and failing that test could have dire consequences for the unwary.

## Celebs and breakouts

Pluralsight likes to skew the normal formula for a convention. You know the mix: chest-thumping keynotes accompanied by a long list of specialist and often highly technical breakout sessions. Last year, it brought Barack Obama to Salt Lake City – not a natural combination of location and speaker, you might think.

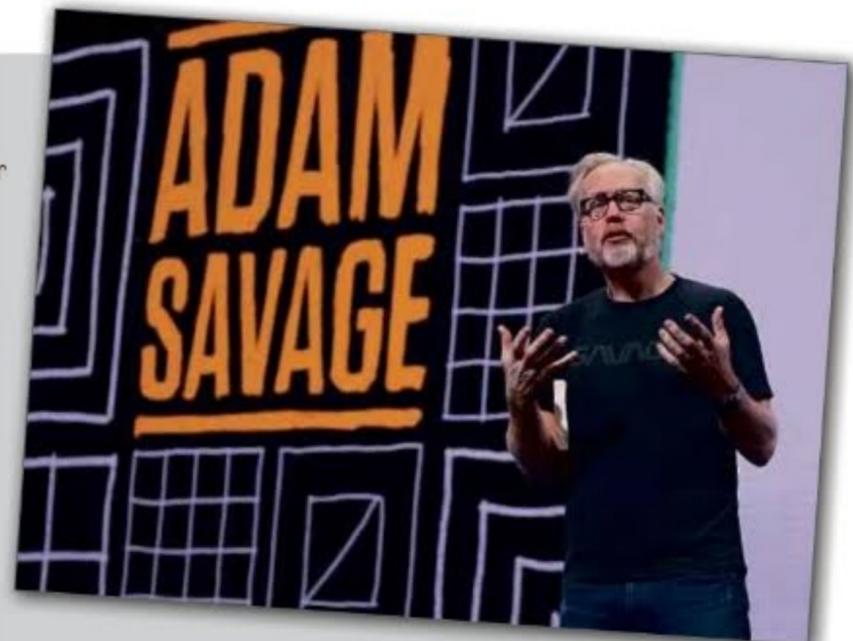
Back to the breakout sessions. Normally at a show, these are war stories from customers, or explanations from blue-chip tech companies about how amazing (but mysteriously free from snags) its latest enormous project was. Pluralsight spreads its attentions rather wider, advising us on "How to be the dumbest person in the room" (an essay on skills acquisition) and "Beyond Bitcoin, bros and Lambos" (a somewhat isolated economics treatise in the midst of lots of social technology subjects).

Rather disappointingly, Microsoft wanted us to "get your organisation ready for the cloud journey" – come on guys, it's been over a decade already, surely the journey's mostly over by now? It's a shame Pluralsight didn't force Microsoft to run a breakout confessional session where the company described all the blind alleys it went up training users to master Azure, and all the customer man-hours wasted on a "figure it out for yourself" model.

The celebrity speakers were an indication of where Pluralsight sees itself as a communications business, as distinct from a tech business, I guess. I say that because I had a hard time relating several of their subjects back to the business of accrediting and testing employees.

Steve Jobs' widow mostly talked about her good works, which had a lot to do with emotional wellbeing and social collectivism, and next to nothing to do with technology. Alex Honnold is apparently a leading proponent of free climbing, and showed us many truly terrifying home videos of himself hanging off the face of Half Dome by one or two fingers: not only was this non-technical, it was a solo undertaking, so no lessons there for group or team management.

Adam Savage clearly had a lot of fun making *MythBusters*, but didn't expand my understanding of software or training during a long disquisition on the



ABOVE Adam Savage's talk expanded my knowledge of frictionless neoprene catsuits, but not software...

relative merits of neoprene versus sheet latex when it came to making frictionless catsuits for stunts replicating faked YouTube videos. There's 40 minutes of my life I won't get back.

Perhaps the most obvious sign of an unconventional business came with Ellen DeGeneres, who was presenting at the very end of the event. 3.40pm is an odd time to do that, if you are a British tech journalist – but it's not odd at all if your kids are in school in Salt Lake City. A good half an hour before proceedings started, we were told that the normal press enclosure up front in the hall was not going to be available and we would have to scrum down with everyone else to get a good seat. Then the world's cleanest kids started arriving, hot from school. It didn't take long to realise that this speech was very likely to be entertaining, funny, engaging, motivating – but for the extended family of the sponsoring business.

Nothing wrong with that, of course. I'm very alert to the wide gap between company handling of press, and company handling of employee families, and I know pretty quickly when my presence is not required – and this was one of them. I want techies, with interesting or difficult problems, and I want two-way conversation. So, I can't tell you what Ellen DeGeneres had to say. I can tell you, though, that Salt Lake City is far more interesting than you might imagine: the area south of midtown reminded me more of Camden than of some hotbed of religious fervour.

## A better way

Pluralsight shows a easier method of doing things: it offers a mix of technology that's not really publishing, not storytelling, but something closer to the way humans think and learn. It keeps a mild level of interactivity, but instead of using a question/answer format, it helps the technician get the right ideas about what to look for, or what to avoid, while attempting to reach a particular goal.

I'm still puzzled by Pluralsight's balance between fandom (see box above), social responsibility and technically driven products, but it must be doing something right. After all, it's making enough money to pull



ABOVE There's a lot on its plate, but Pluralsight, and its CEO Aaron Skonnard, must be doing something right

in America's favourite chat show host. I get the sense that while the Azure deal is big, of course, it's a regular everyday project from Pluralsight's standpoint.

The big revolution here is inside Microsoft, realising that its entire paradigm for communicating about the accursed wizards has been wrong for at least as long as Azure has been available, then finding a simple product with the breadth of expression to get the information across in a format that techies can work with. This realisation rather swept away all of the reservations I had about being at a "not really technical" show.

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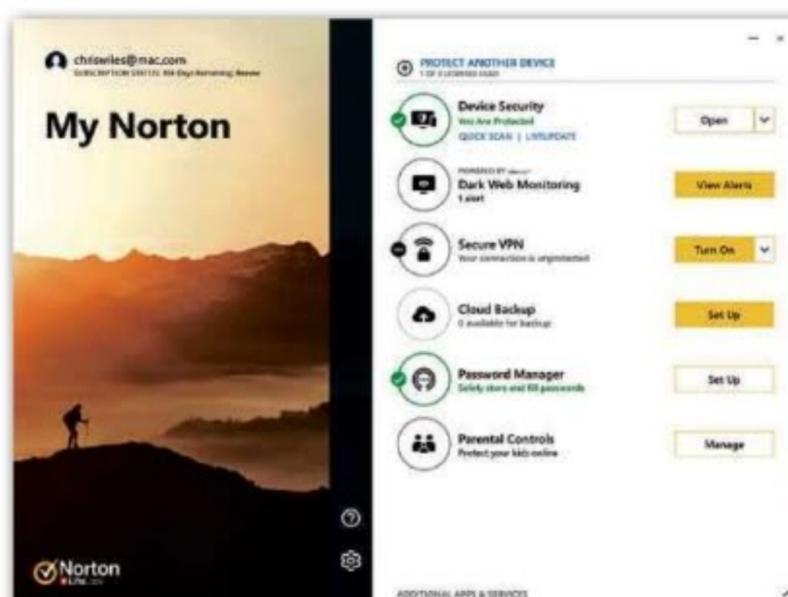


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# Futures

We explore the trends and technologies that are set to shape the future

## THE FUTURE OF BUSINESS BANKING NOW

Open banking and digital innovation mean banking is no longer about queuing at the branch. Nicole Kobie reveals what you and your business need to know about challenger banks

Forget walking down the high street to queue at your bank branch to set up an account, make a deposit or do any other basics of business banking. Thanks to the rise of mobile and online banking, such tasks can be done with a few taps on a smartphone between meetings. But the future of business banking isn't just digital – it's about integrated services and linking up with third-party software to make your finances as streamlined as possible.

That's the idea behind open banking, which is a set of regulations that lets your financial data be shared, opening up the way for new services and apps. Indeed, it's helped spark the rise of so-called "challenger" banks, which are normally digital only, each with intuitive apps, near-instant account setup and handy features such as instant notifications and automated roundups for saving pots. But as compelling as they are, the likes of Monzo, Revolut and N26 started their push into the world of finance via consumer accounts for individuals, leaving small businesses behind.

That's no longer the case. Starling has signed 60,000 businesses (and is approaching a million consumer users), Tide passed the 100,000 mark last summer and Monzo's business

accounts are set to arrive any day now. However, traditional banks have also caught on and don't want to lose their lucrative business clients to newcomers, unveiling their own take on the challenger bank idea with the like of Mettle from NatWest – think big brewers releasing their take on a craft beer. Whichever you choose, it means same-day account setup, easy-to-use apps, and integrated accounting and other software tools.

### ■ SMBs long ignored

It's high time banks paid better attention to small-to-medium sized business (SMBs). According to analyst firm EY, SMBs account for £1.9 trillion in turnover annually and make up 99% of private companies in the UK. But a survey from Adaptive Lab suggested SMBs feel undervalued by larger banks, with too high costs for not enough specialised services. No wonder then that British startup Starling decided early on to target SMBs. "We recognised it was an underserved segment of the market, where the incumbent banks dominate and where there hadn't been much innovation," said Alex Frean, head of corporate affairs at Starling. "We thought there was a real customer need out there."

Oliver Prill, CEO of business challenger bank Tide, adds that his fintech startup started because the co-founders had previously gone through the difficulty of setting up a business bank account themselves. "It didn't work smoothly," he said. "The biggest motivation for switchers at the moment is the huge annoyance they have had with the big five banks... they've really had it with their bank."

Why have incumbent banks failed to offer such services? "We come from a history of monolithic universal banks, where small business is one segment among many others without much mindset to look at it any differently," Prill said. "We fundamentally believe that these are very different industries," he continued, suggesting that one bank may not be able to serve consumers, corporations, sole traders and SMBs very well, let alone those operating across different industries.

All this means that business banking is ripe for disruption – and the disruptors are at the gate. They're helped by the rise of digital in SMBs and API-led fintechs, open banking regulations prising data out of incumbents, and also the Alternative Remedies Package (see boxout on p126), which means there's money



# OPEN BANKING

sloshing around to help boost fintech startups. And, so far at least, it appears to be working.

## ■ Making the move

That said, despite the increasing options, a survey this year from Accenture suggests a mere 15% of SME customers intend to switch their bank in the next year, with only 25% saying they would be willing to move to a digital-only service.

There are two types of customer that challenger banks need to convince: those starting new businesses and those switching from an existing company to a different financial provider. For Tide, about 70% of its customers are new-to-market, and 30% are switching. To win over the first tranche, challenger banks need better awareness, admits Prill. He says Tide opens 12% of all new business current accounts, but its own in-house research suggests there's only brand awareness among 17% of new companies – that's why Tide ads are plastered all over London at the moment. "For the new-to-market, a bank has to be fast... and have a good reputation," he said. "But you need to be aware of the bank in the first place." Frea agrees, noting that the lack of high street banks means

creating awareness is a challenge. "We have to go and find customers and make them aware of us," she said.

And then there are switchers, those annoyed at their current banks. It's not easy to switch, but open banking is making it easier. For consumers, trying out Monzo or Starling is easy: sign up for an account, order a card, install the app, and you can see if it's a system you like without having your salary paid in or transferring over all your direct debits. It's more difficult for businesses to try out a new bank fully, as switching everything over takes time and, therefore, money; you would have to be sure of a new service before taking the plunge.

To help, Tide wants to set up a system for trial switching, in which all your figures, transactions and so on are pulled into the Tide account as a data feed, with your existing account staying the same. That lets companies try a bank effortlessly without much risk. "The trial switching overcomes friction, but you need to have a real reason to switch," Prill said.

## ■ Worth the switch?

Alongside attractive apps with whizzy features, challenger banks are trying to convince SMBs to make the switch by helping with or even taking over admin such as payroll and accounting, either offering such services or software themselves or via a third-party provider. "It's really around



**"We look at the space not as business banking, but as everything a business owner would consider admin and finance"**

saving small businesses time," explained Prill. "We look at the space not as business banking, but as everything a business owner would consider admin and finance." Indeed, Tide sees itself not as a bank, but instead as a platform, letting others build products that SMBs can embed into their banking processes. "We want to be the operating system for an SME, but not the application layer," Prill said.





## What does it all mean?

Finance and accounting are difficult enough without a gaggle of new terms and jargon. Here are the key terms you need to know to understand the future of banking.

### Alternative Remedies Package

Back in 2009, you may recall RBS almost going bust. The government stepped in with a £45 billion bailout, and as that's been deemed by the EU a competition issue, some (very little) rebalancing was required. Long story short, RBS had to kick funds into an Alternative Remedies Package, made up of a £275 million incentivised switching scheme and £425 million for a capability and innovation fund to spur development of services for SMBs. Both of those have helped fund challenger banks, including Starling.

### APIs

This stands for "application programming interface", and is how applications talk to each other. In banking, the use of APIs allows data to be shared from a bank to an app, or vice versa.

### Challenger

The UK is dominated by several huge banks. Challengers are the startups launched to take them on, and are normally tech-focused with feature-heavy mobile apps. Some fintechs that fall into this catch-all term aren't full banks, but accounts with payment cards.

### FSCS

The Financial Services Compensation Scheme protects deposits of up to £85,000 in case a bank fails. Individuals and small businesses are covered, but not all fintechs are included in the scheme, although there are other techniques for protecting deposits.

### Open banking

This is a set of rules that flowed out of the EU's revised Payment Services Directive, and came into force in January 2018. It requires the UK's nine top banks to open up their data to regulated, licensed providers, including fintech startups. These rules are enforced by the Competition and Markets Authority.

And that's where open banking and third-party partnerships come in. Rather than export transactions and then import them into your software of choice, tools such as Xero and FreeAgent are integrated into the app. When the right tool isn't available, Tide builds one; so far, it's created built-in systems for invoices as well as credit. Take invoicing, for example: an SMB needs to create, send and chase that invoice, noting when it's paid and pushing the relevant information into an accounting system. "Across these different product sets – invoicing, credit, payments, accounting – is a connectivity chain that we orchestrate, we make it highly usable," said Prill.

Starling's equivalent is the Marketplace. This is the epitome of the open banking idea, a digital library of services and tools that Starling customers can easily integrate with their account, from receipt tracking to lines of credit, as well as leading accountancy software Xero and FreeAgent. "They can immediately pull your files from your Starling account and populate your accountancy files," Frea said. "We're adding to the Marketplace all the time." Of course, some of the key features aren't high-tech. Starling and Tide offer cash deposits via the Post Office, with Frea noting that it's one of Starling's most popular features.

### What's next?

Prill predicts the banking market will fragment even further, particularly for businesses. Rather than choose the best of few options from five or so big banks, we're already seeing more competition from the likes of Tide,

Starling and the rest. "In the long term, there will be many different models to suit different customer needs," he said. "We think this is a sign of a healthy market, that there is not a monolithic culture but offering true choice."

Such banks will become less about your finances, and more about all aspects of your company – that's Tide's idea with the "OS for SMBs" concept. Right now, invoices and accounting are built into challenger business accounts, but within the next several months, Tide plans to also offer company formations. "The data



**"We think this is a sign of a healthy market, that there is not a monolithic culture but offering true choice"**

we collect to set you up with a bank account... we might as well set up the company for you," Prill said. "We could register your domain and website for you too."

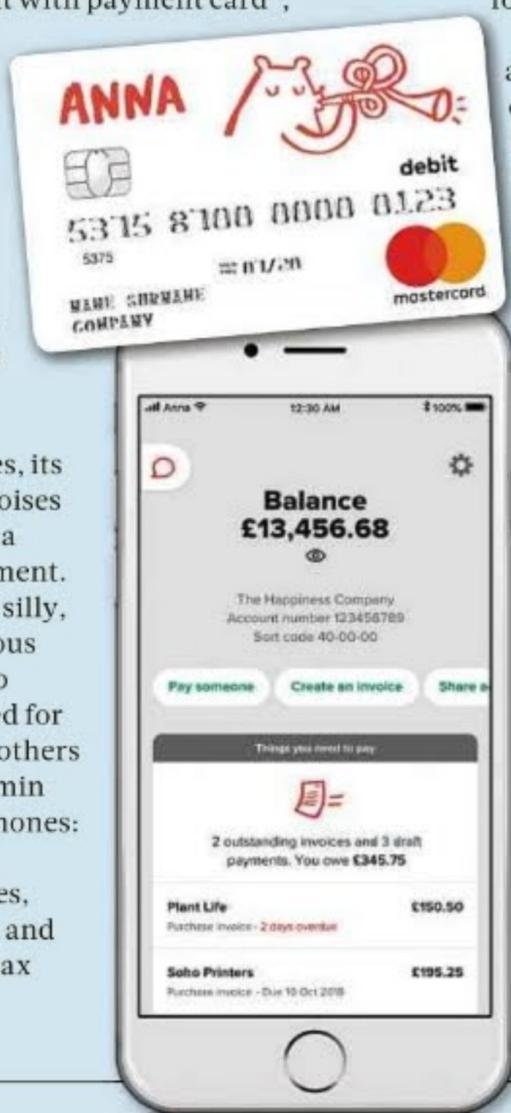
"I think we'll continue to see traditional banking providers lose share," Prill added, promising more richness of services, as well as more variety – and that's where AI could come in, he suggests, with machine learning used to find and suggest the best services for your business from a multitude. So many features and services that small-to-medium sized business need help choosing between them? That's a nice change from which of the five boring banks will stash your money. ●

# HOW TO CHOOSE A CHALLENGER BANK

Ready to make the switch to the future of banking? Choosing the challenger bank for you requires careful consideration, made even more complicated thanks to the variety of features on offer. While most have easy registration, instant notifications and clever apps, it's worth taking the time to think through all the tools and software that your company uses or plans to use in the future to ensure the fintech you choose supports your providers. Does your company need to deposit cash? Transfer funds overseas? Are deposits FSCS protected? Certain challenger banks are better than others on each of those fronts. Here's a quick overview to help you get started, but there's plenty more to dig into when it comes to upcoming features, while other fintechs include N26 and Revolut on the challenger side and Aldermore for business services.

## Anna

This isn't a bank, but a "mobile business account with payment card", and it isn't named after a person – it stands for Absolutely No Nonsense Admin, apparently – and is perhaps most famous for an app with meowing notifications. Yes, its app makes cat noises when you make a contactless payment. That may sound silly, but Anna is serious when it comes to features designed for freelancers and others who do their admin on their smartphones: 1% cashback on certain purchases, invoice creation and follow-up, and tax calculator and reminders. For



## Nicole Kobie compares what the leading challenger banks have to offer – although some don't call themselves banks at all...

support, there's free live chat and a bot.

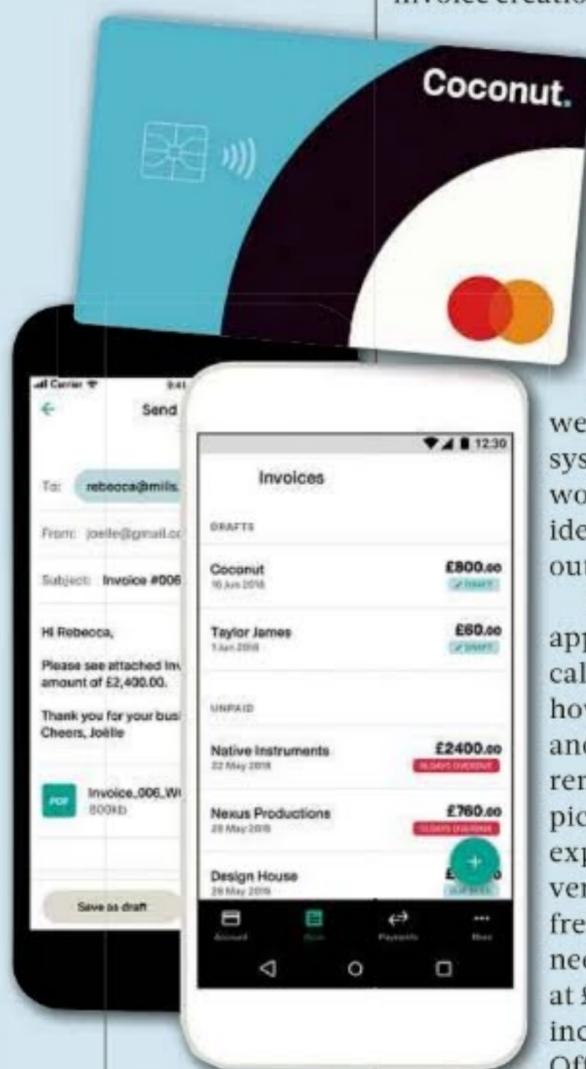
When Anna says invoice creation, it's not just a form to build the document in the app. Users can "cc" the bank into an email with a client, and its system will automatically build an invoice from the deal details. Alternatively, drop the specifics into a chat, and Anna will make and send the invoice out. If an invoice hasn't been paid, Anna will automatically remind clients for you.

That comes at a cost. Anna charges sole traders £5 a month, but drops the fee if there's no activity – handy for those running seasonal side gigs. For limited companies, the fees start at £5 and increase depending on your turnover. There are no additional fees for withdrawals, transfers or card payments. Because Anna isn't a full bank, there is no FSCS deposit protection in case of fraud or the company going out of business. Find out more at [anna.money](http://anna.money).

## Coconut

This British startup offers accounts for sole traders, limited companies, and accountants. Features vary depending on the account type, but include instant notifications of ingoing and outgoing transactions – so you'll know when you get paid – as well as invoice creation and management, and spending categorisation in the app, which is handy for managing budgets. Because invoicing is built in, the idea is that you won't need third-party software integration to manage them; if you're already wedded to a different system, this may not work for you, but could be ideal for anyone starting out or freelancing.

For freelancers, the app includes a tax calculator so you know how much to tuck away and pops up notifications reminding you to snap a pic of a receipt for expenses. There's a free version, but anyone freelancing full-time will need the "Grow" account at £5 a month; that includes five free Post Office deposits and free foreign currency exchange, but there's still a £1 cash withdrawal charge. The limited companies' accounts also include bookkeeping tools and a digital records creation tool for VAT; there's also a limited free version and a more robust one at £5 a month. As Coconut isn't a full bank, it doesn't have FSCS protection; it does hold all funds in a segregated, safeguarded account at Barclays, though, so deposits should be secure if it goes out of business. See more details at [getcoconut.com](http://getcoconut.com).

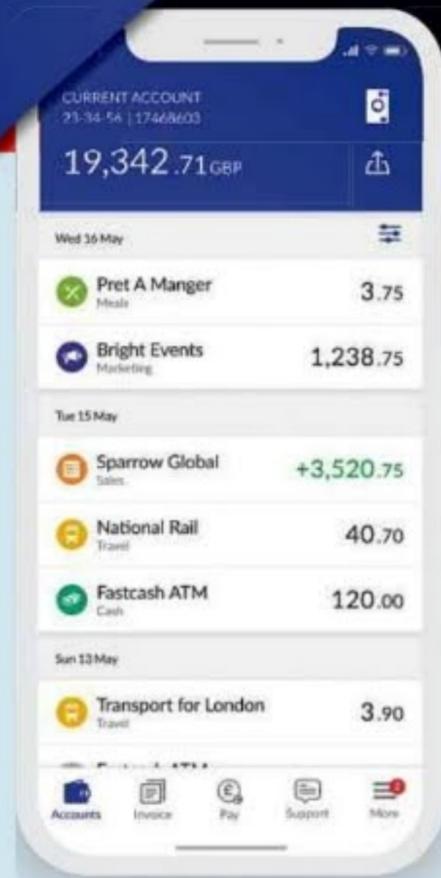


ABOVE UK-based startup Coconut gives you a straightforward overview of your paid and unpaid invoices

LEFT No-nonsense Anna offers a range of serious features for freelancers – as well as cat noises...

## Monzo

Wait, didn't we say on the previous page that Monzo doesn't have a



**ABOVE** Multiple Tide cards can be handed out to employees for quick and easy expense tracking

**LEFT** Monzo business accounts are on the horizon and will integrate with both Xero and FreeAgent

**BELOW** Starling has a simple overdraft and VAT savings pots – and there are no monthly fees for SMBs

## Tide

Tide is entirely for small businesses, so it has a host of key features such as web access, invoice creation, scheduled payments and cash deposits. Accounts can be directly connected to accounting software including Xero, FreeAgent, Sage and more, and there's a nifty system for adding photos of receipts or other notes to transactions, handy for expenses. Multiple cards can be doled out to team members, for easy expense tracking, and read access is supported for admin and finance staff. Tide also touts its third-party integration, and has teamed up with Iwoca for quick credit, for example.

Tide offers accounts for UK registered companies as well as sole traders. There's no monthly fee, but Tide charges for transfers between accounts, ATM withdrawals, and cash deposits. Tide also doesn't have FSCS protection, but holds customer funds in a protected account. For full details, head to [tide.co](http://tide.co).



and enhanced invoices. As Monzo is a full bank, it's FSCS protected up to £85,000 for small businesses.

## Starling

Starling has focused on businesses, and it shows: there's integration with Xero and FreeAgent, an easy to use overdraft, the usual instant notifications, savings pots for VAT and other bills, and built-in foreign transfers using SWIFT. Plus, unlike most other digital banks, Starling business accounts can be accessed not only via a mobile app but online in a browser, too – handy for those with desk jobs. Alongside those features, Starling's Marketplace means there's a growing pile of tools that integrate with your account, from line-of-credit via Growth Street to receipt tracker Flux.

Starling doesn't charge a monthly fee, if you have fewer than ten employees and less than £1.7 million in annual turnover; businesses above that are also currently free for a limited time. If you work in cash, Starling supports deposits Post Office branches for a £3 fee. It doesn't charge fees for ATM withdrawals, domestic transfers or electronic payments. There's a version for limited companies as well as sole traders; the latter also require a personal account. Starling is also FSCS protected. Visit [starlingbank.com/business-account](http://starlingbank.com/business-account).



business account?

Well, this is the Futures section, and in the very near future this British fintech – perhaps the best known of the challenger banks – will finally offer business accounts, perhaps even by the time you read this. Indeed, it's slowly doling out beta accounts, if you register at [monzo.com/business](http://monzo.com/business). As yet, it's unclear what the fees will be, if any.

Accounts feature integration with Xero and FreeAgent, the ability to add multiple users to an account, phone and chat support with real people, and core challenger app features such as instant notifications and savings pots. Next, it's working on international payments, categorised spending, batch payments and a system to set aside cash for taxes. One of the most intriguing aspects of Monzo is its public roadmap, letting you see exactly what features are in the works, including receipt scanning, a web browser access point,

# Next month's issue



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## FEATURES



### How to fix a troublesome laptop

*PC Pro* columnist and computer repair shop owner Lee Grant condenses his years of laptop-fixing experience into a guide.



### Deep dive: colour management

After true blues and rich reds? Darien Graham-Smith shows how colour profiles can help you get the best from your display.



### How to avoid secondhand gotchas

Refurbished laptops, PCs and tablets can come with tempting prices, but what do you need to know before you buy?



# In return for a pint, **Jon Honeyball** does battle with a friend's decade-old, software- encrusted laptop

I was in my local pub, enjoying a nice pint, when my friend Mike sidled up to me and asked if I could take a look at his laptop. I occasionally do this for friends in the village – it's a good neighbourly thing. Of course I don't charge for the favour; if nothing else, the billable rate would be somewhat hilarious. So I'm happy to help in return for the occasional pint.

This isn't the first time I've looked at Mike's computer. He is not a computer wizard, just a normal user. And, like many users, his computer gets into a tangle every few years.

A few days later, he dropped around his aged Toshiba laptop, complete with a Pentium of unspecified nature and a whopping 4GB of RAM. It had to be the thick end of a decade old, and a quick check of the Toshiba website showed that the latest firmware dated back to 2012.

The performance was, well, not really definable as "performance". It took about five minutes to boot, and then ran like a dead rat stuck in treacle. Clicking on a web page took over a minute to bear fruit. No wonder Mike was frustrated: any machine giving me that level of performance would have been thrown in the bin. Or I might have covered it in petrol and set fire to it.

My first thought was that maybe there was some malware in place that was chewing through CPU cycles, or hammering the hard disk. Of course, I found at least three different antivirus packages in place and that can never be a good thing. So I started the long and painfully slow process of ripping out unnecessary stuff, some of which was nearly teenage.

Did he really need a five-year-old version of Adobe Acrobat? No, so that went in the bin. Some ancient and crusty HP printer and scanner software went next. The software that comes with such multifunction devices is usually best left in the box, and not allowed anywhere near a computer. Hamrick's excellent VueScan does everything you need for scanning, and a simple printer driver does the rest: "Scan to cloud" is the sort of feature that makes my toes curl. And "Print from cloud" is even worse.

After carrying out a comprehensive scan using the built-in Windows Defender, it was clear that the machine was not actually infected with Win32.NastyWorm.RuinYourDay. And so

my interest was piqued. It was running Windows 10, but the 1803 version. I banged it up to 1903, after which it seemed to be somewhat more sprightly. The old adage of "the best way to clean up Windows is to reinstall it" applied with a vengeance. A few final tweaks, such as updating Chrome to the latest version, and the machine ought to have been as good as it could get.

Except it wasn't that simple. Now when you boot it, it starts up Windows and then goes to a blank screen. Press the power button, hit Enter, and it goes into power save. Press the power button and it comes back to life, complete with a working display. There are no new drivers to be found, or firmware. It's reached the end of the road.

And this has got me thinking about the new Windows devices that Microsoft is bringing to market. For example, the Qualcomm-based Surface Pro X uses an ARM processor, enhanced so that it can run Windows 32-bit Intel apps. The more modern and current 64-bit Intel apps are simply not supported. The obvious question is "does this

**“How long should a package continue to receive support without a financial contribution from the user?”**

matter?" It would allow a user like Mike to take forward his old apps and still use them. Apps he bought many years ago are still licensed, even if they aren't supported. And here is the crux of the question – should users like Mike have an expectation of keeping this old stuff? How long should a package continue to receive support without any financial contribution from the user?

I confess I am not particularly happy with the idea of a whole bunch of rolling annual licences for software. I accept it for items that are business-critical, because that supports infrastructure, and upgrading is obviously mandatory in that environment. But some vendors are being far from honourable here. I take particular exception to antivirus products that enforce an auto-repeating licence, make it a real hassle to disable, and where you discover that year two can be as much as double the cost of year one. That's just nasty.

Maybe this is a time for users to explore open-source and free software. Does Mike really need a nine-year-old, unsupported version of Microsoft Office, when a brand-new install of LibreOffice is current, supported and free? It's a tough question. And most users seem loath to confront the issues, happier to keep crawling along with crumbly old code that could be riddled with security issues.

■ Jon Honeyball is a contributing editor to *PC Pro* and begs everyone he knows to spring clean their machines each year. Email [jon@jonhoneyball.com](mailto:jon@jonhoneyball.com)



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