HOW TO STAY ANONYMOUS ONLINE p44

PC PRO

20 BEST PODCASTS

From tech to politics to murder mysteries p32

£88 OF BONUS SOFTWARE See p66

Triple your WI-FI SPEED

- Dump your ISP router
- Kill dead spots
- 13 routers on test p76

Ring vs Nest

Battle of the smart doorbells p64

MacBook verdicts

Are the new MacBook Pros too hot to handle? p48

ISSUE 288 OCTOBER 2018 £5.99

SPITFIRE®

VOICE • INTERNET • WAN

IDEAL FOR SPITFIRE SIP TRUNKS

Telecoms and IP Engineering
Solutions for Business since 1988

Barnacle Goose
Branta Leucopsis

Barnacle geese migrate twice a year, sometimes travelling over 3,000 miles in search of warmer climates.

Free migration to Spitfire's Cloud hosted telephone system.

Easy to self-manage.

From £6 per extension per month.

Benefits:

- No upfront costs
- Low monthly rental
- Easy to use management interface
- Short term contracts available
- Assured call quality with Spitfire Voice Approved broadband and Ethernet circuits

Ideal for:

SME businesses
New start ups
Multiple locations
Homeworkers
Seamless multi-site working

YouTube Spitfire Network Services Ltd: Training TechTalks

Sales 0800 319 6300 • Partner Services 0800 319 6500

Innovative • Flexible • Reliable • Supportive • Cost Effective

www.spitfire.co.uk

HIGHLIGHTS THIS MONTH

Full contents overleaf

REVIEW OF THE MONTH

HP Envy x2 with Snapdragon

The world has gone a bit crazy. We're not talking about Donald Trump or the fact that England reached a World Cup semi-final, but the reliable truths of yore: that Windows laptops would contain x86 processors, that Microsoft would no more partner with Qualcomm than America with Russia. But those truths no longer hold. Heralding – perhaps – the start of a new future, HP has released a version of its 2-in-1 Envy x2 with a Snapdragon chip inside.

Find out if it's worth switching to ARM right now on p58 – and if you fancy a more traditional ultraportable then turn to the Envy on p61.

p58

p44

TIP OF THE MONTH

Even if you have nothing to hide, there are plenty of good reasons to protect your identity online. We run through the available options if you want to stay anonymous from p44 – and detail practical steps on how to take advantage of them.

p116

GDPR EFFECT OF THE MONTH

We know all about poor implementations of GDPR, but what about the businesses that are doing it well? We asked a GDPR consultant to share his findings. Here, he shares some winning tips on making GDPR work for you.

p124

OPPORTUNITY OF THE MONTH

Open Banking is about far more than switching from one of the Big Six. Nicole Kobie explores all the ways we can take advantage even if we don't want to switch, and profiles the startups that are sprouting up with exciting products.

PEOPLE OF THE MONTH

p22

Kris Brown and Kristan Bullett

Brown and Bullett may sound like an ITV2 detective drama, but these two are the co-founders of Piksel – and the men behind video-on-demand services back when Netflix was sending DVDs in the mail.

THE LABS IN ONE NUMBER

p76

That's the speed improvement you can expect if you switch from a certain broadband supplier's router to one of our top picks. Discover which from p76.

300%

p32 **Whether you're a football fanatic, politics nut or just fancy a laugh, we've got the podcast for you**

FEATURES

COVER STORY

32 The 20 best podcasts you should listen to

The podcast is going through a major revival. Our contributors pick out 20 of the best – about everything from true crime to obscure history to *The West Wing* – for your listening pleasure. Plus, we reveal the new ways to tune in.

40 Create a slick and fast website using WordPress

Are you launching a new website or just revamping an old one? WordPress is the obvious choice, but there's more than one way to implement it. Barry Collins runs through the various options.

COVER STORY

44 Stay anonymous online

If you're worried about leaking your identity online, Nik Rawlinson has the answer. He demonstrates how easy it is to stay anonymous using tools such as a reputable VPN and the Tor Browser – and a little common sense.

PROFILE

22 Piksel

We meet the British online video provider that works with some of the most famous names in broadcasting, as well as transport hubs such as Heathrow Airport.

→ **THE PC PRO PODCAST**
Join the *PC Pro* podcast live every fortnight or download via iTunes. Visit **mixlr.com/pcpro** to sign up

BRIEFING

10 Your data handed over: no questions asked

Service providers have been accused of passing data from millions of Britons to intelligence agencies on a "gentlemen's agreement".

12 Unveiled: hot hardware releases

The student-focused Microsoft Surface Go, an Alexa TV box and a new range of Lenovo PCs.

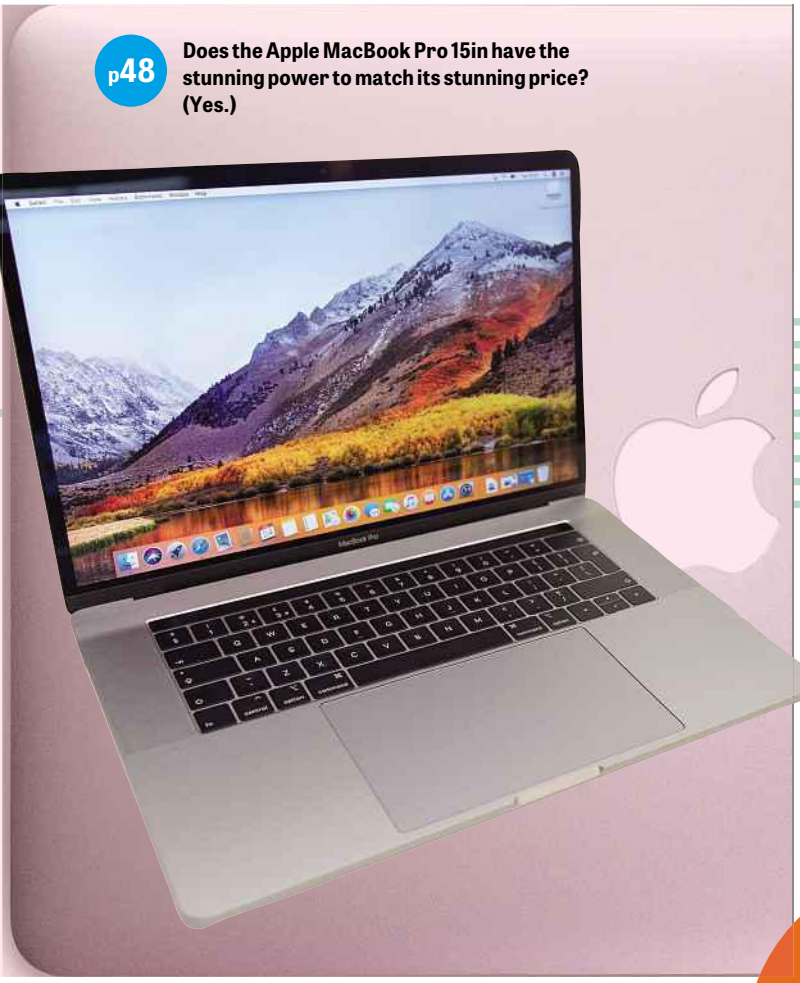
13 Google hikes its Maps API price

The dramatic increase has thrown hundreds of websites into turmoil.

14 Universal broadband? Count to ten

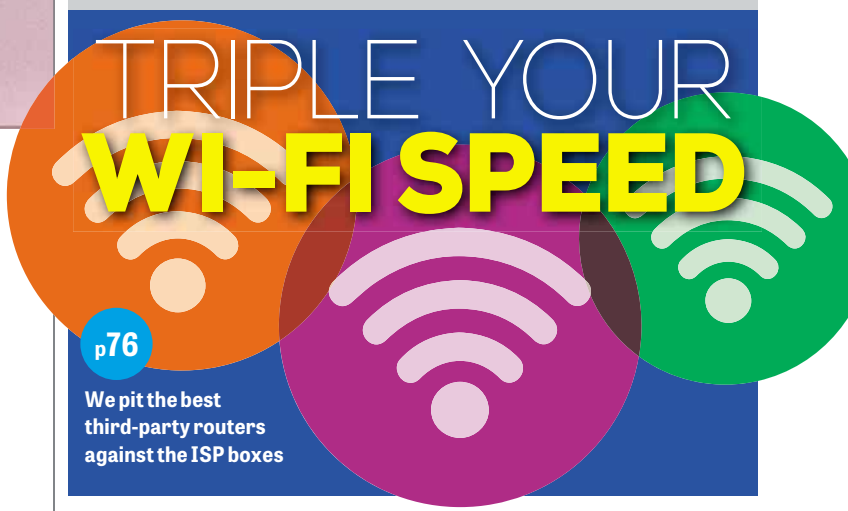
Plans to guarantee broadband speeds for all are foundering, Stewart Mitchell finds, as pressure builds on the government.

VIEWPOINTS



p48 Does the Apple MacBook Pro 15in have the stunning power to match its stunning price? (Yes.)

REVIEWS THIS MONTH



p76 We pit the best third-party routers against the ISP boxes

REGULARS

THE NETWORK

FUTURES BANKING SPECIAL

REAL WORLD COMPUTING

ECOSYS®

Ecology. Economy. Systems.

Be Print Smart.

Colour, Mono, A4 and A3 printers and multifunctional devices designed with your business in mind.

Combining design, technology, innovation and ecology.

Find out more about the benefits of our office-friendly and environmentally friendly ECOSYS range.

Visit: kyoceradocumentsolutions.co.uk/ecosys
LinkedIn: @kyocera-doc-solutions-uk
Twitter: @KYOCERADUK

KYOCERA

KYOCERA Document Solutions

Editor's letter

Sorry is the hardest thing to say

"NEVER SAY SORRY." I'll hide the identity of the person who said that to me, but he did so with utter conviction. To apologise was an admission not only of weakness but, worse, liability. He runs a business with a multi-million-pound turnover, where projects often run late. To say sorry, to admit culpability for an error that led to a delay, could result in clients claiming compensation.

And that, I'm sure, is why big companies find "sorry" so hard to say. By all rights, Apple should be apologising to customers who bought a MacBook only to discover one morning that their keyboard no longer worked. You know, little problems such as letters repeating or not appearing at all. A ssslightt issssueee on a keyyyyyboard.

Now Apple did 'fess up to the problems with the Core i9 on its new MacBook Pro, which we review on p48. But note the crucial difference: it apologised and simultaneously issued a fix, leaving a legal loophole so small that even José Mourinho's sense of humour couldn't fit inside.

Not so the keyboard problem. Instead it updated its service and support pages with a message about owners of certain laptops – pretty much every laptop it's made in the past three years, note – being just-possibly-maybe entitled to a free repair for any keyboard flaws. No mea culpa here. This after some owners have paid hundreds of pounds to fix keyboards on their out-of-warranty laptops; let's hope Apple is actively offering such people a refund.

Don't think for a second that Apple is alone in this. If anything, the company deserves praise: it's far better at saying sorry than other tech firms. It apologised in late 2017 for slowing older iPhones down on purpose, for instance. For other big companies, I have to go back further in time. And I have to go niche. For instance, Dell last issued a public apology back in 2016 for releasing a security certificate that was itself insecure. I'm pretty sure it's made some dumb design decisions since then, but because it's not Apple it doesn't get hit with the same level of scrutiny.

What about Facebook, you say? Didn't Mark Zuckerberg issue an apology over its handling of data and pre-election advertising? He did, but I'm certain he first consulted with about 15 lawyers and looked at the potential damage in lost users if he didn't apologise. Nevertheless, I welcome this apology: it's a welcome break from tradition.

The problem with big tech's usual defensive approach is that it breeds mistrust. What stops democracy descending into dictatorship is transparency. That transparency doesn't appear because politicians want it to: it's there because the public, historically via the press but now via social media too, applies pressure. Even then, we sometimes have to wait years for the truth to emerge.

The system isn't perfect, but it's far better than the current approach we see from the tech giants, where every sorry is wrenched from them like sweets from a toddler. What can we do? First, bring the same level of scrutiny to their decisions as we do politicians. Then we need to create an environment where being open about mistakes is seen as a positive rather than a negative.

This won't happen overnight, but we all have a role to play – first by asking the questions, but then by applauding companies rather than condemning them when they do admit mistakes. So, Apple: I salute you for taking prompt action, not hiding away. Let's hope others follow suit.

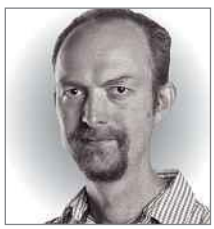
Tim Danton
Editor-in-chief

CONTRIBUTORS

Mark Evans
IT consultant Mark Evans has helped numerous companies implement GDPR, and shares practical advice on making it work for your business. See p116

Nicole Kobie
Even banks are waking up to tech. Nicole reveals how the Open Banking initiative – and some fresh thinking – is changing the fiscal world from p124

Jon Honeyball
Having tested laptops for three decades, Jon shares his insights into why Apple faced such issues with the Core i9 in the new 15in MacBook Pro on p130



Jonathan Bray
Meanwhile, our other Jon was one of the first journalists to get his hands on a Core i9 MacBook Pro. Find out what he thinks of it on p48

EDITORIAL
EDITOR-IN-CHIEF
Tim Danton: editor@pcpro.co.uk
EDITORIAL FELLOW
Dick Pountain
ASSOCIATE EDITOR
Darien Graham-Smith
REVIEWS EDITOR, EXPERT REVIEWS
Jonathan Bray: jon@alphr.com
FEATURES EDITOR
Barry Collins
FUTURES EDITOR
Nicole Kobie
BRIEFING EDITOR
Stewart Mitchell
LETTERS & SOFTWARE EDITOR
Nik Rawlinson

ART & PRODUCTION
ART DIRECTOR
Paul Duggan
FREELANCE DESIGN
Bill Bagnall, Sarah Ratcliffe
SUB-EDITORS
Max Figgett, Priti Patel

CONTRIBUTING EDITORS
Steve Cassidy,
Dave Mitchell,
Jon Honeyball,
Paul Ockenden,
Davey Winder

PHOTOGRAPHY
Monique Woo

CONTRIBUTORS
Mark Evans, Max Figgett,
Alan Martin, Edward Munn,
Emma Sims, Nathan Spendelow

ADVERTISING
Tel: 020 7907 6662
GROUP ADVERTISING MANAGER
Ben Topp: ben_topp@dennis.co.uk

PRODUCTION
GROUP PRODUCTION DIRECTOR
Robin Ryan
NETWORK PRODUCTION MANAGER
Kerry Lambird
PRODUCTION EXECUTIVE
Sophie Griffin

CIRCULATION & SUBSCRIPTIONS
Tel: 0330 333 9493
customercare@subscribe.pcpro.co.uk
CIRCULATION MANAGER
Emma Read
NEWSTRADE DIRECTOR
David Barker
DIRECT MARKETING EXECUTIVE
Luke Tutt

LOGOS & REPRINTS
Tel: 020 7907 6132
ENDORSEMENT LICENSING MANAGER
Ryan Chambers: ryan_chambers@dennis.co.uk

SOFTWARE DOWNLOAD TECHNICAL SUPPORT
software@pcpro.co.uk

We count down 20 superb podcasts from p32, but which podcasts do our contributors listen to – if any?

"I'm an irregular listener to Adam Buxton's, but always catch up with Radio 4's More or Less and Last Word. To keep me company on long runs, I tend to download BBC dramas too."

"(Deep breath) Arsecast and Arsecast Extra, Guardian Football Weekly, Bespoke, The Infinite Monkey Cage, The Football Ramble, Arsenal Vision, Simon Mayo and Mark Kermode's Film Review, Hardcore History (breathes again)."

"James Richardson's Football Weekly, The West Wing Weekly, The Danny Baker Show, Unfiltered with James O'Brien and Athletico Mince are my current dog-walk listening."

"Occasionally I have listened to... More or Less, The Kitchen Cabinet, The Curious Cases of Rutherford & Fry, The Infinite Monkey Cage, Start the Week, In Our Time, The Media Show, Word of Mouth and, of course, PC Pro."

"I listen to a few, but they're pretty geeky: History Extra (from BBC History Magazine), Langsam gesprochene Nachrichten ("slowly spoken news") from Deutsche Welle to keep my German up and Kermode and Mayo's Film Review, which has saved me from watching a few stinkers in the past!"

"PC Pro!"

"The Smashing Security podcast from Graham Cluley is usually worth a listen."

PC PRO

LETTERS letters@pcpro.co.uk
TWITTER @pcpro
FACEBOOK facebook.com/pcpro
SUBSCRIPTION ENQUIRIES 0330 333 9493
customercare@subscribe.pcpro.co.uk

PC Pro, 31-32 Alfred Place, London, WC1E 7DP

MANAGING DIRECTOR John Garewal
DIRECTOR OF ADVERTISING Julian Lloyd-Evans
GROUP CFO/COO Brett Reynolds
CHIEF EXECUTIVE James Tye
COMPANY FOUNDER Felix Dennis

PRODUCTION & DISTRIBUTION
Printed by William Gibbons.

Distributed by Seymour Distribution, 2 East Poultry Avenue, London EC1A 9PT. Tel: 020 7429 4000.

PC Pro is produced by Danton Media Limited and published monthly by Dennis Publishing Limited, a company registered in England, number 1138891.

SUBSCRIPTIONS
Price: UK £49.99; Europe £70; Rest of World £90. Visit dennismags.co.uk/pcpro for our best offers. To renew a subscription, change an address or report any problems, visit managemymags.co.uk

SYNDICATION & INTERNATIONAL LICENSING
PC Pro is available for licensing overseas. Licensing contact: Nicole Adams, nicole_adams@dennis.co.uk, +44 20 7907 6134.

abc ppa The Professional Publishers Association Member

CERTIFIED DISTRIBUTION
23,994 (Jan-Dec 2017)

Dennis

VigorSwitch V1281

HDMI-over-IP Distribution

Brand new from DrayTek, this exciting new product set takes your HDMI video sources - satellite receivers, DVD players, CCTV system etc. in full HD and sends them to TVs around your home or building. Any output (TV) can then select any source (e.g. DVD player) using the app and control it using the original IR remote.

The VigorSwitch V1281 switch is complemented by the HVE290 HDMI-IP converters which connect to each source device or television/projector.

The V1281 system is scalable; you need buy only the HVE290s that you need, adding more later if required.

Ethernet is cheaper, easier to install, has longer range than HDMI and the V1281 is much more cost effective and flexible than an equivalent native HDMI switch unit. With 28 ports, the V1281 can also handle your regular Internet & computer networking. The V1281 is ideal for smart-home and commercial applications.

See web site for full product details and explanations

HVE290 converts HDMI to IP

Router & WiFi Security Guide 2018 - Out Now!

The fully updated and expanded edition of our router and WiFi security guide is our essential guide to the best practices for any router or WiFi user or operator (not just DrayTek) to help keep your network and data safe.

Download and read it today to check that you're doing everything you can to help prevent you or your company from becoming a victim.

www.draytek.co.uk/best

DrayTek Managed Wireless

DrayTek's new managed wireless facility is built into the Vigor 2862 router - Just add DrayTek wireless access points and your users and guests can have reliable coverage and optimised performance, whilst you have control, security and comprehensive monitoring.

- No dedicated/specialist controller required
- Mobility - Wireless throughout your premises
- Load-Balancing across multiple APs
- Reporting, logging & monitoring

Learn more at www.draytek.co.uk/wireless

- ADSL2+/VDSL2 router/firewall
- Load Balancer
- VPN Concentrator
- BT SIN 498 MCT Approved
- 802.11ac 4x4 MU-MIMO
- Configurable QoS
- BGP & High Availability (HA)
- Web Content Filtering
- VLAN tagging & multi-subnet
- PC Pro A-List (V2862Lac)

Vigor 2862 Series

The Ultimate DSL Router

DrayTek

For the full range, visit www.draytek.co.uk

All specifications subject to change. 08/18
Please check web site for current model specifications.

Briefing

Background and analysis on all the important news stories

Your data handed over: no questions asked

Service providers have been accused of passing data to intelligence agencies on "gentlemen's agreement"

TELECOMS COMPANIES AND GCHQ have been criticised after a judicial tribunal ruled that the eavesdropping agency had wrongly been given unfettered access to data from millions of Britons for more than a decade.

According to Privacy International, which took the matter to the Investigatory Powers Tribunal that oversees intelligence bodies, telcos often handed over data without checking that there was a legal basis for doing so.

"The judgement highlighted that the telcos didn't really ask for anything and were just given oral assurance, although it should be said the judges weren't critical of the telcos, but instead the failures by GCHQ," said Millie Graham Wood, a solicitor with Privacy International.

"It was kind of like a gentlemen's agreement, that GCHQ would contact providers and say 'we want this kind of communications data' and without asking for any documentation or looking at any lawful authority they would just hand it over."

The data gathered – from at least 2001 until 2016 – included bulk personal datasets and bulk communications data, which was demanded under laws such as section 45(2) of the Telecommunications Act 1983 and section 94(1) of the Telecommunications Act 1984.

Verbal agreement

The lax way in which orders for data were dealt with by service providers was also shown in case notes from the tribunal. Although any requirements should have been set out in writing, they were often communicated verbally – and the provider complied.

"In some cases, a letter was sent by GCHQ to the CSP [communications service provider] which specified the categories of communications in respect of which data was required by GCHQ. However in most of the relevant cases such letters cannot be found on the files of GCHQ or the CSP," the case notes read.

ABOVE The tribunal showed that telcos often handed over data to GCHQ after a verbal – not written – request

"As was accepted by the GCHQ witness, the likelihood is that in such cases the requirement to provide communications data and the specification of such data was communicated only orally."

The tribunal heard several examples of data requests where no letter was sent and details were handed over on the back of a conversation. "In a sense, the oral agreements were just an extension of something that appears to have been going on for many years prior to the use of section 94 of the Telecommunications Act, without the telcos asking for any legal documentation," said Graham Wood, adding that the cosy relationship was different to what may be demanded by more recently established companies.

"The average person would expect that if GCHQ approached a telco or companies like Facebook or Google seeking vast quantities of data, the

companies would ask to see a warrant and evidence of legal basis," she said.

"It would be shocking if GCHQ could just turn up, say 'Hi, we want this data' and the companies wouldn't ask to see anything."

In the ruling, the tribunal found that successive foreign secretaries up until 2016 delegated data request decisions to GCHQ, when any data requirements should have been overseen by the foreign secretary. (Oddly, GCHQ comes under the purview of the Foreign Office and not the Home Office.)

The government had previously argued that the Foreign Office had overseen all data requests, but was forced to change its position after new evidence came to light.

Because the data was collected without the required oversight, the tribunal found that "in relation to many directions made prior to October 2016 by the foreign secretary to communications service providers to provide data to GCHQ, they were not in accordance with law".

> "It was impossible to know how the data had been used, or if it had been shared with other government bodies"

Although very little has changed in the way that data is shared between service providers and GCHQ, such data requests are now deemed legal because they have proper oversight from the foreign secretary.

Fixed data deposit

Privacy International also expressed its concerns that GCHQ was allowed by a previous ruling to retain the data, and could share it with third parties and foreign agencies.

"Unfortunately the tribunal found that even though the regime was unlawful they weren't going to provide any relief or say that GCHQ has to delete it," said Graham Wood. "They effectively said, 'Even though it's unlawful we'll just tell you off, but won't impose any sanction on you'."

According to Privacy International, it was impossible to know how the data had been used, or if it had been shared with other government bodies. "The data could have been shared with police, departments or foreign agencies," said Graham Wood.

"However, the case looked at these types of sharing on a hypothetical basis and so we will not know the extent of this and whether there has been any misuse or abuse of vast amounts of personal data."

Five stories not to miss

1 Microsoft flies on cloud growth

Microsoft posted annual revenue figures of $110 billion, up 14% on 2017. The company highlighted its Azure cloud platform as the biggest area of growth. Despite being hit with a $16 billion repatriation tax bill, the company posted better-than-expected results across its businesses, and saw its market value soar past $800 billion.

2 Google slapped with €4.3 billion Android fine

The EU hit Google with a €4.3 billion fine over competition violations. Regulators ruled that Google imposed "illegal restrictions on Android device manufacturers and mobile network operators to cement its dominant position in general internet search".

3 PCs return to growth on business sales

PC sales rose year-on-year in Q2 of 2018, marking the first increase in more than six years. Research from analysts IDC and Gartner showed growth of 1.4% and 1.7% respectively. The companies count sales differently, but both said business sales had pushed growth, while consumer demand remained slack. Gartner said Lenovo and HP led the way, with 21.7% of the market each.

4 Google names and shames sites that shun HTTPS

Leading websites – including the Daily Mail Online, Sky Sports, Argos and the University of Oxford – have been publicly shamed by Google, which has started marking all sites that don't use HTTPS. With version 68 of its Chrome browser, Google started warning users of lax security on some 20% of the web's top 500 sites.

5 Porn age verification plans fall short

The government's plans to stop children watching porn were dealt a blow when it was revealed that its impending age verification scheme could be futile. The government intends to make all adult sites block underage viewers, but the regulator has admitted it has no control over adult content on social media, where studies suggest teenagers view most of their porn.

Unveiled

The key details of this month's hot hardware releases

Microsoft Surface Go

In another attempt to keep the Chromebook off its turf, Microsoft has unveiled the Surface Go – the firm's lightest, most affordable Surface machine to date.

At £380, Microsoft is targeting students and people who use devices on the move, boasting that the Go's 10in screen is the ideal form factor to combine work and film viewing.

To meet the price point, Microsoft has made sacrifices. For example, there's a seventh-generation Intel Pentium Gold Processor 4415Y, which is similar to the processors found in many Chromebooks.

Microsoft says it has worked with Intel to squeeze the most out of the silicon in terms of performance and battery life, while still managing to eliminate the need for a processor fan.

The device ships with Windows 10 in S mode, which means it can initially only run apps from the Microsoft Store and use accessories compatible with S mode, but users can switch (once) to a full version of Windows 10.

The initial version only supports Wi-Fi, but Microsoft expects to release a 4G version later this year. Adding the keyboard will bump up the price by £99 while the pen adds another £99.

KEY DIGITS AND DETAILS

Availability August
Price £380
OS Windows 10 in S mode
Processor Intel Pentium Gold Processor 4415Y
Memory 4GB or 8GB
Storage 64GB eMMC drive or 128GB SSD
Connectivity USB-C, 3.5 mm headphone jack, 1 x Surface Connect port, Surface Type Cover port, microSDXC card reader
Dimensions 245 x 175 x 8.3mm (WDH)
Weight 522g without Type Cover

ABOVE **The smallest of the three P330s, the one-litre Tiny, certainly lives up to its name**

Amazon Fire TV Cube

In its quest to squeeze Alexa into every form factor, Amazon has launched the Fire TV Cube, a speaker in a 4K set-top box.

The Fire TV Cube offers voice-controlled access to video or music, with the ability to turn on compatible TVs without a cushion-tossing hunt for the remote.

The system works with multiple streaming services and promises 4K Ultra HD at up to 60fps.

Eight microphones listen out for commands, while the Cube's speaker can deliver weather forecasts, news bulletins and web searches – whether the TV is turned on or not.

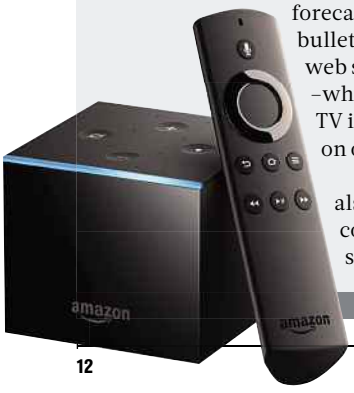
Alexa can also control compatible sound bars and cable or satellite receivers to switch channels or pause, but you can't use your voice to change over-the-air channels.

Linked to smart home devices, the Cube can also control lights, but it doesn't yet support all of Alexa's functions, such as Alexa Calling & Messaging, multiroom music and Bluetooth connections to phones.

The Fire TV Cube is so far only available in the US, with no news on when it will land in the UK.

KEY DIGITS AND DETAILS

Availability Now in US, TBA in UK
Price $120
Display Up to 2160p (4K Ultra HD) 60fps, HDR10 support
Audio formats Dolby Atmos, 7.1 surround sound, 5.1 surround sound via HDMI
Processor 1.5GHz quad-core ARM 4xCA53
Storage 16GB
Connectivity Wi-Fi, Bluetooth, HDMI, micro-USB, Ethernet



ABOVE **With its 10in screen, low price and Windows 10 in S mode, the Surface Go is aimed at students**

LEFT **The Fire TV Cube allows you to switch on the TV with your voice**

Lenovo P330 ThinkStations

Lenovo has announced a range of entry-level workstations based on Intel's new Xeon E processor and the eight-generation Intel Core processors.

Lenovo is aiming the trio of form factors at professionals in design, CAD and other data-intensive industries – as well as medical environments, where a combination of performance and reliability is key. The processors are claimed to be 44% faster than the previous generation.

The P330 series features three form factors: the Tower, Small Form Factor (SFF) and Tiny. Lenovo boasts that the P330 Tower and SFF reduce footprint by 30% on previous versions, while the one-litre Tiny is hailed as the "world's smallest chassis" for a workstation.

According to Lenovo, the Tower can be specced with the Quadro P4000 GPU to create VR environments and, like the SFF, supports up to 64GB of DDR4 memory and multiple storage bays, along with Type-A USB and USB-C, HDMI and Ethernet connections.

The pint-size Tiny features up to 2TB of M.2 NVMe SSD storage, the Nvidia Quadro P620 GPU and up to 32GB of DDR4 memory.

KEY DIGITS AND DETAILS

Availability August 2018
Price TBA
OS Windows 10 or Linux
Processors Intel Xeon E-2100 or up to 8th Gen Intel Core i7
Storage Up to 12TB

RIGHT **The P330's Xeon E processors are claimed to be 44% faster than predecessors**

Google loses way with Maps price hike

Google has been accused of throwing websites into turmoil with a series of changes to the way it charges for its Maps API

IN A MOVE widely criticised in web development forums, Google reduced how much sites could use the Maps API without payment, and massively bumped up the price for 1,000 map loads from 50 cents to $7.

The move has seen rafts of websites abandon Google's offering in favour of rival providers such as Apple Maps, Mapbox and TomTom, causing significant pain for web developers.

"Google decided to make Maps its next billion dollar business by raising prices 14 times and decreasing the free usage limit almost 30 times, all with minimal notice period," explained Tomasz Nawrocki in a blog post from the German pharmacy-finder service In der Apotheke.

According to the pharmacy locator, the changes would have seen its costs for mapping leap from $0 to $5,000 per month, a figure that dwarfed all its other infrastructure outgoings of $1,300. Meanwhile, the free usage limit dropped from 750,000 monthly requests to 28,000.

Google had warned about the price increases, but the scale of the changes came as a shock to many, especially given the complexity of Google's pricing structure.

One UK hobby site owner we spoke to said he thought he would have to shut his pages down when he realised it would cost £6,000 a year. "There are so many different elements to the way it charges I had no idea how much it was going to be – the way it charges it's very, very difficult (almost purposefully) to work it out, which is why I gave up and decided to wait the three months notice period to see what happened," said Rob Clarkson, owner of the stadium-finding and logging site **footballgroundmap.com**.

"For me, based on last year's traffic it was going to be £6,000 – it's just prohibitively expensive and there's no way I or anyone else running a similar site would be able to afford that sort of money," Clarkson explained.

ABOVE Google Maps' huge change in pricing structure has forced sites to look for different map providers

Instead, Clarkson switched map feeds to Mapbox, which will cost in the region of £500 a year.

The change involved a day's work to switch from one provider to another, "which was annoying and I'd rather have spent the time doing something else," said Clarkson.

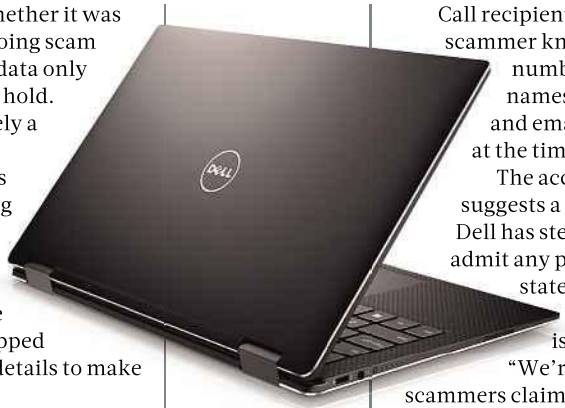
Google has yet to respond to the widespread criticism, but said on its developer site that: "The new plan gives you more flexibility and control over how you use our APIs. You can use as much or as little as you need and only pay for what you use each month." Assuming you can afford it.

Dell won't tell if it's been hacked

DELL IS REFUSING to say whether it was hacked, despite an ongoing scam that appears to rely on data only the PC company would hold.

The scam is effectively a technical support call racket, where criminals phone customers posing as Dell representatives. Whereas the common Microsoft scam is speculative, the fake Dell staffer is equipped with enough personal details to make it convincing.

"I am so getting tired of scammers calling me saying they are from Dell and want to look at some alerts on my PC," reads a typical tweet from Charles Waddell. "Dell what are you doing about my data that was stolen from you?"



ABOVE Dell says that the scam is industry-wide – not a specific attack

Call recipients claim the scammer know their PC serial numbers as well as the names, phone numbers and email addresses given at the time of purchase.

The access to such details suggests a security breach, but Dell has steadfastly refused to admit any problem and in a statement continues to claim that the scam is industry-wide.

"We're aware that some scammers claiming to work for Dell have contacted our customers using basic information about their Dell service history. Being aware of the issue, we're taking proactive measures to shut down these scammers and make our customers aware of the scam," the company said.

The issue dates back to at least 2016, but security experts speculate Dell could have an ongoing problem. "If it's not a hack in the traditional sense, it may have been an 'inside job' by someone who had access to the information," said Graham Cluley, an independent security expert.

"For instance, staff at a call centre may have access to sensitive information. Other possibilities include data being stored in an unsecured cloud bucket."

Cluley said that the company should come clean if it has been specifically targeted. "It doesn't matter if a company has been hacked or not," said Cluley. "What matters is if customer data may have been breached, they deserve to know if there is a chance that their details may be in the hands of criminals."

Universal broadband? Count to ten...

Plans to guarantee dismal broadband speeds for all are foundering, Stewart Mitchell finds, as pressure builds on the government to rethink its Universal Service Obligation

The Universal Service Obligation (USO) that guarantees all households a modest level of broadband will leave many homes without the "guaranteed" speed and remains uncosted, less than 18 months before it is due to come into effect, a *PC Pro* investigation has found.

The USO promises 10Mbits/sec download and 1Mbit/sec upload speeds, with telecoms regulator Ofcom inviting providers to tender for the project.

However, critics point out that even this modest target is already outdated and likely to fail.

"The USO they're suggesting is a fudge – you have a second-rate solution for the majority to fill a criteria that's too low," said Chris Conder, a founder of the community fibre provider B4RN. "10Mbits/sec in a year or two will be a farce – the USO should be 100Mbits/sec."

The comments echo concerns from the House of Lords, which had been pushing for a USO that set the minimum download speed at 30Mbits/sec. "By the government's own admission, the USO is simply a safety net and frankly, not a very good one at that," explained Lord Foster of Bath, highlighting that most of the research preferred a faster base rate.

"I have looked at many Ofcom documents and I cannot find a single one in which they express real enthusiasm for a USO of just 10Mbits/sec. The lack of ambition shown in the USO is common to much of the government's whole approach to broadband rollout."

Faraway fibre

If the near term is bleak for the "broadband challenged", the government has finally – many say belatedly – offered hope of a full-fibre rollout, a 5G roadmap and up to £5 billion in funding.

In its *Future Telecoms Infrastructure Review*, the government acknowledged Britain lagged behind on end-to-end fibre connections. "The UK has only 4% full fibre connections and lags behind many of our key competitors," the paper stated, promising funding and changes to the law. Spain stands at 71% and Portugal at 89%.

The target for full fibre is, however, as distant as 2033. Much work will be needed across industry to make even that modest vision a reality, as it means switching off the ageing copper network and replacing it with fibre.

Key recommendations include full-fibre connections to new-build homes, as well as rules to force unrestricted access to BT Openreach ducts and poles for both residential and business use, including mobile infrastructure.

The DCMS suggested an "outside-in" approach, with rural areas getting priority, while commercial operators would be encouraged in viable areas through schemes to open up ducts, gas lines and sewers to cable providers.

Furthermore, the fibre would be used to drive a 5G network, which under the plans would benefit from more spectrum and easier access to state-owned estate for positioning masts.

The industry largely welcomed the plans, but fibre providers warned against "overbuild" and sought assurances that they would not be sidelined, referencing the way that BT has previously won the lion's share of contracts for broadband improvements.

"While the government is right to state that a full-throttle drive to nationwide full fibre connectivity requires competition and commercial investment to succeed, a fair and equitable playing field for all infrastructure providers is essential," said Evan Wienburg, CEO of fibre provider TrueSpeed. "This has not always been the case.

"There are numerous examples of taxpayers' money being wasted by national incumbent providers building FTTC [fibre to the cabinet] or FTTP [fibre to the premises] networks in areas where privately-funded infrastructure providers have already deployed."

In the light of the government's recent announcement of a major investment for a full fibre Britain, a botched USO might seem insignificant, but the timeline for that rollout runs to 2033. For bandwidth-challenged businesses and homes, that could mean a long wait.

"If the government push for full fibre does translate into a genuine 100% of premises, full-fibre landscape by 2033, then those not in the current scope of the various BDUK projects will probably only have the improvement from the USO to see them all the way through the 2020s," said Andrew Ferguson, an analyst with Thinkbroadband.

When "universal" has limits

Under the USO scheme, selected providers (with BT the frontrunner) would be obliged to provide a connection with synced speeds meeting the "10 down, one up" criteria, but only if it can be done for under £3,400 per household.

It sounds like a reasonable chunk of cash, but there are various get-out clauses that allow providers to avoid costlier premises. "In short, it seems that even if BT is the only USO provider, where existing technology can meet the USO specification you will need to pick that alternate provider," said Ferguson.

"If an area has something that's USO capable – that's basically fixed wireless providers or 4G – you can't claim through the USO scheme."

According to Ferguson, a USO provider "might just send you a 4G router and if a 4G router will do the trick, then why bother rolling out FTTP [fibre-to-the-premises]?"

Where the cost of fibre or copper connection would cost more than £3,400, end users are likely to be offered nothing better than satellite broadband, with all its latency and cost problems.

Ofcom figures suggest that even allowing for areas covered by 4G and fixed wireless, 59,000 premises would be left unserved because an installation would cost more than the £3,400 limit. In its documentation, the Department for Culture Media and Sport admits that "these premises may be left with satellite connections as the only option" and for critics, this undermines the whole point of a USO. "Everybody can be ticked off as having been provided under the USO, because you just put them on satellite – so it's a get-out-of-jail card," said Conder.

The Broadband Stakeholder Group, a trade body for the telecoms industry, justified the exclusion of some homes by saying that making the USO truly universal would be too expensive. "If the cost of providing the connection is over £3,400 then you can either choose to pay the extra or be offered a satellite solution," said Matthew Evans, CEO of BSG. "This helps ensure that everyone benefits to some degree whilst avoiding the exponential costs of the last few premises where they can rise to over £40,000."

ABOVE Users may find themselves in a broadband traffic jam as they wait years for the USO to come into force

Furthermore, if there's a planned rollout from another source – for example from BDUK projects – that's due to be delivered within a year, a householder can't ask for a USO provider to upgrade their service. "You can only invoke the USO if there are no plans for a rollout to your area in the next year," explained Ferguson, "Scotland's planning to finish rollout in 2021 so no-one in Scotland will be able to demand USO."

Yet more delays

With less than 18 months before the USO is due to come into effect, there remains no clear outline of how it will be organised or costed, and there are doubts that everything will be in place in time.

> "Everybody can be ticked off as having been provided under the USO, because you just put them on satellite"

"The government expects the ISPs to fund this through what is known as a Universal Service Fund, although how that will work and how much funding will be generated is anyone's guess," said Gary Hough, regulatory manager at ISP Zen.

Ofcom told us it is still considering who will pay, but the scheme is expected to see bills rise across the board to cover the cost of USO provision. "On average, consumers might see increases in household bills ranging from just under £11 per annum to deliver a standard broadband universal service to just under £20 per annum to deliver a superfast broadband universal service," the regulator said in its USO report to government.

Nobody knows how many people might take up the USO, although Thinkbroadband estimates it would be available to just under a million premises. "Ofcom seems to optimistically think it'll have things in place for next summer," said Ferguson. "Ofcom might be ready but then you have all the providers [who need] to work out what they're doing and set up ordering systems.

"Business can speculate, but until Ofcom has signed it off and the legal challenges are done, you can't build a business plan or build a model on it."

The A-List

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

PC PRO A-LIST

PREMIUM LAPTOPS

Dell XPS 13 9370

Ultraportable from £1,149

from dell.co.uk

This 2018 update to the all-dominant Dell XPS 13 keeps tweaks to the minimum: slimmer bezels, eighth-generation Intel Core processors and the promise of even longer battery life are the most important benefits. Just keep in mind that Dell has embraced USB-C ports at the expense of the old-fashioned Type-A variety.

REVIEW **Issue 284, p54**

ALTERNATIVES

Microsoft Surface Book 2 (NEW ENTRY)

A unique and versatile laptop with a screen that detaches to become a tablet – the £1,830 version is our pick of the bunch. **From £1,149 from microsoft.com/store**

REVIEW **Issue 281, p48**

Apple MacBook Pro 15in (2018) (NEW ENTRY)

A machine for true power users with amazing specifications, including that infamous Core i9 – and up to 4TB of SSD storage. **From £2,349 from apple.com/uk**

REVIEW **Issue 288, p48**

Razer Blade 15

A gaming powerhouse as you would expect. We recommend buying one of the specs with a 144Hz Full HD screen and GeForce 1070 graphics. **From £1,699 from razer.com**

REVIEW **Issue 288, p63**

SMARTPHONES

OnePlus 6

Android, 64GB, £469

from oneplus.net

The OnePlus 6 is terrible news for Huawei, Samsung and Sony, because it begs one simple question: why on earth would anyone pay over £700 for a flagship phone when they can get something that's almost as good for two-thirds of the price? Yes, it lacks IP-certified waterproofing and there's no optical zoom on the camera, but this phone is gorgeous, fast and takes rather nice photos, too. REVIEW **Issue 286, p68**

ALTERNATIVES

Apple iPhone 7

Despite the launch of the iPhone 8 and iPhone X, the iPhone 7 retains its place as the best-value Apple phone. **32GB, £549 from apple.com/uk**

REVIEW **Issue 266, p54**

Honor 9 Lite

A huge 18:9 display and stylish design give this budget phone a high-end look. There's even room for a dual-camera setup on the front. **£200 from store.hihonor.com/uk**

REVIEW **Issue 283, p70**

Samsung Galaxy S8

A stunning phone, complete with a great camera, long battery life and chart-topping speed. **64GB, £609 from samsung.com/uk**

REVIEW **Issue 273, p74**

TABLETS

Apple iPad

9.7in tablet from £319

from apple.com/uk

While we criticise Apple – and quite rightly – for its failure to deliver a new design on this thick-bezelled basic iPad, we can't quibble about its value for money. With support for the Pencil, it's now also a viable alternative to the iPad Pro. REVIEW **Issue 285, p48**

ALTERNATIVES

Apple iPad Pro 10.5

With the Pencil and Smart Keyboard, the Pro is pricey but – for mobile workers – it's definitely worth it. **64GB, £619 from apple.com/uk**

REVIEW **Issue 278, p89**

Amazon Fire HD 10

A top-quality tablet for the price, with a 10.1in IPS display and solid turn of pace. Only the cameras disappoint. **32GB, £150 from pcpro.link/279hd10**

REVIEW **Issue 279, p71**

Huawei MediaPad M5 Pro

This stylish Android tablet comes with a stylus, 64GB of storage and plenty of power. **4G, €499 from huawei.com**

REVIEW **Issue 284, p70**

EVERYDAY LAPTOPS (NEW ENTRY)

HP Envy 13 (2018)

A bargain ultraportable, £849

from hp.com/uk

If you care about the colour accuracy of your laptop screen, this isn't for you. But, for everyone else, it's a bargain. It has buckets of power thanks to a Core i5 processor, 8GB of RAM and GeForce MX150 graphics in our review model (ah0001na), as well as the fit and finish of a luxury machine.

REVIEW **Issue 288, p61**

ALTERNATIVES

HP Chromebook 13 G1

A stylish and high-quality laptop, but with Chrome OS, not Windows. It's fast, has all-day battery life and won't look out of place in a boardroom. **£608 from pcpro.link/271hpc**

REVIEW **Issue 271, p54**

Asus ZenBook 13

A brilliant 13.3in ultraportable that packs an excellent specification into a slender 1.12kg frame – including Nvidia graphics. **£1,200 inc VAT from johnlewis.com**

REVIEW **Issue 286, p58**

Asus ZenBook UX410UA

A superb value 14in laptop, with the looks of a much more expensive machine. The pricier 8GB/256GB version is best, though. **£540 from pcpro.link/280zenbook**

REVIEW **Issue 280, p68**

ENTHUSIAST PCs

Scan Vengeance Ti

Intel Core i7-8086K PC, £2,400

from scan.co.uk

Quite aside from the bragging rights of owning a PC built around an i7-8086K chip, this machine rewards you with ridiculous frame rates thanks to 11GB GeForce GTX 1080 Ti graphics. And it comes pre-overclocked to 5GHz. Use code LN84893. **REVIEW Issue 287, p56**

CCL Reaper GT

In a world of big black boxes, the Reaper GT's all-white finish stands proud. As you'd expect, it includes some cracking components (an AMD Ryzen 2700, 16GB of RAM, a 250GB SSD and 8GB GTX 1080 graphics) with watercooling for good measure. A brilliant high-end PC. **AMD Ryzen 2 PC, £1,450 from cclonline.com REVIEW Issue 286, p80**

Palicomp Intel i7 Nebula

Palicomp's Nebula goes a different route to CCL, with an i7-8700K overclocked to 4GHz and two RAID0-optimised SSDs to accompany its GeForce 1080 graphics. The final result is a stupidly quick machine – and it includes a dazzling light show to match. **£1,650 from palicomp.co.uk REVIEW Issue 286, p84**

WORKSTATIONS

Scan 3XS WI6000 Viz

Core i9-7980XE workstation, £4,650

from scan.co.uk

An overclocked Core i9-7980XE processor, together with 64GB of 3GHz DDR memory and Nvidia's Quadro P4000 graphics, ensured this was a great all-rounder. With a 2TB hard disk and 500GB SSD, it's a brilliant showcase for Intel's top-end CPU. **REVIEW Issue 281, p84**

Apple iMac Pro

There are no major design changes, but the new iMac Pro's internal components are a very different matter. Apple creates a compelling workstation with an octa-core Xeon processor, AMD Radeon Pro Vega 56 graphics and 32GB of ECC memory. **From £4,899 from apple.com REVIEW Issue 284, p50**

PC Specialist Apollo X02

PC Specialist provides a terrific-value alternative with this system based on Intel's eight-core Core i7-7820X. Overclocked to 4.6GHz, with support from 32GB of 3GHz RAM and Nvidia Quadro P4000 graphics, it proved a solid performer in modelling tasks. **£2,500 from pcspecialist.co.uk REVIEW Issue 281, p83**

MONITORS

NEW ENTRY

Eizo FlexScan EV2450

1080p display, £281

from pcpro.link/263eizo

A great-value 24in IPS display that offers more colour-accurate images than you've any right to expect at this price – and a reassuring five-year warranty, too. **REVIEW Issue 263, p72**

ViewSonic VP3268-4K

It's true that you can buy 32in 4K monitors for around £500, but we think it's still worth spending the extra money on this ViewSonic. In return, you get superb colour accuracy and terrific all-round quality. **£883 from pcpro.link/286view REVIEW Issue 286, p65**

Iiyama ProLite X3272UHS-B1

Looking to kit 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. **£300 from box.co.uk REVIEW Issue 288, p72**

ENTHUSIAST/SMB NAS DRIVES

Synology DS918+

Four-bay NAS, £480

from laptopsdirect.co.uk

While all of Synology's NAS drives share the same great OS, with all the attendant apps, the DS918+ stole top spot in our Labs due to its horsepower, the four available drives and the sheer number of roles it can perform. **REVIEW Issue 284, p81**

Qnap TS-453Be-4G

Qnap markets the TS-453Be at businesses rather than home users – although, in our opinion, it's equally at home in both situations. It's straightforward to use and a very solid performer, as well as being extremely versatile. **£515 from 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 that reasonable price, it includes four bays, and its mid-range specification can handle office duties well. **£293 from pcpro.link/284wd1 REVIEW Issue 284, p83**

WIRELESS NETWORKING

NEW ENTRY

Zyxel Multy X

Mesh networking, £250

from pcpro.link/282multy

Not the smallest nodes, but that's for a reason: each one crams in a dedicated 4x4 antenna array for the backhaul alongside separate 2x2 arrays for connected clients. The result? Lighting-fast Wi-Fi and impressively wide coverage for a reasonable price. **REVIEW Issue 282, p85**

NEW ENTRY

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, it delivers extremely fast speeds. **£227 from pcpro.link/288link REVIEW Issue 288, p82**

NEW ENTRY

Tenda Nova MW3

Don't want to spend over £200 on a Wi-Fi upgrade? The Nova MW3 is a bargain choice, killing off notspots and spreading Wi-Fi throughout your home. It's not as fast or wide-ranging as the Zyxel Multy X, but boy does it win on value. **£81 from pcpro.link/288tenda REVIEW Issue 288, p69**

WORKGROUP PRINTERS

Xerox VersaLink C600DN

Colour laser, £780 exc VAT

from printerland.co.uk

The C600DN hit 53ppm speeds in our tests, managing 50ppm double-sided, and produced great results even on cheap 75gsm paper. Low running costs of 1.1p mono and 6.4p colour only add to its attractions. REVIEW **Issue 283, p98**

Brother HL-L9310CDW

If you can't quite afford the Xerox VersaLink C600DN, consider this good-value rival from Brother. This colour laser provides great output quality, low running costs (1.1p/7.8p) and speeds of up to 32ppm, as well as plenty of security features. **£440 exc VAT from printerbase.co.uk**
REVIEW **Issue 283, p94**

Kyocera Ecosys M5526cdw

Low running costs and easy maintenance are the key factors here, with 1.3p per mono page and 9p for colour. Print quality is great too, even if you're kept waiting a little longer for 600dpi prints. **£376 from printerland.co.uk**
REVIEW **Issue 279, p101**

HOME OFFICE PRINTERS

HP PageWide Pro 477dw

All-in-one inkjet, £339

from ebuyer.com

While this isn't the most compact inkjet MFP, it is one of the fastest – it hit 44.8 pages per minute in our tests. With excellent print quality and low running costs, the only thing that counts against it is that you'll need good quality paper to take advantage. REVIEW **Issue 287, p81**

Canon Pixma TX6150

Squarely aimed at home users with a creative bent, the Pixma TS6150 produces excellent photos, and quickly, too: it took 70 seconds for a borderless 6 x 4in print. With respectable running costs, it's a very classy multifunction printer for the money. **£100 from pcpro.link/287can**
REVIEW **Issue 287, p80**

Xerox WorkCentre 6515DNI

Just like the HP, this isn't the world's smallest printer – but for a £299 colour laser, it's amazing what you get in return. Pin-sharp scanning, great all-round printing, and solid speeds of over 20ppm. Only high running costs count against it. **£299 from printerland.co.uk** REVIEW **Issue 287, p85**

VIDEOCONFERENCING

Polycom RealPresence Trio 8800 Collaboration Kit

Full VC kit, £1,209 exc VAT

from pcpro.link/275poly

This kit provides everything for a small business, with no need to hook it up to a laptop or mobile. It's flexible when it comes to positioning and won't be beaten for features or audio quality. REVIEW **Issue 275, p98**

Lifesize Icon 450 and Phone HD

The price is steep, but this complete VC solution makes high-quality videoconferencing a walk in the park – it's impressively easy to deploy and use, while the audio quality delivered by the four built-in mics was top notch. **£3,462 exc VAT from uk.insight.com**
REVIEW **Issue 275, p96**

Logitech ConferenceCam Connect

If you need a portable solution for smaller rooms, this sleek device can be set up in seconds. Despite its size, it can't be faulted for quality and the price is right, too. **£243 exc VAT from pcpro.link/275log**
REVIEW **Issue 275, p97**

BUSINESS WI-FI

NEW ENTRY

DrayTek Vigor 2862Lac

Secure router, £354 exc VAT

from netxl.com

This 802.11ac router is loaded with potential, from bolstered security to a 3G/4G SIM card slot to expansive VPN options. There's almost nothing a business could ask for that it doesn't do, making it an easy choice for any switched-on SME. REVIEW **Issue 286, p100**

WatchGuard AP420

Not cheap, but SMBs wanting enterprise-class wireless security and central management will find it money well spent. The cloud portal is one of the best we've seen, performance is great and WatchGuard's WIPS delivers smart wireless security. **£647 exc VAT from broadbandbuyer.co.uk** REVIEW **Issue 281, p97**

TP-Link Omada EAP225 V3

A brilliantly affordable AC1350 access point that's a great budget choice for small businesses wanting to create a secure, easy-to-manage wireless network in the office. Plus, it can scale up as your needs grow. **£53 exc VAT from scan.co.uk**
REVIEW **Issue 288, p101**

SCANNERS

Xerox DocuMate 6440

USB scanner, £353 exc VAT

from printerbase.co.uk

A brilliant choice for heavy workloads, the DocuMate 6440 hit speeds of nearly 70ppm in our tests. It also has a large ADF and versatile software.
REVIEW **Issue 278, p98**

Brother ADS-3000N

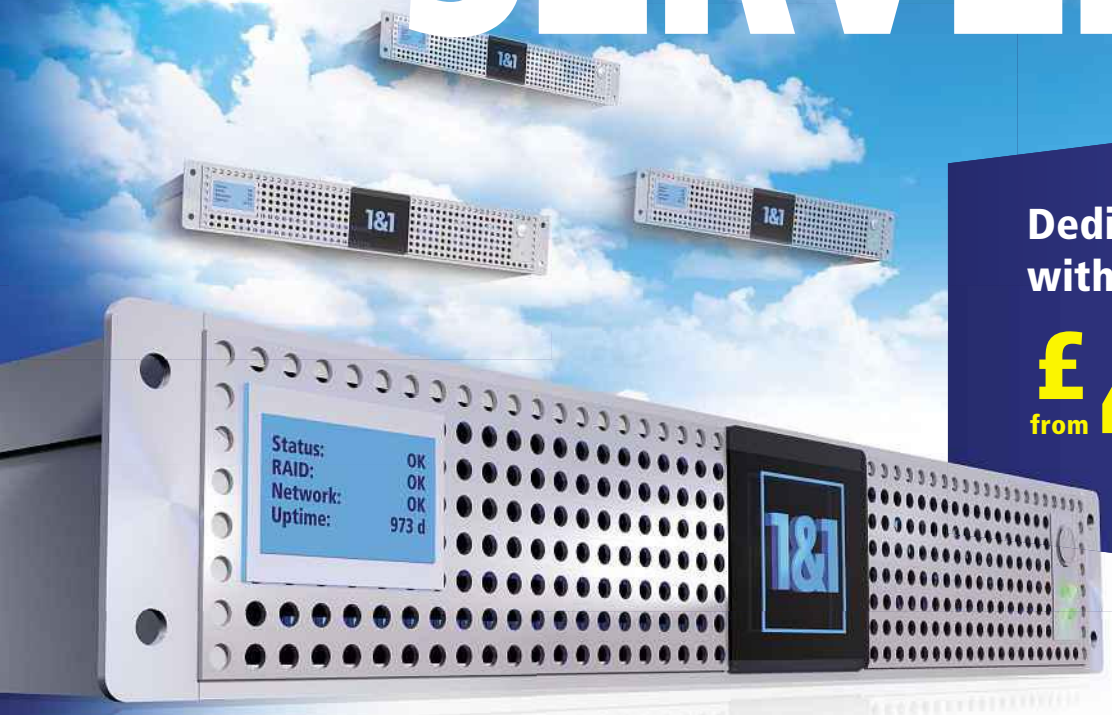
Aimed at mid-sized workgroups, the ADS-3000N is a solid deal: it supports both USB and Gigabit Ethernet network connections, while offering 50ppm scan speeds, a robust 5,000-page daily duty cycle and a generous software package. **£385 exc VAT from pcpro.link/278ads**
REVIEW **Issue 278, p94**

Plustek SmartOffice PL4080

Looking for a flatbed scanner? The PL4080 fits the bill nicely, combining a fast 40ppm duplex ADF with an A4 flatbed scanner. With Plustek's intuitive DocAction software thrown in, it's a great buy. **£345 exc VAT from grooves-inc.co.uk**
REVIEW **Issue 278, p97**

DOMAINS | MAIL | HOSTING | eCOMMERCE | **SERVERS**

NEW BARE METAL SERVER



Dedicated server with cloud features

from £49.99/month* excl. 20% VAT

Next Generation: 1&1 Bare Metal Server

High-performance, dedicated hardware – flexible and expandable!

- ✓ **NEW:** Dedicated server with cloud features
- ✓ Ready to go in 8 minutes
- ✓ Flexible billing model, precise to the minute
- ✓ 100% enterprise hardware
- ✓ Latest Intel® Xeon® E3 v6 Processors
- ✓ Individual firewall configurations
- ✓ 24/7 expert server support

intel XEON inside

Trusted Performance.
Intel® Xeon® Processors.

1 TRIAL TRY FOR 30 DAYS

1 MONTH SHORT TERM CONTRACTS

1 CALL SPEAK TO AN EXPERT

0333 336 5509

1&1

1and1.co.uk

*Example price for a Bare Metal Server S with a standard configuration for one full month. Invoice amount plus costs for any additionally booked resources is due after one month. No setup fee, no minimum contract period. The preparation time of eight minutes is based on the server's provisioning time after booking. Prices exclude 20% VAT.

SECURITY SOFTWARE

Bitdefender Internet Security 2018

A stellar selection of extras, including ransomware protection, along with rock-solid antivirus protection makes this our top choice for 2018. **3 devices, 1yr, £25 from bitdefender.co.uk** REVIEW **Issue 279, p85**

Avast Free Antivirus

We recommend dumping Windows Defender, but if you don't want to spend a penny then Avast's superb protection makes it the best choice. Just ignore the inevitable, relentless upsell. **Free from avast.com** REVIEW **Issue 279, p84**

Kaspersky Internet Security 2018

The best choice for power users and tinkerers, with little different from last year's offering – but with so many features already, that's fine by us. **3 devices, 1yr, £17 from pcpro.link/279kas** REVIEW **Issue 279, p86**

PRODUCTIVITY SOFTWARE

Microsoft Office 2016

We'll be honest: there's very little here for anyone upgrading from Office 2013. However, Microsoft's is still the best office suite for professionals. **Home & Student, £65 from pcpro.link/254off** REVIEW **Issue 254, p62**

Google G Suite

Not a fully-featured alternative to Office, but it has enough core features to cover most people's needs, with extra tools available via add-ons. And it's brilliant for collaboration. **Free from docs.google.com** REVIEW **Issue 284, p35**

Scrivener

A brilliant package for serious writers: not only a word processor, but a tool that helps you organise your ideas and manage the process of composition from start to finish. Expensive, but a trial is available. **£32 from literatureandlatte.com** REVIEW **alphr.com**

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** REVIEW **Issue 268, p72**

Serif Affinity Photo

Don't be fooled by the low price: this is a serious rival to Adobe Photoshop in terms of features, even if it does require a hefty system to make it fly. Even professionals should give it a look. **£34 from affinity.serif.com** REVIEW **Issue 271, p72**

CyberLink PowerDirector 16 Ultra

An excellent tool for 360 video production and also a fine choice for normal video, with powerful plugins that boost it yet further. Not cheap but worth it. **£55 from pcpro.link/278cyb** REVIEW **Issue 278, p73**

RACK SERVERS

Broadberry CyberServe Xeon SP1-208S

It may only have a single CPU socket, but this is a big rack server with a Xeon Silver lining. It's a good option for SMBs, with plenty of room to grow and the ability to keep costs down by choosing your own storage devices. **£1,995 exc VAT from broadberry.co.uk** REVIEW **Issue 284, p94**

Lenovo ThinkSystem SR550

This is an affordable entry point to the world of Xeon Scalable processing. The design allows you to start small and expand as your needs grow, while the server management features are top-class. **£1,858 exc VAT from lenovo.com** REVIEW **Issue 284, p98**

PEDESTAL SERVERS NEW ENTRY

HPE Proliant ML350 Gen10

A perfect expression of HPE's "buy now, upgrade later" mantra, you can upgrade every part of the ProLiant to your needs. We reviewed the model 877621-031, which features an eight-core 2.1GHz Xeon Silver 4110 CPU, 16GB of RAM and a Smart Array RAID card – a fine starting point. **£1,799 exc VAT from ebuyer.com** REVIEW **Issue 288, p96**

Lenovo ThinkSystem ST550 NEW ENTRY

Not as expandable as the HPE ProLiant, but this is a great hardware package – the Xeon and RAM are the same as HP, but it has a Lenovo RAID 930-8i card and a management platform that costs £23 per year. **£1,809 exc VAT from ebuyer.com** REVIEW **Issue 288, p97**

SECURITY

WatchGuard Firebox T15

The Firebox T15 offers the toughest gateway security measures at a pocket-friendly price. It's seems to have every angle covered: the Total Security Suite subscription enables web content filtering, application controls, anti-spam, gateway antivirus, network discovery, IPS and reputation-enabled defence. **Appliance with 1yr Total Security Suite, £429 exc VAT from watchguard-online.co.uk** REVIEW **Issue 285, p100**

Panda Adaptive Defense 360

A clever cloud security solution packed with features and priced right for SMBs. It's easy to deploy and its smart detection and response service hardens malware protection. 25 seats, 1yr subscription, **£1,214 exc VAT from pandasecurity.com** REVIEW **Issue 273, p101**

NAS APPLIANCES

Qnap TS-1277

Thought AMD's Ryzen processors were for consumer PCs only? Qnap clearly doesn't, as evidenced by the eight-core 3GHz Ryzen 7 1700 inside this blisteringly fast NAS appliance. The TS-1277 raced through our performance tests, but impressed just as much for deployment, data protection features and cloud backup. **Diskless, £2,436 exc VAT from span.com** REVIEW **Issue 283, p101**

Broadberry CyberStore 224S-WSS

The perfect platform for Windows Storage Server 2016 Standard, the CyberStore offers 24 hot-swap SFF drive bays at a great price. It also provides huge expansion potential, with seven PCI-E slots. **£5,445 exc VAT from broadberry.co.uk** REVIEW **Issue 274, p100**

BACKUP

Veritas Backup Exec 20

If you want total control over your data protection, Backup Exec 20 is the perfect choice. It's easy to use, yet provides a superb breadth of features, and the price is within reach of even the smallest business. **£370 per TB exc VAT from span.com** REVIEW **Issue 286, p98**

Backup Everything Business

The name makes quite a claim, but it supports Windows, Linux, Mac, VMware, Hyper-V, Exchange and more. Add a price that undercuts Backup Exec, and it's a tempting alternative. **£10 per month for 100GB exc VAT from backupeverything.co.uk** REVIEW **Issue 286, p94**

VOIP SERVICES

3CX Phone System 15.5

There's no getting away from it: 3CX Phone System is a very impressive bit of software. It's a breeze to deploy, has a great range of features, and if you're looking to host your own IP PBX then you can't go wrong. You can even get 3CX to host it in the cloud for free for a year. **8 SC Standard, £266 exc VAT (first year free) from 3cx.com** REVIEW **Issue 285, p94**

RingCentral Office

This cloud-based VoIP service has a great set of call-handling features. SMEs that want an easier alternative to an on-site IP PBX will find RingCentral delivers an affordable and powerful service. **From £7.99 per month exc VAT from ringcentral.co.uk** REVIEW **Issue 285, p97**

Profile

BACKGROUND INFO ON INNOVATIVE BRITISH COMPANIES

Piksel

We meet the company that's trying to help broadcasters counter the pull of Netflix

KEY FACTS

Piksel is an online video solutions provider that works with some of the biggest names in broadcasting, as well as transport hubs such as Heathrow Airport.

HEADQUARTERS
York

FORMED 2013

EMPLOYEES 700

WEBSITE
piksel.com

BELOW Piksel's joint managing directors Kris Brown and Kristan Bullett

It's rare that anyone gets the opportunity to be one of the founding fathers of a new industry. The *PC Pro* staff turned up around 250 years too late to be at the birth of magazine publishing. (For some, that's the closest they've come to meeting a deadline.)

Kris Brown and Kristan Bullett are one of those lucky few who can say "I was there". Before Netflix, before Amazon, even before YouTube, they were building some of the first online video-on-demand services for companies such as Sky and Channel 4. They had no manuals to follow and no market leaders to mimic because they were the pioneers – the people doing this for the first time.

Now joint managing directors of British video solutions firm Pixsel, they can not only look back at 15 years of experience in the internet video market, but look forward to some of the more outlandish innovations that are on the way. You might not be watching the director's cut of your favourite movie in a couple of years' time, for instance, but an ending that's been cut to meet your personal preferences.

In between dreaming of a massacre scene at the end of *La La Land*, I caught up with Brown and Bullett to discuss where video-on-demand is headed.

Building the foundations

While Piksel itself has only been in business since 2013, the company's past can be traced back more than 20 years. It has a history more colourful than some of the videos it delivers.

The company started life as Infocom (UK) back in 1995 and later became Ioko. Ioko was purchased in 2011 by a company called KIT Digital, the eponymously named firm owned by Kaleil Isaza Tuzman. KIT Digital filed for bankruptcy in 2013, after the company announced that previous financial statements had been misstated. Tuzman and fellow executives were subsequently found guilty of inflating the company's share price by buying shares with the company's own money and were convicted of defrauding KIT's investors.

Now distanced from its disgraced former owners, the company re-emerged as Piksel in 2013. It continues to work with some of the biggest names in broadcasting. "Piksel is – depending on your argument – anywhere between 20 and four years old," Bullett told us. "There's been quite a lot of history there," he adds with commendable understatement.

Ioko, as it was back then, started working with companies such as Sky on its first video-on-demand products back in 2003. "That was the start of online video as we know it," said Bullett. "Obviously, there was no Netflix then, I don't even think there was a YouTube then.

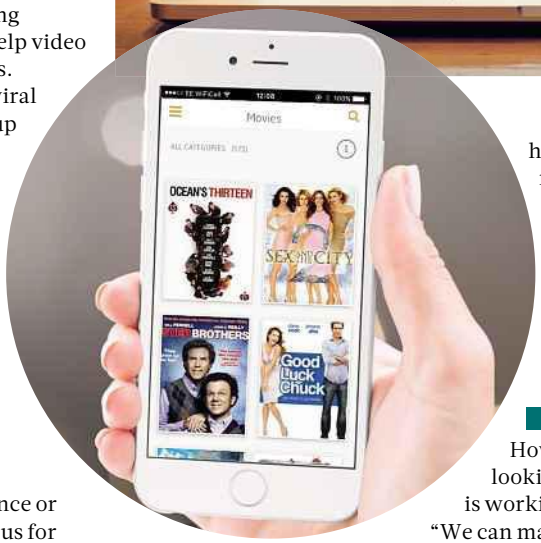
"We built Sky Anytime – or Now TV or Sky Go or whatever it's called these days – for Sky. There were no products available at the time to support this. We built 4 on Demand for Channel 4. Again, it was very early days and a very bespoke implementation."

Nowadays, the company has a broad portfolio of products and managed services to support customers delivering video in all manner of industries. Its Fuse Metadata Manager helps companies manage and deliver huge video catalogues by ensuring video content is correctly tagged, for example. It has products that help orchestrate a video supply chain and deliver that content to viewers. It's also behind the video services in transport hubs, such as Heathrow Airport. "We're a name behind lots of household brands," said Brown.

The Big Data of video

Video is, of course, a Big Data business. Much of the success of Netflix is attributed to the company's success in putting the content that people want to see in front of their eyes – the menu of programmes being recommended to each viewer is tailored specifically to their likes and previous viewing habits. "Metadata is very important," said Bullett.

There are huge amounts and different types of metadata that can be collected for each piece of content. First, there's the technical metadata: which camera was used to shoot the scene, how long is it, what resolution is it shot at, which devices can it



ABOVE LEFT & RIGHT
Fuse Metadata Manager helps companies deliver extensive catalogues by ensuring that video is correctly tagged

support. "That really does go as far as what camera lens was used to record this piece of video," Bullet said.

Then there's the content metadata that describes what the video contains. "When I bring that piece of video content onto our platform, I pull out the technical information, someone may add the description information... but in terms of analysing that video content we can start doing some interesting things to it.

"We're talking about machine learning," Bullett added. "I can do things like entity identification. Do I recognise that object? Do I recognise that landscape? Do I recognise that location?"

How does recognising objects and locations help video producers? In two ways. First, much of today's viral video content is made up of clips cobbled together. If you're putting together the "Top 10 movie car chases in London" or "Top 10 Ronaldo goals", having a platform that can automatically recognise things, people and places is a huge timesaver. Being able to automatically identify scenes of violence or nudity is another big plus for content owners, who are often shipping footage to different geographies with different regulations on what is and isn't allowed to be broadcast.

Then there's the corn that can be earned. "If you can advertise holidays in Cyprus because the video [you're watching] is filmed in Cyprus... there's some pretty obvious benefits there," said Brown.

> "I can see a situation where we are doing on-demand productions of content in a very personalised way"

Piksel's platform can perform other services that increase the value of the footage to its owners or help drive down their costs. For example, the company's software can listen to the audio and then transcribe subtitles, if they've not already been provided. "I'm sure you've seen online videos were the lip-sync is out and it's really annoying," said Bullett. "We can correct that – the computer can see when people's lips are moving and realign the audio. People have to do that manually at the moment."

Piksel's software can even determine the emotional punch of a particular clip. "We have various techniques to understand how happy or sad should this content make you," Bullett explained. "If you're watching Netflix, we can then say 'actually, based on you as a consumer, we know this will make you feel happy, and therefore we can recommend other pieces of content to you that will also make you feel happy." It's got to be better than Prozac.

With all this metadata and the ability to slice and dice video content into different formats, what does the future hold for the video business? Bullett says too many companies aren't thinking far enough ahead. "Frustratingly, so many broadcasters and distributors, all they want to do is try and catch up with Netflix," said Bullett. "You talk to them about interesting things and the response will be, 'ah, Netflix are doing this. Can we do that?'"

Beyond Netflix

However, there are some clients that are looking for a point of differentiation and Piksel is working on finding the answers for them.

"We can make a very personalised experience for you as a consumer," Bullet explained to me. "How far could it go? I can certainly see a situation where we are doing on-demand productions of content in a very personalised way. Can you imagine a situation where you're viewing a personalised version of a movie because they know how you like to consume that content? Not a Director's Cut but a Barry Cut."

And that (terrifying) Barry Cut might not only contain personalised content, but personalised advertising, too. "Once we identify that's a can of Coke in a piece of content, there are techniques that let us replace that with a can of Lilt or a can of Fanta," said Bullett, who is clearly such a clean-living chap that he's not bought a can of soft drink since 1986.

The question is: will consumers start railing against this personalised product placement in the same way they used ad-blockers to stop banner ads for the holiday destination they Googled ten minutes ago? "It's got to be sufficiently subtle if you're going to do product placement," said Bullett. "In the UK, we have legislation against product placement, as well."

You may have been spared. For now. **BARRY COLLINS**

What about you?

Do you work for a British technology company that could be profiled in *PC Pro*? If so, get in touch: profile@pcpro.co.uk

Viewpoints

PC Pro readers and experts give their views on the world of technology

Looking back, my 3D-printing dream was never a goer

In this increasingly cynical age, it's getting harder to buy into seductive visions of the future

Darien Graham-Smith is *PC Pro*'s associate editor. If you want a deformed Raspberry Pi case with three sides, let him know.
@dariengs

Recently I happened across one of those online "futurology" articles, describing the technological developments that were expected to shape the years to come. The interesting thing about this one was that it had been originally written in 2012, so I could see for myself how accurate the author's predictions had been.

Some were spot on – Chinese smartphones and "Big Data" (the commodity, if not the phrase) have unarguably become part of our everyday reality. But one prediction stuck out as, shall we say, a little less prescient – the idea that 3D printing would become a consumer commodity and rapidly upend the entire manufacturing industry.

It's amazing how completely the idea of 3D printing has dropped off the radar. Back in 2013, when I first started trialling the technology for this very publication, I found myself fielding endless questions about it, not just from techie colleagues, but from intrigued friends and family. The potential of those early extruders had clearly captured the public imagination, in a way that few innovations manage.

Yet those first-wave 3D printers always felt like proofs of concept. The ability to mould your own shapes out of molten plastic was all well and good, but almost from day one I found myself hankering for the promised next step – a multi-material printer that could lay down both polymer and conductive metal-based materials. This would open the door to printing basic electronic circuits, and over time, as the technology got smarter and smaller, it would become possible to home-print ever more complex things, with memories and screens, for mere pence. It would be the maker movement on steroids – in hyperspace. Yet somehow it never came to pass.

In retrospect, there are a few very obvious reasons for that. For one, molten polymer is hazardous stuff. The 3D printers I tested came festooned with warning stickers; one included an industrial-grade pair of heatproof gloves in the box. Adding molten metal into the mix isn't exactly going to make things safer.

And it's not as if you only have to worry about human error. My tests were repeatedly disrupted by models collapsing halfway through the extrusion process, or by bits sticking together, causing the model to become more and more deformed as layers piled up in the wrong places. It proved very possible for a model to topple off the platform without any external intervention.

> "At some point, 3D-printing technology really will mature to the point where it can change the world for the better"

It doesn't help that the process is too slow to sit and watch over. My usual modus operandi when testing 3D printers was to kick off a job at 6pm, go home, drink a bottle of wine, sleep for eight hours, and come back in the morning with crossed fingers to see if anything resembling the blueprint had emerged. If the unsupervised machine had been left squirting out molten metal all night, rather than hot plastic, I suspect this might have constituted criminal negligence.

Even if the thing does come out looking like it should, how do you know it's perfect on the inside? The dream is to hook up our freshly-printed creations to a power supply and watch them spring to life. But the tiniest glitch in an internal electrical pathway could result in a short circuit, a runaway heat build-up, and ultimately a pile of cinders where your house once stood.

Not discouraged yet? All right, let's imagine that the technology has moved on a few generations, and that 3D printers can be relied upon to produce perfectly rendered reproductions of our digital designs. How do you know that those designs are themselves electrically safe? I know I'm nowhere near qualified to design anything more complex than a light switch, and even then I wouldn't dare to wire it up, just in case. And if you're thinking you'll get your designs off the internet, as we do with today's static 3D models, that's even worse. You're putting your trust in a stranger with unknown credentials and zero liability. Perhaps they'll be merely incompetent; perhaps they're distributing designs that are malicious.

There's only one way I can see domestic 3D printing working and it involves electrical component manufacturers creating their own certified 3D printers, with known tolerances and fault-handling measures – and restricting them to printing their own, fully tested and cryptographically-signed designs. Needless to say, I very much doubt we'd be allowed to print out those designs for the bare cost of the raw materials. In fact, I'd expect to see a "print at home" surcharge, to capitalise on the convenience of not having to put on your shoes and go out to the shop, or wait 18 hours for Amazon to bring the desired item to your door. So much for the revolution.

It's now obvious that our hopes for 3D printing were never realistic. To put them into context, just look around at how else our perspectives have changed since 2012. We now know that our private activities are spied upon, our smart-home devices are hacked and democracy itself is subverted. Not being able to turn out our own transistors is the least of our worries.

Perhaps all of this has made us more wary of new technology. If I were responsible for regulating mass-market consumer technology, I'd have to say that my own erstwhile vision of a 3D-printing revolution throws up a lot of red flags.

And maybe that's for the best. At some point, 3D-printing technology really will mature to the point where it can change the world for the better. The bigger question is whether humanity will be mature enough to handle it.

darien@pcpro.co.uk

Is your black box actually the router of all evil?

Routers are brilliant – but not brilliant enough if you get one from your broadband provider

Barry Collins is the co-editor of bigtechquestion.com. He knows exactly what that flashing amber light on your router means.
@bazzacollins

I'm torn. Part of me wants to drop to my knees and worship the genuine modern-day miracle that is my router. But part of me also wants to punch its flashing blue lights out.

Let's start with the miraculous bit. The things that even the bog-standard routers dished out by your broadband provider can pull off are nothing short of gobsmacking.

Looking at my router settings now, there are ten different devices connected to it by various means. Laptops, tablets, phones, games consoles, radios, an internet sodding doorbell, for goodness sake. And this is a quiet time. The kids are at school and my partner's at work. If I looked again at 7pm that device tally would jump by 50%, perhaps even double.

The router's doing stuff constantly, around the clock. A little utility tells me my work laptop alone (I work from home) parses around 2GB of data per weekday. The always-on Xbox is updating games in the background, our smartphones are receiving notifications, the doorbell's motion sensors are on the constant lookout for couriers who can't even be arsed to ring the thing before shoving a card through my door (don't get me started). The router's doing a dozen different things at once.

But the speed at which it does all this stuff is the bit that blows my mind. Open a command prompt, type "ping google.com" and watch as your router passes tiny packets of data back and forth between your computer and Google's servers at incomprehensible speeds. Mine just did it an average speed of 16 milliseconds. In a tiny fraction of the time it takes the human eye to blink (around 100 to 400 milliseconds according to the Harvard Database of Useful Biological Numbers), a piece of data has been sent wirelessly from my laptop to my router, through several hops on the internet to Google's servers located in a different continent and made its way back again.

It's why, when a teenager called Chad in Sacramento pulls the trigger button on his Xbox controller and shoots my *Fortnite* character through the back of the head, we both see it in real-time as if we were in the same room. Or, to give a more *PC Pro*-esque example, why a company such as WANdisco can synchronise two copies of entire databases in different continents at the same time. You can't help but marvel at it.

And then... I've just spent half an hour this morning trying to convince the aforementioned doorbell to see my damned router. Every other device in the house could see the router, so the doorbell's probably to blame, but only once the router was fully reset did the two get back on speaking terms. And that's not an isolated incident: once in a while a device will moan it's been kicked off my router, either on its own or as part of a mass walkout prompted by the router taking five and resetting itself.

My router is a BT Home Hub, admittedly a device that's a little long in the tooth now, but only because my experience of the more modern Smart Hub was very different to that of our Labs test. I tried three different Smart Hubs, but repeated dropped connections and a Smart Hub sulking with a glowing orange light became so common that I eventually reverted to the more reliable older model.

Which brings us to the overall conclusion of the Labs and the repeated findings of *PC Pro* readers in our annual Excellence Awards: the own-brand routers dished out by the broadband providers just aren't that good. One solitary, sympathy star for the Sky Q Hub; two stars for the Virgin Media Hub; a middling three stars for the recently revamped TalkTalk Wi-Fi Hub. The aforementioned BT Smart Hub is the best performing router in our tests, but bear in mind there's no practical way to Labs test how well a router holds onto an internet connection.

It's got be the falsest of false economies for the broadband providers. Yes, they're banging out hundreds of thousands of these units every year, but surely the few quid scraped off the router hardware bill is completely outweighed by the cost of supporting millions of customers with these duff routers? BT sent me three different Smart Hubs alone, not to mention the hours I spent speaking to the script readers on the BT technical support lines.

One of my other ventures is a website that answers people's common tech problems. By far the most searched for articles on that site are those that explain what the coloured warning lights on various ISP-branded routers indicate.

> **"Once in a while, a device will moan it's been kicked off my router, either on its own or as part of a mass walkout"**

Routers are astonishing things, helping us to send and receive data at speeds that are almost impossible to comprehend. But it's also impossible to comprehend why the companies that dominate our broadband market are so reluctant to spend a little extra and make their routers even more miraculous than they already are.

barry@mediabc.co.uk

Microsoft wants you to be happier at work

It's high time someone started using data analytics to make life better, rather than just busier

Nicole Kobie is *PC Pro*'s Futures editor. In meetings, she's that annoying person who has an opinion on everything.
@njkobie

If you like meetings, you're probably a manager. To nigh on everyone else, they are pointless time sucks that we only go to on the orders of someone higher up in the corporate chain of command.

I accept that some meetings are useful: deciding who's going to do what, whether goals are being reached and if not, why not. But then there are the rest. Pointless meetings to prep for bigger meetings. The daily, weekly and monthly catch-ups so your manager can pretend they know what you're up to. And the inevitable meeting to figure out why no work is getting done.

Microsoft wants to help. Its new Workplace Analytics tool pulls in data from workers' Office 365 calendars, email and so on, analysing it to "identify collaboration patterns that impact productivity, workforce effectiveness, and employee engagement," according to a Microsoft blog post in suitable corporate speak. In the first set of tools to be released, that means the data will be analysed to understand if you're in too many meetings (you are, everyone is), have too little time for focused work (yup, that too), and if you work late too often (probably yes).

Those insights can then be used to set up "action plans" and "change programmes" to build better teamwork habits, Microsoft boldly claims, such as cutting meetings and reducing out-of-hours emails.

It's easy to see how such data could be abused by HR and management to

micromanage via calendar data surveillance. Indeed, if an employee has too much to do, perpetually works late and has days filled with pointless meetings, there's an easy way to find out: listen to their complaints. But if the poor slog's bosses aren't keen on hearing them out, the hard numbers from Workplace Analytics might help change their minds – or stop such a situation arising in the first place.

That's the idea behind the second clever workplace tool Microsoft has announced: MyAnalytics nudges. Microsoft notes that knowing you need to change and achieving it are two very different things, so it's built a system to nag us into becoming more productive employees with healthier work-life balances.

Get your third meeting invite for a day? A notification will suggest that you schedule in focused work time, so you can actually complete tasks rather than lose an entire day in meeting rooms. Or MyAnalytics will recommend you delegate a meeting to a coworker instead. (They'll appreciate that.) Draft an email out of hours, and MyAnalytics will suggest you send it in the morning, rather than risk interrupting someone else's home life. And it will use AI to remind you of tasks you said you'd do, but haven't yet, and of emails you've received but haven't read or responded to.

MyAnalytics's nudges will soon land as an add-on to Outlook for Enterprise plan users, but I hope Microsoft extends them to anyone who'd like to use them. Gmail already reminds me of emails I've failed to reply to, but I'd happily sign up for a smarter system that tells me I've booked too much for one day or stared at the screen for too long without a break, or that I need to file an invoice or do another easy-to-forget task. As a freelancer working from home, a digital nag would make up for the lack of an in-person manager to hassle me – perhaps I don't miss the office as much as I think I do.

Managers who make use of such a system shouldn't forget that their staff are people, not machines to be managed by spreadsheets. People have different needs, but that's true without or without an AI nudge tool; helpful analytics don't negate the need for conversation and consideration.

Indeed, if used the right way, these tools could make getting the balance right a bit easier. And that's why I find MyAnalytics so intriguing. Yes, of course its key aim is to boost workers' productivity, but it should also improve our work-life balance and make our work lives a little better. It's about time that technology started working for us, and helping us feel and live better, rather than just get more done.

work@nicolekobie.com

Why your next butler may be a self-replicating zombie

Androids imbued with emotional AI might not be realistic, but be careful what you wish for

Dick Pountain is editorial fellow of *PC Pro*. He would still rather open the pod bay door himself.

I was struck by a recent article on our sister site Alphr about the newly important field of emotional AI (**pcpro.link/288dick**), the attempt to imbue computer-based AI systems with something approaching human emotions. The aim is to make communicating with such systems is easier, more effective and more satisfying.

At one end, the attempts are simplistic but doable: Google's Assistant is being tweaked to emulate an emotional connection, so that it apologises for errors and responds to praise with gratitude. At a higher level, systems can be trained to deduce the emotional state of users by combining cues in their recent inputs and knowledge of recent activities – so, you're probably angry if you just got cut off before completing an online purchase.

At the highest level, some researchers would like to build proper models of human emotional response that an AI system can draw on, but critics have been quick to point out the flaw in this – an AI system that can understand human emotions but not feel them would be a sociopath, and how many more smart sociopaths do we need?

> **"Wanting artificial intelligence systems to think and feel the way we do is a futile pursuit, a product of juvenile sci-fi thinking"**

And, of course, this accurately describes the position. As I've written before, a computer can't feel emotion because emotions are biochemical processes that exist only in the bodies of living, moving, perceiving, eating, breeding creatures. Most computers have nothing resembling a body. The few that do – say the control system of an autonomous vehicle, which has vision, motion and collision sensing – could perhaps be provided with a simple emotional system, but the emotions it would employ would be so unlike ours they'd be of no more use in communication than those of an ant.

Wanting AI systems to think and feel the way we do is a futile pursuit, a product of juvenile sci-fi thinking. What AI is good for is amplifying, assisting and correcting our own perceptions and agency, not for replacing us. Driverless cars will never be safe or economically viable, but super-smart cars that remove much of the burden of driving from a human driver are just around corner.

The pursuit of the android is futile not because of the software difficulties, great as those are, but from simple energetics. All living things are composed of cells (honed by four billion years of evolution), each of which contains not only its own energy storage but also the full blueprint and mechanism for its reproduction. Androids with brains made from silicon chips can't ever reproduce themselves, whatever 3D-printer zealots would have you believe – mineral mines, metal works, chemical factories, wafer fabs are required for their reproduction. It will always be cheaper to train a human to do some difficult job, maybe assisted by sophisticated AI tools, than to build an android to do it.

And here's where things have the potential to turn nasty. Stunning advances in genetic engineering enabled by CRISPR technology mean that it will soon be easier and cheaper to modify an animal to do some difficult job than build an android robot to do it, and once created these would be self-replicating. I don't normally go in for pitching sci-fi movie treatments, but I'm very tempted by an update of *The Island of Dr Moreau* in which the evil scientist, instead of chopping up animals and sewing their bits back together, employs CRISPR to create a race of living zombies, which have sufficient intelligence to follow instructions but few emotions and no ability to disobey.

You may believe that we would recoil from such an immoral and disgusting invention and ban it immediately, but how sure are you of that? People are now discussing the problems of unemployment caused by automation by robots, but the consensus remains that it will happen and we'll have to find ways to cope with it. If the imperative to profitability leads people to acquiesce in that, why wouldn't they acquiesce to genetically modified zombie slaves?

If you still object that it would never be allowed, may I recommend a book for your summer beach reading? It's called *A History of the World in Seven Cheap Things* by Raj Patel and Jason W Moore. It explores the stuff humans have been doing ever since the 1400s, and are doing still, to maximise profits by rendering labour, money, food, energy, care, lives and nature itself as cheap as possible. Admit it, you'd like a zombie butler.

dick@dickpountain.co.uk

Draw. Inspiration. Anywhere.

Will Schorer
Illustrator and graphic designer

Illustration: **Baboon**

"I'm blown away with Affinity Designer for iPad. Having the freedom to work from a sketch to a finished vectorised artwork all without any cables, in one app is a dream come true and a huge time saver."

Affinity Designer for iPad

No subscription. Now available to purchase on the App Store.

Download on the App Store

Readers' comments

Your views and feedback from email and the web

Soft phones

Now that several Android phones make do with soft navigation and home buttons, it strikes me that the manufacturers are missing a trick. To tempt a Samsung aficionado to use one of their phones, they could create a Samsung mode and exchange the back and switch buttons. Likewise, a Samsung to standard Android format. As a user of a Samsung tablet and phone, when upgrading my phone I'll stick with Samsung because of this omission. Otherwise, I would be tempted to jump ship. **Neal Entwistle**

Printer prices

I read your printer test with interest (*see issue 287, p76*). I was looking for a colour duplex printer with low running costs and was surprised not only that the Labs winner was an inkjet, but that its maximum output was 40 pages a minute and its cartridges ran to 10,000 and 7,000 pages for mono and colour. But, going online, I discovered that the price had jumped £40 from the original £300.

I would still have bought it, until I realised that it shipped with lower-capacity cartridges stretching to just 3,000 and 1,500 pages. Upgrading to the cartridges quoted in your review hiked the price to almost £700. Would this affect the A-List rating you awarded the printer? Furthermore, should companies not be obliged to supply products as reviewed, at least until publication? **Ewhen**

Star letter

I arrived home to find my wife swearing. She was trying to print PDFs from the web, which had worked several times before – but not now. A quick bit of detective work suggested Edge was the culprit, as every other browser I tried was fine, and so were the files themselves. The only recent change had been April's update to Windows 10.

These things happen, but the response from the support team made me wonder how much Microsoft appears to have lost the plot. It recommended backing up all data, downloading an old build of Windows 10, doing a custom update to roll it back, reinstalling all of the applications, checking data and restoring if necessary. All because its browser couldn't print a PDF. Support then pointed out the system would automatically update again and directed me towards a third-party website, because while they didn't have anything official to stop it, "these guys seem to know their stuff".

Has Microsoft lost all touch with its users and the impact of what it's asking us to do? Surely the best response the support team could have come up with would be to simply apologise, say it was being investigated and suggest that we use a different browser in the meantime.

The MacBook Pro that has been tempting me for quite some time arrives tomorrow. Chris Simons

Our star letter writer wins a copy of Serif Affinity Photo. Five years in the making, it provides sophisticated image-editing tools and a meticulous focus on workflow.

> "To tempt a Samsung aficionado to use one of their smartphones, they could create a Samsung mode"

Tim Danton, *PC Pro* editor-in-chief, replies: I can see the confusion. Although we state that the printer comes with 3,000- and 1,500-capacity cartridges in the review itself, the feature table refers to the cartridges that you will need to buy rather than those supplied. We'll make this clearer in future.

In terms of pricing, for items such as printers we aim to find the best price at time of publication. Unfortunately, prices do go up and down, and we can't control pricing from third-party websites such as Ebuyer and Amazon, who tend to offer the best prices. Where we can agree pricing – for example, for the PCs sent in for review from British manufacturers – we do ask them to stick to the quoted price. In exceptional circumstances, such as when import prices rose suddenly after Brexit, we will allow them to increase prices so long as they can justify the amount.

BELOW Printers often ship with low-capacity cartridges, meaning you'll have to pay extra

In 200 yards, kick left

I would like to watch a game of football controlled by an AI software program, modelled on satnav software, which would constantly recalculate the fastest way to goal.

Just passing the ball from one player to another wastes valuable goal scoring time. Plus, it allows time for a full complement of defenders to position themselves, before an attack on goal is eventually launched.

Surely the satnav program would take every opportunity for the forward players to race into their opponent's half. Possibly with very few defenders goal-side and a much better chance of scoring. **Peter Jones**

Music to our ears

Your article on classical music was very interesting (*see issue 287, p36*), but you failed to mention that it has been one of the primary drivers in the distribution and adoption of high-definition 24-bit audio on download.

In the past two years it's become more and more common for back catalogues, and now new albums, to be released in the format. The forthcoming adoption of Bluetooth 5 on mobile devices and headphones, that at last has the bandwidth to support uncompressed 24-bit audio, can only help spread adoption further. Indeed, even the big music streaming companies are now beginning to

support 24-bit music. This will no doubt be "music to the ears" of audiophiles everywhere, such as your own Jon Honeyball. **Mike Halsey**

Update upset

A few months ago, you published my letter concerning Windows updates. An update is due. I have an 18-month-old Lenovo laptop with 8GB of RAM and an SSD which, in April, took 26 hours to download and install the update, followed by four hours of the laptop being very sluggish. May's took seven hours to download and install, after which it was sluggish for two. In June, the download and install took four hours, and it was sluggish for another hour.

Now I read in issue 286 that Microsoft was also aware of problems the April update caused to certain configurations that included Toshiba and Intel SSDs and advised those affected. Where? On the Microsoft site that you couldn't access, because your computer was locked out.

We were recently advised that we had 28 days to agree to Microsoft's new terms and conditions, or else find an alternative OS. If we used Windows after the 28 days, we automatically confirmed that we agreed to all 26 pages of small print that Microsoft's lawyers had taken six months to write. Part of the terms and conditions included a clause allowing Microsoft to harvest data to "improve upon our Windows 10 experience".

My observations lead me to conclude that Microsoft is using

> "We were recently advised that we had 28 days to agree to Microsoft's new terms and conditions"

our computers to test its next update. The size of the update as downloaded is virtually twice that which Microsoft states. It could only have known of the SSD issue if it was accessing the actual hardware configurations of computers. Effectively a virtual computer is running the next update, to simultaneously check upon its performance. The volume of data being uploaded to Microsoft has dramatically increased and, when I run a tidy up after each update, I have found that a minimum of 137 new "privacy threats" have also been downloaded in the update.

Microsoft still doesn't understand that the computer is our property. It hides behind its terms and conditions to say that we agreed to "test" its product for them. **Peter White**

Readers' poll

On p40, we examine how you can really stay anonymous online. With that in mind, we asked *PC Pro* and Alphr.com readers if there's ever a legitimate reason to hide your identity while browsing.

There's no doubt how most of you feel about this! "Privacy is a right and not a privilege to be abused by anyone," wrote Terry Montague. "God bless the GDPR for helping to get that message across."

"What is legal today may be illegal tomorrow, dependent on which country you are in," wrote Symon. "Also, the amount of information that companies hold about you with your knowledge, and the way they can influence your habits, is akin to NLP [neuro-linguistic programming] and other forms of control."

We'll leave the final word, appropriately, to an anonymous respondent: "I use multiple browsers and incognito mode, but I know that it's pointless. It just makes me feel better."

> "Some web searches and visits could be used negatively against you, so why take the risk when anonymous connections remove most of that?" Anonymous

> "Snowden made me an irritant to government surveillance" Sean Idle

> "I use DNS over TLS, VPNs, spam email accounts, private browser mode, a pfSense router running pfBlockerNG, and so on. I do what I can" Mark E

> "I use Firefox over Chrome and have it set to delete cookies every time I close it" Stewart

> "The private browsing feature in Safari, but haven't gone as far to use a VPN" Anonymous

Join the debate

Join the growing *PC Pro* community on Facebook at facebook.com/pcpro

Get the latest news and updates by following us @pcpro

Email us at letters@pcpro.co.uk

TOUCH *of* GENIUS

Reinventing graphic design on the iPad

With its intuitive interface and touch gestures, Affinity Designer makes creating professional-grade designs easy – with no Mac or PC required

Say "professional graphic design software" to someone and they'll picture a cluttered interface laden with complicated tools and sub-menus. Ask what kit you'll need to run it and they'll probably mention an iMac and pricey graphics tablet.

It doesn't have to be that way. The all-new Affinity Designer for iPad is tailor-made for touch, with a mix of instinctive finger gestures and streamlined workspaces making it easy to create impressive results.

And just because Affinity Designer is easy to navigate and the controls straightforward to find, it doesn't mean that the software is somehow lightweight or short on features.

What's more, while you can use Affinity Designer on your iPad only, it also has a Mac or PC version. They work seamlessly together, so you can start work on one and pick up on the other with all your edit history intact.

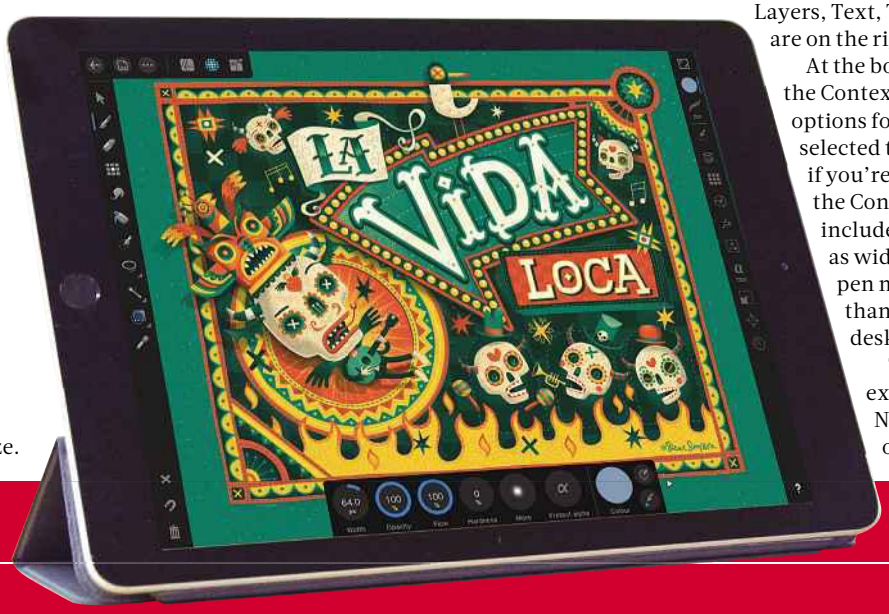
Get in touch

The biggest challenge for a professional graphic design app on the iPad is making touch gestures as second nature as possible. After all, no-one wants to play Twister with their fingers when work needs to be done.

Fortunately, navigating Affinity Designer and using its range of tools via pinching, twisting and swiping is a breeze. For instance, a two-fingered drag will pan around your document; a double tap in the Navigator Studio will zoom to fit; while a spinning top-style twist will rotate the entire canvas.

Affinity Designer also excels at condensing multi-click functions into a single movement. A two-fingered tap on the canvas reverses your last edit, while a single-finger long press and release brings up the Edit menu for clipboard options.

The touch gestures don't end there: you can use a single finger to lock an image's aspect ratio as you resize it, swipe up or down on the Colour Studio icon to adjust luminance and group layers with a mere pinch of the fingers. These movements represent a new, more natural approach to graphic design – one that offers the fine-grained control you'd expect from high-end software, but also leaves room for experimentation.



BELOW Start work on the iPad and then seamlessly continue on your Mac or PC – or vice versa

Change your Persona

One thing that lifts Affinity Designer from the crowd is its Personas. These are effectively three different workspaces encompassing key stages of the design process. This means there isn't one interface jam-packed with tools, but a trio of "rooms" that serve a particular purpose.

It feels like a traditional experience – the digital equivalent of passing a design from desk to desk in an office – but changing Personas in Affinity Designer takes a microsecond. Just tap the toolbar in the top-left of the screen to switch effortlessly between the three workspaces.

The Vector Persona is where you'll probably spend most of your time. It's clean, almost minimalist: all of the main vector tools (such as Move, Node, Pen, Fill and Colour Picker) are located on the left-hand side of the screen, while the Studios (Brushes, Layers, Text, Transform and so on) are on the right.

At the bottom of the screen, the Context toolbar displays options for the currently selected tool. So, for example, if you're using the Pen tool, the Context toolbar will include handy options such as width, colour and the pen mode. It's far easier than digging around in desktop sub-menus.

That simplicity even extends to the labels. Not sure what one of the icons means?

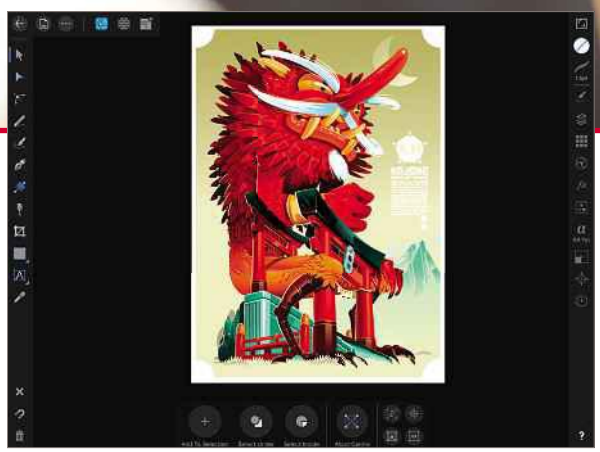
Affinity Designer's instinctive touch gestures come in handy when you're exporting a design in the Export Persona

Tap the question mark in the bottom-right corner of the screen to bring up its name.

The second Persona is called Pixel and plays host to raster brush tools that you can use to create raster digital art from scratch or enhance an existing vector design. These include a Pixel, Smudge Brush, Flood Fill and Freehand Selection Tool. You can also restrict edits to certain parts of your document, such as placed images, as well as create custom raster brushes and – for a more hard-edged, retro look – use the Pixel brush for pixel-aligned painting.

The final Persona is Export, which is a one-stop shop for exporting artboards, layers, groups and objects as export slices to a range of different file types and image sizes.

The workspace is divided into two Studios: Layers and Slices. The former allows you to quickly select layers that you want to export as slices with a tap of the finger. Meanwhile, the Slices studio lets you export areas of your design as universally recognised vector and raster image formats. Again, Affinity Designer's emphasis is on intelligibility: what could be a complicated process in other software is reduced to a few taps and swipes.



Modern artboards

Affinity Designer has another trick up its sleeve – and it's one you wouldn't necessarily expect from an iPad app. Instead of just working on single, standalone designs, you can put together an entire project on an "artboard". These can be of any size and allow you to place multiple design elements – for example, a range of promotional flyers of different sizes – in the same document. Or you could use an artboard to compare slight variations of a design, such as a business card.

You can create an artboard using the settings in the New Document dialog and then add more boards with the original document's dimensions – which is perfect if, for instance, you're putting together a multi-page leaflet or brochure – or other preset sizes. However, if you're unsure about how to best position objects, Affinity Designer allows you to include unique guides and grid layouts on each artboard. You can then automatically snap objects to these guides – not just in the current artboard, but in all other artboards in the document. So no more laborious flicking between separate designs.

ABOVE The majority of users will probably spend most of their time in the Vector Persona, which has a clean interface and clearly labelled tools

You have a few choices when it's time to export artboards. You can export it as a single image, concatenate – essentially link together in a series – all of your artboards in one image, or export multiple artboards as multiple images. Whichever you choose, the process is smooth and will only take a minute or so, which is ideal if you want to share ideas with colleagues or keep clients updated.

If you're looking for a powerful vector tool that blends traditional graphic-design prowess with game-changing touch gestures for the iPad, Affinity Designer is an excellent option. The app's sheer attention to detail – there's even a left-handed mode – makes it ideal for the modern, mobile professional. ●

To find out more, head to affinity.serif.com

20 BEST PODCASTS YOU SHOULD LISTEN TO

CONTRIBUTORS Barry Collins, Tim Danton, Alan Martin, Emma Sims

The podcast is going through a renaissance. We pick 20 of the finest pieces of audio entertainment for your listening pleasure and reveal the new ways to tune in

For a medium that requires enormous effort, is hard to make a living from and appeared to be on its way out a few years ago, the podcast is in spectacular health. Never before have we had such a wealth of audio entertainment to choose from – and all for free.

A list like this is always going to be subjective, but here our staff have picked out 20 genre-spanning podcasts that we think you will enjoy listening to. From advice on how to earn money from a side career, to the grisly details of unsolved murder cases, to a sitcom examining the reintroduction of the death penalty (by referendum, of course), we've got both dark and light covered. And an enormous amount of listening material.

We'll also run through some of the new ways to listen to these shows that you might not have heard of or considered previously. No matter whether you're on your way to work or resting at home, we'll reveal how you can enjoy listening to hour upon hour of great entertainment.

1 REPLY ALL

What is it?
A show hosted by P J Vogt and Alex Goldman about internet culture and how it's changing.

Why should I listen?
Because internet culture is fascinating, and although it sounds niche, the concept encompasses all facets of life. To give you a taste of how diverse this podcast can be, memorable episodes have included one of the presenters letting another hack his smartphone, how a Facebook group mocking office life got taken over by the wrong people, and details of a Reddit community that tries to cultivate voices in your head.

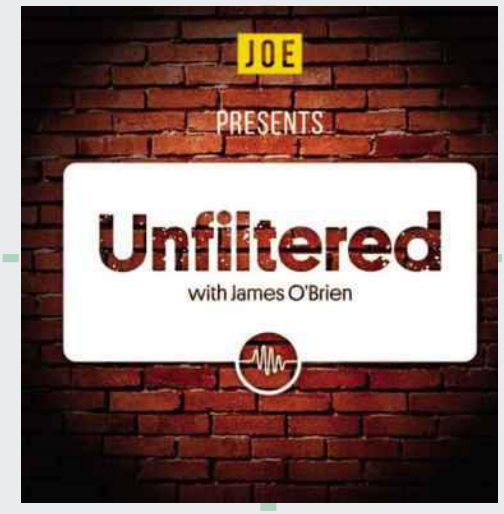
How long and how often?
The episodes are between 30 to 60 minutes long and new ones are released every seven to 14 days.

2 UNFILTERED WITH JAMES O'BRIEN

What is it?
A one-on-one chat delving into the lives and experiences of a public figure, with LBC journalist James O'Brien.

Why should I listen?
Because this isn't your average celebrity interview. Each show is about an hour long and delves below the surface into the guest's personal life, while O'Brien's sensitive yet probing questioning encourages deep reflection on their past and where things could have gone differently. Bill Browder's story about becoming a thorn in Vladimir Putin's side (via a spell on the Interpol wanted list) is absolutely fascinating and offers rare insights into just how sinister the Russian state can be.

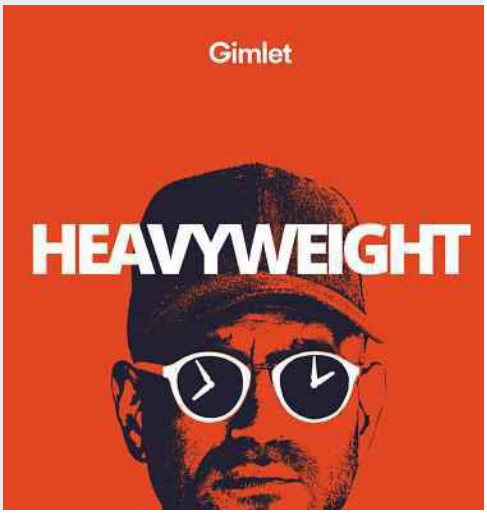
How long and how often?
Weekly. Each episode is around an hour long, including some post-interview analysis at the end.



3 HEAVYWEIGHT

What is it?
Everyone has a moment in their life where things changed. Jonathan Goldstein takes people back to that moment and tries to fix them in the here and now.

Why should I listen?
Each episode is a self-contained story, with a certain amount of charm to it. Revisiting our own past can be tough, but visiting someone else's is a pain-free moment of enjoyable voyeurism. For example, we meet the man who lent Moby an album that was sampled a lot on his hit album *Play* – the one that catapulted him to mega-stardom. Gregor wants a little acknowledgment – or at least his CDs back – and Goldstein seeks to mediate. And, yes, Moby does make an appearance.



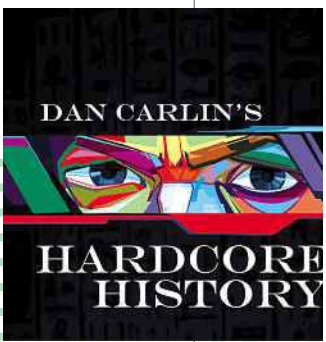
How long and how often?
Heavyweight is broadcast in series and the second series ended in December 2017. We hope it will be back for a third, but for now there are 15 episodes to get your teeth into.

4 HARDCORE HISTORY

What is it?
Dan Carlin's deep-dive into fascinating pockets of history, from the reign of Genghis Khan to the First World War.

Why should I listen?
If you care about history, it's absorbing. Dan Carlin doesn't call himself a professional historian, but a voracious reader of books documenting interesting periods of time. You can definitely tell: each massive episode is packed with facts, quotes and analysis.

How long and how often?
Very and not very. Carlin's podcasts take a phenomenal amount of research. Each episode is upwards of five hours long, and a series can be six episodes in length. It's seriously in depth. As such, new episodes appear every few months, making it a nice surprise when it pops up in your feed.



If you want a relatively short taster, *The Destroyer of Worlds* is a great place to start: a six-hour podcast outlining how Russia and America rationally got themselves into the irrational position of owning enough nukes to destroy the world several times over.

5 THIS AMERICAN LIFE

What is it?

No "best podcasts" list could be complete without *This American Life*. A radio institution, the show has been broadcast on public radio in the United States for more than 20 years and was quick to spot the podcast as a format to massively increase its listener base. It's a show of stories. Each week there's a theme, and then stories are told on that theme.

Why should I listen?

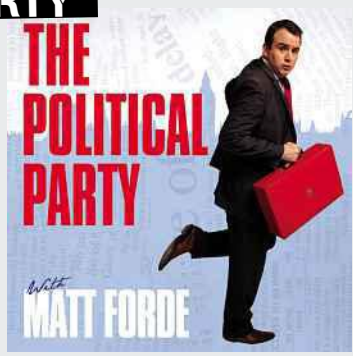
The stories are almost always fascinating and cast light on topics you may not have thought deeply about before. It's also very varied, with tales ranging from the tragic to the ridiculous. You may laugh, you may cry – but you'll always feel something.

There are over 600 episodes archived and dozens of memorable ones. The drama of a car dealership trying to break even, for example, doesn't sound like great radio, but it had us hooked.

How long and how often?

Every week, and they're always an hour long.

6 THE POLITICAL PARTY



What is it?

Comedian Matt Forde interviews MPs from across the political spectrum in a podcast that shows a side of politicians you rarely get to see.

Why should I listen?

Forde has a unique way of getting politicians to open up – no matter their political persuasion. Not only does this give a unique insight into life in Westminster, it also reminds you that there's a human behind the rosette. A human that generally wants to make the world a better place.

Past guests have included rising stars such as Anna Soubry and Stella Creasey, current big beasts such as David Davis and Tim Farron, and a list of grandees that includes Tony Blair, Neil Kinnock, Paddy Ashdown and William Hague.

How long and how often?

There's usually half an hour of comedy, followed by an hour-long interview. So around 90 minutes. Even if the comedy isn't to your taste, it's worth skipping in for the interviews, which take a very different tone. Shows come out on a monthly basis, with a break over summer, when Forde is busy working at the Edinburgh Festival.

The drama of a car dealership trying to break even doesn't sound like great radio, but it had us hooked

7 OPENING ARGUMENTS

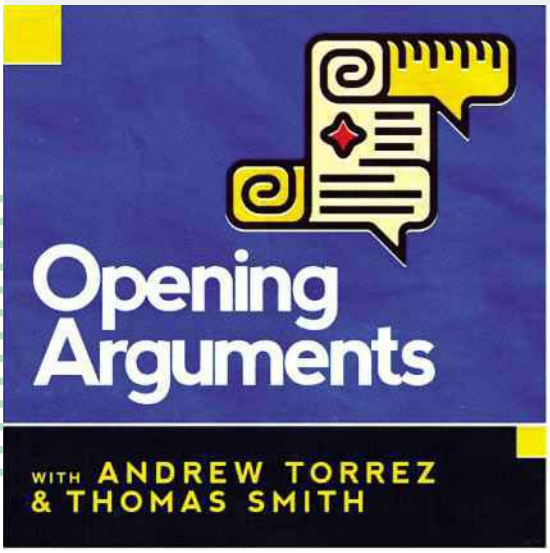
What is it?

Journalist Thomas Smith interviews legal expert Andrew Torrez on the legalese behind the stories in the news.

Why should I listen?

Unless you have a law degree – and possibly even if you do – the legal nitty-gritty of what's in the news is easily lost. Although there's a big disclaimer at the start ("don't take legal advice from a podcast"), the show offers a legal perspective in plain English about the story behind the story.

The episode that brought the show to our attention is titled *Stormy Daniels is a legal genius*. It's not a facetious title: the porn star battling Donald Trump over the legality of a "hush agreement" has played a legal blinder, and this is a scandal that could well bring down the president of the United States – although not for the tawdry reasons you might expect...



How long and how often?

Each episode of *Opening Arguments* is just over an hour long, and you can expect two per week. That's a lot of legal chatter.

8 CAPITAL

What is it?

A six-part, semi-improvised sitcom about a civil service trying to implement the will of the people after a hastily arranged referendum. In this case, the death penalty is to be reintroduced to Britain on a majority of 50.9% to 49.1%.

Why should I listen?

Well, first of all, because it's very funny with excellent performances by the comedians who write and perform it. But more importantly, it gives an insight into the (exaggerated) kind of discussions that must be going on in Whitehall right now as Brexit is implemented in a deeply divided country. If nothing else, it's a good reminder as to why referendums are a terrible idea.

Listen out for Harry Enfield as the minister in charge of the death penalty, too.

How long and how often?

Half an hour per episode, just like a classic sitcom. The first season is six episodes long, but it's unclear if there will be more.

9 CRIMINAL

What is it?

A look at real-life criminal investigations – but not as some kind of police drama. This podcast involves interviewing the officers, relatives and even sometimes the perpetrators themselves to get a unique insight into the world of criminal investigations.

Why should I listen?

Because the stories behind the crime and investigation are sometimes more interesting than the facts themselves. They give a fascinating insight into the psychology of the criminals, as well as the sociological issues that get in the way of investigating them. Take the episode *Angie*, which deals with the brutal killing of a homeless woman from a community that has no interest in talking to the cops. Or the episode *American Dream* – an interview with a man who got away with a string of thrill-seeking bank robberies in the mid-2000s before turning himself in.

How long and how often?

Fortnightly, and anywhere between 15 and 40 minutes.

10 THE BUTTERFLY EFFECT

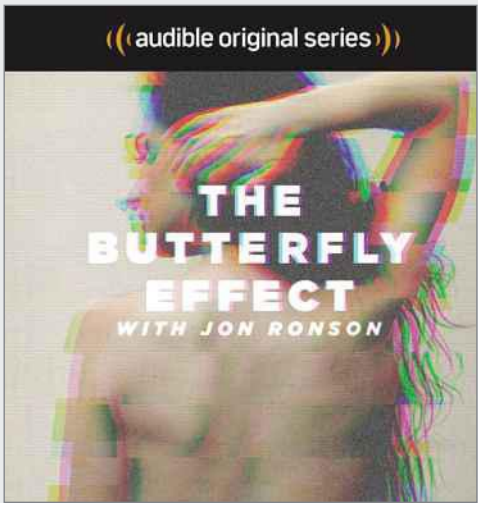
What is it?

Author and journalist Jon Ronson (*So You've Been Publicly Shamed*, *The Men Who Stare at Goats* and *The Psychopath Test*) charts the impact of free online porn on the performers, the internet and culture as a whole.

Why should I listen?

It's a fascinating dive into the laws of unintended consequences and the impact of a whole industry torn apart and rebuilt. It will make you think about the internet very differently – especially the mixed bag of consequences of expecting everything for free. The podcast may be about porn, but its takeaway messages could apply to any number of industries being disrupted by the internet.

Ironically, the podcast – which took over a year to make – was given away free by Audible, although it's now back at the "regular price" of £23.49 for the 3hr 30 mins series, or "free" with an Audible subscription. However, its exclusivity period with Audible is now complete, and you should be able to download it from wherever you usually get your podcasts from. It's one of the best pieces of journalism we've heard this year.

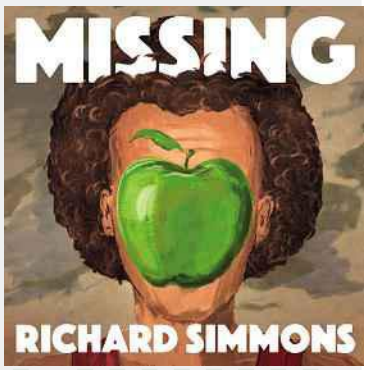


How long and how often?

The whole series was released in Audible in one go. A second season is planned, but there's no release date in mind yet.

The stories behind the crime and investigation are sometimes more interesting than the facts themselves

11 MISSING RICHARD SIMMONS



What is it?

In 2014, the previously outgoing and media-friendly celebrity trainer Richard Simmons retreated from public life without warning, detaching himself from all but a handful of friends and family. Over six episodes, his (former) friend and fitness class member Dan Taberski tries to figure out why, and if he's okay.

Why should I listen?

Even if you know very little about Richard Simmons, this podcast is both fascinating and oddly touching. From the extracts of Simmons, you can see why so many people are left wondering where he went and why: he touched a lot of lives before disappearing.

How long and how often?

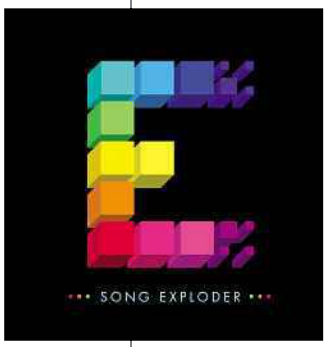
Half an hour and all six episodes are now available for download. Unlike many podcasts, it only works if you listen to each episode sequentially.

Taberski has vowed not to make any more episodes of *Missing Richard Simmons* unless something truly amazing happens. Without wanting to spoil things, that feels unlikely at this point.

12 SONG EXPLODER

What is it?

"Explaining a joke is like dissecting a frog," said E B White and Katherine S White. "You understand it better, but the frog dies in the process." Fortunately, dissecting a piece of music works far better, and here artists come on the show to explain how they made a song, and how it layers together to become the piece you listen to at the end.



Why should I listen?

Because it's rare to hear musicians focusing so intently on their craft, and even songs you know well can hold fascinating secrets. The episodes that will pique your interest will depend on your music taste, but there's bound to be one or two in the archive to meet your needs.

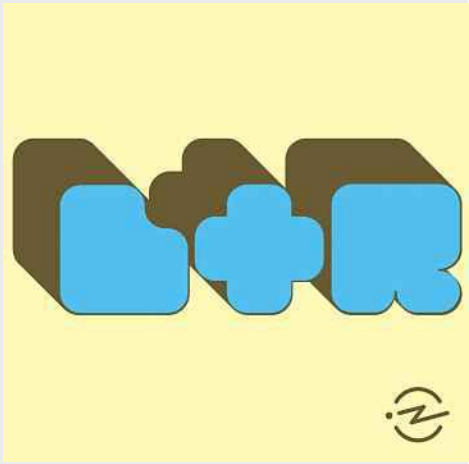
How long and how often?

Between ten minutes and half an hour, depending on what the artist has to say. You get a handful of episodes every month.

13 LOVE AND RADIO

What is it?

An interview – well, more of a monologue, given the interviewer chips in so rarely – with "intriguing characters who aren't quite who you think they are when you first meet them".



Why should I listen?

You will almost certainly never have heard interviews like these before. The people involved aren't necessarily notable but have had extraordinary experiences that you're unlikely to see covered in the mainstream media. One episode gives an inside look into the life of internet blackmailers, while *A Red Dot* features a sex offender explaining his life experiences.

For overall impact, however, it's difficult to look past *The Living Room*. We won't give away anything – even explaining the premise reveals too much – but suffice it to say this is a genuinely sad episode that will make you think about relationships and mortality in a completely different way.

How long and how often?

Usually between 30 minutes and an hour. Episodes have become quite irregular in scheduling – which is understandable given the effort involved in each story.

NEW WAYS TO LISTEN TO PODCASTS

Podcasts first came to prominence when Apple gave them shelf space in iTunes. Nowadays, there are all manner of different ways to get your podcast fix.

The smart speaker makers rarely trumpet the ability to listen to podcasts on their devices, but they're getting increasingly better at it. If you're an Amazon Alexa household, add the TuneIn skill to your devices to get access to a vast library of podcasts. Simply ask Alexa to, say, "play the *Freakonomics Radio* podcast" and she will ferret off and find the latest episode.

If you can't get Alexa to understand which podcast you want (it happens), search through TuneIn's podcast directory from within the Alexa app and commence playback from there. In the app, go to Music, Video & Books, select TuneIn from the Music apps and then click Podcasts to locate the search engine and podcast directory.

Alexa will resume podcasts from where you left off, but only from the last listened-to show. You can't start *Freakonomics*, dip into the *PC Pro* podcast, and then resume where you left off in *Freakonomics* later.

Google has really polished its podcast game of late. Its Google Home devices provide native support for podcast listening – just ask for the show you wish to listen to. Google has also recently launched a new Podcasts app for Android. Within itself, it's pretty basic. You can subscribe to shows, download episodes for offline listening and that's about it.

However, it does let you resume listening from where you left off on your Google Home speaker, and vice versa. So if you're listening to a show at home over breakfast and then shoot off for the commute to work, you don't need to shuffle the episode timeline forward manually on your Android phone.

If you're an Alexa household, add the TuneIn skill to your devices to get access to a vast library of podcasts

14 UNTOLD: THE DANIEL MORGAN MURDER

What is it?

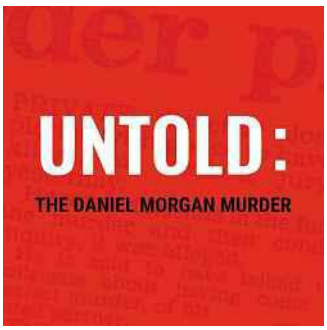
A British twist on *Serial*, the incredibly popular podcast from the makers of *This American Life*, which explores potential miscarriages of justice. That's a glib description, but it certainly has parallels, with interviews and analysis of a 30-year-old unsolved murder.

Why should I listen?

Because it's a fascinating part of British history that's little explored, despite attracting a lot of attention at the time. Journalist Peter Jukes looks into a story that not only includes murder, but asks some very real questions about police, media and political corruption.

How long and how often?

Each episode is around half an hour long, but the story has finished for now. A spin-off ten-part series about the Cambridge Analytica scandal is due for release this year.



15 THE WEST WING WEEKLY

What is it?

An audiobook club for *The West Wing* nerds – not the real West Wing, but the iconic television series from the turn of the century. Each episode from the seven series is pored over individually by *The West Wing* star Joshua Malina (Will Bailey in the show) and self-confessed Sorkin nerd Hrishikesh Hirway.

Why should I listen?

It's rich with both behind-the-scenes insight and critical analysis of *The West Wing*. The best episodes are those that involve interviews with other cast members, in particular Richard Schiff (Toby Ziegler) and Aaron Sorkin (the show's writer for the first four seasons, who still claims never to have watched the three seasons that were completed without him).

They even managed to dig up a previously unheard interview with the great John Spencer who – spoiler alert – died midway through filming of the final series of the show.

How long and how often?

As the name suggests, there's a new episode every week. They're midway through the fourth season at the time of writing. Each episode is around an hour long. The show recommends you watch each episode before they dissect it, as it's replete with spoilers.

16 RADIOLAB

What is it?

You could pigeonhole *Radiolab* as a science podcast, but it's a lot more than that.

Why should I listen?

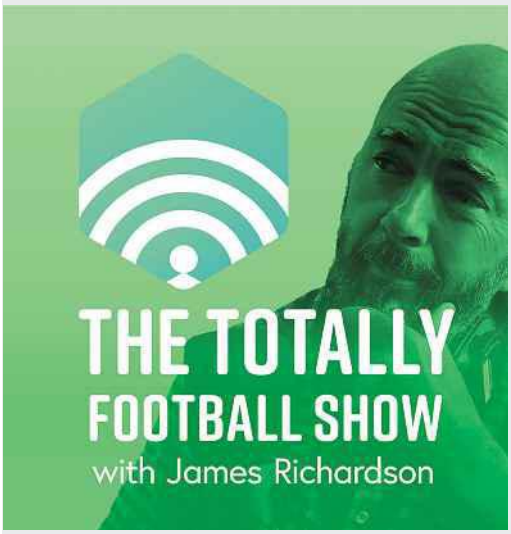
The hosts are interesting and entertaining, and the topics covered are usually enthralling. Plus, it manages to get its messages across in a way that shows the full potential of podcasts with brilliant use of sound, making it a real trendsetter in the space.

The episode on colours and how we perceive them is a brilliant example of this clever use of sound. How do you explain the differences in a spectrum of colour between what a dog can see and what a human can? With a choir, of course.

How long and how often?

Once a week, and usually around an hour or so long. There are shorts in between which are, by their nature, shorter.

17 THE TOTALLY FOOTBALL SHOW



What is it?

A biweekly football podcast that's expertly presented by the effervescent James Richardson, he of Channel 4's *Football Italia* fame. Indeed, he also presents a spin-off show dedicated purely to Italian football in the 1990s.

Why should I listen?

It stands apart from the "should have done better there, Clive" level of analysis that you get from regular football shows. Expert guests include Zonal Marking's Michael Cox, a phalanx of international football experts, and the podcast's ultimate owner and chief (half)wit, Iain Macintosh.

It's a pirate ship of the old *Guardian Football Weekly* crew, including "Producer Ben" and many of the same guests. If it doesn't appeal, *Football Weekly* is still worth subscribing to and The Telegraph's *Total Football Podcast* with regular guest Jamie Carragher has many fans.

How long and how often?

Twice a week during the regular season, released every Monday and Thursday. There are extra specials for big events such as cup finals or tournaments such as the recent World Cup. Each show is around an hour long.

18 FREAKONOMICS RADIO

What is it?

If you've read any of the *Freakonomics* books, you'll know what to expect from this podcast. It's a sideways look at our established facts, with reference to economic theories. However, sometimes the data teases out unexpected results.

Why should I listen?

If you enjoy having your natural expectations challenged with data as well as anecdotes, this is the podcast for you.

Special mention goes to *The Church of Scionology* episode (note: not scientology!), which examines whether businesses really do better when they pass ownership to the children of the founder. Our ultimate pick, though? *The Suicide Paradox*, which digs into the numbers involved in people taking their own life.

How long and how often?

Usually 45 minutes to an hour, and you can expect a new episode every week.

It stands apart from the "should have done better there, Clive" level of analysis that you get from regular football shows

19 THE SIDE HUSTLE SHOW

What is it?

A show for grafters looking to make a bit of extra money on the side. Billed as a "daily show for everyone who works a regular job and wants to start an income-earning project on the side," *The Side Hustle Show* interviews an individual each week who has managed to successfully set up and sustain a side business.

Why should I listen?

It's hosted by Chris Guillebeau, *The New York Times* bestselling author of *The $100 Startup*, who pores over people's ventures: what went right, what went wrong, and how individuals overcame challenges. From a purveyor of "Stoner Culture" emojis to a metal detectorist who gets paid for finding lost jewellery – this show will entertain, amuse and inspire you in equal measure.

How long and how often?

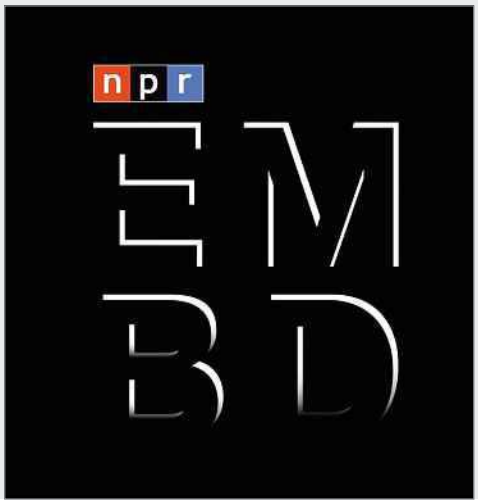
Weekly, with each show lasting between 30 and 45 minutes.

20 NPR EMBEDDED

What is it?
A deep dive look into the stories behind the top-line news, from NPR's Kelly McEvers.

Why should I listen?
It offers insights from across the pond that we rarely get over here, whether it's about mass shootings or the inside workings of the Trump White House. We particularly recommend the deep dive on former White House staffer Steve Bannon, and what his brief time making movies in Hollywood reveals about his politics.

How long and how often?
Each episode tends to be between 30 minutes and an hour, but there's no real release schedule as such. New episodes appear when they're ready, and that is completely acceptable for something as well researched as this.



It features in-depth interviews with artists and scientists on ideas and concepts you may never have considered before

21 THE PC PRO PODCAST

What is it?
A cheeky addendum, which is why we've made our own podcast number 21 in a list of 20 – a bonus Easter egg, if you'll indulge us. Editor-in-chief Tim Danton and columnists Barry Collins, Darien Graham-Smith and Jon Honeyball deliver their verdict on a fortnight's worth of tech stories and try and convince you of the merits of the Hot Hardware of the Week.

Why should I listen?
Because no other tech podcast we know of incorporates such direct input from its listeners. The show is broadcast live on **mixlr.com/pcpro** every other Thursday at 1pm, and there's a regular clutch of listeners who join in via the chat room. They enrich the show with comments, vote for the Hot Hardware and sling the odd insult at the presenters.

How long and how often?
Each episode lasts for around an hour and it's once a fortnight, plus occasional specials around events and shows such as CES.

BEST OF THE BBC

None of the podcasts we've selected above are from the BBC, but that's mainly because the BBC's podcasts tend to be its regular programmes. That makes sense, but it means they aren't podcasts as the rest of the world understands them.

Needless to say, its programmes are excellent. Here our some of our favourites.

1. More or less: Behind the Stats

The brilliant Tim Harford (author of *The Undercover Economist*) and his friendly team of statisticians delve behind the numbers that make up the headlines. There are only three series on Radio 4 per year, where each episode lasts around 25 minutes, but these are supplemented by weekly nine-minute recordings made for the World Service.

2. Desert Island Discs

A show that needs no introduction, having been a BBC staple since 1942. However, note the podcasts have shorter snippets of music due to rights issues. Episodes are weekly and last around 40 minutes.

3. Arts and Ideas

This weekly podcast lasts around 45 minutes and draws from Radio 3's arts programme *Free Thinking*. Intended to tackle bigger subjects, it features in-depth interviews with artists and scientists on ideas and concepts you may never even have considered before.

4. Sport and the British

Created for The Olympics in 2012, this 30-part series of 15-minute episodes takes you from the invention of modern sport – and the birth of the Olympic Games – all the way to the modern-day and television's influence. It's fascinating stuff, although you may have had quite enough of Clare Balding and the jingle by end of the series.

5. Kermode & Mayo's Film Review

As long as you're happy to listen to the grown-up banter between Mark Kermode and Simon Mayo, this weekly, two-hour podcast is packed with genuine insight and passion about the latest cinema releases. It helps that the show has enough pull to attract major names for interviews, too.

CREATE A slick, fast website USING WordPress

Launching a new website or revamping an old one? WordPress is an obvious choice, but there's more than one way to implement it, as Barry Collins explains

If you're planning to set up a new website – or even migrate an existing one – it's highly likely WordPress has crossed your mind. It's the CMS that powers more than half of the world's websites (where a CMS is identifiable), but that familiarity has its downsides.

One is a misconception over your hosting options. If you were planning anything more challenging than a basic blog, you might have thought a self-install of WordPress on third-party hosting was the only way forward. WordPress.com is for teenagers who want to pour out their thoughts on *Fortnite* using a boilerplate template, right? Actually, that's not even remotely the case these days.

WordPress.com now hosts some of the world's biggest websites and it's arguably the perfect host for anyone looking to set up a WordPress-based site. It offers far more flexibility than was the case even two years ago, such as allowing customers to install whichever site theme they choose.

Here I'll share my personal experience of setting up a WordPress.com site to explore the pros and cons of hosting with the mothership and help you get started with your own site.

WordPress vs WordPress.com

Before we start, it's worth underlining the differences between WordPress.org and WordPress.com. Both can be used to power websites and they share many features, but there are key differences.

WordPress.org provides the free, open-source WordPress software that you can use to host a website with any provider. In fact, most web hosts will offer WordPress installers as part of their hosting packages, meaning you rarely have to go to the trouble of hunting down the software and installing it yourself.

With a WordPress.org site, you're entirely responsible for the installation. You (or your web host) must deal with updates, backups and maintenance. WordPress.org just provides the software.

With WordPress.com, Automattic – the company behind WordPress – is both your host and the software provider. Software updates are applied automatically, backups of your site are taken several times a day and WordPress provides facilities such as comment spam filtering.

It's possible to migrate a WordPress.org site to WordPress.com and vice versa, although there are bumps along the way, which we'll also come to. But first, let's deal with some of the misconceptions about WordPress.com.

Breaking the handcuffs

One of the big reasons to avoid WordPress.com in years gone past was the tight restrictions on the look of your site. You could pick from a selection of WordPress Premium Themes, but custom themes were barred, making it very difficult to give your website a unique style.

That's no longer the case. You still get access to WordPress's Premium Themes, many of which are attractive, especially if you're looking for a portfolio-style site for your business. But you can now also upload any theme you wish, or those purchased from stores such as **themeforest.net**.

If you enter the username and API key from your theme store into the site's settings, you'll get reminders when updates are available for your theme from the main WordPress.com dashboard, but these updates aren't rolled automatically in case they break a feature on your site.

Custom CSS tweaks are permitted, letting you alter the design of your theme with a little hand coding, although you don't get access to the site's underlying database, like you would with a third-party host. That could be a showstopper for those who are used to FTP-ing changes to their site's database and does pose further problems, especially if you're migrating from another WordPress.org site.

As well as themes, you also have a free hand to install WordPress plugins, if you've a particular type of SEO service you prefer to use or want greater control over your mobile AMP pages, for example. Although, as with all WordPress installations, you're well advised to take it easy on the plugins to reduce the chance of conflicts and damaging page-load times.

THE GUTENBERG WORDPRESS

Whether you use WordPress.com or WordPress.org on a third-party host, the editor is about to undergo a massive revamp.

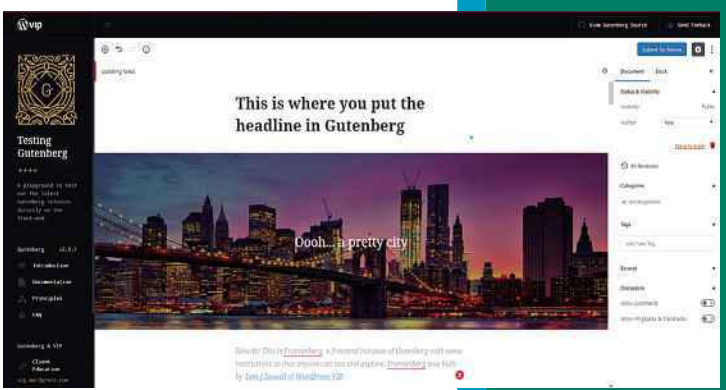
Part of the reason for WordPress's success is that it has a gentler learning curve than many rival CMSes, especially for users who aren't of a technical bent. Gutenberg promises to make creating eye-catching posts even easier.

First, it brings a much cleaner WYSIWYG editor to WordPress posts and pages. Content is organised in blocks. So, you might have a headline block, followed by a photo, followed by an introductory paragraph, and each block can be edited without having to bother with intimidating shortcodes, custom post types, meta-boxes or hand-cranked code.

Insert a featured image, for example, and a box appears on the right-hand side of the editor letting you control the darkness of the gradient on the image. Text can be overlayed on the image and the alignment of the image can be quickly adjusted using onscreen buttons, instead of having to delve in and out of a separate photo menu. And all the changes you're making are previewed live in the editor.

Gutenberg is due to be released this year, but you can play with the new facilities using the live demo at testgutenberg.com.

However, the big question will be how nicely Gutenberg plays with plugins and existing themes, especially if their creator is no longer supporting one you have installed.



LEFT Want to give Gutenberg a test drive before it's launched later this year? Head to testgutenberg.com

BELOW While it was once difficult to make your site stand out from the crowd on WordPress.com, now it's easy

SEVEN THINGS YOU SHOULD DO WITH A NEW WORDPRESS.COM SITE

1 Go to Settings | Permalinks and sort out your permalink structure (the format in which URLs will appear). You want to keep your URLs as short and snappy as possible, whilst adopting a structure that sees search keywords appear in the URL. It's important to get this right from the start as it's difficult to change later. Remember, you can edit individual URLs on posts and pages.

2 Embed Google Analytics. The Jetpack service will provide you with decent site stats, but for full details of key metrics such as page load times, user behaviour when they enter your homepage and other more detailed metrics, you need Google Analytics. Tracking codes can often be inserted in WordPress theme settings. The Yoast SEO plugin is also worth installing, helping to manage Google Analytics and ensure that your posts are SEO optimised.

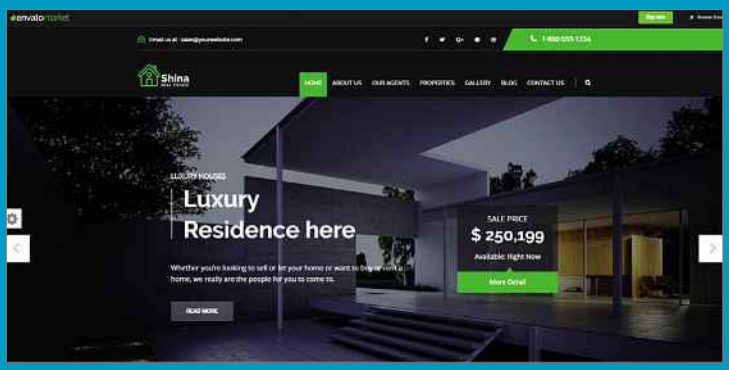
3 Make sure you've got AMP pages switched on to make your content more accessible on mobile devices. AMP is a Google initiative, standing for Accelerated Mobile Pages, which strips any fancy elements out of pages accessed on smartphones to make the pages load faster. AMP sites, marked with a little lightning bolt in Google search results, are given preference in mobile search, which means you can't ignore AMP if you hanker after mobile traffic. You can see how AMP posts will look from the WordPress CMS.

4 Tailor your CMS. At the top of the Posts page you'll see a button called Screen Options. This lets you hide irrelevant parts of the WordPress CMS, making it easier to navigate these box-heavy pages. Don't allow reader comments on your website? Hide the panel that surfaces comments within each post.

5 Check for dummy pages. Themes will often arrive with a host of dummy pages designed to show off the various different layouts within the theme. Make sure you either delete these pages or switch them to Draft.

6 Check the Jetpack settings. Jetpack provides various useful features such as anti-spam filtering, automatic plugin updates and security scanning. Open the Jetpack dashboard from the top left of the main menu in your WordPress CMS to check the services you want are switched on.

7 Install the WordPress smartphone app. It's limited when it comes to posting, but it's a great way to keep an eye on your site stats. The Android app comes with its own homescreen widget, showing Views, Visitors, Comments and Likes for today on your site. It's a handy way to keep an eye out for traffic spikes or lulls that could indicate a problem.



LEFT If you're after a simple portfolio-style site for your business, peruse WordPress's Premium Themes

LEFT Whisper it, but if you opt for the Business Plan, you get the same level of hosting as *The Metro*'s site

"YOU GET A 30-MINUTE VOICE SESSION WITH AN AUTOMATTIC ENGINEER AFTER SIGNING UP"

Unlimited hosting

At £25 per month for the top-end package (if paid a year in advance), small businesses may bristle at WordPress.com's fees when compared to the cheap hosting packages you can find elsewhere. However, if your site is even remotely popular or you're planning to stuff it with lots of multimedia content, that may prove a wise investment.

The Business Plan includes unlimited storage, meaning you never have to worry about uploading too many images or video and busting through your plan's storage limit. Likewise, bandwidth isn't capped, so there's no need to worry about a sudden influx of traffic resulting in a site being dragged offline or an unexpected bill.

The other thing to consider here, and something that's not exactly trumpeted by Automattic, is that you get the same level of hosting on the Business plan as huge commercial clients such as *The Metro* get. The biggest benefit of this is load times. When we transferred our site from (an admittedly cheap) third-party host to WordPress.com, we saw average page load times drop from around five seconds to just under three seconds. Given that Google is known to punish slow-loading sites, that might be the difference between appearing on page one of search results and the relative Siberia of pages two and three.

In the year since we've been running on WordPress.com, we've only suffered one major outage in which the site was unavailable for several hours due to a cable cut near a US data centre. It's disappointing there's not greater resilience for business customers and there's no published uptime guarantee nor compensation for downtime, which may concern some customers. "[There's] no official SLA but we are particularly proud of our dependability and performance – WordPress.com Business uptime was over 99.9% this past year," a WordPress spokesperson told us.

If it's any consolation, there's an option in the settings to get an email if Automattic detects your site is down, so at least you should know if you've got problems. Even if there's often not a great deal you can do about it other than email the support desk.

Talking of support, that's offered via online chat or email only – no telephone helplines. Response times are swift in our experience, however, and you do get a 30-minute voice session with an Automattic engineer after signing up, who can talk you through any technical problems you might be having or just provide general advice on building traffic and optimising your site for Google. Certainly, the expert we spoke to was reassuringly knowledgeable and offered genuine insight.

The backup plan

Another huge advantage of going with WordPress.com is the automatic backup provided by the site's Jetpack service.

Previously, we were relying on a manual backup procedure, which basically involved taking a daily dump of the entire WordPress database and storing it on a local system, ready to re-upload to the server if something went catastrophically wrong.

Premium web hosts may offer better backup solutions, but WordPress.com's system is simple, if not quite as well designed as it was when we first signed up a year ago. Back then, you could simply click on a day in the calendar to roll back the site to how it was on that date, much like Windows' System Restore. Now you have to plough through a long timeline of events on your site, with each event (such as a new post) appearing with a Rewind button alongside it, allowing you to revert the site to the previous state. You can also download a backup of your site if you want to have a local copy.

We've never hit the Rewind button as it's running on a live site, so can't vouch for its efficacy. (I'm mindful of the Honeyball maxim of a backup only being as good as the recovery.) That said, we have no reason to question that the Rewind will work as promised – certainly there are no mass howls of protest about failed backup restores that we can find online.

Making the move

It's obviously easier to move to WordPress.com if you're already running a site based on WordPress – although perhaps not as easy as you'd hope it might be.

WordPress has built-in Export and Import tools in its menu, allowing you to transfer content from one site to another. However, transferring even our reasonably modest months-old site wasn't seamless. The transfer of files from our old host to WordPress.com was frequently interrupted. WordPress's support engineers believed it was down to configuration or bandwidth limits imposed by our former host. We eventually migrated the content across, but it took several re-runs of the import tool.

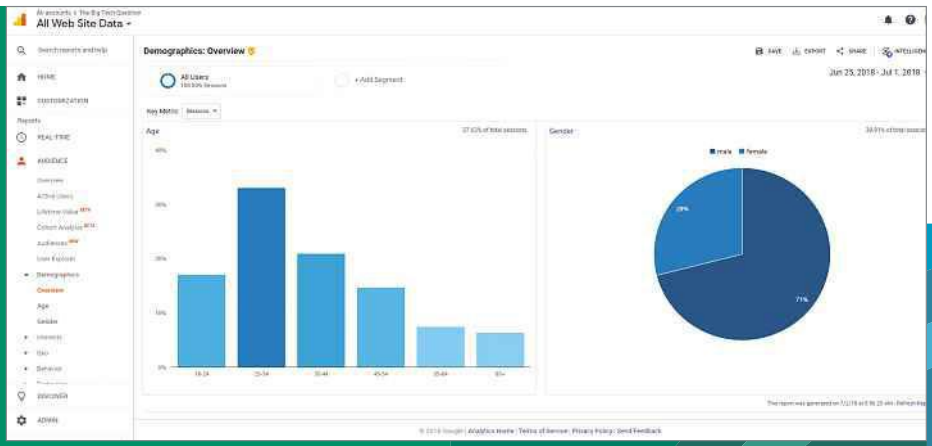
Even when the content did arrive, it was incomplete. The main "featured" image of every post was successfully transferred across with the words, but none of the images embedded in the body copy were. And as we don't have FTP access to the image folder on WordPress.com, we couldn't merely dump a backup of body images into the new WordPress site, which was hugely frustrating. In the end, we ended up fixing dozens of articles by re-uploading images by hand and simply leaving those that were no longer generating much traffic, but it was a tiresome, manual process.

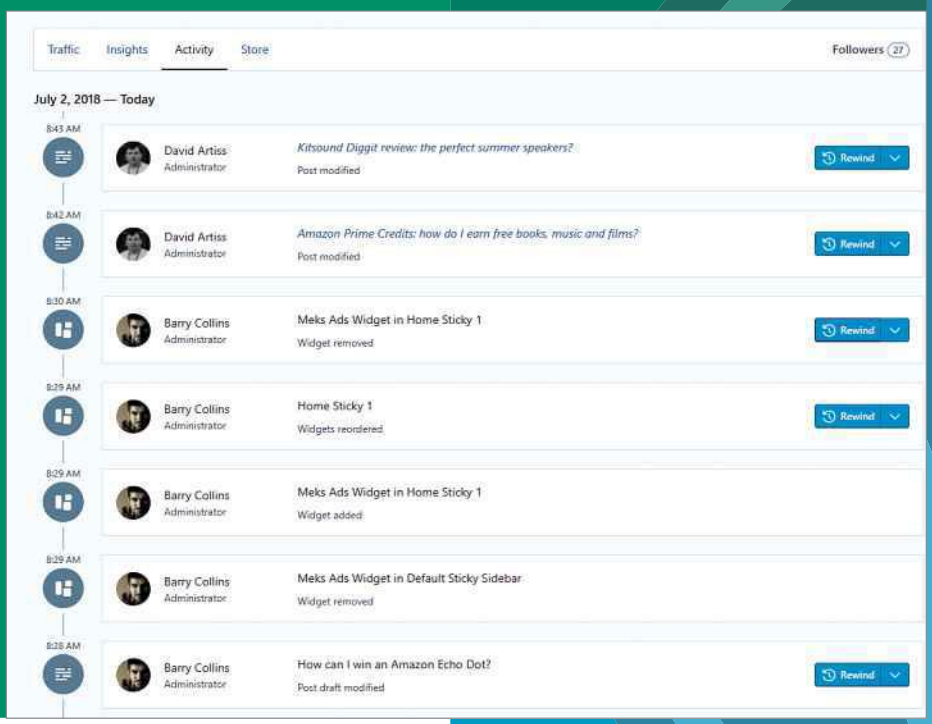
When asked why WordPress.com customers can't have access to their site's database, a WordPress spokesperson told us: "Our goal is to make building a WordPress site accessible to as many people as possible. To that end, we've given customers of the Business Plan the power to add plugins and themes, but more developer-oriented features that pose security and ease-of-use risks, like FTP access, could get users in trouble. We have found that standard hosting (through offerings like Pressable) already work well for those who use FTP."

The right way to WordPress?

A year after we moved to WordPress.com, we've had no regrets about switching. The site is snappy, constantly updated, the backup headache has gone and we get to concentrate on building traffic instead of the mechanics of the website itself.

If you're an old hand with WordPress who prefers to FTP and edit files manually, this isn't the route for you. Those supporting multiple sites on multiple domains might also find conventional hosting cheaper. But for single-site businesses who want to focus on the content, it might well be the right way to WordPress. ●





LEFT If you embed Google Analytics into a WordPress.com site, you will be given metrics such as demographics

LEFT WordPress.com allows you to revert your site to a previous state with a press of the Rewind button

STAY ANONYMOUS ONLINE

Worried about leaking your identity online? Nik Rawlinson shows how it's possible to stay anonymous with a few clever tools – and a little common sense

Google Chrome's "incognito" mode used to open up with a warning that, even while you were supposedly surfing anonymously, secret agents could still be tracking your online activity.

Most of us smiled and dismissed the idea as fantastical; then Edward Snowden broke cover and wiped the smiles from our faces. That specific disclaimer no longer appears, perhaps because we've all learned our lesson.

It certainly doesn't mean the issue has gone away. Online surveillance is still a constant threat, and there are plenty of legitimate reasons for wanting to stay anonymous online. So how can we ensure that what we do in the privacy of our browser really does stay private?

The short answer is that we can't What we can do, however, is minimise our exposure and make life as hard as possible for would-be snoopers.

SIGN UP TO A VPN

Perhaps the simplest and most effective step you can take to protect your privacy is to sign up with a reputable VPN provider, preferably one based overseas. This acts as an encrypted conduit for your internet activity, so that your ISP and other UK-based bodies can't monitor what you're doing – and it makes it a lot harder for the sites to trace where your connection is coming from.

There are plenty of services to choose from, but our advice has always been to pay for a reputable VPN service. Free providers are by no means universally illegitimate, but we've heard stories of user data being accidentally leaked, or deliberately sold to fund operations – which undermines the whole point.

Free providers may also insert their own content into your traffic, replacing third-party ads with their own, which isn't always transparent and raises some troubling questions. At the end of the day, you need your VPN service to be 100% on your side, since they have the capability, should they choose, to see everything you do, from reading your emails to tracking your purchases on Amazon.

As long as you have picked a service you can trust, however, a VPN offers great peace of mind. There's a supplementary benefit, too: you can normally route your connection through servers in a variety of different countries. This allows you to access content that's not generally available to UK browsers, or see how your own site looks to international visitors – an easy way to check there are no issues with page loading times, rendering or censorship.

TURN TO TOR

Tor stands for "The Onion Router" – a name that hints at the multilayered way it works, routing internet traffic through multiple servers before finally passing it on to its destination.

There's nothing new about the general idea of forwarding traffic around in this way – that's basically how the whole internet operates. But Tor adds an encryption element, with each node that your data passes through decrypting a little more of the packet, like peeling away another layer of onion skin. By the time your

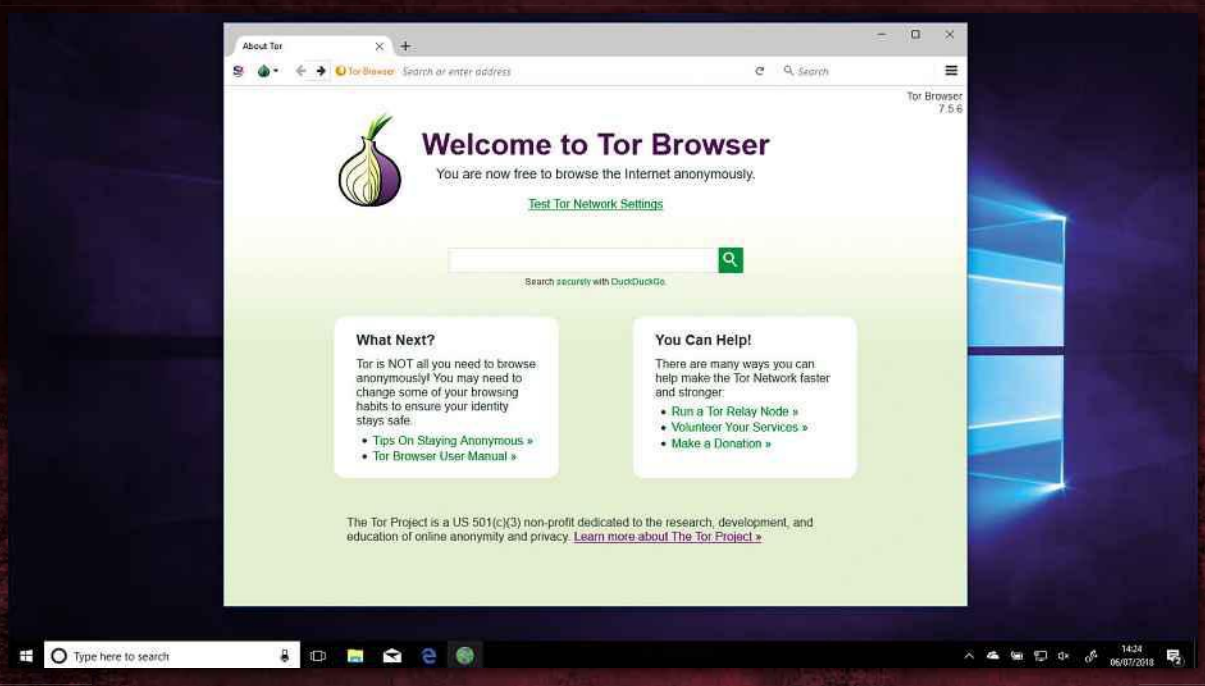
request reaches its destination (the website you want to visit), it will have been fully decrypted, but anyone trying to intercept it en route won't have a complete record of your activity. For the same reason, even the nodes that handle your request won't know precisely where it came from.

Tor sounds like the perfect tool for espionage – so it perhaps makes sense that it's at least partly the product of the United States federal government, having been originally developed at the United States Naval Research Laboratory and refined by DARPA prior to its public launch in 2003.

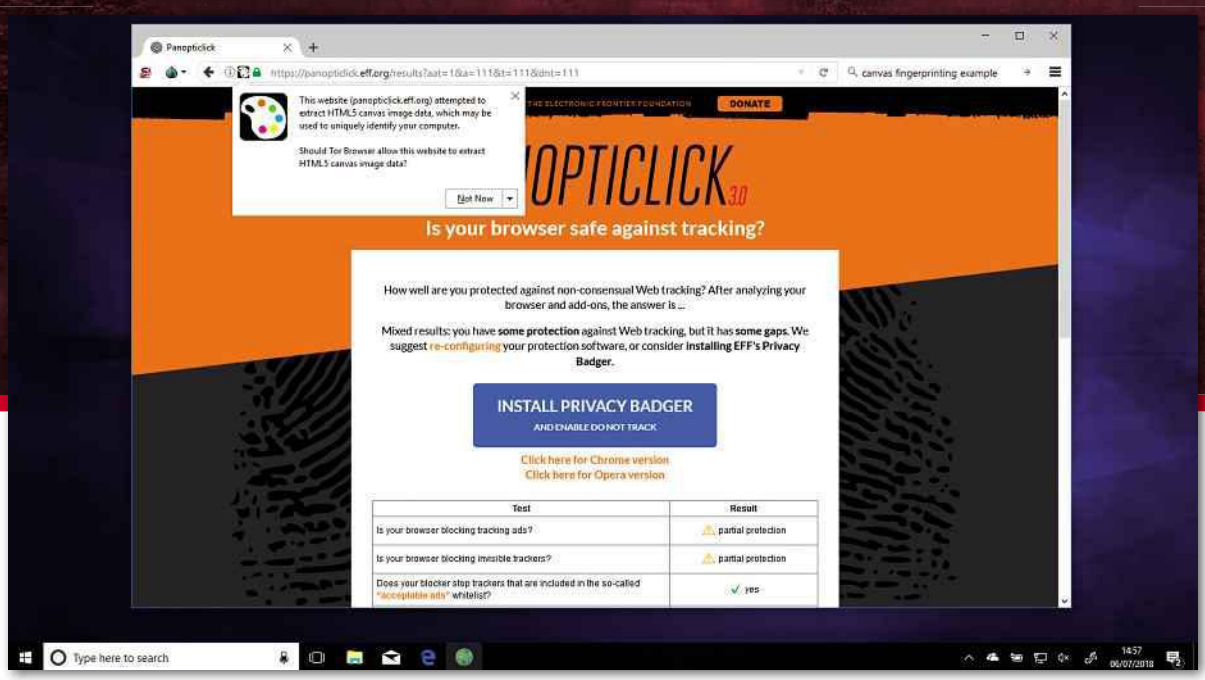
There are questions, however, over whether Tor is really secure. Earlier this year, a vulnerability was found in the Tor web browser that could result in users accidentally connecting directly (and traceably) to their requested sites, without the benefit of Tor's obfuscation. University researchers have found ways to work out the origins of Tor packets, and Europol has recently made some high-profile arrests by successfully exposing the identities of Tor users – though, understandably, the agency hasn't gone into detail about its methods.

ABOVE A VPN encrypts your network traffic, making it all but impossible for your ISP and others to spy on you

If you want to give Tor a go, it's easy: visit **torproject.org** and you can download a browser (based on Firefox) for Windows, macOS and Linux that routes all of the traffic through the Tor network, as well as clearing out cookies and browsing history automatically. However, if you prefer to stick with Chrome, you



LEFT The Tor Browser encrypts your network traffic and routes it through many different nodes to hide your location



LEFT Graphical tricks can be used to "fingerprint" your PC – even if you're not accepting cookies

will find a selection of Tor extensions in the Chrome Web Store.

Like a VPN, Tor doesn't just encrypt your data: it also conceals your location and other details about your connection. When we used the Tor Browser running on a Mac just outside London to visit **iplocation.net**, we were identified as a Windows 7 user in Paris. Subsequent attempts located us in Romania and Norway, so it's going to be pretty hard for anyone to reliably track your ongoing activity. The only catch is that Tor's convoluted routing has a big impact on browsing speed – using it can feel like a trip back to the days of the dial-up modem.

For Android users, another option is Orweb Private Web Browser, which routes requests over the Tor network (**guardianproject.info/apps/orweb**).

FLUMMOX FINGERPRINTING

Staying anonymous online isn't just about ensuring your traffic can't be intercepted. The sites you visit can keep records of your visits and build up an alarmingly detailed profile of your interests and activity – even if you're using a supposedly private browser that doesn't store cookies from one session to the next.

They do this by recognising the device you're using to connect. After all, there probably aren't many PCs out there with the exact same combination of browser, memory, graphics hardware, screen resolution and so forth. The distinctive configuration of your computer acts like a fingerprint, so you can be identified each time you come back to the site – and there's not much you can do to change it. Even if you switch browsers, you're only altering one element of your unique technology mix. Unless you also swap out the graphics card, processor and several other elements at the same time, it's likely you'll still be recognised as the same person.

The thing that's sinister about fingerprinting is that it's not limited to a single site: fingerprint data can be shared and sold, so even sites you've never visited before can identify and track you as you move around the web – even if you're not accepting cookies.

There are ways to defeat fingerprinting. As we've seen, when you surf with the Tor browser, the server you're connecting to sees the details of the exit point of your connection, rather than the computer you're sitting at, so it can't build up a profile. Using a VPN isn't so safe, though: your apparent location changes, but information about your

TEN STEPS TO ONLINE ANONYMITY

It might sound like the quest for online privacy is hopeless. It's certainly true that if you're serious about being anonymous online, you must put in some effort – and the more technical measures and layers of obfuscation you add, the better your chances of maintaining a degree of privacy. Here's a summary of our advice for protecting yourself online.

1 Sign up to a reputable, paid VPN. Ideally, use it all the time; at the very least, use it whenever you're browsing through a public hotspot. Some routers have built-in VPN capabilities, meaning you can transparently protect your entire home, but remember that you won't be protected when you step outside your home, or when you're using a mobile device over a 3G or 4G connection.

2 Install Tor Browser and use it whenever practical. It's not as fast as your regular browser, but it adds encryption and hides your identity at multiple points along the path. If you have a Raspberry Pi, you can set it up as a personal Tor access point, so that every PC connecting through it is automatically anonymised: for instructions, have a look at the Know How video podcast at **pcpro.link/288tor**.

3 Be cautious of browser extensions. These can easily compromise your anonymity, as they run locally on your PC and are able to pass information about your browser and network connection to the site you're visiting – or to anybody else.

4 Always look for "HTTPS" in the address bar of your browser, to confirm that you're using a secure connection that can't be snooped on by a "man-in-the-middle attack". Consider installing the HTTPS Everywhere plugin from the Electronic Frontier Foundation (**eff.org/https-everywhere**) – which is available for Chrome, Opera and Firefox on Windows, and Firefox on Android – that makes your browser default to the secure version of any site you visit.

5 Don't want your email address to get into the wrong hands? Next time you sign up for a service or access a download, use a made-up address from a disposable inbox provider. Our favourite is **sharklasers.com** but there are plenty to choose from: you can receive and read confirmation emails at the website, then never check the inbox again. Don't use a service such as this for important information, though, as messages tend to be automatically purged after a short time.

6 Consider setting up an easily wiped computer for casual browsing. The Raspberry Pi is ideal here, as it's inexpensive to buy and easy to restore to factory-fresh settings. Holding Shift while rebooting drops you straight into the NOOBS installer, from which you can reinstall the OS in a few taps, wiping all tracking data from on the device.

7 Be wary of following web links in your mail client, or opening downloaded PDFs and other document types that link to online resources. Clicking opens an immediate connection to the remote server, and there's no way to know for sure what information will be shared with the operator.

8 We're big fans of cloud backup, but if you really want to protect your privacy, look for a service that lets you protect your personal data with your own encryption key. This ensures that the data on your personal network is never shared with a remote server in any form that could be monitored or stolen – although it also means you need to keep your key somewhere safe, as without it there's no way to recover your backed-up data.

9 Anonymise your web searches by ditching Google and switching to DuckDuckGo (**duckduckgo.com**). It's a silly name but a very sensible service: you get the same results as you would from a Google search, but Google has no record of what you've personally been searching for – and DuckDuckGo doesn't store or share any information about you at all.

10 Don't use social media – although bidding farewell to Facebook is easier said than done...

computer configuration is forwarded to the site you're visiting.

You can reduce your exposure to fingerprinting by disabling JavaScript, because many servers use JavaScript routines to gather their data. Unfortunately, this will also stop many sites from working properly. It's also worth looking for browser extensions that can block specific fingerprinting techniques.

CRUNCHING COOKIES

We all know that cookies allow websites to store information about you, and if you value your privacy it's a sensible idea to clear them out regularly. But regular cookies aren't the only sort of data that sites might store on your PC.

For example, when you access an Adobe Flash element, data packets called "local shared objects" are saved onto your PC. These are managed by the Flash host, rather than the browser, so they may not be deleted when you purge your cookies, and they can be used to identify you even if you switch browsers.

Flash isn't as ubiquitous as it once was, but it's still worth checking if you've got Flash objects hanging around on your system by inspecting the following locations (in File Explorer, make sure "View hidden items" is ticked) :

C:\Users\[you]\AppData\Local\Macromedia\Flash Player\#SharedObjects

C:\Users\[you]\Macromedia\Flash Player\macromedia.com\support\flashplayer\sys

If you're using Chrome, also check this folder:

C:\Users\[you]\AppData\Local\Google\Chrome\User Data\Default\Pepper Data\Shockwave Flash\WritableRoot\#SharedObjects

Another sort of cookie that isn't easily dislodged is the sinister "Evercookie". This tracking file is dropped onto your PC by a JavaScript app embedded in a website; it's saved in the regular cookie folder, but also duplicated in more than a dozen locations across your PC. If you delete the cookie, the script will quietly reinstate a copy from these locations, and the tracking will continue without your knowing it.

Evercookie isn't merely a theoretical threat, though: according to documents released by Edward Snowden, GCHQ in the UK and the National Security Agency (NSA) in the US have both shown interest in using Evercookie to track users across the Tor network. There's no straightforward, universal way of purging all of the Evercookie data, although disabling JavaScript should prevent deleted cookies from being replaced. If you're concerned, a quick web search will yield a few approaches to try.

Reviews

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

Apple MacBook Pro 15in (2018)

Stupendous power at a stupendous price. The 15in MacBook Pro is an exceptional slice of premium technology

PC PRO RECOMMENDED

SCORE ★★★★★

PRICE As reviewed, £5,174 (£6,209 inc VAT) from apple.com/uk

I've reviewed many expensive laptops over the years. Some have been MacBooks, some have been workstations running Windows, but none have been quite as costly as the machine sitting in front of me. It's the top specification of the 2018 15in MacBook Pro and, no, I haven't got the 2 and 6 mixed up in the £6,209 price. But before you grab the reins of outrage and get on your high horse over Apple's inflated prices, consider what this buys you.

At the heart of the machine, there's the six-core 2.9GHz Intel Core i9 CPU, 32GB of DDR4 RAM and a discrete Radeon Pro 560X graphics card with 4GB of GDDR5 RAM. And it's partnered with an immense 4TB SSD, which adds around £3,000 to the base price all on its own.

Plus, while the design and look of the 2018 MacBook Pro is no different from last year's, a handful of subtle improvements have been made. The machine's low-travel butterfly switch keyboard is now quieter and more reliable. And Apple has brought over its innovative True Tone technology from the iPad Pro, which matches the white point of the screen to the environment you're working in at the time. This is no minor upgrade.

Price choices

The highest specification 15in MacBook Pro is clearly outside the purview of regular laptop purchasers. Even the cheapest model costs £2,349, and this is no featherweight: it includes a 2.2GHz quad-core, eighth-generation Intel Core i7 processor, 16GB of RAM, a discrete Radeon Pro 555X graphics chip and 256GB of SSD storage. The table overleaf shows exactly how the various base specifications break down and the cost of upgrades.

Of the laptops we've tested recently, nothing matches the top-end 15in MacBook in terms of raw power and features, but the Razer Blade 15 (*see p63*), Surface Book 2 15in (*see issue 283, p60*) and Dell XPS 15 2-in-1 (*see issue 287, p54*) all offer specifications that are competitive or better than the cheaper MacBooks and are also squeezed into similarly slim and lightweight packages.

Take the Dell XPS 15 2-in-1, for instance. You can pick up one of these excellent laptops with a quad-core 3.1GHz eighth-generation Core i7, 16GB of RAM and a 1TB SSD for £2,499. Alternatively, for even more power, the Razer Blade 15 comes with a six-core 2.2GHz Intel Core i7-8750H processor, 16GB of RAM, an Nvidia GTX 1070 and a 512GB SSD for £2,149. Both Windows machines are, ostensibly, better value than the equivalent 15-inch MacBook Pro when you look at the hardware you're getting for the money. Why pay more?

Design and features

Despite the improvements, one thing that hasn't changed in the 2018 MacBook Pro is its overall physical design. It's available in two colours – silver and "Space Grey" – and while that may seem boring in the context of the headline-making changes, don't be put off: this laptop is just as beautifully put together as ever.

Other manufacturers have caught up with Apple, but there's still something special about the 15in MacBook Pro and its vast expanses of plain, grey matte aluminium, its minimalist collection of ports and its vast glass-topped touchpad. It's a lovely thing and, for a powerful 15in laptop, its 1.83kg weight and 15.5mm thickness are impressive.

The new keyboard is a big improvement over the previous one, too, but Apple hasn't changed the mechanics. Instead, it has added a silicone rubber membrane between the keys and the aluminium base beneath them.

ABOVE You can use the Touch ID button to unlock the laptop – as well as pay for items via Apple Pay

It's a process that achieves a couple of important effects. First, the keyboard is less rattly and clacky than before. It has a more damped, deadened sound to it than before, meaning you should feel less self-conscious when you're rattling out your notes in a quiet meeting room.

Second, it prevents dust and grit from getting under the keys and into the switch mechanisms (according to the folk over at iFixit, at least), which is something that a lot of people have reported as a problem with the previous model.

Below the keyboard, the 15in MacBook's touchpad hasn't changed, but then it didn't need to. Its huge surface dwarfs the touchpad on pretty much every other laptop on the market and its clever multi-stage haptic click mechanism means the mouse click is perfectly responsive, wherever you happen to press it.

"The Core i9 processor in our machine is partnered with an immense 4TB SSD, which adds around £3,000 to the base price alone"

Above the keyboard, the Touch Bar remains in place, with the dual purpose power/Touch ID button built into its right-hand side. You can use this to unlock the laptop and pay for items via Apple Pay; the latter is a useful inclusion, but I'm yet to be convinced about the Touch Bar. It's undoubtedly clever but surely it's time Apple dumped it and went full touchscreen instead.

Physical connectivity is the same as before too, but it's still impressive. You get four 40Gbits/sec Thunderbolt 3-enabled ports, two on either side, offering the ability to charge from any port or connect any peripheral that you care to think of – from 4K displays to external GPUs. Moreover, thanks to the genius of Thunderbolt 3 it's also possible to daisychain up to six devices from each port and even connect two MacBooks directly together for fast file transfer.

BELOW The design of the stunning MacBook Pro hasn't changed in the update, but did it really need to?

Gorgeous display

As always, the display is simply brilliant. It's a Retina-class display with a resolution of 2,880 x 1,800. It measures 15.6in from corner to corner and uses IPS technology, meaning viewing angles are excellent.

Colours are super-accurate too. MacBook displays have always been

calibrated in the factory and this one ships with a huge selection of professional calibrations to choose from. That means, whatever your workflow, you should be able to tweak the colour output to suit – as long as the application you're working in is colour-aware, of course.

Out of the box, though, as has been the case for some time, the MacBook is set to DCI-P3 and it's pretty much bang on. Our measurements show that, with the default profile selected, it covers 99% of the DCI-P3 colour space, reaches a searing 445cd/m² maximum brightness and hits a stunning contrast ratio of 1,409:1.

For colour-critical work, it's a magnificent display, but it's also good to see Apple improving things for everyday use too, with True Tone adopted for this generation of MacBook Pro laptops – both on the main display and the Touch Bar. Essentially, this matches the white point of the screen to that of the ambient light so that your brain isn't constantly adjusting whenever you look away from the display. This works well but is, Apple confirms, merely a tool to reduce eye strain. If you're working on colour-critical graphics, video or photo-editing jobs, you'll need to disable it.

The only problem is that there's no simple toggle switch for this and no keyboard shortcut – you have to delve into the System Preferences and click on Displays to disable it.

Speed and more speed

The big question, given this is the first MacBook Pro ever to offer a six-core CPU, is how fast does it go? Initially, things didn't look good. The Core i9 MacBook Pro had been reported to be throttling to an unacceptable level by various websites, to the point that it was slower than the cheaper Core i7 model below it.

Apple has since issued a fix, though, which seems to have sorted out the problem. In my testing, I've seen steady clock speeds at or above the base clock of 2.9GHz in every test I've run – and raw performance beats every other laptop we've tested.

Our overall benchmarks show the Core i9 is clearly the fastest of all the big, beefy laptops we've reviewed in our media-focused benchmarks. It's faster than the Razer Blade 15, the Acer Predator Triton, Asus ROG Zephyrus and Dell XPS 2-in-1. None of those laptops, as tested, had Intel's Core i9-8590HK CPUs on board, of course, instead running a variety of seventh-generation and eighth-generation Core processors. It's worth noting that it would have been pushing 200, had it not been for the slow image-editing score – this is a bug we've seen with iMac Pros before, and doesn't reflect its capability in the real world.

Storage is searingly quick, too, achieving an impressive 2.6GB/sec and 2.7GB/sec in sequential transfers (read and write respectively), beating most other rivals by a significant margin. Should you need to write large amounts of data to the drive, you won't be held up by the MacBook Pro.

Graphics performance is less impressive, however, with a 118fps result in Manhattan 3 offscreen that is just a third of what we've seen from the Razer Blade 15 and Acer Predator Triton. Although this is clearly not a machine aimed at gamers, it would be nice to see a little more GPU horsepower, as there are plenty of creative applications that take advantage of the GPU.

For example, I ran the same 4K to 1080p down conversion using Adobe Premiere Pro as I did on the iMac Pro earlier this year. It took the iMac seven minutes to encode my 12-minute video clip, while the MacBook Pro managed it in 13 minutes. That's still a great time, but back in the office you can hook up an external GPU such as the BlackMagic Designs eGPU, which houses a full blown Radeon Pro 560, to cut it down further.

What's special about the 15in MacBook Pro is that you can carry all this power around in your bag and work on the go – and despite all that power, battery life is excellent. In our video rundown test, it lasted 8hrs 1min, which is twice the amount I've come to expect from big and powerful Windows laptops

Beyond the niche

The MacBook Pro, in the specification I'm reviewing here, is undoubtedly a niche machine. But it's important to look behind the £6,209 price at the top of this review for a moment. Most of that money goes towards the huge 4TB SSD, which adds an enormous £3,060 to the price of the base, £2,969 Core i9 machine. And "base" isn't really an appropriate word: it comes with a generous 512GB SSD and the same Radeon Pro 560X graphics chip.

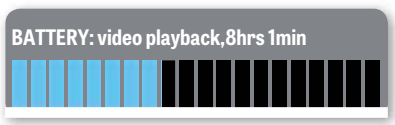
At that price, it looks surprisingly reasonable – it's not quite as good value as the best 15in Windows 10 laptops, perhaps, but it's not much more expensive and you get the bonus of exceptional display quality and superb battery life, plus a greatly improved keyboard.

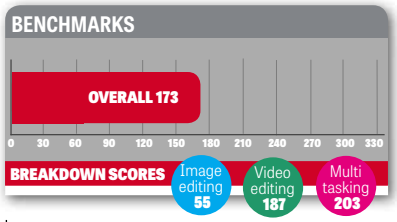
In truth, though, if you're interested in buying a MacBook Pro, it's because you've been using Macs for years and you'll be used to paying a premium. And the fact is that the 15in MacBook Pro, especially in its Core i9 variant, is probably the most powerful 15in laptop money can currently buy. **JONATHAN BRAY**

Base specifications	Price
4-core 2.2GHz 8th Gen Core i7, Radeon Pro 555X, 16GB DDR4, 256GB SSD	£2,349
4-core 2.6GHz 8th Gen Core i7, Radeon Pro 560X, 16GB DDR4, 512GB SSD	£2,699
6-core 2.9GHz 8th Gen Core i7, Radeon Pro 555X, 16GB DDR4, 256GB SSD	£2,699
6-core 2.9GHz 8th Gen Core i9, Radeon Pro 560X, 16GB DDR4, 512GB SSD	£2,969

Upgrades	Additional price
AMD Radeon Pro 560X	£90
32GB RAM	£360
512GB SSD	£180
1TB SSD	£540
2TB SSD	£1,260
4TB SSD	£3,060

ABOVE The MacBook Pro includes four Thunderbolt 3 ports – two on each side





SPECIFICATIONS

Six-core 2.9GHz Core i9-8950HK processor • 4GB AMD Radeon Pro 560X graphics • 32GB RAM • 15in IPS display, 2,880 x 1800 resolution • 4TB M.2 PCIe SSD • 2x2 802.11ac Wi-Fi • Bluetooth 5 • 4 x Thunderbolt 3 • 83.6Wh battery • macOS High Sierra • 349 x 241 x 15.5mm (WDH) • 1.83kg • 1yr limited warranty

Apple MacBook Pro 13in with Touch Bar (2018)

The obvious choice if you're after a hugely powerful 13in laptop, even if others beat it for value and weight

SCORE ★★★★★

PRICE As reviewed, £2,999 (£3,599 inc VAT) from apple.com/uk

If you're hoping for a dramatic overhaul to last year's 13in MacBook Pro, prepare for disappointment. This 2018 update is exactly the same size and shape as before, has most of the same features, and is offered in the same colours, too. (Note that Apple hasn't updated the non-Touch Bar 13in MacBook Pro. That's still available with seventh generation Core processors, and prices start at £1,249.)

But there are changes. First, Intel's eighth-generation Core processors are now in place: choose between a 2.3GHz Core i5-8300H or 2.7GHz Core i7-8559U, costing £1,749 and £2,019 respectively, and then pick which components you want to upgrade. The base spec is 8GB of RAM and a 256GB SSD, with an upgrade to 16GB of RAM costing £180 and a 512GB SSD £200. Ouch. But the real pain comes if you choose the 2TB SSD, which adds £1,400 to the price.

Apple sent us the top-of-the-range spec, and the performance of the Core i7-8559U proved just a little bit special. With a base clock of 2.7GHz and a maximum Turbo Boost clock of 4.5GHz – plus, at 128MB, double the amount of eDRAM in last year's Core i7 MacBook Pro – it powered to an overall 151 in our benchmarks. That's over 50% faster than the Dell XPS 13.

Storage performance from the 2TB SSD was exceptional too, reaching consistent speeds of 2.6GB/sec and 2.5GB/sec for sequential reads and writes. There are no discrete graphics, but Intel's integrated Iris Plus 655 still managed 109fps in the GFXBench Manhattan 3 off-screen test. That's only 5fps behind the MateBook X Pro with its Nvidia MX150 graphics.

The second big change is the improved butterfly-switch keyboard, which now has a thin rubber membrane between the keytops and its aluminium base. This has multiple effects. First, it makes the keyboard quieter and, oddly, it also imparts a softer, more finger-friendly feel. It should make the keyboard more resistant to dust and grit, too.

The final upgrade is a True Tone display, which works just as well here as it does on Apple's iPad Pro tablets. Its resolution is a "Retina-class" 2,560 x 1,600, which means it's as sharp as the eye can see at normal distance. Technically, it's beyond reproach: brightness peaks at a ludicrous 502cd/m² and the contrast ratio is 1,451:1. The screen also covers 99% of the DCI-P3 colour gamut.

As it has done for some years now, the 13in MacBook Pro marries good looks with a good dose of practicality. The Touch Bar machines have four USB-C Thunderbolt 3 ports – a pair on each side – allowing you to connect everything from monitors to external graphics boxes. The lack of an SD card reader or USB Type-A port is irritating, but the huge flexibility and bandwidth of Thunderbolt 3 more than makes up for this.

Elsewhere, it's impossible to criticise Apple's decisions. It hasn't upgraded the webcam, but it didn't need to: with its crisp images, it's still the best in the business. From a physical perspective, this remains a gloriously desirable machine. Its solid machined aluminium chassis, clean lines and minimalist looks strike all the right notes.

It's true that others beat it for weight, however. You only need to look at the Asus ZenBook 13 Deluxe (*see p60*) or the HP Envy 13 (*see p61*) to see how light other manufacturers are making 13in laptops, but 1.37kg is still little enough to sling in your bag without worrying.

Battery life is strong, lasting for 8hrs 25mins in our video-rundown test. Its only key rival with better battery life is the Dell XPS 13 (*see A-List, p16*), which lasted for 10hrs 58mins, and it's certainly better value.

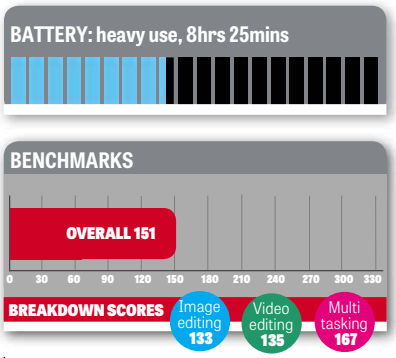
If it's sheer grunt you want in a 13in laptop, however, the MacBook Pro is unbeatable. It's hugely fast in its Core i7 guise and you can configure it to a degree that you simply can't with a Dell XPS 13.

Combine that with Apple's traditional strengths – a great screen and fabulous build quality – and you have a laptop that sits proudly alongside the very best that the Windows fraternity has to offer. **JONATHAN BRAY**

"The MacBook Pro 13in powered to an overall 151 in our benchmarks – that's over 50% faster than the Dell XPS 13"

SPECIFICATIONS

Quad-core 2.7GHz Core i7-8559U processor • Intel Iris Plus Graphics 655 • 16GB RAM • 13.3in IPS display, 2,560 x 1,600 resolution • 2TB M.2 PCIe SSD • 2x2 802.11ac Wi-Fi • Bluetooth 5 • 4 x Thunderbolt 3 • 58Wh battery • macOS High Sierra • 304 x 212 x 14.9mm (WDH) • 1.37kg • limited warranty

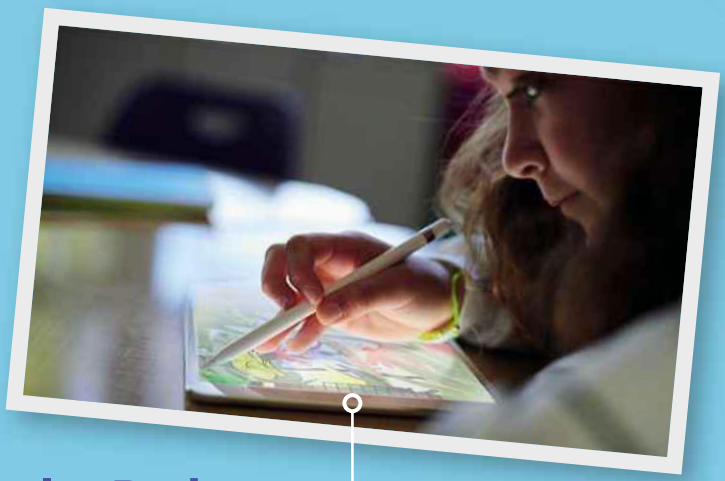


ABOVE The design hasn't changed: the Pro is the same size and shape as before

BELOW The True Tone screen will adapt to the ambient light in the room

Back to School 2018 MUST HAVES

Make sure you're prepared for the start of term with these essential devices – perfect for school or university



Apple iPad

apple.com/uk

FROM £319

The new 9.7-inch iPad and Apple Pencil (£89) give students the ability to be even more creative and productive, from sketching ideas and jotting down handwritten notes to marking up screenshots. For extra protection, consider buying a keyboard/case combo too.

Chillblast Leggera Ultrabook for students

chillblast.com/leggera

£999

The Chillblast Leggera is a slimline aluminium Ultrabook that's small enough to carry everywhere you go comfortably. Its svelte 1.3kg design belies its incredibly powerful components: an Intel Core i7 CPU, 1TB M.2 SSD and 8GB of DDR4 RAM. Then, to top it all off, a battery that lasts all day. Students save 5% off the £999 price with code STUDPUB18.

iiyama ProLite XB2474HS-B1

amazon.co.uk

£129.99

The iiyama XB2474HS-B1 is an ideal solution for teachers and students, featuring a VA 24-inch panel that offers exceptional viewing angles, a height-adjustable stand and HDMI and DisplayPort connectivity for compatibility across all PC and laptop platforms. And don't forget about the three-year warranty, too.

Kingston UV500 SATA SSD 480GB

ebuyer.com

£99.99

Kingston's UV500 SATA solid-state drives dramatically improve the responsiveness of your existing system with incredible boot, loading and transfer times compared to mechanical hard drives. This SSD is 10 times faster than a traditional hard drive. It also has end-to-end data protection, thanks to 256-bit AES hardware-based encryption and TCG Opal 2.0 security management solutions.

Chillblast Triton game design desktop for students

chillblast.com/triton

£999

Need a PC that can power through game design, graphics and 3D animation workloads? Meet the Chillblast Triton. With a powerful 8th Gen six-core Intel Core i5 processor, GeForce GTX 1060 graphics and 16GB of RAM, it's got everything you need. Students save 5% off the price with code STUDPUB18.

Canon Pixma TS6150 Printer

amazon.co.uk

£113

This stylishly small all-in-one is ideal for fast document and photo printing. It's a flexible choice for students, too, whether you want quick copies of documents or to scan in photos for later reference. With wireless and wired options, it's well connected for the modern age, supporting smart devices, social networks and cloud storage services. And you can count on its quality, with five inks to help produce beautiful photos, as well as crisp text and graphics. Plus, enjoy smartphone-like touch control from different angles using a tilting 7.5cm LCD colour screen, and cut your running costs by choosing XL and XXL ink cartridges.

Nuu Mobile G3

nuumobile.com

£199.99 + free case offer

Beauty meets design. The G3 offers exceptional value for money for students and parents alike. Enjoy a 5.7-inch 18:9 display, edge-to-edge curved glass, fingerprint ID, facial recognition, 13+5 dual rear camera, 13MP front camera, 4G Dual-SIM, 4GB RAM with 64GB of storage, a microSD slot and NFC Google Pay. Plus a free Tudia Lite case (valued at £15) when purchased in Aug/Sept 2018.

Checkout code: SUMMER18.

2 Year Warranty & UK Support Centre

AOC 24P1

uk.insight.com

£166

The stylish and compact AOC 24P1 is perfect for dorms and bedrooms alike, with three borderless sides surrounding its 23.8-inch IPS display. With a Full HD 1,920 x 1,080 resolution, it includes a full range of display inputs (VGA, DVI, HDMI, DisplayPort), 4 x USB 3.0 hub, built-in speakers and an improved ergonomic stand with 150mm of height adjustment.

Synology DiskStation DS418play with Seagate IronWolf 4TB

ebuyer.com

£519.99

Don't worry about losing crucial essays. Together, the Seagate IronWolf hard disk and Synology DS418play 4-bay NAS actively protect data thanks to the IronWolf Health Management app. For entertainment, the Synology DS418play supports 4K transcoding for up to two channels of H.265/H.264 video at the same time. And it should last as long as your studies: the IronWolf's RV sensors enable 24x7 RAID performance and multi-user workloads of 180TB per year.

Microsoft Surface Book 2

microsoft.com

From £1,149

Looking for a laptop with a difference? The Surface Book 2 is certainly that, with the ability to work happily as a laptop – and then become a tablet at the touch of a button. Simply detach the screen and start scrawling notes with the optional Surface Pen (£100). Back in laptop mode, you'll find the combination of a top-quality keyboard and 13.3-inch PixelSense display mean you work happily for hours. Add Nvidia GeForce GTX 1060 graphics for some after-hours entertainment, and a battery life of up to 17 hours, and this will make you the envy of your friends. Special pricing for eligible students, parents and teachers – see site for details.

iStorage datAshur Personal²

istorage-uk.com

8GB, £39; 64GB, £79

The datAshur Personal² USB 3.0 flash drive secures data you don't want others to see, so no need to worry about private files falling into the wrong hands! Incorporating a rechargeable battery, the user enters a 7- to 15-digit PIN via the on-board keypad before connecting the drive to a USB port. Data transferred to the drive is encrypted in real-time, which protects from unauthorised access even if the device is lost or stolen. It's compatible with all operating systems, with drag-and-drop encryption and plug-and-play simplicity. In plain and simple terms, without the PIN, there's no way in!

Loupedeck+ photo-editing console

WEX Photo Video, amazon.co.uk and specialist photography stores around the country

£199

Loupedeck+ is the *PC Pro* Recommended photo-editing console that lets you be more creative, makes your editing faster, and allows you to focus on what's important – your photos. Loupedeck+ is compatible with Adobe Lightroom Classic CC and Aurora HDR.

How we test

Laptops and PCs

We run our own benchmarks on every Windows and macOS system we test. These are based around image editing, video editing and multitasking (where we run the video editing benchmark while simultaneously playing back a 4K video). At the bottom of each laptop and PC review you'll find the system's score in each of these tests, plus an Overall score.

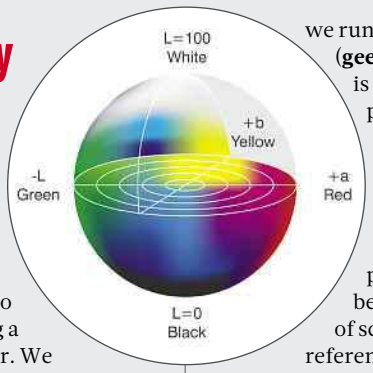
If a laptop scores 70, say, then it's 30% slower than our reference system – a PC with a Core i7-4670K and 8GB of RAM. If it scores 160, then it's 60% faster.

We test laptop battery life by playing back a full-screen video until the battery runs out. We set the screen brightness to 170cd/m², or as close as we can get using its settings, and switch to Flight mode.

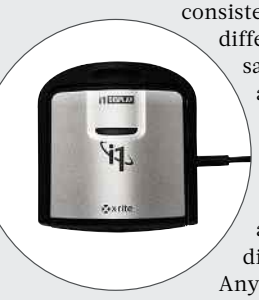
ABOVE We put PCs and laptops through intensive benchmarks and test laptops for battery life

Screen quality

In each laptop, phone, tablet and monitor review you will see our conclusions about the screen quality. Some of this will be subjective, but we also test each screen using a Display i1 Colorimeter. We measure for maximum brightness, colour accuracy and consistency – there may be a difference in brightness, say, from the middle and the edges of the panel.



We also measure Delta E, which gives a guide as to how accurately the panel displays a colour. Anything under 1 is excellent and likely to be difficult for the human eye to distinguish; 1-2 is still strong; above this suggests a panel that you shouldn't trust for colour-accurate photo editing.



LEFT & FAR LEFT To measure a screen's sRGB gamut coverage and Delta E, we use a Display i1 Colorimeter

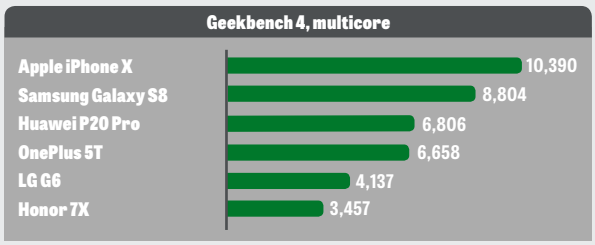
Phones and tablets

We run a selection of publicly available benchmarks on all the phones and tablets we test. First, we run Geekbench 4 (**geekbench.com**). This is a good test of the processor and memory in particular, and includes both a test for single-core and multi-core performance. See below for a selection of scores to provide a reference of what's good... and what's not so good.

We also run the graphics-intensive GFXBench (**gfxbench.com**) to see how well the phones and tablets are likely to perform in games.

As with laptops, we test smartphone and tablet battery life by playing back a full-screen video until the battery runs out. We set the screen brightness to 170cd/m², or as close as we can get using its settings.

BELOW We play back a video, setting the screen to 170cd/m², until the battery runs out to test battery life



What our awards mean

Recommended
This, quite simply, is a product we would recommend you buy – if it meets your needs.

A-List
The best buy in its category right now. The product will also feature on our A-List, starting on p16, updated each month.

Labs Winner
Each month we run a group test, or Labs. This product has managed to beat all others to top position.

The pcpro.link

Throughout the magazine you'll see pcpro.link shortcuts. Enter these into the address bar of your browser and it will take you to a particular page, which will either be too long or awkward for us to publish or will take you to the precise shop from which to buy. If it's Amazon, note that we have an affiliate deal in place so we will receive a commission from each sale. This will never affect our verdict of a product, and if another reputable vendor is selling the product cheaper then we will use them instead.

Prices will vary

Prices we publish are correct on the day we publish, but we often see prices change – especially on sites such as Amazon. However, we do work with British PC retailers to ensure the prices we quote for their systems are correct. If the price isn't being honoured, contact us via letters@pcpro.co.uk.

3XS SYSTEMS PRO GRAPHICS

Performance you can count on

Workstations for design, visualisation and VR

WI4000-Series

Based on the mainstream Intel® Socket 1151 platform which supports Intel® Core™ i3, i5 and i7 CPUs with up to six cores and dual-channel DDR4 memory for excellent performance in a wide variety of DCC applications.

3XS WI4000 Design

- Intel® Core™ i5 8600K processor overclocked to 4.8GHz
- 16GB Corsair Vengeance DDR4 3000MHz
- 4GB NVIDIA Quadro P1000
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£1,479.99 INC VAT

3XS WI4000 Viz

- Intel® Core™ i7 8700K processor overclocked to 4.8GHz
- 32GB Corsair Vengeance DDR4 3000MHz
- 8GB NVIDIA Quadro P4000
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£2,219.99 INC VAT

WI6000-Series

Based on the high-end Intel® Socket 2066 platform which supports Intel® Core™ i7 and i9 CPUs with up to 18 cores and high-bandwidth quad-channel DDR4 memory for superlative performance in a wide variety of DCC applications.

3XS WI6000 Design

- Intel® Core™ i7 7820X processor overclocked to 4.5GHz
- 32GB Corsair Vengeance DDR4 2666MHz
- 4GB NVIDIA Quadro P1000
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£1,999.99 INC VAT

3XS WI6000 Viz

- Intel® Core™ i9 7900X processor overclocked to 4.5GHz
- 64GB Corsair Vengeance DDR4 2666MHz
- 8GB NVIDIA Quadro P4000
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£3,159.99 INC VAT

Customise your workstation today at

scan.co.uk/3xs · 01204 47 47 47

WI8000-Series

Based on the ultra high-end Intel® Socket 3647 platform which supports a pair of Intel® Xeon™ Scalable CPUs with up to 28 cores each and high-bandwidth 6-channel DDR4 memory for superlative performance in a wide variety of DCC applications which require a lot of CPU cores.

3XS WI8000 Sim & CFD

- 2 x Intel® Xeon™ Silver 4114 10 Core with HT
- 64GB ECC Registered DDR4 2666MHz
- 2GB NVIDIA Quadro P620
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£3,739.99 INC VAT

3XS WI8000 Viz

- 2 x Intel® Xeon™ Silver 4114 10 Core with HT
- 128GB ECC Registered DDR4 2666MHz
- 8GB NVIDIA Quadro P4000
- 250GB SSD & 2TB HDD
- 3 Year Premium Warranty

£5,099.99 INC VAT

Intel Inside®.
Powerful Productivity Outside.

SCAN

HP Envy x2 12-e051na (Snapdragon)

The HP Envy x2 is a great 2-in-1 laptop with sterling battery life, but it can't serve as your only work device

SCORE ★★★★☆

PRICE £834 (£1,000 inc VAT) from currys.co.uk

This is not just another laptop. It could represent a huge change in the direction of the tech industry; a moment that, when we look back on it in years to come, we'll point at and say: "That's when everything changed."

Not that you'd think that to look at the HP Envy x2. On the face of it, it's just another 2-in-1. Another Windows 10 tablet with a keyboard cover and stylus. Another Surface Pro clone.

You're not a clone

Except it's anything but. Instead of an Intel CPU inside, the Envy uses a Qualcomm Snapdragon 835, the same chip found in many of 2017's flagship smartphones. Indeed, the Envy x2 has 4G capability built in. It even has a phone number people can call you on, plus a 4G EE SIM with 24GB of data (or buy it SIM-free from HP for £849 for a limited time).

The £999 price includes the keyboard and active stylus, which matches a Microsoft Surface Pro (Core m3) with the Type Cover and Surface Pen included. And it's around the same price as the most basic Apple iPad Pro 12.9in with the Smart Keyboard (but no stylus).

The HP is better equipped than either the Surface Pro or iPad, though. Not only does it comes with that 4G modem built in, but 128GB of UFS 2.1 flash storage. The basic iPad Pro comes with 64GB storage and the Surface Pro with a 128GB SSD, but neither comes with 4G. With the keyboard and stylus included in the box, the HP Envy x2 is a great deal.

Solid build

The HP Envy x2 isn't as elegant as either the Surface or iPad Pro, but it's still an attractive unit. Built around a 12.3in, 1,920 x 1,080, Full HD IPS display, it exudes quality.

BATTERY: video playback, 11hrs 48mins

The x2 is slim at 7mm and weighs only 720g, which rises to 1.21kg with the keyboard folio case attached. You don't get much connectivity – there's a single USB-C port and a pin-eject microSD tray on the left, and a 3.5mm audio jack on the right – but this is designed as a mobile device rather than a desktop replacement. And if you do need extra ports, a basic USB-C dock won't cost a fortune.

As with the Surface Pro, the case serves a triple purpose: to protect the tablet from damage in your bag; to prop up the screen at a comfortable angle when you're working on it; and to be used as a keyboard in its own right. It does all three jobs admirably. The rear cover splits in two and folds back to act as an adjustable kickstand.

It's a touch bulky, since it wraps around both the front and rear of the tablet. However, that means it provides protection for both sides of the tablet, while the Surface Pro and iPad's keyboard covers protect only the front. It also works well perched on your lap, thanks to the grippy fake-leather material the case is constructed from, and, if you drop it, the Gorilla Glass display should resist shattering better than regular laptop screens.

The keyboard itself is an excellent example of the breed. The keys have plenty of travel and a positive action, while the wide touchpad beneath is both sensitive and reliable. It has a heavy click action, which takes a while to get used to, but the HP Envy x2 is largely an enjoyable device to use.

ABOVE It's great to see the stylus and keyboard bundled as part of the £999 deal – plus plenty of data

"The case serves a triple purpose: to protect the tablet from damage; to prop up the screen; and to be used as a keyboard"

ABOVE This is the first Windows laptop we've tested to use a Qualcomm chip

The cameras are better quality than you get on most Windows machines, too. There's a 13-megapixel rear camera with HDR that takes decent photos, while the front-facing, 5-megapixel camera is also very good. There's no fingerprint reader, but the Windows Hello-compliant front camera means you can unlock the x2 without typing a PIN or password.

Strong display

In a world where edge-to-edge designs and 3:2 aspect ratio screens have become common, the HP's 16:9 wide-bordered display looks old-fashioned. It is, however, top quality. Contrast is an excellent 1,377:1, and maximum brightness reaches a stunning 505cd/m², which is enough that you can use the Envy in most conditions. It struggles in very bright direct sunlight, but is perfectly usable if you find a shady spot in the garden.

Colour accuracy is excellent, too. The screen covers 96.1% of the sRGB colour gamut and delivered an average Delta E of 1.45 in our tests, both of which are excellent results.

There's no problem with stylus sensitivity, either, and since the stylus supports both pressure and angle sensing, it's as fully functional as the Apple Pencil or the Surface Pen. The feel of the nib on the screen is a match for the Surface Pro, but you'll never match the sensation of writing with a real pen on paper.

Mixed performance

As good as the ergonomics, design and display are, the success of the HP Envy x2 hinges almost entirely on how the Snapdragon chip performs in day-to-day use. And on that front, the situation is mixed.

Like the Surface Laptop, this machine runs Windows 10 in S mode out of the box (the operating system formerly known as Windows 10 S), so unless you take advantage of the free "upgrade" to Windows 10 Pro, you'll be limited to installing apps and games from the Windows Store.

Stick with Windows Store apps and you'll largely be fine. Microsoft Edge works smoothly, as do basic tasks with Google Docs. Even when you load Edge up with tabs, the Envy x2 is snappy and responsive.

It's a different story when you switch to Windows 10 Pro and try to run full Windows applications. Since the Snapdragon hardware doesn't run Windows code natively, there's an extra layer of software translating the instructions of applications such as Chrome. This means that, although most things I tried to install worked, they didn't run quickly. Even basic apps such as Chrome run slowly, and I found they crashed regularly, too. And note that 64-bit apps don't work at all.

This also means there's no sensible way of running our benchmarks. Instead, I ran a few cross-platform mobile tests to get a feel for raw performance. GFXBench DirectX reported an average frame rate of 24fps in the Manhattan 3 test at native resolution, while Geekbench 4 delivered single- and multicore scores of 842 and 2,981.

These are far from stellar results; indeed, they're not much better than the Asus Transformer Mini, an Atom-powered Windows detachable from 2016.

Storage performance is middling, too. Running the AS SSD test gave sequential read and write speeds of 430MB/sec and 212MB/sec respectively. I'd expect more from a machine costing a thousand pounds.

The big attraction of the Envy x2 isn't outright performance, however, but battery life and the integrated, Gigabit-class 4G. On both fronts, the HP Envy x2 delivers. The battery life is, quite simply, brilliant. That said, in our video-rundown test, we couldn't reach Qualcomm's claimed battery life of more than 20 hours, with the x2 lasting 11hrs 48mins in Flight mode with the screen set to a brightness of 170cd/m².

This translated into phenomenal stamina in regular day-to-day use. I worked on the Envy x2 for a full day – emailing, messaging, writing and browsing the web for research – and it still had enough juice left to last a weekend of occasional browsing and online shopping.

Almost there

The HP Envy x2 is no mere proof-of-concept: this is a fine 2-in-1 laptop and – with the bundled data and accessories – a better deal than the Core m3 Surface Pro or the 12.9in Apple iPad Pro. The trouble is, in many ways it isn't as good as either.

LEFT Typing on the Envy x2 is a surprisingly pleasant experience: HP gets the basics right

On the one hand, its performance is acceptable for lightweight tasks and its battery life is exceptional. But, on the other, you can get more done without losing much stamina if you opt for one of the better Intel-based machines. Or you could buy an iPad Pro 12.9in and get equally good battery life and more power (plus a far better range of apps).

While I like the HP Envy x2, it feels like a product that's ahead of its time. Perhaps when the next generation of Windows on Snapdragon products roll around, with the more powerful Snapdragon 850 onboard, they'll better justify the price. For now, though, I'd advise most people to stick with a regular laptop or an iPad Pro. **JONATHAN BRAY**

RIGHT Even with the wraparound case, this is a slim and light 2-in-1

SPECIFICATIONS

Octa-core 2.2GHz Qualcomm Snapdragon 835 processor • Adreno 540 graphics • 4GB RAM • 4G modem • 12.3in IPS display, 1,920 x 1,280 resolution • 128GB UFS storage • 13MP rear camera • 5MP front camera • 802.11ac Wi-Fi • Bluetooth 5 • USB-C 3.1 • microSD card slot • Windows 10 S • 45Wh battery • HP Digital Pen • tablet only, 293 x 210 x 6.9mm (WDH) • 700g • 1yr warranty

Asus ZenBook 3 Deluxe UX490UAR

Squeezing a 14in screen into this slender 1.1kg frame remains a great feat, but it should be quicker

SCORE ★★★☆☆

PRICE £1,142 (£1,370 inc VAT)
from pcpro.link/288zen

Just as IBM did with the ThinkPad, Asus has made a design decision with the ZenBook and stuck with it. The result: one glance and you know exactly what you're getting. An ultra-thin laptop, brushed aluminium finish and rounded corners. Even with the gold edging, the royal blue finish you see here isn't to everyone's taste, but Asus offers it in aluminium grey as well.

What's changed from predecessors is the specification. An Intel Core i7-8550U processor is the key element, with the "8" signifying that this is an eighth-generation chip. With four cores and eight threads, 16GB of RAM and a fast 512GB NVMe SSD, this is a machine set up for speed.

However, I was disappointed in its overall score of 61 in our benchmarks. It performed well in our shorter image-editing tests, but once the benchmarks stretched beyond ten minutes the cooling system hit its limit. It only performed a bit better in the Geekbench 4 tests: 4,699 single-core, 11,907 multicore. Tellingly, the case near the processor grew hot to the touch as well. All of these results were with Asus' Quiet Fan utility switched off – switch it on, and the ZenBook will attempt to cool itself without using the fan and you can expect even slower performance.

Although I would have preferred stronger scores, my suspicion is that the majority of people will still find this a nippy machine. For most, a far bigger factor is battery life, and here the ZenBook lasted a creditable 8hrs 2mins in our video rundown tests. Add the 12.9mm-thick chassis and 1.1kg weight, and this is one of the most portable 14in laptops around.

Despite this slenderness, the speakers are great. Gone are the days of weedy sound in ultraportables: the four speakers combine with excellent effect, adding mood to movies and vim to vocals.

The screen is also a pleasure to watch films on, with a contrast ratio of 1,414:1 and a maximum brightness of 289cd/m² on battery and 337cd/m² when plugged in. Don't expect it to display every colour on the spectrum: it covered 82.1% of the sRGB gamut in our tests, which dropped to 59% for the Adobe RGB gamut.

Those figures are similar to the HP Envy 13 opposite, but the ZenBook's Delta E figures show this is a superior panel. Its worst result was 5.05, for greens, but an average of 2.08 is darn close to a calibrated monitor. In short, so long as you aren't a photographer or video editor, you'll be happy.

It's a 14in panel with a Full HD resolution, and that 0.8in over the 13.3in panels in most ultraportables is obvious in practice. If your eyesight isn't as sharp as it once was, you'll like the fact you don't need to lean in as close to see what's on-screen. It's just a shame that Asus hasn't slimmed down the side bezels: at 9mm, they're twice the size of some rivals.

I'm also surprised it hasn't inserted a Windows Hello-compatible infrared webcam into the generous 18mm bezel at the top (you're stuck with a miserable VGA webcam for Skype calls). Instead, it expects you to enroll your fingerprint via the tiny square sensor tucked into the top-right of the touchpad. This is okay, but with so much space elsewhere, it's an odd decision.

ABOVE It may not cover every colour on the spectrum, but the screen is great for watching films

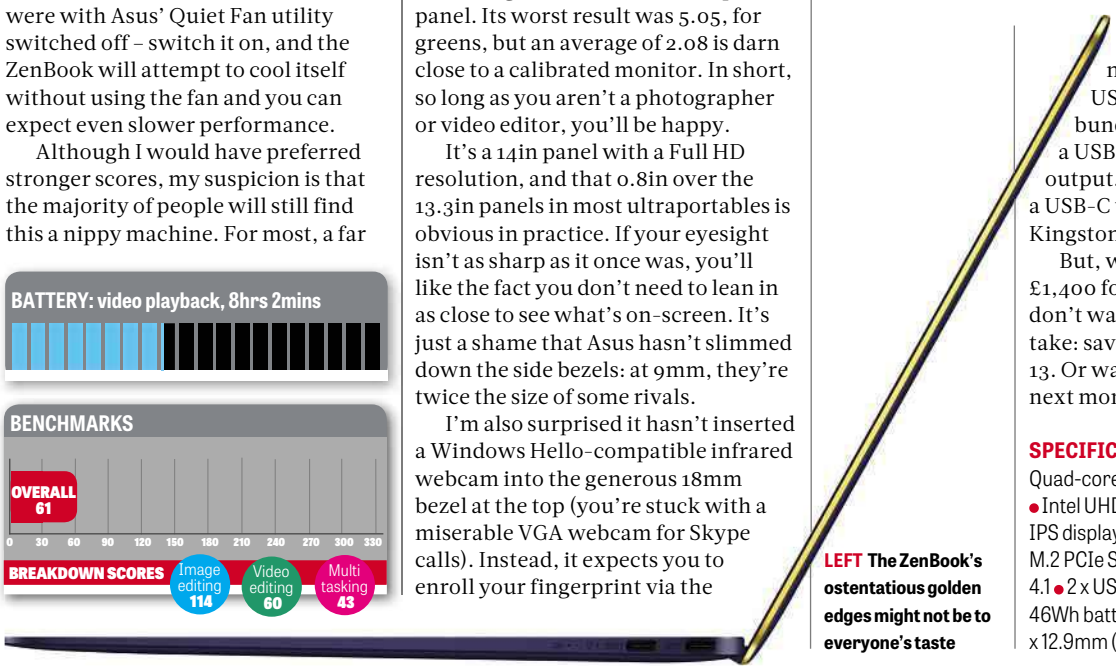
The keyboard is quiet to type on and, with large keys, touch typists will have no trouble hitting high speeds. Asus makes no silly mistakes with positioning too, with separated cursor keys, a double-height Enter key and a generously sized Backspace button. Don't expect much feedback from the short-travel keys, though.

I have mixed feelings about the physical connections. I like the two Thunderbolt 3 ports, because this gives you so many options: buy a Thunderbolt 3 dock and you can turn this machine into a proper workstation: dual 4K displays at 60Hz, Ethernet connectors, USB ports, the lot.

"Gone are the days of weedy sound in ultraportables: the four speakers combine with excellent effect, adding mood to movies"

But, for now, the lack of conventional USB and video ports means you'll need to carry around the mini USB-C port replicator Asus bundles in the box: this gives you a USB Type-A port and HDMI output. Still, you're better off buying a USB-C travel adapter such as the Kingston Nucleum (£60 on Amazon).

But, when you're paying almost £1,400 for a laptop, you probably don't want to fork out more cash. My take: save money and buy a Dell XPS 13. Or wait for our Ultrabooks Labs in next month's issue. **TIM DANTON**



LEFT The ZenBook's ostentatious golden edges might not be to everyone's taste

SPECIFICATIONS

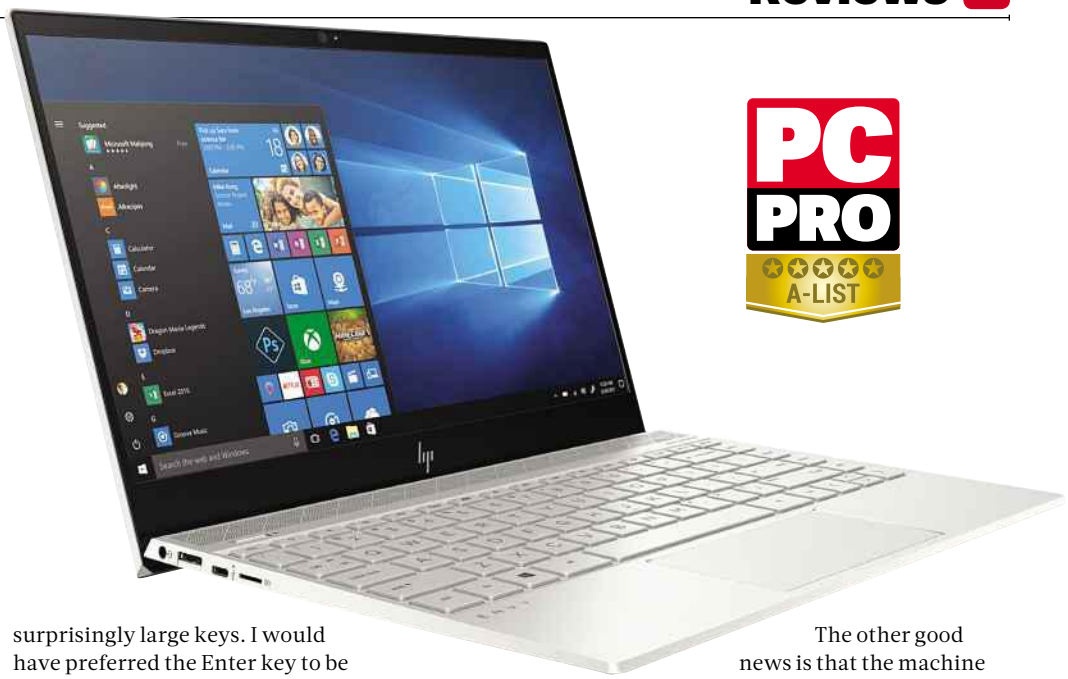
Quad-core 1.8GHz Core i7-8550U processor • Intel UHD Graphics 620 • 16GB RAM • 14in IPS display, 1,920 x 1080 resolution • 512GB M.2 PCIe SSD • 2x2 802.11ac Wi-Fi • Bluetooth 4.1 • 2 x USB-C Thunderbolt 3 • USB-C 3.1 • 46Wh battery • Windows 10 Home • 329 x 242 x 12.9mm (WDH) • 1.1kg • 1yr limited warranty

HP Envy 13 (2018)

Not without flaws, but the 2018 update of the Envy 13 is the best-value ultraportable we've ever seen

SCORE ★★★★★

PRICE £708 (£849 inc VAT)
from hp.com/uk



PC PRO A-LIST

It's been some time since I've been so surprised by a laptop's price that I utter the words, "How much?" out loud. But that's precisely what happened when I scoured HP's website for this 2018 update to the Envy 13 family. I had it pegged at four figures, perhaps £999 at a push. But £849? For this? That's a bigger bargain than two-for-one on Pringles.

Much stems from the design. Cast in aluminium, it looks stylish without the ostentatious gold flashes of HP's Spectre range. And while its bezel isn't as slim as the Dell XPS 13's, it still has an edge-to-edge look due to the Gorilla Glass stretching from side to side and top to bottom.

This is a touchscreen too, but don't get too excited: it's a nice-to-have rather than a vital inclusion, because the screen doesn't fold back to create a tablet. In fact, the screen is the main sign of cost-cutting: sRGB gamut coverage of 76.5% is okay, but an average Delta E of 3.29 means colour accuracy isn't its forte. Indeed, I measured a Delta E of 13.3 for reds, which is nothing short of appalling.

Nor is it the brightest screen. With a peak brightness of 278cd/m², I often found myself hitting the brightness up button in the hope of a bit more punch. Still, in combination with its 1,119:1 contrast ratio, watching Netflix proved a pleasure: HP rightly makes a fuss of the four Bang & Olufsen-tuned speakers, which are surprisingly rich.

One neat touch is that the rear of keyboard rises by a few millimetres as you open the screen, making typing more comfortable. The keyboard itself is unfussy, with spaces between the surprisingly large keys. I would have preferred the Enter key to be double-height, but that's my sole criticism: there's no annoying function doubling, the power key sits separately so can't be hit accidentally, and the keys themselves have a pleasant feel. I could type on this laptop for hours.

This isn't a Microsoft Precision touchpad, which is a shame because it misses out on some Windows 10 gestures. However, it still includes the basics – such as resting three fingers and swiping up to reveal the Timeline feature – and responds accurately.

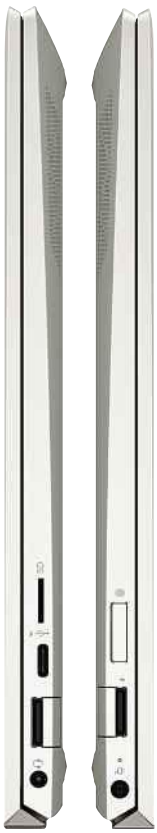
Some people may not like HP's positioning of the fingerprint reader, which sits on the right-hand of the chassis next to one of the two USB 3.1 ports. I soon got used to this, though, and applaud the supplied ports. There's no dedicated video output, but a USB-C 3.1 port means you can connect a screen directly or via an adapter – HP includes an HDMI one in the box. I would have liked the more flexible Thunderbolt 3 rather than USB-C, but for most people this point will be moot.

There's a microSD slot, and a 3.5mm headphone jack, but you should consider a permanent USB-C docking station for use at a desk. This can then add Ethernet ports and extra USB ports, with some also providing power charging.

The Envy will just about survive a working day on a single charge. It lasted for 7hrs 10mins at 170cd/m², which is okay but not a great result compared to rivals. Fortunately, it can charge back up to 50% within 45 minutes.

ABOVE The 2018 HP Envy 13 looks stylish with its Gorilla Glass screen and smooth, aluminium body

"One neat touch is that the rear of the keyboard rises by a few millimetres as you open the screen, making typing more comfortable"



LEFT A weight of only 1.21kg and a height of 14.9mm means the Envy 13 lives up to the title "ultraportable"

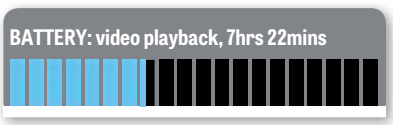
The other good news is that the machine is so slim and light you can chuck it in a bag and forget it's there. I weighed it at 1.21kg, and with a width of 307mm and height of 14.9mm it deserves the ultraportable moniker.

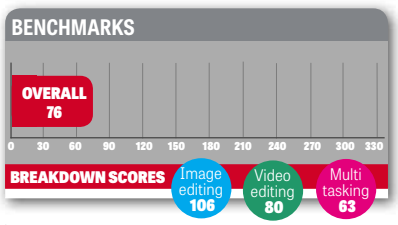
Despite that slim chassis, HP includes a respectable specification. The Core i5-8250U is a great mid-range chip, and even though you only get 8GB of RAM in this spec it powered to a creditable 76 in our benchmarks. There is fan noise when it's pushed, but in general use I never noticed it kick in.

There's even some gaming capability, with a GeForce MX 150 inside. It isn't the fastest chip, but it hit an average of 38.9fps in *Metro: Last Light* at the screen's full resolution – but I had to drop the quality to Medium and switch off all effects. It even proved capable of VR using a Windows Mixed Reality headset. The Steam VR environment is beyond it, though.

There are higher-spec versions of the new HP Envy. Codes that begin with 'ah000' identify the 2018 models and, for instance, I would seriously consider the £1,099 ah0003na, which includes 16GB of RAM, a 512GB SSD and a Core i7-8550U.

But the ah0001na we reviewed is the true bargain. Yes, the screen isn't the best and there are minor bugbears, but for £849 you're buying a high-quality laptop with all the power most people need. **TIM DANTON**





SPECIFICATIONS

Quad-core 1.6GHz Core i5-8250U processor • 2GB Nvidia GeForce MX150 graphics • 8GB RAM • 13.3in touch IPS display, 1,920 x 1080 resolution • 256GB M.2 PCIe SSD • 2x2 802.11ac Wi-Fi • Bluetooth 4.2 • USB-C 3.1 • 2 x Type-A USB 3.1 • microSD card reader • 53.2Wh battery • Windows 10 Home • 307 x 212 x 14.9mm (WDH) • 1.21kg • 1yr C&R warranty

pcspecialist

CUSTOM GAMING
DESKTOP & LAPTOPS

ORDER ONLINE NOW AT

WWW.PCSPECIALIST.CO.UK

GET A FURTHER £15 OFF WITH THIS EXCLUSIVE VOUCHER CODE:

PRO18

Some features require Windows 10. Update available through Windows Store. Internet access required; fees may apply.
Microsoft, and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

/PCSPECIALIST /PCSPECIALIST

Razer Blade 15 (2018)

A top-notch 144Hz display and Max-Q GeForce GTX graphics make this a winner – if you can afford it

SCORE ★★★★★

PRICE As reviewed, £1,942 (£2,330 inc VAT) from razer.com

PC PRO RECOMMENDED

Razer's Blade series of ultra-skinny gaming laptops have always been an easy sell, but this latest iteration is its best yet. With a fresh design and cutting-edge internals – including the latest Max-Q Nvidia GPUs – the Blade 15 is a mobile gaming beast. If you're a hardcore gamer who happens to have a hefty trust fund to raid, keep on reading.

The star of the show is a buttery-smooth 144Hz screen. And notably, a 15.6in one. Razer has performed some witchcraft to ensure that this Razer Blade is the same weight and size as its 14in predecessor. How? In a trick borrowed from the Dell XPS 13, it's dropped the thickness of the side bezels to 4.9mm.

Our review model includes a 1,920 x 1,080 IPS screen, but be careful when you order: the bottom-end Blade 15 only includes a 60Hz Full HD screen. I recommend sticking with the 144Hz display – quite aside from the extra responsiveness in games, it's simply wonderful. The panel proved capable of producing 90.3% of the sRGB gamut, with an average Delta E of 2.16 and a maximum of 4.48. A top brightness of 330cd/m² is less praiseworthy, but that's still fine if you keep out of direct sunlight.

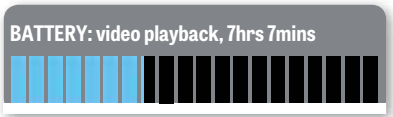
If you opt for the 144Hz Full HD screen, you have three options: GTX 1060 graphics and 512GB of storage for £1,980, GTX 1070 and 256GB of storage for £2,150, or a GTX 1070 with 512GB of storage for £2,330, as tested. If you're spending £2,000, there's a strong argument for going all the way and spending another £350. You can also wait for the 144Hz 4K touch version, but the price is likely to approach £3,000.

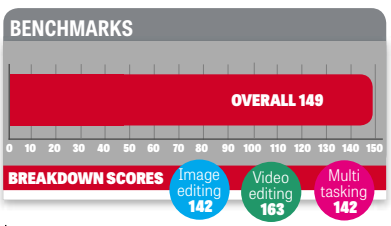
Each Blade 15 is equipped with Intel's six-core, 12-threaded, eighth-generation Core i7-8750H processor, clocked at 2.2GHz and capable of boosted clock speeds up to 4.1GHz. With 16GB of 2,667MHz DDR4 RAM, it stormed through every test. In our benchmarks, it managed an exceptional image test score of 142, which is on par with a pricey desktop system. Its overall score of 149 makes this the fastest ultraportable gaming machine we've tested.

Even being a downclocked Max-Q model – which it has to be to fit inside this chassis – the GTX 1070 ensures slick gaming performance. At its native resolution, the Blade produced a smooth 91fps in *Dirt: Showdown*, and that was with its highest settings; switch down to 720p and this shoots up to over 100fps. *Metro: Last Light Redux* proved more taxing on Very High settings but still recorded playable results. With SSAA switched off and all the other quality settings dialed to full, it managed 55fps.

The 512GB SSD is also quick. I used the AS SSD benchmark to record a sequential read speed of 1,013MB/sec and a sequential write speed of 2,099MB/sec

Battery life is much improved on the 14in Blade, too. With an improved heat pipe, larger vapour chamber and dual cooling fans, it survived for 7hrs 7mins in our video rundown test. That's almost an hour and a half longer than its predecessor in the same conditions. Gaming will drain the 80Wh battery significantly faster, but the Blade only lost a fifth of its charge following an intense 30-minute *PUBG* shootout.





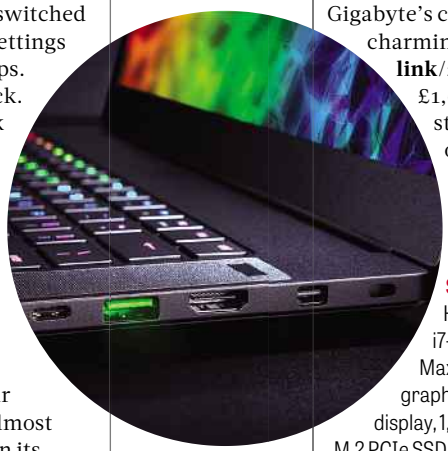
ABOVE The Razer Blade is as striking as ever, with an all-black chassis and RGB-backlit keyboard

Some things stay the same as before, most notably the three-headed green snake logo illuminating the laptop's lid, the all-black aluminium chassis and the RGB-backlit keyboard. Each key is nicely spaced and will be just as good to use whether you're pounding the WASD cluster or using it to write an email. The glass-topped Windows 10 Precision touchpad, meanwhile, has slightly increased in size and is lovely to whizz your finger across.

"With an improved heat pipe, larger vapour chamber and dual cooling fans, it survived for 7hrs 7mins in our video rundown test"

Despite its slim chassis, the Blade 15 has more than enough ports for your travels. The right side includes a Thunderbolt 3 USB-C port, HDMI 2, mini-DisplayPort and a Type-A USB 3 port. The left houses a further two USB 3 ports and a 3.5mm audio jack, while 2x2 802.11ac and Bluetooth 5 cover wireless duties.

So this is an attractive machine. If the price is too high, then consider Gigabyte's cheaper but not-so-charming Aero 15X (**pcpro.link/288aero**), which starts at £1,659. But if you're already stockpiling 2018's long list of PC game releases, and you can afford it, you'll love the new Razer Blade 15. **NATHAN SPENDELOW**



ABOVE There's a good range of ports on each side, including HDMI 2 and mini-DisplayPort

SPECIFICATIONS

Hexa-core 2.2GHz Intel Core i7-8750H processor • 8GB Max-Q Nvidia GeForce GTX 1070 graphics • 16GB RAM • 15in IPS display, 1,920 x 1080 resolution • 512GB M.2 PCIe SSD • 2x2 802.11ac Wi-Fi • Bluetooth 5 • USB-C Thunderbolt 3 • 3 x Type-A USB 3.1 • HDMI 2 • mini-DisplayPort 1.4 • 80Wh battery • Windows 10 Home • 355 x 235 x 17.3mm (WDH) • 2.1kg • 1yr limited warranty

Nest Hello vs Ring Video Doorbell 2

The Hello has more advanced features, but Ring's device is easier to use and costs less – it's our pick of the two

Nest
SCORE ★★★☆☆

Ring
SCORE ★★★★☆

PRICE **Nest, £191 (£229 inc VAT) from nest.com; Ring, £149 (£179 inc VAT) from pcpro.link/288ring**

Once the sole domain of the wealthy and paranoid, video doorbells are booming in popularity. It's easy to understand why. They let you see and speak to whoever's at the door without having to open it; they can monitor the outside of your house and alert you when motion is detected; and they allow you to be in when you're out – especially useful if a courier turns up with a package unannounced.

Nest is the latest big name to join in the fun, with the Google-owned brand releasing the high-end Hello to take on the market-leading Ring Video Doorbell 2. Let battle commence.

Ease of setup

Ring wins the ease of setup round hands down. Even a novice DIY-er with a screwdriver and a few minutes to spare should be able to get it up and running in less than half an hour – you don't even have to own a screwdriver as one is included in the box.

That's mainly because the Ring Video Doorbell 2 is powered by a removable and rechargeable lithium-ion battery. All you need do is screw it onto your door frame, charge up the battery and screw the cover on. Next, it's a simple matter of downloading the app to your smartphone, running through the setup routine and signing up for a Ring account so you can access and download clips once they've been recorded. The doorbell connects to your home Wi-Fi via 2.4GHz 802.11n.

ABOVE **Even a novice can set up the Ring, while installing the Hello may require professional help**

The Hello, on the other hand, is mains-powered only. Installation is quite involved, so I'd recommend getting a electrician to put it in or stump up the £100 installation fee Nest itself charges.

There are definite advantages to Nest's approach. Because it doesn't have a battery built in, it's more elegant than the Ring 2 and also looks much less like a security camera. There's no battery to pull out and recharge every couple of months or so and, as part of the setup, it can be integrated with your existing door chime if you have one.

Note that you can also integrate the Ring with your mains and an existing chime, but again you'll need some electrical know-how.

Video surveillance

Which brings us to to the Chime Pro, Ring's Wi-Fi extender unit that also acts as a chime. If you buy the Chime Pro as part of a bundle at time of purchase, the Ring's price rises from £179 to £199 (the Chime Pro costs £50 separately). The Nest Hello might look similar at £229, but that rises to £329 with installation and doesn't include the price of a chime. Overall, the Ring will probably cost around £130 less to get set up than the equivalent Nest product.

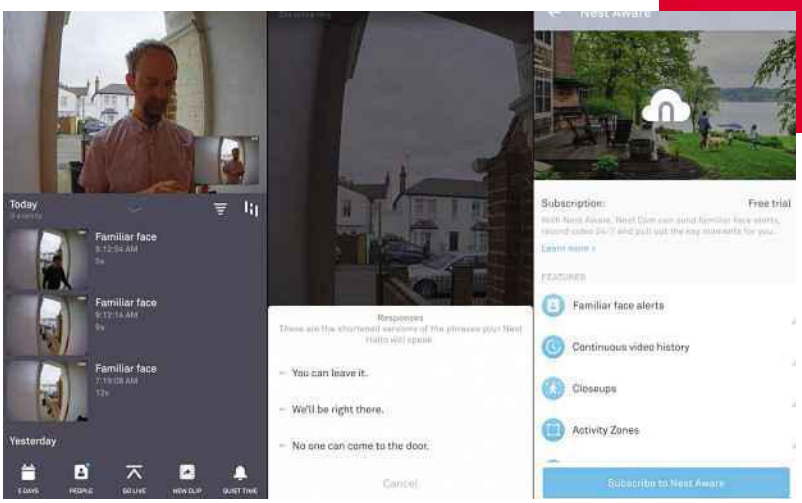
Also consider subscription costs for the companies' online video storage facilities. Ring's prices start at £25 per year, Nest's at £30 per year. You'll need to pay for this after the first month – otherwise, you can't view clips after they've been recorded or download them for sharing with the police if you've been broken into.

The Nest Hello's video resolution isn't as high as the Ring Video Doorbell 2. It's 1,600 x 1,200 (recorded on a 1/3in sensor), while the Ring 2 records 1,920 x 1,080 video. In most other respects, however, the Nest matches or betters its rival.

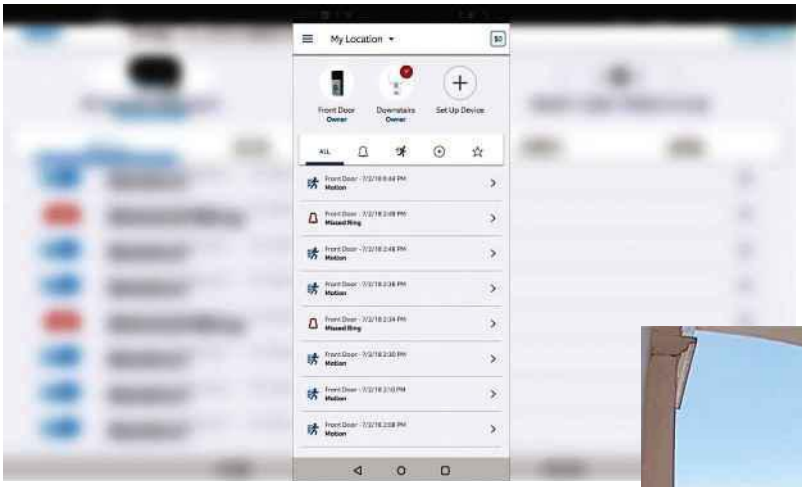
ABOVE **HDR means that the Nest can deal with tricky light and infrared LEDs boost its night vision**

The first area of superiority is that the Nest records video 24/7, just like a regular security camera, and it saves that video direct to Nest's servers. This means you can review any minute of the day, whereas the Ring 2 records clips only when it detects motion.

The level of subscription you buy determines how far back you can go in your video history. The cheapest £30-per-year subscription gives you access to continuous video recording five days into the past; the next level up is £40 per year for ten days; and if you want a full month (30 days), it's an incredibly pricey £200 per year.



LEFT **The Hello's "familiar face alerts" give you a tailored announcement whenever a regular visitor arrives**



LEFT You will get a notification when the Ring detects motion, but you can set zones to avoid constant smartphone pings

BELOW The Ring's fisheye lens gives you a 160-degree, wide-angle view of outside

Ring's subscriptions, conversely, are far more reasonable. You don't get continuous video recording, but at £25 per year for 60 days of access to your recorded clips, it's more flexible.

Hello's clever features

It is possible to run a Nest Hello without one of these subscriptions. You'll still get alerts on your phone when someone rings the doorbell and will still be able to carry out a conversation remotely via the doorbell's speaker and microphone when you're not in.

But if you do, you'll miss out on many of the system's cleverest features. The best of these is the Hello's "familiar face alerts" feature, which works in a similar fashion to Nest's Cam IQ security cameras. Whenever someone new comes to the door, the app asks you if you want to ignore or add that person to your list of familiar faces. Then, whenever that person comes to the door again, you get a personalised announcement via (if you have one) your Google Home or Home Mini speaker.

Frustratingly, this doesn't work nearly so well on the app. Sometimes a face is labelled when someone you know arrives at the door, but mostly all you get is a notification that "someone" has rung the bell or that a "familiar face" has been spotted. You can filter by "familiar faces" to make it easier to track down when people are coming and going, but it would be nice to have the faces feature actually work properly via the app.

The ability to create timelapse movies of sections of saved video is another neat option, as is the closeups feature, which automatically zooms in on areas of action when something happens within the frame. These are still considerably less useful than knowing when your kids get home from school, however.

The Nest Hello doesn't neglect the basics. Video quality is crisp and clear, as is the speaker and audio quality; HDR ensures the camera copes with tricky lighting conditions well; and infrared LEDs mean it can see in the dark.

It's wonderful being able to converse with couriers and let them know where to leave a parcel but, if you don't want to talk yourself, the Nest Hello also offers a list of canned responses you can use.

The one big caveat is that with continuous video recording, you'll be using an awful lot of data on a day-to-day basis. In Low quality mode, this equates to 30GB per month; in Medium quality it's 120GB per month; and in High quality it's a mind-boggling 300GB per month.

You can record to a schedule or disable it automatically while you're home, but that does somewhat negate its usefulness as a security device. Essentially, you need an uncapped data plan to make the most of the Nest Hello. If you don't have one, this isn't the product for you.

Ring fights back

How do the Ring Video Doorbell 2's features compare? Rather poorly. In particular, it doesn't have the face recognition or continuous video recording of the Nest Hello – it relies on a doorbell press or motion detection to trigger the notifications and video clip recording.

You can set it up so that it gives a pre-chime as a visitor approaches the door, giving you advance warning that someone is about to ring the bell. And it also works with Echo devices, meaning you can hear that someone is at the door wherever your Echo happens to be. Plus, if you own an Echo Show or Spot, you can see the view from the camera.

Frustratingly, though, you can't talk through the Echo to your doorbell: you still need to use the app.

Nor is the motion detection perfect. In theory, you can set up motion "zones" so notifications don't go off when you don't want them to, but they're imprecise. I would prefer to be able to draw a box on the screen to limit what triggers the pre-chime. Instead, Ring only allows you to reduce or increase the sensitivity and change the direction.

But, just like the Nest Hello, Ring gets all the basics right with the Video Doorbell 2. Video quality is excellent: it records at 1080p so you'll be able to clearly make out faces, it has infrared LEDs so it can see in the dark, and its fisheye lens gives you a 160-degree, wide-angle view so you'll be able to capture video to the sides of the camera as well as directly in front. Audio comes through loud and clear.

If all you're looking for are the key features of a video doorbell – being able to speak to couriers when you're out, checking who's ringing the bell – then it does the job perfectly.

Which to buy?

The Nest Hello is clearly a fantastic product. It works beautifully, and it's more elegant and far cleverer than its main rival, the Ring 2 video doorbell. However, it still suffers from the same issues as the rest of the Nest cameras.

"The Nest Hello doesn't neglect the basics – video quality is crisp and clear, as is the speaker and audio quality"

The first is that it's expensive to buy and install – considerably more so than the Ring 2. The second is that the subscription is more expensive, at £40 per year for the cheapest plan. It's also data-hungry.

All these factors mean that, while brilliant, the Nest Hello isn't for everyone. It's replete with clever and convenient features, and a step ahead of the Ring Video Doorbell 2 from that viewpoint. But features aren't everything. Despite its foibles, the Ring's ease of use and more reasonable price mean it's the best video doorbell to buy right now.

JONATHAN BRAY

SPECIFICATIONS

Nest: 1,600 x 1,200 video • 160° field of view • infrared • 802.11n wireless • Bluetooth • 43 x 26 x 117mm (WDH) • Limited warranty

Ring: 1,920 x 1,080 video • 160° field of view • infrared • 802.11n wireless • Bluetooth • 64 x 27 x 128mm (WDH) • 2yr warranty

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

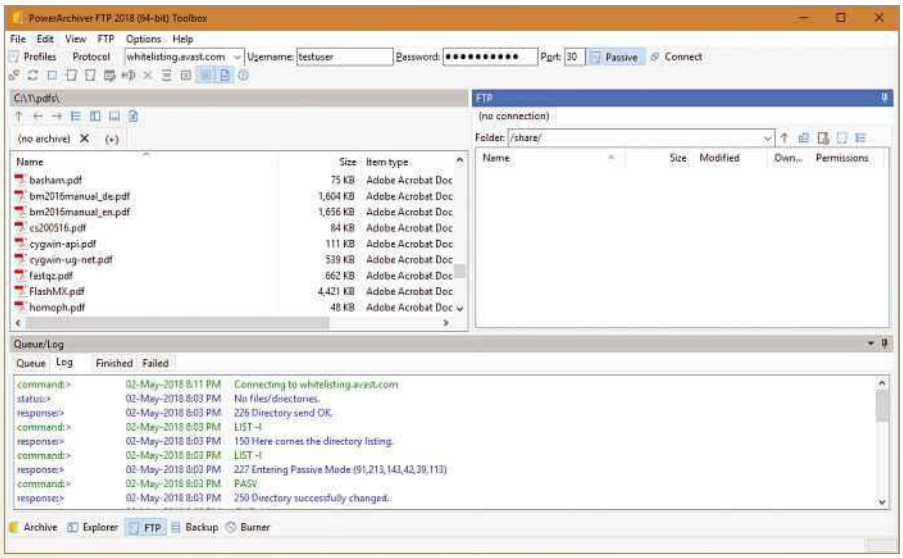
Total value this month £88

PowerArchiver 2018

- **Full product worth £17**
- **powerarchiver.com**

THERE ARE PLENTY of different archive formats, each with their own merits – but most operating systems only have built-in support for a limited range. This comprehensive archiving tool can read and write more than 50 different formats, including ZIP, 7-ZIP, TAR, GZIP and even ISO. It also supports high levels of encryption, allowing you to choose your preferred encryption standard. It can sign Adobe PDF and Microsoft Office documents, too.

PowerArchiver is extremely fast, and VSS and UAC elevation support help it cope with problems where other tools fail. It can even compress files that are in use or that you need administrator rights to access. There are also tools to repair archives, convert between formats, create self-extracting archives and a whole lot more. And it's all wrapped up in a slick, minimalist user interface that fits seamlessly into Windows 10.



REQUIRES **Windows XP or later; 150MB hard drive space; online registration**

How to claim your bonus software

1 Visit the *PC Pro* download site at **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**.

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 30 September 2018

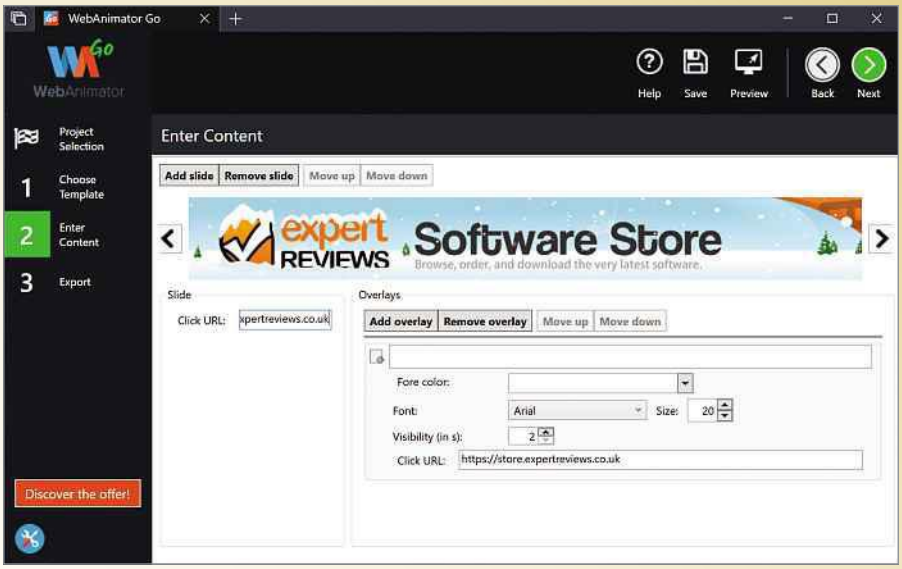
pcprodownload.co.uk

WebAnimator Go

- **Full product worth £19**
- **webanimator.com**

WANT TO GRAB the attention of visitors to your website? WebAnimator Go helps you produce stylish animated web graphics in minutes, without Flash or animated GIFs. Simply launch the application and choose the type of graphic you require – perhaps a zoom rotate, sliding text or a background effect such as falling snow in winter.

Next, set your size: WebAnimator Go supports a wide range of standard banner sizes. Then you can choose a background, add overlay graphics and set the effect duration. Once you're happy, simply export your banner for use on your website. If you want more, Incomedia offers two Template Packs, and if you choose to upgrade to WebAnimator Plus, you can also embed audio and video and include customised JavaScript code.



REQUIRES Windows XP or later; 10MB hard drive space; online registration

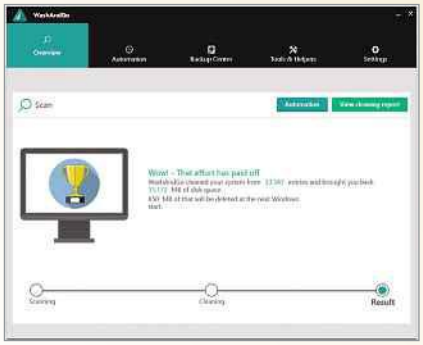
Ashampoo Undeleter

- **Full product worth £11**
- **ashampoo.com**

REQUIRES Windows 7 or later; 10MB hard drive space; in-application registration

- Automatically (and easily) search your hard drive for deleted files that haven't yet been overwritten
- Recover partial files, with full details of the resulting quality before you go ahead
- Works with NTFS with or without compression and encryption, as well as FAT 12, 16 and 32 partitions

WashAndGo 19



- **Full product worth £27**
- **abelssoft.net**

REQUIRES Windows 7 or later; 50MB hard drive space; in-application registration

- Restore your system to its original performance and stability with the most thorough clean possible
- Identifies leftover files and Registry keys to recover lost megabytes, with full control over what's retained
- Can be set to run when Windows starts, daily, or to your preferred schedule for true set-and-forget optimisation

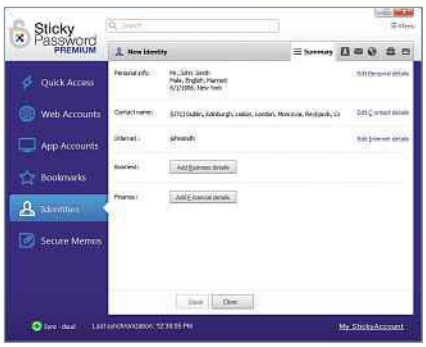
Malware Fighter 6

- **Six-month licence worth £7**
- **iobit.com**

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

- Scan for spyware, adware, trojans and bots that your regular antivirus software might have missed
- Includes real-time protection to monitor startup programs, browser settings, cookies and web history
- Offers scheduled scanning, protection against USB-borne viruses, process scanning and more

Sticky Password Premium 8.1



- **One-year licence worth £7**
- **stickypassword.com**

REQUIRES Windows XP or later; 50MB hard drive space; online registration

- Set unique passwords for every website without having to remember them yourself
- Allows you to set a master password to unlock all others, with optional second-level protection using a USB or Bluetooth device
- Includes an optional virtual keyboard for input to keep you safe from potential keyloggers

Linksys Velop Dual-Band

By shrinking its original design, Linksys has created a middling mesh system with little to recommend it

SCORE ★★★☆☆

PRICE £183 (£220 inc VAT)
from pcpro.link/288velop

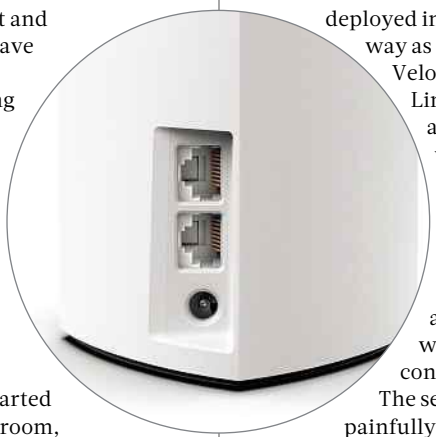
We've always liked the original tri-band Linksys Velop. One of the first consumer mesh networking systems on the market, it did a superb job of extending wireless coverage in the home. Only the price was hard to swallow: even now, a three-node pack will set you back £375.

Enter the Velop Dual-Band, a simpler, smaller system that ditches one of the 5GHz radios from each unit and slashes the price. The more petite design is rather endearing: at only 141mm tall, the nodes are easy to tuck away – but in the world of Wi-Fi, smaller dimensions imply shrunken aerials and a weaker signal.

That's borne out by the fact that Linksys recommends this triple-pack for homes up to 4,500 square feet, while the original system can cover up to 6,000 square feet. The loss of one 867Mbits/sec 5GHz radio means there's only one per node instead of two, so both client and backhaul traffic have to share the same channel, squeezing the available bandwidth.

To find out how much difference this makes, I put the Velop Dual-Band through my usual set of domestic tests (*see p79 for details*). Things started well: in the living room, the Velop Dual-Band model gave me a respectable 13MB/sec – slower than the 17MB/sec I'd got from the regular Velop, but still enough bandwidth to get the full benefit of a 100Mbits/sec internet connection.

But, once I started roaming about the house, speeds fell precipitously. In the bedroom, I got only 7MB/sec, versus the original Velop's 17MB/sec. And in the bathroom – always a tricky spot to reach, owing to a thick wall and a radiator – I got download speeds of merely 5MB/sec, compared to 11MB/sec for the larger units.



LEFT Like the MW3 opposite, each node only has two Ethernet ports – but this time they're faster

The reason became apparent once I delved into the technical details: the 5GHz signal from the Dual-Band nodes had proved too weak to project consistently through the walls in my home – a problem I hadn't had with the larger units – and my test laptop had automatically fallen back to the slower 2.4GHz band. This provides better penetration but, as we saw, slower speeds. And if you're tempted to force a 5GHz connection, you're out of luck, as the firmware doesn't support band splitting.

What you lose in advanced features, though, you make up for in ease of use. The Velop Dual-Band is deployed in exactly the same way as the original Velop, using the Linksys smartphone app. The setup wizard guides you through each step of the process, and it's convenient to carry the phone around the house with you as you configure each node.

The setup process is painfully slow, though – installing each unit involves a lot of waiting while connections are tested and established, and the whole rigmarole took me more than half an hour. Still, you should only have to go through it once.

By default, the Velop system replaces your existing router – although you'll still need to use its built-in ADSL modem, or buy a separate one – so once the nodes are in place, you may also want to spend some time configuring your home network. This can also be done through the app, or you can use the (rather sluggish) web portal. It's not the world's most feature-packed router, but you can reserve IP addresses for specific devices, set up port forwarding for local services, blacklist specific websites and enforce scheduling for individual devices.

ABOVE The pint-size nodes are easy to hide from view – but you're sacrificing signal

If you want to keep your router, you can set up the Velop nodes as access points. You may also want to do this if you have a lot of wired clients, as each Velop unit only has two Gigabit Ethernet ports – and, on the primary node, one is taken up by the connection to your modem or router.

"If you want to extend a stable wireless connection around a medium-sized property, it provides everything you need"

Once set up, you can pretty much forget about the Velop: the three nodes appear as one network, with the firmware automatically steering clients onto the strongest available connection from wherever they happen to be.

So should you buy it? The price above is for the three-pack version, but smaller homes could make do with the two-pack edition for £150. These prices bring it in line with the BT Whole Home Wi-Fi, but note the Tenda Nova MW3 opposite.

If you simply want to extend a stable wireless connection around a medium-sized property, the Velop Dual-Band provides everything you need in an unobtrusive package. But it's too lightweight to deliver top performance, even at medium range. For a faster network, check out the BT Whole Home Wi-Fi kit, and if price is key, look no further than the opposite page. **DARIEN GRAHAM-SMITH**

SPECIFICATIONS

3 x 802.11ac Wi-Fi units • 400Mbits/sec on 2.4GHz • 867Mbits/sec on 5GHz • 2 x Gigabit Ethernet ports per unit • iOS and Android apps • 79 x 79 x 141mm (WDH) • 1yr warranty

Tenda Nova MW3

By far the cheapest mesh wireless kit we've tested – what it loses in speed, it makes up for in convenience

SCORE ★★★★☆

PRICE £68 (£81 inc VAT)
from pcpro.link/288tenda

PC PRO RECOMMENDED

Mesh networking kits aren't cheap – or at least, that's the received wisdom. Tenda's Nova MW3 system turns that on its head: for less than the cost of a regular mid-range router, you get a full set of three Wi-Fi nodes, ready to distribute wireless connectivity to the far reaches of your home. At such a low price, can it possibly be any good?

First signs are excellent. The MW3 units are inconspicuous white cubes, with bumpy tops to add a hint of visual interest. They're small too, measuring only 90mm on each side, so they won't dominate a shelf. Getting set up is astonishingly easy. Once you've powered up your first node, and hooked it up to your modem, the Tenda smartphone app sets up your internet connection and invites you to specify a name and password for your new wireless network.

Then it's a simple matter of carting the other two nodes into different rooms, plugging each one in and waiting a few minutes while they boot up and receive their settings from the primary unit. A coloured LED on each unit will warn you if it's too far away from its brethren to get a good signal.

There's nothing more to configure unless you want to apply custom network settings. You can optionally enable an isolated guest network, configure port forwarding and set up simple parental controls, which let you block internet access for specific clients during defined times.

A few key features are missing, though. For one, you can't bind IP addresses to specific devices, which might annoy those who want to precisely replicate their old network. There's also no proper access point mode. If you connect the Tenda system to your existing router, it will operate as a separate subnet, which means that some clients might not be able to communicate with each other. Hopefully, that will be resolved in a future firmware update.

As well as 802.11ac wireless, each node offers two Ethernet connectors. That's par for the course for compact mesh systems, but it always feels rather constraining – especially since one port on the primary node is taken up by the connection to your broadband modem.

For several reasons, I wasn't expecting the Nova MW3 to deliver exceptional performance. For one, its 5GHz radios claim a modest maximum data rate of 867Mbits/sec, which is half that of the units in BT's Whole Home Wi-Fi (*see issue 282, p81*).

What's more, since there's only one radio per unit, your devices have to share that bandwidth with "backhaul" traffic as it's forwarded from node to node. The small size of the nodes meanwhile limits the size and, therefore, the range of the internal antennae: the three-node Tenda kit promises coverage up to 300m², while the BT system offers a much more generous 420m².

In use, though, I found the Tenda MW3 delivered a solid, if not exactly speedy, connection. Having distributed the units along the length of my home, I could download files from my NAS drive to an 802.11ac-enabled laptop at average rates of 9MB/sec in the living room, 8MB/sec in the bedroom, and 7MB/sec in the bathroom.

That's low compared to the best new standalone routers (*see p93*) and falls behind other mesh networks, too. The BT Whole Home Wi-Fi system was more than twice as fast in the living room and never slower than 12MB/sec. The discrepancy was larger than I had expected.

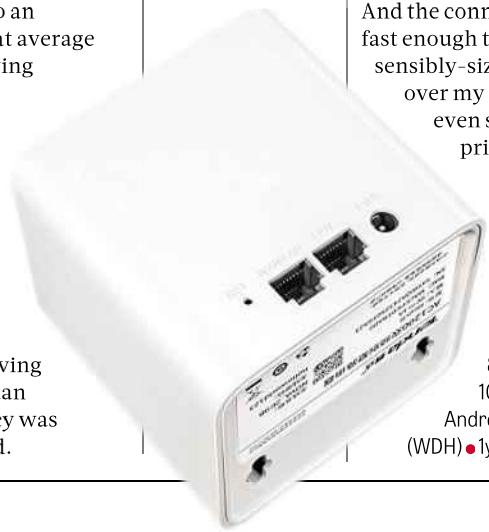
ABOVE The subtle, sugar cube-style design means the MW3 nodes won't dominate a room

A skim of the Tenda's technical specifications revealed the explanation. Alongside lightweight Wi-Fi hardware, the MW3 nodes also use 100Mbits/sec Ethernet ports, rather than the Gigabit type we're accustomed to. That puts a hard speed limit of around 10MB/sec on all wired resources – including your NAS drive and your internet connection. This doesn't have to be a deal-breaker, though. The system was still nippy enough to give me the full speed of a 50Mbits/sec (around 6MB/sec) fibre connection all through my home.

"The MW3 system cleared up the notspots in my home, with practically zero configuration required on my part"

If you're looking for superfast downloads or if you regularly access big files from a home NAS drive, then the Tenda Nova MW3 clearly isn't the right product for you. That doesn't mean it's a write-off, though. The MW3 system cleared up the notspots in my home, with practically zero configuration required on my part. And the connection was still perfectly fast enough to browse the web, ping sensibly-sized files back and forth over my home network and even stream 4K video. At this price, I suspect it will make a lot of people very happy. **DARIEN GRAHAM-SMITH**

BELOW Each of the MW3's nodes comes equipped with two Ethernet ports



SPECIFICATIONS
3 x 802.11ac Wi-Fi units • 300Mbits/sec on 2.4GHz • 867Mbits/sec on 5GHz • 2 x 10/100 ports per unit • iOS and Android apps • 90 x 90 x 90mm (WDH) • 1yr warranty

Loupedeck+

The photo-editing console's improved hardware and reduced price make this even more tempting for togs

SCORE ★★★★★

PRICE €191 (€229 inc VAT)
from shop.loupedeck.com

ABOVE The buttons of the Loupedeck+ are friction-free and have a much deeper travel than its predecessor

The first iteration of the Loupedeck photo-editing console landed on my desk last year (*see issue 276, p68*), and I loved it – bar one thing. The build quality didn't reflect its premium €369 price. The revamped Loupedeck+ not only corrects that significant shortcoming, it also costs almost 40% less.

For those unfamiliar with the Loupedeck, think of it as a mixing desk for Adobe Lightroom. Instead of using a mouse or regular keyboard to adjust exposures, contrast, vibrance or the dozens of other parameters you can tweak in a photo, Loupedeck lets you navigate and edit your photos from a console of dials, knobs and dedicated buttons.

LEFT You can do the same job with a keyboard and mouse, but the Loupedeck+ makes editing a more intuitive experience

It was those buttons that were literally the sticking point on the original Loupedeck. They were hugely unsatisfying and badly cut, leading keys to stick or requiring you to repeatedly prod a button to move to the next photo in the filmstrip, for example. Things are much improved this time around.

The buttons are friction-free and have a much deeper travel than the chiclet design of the previous model, leaving no uncertainty as to whether a button press has registered or not. The only way keys will get stuck now is if you spill a can of Coke over them in a late-night editing session.

It's not the only physical improvement. More customisable buttons and dials have been added, meaning if you make regular use of a setting or preset that hasn't already earned itself a dedicated button/dial you can assign it yourself using the Loupedeck software. Furthermore, there's now a Custom Mode, where you can assign alternative functions for all the main dials. However, it would be quite a feat of memory to remember the alternatives all those dials are assigned to.

Other strange choices are carried over from the original. The huge Control Dial in the top-left of the keyboard is still assigned to cropping/rotating images when developing photos, a peculiar choice to my mind. I would much rather it could be assigned to something such as exposure or sharpness, but this is one of the few dials on the board where that isn't an option. It has only a limited set of functions to which it can be designated.

That sharpening still hasn't been assigned a dial of its own is bizarre, although you can easily assign it to one of the two customisable dials yourself. You'll just have to remember which it is or place a sticker on the board.

It's also disappointing to see software support hasn't been extended to Photoshop, especially as many Lightroom users will flit between the two Adobe products. Perhaps it's understandable, though, as the variance in controls between the two products is significant.

Software support for the Loupedeck+ has at least expanded. If you're a fan of HDR photography, the console can also be used with Aurora HDR 2018, a niche package designed for creating those high-contrast, hyper-realistic looking images.

So, the physical design and software support have improved, but it's value for money that sees the biggest leap. While the €229 asking price for the Loupedeck+ is hardly pocket money, it's a much more reasonable proposition than before and a price likely to tempt those of us who spend hours at a time ploughing through thousands of photos in Lightroom.

"It's a price likely to tempt those of us who spend hours at a time ploughing through thousands of photos in Lightroom"

ABOVE The whopping Control dial in the top-left of the keyboard is used for cropping

And that remains the chief selling point of the Loupedeck+ – its ability to make those mammoth curating and editing sessions less tiresome. Ratings can easily be assigned to photos, or images selected as "picks" to help narrow down huge albums. You can boost the luminance of blues in the sky or the golden wheat in the fields without having to barrel down into Lightroom's submenus – it's just a button press and flick of a dedicated scroll wheel for each colour channel. Clarity, tints and colour temperatures can all be finely tweaked with the dials, without having to avert your focus from the full-screen photo in front of you.

None of this is impossible to achieve with mouse and conventional keyboard alone, and if you've already got the keyboard shortcuts for (most) of the above burned into your muscle memory, the benefits of the Loupedeck+ may be slight. But the Loupedeck – even a year after its release – is one of those rare pieces of hardware I look forward to working with, and the Loupedeck+ has only increased the pleasure.

BARRY COLLINS

SPECIFICATIONS

Supports Windows 7 and above, macOS 10.10 and above • 395 x 150 x 40mm (WDH) • 670g • 1yr RTB warrranty

From Apple to Zeiss, and everything in between

Try these magazines from just £1:

magazinedeals.co.uk/tech

Whether you're an IT professional or a first time buyer, Dennis technology has a magazine for you, all of which are written and produced by expert editorial teams. We cover the whole spectrum of technology news, reviews and features.

Iiyama ProLite X3272UHS-B1

A terrific value 4K display that offers few features but all the quality that most people need

SCORE ★★★★★

PRICE £250 (£300 inc VAT)
from box.co.uk

Two months ago I reviewed the super-stylish and super-flexible 32in ViewSonic VP3268-4K (*see issue 286, p65*), falling in love with its amazing colour accuracy. This ProLite represents a humble return to planet Earth, with modest aspirations matched by a modest set of features – but that's amply reflected in its price. After all, you can buy three of these Iiyama screens for the price of one ViewSonic.

Viewed in that light, and in comparison to other 32in 4K screens on the market, it offers amazing value. Because this is still a high-quality display. It covers 99.7% of the sRGB gamut whether in Standard mode or its "internet" preset, and while an average Delta E of 3.5 is hardly anything to shout about – if colour accuracy is important to you, you would hope for less than one – that's still good enough that most people will never notice.

It helps that its viewing angles are excellent. With a VA panel and LED backlighting, Iiyama claims 178° on both the horizontal and vertical – to the naked eye, there's very little drop-off to be seen. This isn't the most uniformly lit panel, however. In the top-left area, its brightness dropped away by almost 10% compared to the centre, with similar results at the bottom left. Will you notice? Probably not, but if you're wondering why this screen costs £300 and the ViewSonic £900, that's one giveaway.

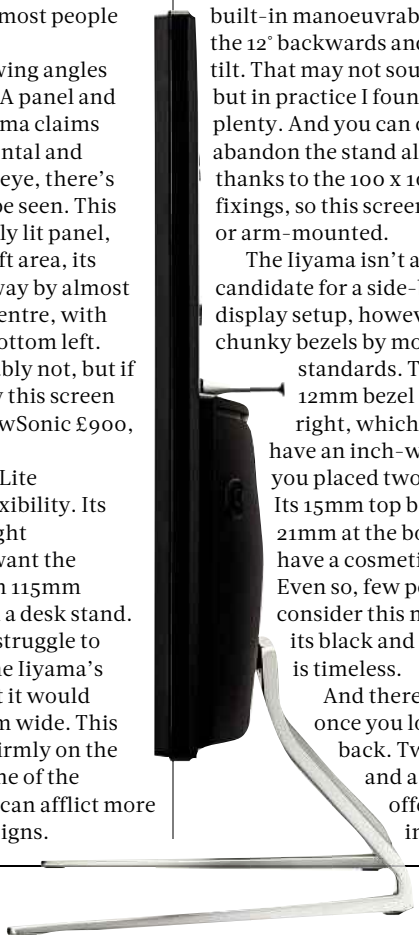
The other is the ProLite X3272UHS's lack of flexibility. Its metal feet offer no height adjustment, so if you want the screen lifted more than 115mm you'll have to invest in a desk stand. Even then, you might struggle to find one that works: the Iiyama's feet sit so far apart that it would need to be at least 40cm wide. This does mean that it sits firmly on the desk, though, with none of the irritating rocking that can afflict more stylish and narrow designs.

The practical side effect of the inflexible stand is that, if you want to show the contents of your screen to a neighbour, you have to manually rotate it. Not a difficult task when the whole unit weighs 6.8kg, but a pain. Office dwellers will appreciate the matte screen coating, though, which does a great job of minimising reflections from overhead lights.

With no portrait mode, the only built-in manoeuvrability comes via the 12° backwards and 4° forward tilt. That may not sound like much, but in practice I found it was plenty. And you can choose to abandon the stand altogether thanks to the 100 x 100mm VESA fixings, so this screen can be wall- or arm-mounted.

The Iiyama isn't a great candidate for a side-by-side display setup, however, with chunky bezels by modern standards. The key stat is a 12mm bezel on the left and right, which means you'd have an inch-wide border if you placed two side by side. Its 15mm top bezel, and 21mm at the bottom, only have a cosmetic impact. Even so, few people would consider this monitor ugly: its black and silver combo is timeless.

And there is good news once you look round the back. Two HDMI ports and a DisplayPort offer plenty of input choice,



LEFT **There are two HDMI ports and a DisplayPort around the back of the Iiyama**

ABOVE **Considering its low price, the ProLite's image quality is excellent**

PC PRO RECOMMENDED

"Office dwellers will appreciate the matte screen coating, which does a great job of minimising reflections from overhead lights"

and there's a picture-in-picture mode, if such things appeal. Of more day-to-day use is the pair of 2W speakers, which are basic but capable of belting out Radio 4 whilst you're typing away. There's even a place to store your headphones, with a 3.5mm jack tucked next to the video inputs.

The basic OSD reflects this screen's abilities. It's easy to navigate: press the rotary button down to activate, then rotate it in the relevant direction. You can manually tweak the colour temperature and the balance between red, greens and blues, but the most useful option is to flick between the presets. For example, the gaming mode maxes the brightness and lets you control the overdrive function from -2 to +2. With a 3ms response time, though, I found it performed perfectly well in games without adjustment – it's the 60Hz vertical refresh rate that holds it back.

Will this screen set your world alight? No. Will it make you the envy of your friends and colleagues? Again, no. But it will do a solid job and, at £300 a pop, it makes a particularly excellent choice if you're upgrading a batch of screens in an office environment.

TIM DANTON

SPECIFICATIONS

31.5in 3,840 x 2,160 VA panel • 8-bit +A-FRC panel • 4K at 60Hz • 3ms response time • DisplayPort 1.2 • 2 x HDMI 2 (with HDCP) • PiP • 2 x 2W speakers • -4° to 12° tilt • 730 x 254 x 546mm (WDH) • 6.8kg • 1yr limited warranty

Land Rover Explore

The Land Rover Explore is a great expedition companion, but it's hard to recommend as an everyday phone

SCORE ★★★★☆

PRICE £499 (£599 inc VAT)
from landroverexplore.co.uk

While many smartphones include some level of waterproofing, they aren't truly rugged. For that, you need to pay £800 or more for a specialist phone such as the CAT S61. Land Rover aims to hit the middle ground with the Land Rover Explore, a phone "created for the outdoors".

It's IP68 rated, which means it's resistant to dust and dirt and can be fully submerged to a depth of 1.5m for half an hour. A Mil Spec 810G rating means it can withstand extremes of temperature, humidity and altitude. Attach the bundled Adventure Pack and you not only boost its battery by 3,620 mAh and add a larger GPS antenna; it's also been drop tested to 1.8m. Then there's a robust case that can be attached to a belt or bag using a carabiner, and it comes with mapping app ViewRanger pre-installed, along with free map vouchers.

The phone borrows design cues from the iconic Land Rover Discovery. The casing's rounded corners mimic the shape of a bonnet, and the speaker grille below the display resembles the grille on the front of a car. Even the camera surround echoes the Defender's circular headlamps.

Despite its toughness, the Land Rover Explore isn't as chunky as you might expect. Yes, it's heavy at 228g, but it will fit happily in a trouser pocket. Connect the Adventure Pack and things get bulkier. In this state, it weighs 354g but you might prefer to slip in into the rubber case and attach it to a backpack. I did precisely that, but within a few minutes heard a thud as the phone landed face down on the pavement, leaving only the carabiner and the clip that connects it to the case still tethered to my bag.

The screen escaped unscathed, with only a few small chips on the bezel where it had come into contact with the tarmac. No doubt it helps that the phone's display is covered with Corning Gorilla Glass 5 and a tough factory-fitted screen protector (Land Rover has also worked with the Bullitt Group, which makes the CAT phones, to ensure the display will respond to gloved fingers, even when it's wet).

But then I saw the flaw in the design that caused the crash. When you hang the phone from its carabiner attachment, it constantly pulls against a small, 2mm plastic notch. Should you fail to engage the clip fully, or it becomes snagged, the attachment will come loose and the phone tumbles to the ground. Not great if you're abseiling down a rocky cliff face.

The Explore's 5in 1,920 x 1,080 display is fine for everyday use, covering 91.6% of the sRGB colour gamut. Contrast, though, was a woeful 739:1, which is probably a consequence of the screen protection. Land Rover compensates with a maximum 546cd/m² brightness, so it is at least easy to read in all but the brightest of conditions.

The area of greatest disappointment, though, was its performance. Its Mediatek Helio X27 chip produced scores of 1,768 and 4,818 in the single- and multi-core Geekbench 4 benchmarks respectively. That's on par with the two-generation old Snapdragon 821. The Explore returned an average frame rate of 20fps in the GFXBench 3 Manhattan onscreen benchmark, which is a long way behind other phones that cost this much money. In everyday use, swiping through menus, browsing the web, and even loading maps, you shouldn't have any problems, but this isn't a phone for playing graphically intensive games.

Considering the Land Rover Explore has a large 4,000mAh battery, I was also disappointed by its battery life, at least in our video rundown test. Without the Adventure Pack attached, the Land Rover Explore lasted 11hrs 13mins. In response, Land Rover says this isn't the sort of activity the phone has been optimised for; instead, it's been tweaked to deliver the best performance in activities that require GPS and cellular connection in areas of weak signal, so you can keep in touch while you're out in the wilds. This seems fair because, with the Adventure Pack attached, the Explore lasted several days between charges when used to record hour upon hour of outdoor activities in Strava.

You'll be able to capture sharp, colour-accurate pictures in good natural light, with the 16-megapixel rear-camera employing a f/2.0 aperture. Unfortunately, in low-light conditions there was an obvious lack of detail, with softness evident throughout the frame. And although the Land Rover Explore will shoot footage at up to 4K and at 30fps, it does so without video stabilisation.

ABOVE Design nods to the iconic Land Rover Discovery abound: the speaker below the screen even looks like a car's grille

"Land Rover's intentions are clear: to create a smartphone for those who spend much of their lives in the great outdoors"

Land Rover's intentions with the Explore are clear: to create a smartphone for those who spend much of their lives in the great outdoors. When assessed on those terms, it's a roaring success, oozing style and refinement while boasting practically every mark of robustness and resilience you could ask for in a smartphone.

However, the Explore's camera is below par and its day-to-day speed is that of a budget phone, not one costing £600. Consequently, I can't help but feel that, with such an iconic, luxury brand, it would have been better to equip the Explore with the best components possible, even if it meant charging customers £800.

EDWARD MUNN

BELOW The rugged case can be attached to a bag or belt with a caribiner – but make sure to engage the clip fully

SPECIFICATIONS

Deca-core 2.6GHz MediaTek Helio X27 processor • 4GB RAM • Adreno 505 graphics • 5in IPS screen, 1,080 x 1,920 resolution • 64GB storage • microSD slot • 16MP rear camera • 8MP front camera • 802.11ac Wi-Fi • Bluetooth 4.1 • USB-C connector • 4,000mAh battery • Android 8 • 75.3 x 14 x 152mm (WDH) • 232g • Adventure Pack bundle • 1yr warranty

How to choose the right phone for your VoIP needs

Great, you've made the switch to a legacy-free VoIP system. Now you need to make sure you choose the right phone to match your workforce's requirements

It's hard to get accurate advice on which IP phone to buy. There are plenty of advice articles on the internet, but they're often vague and it's not always clear whether they're simply there to make you buy the most expensive phone. To dig into the details, we spoke to Nick Borg, product manager for 3CX and a veteran of deploying many VoIP systems to businesses. As will become clear, he's just as keen for you to buy the right phone for your VoIP system as you will be.

SIP phones vs IP phones

First things first: what, we asked Nicolas, was the difference between SIP and IP phones. Or was that a stupid question? "It's not a stupid question! Yes, all SIP phones are IP phones, but you need to understand that there are many different VoIP protocols out there. They're like languages. So, when you're buying a SIP phone, you're buying a phone that can talk in SIP language – and because 3CX has chosen SIP, you need to make sure that your chosen IP phone speaks SIP."

Do you need an IP phone at all?

Surely, we suggested, people can get away with softphones? Isn't that why 3CX puts so much effort into the apps for Android and iOS phones? "Some people want a phone. They want to pick it up to answer it, they want to dial the numbers," said Borg. "I would reverse the question and look at it from the point of view of an administrator or the users themselves."

ABOVE One phone doesn't fit all: only a few people will need advanced features such as video calling

BELOW An IP phone doesn't mean it has to be wired – DECT phones are available that work with 3CX

Borg cited the example of a 24/7 call centre where people will be sharing desks: you need to not only have a hardware phone, but make sure it supports hotdesking. Contrast that to a delivery service: "So, this guy is always in a truck or van. I would make sure I give him an app on a phone. It depends on the nature of your work and what you want from your apparatus."

Match each user's needs to the phone

This raises a wider point – the need to match the phone to the specific user's requirements. If you start hunting for an IP phone, you'll be bombarded with features: colour screens; multi-way voice conferencing; dual Gigabit ports; Power-over-Ethernet (PoE); support for a dozen lines and multiple SIP accounts; HD audio; video. How do you choose what's right for your business?

"First of all, try not to buy too many different types of phones. Buy phones from the same manufacturer, if you can," said Borg. "A phone is a living entity on my network. It can be compromised. You can have man-in-the-middle attacks, you can have eavesdropping. You need to keep this phone up to date. So maintaining many different types of phones is asking for trouble."

That doesn't mean buying one phone and giving it to every single person in the business. But it does mean that all people doing a similar type of job should have the same phone. For example, executives will benefit from a colour LCD that shows them who's calling, but if you're outfitting a sales floor then you may not need an LCD at all. Take the time to understand the benefit of each feature and match it to the user case.

"Take the example of a busy employee, focusing on his work – it would be good to alert him with an audio cue that says whether it's a sales call or a technical call. If, for example, it says 'tweet tweet tweet', that's his sales cue. He knows what kind of call is coming in and can prepare for it. That's how you need to think about features. How can you make your staff more productive, more efficient?"

Choosing an executive's phone

So what about specific examples: an executive may want a flashier phone than others in the office, but is there really any argument for this other than status? "The executive is on top of the chain," said Borg. "You don't want to waste his or her time with speculative calls, so you filter them. The CEO might assign a pool or people to be his first barrier, and when a call does come through he or she will need to know exactly who's on the line."

Borg points out that executives will also need the highest-quality audio and support for multi-way audio conferencing, and while they may not yet make video calls this is now an ever-present feature on executive-level phones. "Also, executive phones are more compact and have fewer buttons, as opposed to receptionist's phones, which would have more buttons, more lights blinking, more statuses, more notifications." Talking of which...

Choosing a receptionist's phone

"Normally, a receptionist's phone needs to be pretty pumped up," enthused Borg. "There are some receptionists who have enormous amounts of calls to make." As such, they need a way to handle all those calls – and to make sure they don't transfer a call to someone who's already busy. A key weapon to handle this is a sidecar.

"If you have a company with 500 people in it, how can the receptionist see if someone's already on a call? A busy lamp field (BLF) helps, but a normal phone only has maybe ten keys – or, if it's digital, you can swap between pages and get about 40. But beyond that you need more. Attach a sidecar, even two sidecars, four sidecars, and these will extend your lamps from tens to hundreds." That doesn't mean you need to cram in features – five-way audio conferencing might be overkill.

Hotdesking hot tips

One of the biggest advantages of some IP phones is that users can log into them in the same way they do their computer. That's perfect for an office based on hotdesking or that operates 24/7 in shifts. "Let's say you come in at 8am," said Borg. "The phone on your desk is in 'neutral' mode, but once you enter your username and password, it becomes your phone. All your caller IDs. All your logging. Your shortcuts. At home time, log out of the phone and everything is cleared. The next person in has a fresh phone."

This isn't some cleverness on the part of the phone, Borg explains. "It's because the IT team has set up your profile, just like they do on your workstation. You can make incredible cost savings this way."

Buying a phone specifically for 3CX Phone System

Head to **www.3cx.com/sip-phones** and you'll see a long list of SIP phones that 3CX recommends for its system. Is it a problem if you choose different ones? "Yes, that's going to be a problem! 3CX and the phones are in an intimate relationship – it takes two to tango," said Borg. "We've actually seen cases where the PBX malfunctions because of unsupported phones."

So why does it matter so much? "It's a matter of language. Let's say you buy a phone designed for a proprietary PBX. How can it understand what 3CX is saying to it?"

3CX also works hard to ensure that all the phones it recommends are secure from the latest threats and work with any updates to the 3CX Phone System. "There's a guarantee behind that list that trained staff are checking firmware updates, checking for vulnerabilities, checking how well the phone behaves, to give you the best user experience."

You can also rest assured that, if a problem is found, 3CX will be in direct contact with the phone manufacturer to fix it. "I have a relationship with the manufacturers on that list. I can go and tell them, 'There's a problem, an LDP doesn't work, it's crashing this customer. We have to do something about it.' And you see the fixes come in the next update.

"If your phone isn't on that list, we can't support it. We don't have the phone, we can't test it, and who is going to update the firmware to fix the problem? We don't have the relationship so we can't fix it."

In short, stick to the approved list!

ABOVE Trim costs by stripping away the unnecessary features, such as colour LCD phones

Saving costs

Which brings us to the thorny matter of paying for all of these phones. Let's say you've asked for a quote for phones and it's come in too high – 20% above budget. How do you choose where to make your savings? And where shouldn't you compromise? "The first thing I ask our customers is 'What do you have now?' because what you own already can sometimes be reused," said Borg. "Don't forget, 3CX also works on a lot of legacy phones, and sometimes you only need a phone to make and take calls.

Don't be afraid to strip to the minimum feature set, either. "Many small businesses don't need all these fancy features. It's just enough to hold and resume. You don't need to make a three-way audio conference, you can live without headset integration."

The cost savings don't end there. "There are things that can really cut costs. For example, look at screen size and the size of the phone. Perhaps your users want smaller phones, a smaller display. Perhaps monochrome is fine. I've been using a monochrome display on my phone and it's pretty clear – I have my message indicator, my caller ID coming in, I can see everything.

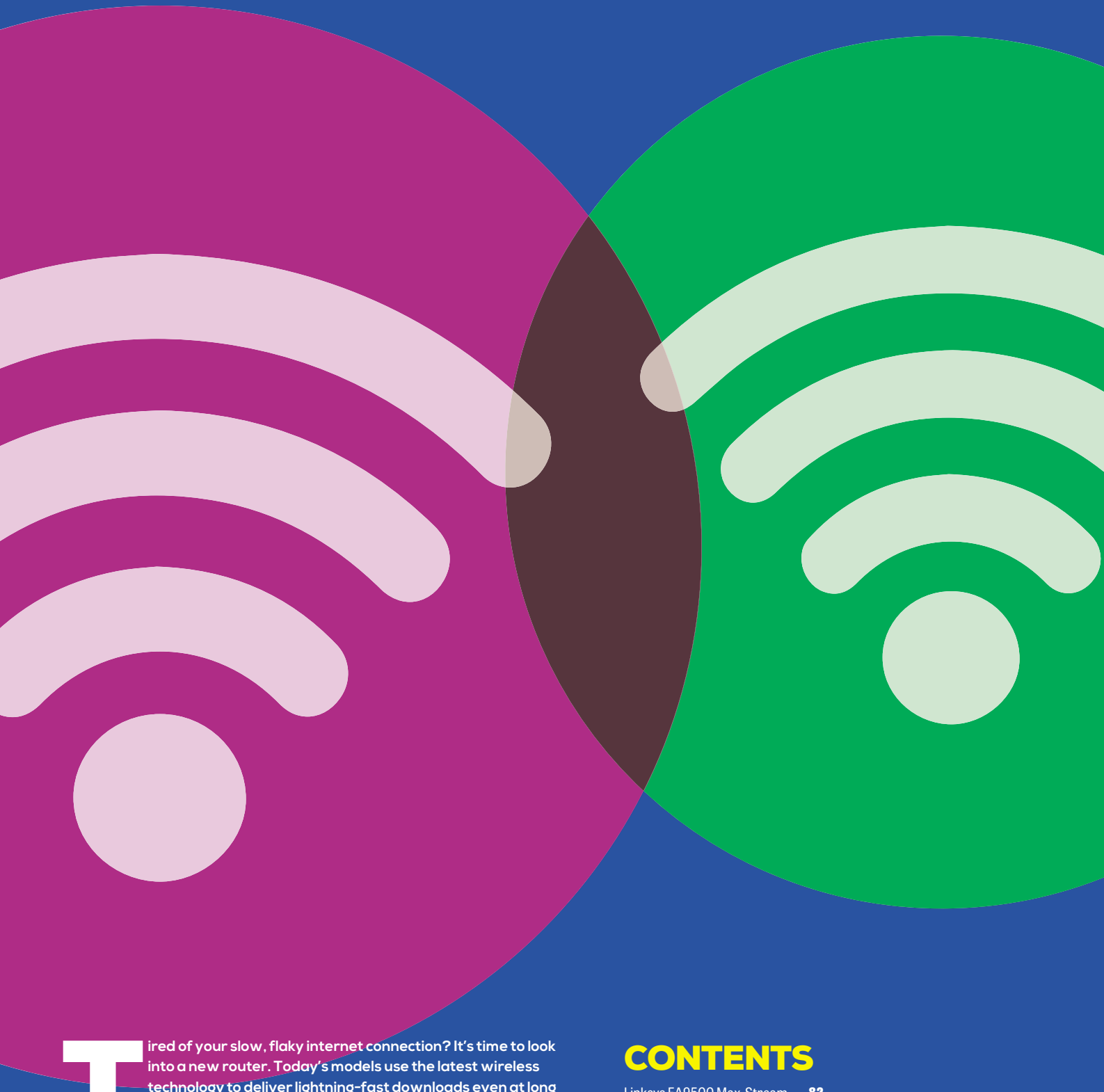
"You can cut costs on energy, too. Why buy phones with a power supply when you can use PoE? It might be more expensive now, but in the long run it will save you money. And, similarly, look for phones that can save energy. As the admin, I don't want 500 phones with bright displays that never dim."

RIGHT Receptionists will benefit from sidecars that show exactly who's on a call and who's free

LEFT 3CX supports some wireless headsets that attach to a base station – just make sure you buy from its pre-tested list

TRIPLE YOUR WI-FI SPEED

TIME TO REPLACE YOUR ISP'S ROUTER? WE COMPARE THE LATEST LIGHTNING-FAST ROUTERS WITH THOSE ISSUED BY BROADBAND SUPPLIERS



Tired of your slow, flaky internet connection? It's time to look into a new router. Today's models use the latest wireless technology to deliver lightning-fast downloads even at long range. They're smart too, with built-in features such as VPNs, guest networks, remote file access, parental controls and more.

This month we've put 13 routers to the test. Not only those upmarket models that will grow with your needs, but also the current standard offerings from BT, Sky, TalkTalk and Virgin. That way, you can directly compare performance and features.

We've tried out each one's Wi-Fi capabilities in a real-world setting, dug through the spec sheets and got hands-on with their interfaces to find the best, most versatile and most user-friendly routers on the market. If you're ready to upgrade your home network, read on.

CONTRIBUTOR: Darien Graham-Smith

CONTENTS

9 STEPS TO YOUR PERFECT ROUTER

While many routers look the same, what lies beneath the surface could make a big difference to your daily life

Routers are unassuming things. They sit quietly in the background and, save for a few flickering LEDs, they don't directly communicate with us at all. You probably don't think about yours for months on end.

Yet a modern router is a highly sophisticated bit of technology. No two models are quite alike, and their capabilities go far beyond the basics of hosting your home Wi-Fi network. Upgrading can bring huge performance benefits, as well as a range of useful extra features. This month we've tested the best, fastest and most feature-packed routers on the market, to give your network the boost it deserves. Here's our guide to choosing the right one.

1 Making the connection

When you're buying a new router, the very first question is whether it will work with your internet connection. As our feature table overleaf shows, many models come with a built-in ADSL2+/VDSL modem; in most cases you should be able to simply plug one of these into your phone socket and keep on trucking (although you may need to enter the right configuration information for your ISP). There are exceptions, though: Sky requires logon credentials that most routers can't provide, and Virgin's fibre-to-the-premises services use a less common modem type called DOCSIS.

Some routers don't have a built-in modem at all, but this isn't necessarily a problem. You may be able to obtain a standalone modem that connects to your router's Ethernet WAN socket, or you might even be able to configure your existing router to act as a modem, while your new router manages your home network. It's also often possible to set up your new router as a wireless access point, and let the old router continue to handle your internet connection.

2 Understanding wireless

When it comes to Wi-Fi, you definitely want the latest 802.11ac standard. All of the routers on test here have it, but older gear may be limited to the slower 802.11n standard. Ideally, look for MIMO (multi-in, multi-out) and "Wave 2" MU-MIMO (multi-user MIMO) technologies, which support multiple radio connections at once, for the fastest, smoothest data throughput.

ABOVE **This Linksys router is packed with Ethernet ports and external aerials – both valuable inclusions**

Having more physical radios also helps. A "tri-band" design means the router has one 2.4GHz radio and two 5GHz transceivers, to keep congestion to a minimum, while a dual-band router has one of each. While 2.4GHz networking isn't as fast as the 5GHz band, it's still used by some older devices, and travels through walls more easily: most routers broadcast a "mixed mode" network that combines both, so if a device can't get a good 5GHz connection, it will automatically drop down to the 2.4GHz one. If you need a fast signal over a wide area, consider a mesh system instead of a standalone router – see p92.

"Manufacturers' claims about transfer speeds should be taken with a large pinch of salt – keep your expectations realistic"

Manufacturers' claims about transfer speeds should be taken with a large pinch of salt. For example, TP-Link advertises that its Archer C5400 router has a wireless bandwidth of 5,400Mbits/sec – equivalent to more than 600MB/sec. But that's calculated by adding up the theoretical maximum speeds of all three radios, which is a bit of a cheat since each device on the network will only be communicating with one radio. What's more, those speeds aren't remotely attainable in the real world: as you'll see on p93, the fastest download speed we saw from any router this month was 30MB/sec.

Let's not single out TP-Link, though. Every manufacturer does it and, by and large, the bigger numbers do tend to imply better performance. Just keep your expectations realistic.

3 Removable antennae

It's not just the radio hardware that determines the speed and strength of a wireless connection – a decent array of aerials is vital, too. It's no coincidence that the worst long-range Wi-Fi performance we saw this month was from a unit with three small internal antennae; routers equipped with chunky external aerials fared much better.

In many cases, those external aerials are connected by a standard screw connector. This gives you the option of fitting larger antennae, which could make a noticeable difference to the signal. If the aerials aren't replaceable, that needn't be a disqualifying consideration – for example, the Linksys EA9500's captive aerials do an excellent job. But if you're torn between two models, it's worth thinking about as a tie-breaker.

4 Ethernet

Wired networking isn't dead. In fact, domestic Ethernet is probably more popular and useful in the home than it was ten years ago. Much faster than any Wi-Fi connection – and more stable – it's the best choice for NAS

drives, smart TVs and anything that's located near to your router.

Ideally, then, you want a router with plenty of Ethernet sockets. Older, cheaper routers may only offer 100Mbits/sec connections, but there's no reason to settle for that today: Gigabit is where it's at. If you run out of sockets, you can extend your wired network with a standalone Gigabit switch – a five-port model can be bought online for less than £15 – but that's less elegant, and will take up an extra power socket.

5 USB ports and media features

Most of this month's routers offer at least one USB port. This lets you conveniently plug in an external hard disk or flash drive, and access it from anywhere on the network as if it were a regular network share or NAS appliance. Some models even have a built-in DLNA server, so video files stored on your hard disk can be streamed directly to any compatible device on your network.

If you're interested in that capability, we recommend you look for USB 3: a slower USB 2 connection is likely to get bottlenecked, and video streams could become choppy if you try to access files at the same time.

6 Printers and 3G failover

USB isn't just for storage. Your router may also allow you to directly connect a USB printer, so everyone on the network can conveniently access it over your wireless network. Some of this month's routers have full print servers built in, so getting set up is as easy as with a professional network printer. Others require you to install a local app that forwards print jobs to the router. It's not a big imposition, but it's less elegant and could be an obstacle if you want to print from a tablet or smartphone.

Finally, on some more business-oriented routers, you can also plug in a 3G or 4G USB dongle: if your main internet connection goes down, the router can then automatically switch to a mobile data connection, so you can carry on working (albeit at slower speeds). This might be overkill for a typical domestic network, but for those who work from home it's certainly worth thinking about.

ABOVE Some forward-thinking router manufacturers have added support for Alexa commands

"Wired Ethernet is much faster than any Wi-Fi connection, and more stable – perfect for NAS drives and smart TVs"

7 Parental controls

If you have kids in the house, you don't want them looking up unsuitable websites in the middle of the night. Router-based parental controls are a great solution, as you don't need to install any software on children's devices, and there's nothing for them to tamper with.

Most routers will let you blacklist specific URLs – so if, for example, you want to keep your children off Facebook, it's easily done. Category-based filtering may also be on offer, allowing you to block all sites relating to sex, violence, gambling or what have you with a click, although you will have to put some trust in whatever service is used to identify and categorise such sites.

You can normally set up an access schedule for nominated devices, so your kids can only connect to the internet at approved times. Some routers are a lot more flexible than others in this area: for example, the DrayTek Vigor2762ac lets you configure up to 15 time slots that can recur at whatever intervals you specify, while other systems only let you define a single block of time, with no flexibility for homework breaks or weekend hours.

8 Smartphone and Alexa support

All of this month's routers let you check and change settings via a web browser, but it may also be possible to use a smartphone app. This is normally a more user-friendly experience, giving you access to the key settings with a few taps – and you don't even have to be at home to do it, so you can check your security from anywhere. These apps aren't always password-protected, though, so make sure you keep your phone locked when not in use.

Another trendy feature is integration with the Amazon Echo platform: several manufacturers have created skills that enable Alexa to tell you the status of your network, adjust settings or even reboot the router. You can't do complicated stuff like setting up port forwarding or changing your Wi-Fi passphrase, but it's a nice convenience for Echo owners.

9 Guest networks

It's only polite to share your wireless network with friends and visitors, but it could be risky – depending on your security settings, they could access your shared devices and even unwittingly infect you with malware. For this reason, many routers offer a guest network function – a virtual wireless network, with its own password, that allows guests to access the internet but isolates them from your home network. You can simply switch the guest network off when it's not needed (or sometimes to a preset schedule) so users can't continue to piggyback on your Wi-Fi without your knowledge.

How we test

To test the wireless performance of each of this month's routers, we followed our usual real-world approach. In this case, we set up each one in a family home – a 1930s townhouse in London with thick walls and plenty of interference from electrical appliances and neighbours' wireless networks – and installed the latest firmware.

We then used a Windows 10 laptop equipped with a USB 802.11ac adapter to test download speeds by copying a series of 100MB data files from a NAS drive attached directly to the router via Gigabit Ethernet. We carried out the test in three locations: the living room, where the router itself was located, the upstairs bedroom, and the upstairs bathroom at the rear of the house.

The graphs on p91 show the download speeds we obtained from each router in each location. You shouldn't expect to see identical results in your own home, but the figures give an useful indication of the relative performance and penetration of each router.

These results were then weighed together with the price of the router and its feature set – as detailed overleaf – to arrive at an overall rating out of five for each router.






	Billion BiPAC 8900AX-2400	BT Smart Hub	D-Link EXO AC2600	D-Link DIR-895L AC5300	DrayTek Vigor2762ac	LABS WINNER Linksys EA9500 Max-Stream
Overall rating	★★☆☆☆	★★★★☆	★★★★☆	★★★☆☆	★★★★☆	★★★★★
Price and supplier						
Price (inc VAT)	£208 (£250)	£108 (£130) or free with new internet package	£104 (£125)	£250 (£300)	£121 (£145)	£189 (£227)
Supplier	amazon.co.uk	shop.bt.com	ebuyer.com	pcpro.link/288dlink	broadbandbuyer.com	pcpro.link/288link
Manufacturer	billion.uk.com	home.bt.com	eu.dlink.com	eu.dlink.com	draytek.co.uk	linksys.com
PC Pro reliability rating[1]	N/A	81%	N/A	N/A	96%	84%
Warranty	2yr RTB	1yr RTB	2yr RTB	2yr RTB	2yr RTB	2yr RTB
Dimensions (WDH, without antennae)	230 x 155 x 37mm	236 x 31 x 116mm	259 x 184 x 46mm	417 x 263 x 150mm	207 x 130 x 37mm	318 x 265 x 67mm
Connectivity						
Wi-Fi standards supported	802.11a/b/g/n/ac	802.11a/b/g/n/ac	802.11a/b/g/n/ac	802.11a/b/g/n/ac	802.11b/g/n/ac	802.11a/b/g/n/ac
Radios	2.4GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz + 5GHz
Quoted 2.4GHz speed	600Mbits/sec	450Mbits/sec	800Mbits/sec	1,000Mbits/sec	300Mbits/sec	1,000Mbits/sec
Quoted 5GHz speed	1,800Mbits/sec	1,733Mbits/sec	1,733Mbits/sec	2,167Mbits/sec	866Mbits/sec	2,167Mbits/sec
MIMO channels	4x4	4x4	4x4	4x4	2x2	4x4
MU-MIMO	✓	✓	✓	✓	✗	✓
Gigabit Ethernet ports	4	4	4	4	4	8
USB ports	1 x USB 2	1 x USB 3	1 x USB 2, 1 x USB 3	1 x USB 2, 1 x USB 3	2 x USB 2	2 x USB 3
Other ports	None	None	Ethernet WAN	Ethernet WAN	None	Ethernet WAN
WPS push-button	✓	✓	✓	✓	✓	Soft button in web interface
Internal modem	ADSL2+/VDSL2	ADSL2+/VDSL2	None	None	ADSL2+/VDSL2	None
3G/4G	Via USB	✗	✗	✗	Via USB	✗
Replaceable antennae	✗	✗	✓	✓	✓	✗
Parental controls						
Blacklist URLs	✓	✗	✓	✓	✓	✓
Filter web content by category	Via OpenDNS	✗	✗	✗	✓	✗
Per-device access schedule	✓	✓	✗	✗	✓	✓
Schedule granularity	Up to 32 recurrent time slots	15-minute slots for each day of the week	Hourly slots for each day of the week	Hourly slots for each day of the week	15 slots of any length, repeating at user-specified intervals	Hourly slots for each day of the week
Other features						
AP mode	✗	Unofficial	✗	✓	✓	✓
Wireless bridge	✓	✗	✗	✗	✓	✗
Guest network	✓	✗	✓	✓	✓	✓
Dynamic DNS	✓	✓	✓	✓	✓	✓
VPN server	✓	✗	✓	✓	✓	✗
Streaming server	DLNA	✗	DLNA	DLNA	✗	DLNA
iTunes server	✗	✗	✗	✗	✗	✗
Print server	✓	✓	✗	Via host app	✓	Via host app
Disable LEDs	✗	✓	✗	✗	✗	✓
Smartphone app	✗	✗	✓	✓	✗	✓
Works with Alexa	✗	✓	✗	✗	✗	✓

1. *PC Pro* Technology Excellence Awards 2017

	Netgear R9000 Nighthawk X10	Netgear XR500 Nighthawk Pro	Sky Q Hub	Synology RT2600ac	TalkTalk Wi-Fi Hub	TP-Link Archer AC5400	Virgin Media Hub 3
							
	RECOMMENDED			RECOMMENDED			
	★★★★★	★★★★☆	★☆☆☆☆	★★★★☆	★★★☆☆	★★★☆☆	★★☆☆☆
	£325 (£390)	£200 (£240)	Free with new internet package	£180 (£217)	£25 (£30) for existing customers, free with new fibre package	£213 (£256)	Free with new internet package
	pcpro.link/288x10	pcpro.link/288xr5	sky.com	pcpro.link/288syn	talktalk.co.uk	pcpro.link/288tpl	virginmedia.com
	netgear.co.uk	netgear.co.uk	sky.com	synology.com	talktalk.co.uk	tp-link.com	virginmedia.com
	86%	86%	N/A	N/A	N/A	83%	N/A
	2yr RTB	3yr RTB	Lifetime of contract	2yr RTB	Lifetime of contract	3yr RTB	Lifetime of contract
	224 x 168 x 74mm	322 x 244 x 55mm	211 x 141 x 34mm	280 x 169 x 77mm	259 x 59 x 165mm	230 x 230 x 43mm	73 x 158 x 225mm
	802.11b/g/n/ac/ad	802.11b/g/n/ac	802.11b/g/n/ac	802.11a/b/g/n/ac	802.11a/b/g/n/ac	802.11a/b/g/n/ac	802.11a/b/g/n/ac
	2.4GHz + 5GHz + 60GHz	2.4GHz + 5GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz	2.4GHz + 5GHz + 5GHz	2.4GHz + 5GHz
	800Mbits/sec	800Mbits/sec	300Mbits/sec	800Mbits/sec	450Mbits/sec	1,000Mbits/sec	300Mbits/sec
	1,733Mbits/sec	1,733Mbits/sec	1,300Mbits/sec	1,733Mbits/sec	1,733Mbits/sec	2,167Mbits/sec	1,300Mbits/sec
	4x4	4x4	3x3	4x4	4x4	4x4	3x3
	✓	✓	✗	✓	✓	✓	✗
	6	4	2	4	4	4	4
	2 x USB 3	2 x USB 3	None	1 x USB 2, 1 x USB 3	None	1 x USB 2, 1 x USB 3	None
	Ethernet WAN, 10GbE	Ethernet WAN	None	Ethernet WAN, SDXC card reader	Ethernet WAN	Ethernet WAN	None
	Soft button in web interface	✓	✓	✓	✓	✓	✓
	None	None	ADSL2+/VDSL2	None	ADSL2+/VDSL2	None	DOCSIS 3 cable
	✗	✗	✗	Via USB	✗	✗	✗
	✗	✓	✗	✓	✗	✗	✗
	✓	✓	✓	✓	✗	✓	✗
	✓	✗	✗	✓	✗	✓	✗
	✓	✓	✓	✓	✗	✓	✗
	Single time slot on specified days	Single time slot on specified days	Single time slot on specified days	Hourly slots for each day of the week	N/A	Total usage limits plus bedtime periods for weekdays and weekends	N/A
	✓	✓	✗	✓	✗	✓	✗
	✗	✗	✗	✓	✗	✗	✗
	✓	✓	✗	✓	✗	✓	✓
	✓	✓	✓	✓	✓	✓	✗
	✓	✓	✗	✓	✗	✓	✗
	DLNA, Plex	DLNA	✗	DLNA	✗	DLNA	✗
	✓	✓	✗	✗	✗	✗	✗
	✓	✓	✗	✓	✗	✓	✗
	✓	✓	✗	✗	✓	✓	✗
	✓	✓	✗	✓	✗	✓	✗
	✓	✓	✗	✗	✗	✓	✗

Linksys EA9500 Max-Stream

The EA9500 is a brilliant all-rounder that delivers superfast speeds – for a reasonable price

SCORE ★★★★★

PRICE £189 (£227 inc VAT)
from pcpro.link/288link

Living room **28** MB/sec

Bedroom **22** MB/sec

Bathroom **13** MB/sec

The EA9500 is an imposing slab of a router, festooned with no fewer than eight (non-removable) antennae. It's not quite this month's biggest model – that's the D-Link DIR-895L – but it fits into the plus-sized category, alongside the Netgear R9000 Nighthawk X10.

A big case with lots of aerials usually implies strong wireless performance, and on paper, the EA9500 is capable of 1,000Mbits/sec on the 2.4GHz band, and a whopping 2,167Mbits/sec on each of its two 5GHz radios. By default, these appear as a single 802.11ac network, but a band steering option works behind the scenes to balance clients across the two 5GHz connections, keeping contention to a minimum.

Needless to say, we didn't get anywhere near those speeds in our tests, but the EA9500 still served up an impressively fast connection, with solid download speeds of 13MB/sec even at the far end of its range. It wasn't quite the fastest router in any test, but it was consistently either second or third, and never more than a whisker behind the winner. In short, if you're looking for fast, pervasive Wi-Fi, the EA9500 delivers.

Aficionados of wired Ethernet will be happy, too. Round the back of the EA9500 you'll find a generous eight Gigabit Ethernet ports – more than any other router in this month's roundup – in addition to a separate Ethernet WAN socket (which you'll need, as this router doesn't have a built-in modem).

There's additionally a pair of USB 3 ports, allowing you to attach a printer and an external hard disk simultaneously. Be aware that the EA9500 doesn't have an internal print server, however: you'll have to install the Linksys printer software on a Mac or PC to manage and share it.

External drives are automatically shared as soon as you plug them in, although if you dig into the web portal you can optionally set up custom shares and even protect them with individual usernames and passwords. Interestingly, you can also make files available over the internet via FTP – a niche feature, perhaps, but a potentially handy one. Enable the DLNA server and any video files on the disk are published for streaming to compatible devices.

Most of the other features you would hope for are present and correct too – a ring-fenced guest network is created by default, and you can set up access schedules for individual devices. There's built-in support for the **dyn.com** and **no-ip.com** dynamic DNS services, and if you connect your account to Amazon then you can ask Alexa to read out your wireless credentials, as well as command her to turn the guest network on and off.

ABOVE **With its eight antennae and plus-size case, the EA9500 isn't a shrinking violet**

PC PRO LABS WINNER

BELOW **The Smart Wi-Fi web interface looks good, but it's frustratingly slow**

There are just a few niggles. If you don't want to mess with your existing network settings, you can switch the EA9500 into AP mode and use it purely as a wireless access point, but there's no wireless bridge mode. Still, I doubt many people would want to use a powerful router like this as a mere extender.

More annoying is the "Smart Wi-Fi" web interface, which is nicely laid out but frustratingly slow. After every click there's a wait of a few seconds for the next page to open, which makes even the simplest administration task feel like a chore.

I'm also particularly unimpressed with the network map. Linksys has taken a graphical approach here, and it's really unhelpful. Each client is represented by an icon and a name, but if you want to see an IP address, it's two clicks to open each device's information window, and another to close it again. And if you have more than 16 devices, they won't fit on a single page, so you have to flick back and forth to get a full overview. Why not just give us a conventional table?

Still, that's probably the worst criticism I can level at the Linksys EA9500 – and you can get around it by using the Linksys smartphone app, which has a cleaner interface and lets you check up on your network status and even tweak settings remotely.

All told, the Linksys EA9500 Max-Stream is a superb all-rounder. While not quite as feature-packed as Netgear's mighty Nighthawk X10, it's far more sensibly priced, delivering terrific wireless speeds and great wired connectivity. What more could you want?

Netgear R9000 Nighthawk X10

Yes, it's expensive – but you get a lot of bang for your buck, including unbeatable speeds and bags of features

SCORE ★★★★★

PRICE £325 (£390 inc VAT)
from pcpro.link/288x10

Living room	Bedroom	Bathroom
26 MB/sec	22 MB/sec	14 MB/sec

Netgear's futuristic-looking Nighthawk X10 is advertised as the "world's fastest router", with a claimed wireless bandwidth of 7,133Mbits/sec. That's fast enough to download 50GB of data in less than a minute – and if you think that sounds like an impossible feat even for 802.11ac, you're right. Uniquely among this month's routers, the X10 includes a 60GHz 802.11ad radio, allowing compatible devices to communicate at up to 4.6Gbits/sec. That sounds great, but the catch is that 60GHz networking only works well over very short distances (*see p93*), so it's mostly useful for same-room devices like smart TVs; you won't find it on mainstream laptops or tablets.

Still, even over regular 802.11ac, the Nighthawk X10 is an exceptional performer. Its chunky illuminated antennae deliver fantastic 5GHz penetration: even in the bathroom at the far end of my home, I was able to enjoy the full speed of my 100Mbits/sec fibre broadband connection. The TalkTalk Wi-Fi hub was a whisker faster in the bedroom, but overall the X10 delivers the best all-round wireless performance of any router we've tested.

There's more good news on the feature front. Although the X10's six Gigabit Ethernet ports aren't quite as generous as the Linksys EA9500's eight, they're accompanied by a 10GbE port, allowing you to hook up an enterprise-grade NAS device or a superfast internet backbone, should you have access to such things. You can aggregate the fifth and sixth Ethernet ports for faster client connections, too.

Hidden at the side there's also a pair of USB 3 sockets, which let you connect a printer or external storage device. Files can be easily shared across your home network, and optionally over the internet, either through Netgear's ReadyShare website or via direct FTP connection.

USB storage also works in conjunction with one of the X10's star features. Its powerful quad-core ARM CPU enables it to run a full installation of Plex Media Server, giving you a far richer set of video features than DLNA, along with a slick graphical interface that you can access from anywhere in the world. It's not limited to USB, either; your Plex library can live anywhere on your home network, so it's just as handy for those who like to keep their files on a NAS drive or a desktop PC.

Finally, you can use USB media as a download destination for the router's built-in download client, which supports HTTP, FTP and BitTorrent. This is potentially handy if you don't want to leave your laptop on overnight, but it's a shame it doesn't support watched folders: it's a bit of a drag to have to dig into the web interface every time you want to download a torrent.

Still, it's not a bad interface. The white boxes and grey gradients look a bit Web 1.0, but everything is laid out clearly, with a straightforward set of buttons taking you directly to the various settings areas. Unlike some router interfaces, it's responsive, and as you click around you'll find all the settings you're likely to want, including VPN and dynamic DNS options. One thing that's missing is a fully wireless bridge mode, but the X10 will work as a wired-to-wireless bridge in either direction (connecting wired devices to a wireless network, or vice versa).

ABOVE **The futuristic X10 looks like a cross between a spy plane and alien mothership**

PC PRO RECOMMENDED

BELOW **The web interface is a little dated, but it's intuitive and responsive**

Perhaps the X10's biggest weakness is its parental control feature. On the positive side, the system integrates nicely with OpenDNS to provide category-based web-filtering profiles on a per-device basis, and you can block internet access for specified clients between certain times. Sadly, this latter feature is very limited: you can only specify a single block of time, and choose whether or not it applies on each day of the week. If you want a different schedule for weekends, or for different family members, you'll need a third-party solution.

That shortcoming aside, there's very little to criticise about the R9000 Nighthawk X10 – except the price. At £390, it's by far the most expensive router here, costing more even than most multi-node mesh systems. Yes, you get a lot of features for your money, and if you want the latest, fastest networking technologies then there's simply no competition. However, for basic, domestic Wi-Fi duties the Linksys EA9500 will make you just as happy – and leave you £160 better off.

Netgear XR500 Nighthawk Pro

Whether you're a gaming fanatic or not, the XR500 Nighthawk Pro is an excellent choice of router

SCORE ★★★★☆

PRICE £200 (£240 inc VAT)
from pcpro.link/288xr5

Living room **27** MB/sec

Bedroom **14** MB/sec

Bathroom **9** MB/sec

There's a familial resemblance between this Nighthawk router and the top-of-the-line X10. Not only do both come in low-profile cases with four antennae, they each sport the same pair of USB 3 sockets tucked away on the left-hand side, along with Wi-Fi and WPS buttons on the top and a switch at the back to disable their numerous status LEDs.

The XR500 is a slightly different proposition to its high-end sibling, however. For a start, it eschews the 60GHz radio, substituting a second 5GHz radio for better performance under high load. It also loses the 10-Gigabit Ethernet port, which is probably wise, and cuts the regular Ethernet ports down from six to four. All of this has a salutary effect on the price: the XR500 Nighthawk Pro is a full £150 cheaper than the X10.

If the differences stopped there, the XR500 would be a tempting buy. However, there are two other things you need to be aware of. First, its antennae aren't as hefty as the X10's, and we found that 5GHz penetration wasn't as good. In our tests, the XR500 delivered a strong 27MB/sec at close range, but dropped off more sharply than the X10 as we moved away.

Second, the XR500 Nighthawk Pro is designed as a "gaming router", and in this case that doesn't just mean fancy flashing lights. Rather than relying on its own-brand firmware, Netgear has licensed the Linux-based, gamer-oriented DumaOS: open up the web portal and you'll be greeted by a brooding, blood-red dashboard showing a live overview of key network statistics, with panes that you can drag around and resize to suit your preferences.

DumaOS equips the XR500 with some unique features. For one, its geo-filter function lets you blacklist hosts more than a certain distance away – the idea being to force games to connect you to a nearby server, rather than choosing one in the USA or Japan, with all the latency that implies. There are also graphical bandwidth allocation tools, designed to make sure other network users can't bog down your connection; you can tell the router to automatically prevent individual applications from saturating the link, click and drag to manually divide up the available bandwidth between registered clients, and nominate devices, ports and services to prioritise.

If you're a keen gamer, such abilities may be music to your ears. Or, you might not care about them at all – but, hey, you're under no obligation to use them. And the good news is that you don't miss out on the regular router functions: click the Settings link at the side of the DumaOS portal and a familiar sub-pane opens, exposing very nearly all the same configuration options as found on the X10.

ABOVE **Built for games, the Nighthawk Pro reminds us of the enemy forces in *Space Invaders***

BELOW **DumaOS offers gamer-friendly features such as geo-filtering**

This represents a pretty decent set of everyday networking features, and includes support for VPN connections, dynamic DNS and even a modicum of Alexa integration, allowing you to check settings, control the guest network and reboot the router with a voice command. Plug in a USB hard disk or flash drive and you can access your files at home and over the internet, using Netgear ReadyShare.

There are a few notable absences, though. The XR500 doesn't run Plex – you'll have to make do with ordinary DLNA streaming, or use the built-in iTunes server. Netgear's category-based website filtering service isn't available either, presumably because the third-party firmware doesn't support it. And while you can block individual sites, or restrict individual devices' internet access to a preset schedule, timetabling remains so inflexible as to be almost useless. Finally, the Netgear configuration pages aren't presented in their original form: most of the graphical and structural elements have been stripped out, leaving you with a flat, text-heavy experience.

But those issues won't be deal-breakers for most people. If you're an avid gamer forced to share your network with friends and family, the clever capabilities of DumaOS make this a great choice of router. Even for non-gamers, the XR500 gives you most of the useful features of the Nighthawk X10 for a much lower price. Before you buy, though, weigh it up against the Synology RT2600ac, or the Linksys EA9500, which have better long-range performance.

Synology RT2600ac

Though not quite the fastest or cheapest option, the RT2600ac is a versatile and user-friendly router

SCORE ★★★★☆

PRICE £180 (£217 inc VAT)
from pcpro.link/288syn

Living room 22 MB/sec

Bedroom 21 MB/sec

Bathroom 14 MB/sec

Synology is a name more usually associated with NAS drives than routers – and when you first open up the RT2600ac's web portal you'd be forgiven for thinking you'd accidentally logged into a storage device, because it looks an awful lot like the company's DiskStation Manager software.

That's no bad thing: the intuitive mouse-driven interface makes many rivals look clunky and outdated. Icons, live graphs and illustrations help you find your way around with ease. But this is no Fisher-Price front-end, and as you click through the tabs you'll find no shortage of technical stats and network settings. These include upmarket features such as a true wireless repeater mode, email and SMS notifications for specified errors and events, and the option to fall back to a connected 3G/4G USB adapter if your main internet connection goes down.

The physical design is just as thoughtful. Alongside its four Gigabit Ethernet ports, the RT2600ac has a switch for enabling and disabling Wi-Fi, a nice clicky WPS button and a sensible arrangement of USB connectors – a USB 2 one at the back for an always-connected 4G dongle or printer, and a more accessible USB 3 port at the side for storage. Uniquely, there's also an SDXC card slot at the front, offering an easy way to get photos off a camera if your laptop doesn't have a built-in reader. And an Eject button lets you ensure storage devices are safely dismounted before unplugging them – a very nice touch.

On the subject of storage devices, you won't be surprised to learn that Synology's router beats the rest hands down when it comes to file-handling capabilities, with entire pages of features transplanted directly from the company's NAS platform. For example, you're not just able to create password-protected user accounts for access to connected USB drives: you can let users choose their own passwords, enforce complexity rules and even insist on two-factor authentication. Or, you can use LDAP authentication – or join a Windows domain. And as well as basic file sharing, you can enable services such as WebDAV and Apple Time Machine.

To further expand the RT2600ac's capabilities, it's also possible to install apps from the built-in Package Center. Synology's Cloud Station and Download Station add-ons are a few clicks away, if you want them, as is the DLNA streaming server. Other services are more business-like: a VPN server, a plugin for RADIUS authentication, and Synology's DNS server are all on offer.

For those deploying the RT2600ac in a family environment, meanwhile, there's a solid set of parental controls. You can define a weekly internet access schedule for each device on your network, optionally enforce safe searching and apply web filtering with varying degrees of strictness across 20 site categories.

ABOVE Alongside four Gigabit Ethernet ports, the RT2600ac has a handy switch for disabling Wi-Fi

PC PRO RECOMMENDED

BELOW Synology's web portal is one of the best – it's both slick and intuitive

While the RT2600ac ticks a lot of feature boxes, its compact case and quartet of modestly sized aerials don't exactly scream high-performance. In use, we found it couldn't match the top speeds of bigger, more expensive rivals: connecting from the same room yielded a maximum download rate of 22MB/sec – a clear step behind the 28MB/sec we got from the Linksys EA9500, and the ludicrous 30MB/sec of the enormous D-Link DIR-895L.

Yet the RT2600ac did impress us with its consistency. Moving up to the bedroom saw download speeds barely dip, to 21MB/sec, and even in the bathroom the Synology kept up 14MB/sec – on par with the more expensive Netgear Nighthawk X10, and faster than anything else on test. This a more powerful radio than the headline speed might suggest.

At £217 inc VAT, the Synology RT2600ac isn't exactly a bargain. If you're looking for an office-friendly workhorse, the DrayTek Vigor2762ac costs nearly £60 less – and if it's pure performance you're interested in, the similarly priced Linksys EA9500 offers has higher speeds and twice as many Ethernet ports, not to mention a second 5GHz radio to keep things running smoothly when your network gets busy. But if the RT2600ac's features suit your needs, it's a superb little router – and every time you open up the interface to check your network status or change a setting, you'll be glad you chose it.

BILLION

Billion BiPAC 8900AX-2400

The Billion offers a range of business-focused features, but the speeds – and price – are disappointing

SCORE ★★☆☆☆

PRICE £208 (£250 inc VAT)
from amazon.co.uk

Living room	Bedroom	Bathroom
11 MB/sec	11 MB/sec	10 MB/sec

Where some routers go for flashy stylings, Billion's high-end offering looks aggressively functional, a militaristic grey box with four bionic legs. Even the name is pointedly unsexy.

That makes sense, because this is clearly a business-first router. That's not to say you can't buy one for home use: it'll happily work with all your tablets and smart gadgets, and it even comes with a convenient internal DSL modem. The single USB socket meanwhile permits media streaming over DLNA, although since it's only USB 2 it's probably intended more for a printer, or for local file sharing.

Similarly, while Billion doesn't provide a parental control service of its own, it lets you hook into OpenDNS to take advantage of category-based web filtering. And the access scheduling feature is actually pretty versatile, letting you configure up to 32 blocking periods of any duration throughout the week.

At the same time, there's plenty of stuff here that's really only useful to IT professionals; we're talking not just extensive VPN support, but IPv6 tunnelling options, SNMP and TR-69 management services, 3G/4G failover and more. What's more, it's wrapped up in a web portal that's jam-packed with technical information and options: non-experts are likely to find it overwhelming, with basic settings buried away in more obscure stuff.

There's another reason why we'd hesitate to recommend the BiPAC 8900AX-2400 for domestic use. On paper it should be the equal of any MU-MIMO router, with a high quoted data rate of 1,800Mbits/sec on the 5GHz band. In practice, though, we found wireless performance topped out at around 11MB/sec over 802.11ac, regardless of whether we were sitting right next to it or wandering about the other end of the house. Full marks for consistency, but not many for speed.

ABOVE The 8900AX-2400 isn't going to win any beauty contests – it's just a grey box

Finally we come to the price. If you don't need all of the hardcore networking features that the 8900AX-2400 offers then there are much more consumer-friendly options at this price point, and below it. And if you are kitting out a busy office, the DrayTek Vigor2762ac is a persuasive alternative at a much lower cost.

BT

BT Smart Hub

Even if you aren't a BT customer, the Smart Hub could be a cost-effective way of boosting your network

SCORE ★★★★☆

PRICE £108 (£130 inc VAT)
from shop.bt.com or free with new internet packages

Living room	Bedroom	Bathroom
25 MB/sec	21 MB/sec	11 MB/sec

Officially, the BT Smart Hub only works with a BT Broadband connection – but with a bit of Googling you'll find homebrew instructions for making it work with various other ISPs, or for setting it up as a wireless access point.

That could well be a worthwhile upgrade on what you're using now. Although the Smart Hub's antennae are all internal, there are seven of them, with a claimed maximum 5GHz speed of 1,733Mbits/sec, and these proved highly effective at close and medium range, giving us a solid 25MB/sec connection in the living room and a creditable 21MB/sec in the bedroom. The tougher bathroom test took speeds down a notch, but the Smart Hub still served up a respectable 11MB/sec – more than enough bandwidth to get the full benefit of a 60Mbits/sec fibre connection.

Physical features are minimal: you get a bog-standard set of four Gigabit Ethernet ports, a WPS button and a single USB 3 socket. This provides basic file-sharing services if you plug in a USB hard disk, but there's no sort of access control, nor any provision for streaming media files or connecting a printer.

The software side of things isn't exactly loaded with features, either. There's no built-in web filtering (that's handled at the back-end for BT customers), but there is a granular scheduling tool, which works with 15-minute time slots rather than hour-long blocks. The web interface is easy to get along with, too: the presentation is simple and clear, and when you click on a button or link, the response is satisfyingly instant.

ABOVE The Smart Hub's seven antennae are internal, but they proved highly effective

The Smart Hub is a decent wireless router, and if you're a BT broadband customer there's no need to look any further – so long as it supplies you with a reliable connection, which, judging from forums, isn't always the case. Perhaps this is why secondhand units are popping up online for as little as £45 – making them a cheap experimental buy for non-BT customers hoping to get a Wi-Fi boost.

NEW STANDARDS

Networking standards are always advancing – here's what you need to know about next-generation technologies

All of this month's routers support the current Wi-Fi standards, but technology never stands still for long. Do you need to worry about your new router becoming obsolete? Here's our guide to three emerging network standards, and what they mean for buyers.

802.11ad

This ultra-high-speed wireless networking specification isn't exactly new – the standard has been knocking around since 2009, and indeed it's already built into the Netgear R9000 Nighthawk X10 (*see p83*).

802.11ad uses very high frequency radio waves – on the 60GHz band, to be precise, versus the 5GHz band used by 802.11ac – to achieve speeds of up to 8Gbits/sec. Unfortunately, it's an inescapable rule of physics that the shorter a radio wave gets, the less able it is to penetrate solid objects. In the case of 802.11ad, the signal can barely travel through a single wall, meaning it's more or less a line-of-sight connection only. It's no surprise that, despite having been on the scene so long, it's never hit the big time.

Don't write 802.11ad off just yet, though. Some manufacturers believe that 60GHz networking is about to find its niche in devices such as virtual reality headsets, which need to stream huge amounts of graphical data wirelessly over short distances. We'll believe it when we see it, though – for now, it's something you can definitely live without.

802.11ax

This upcoming wireless standard uses a technique called orthogonal frequency division multiplexing (you heard) to carry more data than 802.11ac over the same type of radio connection. This should allow faster communications, whilst simultaneously reducing the effect of interference – potentially leading to four-fold increases in real-world performance. Early 802.11ax devices, showcased at CES at the start of the year, promised faster-than-Ethernet downloads, with a nominal top speed of 11Gbits/sec.

It's widely expected that 802.11ax will become the industry-standard successor to 802.11ac. The catch is that the standard hasn't yet been officially certified: the full specification isn't expected to be finalised until next year, and it will probably be a year or two after that before the technology trickles down into mainstream consumer devices. Look for 802.11ax on your next router, perhaps, but we suggest you don't hold your breath this time around – you could be waiting a long time.

ABOVE **The 802.11ad standard is built into the Netgear R9000 Nighthawk X10**

"Look for 802.11ax on your next router, perhaps, but don't hold your breath this time around – you could be waiting a long time"

WPA3

WPA3 has nothing to do with the speed of your wireless network, but everything to do with its security. The latest version of the Wi-Fi Protected Access standard was published in June 2018, and it brings some significant advantages over the current WPA2 system.

One of those is that it's not vulnerable to the "KRACK" exploit, discovered last year, which could allow a determined intruder to break into your wireless network by tricking the system into reusing a known encryption key. There's also a new authentication system that makes it impossible to trick your way onto a protected network by using brute-force to deduce the required credentials. Both are very positive enhancements, though we doubt many people's home networks are interesting enough to attract such concerted hack attacks.

Perhaps more significant is an upgrade to the way open wireless networks are handled. Currently, if you connect to an unsecured hotspot, all of the information you exchange with the router is unencrypted, and can be easily captured and spied on by anybody within range. With WPA3, data packets are securely encrypted even on "open" connections.

We've yet to see any hardware that supports WPA3, but when it does come along the transition should be seamless, as it's fully backward-compatible with existing WPA2 gear. If you're buying a new phone or laptop in the next year or two, it's well worth keeping an eye out for WPA3, so you can enjoy far greater security on open networks – and you can then upgrade to a compatible router as and when a convenient opportunity comes along in the future.

BELOW **The future 802.11ax standard should reduce the effect of interference**

D-LINK

D-Link EXO AC2600

It's not very fast or stuffed with features, but the EXO is an affordable router that does everything you need

SCORE ★★★★☆

PRICE £104 (£125 inc VAT)
from ebuyer.com

Living room 20 MB/sec | Bedroom 18 MB/sec | Bathroom 10 MB/sec

The EXO AC2600 is a very sensible router. The design is compact and scrupulously sober, and the technical specification carefully ticks all of the important boxes, without wasting too much effort and expense on niche features.

Needless to say, that begins with 802.11ac, powered by a single 5GHz radio and partnered with a secondary 2.4GHz transmitter for legacy devices and long-range connections. D-Link claims a maximum throughput of 1,733Mbits/sec on the 5GHz band, which in theory ought to mean it's as fast as the Netgear Nighthawk X10. But, in practice, the EXO's smaller antennae and cheaper internals have an inevitable impact, and the EXO AC2600 consistently placed towards the back of the pack in each one of our tests. That doesn't imply terrible performance, but if you need to fill a large house with fast Wi-Fi, this might not be the best option.

For wired connections, there's the expected four Gigabit Ethernet connectors at the rear, and a WPS button at the side. Perhaps the EXO's one burst of extravagance is the provision of not only a USB 2 port at the back but also a SuperSpeed USB 3 port at the front. You can configure up to nine users, and give them access to USB media via either SMB or FTP; DLNA streaming options consist of a simple on/off toggle, and printers aren't supported at all.

Explore the rather austere-looking management interface and you'll also discover that there's no sort of AP or bridging mode. Parental control features are quite limited too: you can blacklist up to 24 specified URLs, but this affects all users, and there's no category blocking at all. You can, however, create multiple access schedules, and apply them to individual clients.

ABOVE The EXO's design mirrors its technical spec: it's sensible and compact

The D-Link EXO AC2600 isn't the fastest router on the market, and it's certainly not the most feature-packed. It is, however, one of the cheapest options in this month's group test, and it does everything that most people will require. If you're struggling with an outdated router, this unfussy little box is well worth a look before you move up to the more expensive options.

D-LINK

D-Link AC5300

It's eye-catching and the performance is great – but the price makes the AC5300 difficult to recommend

SCORE ★★★☆☆

PRICE £250 (£300 inc VAT)
from pcpro.link/288dlink

Living room 30 MB/sec | Bedroom 21 MB/sec | Bathroom 12 MB/sec

The second router from D-Link this month is a very different proposition to the first. Where the AC2600 is petite and unassuming, the AC5300 makes a very visible statement. It's the bulkiest, most conspicuous router here, and it's also the second most expensive.

Evidently, much of the money has gone on the design. There's no snazzy 60GHz radio or 10GbE connectors, as found on the Netgear Nighthawk X10, to justify the price. Peer around the case and you'll find the exact same physical connections as on D-Link's much cheaper EXO AC2600, including just four Gigabit Ethernet ports – which feels a bit mean when you're paying this much.

The internals, thankfully, are a significant step up. A second 5GHz radio is included, and each one supports (in theory) a huge bandwidth of 2,167Mbits/sec – a claim only two other routers this month can match. Factor in the eight antennae and you have a recipe for excellent wireless performance: at close range, the AC5300 delivered the highest download speeds of any router we tested in this month's roundup, and while speeds naturally dropped off as we moved further away, the AC5300 remained consistently towards the front of the pack.

On the software front, the AC5300's web interface is all but identical to the AC2600's, and to be honest this feels decidedly drab by comparison to the unit itself. It does, however, support a few features that the cheaper model lacks, including an access point mode and a media bridge function, which enables you to connect wired devices to a wireless network. There's support for USB printing too, though it's not perfectly straightforward – as with the Linksys EA9500, you have to install a third-party app on each system you want to print from.

ABOVE The AC5300's bulky, beetle-like looks are certainly a conversation starter

With those additions, we're certainly looking at a more rounded networking device than the AC2600, and its performance can't be faulted. Even so, it's very hard to recommend the AC5300 at £300 when the Linksys EA9500 offers a similar package for £73 less. Still, you can't put a price on style: if you're taken by the AC5300's arresting looks then by all means splash out.

tp-link

deco™

HomeCare™

Parental Controls
Antivirus
QoS

3 year
free service

High-Speed Mesh Wi-Fi for Your Smart Home

Deco M9 Plus
AC2200 Tri-Band Mesh Wi-Fi System
with Smart Home Hub

Cover up to 4,500 sq. ft. and connect over 100 devices.

Wi-Fi Dead-Zone Killer

Eliminate weak signal areas with whole home Wi-Fi. No more searching around for a stable connection.

Tri-Band Wi-Fi & TP-Link Mesh

Three high-speed wireless bands plus strong, dynamic backhaul delivers fast, stable Wi-Fi across your home.

3-Year Free Built-In Antivirus

TP-Link HomeCare™ protects all connected devices in your home from viruses and malware.

Integrated Smart Home Hub

Replace many smart hubs to save money and space. The Deco app controls all your smart home devices from a unified screen.

Setup and Control with the Deco App

The Deco app makes setup simple and is your console to control all connected smart devices.

Compatible with **amazon alexa**

Works with **IFTTT**

DRAYTEK

DrayTek Vigor2762ac

If it's advanced features you seek, the Vigor2762ac is a great choice – and the price is right too

SCORE ★★★★☆

PRICE £121 (£145 inc VAT)
from broadbandbuyer.com

Living room 25 MB/sec | Bedroom 17 MB/sec | Bathroom 10 MB/sec

At first I thought I'd been sent the wrong model: it was hard to believe that this tiny, two-aerialed little box could be DrayTek's top-of-the-range prosumer router.

However, it's a mistake to judge the Vigor2762ac by its size. For sure, its wireless credentials aren't as ambitious as some of its heftier competitors, with a quoted maximum bandwidth of just 866Mbits/sec on the 5GHz band – which is the lowest here by some distance. Yet, in our tests it generally kept up with the pack, delivering a solid 10MB/sec even at the remote end of my home. There's no MU-MIMO, mind you, and, of course, only two aerials, so if you have lots of wireless devices running flat out, the Vigor2762ac might not cope as well as a pricier model.

The diminutive case also packs in a pair of USB 2 sockets. You can use these to share storage across your network via SMB or FTP (there's no media-streaming option), or hook up a compatible printer. If downtime is a no-no, you'll be pleased to know that you can also plug in a 3G or 4G USB modem to take over if your primary internet connection goes down – although be warned that, since the two ports are stacked tightly on top of one another, a bulky dongle could potentially obstruct access to the second connector.

Access controls are impressively flexible. The scheduling function lets you configure up to 15 time slots of any length, recurring on specified days of the week, monthly or at an interval of your choosing, and you can blacklist not only URLs but individual services and specific applications. There's a built-in category-based filtering service too, although you have to subscribe to activate it, which costs a fairly steep £50 per year.

ABOVE The all-white Vigor2762ac might be small, but it keeps up with the pack

Overall, the DrayTek Vigor2762ac is a fine choice for home, and an even better one for work. The price is very competitive, and the manufacturer's 96% reliability score from *PC Pro* readers speaks for itself. Its only weak suit is ease of use: as with the Billion, the web portal is absolutely loaded with technical information and advanced enterprise-level features, which may frustrate and discourage less technical users.

SKY

Sky Q Hub

This low-profile router is sadly short on features and connectors, and can't match the performance of its rivals

SCORE ★☆☆☆☆

PRICE Free **from sky.com**
with new internet packages

Living room 17 MB/sec | Bedroom 6 MB/sec | Bathroom 3 MB/sec

The Sky Q Hub isn't for everyone – and I mean that literally. It works only with Sky's own broadband services, so if you're with another ISP it's off the table.

Frankly, you're not missing out on much. Probably the best thing about the Sky Q Hub is its tasteful low-rise design, which makes it a nicely inconspicuous presence in any living room. The minimal approach comes with a downside, though: there are no USB ports, and just two Gigabit Ethernet sockets. That immediately makes the Sky Q Hub the worst-connected router on test this month.

Open up the web portal and you'll note that there's also no VPN support, nor any provision for a secure guest network. Parents may be pleased to see the option to set up a custom access schedule, but it's pretty much useless as you can't apply it to individual clients – either everyone has access at certain times, or no-one does. On a more positive note, Sky subscribers can use Sky's Broadband Shield service to block unsavoury websites, and the router interface lets you additionally blacklist not just specific URLs, but also sites containing specified keywords.

The Sky Q Hub stumbles again when it comes to performance – another consequence of the space-saving design, we presume. Even at short range we got disappointing download speeds of just 17MB/sec, and once we stepped into a different room the Sky Q Hub's performance plummeted into last place. It's worth mentioning that if you have Sky Q TV services, the main box and any mini units around your home will double up as wireless extenders, a clever bit of engineering that should improve matters considerably. If you don't, though, you're on your own.

ABOVE The tasteful, low-key design of the Sky Q Hub is perhaps the best thing about it

You'll gather that we're not fans of the Sky Q Hub, and annoyingly the ISP doesn't officially support third-party routers, so you can't just swap it out for a better one. You can still upgrade your experience, however, by finding a router that will plug into to the Q Hub and serve as a more effective wireless access point – and we strongly recommend that you do.

TalkTalk Wi-Fi Hub

If you're a TalkTalk customer with an older router, it's worth the upgrade – but key features are missing for now

SCORE ★★★☆☆

PRICE £25 (£30 inc VAT) for existing customers, free with new fibre internet packages from talktalk.co.uk

Living room	Bedroom	Bathroom
26 MB/sec	22 MB/sec	12 MB/sec

TalkTalk is a decent internet service provider, but historically the poor performance of its bundled "Super Router" has done it no favours. Since May, the company has been rolling out a new hub that aims to improve matters.

And we've got to say, we can't fault the new hub for speed. At close and medium-range, this unassuming little box, with no external antennae, proved just as fast as Netgear's mighty Nighthawk X10 – and while it wasn't quite able to keep up the pace at long range, it got impressively close, ranking fourth in a field of 13.

The feature set is very limited, though. You get four Gigabit Ethernet sockets and a WPS button, but no USB connectors, so you can forget about file and printer sharing. Video streaming is out too.

Indeed, when you open up the web portal you'll find there's practically nothing to configure – no VPN support, no option to use the hub as a bridge or access point and no way to set up a guest network. There's also zero in the way of parental controls: the assumption is that you'll use TalkTalk's hosted HomeSafe service, but this is a very blunt instrument as it doesn't let you apply custom restrictions to individual devices.

The one area where the Wi-Fi Hub exceeded our expectations was dynamic DNS support: you can choose from seven different services, and once you've provided your credentials the router handles everything else. And to be fair, the core router functions – port forwarding, MAC address filtering and so forth – are all present and correct.

ABOVE The subtle, Damien Hirst-esque design belies the power of the Hub

The Wi-Fi Hub is still pretty new, so we're optimistic that future updates might fill in some of the missing features. For now, though, it's very much a case of performance at the expense of all else. Still, that's not a terrible proposition, and if you're an existing TalkTalk customer with the older router, the £30 upgrade charge is pretty reasonable. You can also buy it if you're with another ISP, although in this case you'll have to pay the full £120 RRP, which makes it slightly less of a bargain.

TP-Link Archer C5400

The C5400 has a snazzy web interface and great parental controls, but Wi-Fi speeds are unexceptional

SCORE ★★★☆☆

PRICE £213 (£256 inc VAT) from pcpro.link/288tpl

Living room	Bedroom	Bathroom
21 MB/sec	21 MB/sec	6 MB/sec

With its slim, square design and eight flip-up antennae, the Archer C5400 certainly looks the business. And internally, it boasts two 5GHz radios, each with a maximum bandwidth of 2,167Mbits/sec, for a huge total throughput that's matched only by D-Link and Linksys this month.

Unfortunately, as we've seen in this Labs, such figures don't always translate to real-world performance. Over a same-room connection, the Archer C5400 gave us distinctly slower download speeds than its rivals, and while that headline speed didn't falter as we moved to the bedroom, the TP-Link slumped far down the table when we moved away to the bathroom.

It's a shame, because the Archer is otherwise a rather snazzy router. The web portal is one of our favourites – it's easy to navigate, perfectly responsive and even fairly tasteful, with a gentle blue background. The Status page is detailed yet clear, and the links down the side provide quick, logical access to all the core settings.

There's a good set of features too. File-sharing and print server functions let you make good use of the unit's twin USB ports, and the TP-Link Cloud service allows you to access your files over the internet too. Set up the built-in OpenVPN server and you can connect directly to local shares and NAS appliances while you're out and about – and to make this as easy as possible, TP-Link offers its own dynamic DNS service (although **no-ip.com** and **dyn.com** are supported, too).

TP-Link's parental controls meanwhile are among the best we've seen. You can easily set up device-specific usage limits and schedules with a few clicks, and TP-Link's HomeCare service provides three years of free category-based restrictions. The company hasn't yet decided how much it will cost to continue the service after that – but by then you may well be ready to replace your router anyway.

When you're paying this much, you're entitled to expect top-class performance, and based on our experience the C5400 sadly doesn't deliver that. Nevertheless, it's an undeniably likable router, especially if you have kids; if coverage isn't your top priority, it's well worth a look.

ABOVE The flip-up antennae and slim base mean the C5400 is undeniably stylish

Virgin Media Hub 3

Slow and lacking in features, the Hub 3 covers the basics but a third-party router will serve you much better

SCORE ★★☆☆☆

PRICE **Free** with new internet packages from virginmedia.com

Living room	Bedroom	Bathroom
10 MB/sec	8 MB/sec	7 MB/sec

The oddly shaped Hub 3 is included with all Virgin Media broadband packages, including the company's insanely fast 362Mbits/sec fibre-to-the-premises services. Unfortunately, the hardware isn't anywhere near fast enough to convey that sort of speed to wireless clients.

Indeed, in our tests it proved a poor performer all round. Short-range download speeds of 10MB/sec gave us most of the benefit of our 100Mbits/sec internet connection, but still, we're talking last-place performance – which naturally only slowed down further as we moved around the house. Virgin customers have also complained about random spikes in latency and flaky DNS performance, though a recent firmware update seems to have improved matters.

What's more, the Hub 3 is one of this month's least versatile routers. Cast an eye down our feature table and you'll see a whole string of unticked boxes: there's no support for dynamic DNS, no VPN, no smartphone app, no Alexa integration and nothing in the way of router-based parental controls. You'll also notice that there's no USB or other connectors, so file and printer sharing are off the table.

All of this leaves you with little reason ever to interact with the web portal. That's probably just as well, because it's very laggy: logging in and viewing a list of connected clients takes a tiresome 30 seconds.

The Hub 3 has a few saving graces, though. It does at least offer a guest network, so visitors and friends can't run amok on your private Wi-Fi. You can also switch the whole thing into modem mode, which effectively disables its router functions. You can then carry on using the Hub to negotiate your connection to Virgin Media, and connect a third-party router to run your home network.

ABOVE **The book-like Hub 3 looks completely different to all of the other routers on test**

It goes without saying that, if you're a Virgin Media customer, we strongly recommend that you take advantage of this option. The Hub 3 does its job, in a very basic sort of way, but even a mid-price third-party alternative will give you a much richer range of features, far better performance – and a pleasanter overall experience.

ROUTER OR MESH?

A mesh networking system can provide screamingly fast speeds throughout your home, but do you actually need one?

This month we've focused on conventional standalone routers, but what about mesh networking systems? The promise of a consistent signal coverage throughout your home sounds great, but there are reasons why it may make sense to pick a conventional router instead.

1 Higher price

High-quality mesh networking gear isn't cheap. And that's hardly surprising – the best systems use no fewer than nine Wi-Fi radios, spread across three nodes. While the Tenda MW3 (*see p69*) is the exception that proves the rule, in general mesh prices are higher; you might be better off buying a cheaper router and a separate Wi-Fi extender.

BELOW **Mesh systems such as the Zyxel Multy X offer fast speeds over a wide area, but is it worth paying extra?**

2 Limited connectivity

Many mesh systems have only two Ethernet sockets per node, which is hardly ideal if you have lots of wired devices. They normally lack USB connections too, so you can forget about file and printer sharing, and while WPS is sometimes supported, it's rare that you get a physical button. If you need lots of connection options, a traditional router is a better bet.

3 Fewer features

Most mesh networking systems support basics such as a guest network, port forwarding, IP address reservation and simple parental controls. If you want more advanced capabilities, though – such as wireless bridging, 3G failover and built-in VPN support – you're far more likely to find them in a standalone router.

4 Less bandwidth

Multi-node systems may advertise high data rates, but some of that bandwidth is eaten up in passing packets around from node to node. If you opt for a tri-band mesh system with a dedicated backhaul channel, your clients will only get the same bandwidth as you'd see from a regular dual-band router. And if your mesh system doesn't have a dedicated backhaul, that leaves less capacity for your downloads and file transfers.

With all those caveats, however, mesh systems still have a role to play. If you live in a big old house with thick stone walls, a mesh system can give you a better, faster, more pervasive connection than an individual router.

VIEW FROM THE LABS

Wireless networking is a fickle thing, but if a router can stand out from the crowd in my house, it should do so in yours too

I say this every time we cover networking gear in the Labs, but it bears repeating: the results below show how this month's crop of routers fared in my own home – but when it comes to wireless, every home is different. Your house surely has a different layout to mine, which is likely to have a significant effect on the way your Wi-Fi signal propagates. And that's before we talk about unpredictable interference patterns from home appliances and neighbours' wireless networks.

I'm not saying you should disregard my findings – just don't be surprised if you buy one of our recommended routers and find that your connection is slightly faster or slower than mine was. These tests are more about establishing a hierarchy; based on the figures below, you can be pretty confident that, in a given environment, the Linksys EA9500 will deliver a stronger, faster connection than (say) the Virgin Media Hub.

And let's take a moment to pick apart the idea of a "stronger, faster connection". It would be horribly misleading to say that, in the world of Wi-Fi, strength and speed are simply different ways of looking at the same thing – but as a rule of thumb it's not a million miles off. You can think of it like this: when the router and client have a strong, stable connection, they can spray data packets back and forth at top speed. When the connection is weaker, a higher proportion of those packets get lost or corrupted, and have to be resent. It ends up taking longer on average for a given chunk of data to travel through the air.

Darien Graham-Smith is associate editor of *PC Pro* and willing to move into a mansion for long-term testing of router speeds

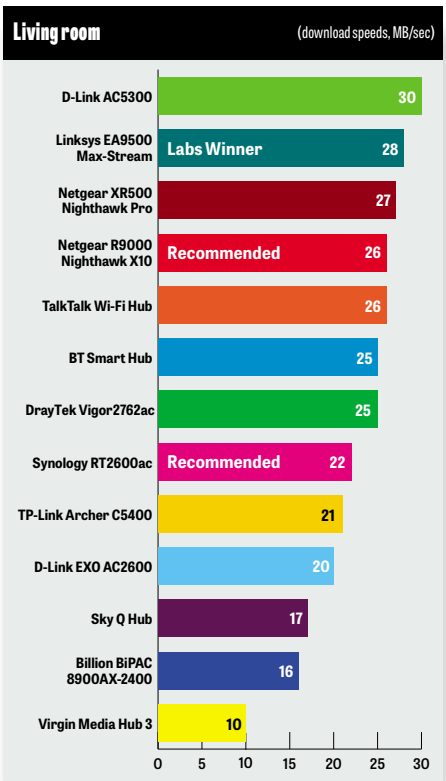
This is one reason why we carry out our performance testing over the local network, rather than using an internet-based speed testing service. According to Ofcom's latest figures, the average broadband speed across the UK is 46Mbits/sec, equivalent to just under 6MB/sec. If I'd used such an internet connection to test wireless performance, 38 out of the 39 bars below would show a maxed-out download speed of 6MB/sec, which wouldn't be very helpful.

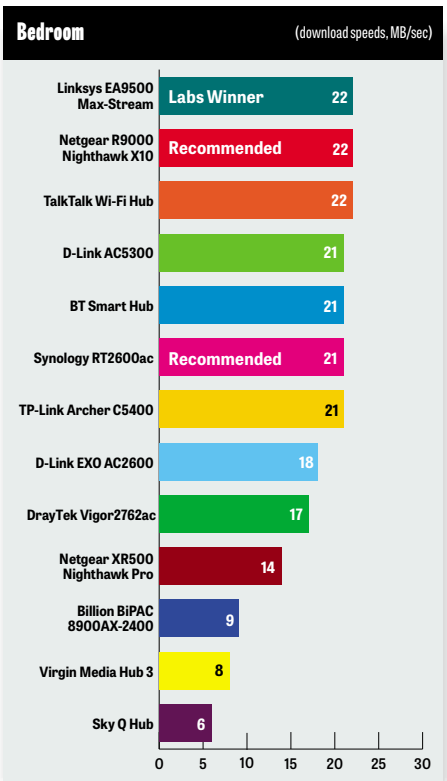
"As our libraries of personal data grow too big to sensibly live in the cloud, the home network is becoming more important than ever"

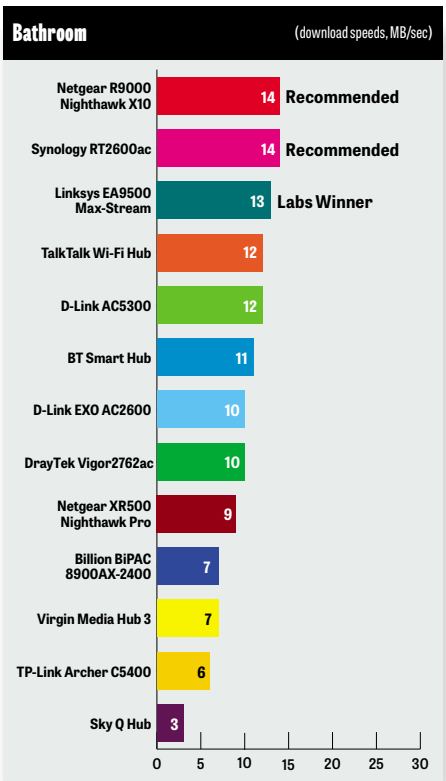
Using an unthrottled local connection allows us to see exactly how fast each router can go – and that in turn gives us an idea of how well it's likely to cope with adverse conditions and long-range connections. To reiterate, speed and strength don't perfectly correlate: an iffy connection to a 2,133Mbits/sec radio might be faster or slower than a rock-solid one to an 867Mbits/sec radio, and your laptop's antenna comes into play as well. Still, the results below let us declare with confidence that the Netgear X10 or Synology RT2600ac can sustain a connection in areas where the Sky Q Hub simply can't reach.

Plus, local file transfer speed is far from academic. In my everyday life, I fill up my camera with blurry photos, record interminable guitar solos and even put together the odd clunky video; gigabytes of data get shunted around my LAN on a regular basis, and it's all regularly backed up to my NAS drive. As our libraries of personal data grow too big to sensibly live in the cloud, the home network is becoming more important than ever; ideally, your router should let your devices communicate as smoothly and speedily as possible. ●

Speed test results







The Network

Practical buying and strategic advice for IT managers and decision makers

How to survive a dreaded audit
Steve Cassidy explains how to turn audits to your advantage p102

Digital transformation
In this month's Cheat Sheet, we explore what it really means p105

Supporting remote workers
We ask the experts how to best support remote staff p106

BUSINESS FOCUS

Choose the perfect tower server

Take control of your security, services and business apps with an affordable tower server. Dave Mitchell reveals what to look for and puts four models to the test

Investing in on-premises server hardware might seem a little backward in these cloudy times. But the latest designs are perfect for growing small businesses, delivering 24/7 availability and putting you in total control of your data security, services and apps.

Tower servers are very easy to deploy, too. Unlike rack servers, they don't demand dedicated cabinets, they'll slot neatly into an existing PC-based network, and they're simple to upgrade as needed.

That last point is important. This month, we're focusing on servers that are affordable for smaller businesses, but which have scope to grow with your needs, representing a solid long-term investment.

To that end, we've tested a selection of single- and dual-socket servers from four of the biggest names in the industry – Broadberry Data Systems, Dell EMC, HPE and Lenovo – and put them through their paces to help you pick a server that will answer your needs now and far in the future.

CPU bonanza

Some businesses seek to cut costs by choosing a cheap entry-level tower equipped with a low-cost Xeon E3-1200 v6 chip. This could prove to be a false economy, though, as the E3 family has very limited upgrade potential. Not only does it only support a single processor socket, there's a hard maxmimum of 64GB of memory – and it doesn't have much of a roadmap to speak of, as it's due to be succeeded by the upcoming Xeon Entry family later this year.

The newer Xeon Scalable family is a more sensible choice for almost everyone, comprising no fewer than 51 different processor models grouped into Bronze, Silver, Gold and Platinum designations.

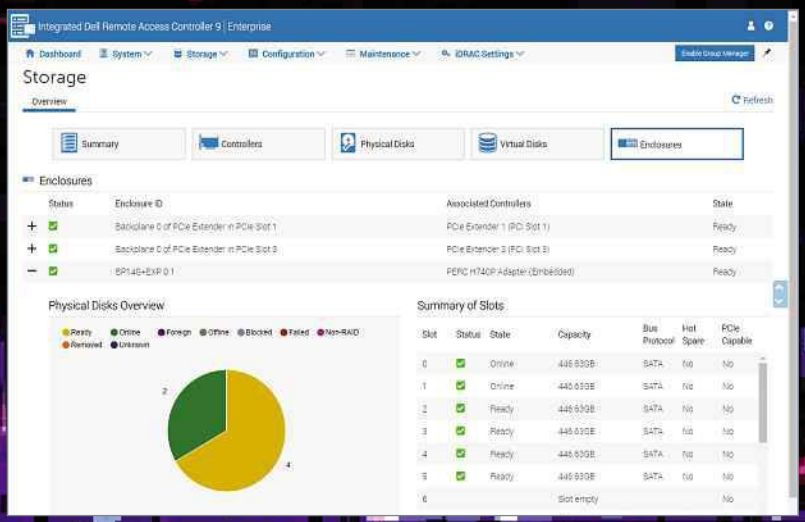
For a small business tackling light to moderate workloads, the Bronze and Silver ranges are perfect. In fact, there are only two Bronze models to choose from - the six-core 3104 and the eight-core 3106, both of which run at 1.7GHz, with support for up to 768GB of DDR4 memory and single (1P) and dual (2P) socket servers. The five Silver models range from four to 12 cores, with clock speeds ranging from 1.8GHz to 2.6GHz.

"Some businesses seek to cut costs by choosing a cheap entry-level tower, but this could be a false economy"

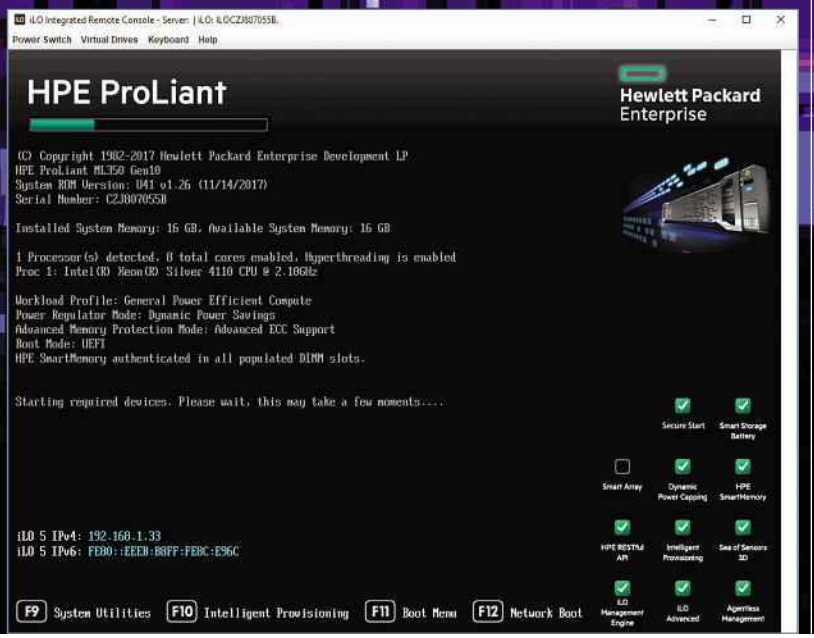
If you're unsure which model is right for you, a good starting point is the Silver 4110 model, which runs at 2.1GHz and features eight physical cores. It's a great balance of value and power – no wonder all four of the vendors who took part in this month's reviews chose this CPU for their servers.

2P or not 2P

If you're looking for a server to handle basic services such as file, print and messaging for a small user base, a mid-range single-processor ("1P") server will do the job nicely. However, if you find you need more power in future, another benefit of Xeon Scalable systems is that – assuming your motherboard has a second slot – they all allow you to drop in an identical second processor when the need arises. This doesn't just open up increased processing power –



LEFT Dell's iDRAC9 controller lets you monitor and manage server storage



LEFT HPE's iLO5 has great remote control features – if you pay for the licence...

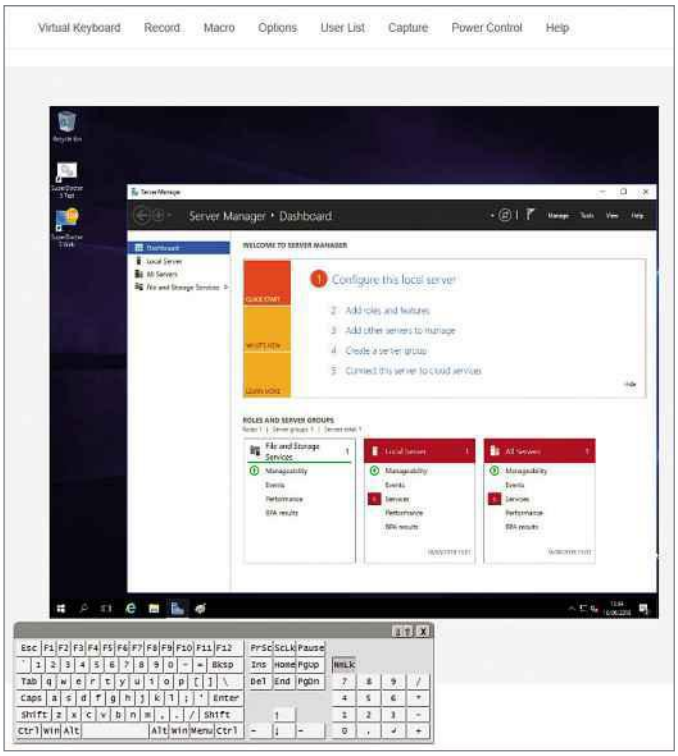
BELOW ... whereas Broadberry includes remote access as a standard feature

installing a second CPU enables its attendant DIMM slots, doubling your maximum memory potential.

Alternatively, since all Xeon Scalable processors use the same standard LGA 3647 socket, it's also a cinch to carry out an in-place processor upgrade. So you can start with a Bronze CPU, and then if you find it's holding you back, replace it with a faster, more core-heavy Silver or Gold model.

To be clear, though, unless you're planning on running heavy-duty apps such as big databases, the Xeon Gold and Platinum models are overkill – and they're also expensive. A 16-core Gold 6130 model, for example, could set you back nearly £2,000 - around the same price as you'll pay for one of the complete server systems we review on the following pages.

If you think you might want to upgrade your CPU in future, just be sure to check whether your server chassis has any thermal restrictions. You've nothing to worry about with Bronze and Silver CPU models as they all have a low 85W TDP, but some of the meatier models have TDPs of 125W and above, and not all enclosures are able to meet their cooling needs. In each of this month's server reviews we've listed the maximum TDP rating of each chassis to help you choose.



Storage and RAID

Expandability isn't just about your CPU. It's a fact of life that server storage almost invariably gets eaten up faster than you've planned for, so it's essential you have plenty of scope to add capacity. This is one of those areas where tower servers excel, as they can offer huge banks of readily accessible drive bays: one of the models we test this month supports up to 32 drives.

Remember, though, that physical mountings are only one part of the puzzle. It's a given that you'll be using RAID to protect your critical data, so check the number of hard disks your server's RAID controller can handle. If your needs exceed this, it's not the end of the world but you will have to shell out for a more upmarket card, and manage the upheaval of installing it.

When it comes to choosing your drives, SATA disks offer the best price-to-capacity ratio, but if performance is a priority, that's a reason to consider more expensive Nearline SAS (NL-SAS) or SAS drives.

Manage and protect

Once your server is up and running, it will quickly become central to your business – so you need to know it's in good health. All four servers on review this month include remote monitoring, so you can keep an eye on their vital signs using a web browser.

Remember too that RAID can protect you from hardware failures, but it isn't a backup solution. We very strongly suggest you get a proper backup product up and running right from the outset. For further guidance, refer back to our backup software buyer's guide in issue 286, where we look at on-premises, cloud and hybrid solutions.

If this is starting to sound like a big project, don't be daunted: the tower servers we've reviewed this month include everything you need to get started, and we've chosen them to suit a wide range of budgets and requirements – so all you need to do to find out which one fits your growing business is read on.

Broadberry CyberServe Xeon SP1-P04S

A great balance of features, storage and upgrade potential make this a sound choice for a first server

SCORE ★★★★½

PRICE As reviewed, £1,745 exc VAT
from broadberry.co.uk

If you're looking for a server that's ready to go out of the box then Broadberry's CyberServe Xeon SP1-P04S does the job very nicely. The system we tested came preinstalled with a pair of fast 480GB Intel SATA SSDs and a generous 32GB of DDR4 memory – yet it's priced right for IT managers on a strict budget, and offers space to grow further.

At the heart of the server beats Intel's popular eight-core 2.1GHz Xeon Silver 4110 CPU. That provides more than enough power for most SMEs, though you should note that the Supermicro X11SPL-F motherboard is of the single-socket variety, so you won't be able to add a second CPU down the line if your needs expand.

Still, you always have the option to step up to a more powerful processor, such as the Gold 5100 or 6100. Indeed, the chassis's maximum 165W TDP rating will accommodate more or less any Xeon Scalable processor, short of a handful of ultra-high-end models. The active CPU cooler isn't too bothersome, either: overall noise levels were pleasantly low, with the SPLnFFT iOS app measuring a peaceful 42.2dB from 1m in front.

RAM meanwhile is eminently upgradeable. The supplied 32GB will be ample for most small business apps, but with six free slots you can upgrade to a theoretical maximum of 1TB.

ABOVE The chassis can accommodate high-end Xeon CPUs

It's good to see that the server presents a very tidy interior, with all key components within easy reach and all cabling neatly tucked out of the way. A whopping seven PCI-Express slots are up for grabs, so another easy upgrade might be to supplement the dual embedded Gigabit Ethernet network ports with your choice of industry-standard 10-Gigabit adapters.

Should you need to add extra drives, a hot-swap cage lurks behind the lockable front door, with disk carriers ready and waiting in the unpopulated slots. It's a shame that there are only four bays, and you can't add more, as the space below the resident cage is occupied by a large fan. On the upside, we've always liked the way that Broadberry lets you install your own hard disks – something that would invalidate the warranty on certain blue-chip servers. This means you're free to source your drives wherever you like, and you won't get stung when you want to expand your storage.

All drives are handled by the Intel C621 chipset, which includes Intel's Rapid Storage Technology enterprise (RSTe) RAID controller. This supports stripes, mirrors and RAID5 arrays, and can be managed using Intel's free RSTe Windows utility. We tested it by hot-plugging a couple of 12TB Seagate hard disks, and saw them instantly pop up in the RSTe interface, allowing us to quickly create a 12TB mirrored repository for all our business data.

Finally, the motherboard also includes Supermicro's embedded RMM chip and a dedicated network port for remote access. It isn't as feature-rich as HPE's iLO5 or Dell's iDRAC9, but the HTML5-based web interface exposes the server's power controls and reveals plenty of information about key components – and it comes with full KVM remote control and virtual media services at no extra cost. You also get the free SuperDoctor 5 software, which uses the local Windows SNMP agent to drive a colourful web interface packed with graphs and status dials.

PC PRO RECOMMENDED

"Broadberry lets you install your own hard disks – something that would invalidate the warranty on certain blue-chip servers"

In all, the CyberServe Xeon SP1-P04S is a great starter package for small businesses looking to take a first step onto the Xeon Scalable ladder. The dual Intel SSDs add a lot of value, there's upgrade potential for the future and Broadberry doesn't hold you to ransom with the hard disks.

LEFT The CyberServe includes plenty of free management tools

SPECIFICATIONS

2.1GHz Xeon Silver 4110 processor • Supermicro X11SPL-F motherboard • 32GB 2,400MHz DDR4 (max 1TB) • Intel C621 RSTe RAID • supports RAID0, 1, 10, 5 • 2 x 480GB Intel S4500 Enterprise SATA SSDs (max 4) • M.2 SATA SSD slot • 2 x Gigabit Ethernet • 7 x PCI-Express 3 • 500W fixed PSU • Supermicro RMM • 178 x 534 x 432mm (WDH) • max 165W TDP • 3yr on-site NBD warranty

Dell EMC PowerEdge T640

A versatile server with all the power a small business needs – and massive expandability for the future

SCORE ★★★★½

PRICE As reviewed, £1,923 exc VAT
from dell.co.uk

Dell EMC's PowerEdge T640 costs more or less the same as this month's other servers, but it's designed with an eye on greater things. For a start, it supports every Xeon Scalable CPU on the books – all the way up to the Platinum 8180, with its 28 cores and huge 205W TDP.

It also offers huge storage capacity. Its 5U width affords room for up to four drive cages, which (with the addition of an extra backplane) can be packed with up to 18 regular 3.5in drives or 32 SFF drives. For maximum storage performance, the 16-bay SFF model can also be combined with up to eight PCI-E NVMe SSDs. These fit into a dedicated cage in the upper half of the front panel, cabled through to a pair of PCI-E bridge cards.

Whatever disk configuration you choose, Dell EMC's BOSS (boot-optimised storage solution) PCI-E card helps you make the most of it by running the OS from a separate pair of mirrored M.2 SSDs; this costs around £477 with two 240GB drives.

For standard SATA drives, the embedded PERC S140 drive controller may be all you need, with its support for stripes, mirrors and RAID5 arrays. Our test system, however, came with a PERC H740P card, which brings 12Gbits/sec SAS3 into play and includes 8GB of NVRAM cache, plus an integrated battery backup.

And when you want to add more drives, you'll appreciate the T640's spacious interior. The RAID card is tucked away at the top of the motherboard, and there's a slot above this for a dual SD card controller which adds hypervisor redundancy with hardware mirroring.

In the centre of the motherboard sit a pair of CPU sockets; the price includes a single 2.1GHz Xeon Silver 4110 CPU, but you can easily slot in a second one in the future to gain a big boost in processing power. Similarly, our test system came with 16GB of DDR4, but with 24 DIMM sockets you can push this up to a maximum of 1.5TB with dual CPUs – or all the way up to 3TB if you splash out on high-end Gold or Platinum CPUs.

Our T640 spec only required two fan modules, fitted at the rear of the motherboard shroud, but if you choose to add a second CPU or max out the hard disks you'll need to invest in the additional four-fan module, which slips in behind the backplane.

Round the back, dual 10GBase-T ports come as standard, and eight PCI-E slots give you loads of room for additional network cards. The platform can handle up to four GPU accelerator cards too, for virtual desktop infrastructure deployments, although these are only supported in the rackmount version.

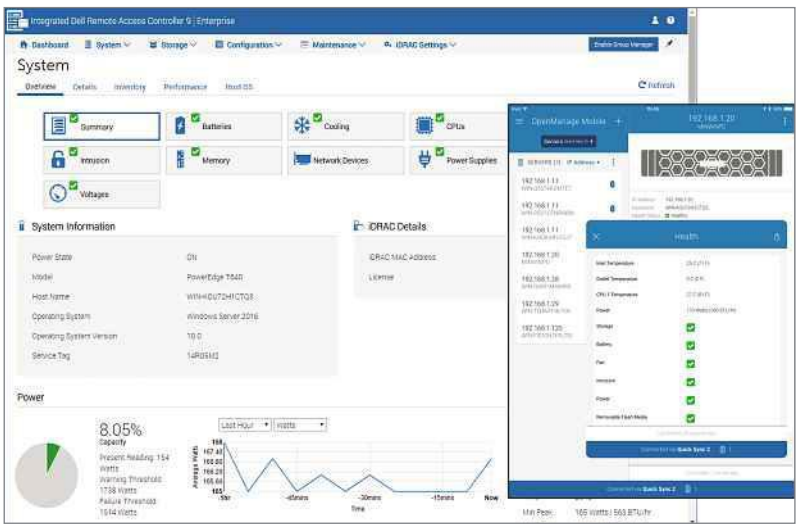
ABOVE The T640's wide chassis will accommodate a huge bank of hard disks

A final plus is manageability: Dell's iDRAC9 controller presents a wealth of data about all the critical hardware, in a slick HTML5 web interface. The System Lockdown mode prevents unauthorised users fiddling with the configuration, and firmware updates are cryptographically signed for extra security.

We also love the server's Quick Sync 2 feature: tapping a button on the front activates Bluetooth, which let us connect our iPad directly to the server via the OpenManage Mobile (OMM) iOS app. After scanning the QR code on the system label, we instantly had access to all sorts of server information, alerts and health status, while standing right in front of the server.

"The price includes a single 2.1GHz Xeon Silver 4110 CPU, but you can easily slot in a second one in the future for a big processing boost"

The PowerEdge T640 is one of the most versatile towers we've seen. It's priced right for SMEs seeking a first server, yet offers vast expansion potential. Factor in Dell's exemplary management features and it's just the ticket for a fast-growing business.



LEFT The iDRAC9 controller and OMM iOS app deliver quality management features

SPECIFICATIONS

2.1GHz Xeon Silver 4110 processor (max 2) • 16GB 2,400MHz DDR4 (max 3TB) • Dell PERC H740P SAS3 RAID/8GB NVRAM cache/BBU • supports RAID0, 1, 10, 5, 6, 50, 60 • 16-bay SFF drive cage • 1,300GB 15K SAS3 SFF hard disk (max 32) • dual 10GBase-T • 8 x PCI-Express 3 • 495W hot-plug PSU (max 2) • iDRAC9 Enterprise with Gigabit Ethernet • 220 x 715 x 443mm (WDH) • max 205W TDP • 3yr on-site NBD warranty

HPE ProLiant ML350 Gen10

A top-value Xeon Scalable tower with a flexible range of upgrade options to cope with future demand

SCORE ★★★★★

PRICE Model 877621-031, £1,799 exc VAT from ebuyer.com

HPE's ProLiant ML350 Gen10 is a perfect expression of the company's "buy now, upgrade later" mantra. Prices start low: the cheapest pre-configured model (877619-031) costs just £1,443, with a six-core 1.7GHz Xeon Bronze 3104 CPU, 8GB of DDR4 RAM and an embedded S100i SATA controller. Every part of the specification can, however, be upgraded to suit your needs.

We stepped up to the 877621-031 model, which costs another £356 but offers a lot more power. It features an eight-core 2.1GHz Xeon Silver 4110 CPU, 16GB of RAM and a Smart Array P408i-a RAID card, which supports 12Gbits/sec SAS 3 drives.

Storage choices are extensive: the ML350 Gen10 uses HPE's standard 8+8+8 drive bay layout, which means the single SFF hot-swap cage in our system can be supplemented with two additional cages for a total of 24 drives. If you want the highest storage capacity, you can also choose a model that comes with 12 LFF bays certified for 12TB drives. Want the server to host high-demand apps? That's no problem either: a dedicated cage can be fitted in the centre location to take up to eight super-fast NVMe SSDs, which attach to two riser cards fitted in the first and third PCI-Express expansion slots.

The P408i-a RAID controller meanwhile occupies a dedicated slot at the top of the motherboard; it supports every conceivable array type, and features 2GB of battery-protected cache. Ours was cabled directly to the SFF drive cage, and adding HPE's SAS expander card allows it to manage all 24 bays.

The motherboard offers dual CPU sockets, so you can install a second processor to match the first, or move up to a more hefty model – the entire Xeon Scalable family is supported. A set of 24 DIMM slots allows the server to be expanded to a massive 3TB of memory, and if the quartet of Gigabit Ethernet ports isn't enough, you can always drop a 10-Gigabit Ethernet card into one of the system's eight free PCI-Express slots.

All entry models come with two cooling fans fitted at the rear of a large plastic air shroud covering most of the motherboard; note that many upgrades (including dual CPUs and the 24-drive chassis), require you to add an extra set of four hot-swap fans behind the drive backplane.

The ML350 Gen10's remote management facilities are excellent thanks to HPE's iLO5 chip, which provides a web interface packed with useful information about critical components. If you want to take advantage of power metering, full OS remote control and virtual media services, however, you'll need to shell out for an Advanced or Essentials licence – features which other servers give you for free.

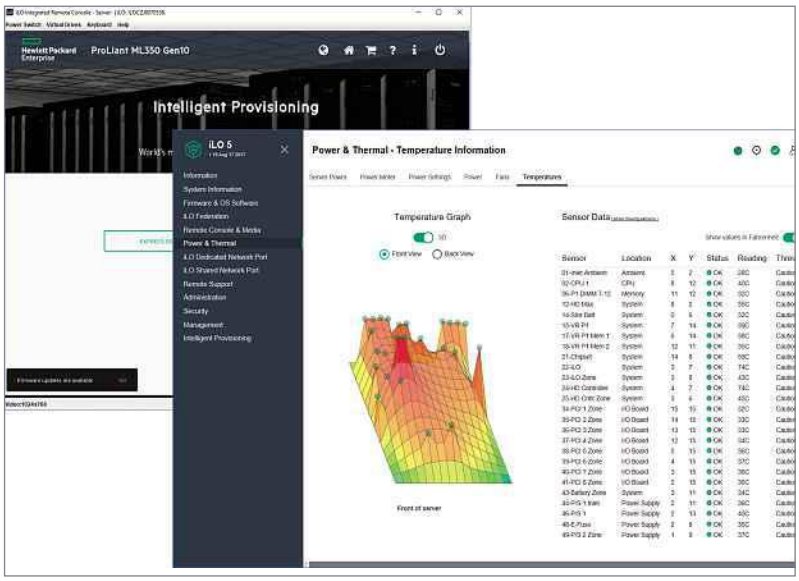
ABOVE Eight PCI-Express slots open up plenty of expansion options

The iLO5 also offers great security, with Secure Start, Secure Recovery and breach detection technology. Firmware is validated during startup using HPE's clever fingerprinting technologies, and the server will refuse to boot if it detects firmware tampering.

It's alternatively possible to use HPE's iLO Mobile iOS app to remotely access the iLO5; we found that with this, our iPad provided the same level of detail as the standard web interface. And adding the server's iLO5 details to the lab's virtualised Hyper-V HPE OneView app enabled us to monitor all our ProLiant servers, view power usage and temperatures and manage remote control sessions.

"If you want to host high-demand apps, a cage can be fitted in the centre location to take up to eight superfast NVMe SSDs"

In all, the ProLiant ML350 Gen10 offers a perfect balance of value, features and upgrade potential, making it a great choice for a small organisation with an eye on future expansion.



LEFT HPE's iLO5 chip provides detailed server monitoring

SPECIFICATIONS

2.1GHz Xeon Silver 4110 processor (max 2) • 16GB 2,400MHz DDR4 (max 3TB) • HP Smart Array P408i-a SR Gen10 SAS3 RAID • supports RAID0, 1, 5, 6, 10, 50, 60, ADM/10 • no disks supplied (max 24 SFF/12 LFF) • hot-swap SFF 8-bay backplane • 4 x Gigabit Ethernet • 8 x PCI-Express 3 • 800W hot-plug PSU (max 2) • HP iLO5 Standard • 175 x 685 x 466mm (WDH) • max 205W TDP • 3yr on-site NBD warranty

Lenovo ThinkSystem ST550

Not the most expandable platform in the world, but a solid, easy-to-deploy server for moderate workloads

SCORE ★★★★★

PRICE As reviewed, £1,809 exc VAT from ebuyer.com

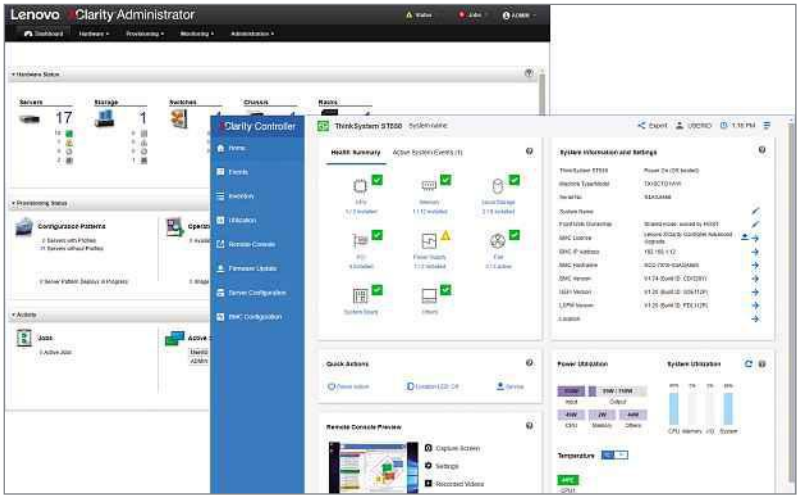
The ThinkSystem family is barely more than a year old, but it's established Lenovo as a force to be reckoned with in the server market – and the new ThinkSystem ST550 is well worth a look if you need a fuss-free server to handle your everyday apps along with file, print and web serving.

For the price, it's a great hardware package. There's an eight-core 2.1GHz Xeon Silver 4110 in the driving seat, and a spare socket for a second CPU for when you want to boost your parallel processing. The chassis has a comparatively low 125W TDP limitation, but it supports all Bronze, Silver and Gold 5100 CPUs, plus Gold 6100 models with up to 20 cores.

The price also covers 16GB of TruDDR4 RDIMM memory, and 12 DIMM slots allow this to be boosted to a maximum of 768GB in dual-CPU configurations – or double that with the forthcoming option to move up to 128GB DIMMs.

The chassis feels reassuringly solid and offers very flexible storage options. Our system came with an eight-bay hot-swap SFF backplane, with room for a second above; you can fit a total of 20 SFF drives (using optional cages which occupy the two 5.25in expansion bays), or up to eight LFF disks. Four super-fast PCI-E NVMe SSDs can also be installed by replacing the standard SFF cage with Lenovo's AnyBay module, which uses an NVMe switch adapter fitted in the second expansion slot to connect the drives directly to the first CPU.

RAID options start with the basic Intel RSTe controller, which supports up to eight SATA drives in striped, mirrored and RAID5 arrays. Our test system came with Lenovo's own RAID 930-8i card, which adds support for 12Gbits/sec SAS3 connections, plus RAID6 support and a potentially valuable 2GB of battery protected cache. Note that since it only has eight SAS3 ports, it's fine for managing the supplied SFF backplane, but if you want to add further drives you'll need a second RAID card. For increased future-proofing, consider specifying the 16-port or 24-port versions of the RAID 930 card, so extra disks can be simply plugged in as and when the time comes.



LEFT The XClarity Controller provides a great range of management features

ABOVE The ST550 may look unassuming but it's sturdy and easy to get along with

If you're shopping for your first server, you'll be pleased to know that getting set up is a piece of cake, thanks to Lenovo's XClarity Provisioning Manager. This guided us through the process of configuring a RAID array, and helped us get Windows Server 2016 running in less than 30 minutes.

Maintenance and upgrades are a breeze too, as the interior of the server is nice and tidy, with easy access to all the key areas. Dual Gigabit Ethernet ports are built in, and the six available PCI-Express slots give you plenty of room to install additional 10-Gigabit adapters, should you need to boost your networking bandwidth.

The final piece of the puzzle is Lenovo's XClarity Controller (XCC), a management platform that puts the ST550 up there alongside HPE's iLO5 and Dell's iDRAC9 for remote management features. The web interface delivers all the information you could want about system health and critical components, with friendly coloured graphs showing resource utilisation and system-wide power usage. To get the best from it, you'll need an Advanced licence, which adds power management graphs, remote control, virtual media services plus OS provisioning; it would be nice if those things came as standard, but for a mere £23 per year it's hard to complain. Other valuable features of the XCC include automated firmware update tools and a range of options to set access security.

"Maintenance and upgrades are a breeze, as the interior of the server is nice and tidy, with easy access to all the key areas"

If you're nervous about moving to an in-house server, you can rest easy with the ThinkSystem ST550. It's wonderfully straightforward to set up, ticks all the important boxes and gives you a decent degree of scope for future expansion.

SPECIFICATIONS

2.1GHz Xeon Silver 4110 processor (max 2) • 16GB 2,400MHz DDR4 (max 768GB) • ThinkSystem RAID 930-8i/2GB cache/BBU • supports RAID0, 1, 5, 6, 10, 50, 60 • 2 x 300GB 10K SAS3 SFF hard disks (max 20) • 2 x Gigabit Ethernet • 6 x PCI-Express 3 • 750W hot-plug PSU (max 2) • XClarity Advanced with Gigabit Ethernet • 177 x 670 x 440mm (WDH) • max 125W TDP • 3yr on-site NBD warranty

Epson WorkForce Pro WF-C5790DWF

Colour prints are a little drab, but this speedy inkjet has great cloud support and laser-beating running costs

SCORE ★★★★½

PRICE £219 exc VAT

from printerbase.co.uk

The received wisdom has it that inkjet printers are slower and more expensive to run than lasers – but Epson's WorkForce Pro range of MFPs turns that on its head, with low consumable costs and print speeds that give mid-range lasers a run for their money. That's especially true of the top-dog WF-C5790DWF, which combines print, copy, fax and scan functions, supports both wired and wireless operations, and churns out A4 pages at a swift 24ppm.

Costs are kept low by Epson's replaceable ink pack system (RIPS), which ditches clunky cartridges in favour of simple bags that slot into receptacles in the printer's base. The high-capacity bags deliver a mono page for 1.1p and colour one for 4.9p – easily half the price of comparable lasers. Even if you choose a lower-capacity refill, you don't get stiffed, as the 3,000, 5,000 and 10,000-page ink packs all work out to roughly the same price per page, so you can simply buy whichever is most convenient. As a bonus, the WF-C5790DWF is easy on the electrical bill too: we measured a peak power consumption of just 22W when printing, while a laser can easily suck up more than 500W.

Getting set up is straightforward – but you have to start by picking between wired or wireless mode, as they can't both be active at once. Once we'd connected the printer to our Wi-Fi network (using the generously sized touchscreen), Epson's Windows-based installation software immediately spotted it and installed the appropriate drivers, along with desktop fax and scan utilities and a browser plugin.

You're not limited to desktop clients, of course. We had no issues printing from our iPad over AirPrint and Wi-Fi Direct, and Epson's iPrint iOS app worked perfectly to pull in scans and print files and photos. It even gave us a handy view of ink levels, and let us print files straight from Dropbox, Google Drive and OneDrive.

For those located further afield, Epson's Connect service lets remote workers print to the MFP by simply emailing documents to a preset address. Via the Connect portal you can optionally limit which senders are allowed to print, as well as restricting specific operations such as printing onto photo paper.

Speed-wise, the MFP lives up to Epson's claims. Our sample Word document emerged from the printer at precisely 24ppm in both draft and standard driver modes, although switching to high-quality mode saw speeds fall drastically to 6.2ppm. Likewise, our DTP-style colour document flew out at 24ppm in standard mode, but only 6ppm at the highest quality. Inevitably, switching to duplex mode saw speeds drop, but our Word document still emerged at 16ppm in standard mode. It's a noisy affair, though, with the SPLnFFT iOS app measuring a peak of 69dB from 1m away.

ABOVE **The big colour touchscreen makes it easy to connect to a wireless network**

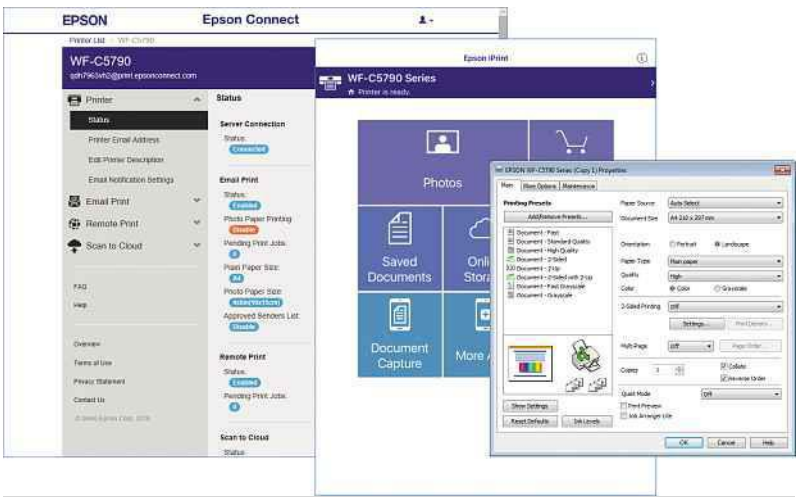
PC PRO RECOMMENDED

Quality is more than acceptable for everyday office documents; text as small as 6pt came out looking clean and sharp with no hint of dusting around characters. Photos also exhibited plenty of detail, even in darker areas, although for the best results you'll need heavier (and more expensive) 100gsm paper. The only disappointment was that colour photos lacked the vibrancy you might expect from an inkjet; solid colour blocks of pure cyan, magenta and yellow looked slightly pallid, even on semi-gloss photo paper.

Finally, the integrated scanner delivers great output quality, and it's no slouch either – our document was sucked through the 50-page ADF and scanned at just under 15ppm. Note that switching to duplex mode slowed things down to a more pedestrian 5ppm, even though both sides are scanned in a single pass.

"Epson's iPrint iOS app worked perfectly to pull in scans and print files and photos, and even gave us a handy view of ink levels"

The WF-C5790DWF might not be our first choice for eye-catching colour photo prints, but overall it's a great general-purpose MFP for any small business. It's easy to deploy and use, cloud support is top-notch, print quality is great – and it costs a lot less to run than a laser. **DAVE MITCHELL**



LEFT **Epson offers great cloud support, and a well-featured Windows driver**

SPECIFICATIONS

4,800 x 1,200dpi A4 inkjet MFP • 1,200 x 2,400dpi colour flatbed A4 scanner • 24ppm mono/colour • 10.9cm colour touchscreen • 2 x USB 2 • Gigabit Ethernet • 802.11n wireless • NFC • 33.6Kbits/sec fax/modem • 2 x RJ-11 • duplex • 250-sheet input tray • 80-sheet MPT • 50-sheet ADF • rec monthly duty cycle, 2,500 pages • 425 x 535 x 357mm (WDH) • 18.4kg • 1yr on-site service warranty. Options: 500-sheet paper tray, £118 exc VAT

TP-Link Omada EAP225 V3

This affordable AC1350 AP can be used on its own or centrally managed – it's a great investment for SMEs

SCORE ★★★★★
PRICE £53 exc VAT
from scan.co.uk

If you're just starting to kit out your office with Wi-Fi, TP-Link's Omada EAP225 V3 could be the perfect first step. It's cheap, costing just a shade over £50, yet it's fully compatible with TP-Link's free Omada Controller software – so as your business grows, you can add more APs and manage them all from a central console.

There are no compromises on features either. The EAP225 V3 supports concurrent 2.4GHz and 5GHz operations, and uses MU-MIMO technology to provide multiple lanes on your wireless highway, allowing it to support a large user base with minimal congestion.

Physically, it's an unassuming thing, with its five antennae tucked away inside the casing – three for the 2.4GHz band and one for each of the twin 5GHz radios. Its single Gigabit Ethernet port is PoE-enabled, which keeps cable routing simple. And, thoughtfully, TP-Link includes a small PoE injector module in the box, so if you don't already own a PoE switch that's no problem.

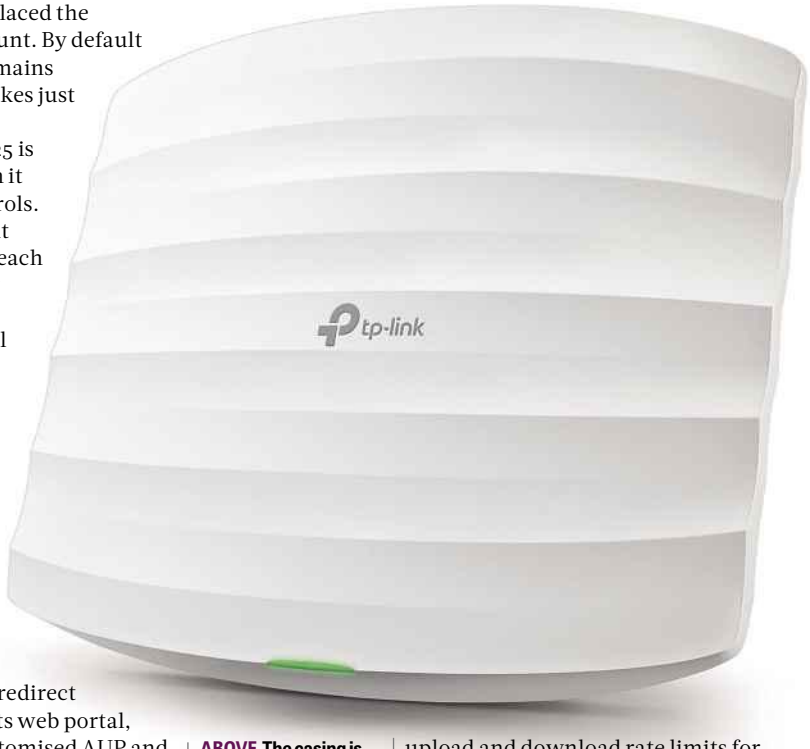
The AP is a cinch to deploy in standalone mode. We simply plugged it in, connected to it wirelessly from a laptop and opened up the web portal. On first contact, we were sensibly asked to supply a new username and password, which replaced the supplied admin account. By default the network itself remains unsecured but this takes just a few seconds to fix.

Indeed, the EAP225 is pretty versatile when it comes to access controls. It supports up to eight SSIDs on each radio, each with its own security profile and schedule options, so individual SSIDs can be made available only at specific times.

You can also decide whether to mask or broadcast each SSID, and optionally isolate wireless clients from seeing each other. If you're setting up a guest network, the AP can redirect connecting users to its web portal, which presents a customised AUP and demands a global password before granting them internet access.

Performance is very good: from our Netgear AC1200-equipped Windows 10 desktop located at close range, we were able to copy a 2GB file over the LAN at a speedy 60MB/sec. We also tested coverage using the SweetSpots iPad app and found we were able to get 43m down the main building corridor before losing the signal – so a single unit should be easily able to cover the whole of a small office.

For centralised management, we turned to the free Omada Controller software, which installed on our Windows 10 desktop in two minutes. One nice feature you come across right away is the ability to import a map of your offices, so you can use the heatmap tool to plan out your coverage. A pop-up menu at the bottom of the web console provides quick access to features such as guest portals, scheduled power cycling and upload and download rate limits for each SSID. The software also comes with QoS preconfigured, so it will apply the same traffic prioritisations as provided by the standalone AP.



ABOVE The casing is inconspicuous, but there's plenty inside

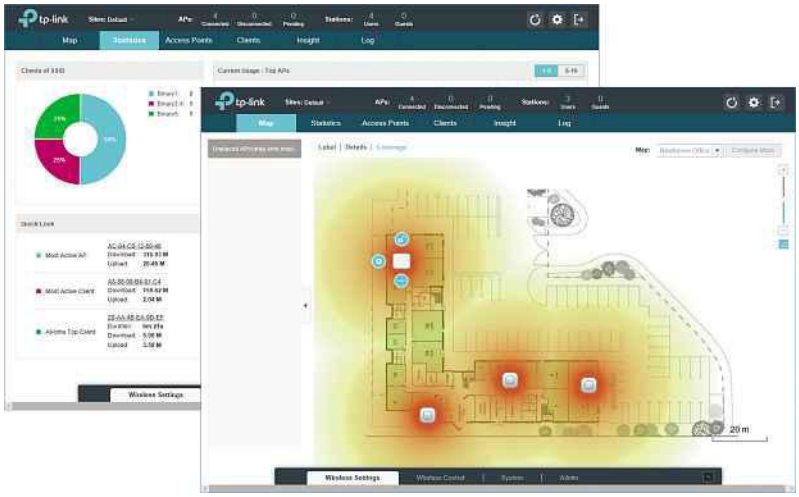
PC PRO RECOMMENDED

And when you want to add more APs, you don't have to stick to the same model: alongside a pair of EAP225 V3 units, we installed an Omada EAP225 Outdoor AP and one of TP-Link's older AuraNet EAP330 V1 units. The software immediately spotted all four as soon as they came online; "adopting" an AP disables its local web interface and tells it to pick up its settings from the Omada Controller software instead.

Once provisioned, all member APs present all SSIDs, so clients can roam seamlessly across them as they move around the premises. The statistics page provides graphs, tables and charts of what's happening on each AP and SSID, as well as numbers for the whole network, and the "Quick Look" option helps spot bandwidth-hungry users.

"One nice feature is the ability to import a map of your offices, so you can use the heatmap tool to plan out your coverage"

TP-Link's Omada EAP225 V3 is hard to fault. It's cheap, it delivers good performance and coverage, and the controller software means you're ready to add extra APs and scale up to centralised management when the time is right. **DAVE MITCHELL**



LEFT TP-Link's Omada Controller software makes it easy to expand your network

SPECIFICATIONS

AC1350 802.11ac wireless AP • concurrent 2.4/5GHz radios • Gigabit Ethernet • 802.3af PoE • 5 x internal aerials (3 x 2.4GHz, 2 x 5GHz) • wall/ceiling mount • PoE adapter • 205 x 182 x 37mm (WDH) • web browser management • TP-Link Omada Controller software included • lifetime warranty

An IT audit can be a daunting prospect for businesses – but it doesn't need to be that way, as Steve Cassidy explains

THE DREADED AUDIT

How to get through it and what to avoid

Do you know what's on your office computers? Perhaps more to the point, *how* do you know? Such questions might seem rather pointed, especially when they're being asked by a nitpicking professional such as an insurer or an accountant. But they're ones that you, as an IT manager, should be asking yourself – rather than waiting for circumstance to expose any gaps in your knowledge.

What is the purpose of an audit?

An audit isn't just a list of assets – it's the basis for a plan of action. That may make it sound even more complicated than you were fearing, but it also means that an audit doesn't have to be a vast, all-encompassing project. An audit of business assets, for example, won't need to look at many of the specifics that a security audit will cover, and a software licensing audit won't need to worry about value – just compliance. A portable appliance testing (PAT) audit meanwhile will barely record any information at all, apart from the date on which each device passed the test, typically recorded in fading ballpoint on little stickers attached to each machine.

In each case, the process of determining and recording exactly

what you're working with isn't an end in itself. Rather, it's the start of a project – potentially a business-critical one. The exact scale and import are difficult to predict ahead of time, because the whole rationale of an audit is that you don't know what discoveries you'll make and what the implications may be until you look.

In other words, your business may well have got away so far without having to carry out an audit, and you may be questioning whether you need one now. But if you want to head off nasty surprises in the future, it's in your own best interest to embrace auditing, and to do it frequently.

What about very small companies?

Tiny startups may not own many physical computers, but that doesn't mean there's nothing to audit. That's partly because the smallest businesses are often heavily reliant on the cloud. This makes a lot of sense in terms of costs and flexibility – but cloud operators have a tendency to treat small business customers like experimental subjects, frequently tempting them with upgrade offers and poorly defined technical updates that leave the customer with a patchy and unclear audit trail.

It's easy, in an environment like this, to end up in a situation where you're unsure exactly which cloud products have access to what data, what sort of access protections you have in place, and so forth. You know what the solution is - and the upside of going through an audit like this is that it makes on-premises auditing seem comparatively painless.

Do we need regular audits?

In an ideal world, you should be regularly carrying out audits as a matter of course – but the truth is that auditing is an intrusive and expensive process, and nobody really does it without a serious business driver behind it. So prioritisation is the order of the day. It may sound like a good idea to have an annual H&S/PAT audit, but if you have concerns over the state of your software licensing then that's where you're going to want to direct your energies. It's not that electrical safety is unimportant, but an accusation of software piracy can quickly progress to an enforced, overseen physical audit by an independent third party.

Irregular snap audits tailored to the question of the moment can be more useful than repetitions of the same tests, year in, year out. If you target your audits as tightly as possible, that gives you the best chance of finding out what you need to know, with the minimum cost and disruption.

Can't software tools do most of the work?

Software tools can be very helpful if there are certain specific things you want to discover. But they're subject to some very irritating limitations, including the infuriating fact that you often can't take advantage of their automated data collection capabilities unless you send a person round to every machine to actually click all the dialog boxes.

Software tools also tend to lack any sense of discretion. When you're carrying out an internal audit, the impulse is often to kitchen-sink the job and ask for every possible bit of data. This is liable to leave you unable to see the wood for the trees, and while the software may be able to discover irregularities, it's very unlikely to put them into context for you, or tell you which ones you need to panic about.

Some companies skip the software and ask employees to self-report the information of interest, but this comes with its own risks. Obviously, you need to account for devices that aren't anybody's personal workstation. And you can't always rely on staff to recognise or honestly report stuff that shouldn't be there: that's something I saw first-hand after a distressing visit to a regional office in which I had been asked to remove a pornographic background image from a secretary's machine. With that task achieved, we carried out a rapid sweep of the whole organisation and found undreamt-of quantities of non-work-related images lurking on various machines.

What should I expect from an external auditor?

It's clear that there are advantages to taking on an experienced outsider to run your audit. In fact, you may already have one on call, because any outsourced IT support contract is going to rely on accurate auditing to confirm exactly what the provider is responsible for. Obviously there's a cost involved, but with experience comes efficiency, and independent audits are generally narrower than internal ones – which needn't be a problem as long as the purpose is sufficiently well defined. Certain companies even offer all-remote audits too, using a remote access tool such as TeamViewer: again, that's fine, and more time-efficient than having a horde of clipboard-wielding inspectors descend on your premises – as long as everything you're looking for is remotely discoverable.

There's also one other sort of external audit that's worth thinking about, and that's the sort that isn't directly instigated by you. For example, say you are a travel business, and you want to enter into a partnership with American Express. The process is likely to begin with a third-party audit of not just what your computers contain, but how you run them – and if you don't pass muster, you won't be doing business.

This is a much more stressful scenario than finding an out-of-date version of Office running in reception, and the remedy isn't a simple upgrade but a root-and-branch reform of how your company works. You might want to get in your own external auditor to help you make sure your business meets the required benchmarks before the real examiners get a look in.

"When you're carrying out an internal audit, the impulse is often to kitchen-sink the job and ask for every possible bit of data"

Should our audit address future needs as well as existing resources?

At their simplest, audits are about meeting a certain standard – be that accounting, technological, operational or financial. To be precise, the audit is to discover whether and by how much you fall short of that standard. So while the information might help you plan out future projects, the majority of audit activities are implicitly subtitled "...and how do we fix it?"

Indeed, it's a mistake to make the audit bigger than what it really is, namely a specific and specialised process. Once the audit is complete, there follows a separate period of analysing what the results have to say, and then another period of drawing up a plan of action. This in turn leads to a tendering process. Each of these steps have their own sequences, terms of reference and audiences, and lumping them in with the actual audit only serves to complicate things.

How do you know that your audit is good enough?

Here's where things get tricky! For a start, "auditing" means different things in different contexts. Notably, in the world of ITIL – a standard for how IT resources are managed – it can mean getting the management right, rather than the results. If you're seeking reassurance that you're doing the right thing, you could easily be led up the wrong path.

Furthermore, even the sorts of audit we're talking about come in all shapes and sizes. Some data sets will fit on a beermat, while others are so broad or fast-moving that they can never properly be completed. You will look in vain for universal guidelines.

If that sounds hopeless, the slightly faded buzzphrase "fail often, fail early" may be of some use. It's far better to have an approximate audit than none, because as soon as you start to collect data, that data will start to speak for itself. If you try to put together a set of axioms and assumptions before you even start, you're likely to find that your results overturn at least some of those ideas.

For similar reasons, if you're doing your auditing in-house, it's never too early to bring your IT staff into contact with your chosen auditing tools and practices. It hardly matters how approximate they are on the first pass: once the agent software is up and running across your network, each iteration of the results will give them pointers on where to look next.

Practically speaking, how do we execute an audit?

There's no one-size-fits all flowchart for carrying out an IT audit, and precious little in the way of generally accepted best practice. But personally I'd expect to see IT workers physically sitting down at computers, and logging in with the credentials of the people who normally use them. That way they get to see each machine and its connections as a regular user would: when it comes to spotting and diagnosing strange behaviours by company PCs, there's no substitute for the human eyeball.

For data capture, I would expect to come away with a paper tick-list for each PC, covering its basic physical specification and software revisions, along with a list of any missing management and security tools. It's not the most scintillating task, but if you need to do an audit it's usually precisely because this critical information hasn't previously been properly recorded.

How does auditing work when you're using cloud services?

A good, and increasingly relevant, question. The short answer is: it doesn't. The major cloud providers offer tools that let you hunt out cloud instances that happen to contain your company name or postcode or similar, but if you're trying to authoritatively find and catalogue all the VMs in the cloud that are being accessed by your apps and employees then good luck.

If you really need to keep track of that stuff, your best bet is to set up some traffic-sniffing tools at your border devices, and try to identify what's communicating with an Amazon or Azure address. This isn't exactly within the bounds of a traditional audit, though – it's more like an interrogation, or a penetration test in reverse.

How do we audit when staff are using their own devices?

The "BYOD" (bring your own device) model has become popular, and it's not the quagmire you might fear. Generally, BYOD works because the services your employees are using reside in the cloud. The specifics of the actual device they're using are almost irrelevant, and the service standard is about not leaving very much on the machine, or asking much of the purchasing power of the user. So most of the disaster scenarios are actually pretty unlikely to arise.

If you really need to find out what's happening on your employees' personal machines then there's a universe of MDM (mobile device management) tools and services to explore. These might not normally be marketed as auditing tools, but they can do a decent job of collecting the information you care about.

"When it comes to spotting and diagnosing strange behaviours by company PCs, there's no substitute for the human eyeball"

The biggest challenge will be getting your users to agree to install the device-manager application, as this isn't always painless for them. It's not at all unusual for MDM products to insist on a cold reset of the device, or to require that a different username and password is used, distinct from the one that the device owner uses to store 2,500 holiday pictures. That disaster is a different subject, thankfully, from auditing.

What should we be doing with our audit results once we have them?

As I've mentioned, an audit is the start of a process, not an end in itself. Whether this is understood or not, there's an instinct in many companies to treat the findings as if they were valuable business secrets, and to keep them as far as possible from the eyes of the public and the workforce. This is a pointless bit of superstition, in my opinion. Far better to share your findings with your staff, and canvass their experiences and opinions – for exactly the same reasons that you carried out the audit in the first place.

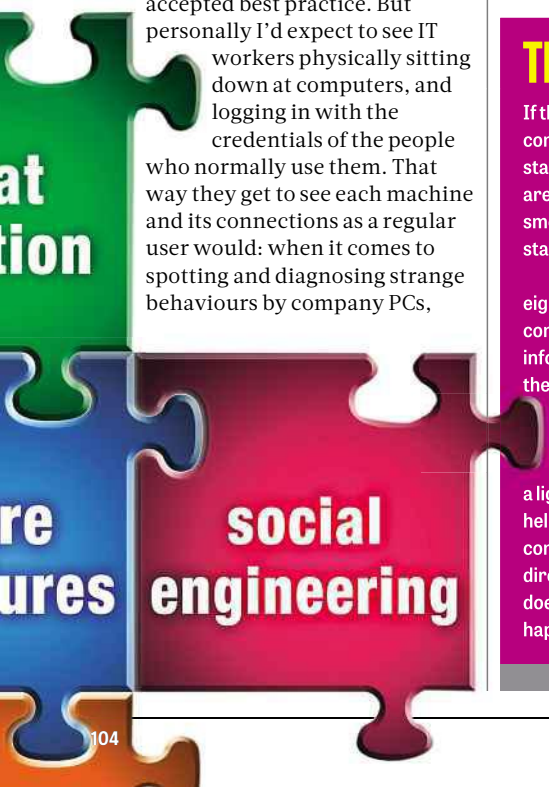
In short, even in the most hierarchical businesses, the only sensible conclusion to an audit process is an open discussion of what has been found and what ought to be done. There's a good chance your audit will have turned up something unexpected, so be open-minded in your response. ●

The cardinal don't of IT auditing

If there is one sin above all others I'd caution against when it comes to the dreaded audit, it's trying to lock down and standardise everything ahead of time. Yes, in theory, if all your PCs are functionally identical then that should help your audit go more smoothly, and minimise concerns over licensing, security standards and so forth.

But, inevitably, when someone uses the same computer for eight hours a day, there's going to be some blurring of the lines: it's company property but it's also their digital home. A truly informative audit should reflect the way people are actually using their computers, rather than merely mirroring back the results of a recently imposed policy that will surely start to break down shortly after the audit report is completed.

Your best approach, therefore, is to begin your audit with a light touch, to collect some preliminary findings that can then help to focus a second pass more closely on the subjects of concern. Allowing the information to send you in the necessary directions may not feel like such a well managed process, but it does give you results that are genuinely a reflection of what's been happening on all those machines you've not seen for ages.



Digital transformation

Davey Winder introduces a game-changing idea that could revolutionise your processes – and your revenue

"Digital transformation"? Sounds like a marketing buzzword...
There's an element of hype to it, for sure – but underneath the marketing speak, the idea behind "digital transformation" is a practical one that every business should take note of. It's about embracing technological changes, cultural changes, process changes and so forth to improve the way you do business.

And what does that actually mean?
It means taking a fresh look at the practices that underpin your business. They may not have been updated in many years – and even if they have, it's a good bet that both technology and customer expectations have moved further. That means there are almost certainly some big changes you could make to deliver better value to your customers and more efficient workflows for you.

So it simply means taking advantage of new technologies?
That's a part of it, but digital transformation is a more fundamentally radical idea. It's not so much about evolving your existing processes as forgetting about them entirely. If you focus instead on what you want to achieve, you may well find that the latest technologies and resources open up new and better ways to attain your goals. The key in many cases is to break out of the silo mentality that keeps the back office separate from customer interaction, and to look for ways to link up previously separate processes – to join the technological dots and deliver a business that is more flexible and efficient.

So we're not talking about a purely digital transformation, but a complete reorganisation of the business?
It could go that far. The key thing to understand is that technology enables the transformation, but the goal isn't itself technological – it's not about moving things into the cloud and deploying data analytics software or whatever. It's about shaking up the established mindsets within your organisation, from top to bottom. If that sounds suspiciously airy, be assured that it's a means to a very down-to-earth end: industry analyst Gartner believes that digital transformation can help businesses achieve the holy grail of generating more revenue while reducing costs.

"You may well find that the latest technologies and resources open up new and better ways to attain your goals"

So what might such a project look like in the real world?
Many businesses' data processing practices are ripe for a bit of transformation. The instinct is always to hang onto as much data as is legally possible, but this throws up two challenges: how do you store an ever-growing mass of data, and how do you make the best use of it? If you don't have good answers to those questions, you're going to end up with ever rising costs for an asset that delivers little real value. I mentioned above that digital transformation isn't *just* about the cloud or data analytics, but here's a case where those technologies can enable a worthwhile transformation: moving your data into the cloud can be cheaper and more flexible than an on-premises server infrastructure, and analytics can help you gain much more value from the data you have by extracting business insights such as customer behaviours and market opportunities from otherwise dead data stores.

Won't rewriting our existing processes be a nightmare for staff?
If your transformation is handled properly, the fallout should be positive. For example, enabling employees to work collaboratively with documents helps them save time and be more flexible in their processes – which should give them greater job satisfaction. It's natural to be cautious of any culture change, but digital transformation ought to deliver an uplift for both the business and the workforce. ●

Digital transformation checklist

1 **Start by identifying your goals** and work backwards from there. Nine times out of ten this means identifying a customer need, then working out how best to offer it.

2 **Get all stakeholders on board,** from the boss to the shop floor. Management sign-off isn't enough: you need staff to embrace change.

3 **Build agility into everything** – because the world doesn't stand still. Create processes that can be quickly adapted for incoming technologies, so you can efficiently transform again when you need to.

4 **Keep it simple,** not just for the IT department but across all business functions, from sales to accounts. A successful digital transformation should help staff work more easily and efficiently, not burden them with new challenges.

5 **Remember that digital transformation isn't the destination.** The destination is happier customers and increased revenue. Digital transformation is simply a vehicle that can help you get there – and some parts of the journey may not even be driven by technology.

THE BUSINESS QUESTION

How do I best support my remote workers?

Whether you've already released workers from their desks or are considering it for the future, we speak to the companies that help to make it happen

Anders Reeves is CEO of Conosco, a company that doesn't just support remote workers – it lives and breathes the whole concept. "We had a star employee in our London headquarters who was originally from Zimbabwe," he explained to *PC Pro*. "He wanted to return to South Africa with his wife so, rather than part company, the founders allowed him to spin off a similar operation there, and it turned out to be a brilliant operating model for the business."

More than half of Conosco's employees work remotely now, but Reeves claims they're fully integrated and supported as part of the business.

"We created OurCafe," Reeves said. "Every Wednesday, in both London and South Africa, we down tools, sit in our respective boardrooms and eat together. The webcams are open, and we've got this great banter and recognition, despite the fact that the teams are thousands of miles away. It's like being in the pub or coffee shop for an hour a week, and if a client comes in we can introduce them to the whole company, even though half of them are half a world away."

The secret of Conosco's success, at least in part, is finding a process that works for the people who work for it. In doing so, it's smashed the industry average for retention. London support firms typically retain staff for a couple of years. At Conosco, the average employee sticks around for eight.

Far from being niche, remote working is becoming the norm for an ever-greater proportion of employees, and even those who don't work away from base now, may want to do so in the future. The question is how you, as a business, support them.

A business in the cloud

"In an ideal world you'd have the conversation about what's best for your infrastructure before you even set things up," said Chris Short of SBS IT, although he acknowledges that won't always be possible – particularly not for an established company looking to make the switch. "Office 365 ticks a lot of boxes for us and satisfies the legislation surrounding GDPR for email, cloud storage and collaboration. That said, we wouldn't encourage anyone to switch away from what they're already using unless there were security or legislative issues ahead."

"You've got to ask whether a company with 50 seats needs an IT department – or the racks of servers that were once commonplace"

The move to relying more on the cloud has simplified remote working and, said Short, is causing smaller companies to examine their existing support provision. "You've got to ask whether a company with 50 seats needs its own IT department – or the racks of servers that were once commonplace. Some of our clients do, but only the ones with very specific requirements, processing a lot of data and using a lot of space. Doing that in the cloud would be cost-prohibitive."

Outsourcing to a firm such as SBS IT or Conosco, then, could take much of the pain out of a switch from

purely on-site working to an on-site and off-site mix.

While Short is happy to accommodate any hardware and software mix, he advocates limiting user privileges. Preferably, restrict admin access to the support contractor and a senior member of staff, because this will minimise the likelihood of home workers installing their own applications and, with them, vulnerabilities.

Supporting remote workers, remotely

How do you support workers when you'll never be able to visit their desks? That's where remote support tools come into their own, and NetSupport's managing director, Al Kingsley, told us that NetSupport Manager is evolving to meet the growing demand for off-site working. "A lot of our evolution tends to be in response to our customers' changing needs," he told *PC Pro*.

A cornerstone of many IT departmental workflows for the past 30 years, NetSupport Manager has integrated new ways of connecting, growing from LAN-only to encompass first WAN, then the internet. With every change, it's reconsidered the security implications of pushing updates, viewing screens and controlling client machines over longer distances and across less predictable topologies.

"A couple of releases back, we integrated the PIN-connect server," Kingsley explained. "It's another secure and quick connection option within NetSupport Manager that from a company perspective saves IT teams a lot of time and money by reducing travel time to any of the multiple sites that the company has – and its associated expenses. The work can be done remotely and on the go."

Similarly, SBS IT uses ConnectWise to remotely monitor and manage its clients' desktops. Like Conosco, highlights the potential cost savings of contracting out IT support at the same time as adopting remote working.

"We tend to price on a per-computer or per-user basis, with the latter covering the user for up to three devices," Short said. "The latter is a little more expensive because we have to install agents on three machines, but it includes unlimited remote support during business hours, patch management, maintenance windows outside working hours and antivirus. If we need to attend site we make an additional charge at a reduced hourly rate, but most of our work can be done remotely."

It's a similar story at Conosco, which prides itself on adding just two cost lines to clients' accounts, which remain within the client's control.

"One is a support cost that scales as the business scales," said Reeves. "The other is a pool of money that we're allowed to draw down from every year from our client's IT budget, which we can allocate to infrastructure projects, high-end security audits and consultancy or anything from our digital transformation capability. If the fund's not enough, clients can dial it up but, equally, they can dial it right down."

The basics

Turn back the clock and remote working would be impossible for the vast majority of employees, but that's no longer the case. Universal (almost) fast and stable broadband connections have made central office locations less appealing, and agile companies are saving costs while accommodating their staff's changing expectations.

"The landscape has changed enormously over the last five years in terms of both stability and pricing," said Short. "A small business that uses an office suite and email as its main tools can have staff working remotely with far less need for IT support."

Rather than rolling out an Exchange server of their own, he recommends clients pay Microsoft's per-seat fees for mailboxes and storage, and save themselves a lot of cost, alongside the hassle of maintaining their own infrastructure.

"Universal (almost) fast and stable broadband connections have made central office locations much less appealing"

Remote working is successful when it's built on trust, said Conosco's Reeves. "I've seen senior managers empower their staff, so that when they're not on site and they're working remotely they're trusted to get on with the job. A key part of building a strong business culture is trusting your employees."

Trust can still be an issue in businesses where presenteeism holds fast, but things are changing. Staff are increasingly tech-literate, and used to the idea of working whenever and wherever they choose. The question, then, may not be how you could ever support a remote workforce, but why you aren't doing it already.

Platforms such as Office 365 and Google Apps, along with remote management software and the support of outsourced IT providers, have changed the landscape faster than many boardrooms realise.

NIK RAWLINSON

The expert view Jon Honeyball

Who wants to commute into an overcrowded city centre every day? That's still the nightmare scenario for many people, who spend thousands of pounds each year, along with weeks of their life and unknown toll on their blood pressure, to reach an inner-city office. Going to London even for a single occasional meeting brings me out in a sweat, and was one reason we decided to relocate to the market town of Huntingdon in Cambridgeshire.

With the rise of fast, affordable and reliable IP connections, both fixed and via 4G mobile, the biggest technical barrier to remote working has been swept away. What's left is the inability of an organisation to accept and embrace remote working. Clearly it doesn't work all the time for all organisations – you can't build Jaguar cars from the comfort of your home. But even those jobs that are intensively onsite can have occasional days where the worker can operate from home, or from a remote site.

And that's the win. Happier employees make for better workers. It's the natural extension of the progress from enforced hours of work through to flexitime through to job sharing. And the final bastion to fall, the suit for work every day.

As we approach the third decade of the 21st century, remote diverse working should be the norm wherever possible and practicable. Of course, this must be balanced against home time, intrusion into the family space, and that creeping worry that you ought to check your phone for work emails, even at 2am. Much of the proper management of remote working can help with this – don't route emails to the client app if it's out of working hours, for example.

So remember to be careful. Organisations can be very good at taking without giving back, and a ratchet effect into 24-hour working isn't a good move for anyone. A sensible organisation tries to get the best from its employees, allowing them to be maximally efficient and effective, but a truly wise one lays down hard rules about personal time, too.

SUBSCRIBE NOW!

Subscribe to PC PRO today and save on the single issue price.

Each issue of *PC Pro* will be delivered directly to your device each month.

SEE NEXT PAGE FOR SET-UP INSTRUCTIONS

HOW TO SUBSCRIBE...

...on an iPad or iPhone

STEP 1 Return to the *PC Pro* library

STEP 2 Choose your subscription term and tap twice on the 'price' box

STEP 3 Choose whether to create an optional PixelMags account

STEP 4 Enter your Apple ID password to confirm

Download on the App Store

...Windows 8

STEP 1 Return to the *PC Pro* library

STEP 2 Choose a subscription term from the bottom left menu and click/tap the corresponding 'Purchase' button

STEP 3 Click buy on the popup bar

STEP 4 Enter your Microsoft account details to confirm

...on an Android device

STEP 1 Open the Google Play Store homepage and navigate to the Newsstand section using the tabs at the top

STEP 2 Search for *PC Pro* using the search icon in the top right of the screen

STEP 3 Click the 'Subscribe' button and pick your term

STEP 4 Enter your Google password to confirm

...via the Zinio app

STEP 1 Search for *PC Pro* via the search box in the Shop tab

STEP 2 Tap the 'Subscribe' button

STEP 3 Choose whether to create an optional Zinio account

STEP 4 Enter your Apple ID password to confirm

Subscribe to *PC Pro* today and save on the single issue price

JON HONEYBALL

"The lack of any sort of meaningful logging and reporting is a huge hole in the side of the boat"

After years of loyal service, it may be time to leave Dropbox. Plus, some words on the blind stupidity of Office 365 and those who misuse it

Don't tell Intel, but Microsoft is working on a custom CPU design, called E2. Not much is known about it, but researchers have been working on the project for some time. And they've ported Windows and Linux to it, along with a bunch of development tools. The big chip firm Qualcomm might be involved, too.

The work is being done at Microsoft Research, and it published a paper about it – it's since been deleted (you can grab a view on the web archive at **pcpro.link/288e2**). The paper says:

"At the heart of E2 is an advanced Explicit Data Graph Execution (EDGE) instruction set architecture (ISA), which, unlike conventional ISAs, encodes the data dependencies between instructions, freeing the microarchitecture from rediscovering these dependencies at runtime, and groups instructions into atomic blocks (similar to transactions), providing a larger unit of work, and allowing the microarchitecture to tolerate growing wire delays. These two ISA features enable E2 to utilise a dataflow execution model, providing power-efficient out-of-order execution."

It also says: "E2 is configurable to provide many physical cores working independently; many physical cores working in parallel to perform the same operations on multiple data sets simultaneously; many physical cores composed together to form logical processors to accelerate single-threads of execution. Core fusion allows E2 to span a wide power/performance spectrum, from power-efficient embedded processors to high-performance server-class processors."

Microsoft has apparently said that this is all just research, the sort of thing that MSR does all the time. It has no plans to bring this to market any time soon.

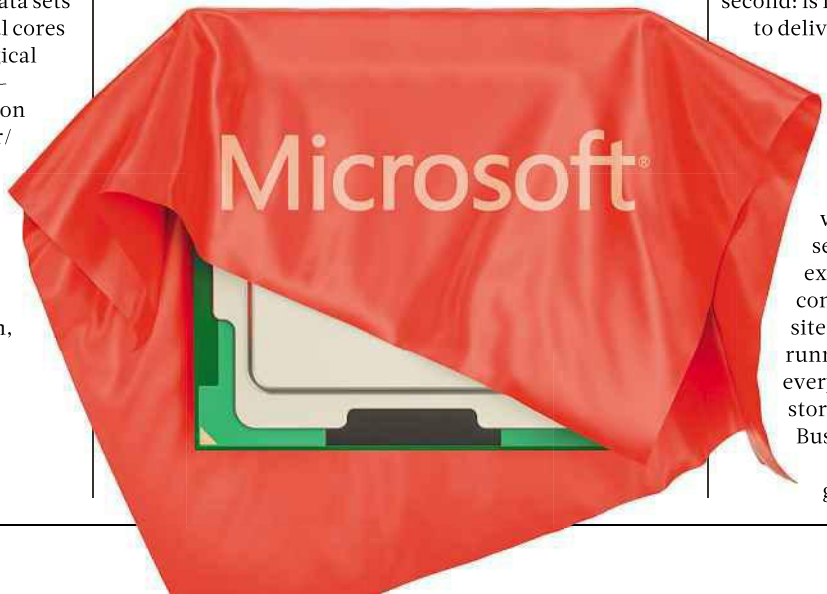
However, the words that keep leaping off the page at me are "power-efficient". Mix in the rumours that Qualcomm is involved, and we have an interesting possible route forward. So let's just spin in a big conspiracy theory, and a spoonful of conspiratorial arm-waving.

Despite the value of the relationship to both parties, there's always been a love-hate relationship between Microsoft and Intel. Intel was bruised that Windows NT was deliberately designed to be hardware-agnostic, originally running on Intel, MIPS and then Alpha and Motorola. Let's not ignore the influence of Dave Cutler, head of NT, here – given his previous role at Digital on both Alpha and VMS.

Questions still linger about where the Intel x86 CPU design came from, which almost magically appeared from AMD – Intel's competitor – shortly after Alpha was cancelled for Windows 2000 and Intel was pushing its Itanium platform. And then the whole screw-up by Intel over low-power chipsets, leading to the world moving to the ARM processor design for mobile phones and tablets, which effectively killed attempts by Microsoft to push Windows into that space. Then the aborted Windows 8 RT port to ARM, which was quietly dropped because the OS, tools and available apps were a mess. And now we have the Snapdragon chipset running x86 code on Windows 10 (*see p58*) – again, an Intel rival.

Jon is the MD of an IT consultancy that specialises in testing and deploying hardware
@jonhoneyball

"Microsoft and Intel aren't in a committed, loving and stable relationship"



BELOW I wonder what Microsoft might be keeping under wraps...

Now, most everything in the previous paragraph can be viewed from many directions, and spin applied to suit any position. But Microsoft and Intel aren't in a committed, loving and stable relationship. With the move by Microsoft to do its own hardware, in the shape of the Surface family, it makes sense to ask the question "why stick with Intel?" After all, it has money and resources in abundance: effectively an unlimited amount of both. Rather than working with ARM, why not come up with a custom chipset just for itself? This makes for an excellent Sunday morning conspiracy theory to ponder over a large mug of coffee.

Of course, the reality might just be simpler: it is indeed a research project, with no product deliverable in sight. But if I were running Microsoft, I'd want to follow Apple's lead into owning all of its own silicon. Where does Microsoft want to be in 2030? That's the first big question. The second: is Intel the capable partner to deliver this?

Time to drop Dropbox?

I've been a Dropbox user for years. We use it in the lab to sync between workstations, laptops and servers, and it provides excellent transport for connecting to multiple site archive boxes, mostly running on Synology. Almost everything of importance is stored in our Dropbox for Business account.

But recently, I've been getting somewhat annoyed

with it. First, for reasons I'll explain in a minute, I had to rebuild the Dropbox installation onto my main desktop machine. That required pulling down about 2TB of data. This wasn't a big issue; the lab has a 1GB fibre-to-the-premises line.

The process is simple: install the app, log into the account, and sit back while a miracle occurs. Which is fine, except that the reporting tools that appear during this process are truly appalling. It will cheerfully tell you that there are multiple thousand files outstanding. And then that there are 27 seconds left. Which counts down to 0, and then starts up again, but now at 14 minutes. Or 2 days. Or 9 seconds again. Frankly, this is amateur-hour coding and Dropbox needs a radically better administrative view of what is actually happening. The lack of any sort of meaningful logging and reporting is a huge hole in the side of the boat, when working with both a lot of data and a multi-machine business environment.

Also a pain is the implementation of shares. We use them all the time when sending data to a customer. Right-click on the ZIP file, choose Copy Dropbox Link, and paste it into the email. The customer can click on the link and download the file. It's simple, it's reliable and it works.

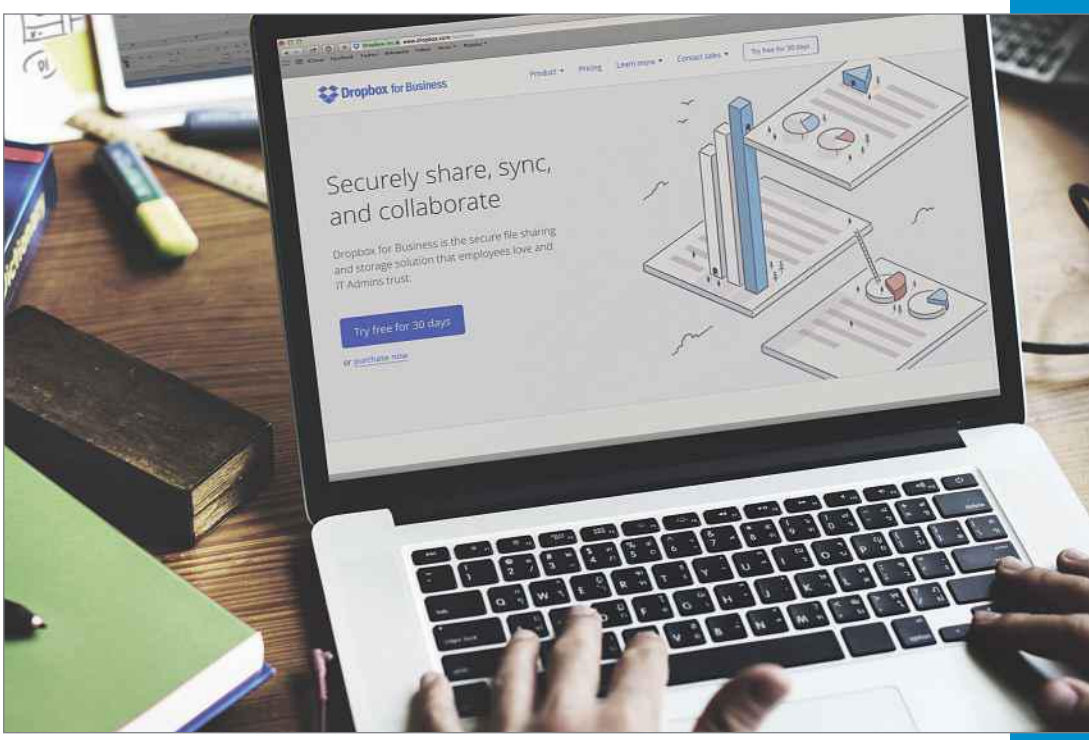
And that's just fine for sharing some photos of your cat with your grandmother. However, in a business context you really want to be able to ensure that the link is valid only for a short period of time, after which it expires. Or is made single-use, so it works only once.

All of that is missing from Dropbox. If you go to the web interface, you can of course set up a share, and here you can set such important time-out values. It's just that the Mac and Windows client doesn't support that bit of useful functionality.

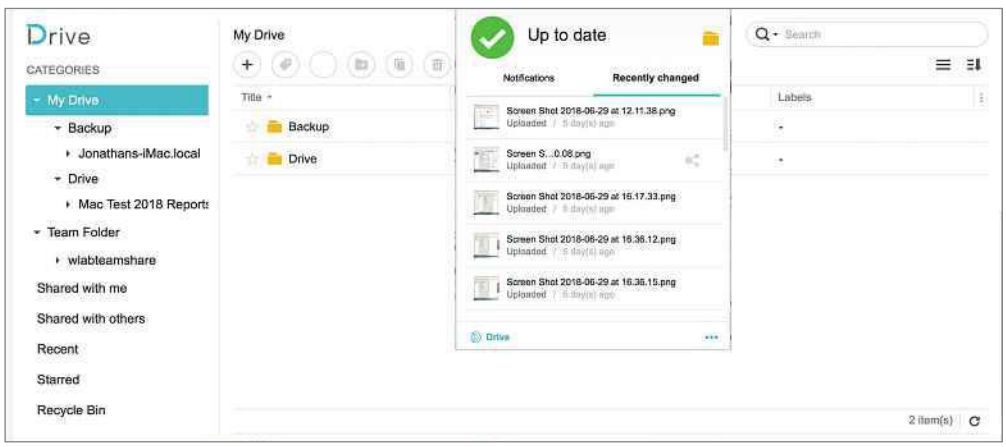
I spoke to Dropbox, saying that as administrator of the Dropbox for Business account, I should at the very least be able to set a default for all share creation. Say, three days and three uses, default across all accounts. Dropbox wriggled and said that this wouldn't be right for all users, at which point I reminded them what the term "default" meant – other customers could have a different default, including indefinite life for the link, if they so desired. Apparently the idea will be considered, but I'm not holding my breath.

So I've been looking at alternatives. The obvious first place was Synology, because it provides the storage infrastructure across all our sites. It has a rather neat tool called Synology Drive, which acts just like Dropbox or equivalent. The storage isn't in the cloud, but on your local Synology NAS box. It, too, has a Sharing Link facility: right-click and the UI offers a cloud accessible Share link via **gofile.me**. You can set a password on the link, and a validity period that can include a specified start date/time and an end date/time. Plus a limit on the number of accesses, too. Frankly, this is far more comprehensive and easier to access than the dumb Dropbox capability.

So I'm pondering: do I move the lab entirely off Dropbox? I'd be moving to the Synology platform, but I like that. I could use Synology's own sync and file replication snapshots to keep the various NAS boxes in sync across all sites. I get a better Share file function. I get better resync and control. And I don't have to pay the thousand quid per year I'm spending on Dropbox for Business. Oh, and my data stays on my servers, not on Dropbox's servers in the USA. I'll be exploring this deeper over the next month or so, but Dropbox has, in my eyes, dropped the ball and lost its way on multiple fronts. It might well be time to move.



ABOVE I've been a loyal customer of Dropbox for years, but it might be time for a change



BELOW Why switch from Dropbox? Because Synology Drive does such a good job

Eight years of Thunderbolt

Some eight years ago, I bought a pair of 12TB (6 x 2TB) Thunderbolt arrays from Promise. They've been doing totally reliable work for years, requiring only a couple of disk replacements. The primary one started glitching, throwing up reports that one of the hard disks had a minor error, and was restarted within the array. Then the reports became more

frequent. I knew something was wrong, because the performance of my iMac had fallen through the floor.

I ordered an overnight delivery of a drive to replace the offending item. When it arrived, I pulled out the dying disk and popped in the new one. RAID rebuild started, and progressed up to 35% complete, where it sat. The minor error issue had now moved to a different disk in the array. At this point, I harrumphed and decided to rebuild the storage around a new array. Looking at the options, I decided to try the new LaCie 6Big array on Thunderbolt 3. This immediately presented a problem: the array is Thunderbolt 3, yet my ageing original iMac 5K is Thunderbolt 2. Turns out that the Apple Thunderbolt 2 to 3 adapter can be used either way around. You can connect a Thunderbolt 2 device to a Thunderbolt 3 computer; or a Thunderbolt 3 device to a Thunderbolt 2 computer.

I'm quite impressed by the LaCie 6Big so far. It has a good management tool, the performance seems solid if not stellar, and it works. Why didn't I go for the new Promise Thunderbolt 3 unit? It wasn't available at the 36TB size I wanted at the time. I'll be wanting to replace the second old Promise unit in the next few months, and will almost certainly go back to Promise for that one. Diversity is a good thing.

Talking of diversity, the new Dell XPS 27 all-in-one desktop unit I mentioned last month has a Thunderbolt 3 port. So I bought a rather useful external Thunderbolt 3 desk multi-port adapter. I've found it to be worthwhile, and it seems that Thunderbolt 3 is at last useful on a PC.

And lastly on the subject of Thunderbolt, long-term readers will remember my excitement at finally being able to buy Thunderbolt 2 fibre cables some years ago. I ended up buying three of these cables, and they've proved to be very useful.

However, two of them have become somewhat unreliable. At the recent NAB conference at Las Vegas, I managed to speak with Mark Bradley, director of emerging applications at Corning, the maker of the cables. I've known Mark since the first days of Thunderbolt, and he's a fine ambassador for its products. I explained the unreliability issues that I was starting to experience, and he suggested that the cables might be wearing out. Well, not the fibre itself, but the super-clever transceivers built into each plug. Five or six years of continuous operation, especially on a product with a hot chassis such as an iMac or Mac Pro, can cause accelerated wear. Mark kindly offered to replace all three cables, which is a level of support and kindness that goes beyond the normal. The cables arrived this week, and I shall be trying them out shortly.

ABOVE **The LaCie 6Big array isn't the fastest around, but the management tool makes up for this**

Blind stupidity in Office 365

A university in London recently appointed a new professor of information technology. The press release stated: "If people don't understand IT, they will sleep-walk into more data-breaches, privacy violations and technological misapprehensions than already make the front pages. In this series of lectures, I want to challenge those misunderstandings and present a more balanced picture of computer science."

Well done, sir. Clearly, there isn't enough understanding about the sorts of data breaches and privacy violations out there. So let's start with your communications manager, who managed to send out this self-congratulatory pronouncement to hundreds of people, with all of their email addresses listed in the CC field rather than the BCC field.

As you can imagine, this resulted in much banging of my head. I replied, suggesting that it would be helpful if the professor explained what had happened, given that he was an expert on the matter. Now, you'd think the communications manager would say, "oh my goodness, what a stupid error, please let me apologise" and send this out to every recipient of the original email – but this time using the BCC

BELOW **That moment when you realise you've cc'ed several hundred people in an email instead of bcc'ing them...**

field correctly. But no, clearly that isn't the sort of communications they like to manage.

Instead, I was told that they had obtained the list from Gorkana, a well-known media database, and that they'd tell Gorkana that I wasn't to receive information from them in the future. No worries, I doubt I'd lose any sleep at being cut off. So I was somewhat intrigued to receive an email from Gorkana asking if I really did want to have my account closed, as requested by said communications manager. I tersely replied not, copying in the email thread. Gorkana replied, saying that my account wouldn't be closed and that "we'll make sure our client understands how they should operate, so hopefully a similar issue won't happen again". Which I think means "it's spanking time", both for the misuse of the original data set and attempting to have my Gorkana account closed.

But it does raise the obvious question: how is it possible, in 2018, to put hundreds of email addresses into Office 365 and splurge out such a mess? It turns out that there's no setting in Office 365 to effectively limit the number of people who can be on a CC list, or to re-route the email to an internal administrator if something goes wrong. I'll be emailing my good friends at **exclaimer.co.uk** to see if this is something they can add into their toolset.

Time Machine stole my space

My Mac Pro has 1TB of super-fast internal storage, so it came as a surprise to discover that some 700GB of it had gone MIA. Some tools suggested that this was hidden space, and that the OS had swiped it for Time Machine snapshots. This is a new feature of the latest version of macOS, and I discovered the issue using the rather good DaisyDisk tool.

Some digging around the net gave me a hint of what to do. Opening up a terminal window and typing "tmutil listlocalsnapshots /" will tell you what Time Machine snapshots are lurking on your disk. If you want to kill them off, use "tmutil deletelocalsnapshots" followed by the date listed on each snapshot. Magically, my 700GB of storage reappeared. I'd suggest keeping an eye on this.

jon@jonhoneyball.com

PAUL OCKENDEN

"The servers were all plugged into unmanaged switches via a bird's nest of tangled cables"

Paul offers a friend some IT guidance, and looks at the downsides of straying from the big four mobile networks

About a year ago, a mate of mine asked me to do an informal audit of the IT systems of a local company where he'd just been hired as head of technology. What I found can best be described as a colossal mess. The server room had around 30 servers of various makes and vintages, some in racks, but many just piled on top of each other. All of the machines were switched on, consuming lots of electricity and creating an ear-splitting amount of noise.

The servers were all plugged into unmanaged switches via a bird's nest of tangled network cables, none of them labelled. Many of the machines were also plugged into domestic four-way extension leads! There certainly weren't any power management devices to be seen.

The whole thing was a shambles – and, more importantly, a disaster waiting to happen. Obviously, I won't name and shame my friend or the company here. What I will say is that it's an outfit dealing in tech electronics and really should have known better! Said company isn't alone, though. Over time, many firms find themselves slipping into a similar state.

My friend and I eventually managed to log into each of the servers. There was no central management, obviously, although the Windows servers were at least sitting within a domain, and the various Linux and other boxes all shared the same root password as the Windows administrator account. Not a good thing – but it did make our task much easier!

Paul owns an agency that helps businesses exploit the web, from sales to marketing and everything in between
@PaulOckenden

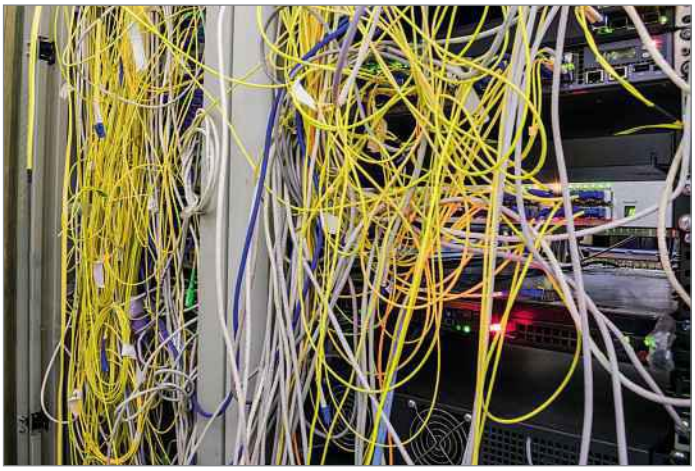
We found that of the 30 or so servers, six were powered up and doing precisely nothing. Three didn't even have network cables attached. And of those that were doing stuff, four were just churning away on jobs no longer needed. So we whittled things down to approximately 20 useful servers.

The first step in sorting out this mess was to suggest a degree of consolidation. There were several file servers and around ten web and intranet servers running various applications. With the aid of an Excel spreadsheet, and a bit of juggling, I was able to reduce the box count to just 12.

But then I added some more. Why? Well there was no redundancy at all in the firm's systems. It had an SQL server running lots of important tasks, but it was just a single instance. So, I suggested that as a bare minimum a second SQL Server be installed with mirrored databases, set up within a high availability group.

Likewise, the intranets and various mission-critical web applications were running in a standalone mode, so I suggested secondary servers with automatic failover in case something were to go wrong. Same again for email. And we needed to add a backup appliance, too. We were quickly back up to around 20 servers again.

Now, had this been a normal firm I'd probably have been suggesting that much of this processing be moved to the cloud. Tools such as AWS and Azure are pretty reliable and very economical. But because of



BELOW This isn't the server room in question, but it looked quite similar!

the particular industry this company works in, and the nature of some of its contracts, use of cloud computing and storage is strictly forbidden.

Twenty physical servers is daft, though. The key to sorting out this mess was virtualisation. A single, beefy server would probably run virtualised copies of all of these physical servers quite happily, but then we'd be back to having no redundancy. If the big server goes bang then you end up with a whole company twiddling its thumbs.

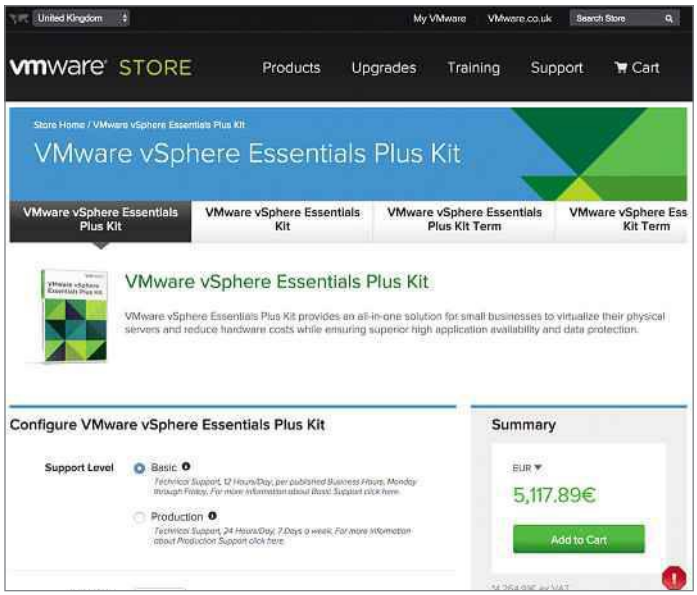
So for reasons I'll explain in a minute, I suggested three physical servers plus a SAN for storage (a good SAN will have redundancy built in). Also, high availability pairs of managed network switches and PDUs, to avoid a single point of failure. It's an ideal setup for a SME – and the whole thing can easily fit into a half-height rack, leaving plenty of space for other comms kit, routers, firewalls and the like. In fact, it's pretty much a reference setup for SME virtualisation.

Why three servers? Well, I like to have two running all the mission-critical services with mirrored data and files. Items such as intranets, web servers, email and database servers. Each physical host can run half of the "live" services to even out the CPU and memory load. In the instance that one of this pair of servers dies, the other can continue running everything.

The third server is used for development, test VMs and anything non-essential, and also a temporary repository should you need to move a VM off one of the main servers.

When it comes to running a virtualised environment on these servers, there are plenty of options. I've tried most, but always come back to VMware. If you're a real cheapskate then you can get away with running its ESXi hypervisor on each server for free (albeit with limitations), but I'm a fan of VMware vSphere Essentials kits. These are specially designed for a three-server setup such as the one described above. You can have a maximum of two CPUs in each server, but with today's multicored server CPUs, this isn't an issue.

There are two versions of the Essentials kit. The standard one costs a shade under £500 and gives you a full-fat copy of the ESXi hypervisor for each machine, plus a copy of vCenter for centralised management of your VMs. If you can stretch to it, though, I'd recommend the Essentials Plus Kit. It has the same three servers and six CPUs limit as the basic kit, but Plus bundles a shedload of useful software. It costs just under four grand, but I think it's well worth it.



ABOVE The VMware vSphere Essentials Plus Kit comes with lots of useful extras

As well as the hypervisors and vCenter, the Essentials Plus kit offers a high availability function that restarts a VM on an alternative host should the main one fail. It helps to keep everything running should a physical server fail.

Then there's vMotion, which I love. It lets you migrate a VM from one physical server to another while it's actually running! I've tried setting up a continuous ping while this happens and you might see a fraction of a second outage, but that's all. All the software running on the original server just continues to run on the new one. Session state is maintained in any applications, and even file writes just continue from where they got to before the migration kicked off.

In my own company, we use vMotion to move VMs to chunkier hardware if there's a temporary load increase (perhaps a web server getting swamped because something has gone viral), and then move it back again a few days later. vMotion also means you can easily move all the VMs off a host if you need to do hardware maintenance or update any firmware, without any downtime whatsoever.

The VMware Essentials Plus kit also offers Data Protection or VDP, which is a backup appliance based on EMC's Avamar technology. It offers agentless backups and has built-in deduplication – but I struggle with VDP. I've found it to be unreliable, needing a lot of nursing to keep it running. Backups should be "set and forget".

"I struggle with VDP. I've found it to be unreliable, needing a lot of nursing to keep it going"

I've recently discovered an alternative product called VM Backup from Paragon. It's designed to work with the VMware Essentials kits (either the standard one or the Plus Kit), even having the same three-server/six-CPU limit. It's another £344, but well worth it. So far it has been working well for me, but I'll report in more detail in a future column.

We haven't finished with the Essentials Plus Kit yet, though. There's also vShield Endpoint, which provides agentless antivirus and antimalware protection for all of the VMs running on the three hosts. Finally there's vSphere Replication, which provides asynchronous replication between VMs at hypervisor level. It will work across sites, but is also good at keeping backup copies of VMs ready in a multi-server setup. It works well with the high availability software I mentioned a few paragraphs back.

The other bit of the jigsaw is VMware Converter, which is free, and will take a running server and create a P2V (physical to virtual) clone of it, suitable for running on a hypervisor. Again, other tools are available, but I've always got on well with VMware Converter.

The only thing you need to be aware of with the VMware Essentials Kit is that there's no way to go beyond the three-host/six-CPU limit without paying lots of money. Essentials is designed for SMEs, and VMware has deliberately imposed limits that protect its more expensive "big company" revenue streams.

BELOW Paragon's VM Backup is a perfect add-on for VMware's Essentials kits

But with modern servers, you'd be amazed at just how much you can consolidate onto three hosts. Especially when the VMs will be copies of ancient servers that probably have little requirement for disk space, memory and CPU grunt.

So what did the company do? Well, as I mentioned, my audit was an informal one. I was expecting it to call in "proper" consultants to tell them pretty much the same thing. Instead, it went with my Excel spreadsheet. The company spent a few quid on new hardware and software, but saved a fortune in electricity and air-conditioning costs. It has also reclaimed the old server room as a new office and the half-height rack now sits in a broom cupboard, making hardly any noise!

Virtually identical?

I guess most people are aware that here in the UK there are really just four mobile networks: EE, O2, Three and Vodafone. Even these big names share base stations and parts of their infrastructure – so the real number of networks will average out at somewhat less than four.

All the other mobile networks you've heard of are MVNOs – or Mobile Virtual Network Operators – which piggyback on top of one of the four core networks. So, for example, Virgin Mobile uses EE, as does BT (which is hardly surprising as BT now owns EE). Tesco Mobile runs across the O2 network, as does Sky Mobile and Giffgaff. Again, this makes sense once you realise that O2 and Giffgaff share the same parent company, Telefonica. Vodafone doesn't have many MVNOs on its UK network, but two that you might have heard of are Lebara and Voxi. And then there's Three, which is the network behind the ever-popular ID Mobile and up-and-coming Smarty.

You'll nearly always find that the MVNOs are cheaper than the big four networks, and often by some margin. Sometimes, they offer extra goodies such as data rollover and caps on out-of-plan charges. So this makes it a no-brainer – everyone should sign up with an MVNO over one of the big four networks, right?

Maybe. But maybe not. You see, things aren't always quite as simple as they first appear. Just because an MVNO runs on a particular network, doesn't mean it gets everything that the host network offers to its customers. Indeed, it doesn't even mean that the MVNO's customers get the same network coverage.

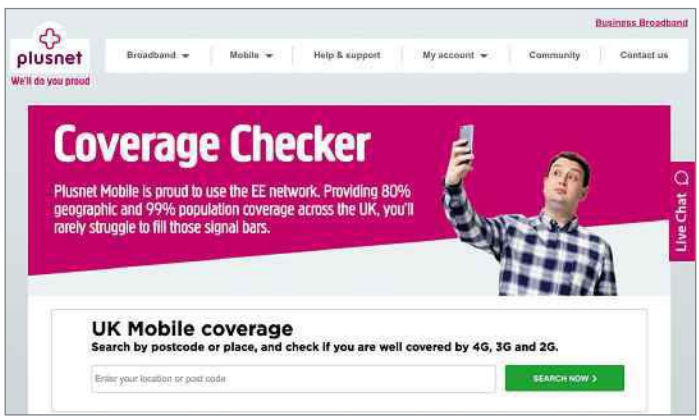
As an example of this, take Plusnet Mobile. It uses the EE network, and like its host network, Plusnet is owned by BT. Plusnet Mobile even boasts within its advertising that it's "Proud to use the EE network". There's just one problem – Plusnet only uses part of EE's network.

EE runs its 4G services at 800MHz (Band 20), 1,800MHz (Band 3) and 2,600MHz (Band 7). Band 3 is used for the main core of the network, while Band 7 is used to provide additional capacity in cities and other built-up areas; it's also the band that EE uses for its "double speed" 60Mbits/sec service. Band 20 is used primarily for Voice-over-LTE services – normally a phone will drop back to 2G or 3G when a call comes in, but VoLTE avoids that. It makes sense to run this at 800MHz because that's better at penetrating inside buildings and other structures, and works well over longer distances such as rural locations.

That all sounds great, and for EE customers it is. But Plusnet Mobile uses only Bands 3 and 7. The MVNO has no access to EE's Band 20 services, so this means that there will be places in the UK that you'll get a signal on EE but not with Plusnet. I asked the company about this, and it said "we're working on the ability for Plusnet customers to access 800MHz so they can get even broader coverage in the future". That's fine, but I suspect most people reading the "Proud to use the EE network" claim will assume that the maps are identical today.

ABOVE Beware: not all mobile networks are created equal

"An MVNO won't necessarily get everything the host network offers to its customers"



BELOW Plusnet is "proud to use the EE network", but it doesn't use all of it

Don't get me wrong. I'm not singling out Plusnet; I'm using it as an example because I'm an actual paying customer! If you look at other MVNOs, there aren't only frequency bands missing, some of them don't even offer 4G. And even when 4G is offered you'll often find that, with an MVNO, the data rate is capped at a lower level than the host network, and the traffic will be given a lower priority.

It's hard to get actual figures for much of this stuff, especially since there are a couple of websites out there claiming to carry definitive data but that are actually putting out misleading information. But going back to Plusnet again, I found a comment on its support forum from one of its technical staff saying that the data rate is capped at 40Mbits/sec, whereas the EE host network offers 60Mbits/sec as standard, and 90Mbits/sec on "Max" plans.

Also bear in mind that the main four networks tend to offer Wi-Fi calling where the handset supports it, or VoIP apps where it doesn't, to help in areas where coverage is poor. Most of them also provide official (and legal!) signal booster boxes. Such things aren't unknown in the MVNO world, but they're pretty rare.

Now you might be prepared to live with these limitations in exchange for a huge drop in your monthly fees. I certainly am; I have contracts with both Plusnet and ID Mobile. But I think it's time these MVNOs stopped giving the impression they offer the same coverage as the underlying network, when in many cases they patently don't.

@PaulOckenden

MARK EVANS

"Management that will engage with the requirements of GDPR has been something of a rarity"

Now that GDPR is embedded in British law, how are businesses reacting? A consultant shares his early experiences and what we can learn from them

I found myself at a crossroads, one no doubt familiar to many *PC Pro* readers. I'd taken the IT function within my employer's business as far as it could go and, in doing so, put myself in a position where I'd have to take a step back with a new employer and do it all over again – or set off on my own in a specific area. The fact you're reading this suggests the route I chose, but what about the area?

It helped that I had a long-running interest in data protection and cybersecurity, along with the relevant certifications. It was time to put those to use in my own business. But that makes it sound like my education stopped, which is far from the truth. I've had some time to engage with different businesses since making the switch, and have come to appreciate the impact of the General Data Protection Regulation (GDPR) on organisations large and small.

Question the unquestionable

My first insight is that there was no possibility of selling the idea of "first mover advantage" with regards to conformance of GDPR. It was seen as a hurdle to be crossed with no financial return. Conversely, several organisations with whom I worked saw GDPR as an opportunity to spring clean. In an environment where "return" was sought from adopting the requirements of the regulation, some businesses approached their data, both digital and paper-based, with admirable pragmatism.

One organisation effectively said, "Do GDPR to us!" and it was pleasantly surprised to find that one exercise – a data-mapping session – led to it being able to destroy paper archives that it had no legal basis to retain. The saving? Tens of thousands of pounds per annum in reduced storage space in a London facility. The impact? None. Apparently, no-one ever reviewed the paper, but no-one had the time to review the necessity for such storage. GDPR gave this firm the time for reflection and it paid dividends, even before taking into account the potential sanctions regime that came into force on 25 May.

Mark was head of IT at a global company and now runs his own consultancy, Athene Secure, specialising in GDPR and training
@MarkXavierEvans

My takeaway? Question the (often) unquestionable. The paper data was costing a small fortune to store but it was almost an article of faith that the data was untouchable, up to the point where GDPR required some introspection. The paper-based data wasn't adding any value to the business. It was presenting a potential vector for a data breach. Taking a view that the data should be destroyed was a win-win for the organisation in terms of removing non-compliant data, removing opportunities for the data to leak, and also costs of storage.

"New staff will prefer to work in a place that has a mature attitude to data protection"

Power of leadership

I ran a GDPR training session for a small company involved in residential care in Nottinghamshire. I was pleased to discover that the heads of the organisation's care homes were in attendance. As was the MD. He was an impressive individual, with a background in corporate law. He listened, asked pertinent questions, and was satisfied with the need for the regulations. As such, he interrupted me on several occasions to stress to the care home managers that figuring out how the regulations could be adopted practically in an organisation that was primarily paper-based was non-negotiable and a priority.

Coming across senior management who will engage with the regulatory requirements of GDPR has proven to be something of a rarity. I'm surprised, because the regulation has some strenuous sanctions for organisations that, by act or omission, fail to comply.

Here, the MD had taken a half-day out of his schedule to fundamentally understand the changing regulatory landscape and to underline and endorse the effort to comply, leading from the front. His care home leaders were quick to understand what was required and came up with pragmatic suggestions and ways in which GDPR could benefit them and their residents. I came away enthused by their new-found zeal!

If you work for an organisation that handles personal data, where senior management is seeking to ignore the regulation, my advice is to get a job somewhere else, quickly. Data protection will become a standard by which organisations are judged. We're still in the early stages of adherence, but it won't be long before we have employees who know no different.

In an environment where the search for talent is growing ever-sharper, the lack of engagement with GDPR from senior management will snowball through an organisation as staff leave to work in a "safer" environment, unthreatened by potentially business-ending fines and reputational damage, and new staff will prefer to work in a place that has a mature attitude to data protection.

At this point, there might be some thinking: "Well – you work in data

RIGHT GDPR changes are most successful when initiated with support from senior management

protection, so of course you're singing the praises of data protection!" But it will take only one Gerald Ratner-esque comment from a senior manager to drive a long-standing business into treacherous waters. At that point, the value of data protection and privacy will become an existential concern of senior managers and shareholders. It's likely to mean more regular, heightened scrutiny from supervisory authorities, too…

High stakes for stakeholders

Assessing an organisation for its conformance to GDPR is a multi-stakeholder undertaking. It isn't the job of one business area in isolation. Done properly, key stakeholders are involved for their input and to assess the cultural drivers within any business. The "micro" cultures in many businesses need to be persuaded to involve themselves and to drive towards achieving a defensible position, if the organisation is ever faced with a data-protection audit. This, in turn, requires strong senior leadership, as mentioned above.

Peter Drucker memorably said, "Culture eats strategy for breakfast." If you need to address key cultural aspects of the business, it needs buy-in across the organisation. It needs praise or penalty directed to employees to enforce. If you can sell the idea of improving the efficiency of the business by adopting responsible data-handling and the avoidance of penalties, the culture will gradually change. I've seen organisations whose expectation is to "have GDPR done to them" and it really is a waste of time and effort. A thin veneer of compliance will peel away as people go back to their tried-and-tested processes, those that may lead to data breaches and a negative outcome for the organisation.

Borrowed time

I smile wryly when I hear people say, "It's after 25 May and nothing has happened, so it's all a bit 'Y2K', isn't it?" Anyone who believed that the Information Commissioner's Office (ICO) would be hitting an organisation with a €20 million fine on 26 May doesn't understand the legal system or how investigations work. The ICO isn't going to wave a magic "sanctions wand" and attack UK businesses indiscriminately.

The ICO has a tightrope to walk, in terms of sanctioning organisations. The fastest way to undermine its work is to apportion fines and force businesses to go under. Fear isn't a supportive environment for business, and so the ICO is seeking to undertake a consultative role with business in general. This was never going to kick into action on Friday 25 May, immediately before a Bank Holiday weekend. This will be a slow-burn. Once the regulation is embedded in UK Plc under the guise of the Data Protection Act (2018), woe betide any organisation whose sole response to a data audit is a plaintive, "We've tried nothing, and we're all out of ideas!"

A band of brothers (and sisters)

My biggest surprise, however, has been in the body of keen, driven people who have engaged with the regulation and undertaken reams of paper-based study to help guide organisations. Yes, there are total charlatans out there, offering poor advice for a very good fee. But I've seen more camaraderie, more passing of information and, yes, more opportunities, between data-protection operatives than in any other sphere of IT throughout my career.

There are excellent consultants out in the wild, offering advice to organisations from managers of social clubs to social media entrepreneurs, all with a drive to protect the organisation and their data subjects.

Is this a self-serving echo-chamber? Not at all. Robust arguments are pursued as people deal with the start of the biggest shakeup of data privacy we've seen. GDPR is making waves. The state of California has pursued very similar legislation and the effect on Silicon Valley is only now starting to appear. Other countries are seeing that GDPR is workable, putting the data subject (you!) back in control of his or her data. The end result is a higher standard of data privacy consultancy.

As is the case with people and businesses: change is life. GDPR is just another change through which people and organisations will have to evolve. I'm certainly glad that I've had the opportunity to engage with people who are pursuing their position within the regulation, either as business operators or consultants. It's a refreshing change. And the story is still in its preamble for everyone.

mark@athenesecure.com

ABOVE GDPR is making waves, and will result in a higher standard of data privacy consultancy

"If you need to address key cultural aspects of the business, it needs buy-in across the organisation"

BELOW The ICO will come down hard on businesses – in time

DAVEY WINDER

"So what should you be doing to mitigate the IoT botnet threat? Start with a network audit"

Davey casts light on malware attacks on IoT devices, advises on router hygiene, and reveals why your VPN may not be as secure as you think

"Turn it off and on again" is more than just a comedy catchphrase from every episode of *The IT Crowd*; it's also a tool in the security bag. Take, for example, malware that hits Internet of Things devices and recruits them as unknowing workers, most often in a botnet. The design of most "things" is lean and cheap, with minimal complexity: there's often no way to update firmware, even if a vulnerability has been discovered.

The only real option to get rid of malware, then, has been to "switch it off and on again". But that's hardly a silver bullet: the vast majority of IoT devices will never be rebooted unless there's a power outage. Even if they were to be, reinfection would soon follow, unless the underlying weakness in security is identified and resolved.

Even so, you might think that the emergence of a new and persistent botnet is no big deal, but I'd argue the opposite. The evolution of the Hide and Seek (HNS) botnet is something we all need to worry about. Let me point you in the direction of the Q1 2018 Threat Landscape Report from Fortinet (**pcpro.link/288fort**), which shows that 58% of botnet infections are a dead duck in less than 24 hours, and only 5% last longer than a week. Even the most infamous IoT malware family, Mirai, averages a bot lifespan of just five days.

From the moment HNS appeared in early 2018, it was obvious the actors behind it meant business. For a start, it was only the second botnet to employ a decentralised peer-to-peer architecture, and the first to use a custom-built one rather than using a BitTorrent-based system. Unlike many other IoT botnets, HNS doesn't yet appear to be interested in recruiting devices for executing DDoS attacks. Instead, it has data exfiltration and code execution capabilities.

Davey is an award-winning journalist and consultant specialising in privacy and security issues
@happygeek

And then, it evolved – and evolved quickly. Within months, the HNS developers managed a second "first" in finding a way to bring persistence to the botnet party. HNS-infected devices would stay infected, stay part of the botnet, even after a reboot. How? Over to the security researchers at Bitdefender Labs (**pcpro.link/288bit**) for the inside info: "Once the infection has been performed successfully, the malware copies itself in the /etc/init.d/ and adds itself to start with the operating system. In order to achieve persistence, the infection must take place via Telnet, as root privileges are required to copy the binary to the init.d directory."

HNS also restricts access to port 23 once it has successfully brute-forced Telnet access, and it does this to prevent competing bots from doing the same. The good news is that HNS doesn't yet appear to have executed a payload – or, to put it another way, it hasn't been weaponised. Instead, it's been busy expanding the number of devices it can reach, by using ten binaries compiled for various platforms and incorporating support for exploiting new vulnerabilities.

Apart from the data exfiltration capability that's been there from the get-go, HNS now seems to have an attack capability that can be easily monetised. "Based on the evidence at hand, we presume that this botnet is in the growth phase," Bitdefender Labs reckons, "as operators are trying to seize as many devices as possible before adding weaponised features to the binary."

As already mentioned, older botnet families such as Mirai have "virtual persistence", in that power-cycled devices tend to get reinfected in short order unless those vulnerabilities that were allowing it in the first place are resolved. So what should you be doing to mitigate the IoT botnet threat in general, and for Hide and Seek? Start with a network audit so you know what devices are on the network, and then disconnect those that aren't necessary. It may sound obvious, but legacy kit, unauthorised user devices and the like aren't rare sightings.

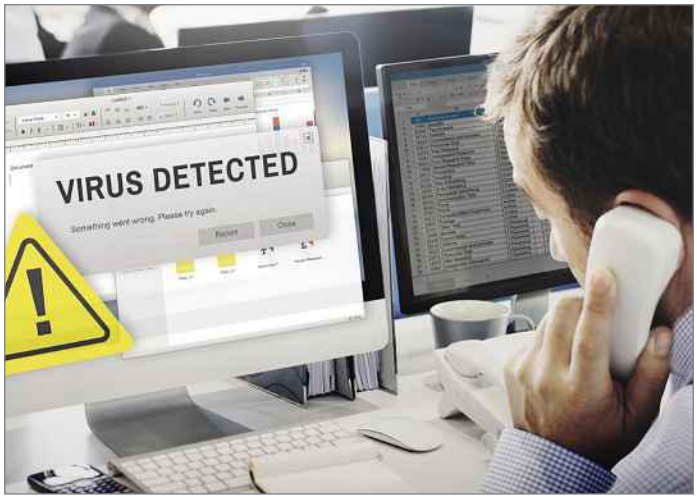
Once you've removed the baggage, change any default admin passwords, power-cycle all non-mission-critical devices, and install available firmware updates. Delving deeper into the HNS mitigation (worth doing, as you can bet your bottom dollar the bad guys have been watching what HNS is doing and will be copying it soon enough), disable Telnet logins for devices where you can.

Of all this advice, the single most important is to change the admin passwords of devices from the default, to something long and complex, so as to foil both brute force and dictionary attack modes.

Bad router hygiene

Talking of network connected devices, and as a great example of why security hygiene needs improving, the latest research from Avast threw up some numbers that certainly gel with my experience of the issues.

Researchers found that 51% of those asked had never logged into their router admin interface, and 72% hadn't ever updated the firmware. Broadband Genie did a similar survey earlier this year and the numbers were equally disappointing: 86% hadn't updated router firmware; 82% hadn't changed the admin password; 70% hadn't checked to see what devices were connected to the network; and 51% hadn't done any of the above.



BELOW **It's a mistake to underestimate botnets such as Hide and Seek**

Home users are less likely than businesses to audit network devices, change admin passwords or update firmware. That snippet hasn't come from research, but rather my own experiences. It's understandable, because most consumers aren't the slightest bit "technical", nor are they interested in tweaking kit that they just assume will work out of the box.

By not making the security implications of admin defaults clear enough, vendors aren't helping. While adding a "change admin password" step to the simple diagrammatical setup instructions would be helpful, it would also be a miracle. Inserting a "now change your password" requirement to open on first use, without which the device wouldn't function properly – ditto.

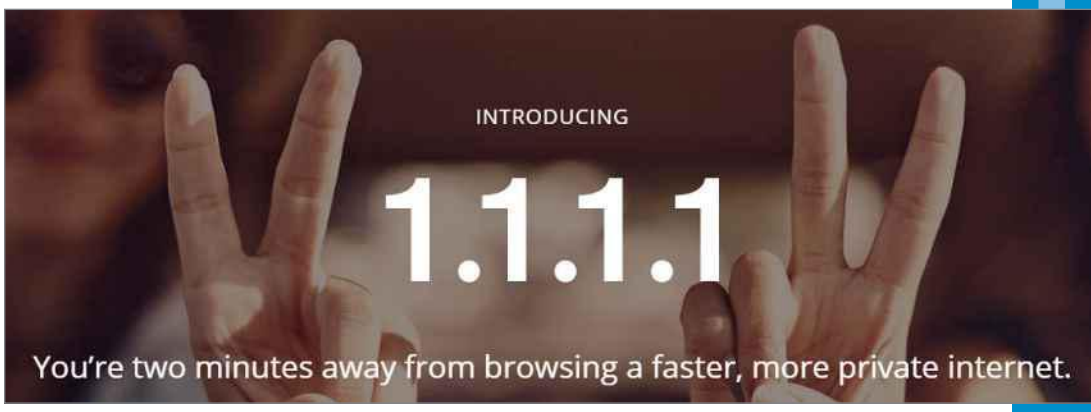
Businesses at the smaller end of the scale, those without the resources for a dedicated IT team (or even an individual), don't do any better. I've gone into so many such businesses over the years, where simple security measures would have prevented many of the problems they paid me to unravel. Problems, it has to be said, that are becoming increasingly prevalent with mass-scanning botnets that quickly discover and take control of poorly secured devices.

DNS settings

Something else that most people don't ever change are DNS settings. The Domain Name System is one of few remaining real dark arts of the internet. It's also, once again, one of those things for which the defaults remain untouched by the majority – from consumer to small business. Larger businesses with more complicated network needs are a different kettle of dedicated DNS fish, so this advice is aimed primarily at the small end of the business scale and the prosumer market.

I'm assuming most *PC Pro* readers will know what DNS does, so I won't cover that in any more detail than to say it manages the human-machine translation between numerical IP addressing and alphabet-based URLs. Most of the time, using the ISP-provided DNS is fine and dandy. It's the "some of the time" that you need to worry about, even if it means a one-off occurrence when your ISP DNS goes down for some reason.

That one-time event could cost you money if your business is disconnected for an hour, or longer, and even the prosumer will find stress levels rising if the internet is effectively down.



ABOVE Cloudflare introduced the free 1.1.1.1 DNS service on 1 April, but it's no joke

Aha, I hear you cry – this is the reason you have a primary and a secondary DNS configuration. If one fails then the other acts as an automatic failsafe to keep things working. Of course, both these will point at DNS operated by the same ISP by default, and there's always the chance that it's an ISP-wide problem, so both go down.

Rather than risk it, you can keep your primary DNS as the ISP default and change the secondary to another such as Google (8.8.8.8 or 8.8.4.4), Cloudflare (1.1.1.1) or OpenDNS (208.67.220.220 or 208.67.222.222), for example. That way, you have a viable "worse case scenario" backup.

"By not making the security implications of admin defaults clear, vendors aren't helping"

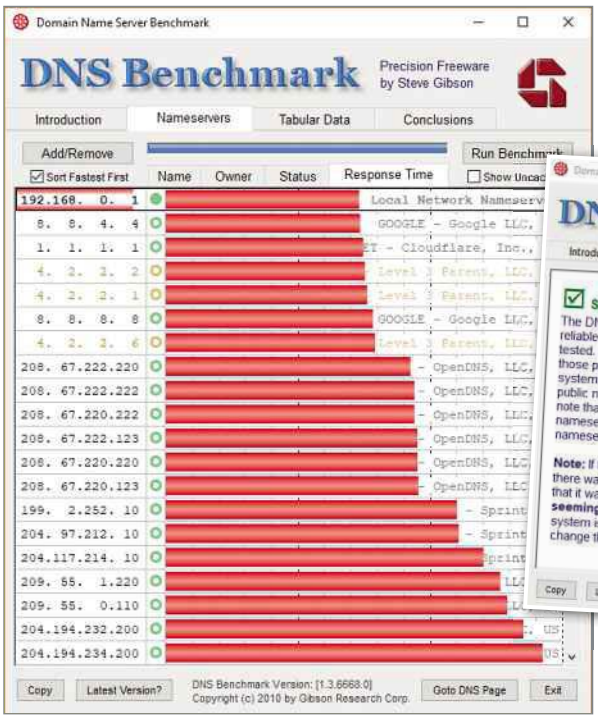
DNS speed test

Steve Gibson over at GRC has a dedicated DNS speed test app (**pcpro.link/288dns**) that Windows users can download for free; I understand it's Wine compatible, if Mac users are interested in giving it a spin. It will compare your current DNS nameservers with a database of other known resolvers and display the results in terms of what it calls "characterisation", which includes auditing redirection behaviours.

The beauty of this app is that it benchmarks the alternatives relative to your location at the time; geography has an impact upon DNS performance. There's an option to automatically create a custom list of the top 50 fastest resolvers to be used as the comparison benchmark. However, unlike the default, this won't be filtered for rogue and potentially suspect operators.

Switching your DNS to a different provider based purely on a "speed" indicator isn't good practice, for obvious reasons. That said, I like that the testing is relatively quick and the presentation of the results flexible. You can get a written summary, in plain English, from the Conclusions tab, which includes how well your current nameservers responded and whether you should consider changing to an alternative. Want the full tabulated results? No problem, although the nameservers list display is far more readable as it can be sorted by response speed, name or owner.

BELOW Not a lot between default, Google's or Cloudflare's DNS servers – so maybe use one of the latter as a failsafe?

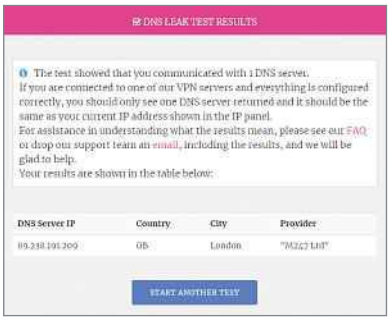


Leaking VPN?

The GRC site used to have a DNS leak-test resource that could check if your VPN was actually "anonymising"

ABOVE Steve Gibson's DNS benchmarking tool provides a most welcome plain-English summary of the results

Continued from previous page



ABOVE **Running a DNS leak test is a quick and dirty way to see if your VPN walks the privacy walk...**

all traffic correctly or not. Actually, VPNs shouldn't be seen as an anonymising service in the truest sense of the word, but rather one that keeps your traffic private – which is a different thing entirely. I say "used to" because the GRC test still appears to be there, but I couldn't get it to work for me. Your mileage may vary, of course, so feel free to give it a go at **dnsleaktest.com**. There's an alternative at **my-private-network.co.uk** (a VPN provider, but there's no hard sell when using the test) that works in a similar way.

If your VPN service – and here I'm talking to those who use a service rather than have configured their own router-based VPN – is working properly then it should route all traffic, including DNS queries, via the VPN. This isn't always the case, and system default DNS servers can sometimes be used even when a VPN service is running. This matters: you won't realise that there's a "DNS leak", but threat attackers monitoring your traffic will be.

Once connected via the VPN you want to test, select the Thorough mode and hit Start. In around 30 seconds, the results will be displayed. In the results box you'll see any DNS nameserver IPs that were used during the test. There should be only one IP, and it should be the same as the one displayed on the main page telling you the IP of your VPN connection. If you have more than one IP showing, or the IP doesn't match, then you have a DNS leak and your VPN connection isn't as private as you thought.

davey@happygeek.com

STEVE CASSIDY

"The modern Acronis is spreading its attention far more widely than shovelling bytes on and off your PC"

If there's one person you call in to solve the problem that is ransomware, Steve discovers, it's Serguei. And he's no cuddly meerkat

Never have I looked forward to the end of a travel season as I have this one. Madrid, Bremen, Vegas, San Francisco, San Jose, Oakland, Stuttgart, Schaffhausen, Munich, Hanover, Cologne; truly a case of wherever I lay my hat. Although, this time, it wasn't jetlag or weird diseases that had me eyeing the last trip with keen anticipation. It was the prospect of a sitdown and chat with Serguei Beloussov.

Serguei is CEO of Acronis. We met at the firm's new HQ in Schaffhausen, at the northern tip of Switzerland. This isn't our first encounter, because the Russian group that includes Acronis also includes Parallels – fine suppliers of web control panels and virtualisation software.

Serguei used to run Parallels back in the initial days of cloud computing, so we've crossed paths a few times. It was Serguei who passed on a joke from Prince Andrew, who had said at the end of a presentation on quantum computing that he may have appeared to be asleep during the more technical slides, but that he had in fact been alert and attentive at the same time. From this I learned that Prince Andrew is no slouch – and that Serguei definitely gets around.

Fast forward a half decade and here we were, in a chic open-plan office with some racing car drivers, locals and a few Swiss chocolate nibbles. Even if I occasionally dropped into off-state Prince Andrew mode, I couldn't fail to notice how the word "protection" kept coming up in all the product briefings. Nor was it being used in the same way: this wasn't a last resort backup method for home users or corporates. Something far more interesting was happening. The penny finally dropped for me when I did eventually find a techie and ran through a few screens of one of the centralised corporate backup products. Under the list of saved images of a distant cloud-connected laptop's drives, there lurked a button: "Run as VM".

Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart

@stardotpro

This isn't actually rare when it comes to backup archives of real machines: you can open a Windows Server backup as a VM, for instance. What's unusual, and set me thinking, is that in this case the backed-up laptop image can be run as a VM in the cloud, on the servers delivering the backup platform itself. Given the most likely circumstance in which you'd want to restore a user's machine (laptop left on top of car; tablet dropped in industrial cake mixer), this is likely to be an absolute game changer for the users, more than for the techies. Why? Because now users can access their most recent files via that VM, rather than having to wait for IT to supply a whole new laptop.

Several years ago, I bemoaned the horror of a business whose IT strategy was to send each new employee down to the corner laptop store and tell them to buy whatever they wanted. Several years before that, I was wowed by a stage demo from Citrix that showed how running VMs under a hypervisor on a laptop could ensure that you keep a cloud-stored backup of that machine in sync with the local

BELOW **Serguei Beloussov, CEO of Acronis, talking about ransomware in Switzerland**

copy. This counteracted the most frequent misunderstanding of "backup", because even local work-in-progress counted as a state change to the VM and therefore presented to a hypervisor-resident sync process.

The point about Acronis versus Citrix here is that Acronis can start small, and insert itself into a pre-existing environment of not-ideally-built laptops and PCs. Citrix required a cold start with much forethought, planning and the dreaded "infrastructure". We're also in a brave new world when it comes to laptop OSes and the software found on them. In the Citrix era, there were still over 90 applications in the Ford Motor Company laptop manifest, and a lot of installed Windows XP machines to run them. These days, such horrifying intricacy has been engineered out.

Serguei's ambition doesn't stop at being a fairly well-regarded player in the PC backup marketplace, however. I say "fairly", because I think that's fair: I canvassed my fellow RWC columnists on the brand, and their reaction wasn't uniformly positive. That reminded me of the last time I met Serguei, just as he'd been given the news that he was moving from Parallels to Acronis, because "some things were not right". To me, that and the lukewarm reception from the *PC Pro* panel are two sides of the same coin. Certainly, the modern Acronis is spreading its attention far more widely than just shovelling bytes on and off your PC.

And I mean *a lot more* widely. Remember, Serguei gets around. When he kept saying "protect" in that crackly Russian/English accent, I was thinking it was the classic marketing slogan about how backups protect your files. Sure, I thought to myself, fair enough. But this isn't what he meant at all. As is usual when we meet, the actual detail emerged from an apparently unrelated aside about the way that ransomware had sealed the fate of cryptocurrencies, and what this might mean for the future of blockchain. Suddenly, Serguei shifted gear and he said that he had a nightmare vision of the future of ransomware and backup.

What if, said Serguei, the people in control of ransomware economics realised that high-value, high-profile damaging hacks were over? Where would they go next? They have both the time and the resources to do a lot of R&D, and they want a less dramatic and painful revenue stream. It's much better to be a taxman than a bank robber, after all. How can ransomware authors convert their role so that ransoms become a more reliable source of income?

His answer? Corruption. Not of people, but of documents. Want to be a successful ransomware operator? Don't lock a document or scramble it: just deface it. Put white blobs in pictures, mix up the words in documents, so that the copy on your PC becomes different from the one sent to your correspondent.

The most likely use of a historic backup or archive is to retrieve a file because some bank or lawyer or whoever has a question or a dispute about what was said when that backup was a live work in progress. If you send a corrupted version then they'll say "that's not what we have on file" and it's game over. While your back was turned, some silent little infector has called into question the entire basis for using a computer at all. It's the return of bit-rot, only this time it isn't unreliable hardware, it's nasty men who want your money. Then you can have your stuff back.

Serguei thinks that ransomware authors will move to an on-demand decrypt/un-deface model, with a few euros charged per document unlocked. His idea to combat this is to use the blockchain model as a long-term, publicly readable repository of document originality. A file is protected not just because it's stored on your machine and somewhere else, but because it has a continuous history, showing that modification hasn't happened.

It isn't often I'm stunned by the audacity of both a problem and the solution. It's even less often that I get an immediate gut reaction that says someone is right. This time, I had both. If anyone was to have the range of research and the simple travelling air miles to have come up with this opinion, it's Serguei Beloussov.

ABOVE **The new face of ransomware could involve the corruption of documents rather than full encryption**

"Want to be a successful ransomware operator? Don't lock a document or scramble it: just deface it"

I know the old lags will say that effective protection against such a threat can be put together with not much more than a ZIP file utility with passwording, or even just a step back in time to writing archive sets of your work files to DVD or Blu-ray. As soon as the files are offline, the threat disappears. Which is fine, if you're 100% confident of your disk-writing processes, and of the durability of the discs you buy – but this still isn't the main shortcoming of doing this. It's the fact that this is a blast from the past, and it doesn't get through to the Chromebook'n'cloud generation. What if the entity held to ransom was your cloud backup storage provider, holding your stuff on its machines?

I'm sure Serguei's approach won't be the only solution. But, as ever, he seems to be the one looking furthest ahead and taking action on what he sees as the future.

A summer CeBIT

Normally I write about CeBIT while wearing a heavy jumper. That's because, since the early 1980s at least, CeBIT has been a winter exhibition. And Hanover gives pretty good winter, it must be said: pitch dark, snowbanks on pavements, the lights of bars and restaurants twinkling through frosty windows. All of that changed in 2018, however. This year's enormous tech trade fair has been disrupted. The blazing

BELOW **CeBIT's new egalitarian hall layout: note the intermix**

skies of June shone down on the Hanover Messe showground, with a wholesale rearrangement of the entire format of the show and a good deal of fear and loathing on the part of everybody involved. Was the sheer discomfort of the winter season actually an integral part of the whole story? Would this change mark a steepening decline in the reputation of the event?

Who cares, right? It's just a computer show. Why go to these things expecting anything other than people selling you stuff? They all operate the same way, so how can you tell them apart?

The answer is simple. Of all the shows I've been to, CeBIT is the only one with added national leaders. They don't make the trip for CES in Vegas or Computex in Taiwan. They do turn up in Hanover. This is a reflection of the importance CeBIT had a decade or more ago, when all the world's industries would turn up to see what the world's tech firms had to say (a position the show has held since the late 20th century). That isn't a regular trade show; that's a component of world trade, technology trends, business decisions and consumer spending. If you had the stamina over a few short days, you could then encompass a large proportion of a year's research, just by doing a business card supermarket sweep round the entire show.

To heighten the impression of change, the show had changed occupancy of the immense Hanover exhibition centre. No more central press centre; no more sitting on the grass outside the IBM hall in prime position. This fuelled an unexpected sense of panic: had the show really shrunk that much? Those empty halls were beside the entrance, too, and the taxi rank. Every driver wanted to know what the show was like, as we rode back and forth from the hotel. It's fine, we said: but mostly, we were reflecting on the grotty chairs and hipster tables in the "new" press room. Yes, some people turn up and just sit in the room, stacking up press releases. This year, they had to follow George Michael's advice when he sang "let's go outside".

Because all those bigger brands had done exactly that. There was, tucked away out of sight of the cab drivers and kibitzers, an enormous fairground. SAP had a Ferris wheel the size of the London Eye. IBM had gone for weird, with a quantum computing device straight out of the original *Star Trek* (see the picture above). Oh, and a massive mobile crane and a load of chairs and tables, which you could see was IBM-only once the chairs, tables and their occupants were 100m in the air (again, check out the picture). Volkswagen had a hall to demo the E-Go, its latest, cute little all-electric vehicle – but I fell in love with the e-quadbike, which I assume wasn't actually a Volkswagen product.

Inside, the old and rather pointless segregations of exhibitors are history. You can walk down an aisle past a German state developer's alliance promotion, a Taiwanese maker of mains leads and a drone collective – this gets over the previous problem of some halls being a single-purpose ghetto, and people not visiting some exhibitors because the extreme climate would keep them in the halls nearer the train station.

LEFT IBM quantum computing ... thing. May exist in several universes

ABOVE IBM's logo on the underside of a fairground ride with a giant crane... taken from the ground because I'm not getting on that!

I didn't share the trepidation of the folk I talked to, that this was a move away from one of the few traditions the IT sector. However, I think there may be some point to what those doubters have to say, because CeBIT was an enormously dominant event for a very long time. I think this new summertime slot is a sensible response to the way that IT has pervaded everything in our lives, and the slow emergence of IoT into industries whose best exhibits don't fit inside a stand.

Perhaps the answer is found with my friends at Software AG, which used the event to announce another purchase in its burgeoning portfolio of IoT-related businesses. This time it was TrendMiner, which shows near real-time stuff about your fight with the squirming, malevolent firehose that is IoT data from sensors. The reschedule to summertime denied us the bemused presence of Angela Merkel this year – we were meeting just after that arms-crossed picture with Trump in the Far East – and the style of the new festival was evidently a learning experience. What do you do outdoors, if you're a pure software business? Software AG had a 4x4 campervan ex-military truck.

This is perhaps the ultimate in dogfooding: hedging bets between the old, winter, inside world of CeBIT and the promising and sunny outdoors world of 2018, to discuss the latest in a series of purchases that make it more likely you'll solve your problems inside your brand, than outside. Which is precisely what CeBIT's organisers are hoping for with this break from tradition.

cassidy@well.com

buyacar.co.uk

The easiest way to buy your next car

Skip the forecourt - great deals from the comfort of your home

With over 40,000 new and used cars to choose from across the country, **buyacar.co.uk** makes it simple to find the car you want and will deliver it straight to your door.

Zero hassle
Choose from thousands of cars, apply for finance online with us and value your existing car - all from the comfort of your home.

The very best prices
Whether buying outright or taking one of our affordable monthly payment plans, we've travelled the UK for the best deals - so you don't have to.

Peace of mind
All our cars come from UK main dealers and go through rigorous checks and tests before they arrive at your door.

All cars come with a 14-day money-back guarantee

Find out more at buyacar.co.uk

100% would recommend!
All members of staff are lovely and willing to help.
SHANNON

Pleased with service
The process of getting the car was very easy and secure.
DANIEL

Easy Peasy!
No trawling garage showrooms! Already recommending to friends & family.
KAREN

Purchased VW Golf
I was nervous about buying on the internet. Needn't have worried.
SIMON

READ MORE REVIEWS ON TRUSTPILOT

Futures

We explore the trends and technologies that are set to shape the future

Five fintechs to bet your money on
The startups aiming to make your financial life easier p126

What is... PSD2?
The banking regulation that could change how you do business p128

The future of banking is coral
Nicole Kobie offers her take on Open Banking p128

Banking opens its doors to apps

Open Banking means a world of new services and tools built by third-party app makers. Nicole Kobie reveals what the banking revolution means for consumers and businesses

The future of banking is open – whether the big banks want it or not. British and EU regulators have rolled out a series of changes under the guise of Open Banking, which forces the largest retail finance players to offer customer data to third parties via an API, so they can build innovative new services.

That means you can keep your account with RSB, Lloyds or Nationwide, but not be limited to their services. So your data could be accessed by apps tracking your invoices, managing your spending and helping you save for taxes.

"This is a remarkable project: one with the potential to change retail banking forever," explained Imran Gulamhuseinwala, trustee of Open Banking Limited and global fintech lead at EY. "If we get it right, we will for the first time anywhere in the world put the customers in control of their financial data, their privacy and their money. It is difficult to overstate just how revolutionary Open Banking could and should be."

What is Open Banking?

The shift to Open Banking was required by new regulations at an EU and a local level. On the latter front, after an investigation by the Competition and Market Authority revealed a lack of innovation at British banks, plus serious difficulties for customers trying to switch providers, it demanded change.

Open Banking is the retail banking industry's response, said Gulamhuseinwala, but it also comes alongside EU regulations known as PSD2 (*see p128*) that force large retail banks to open up their data to third-party developers via APIs. "[Open Banking] is tasked with delivering the APIs, data structures and security architectures that will enable developers to harness technology, making it easier and safer for individuals and SMEs to securely give access to their financial information (should they so choose)," he said.

Open Banking Limited is governed by the CMA and funded by it, the Financial Conduct Authority (FCA) and the nine biggest British banks: AIBG, Bank of Ireland, Barclays, Danske, HSBC, Lloyds, Nationwide, RBS and Santander. As of January, those banks were required by the PSD2 to offer Open Banking tools, although six missed the first deadline.

Gulamhuseinwala doesn't think regulation is the only impetus behind the changes. "Open Banking is not happening simply because the regulators are mandating it," he told *PC Pro*. "It is happening because there is commercial opportunity."

And that's been spotted by startups. "Financial services has traditionally been a utility-based sector with a small number of players providing a largely homogeneous set of products," said Gulamhuseinwala.

"We will for the first time anywhere in the world put the customers in control of their financial data, their privacy and their money"

"What the fintechs are demonstrating is that you can come into the market and you can provide a great proposition because the barriers to entry are so low now. There is an opportunity to challenge some of these established players. I anticipate seeing non-financial services companies also entering this space – mobile phone operators, pure tech companies and insurance companies. All of those lines are going to blur."

That said, we're in the early days of Open Banking. The regulations only landed in January, and some of the efforts have been set back by banks'

delays offering those APIs. Plus, it also takes time for developers to get the necessary approvals from regulators, said Chris Gorst, fintech researcher at innovation quango Nesta and lead of its Open Up banking challenge. "I think it's been a fairly slow start in terms of actual products and services coming to market," he said. "I think that will change over the coming months. You're seeing more and more organisations getting all of the authorisations they need to start using Open Banking.

"We're kind of in the early stages of waiting to see how this is going to play out. I think that's the reality, and I think people are increasingly realising that Open Banking is quite a long game, and that maybe we've just inched over the start line now."

What it means for you – and businesses

Startups and fintechs are already popping up with services. While many remain in beta or limited release, they show the direction Open Banking is taking and suggest what the future of finance is for individuals and SMEs.

Gulamhuseinwala says Open Banking could unbundle current accounts from overdrafts, letting customers get an overdraft from a lender with a better rate, as well as shift their payment processing to a cheaper provider.

Nesta's Open Up Challenge has picked ten Open Banking startups to back, with support including £100,000. They offer a range of tools: Coconut helps freelancers and sole traders track taxes and expenses, Credit Data Research rates companies' potential for credit to make lending easier, and Funding Options lets SMBs compare financial services products.

Gorst predicts that take-up of such services will be faster among sole traders and SMBs than individuals, as the former have plenty of pain points that could use treatment. "I think on the very micro end of the scale, in particular sole traders and freelancers, those are often people who don't necessarily have the time to deal with the financial and tax and administrative side of their business, and they may not have the capabilities as well," he said.

Gulamhuseinwala agrees. "I think SMEs will be one of the early beneficiaries of Open Banking – and it will be every bit as game-changing as it will be for individual customers," he said. "The CBI [Confederation of British Industry] estimates that SMEs spend 20 to 25% of their time on managing finances and accounting – that's a huge investment of resource which Open Banking can erode by automating routine filings, freeing entrepreneurs up to focus on what they do best: building their business."

For example, Open Banking apps could automate invoicing, expenses, tax, accounting and other administrative burdens faced by small businesses – and help them raise funds, by letting them share banking information with would-be loan providers. "What Open Banking does is to enable the process of small businesses sharing data and information… so the decisioning and even the provision of funds can be more or less real-time," Gorst said, making it easier and faster to find a wider range of loan options. "Open Banking is just super well-suited to making that happen."

Better data also means a more accurate eye on cash flow, with Gorst pointing to Open Up startup Fluidly. This helps SMEs see their current financial situation, as well as what's likely to happen in the next few weeks. "We know that cash flow is the thing that kills a lot of small businesses unnecessarily," said Gorst. "If you can help a small business to get on top of that more quickly, it might [survive] by taking corrective action more quickly, whether that's calling in a debtor or maybe even kind of getting a short-term overdraft arranged. Because Open Banking has that real-time picture of where things are, it's very well suited."

The future of finance

Such visions may have small businesses eager to join the Open Banking revolution, but be patient: services will take time to build. "We are really just at the start of our story: new technologies and practices take time to bed in and while I truly believe that this will change the way we work in our economy, that promise will take time to realise – several years at least," said Gulamhuseinwala.

Indeed, adoption has so far been slow thanks in part to negative press coverage focusing on data risks, Gorst believes, as well as low public awareness. "That will change with some killer app that wasn't possible, or services that weren't possible before," he said. "I think we haven't seen that service quite yet emerge."

That killer app may arrive as more data is released. So far, PSD2 only requires banks to share data that's already being "exposed through existing online channels," Gorst said. "Banks actually have richer data than that, which could potentially be useful for their customers." That may happen in future versions of the standard, which is set for frequent updates to better keep up with changing technologies. "The idea is that this standard will get better and richer and enable more and more use cases," Gorst added.

Such changes will not only encourage startups to work with bank data to create new tools and services, but Gorst predicts bigger players will step into the ring, be it under-pressure banks themselves or tech firms such as Amazon and Facebook. "That would obviously be a massive game changer," he said. "It's hard to see those guys not thinking of that as a potentially interesting thing for them."

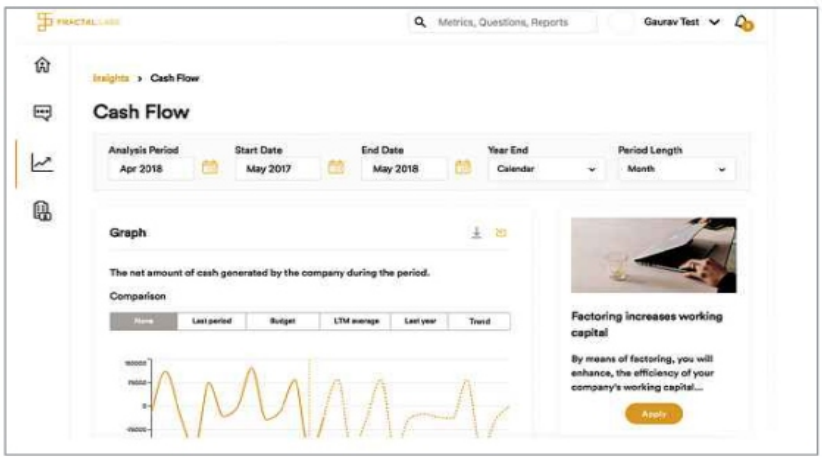
"I think people are realising that Open Banking is quite a long game, and that maybe we've just inched over the start line now"

Should that prove true, the implications for data privacy are major, he added. "Some people have said that it's a bit unfair that Amazon can now get your banking data, but the bank can't get your Amazon data."

While it's early days for Open Banking, Gulamhuseinwala is optimistic about the work he's already seeing. "New products are emerging from incumbents as well as new entrants," he said. "Innovative new ways of making money, of making life-changing financial decisions and paying for things are slowly beginning to appear." ●

Five fintechs to bet your money on

Pulling British banking into the digital age will take effort – and these five startups are on the job, building tools to make it easier to manage your financial life



LEFT **Can't afford to hire a financial assistant for your small business? Fractal Labs' tools will help you manage your cash flow**

Fractal Labs

Want a financial assistant but don't have enough in your bank account to hire one? Fractal Labs has developed an automated helper to assist SMBs manage their cash and find loans, and help banks judge credit applications.

"Fractal connects SMEs' bank transaction data and accounting data via APIs, on a permission-based basis," said CEO and founder Nick Heller. "We aggregate key financial data including bank transactions, accounting data, budget data and qualitative signals (through our conversational chatbot interface). We then apply machine intelligence to this data, enabling transaction categorisation, forecasting, financial analysis and credit scoring." All of that is then pulled into a single platform.

That's good for firms looking for financing, said Heller, but should also benefit banks by making it cheaper to gather disparate, but key, financial information about a client. The sort of data that's necessary to assess risk using intelligent analysis tools. In other words, Fractal is effectively "removing friction from the financing market" by greasing it with data.

Fractal launched before Open Banking arrived, but Heller said the additional data has extended what the startup can offer its customers. "In the era of Open Banking, big banks risk becoming a utility that by law needs to give third-party providers access to their clients' transaction data, if the clients choose so," explained Heller. "Depending on how the big banks choose to position themselves in the face of innovation, the consequences for individual banks will be defining."

Fractal is set to hit beta this summer. Find out more at **askfractal.com**.

Coconut

Freelancers, sole traders and the self-employed have different financial needs than those drawing a regular salary. To help, Coconut has designed a current account just for them, which automatically manages invoices, estimates taxes and tracks expenses.

"We call these businesses 'personal businesses'," said CEO Samuel O'Connor, explaining that includes owner-operators as well as micro-businesses up to ten employees. "We think they're different because there might be an intersection between personal life and business life that's kind of inextricable."

And such personal businesses are underserved by existing banks, O'Connor says, with only a quarter contributing to a pension, and many struggling to get a mortgage or business financing. "Open Banking presents a unique opportunity," said O'Connor. "On one hand, there's the automation of these day-to-day processes, particularly around bookkeeping such as expenses, tax and getting paid." Beyond that, Coconut aims to pull together all the details of someone's finances to help them find financial products such as loans and pensions, or minimise taxes.

Currently, British banks don't offer enough data to let Coconut accomplish all this, hence the requirement to set

BELOW **Coconut has designed a current account that's tailor-made for sole traders, freelancers and the self-employed**

up a bank account with the startup. But Open Banking helps give it a wider picture of your financial situation, as some business expenses might sit outside your company account. "One example might be the working from home allowance, where you can expense a portion of your rent or mortgage, and that will probably sit in your personal bank account," he said.

Coconut opened an iPhone-based beta for sole traders in January, with an Android version in the works. Find out more at **getcoconut.com**.

Countingup

Bookkeeping isn't the reason anyone gets into their job (unless you're an accountant), so Countingup aims to make it easier by bringing banking and accounting into a single tool. Like other finance startups, it didn't wait for Open Banking to get started, instead offering a business current account with plenty of SMB-friendly features, such as speedy signups and instant transaction notifications, and pulling in data from other sources to automate your bookkeeping.

"As well as offering banking, we also offer a built-in accountancy solution – something no bank currently has. Financial reports like profit and loss get automatically populated at the point of transaction, saving time and hassle while also ensuring accuracy," said founder and CEO Tim Fouracre.

The Open Banking changes aren't necessary for Countingup to offer its service. Rather than rely on a limited API, it works with a third-party banking provider to offer current accounts, so it gets a fuller view of customer data. That said, Open Banking will let the startup extend its services in the future. "Access to our accounting and banking data could provide an easier way for small businesses to get access to capital, for example, from lenders," he said.

Countingup is available now. For more information, head to **countingup.com**.

Fluidly

Fluidly aims to be your business' autopilot via real-time cash flow forecasting, so you know exactly what to expect with your finances.

"Banks and accounting data tell you what has happened in the past, but Fluidly gives insight into what is coming up – whether that's ensuring a business has funds to make payroll or their tax bill, or helping them get paid faster and more reliability by dynamic cash flow management," said CEO Caroline Plumb OBE.

Fluidly gathers data from your accounting software before cleaning and categorising it to use in its AI-based modelling tools. Open Banking's data APIs mean it will be able to boost its forecasts. "Our forecasting uses machine learning techniques to predict what will happen in the future... the more information about what has happened historically, and what is happening now for a business, the better," said Plumb.

Plumb expects banks to evolve to become platforms. "They'll aim to be the key partner or hub for a relationship and supplement this with multiple specialised providers who can broaden their range of services."

Fluidly is available now. For more details, go to **fluidly.com**.

Starling Bank

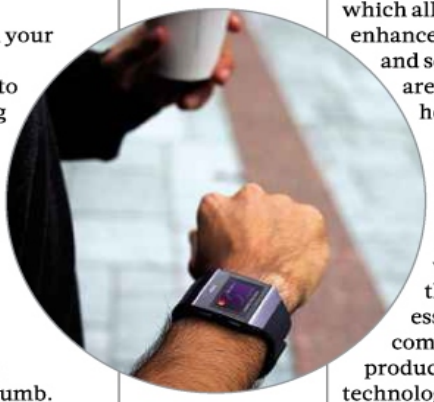
This London-based, mobile-only bank launched its first current accounts in May 2017 with business accounts following in March 2018. SMBs can sign up in fewer than five minutes from their smartphone, and export all their transactions directly to their accounting software.

Naturally for a digital-first bank, Starling is well ahead on the various regulations. "Starling were the first bank in the UK to release a suite of tools [APIs] to allow third parties to get their ideas off the ground, releasing an in-app marketplace which allows Starling customers to enhance their experience with apps and services from experts in their areas," said Alexandra Frean, head of corporate affairs.

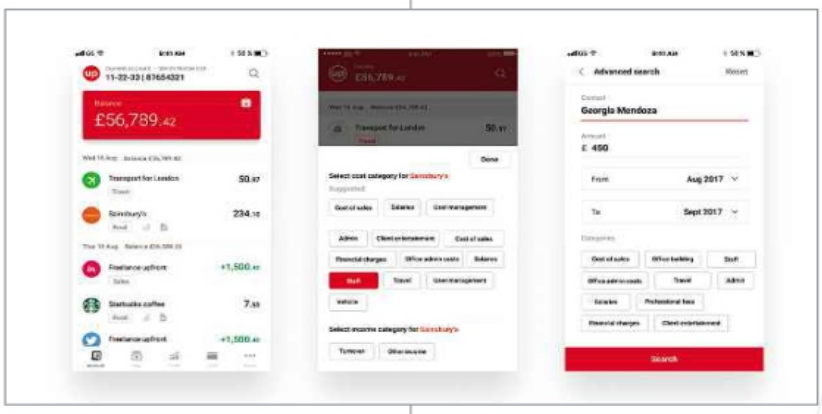
Plus, it means the mobile bank can constantly add new features. "What makes Starling stand out is that, unlike any of the big banks, we are entirely situated in the cloud," she said. "We are essentially a technology company that has banking as a product. So, for us, that means that technology and implementation of technology run throughout the entire company rather than acting as a support function to the business."

Which is why Starling isn't worried about taking on the giants. "The big banks know they can't afford to ignore [mobile banking] and that they will have to undergo a massive digital transformation to provide the kind of mobile services that many customers now expect," Frean claimed. "They are watching very closely what we do and copying some of it. But they are struggling to keep up with what we and other fintechs are doing. Their problem is that they are encumbered with outmoded legacy IT systems, whereas we built our own technology from scratch."

Find out more about Starling Bank at **starlingbank.com**.



BELOW Don't want to put down your coffee? Starling Bank lets you use your Fitbit Ionic smartwatch to pay



LEFT Countingup makes your life easier by combining banking and accounting into a single tool

BELOW Fluidly gives an overview of what will happen to your finances in the future – so you don't get caught out

What is... PSD2?

Don't let the numerical acronym put you off: this key banking regulation could change how you do business in your personal and work life – for the better

The original Payment Services Directive (PSD) was designed to make it easier and safer for payments to flow across EU borders, and comes alongside the UK's Open Banking regulations. The update builds on the 2007 version by limiting surcharges, ensuring consumer complaints are heard quickly and strengthening security standards, as well as introducing a framework for sharing account information. That last bit is key to Open Banking: letting third-party companies and apps manage your finances with your bank on your behalf. Here's how it works.

What does PSD2 mean for Open Banking? PSD2 requires nine of the biggest UK banks to allow third parties to access bank account data to build new services. It's an EU-level change that's been a long time coming, but follows a report from the UK Competition and Markets Authority. This demanded change after finding that traditional high-street banks weren't innovating enough or offering distinct services, locking in customers with a lack of real competition.

What third parties can access account information? There are two categories: account information service providers (AISPs) and payment initiation service providers (PISPs), and they largely do what it says on the tin. An AISP lets you pull all your account information, across multiple banks, into a single place. That could be to watch your spending or for a bank-comparison site, to let you choose the right account provider for you. A PISP can make payments directly from your bank account, although so far it only works for online sales rather than in-person shopping. That doesn't mean it's open season on your data, however. Companies looking to organise your financial life need your permission first, and must be approved by the Financial Conduct Authority.

How will these PISPs and AISPs get access? PSD2 means the nine big banks are required to offer APIs of their data to PISPs and AISPs. Don't choke on that alphabet soup: all it means is banks must offer the same data feeds that apps use on smartphones or to interact with Facebook. APIs open up data without allowing full access, and are a standard way for apps to pull in the information they need.

What about security? This is one big question for the nine banks: how can they share data with third parties without risking data breaches? Security concerns are one likely explanation for delays to the rollout – we would hazard fear of competition is another – not least as banks are famed for their out-of-date IT, with RBS fined £56 million over an outage in 2012 and TSB struggling with similar challenges this year.

When does PSD2 land? It's already here. Most of PSD2 came into force in mid-January, although some of the access requirements are on a slower rollout schedule, coming into play next year. The nine banks in question were supposed to make customer data available from January, but six missed the initial deadline. All but one has complied now. That means you can in theory use apps – such as those created by our profiled startups on these pages – to manage your finances, and while it will be some time before there's wide availability and support for every bank and mobile OS, with PDS2, the future of banking is on its way.

OPINION

Nicole Kobie

The future of banking is bright neon coral

I was sitting in the rattling wooden carriage of a heritage steam train on the Isle of Man when it became clear the future of banking was already here. Forget admiring the passing countryside as we raced by; my travel companions and I were instead staring at our phones, sorting out our spending on hotels and rounds in the pub. Rather than take out cash, or make a note of who owes what to send from bank accounts when we returned home, we sorted it all out digitally in minutes, flinging virtual money to each other from the comfort of an old-fashioned train carriage.

British banks only recently started to offer easy ways to transfer money to friends, well behind their peers in other countries. When I first moved to London from Canada 15 years ago, my parents could email money to my account, while banks in countries such as Kenya and Rwanda led with mobile services via SMS well before the rest of us caught on.

Given that, the big British banks should be grateful that Open Banking is being forced on them – if it wasn't, they'd risk falling further behind still. Even before PSD2 forced my bank to spit out an API to support clever new services and apps, I was already on the road – or the rails, as the case may be – to modern banking thanks to British startup Monzo.

Monzo's bright coral cards always attract attention at shops – they are nigh on neon, making them impossible to miss – but it's the services that convinced me to sign up. Not only is there no foreign currency charge, handy for frequent travellers, the app is a perfect example of mobile banking. Everything just works. Transactions are instantly noted, for example, making it simple to manage spending; my main bank's app isn't bad, but it takes days for my spending to appear.

Monzo didn't wait for Open Banking regulations to kick in before offering this glorious glimpse at the future of finance. Instead, it first worked as a pre-paid credit card, before evolving to an actual bank with fully functioning accounts. If my main, more traditional bank doesn't up its digital game, there's increasingly little reason to stick with its creaky, slow ways. By forcing the big banks to let startups offer innovative services on their behalf, Open Banking may just keep them relevant a little bit longer.

@njkobie

Next month's issue

PC PRO

On sale
13 September 2018

LABS

Ultrabooks

Slim, stylish designs. Great battery life. Chart-topping performance. Find your perfect laptop partner in our roundup of all the best Ultrabooks next month.

Subscribe today

Start your subscription to *PC Pro* and claim a free three-in-one USB charging cable, while stocks last. You can read *PC Pro* in print, on your iPad, iPhone or Kindle Fire. See p108 for details.

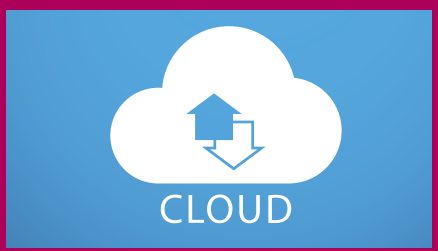
FEATURES

Excellence Awards 2018

Your votes are cast! Now it's time to reveal which manufacturers and suppliers provide the UK's most reliable products, services and support.

Switch to your perfect broadband

You're probably paying too much for an inferior broadband service. We show how to switch to the best choice for your needs.



How to back up with zero effort

With cloud services, it's now possible to save yourself from data disaster without jumping through horrible hoops.

Please note: Labs and features are subject to change

The Core i9 chip may not be the only thing Apple throttles, argues Jon Honeyball

When news broke that the latest shiny Intel processors in the new MacBook Pros were getting all flustered, overheating and slowing right down, we shouldn't have been surprised. No matter how you slice and dice it, heat is the absolute bane of any CPU designer, and thus anyone who puts them into mobile phones, laptops, tablets and other devices. Remember the good old days when laptops were thick and heavy? And had significant ventilation slots on the sides and bottom to allow the heat to dissipate away? Those with long memories will recall how a laptop could get too hot to stay on your lap, especially if you were wearing shorts.

Of course, this heat comes from somewhere, and it's the micro nuclear furnace that runs within the CPU chip itself. This puts out heat in quantities directly related to a number of factors: the voltage rail in use on the CPU, the clock speed of the CPU and the manufacturing size of the chipset tracks. Higher voltage tends to lead to higher power dissipation (V=IR for those who remember schoolbook physics). Run the clock faster,and the CPU does more work, which equals more heat. Smaller tracks mean components closer together, which means less resistance – which means lower heat output.

CPUs have been getting better over the years. I well remember the thermal impact of adding a second Pentium Pro to a desktop motherboard some 20 years ago. Back then, each core ran at constant speed and on a high voltage rail. Today, we have multi-core CPUs, and it's possible to vary the driving parameters such as voltage and frequency on each core in real-time. If the computer gets busy, you can ramp up the CPU voltage and clock speed. If it's idling, then pull back on them. If you only need two cores out of the four to do some work, only increase those, for the fraction of a second necessary to complete the thread.

So what happened with the MacBook Pro? It was a perfect storm – Apple replaced the quad-core i7 CPU with a six-core i9. That's 50% more number-crunching, which makes a power-hungry user such as myself positively tremble at the thought. Allowing an increase from 16 to 32GB of RAM means I can throw bigger and better workloads at the CPU. Bigger SSD options means that I can store more of this stuff, for instant load and compute.

Now only an idiot would expect that all of this would be possible with exactly the same thermal architecture as used by the older design. Intel has been slow to decrease its die size, and is still playing a long and painful game of power management catch-up alongside its rival ARM. Could you really envisage a smartphone running an i7 or i9 CPU today? Even if it did, how long would the battery last?

No, the problem is that laptop designers have run off the tracks, and Intel has pushed them there. Everyone wants a light, slim, portable laptop. Even better if the screen detaches and it turns into a tablet, just like the Surface Book. We want something not much bigger than a pad of A4 paper to have four, or now six, CPU cores of number-crunching alongside a superfast GPU for graphics operation. Oh, and it has to be silent because it doesn't need fans, and last for at least ten hours because... well, why not?

As you could have predicted, this particular bubble has finally burst. It's just like Wile E Coyote running off the cliff and keeping going right up to the point where he looks down. Road Runner, apparently, could just keep going.

> "The problem is that laptop designers have run off the tracks, and Intel has pushed them there"

It has been argued that Intel has fallen behind the curve here. It promised a more rapid development process, which it has failed to deliver. This is the outcome of that.

What to do about it? Well, I confess I was particularly thrilled at the thought of the new MacBook Pro because, although my four-year-old 13in example is still doing sterling service, the 16GB RAM and 512GB of storage is a little cramped at times. Moving to 32GB and 2TB would be very useful indeed. The six-core i9 processor was the icing on the cake.

However, I waited to see what the initial reports said, and lo and behold the i9 shut down under heavy load. This somewhat dulled my initial enthusiasm for spending a few thousand hard-earned pounds on a new laptop.

Apple has apologised and brought out a fix that seems to solve some of the issues, which is a good start. But let's not forget that this is just the latest bump in the road in the relationship between Intel and Apple; maybe the rumours of Apple producing its own high-performance CPU for desktop and laptop use are really going to come true. What's certain is that the current road has already led us off the cliff. And like Wile E Coyote found, the ground is a long way down.

Jon Honeyball is contributing editor of *PC Pro* and, when it comes to iconic cartoon characters, is definitely the Road Runner. Meep meep! Email jon@jonhoneyball.com

Chillblast

UK's most awarded PC Manufacturer

FASTER
LIGHTER
MORE POWERFUL

CHILLBLAST **PROPHET** 15.6"

GTX 1050 Ti GAMING LAPTOP

Processor:	Intel® Core™ i7-8750H
Memory:	8GB DDR4 2400MHz
Graphics Card:	NVIDIA GeForce GTX 1050 Ti 4GB
Display:	15.6" True HD 144Hz Display (1920x1080 Resolution)
Storage:	1TB SSHD Hybrid Drive
Operating System:	Windows 10 Home
Dimensions:	359mm x 236mm x 22mm

Price from: **£1099.00** inv VAT

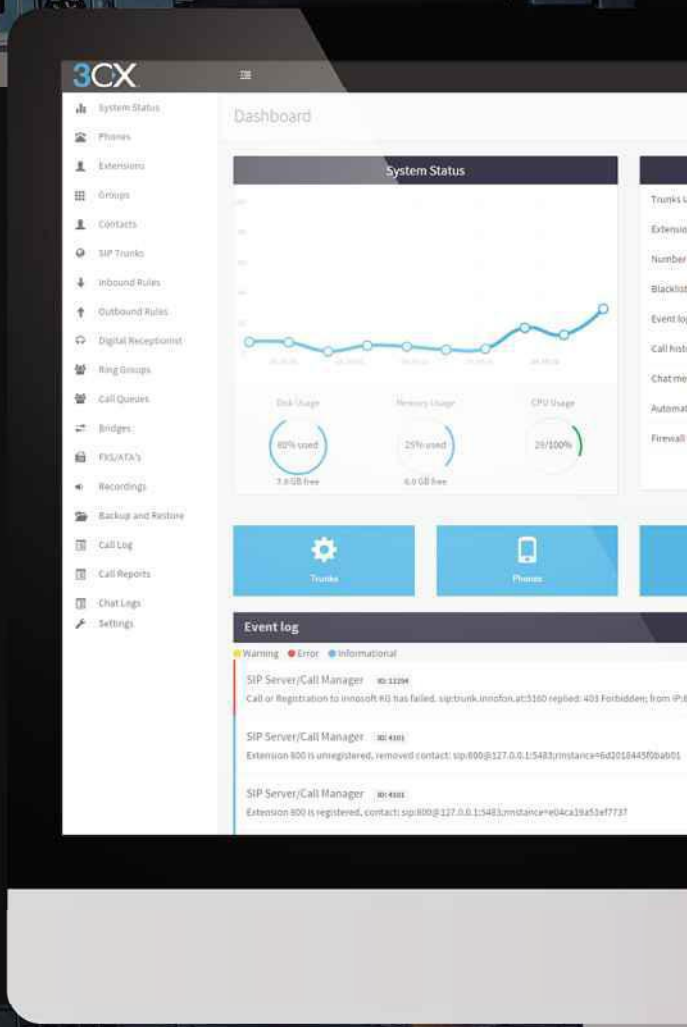
www.chillblast.com

3CX PBX in the Cloud
1 year **FREE** - no ties!

3CX Phone System

Move to 3CX - a software IP PBX providing easy management and complete Unified Communications features at lower cost.

- Easy to install & manage
- Inexpensive to buy and expand
- On-premise: virtualized or miniPC (Windows/Linux)
- Cloud: In YOUR cloud account (Google/OVH/Amazon)
- Integrated Smartphone clients
- WebRTC based web conferencing



WWW.3CX.COM

PC PRO RECOMMENDED
PC PRO BUSINESS SOFTWARE OF THE YEAR 2017
PC PRO A-LIST
ITPRO EDITOR'S CHOICE

3CX®