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HIGHLIGHTS THIS MONTH

Full contents overleaf



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REVIEW OF THE MONTH

Samsung Galaxy Z Fold7

So here we are with Samsung's seventh generation of foldable phones: first up, the Fold is a full-size phone that unfolds to become an 8in tablet; then comes the Flip, a *Star Trek*-style flapper. While it hasn't quite said it to us in so many words, we get the impression that Samsung thinks it's finally cracked the Fold this time around, with no compromises to speed or camera quality despite its 8.9mm depth – the same as a normal phone. But naturally there has to be some trade-off, and here it comes in the form of a £1,799 starting price. To be worth that, it had to be perfect in almost every way – read our verdict on p48.



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Talking of folding, it's surely time to make the decision of whether to stick with Windows 10 or move on. Lee Grant answers all your most pressing questions from p26.



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UNEXPECTED SYMPATHY OF THE MONTH

With connectivity now on offer everywhere you go, from football matches to festivals, when was the last time you wondered how everything "just works"? Barry Collins has the answer.



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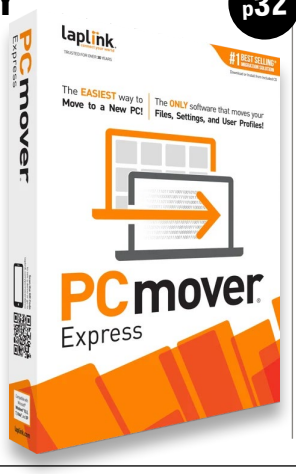
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We arm-wrestled Laplink and we won: every *PC Pro* reader can claim a copy of PCmover Express, worth £25, to help them migrate from any version of Windows back to good old 7.



THE LABS IN ONE NUMBER

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Let's keep this simple: we tested 22 monitors measuring between 24in and 34in so that you'll be able to find a screen that delivers exactly what you need. Did we succeed? Turn to p74 to find out.

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22 pro-quality monitors

- Best value
- Best quality
- Best for you

p74



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WINDOWS 11 ALL YOUR QUESTIONS ANSWERED

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- And many more!



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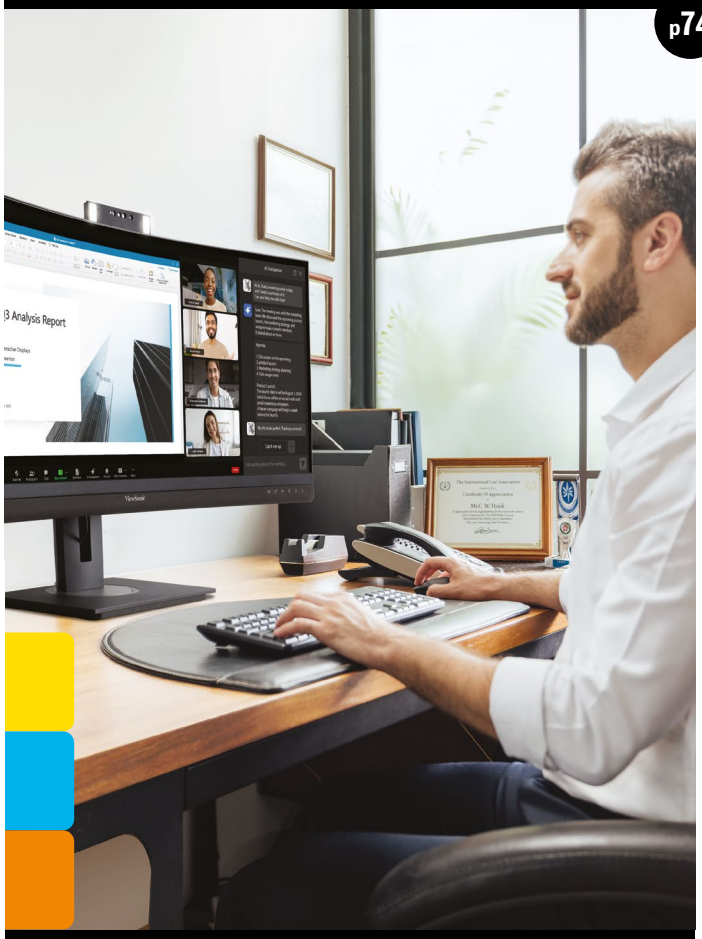
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My Microsoft lover only ever has one thing on its mind

Is there a single person alive who loves Microsoft, shareholders aside? The answer to this rhetorical question is no, and I know why: like so many long-term partners, it takes us for granted.

Just now, I was hit by a warning message in Edge because I don't use Bing as my search engine. Well, no, I use Google. A choice I could only make by navigating its forest of options to find the setting I was looking for, stuck in the same metaphorical toilet cubicle where Arthur Dent found the bypass plans. Strange how easy Microsoft makes it for me to change back to Bing.

Then there's the data honey trap known as OneDrive. We all know someone who has fallen for the "you risk losing your photos, videos and everything you treasure because OneDrive is full" bait. Pay us now! It's okay, Microsoft whispers, it's only £1.99 every month. You'll barely notice it trickle out of your account.

And sure enough, most people won't. But that adds up to millions of pounds, dollars, euros per month keeping Microsoft in diamonds and pearls. How nicely it complements the Enterprise licences Microsoft charges businesses, including Jon Honeyball's, as he describes on p110.

It's easy money, so much easier than asking for one-off fees such as £30 for Extended Support if you're running Windows 10. Until June, that was the only way home users could keep using their Windows 10 PCs without nag screens, but now Microsoft says you can gain that support merely by signing up to a cloud-based Windows account and synchronising your backup settings.

If alarm bells aren't already ringing inside your head, allow me to help. What happens a month later, when you've synced 50GB of photos to the cloud? Up pops that demand for £1.99 per month; fail to pay and your data is at risk, Microsoft says. You'll probably find that you can't even access them, with a big red "X" marking the files as unusable. How much easier to pay the ransom – sorry, the monthly fee – and get everything working again.

Now, I'm probably as close to a Microsoft fan as you can find. I enjoy using Surface devices, I was one of the few people with kind things to say about Windows Phone, and despite flirting with Google Docs I still use Word and Excel every day.

But I now wonder if I'm stuck in my own lifelong Stockholm Syndrome, unable to break free from my captor. At least when you buy Apple devices it's more open about its desire to lock you into its ecosystem, with the handy perk of things such as file synchronisation simply working.

Despite this, I've never been tempted by Apple's overtures, so if I'm going to abandon Microsoft that leaves me with only Chromebooks and Linux. Trouble is, neither fit into my way of working. All of which means that I'm trapped in Microsoft's arms, even as I feel its fingers reach for my wallet. Fine, Microsoft, take the cash. But, just for the record, I'll never love you.

Tim Danton
Editor-in-chief

PC Pro needs your help!

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In honour of our monitor megatest from p74, we asked our contributors: if you could design your own perfect monitor, what would it be?

"I want everything. A panel that can display perfect whites when I'm working on documents and lush scenery when I'm watching films. That is both tall and wide enough to perfectly fit my view. That includes a brilliant webcam, microphone and speakers so I can clear the clutter from my desk. In short, I want a monitor I look forward to switching on each morning."

"Mine would be A3 size, switchable to show two pages A4 portrait, or single page A3 landscape, and rotatable to single page A3 portrait. Touchscreen, just HD res. Its mounting should offer stiff support at any angle from vertical to flat."

"What I really want is a monitor that lets me extend the screen upwards or out to the side when I need a bit more workspace – then pull it back to more compact dimensions when I want a tidy desk."

"Monitors are like homes. Every time you move into a bigger one, you want one that's even bigger. Although I actually don't want a bigger monitor: I want apps that behave better when windowed, even when in relatively small windows. Too few behave properly, meaning you're always looking for a larger screen to compensate."

"It already exists, costs a bargain £94 and I've bought two of them. Raspberry Pi's 15.6in monitor (1,920 x 1,080) is powered by USB-C and doesn't even require a plug if you're running it from a Pi 5. It has a fold-flat stand that lets me prop up one on a little Ikea ledge shelf, where it's connected to my Pi 5 to use with my plotter. The other one is connected to my PC and fixed to a hydraulic arm so I can get it out of the way when not in use."

"I want a MoniDrone: a screen that knows where I am and hovers at just the right height and distance for my wonky old eyeballs. I also want those Fujitsu projector glasses that use lasers to display on your retina, and which correct for dodgy eyeballs to remove the need for glasses. But then, I'm greedy."

"Given the laptops brought into the shop on a daily basis, my perfect monitor would be one that has been cleaned. It's like not flushing the toilet before the plumber arrives"

"Apple Vision Ultra with 8K panels. It's all I could possibly need."

"I've already had it for years: a 49in Dell UltraSharp."

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UK reaching for the Starlink

Can the UK really provide a Starlink rival, or are there better opportunities for our space industry?

When you think of the UK space industry, you might struggle to think of anything beyond Colin Pillinger's Beagle struggling to beam a signal back from Mars. However, the UK space industry is a significant business, with more than 20,000 British workers engaged in cutting-edge research such as manufacturing semiconductors or pharmaceuticals in microgravity.

Some think it should be bigger, potentially taking on giants such as SpaceX and Amazon with a UK-based launch programme. Could the UK really make a serious dent in space? This is what politicians have been discussing for the past few months.

The UK space industry

The House of Lords might not seem like the obvious home of cutting-edge tech policy, but the Lords Committee on UK Engagement with Space has been hearing from experts, trying to understand the opportunities and challenges facing the UK space industry.

Calling it an industry, though, is stretching the term. It's currently a diverse mix of businesses, some of which are on the very edge of what you might label "space" firms. Official figures claim there are about 52,000 people currently working in the UK space industry, but according to Dr Heidi Thiemann, director of the Space Skills Alliance, around 20,000 of those are in TV broadcasting – essentially Sky TV. "People who are working in the Sky offices and Sky call centres are counted because it's part of the economy, because Sky are using satellites," she said. "Our view is that's not really spacey."

ABOVE Could the UK soon have its own sovereign launch capability?

Thiemann prefers to focus on the companies "manufacturing satellites – designing, building, launching and then operating them". Then there are the businesses working with data beaming down from satellites, including Earth observation, communications and telecoms firms. "We do have a really great side of the space industry [based] around scientific exploration as well," said Thiemann. "We're very good at building small satellites doing really innovative things."

> "We do have a really great side of the space industry [based] around scientific exploration... We're very good at building small satellites doing really innovative things"

Thiemann name-checked a few British companies that are doing extraordinary things in space, such as "microgravity as a service" firm SpaceForge, which sends mobile factories into Low Earth Orbit to manufacture high-value materials used in semiconductors or pharmaceuticals. The "10 trillion times lower ambient pressure removes contamination issues," according to the firm's website, while near absolute zero temperatures mean materials cure quickly, without the need for cryogenics. Then there are more familiar names, such as the Met Office, which of course keeps an eye on the weather from a range of satellites.

However, some observers wonder if the UK should be targeting even bigger names.

Sights on Starlink

One of the House of Lords Space Committee sessions focused on the idea of the UK having its own sovereign launch capability, potentially providing competition for companies such as SpaceX. Opinion was divided on how ambitious the UK's aims should be in this regard.

"Britain should absolutely have its own sovereign launch capability," Phil Chambers, CEO of small satellite launch firm Orbex told the committee. "If you want to launch a satellite today, you have to sign up with SpaceX and wait almost two years to get it into space. Launch demand is up 4x since 2017. There are just not enough launchers."

However, Dr Martin Heywood, director of Newton Launch Systems, was more circumspect. "We are not a good location to launch from," he said. "We are limited really to polar or sun-synchronous orbit, which is a fraction of the global market. We are limited in size with the spaceports we have at the moment to a small satellite launch, which is up to about a 500kg payload. A lot of the growth is in other areas, such as in satellite constellation."

He added: "There is a case for a UK launcher commercially, but I do not see us having multiple launches for multiple launch sites. The north coast of Scotland is not going to resemble Florida in ten years; it will be far from it."

Heywood said the opportunity lies not in trying to create a British Starlink, but specialist, smaller launches that can't wait for a spot on a SpaceX launcher. "There will be needs – and defence is a very obvious example – where the government want to launch something on a certain date to a certain place and are not going to wait two years for SpaceX.

"There will be others, such as a university with a little research rocket, which is far more attracted by knocking a zero off the price, as would happen if you went to America, than launching from this country. We will not be competing on price; it will be a specialist niche market."

Skills shortage

A lack of launch sites isn't the only thing holding the UK space industry back; there's also a shortage of skilled workers.

"A lot of the work over the last ten-odd years, and probably since the UK Space Agency was formed back in 2010, has been on young people and graduates, getting lots of young people really excited about space and getting them to want to work in space," said Dr Thiemann. "And that's actually done a pretty good job. There's a lot of young people that want to work in space, and a lot of the graduate schemes and early-career space jobs are essentially over-subscribed."

> "I do not see us having multiple launches for multiple launch sites. The north coast of Scotland is not going to resemble Florida in ten years; it will be far from it"

The shortage lies in what Dr Thiemann calls the mid-career. "Either we've not trained up enough young people to get them through the pipeline, or we are losing people in mid-career that have a family, or they have caring responsibilities, or they go work in another sector, and we're missing some of that knowledge and experience in the middle," she said. "Because often you want people to see a mission lifecycle. We want them to have that design, build, launch, operate, decommission [experience] and that could be five to ten years, and that's the kind of gap of experience that we're missing."

Dr Thiemann admits that salaries in the space sector can struggle to keep pace with other parts of the tech industry, but believes that there are big opportunities there for IT professionals who want to be part of it. People who have transferable skills and want to "apply some of my skills to solve problems that space has, where there's some really interesting challenges". Even if we're probably not taking on Starlink in the near future.

Microsoft tests self-healing Windows

And it's going to let you ditch default apps, too

Microsoft has begun testing a new Windows recovery feature that will hopefully prevent a repeat of debilitating events such as the CrowdStrike outage.

Quick machine recovery was announced last year, in response to the CrowdStrike failure that left millions of machines worldwide unable to boot without manual recovery. It's now being tested in the Canary channel for Windows Insiders, suggesting it could be part of this autumn's 25H2 update.

Microsoft claims the new feature "automatically detects and fixes widespread issues on Windows 11 devices using the Windows Recovery Environment (WinRE)". Furthermore, "if a device experiences a widespread boot issue, it enters WinRE, connects to the internet, and Microsoft can deliver a targeted fix through Windows Update".

IT admins will be given the option to enable and customise quick machine recovery via the Intune Settings Catalog UI. The setting is already enabled by default for home users.

Quick machine recovery isn't the only new tool IT admins are being handed. The Windows 11 25H2 update also looks likely to include an option for business and enterprise users to remove all unwanted Microsoft apps in one hit. The Remove



ABOVE The forthcoming Windows 11 25H2 update could help admins prevent future outages

Default Microsoft Store Packages option will be available via Group Policy.

More than 20 apps are available for removal using the policy, including the Xbox Gaming App, Microsoft News and the Microsoft Solitaire Collection, which are arguably unsuitable for business environments in the first place. Not only will this save disk space at the point of installation, it will mean the apps won't waste resources when updating in the background.

There's no indication that Microsoft plans to offer this feature to home users, meaning they'll potentially still be saddled with a heap of unwanted Microsoft apps, let alone any extra apps that manufacturers include with their Windows installs.

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Developers dictate your broadband deal

Millions of people moving into new builds are finding their broadband choices are limited, reports Barry Collins

If you're moving into one of the 1.5 million new homes the government has pledged to build over the course of this parliament, you might think the last thing you need worry about is the broadband. Surely a new build will have full fibre running to it as a matter of course?

In the vast majority of cases, it will. However, you might have no choice over which broadband provider you're saddled with. Many property developers strike exclusive deals with ISPs that leave customers paying over the odds for a shoddy service, with no option to seek an alternate provider, and little hope of the situation improving.

What the regulations say

Developers of new build properties are obligated to provide high-speed broadband, following amendments made to the Building Regulations 2010 under the last government.

The revised regulations stipulate that people moving into new homes should have access to "gigabit-capable" broadband connections when construction is completed. That's subject to a £2,000 per home cost cap for developers. If it proves more expensive to connect homes, developers "must install the next fastest connection available".

In 98% of cases, according to 2024 figures from ThinkBroadband, that means new builds are connected to a full-fibre network. As the developer is building the roads to the property, it obviously makes sense to include the necessary underground ducting for fibre connections, meaning the freshly laid roads don't have to be dug up again when people move in.

What the regulations don't mandate, however, is choice. The property developer doesn't have to give Openreach or any other network provider a chance to tender. They can choose a single fibre provider – maybe one it even owns itself – and leave new homeowners with no option but to sign a deal with the developer's chosen provider.

Unwanted exclusive

Persimmon Homes is a developer with builds spread right across the country, from the north of Scotland down to Devon. Although its website promises "a great range of schemes to help you buy your new Persimmon home", what it didn't offer was a great range of broadband providers. Instead, homeowners on new Persimmon estates were effectively locked into an exclusive deal with one provider, FibreNest, which just so happens to be owned by Persimmon Homes.

FibreNest's packages aren't exactly a bargain. Its fastest 900Mbits/sec connection (with only 100Mbits/sec uploads) costs £56 per month. In an area of Sussex where there is competition among several fibre providers,

How much does it cost to fibre new homes?

Given they are almost guaranteed business for the next however many years, you might think that fibre providers would connect new builds for free. However, that's not always the case.

Openreach will install fibre for free in any residential or commercial development with 20 or more new plots. However, for fewer than 20 plots there's a rate card listing the maximum contribution per plot for the developer. Eligibility for the rate card is subject to an initial survey, suggesting there are some (perhaps remote) sites that Openreach won't, well, reach.



For a single property, the maximum Openreach will ask the developer to contribute is £2,000. For a development with 19 plots, the maximum per plot is £225 (or a total of £4,845). Curiously, a seven-home plot is potentially the most expensive for the developer, costing up to £1,400 per home (or a total of £9,800).

Of course, even £1,400 is relatively small beer compared to the overall cost of the property, and the developer will pass the cost on to the homeowner in terms of the initial buying price. So, if you're moving into a new estate with fewer than 20 homes, you may well end up (indirectly) paying for your broadband twice.

LEFT Openreach installs fibre for free in new developments with more than 20 plots



Community Fibre offers symmetrical gigabit connections for precisely half that monthly fee.

It's not only the price of FibreNest connections that homeowners object to: a petition on **change.org** signed by more than 2,200 people is full of complaints about the service. "We had Virgin at our old house," writes one signatory. "Probably had three unscheduled loss [sic] of service in 20 years. Been with FibreNest for one year and had over 15 instances. One lasting the better part of two days."

FibreNest is the "only option to get fibre internet", writes another. "I don't think they'd have any customers if there were any other companies able to offer a service."

Persimmon didn't respond to a request for comment.

In May, FibreNest was sold to the BUUK Group, and will now become part of the OFNL network, meaning owners should eventually get more choice, but Persimmon Homes is by no means the only developer offering limited options.

According to figures from ThinkBroadband, a mere 17% of new build homeowners have a choice of multiple fibre networks (Openreach and then at least one other). And though networks such as OFNL do offer a selection of ISPs, that choice can be bewildering for customers.

"My developer [Taylor Wimpey] selected OFNL's 'future-proof' fibre network for an 'ultrafast solution', delivering speeds of up to 1Gbit/sec," said Danny Last, who recently moved into a new development in Hassocks, West Sussex.

"What that meant was being presented with a choice of 18 service providers I'd mostly never heard of. MTH Networks, anyone? I plumped for Link Broadband purely as a lucky dip and, so far, not too bad to be fair."

Where's Openreach?

Almost all of the well-known broadband providers use Openreach, of course. But there's no guarantee that Openreach will have access to a new build area, because it has to gain permission from the property developer to reach those customers.

"Openreach doesn't have the public access rights to just go ahead and build our network on a new development," said Andrew Neilson, senior manager for new sites at Openreach. "We have to, by what's called a wayleave, be given that invitation, that legal permission to come in and install our infrastructure.

"It's down to the developer to make their choice over which network provider they want to be installed on their new development," Neilson added.

ABOVE Openreach has to give rivals access to its infrastructure, but the inverse isn't true

> "A mere 17% of new build homeowners have a choice of multiple fibre networks"

Eventually, new housing developments are normally adopted by the local authority and become public highways, but that process can take many years. Even then, it's highly unlikely you're going to see vans from Openreach – or any other fibre provider – rolling down the road. "Even when it does become public highway, because Openreach doesn't have its duct boxes and poles on site, it would then be cost-prohibitive for us to go in and dig up the entire roads, footpaths and front gardens to get our network in," said Neilson. Not to mention the fact that residents are highly unlikely to want relatively new roads and pavements dug up.

Consequently, if Openreach doesn't "get installed on day one, we effectively see ourselves as locked out, because it's not commercially viable to go in and retro-build these once they're complete," Neilson added.

Access to ducts?

Surely, you might think, Openreach wouldn't need to dig up roads afresh? It could simply use the ducts the existing fibre provider has installed on the new housing estates.

Regulator Ofcom insists that legislation already exists to make this possible. "The Access to Infrastructure (ATI) Regulations is a piece of government legislation (separate to Ofcom rules), which states that any company with infrastructure must let other companies access it," a spokesperson for the regulator told *PC Pro*. "That could be a water company letting a broadband company use its sewers to lay cables, or one broadband company letting another broadband company use its tunnels to lay cables. This significantly reduces the time and cost for a broadband company to lay its own cables somewhere."

However, Neilson insists that there's one big problem with this regulation – it's not subject to any price controls. Openreach's former state monopoly status means that it has to give rival fibre providers access to its ducts and poles at a rate stipulated by the regulator, but the inverse is not true. Rival fibre providers can charge Openreach (and others) whatever they like for access to their ducts.

"When we have sought access to other network providers' ducts and boxes, we couldn't get to a place where commercially it was viable," Neilson claimed.

He wants the ATI Regulations to be "much closer" to the Physical Infrastructure Access conditions that Openreach is forced to offer rival fibre providers. "We're keen, from an Openreach point of view, to see adjustments to the ATI that aligns more to a fair and reasonable access, in the same way that we have to open our network up," Neilson said.

Until such a point, it seems highly likely that the millions of new build homes that are cropping up all over the country are going to have a reasonably limited selection of broadband providers to choose from. If they even have a choice at all.

At least the idea of property developers trying to lock homeowners into their own ISP appears to have passed. "Most developers decided that actually they prefer to stick to building houses, to be honest, rather than the longer-term investment and plan to build fibre networks," said Openreach's Neilson. "That didn't really work for them."

The A-List

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

PC PRO A-LIST

PREMIUM LAPTOPS

Apple MacBook Pro M4

M4 beast from £1,599

from apple.com/uk



This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version from £1,599 or 16in from £2,499? And then how much do you upgrade, as Apple isn't afraid of high prices. But whatever you choose should last for years, and look great while it's doing it.
REVIEW **Issue 364, p50**

Apple MacBook Air M4

If you don't need the all-out power of the Pro, this is a brilliant, cheaper alternative despite the unchanged chassis and screen. **13in from £999, 15in from £1,199 from apple.com/uk**
REVIEW **Issue 368, p54**

Asus Zenbook S 14 OLED

Asus pairs a Core Ultra 9 288V with a 72Wh battery to produce a laptop that lasts almost 20 hours on a charge. What's more, this 1.2kg machine looks (and feels) the business. **From £1,750 from scan.co.uk**
REVIEW **Issue 362, p46**

Asus ProArt PX13

With AMD's new Ryzen AI 9 HX 370 inside, this 1.4kg compact powerhouse offers incredible amounts of power. Add a fantastic OLED screen and RTX 4070 graphics and it's a winner. **From £2,000 from uk.store.asus.com**
REVIEW **Issue 361, p50**

BUSINESS LAPTOPS

Dell Pro 13 Premium

Sheer quality from £1,452 exc VAT

from dell.com



Dell's business laptop series has a new name, but its commitment to build quality and astonishing levels of configuration remain the same. Here, you benefit from a 1.1kg weight and 24-hour battery life, with Intel's 200V vPro series there for easier remote management. Just make sure you avoid the cheap screen option.
REVIEW **Issue 368, p46**

Lenovo ThinkPad X1 Carbon Gen 13

The best executive laptop out there, with true all-day battery life even if you buy the 14in OLED version. At 1kg and with the latest components, it's worth the price. **From £1,875 exc VAT from lenovo.com**
REVIEW **Issue 370, p52**

Lenovo ThinkPad T14s Gen 6 (Snapdragon)

There's no better laptop if you want to try out Snapdragon, thanks to its combination of build quality, speed and battery life. **£1,500 exc VAT from lenovo.com**
REVIEW **Issue 360, p56**

HP OmniBook Ultra Flip

A top-quality 2-in-1 with a terrific 14in OLED panel, great build quality and superb battery life thanks to Intel's latest generation Core Ultra 7 processors. **From £1,699 from hp.com**
REVIEW **Issue 365, p46**

CREATIVE & GAMING LAPTOPS

Lenovo Legion Pro 7i Gen 10

RTX 50 power from £2,800

from lenovo.com



A surprisingly elegant chassis considering the power within, even if it still weighs 2.7kg. In return you get a 16in OLED panel, Intel Core Ultra 9 275HX CPU and, in our test system's case, and Nvidia RTX 5080 GPU. Lenovo simply doesn't put a foot wrong.
REVIEW **Issue 370, p75**

NEW ENTRY

Razer Blade 14

Our pick of the 14in gaming laptops thanks to its quiet running, gorgeous design and brilliant OLED panel. And the RTX 5070 graphics makes sense at this size. **RTX 5070, from £2,400 from razer.com**
REVIEW **Issue 372, p58**

Asus ProArt P16 (2025)

Packing a RTX 5070, Ryzen AI 9 and brilliant 16in OLED panel into its slim, 1.9kg chassis, this is a fantastic choice for demanding creatives. **£2,800 from asus.com**
REVIEW **Issue 371, p60**

Asus ROG Strix Scar 18 (2025)

Don't want to make any compromises? Choose this 18in monster, which weighs 3.3kg but extracts every drop from its components. **RTX 5090, £4,700 from asus.com**
REVIEW **Issue 370, p71**

EVERYDAY LAPTOPS

Lenovo Yoga Slim 7x

Copilot+ PC for £899

from currys.co.uk



Lenovo fought off all-comers in our most recent group test due to its all-round quality – we love the slimline, blue, all-metal design and 14.5in OLED panel – and the fact that its battery keeps this 1.3kg laptop going for over 20 hours. It's a great advert for Qualcomm's Snapdragon X Elite chips.
REVIEW **Issue 371, p88**

Asus Vivobook S15

This affordable laptop still includes an all-metal shell and 15.6in OLED panel, saving money by using a solid 8-core Snapdragon X Plus chip. **£699 from currys.co.uk**
REVIEW **Issue 371, p83**

HP OmniBook Ultra 14

If you have £999 to spend, consider the 16GB/512GB version of this cracking machine, with its aluminium chassis, 14in IPS panel and speedy Ryzen AI 365 CPU. **From £999 from hp.com**
REVIEW **Issue 371, p87**

Microsoft Surface Laptop, 13-inch

Another laptop powered by a Snapdragon chip, but it's low power so this stylish laptop is best for less demanding tasks. **From £899 from microsoft.com**
REVIEW **Issue 371, p54**

CHROMEBOOKS

Samsung Galaxy Chromebook Plus (2024)

Core 5 power for £749

from samsung.com



The first truly desirable Chromebook since the Pixelbook, this is a top-quality laptop from the all-metal chassis to the 15.6in Full HD OLED screen. And thanks to Intel's Core 5 120U processor, it's fast enough to last for years.

REVIEW **Issue 364, p65**

Acer Chromebook Plus 516

If you can't afford the 15.6in Samsung Galaxy Chromebook Plus then Acer's Chromebook Plus 516 makes a solid but less beautiful alternative – as reflected in its price. The 15.6in screen provides plenty of space on which to work, and it proved a fast performer in our tests.

From £399 from acer.com

REVIEW **Issue 371, p90**

Acer Chromebook Spin 714

If you're looking for a convertible, this is the best choice around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this 2-in-1 for the money. **£799 from currys.co.uk**

REVIEW **Issue 356, p83**

MINI PCs

Apple Mac mini M4

Little monster from £599

from apple.com/uk



This is a big and timely update for the Mac mini, with a much smaller (and squarer) design that's easy to tuck behind a screen. But what lifts it above the pack is the astonishing power of the M4 and M4 Pro chips, with barely any cooling required. As ever with Apple the upgrade costs are high, but at least its starting price is reasonable.

REVIEW **Issue 364, p44**

Geekom A6 Mini PC

The Geekom A6 Mini PC steals the A8's place on our A List thanks to its sheer value for money. The A6 costs £220 less but doesn't compromise on quality or connectivity, and while the Ryzen 7 6800H is a step down from the Ryzen 9 8945HS in the A8, it remains a superb performer.

£499 from geekom.co.uk

REVIEW **Issue 367, p56**

Minisforum Venus UM790 Pro

Ignore its basic looks, for this compact system packs in a fast AMD Ryzen 9 7940HS processor, 32GB of DDR5-5600 RAM and 1TB SSD along with a generous selection of ports, including two USB-C 4 connectors. And the price is super-aggressive.

£549 from store.minisforum.uk

REVIEW **Issue 363, p91**

ENTHUSIAST PCs

Scan 3XS Edge iCue

Silent but deadly fast for £2,800

from scan.co.uk



With the RTX 5080 comes a refresh of best enthusiast PCs. The Scan is a shade slower than its Ryzen 9 9800X3D rival from Wired2Fire, but even at full pelt it remains astonishingly quiet.

REVIEW **Issue 367, p50**

CyberPower PC Ultra 3D5090

If you're after the fastest gaming PC you can buy for £4,000, let's make things easy for you: buy this. It's packed with speedy components, from AMD's Ryzen 9 9950X3D to RTX 5090 graphics to a 2TB Gen 5 SSD.

£4,000 from tinyurl.com/370cyber

REVIEW **Issue 370, p58**

PCSpecialist Hydra R60S

This compact PC makes little noise but still packs a gaming and creative punch thanks to RTX 4060 graphics and AMD's older but speedy Ryzen 5 7500F. You can upgrade to an RTX 5070 when budget allows. **£999 from pcspecialist.co.uk/reviews**

REVIEW **Issue 368, p60**

ALL-IN-ONE PCs

HP Envy 34 All-in-One

£2,099 widescreen wonder

from hp.com



Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.

REVIEW **Issue 335, p46**

Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money.

From £599 from dell.co.uk

REVIEW **Issue 350, p47**

Apple iMac M4

Anyone hoping for a 27in iMac will be disappointed, but everyone else should be delighted by this M4-powered all-in-one with its 24in 4,480 x 2,520 IPS panel. It's fast inside and out, too, with Thunderbolt 4 and Wi-Fi 6E both part of the package. **From £1,299 from apple.com/uk**

REVIEW **Issue 364, p48**

CREATIVE WORKSTATIONS

Armari Magnetar M64T7-AW1650G4

Threadripping power for £8,329 exc VAT

from armari.com



AMD's Ryzen Threadripper 7980X is the star of this particular show, dominating our benchmarks with the help of 128GB of RAM, two 2TB Crucial PCI-E 5 drives in RAID0 configuration and AMD's Radeon Pro W7800 professional GPU. And it's all wrapped up in a custom Armari case with liquid cooling.

REVIEW **Issue 361, p92**

Scan 3XS Evolve Studio Pro

Thanks to its combination of a Ryzen 9 9950X3D and GeForce RTX 5090, this will race through games – but it's also a fantastic choice for 3D animation and modelling. With top-quality components throughout and a gorgeous case, it will perform for years. **£4,167 exc VAT from tinyurl.com/369scan**

REVIEW **Issue 369, p48**

Apple Mac Studio

Now updated with your choice of M3 Ultra or M4 Max chips, this is the natural choice for professionals who rely on Apple hardware (or software). As with all Apple products, prices rocket once you add memory and storage, but this is a long-term investment. **From £1,749 exc VAT from apple.com**

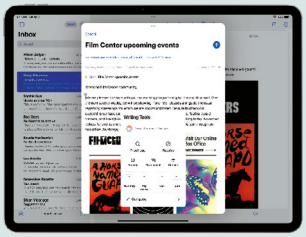
REVIEW **Issue 369, p52**

TABLETS

Apple iPad Air M3

Languid power from £599

from apple.com/uk



It's hard to be too excited by this update as it's exactly the same design but with an M3 chip inside. But when the original was so damn good, whether in 11in or 13in variants, and Apple Intelligence is thrown in, it remains the best choice for the vast majority of tablet buyers.

REVIEW **Issue 368, p56**

Apple iPad Pro M4

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing £1,299. **From £999 (11in, 256GB) from apple.com**

REVIEW **Issue 358, p48**

OnePlus Pad 3

Not only the best Android tablet you can buy but a genuine rival to the iPads thanks to its support for Apple products via integrated file sharing and a Mac Remote Control feature. It's also fast, packs a superb 13.2in screen and comes with a fine array of accessories. **From £529 from oneplus.com**

REVIEW **Issue 371, p62**

EVERYDAY PHONES

Google Pixel 9a

Why pay more? From £499

from store.google.com



If you can live without an optical zoom then it's hard to think of a reason to pay more for a phone. The AI features are genuinely useful, it's fast, the battery lasts forever, the camera is superb and the 6.3in OLED panel is a joy to gaze at.

REVIEW **Issue 369, p74**

Nothing Phone 3a

Looking to get the best possible phone for around £300? This is it. Quite aside from Nothing's unique design, it features a gorgeous display and high-quality cameras – including an optical zoom that few phones in this price bracket can match.

£329 from nothing.tech

REVIEW **Issue 368, p77**

Honor 400

This is a luxury phone without the luxury price. Taking many cues from the iPhone's design, including its software, the Honor 400 packs a 6.6in AMOLED panel, high-quality 200MP main camera and a mid-range Snapdragon processor. It's great value.

256GB, £400 from honor.com

REVIEW **Issue 371, p72**

PREMIUM PHONES

NEW ENTRY

Samsung Galaxy S25 Ultra

AI in your hand from £1,249

from samsung.com/uk



So good it tempted our reviewer – an iPhone devotee – to move to the other side. That's thanks to the faultless hardware, brilliant photography performance and Samsung's slick AI, not to mention the integrated S Pen stylus. It's not cheap, but you're buying for the long term with seven years of OS updates.

REVIEW **Issue 367, p70**

Samsung Galaxy Z Fold7

The price sticks in our craw and we miss the S Pen support, but Samsung has absolutely nailed the foldable phone at its seventh attempt. It's slim, sturdy, super-fast and it packs cameras so good that – optical zoom aside – this phone's photos are almost inseparable from the S25 Ultra.

256GB, £1,799 from samsung.com

REVIEW **Issue 372, p48**

Apple iPhone 16 Pro

Even without Apple Intelligence, the introduction of a 5x optical zoom, classy 6.3in OLED panel and Apple's ludicrously fast A18 Pro chipset make this the best update to an iPhone Pro for years. And if you need one more reason to buy, how about its much improved battery life? **128GB, £999 from apple.com/uk**

REVIEW **Issue 363, p70**

24IN TO 27IN MONITORS

NEW ENTRY NEW ENTRY NEW ENTRY

BenQ DesignVue PD2730S

5K + Thunderbolt, £1,000

from scan.co.uk



A great choice for creative professionals and demanding users alike, and if your budget can take it why not daisy-chain two together over Thunderbolt? You'll love the image quality and 5K resolution.

REVIEW **Issue 372, p89**

Asus ZenScreen Smart Monitor MS27UC

This stylish 27in monitor packs a high-quality 4K screen, but where it distinguishes itself is by loading Google TV and great speakers to turn it into a great choice for those who need to work and play. **£399 from argos.co.uk**

REVIEW **Issue 372, p88**

Iiyama ProLite XUB2797QSNP-B1

This 1440p monitor may lack the luxuries of its A-List brethren, but you can't argue with the quality of the panel, nor the connectivity – with an RJ45 port, this is a true docking monitor.

£237 from iiyama-monitors.co.uk

REVIEW **Issue 372, p84**

32IN+ MONITORS

NEW ENTRY NEW ENTRY NEW ENTRY

Iiyama ProLite XCB3497WQSNPH

Curved quality, £380

from scan.co.uk



All three displays here use curved 34in panels with a 3,440 x 1,440 resolution. Despite an aggressive price the ProLite packs everything you need including RJ45 networking and a KVM.

REVIEW **Issue 372, p93**

MSI Modern MD342CQPW

You won't find RJ45 networking here – as expected to hit the bargain price – and others go brighter, but this 34in curved, white monitor delivers terrific colour coverage, a decent pair of speakers and USB-C docking in a stylish casing.

£299 from currys.co.uk

REVIEW **Issue 372, p91**

Philips 34B2U6603CH

This monitor packs in every feature we can think of: Thunderbolt 4, daisy-chaining, excellent 5W speakers, 2.5GbE networking and a high-quality webcam. The cheaper ViewSonic VG3457CV beats it for clean whites, but the Philips is a better all-rounder.

£559 from uk.insight.com

REVIEW **Issue 372, p92**

WEBCAMS

Logitech MX Brio 705 for Business

Consistent brilliance for £219

from logitech.com



Consistent image quality in all lighting conditions coupled with top build quality and nifty features – such as a presenting mode for items on your desk – make this a fantastic all-round choice.
REVIEW **Issue 356, p68**

Logitech Brio 105 for Business

While you can buy 1080p webcams for a third of the Brio 105's price, they won't hold a candle to the Logitech webcam's quality – especially in low-light conditions, such as one candle. It's also easy to manage, for businesses and individuals.
£45 from logitech.com
REVIEW **Issue 360, p77**

Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.
£329 from amazon.co.uk
REVIEW **Issue 352, p75**

HOME OFFICE PRINTERS

HP OfficeJet Pro 9135e

Do-it-all inkjet for £193

from printerbase.co.uk



This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.
REVIEW **Issue 365, p85**

Epson EcoTank ET-2865

As usual with ink tank printers, you don't get many frills with the Epson EcoTank ET-2865 (so no ADF or screen). What you do get is incredibly low running costs of 0.5p for colour and 0.2p for mono, plus high-quality prints and scans.
£233 from uk.insight.com
REVIEW **Issue 365, p84**

Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking. **£186 from printerbase.co.uk**
REVIEW **Issue 365, p88**

WORKGROUP PRINTERS

Canon Maxify GX6550

Ink tank all-in-one for £392 exc VAT

from canon.co.uk



Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.
REVIEW **Issue 350, p58**

Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page. **£415 exc VAT from printerland.co.uk**
REVIEW **Issue 353, p84**

Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from printerbase.co.uk**
REVIEW **Issue 341, p87**

WIRELESS ROUTERS

Netgear Nighthawk RAXE300

Fast Wi-Fi 6E router, £350

from amazon.co.uk



The RAXE500 is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.
REVIEW **Issue 341, p68**

TP-Link Archer BE550

At almost half the price of the Netgear Nighthawk RAXE300, this is a brilliant mid-range choice thanks to a 6GHz radio and five 2.5GbE ports – you'll enjoy superb wired and wireless performance, and it even comes with a wide set of features. **£180 from amazon.co.uk**
REVIEW **Issue 371, p70**

Asus RT-BE58U

A great deal for those on a tight budget, this dual-band Wi-Fi 7 router (there's no 6GHz radio) performed well in our 5GHz tests at a price that can't be beaten. You can even enable MLO across the 2.4GHz and 5GHz bands.
£99 from amazon.co.uk
REVIEW **Issue 371, p70**

MESH WI-FI

TP-Link Deco XE200

Clever Wi-Fi 6E for £400

from amazon.co.uk



There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code BOBKTDPWC8) should be enough for most premises.
REVIEW **Issue 349, p65**

Netgear Orbi 770

If you're eager to upgrade to Wi-Fi 7 then the Orbi 770 is the best mesh option yet. Its speed and range are both excellent, with a twin-pack covering 420m² (says Netgear), and the wired connectivity superb: four 2.5GbE connectors on the router unit, two 2.5GbE ports on the satellites. But it ain't cheap. **2-pack, £600 from amazon.co.uk**
REVIEW **Issue 364, p70**

Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from amazon.co.uk**
REVIEW **Issue 350, p54**

BUSINESS WI-FI

NEW ENTRY

Ruijie Reyee RG-RAP73Pro

Wi-Fi 7 AP, £201 exc VAT

from broadbandbuyer.com



The RG-RAP73Pro delivers a wealth of features and top Wi-Fi 7 performance at a tempting price. Broadbandbuyer's provisioning service makes light work of deployment, and the free Ruijie Cloud service offers top-notch remote management.
REVIEW **Issue 369, p103**

TP-Link DR3650v

"Business Wi-Fi" doesn't do justice to this all-in-one communications, security and networking solution, which combines a dual-band AX3000 access point with WAN redundancy, failover services and a treasure trove of features. **£208 exc VAT from broadbandbuyer.com**
REVIEW **Issue 368, p103**

DrayTek VigorAP 905

The VigorAP 905 is ideal for businesses seeking a well-endowed Wi-Fi 6 AP with top-notch wireless meshing support. It's a breeze to deploy, wireless performance is good, and a price of only £83 makes it outstanding value. **£83 exc VAT from broadbandbuyer.com**
REVIEW **Issue 372, p102**

NAS SERVERS

Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com



This stalwart retains its top spot on the A-List thanks to its powerful performance (courtesy of a Ryzen chip), huge capacity via eight LFF/SFF hot-swap SATA bays and an unmatched set of business-friendly apps. And it's all built on Synology's DSM 7.2, which is focused on data security.
REVIEW **Issue 368, p99**

Asustor Nimbustor 4 Gen2 AS5404T

Built for SMBs and enthusiasts who demand the best performance, the AS5404T is a four-bay NAS that offers much more than most, with some nice surprises under its standard-looking exterior.
£441 (£529 inc VAT) from amazon.co.uk
REVIEW **Issue 369, p88**

Qnap TS-264

The Qnap TS-264 is aimed at those who want a bit more from a traditional two-bay NAS. It's effectively the two-bay version of the excellent four-bay TS-464, and like its sibling provides strong speeds over its pair of 2.5GbE ports – and includes two M.2 NVMe slots.
£391 (£469 inc VAT) from ukstore.qnap.com
REVIEW **Issue 369, p86**

VIDEOCONFERENCING

Biamp Parlé VBC 2800

Go big for £2,918 exc VAT (MSRP)

from midwich.com



We thought the VBC 2500 was a great VC room bar, and the new VBC 2800 delivers Biamp's undeniable expertise to larger meeting rooms. Video and audio quality are outstanding, speaker framing is super fast and the smart combination of dual camera lenses makes sure everyone is in the big picture.
REVIEW **Issue 364, p98**

Owl Labs Medium Room Solution

The Owl 4+ and Owl Bar partnership offers smart tracking and dynamic split-screen views to ensure everyone is in the picture, while the Whiteboard Owl adds extra professionalism to presentations and training sessions.
Owl 4+, Owl Bar, TV mount, £2,999 exc VAT from owllabs.co.uk
REVIEW **Issue 364, p100**

Ricoh Meeting 360

Ricoh's Meeting 360 is up against stiff competition in the panoramic meeting hub market but stands out for its excellent build quality and generous three-year warranty. It's easy to use and delivers good video and audio quality, while the smart app allows you to create a view for every occasion.
£744 exc VAT from amazon.co.uk
REVIEW **Issue 364, p101**

SCANNERS

Brother ADS-4900W

60ppm for £529 exc VAT

from tradescanners.com



An incredible range of features at a competitive price. Scan speeds are even faster than the quoted 60ppm, output quality is excellent and top-notch software and apps deliver a wealth of options.
REVIEW **Issue 370, p98**

Ricoh fi-8040

Ricoh's fi-8040 offers SMBs a remarkable range of features for a great price. Output quality is beyond reproach, it delivers on its 40ppm promises and the multiple operational modes make it highly flexible. **£249 exc VAT from thescannershop.com**
REVIEW **Issue 370, p101**

Canon imageFormula DR-S350NW

You don't need to install this affordable networked desktop scanner, which almost hit 55ppm scan speeds in our test. Canon backs it up with a fine software package. **£433 exc VAT from printerland.co.uk**
REVIEW **Issue 370, p99**

SECURITY APPLIANCES

NEW ENTRY

DrayTek Vigor C510ax

Unbeatable redundancy for £447 exc VAT

from broadbandbuyer.com



Ideal for SMEs and remote sites that need always-on internet access. It's packed with WAN redundancy features, the latest DrayOS 5 software delivers a wealth of features, and it all comes at a great price.
REVIEW **Issue 372, p99**

NEW ENTRY

Zyxel USG Flex 50HP

Don't be fooled by its size: Zyxel's USG Flex 50HP packs in an impressive set of security services for the price. It's ideal for protecting small offices and remote sites, and the slick Smart Sync feature means never having to choose between local or cloud management.
Appliance with 1yr Gold licence, £316 exc VAT from store.zyxel.com
REVIEW **Issue 372, p101**

NEW ENTRY

WatchGuard Firebox T85-PoE

A powerful gateway security package ideally suited to protecting large remote sites. Licensing schemes are easy to understand, and WatchGuard's cloud portal makes light work of remote management. **Appliance with 3yr TSS subscription, £4,284 exc VAT from broadbandbuyer.com**
REVIEW **Issue 372, p100**

SECURITY SOFTWARE

Avira Prime
Avira wins for all-round AV performance, plus a solid VPN, for a fair price. Watch out for a second-year hike to £91, though. **First year: 5 devices, £52 from avira.com**
REVIEW **Issue 366, p84**

Bitdefender Total Security
A long-term award winner in our security suite Labs, Bitdefender continues to charm for its consistent AV performance, solid feature set and extremely competitive price. **5 devices, 1yr, £20 from store.pcpro.co.uk**
REVIEW **Issue 366, p85**

Avira Free Antivirus
There's absolutely no need to pay for a full security suite if you only want antivirus protection, and Avira is our top choice simply due to its excellent and consistent performance in tests. **Free from avira.com**
REVIEW **Issue 366, p89**

VPNs

ExpressVPN
Blistering speeds, outstanding region-shifting performance and a good track record on security mean this VPN is worth the expense. **2yr 4mth $140 (£113) from expressvpn.com**
REVIEW **Issue 370, p84**

NEW ENTRY

Mullvad
A consistent performer with consistent pricing – there's no need to sign up for the long term as it costs only €5 per month as a flat rate – but not the best choice for region shifting. **€5 (£4.34) per month from mullvad.net**
REVIEW **Issue 370, p85**

NEW ENTRY

Proton VPN Free
While Proton's VPN Plus is also a great choice, if you're looking for a freebie then choose this VPN for its fast connections (or alternatively Windscribe if you need to choose territories). **Free from protonvpn.com**
REVIEW **Issue 370, p89**

LINUX DISTROS

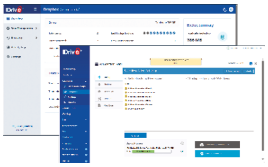
Ubuntu
A fine choice for Windows switchers thanks to its familiar design, with regular six-monthly updates and a Long Term Support version. **Free from ubuntu.com**
REVIEW **Issue 367, p92**

Fedora Workstation
One of the longest-established distros, and with a strong link to Red Hat Enterprise Linux, Fedora Workstation will particularly appeal to business migrators. **Free from fedoraproject.org**
REVIEW **Issue 367, p85**

Linux Mint
There's a good reason this is a popular choice for Windows 10 refugees, including a familiar "Start menu", and it's easy to give it a trial before committing. But consider Zorin OS, too. **Free from linuxmint.com**
REVIEW **Issue 367, p86**

CLOUD BACKUP

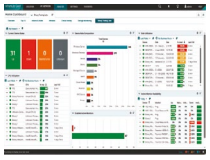
IDrive Business
An incredibly affordable hybrid backup solution. It's easy to deploy, supports Google Workspace, Microsoft 365, Dropbox and Box, and is ideal for protecting remote and on-premises systems. **5TB, £791 exc VAT per year from idrive.com**
REVIEW **Issue 371, p100**



Barracuda Backup Vx
This affordable virtualised on-premises backup solution is easy to deploy on VMware or Hyper-V hosts and integrates local and cloud backup. **From £804 exc VAT per year from barracuda.com**
REVIEW **Issue 371, p99**

NETWORK MONITORING

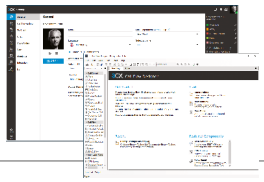
Progress WhatsUp Gold 2024
A great SMB choice as it presents a clear picture of your network and is available in a wide range of licensing plans. It's a cinch to deploy, doesn't require a lot of host resources and the new features make it even easier to customise. **Enterprise, 50 devices, £1,177 exc VAT per year from whatsupgold.com**
REVIEW **Issue 366, p100**



Park Place Technologies Entuity 22
An impressive toolbox of monitoring services all easily managed from a web console that offers a wide range of informative dashboards. **From $150 per node/year from parkplacetechnologies.com**
REVIEW **Issue 366, p99**

VOIP SERVICES

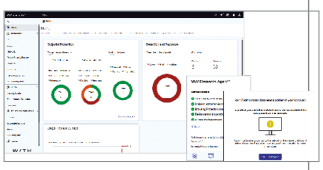
3CX Phone System 20 Update 5
Deployment options are extensive, call-handling features are excellent and, although you'll need to source a SIP trunk, it's incredibly affordable. **Enterprise, 8SC, £385 exc VAT per year from 3cx.com**
REVIEW **Issue 369, p98**



TelephoneSystems.Cloud
Ideal for businesses that don't want any unpleasant billing surprises, with an impressive range of call-handling features. **From £11 exc VAT per user per month from telephonesystems.cloud**
REVIEW **Issue 369, p100**

ENDPOINT PROTECTION

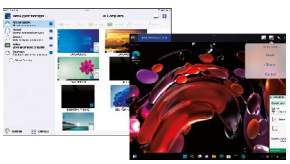
WithSecure Elements Endpoint Security
A comprehensive set of protection measures for a great price, easily managed from a cloud portal. It supports a wide range of devices and the Luminen tool delivers AI-powered reporting services that present detailed summaries of events with a click. **100-499 devices, £37 exc VAT each per year from withsecure.com**
REVIEW **Issue 363, p101**



Sophos Intercept X Advanced
An unbeatable range of tough security measures. Deployment is a breeze, and a multitude of security policies make it highly flexible. **100-199 users, £48 exc VAT each per year from enterpriseav.co.uk**
REVIEW **Issue 363, p98**

REMOTE SUPPORT

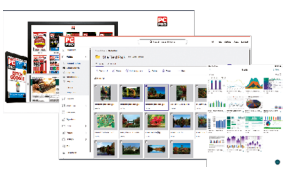
NetSupport Manager 14.1
Sets the standard for on-premises hosted support for local and remote workers. It delivers a remarkable range of features and its one-time cost per seat will appeal to businesses concerned about subscription fees. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**
REVIEW **Issue 361, p100**



ISL Online Standard
Perfect for SMBs wanting cloud-based support. Features and access security are excellent, as are its flexible licensing plans. **Standard Cloud/One user, £287 exc VAT per year from islonline.com**
REVIEW **Issue 361, p99**

CLOUD FILE-SHARING

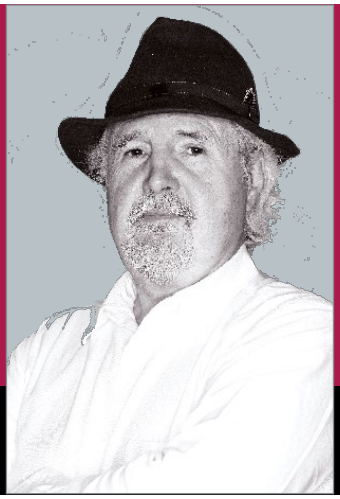
Progress ShareFile Premium
Progress ShareFile Premium will appeal to SMBs seeking affordable and easily managed cloud collaboration services. It offers plenty of app integrations plus support for large file sizes, and the AI-powered features deliver smart security measures. **£19.90 exc VAT per user per month billed yearly from sharefile.com**
REVIEW **Issue 367, p98**



Dropbox Business Plus
Collaboration tools, app integrations and a huge maximum file size limit – plus malware scanning and data classification – make this a great choice. **£18 exc VAT per user/month billed yearly from dropbox.com**
REVIEW **Issue 367, p96**

Some like IT hot, but surely not their USB drives

If you've been wondering why your USB drive has been doubling as a thumb warmer, Dick might just have the answer



Dick Pountain is editorial fellow of *PC Pro*. He still occasionally dreams that he's trapped inside the Windows Registry. dickpountain.co.uk

I've been watching the rebellious mood that's growing among Microsoft Windows 11 users with a degree of (not very nice) complacent amusement, as someone who dumped Windows in favour of a Chromebook more than eight years ago. My defection was as much an accident as an act of prescient wisdom. When Dennis Publishing moved to new offices, then-CEO James Tye took the quixotic decision to deploy Chromebooks to all; I took the opportunistic decision to borrow one and, being totally brassed-off with Windows 8.1, immediately became hooked.

The Asus Chromebook I then bought for myself still works well and has been a source of great pleasure but for one problem – Google stopped supporting its version of ChromeOS about a year ago, and I soon started encountering apps that demanded an OS update I couldn't procure. So I splashed out £230 on a new Asus CX3402 Chromebook Plus, which has a better screen, twice the memory, an 8-core Intel CPU and ten years of guaranteed updates.

Migrating to the new machine was as arduous as usual: charge the battery, switch it on and wait a few minutes for my online life to sync down from the cloud. There were two extra chores, though. I'm far from being a trusting person in all matters digital, so I also keep data I consider crucial on a 128GB memory stick that lives permanently in my USB port. Chore number one: unplug that and plug it into the new machine. Another quirk of mine is that I don't like touchpad cursor control and so use a Logitech Wireless Mouse, whose dongle lives in another USB port.

I periodically back up the contents of the USB stick, a tiny metal-cased one from Integral, for which purpose I swap the Logitech dongle for another backup memory stick. A few weeks later I was doing such a backup when I noticed that the sticks had become very hot. Not warm; hot enough to make me flinch on touching them, hot enough to worry.

> "The consensus was that the heat is due to the huge capacities of the current generation of sticks"

I went online to the source of all wisdom that is Reddit, where I discovered hundreds of people reporting the same experience. The problem affected all types of computer, not only Chromebooks, and with a variety of brands of stick. The consensus was that the heat is due to the huge capacities of the current generation of sticks and the poor ventilation of the smaller cases, but that it wasn't a problem.

I pretended to believe that and to live with it for a few more months, until I started to get unreliable behaviour from the toasting stick. First it started unmounting at random times, though it always came back after unplugging and replacing. Then, during a backup session, I began to see "copy failed" messages and directories go missing from listings, at which point I panicked. I dug out my original Asus, where I confirmed that the contents of the stick were in fact intact, and that it didn't get hot, and I carried out the backup there on its cooler, older USB ports.

Something clearly had to be done because it's become part of my work practice to keep this tiny, unknockoutable USB stick permanently in place, and changing to some huge protruding one wasn't acceptable. My first recourse was a heatsink, cobbled together by wrapping the Integral stick tightly in aluminium cooking foil held in place with a 15mm binder clip with the handles detached. This worked, dissipating enough heat to reduce it to just warm to the touch, but it was too inelegant for me to live with.

> "The computer is becoming the poor cousin to the smartphone, for which USB sticks are not relevant"

I couldn't find any hard info online about which brands were most liable to overheat, but testing my own collection – one I've accumulated over the years – revealed that SanDisk, Patriot and Tab all got just as hot. As I was dolefully scrolling down the endless Amazon list of sticks, one from Samsung caught my eye because it looked nicer: the same shade of grey as my computer, short, fat and shiny. I ordered one and discovered that it's just as fast as the stick it replaced, and barely gets warm.

What moral to draw from this story I'm not really sure. I'm not a semiconductor engineer and can't find an adequate explanation online as to why such a huge discrepancy in performance exists between brands. Does the difference lie in the chips themselves, the design of the cases, the electrical interfaces or a problem in USB-C sockets? While I eventually found a long and technical description at **tinyurl.com/372hotusb** online (it boils down to power-saving states in the USB controllers), such silence is deafening and disturbing when data loss is a distinct possibility.

But of course the computer is becoming very much the poor cousin to the smartphone, for which such sticks are not relevant – and for which professional standards of data hygiene are barely relevant either.

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If Europe can't fix the App Store, no-one can

There's only one real lesson to draw from the Apple App Store vs European Commission battle, which is that digital markets are broken



Nicole Kobie is *PC Pro*'s Futures editor. The real magic of ebooks is a non-Amazon e-reader or the Libby app paired with an account for your local library.
@njkobie

Let me start by saying I prefer physical books to ebooks, but I keep novels on my phone in the hope they'll distract me from scrolling Instagram – and, when it comes to work, searchable ebooks are handy for research. So now and then I try to buy an ebook on my phone. It goes like this: see an ad or post about a book, search it, click the Amazon listing in the Google results, causing the Amazon app to open. The marvels of living in the future, a book in a matter of clicks!

But wait. Under "Kindle Edition", the following message appears: "This app does not support purchasing of this content." Sigh, then open the Amazon website and again search for the book so that I can actually purchase it.

What's with the friction? Because Kindle books are digital purchases, Amazon would have to give as much as 30% of the in-app sales price to Apple. Now, it's perfectly understandable that Amazon doesn't want to do that. But it's also reasonable for Apple to want to be paid for running the App Store, as it comes with costs. There is surely a price that would placate them both, but unpicking what that is – and what it would be for less gigantic app-based companies, such as yoga studios and game developers – is no easy task.

> "It's reasonable for Apple to want to be paid for running the App Store, as it comes with costs"

The EU is trying and so far failing to fix this problem. Earlier this year, the European Commission (EC) slapped Apple with a €500 million fine for running foul of anti-steering rules in the Digital Markets Act by banning developers from telling customers they can buy services cheaper on their website rather than in the app.

Apple is appealing that fine, but has introduced a new fee structure to avoid the EC demanding more extensive changes to the App Store. Instead of a 30% slice off the top (or 15% for smaller developers), Apple now charges a mix of 2% acquisition fee on new users, 5% to pay for "core technology", and store charges between 5% and 13%. That means developers could end up paying between 10% and 20% – less than before, but still a hefty fee.

Apple's response: "The EC is mandating how we run our store and forcing business terms which are confusing for developers and bad for users." Fair enough, but on the other hand, 30% plus the inability to tell customers where to get a better deal is surely even worse.

It seems clear that Apple intends to nitpick these rules into such a complex system that it becomes ridiculous. And there's little that regulators can do to force Apple to behave. That €500 million fine is about half a day's revenue for Apple. And though the EC can force a daily fine of 5% of revenue for failure to comply, Apple will drag its feet making the smallest possible changes while fighting even those in court.

In the meantime, consumers are left with a situation akin to the cookie law. Back in the early 2000s, regulators were trying to fight a real problem: web giants using digital surveillance that infringed personal privacy to boost online advertising. But the solution, generally in the form of annoying pop-up banners, was irritating to users and didn't actually prevent web stalking. People weren't protected, they were annoyed.

The App Store battle looks set to follow that lead. Apple is making its own App Store worse rather than offering a reasonable solution, while regulators trying to find a balance between what corporations want and laws demand are degrading the situation for consumers. To anyone who thinks capitalism and the hunt for extreme margins and profits always lead to better services or products, here is evidence that's not true.

Of course, Apple should be compensated for running the App Store. Apple doesn't break down such financial details, but in another app case, a witness for Epic Games claimed Apple had an operating margin just shy of 78% in 2019 – which has been denied by the company – with annual profits of around $23 billion.

> "To anyone who thinks capitalism and the hunt for extreme profits always lead to better services or products, here is evidence that's not true"

So I get it: the golden goose must be protected at all costs. If Apple charged between 12% and 20% – as per its EC-mandated fee structure – it would make between $9.2bn to $15bn instead. Although perhaps more developers would eat the difference and keep sales in-app, or consumers would be more willing to spend a smaller premium for the convenience.

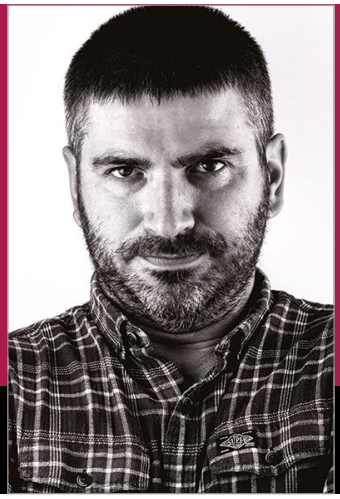
Of course no business will cross its fingers and hope for such best-case scenarios given the sums involved – they'll call their lawyers first. The EU and Apple must be shelling out millions in legal fees, not to mention way too much intellectual energy, fighting over how much to hike the price of an ebook or yoga class or gem-shuffling game, while making it harder to buy the very digital services that tech giants harass and stalk us to advertise in order to convince us to buy.

No wonder I prefer a book made out of paper. At least it makes sense.

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Crypto lessons from Pratchett's Discworld

Tempt enough people to believe in crypto and watch trust in "real" money implode



Barry Collins is not an economist, but if he scribbles that he is on a bit of paper, he's wondering whether he'll land a TED Talk. Email speaking invites to barry@mediabc.co.uk.
@bazzacollins

I'm a latecomer to Terry Pratchett, didn't pick up a single book of his until after he died. So I've only recently polished off the excellent *Making Money*, which set my brain whirring on the nature of money.

For those who haven't ventured into Pratchett's Discworld, *Making Money* is about how a conman-turned-bureaucrat revolutionises the economy. After introducing stamps while head of the Post Office and seeing how they quickly become a form of currency, he sets out to replace the coin-based economy with paper notes.

The paper itself is practically worthless, unlike the gold or other metals used to mint coins, many of which cost more to make than the face value of the coins themselves. But what makes those bits of paper valuable is trust – confidence in the bank's authority, even though the bank itself is run by a confidence trickster named Moist von Lipwig.

"I read somewhere that the coin represents a promise to hand over a dollar's worth of gold," Moist says to his chief cashier in the book, who replies: "In theory, yes," adding, "I would prefer to say that it is a tacit understanding that we will honour our promise to exchange it for a dollar's worth of gold provided we are not, in point of fact, asked to."

The same, of course, applies to the money we have sat in real banks. Conceptually, I think many of us still carry around the romantic notion that somewhere in a bank safe sits a pile of cash with our name on it, waiting for us to withdraw it when needed. The banks reinforce this notion by demanding 24 hours' notice if you want to take out a cash lump sum: someone's got to climb into that big safe at bank HQ and bring your money to the branch, after all.

Of course, that's pure fantasy. Our balances are nothing more than figures in a database. When you buy a pint of milk in Tesco, no cash changes hands, or very rarely these days – it's all just numbers in a spreadsheet.

That system only works on trust. When you leave the supermarket with your pint of milk, Tesco trusts that the figures in your bank balance will get slightly smaller and theirs will get slightly larger. And when a staff member goes in there to stack the shelves in the evening, they trust Tesco to shuffle some numbers from its bank account into theirs at the end of the month. Without that trust, the whole system collapses.

Which brings me to bitcoin and other cryptocurrencies. Conceptually, they're not far removed from "real" money. Yes, there are no actual bitcoins that you can flip to decide who kicks off a football match, for example, but as we've discussed the vast majority of transactions don't involve cash either. It's all just numbers in a database, arguably an even more secure database than the ones we use for real money.

What's missing at the moment is trust. Yuval Noah Harari, the author of *Sapiens*, calls bitcoin a "technology of distrust", advocated by people who don't trust banks and governments. "Today, more than 90% of dollars, yens, euros and other currencies is just data in computers," he said in an Instagram video post last year. "Bitcoin is basically a return to gold. Electronic gold. It assumes that we shouldn't trust institutions and shouldn't allow them to create money at will."

> "Many of us still carry around the notion that somewhere in a bank safe sits a pile of cash with our name on it"

> "Trump has swung from comparing bitcoin to a 'scam' to launching his own cryptocurrency, championing crypto at White House functions"

Except now one of the leading proponents of cryptocurrencies is Donald Trump, the leader of the biggest financial institution in the world – the US government. Trump has swung from comparing bitcoin to a "scam" to launching his own cryptocurrency, championing crypto at White House functions and revoking measures designed to limit risks to crypto investors.

In doing so, he undermines trust in the dollar, which has fallen faster and harder in the first six months of his second presidency than in any other. The dollar has been trusted as the world's reserve currency because of centuries worth of checks and balances, which bitcoin, $TRUMP and other cryptocurrencies simply don't have. Having already undermined trust in the media, in the rule of law, in democracy itself, he's now moving on to dismantle trust in the financial institutions that underpin the world's biggest economy.

Just as Moist von Lipwig convinced a city to believe in little pieces of paper (any association between the renowned fictional fraudster and Donald Trump is purely in the reader's imagination), crypto's biggest strength is narrative power. The systems that survive aren't always the most logical. They're the ones people believe in just enough.

Which brings me to one final quote from *Making Money*. "People don't like change. But make the change fast enough and you go from one type of normal to another."

barry@mediabc.co.uk

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intel CORE 7

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Argos · Box · currys · laptops direct · OVERCLOCKERS UK · SCAN

Readers' comments

Your views and feedback from email and the web

Dead lifts

Olivia Whitcroft's article on unenforceable contract terms (*see issue 371, p116*) reminded me of an incident from many years ago that made me smile. I was negotiating the lease for the office accommodation for my fledgling business. The landlord was a well-known insurance company and the lease contained a term along the lines of "we shall not be responsible for death or injury caused by the lifts, even if this results from the negligence of the landlord". I queried this with my solicitor, saying it surely couldn't be legally enforceable. He agreed and contacted the landlord's solicitor to have the clause removed. The response came back: "My client realises that the term is unenforceable but wishes to retain the comfort of the wording."

Brian Preece

American bias

I enjoyed Nicole Kobie's article about idioms and AI (*see issue 371, p126*), but it did make me think that a lot of the training for AI comes from the US, which can be a different language compared to English. Take your quote, "to lick a badger". If I was to lick this poor badger I would be using my tongue and most British people would agree; we might also say we beat or tricked this poor badger.



ABOVE Mumbo jumbo: does AI have an American bias?

I am also reminded of these infinite monkeys on typewriters producing the works of Shakespeare. How many goes to get it right, and who's out there checking AI and all it has produced?

Rodney Briddon

Futures editor Nicole Kobie replies:
Thanks for getting in touch! Yes, it's definitely a challenge that the training is so American-led, but at this point I think these companies have hoovered up most of the English-language internet, so hopefully ChatGPT and the rest will be able to sound like us, too.

I don't think anyone is checking the results. I use AI now and then for search (because Google is broken for research) and it still invents facts and makes up links. It astonishes me that anyone uses this for real work.

Hive mindless?

I received a call from a friend today that her Hive outdoor camera will stop working on 1 August, so I looked on the web and found the following statement from Hive: "We've made the tough decision to discontinue our smart security and leak detection products – and develop smart home tech that'll get us closer to Net Zero."

I wonder how Centrica, which owns the Hive brand and charges more for its gas supplies than any other provider, can justify this kind of greenwashing when it will be consigning many thousands of electronic devices to landfill. Are we on the same planet as these people?

Gordon Jackson

Contributing editor Lee Grant replies:
You're right to be angry. The enforced termination of functioning technology is bad enough, but framing it as necessary to avert the climate crisis is greenwashing of the highest order. No technology lasts forever, but the embedded emissions in digital home devices should require supporting them for multiple decades, not just a few years as is currently accepted.

Hive also loses marks for directing customers to dispose of products at local recycling centres rather than providing a take-back programme. As a result, taxpayers are covering the recycling costs, rather than Hive denting its profits.

Star letter

Legal process(ors)

My self-built PC is four years old, based on a Ryzen 7 2700X processor and 16GB of RAM. However, it was not passed by the Microsoft PC Health Check as being suitable for installing Windows 11 until I activated the TPM and Secure Boot in the BIOS.

I loaded Windows 11 and everything seemed okay until I tried to shut down. The apps were closed, the screen went black but the PC was still on. After 30 minutes I did a forced shutdown using the on/off button.

This was just the start of my problems. I always have to do a forced shutdown, then can never be sure it will boot up properly next time. It won't sleep, but if I leave it unattended for a while, it shuts down completely! I have now discovered that my processor has never been suitable for Windows 11, nor is it possible to make it so.

Which begs the question: why wasn't AMD issuing warnings when this became apparent in 2019? I bought my Ryzen 7 2700X at the end of that year. It's clear that AMD would have been aware of the problems regarding processors based on the Zen+ architecture, such as my Ryzen 7 2700X, before I purchased it, but did nothing.

I'm now left with carrying on with Windows 10 or replacing my processor. Isn't AMD breaking consumer protection laws by its actions? Ironically, one of the main reasons for building a PC was so I could make it more future-proof.

Jim O'Rourke

Contributing editor Rois ni Thuama replies: I feel for you, Jim. This lack of transparency is frustrating and there's no quick answer. There is a very long answer, and I'll have a stab at giving you a snapshot.

Did AMD make a representation in its marketing material that the processor *was* compatible with Windows 11? If yes, this is material to the contract and could go some way to help you resolve the issue. But we'd need to see it. Also, this representation would have needed to have been the reason you bought the processor, so even if it's yes to the first question you by no means have a slam-dunk case.

If the answer is no, as I suspect it might be, AMD has the quite reasonable defence that it cannot list all the things its processor would be incompatible with because the list would be too long. To make the point in a somewhat absurd fashion, the processor isn't compatible with Lotus 123, WordPro or Windows 3.1/95/98/ME/XP/Vista. Bonkers I know, but you get the point.

Despite this unhappy situation, I'm sympathetic to your position. We need greater clarity and transparency when buying kit. Without stepping on Lee's territory too much, it's a terrible waste of space in a landfill while also being a terrible waste of buyers' time, money and resources. On a brighter note, I think legislators will get around to cleaning this up. Just not any time soon.



This month's star letter writer wins a Cherry Stream Desktop Comfort keyboard and mouse wireless set, worth £80. For a chance to win, email letters@pcpro.co.uk

Wi-Fi confusion

I have been reading about the Netgear Nighthawk RS100 router in the recent edition (*see issue 370, p65*). I do question some of the results mentioned in your article, with you stating that performance was up to 57Mb. I performed a test on my own 5GHz Wi-Fi network and got results up to a maximum of 511Mb, which is about nine times faster.

My router is nothing special, just a standard BT Home Hub with 2.5GHz and 5GHz bands. How do you test?

Michael Ashworth

Associate editor Darien Graham-Smith replies: Apologies for any confusion! In our router reviews we report file-transfer speeds in megabytes per second, the idea being to give you a clear idea of (for example) how quickly you might download a 200MB driver package. However, the low-level network connections that underpin these file transfers are usually specified in terms of megabits per second, and evidently your testing software followed this convention. Since there are eight megabits to one megabyte, the average 57MB/sec transfer speed that I saw from the Netgear Nighthawk RS100 is equivalent to 456Mbits/sec – not far off the 511Mbits/sec you saw from your own router. Hopefully that puts the RS100 in a fairer light!

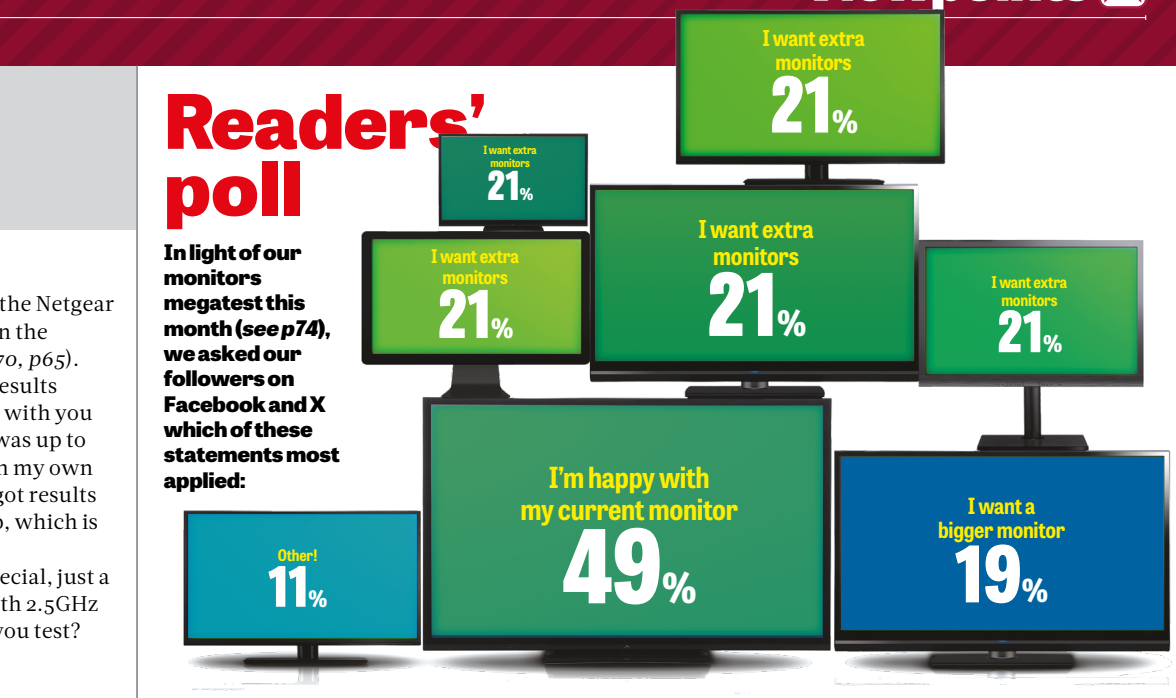
Does Linux need AV?

With the imminent end of life of Windows 10, I have seen many suggestions to use Linux to replace Windows 10 on unsupported hardware, and I am considering doing this on a laptop. However, I had a thought about AV security. With Windows, Defender is a built-in AV and firewall for Windows; does any Linux distro have an equivalent?

How about an article on Linux security options, and also, are there any distros that allow Windows programs to run in Linux by default, or do they all require something like Wine to be installed?

Stuart McIntosh

Contributing editor Davey Winder replies: No Linux distro, as far as I am aware, has built-in AV. However, the open-source ClamAV is highly recommended by many users. As for running Windows programs, you're stuck with Wine or similar, I'm afraid. Finding the right distro for you will likely be a matter of trial and error, but Mint or Ubuntu are good starting points for ease of use.



Readers' poll

In light of our monitors megatest this month (*see p74*), we asked our followers on Facebook and X which of these statements most applied:

While nearly half of our respondents were happy with their current choice, others were suffering from buyer's remorse. "I have 2 x 27in Dell UltraSharp 1440p monitors; excellent monitors," wrote Michael Oglesby. "But in hindsight, I wish I'd gone for the Dell UltraSharp 49in curved; the gap between the two monitors bothers my OCD." And that comment was the start of a surprising trend among respondents, many of whom had already jumped to curved monitors or were planning to buy them next. How fortunate that our group test (*see p74*) includes five fine examples to choose from.

The second most popular option is to have two monitors. "I have two 24in screens side by side, but I've found the combination of a large wide screen and a smaller secondary screen at work to be very efficient, so that will be my next arrangement," wrote Paul Bamberger.

Martin Bailey isn't necessarily willing to stop at two. "I want a monitor that's designed to be the 'left-hand monitor' and a monitor designed to be 'right-hand monitor'. And, optionally, a 'middle monitor'. So that means: no bevel along one edge, synced OSD settings, magnetically affixed (but allows me to set them as an angle to each other)." We'll see what we can do, Martin.

And some of our readers – well, quite frankly, they're just greedy. "I want another couple of monitors, ideally designed to be linked together so there is no border," said Michael Tott. "I want a bigger monitor!" said Ro Barltrop, who's currently making do with a curved 34in AOC with a 16:10 ratio. "Ideally I'd like a 40in monitor but with 1.5 times the height... When in development mode I have multiple windows open, browsers, IDE, notepads, VMs, Word, oh and email."

We'll leave the final word to the wise John Moore. "Monitors are like bicycles – the perfect number to own is n+1, where n is the number of monitors that you already own."

> "[I'm happy with my] 55in 4K Samsung QLED. It's a decent amount of real estate."
> **Andre O'Hooligan (@grumpstation)**

> "Curved ultrawides were a revelation for me. Can't see me going back."
> **Gavin Gallagher (@gav_gall)**

> "I'm fine with my 2, but would happily swap for 1 big curved one if they ever break."
> **Stuart Hughes**

> "Totally happy with my 24in for gaming, anything bigger means no room on the desk."
> **Tanya Taylor**

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WINDOWS 11

ALL YOUR QUESTIONS ANSWERED

The support deadline for Windows 10 is perilously close. Lee Grant explores your options if you're still clinging to a Windows 10 PC

October will be here before you know it, and Microsoft will pull the plug on Windows 10 support. The great migration to Windows 11 will now have to begin and if you still haven't decided what to do, then (like a doctor with a concerned look on his face) I'm here to talk you through your options.

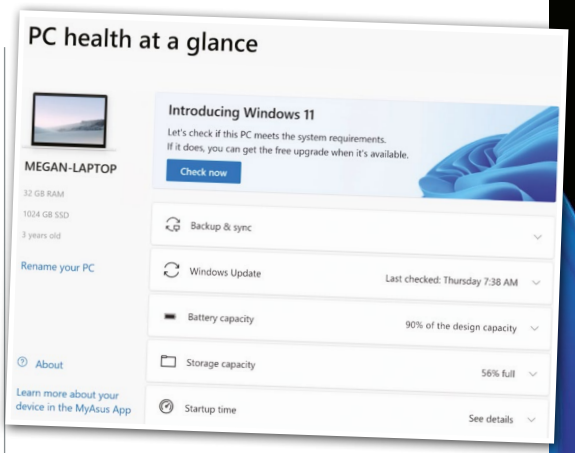
For the past year, barely a day has passed when I haven't had this complicated conversation with a customer, so *PC Pro* has asked me to empty my brain and give you advice on what to do with your Windows 10 machine.

We'll look at your hardware, explain the upgrade options for AMD and Intel, for desktops and laptops, helping you to create a plan of action. Let's begin by working out exactly what you own.

Is my machine compatible with Windows 11?

The first thing to ascertain is whether your machine can jump from Windows 10 to Windows 11. Thankfully, Microsoft's PC Health Check (**tinyurl.com/372healthcheck**) will scan a system and compare it to the Windows 11 system requirements before giving a yes or no verdict. If you get the green light, then Microsoft's glittering curtains will part and you'll be granted a VIP pass to Window 11's upgrade paradise, free of charge. If the vote didn't go your way, then don't panic because the Health Check is far from infallible.

The app can only make comparisons with the hardware currently inside your machine. It can't work out if a cheeky tweak or upgrade could nudge it over the line. This is especially true with AMD desktops.



ABOVE Microsoft's PC Health Check will tell you if your system is compatible with Windows 11

Can I upgrade an AMD desktop?

I've just worked on a 2019 desktop where its Ryzen 2700X CPU got the thumbs down from the PC Health Check. The machine's Gigabyte B450M DS3H motherboard, like most AM4 boards, accepts a broad range of AMD CPUs. The technology span of this model is six years, starting with 2018's dual-core Athlon 200GE, topping out with 2024's 16-core Ryzen 9 5950XT. Fitting a Ryzen 7 5800XT into this machine was a cost-effective upgrade, satisfying PC Health Check to allow the upgrade to Windows 11.

Fortunately for people seeking an AM4 CPU upgrade, 5th generation Ryzen chips remain in production. AMD conceived the AM4 socket to be flexible and upgradable, and it has delivered. The ease with which a new AMD CPU could be dropped into a motherboard was a revelation to performance-hunting gamers, and the same versatility is sparing Windows 10 machines from the crusher.



ABOVE Upgrading your AMD-based system with a new CPU may clear your path to Windows 11

THERE'S NO WAY TO SUGARCOAT THIS, BUT IF YOUR LAPTOP'S CPU DOESN'T MAKE THE GRADE, THEN THERE ISN'T MUCH YOU CAN DO ABOUT IT



AM4 handles three generations of Zen micro-architectures, and BIOS upgrades have made it possible to increment through them. The brilliance of AM4 is its versatility, so if PC Health Check gives your AMD desktop the red flag, then investigate the options for your motherboard.

Can I upgrade an Intel desktop?

If PC Health Check is whining about your Intel-based system, then you may have a problem. Whereas AMD has executed long-term desktop stability, Intel has changed direction more times than a man running from an alligator.

Intel launched the LGA 1151 socket, which supported 6th gen Skylake, 7th gen Kaby Lake, 8th gen Coffee Lake and 9th gen Coffee Lake Refresh, back in 2015. Although all these Lake variants would physically fit into the same socket, the chipsets that powered them were inflexible and there wasn't a BIOS solution to flip a motherboard between chipsets.

ABOVE If your laptop doesn't make the grade, there's not much you can do about it

Windows 11 requires a minimum of 8th gen Intel (and a few Socket 2066 7th gens). If you have an Intel LGA 1151 desktop with 7th gen or lower, there's no upgrade path.

Irrespective of which platform you're running, don't despair if your machine won't pass Windows 11's hardware requirements. We have plenty of other suggestions for you, which we'll come to later in this feature.

What about laptops?

Ha, ha! You're funny.

No, seriously, what about laptops?

OK. There's no way to sugarcoat this, but if your laptop's CPU doesn't make the grade, then there isn't much you can do about it. The system-on-a-chip designs of modern laptop CPUs means that they're soldered to the motherboard. This innovation introduced slim laptops but it killed off CPU upgrades. Sadly, the non-upgradable architecture is also prevalent in many all-in-ones, small form factors and mini PCs. Most of these are essentially laptops in a different shaped box.

In more positive news, it's usually possible to upgrade the RAM and hard drive on a laptop, which is a good idea on a Windows 11 machine.

CLAIM AN EXTRA YEAR'S SUPPORT FOR FREE

The Windows 10 Extended Security Update program (ESU) should be available to most users by late August. The ESU runs from 15 October 2025 until 13 October 2026 keeping Windows 10 updated with security patches, but no new features.

There are three ways to enrol. The simplest is to pay Microsoft $30 (or equivalent), but it's also possible to cash in 1,000 Microsoft Reward Points. You may have already earned these by searching via Bing on a PC or a mobile, via Xbox gaming rewards or from buying apps, movies and TV shows from the Microsoft Store.

The third method is more curious: Microsoft is giving the ESU to Windows Backup users for free. The app stores user settings, credentials, apps and folders safely in Microsoft OneDrive but, for the unaware, there's a trap. Windows Backup will, by default, try to move your Desktop, Documents and Pictures folder to OneDrive. That shouldn't be a problem for Windows 10 users already using OneDrive sync, but if your files are local and your Microsoft account has the standard 5GB storage, you're about to drown in "out of storage space" warnings as Windows Backup uploads your data.

The problem is worse for those running a Microsoft email account (Hotmail, Live, MSN, Outlook) because, since 2023, Microsoft has tallied email attachments against OneDrive storage. The moment OneDrive's storage limit is reached, users can no longer send or receive email. In other words, using Windows Backup to get a free ESU could kill your email. It is possible to turn off Windows Backup's default behaviour, but it returns on each launch. Be aware.

What should I do to prepare for Windows 11?

Once your machine meets Windows 11's requirements, look at what else will boost the performance. I hope it isn't too heretical to say that although Microsoft has done much to improve the performance of Windows 11, I've worked on machines where the innate sluggishness is reminiscent of its great-great-grandparent, Windows Vista.

As with Vista, the best remedy to Windows 11's performance woes is to upgrade the hardware, particularly hard drives and RAM. Despite the price of SSDs plummeting in recent years, there are plenty of Windows 10 installations chugging along on spinny drives. For these machines, the best bang-for-buck is a migration to SSD (*see "Hard drive cloning", right*).

A 2.5in SATA SSD is the simplest option, as it will slot straight onto the connectors, but if your motherboard has an unused M.2 slot (and many do), you can "jump the bus" by moving from a theoretical transfer speed of 600MB/sec to 4,000MB/sec for PCIe 3 and 8,000 MB/sec for PCIe 4. Check the documentation to see which flavour of M.2 is present, as there's a huge performance gain to be had. One potential problem with upgrading to Windows 11 from a machine that originally had a SATA drive is an incompatible partition type, but we have a fix for that (*see "Changing the Partition: MBR to GPT", p30*).

Although Windows 11 only requires 4GB of RAM, it will run like a Ferrari with a flat tyre on that quantity. Think about giving your machine more resources to work with and, if you're uncertain which RAM to purchase, seek your friendly neighbourhood computer store. Alternatively, retailers such as Crucial and Mr Memory have tools to help match memory to your machine.

Why has my TPM not been detected by PC Health Check?

I'll bet that it hasn't been turned on. Until Windows 11 rocked up, few people outside of the business world gave a hoot about the Trusted Platform Module (TPM), so millions of machines left factories with it disabled. Switching it on is simply a case of heading into the BIOS/UEFI and finding the correct option.

This being the world of technology, different BIOS manufacturers put the software switch in different locations and often give it a misleading name. If you can't find it, then upgrade the BIOS (see your documentation) to the latest version and the TPM should spark into life.



HARD DRIVE CLONING

If upgrading your machine's hard drive is appealing, then the most convenient method is to clone it to a new drive. For this process, you may need hardware to connect an additional SATA or M.2 drive to your machine.

The magic part is handled by software that will ensure that the partition style, structure and data are replicated correctly. Some SSD manufacturers, such as Samsung or ADATA, supply software for the job, but many cheapskate value brands don't offer this to their customers.

Thankfully, you won't be short of "free" options, though many of these, by a staggering coincidence, restrict the ability to automatically clone from a larger drive to a smaller one, which commonly occurs these days when people clone a hard disk to an SSD. My tips are CloneZilla (enable the "-icds" and "Resize partition table proportionally" settings), DiskGenius or grabbing yourself a discounted copy of EaseUS Disk Copy Professional from the *PC Pro* store (tinyurl.com/372easeus).



ABOVE Upgrading to an SSD is one of the most effective things you can do

Despite your best efforts, my desktop hardware remains incompatible. What can I do?

You're not alone. There are several hundred million machines out there that can't clear Windows 11's hardware high jump, but that doesn't automatically mean they'll be cast onto various e-waste mountains. Not yet, anyway.

Despite the annual headline declaring that the desktop is dead, I can assure you that isn't the case. They're certainly not as popular due to socioeconomic and convenience considerations, but for those who have an ATX desktop running Windows 10, there's no need to buy a whole new PC to run Windows 11.

Maximise the modularity of the platform by performing a selective hardware upgrade and swap out the CPU, motherboard and (possibly) the RAM. Size up your existing motherboard or case, to see which form factor you'll need. As someone who has accidentally ordered an ATX board for an M-ATX case more times than I'll admit, I know it's vital to get this right. If you're unsure, the motherboard manual will list the form factor and the case's documentation will highlight which form factors it can accept.

Another benefit of a selective upgrade is the opportunity to switch CPU teams. If you've been on Intel and fancy a bit of AMD, then now is the perfect opportunity. Ensure that your board and chosen chip are compatible (see manufacturer's documentation or ask your vendor), then check if your new CPU comes with a cooler.

DESPITE THE ANNUAL HEADLINE DECLARING THAT THE DESKTOP IS DEAD, I CAN ASSURE YOU THAT ISN'T THE CASE



ABOVE If you're not a keen gamer, you can probably get by with the graphics on a CPU

If you wish to re-use an existing liquid loop, check it's compatible with the new chip, and if you're moving between Intel and AMD sockets, unearth the correct mounting brackets and bolts before you begin. If you're using a dedicated graphics card, a saving can be made by buying a CPU without a built-in GPU. Alternatively, if your dedicated graphics card is ageing, and particularly if you're not into games, then consider pulling the old GPU as the graphics technology aboard new generation CPUs will probably give better performance.

The only warning flag is RAM. AMD's AM5 socket uses DDR5, whereas Intel's LGA1700 boards can come in both DDR4 or DDR5 flavours. Again, match to what you already have or treat yourself to something newer.

To minimise the risk of buying incompatible parts then look for a pre-packaged component bundle from your local computer store or an online vendor such as CCL or Scan. If you're confident enough to purchase but less certain about changing the PC's engine yourself, then talk to your local, reputable, computer shop.

Won't Windows baulk at new hardware?

Changing the major components of your desktop will have implications for your existing Windows installation, and it's impossible to predict what will happen until the machine is fired up. Luckily, Windows 10 is exceedingly forgiving when it encounters new hardware and will likely whirr away merrily before normal service resumes. Remove all the old software drivers associated with the previous motherboard, CPU or GPU, then install the new stuff. Depending on how your machine was originally built, you may need to reactivate Windows 10. If you hit problems, you can always buy a new licence from the PC Pro store (**tinyurl.com/win11licence**). Once the machine is activated, then the Windows 11 upgrade process can begin.

What can I do with an incompatible laptop?

As we've mentioned, laptops aren't designed to be upgradable (Framework being the notable exception), and because parts are bespoke for specific models, there's no interchangeability between machines. I can't install a motherboard from an HP ZBook Firefly into an Asus Zenbook because it physically won't fit. There's no ATX standardisation for laptop parts.

If at this point you've had enough and want to buy a new machine, then dispose of your old one responsibly (*see "Reuse and recycle responsibly", opposite*). If you're in the mood for rolling the dice, then I have more options for you.

Let's take a moment. The reason we're here is that Microsoft decreed that only certain bits of hardware could run Windows 11 and everyone else can do one. Well, guess what? They're not the police and Satya Nadella will not kick down your front door demanding to know why you haven't upgraded. It's your hardware and, as the kids say, "you do you".

There is the option to do nothing at all and remain on Windows 10. A point from history that Microsoft is conveniently ignoring is that when Windows Vista was on the chopping block, there wasn't a free upgrade path to Windows 7. The Vista to 7

CHANGING THE PARTITION: MBR TO GPT

One of the lesser-known requirements of Windows 11 is for the boot drive to have a GPT (GUID partition table) partition style. Most Windows 10 machines already have this, but not all, so let me show you how to fix it.

Warning: before you begin, work out which key combination your machine uses to get into the BIOS/UEFI. You'll need this during the process and it's better for your blood pressure to have this information now rather than not have it in about ten minutes.

Open Disk Management in Windows 10 and ignore the information in the top half of the box. Right-click on the "Disk 0" (or applicable), then select Properties. Select the Volumes tab and Partition Style should confirm you're running MBR.

Next, open a command window as Administrator and type "mbr2gpt /validate /allowFullOS" without the quotes. This will peek at your drive, perform a trial conversion, and flag any issues. Type "mbr2gpt /convert /allowfullOS". This time the command will, hopefully, complete without bother.

Restart the PC and enter the BIOS/UEFI using the key combination in our warning (you read that, right?). Once there, you need to enable UEFI booting mode by, most usually, disabling CMS or Legacy Boot mode. It will be there somewhere so look carefully. Once the change has been made, save, exit and you're golden. Re-check the Partition Style in Disk Management if you don't believe me. Windows 11 will now install.



REUSE AND RECYCLE RESPONSIBLY

Despite our best efforts, there may be some readers that opt for a new machine. If so, there's an opportunity for someone else to reuse it. Aside from local repair cafés, one resource is Recycle your Electricals (recycleyourelectricals.org.uk), which helps get hardware to new owners.

If you want to recycle the machine, don't launch it into your bin or general rubbish. Recycle your Electricals can find local drop-off points, but if you own a branded machine from a major tech manufacturer, contact them and find out where their take-back scheme collects from. It's important that the bill for recycling machines falls to OEMs and not local taxpayers.

migration was slow until Google stopped updating Chrome and, eventually, people shifted because they couldn't log into *FarmVille*. My point is that short of bricking machines, Microsoft has no influence over people who don't want to migrate and responsibility falls to other software companies. Firefox normally supports Windows for several years after the EOL date, and Norton only stopped supporting Windows XP in 2024. I fully expect to see Windows 10 machines in the workshop for the next few years.

If you fancy upgrading to Windows 11 without changing your hardware, then there's the option to run it on unsupported hardware. There are a few methods to achieve this, even without a full re-install, but one of the easiest methods is Flyby11 (**tinyurl.com/372flyby11**), which tweaks the Registry, downloads Windows 11 and begins the setup. I've been running an unsupported laptop for around a year with no problems, but there's uncertainty whether these machines will willingly upgrade to 25H2 or a full re-install will be required.

In order for such reckless and dissenting rhetoric to be written in this fine magazine, we've had to give our security expert, Davey Winder, a brown paper bag to hyperventilate into. Therefore, *PC Pro* would like to clarify that there could be potential security implications in continuing to run Windows 10 beyond the deadline. However, I've yet to see a machine virused to the eyeballs because of an unsupported OS and remind everyone that CrowdStrike ripped through Windows 11 security like norovirus on the QE2. #JustSayin'.

If you really need more time with Windows 10, then Microsoft offers its Extended Security Updates (ESU) program. For home users, £30 buys you an additional 12 months of security support, but no new features. Or you can claim it for free, as we explain on p28. Businesses get up to three years of ESU, beginning at £61, then doubling every year. Think of the ESU as give breathing room to individuals or businesses that are struggling to migrate.

For those running legacy apps that won't run on Windows 11, then virtualising your current Windows 10 environment to run under Windows 11 as a virtual machine may be the answer. However, be aware that our previous warnings about unsupported software also apply to VMs.

BELOW Bazzite is a gaming-focused Linux OS that can boost performance



What about jumping ship to Linux?

October's deadline serves to remind us that Windows is not the only OS in town. There can't be many *PC Pro* readers that haven't tried Linux over the years, and there are claims that in 2025 almost 1,000 variations exist.

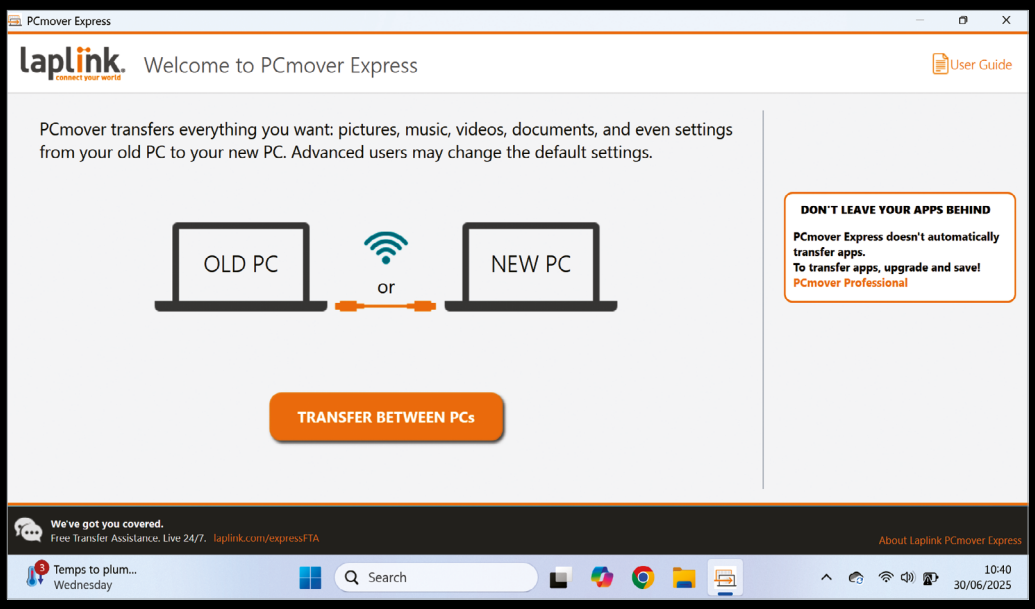
Luckily for you, Nik Rawlinson wrote a fabulous Linux rundown earlier in the year (*see issue 367, p78*) packed with tips and distro advice. Alternatively, Endof10 (**endof10.org/places**) can locate an organisation nearby that will help you to migrate from Windows to Linux.

Two Windows alternatives that Nik didn't have room to mention are Bazzite, a gaming-focused Linux that has Steam pre-installed. If your Windows 10 gaming rig won't upgrade, then Bazzite will keep you playing and, so my customers report, can reduce hardware overheads and boost gaming performance.

My other recommendation is Chrome OS Flex, which is the nearest you can officially get to turning a Windows laptop into a Chromebook. It's free, fast, supported and a very pleasant user experience. The quid pro quo is that you can't download from the Google Play Store, but access to the Chrome Web Store works fine. It really is a great way to migrate into the Google ecosystem.

WINDOWS 10 MOVING DAY: GRAB YOUR COPY OF LAPLINK PCMOVER EXPRESS

We've teamed up with Laplink to give *PC Pro* readers software that makes it even easier to migrate from an old PC to a new one – for free



As Windows 10 nears the end of its support period, you may be planning to invest in a new laptop. Unfortunately, the excitement of getting a new computer is somewhat spoiled by the hassle of transferring all your personal files and settings across from your old machine. Windows unhelpfully scatters your documents and configuration files all over the file system, and even buries some settings in the Registry, so trying to copy everything across by hand is a tedious and indeed almost impossible endeavour.

That's why this month we're giving *PC Pro* readers an exclusive licence for Laplink PCmover Express. This ingenious tool can transfer every bit of your personal content from an old PC to a new one in just a few clicks – including not just files, but user accounts and Windows settings, too. The only thing that's not moved is your applications: if you need a complete, programs-and-all migration, see p54 for details of our Laplink PCmover Professional 11 offer.

PCmover Express works with any version of Windows from 7 onwards, and requires no special hardware or configuration. The software automatically establishes a link between your old and new computers, and handles every aspect of the transfer – all you need to do is make sure that both systems are connected to the same network. A regular Wi-Fi connection is fine, although if you can connect both computers to your router with Ethernet cables that will probably speed things up.

To save more time (or disk space) you can also optionally configure PCmover Express to transfer only selected items, or migrate folders to new locations on your new PC to avoid any confusing conflicts. Your old PC meanwhile continues working just as before, so you can keep it as a spare or pass it on to a family member.

1 Install on first PC

Start by installing PCmover Express on either your old PC or on the new one you want to transfer your personal data onto – either way round is fine. The first time you run the software, you'll be prompted to license it by entering your name, email address and serial number. If you haven't already got your serial number, you can obtain one by registering at **pcprodownload.co.uk**.

2 Install on second PC

Once your first installation of PCmover Express is licensed and set up, you'll be prompted to go and install the same software on your other computer. For this you can use the same licensing information, including the same serial number. When you've got the software running on both PCs, ensure that both are connected to the same network, then hit the Next button.

3 Select transfer direction

All being well, both computers should now be showing a screen like this one. The big orange arrow indicates the direction in which your data will be copied; if it's pointing the wrong way, simply click "Switch Transfer Direction" below the graphic. When you're correctly set up, click the orange "Analyze PC" button on the new computer to start scanning for files to copy.

4 Select what to transfer

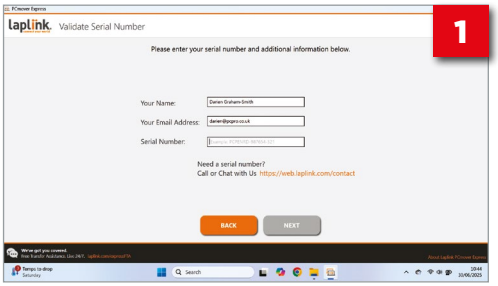
If you want to copy across all personal user accounts, files and settings, you can just wait for PCmover Express to finish searching your hard disk and then hit "Next". Otherwise, click the orange link at the bottom labelled "Choose What To Transfer": this will take you to the page shown here, from which you can pick whether to copy everything or just your files.

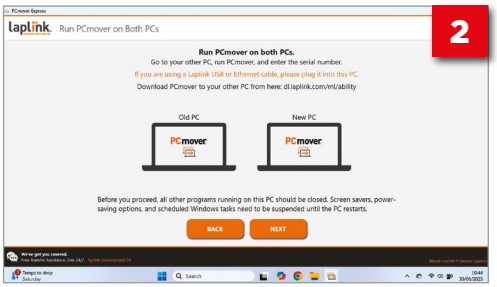
5 Select and redirect

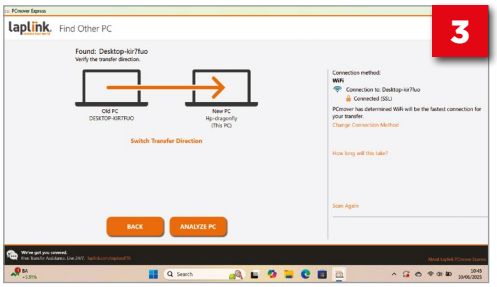
For even finer control, click the orange "Customize" link at the bottom of the "Choose What To Transfer" page. You'll now see an Explorer-style interface, from which you can browse your old hard disk, and select or exclude individual items from the transfer. Using the right-hand pane you can also specify a location on the new PC for any file or folder.

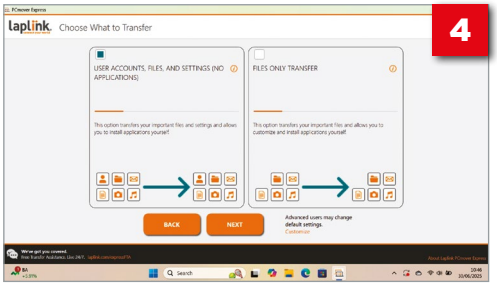
6 Start transferring

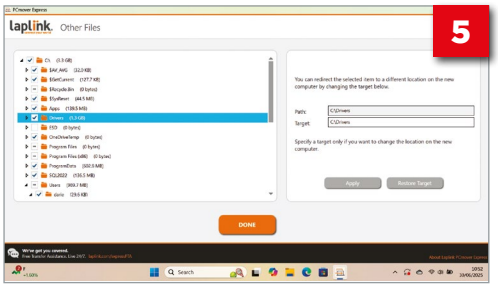
Once you've selected everything you want to be moved onto the new PC, click "Done", then "Start Transfer". PCmover Express will now get to work, with a blue progress bar showing you how far through the process it's got. From this screen you can also keep an eye on how much data has been processed, and see the estimated network speed and time remaining.

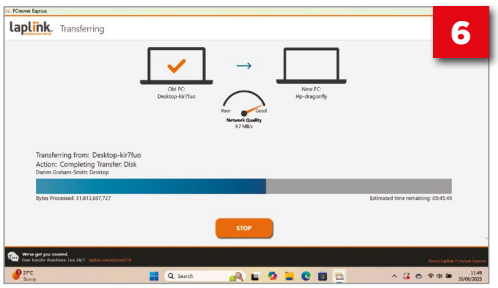


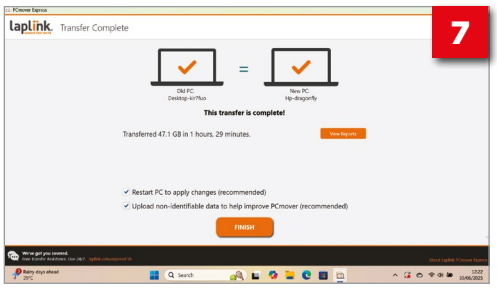


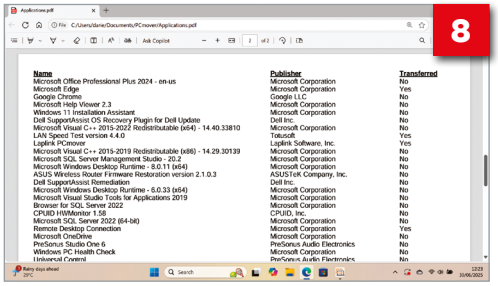












THIS INGENIOUS TOOL CAN TRANSFER EVERY BIT OF YOUR PERSONAL CONTENT FROM AN OLD PC TO A NEW ONE IN JUST A FEW CLICKS

7 Complete the transfer

Once the process is complete, you can quit the program. By default, this will trigger a restart of your PC, so that Windows can pick up any changes to your system settings and any newly imported user accounts. Before you do this, you might choose to click the "View Reports" button to see a rundown of exactly what PCmover Express has done for you.

8 Get a report

There are a few different reports available, but the Applications report is likely to be the most useful. While PCmover Express doesn't migrate applications itself, this report lists all the programs it's identified on your old PC, so you know what you need to reinstall – and details which ones are already present on the new PC, so you know what you can skip.



THE WI-FI WARZONES

FROM MUSIC FESTIVALS AND SPORTS STADIUMS TO 100MPH TRAINS, BARRY COLLINS DISCOVERS HOW WI-FI IS INSTALLED IN CHALLENGING ENVIRONMENTS

It's hard enough getting Wi-Fi to work reliably in a two-bedroom flat, let alone a field containing thousands of smartphone-wielding festival-goers or a train belting through the British countryside. But there are networking professionals who are used to working in these Wi-Fi warzones.

We've talked to networking experts who have installed Wi-Fi in brutally challenging environments to find out how they do it. Whether it's preventing visitors dragging down the network at Brighton Pride, installing under-seat access points in football stadiums or making sure overgrown shrubs don't knock out the Wi-Fi on the 5.15 to Basingstoke, we've got the inside story on how some of the most extreme Wi-Fi networks are put together.



FESTIVALS AND OUTDOOR EVENTS

You might not give much thought to it when you're standing in the middle of a field listening to a band, but it's someone's job to make sure that field is humming with Wi-Fi so that the ticket gates, security, the bar, production and others on site can operate. That someone is often Dominic Hampton, the managing director of attend2IT.

Hampton's company provides the network at massive public events such as Brighton Pride, the Great Escape Festival and the Secret Garden Party, where you're dealing with tens, if not hundreds, of thousands of attendees in locations such as public parks, that obviously aren't built with Wi-Fi infrastructure in mind.

You might think the first job on any festival site would be conducting a site survey, but Hampton places little faith in them. "In the event world – especially trade shows, especially outdoor county shows and stuff like that – you can't possibly know what every marquee is going to look like," said Hampton. "People go 'oh, do a Wi-Fi survey'. What's the point? First, it's a field when you do the test; and second, you have no idea what an individual stand is going to be, what it's going to look like, what it's going to be made out of."

Instead, Hampton would rather over-provision. "We over-engineer, because renting an extra access point is nothing," he said. "If you're renting it for a weekend, the survey is probably going to cost more than just throwing some more APs at it."

The big challenge in places such as fields and parks is getting wired connectivity to them in the first place. To install a leased line can take anywhere between a fortnight and nine months, said Hampton. He's done events where the leased line was installed the day after the event finished. "That's fine because it's a yearly event, so they get to use it the following year," he added. But that means backup wireless connectivity, such as Starlink, is a must for every job.

The size of the pipe required depends on the requirements, particularly if the event is providing guest Wi-Fi. "Everyone wants to give people guest Wi-Fi, but someone's got to pay for the guest Wi-Fi, and none of the guests will," said Hampton. "We did an experiment ten years ago where we charged 50p at an event for visitors to go on the Wi-Fi and we had two people, whereas on a typical event when you give it to them for free, you'll see 50% of the guests will go online."

Providing guest Wi-Fi will normally double or triple the cost of providing only a private network for the event, Hampton said, because you need a 10Gbits/sec line, rather than a 1Gbit/sec connection, and you need to triple the number of access points. Why? Because at a music festival where everyone is uploading video clips of the performers to their Instagram feeds, the demands on the network are immense.

ABOVE Events such as festivals create huge challenges for Wi-Fi providers

There are huge challenges in physically reaching visitors, too. "At a typical festival you've got a stage at the front, you've got the bar surrounding it, and you've got a big bowl of people in the middle," said Hampton. "To do guest Wi-Fi properly, you've got to put access points around the outside – well, that's fine, you're doing that for the traders anyway – but you've got to get access points in the middle of that bowl of people, which is almost impossible to do."

THE BIG CHALLENGE IN PLACES SUCH AS FIELDS AND PARKS IS GETTING WIRED CONNECTIVITY TO THEM IN THE FIRST PLACE

Consequently, most events decide against the cost of providing guest Wi-Fi, but that doesn't mean the network won't suffer under heavy demand. Hampton says one of the biggest risks at events is "production attacking itself".

"What we've found at festivals, is production will put up a poster in their production office and go 'the Wi-Fi network is this and the password is this'. We had an instance at a festival ten years ago where they'd asked us to design it for 1,000 traders and there were about 4,000 people on it."

Hampton's firm changed the password "and that worked for about two hours, and then we were back up to three or four thousand people". Hampton went into the production office to work out what was happening and found "traders were walking in with some bull***t excuse, my

BELOW Networks can feel the strain when everyone is uploading at once





tap's not working or something, and just looking at the password and going off and telling everybody else". Now attend2IT uses WPA2 Enterprise, and everyone is allocated a unique username and password to prevent production inadvertently conducting a denial-of-service on its own network.

Of course, the biggest denial-of-service-attack comes when you've got no power, and when you're putting on events in a field, power can't be taken for granted. Electricity on such sites is provided by specialist companies using generators, and "they will want to turn the generators on as late as possible, or the organisers will, because they're the ones paying the bill," said Hampton. But if you're trying to rig up the site's Wi-Fi network you naturally "want the generators on as early as possible so that we can start rigging stuff".

Thus it becomes a haggle. But if there's one set of contractors on site that attend2IT will keep on side by dishing out Wi-Fi passwords, it's the company providing the power.

SPORTS STADIA

The demands of serving an audience at a music festival/concert are in some ways similar to that of a crowd at a football match. Just as everyone will get their phone out to take a video of, say, Oasis singing "Wonderwall", so football fans will grab footage of the teams coming out on to the pitch or celebrating a goal. And the first thing they'll want to do is upload it to social media. Potentially tens of thousands of people uploading high-definition footage, all hammering the network at the same time. That takes some managing.

And while providing Wi-Fi in a field is a challenge, dealing with the architecture of a sports stadium isn't a walk in the park, either. "Providing Wi-Fi in stadiums is a challenging deployment for multiple reasons, including extreme user density and unpredictable traffic patterns," said Mittal Parekh, senior director of products at Ruckus Networks, which has kitted out stadiums around the world. "With tens of thousands of fans trying to connect simultaneously, often in concentrated areas like seating bowls and concourses, you're dealing with high levels of radio frequency interference, bandwidth congestion and coverage obstacles."

Those obstacles can be both human and physical. Stadiums are huge bowls of concrete and steel, which block and absorb Wi-Fi signals. Then, of course, you've got tens of thousands of meat bags (or spectators, as they're more politely called) getting in the way too. Those spectators will also be carrying at least one personal device, which could be spitting out radio interference, particularly if they're in Wi-Fi hotspot mode themselves. Annoyingly, those spectators don't sit still, either: they're moving through concourses, heading to the hot dog kiosk, popping to the toilets, all of which requires careful access point positioning and seamless handoff between them.

ABOVE Sports stadia provide a different yet equally difficult challenge

While you may think the solution is to flood the stadium with access points, that's not always possible. "At many venues, there are aesthetic constraints," said Parekh. "APs and antennas often need to be hidden or integrated into the stadium's architecture for aesthetic reasons, limiting optimal placement and potentially impacting performance. Historic or iconic venues may have additional restrictions around preserving their appearance and structure."

STADIUMS ARE HUGE BOWLS OF CONCRETE AND STEEL, WHICH BLOCK AND ABSORB WI-FI SIGNALS

That's forced companies such as Ruckus to come up with cunning solutions, such as under-seat access points. "For some stadiums that have no roof, or deployments where the performance requirements are very high, you must bring APs close to the clients," said Parekh. "When you bring the signal much closer to users, it reduces issues caused by obstructions like human bodies and stadium materials."

The company's Wi-Fi 7 under-seat access point is not only weather-proof, it's designed to withstand pressure washing so that the kit isn't ruined when they're cleaning the stadium. While the density varies from stadium to stadium, Parekh said a typical deployment would see an under-seat access point serve 50 to 100 seats, which roughly equates to one access point every two or three rows. Hyper-directional overhead deployments can serve two to three times as many visitors, if under-seat isn't an option.

There's another huge challenge with stadium deployments: making sure the Wi-Fi provided for visitors doesn't interfere with the stadium's own private network, used for everything from CCTV to entry gates to the club shop. Parekh said it requires a "sophisticated blend of technology, policy and operational best practices" to ensure the hordes uploading footage of, say, Cole Palmer's latest banger doesn't disrupt the serving of bangers from the food kiosk.

Some of that is achieved through "advanced RF design", using features such as Ruckus's BeamFlex to ensure that the best RF channel is used for every client and transmission. Then network segmentation and quality-of-service settings are applied to ensure critical apps such as ticketing and security get priority over the TikTokers. Traffic is also monitored in real-time so that these settings can be adjusted dynamically, potentially even capping per-user bandwidth to ensure the overall health of the network.

"Coordination is key to make sure that high-value services have priority over low-value use, and Wi-Fi 7 brings a new set of features to allow more efficient use of the spectrum and quality of service," said Parekh. "On top of that, AI can now track KPIs [key performance indicators] and propose adjustments to meet SLAs [service level agreements]."

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ABOVE RIGHT **South Western Railway has recently installed a 2Gbits/sec service on a stretch of track**

TRAINS

Providing Wi-Fi at festivals or stadiums is a tough gig, but they have the advantage of being stationary (even if the people in them aren't). Trains, however, shift a bit. Even on Britain's creaking network.

FirstGroup recently completed a rollout of a new mmWave 5G Wi-Fi network on more than 200 South Western Railway trains, running on a 70km stretch between Basingstoke and Earlsfield. The service offers around 2Gbits/sec of bandwidth per train, whereas previous 4G/5G solutions have typically delivered around 30Mbits/sec – barely enough for a handful of passengers to stream something from Netflix on the commute home.

"When we started out deploying, we thought the hardest part of this would have been getting trains in the depot to fit them with radio antennas," said Gareth Palmer, commercial and finance director at evo-rail, a telecoms company that is part of FirstGroup; until recently this included South Western Railway, before it moved back into public ownership. "But no, not at all. The hardest part was the track-side element."

The South Western network doesn't rely on regular 5G masts provided by the mobile networks. They're too thinly spread, especially in the less densely populated areas that a train will pass through. The "track-side element" that Palmer refers to consists of 57 different antennas, which beam the signal via line-of-sight to a receiver on the train. The trains have their own antenna on the front and another on the back, so as long as one of those train antennas is within range of a track-side antenna, you've got a network that doesn't lose connection as the train hurtles past. That means you need to have an antenna every 1.2 kilometres along the track.

SCOTRAIL IS CURRENTLY RUNNING A TRIAL THAT'S SEEN SIX TRAINS FITTED WITH STARLINK SATELLITE EQUIPMENT

That's where it gets tricky, because putting 5m tall antenna on the side of railway lines isn't straightforward. Palmer rattles off a long checklist of items that have be ticked off before an antenna can be installed, including getting permission from the landowner, planning consent, ensuring there's no interference with nearby railway infrastructure, and potential landslips that might require the installation of a retaining wall. Network Rail alone has an approvals process requiring about 20 sign-offs for each pole. "If you change the location of one track-side antenna, you have a knock-on effect with the next antenna, and the next one and the next one and the next one, because... you don't want dead spots in any of it," said Palmer.

Even when the antennas are installed, there are potential obstructions that could interfere with the line-of-sight between antenna and train. "At this time of year with this sort of weather where's it really hot and sunny, yet you get a downpour, vegetation sprouts out from nowhere," he said. "So, you've got to keep on top of that."

Then, of course, there's the issue of cuttings (excavations made in the ground to allow the train to pass through hills or uneven terrain) and tunnels. How does the network cope with those? For cuttings, the height of the antennas can be adjusted to maintain line of sight, while the Basingstoke-Earlsfield stretch fortunately has no tunnels to contend with. However, Palmer insists it wouldn't be a huge problem if there were. "You can quite easily have an antenna at the start the tunnel and rear of the tunnel," he said. "As long as you've got that line of sight, you're fine." Even in tunnels that bend, antennas can be placed inside that maintain the connection.

Inside the trains themselves, you need an access point in each carriage, with the train's own communications backbone passing the signal through the length of the train. And it's not only the passengers on board who benefit from a nippy connection, but the train companies, too. The Wi-Fi can be used to control devices such as on-board advertising screens or even CCTV. Palmer said they are currently exploring whether it would be possible for staff in a depot to see in real-time what's happening on the CCTV cameras installed in every train carriage. "From a safety perspective, for crime reporting, suddenly you've got something that didn't exist before," he said.

5G isn't the only technology being used to upgrade Wi-Fi on British trains. For example, ScotRail is currently running a trial that's seen six trains fitted with Starlink satellite equipment, potentially providing high-speed internet on some of the most rural and challenging parts of the country's train network.

The rail companies hope the investment they're putting into improving onboard Wi-Fi might tempt a few more passengers away from the planes. "There is a school of thought that it will create an uplift in the number of people travelling [by train]," said Palmer. "There's all sorts of things that make the business case worthwhile for a train operating company."

BELOW **Track-side antennas provide an uninterrupted Wi-Fi service**





KEEP YOUR COOL

IF YOU WANT A FAST, RELIABLE COMPUTER, HEAT IS THE ENEMY. DARIEN GRAHAM-SMITH EXPLORES WHY THERMAL MANAGEMENT IS SO IMPORTANT, AND HOW TO KEEP YOUR OWN PROCESSOR RUNNING COOL

The CPU in your phone, tablet or computer processes billions of operations a second. On the microscopic scale, that means opening and closing billions of tiny electrical gates. This is done using electrical energy – and, as you may recall from physics class, no electrical process is 100% efficient. Every time a transistor is activated, a small amount of energy is lost as heat.

Is this a big deal? In isolation, no. The heat generated by the operation of a single transistor is minuscule. No chip manufacturer publishes this figure; we suspect it would be difficult to even estimate on such a tiny scale.

However, with billions of operations per second going on across billions of transistors, the heat can quickly build up, causing a significant proportion of the chip's area to become measurably hotter. In fact, that's an understatement: without some sort of thermal management, the internal temperature inside a typical desktop CPU would easily go well beyond 100°C in everyday use.

Exactly how much heat a chip will generate – and how quickly – depends on a variety of factors. One is exactly how fast it's running, as running more operations per second naturally leads to a quicker build-up of heat. This is why overclocking is considered a risky business, and why enthusiasts often invest in souped-up coolers, as we'll discuss below.

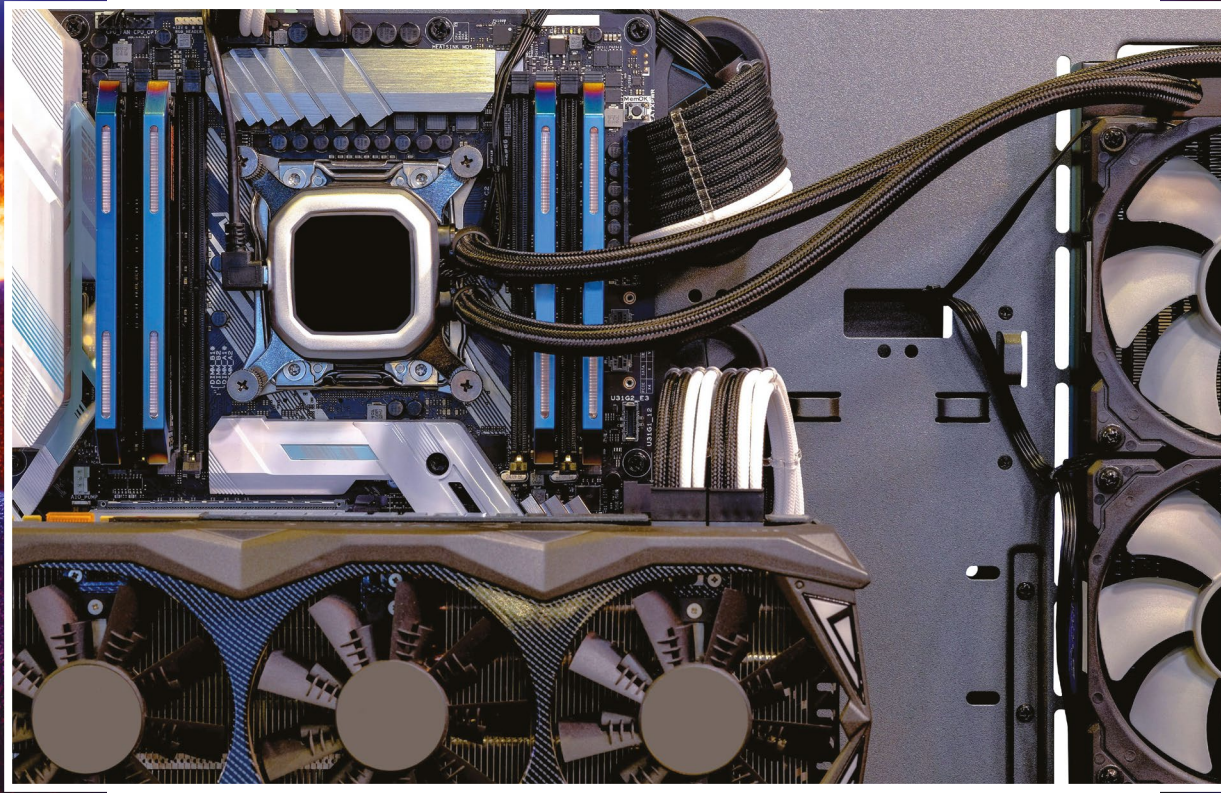
The complexity of the task is a factor, too. Chunky workloads such as video editing and AI processing can light up dozens of cores at once, while many desktop programs run largely on a single CPU core – meaning a large portion of the chip is left sitting idle, and cool. In fact, modern chip designers aim to completely power down unused chip areas whenever they're not in use, partly to reduce power consumption but also to minimise heat buildup.

This brings us to the final factor: the physical make-up of the chip itself. All things being equal, a chip with a billion transistors will generate more heat under load than a simpler design. Hence, chips intended for thin and light laptops, which have limited cooling capabilities, tend to use simpler designs with fewer cores. Desktop processors can afford to pack in more silicon, while server hardware typically uses large complex chips with high core counts and fast clock speeds, relying on high-powered external cooling systems to prevent overheating.

THERMAL THROTTLING ISN'T AS BAD AS A CPU CRASH, BUT HAVING YOUR WHOLE SYSTEM SLOW DOWN ISN'T GREAT

THE DANGERS OF OVERHEATING

So why do we care if a CPU gets hot? To an extent, we don't. Chips are designed to run indefinitely at temperatures up to around 90°C or 100°C, depending on the model. But if the inside of the processor gets hotter than that, the transistors inside it may start to malfunction. As the heat increases, the silicon material gets



increasingly conductive, to the point where electrons can start to leak through gates that are supposed to be closed. There's really no way to work around this sort of fundamental operating error: the inevitable outcome is program glitches, quickly followed by a complete system crash.

If you make a regular habit of running a chip at unstable temperatures, the consequences can be even worse. A phenomenon known as electromigration occurs at high temperatures, causing the transistors to become deformed. This results in a chip that's permanently unstable and unreliable, even at room temperature.

To safeguard against these scenarios, all modern processors manage their own internal temperatures using a technique called thermal throttling. This simply means that if a chip detects that it's getting too hot it will automatically dial down its own operating speed until the temperature returns to an acceptable level. (The same principle is applied in reverse to apply short bursts of "Turbo Boost", briefly raising the clock frequency to speeds that can't be safely sustained for extended periods.)

Obviously thermal throttling isn't as bad as a CPU crash, but having your whole system slow down isn't great. And if thermal throttling doesn't bring the temperature down to acceptable levels, the processor will usually shut down completely, in a bid to prevent permanent damage. If you don't want your computing experience to be interrupted by intermittent slowdowns and crashes, cooling is a must for any microprocessor device.

PASSIVE AND ACTIVE COOLING

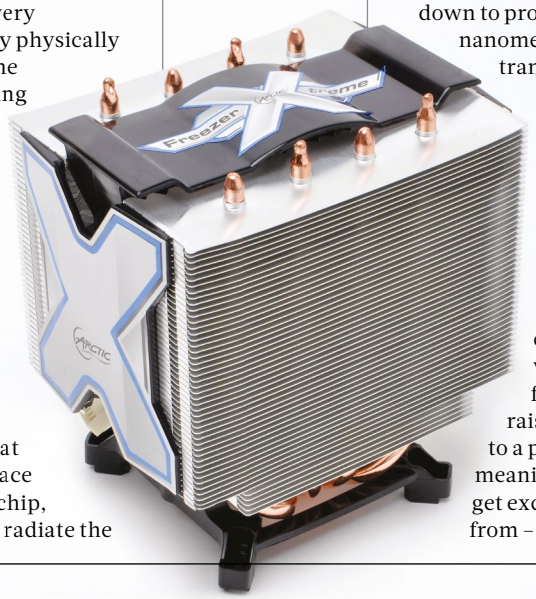
CPU coolers work in a very straightforward way, by physically attaching to the lid of the processor and conducting heat away from it. The simplest sort of cooler is a passive heatsink, typically an all-metal assembly, made of a highly heat-conductive material such as copper or aluminium. The top of the heatsink is usually adorned with dozens of fins or other protuberances that give it a far greater surface area than the lid of the chip, helping it to effectively radiate the heat away. Early generations of Intel chips relied entirely on passive cooling, from the original 4004 processor released in 1971 until the introduction of the faster and more complex 80486 series in 1989.

ABOVE Liquid-cooling assemblies help draw the heat well away from the motherboard to a separate cooler unit

Passive heatsinks are still used today on thin and light laptops, where the designer doesn't want to add the complexity, weight and noise of a fan. The trade-off is that these compact laptops don't usually offer the highest possible performance: passive cooling can't fully dissipate the heat generated by a powerful CPU running flat out.

That's not to say that passively cooled silicon has to be slow, however. As we mentioned in our recent feature on the latest CPU generations (*see issue 369, p42*), the latest processors are now getting down to process sizes of one nanometre and below. As the transistors shrink, so does the power required to operate them – which in turn means that the amount of electrical energy that's converted into heat goes down. It becomes possible to run the chip faster and faster, with more transistors firing at once, without raising the temperature to a problematic degree, meaning it's possible to get excellent performance from – for example – a

BELOW Passive cooling can help keep temperatures down without a fan



PASSIVE COOLING CAN'T FULLY DISSIPATE THE HEAT GENERATED BY A POWERFUL CPU RUNNING FLAT OUT

MacBook Air using Apple's latest M4 processor with passive cooling.

Even so, there's no denying the advantages of active cooling. There's a MacBook Pro model that uses the exact same M4 processor as the Air, but it proves consistently faster in benchmarks. That's because it combines its heatsink with a powered fan, which blows the heated air away from the heatsink and out of the computer casing, while a vent on the other side of the case draws in fresh, cool air to replace it. This allows the processor to run at higher speeds for longer, without the need for thermal throttling.

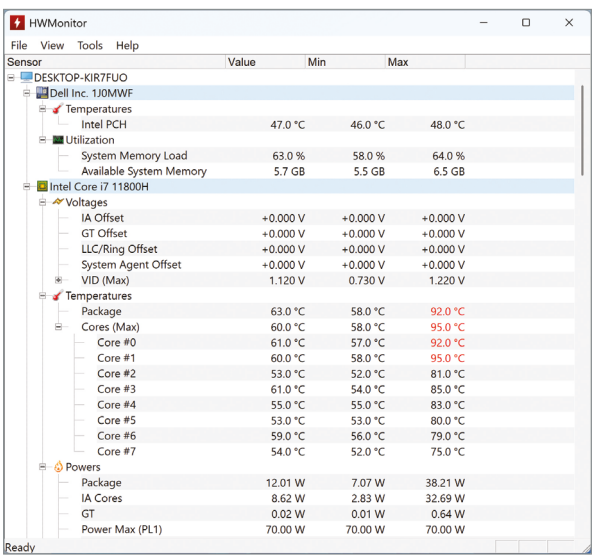
Heatsink and fan arrangements – of various sizes and designs – are found in computers of all sizes, from business laptops to massive pedestal servers. But for the most demanding cooling jobs, enthusiasts and data centres may turn to liquid cooling. Here, the heatsink block that's attached to the CPU lid contains conduits for a liquid coolant – typically distilled water, or a chemical mixture similar to the radiator fluid used in a car. This liquid is pumped through tubes to a main heatsink and fan assembly located elsewhere in the case, where the heat is blown away just as with a standard air cooler.

Since the coolant transfers heat more efficiently than air, it can do a better job of carrying heat away from the processor. Moving the main heatsink away from the motherboard also helps to manage ambient temperatures around all the core components. For extreme performance, the cooling liquid itself may be externally cooled for maximum performance: in world-record overclocking attempts, where regular CPUs are pushed to 8GHz and above, liquid nitrogen is often used, at temperatures of around -200°C.



ABOVE Air coolers' fans simply blow air across the fins of the heatsink to dissipate heat

BELOW HWMonitor shows the operating temperatures of your CPU cores



DON'T BRING THE NOISE

As well as efficient heat transfer, another oft-touted advantage of liquid cooling is that, since the fan doesn't need to work as hard as with a standard air cooler, the whole assembly can be quieter. If you've ever heard the fan in your desktop rev up like a motorbike when processing a big folder of files, you'll appreciate the appeal of this.

Modern computers do their best to minimise fan noise – the CPU fan will normally run at a slow, near-silent rate, or stop altogether, when the processor is within a comfortable operating temperature. But as the temperature rises it will ramp up to faster, much noisier speeds. High-end PCs may also include case fans, which help circulate air around the whole internal space of the computer, at the expense of more noise.

If your fan seems to spring to life at the slightest provocation – spinning up audibly when you do something as simple as opening a web browser, and reaching a crescendo if you dare to try a game – then that might be a sign that your computer is running hotter than it should.

HOW DO I KNOW IF MY COOLING IS INADEQUATE?

As we've mentioned, an overheating CPU will try to manage its own temperature before you get to the point of errors and crashes. So unless you're intentionally overclocking your system and pushing it harder than it can handle, the most likely symptom of a cooling issue is a drop-off in performance, indicating that the system is regularly having to throttle itself. This can be tricky to spot, because processor speeds always fluctuate up and down according to your workload, making it tricky to pin down and replicate a suspected slowdown, but if intermittent slowness is accompanied by a fan that's whirring like a jet engine, that's a clue that you need to cool down.

On a smartphone, a tablet or a laptop, you can try the very basic, very unsophisticated approach of simply running your hands over the casing and seeing if any part of it feels uncomfortably hot. As we've noted, CPUs can handle internal temperatures of over 90°C, so a warm case doesn't necessarily indicate a problem, but if it's painfully hot that's not a good sign. This is why our reviewers often comment on how hot high-end phones get during demanding gaming sessions: the issue isn't just whether the thing is uncomfortable to hold, but also a question of whether the CPU and graphics hardware might be struggling to deliver their best performance.

The touch test isn't really viable with a desktop PC, but you can use a

free tool such as HWMonitor (**tinyurl.com/372hwmonitor**) to directly view the temperature readouts from the internal thermometers built into your processor and motherboard. That particular tool is for Windows only, but there are equivalents available for all other major platforms. For an even more in-depth view you might like to combine this with a CPU monitoring tool such as CPU-Z (**tinyurl.com/372cpuz**), to track whether the processor's core speeds correlate with changes in temperature.

LOWERING THE TEMPERATURE

If you want to improve your cooling, your best approach will depend very much on the type of device you're using. For a fanless device such as a phone or a thin and light laptop, your options are frankly very limited. Just try to avoid using it in direct sunlight, and always place a laptop on a flat surface like a table, where there's space for air to flow under the chassis, rather than placing it on a pillow on your lap, which will make it warm up extra quickly. You might be able to reduce heat generation by activating a low-power "battery saver" mode, though this will naturally impact on performance as well.

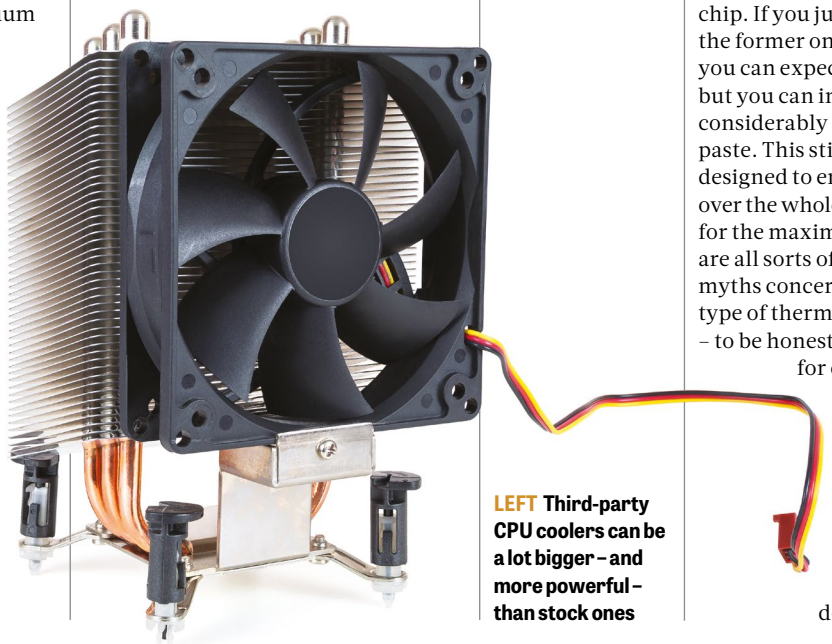
For devices with fixed fans, such as business laptops and games consoles, you may be able to give your cooler a boost by clearing out the vents. Over time, these can get clogged up with dust that's sucked in by the fan, impeding the flow of air so the inside of your device doesn't cool effectively. Clear it out with a good hearty blow, or invest a few quid in a can of compressed air that you can squirt aggressively into all available openings. If you're comfortable with a screwdriver, take the case off and give the internals a thorough blasting – or perhaps use a handheld vacuum cleaner to neatly vanquish any dust and crumbs.

For traditional tower-style desktop PCs, the situation could hardly be more different. A desktop CPU from AMD or Intel normally comes with a standard "stock" cooler that attaches to the motherboard and keeps the CPU relatively cool, but there's no shortage of third-party replacements, featuring bigger heatsinks and larger, faster fans. These can enable more sustained operation at Turbo speeds, stable overclocking, and quieter operation, too.

Note, though, that these coolers come with no guarantees. Their real-world effectiveness will depend on all sorts of factors, including the workloads you're throwing at your computer and the airflow inside and around your case. And while all desktop CPUs are guaranteed to hit their advertised frequencies, anything beyond that is a lottery. You might get lucky and find that an upgraded cooler allows your CPU to run stably at 6GHz, or you might be stuck at 5GHz.

If you're shopping for a cooler upgrade, be aware too that different chips may require different fittings. In general, any heatsink will clamp on to the flat top of any desktop processor, but the mounting assembly will need to line up with the holes in your motherboard; these may be in different places depending on whether it's an AMD or Intel board, or which generation of chip it is.

A final factor to consider is what goes between the heatsink and the chip. If you just clamp the bottom of the former on to the top of the latter you can expect fairly good cooling, but you can improve matters considerably using a dollop of thermal paste. This sticky, greasy substance is designed to ensure gap-free contact over the whole surface of the processor, for the maximum heat transfer. There are all sorts of recommendations and myths concerning the application and type of thermal paste you should use – to be honest it's a bit of a rabbit hole for enthusiasts – but if you're considering an aftermarket cooler upgrade, it's worth at least investing in a small tube of cheap stuff and applying a blob on top of your chip to help the cooler do its thing. ●



LEFT Third-party CPU coolers can be a lot bigger – and more powerful – than stock ones

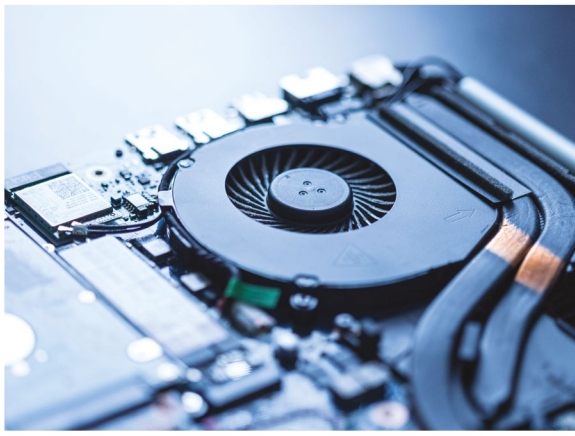
UNDERSTANDING TDP

If you want to know how much heat a particular CPU is likely to generate – and hence what sort of cooling it's likely to need – you can check its thermal design power, or TDP for short. This is an indication of the amount of heat the processor is expected to generate, on average, over a set period of time under a standard workload.

TDP is cited in watts, which might seem confusing at first – we're accustomed to using the watt as a unit of electrical power, not heat. But while TDP deals with a different form of energy, the measure is the same, namely joules per second.

TDP can vary enormously from chip to chip. AMD's top-end Ryzen 9 9950X3D desktop CPU cites a TDP of 170W under full load, indicating that it will need a hefty cooler. By contrast, Intel's Core Ultra 5 225U, designed for lightweight laptops, has a TDP of just 15W, indicating that it will run happily with a much smaller and less powerful cooling system.

Don't get too hung up on these numbers, though: your CPU will almost certainly spend most of its time running well below its stated TDP. If your cooler can't fully dissipate the stated amount of energy, the consequence is likely to be nothing worse than an occasional spot of throttling.



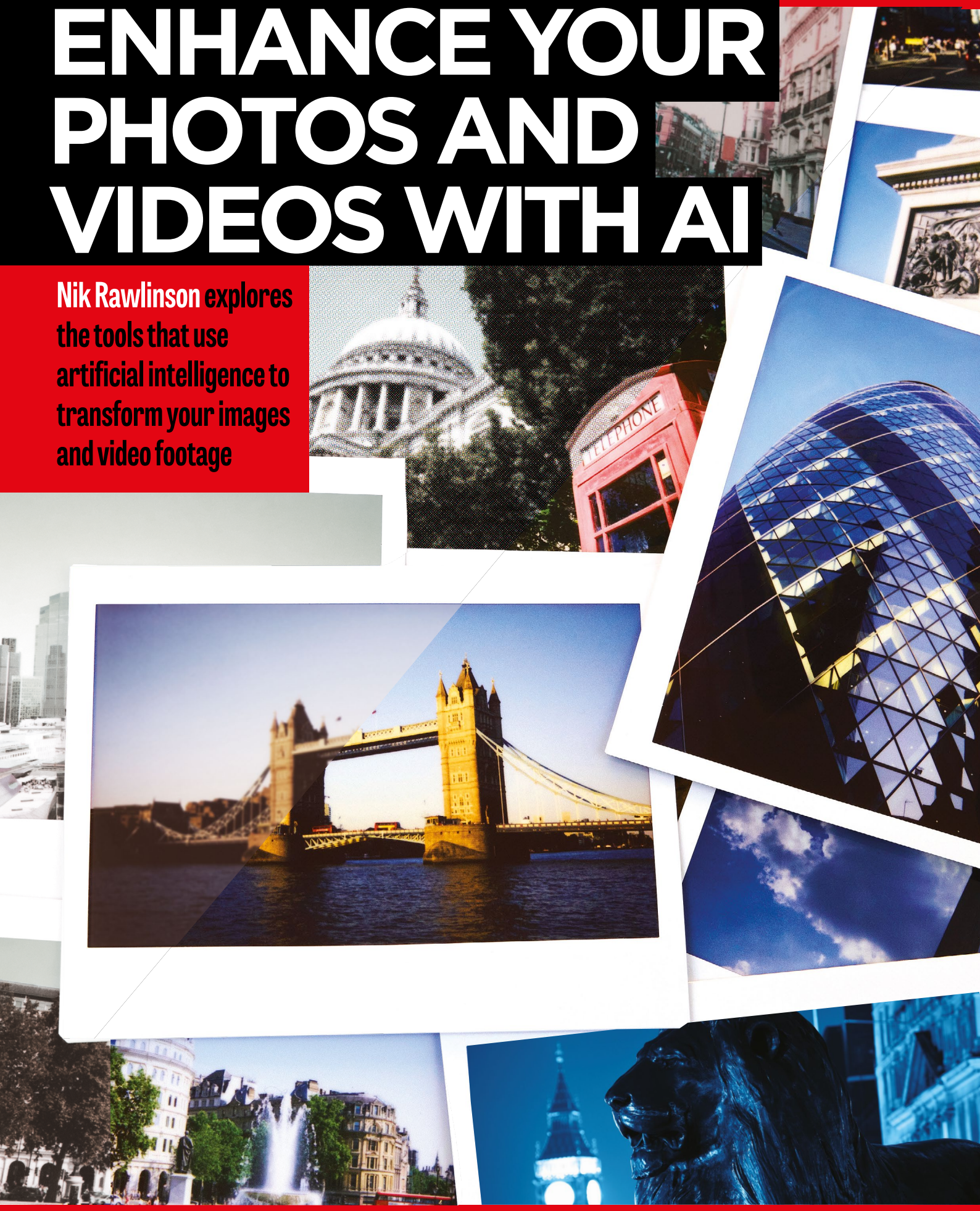
ABOVE Laptop cooling systems are closely integrated with the chassis and can't normally be replaced or upgraded

That said, there's never any harm in going for the best cooling system you can accommodate. Standard chips won't go above their set Turbo Boost speeds unless you manually overclock them, but with powerful cooling they may be able to use those top Turbo speeds more frequently and for longer, while keeping to their preset thermal boundaries.

IF YOU'RE SHOPPING FOR A COOLER UPGRADE, BE AWARE THAT DIFFERENT CHIPS MAY REQUIRE DIFFERENT FITTINGS

ENHANCE YOUR PHOTOS AND VIDEOS WITH AI

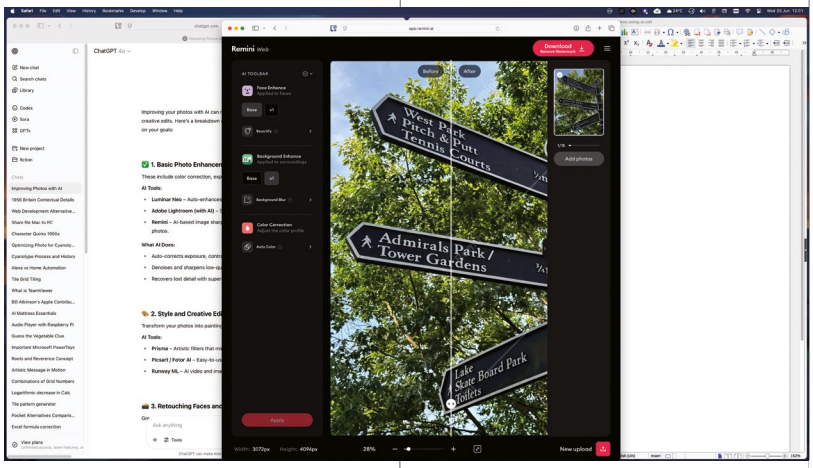
Nik Rawlinson explores the tools that use artificial intelligence to transform your images and video footage



We all know that AI has an uncanny ability to generate text, graphics and videos from scratch. But it can also work wonders with your existing photo and video content, applying complicated adjustments and edits that would be tricky and time-consuming to accomplish by hand, and producing professional-quality results – most of the time, at least.

Since AI operations demand a lot of computing power, the best services for working with images and videos almost always cost money – but depending on your requirements there are often cheap and free options available. Here's a rundown of what you can do, along with our favourite tools for such jobs, whether you're working with stills or moving images.

The best services almost always cost money, but there are often cheap and free options available



LEFT **Remini offers a wide range of AI-enhanced editing tools**

Upscale low-resolution photos and video

Low-resolution images are a pain. They look cheap on the screen, and even worse when you try to print them out. AI engines can do a highly effective job of upscaling pictures – especially portraits – by filling in missing detail, based on what they've learnt from looking at millions of other similar images.

If you just want to upscale one or two images you can do it for free using ChatGPT (*see the box on p45*). For more control, or to batch-process a large number of images, you'll want a specialised AI service. Remini (**remini.ai**) is one that's designed specifically to enhance the detail and sharpness of low-resolution images. Its default settings double the resolution of your image in each direction, up to a maximum of 4,096 x 4,096 pixels – big enough to print an A3 poster at around 250 DPI.

You don't need any particular skills to get the most from Remini. Just upload your image and it will be immediately upscaled using the default settings. A split interface lets you zoom and pan around the image for a closer look, and you can drag a slider to compare the original image with the result.

Additional options, revealed by clicking the Background Blur and Beautify drop-downs, let you soften the surroundings or apply a range of facial enhancements. There's also a tone control, offering a selection of preset colour filters. Even better, it can also enhance video files of up to 240 seconds or 240MB for Personal users – or twice as long on a Business subscription.

Subscriptions are offered on weekly, monthly or annual terms, starting at $6.99 a week for the Personal plan, which lets you upload 20 photos a week and download output in JPEG format. And to tempt you to try out the service, you can get your first week for just 99p.

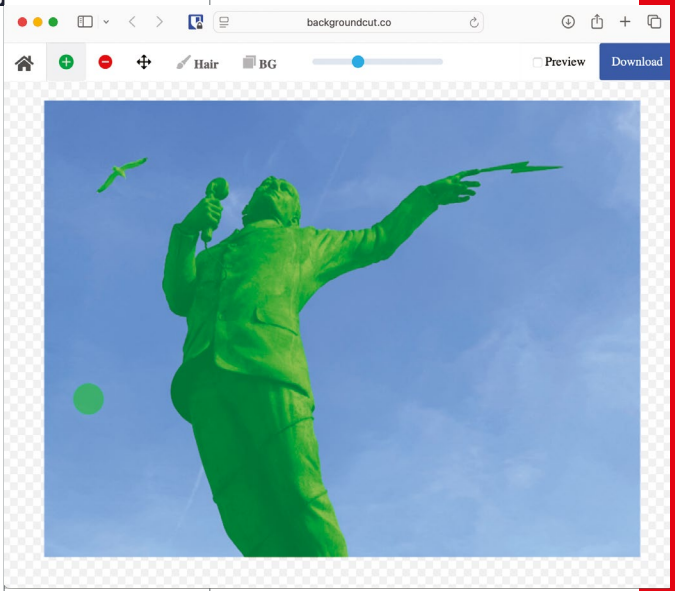
Render like a pro

If it's mainly videos that you want to enhance, UpscaleVideo (**upscalevideo.ai**) is well worth a look. It can quadruple video resolution – so 1080p becomes 4K and 4K becomes 8K – as well as sharpening your footage, reducing noise and compression artefacts and even batch-processing assets using drag and drop. It's available for Windows 11 machines with Nvidia GPUs, and Macs running macOS X 14 or later on Apple silicon; a personal licence costs $129, while commercial use costs $30 per seat per month.

Another professional option is Topaz Labs' Video AI 7 (**topaz.ai**), which can upscale videos of any resolution to 4K. It now previews renders as they export, supports EXR files with enhanced colour support, and can run locally or in the cloud. It's not exactly a value option, however: Video AI 7 costs $299 for a perpetual personal licence, and if you want to use it commercially you'll need to upgrade to Video AI Pro, which is available on a per seat, per year basis, at $1,099 for individual users or from $4,999 for teams of five. This also unlocks on-site multiple GPU rendering, so you don't need to share your footage with a third party for high-speed processing.

Fill the gaps

As well as extracting images from scenes, AI can add new content. Adobe Photoshop has long had an algorithmic Content-Aware Fill feature, but in recent years that's been joined by two new AI-powered capabilities called Generative Fill and Generative Expand. The former can be used to replace parts of an image with generated content, produced according to your direction and blended seamlessly into its surroundings. For example, if there's a car in the background of your family photo, you could use the marquee tool to select it, then tell Generative Fill to replace it with a bush or tree.



BELOW **BackgroundCut does just what its name suggests**

Generative Expand deals with the problem of photos that are cut off too tightly, or cropped to the wrong shape: it extends the image, using AI to generate realistic-looking details beyond the existing canvas. To use it, select the crop tool and use the grab handles to drag out, rather than in, from the existing edge of the frame. The default behaviour

will analyse the existing content and automatically produce new content to match – or, you can type a prompt to guide the generation process if you need greater control over what it produces.

Similarly, you can use AI to produce video content to pad out your existing footage. Google Gemini Veo 3 (**tinyurl.com/372googleveo**) is one of the most engaging recent arrivals: it's designed for producing eight-second videos, again based on text prompts, which makes it an interesting option for generating B-roll content for context or quick cut-aways. Such content is particularly useful when you want to disguise any edit that would otherwise result in a jump-cut.

You can use it in either Gemini or Flow, but note that it isn't included in the free tier – at a minimum, you must be on the Google AI Pro plan at £18.99 a month (although it's free in your first month if you want to give it a try).

Extract objects from their backgrounds

Another job for which AI is perfect is extracting images from their backgrounds, giving you a clean cutout. Again, if you just need to produce the occasional edit, ChatGPT can help, as we discuss opposite. For a more flexible approach, BackgroundCut (**backgroundcut.co**) is a tool that's specifically designed to identify the primary subject of your photo and extract it from its surroundings. We've found it impressively quick and accurate when working with photos of people, and you can use it for free if you only want to download images of 0.5 megapixels and smaller, while paying customers can download high-resolution extractions of up to 12 megapixels.

Once you've uploaded your image, BackgroundCut performs a first pass and presents a preview of the result. We've found it's usually very accurate right off the bat, but if need be you can manually refine the selection, using green and red brushes to mark areas that should be kept or removed. Your results can then be downloaded in PNG format, with transparent backgrounds.

Pricing is refreshingly simple, at $9 per month for unlimited single-image processing. For bulk processing you'll need to buy credits, costing $10 for 500 images, but be aware that these expire if not used within 60 days. You can also spend credits to use the API, which allows BackgroundCut to integrate with other tools such as Figma and WooCommerce, and there's a Chrome Extension in the works.

Add an image background

We've seen how AI can remove the background from an image; Envato's ImageEdit tool (**labs.envato.com**) goes the other way, creating a whole new replacement background for your picture.

We tried it with a photo of an insulated sports bottle from stock photography site Unsplash (**unsplash.com**); you can see the original photo in the thumbnail strip at the bottom of the screenshot below. Once ImageEdit had ingested the photo, we clicked Replace in the sidebar and entered the prompt "replace the background with a bench in a gym locker room so the bottle is sitting on the bench".

ImageEdit examined the image and within 30 seconds had finished interpreting our prompt. The result was the bottle on a bench you can see in the screenshot below, complete with arty shallow depth of field.

ImageEdit can be accessed as part of an annual subscription to Envato Elements. For individual users, this costs €14.50 a month and includes unlimited downloads from Envato's library of more than 22 million assets and templates, as well as AI-enhanced image, video and audio editing with a lifetime commercial licence for assets.

Add subtitles to your video

Video subtitles are a must for accessibility, and they can also increase engagement. For example, fast food giants A&W Canada found that adding captions to a video story on social media "increased watch time by 25%".

Manually typing and placing subtitles is a drag, but this is another area in which AI can help. If you're comfortable with the command line, you can use OpenAI's Whisper tool to automatically generate subtitles for free from all the most common audio and video file types. You can download the source code from **tinyurl.com/372whisper**, or grab an unofficial Windows installer from **tinyurl.com/372whisper-install**.

Manually typing and placing subtitles is a drag, but this is another area in which AI can help



BELOW **We used the karaoke style to add subtitles to this archive video from NASA**



LEFT **The bench and lockers in this photo are entirely AI generated**

If you prefer not to use the command line, another option is to try YouTube's auto-captioning service. Just upload your video – setting it to private or unlisted if you don't want it to be generally available – and let the site automatically generate subtitles for it. Once it's done, open the video and click "...more" in the description panel. Click "Show transcript" and then "Toggle timestamps"; you can now copy and paste the generated subtitles to anywhere you like.

For a professional solution, Magic Hour (**magichour.ai**) has a wide range of AI image- and video-editing capabilities, including creating videos from prompts, inserting new faces into existing footage and, yes, generating subtitles. It offers four subtitle styles, including a no-nonsense minimalist text-on-screen

option and an engaging karaoke style, in which each word turns yellow as it's spoken on the soundtrack. We found the results to be highly accurate with our test videos.

You can trial Magic Hour for free on any video of less than 50MB; the output will have a watermark, and will be limited in resolution, but you'll get a good idea of how the tool works. Paid plans start at £8.33 a month if you sign up for two years, or £10 a month if you'd rather not commit for that long. Note that the yearly plan lets you generate around an hour of subtitled output a month, while on the monthly plan this drops to seven minutes. Beyond this, pro and business plans increase the resolution and total amount of footage you can play with.

Keep things private... without keyframes

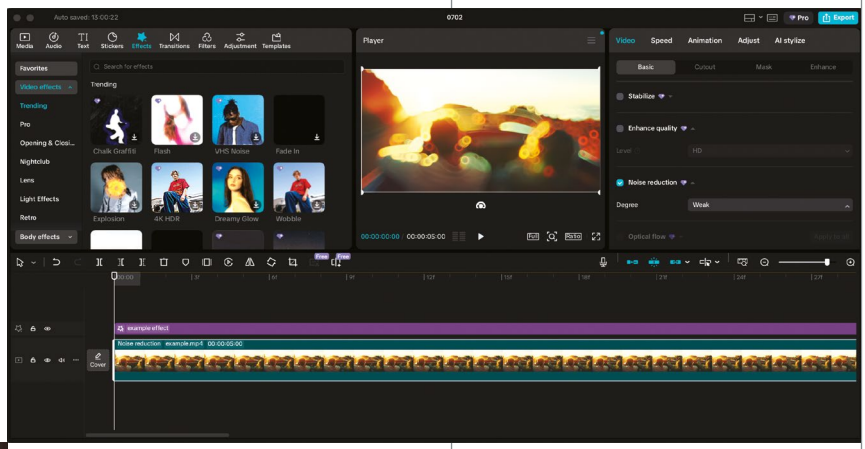
Sometimes you need to obscure elements in a video, such as someone's face or a car number plate. Traditionally, you'd handle this by applying a blurring effect to a specific region of the frame, and then moving it around to follow the underlying people or cars.

This can be tricky and tiresome, and it's another task where AI can help. The aptly named Video Blur AI (**blurvideo.ai**) service promises automatic recognition and tracking of both faces and licence plates, so you can blur every identifiable element in a busy scene without having to manually process each one.

If you prefer, you can be more selective: for example, you might only need to blur minors, or people who haven't given specific permission for their likeness to be included. Once Photo Blur has recognised all the faces in your footage, it will assign each one a number, after which you can specify which particular faces you want to obscure, and leave the rest in clear view.

Sharpen up sub-standard footage

While low-quality photography can sometimes be passed off as a deliberate, artistic choice, it's hard to get away with that in video. Noisy footage is usually a distraction, and unpleasant to watch for extended periods. If you can't re-shoot your raw material, AI can help clean it up.



ABOVE CapCut's built-in noise-reduction tool allows you to clean up low-quality raw video material

The free app-based version of CapCut (**capcut.com**) includes a built-in AI noise-reduction tool. In order to use it, first import your material, then drag it onto the timeline and select it. It will show with a white border to show that it's active; now click Video at the top-right of the adjustments panel, make sure that Basic is selected on the row below, then scroll down to "Noise reduction". Tick the box beside the heading, then select either Weak or Strong from the drop-down menu to determine the strength of the correction applied.

You'll notice that there's a diamond icon beside this feature, indicating that it's a pro-level function. Although you can see what effect the option has when you play back your edited video, you'll need to upgrade to continue using the tool in the long term. At the time of writing, this costs $9.99 a month or $90 a year.

As well as unlocking noise reduction, a CapCut subscription gets you several other AI tools, including relighting, expanding the video frame, lip sync and reframing. Some of these tools need permission to upload your media to CapCut's servers, which might be a privacy concern – but that's par for the course considering the computing power required for this type of function.

AI image editing for free with ChatGPT

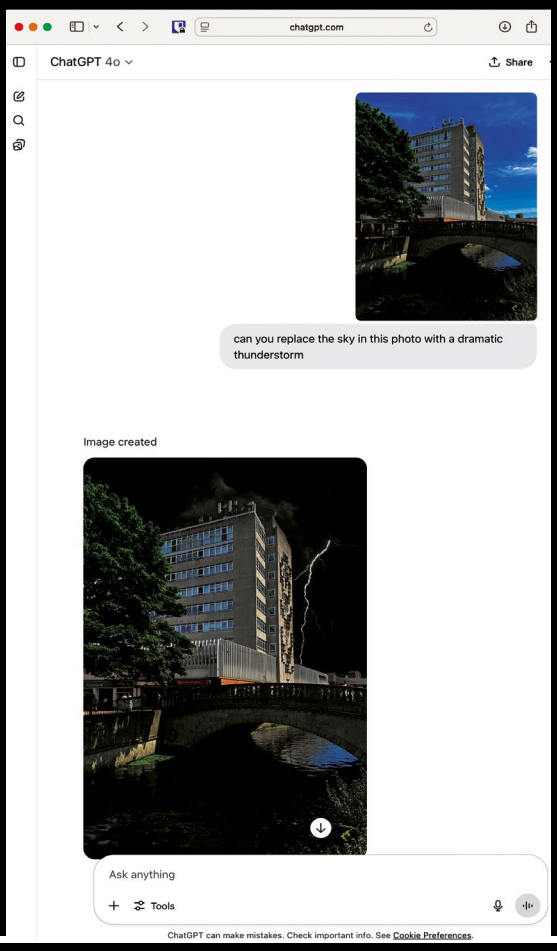
If you don't want to invest in a specialist AI-powered editing service, ChatGPT can do a surprisingly good job with images, even for free users. For example, you can upload a photo and ask the engine to resize it to your desired dimensions for an AI-upscaled version. The results might look a little airbrushed, but generally it's a lot better than just blowing up your low-resolution original.

It can handle more advanced operations, too. We asked ChatGPT to replace the blue sky in an uploaded image with a thunderstorm (see below) – and the 4o model did a fairly good job. It wasn't perfect: it didn't change the blue sky reflected in the river or correct the lighting on the building, but it's a good start. You might be able to improve things by refining the prompt.

We also asked ChatGPT to cut out the building from its background, which it managed with an impressive level of accuracy. We were then able to download the result as a PNG with a transparent background.

There are, however, two potential issues with using ChatGPT for image processing. One is that it lacks options for precisely tweaking and adjusting the results, unlike most dedicated tools. The other is that it comes with various practical limitations. Uploaded images must be 20MB or smaller, and if you're an individual user there's also an overall usage cap of 10GB, which rises to 100GB for organisations.

Free users can typically upload three images every 24 hours when using GPT-4o, although the exact number depends on load and recent rate-limit updates. Paid plans are limited to uploading 80 files in any three-hour period. You'll find further details on upload and usage limits at **tinyurl.com/372chatgpt-limits**.





FROM PHONE CALLS TO ROLL CALLS: 3CX HAS THE ANSWER

How Yellowgrid, a 3CX Platinum distributor, has taken advantage of 3CX Phone System's customisable nature to create a time-saving solution already embraced by over 100 UK schools

One of the many benefits offered by 3CX's Phone System is its flexibility. An award-winning platform in its own right, thanks to integrations from the company's trusted partners it can become a turnkey solution to problems facing an entire industry.

In the case we're examining here, that industry is education. In particular, the schools and colleges that need to do far more than answer the phones. Before they can take any action they have to be absolutely certain that the incoming caller is who they say they are – and to check for any safeguarding issues. Only then can they process absences or answer queries.

Now, 3CX partners have a solution to this in the form of a 3CX integration for the education-focused management information systems (MIS) from Arbor, SIMS, isams and Bromcom. In partnership with EdTechPro, Yellowgrid has created a complete solution that 3CX partners can provide to their clients.

We spoke to Craig Graham, founder of Yellowgrid, to find out more about this solution and the advantages it offers schools.

One example problem

One of the biggest challenges facing any school is handling the sheer volume of calls from parents and guardians. Each call needs to be handled efficiently and correctly, and if you're relying on manual systems then those two factors don't go hand in hand. The line could be fuzzy, there might be a language barrier, the school's call handler might simply mishear or mistype a name.

This is where calling line identification, or CLI, comes into play. "Because we're reading in the CLI of the parent, and that CLI is attached to a particular student, picking up the correct record is quick and accurate," said Craig.

ABOVE 3CX is helping schools and colleges with the huge volume of calls they receive

Normally, the school receptionist – or whoever is taking the call – would then need to jump around the various sections of the school's MIS to record absences for the different lessons attended by the child that day. Thanks to Yellowgrid's integration with all the most common systems, that becomes a matter of "a few clicks", said Craig.

But it can be even more automated than that. Thanks to 3CX's support for converting speech to text using AI, forward-thinking schools can encourage parents and guardians to leave voicemails which will then be automatically processed.

The 3CX advantage

This level of automation and integration is made possible thanks to the fact that the 3CX Phone System is designed for customisation. "3CX is a bit like a jigsaw puzzle in that you can piece it together how you see fit," said Craig. "This allows us to do things like provide solutions specifically for certain verticals, like education, to make 3CX more attractive in that particular market."

This means that 3CX distributors such as Yellowgrid can create custom solutions that solve specific problems, or simply enhance the 3CX offering, which it then offers to resellers. "Once we solve the problem, we then offer these solutions downward through the channel, which will then hopefully hit the end user – in this case, schools and academies and trusts," Craig explained.

Take part of the problem mentioned above, where a school uses a specialist MIS. 3CX is a global company and already provides integrations with popular MIS systems such as Salesforce and Microsoft Dynamics. But there are hundreds, thousands of MIS systems out there, many of them hitting specialist verticals such as education. Companies like Yellowgrid, with its team of technical

experts who specialise in 3CX, are there to ensure that when resellers implement 3CX they already have a solution in place.

A collaborative story

Craig and his team were already working on an integration for schools when he came across work done by a tech solutions company that specialises in education called EdTechPro. Rather than work separately, Yellowgrid and EdTechPro collaborated to produce turnkey solutions for the different MIS systems.

The division of labour was simple: EdTechPro continued to develop its integration with specialist education MIS systems such as Arbor, and Yellowgrid concentrated on its strength: creating a compelling solution based on automation.

"What we are very good at is the whole automation of deploying 3CX customised for the needs of the end user, so that they don't have to do things like add SIP trunks, add numbers, add extensions, add MAC addresses to devices. All that is automated from end to end through our DevOPs teams."

This means you avoid the manual process of deploying 3CX on a virtual machine or in the cloud; you can even skip the process of choosing the right phones as Yellowgrid, a Fanvil and Yealink distributor, will handle all this for its resellers.

Early successes

Despite being a relatively new product, Craig estimates that over 100 schools have already switched to its latest solution. "We introduced this concept to a small number of 3CX partners who focus within the education sector and they've loved it, the schools have loved it."

A big part of the appeal is that it solves a problem for multi-academy trusts; these days, groups of schools in England are usually run by a trust rather than the local education authority.

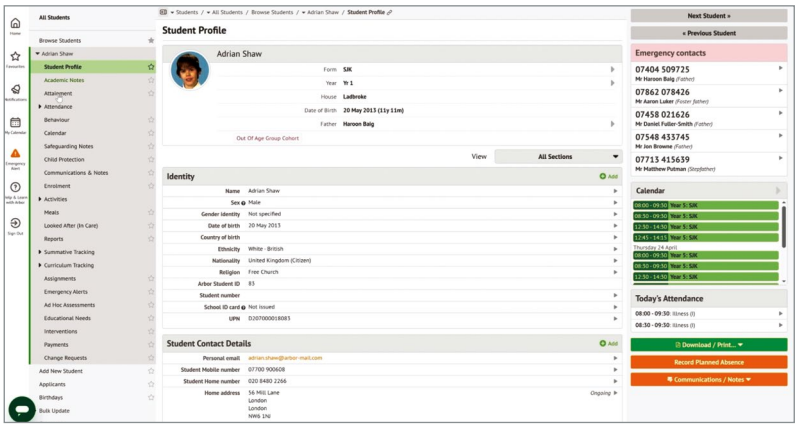
"The academy trust wants a single phone system to serve a bunch of local schools, but each of those schools has got its own individual MIS," said Craig. "Our middleware will allow a single 3CX system to connect to multiple MIS systems, so in that way we've solved the problem of academy trusts getting the economies of scale of having a single phone system to serve multiple schools."

As with any development, this isn't finished. In fact, Yellowgrid only added the AI-transcribed voicemail in response to demand from early customers. "That's proven really popular, actually," said Craig.

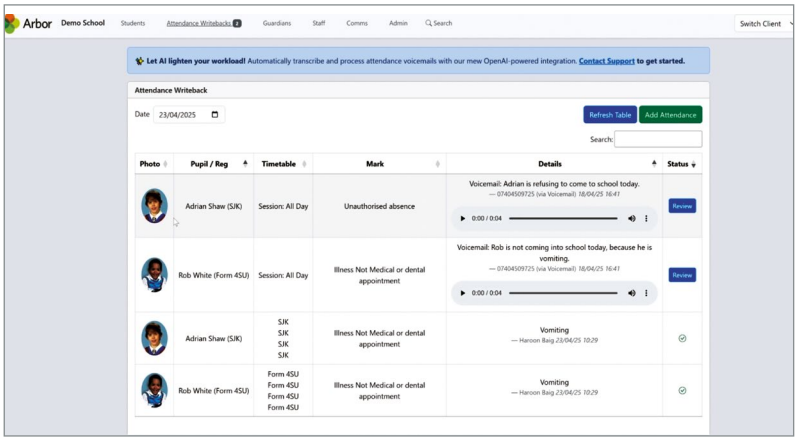
Any other surprises? "I suppose the only surprise is how well it's been received, because 3CX has got a lot of advantages for education based on its licensing method," he said, referring to the fact that you only pay for the maximum number of simultaneous calls rather than individual phone numbers.

And the opportunities will only grow. Yellowgrid has already noticed more education-focused queries since it started offering the integration, and with many schools stuck on PSTN systems – which will need to be replaced by VoIP by January 2027 at the very latest – he expects this to only increase. Fortunately, migrations can normally be completed during any of the school holidays.

They're also benefiting from schools who jumped early to a VoIP system and haven't had the best experience. "Other schools have fallen foul of adopting the first VoIP platform and finding it not really doing what they were hoping it would do, particularly with the multi-academy trusts."



ABOVE **The Yellowgrid solution allows schools to bring up calling line identification in an instant**



BELOW **Yellowgrid added AI-transcribed voicemail in response to customer demand**

10 REASONS 3CX MAKES SENSE FOR EDUCATORS

1 No per-user pricing

Due to 3CX's simultaneous call price model, schools pay based on the number of simultaneous calls rather than per user. This alone can cut costs dramatically compared to rival systems.

2 No expensive hardware

While you can buy dedicated IP phones, 3CX will work directly on computers and apps on phones and tablets (Android and Apple).

3 Simple & quick setup

Working with your preferred partner, a 3CX deployment is typically completed quickly and with minimal disruption – even across multi-site academy trusts.

4 Brilliant MIS integration

As the Yellowgrid example makes clear, one of 3CX's greatest abilities is being able to be tailored to specialist MIS systems.

5 Flexible hosting

You can host 3CX where you like: on-premise, in the cloud or via a managed provider.

6 Call recording and logging

When it comes to safety and complying with safeguarding policies, you need a platform that will keep a log and record of all calls.

7 AI transcription

Going several steps beyond call logging, transcription allows easy analysis of your calls and makes searching records a breeze.

8 All-in-one platform

With voice, video, chat and CRM integration, you have everything you need for parents and staff alike.

9 Easy to scale

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Samsung Galaxy Z Fold7

No S Pen support and a bonkers price, but this is a gorgeously thin and light foldable with a magnificent 8in internal display

PC PRO RECOMMENDED

SCORE ★★★★☆

PRICE 256GB, £1,499 (£1,799 inc VAT)
from samsung.com/uk

I've used many foldable phones over the past couple of years, but none has tempted me to buy one myself. Until now.

For the Galaxy Z Fold7 is not just another iterative upgrade. Thanks to aggressive slimming down and re-engineering, Samsung's latest folding design finally manages to feel like the best of both worlds, not a clunky trade-off between a phone and a tablet. It's deliciously thin and light, yet offers masses of screen space, excellent cameras and no compromise in raw power.

Now, let's get the difficult part out of the way. At £1,799 inc VAT, this is one of the most expensive phones you can buy. And that price is for the base model with 256GB of storage and 12GB of RAM; you'll pay £2,149 for 1TB of storage and 16GB of RAM.

In return, you're buying a real prestige phone. It looks great whichever of the four colours you choose: if you want to stand out, pick the bold Blue Shadow option. If you don't like that, go for Jetblack or Silver Shadow. There's also a Mint colour exclusive to buyers on **samsung.com**.

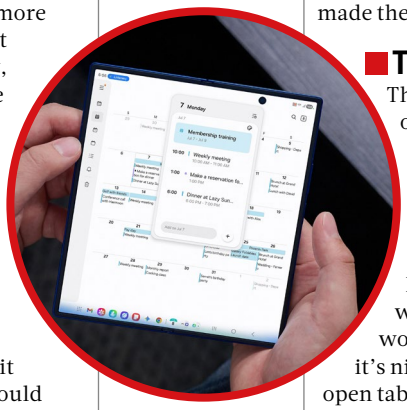
Thin, light and sturdy

Whichever finish you go for, the design is such a huge improvement over the Z Fold6 (*see issue 360, p72*) that it feels like a totally new device. It's so lightweight I was pleasantly surprised every time I picked it up.

At the same time, Samsung claims that it has made the Fold7 far more durable, with a new hinge that distributes stress more evenly, plus stronger materials for the frame and display. It feels robust in the hand, despite being only 4.2mm thick when unfolded, and I love how the hinge barely protrudes when closed.

I do have quibbles with the design. The rear camera bump is quite thick, so the phone wobbles when you set it down on a table. The casing could also be easier to open – it's so thin you have to dig your nails in. And, as with most foldables, the IP48 rating means it's water-resistant but vulnerable to particle intrusion, so in dusty environments you'll need to handle it with more care than a traditional handset.

ABOVE The main display has grown from 7.6in to 8in – a noticeable boost



ABOVE The crease across the display is totally inconspicuous

A final disappointment is that, unlike Samsung's previous Fold phones, the Fold7 doesn't support the S Pen stylus. That's a pity, as the large display is well suited to pen-style input, but this feature had to be sacrificed in the name of thinness – and when you hold the phone in your hand, it's hard to say Samsung made the wrong choice.

Three brilliant screens

The Galaxy Z Fold7 brings not one but three major display improvements over last year's Z Fold6. For a start, the main inside display has grown from 7.6in to 8in which is a noticeable jump. I appreciated the extra space whether watching videos or working on spreadsheets – and it's nice being able to see multiple open tabs at once in Chrome.

Samsung has also done excellent work in making the crease across the display as unobtrusive as possible. It's still there, but so inconspicuous that I

Photo gallery

One of the Galaxy Z Fold7's biggest strengths is its camera setup, which can even match the flagships – not something we said about the Fold6 (images: Mark Spoonauer/Lance Ulanoff)



A superb start for the Fold7's main camera, with flowers in popping blue and a light haze to the fountain



The Fold7's 12MP ultrawide has a solid 120° degree field of view and is capable of expansive shots



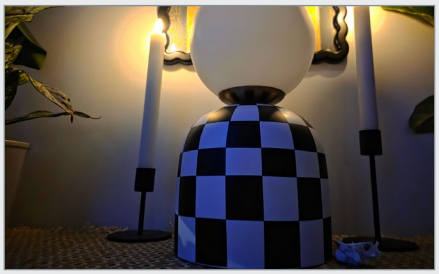
Shoot at the main camera's full 200MP and you can crop in for superb levels of detail



The Fold7 delivers detailed macro shots using the 12MP ultrawide camera – better than the Fold6



The Fold7 competes well with flagship competition for portraits, with great colours and definition



Indoors the Galaxy Z Fold7 struggled with focus in a dark room with two candles for lighting

forgot about it. One of the biggest complaints about early foldable phones is now basically a non-issue.

Finally, the cover display has grown, too: it's now 6.5in, up from 6.3in on the Fold6. The extra width makes typing more comfortable, and I had no problem checking emails, responding to Slack messages or changing tracks on Spotify without opening the phone.

Brightness and colour performance on both screens are as good as you could ask for. In our tests, the Z Fold7's main display achieved a peak brightness of 2,310cd/m², easily beating the 1,860cd/m² of the Galaxy S25 Ultra (*see issue 367, p70*). The main display also covered 96% of the DCI-P3 colour space in Natural mode and 105% in Vivid mode – an excellent result that ensures apps, games and videos all look fantastic.

Upgraded cameras

A less visible change is to the main camera, which now includes a 200MP sensor rather than 50MP in the Fold6. Pictures look more detailed, and it's good to have more scope to crop shots. My sample image of a fountain in a park came out with colours that really pop, and subtle but beautiful background blurring that, for my money, looks better than the same scene shot on an iPhone. Portraits have great separation between subject and background, too, and colours are again bright and vibrant.

The 12MP ultrawide camera, meanwhile, has been upgraded with autofocus, so you can now enjoy gloriously sharp macro shots. And while I don't like the way the new 10MP punch-hole selfie camera intrudes on the display, I can't deny that it takes better photos than the old under-screen one on the Z Fold6, with cleaner definition and richer colours.

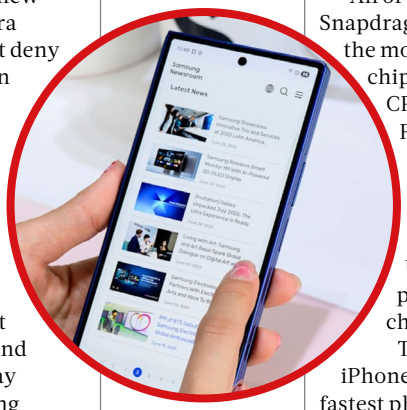
The Galaxy Z Fold7 is also super smart when it comes to AI-powered photo edits. A tap of the Eraser button automatically identified a bunch of passers-by to zap out of my photo – two more taps and they were gone. The big display works brilliantly for comparing before and after shots; for example, using tools that turn you and your friends into a comic, a 3D cartoon, a watercolour or a sketch.

The Fold7 is also a great choice for video capture, with up to 8K at 30fps. I can't complain about detail or exposure, while Audio Eraser is on hand to remove background noise (it works on audio-only recordings, too).

Processor and battery

In terms of speed, the Galaxy Z Fold7 is a terrifically capable phone. It easily ran three apps at once on the big screen, courtesy of Samsung's multi-window mode, without a hint of lag or stutter. In the open-world RPG *Wuthering Waves*, graphics looked stunning and packed with detail – and the frame rate stayed smooth as I battled a ginormous monster and ran for my life.

BELOW Samsung has increased the width of the front display to great effect



All of this is courtesy of a Snapdragon 8 Elite processor, one of the most powerful smartphone chips around. In the Geekbench 6 CPU benchmark, the Galaxy Z Fold7 achieved superb scores of 3,052 for single-core performance and 9,735 in the multicore test. That's on a par with the Galaxy S25 Ultra, so there's really no performance penalty for choosing the folding phone.

The Fold7 also beat the iPhone 16 Pro Max – currently the fastest phone Apple offers – in the 3DMark graphics test. The Samsung averaged 41fps in the demanding Solar Bay Unlimited portion of the test, while the iPhone managed only 28fps.

"It's deliciously thin and light, yet offers masses of screen space, excellent cameras and no compromise in raw power"

There's only one part of the hardware that doesn't impress, and that's the battery. The Fold7 uses the same 4,400mAh unit as its predecessor, and with a screen this size that's not enough to guarantee all-day usage. In our tests, the Galaxy Z Fold7 achieved a mediocre 10hrs 55mins of surfing the web over 5G, so if you want to run demanding apps and games you're liable to need a top-up before bedtime. For comparison, the



Galaxy S25 Ultra and iPhone 16 Pro Max both lasted more than 17 hours in the same test.

Recharging isn't all that speedy, either. The phone charges at a relatively slow 25W, and I found that a full half-hour of charging only got me back up to 54%. Wireless charging is stuck at 15W.

OneUI and AI

The Galaxy Z Fold7 runs Samsung's One UI 8 software, which is based on Android 16. Most of the features here are the same as on the S25 Ultra, but Samsung deserves credit for making them not only work well, but tuning them for a foldable phone.

For example, I love that you can long-press the Z Fold7's side button to quickly open a live audio and video chat with Google's Gemini Live AI assistant – and the window pops up in the corner of the screen, so it doesn't cover the app you're using. You can even access Gemini while you're playing a game: I asked where I should go next in *Wuthering Waves* and the AI gave me directions to the next checkpoint. When you're talking to Gemini you'll see an indicator in the top left corner that it's listening, which you can tap to pause or turn it off at any time.

Google's Circle-to-Search feature gets an upgrade in One UI 8, too: you can now use it while playing a game and access instant tips or find out more about characters or enemies. And when you're using the multi-window feature, another perk is that you can drag and drop AI-created content from one window to another, including images.

For some, the star of the show will be the new version of Samsung's Studio video editor, which takes full advantage of the expanded screen to support multi-layer editing. For creators, it's an amazing boon to be able to assemble advanced edits directly on the device – and for now it's exclusive to this phone.

Like other premium Samsung phones, the Galaxy Z Fold7 comes with seven years of OS and security updates. However, it only includes six months of access to Gemini Advanced, while Google's Pixel phones benefit from a full year.

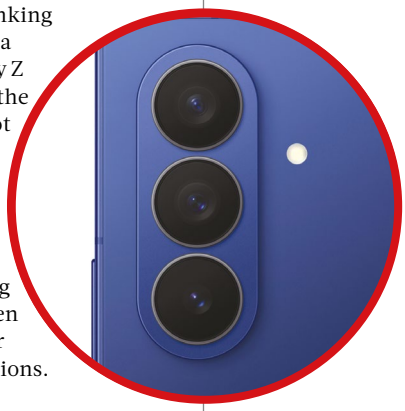
A promise fulfilled

The Samsung Galaxy Z Fold7 is a triumph of engineering and design. It packs in larger displays than before, while making the body so thin and light you forget that you're carrying a foldable. There's enough power for seamless multitasking, with AI features that shine on the bigger canvas, and the camera system is top-notch, too.

There's no denying that the price is a challenge. Other negatives: the phone's less than impressive battery life and the lack of stylus support. Most people looking for a high-end phone will probably be happier with the Galaxy S25 Ultra, which lasts longer and has even better cameras for hundreds of pounds less.

But if you're thinking about splurging on a foldable, the Galaxy Z Fold7 is absolutely the one to go for. It's not just the best foldable phone on the market, it's the first that delivers on the folding vision that Samsung and others have been inching towards for the past six generations.

MARK SPOONAUER



BELOW The trio of cameras delivers fantastic results

SPECIFICATIONS

8-core 4.32GHz/3.53GHz Qualcomm Snapdragon 8 Elite SoC • 16GB RAM • Adreno 830 graphics • Hexagon NPU • 6.9in foldable 120Hz AMOLED screen, 1,224 x 2,992 resolution • 4in AMOLED 165Hz cover screen, 1,272 x 1,080 resolution • 512GB storage • IP48 • dual 50MP/50MP rear cameras • 50MP selfie camera • 5G • Wi-Fi 7 • Bluetooth 4 • USB-C 2 connector • 4,700mAh battery • Android 15 (3yr OS updates) • open, 74 x 7.2 x 172mm (WDH); closed, 74 x 15.7 x 88mm (WDH) • 199g • 1yr warranty



BELOW The Galaxy Z Fold7 is currently the best foldable phone on the market

Samsung Galaxy Z Flip7

The bigger "Flex" display is the undoubted star, and it's now more flexible than ever thanks to AI enhancements

SCORE ★★★★½

PRICE 256GB, £874 (£1,049 inc VAT) from samsung.com/uk

While it doesn't have the high-end internals of the Fold7, the Z Flip7 is a compelling phone in its own way – and far more affordable. The standard model comes with 256GB of storage at £1,049, with the 512GB version costing £1,149, so it's very much on a par with its arch rival, Motorola's Razr 60 Ultra (*see issue 370, p46*).

The Flip7 comes in four colours, including vibrant Coralred; you can choose the same elegant Jetblack and Blue Shadow options as the Fold7, or Mint if you buy from Samsung's website. Like its predecessors, the Flip7 has flat edges that dig into your hand, and it remains tricky to open one-handed, but there are welcome changes. For a start, it's thinner at 6.5mm thick when opened. It's also a little heavier at 188g – but that's excusable because both the inner and outer displays are now larger than on previous models.

The construction is tougher, too, thanks to the new "Armor FlexHinge". However, the phone keeps the same IP48 rating as before. And while it might be harder to break, my test unit soon picked up scuffs from daily use, so consider slapping on a case.

Screen upgrades

One of the most significant changes is to the size and shape of the outer screen. Where Samsung's previous Flip phones cut off the screen around the camera surrounds, the Flip7's cover display flows around them, while also ditching the black bezel in favour of an edge-to-edge display. This extra space makes a huge difference: at last I feel comfortable catching up on my emails or shooting video on the cover screen.

I wish the outer display had native support for all apps, like the Razr 60 Ultra, but you only need install the Samsung Good Lock app from the Play Store to enable third-party software to run on the outer display. The app does a good job of shrinking your apps so that the cameras don't get in the way.

The inner display enjoys a size bump, too, up from the 6.7in diagonal

of the Flip6 to 6.9in. That may not sound much, but it definitely improves the experience of running two apps simultaneously. Its quality is also impeccable: I measured a peak brightness of 1,989cd/m², and colours look great even at acute angles. While there's still a visible crease across the middle of the display, it's not as deep as on previous Flip models and easy to ignore. I was more than happy watching videos on this screen, even on sunny days.

Camera questions

It's a shame that the Galaxy Z Flip7 doesn't get the same sort of camera upgrade as the Fold7. Everything remains as it was on the Z Flip6, with a 50MP main sensor, 12MP ultrawide and 10MP selfie camera.

Still, these do a decent job. In test shots of my garden the Flip7 captured plenty of detail around tree branches, producing a striking image with strong contrast. And while there's no optical zoom, digital scaling works well: at 2x magnification you can barely tell the image has been artificially enlarged, and Samsung's "ProVisual Engine" does an amazing job of keeping things clean and clear even as you approach the maximum 10x zoom – definitely better than the results I saw from the Motorola Razr 60 Ultra.

The Flip format also remains brilliant for creators, due to the way you can fold it around and orient the screens and cameras however you want. Pairing the larger display with the rear cameras helped me frame myself, and I love how I can have both the main and outer screens running at the same time. The Galaxy Z Flip7 can shoot video at 4K resolution at up to 60fps, and it's all supported by the most robust software out there: Samsung's native camera app offers manual controls for both stills and video, portrait video mode, LOG recording and much more, making this feel like a serious photographic tool.



PC PRO RECOMMENDED

LEFT **With a larger inner display and a tougher hinge, the Flip7 is a fine upgrade**

"The extra space makes a huge difference: at last I feel comfortable catching up on my emails or shooting video on the cover screen"

Power pack

Inside, the Flip 7 is powered by Samsung's new 10-core Exynos 2500 chipset. This doesn't match up to the market-leading Qualcomm Snapdragon 8 Elite, as found in the Motorola Razr 60 Ultra, but it's not a million miles off. In the Geekbench 6 benchmark the Flip7 managed single- and multicore scores of 2,286 and 8,079 respectively, suggesting that it's around 80% as fast as the Razr.

After putting in some playing time with *Age of Origins* and *Diablo Immortal* on the Galaxy Z Flip7, I can say that I didn't notice any difference in the experience between this and other phones. Spells that I cast in *Diablo Immortal* didn't cause the frame rate to drop; large battle sequences in *Age of Origins* didn't stutter.

To go with its larger screen, the Z Flip7 packs a slightly bigger battery than the previous generation, with capacity increased from 4,000mAh to 4,300mAh. I found the phone lasted even longer than that modest boost would suggest: where the Flip6 gave us 11hrs 1min of web surfing on a full charge, the Flip7 hung on for 12hrs 24mins. That's still some way short of the Razr's 15hrs 42mins, but a full charge of the Flip7's battery got me through the day with no issues. The main frustration is you're stuck with a maximum 25W charging rate: after 15 minutes, a flat battery only got to 29%.

Snap decision

The Z Flip7 runs the same One UI 8 system software as the Fold7, and this is great for multitasking. A handy split-screen mode lets you easily run two apps stacked vertically, and you can optionally float a third one over the top in a pop-up view. The new multimodal capabilities of Gemini Live are here too, enabling Google's AI assistant to tap into the camera, see the world around you and give advice and information about your surroundings.

Other additions include the Now Brief and Now Bar, which offer rich live notifications, and cross-app actions, which let you use voice commands to perform complex tasks that involve multiple apps. For me, the biggest addition to the software is Samsung DeX, which lets you hook up a monitor to the phone for a full desktop PC-like experience.

While the Galaxy Z Flip7 trails behind the Motorola Razr 60 Ultra in raw performance and battery life, in my view it delivers a better overall experience, especially with its new, larger cover display. Although light and compact, it packs in plenty of big features for a price that's a lot less alarming than that of the Fold7. And no other phone format matches the utility of the Flip when it comes to shooting photos and video. **JOHN VELASCO**

BELOW **Google's AI assistant Gemini can provide context-sensitive information**





LEFT **The outer screen now flows around the camera lenses, giving you lots of extra space**

SPECIFICATIONS

10-core (3.3GHz/2.7GHz/2.4GHz/1.8GHz) Samsung Exynos 2500 SoC • 12GB RAM • Xclipse 950 graphics • 6.9in foldable 120Hz AMOLED screen, 1,080 x 2,520 resolution • 4.1in cover 120Hz AMOLED screen, 948 x 1,048 resolution • 256GB/512GB storage • IP48 • 5G • dual 50MP/12MP rear cameras • 10MP front camera • Wi-Fi 7 • Bluetooth 5.4 • 4,300mAh battery • USB-C 3.2 Gen 2 connector • Android 16 with One UI 8 (7yr updates) • folded, 75 x 13.7 x 86mm (WDH); unfolded, 75 x 6.5 x 167mm (WDH) • 188g • 1yr warranty

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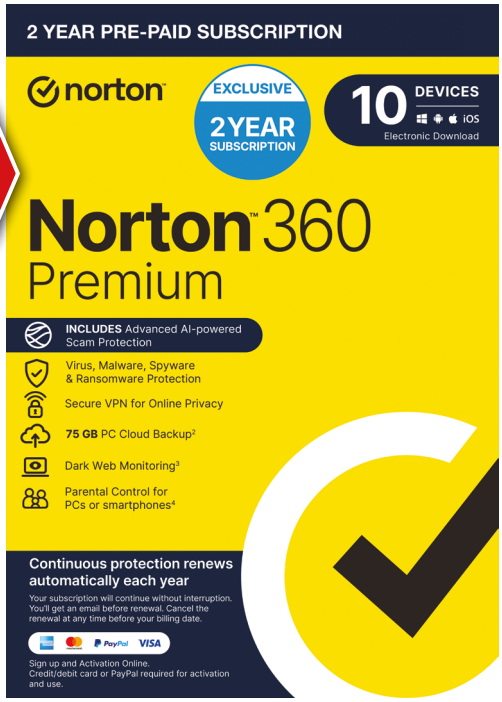
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There's also 75GB of cloud storage for secure backup, while Norton's Dark Web Monitoring service will alert you if private details – such as your email address and passwords – have been compromised online.

Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, allowing you to set browsing times and restrictions, and you also get GPS location monitoring for Android and iOS.

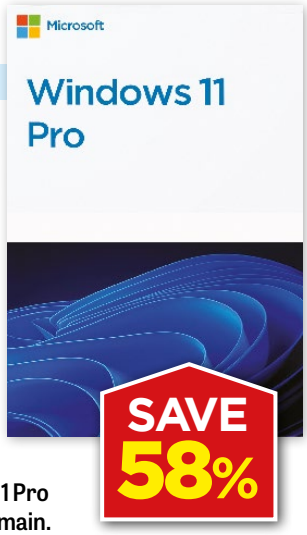
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Laplink PCmover Express (*see p32*) is a brilliant way to migrate your PC to Windows 11, but the one thing it can't move is your applications. For that, you need Laplink PCmover Professional 11, and we're offering a single-migration licence for £34.95, a 30% saving, or a licence for migrating three PCs for £49.95. That's half price!

In return, you're buying a powerful tool that can automate the transfer of applications, settings and files from one PC to another. If your system has several user accounts, PCmover Professional can transfer any or all of them, preserving the security details about who owns which files.

If you're moving from one PC to another, then as long as you can connect the two – either directly or on the same network – PCmover Professional can transfer your data at super-high speed. Can't connect the PCs? The program can also save the data from your old system to a file, for instance on an external drive.

If you run into any problems, your licence includes free support from Laplink via a dedicated freephone number in the UK.

Nothing Phone (3)

The most expensive Nothing phone yet also packs in the latest tech, a zoom camera and a distinct design

SCORE ★★★★☆

PRICE 256GB, £666 (£799 inc VAT)
from nothing.tech

Let's get the painful bit out of the way: the Nothing Phone 3 costs £200 more than 2023's Nothing Phone 2 (*see issue 349, p72*). That puts it head to head with the Samsung Galaxy S25 and Google Pixel 9, but as usual with Nothing it offers a specification, a design and, most of all, an attitude all of its own. The standard model comes with 12GB RAM and 256GB of storage – a good amount for a phone of this price – or you can go up to 16GB RAM and 512GB storage for another £100, which isn't bad for twice the storage capacity and a third more RAM.

Whether you choose the black or white finish, the Phone 3 makes a visual statement. With its transparent back panel, exposed screws and as many greebles as the sides of a starship, it's unmistakably a Nothing handset. However, the signature pulsing lights on the rear have been replaced with the Glyph Matrix – a small circular display that's capable of communicating far more than the old LEDs could, and which can be controlled with a dedicated action button on the rear.



The main display is a step up from the Phone 2, with a higher resolution, higher brightness ratings and faster touch sampling, along with the same 120Hz adaptive refresh rate. It hits around 850cd/m² outdoors and 1,200cd/m² with HDR content, so not quite as bright as the Google Pixel 9 Pro XL, which outshines all other smartphones we've tested.

Another notable change is the addition of a 3x telephoto camera to the previous model's main and ultrawide cameras, all of which offer a native 50MP resolution. Images don't quite match up to the best phones on the market: they're good, but my tests shots looked flat compared to the Google Pixel 9 Pro XL, and not as sharp or detailed as those taken on the Samsung Galaxy S25 Ultra. Still, the new zoom module works well, picking up lots of colour and detail. I'm pleased to see a telephoto macro mode too.

Inside, a mid-range Snapdragon 8S Gen 4 processor runs the show. While the Phone 3 lagged behind the Galaxy S25 in the Geekbench CPU and 3DMark GPU tests, returning 2,159/6,800 in the former and 4,153 in Wild Life Extreme Unlimited (the S25 scored 2,916/9,885 and 5,841 respectively) the gap isn't noticeable in everyday use. I could happily play *Ex Astris* with maximum graphical settings at a solid 60fps – and while the phone did get rather hot in the top left corner, I had no problem holding it perfectly comfortably.

The Phone 3's battery uses the latest silicon-carbon materials to make the cell more energy dense, meaning it can cram 5,150mAh of capacity into a compact space. However, in my YouTube-based battery test I found the Phone 3 drained 22% of its battery after three hours of continuous playback, while the Galaxy S25 Ultra and Pixel 9 Pro XL, both with similar-sized batteries, only dropped by 15%.

Still, recharging is quite quick. Using a generic 50W charger I could take an empty battery back up to 39% in 15 minutes, 68% in 30 and 100% in 52 minutes. Nothing promises it will take 19 minutes to reach 50% using one of its own 65W chargers, and there's support for 15W wireless charging, too.



LEFT The Glyph Matrix display on the rear can show a variety of useful information



ABOVE The distinctive Nothing look makes a real statement

LEFT A 3x telephoto lens has been added to the main and ultrawide cameras

The Nothing OS 3.5 software is based on Android 15, with a dot-matrix look and mono colour scheme that emphasise the Phone 3's uniqueness. The most notable custom feature is the Glyph Matrix, which supports a wide variety of functions. Some are purely practical, such as showing your battery level, the time of day or acting as a digital spirit level; others are purely for fun, such as the Spin the Bottle, Magic Eight Ball and Rock-Paper-Scissors modes. I like all of them, and an SDK is available for third-party developers to add their own functions.

The Essential Space and Essential Key features have returned from the Nothing Phone 3a, to quickly capture screenshots, photos and voice memos, and catalogue the info they contain. A new Essential Notifications feature smartly filters notifications based on contacts, apps and keywords – then pops up glyphs on the back, to alert you about what awaits you when you turn the phone over.

If you're hungry for more, Nothing OS 4 (based on Android 16) is promised by the end of the year, along with five years of further OS updates beyond that and seven years of security updates. That's not quite on a par with Samsung and Google's seven-year pledges, but it should cover the whole time you're likely to be using this phone.

The Nothing Phone 3 is clearly no ordinary smartphone, and that may put many people off. The substantial price increase over last year's Nothing Phone 2 stings, too. However, the extra cash pays for a fine hardware specification: if you like novelty and personality from your tech, while still needing a handset that's powerful and versatile enough for everyday use, there's really nothing else out there like the Phone 3.

RICHARD PRIDAY

"If you like novelty and personality from your tech, there's really nothing else out there like the Phone 3"

SPECIFICATIONS

8-core (3.2Hz/3Hz/2.8GHz/2GHz) Qualcomm Snapdragon 8s Gen 4 SoC; 12GB/16GB RAM • Adreno 825 graphics • 6.7in 120Hz AMOLED screen, 1,260 x 2,800 resolution • 5G • 256GB/512GB storage • dual nano-SIM • IP68 • triple 50MP/50MP/50MP rear cameras • 50MP front camera • Wi-Fi 7 • Bluetooth 6 • NFC • 5,150mAh battery • USB-C 2 connector • Android 15 (5 major updates) • 76 x 9 x 161mm (WDH) • 218g • 1yr RTB warranty

Lenovo Yoga Book 9i Gen 10 (14in Intel)

A well-thought-out dual-screen laptop, offering strong performance and usability but limited battery life



SCORE ★★★★☆

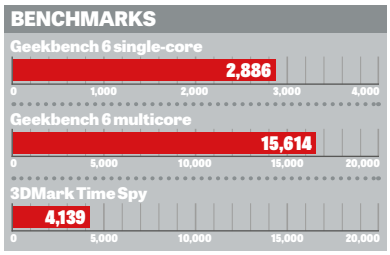
PRICE From £1,658 (£1,990 inc VAT) from lenovo.com

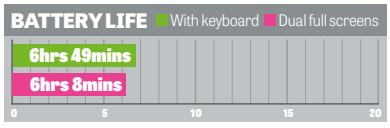
Sci-fi filmmakers understand a simple truth: nothing says futuristic tech quite like a keyboard-free design. The Lenovo Yoga Book 9i Gen 10 embraces that vision, greeting users with two stunning 14in OLED displays and not a button in sight – unless you include the bundled, detachable keyboard.

For those of us who live in the here and now, the question must surely be: why? Essentially, as with the first such Yoga Book 9i (*see issue 347, p64*), the more recent Asus Zenbook Duo UX8406CA (*see issue 368, p52*) and the various "Fold" designs based around a single, foldable OLED screen, the answer is to give you a laptop design when in cramped conditions and a mini desktop when you have the space.

For those Fold devices, the screen opens up to become a large screen with the keyboard floating below. For these cheaper dual-screen versions, it's all about the screen setup. One can sit atop the other, they can go side by side or you can set them up in tent mode.

The "why" then depends on the mode: tent for sharing content, while the other two should make it possible to do your work faster. A coder or video editor might choose the vertical option to have the IDE/video editor on one screen and their output on the other. An office worker may have reference material on the left and the working document on the right, or merge the two into one screen and try to ignore the expanse of bezel in the middle.





Outstanding choice

None of these ideas works without some kind of stand. Asus' solution is a kickstand built into one of the bases, but Lenovo chooses a magnetic stand that can be used to support the screens in the positions shown above: one on top of the other, or opened like a book. The keyboard magnetically attaches to the stand in either configuration, and it's simple to arrange. It's also a slicker solution than Asus', which sits unevenly if the screens are placed horizontally; that is, with one to the left and the other to the right.

ABOVE The Yoga Book 9i is a versatile laptop that can be set up in a variety of ways

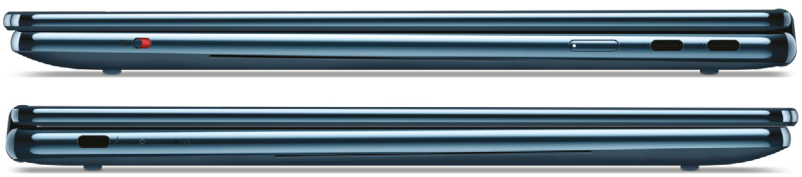
Of course, you could argue that portable 15.6in displays do a similar job. But this setup stands out with its perfectly matched, high-quality screens and the ability to use them vertically. I found this especially useful for comparing documents side by side. Additionally, this configuration is more compact than carrying both a laptop and an external monitor. I couldn't be more impressed.

"This setup stands out with its perfectly matched, high-quality screens and the ability to use them vertically"

The innovation continues with Lenovo's thoughtful design for easy transport. The stand wraps round the keyboard and magnetically attaches to the top of the Yoga Book, while the pen conveniently fits into a loop on the stand.

Port-ability

There is one other mode you use the Yoga Book in: as a tablet, accomplished by opening the screen 360°. I'd argue that the Yoga Book is more convincing than a typical 2-in-1 convertible since it doesn't leave an exposed keyboard under your fingertips. However, you'll still need to use Windows 11.



BELOW The slender design means there's little room for ports

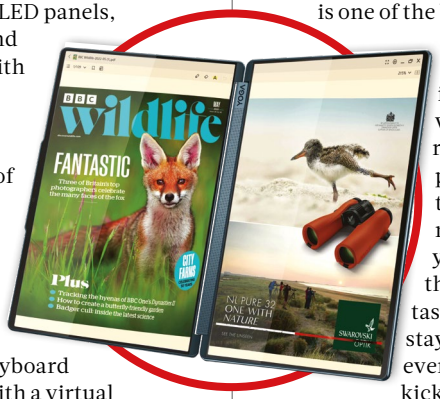
The other inevitable downside is its weight: 1.2kg is a lot to carry if you're trying to use it one-handed. Considered as any other 14in laptop, though, it's light and compact, measuring 316 x 210 x 15.5mm without the keyboard and stand.

With inevitably slender dimensions for each side, there's little room for ports: one Thunderbolt 4 sits on the left, two more on the right. There isn't even a headphone jack, and remember that one of those ports is needed for the 65W power supply.

There is at least a kill switch for the webcam. When active, the 1440p webcam delivers excellent quality, positioned above the display for optimal framing. It provides a sharp image with minimal noise and proved capable of accurately exposing my face in difficult lighting conditions.

Double-screen joy

One reason for this laptop's high price is the cost of two top-quality 14in OLED panels, each with a 2,880 x 1,800 resolution and support for touch and active pens. Colour coverage is excellent, stretching well beyond the DCI-P3 gamut (133%). The screens are also bright for OLED panels, peaking at around 470cd/m² and with superb colour accuracy: we measured an average Delta E of 0.29 on both.



If you tap eight fingers on the lower screen (in laptop mode) then a virtual keyboard appears along with a virtual touchpad beneath. Its large, responsive "keys" combined with haptic feedback and sound effects meant I reached 60 words per minute – half my usual speed on a physical keyboard, but I was surprised I could go that quickly. There are all sorts of settings you can play around with, too, from the level of haptic feedback to colour schemes and settings.

The virtual touchpad works even better, located in the same place as usual and including two virtual buttons. It cleverly includes a virtual notepad on the right, designed for use with the included stylus. Lenovo bundles a low-profile mouse, too, and it's no throwaway device: its clicks are satisfying rather than annoying, there's a rubberised, notched scroll wheel, and it supports dual connections via a switch on the bottom. It's powered by one AA battery, while the keyboard and pen recharge over USB-C.

The virtual touchpad also appears if you position the detachable keyboard on the top half of the lower screen, so where it's normally found on a laptop (you can put it at the bottom of the screen too, giving you extra screen space above). With the keyboard in its regular place I was back to my usual typing speeds, and I found it locked into position well with only the occasional slide.

Potential power

Lenovo provides two CPU options with the Yoga Book 9i: an Intel Core Ultra 7 255H or Ultra 9 285H. It's hard to argue that the latter is worth the extra £290 Lenovo charges, as they're both 16-core chips, and both configurations include 32GB of soldered-on RAM.

The Core 9 Ultra is around 10% faster in multicore tasks due to its higher clock speeds, but it's not as if the Ultra 7 255H is a slouch. It pushed the Yoga Book to 15,614 in Geekbench 6, while a single-core result of 2,886 is strong too. This level of performance is one of the big advantages this two-screen design holds over its Fold rivals, which don't have room for such powerful CPUs and the cooling they need. Not that you'll often hear the fans: in lighter tasks they generally stay switched off, and even when they do kick in they're quiet.

Whether you choose the Ultra 7 or the Ultra 9, you'll benefit from Intel's strong Arc 140T integrated graphics. Its gaming potential is indicated by the solid 4,139 in 3DMark Time Spy and 55fps in *Sid Meier's Civilization VI: Gathering Storm* at 1080p, dropping to 33fps at 2,880 x 1,800. Unlike its Lunar Lake 200V chips, the Arrow Lake 200H series include a first-generation NPU rated at 13 TOPS, so well below Copilot+ PC territory.

One final factor to note if choosing the Ultra 9 285H is that it will have an impact on battery life, with a thermal design power (TDP) of 45W compared to 28W for the Ultra 7 255H. Both chips are designed for power over efficiency, reflected in a miserly 6hrs 49mins of use if the keyboard is attached and 6hrs 8mins if both panels are fully on. And remember, that's with light use.



BELOW An elegant, flexible kickstand is built into the base

Bottom line

Before you buy, the other big decision is storage. The price here is for a 512GB SSD, but upgrading to 1TB costs a tempting £40 extra. As you can imagine, the chassis is not designed for end-user upgrading. You'll need to find an expert to hack into the chassis, and while the battery is also replaceable – again, only by experts – we suspect that won't happen often.

"Lenovo has produced the best design yet for a dual-screen laptop. This is a powerful productivity tool for people who need to work on the go"

You should also extend the stingy one-year warranty. There are two touchscreens to potentially go wrong here, and compared to the cost of the actual laptop an upgrade to four years for £108 at the time of purchase, if you go direct through Lenovo, is good value. Note that this doesn't cover accidental damage, which costs around £60 per year.

These are all things to consider before you buy, along with the poor battery life and minimal ports. Both potential irritations.

What I can say is that Lenovo has produced the best design yet for a dual-screen laptop due to its mix of power, the elegant yet flexible stand, an excellent detachable keyboard and clever software to tie it all together. This is a powerful productivity tool for people who need to work on the go, and even when you factor in the warranty and upgrades it's arguably worth the money. **CHARLES JEFFERIES**

LEFT You can open up the laptop for an enormous tablet



LEFT Tent mode is perfect for sharing content with colleagues

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LE-cores) Intel Core Ultra 7 processor 255H • Intel Arc 140T graphics • 32GB LPDDR5X-8400 RAM • dual 14in 120Hz OLED touchscreens, 2,880 x 1,800 resolution • 512GB M.2 PCIe Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 1440p IR webcam • 3 x Thunderbolt 4/USB-C 4 • 88Wh battery • keyboard • folio cover/stand • Lenovo Linear Pen • Bluetooth mouse • Windows 11 Home • 316 x 210 x 15.5mm (WDH) • 1.2kg • 1yr C&R warranty • part code 83KJCTO1WWGB2

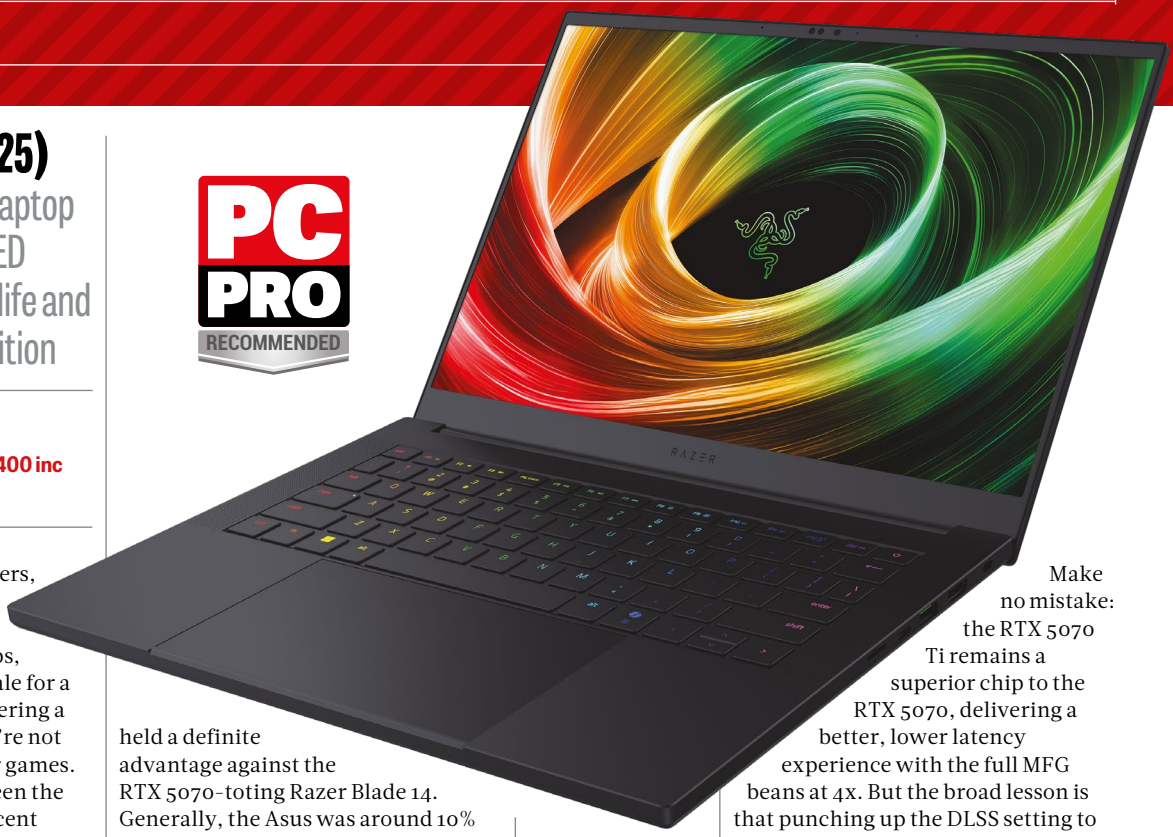
Razer Blade 14 (2025)

The best 14in gaming laptop thanks to its lovely OLED panel, decent battery life and relatively quiet disposition

PC PRO RECOMMENDED

SCORE ★★★★☆

PRICE As reviewed, £2,000 (£2,400 inc VAT) from razer.com



ABOVE The Blade 14 is an excellent choice for gaming on the go

To misquote Austin Powers, 14in laptops are my jam. They're the best form factor for gaming laptops, being an actually portable scale for a normal human, yet still delivering a large enough screen that you're not perpetually squinting at your games. But Razer's Blade 14 hasn't been the best 14in gaming laptop in recent years. That accolade has belonged to Asus' beautifully crafted ROG Zephyrus G14 (*see issue 370, p72*).

This year is all about Razer fighting back with slimmer designs, however. We saw that with the Razer Blade 16 (*see issue 369, p58*) and again here, with Razer returning to the matte black MacBook aesthetic so beloved by its fans. That means the Blade 14 is almost exactly the same size as this year's G14, shading a little thinner at the front where it angles downwards ever so slightly. Where Asus wins is that it finds room for up to RTX 5080 graphics inside, whereas Razer tops out at the RTX 5070.



LEFT The 14in format is genuinely portable, although we don't recommend holding your laptop like this

On the face of it that sounds like a miss for the Blade, but having spent weeks testing both of these machines cheek by jowl I'm left feeling that was a smart move by Razer. These are small laptops after all, and that means the G14 struggles with hardware too spicy for its constrained cooling: to keep things cool, the G14's fans not only go loud but emit a genuinely annoying two-tone whine.

Gaming chops

When gaming at 1080p, the RTX 5070 Ti in the Asus ROG Zephyrus G14 that I tested held a definite advantage against the RTX 5070-toting Razer Blade 14. Generally, the Asus was around 10% faster across my tests. For example, at high or highest presets, the Zephyrus G14 was faster in *Metro Exodus: Enhanced Edition* (93fps vs 84fps), *Baldur's Gate 3* (68fps vs 65fps) and *F1 24* (85fps vs 78fps).

The Blade 14 claimed its sole victory in *Cyberpunk 2077*, with 45fps vs 44fps, but switching to the screens' native resolutions of 2,880 x 1,800 saw a huge reversal: the Blade 14 averaged 7fps to 20fps for the G14. *Cyberpunk*'s ray-traced visuals are simply too big a challenge for the RTX 5070.

This is where Nvidia's heavily hyped upscaling and Frame Generation come in. Running the G14 and the Blade 14 at native resolution with DLSS and x2 FG enabled saw the Razer almost catch up with its rival, averaging 62fps (with 43fps lows) versus 66fps (49fps lows). Of course, not all games support Nvidia's latest tech, but I saw the pattern repeat in *F1 24* and *Black Myth: Wukong*. The 8GB of RAM of both GPUs limited speeds, but they now became playable – 84fps and 102fps in F1 24, 63fps and 70fps in *Black Myth*.

Make no mistake: the RTX 5070 Ti remains a superior chip to the RTX 5070, delivering a better, lower latency experience with the full MFG beans at 4x. But the broad lesson is that punching up the DLSS setting to Balanced or even Performance will give you fluid gaming at the Razer Blade's native resolution.

Couldn't core less

Razer only provides one CPU option for the Blade 14, and that's AMD's Ryzen AI 9 365. This is two cores poorer than the Ryzen AI 9 HX 370 in the G14, but it jettisons a pair of the efficiency-geared Zen 5c cores rather than the full-fat Zen 5 cores. That means you're still getting the same four high-speed cores for focused gaming performance and 20 threads for anything that needs multithreading grunt.

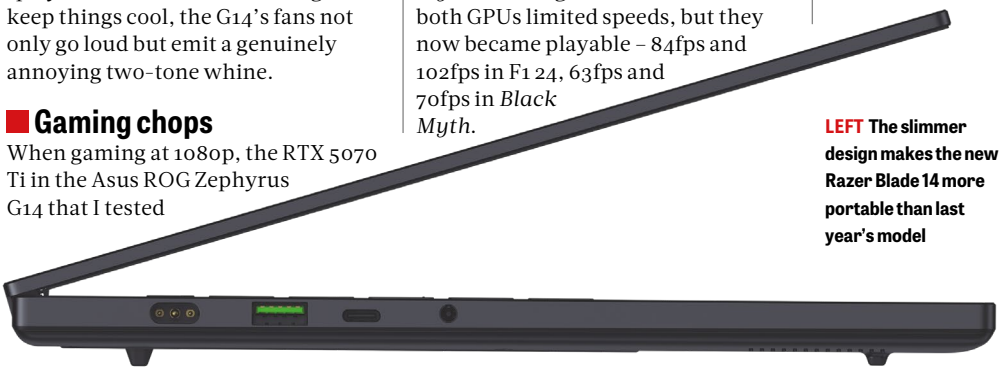
There's a definite difference between the G14 and Blade when it comes to productivity apps. You can see that in the Cinebench 2024 multicore results opposite, and also in Blender 4.2 Junkshop: the G14's CPU completed 97 samples per minute versus 81 for the Razer. But unless you spend serious time inside apps such as Blender I suspect you'll rarely notice those missing Zen 5c cores.

"Battery life is a traditional strength of Razer laptops and the same is true here – compared to other gaming laptops at least"

Arguably, the bigger loss is the integrated GPU. The Blade's Radeon 880M is missing four compute units compared with the Radeon 890M. On laptops, being able to park the power-greedy Nvidia GPU and rely on integrated graphics will give you far more gaming time on the go.

Battery strength

Battery life is a traditional strength of Razer laptops and the same is true here – compared to other gaming laptops at least. We test with the default settings, so don't deactivate



LEFT The slimmer design makes the new Razer Blade 14 more portable than last year's model

the Nvidia chip, and it lasted for 5hrs 1min in our light-use test and 2hrs 14mins in the PCMark 10 gaming test. The Asus ROG Zephyrus G14 lasted half an hour less when gaming.

You can set up a custom profile that will apportion power appropriately to the CPU or GPU depending on your preference. You can even adjust down the CPU voltage – essentially undervolting in miniature – to a stable level to maximise your power draw. I was able to pull it all the way down to the maximum adjustment of -30mV without encountering an issue.

Frustratingly, you don't have any of those options when you're running on battery power. Synapse, Razer's much-maligned control software, only allows the Balanced preset here, not even giving you the fully stripped-back Silent preset to preserve precious battery life.

Premium OLED

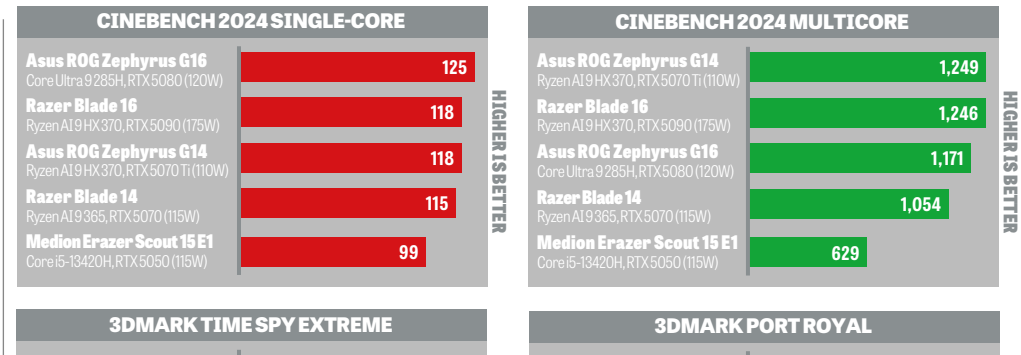
There's nothing you can do about the power draw of the superb 2,880 x 1,800 OLED panel other than adjust its brightness, with a peak of 341cd/m² in SDR mode and 569cd/m² with HDR turned on in Windows. This adjusts its colour profile, too, with DCI-P3 coverage increasing from 77% to 82% – a highly respectable figure that reflects the juicy colours you can see on-screen. Accuracy remains excellent in both scenarios, with an average Delta E of 0.29 in SDR mode and 0.31 with HDR active. While 120Hz is technically a downgrade on last year's 240Hz IPS panel, in reality 120Hz is a perfect match for the Blade 14's skills.

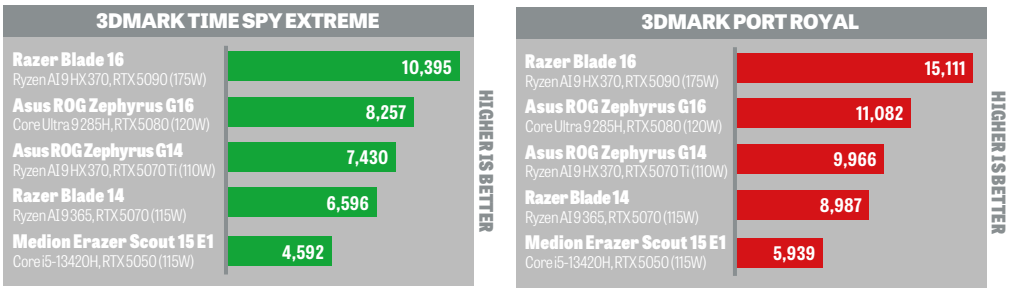
Sadly, Razer hasn't included the improved keyboard from the Blade 16 with this machine. This, along with the G14, has far more travel in its keys, which makes for a more pleasant typing experience than the 1mm of travel here. I also failed to hit the super-small apostrophe key on more than one occasion. You'll have no complaints about the huge trackpad, however, which sticks to mechanical rather than haptic technology.

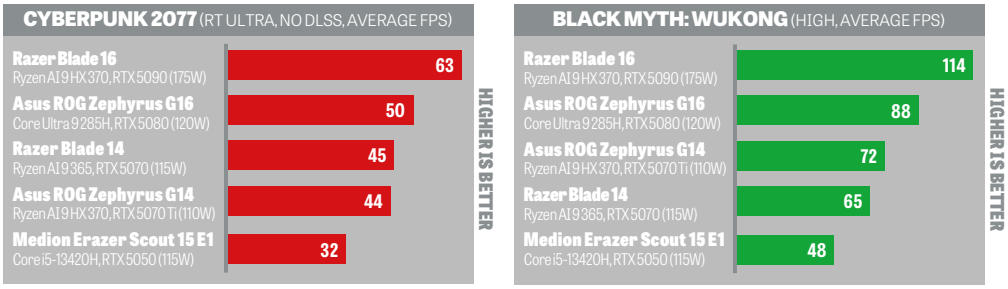
One area where the Blade 14 wins is audio, with a mighty six speakers packed into its frame, tuned for THX 7.1 surround sound. They pack a remarkable punch for such a small laptop. The Full HD webcam is a more predictably average affair, but it does support Windows Hello (there's no fingerprint reader as a backup).



LEFT The superb OLED display is colourful and accurate







Razer-fat margins

Pricing is a perennial problem with Razer machines, and so it is here. The RTX 5070 specification starts at £2,400 inc VAT, while you can buy the Zephyrus G14 with an RTX 5070 for £2,099 from **very.co.uk** at the time of going to press. You will get weaker performance, however, as Asus runs its RTX 5070 at 90W while Razer provides up to 115W of power; the CPU is weaker, too. Alternatively, you can buy the RTX 5070 Ti spec of the G14 for £2,499 from Asus. All these specs include 32GB of RAM and a 1TB SSD.

For me, the choice is obvious: I would go for the Razer Blade 14. Due to its sheer noise, I never wanted to use the G14 at full power, even when wearing a headset, while I found the sound of the Blade 14 at full chat far more acceptable.

"I want a system that is truly mobile, one that I can take around without busting my back and that has a decent amount of power"

If you simply want maximum frame rates out of your 14in laptop, your view will differ. But I want a system that is truly mobile, one that I can take around without busting my back and that has a decent amount of power without needing to shout. I don't need it to be a desktop replacement in either size or performance. All of which means that this year's best 14in gaming laptop is the Razer Blade 14. **DAVE JAMES**

SPECIFICATIONS

10-core/20-thread AMD Ryzen AI 9 365 processor • 8GB Nvidia GeForce RTX 5070 graphics (115W) • 32GB LPDDR5X-8000 RAM • 14in non-touch, OLED display, 120Hz, 2,880 x 1,800 resolution • 1TB M.2 Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 1080p webcam • 2 x USB-C 4 • 2 x USB-A 3.2 Gen 2 • HDMI 2.1 • UHS-II microSD card reader • 3.5mm combo jack • 72Wh battery • Windows 11 Home • 311 x 224 x 15.8-16.2mm (WDH) • 1.6kg • 1yr limited warranty

Medion Erazer Scout 15 E1

A keen price for an RTX 5050 laptop means this is a good buy if gaming on the move is your main priority

SCORE ★★★★☆

PRICE £708 (£850 inc VAT)
from scan.co.uk



German manufacturer Medion loves to deliver value-packed products, and so it's no surprise to see it sell an RTX 50 series gaming laptop for a mere £850. To hammer home that point: that price is buying you the latest generation of Nvidia technology, complete with support for AI frame generation. It's an incredible feat.

Naturally, it's the bottom-end RTX 50 chip, the laptop version of the RTX 5050. That means roughly half the spec of the mobile RTX 5070 in the Razer Blade 14 (*see p58*): 2,560 CUDA cores versus 4,608, 440 AI cores rather than 798. But they do share the same memory specs, with 8GB of GDDR7 RAM and a 384GB/sec memory bandwidth. You can read the full comparison at **tinyurl.com/372nvidia**.



LEFT **The keyboard isn't the best, but there is room for a number pad**

What does that mean in terms of gaming? In general, helped by 115W of power for the GPU, it's fast enough for 60+ frames per second in demanding games. It averaged 74fps and 98fps in *Dirt 5* at High and Ultra High settings respectively, with similarly satisfying results of 86fps and 98fps in *Shadow of the Tomb Raider*. You can squeeze out a few more frames by switching to the Performance settings in the Erazer Control Center app, but that comes with a high level of fan noise.

Tougher games mean you'll dip below 60fps, unless you choose weaker settings. For example, in *Cyberpunk 2077* with RT Ultra settings but all DLSS assistance switched off, it slumped to 32fps. Activating DLSS Super Resolution saw that increase to a playable 50fps. Similarly, *Black Myth: Wukong* returned 58fps at Medium settings but 25fps at Cinematic.

Looking across all the scores, the Erazer Scout proved roughly 30% to 40% slower than the Blade 14, which suggests that Medion chose wisely with its processor, the Intel Core i5-13420H. That's over two years old but remains a solid chip thanks to its four powerful P-cores to accompany the more modest quartet of E-cores. You have 12 threads to throw at tasks that need them, and while multicore scores of 10,002 in Geekbench 6 and 629 in Cinebench 2024 fall well behind the Razer Blade 14 with its 10-core/20-thread AMD Ryzen AI 9 365, this is no slouch. There's no NPU, of course, so forget about Copilot+ PC certification.

Then again, with a bulky chassis measuring an inch thick and a 2.2kg carrying weight, this was never going to be an exemplar for Microsoft's slim and light brand. It looks like the budget laptop it is, with Medion adding minimal branding on the lid – the faintest of logos stuck on – and a clear emphasis on utility. That means plenty of connectivity, with two USB-A ports on the left-hand side, USB-A and USB-C on the right, while the rear is home to the DC input, RJ45 port, HDMI and a mini-DisplayPort.

The rear vents are where the hot air emerges, and it's quite a stream at full belt. Little wonder that the battery life is so poor: 2hrs 30mins in our light-use test and 1hr 4mins when gaming. Removing the base reveals the other reason – a paltry 53Wh battery – plus a second M.2 2280 slot lying empty. So if the supplied 1TB SSD isn't enough, you have an easy upgrade.

It's always welcome to see upgradable memory, too, with two 8GB SODIMMs provided.

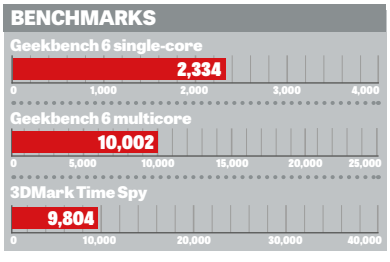
Another sign of this laptop's budget comes from the 15.6in panel. Its 1080p resolution makes sense for a gaming-focused system, as does a 144Hz peak refresh rate, but colours are not its strong point: it covers 43% of the DCI-P3 space and 61% of sRGB, so even a peak brightness of 339cd/m² and high contrast ratio of 1,578:1 aren't enough to lift images.

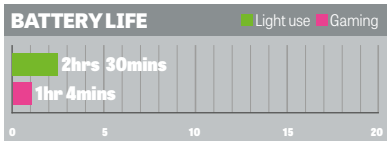
Medion jazzes up the keyboard with delineated WASD keys and a choice of backlight colours, but again its budget roots shine through. The keys have little travel, a cheap feel and they're slimmer than ideal, making touch typing tricky (the Shift keys are far smaller than normal). These sacrifices are partially to make room for the dedicated number pad. The good news? The touchpad is fine and the 1080p camera more than up to web calls. Let's not dwell on the quality of the speakers, however.

Despite all my criticisms, I can't dismiss the Erazer Scout 15 E1. Yes, Medion makes many compromises here, but its key choices of Intel processor and RTX 5050 graphics ensure that it performs excellently in games. You do need to activate the Performance mode to get the best out of it, and that means it must be plugged in, but gamers on a budget will find much to admire. **TIM DANTON**

ABOVE **The Scout 15 packs the latest Nvidia graphics at a low price**

"Medion makes many compromises here, but its key choices of Intel processor and RTX 5050 graphics ensure that it performs excellently"





SPECIFICATIONS

8-core (4 P-cores, 4 E-cores) Intel Core i5-13420H processor • 8GB Nvidia GeForce RTX 5050 graphics • 16GB DDR5-5600 RAM • 15.6in non-touch IPS display, 144Hz, 1,920 x 1,080 resolution • 1TB M.2 PCIe Gen 4 SSD • Wi-Fi 6E • Bluetooth 5.3 • 1080p webcam • 1GbE RJ45 • USB-C 3.2 Gen 2 • USB-A 3.2 Gen 2 • USB-A 3.2 Gen 1 • mini-DisplayPort 1.4 • HDMI • SD card reader • 2.5GbE • 3.5mm combo jack • 54Wh battery • Windows 11 Home • 361 x 247 x 25.8mm (WDH) • 2.2kg • 1yr C&R warranty • part code: 4061275239638

Asus ROG Flow Z13 (2025)

A sleek device capable of great on-the-go-gaming with the inevitable caveat of a stonkingly high price

SCORE ★★★★☆

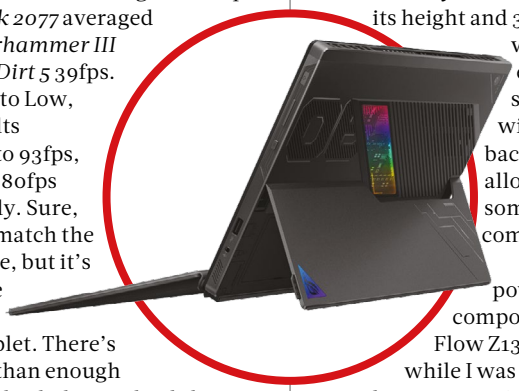
PRICE £1,833 (£2,200 inc VAT)
from uk.store.asus.com



If you're a gamer on the move, you've never had so much choice – this month alone we review the new Razer Blade 14 (*see p58*) and Lenovo's Legion Go S with Steam OS (*see p72*). But what if you could take the best of a gaming laptop and handheld and mosh them together? The answer is the Asus ROG Flow Z13: a high-performance gaming tablet that can play AAA titles at good, as opposed to merely playable, frame rates.

The power stems from AMD's Ryzen AI Max 390 processor. Part of the Strix Halo family announced at CES, this includes a dozen Zen 5 cores, a powerful Ryzen NPU AI rated at 50 TOPS (easily enough to meet Microsoft's Copilot+ PC requirements) and Radeon 8050S Graphics. This is no ordinary integrated GPU, scoring similarly to the mobile version of Nvidia's RTX 3060.

That's reflected in its highly respectable 4,634 in 3DMark Time Spy, but note its averages in games at their default Ultra settings at 1080p: *Cyberpunk 2077* averaged 73fps, *Warhammer III* 63fps and *Dirt 5* 39fps. Switching to Low, those results increased to 93fps, 122fps and 80fps respectively. Sure, that can't match the Razer Blade, but it's impressive for a gaming tablet. There's also more than enough power for the daily grind, while Geekbench 6 scores of 2,162 (single-core) and 11,575 (multicore) show that it can handle tasks that call upon all 12 cores when needed.



LEFT A small window on the rear allows you to see the components

Considering this tablet's gaming tendencies, battery life is surprisingly strong. It lasted for around six hours of light use and the same when viewing videos, while gaming life depended on the title. Away from AAA games I saw around four hours of life, but when playing *Cyberpunk* that dropped to an hour-and-a-half of game time before the device shut off. This limits how truly portable this device is, no matter how thin and light it might be.

That brings me to one of my favourite aspects of the Asus ROG Flow Z13: its compactness. This is a device you can chuck into any bag thanks to its tiny dimensions. And while many gaming laptops weigh over 2kg, the Asus ROG Flow Z13 comes in at only 1.2kg. That's the tablet alone, with the detachable keyboard adding 5.5mm to its height and 390g to its weight. For an extra touch of style, a small window on the back of the device allows you to view some of the components inside.

Despite the power of those components, the ROG Flow Z13 stayed quiet while I was using it. Even when running AAA titles at Ultra settings I could barely hear the fans, which makes it perfect for using on the go as you're not disturbing people around you. It also stayed cool, meaning I could use the touchscreen as intended without worrying about hurting my hands or fingers.

While it doesn't have an OLED screen, the IPS panel covers all of the DCI-P3 space and offers an exceptional refresh rate – for a tablet – of 180Hz. It's also Pantone-validated, while a peak brightness of 500cd/m² means it's readable in all conditions indoors. A glossy, reflective finish makes outdoor play more challenging.

ABOVE Asus' ROG Flow Z13 is great for gaming on the go – if you have deep pockets

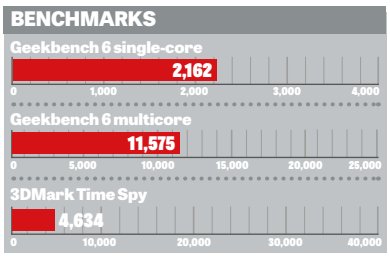
"The IPS panel covers all of the DCI-P3 space and offers an exceptional refresh rate – for a tablet – of 180Hz"

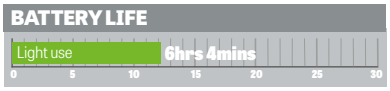
I usually despise tablet keyboards for their squidgy feel, but Asus has done a great job here with a firm enough keypress to provide a satisfying typing and gaming experience. If you're playing competitive titles, I recommend adding an external gaming keyboard for more precise responses; likewise a mouse, as the built-in trackpad isn't as responsive as you might hope.

The ROG Flow Z13 packs plenty of ports: USB-A, HDMI, an audio jack, a microSD card slot and two USB-C ports. Either of these can be used for charging or connecting to a monitor, and thanks to support for USB4's high transfer speeds they also make a good choice if you need to add more storage. And you might, as unfortunately Asus only finds room for a 1TB SSD here.

While I would still use a headset when gaming for their directional precision, the speakers here are a great choice for watching videos and movies. This all adds to the sense of quality, which is to be expected when paying this much: Asus is only selling one spec of the ROG Flow Z13 in the UK, and it's expensive when you compare it to what the Razer Blade 14 delivers for a similar price. Asus softens the blow by bundling a stylus, gaming mouse and headset.

More pertinently, it's fast enough to deliver playable frame rates at 1080p even in AAA games, and outside of gaming I enjoyed using the Flow Z13 day to day: typing on it is a pleasure, and I found it easy to switch between tablet and laptop mode by the simple means of removing the keyboard or flipping it back. If you need that flexibility and want gaming capability, it's both a great choice and your only one, as no other product is quite like it. **JASMINE MANNAN**





SPECIFICATIONS

16-core/32-thread AMD Ryzen AI Max 390 processor • 32-core AMD Radeon 8060S integrated graphics • 32GB LPDDR5X-8000 RAM • 13.4in 180Hz IPS touchscreen, 2,560 x 1,600 resolution • 1TB M.2 Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 5MP IR webcam • 13MP webcam • 2 x USB-C 4 • USB-A 3.2 Gen 2 • HDMI 2.1 • UHS-II microSD card reader • 3.5mm combo jack • 70Wh battery • Windows 11 Home • Asus Pen SA203H • ROG Impact Gaming Mouse • ROG Fusion II 300 headset • 300 x 204 x 13-14.9mm (WDH, tablet only) • 1.2kg (tablet only) • 1yr C&R warranty • part code: GZ302EA-RU014W

HP OmniBook 5 NGAI 16-ag1001na

Affordably priced with a roomy keyboard, but its dull display and lacklustre performance hold it back

SCORE ★★★☆☆

PRICE As reviewed, £708 (£850 inc VAT) from hp.com



Be careful if you hunt for the HP OmniBook 5 laptop online: it comes in 14in and 16in guises with a selection of processors, ranging from previous-generation AMD processors and Intel Core Ultra variants to the version on test here: based around AMD's Ryzen AI 300 Series chips, HP is declaring this a Next Generation AI device. Thus the NGAI horse-shoed into its name.

We reviewed the base configuration with an AMD Ryzen AI 5 340 processor with Radeon 840M graphics, 16GB of RAM, 512GB of storage and a 16in WUXGA (1,920 x 1,200) IPS non-touch display. Spend another £150 and that jumps to a Ryzen AI 7 350 with Radeon 860M graphics, a 1TB SSD and a touchscreen.



LEFT The screen and keyboard are spacious but not without flaws

As this is a Copilot+ PC you get Microsoft's local AI features, including the preview version of Recall. Arguably, HP's AI Companion app is more useful right now. This uses AI to analyse your files or optimise your PC's performance, and can also perform basic generative AI tasks such as summarising documents.

And that's as Next Generation as things get, with HP breaking no moulds with the OmniBook 5: the plain, matte aluminium chassis is only interrupted by the silver HP logo on the lid. HP keeps the weight under control at 1.8kg, and it's only 18.6mm thick at the rear, tapering down to 17.9mm at the front.

A width of 358mm means room for a number pad next to the decent-sized keyboard, but this includes a couple of needless irritations. First, the power button is sandwiched between the Print Screen and Delete keys, making it too easy to press by accident. The second is more subjective: the keys require such a firm press to activate that I found myself slowed down when typing.

The good news? The keys are quiet, while the OmniBook's touchpad is just as roomy as the keyboard. You'll find dual bottom-firing speakers on the left and right edges of the keyboard deck, and they deliver a surprising amount of depth, good mids and weak bass. So, pretty much what you'd expect for the price, and the same can be said for the 1080p IR webcam; video is dull and grainy, but good enough for work web calls in combination with a microphone that proved adept at cutting out background noise.

Considering the laptop's size, HP hasn't overloaded it with ports, with USB-A and a 3.5mm jack on the left and two USB-C, HDMI 2.1 and a USB-A port on the right. The USB ports top out at 10Gbits/sec, so aren't great for attaching external drives if the supplied 512GB SSD fills up.

Opening up the bottom reveals that the SSD is replaceable, as is the Wi-Fi 6 card, but that's it aside from the battery as the 16GB of memory is embedded.

This brings us to the AMD Ryzen AI 5 340 processor, which is a fine choice for everyday office tasks. Where it struggles is apps that demand threads, as reflected in a Geekbench 6 multicore return of 10,223. Gamers should also look elsewhere, with an unconvincing 35fps in *Sid Meier's Civilization VI: Gathering Storm* at 1,920 x 1,200.

A dull display doesn't help the gaming experience, with lowly 44% coverage of the DCI-P3 colour space and a mere 62% of sRGB. Not that you need measurements to notice, with the panel's dullness obvious the moment you switch it on. This is a real letdown as one of the obvious reasons for choosing a 16in laptop is that you intend to stare at the display for extended periods.

Perhaps surprisingly for such a chunky unit, it lasted for well over 11 hours in our light-use battery life test. All of which means that the HP OmniBook 5 has its strengths, but these aren't enough to outweigh its flaws. The display is particularly disappointing for a laptop of this price, so the only reason to buy it is if HP drops the price by at least £150.

STEVIE BONIFIELD

ABOVE The OmniBook 5 is disappointing in too many respects for us to recommend it

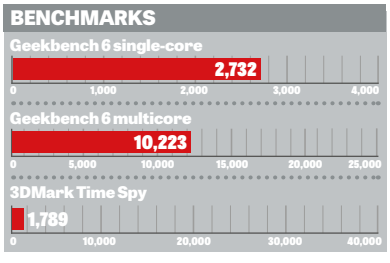
"The HP OmniBook 5 has its strengths, but these aren't enough to outweigh its flaws. The display is particularly disappointing"

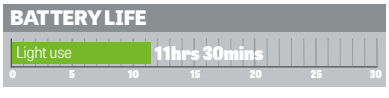
SPECIFICATIONS

6-core/12-thread AMD Ryzen AI 5 340 processor • AMD Ryzen AI • AMD Radeon 840M graphics • 16GB LPDDR5X-7500 RAM • 16in 60Hz IPS non-touch panel, 1,920 x 1,200 resolution • 512GB M.2 PCIe Gen 4 SSD • Wi-Fi 6 • Bluetooth 5.4 • 1080p IR webcam • 2 x USB-C 3.2 Gen 2 • USB-A 3.2 Gen 2 • USB-A 3.2 Gen 1 • HDMI 2.1 • 3.5mm combo jack • 59Wh battery • Windows 11 Home • 358 x 254 x 17.9-18.6mm (WDH) • 1.8kg • 1yr RTB warranty • part code BG3K6EA#ABU



BELOW The selection of is limited for such a large laptop





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01270 898 104
sales@palicomp.co.uk

pro-series

mid [PRO1]



£449.99

CPU	AMD RYZEN 5 8500G
Core	6 Cores - 12 Threads
Clock	(3.5/5Ghz Turbo)
Mob	ASUS TUF A620M-PLUS WIFI
RAM	ADATA 16GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	AMD RADEON Graphics
Case	KOLINK Observatory HF MESH
O/S	*NO OPERATING SYSTEM*
PSU	BUILDER 500W PSU

Max [PRO2]



£979.99

CPU	AMD RYZEN 5 7600X
Core	6 Cores - 12 Threads
Clock	(4.7/5.3Ghz Turbo)
Mob	ASUS PRIME B650M-A WIFI II
RAM	ADATA 32GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	NVIDIA RTX4060 TI 16GB
Case	1stPlayer D3-A aRGB - Black
O/S	*NO OPERATING SYSTEM*
PSU	CIT 700W PSU

UBER [PRO3]



£1159.99

CPU	INTEL Core i5 14600K
Core	14 Cores - 20 Threads
Clock	(2.6/5.3Ghz Turbo)
Mob	ASUS B760M-K
RAM	ADATA 32GB DDR5 5600Mhz
M.2	ADATA 2TB S70 Blade M.2 nVME
GPU	NVIDIA RTX4060 TI 16GB
Case	GAMEMAX F15M MESH
O/S	*NO OPERATING SYSTEM*
PSU	BEQUIET 850W Gold PSU

Aurora RANGE

i3 Aurora [AUR1]



£629.99

CPU	INTEL Core i3 14100F
Core	4 Cores - 8 Threads
Clock	(3.5/4.7GHz)
Mob	ASUS B760M-K
RAM	ADATA 16GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	NVIDIA RTX3050 8GB
Case	GAMEMAX Abyss Mini RGB
O/S	MICROSOFT Windows 10/11
PSU	CIT 600W Bronze PSU

i5 Aurora [AUR2]



£999.99

CPU	INTEL i5 14400F
Core	10 Cores - 16 Threads
Clock	(Turbo 4.7Ghz)
Mob	ASUS B760M-K
RAM	CORSAIR 32GB DDR5 6000Mhz
M.2	ADATA 2TB M.2 NVMe
GPU	NVIDIA RTX4060 8GB
Case	CORSAIR iCUE 4000X
O/S	MICROSOFT Windows 10/11
PSU	CORSAIR 650W PSU

i7 Aurora [AUR3]



£1599.99

CPU	INTEL Core i7 14700KF
Core	20 Cores - 28 Threads
Clock	(3.4/5.6Ghz Turbo)
Mob	ASUS PRIME Z790-P WIFI - DDR5
RAM	CORSAIR 32GB DDR5 6000Mhz
M.2	ADATA 1TB S70 Blade M.2 nVME
GPU	NVIDIA RTX4070 12GB
Case	CORSAIR iCUE 4000X RGB
O/S	MICROSOFT Windows 10/11
PSU	CORSAIR 650W Gold PSU

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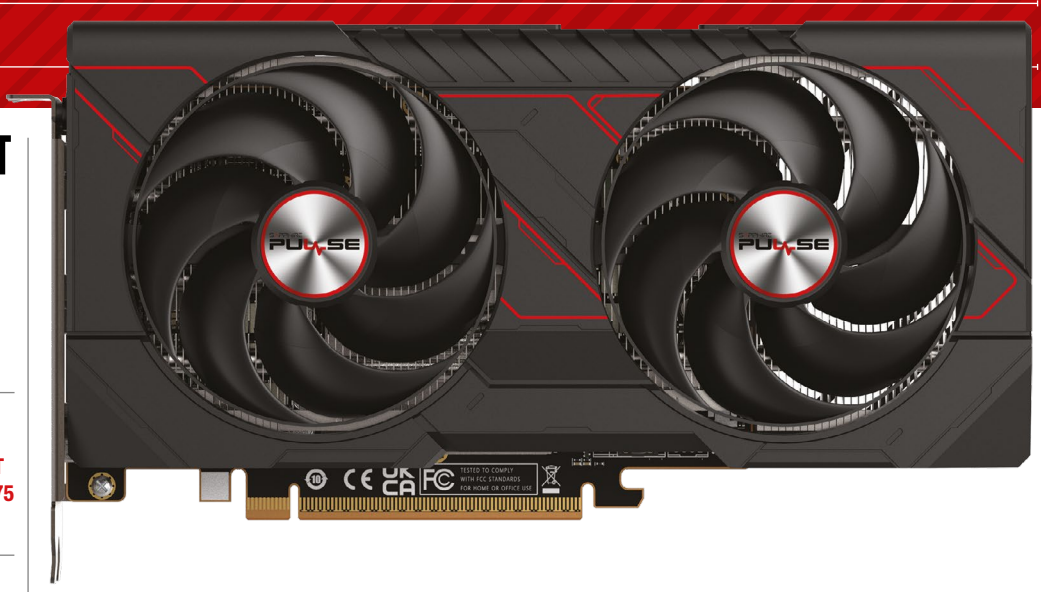
*Sales subject to our terms of sale available online - www.palicomp.co.uk - Configuration issues will be advised by phone - any alternatives will also be advised by phone before proceeding with the order. Systems Custom built then are tested 100% prior to dispatch - dispatched via courier for next working day delivery - other delivery options available online. 0% Finance upto 12 months only - terms online - early settlement fee just £29.00 - apply online or phone. Prices inclusive of VAT and free UK mainland shipping. Q-jump cut-off time 15.00pm.

AMD Radeon RX 9060 XT

The 16GB version is worth the extra due to its overall gaming performance and value compared to Nvidia

SCORE ★★★★☆

PRICE Sapphire AMD Radeon RX 9060 XT Pulse: 8GB £225 (£270 inc VAT); 16GB, £275 (£330 inc VAT) **from scan.co.uk**



AMD has released two versions of the RX 9060 XT: one with 8GB of RAM, the other with 16GB. At current street prices, this pitches the cheaper version directly against Nvidia RTX 5060 cards and means the 16GB version sits alongside 8GB versions of the RTX 5060 Ti; if you want 16GB editions of that card, you'll pay a minimum of around £400.

Both versions of the RX 9060 XT have identical specs, aside from the 16GB version's extra dollop of memory and slightly higher TGP (160W versus 150W). They use the same GPU die with identical clock speeds, with their main advantage over the RX 7600 and RX 7600 XT being their new RDNA 4 architecture and faster clocks.

AMD follows Nvidia's lead by sticking with a 128-bit memory bus in these low- to mid-range cards, which unnecessarily constrains memory bandwidth and inevitably limits the cards' potential performance. Intel is leading the way here by granting the far cheaper 10GB Arc B570 (around £180) a 160-bit memory bus, while the B580 – now around £250 – includes 12GB and has a 192-bit bus.

Across synthetic benchmarks, the RX 9060 XT 16GB and RTX 5060 Ti are more or less tied across resolutions, with Nvidia's card still leading AMD in ray-tracing performance. But the gap is closing: the RX 9060 XT 16GB is only about 15% slower than the RTX 5060 Ti 16GB in synthetic ray-tracing performance. And it's notable that AMD's cards sandwich the 16GB RTX 5060 Ti in 3DMark Time Spy.

Switch to creative benchmarks and the RX 9060 XT cards are largely competitive against Nvidia's GPUs, until you get to 3D model rendering. Unfortunately, I can't say more about this since the Blender benchmark refused to run on either RX 9060 XT card, but this isn't a traditional strength of AMD's GPUs so the only real question is how far behind the Nvidia cards the RX 9060 XT falls.

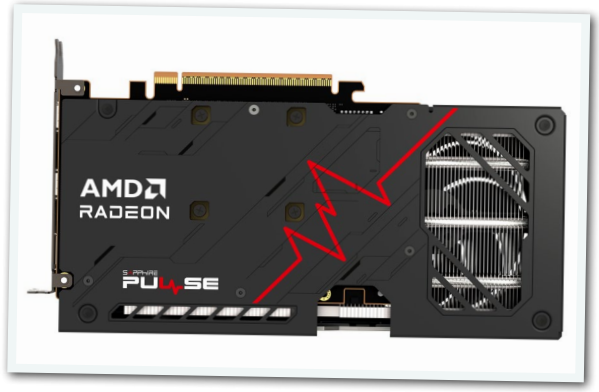
Creative workloads aren't what AMD Radeon cards are known for, though. PC gaming is where these cards compete, with the RX 9060 XT 8GB proving roughly 4% slower than the RTX 5060 in our 1080p gaming tests, while the RX 9060 XT 16GB was 9% slower than the RTX 5060 Ti 16GB at the same resolution. Gen on gen, the RX 9060 XT 16GB outperforms the RX 7600 XT by about 44% at 1080p, while the RX 9060 XT 8GB is 46% faster than the RX 7600.

ABOVE **AMD's RX 9060 XT is going head to head with Nvidia's RTX 5060 cards**

A glance at the graphs below shows a similar story at 1440p, with the RX 9060 XT 16GB sitting well below the RTX 5060 Ti but 4fps ahead of the RTX 5060. The RX 9060 XT 8GB falls 10fps behind its sibling and proved 5fps slower than the RTX 5060. This put the Intel Arc B580 almost within touching distance. Once again, AMD can claim a big gen-on-gen improvement, with the RX 9060 XT 16GB outperforming the RX 7600 XT by 53%, while the 8GB model outperforms the RX 7600 by a dominant 63%.

"Ultimately, the RX 9060 XT cards kept close to their competition from Nvidia, but couldn't quite overtake them"

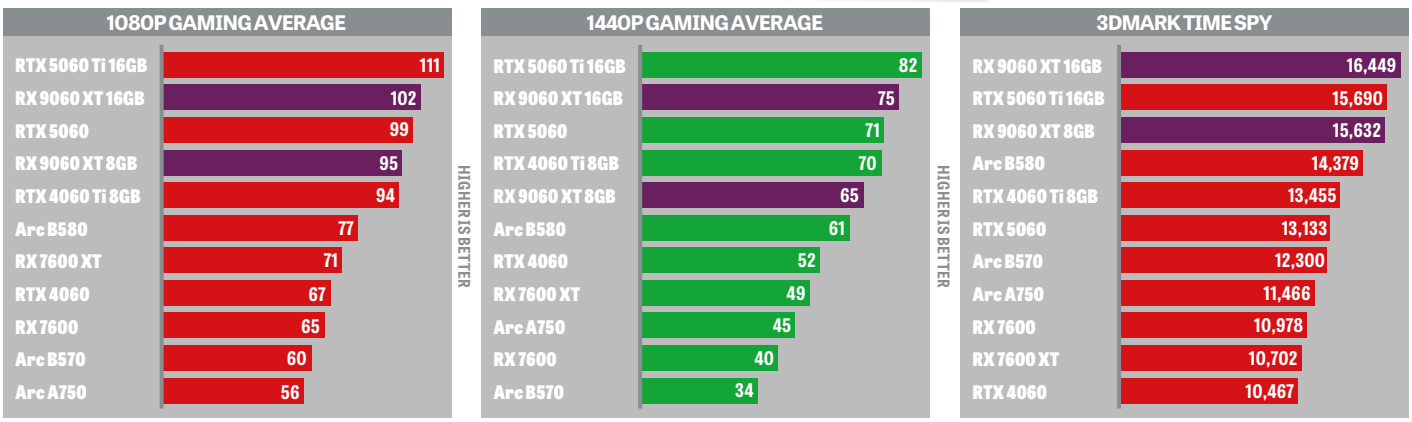
Ultimately, the RX 9060 XT cards kept close to their competition from Nvidia, but couldn't quite overtake them. In the case of the RX 9060 XT 8GB, the RTX 5060 simply offers better value. The RX 9060 XT 16GB is a stronger choice, coming within a few points of the RTX 5060 Ti at a much lower price, so if this is the price range you're shopping in – and you don't need a card for 3D modelling – this is the one to choose. **JOHN LOEFFLER**



BELOW **The cards are built using the new RDNA 4 architecture**

SPECIFICATIONS

PCIe Gen 5 x16 graphics cards • 3,130MHz boost clock • 8GB/16GB GDDR6 memory • 128-bit memory interface width • 322GB/sec memory bandwidth • 32 compute units • 2,048 GPU shaders • 64 AI/matrix processors • 32 ray accelerators • 64 render output units • 150W/160W TGP



Asus ZenWiFi BD4

A decent mesh for a very fair price, but a regular Wi-Fi 7 router will do all that most people need

SCORE ★★★★☆

PRICE Two stations: £150 (£180 inc VAT); three stations: £203 (£244 inc VAT) from amazon.co.uk

We've tested a few Wi-Fi 7 meshes in the past, but never one this cheap. Prior to the arrival of the Asus ZenWiFi BD4, the most affordable Wi-Fi 7 mesh system we'd seen was Amazon's Eero Max 7 (*see issue 352, p68*) – yours for a knockdown £1,150 inc VAT.

That was back at the end of 2023, however. The market has moved on, and the latest Wi-Fi 7 systems are much more affordable. The ZenWiFi BD4 comes in at a fraction of the price of the Eero: you're looking at £180 for two stations, or £244 for three.

To be fair, this is a more cut-down proposition than Amazon's chunky mesh. That system supported wireless connections at up to 4.3Gbits/sec with 4x4 MIMO, while the ZenWiFi BD4 offers a more modest 2.9Gbits/sec on the 5GHz band and only 2x2 multi-streaming. And while the 2.4GHz radio is rated at a respectable 700Mbits/sec, there's no support for the 6GHz frequency range – so you can forget about the ultra-fast, ultra-fat 320MHz channels that help Wi-Fi 7 achieve true next-generation speeds.

Still, that doesn't necessarily spoil the deal. As we saw with Asus' dirt-cheap RT-BE58U router last month (*see issue 371, p70*), 2.9Gbits/sec is enough for most purposes as long as you can hold a decent signal – and with a three-station mesh, that shouldn't be a problem. I tested the ZenWiFi BD4's performance in my usual way, setting up the three mesh stations in the study and upstairs bedroom plus the downstairs living area, then carried a laptop around my home and measured upload and download speeds in different rooms.

As you can see from the graph below, the ZenWiFi BD4's performance isn't in the same league as the Eero Max 7 – no great surprise there. More disappointingly, though, it doesn't even match up to the standalone RT-BE58U. That's because, although the two systems have nominally identical Wi-Fi specifications, a portion of the ZenWiFi's bandwidth is used up passing data back and forth between the mesh units, meaning that there's less for your devices.

The ZenWiFi BD4's case also isn't helped by the fact that Wi-Fi 7 is simply a very efficient and effective standard. It does a measurably better job than older systems of conveying a good quantity of data even over a weak connection, enabling a freestanding router such as the RT-BE58U to provide decent coverage all around a typical UK home without needing additional stations. Sure, if you live in a mansion then a mesh will help you get a strong signal at the far end of your estate, but for most people it's overkill. To put that into practical terms, the average UK detached home has a floor space of around 150 square metres; the ZenWiFi BD4 promises a coverage area of 470 square metres with two mesh units, or 600 square metres with three.

Regardless of whether the wireless specification fits your needs, you can't fault the ZenWiFi BD4 on features. Just as with the RT-BE58U, Asus bundles more or less every network management feature you could possibly ask for, including network security, parental controls, inbound and outbound VPN components, configurable QoS, traffic management and multiple configurable SSIDs. The only omission is support for USB storage and network connections, and that's only because these units don't have USB ports. Each station does have a pair of 2.5Gbits/sec Ethernet sockets, however, so data will flow quickly between wired clients.

For setup and basic management, the Asus Router smartphone app is a winner. It opens with a clear overview of your network, and provides easy access to information about which clients are connected to which mesh station, and what's happening on your network. It's not so great for advanced configuration: once you dig past the main status pages it's easy to get lost in the burrows of panes, pages and menus that lurk beneath.

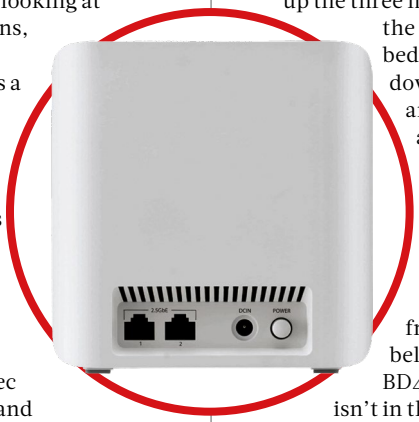
What's more, the app doesn't even expose everything the router is capable of. For the full set of controls you'll need to use the web portal. This is easier to navigate, if only because it's designed for a bigger screen, but it's both dense and technical: beginners won't feel at home.

"It's impossible to complain about a Wi-Fi 7 mesh for this low price, and the ZenWiFi BD4 is fast and versatile enough for most purposes"

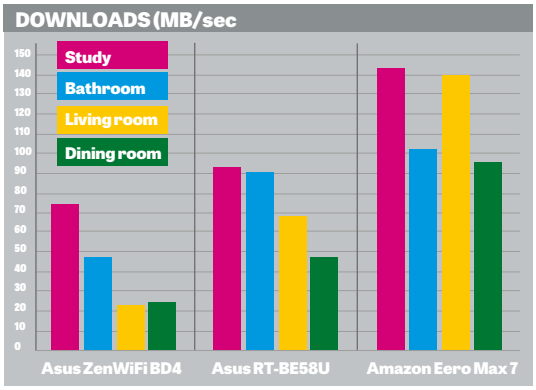
It's impossible to complain about a Wi-Fi 7 mesh for this low price, and the ZenWiFi BD4 is fast and versatile enough for most purposes – especially if you plan to take a walk on the wired side. However, it's likely that a standalone Wi-Fi 7 router will serve you just as well for a lower price. **DARIEN GRAHAM-SMITH**



ABOVE The ZenWiFi BD4 will cover a huge area – bigger than most people's homes



LEFT Each station has a pair of 2.5Gbits/sec Ethernet sockets



SPECIFICATIONS

Dual-band 2.4GHz/5GHz router • 2x2 MIMO • 2 x 2.5GbE LAN/WAN (per station) • 1.5GHz quad-core processor • 140 x 70 x 140mm (WDH) • 1yr warranty

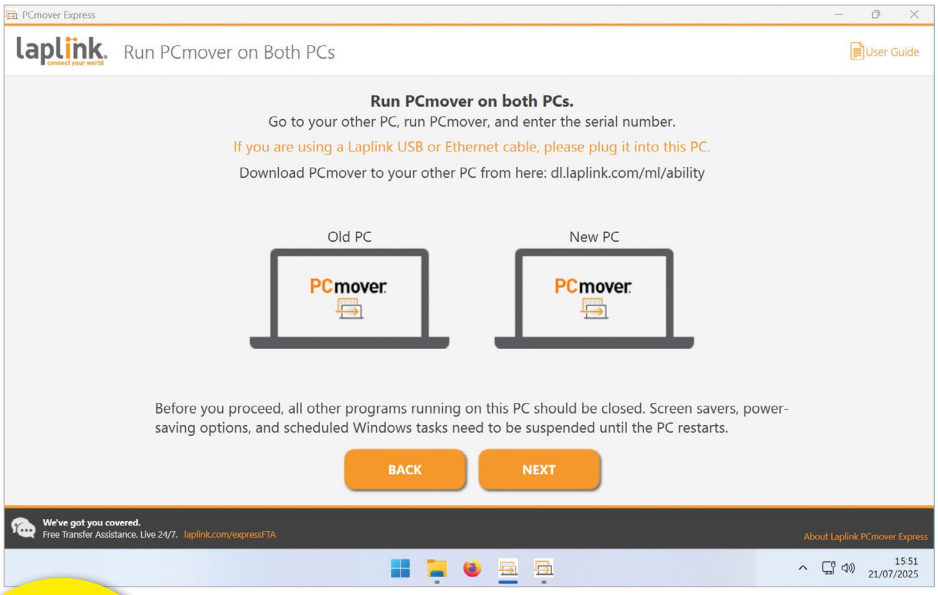
Your bonus software

Total value this month £144

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

Laplink PCmover Express 11

Full product worth £25
laplink.com
REQUIRES Windows 7 or later; 250MB drive space; online registration



Laplink PCmover Express takes the pain out of migrating files, settings and other data from one PC to another. It's the ideal tool for bringing everything onto a new Windows 11 PC from an older computer – without having to go through the hassle of manually finding and copying all your personal data and settings.

The heart of the program is an easy-to-use, step-by-step wizard that walks you through the migration process. It starts by scanning your old system, and revealing everything it's found: you can then decide whether to transfer everything, or select specific items, settings and accounts. Your selected data can then be saved to a file, or transferred directly over the network to a second copy of PCmover Express running on your new PC.

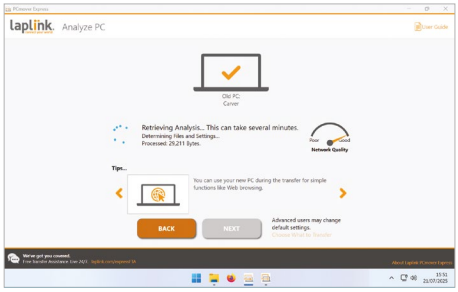
This Express edition of PCmover comes with a few restrictions. It's designed for personal use, and it will only copy files, settings and other user data from your system drive – installed applications aren't moved across. Fortunately, as many apps are now hosted in the cloud, getting set up again shouldn't take too long, especially once all of your most important data has already been transferred.

Full walkthrough see p32

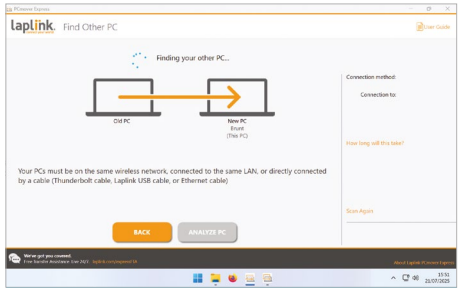
Note too that PCmover is designed to migrate to a new Windows 11 PC from one running Windows 7, 8, or 10 – copying data from a newer OS to an older system isn't supported.

You'll find a walkthrough on p32 showing exactly how to use PCmover Express 11 to migrate your files over a home network – and if you do hit any issues, Laplink is there to help you get everything transferred smoothly, providing toll-free, 24/7 telephone assistance for all users.

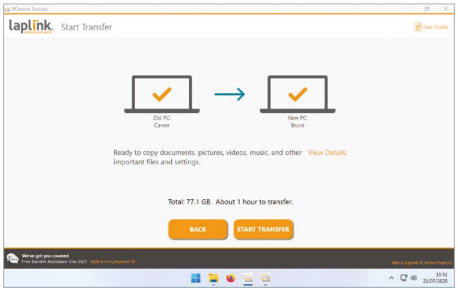
Laplink can also help if you need to move your installed applications from one PC to another. While PCmover Express won't do that job, PCmover Professional can, in addition to all your data and settings. If you rely on a lot of locally installed software, that could be just the tool you're looking for – and you can take advantage of a 30% discount off the RRP of PCmover Professional 11. To upgrade for only £34.95, see p54 or head to the *PC Pro* software store at **store.pcpro.co.uk**.



ABOVE PCmover Express searches your hard disk for files and settings, and lets you choose what to transfer to your new computer



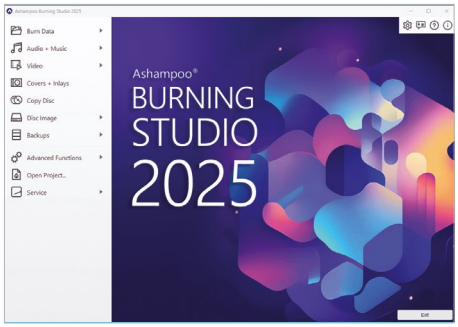
ABOVE You don't need an external hard disk or a special cable – your old and new PCs just need to be connected to the same network



ABOVE The copying process is fully automatic – leave PCmover Express to do its thing, and check back in when it's finished

Ashampoo Burning Studio 2025

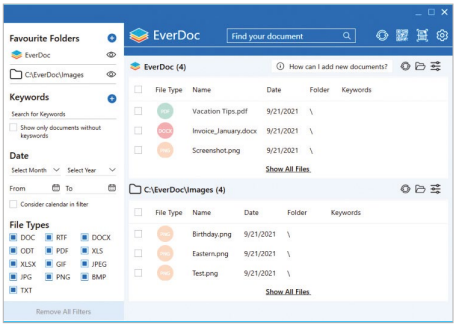
- Complete disc-burning suite with support for a wide range of file types, including MP3, WMA and OGG
- Create autostart discs that display interactive menus when inserted; send emails, link to web pages and more
- Also includes a simple backup utility, plus disc copier and cover designer tools



Full product worth £30 ashampoo.com
REQUIRES Windows 7 or later; 200MB drive space; in-app registration

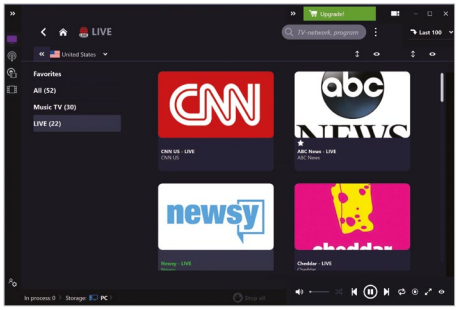
Abelssoft EverDoc 2025

- A simple document management and archiving tool, built around a virtual printer driver
- Archives are fully indexed: type a keyword into the search box to instantly browse your matches
- Can also index, search and retrieve the contents of your Dropbox, OneDrive and Google Drive folders



Full product worth £30 abelssoft.net
REQUIRES Windows 10 or later; 100MB drive space; in-app registration

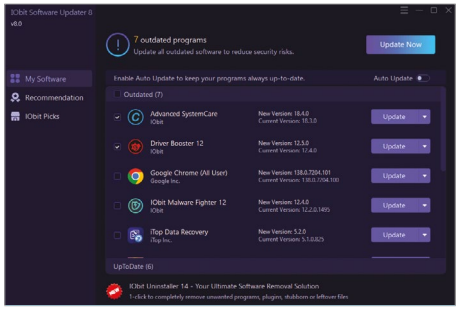
Audials TV Recorder 2025.2



Full product worth £10 audials.com
REQUIRES Windows 10 or later; 200MB drive space; in-app registration

- Record streaming TV to your hard drive or SSD to watch at your leisure
- Search for shows using keywords, or filter channels by country and type
- Watch in a small window while you work

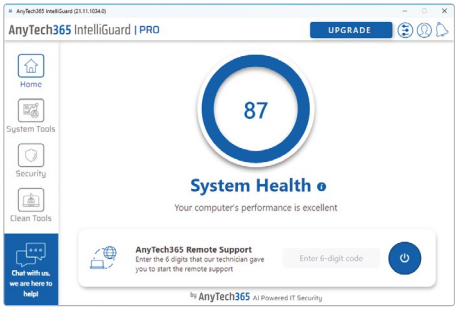
Iobit Software Updater 8 Pro



Six-month licence worth £10 iobit.com
REQUIRES Windows 7 or later; 25MB drive space; online registration

- Improves your PC's security by identifying out-of-date applications
- Scans installed programs and compares them with an online database of the latest versions
- Creates system restore points for easy roll-back

AnyTech IntelliGuard Pro



One-device, one-year licence worth £39
anytech365.com REQUIRES Windows 10 or later, 270MB drive space, in-app registration

- A suite of system optimisation and monitoring tools, plus access to in-person and AI support
- Optimise the startup process by viewing and disabling auto-running apps, tasks and services
- Includes password manager and secure folder

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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 reenter the coupon code on the spine or cover.

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Lenovo Legion Go S (SteamOS)

Puts the Windows 11 version to shame thanks to its snappy interface and far stronger performance



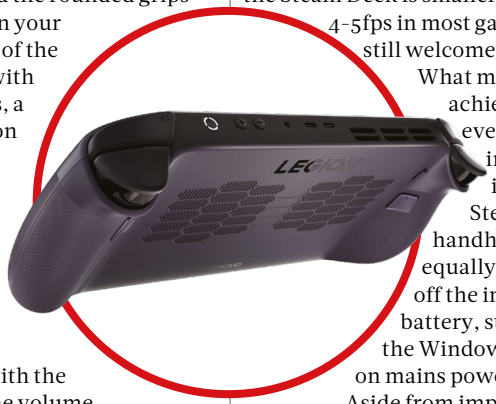
SCORE ★★★★☆

PRICE Ryzen Z2 Go, £500 (£600 inc VAT) from lenovo.com

I reviewed the Windows 11 version of the Legion Go S back in March (*see issue 367, p76*); now there's an alternative model that ditches Windows in favour of the Linux-based, gamer-oriented SteamOS.

The design is identical, with an 8in IPS touchscreen flanked on either side by familiar gaming controls. The most visible difference is that where the Windows version is white, the SteamOS model is a deep purplish colour, which Lenovo calls Nebula. I find this more appealing, especially as it does a better job of masking dirt and grime.

The chassis is an all-plastic affair, but it feels sturdy. Its weight of 740g is reassuringly substantial but not burdensome, and the rounded grips sit comfortably in your hands. The front of the unit is adorned with two thumbsticks, a D-pad, four action buttons and four system buttons, including a dedicated Steam button. Along the top edge sit two shoulder buttons and two triggers, along with the power button, the volume control, a 3.5mm headphone jack and two USB4 ports, which can support an external display as well as peripherals and power. The back panel is home to two additional buttons (Y1 and Y2), plus a pair of sliders that let you adjust the travel distance of each trigger.



Testing the performance of the Steam-powered Legion Go S proved trickier than you might expect because our review unit was powered by an AMD Ryzen Z1 Extreme processor – this model isn't currently being sold in the UK. Instead, we get almost the same hardware as the Windows edition, which means an AMD Ryzen Z2 Go processor, 32GB of RAM and a 1TB PCIe Gen4 SSD. (In theory you can upgrade the SSD to a larger one, but this involves removing the triggers, ideally without snapping any retaining clips. You might prefer to stick a microSD card into the slot on the bottom edge.)

To test performance, I dug out the Windows version of the Legion Go S and installed the latest release of SteamOS. That might sound drastic, but I'd recommend it to anyone who owns the Windows edition: with the new OS the Legion Go S consistently outperformed its Windows-based benchmark scores, with 39fps in *Shadow of the Tomb Raider* versus 16fps, 32fps in *Dirt 5* against 20fps and 32fps in *Assassin's Creed Mirage* versus 21fps. All those scores are at maximum settings. Its advantage over the Steam Deck is smaller, think 4-5fps in most games, but still welcome.

What makes this achievement even more impressive is that the SteamOS handheld ran equally smoothly off the internal battery, still beating the Windows 11 version on mains power.

Aside from improved performance, SteamOS has another advantage over Windows 11: the user interface. Windows 11 isn't designed for a touchscreen of this size. SteamOS, on the other hand, is a perfect fit: buttons, menus and UI elements are sized just right, and respond appropriately to touch. From switching Steam profiles to changing Wi-Fi networks and configuring system settings, it's a breeze. Those wanting to dig into the underlying OS aren't left out, either: by pressing and holding the power button, you can bring up a menu that allows you to switch to Desktop mode and explore a full Linux environment.

Games look great on the Legion Go S. The 1,920 x 1,200 IPS display has a maximum refresh rate of 120Hz and good colour performance: 82% coverage of the DCI-P3 space. Brightness goes up to 441cd/m², but even at 50% brightness I had no complaints about the visuals. Sunlight reflected atmospherically off muddy water on horse trails in *Red Dead Redemption 2*, while the neon glow and smoke-filled environments of *Cyberpunk 2077* created the perfect ambience.

ABOVE Games look great on the 1,920 x 1,200 IPS display

PC PRO RECOMMENDED

"Windows 11 isn't designed to be used with a touchscreen of this size. SteamOS, on the other hand, is a perfect fit"

Visually, at least; aurally, the Legion Go S's fans were always audibly running. The console never felt hot to the touch, even after an extended gaming session, but the fan noise interfered with the 2W speakers. And these were never exactly immersive.

The battery in the Legion Go S is rated at 55Wh, so I wasn't expecting endurance miracles. However, the small screen helps here, as I consistently enjoyed more than two hours of gaming at 50% brightness before needing to recharge, even with the detail settings turned up to maximum.

LEFT Two USB4 ports on the top can support an external monitor

When I first saw the Legion Go S hardware running Windows 11, I wasn't smitten: the ergonomics and display were great, but the performance and value just weren't there. With an OS that's optimised for gamers, however, it's a much more persuasive deal, with tangible performance benefits and a gorgeously smooth all-round user experience. Incredibly, Lenovo has beaten Steam at its own game.

BRANDON HILL

BELOW The all-plastic chassis feels solid and is comfortable to hold



SPECIFICATIONS

4-core/8-thread AMD Ryzen Z2 Go processor • AMD Radeon graphics • 32GB LPDDR5 RAM • 8in 120Hz IPS touchscreen, 1,920 x 1,200 resolution • 1TB M.2 PCIe Gen4 SSD • microSD card reader • Wi-Fi 6E • Bluetooth 5.3 • 2 x USB-C 4 • 3.5mm combo jack • 2 x 2W speakers • 56Wh battery • SteamOS • 299 x 128 x 22.6mm (WDH) • 740g • 1yr C&R warranty

PC PRO

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CHERRY MW 8C ERGO MOUSE & MOUSE PAD

Designed for right-handed users, this mouse will still be comfortable even after hours of intensive work, while the extra-large mouse pad is the perfect accessory for your mouse and keyboard.

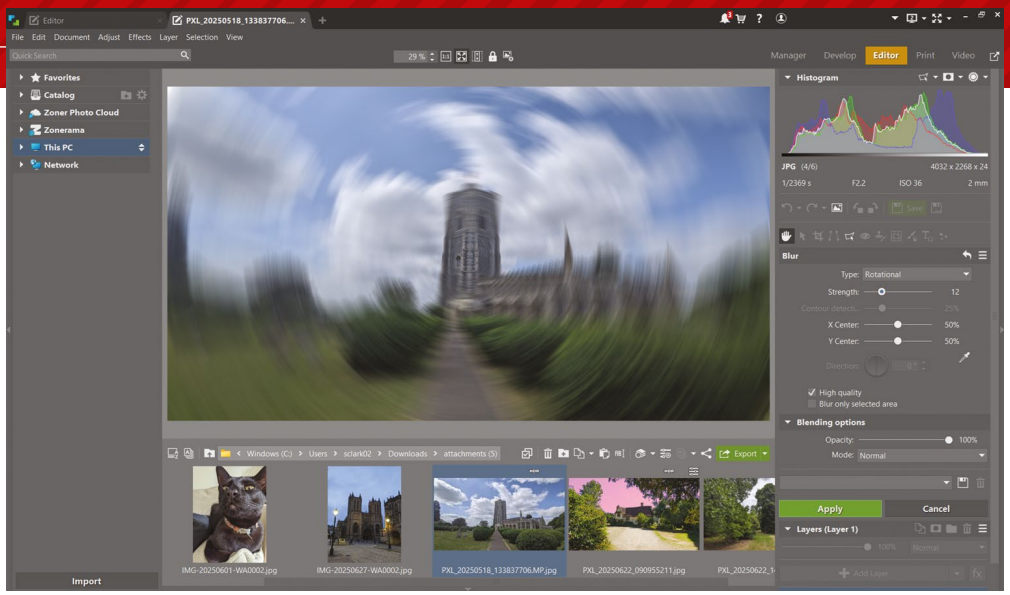
Closing date: 17 August 2025. On completing and submitting this survey, you will automatically be entered into a draw for one of these prizes. No correspondence will be entered into and the winners will be notified by post or email within 28 days of the closing date. The prize draw is not open to employees of Future Publishing or participating companies. No cash alternative will be offered. The prize(s) described are available at the date of publication. Events may occur that render the promotion or the rewarding of the prize impossible due to reasons beyond *PC Pro*'s control, which may at its discretion vary or amend the promotion, and the reader agrees that no liability shall be attached to *PC Pro* as a result thereof. Proof of emailing will not be accepted as proof of delivery and no responsibility can be accepted for entries lost, delayed or mislaid, or for any technical failure or for any event that may cause the survey to be disrupted or corrupted. Unless otherwise stated, entry to all prize draws is restricted to entrants of 18 years of age or over. Names of winners will be available on receipt of a request enclosing a stamped self-addressed envelope to: Competitions Manager, Future Publishing, Quay House, The Ambury, Bath, BA1 1UA. If the winner of a prize draw is unable to take up a prize for any reason, the editor reserves the right to award it to an alternative winner, in which case the first winner chosen will not be eligible for any share of the prize whatsoever. The editor's decision is final and it is a condition of entry to any prize draw that the entrant agrees to be bound by these rules whether they be published or not, and that the decisions of the editor and judges on any matter whatsoever arising out of or connected with the prize draw are final. No purchase of the magazine is necessary.

Zoner Studio

This photo-editing app is loaded with all the core tools that intermediate users will need to fine-tune images

SCORE ★★★★☆

PRICE $59 per year from zoner.com



Zoner Studio is a Windows-only take on both Photoshop and Lightroom. It isn't as powerful as either, although a slew of regular updates is changing that, but it's a good entry-level/intermediate photo editor and organiser for a reasonable price. After a recent name change from Zoner Photo Studio X to Zoner Studio, I tested the latest version to see how it measures up against the best Adobe Photoshop alternatives.

For me, the pricing is a big plus. There isn't a free version available, only a free trial, but Zoner Studio's $59 (around £44) per year cost is low when compared to the £20-per month Adobe demands for Photoshop and Lightroom. Your other option is a tool such as Affinity Photo 2, which has a one-off cost of £68. Unlike those multi-platform rivals, Zoner Studio leans more towards entry-level users who want to build their skills.

You'll have no problems navigating Zoner Studio, which is a big aspect of its appeal. The main part of the screen is devoted to your selected image, with files and folders beneath that can be scrolled through. It's a nice touch, making navigation that much easier.

Where new users may come unstuck are the five options to the top right of the screen. Manager, Develop, Editor, Print and Video. A little exploration won't go amiss, and feel free to play: Zoner Studio features non-destructive editing, letting you experiment with new tools without modifying the original file.

Manager is for organising and tagging photos. Develop is Zoner's take on Lightroom, where you can edit RAW images, and Editor is for all other tweaks you want to make to your media, such as adjusting the colour temperature or sharpening images. It's all nicely laid out and easy to find what you're looking for, with most options replicated in menus along the ribbon, which contextually change depending on which mode you're in. Despite Zoner's best efforts, you might find the sheer number of options overwhelming at first, and you may be bewildered by the side-panel icons – there are a lot here, not all of them intuitive, but hovering your mouse over them reveals a name and brief description.

Your photos are always accessible in Zoner, since there's a file explorer tab to the left of the screen (there's an import function along the ribbon, too, but I never found the need to use this). Photos appear on a timeline at the foot of the main panel. When you've selected your image, it can then be edited and adjusted via the Editor tab.

All the familiar image-editing tools are here, from cropping and rotating to adding watermarks or directional blurring. Predictably, there are heaps of tools for toying with the exposure (shadows, contrast and so on), white balance (temperature and tint) and colour (such as saturation). I also like the addition of the tone curve, as you'd find in Lightroom, for lightening or darkening an image, or bringing specific colour channels to the fore.

There's also a Quick Edit option, which populates the panel with the core tools most photographers and designers use without needing to fumble through the menus. The editing process can further be streamlined with the likes of Quick Fix and – ideal for social media – Quick Filters. All of these work instantly, just a press of the button.

ABOVE The main part of the screen shows your selected image, making edits easy

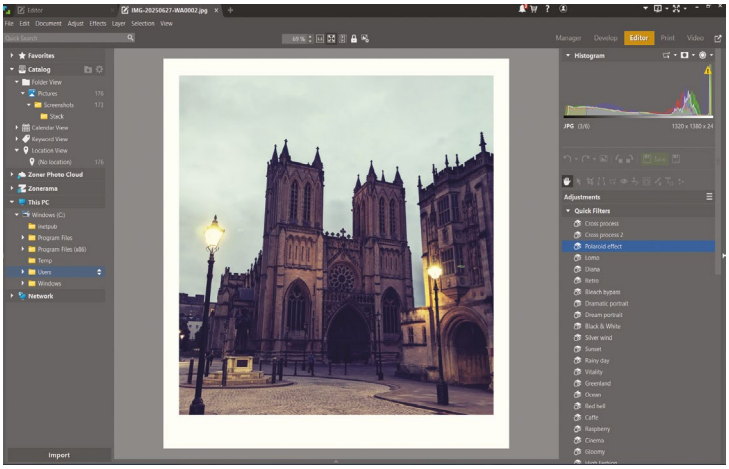
The software includes AI-powered tools, all of which deliver good results impressively quickly. These include AI Masking, found in the Develop tab. Choosing this gives you the option to let Zoner automatically select the photo's subject, background, objects or sky for fine-tuning. For anyone looking to streamline their workflow, these are must-use tools, and I was pleased with the speed and accuracy here.

> "It will take some getting used to if you're new, but absolutely no time at all if you're already familiar with recent photo editors"

One of the stand-out tools is the AI Background Remover. Once it completed its work, I could quickly add a colour background or create a transparent one for compositing into other images. Occasionally, the process removed elements of the subject – typically when on darker or similarly coloured backgrounds – but I had no serious complaints with this one-click background removal tool.

Perhaps the biggest issue, at least for those looking to make the switch from Photoshop, is the lack of support for .PSD files. Instead, the software uses its own .ZPS files, which work the same with layers and effects, but there's no way to import Photoshop files into the app.

Overall, Zoner Studio packs in a wealth of tools for photo editing. It will take some getting used to if you're new, but absolutely no time at all if you're already familiar with recent generations of photo editors. If you don't need .PSD file support, there's much to like here for the price. **STEVE CLARK**



BELOW The interface is very well laid out and easy to navigate

REQUIREMENTS

64-bit Intel or AMD CPU with SSE 4.2 support • 8GB RAM • Windows 10 or Windows 11 (64-bit)

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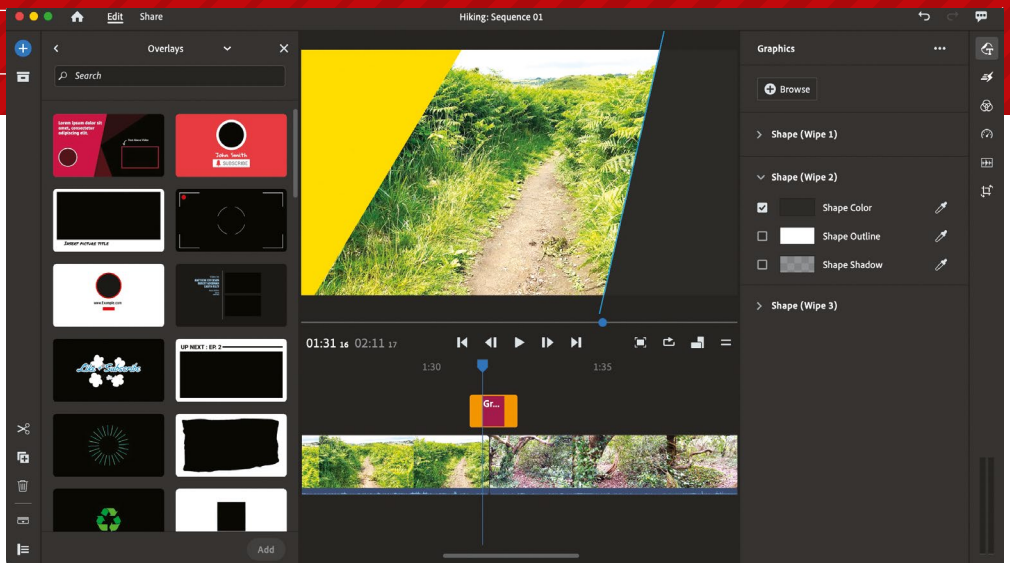
Find your monitor at iiyama.com

Adobe Premiere Rush (2025)

Easy to use with hidden power, even if it lacks the sophisticated effects of DaVinci Resolve 20

SCORE ★★★★☆

PRICE Free **from** adobe.com



While Premiere Pro is Adobe's high-end video editor, even regular Premiere Elements can feel too powerful and complicated to some. For those wanting a simple video editor that can work on both computers and mobile devices, Adobe offers Premiere Rush.

As the name implies, it's all about cutting content quickly, with an emphasis on creating simple social media or marketing videos. Perhaps most surprisingly, Premiere Rush is free. Set up an Adobe ID and you can download Rush for your computer via the Creative Cloud app and your mobile device via its app store.

Whether you're working on a computer, phone or tablet, the interface is similar – but not identical. For instance, options for graphics, effects, colour correction, speed adjustments, audio and cropping can be found top right on a computer, but at the bottom of the screen on a phone. Luckily, the icons are identical, so it will take you seconds to recognise what you're after and learn where they're positioned.

The biggest difference between devices is how the playhead – the vertical line that shows your current position on the timeline – behaves. On a computer, it acts in a typical manner: click and drag it to another location to skim through your footage, or click on another location on your timeline to jump to that point. On a mobile device, the playhead remains fixed at the centre; you move the project left or right through a drag of the finger. It quickly makes sense, but you can only edit in portrait orientation.

To help create a project quickly, Rush uses what Final Cut Pro and CapCut users would recognise as a "magnetic timeline", which means when you alter the length of a clip in your project, you don't end up with a gap between it and any clip that you've added further along the timeline. Instead, they all move to fill that gap. Extend a clip and they're all pushed forward. You can easily swap the order of the clips and no gap is ever left in your timeline.

By default, it looks like you can only work with a single layer of audio and video, which also gives the impression that this is a simple app. In reality, Premiere Rush supports four layers of video and three layers of audio, allowing you to place clips over others, thereby creating more complex projects.

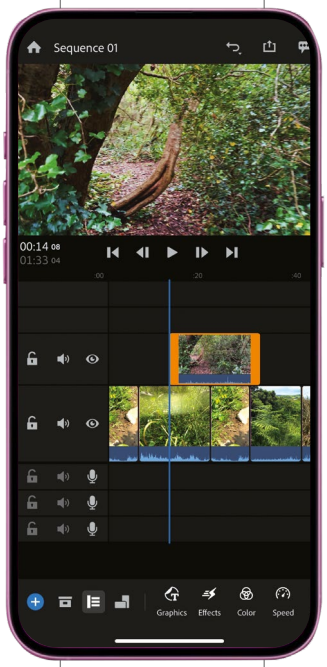
The magnetic timeline only works on the first layer. When you add a clip above another, that upper clip will attach itself to a lower one. Delete the lower clip and that upper clip will be gone, too. Move that lower clip to another location, and this will also move the upper clip(s) connected to it.

Premiere Rush comes with a handful of effects, such as animated overlays, be they text layers, lower thirds or animated transitions, and they're all applied on a second layer. Each graphic is fully customisable with changeable parameters appearing when you select it (to the right on a computer, at the bottom on a phone). Alongside those transitions you'll find a handful of "standard" ones in the Effects section, as well as Reframe and Pan and Zoom tools.

There are limitations to what you can do. For example, the Pan and Zoom tool only works on photos, and the speed alteration tool is very basic. On the other hand, there are areas where Rush surprises with its power. I particularly liked that you can make colour adjustments, either based on filters or through manual alterations, and save those changes as new presets that can be applied to other clips.

When it comes to sharing, you can export your project to your local drive, or upload it to YouTube, Facebook, Instagram or Behance. You even have access to advanced format settings, which is great for pro users.

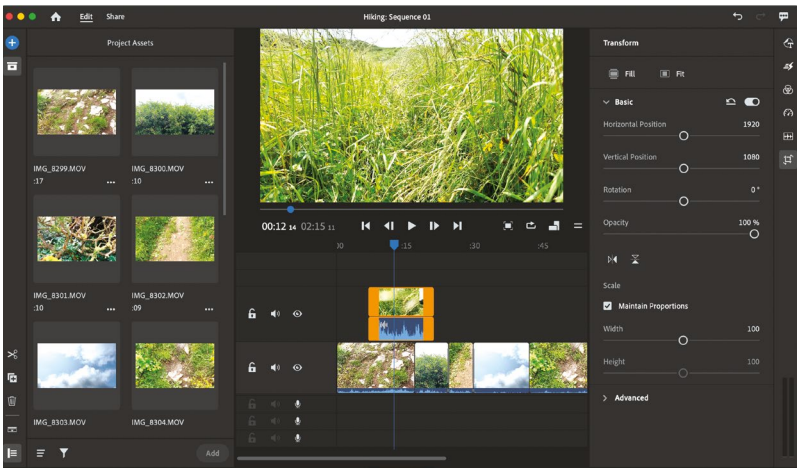
One feature no longer present is the ability to sync your project between devices, as long as they logged into the same Adobe ID. Adobe nuked that option, even for subscribers, in 2024. I still mourn this feature, but otherwise this is an excellent free app. **STEVE PARIS**



ABOVE **Premiere Rush makes editing videos easy – and it won't cost you a penny**

ABOVE **The interface is similar whether you're working on a phone, tablet or PC**

"Set up an Adobe ID and you can download Rush for your computer via the Creative Cloud app and your mobile device via its app store"



LEFT **The software supports four layers of video and three layers of audio**

REQUIREMENTS

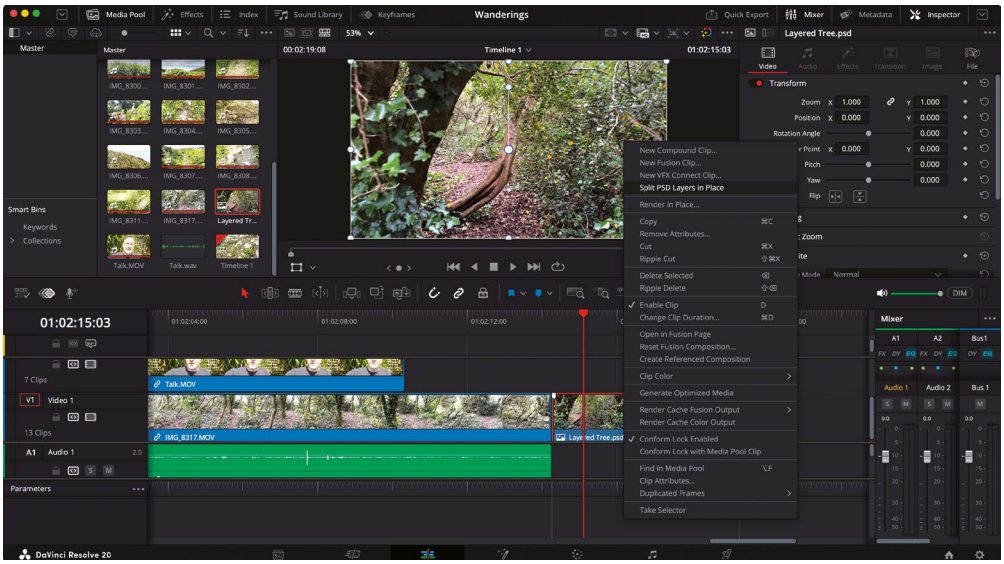
Apple: Apple M1 or 64-bit Intel Core i5/i7 or later • 8GB RAM • macOS 15 or later. **Windows:** 64-bit Intel Core i5/i7 or later • 8GB RAM • 64-bit Windows 10 or later. **iOS:** iPhone 7 or later • iPad with A9 ARM or later • iOS 13 or later. **Android:** Android 9 or later (list of supported phones at tinyurl.com/372adrush)

DaVinci Resolve 20 (2025)

You can't argue with free professional-grade editing tools, even if some of the best features are kept for Studio

SCORE ★★★★★

PRICE Free **from** blackmagicdesign.com



When it comes to professional video editing, you might think of Adobe Premiere Pro, Avid Media Composer or Final Cut Pro. You might also imagine paying a small fortune for them. But there's another option that offers professional-grade tools for free: Blackmagic Design's DaVinci Resolve. There are no awkward compromises here; no ads, no watermarks.

It does have limitations, the biggest being that it restricts exports to 4K and 60fps. DaVinci Resolve Studio raises the ceiling to 32K/120fps and includes a host of other advanced features for £225, and that fee includes all future updates, large or small.

Here, we're focusing on the free version. A program that not only allows you to edit a video project, but integrates a bunch of powerful features that would often be offered as a separate dedicated program. To make it easier working with so many tools, Resolve is broken down into seven different categories.

These are organised in the order in which your project progresses: you import and sort out your clips in the Media page, then use Cut or Edit to build your project; then comes Fusion, where you assemble complex special effects, followed by Color for colour correction, Fairlight to work on audio and Deliver to export your work.

It's all well designed and easy to understand for newcomers, with the possible exception of Cut and Edit. Why would anyone need two separate pages to create a video? The answer is simple: one is to do quick work, while the other offers additional tools and precision. Cut can also be seen as an introduction to Resolve, for those with little experience of video editing.

You can easily switch from one to the other, using tools in Edit that aren't available in Cut, then moving back to Cut to carry on in a simplified environment (you can still see the effects of the tools you used in Edit even if you can't access and alter them while in Cut). If you're an experienced editor, you'll soon get used to Resolve's way of working, but newbies might feel overwhelmed by the sheer power at their disposal – it's a long way away from Adobe Rush.

But don't panic and run for the hills, as this software can and does grow with your skills and confidence – being able to switch between the basic Cut to the more advanced Edit is testament to that. To help you on your journey, Blackmagic Design offers a detailed series of tutorials, complete with project files, on its website. Again, this is free.

Even seasoned users may resort to this, as DaVinci Resolve 20 includes a huge number of new and improved features. For instance, you can now (finally!) easily extract a multi-layered PSD file and work with its layers individually in the Edit page's timeline (prior to version 20, this was only possible in the Fusion page).

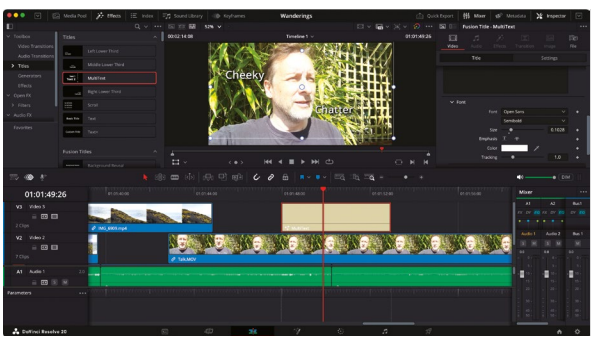
You can record a voice-over directly from the Cut and Edit pages, with controls located above the timeline. You've got numerous options here, such as a countdown timer, being able to choose from all connected microphones (even your iPhone), where to save the recording and on which layer to display it, for instance.

The text tools have received some love, too. Your text can wrap inside a text box, and there's a new "multi text" clip within which multiple text boxes can be created, enabling you to create complex titles without cluttering your timeline.

ABOVE DaVinci Resolve is packed with pro-grade features

PC PRO RECOMMENDED

"There are no awkward compromises here; no ads, no watermarks. This a piece of software that everyone should grab"



BELOW The software has seen major improvements in a host of areas

If you're working with multiple timelines in a single project, you'll appreciate being able to open a second one in the source viewer. This isn't new, but v20 allows you to also edit that timeline from there, enabling you to see two timelines at once, switch between them and edit either (the playhead changes from red to blue to help you differentiate them).

But I've saved the best for last: the revamped keyframe tools. These are now available in multiple locations, depending on your preferred way of working. You can see them top left, either as a list or as curves, with the latter making it much easier to tweak them. These keyframes are also available in the timeline itself, giving you a greater visual feel for how they affect the clips in question.

All this is just scratching the surface of a huge update, and the only downside is that the upgrade to Resolve Studio is even better: this can automatically edit a Multicam project, retime a score so it fits the exact length of the footage, and take your script and let AI edit the scene based on the clips you've imported – complete with multiple takes spread across multiple layers so you can choose between them.

Despite the fact these phenomenal time-saving tools are reserved for paying customers, Resolve 20 remains an incredibly powerful application in its own right. If you're serious about film-making but have to watch your budget, download DaVinci Resolve now. **STEVE PARIS**

REQUIREMENTS

Apple: Apple M1 or later (or GPU that supports Metal) • 8GB RAM • macOS 14 or later. **Windows:** GPU with at least 4GB RAM • 16GB RAM • Windows 10 Creators Update or later. **Linux:** discrete GPU with at least 4GB RAM • 32GB RAM • Rocky Linux 8.6 or later



MONITOR MEGATEST

Whatever size, shape or price of monitor you're looking for, one of these 22 displays holds the answer

When we set out on the month-long journey that is a Labs, we had one thing in mind: to provide a comprehensive overview of the monitor market so that you can buy with confidence.

We've concentrated on the mainstream. There are a handful of truly premium monitors here, but most are aimed at so-called typical users: most of these monitors would be equally happy in a home office as a work office, several are ideal for students, and some will also appeal to creative professionals. We only drew the line at out-and-out gaming monitors.

The end result is an exhaustive test of 22 current monitors varying from compact 24in displays (also worth considering as secondary screens) to 34in widescreen monsters. In the unlikely event that you can't find exactly the right screen for you, then also read our "What to look for when buying a monitor" guide on p78 as it should steer you to the right choice.

CONTRIBUTORS Rowan Campbell, Tim Danton



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					RECOMMENDED	RECOMMENDED	LABS WINNER			
	AOC 24B3CF2	Asus ZenScreen MB249C	Eizo FlexScan EV2410R	Acer Vero CB272K bmiiprx	Asus ZenScreen Smart Monitor MS27UC	BenQ BL2790QT	BenQ DesignVue PD2730S	Dell 27 Plus 4K USB-C	Eizo FlexScan EV2740X	HP Series 5 Pro 527pm
Overall rating	★★★★☆	★★★★☆	★★★☆☆	★★★★☆	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★☆	★★★★☆
Buying information										
Price	£112 (£134 inc VAT)	£241 (£289 inc VAT)	£231 (£278 inc VAT)	£224 (£269 inc VAT)	£333 (£399 inc VAT)	£213 (£255 inc VAT)	£833 (£1,000 inc VAT)	£283 (£339 inc VAT)	£666 (£799 inc VAT)	£320 (£384 inc VAT)
Supplier	misco.co.uk	asus.com	grooves-inc.co.uk	currys.co.uk	argos.co.uk	scan.co.uk	scan.co.uk	dell.com	colorconfidence.com	hp.com
Part code	24B3CF2	MB249C	EV2410R-BK	UM.HB2EE.039	MS27UC	BL2790QT	9H.LN7LA.TBE	S2725QC	EV2740X-BK	9E0Y9UT#ABU
Service & support										
Warranty	3yr limited	3yr limited	5yr limited	3yr limited	3yr limited	3yr limited	3yr limited	3yr limited	5yr limited	3yr limited
Overall brand satisfaction [1]	90%	87%	N/A	90%	87%	90%	90%	89%	N/A	89%
Manufacturer's reliability [1]	91%	90%	N/A	91%	90%	93%	93%	91%	N/A	91%
Customer support satisfaction [1]	76%	74%	N/A	83%	74%	79%	79%	80%	N/A	82%
EPEAT rating	✗	✗	Gold with Climate+	Silver	✗	Bronze	Gold	✗	Gold with Climate+	Gold with Climate+
Display										
Panel size	23.8in	23.8in	24.1in	27in	27in	27in	27in	27in	27in	27in
Resolution	1,920 x 1,080	1,920 x 1,080	1,920 x 1,200	3,840 x 2,160	3,840 x 2,160	2,560 x 1,440	5,120 x 2,880	3,840 x 2,160	3,840 x 2,160	2,560 x 1,440
Aspect ratio	16:9	16:9	16:10	16:9	16:9	16:9	16:9	16:9	16:9	16:9
Pixel density	93ppi	93ppi	94ppi	163ppi	163ppi	109ppi	218ppi	163ppi	163ppi	109ppi
Panel type	IPS	IPS	IPS	IPS	IPS	IPS	IPS	IPS	IPS	IPS
Curvature	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Key specifications										
Peak brightness (stated)	250cd/m²	350cd/m²	350cd/m²	350cd/m²	350cd/m²	350cd/m²	400cd/m²	350cd/m²	350cd/m²	350cd/m²
Static contrast ratio (stated)	1,300:1	1,000:1	1,300:1	1,000:1	1,000:1	1,000:1	2,000:1	1,500:1	2,000:1	1,500:1
Display colours	16.8 million	16.8 million	16.8 million	1.07 billion	1.07 billion	16.8 million	1.07 billion	1.07 billion	16.8 million	16.8 million
Colour depth	6-bit + FRC	6-bit + FRC	8-bit	8-bit + FRC	10-bit	6-bit + FRC	8-bit + FRC	8-bit + FRC	8-bit	8-bit
DisplayHDR certification	✗	✗	✗	✗	DisplayHDR 400	✗	DisplayHDR 400	✗	✗	✗
Maximum frequency (vertical)	100Hz	75Hz	60Hz	60Hz	60Hz	75Hz	60Hz	120Hz	60Hz	100Hz
Claimed response time (grey to grey)	4ms	5ms	5ms	4ms	5ms	5ms	Not stated	4ms	5ms	5ms
Adaptive sync?	✓	✓	✗	✓(AMD FreeSync)	✓	✗	✓(AMD FreeSync Premium)	✓(AMD FreeSync Premium)	✗	✗
Video inputs/outputs										
DisplayPort (version)	✗	✗	✓(1.3)	1 (1.2)	1 (1.4)	1 (1.2)	1 (1.4)	✗	1 (1.2)	1 (1.4)
HDMI (version)	✓(1.4)	✓(1.4)	✓(1.4)	2 (2.0)	1 (2.0)	1 (1.4)	1 (2.1)	2 (2.0)	2 (2.0)	1 (2.0)
USB-C (power rating)	✓(65W)	✓(60W)	✗	✗	✓(90W)	✓(65W)	✓(90W, Thunderbolt 4)	✓(65W)	✓(94W)	✓(100W)
Daisy chaining	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓
Other	✗	✗	D-SUB, DVI-D	✗	✗	DisplayPort out	Thunderbolt 4 out (15W)	✗	✗	DisplayPort out
Ports & docking										
RJ45 (1GbE unless stated)	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓
USB-A	2 (USB 3.2 Gen 1)	✗	4 (USB 3.2 Gen 1)	✗	2 (USB 2)	3 (USB 3.2 Gen 1)	3 (USB 3.2 Gen 1)	2 (USB 3.2 Gen 1)	3 (USB 3.2 Gen 1)	3 (USB 3.2 Gen 1)
USB-B	✗	✗	✓	✗	✗	✗	✗	✗	✓	✓
USB-C (power rating)	✗	✗	✗	✗	✗	✓(7.5W)	✓(7.5W)	✓(15W)	✓(15W)	✓(15W)
Headphones socket	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓
Other	✗	✗	✗	✗	Bluetooth 5.2, Wi-Fi 5	✗	✗	✗	Line out	✗
Stand features										
Adjustable height	110mm	180mm (with arm)	130mm	165mm	100mm	110mm	150mm	130mm	195mm	150mm
Portrait mode	✗	✓(with arm)	✓	✓	✗	✓	✓	✓	✓	✓
Tilt angle (forward/back)	5°/23°	5°/20° (with arm)	5°/35°	5°/35°	5°/18°	5°/20°	5°/20°	5°/21°	5°/35°	5°/20°
Swivel angle (left/right)	✗	90°/90° (with arm)	180°/180°	178°/178°	✗	20°/20°	30°/30°	30°/30°	45°/45°	45°/45°
Other features										
Webcam	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓(5MP)
KVM	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓
VESA mount [2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Integrated power supply	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓
Speakers	2 x 2W	2 x 1W	2 x 1W	2 x 2W	2 x 5W	2 x 2W	2 x 3W	2 x 5W	2 x 2W	4 x 3W
Cables supplied [3]	HDMI, USB-C	HDMI, USB-C	DP, USB-B	HDMI	DP, HDMI, USB-C	HDMI, USB-C	DP, HDMI, TB4	HDMI, USB-C	DP, USB-C	DP, USB-B, USB-C
Other	✗	C-clamp	Eizo Screen InStyle	✗	Google TV, remote control	Microphone	Display Pilot 2, Hotkey Puck G3	Dell Display and Peripheral Manager	Eizo Screen InStyle	HP Display Center
Size & weight										
Dimensions with stand (WDH) [4]	542 x 230 x 360-470mm	539 x 23.6 x 346mm	531 x 233 x 358-488mm	614 x 270 x 390-555mm	614 x 170 x 409-509mm	614 x 239 x 424-534mm	614 x 242 x 428-578mm	612 x 200 x 389-519mm	612 x 242 x 371-566mm	613 x 229 x 394-544mm
Weight with stand	4.6kg	4.8kg	6kg	8.3kg	6kg	8.4kg	8.2kg	6.7kg	8.2kg	7.9kg

[1] Monitor reliability rating in reader-voted *PC Pro* Excellence Awards 2024 (see issue 363, p35). N/A indicates not enough feedback to give a rating. [2] 100 x 100mm unless stated.
[3] All monitors include power cables. DP = DisplayPort, TB4 = Thunderbolt 4, USB-B denotes a USB-B to USB-A cable. [4] Includes stand at its lowest height for monitors with height adjustment.



32/34IN MONITORS

RECOMMENDED				RECOMMENDED		RECOMMENDED		RECOMMENDED	RECOMMENDED	RECOMMENDED	
Iiyama ProLite XUB2797 QSNP-B1	MSI Pro MP275QPDG	Philips 27B2G5601	Sharp MultiSync EA272U	ViewSonic ColorPro VP2788-5K	Acer SH322QU Abmiphux	AOC Graphic Pro U32U3CV	HP P34hc G4 Curved Monitor	Iiyama ProLite XCB3497 WQSNPH	MSI Modern MD342CQPW	Philips 34B2U 6603CH	ViewSonic VG3457CV
★★★★½	★★★★½	★★★½☆	★★★★½	★★★★½	★★★½☆	★★★★½	★★★½☆	★★★★★	★★★★★	★★★★½	★★★★½
£198 (£237 inc VAT)	£208 (£249 inc VAT)	£271 (£325 inc VAT)	Price on application	£999 (£1,199 inc VAT)	£190 (£230 inc VAT)	£417 (£500 inc VAT)	£319 (£383 inc VAT)	£317 (£380 inc VAT)	£249 (£299 inc VAT)	£466 (£559 inc VAT)	£427 (£512 inc VAT)
iiyama-monitors.co.uk	scan.co.uk	uk.insight.com	sharp.co.uk	visunext.co.uk	business.currys.co.uk	amazon.co.uk	hp.com	scan.co.uk	currys.co.uk	uk.insight.com	visunext.co.uk
XUB2797QSNP-B1	MP275QPDG	27B2G5601/00	60006064 (order number)	VP2788-5K	UM.JS2EE.A06	U32U3CV	21Y56AA#ABU	XCB3497 WQSNPH-B1	MD342CQPW	34B2U6603CH/00	VG3457CV
5yr limited	2yr limited	3yr limited	3yr limited	3yr limited	2yr limited	3yr limited	3yr limited	5yr limited	3yr limited	3yr limited	5yr limited
90%	89%	N/A	N/A	N/A	90%	90%	89%	89%	89%	N/A	N/A
91%	90%	N/A	N/A	N/A	91%	91%	91%	91%	90%	N/A	N/A
85%	84%	N/A	N/A	N/A	83%	76%	82%	82%	84%	N/A	N/A
Silver	✘	Gold	✘	Silver	✘	✘	Gold	Silver	✘	Gold	✘
27in	27in	27in	27in	27in	31.5in	31.5in	34in	34in	34in	34in	34.1in
2,560 x 1,440	2,560 x 1,440	2,560 x 1,440	3,840 x 2,160	5,120 x 2,880	2,560 x 1,440	3,840 x 2,160	3,440 x 1,440	3,440 x 1,440	3,440 x 1,440	3,440 x 1,440	3,440 x 1,440
16:9	16:9	16:9	16:9	16:9	16:9	16:9	21:9	21:9	21:9	21:9	21:9
109ppi	109ppi	109ppi	163ppi	218ppi	93ppi	140ppi	110ppi	110ppi	110ppi	110ppi	109ppi
IPS	IPS	IPS	IPS	IPS	IPS	IPS	MVA	MVA	MVA	MVA	MVA
✘	✘	✘	✘	✘	✘	✘	1500R	1500R	1500R	1500R	1500R
300cd/m²	250cd/m²	300cd/m²	400cd/m²	500cd/m²	300cd/m²	400cd/m²	250cd/m²	350cd/m²	300cd/m²	350cd/m²	350cd/m²
1,300:1	1,300:1	1,500:1	1,000:1	2,000:1	1,000:1	1,000:1	3,500:1	3,000:1	3,500:1	4,000:1	3,000:1
16.8 million	1.07 billion	16.8 million	1.07 billion	1.07 billion	1.07 billion	1.07 billion	16.8 million	16.8 million	1.07 billion	16.8 million	1.07 billion
8-bit	8-bit + FRC	8-bit	8-bit + FRC	8-bit + FRC	8-bit + FRC	8-bit + FRC	8-bit	8-bit	8-bit + FRC	8-bit	8-bit + FRC
✘	✘	✘	✘	DisplayHDR 400	✘	DisplayHDR 400	✘	✘	✘	DisplayHDR 400	✘
100Hz	100Hz	100Hz	75Hz	75Hz	75Hz	60Hz	60Hz	120Hz	120Hz	120Hz	100Hz
4ms	4ms	4ms	5ms	5ms	4ms	4ms	5ms	14ms	4ms	4ms	5ms
✓	✓	✓	✘	AMD FreeSync Premium	✓	✓	✘	AMD FreeSync Premium	AMD FreeSync Premium	✓	✘
1 (1.4)	1 (1.2a)	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.2)	1 (1.4)	1 (1.2)	1 (1.4)	1 (1.4a)	1 (1.4)	1 (1.2)
2 (2.0)	2 (2.0b)	1 (2.0)	1 (1.4)	1 (2.1)	1 (2.0)	2 (2.0)	1 (2.0)	2 (2.0, 1.4)	2 (2.0b)	2 (2.0)	2 (2.0)
✓ (96W)	✓ (98W)	✓ (90W)	✓ (90W)	✓ (100W, Thunderbolt 4)	✓ (65W)	✓ (96W)	✓ (65W)	✓ (95W)	✓ (98W)	✓ (100W, Thunderbolt 4)	✓ (100W)
✓	✓	✓	✓	✓	✘	✘	✘	✘	✘	✓	✘
DisplayPort out	DisplayPort out	DisplayPort out	DisplayPort out	Thunderbolt 4 out	✘	✘	✘	✘	✘	Thunderbolt 4 out	✘
✓	✓	✓	✓	✘	✘	✓	✘	✓	✘	✓ (2.5GbE)	✓
3 (USB 3.2 Gen 1)	4 (USB 3.2 Gen 1)	4 (USB 3.2 Gen 2)	3 (USB 3.2 Gen 1)	2 (USB 3.2 Gen 2)	✘	3 (USB 3.2 Gen 1)	4 (USB 3.2 Gen 1)	2 (USB 3.2 Gen 1)	2 (USB 3.2 Gen 1)	4 (USB 3.2 Gen 2)	4 (USB 3.2 Gen 1)
✘	✓	✘	✘	✘	✘	✘	✓	✓	✓	✘	✘
✓ (15W)	✘	✓ (15W)	✓ (4.5W)	✓ (2 x 15W)	✘	✓ (15W)	✘	✓ (2 x 7.5W)	✘	✓ (45W)	✓ (15W)
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ (combo)	✓
✘	✘	Extra USB-C	✘	✘	✘	USB-C upstream	✘	✘	✘	✘	IR sensor
150mm	130mm	150mm	150mm	120mm	100mm	150mm	130mm	150mm	110mm	180mm	110mm
✓	✓	✓	✓	✓	✘	✓	✘	✘	✘	✘	✘
5°/23°	5°/20°	5°/30°	5°/35°	5°/22°	5°/15°	7°/23°	5°/21°	5°/23°	5°/20°	5°/30°	5°/40°
45°/45°	45°/45°	180°/180°	170°/170°	30°/30°	180°/180°	30°/30°	✘	45°/45°	30°/30°	180°/180°	60°/60°
✘	✓ (1080p)	✘	✘	✘	✘	✘	✘	✓ (5MP)	✘	✓ (5MP)	✓ (5MP)
✓	✓	✓	✘	✓	✘	✘	✘	✓	✓	✓	✘
✓	✓	✓	✓	✓	✓ (75 x 75mm)	✓	✓	✓	✓ (75 x 75mm)	✓	✓
✓	✓	✓	✓	✘	✘	✓	✓	✓	✘	✓	✓
2 x 2W	2 x 2W	2 x 3W	2 x 1W	2 x 5W	2 x 1W	2 x 3W	2 x 3W	2 x 5W	2 x 3W	2 x 5W	2 x 5W
DP, HDMI, USB-C	HDMI, USB-B, USB-C	DP, HDMI, USB-C	USB-C	DP, HDMI, TB4, USB-A	HDMI, USB-C	DP, HDMI, USB-C	DP, HDMI, USB-C	DP, HDMI, USB-B, USB-C	DP, USB-B	DP, HDMI, TB4	HDMI, USB-C
✘	MSI Productivity Intelligence	Earphone hook, Philips SmartControl	Human sensor	✘	✘	✘	HP Display Center	✘	✘	Earphone hook, human sensor, microphone	LED fill light
614 x 210 x 401-551mm	614 x 234 x 449-579mm	614 x 235 x 393-543mm	612 x 250 x 378-528mm	613 x 210 x 423-543mm	715 x 269 x 421-521mm	714 x 259 x 459-609mm	809 x 235 x 388-518mm	807 x 240 x 443-593mm	809 x 251 x 424-534mm	807 x 281 x 395-575mm	808 x 236 x 424-534mm
6.1kg	7.1kg	7.2kg	9.2kg	6.4kg	7.5kg	8.5kg	10.5kg	9.7kg	8.1kg	11.2kg	9.5kg

What to look for when buying a monitor

Before you jump into individual reviews, it's worth considering the bigger picture when selecting which display is right for you

How big should you go?

This question isn't as easy to answer as it may seem. For example, if you're on a tight budget, a 24in Full HD monitor may make perfect sense, not least because text will look sharper than the same resolution (1,920 x 1,080) on a 27in panel.

However, rules of thumb apply. The first is that larger is generally better – but only if the number of pixels per square inch, the pixel density, remains above a certain level. For most people, that means around the 100ppi mark: you can get away with 92ppi (the pixel density of a 24in Full HD panel), but you'll notice a jump in sharpness if you choose a 27in monitor with a 2,560 x 1,440 resolution as that works out to 109ppi.

The second rule of thumb is that people's perception of sharpness diminishes once you go above 110ppi. But this is a rule of thumb for a good reason: if you're a photographer then you'll appreciate the greater sharpness of a 27in 4K screen. Likewise if you're a spreadsheet junkie who wants to cram as much data into view as possible.

Our third and final rule (for now) is that wider aspect ratios give you more room to work. If you switch from the 16:9 aspect ratio of a typical screen you'll notice how much space there is to spread windows when you move to a 21:9 aspect ratio. That's particularly useful for people who tend to have a central window and then use the rest of their desktop space as locations for reference information.

One more thing: eyesight comes into play here. If you struggle to see the screen at normal viewing distances then you may find yourself increasing the dots per inch beyond Windows' recommended settings. If you find yourself doing this, you'll appreciate higher ppi panels.



ABOVE Go for a larger screen if you like to have lots of windows open on your desktop

Larger is generally better – but only if the number of pixels per square inch, the pixel density, remains above a certain level



BELOW Portable monitors are usually smaller than Asus' 24in ZenScreen MB249C

Colour palettes

Monitor manufacturers often talk about coverage of colour spaces. Most often, they'll talk about sRGB coverage. This is a conservative colour space created at the birth of the internet to ensure that when someone created a graphic they would have a good idea that the colours would appear accurately on people's monitors. Sometimes you'll see a quote for NTSC colour coverage, and that dates all the way back to early colour TVs.

The IT industry later developed new colour spaces: Adobe RGB, DCI-P3 and Display P3. Adobe RGB is only of importance to those who work in print and need to know that what they see on the screen will match with what they send to a professional printer. DCI-P3 emerged with digital cinema and is the standard with which Hollywood studios work.

And Display P3 is an Apple variant of DCI-P3 designed to produce better results on computer displays.

What matters to most buyers is that they see pleasant colours. Anything below 60% of sRGB will look dull, with increasing richness until you get to 100% – and beyond, as a monitor can show colours that stretch beyond any single colour space. If you want vivid colours, look for a monitor that quotes 80% or above for the DCI-P3 space.

Contrast & colour accuracy

Five years ago you could make a buying decision based on high levels of contrast and the promise of a Delta E below 2. They were both good proxies for quality. These days, they are far less relevant as almost every monitor you will ever buy has a contrast ratio of 1,000:1 or above and an average Delta E below two.

But going back to our rules of thumb, if you see an IPS monitor with a contrast ratio of 2,000:1 then that does suggest it includes a high-quality panel and should result in more impactful images.

Bits and HDR

Scan the "Colour depth" line in our feature table on p76 and you'll see that they range from 6-bit to 10-bit panels, and as you would expect more bits equals greater colour coverage. And a higher price.

A 6-bit panel covers 262,144 colours, but that's not enough for modern tastes. That's why every 6-bit panel here adds a technology called frame rate control, or FRC. Also known as "temporal dithering", FRC

alternates between different colour shades so quickly that it simulates the desired shade.

FRC is so effective that few would be able to tell between a 6-bit + FRC panel and a true 8-bit panel, and they can both claim to cover 16.8 million colours (16,777,216, or 256^3, to be precise). Many manufacturers also employ FRC to boost their 8-bit panels to 1.07 billion colours (1,0243). This matches the range of colours provided by 10-bit panels.

You will also see that some manufacturers list their monitors as "HDR-ready" or supporting HDR10. However, neither is a true indication that you'll enjoy HDR films and video with the impact you might hope, and even those that have gained DisplayHDR 400 certification won't blast you away. If this really matters to you, look for DisplayHDR 600 or even DisplayHDR 1000 certification, but these are only available on expensive panels, usually ones using OLED or micro-LED technology, as described below.

Types of panel

This group test reflects the type of panels you will generally find when looking for a monitor. All the monitors here use either in-plane switching (IPS) or vertical alignment (VA) panels (sometimes referred to as multiple vertical alignment, or MVA). IPS panels tend to give cleaner whites so are often favoured for business use, while VA panels tend to offer greater contrast and lower response times. They're also easier to use in curved monitors.

You'll also see OLED and micro-LED panels, particularly in gaming monitors (which are outside the scope of this Labs). Where IPS and VA panels use a number of LED backlights that shine through to provide illumination, every pixel in an OLED and micro-LED panel has its own source of light. Thus they can each be switched off, to give the distinctive inky black that you won't find on standard displays.

Curved vs straight

Some people swear by curved monitors, especially gamers, as it helps them feel more immersed in games. Even more so if you opt for a setup with two, or even three, curved monitors. You'll see that all five of our curved monitors this month have a 1500R rating, which means that if they formed a circle around you the radius would be 1,500cm – so, one-and-a-half metres.



ABOVE Curved monitors are often favoured by gamers

Refresh rates and response times

Another big change in recent years is the move to faster vertical refresh rates. This used to be 60Hz, and some monitors still are, which is fine for everyday use. However, the shift to 100Hz and 120Hz means a slightly more "solid" image that you may notice when browsing through documents or websites. It also helps in gaming, although with specialist gaming monitors the speeds now hit 240Hz and beyond, to match the frames per second generated by high-end graphics cards.

IPS panels tend to give cleaner whites, while VA panels tend to offer greater contrast and lower response times

To avoid tearing in games – that glitch where you pan across and the scene seems to jump – you should look for support for adaptive sync technology. This aims to perfectly synchronise the output from the graphics card to what appears on your screen. Many manufacturers use their own technology, but AMD also provides its FreeSync technology for free and charges for FreeSync Premium (which helps at lower frame rates, for instance).

Finally, look for low response times. For most gamers, 5ms grey-to-grey is fine, but gaming monitors will go far lower.



BELOW A flexible stand is crucial both for productivity and your posture

Flexible choices

Every monitor in this group test includes a height-adjustable stand. And we feel such a stand is now crucial so that you can put the monitor at exactly the right height (the top of the screen should be at eye level, or slightly below, so that you're always looking downwards).

You'll never regret having a flexible stand, so look for the capability to pivot it through 90° and have the ability to tilt a generous amount. Eizo wins here, with both of its monitors providing a superb 35° backwards tilt compared to the typical 20° to 25°.

Having a VESA mount slot means that you can buy an arm or wall mount.

Look at the warranty

People often skirt over the warranty when buying electronic goods, and that's fine if things don't go wrong. If something does happen, though, you will be extremely pleased to have paid a little more for a monitor with an on-site exchange warranty, as the company will swoop in, remove your faulty display and replace it with a working unit. Most monitors include a "limited" warranty where they will arrange collection and attempt to repair it, usually within 14 days.

Fortunately, monitors are among the most reliable equipment around, which we know from our annual *PC Pro* Excellence Awards (*see issue 363, p35*). You can see how satisfied our readers were with each company in the scores in the feature table on p76.

Sustainability questions

Finally we come to sustainability. Monitors are not a product that you will be able to repair yourself, so we're looking for circularity (how easy it is to reuse components at end of life), recyclability and the environmental cost of building and shipping each monitor.

Naturally, we have to rely on the companies' own environmental claims (for example, use of post-consumer recycled plastic) and third parties for this. While imperfect, EPEAT is the best proxy we've found, as it examines supply chains for the parts used in manufacturing and delivers a wider verdict on each company's actions. This is summarised in the EPEAT rating on the feature table on p76.

One final word: a product that is thrown away after three years is far less sustainable than one that delivers great results for ten years. This is one reason why we will recommend Eizo monitors, for instance, despite their high initial price.

One last thing

There's only one way to truly see how good a panel is, however, and that's to read independent tests such as *PC Pro*'s.

AOC 24B3CF2

The cheapest monitor on test, but this 24in USB-C Full HD display is a great choice if the size is right

SCORE ★★★★☆

PRICE £112 (£134 inc VAT) **from misco.co.uk**



This 24in Full HD monitor couldn't be any more different to AOC's Graphic Pro U32U3CV sibling on p90 if it came in neon green and spoke Russian. It's basic, it's small, it's cheap – and while it was never going to vie for awards there are plenty of factors in its favour.

Most important of all, the AOC 24B3CF2's image quality is far better than you might expect for the price. Stick to the native colour mode and this 1,920 x 1,080 panel covers a respectable 71% of the DCI-P3 gamut, which compares well to many budget monitors we've seen. Colours don't exactly pop, but nor is it dull.

There's also an sRGB mode, which locks well to that gamut and means whites appear a shade whiter. With solid colour accuracy, the only area where we would have liked more, to heavily paraphrase Oliver Twist, is brightness. Still, a 277cd/m² peak is fine unless you plan to place the 24B3CF2 next to a window that catches the sun. It's also easy to tweak such settings using the OSD, which responds quickly to presses via the four shortcut buttons tucked away on the bottom right of the fascia.

The plus side of the minimal electronics – which are needed to control more sophisticated screens – is minimal power draw, with only the Eizo FlexScan EV2410 being more parsimonious in this test. But where Eizo eschews USB-C, AOC makes it one of this monitor's key features, with the USB-C port capable of delivering 65W to a connected laptop. Mind you, that's all you'll find at this monitor's rear other than an HDMI input and two tightly squeezed USB-A ports.

ABOVE Image quality is far better than you'd expect for the price



We've seen cheap monitors with exceptionally basic stands before, where you felt a well-timed breath would push them over, but not so here. AOC provides a sturdy base complete with 110mm of height adjustment, and even though the stand doesn't offer any swivel the 24B3CF2 is manoeuvrable via the simple virtue of being so light: at 4.6kg, it's even lighter than the portable Asus ZenScreen (with its stand) below.

There are two final pleasant surprises. One is that this panel goes up to 100Hz and supports adaptive sync, so gaming is on the after-hours menu. The second is that it includes a pair of speakers. True, they're pretty dreadful, but it's still handy to have the option for sound on occasion.

We can't deny that you're getting what you pay for here. Nevertheless, if all you need is a compact 24in monitor that supports USB-C and you're on a tight budget, then AOC makes all the right cuts in all the right places.

Asus ZenScreen MB249C

A portable 24in monitor that's a big step up from its 15.6in siblings and can lead a double life as a desk screen

SCORE ★★★★☆

PRICE £241 (£289 inc VAT) **from asus.com**



There's one problem with most portable monitors: they're just as small as the screen on the laptop they aim to complement. Asus solves that dilemma with a comparatively giant 24in monitor that you can stuff into a suitcase for travel as it only weighs 2.9kg. That doesn't include the stand or any screen protection, however, and don't forget to pack the compact 90W AC adapter.

Spreading 1,920 x 1,080 pixels over a 23.8in diagonal results in a 93ppi pixel density so text isn't ultra-sharp. However, it's so much easier to work on two windows side by side with a monitor such as this than a 15.6in panel, so if you chuck in a keyboard and mouse you should be able to reach similar levels of productivity in, say, a hotel room as you do at home. And not be so tired from squinting after an hour's work. All that said, we still yearned for 2,560 x 1,440 pixels.

Image quality is surprisingly good, with the ZenScreen's average Delta E of 0.7 reflecting its excellent colour accuracy. Just don't expect colours to whack you between the eyes with their vibrancy. This is essentially an sRGB display, covering around 90% of that space and 78% of the DCI-P3 gamut. Asus makes it easy to jump between colour profiles using the button-operated OSD, so we ended up working in the Standard space, where whites look good – albeit not perfect – and Game mode, where we felt streaming services looked the best. There's a solid pair of speakers built in, but with little bass and dominant trebles we didn't love it when listening to music.

ABOVE The ZenScreen is an ideal solution for workers on the move



Asus provides interesting mounting options. On your travels, you'll likely rely on the built-in kickstand, but there's also an option for hanging it over partition walls (in shared office situations) or on a clamp arm. The latter wasn't available for testing, despite being bundled with retail units, but it looks a great option for use at home – push the screen right back (up to 144mm) when you don't need it, bring it close when you do. The arm also brings screen rotation as an option and offers up to 180mm of height adjustment. The screen detaches quickly, too.

There's less flexibility when it comes to video inputs, with only USB-C and HDMI on offer. Connect over USB-C and it can charge your laptop at the same time, though, with 60W of power up for grabs.

While we would have liked a higher resolution, the MB249C is a creative solution to a problem that besets many workers on the move. Considering that it can then also double as a second monitor at home or in an office, we think it's worth the asking price.

Eizo FlexScan EV2410R

A basic 24in display with backwards compatibility in mind, so only consider it for those edge cases

SCORE ★★★☆☆

PRICE £231 (£278 inc VAT)
from grooves-inc.co.uk



The Eizo FlexScan EV2410R stands out from the 24in crowd – admittedly a thinning crowd due to the dominance of 27in screens – thanks to its 16:10 aspect ratio and array of ports. Eizo opts for old-style DVI-D and VGA connectors to keep the HDMI and DisplayPort inputs company, which is a calculated move: this monitor is designed for environments such as healthcare and education that rely on equipment using these old standards.

There's no USB-C input, but there is a USB-B port along with four USB-A ports: two sit at the back, the other two on the left-hand side for easy access. You'll also find a 3.5mm headphone jack along with a line out, and although it's always good to see built-in speakers the weedy pair here are for emergency use only.

There's every chance this monitor will be running 24/7, and with a 10W draw at 200cd/m² it's the most efficient display on test. It's backed by Eizo's generous five-year warranty, with the promise of no bright sub-pixels for the first six months, and as always with Eizo monitors it feels solid. Almost too solid: we had to pull the display forward with some force to move it within its wide -5°/35° tilt. By contrast it's incredibly easy to swivel, rotating the full 360°, which reflects the likely usage of this monitor – atop a trolley, say, or tucked into a server room – where people might use it from any angle.

ABOVE The FlexScan EV2410R is designed for a niche market



The medical colour space DICOM is one of six you can choose from the excellent touch-sensitive OSD: tap the bottom right bezel and two user-definable spaces appear, along with sRGB, Paper (sepia) and Movie. The intuitive, responsive OSD provides an object lesson in how to making it easy to change options.

It's ironic, then, that there's so little to change; when we jumped from default to the sRGB colour space it barely altered the measured gamut, namely 99% sRGB and 80% DCI-P3. There are also two EcoView settings, but you'll want to switch off Auto EcoView or forever be stuck at a ridiculously low brightness. The EcoView Optimizer 2 is more useful, as the screen remains easy to read despite lowering the brightness of the backlight in tandem with increasing the gain. However, with this switched on colour accuracy drops, with its average Delta E moving from its 0.41 norm to 6.92.

It's unfair to compare the Eizo to rivals here as this isn't a mainstream monitor: we wouldn't roll it out in an office as it doesn't support USB-C. Still, it fills its niche extremely well.

Time to dock

USB-C ports are now ubiquitous, but that alone doesn't make a docking monitor

There was a time when you could stick a USB-C port onto a monitor, throw in a couple of USB-A ports, and consider the docking box ticked. So long as the USB-C port could feed enough power into the laptop – and 65W is plenty for most – surely punters had everything they needed: plug in the laptop with a single USB-C cable when at the desk, unplug it when it's time to leave.

But as this Labs shows, several manufacturers have upped the ante. Part of that comes from the available power on offer, with many USB-C ports now capable of delivering 90W to 100W. That's enough to feed a MacBook Pro and even some gaming/creative laptops. The next big tick to look for is wired networking, with ten monitors here including RJ45 ports. One even supports 2.5GbE networking. With no space on most laptops for an RJ45 port, a modern docking monitor is an excellent way to bring this more reliable form of connectivity to your setup.



ABOVE Modern monitors have turned into super-powered docking stations

If you want to connect a second computer, especially if it's a desktop PC, then look out for USB-B inputs, too. This standard is almost 30 years old, but it remains the most common method of providing access to the connectivity (USB-A ports, USB-C ports, wired networking) provided by these most modern of monitors.

They even go one step beyond connectivity by including webcams. These are of varying quality, but make a lot of sense in the post-pandemic working culture of endless Zoom and Teams calls. How much neater to have everything built into the monitor, including the microphone.

That brings us to the final audio ingredient: speakers. Again, it isn't enough to check that these come with the monitor, as some are high-fidelity units while others are like people relaying messages via a tin can. But choose the right monitor and you can cut the clutter on your desk to zero.

All of which means that our advice to a prospective monitor buyer is to consider your options carefully, as you're now buying into a complete communications hub. Make sure you know what you're buying, and what you might be missing out on.

Acer Vero CB272K bmiiprx

Starting to show its age in terms of connectivity, but still a high-quality 4K screen for a competitive price

SCORE ★★★★☆

PRICE £224 (£269 inc VAT)
from currys.co.uk



We need to tackle this monitor's great weakness from the start: it doesn't include a USB-C input. You're stuck with one DisplayPort and two HDMI ports, and no fancy luxuries such as USB hubs or RJ45 networking. All of which makes this sound like a bottom-of-the-pile, budget 27in monitor, but as soon as you switch it on you'll discover that this is far from the case.

First of all, let's talk about the clarity of the Vero CB272K's whites. Choose the sRGB mode and it locks down with near perfection, with 95% coverage with 95% of volume. That means every colour you see falls in the sRGB gamut. With strong colour accuracy to back this up, you can trust what you see. You won't get the sheer breadth of colours offered by more expensive panels such as the ViewSonic VP2788-5K, but photos and films still look strong if you switch to the Standard or Movie mode. It helps that brightness pumps all the way up to 420cd/m² (70cd/m² higher than Acer's stated brightness).

With no data connection back to a host computer, you're reliant on the on-screen display (OSD) to control the settings. Acer provides a simple trio of buttons on the back right of the monitor to navigate through the options, with handy shortcuts for switching between inputs, adjusting brightness and jumping between colour modes (avoid the top button as this is the power switch, which we hit a few times by accident). There's also a joystick if you want to explore the panel's more advanced options.

ABOVE Strong colour accuracy makes the CB272K a 4K bargain



Fundamentally, however, you're fiddling at the edges. No amount of tweaking is going to change this panel's refresh rate of 60Hz, for example, so while it's good to see support for AMD FreeSync we would not recommend this panel to gamers. It does make a passable choice for TV streaming services, though, with a pair of 2W speakers that are just good enough for soundtracks and just not-quite-good-enough for music.

But that's fine, because this monitor falls neatly into the "work" category. That's where a 4K resolution, strong colour accuracy and the stand's excellent mobility – it pivots, tilts back 35°, swivels almost 360° and provides a tremendous 165mm of height adjustment – can make a real difference. And if you catch the sales, you might find it for £199 at Currys, as we did during our test period. At that price, despite its lack of a USB-C input, the Acer Vero CB272K becomes a bargain.

BenQ BL2790QT

Not the most exciting monitor on test, but it meets all key criteria at an aggressive price

SCORE ★★★★☆

PRICE £213 (£255 inc VAT)
from scan.co.uk



Unlike the glamorous BenQ DesignVue PD2730S (*see p89*), the BL2790QT is targeted at office users. That means a much less expansive colour gamut, one that's essentially tied to the sRGB colour space – so don't expect vivid imagery. The colours that you do see are accurate, however, with an excellent average Delta E of 0.41. It's also sharp, with the 2,560 x 1,440 pixels an ideal fit for a 27in diagonal.

BenQ's intuitive OSD is easy to navigate using the joystick, with a selection of Color Modes to jump between: Standard, Coding, Care Mode, Movie, Game, ePaper (sepia) and User. Using the latter you can tweak the colour temperature, and we found doing this produced a cleaner white than default – it's so easy to do you might as well tweak it yourself.

It's also worth exploring the Eye Care menu, with a built-in "Business Intelligence" sensor that adjusts brightness depending on the levels of ambient light. There's also a "Color Weakness" mode that allows you to adjust the intensity of greens and reds. Both these features, together with the option of reminders about looking at the screen for too long, widen the BL2790QT's office appeal.

While BenQ doesn't include a webcam it does provide a microphone, which you activate via a button on the bottom of the bezel. A white LED handily appears to show that it's active, and while the mic is far from podcast quality it's fine for web calls. There's even a noise filter if you need to block out office hubbub.

ABOVE A sharp and colour-accurate display at a good price



The mic only works if you connect using the USB-C port, which delivers a relatively modest 65W of power to connected laptops, but there are also DisplayPort and HDMI inputs. A second DisplayPort sits ready for daisy chaining, so (similarly to the Iiyama ProLite XUB2797QSNP-B1) you can have a twin-display setup for around £500. Unlike that monitor, however, there's no RJ45 for wired networking. What you do get is a USB hub, with two extremely awkwardly placed USB-A ports at the rear – one hampered by being so close to an edge – but the other USB-A connector is kept company by a USB-C port on the bottom of the panel's bezel.

We've seen more flexible stands than this, with 110mm of height adjustment and a slightly stingy 20° swivel from left to right, but it does support portrait mode (like every other sub-32in monitor here), and BenQ also wins for the quality of its speakers. They're actually good enough to enjoy music. If that's more important to you than wired networking, the BL2790QT makes a fine alternative to the Iiyama.

Dell 27 Plus 4K USB-C

Others offer better value, but this is a great choice if you're after a compact and stylish 4K monitor

SCORE ★★★★☆

PRICE £283 (£339 inc VAT) from dell.com

Take care if you choose this monitor: it comes with three different resolution panels (Full HD, QHD or the tested 4K), and you can select each with or without USB-C. The price changes – for example, the non-USB-C version costs £269 inc VAT – but the looks stay the same, with a chic design distinguished by ultra-slim bezels and a matt white stand. It's definitely one of the most stylish monitors around.

Dell takes the unusual step of hiding away the USB hub, which consists of a USB-A and USB-C port in a pop-down unit at the bottom left of the bezel. It's neat, until you plug cables in and they remain visible. A second USB-A port sits in a cavity at the rear, which is also where you'll find one of the two HDMI 2.1 outputs. A panel covers up this cavity to keep things looking neat, with a cable tidy at the rear of the stand for the USB-C cable and power cable; both plug into the rear of the unit with no secret cavities to hide them.



It's a flexible setup thanks to 130mm of height adjustment, respectable amounts of tilt and swivel, plus support for portrait mode. You'll also appreciate Dell's solid build quality, with the only negative being the plasticky nature of the pop-down USB hub.

This isn't a monitor for creatives due to the panel's limited palette: in its default mode it covered 81% of the DCI-P3 space, which is punchy, but it's in sRGB mode where this panel excels: it covered 97% of the gamut with a 99% volume, and that means you can trust what it displays (its average Delta E of 0.6 reflects strong colour accuracy). Whites look fantastic, too. Dell states a maximum brightness of 350cd/m², but we measured 388cd/m².

ABOVE Dell's stylish 27 Plus 4K is a flexible, well-built monitor



You can take control of the settings via Dell's neat and responsive menu, controlled by a joystick, while Dell Display & Peripheral Manager is on hand for those who prefer software. There are a few preset modes to switch between, plus one custom option, and if you want to play games then it's worth switching into, say, FPS as this will increase the grey-to-grey response time to 4ms. Also note the support for AMD FreeSync Premium, while 120Hz refresh rates will help to ensure on-screen action looks slick.

Those who listen to music while they work, or want to watch films, will also appreciate the powerful and well-balanced 5W speakers. Bass doesn't exactly boom, but most people will be happy with the output.

Happy enough to pay £339 inc VAT? Yes, simply due to the all-round quality, but no-one is going to claim that this is a bargain buy.

Eizo FlexScan EV2740X

This top-quality panel is backed with every feature you'll need and the best warranty around

SCORE ★★★★☆

PRICE £666 (£799 inc VAT) from colorconfidence.com

Eizo describes the EV2740X as "premium 4K for business", and we can't think of a better set of words to describe it. This monitor is designed to be rolled out en masse so that users can plug it in and enjoy top-quality images while admin teams can manage them from afar.

That's possible thanks to a built-in RJ45 connector and the Screen InStyle software, which gives IT control over energy usage – by forcing the monitor into Eco Mode – and colour profiles. That may seem draconian, but if this is a shared monitor you want everyone to plug into it and enjoy the image.

And enjoy it they will. Anyone who spends most of their time in Excel or Word will love the clean whites: no monitor on test came closer to the 6500K ideal colour temperature, with 6503K in its default mode. A contrast ratio of almost 2,000:1 helps. It's colour accurate, too, thanks to an average Delta E of 0.27 and 84% coverage of the DCI-P3 gamut.



That's in default mode, with two user-definable profiles to accompany sRGB, Paper, Movie and DICOM. The first locks it effectively to the sRGB colour space, Paper provides an eye-friendly sepia mode for reading, Movie frankly makes very little difference whatsoever, and DICOM is there for medical environments.

ABOVE A high-quality display that's perfect for business rollouts



It's easy to switch between them in the touch-sensitive OSD: tap the bottom right of the bezel and relevant options appear, including shortcuts to control the brightness and volume, activate the full OSD and switch between the inputs. Here, Eizo spoils you: not only is there USB-C, but two HDMI connectors, a DisplayPort and a USB-B input if you wish to connect a second monitor and share the Ethernet connection and USB ports. There are two USB-A ports at the rear, with one more on the left-hand side along with USB-C, line in and line out. There's even a fine pair of speakers.

The superb stand is one of the most robust here, with no hint of a wobble, while you can twist, pivot and rotate the panel to an extensive degree. Add a height adjustment of up to 195mm – the highest here – and you simply won't find a more user-friendly setup.

The drawback of all this quality is that you have to pay for it. And make no mistake that you are paying a premium, even when you consider the excellent five-year warranty with the promise of no bright sub-pixels for the first six months. The counter-argument is that this monitor should last for many years, well beyond the warranty, thanks to an element of over-engineering that's also reflected in the price.

HP Series 5 Pro 527pm

It may seem overpriced in this company, but you're rewarded with rich colours and excellent video skills

SCORE ★★★★½

PRICE £320 (£384 inc VAT) from hp.com



While it's highly subjective, the HP Series 5 Pro 527pm earns our prize as the best-looking 27in display on test, with slim bezels matched to a minimalist matte silver stand. It's maxi when it comes to movement, though, with pivot support, 150mm of height adjustment and the ability to swivel 45° both left and right.

Cable management is easier than most as they plug in horizontally rather than vertically, which avoids cables dropping below the screen; it's further helped by a neat cable tidy that sits hidden behind the slim rod of the stand. There's no shortage of potential wires thanks to an RJ45 port, USB-B port and a trio of video inputs: USB-C (feeding up to 100W of power), HDMI and DisplayPort. There's also a DisplayPort output for those wishing to daisy-chain a second screen.

Naturally HP provides a USB hub for connecting peripherals, with a trio of USB-A ports and a USB-C port that can charge at up to 15W. Two of those USB-A ports sit at the bottom of the panel's bezel, along with a 3.5mm jack, while a clever and highly intuitive control unit at the rear gives control over settings. Or you can use HP's Display Center software.

In terms of the panel's gamut, you don't have much room for play. There's some wiggle room over colour temperature, and HP's Enhance+ effect for sharpening, but HP clearly has confidence that the out-of-the-box settings work – and it's right. Whites look gorgeous, and unlike so many of the 27in IPS panels on test this month it covers almost 90% of the DCI-P3 colour gamut. If all the other panels deserve grade A status, this one is A+. HP also deserves recognition for gaining EPEAT Gold certification with Climate+ for this monitor.

ABOVE This monitor screams quality from every angle



Finally we come to the video-conferencing setup that gives this monitor its full name (the HP Series 5 Pro 27 inch QHD USB-C Conferencing Monitor). The pop-up, tiltable 1440p webcam is the star, providing plenty of detail and rich colours even in darker conditions, but its supporting cast of microphone and speakers are excellent, too. This is one of the few monitors on test we'd be genuinely happy to listen to music through.

Is the Series 5 Pro worth the 50% premium over the Iiyama? Perhaps not: the jump in quality and feature set isn't that significant. Nor can we ignore that the Dell 27 Plus 4K USB-C (*see p83*) offers a higher-resolution screen for less, albeit without video-conferencing skills. But sometimes it's not about what you could buy and what you do buy; and if that ends up being the HP Series 5 Pro 527pm, you won't be disappointed.

Iiyama ProLite XUB2797QSNP-B1

Yet another great-value monitor from Iiyama and one that begs the question: why pay more?

SCORE ★★★★½

PRICE £198 (£237 inc VAT) from iiyama-monitors.co.uk



It shouldn't surprise us to see a high-quality yet superb-value Iiyama monitor, because that's what the company has produced for years. Here it delivers a 27in QHD (2,560 x 1,440) display based on a lily-white IPS panel. Although anyone hoping for wide colour gamuts should look elsewhere: it covers 77% of the DCI-P3 space compared to 97% of the ViewSonic VP2788-5K, to take an expensive example, and that means you miss out on lush hues in scenery.

The Iiyama display performed excellently in our colour accuracy tests, however, and its peak brightness of 317cd/m² is more than enough for office locations. We found it usable at half that brightness.

In terms of features, it's quicker to cover what the XUB2797QSNP-B1 doesn't include. First, there's no USB-B port, which remains you miss out on a handy way to share peripherals plugged into the USB hub: a trio of USB-A ports and single USB-C port. These all sit at the rear, but are still easy to access as it's a flexible stand that can pivot 90°, rotate 45° in either direction and tilt back 23°. The second omission is a high-quality pair of speakers; the 2W units here are clearly geared towards voice rather than percussion, so choose the BenQ BL2790QT if that's important to you.

ABOVE It looks basic next to the HP, but boy does it win for value



Now let's cover what you do get. First up, wired networking, which makes this a true USB-C docking monitor (*see "Time to dock", p81*). The USB-C port also delivers a generous 96W of power, enough to feed even demanding laptops, and there's even support for daisy chaining via a DisplayPort out. Buy two of these monitors and you can have a killer setup for under £500.

Nor does Iiyama stint on video inputs, with two HDMI 2.0 ports and one DisplayPort input. If you use any of these along with the USB-C connection then you can share an attached keyboard and mouse, but that will involve heading into the OSD and manually activating the KVM switch. A pain, as this isn't the friendliest of OSDs to use.

So there are signs of this monitor's low price in daily use, but once you factor in Iiyama's five-year warranty and proven track record for reliability, not to mention the gaming potential thanks to the panel's peak 100Hz refresh rate and support for adaptive sync, the Iiyama ProLite XUB2797QSNP-B1 stands out as one of this month's bargains.

MSI Pro MP275QPDG

Cheap enough that you can buy two – and daisy-chain them – for a fantastic setup, but colours needs tweaking

SCORE ★★★★☆
PRICE £208 (£249 inc VAT)
from scan.co.uk



The MSI brand springs to mind when thinking about graphics cards and motherboards, but it has a long history of producing displays, too. And not just gaming offerings: we've previously been impressed by its business-focused range and this is yet another solid performer.

We say solid rather than outstanding because the 27in 2,560 x 1,440 panel has modest colour coverage, with 73% of the DCI-P3 gamut within its range. That means colours lack the pop of the HP Series 5 Pro 527pm, say, so anyone hoping to be entertained should look elsewhere. Instead, think of this as a work-focused panel. We suggest you play around with the colour temperature, however, with whites not looking their best in sRGB mode due to a cool-ish 6090K colour temperature. We spent several minutes adjusting the colour temperature, when that should have been sorted out of the box.

The joystick-controlled OSD works well for such tweaks, but we found it easier to switch to the Productivity Intelligence app (even if this prompted us to connect the USB-B connection, despite already being connected over USB-C). It's clunky but provides enhanced control over every setting, so is well worth investigating.

MSI provides a generous selection of inputs, with two HDMI connectors and one for DisplayPort. That's alongside the USB-C port, capable of delivering up to 98W of power to laptops (or one of MSI's Cubi mini PCs), and it's always good to see an RJ45 connector at the rear alongside the aforementioned USB-B connector and four USB-A ports.

ABOVE The styling is basic, but we do love the 1080p webcam



It's a shame MSI couldn't move two of these to the side for easier access, but there's enough backwards tilt (20°), swivel (45°) and height adjustment (130mm) to manoeuvre it and plug in your keyboard and mouse. You won't need to add a webcam as MSI packs a 1080p unit here, and despite this monitor's competitive price it's a high-quality device that coped in low light and produced sharp images with a nice range of colours. With an effective integrated mic and decent pair of 2W speakers – good enough for listening to music at low volumes, but far from Echo standards – every important base is covered for a home office. We think SMEs should also seriously consider it for a small office rollout, but note that you'll need to screw the backplate in: there's no tool-free option.

With support for daisy chaining a second monitor using the DisplayPort output, MSI packs in a lot for your money. To the point where you might consider buying two.

Philips 27B2G5601

A perfectly good monitor with nice extras, but it's made to look overpriced by several of its rivals

SCORE ★★★☆☆
PRICE £271 (£325 inc VAT)
from uk.insight.com



The Philips 27B2G5601 has four direct competitors this month: BenQ, HP, Iiyama and MSI all submitted 27in IPS panels with a 2,560 x 1,440 resolution and business-friendly features. Here, that means a an RJ45 port for wired networking and a 90W feed to laptops over USB-C, which is ideal for workers who want to use their monitor as a docking station. There are also single video inputs for DisplayPort and HDMI.

So far, so usual. Where Philips veers from this month's playbook is by including two ways to daisy-chain a second monitor: there's a DisplayPort output, as we see on its rivals, but also a second USB-C port dedicated to this purpose. This monitor also packs four speedy USB-A 3.2 Gen 2 ports, where most USB-A ports on monitors only support Gen 1. That means data transfers should be twice as quick, always welcome when using external drives, and it's good to see that the final USB-C port (for data only) also supports the faster standard.

Philips pumps up the volume by opting for 3W speakers compared to the more commonplace 2W units, but dim your expectations. They're brash units with poor balance, so we couldn't enjoy music on them. Perhaps that's why Philips also builds a flip-out headphone holder into the left side of the display, a feature more commonly seen on gaming monitors. It sits adjacent to a 3.5mm jack, the USB-C data port and two USB-A ports, so it's easy to add peripherals.

ABOVE Philips knows how to build an attractive monitor



The OSD is extremely rapid even if the navigation isn't intuitive, but this is where Philips SmartControl can step in (if you're connected over USB-C). It's an excellent way to explore the image options, with control over the colour temperature and "Smart Image" presets such as Office, Photo and Movie. These won't shift the colour space, which covers around 77% of the DCI-3 gamut, but if you choose sRGB mode it will lock it down effectively to that space, albeit limiting it to 89%.

Even in the Philips' default mode whites look great, and we can't be overly critical of a peak brightness of 304cd/m². That's fine for typical office use. One final factor in Philips' favour is the flexibility of the stand, with 360° of swivel movement and plenty of backwards tilt at 30°. It also supports portrait mode and provides 150mm of height adjustment.

Fierce price competition makes the Philips 27B2G5601 look expensive, but if you'll take advantage of its faster transfer speeds and its USB-C daisy chaining then it's just about worth the premium.

Sharp MultiSync EA272U

A high-quality panel supported by a solid and flexible stand, all backed up by remote management

SCORE ★★★★☆

PRICE Quotes provided on application with Sharp



We've finally reached the end of the five-year branding road: NEC Display Solutions became NEC/Sharp in 2020 and has now become Sharp, with this the first monitor under the new name. As with its predecessors, the MultiSync EA272U is squarely aimed at enterprise buyers so you'll rarely find it in retailers. Although individual units can be bought from some specialists for around £475 exc VAT, it only makes sense when bought as part of a fleet.

That's in part because you can probably negotiate a lower price, but also because it's designed for remote management. The physical part is connecting to your network via the RJ45 port, with the soft component coming via the NaViSet software. This allows you to manage each monitor as a separate asset along with taking control of settings such as user sensing, where it will switch into standby if someone drifts away.

You can also lock the monitor to its Eco 1 setting, which is a perfectly pleasant 250cd/m². This drops the power consumption to 21W from its peak of 30W at maximum brightness (436cd/m²), or if you're feeling parsimonious you can drop it to Eco 2 at 15W – but that does reduce brightness to a dim 127cd/m².

ABOVE Sharp makes a strong showing with its first MultiSync display



You can unlock the settings and let users take control, but that might result in confusion as Sharp hasn't implemented the most intuitive OSD. Nor is there much flexibility beyond colour temperature, even if you switch between the "DV modes" of, say, Standard, Movie and Photo. In all our tests, the panel covered 100% of the sRGB gamut and around 90% of DCI-P3, which means a punchy image. Accuracy is great, too, and thanks to the 4K resolution text looks super-sharp.

Build quality is top-notch despite the outstanding flexibility of the stand, with a particularly notable 35° backwards tilt and 170° swivel on both sides, and you can also daisy-chain a second monitor via the DisplayPort out. Sharp also provides speakers, but they're too brash to enjoy music; think web calls only.

It's a fine standalone debut for Sharp, showing that the MultiSync brand remains in safe hands. If you can negotiate an upgrade on the standard three-year warranty then this becomes a strong alternative to Eizo for corporate rollouts.

ViewSonic ColorPro VP2788-5K

This 5K Thunderbolt monitor packs OLED-like intensity and amazing connectivity – for a price

SCORE ★★★★☆

PRICE £999 (£1,199 inc VAT) **from visunext.co.uk**



If we gave awards on the basis of features alone, this display would walk away with a cabinet's worth. The two Thunderbolt 4 ports mean you can daisy-chain two together and view a staggering number of pixels in a compact area: imagine having two 5,120 x 2,880 screens side by side. The second panel may require its own power supply, though, as the "down stream" port can only feed up to 15W.

The VP2788-5K includes a separate power brick, and it's meaty at 230W. Still, with up to 100W of that feeding a connected laptop and 15W going to a separate USB-C port, you can see how the power is used up. There are also HDMI and DisplayPort inputs at the rear, and if you connect a second computer via USB-C you can share connected peripherals between the two: a pair of USB-A ports and fourth USB-C port are all ready to be shared.

A 5K resolution is unusual for a 27in monitor – only the BenQ DesignVue PD2730S matches it in this Labs – and results in a super-sharp pixel density. You could argue it's overkill, but if your eyesight is good it will make it easier to split three windows across the screen – and unlike the 32in and 34in widescreens on test, the VP2788-5K doesn't take up much space on a desk.

It's a top-quality panel that's been fine-tuned by ViewSonic to deliver the goods no matter the colour space you prefer to work in. Choose sRGB and it locks almost perfectly (97% out of a 98% volume), likewise DCI-P3 (97% out of a 97% volume). Three presets sit empty if you want to perform your own hardware calibration. Those sit in the Color Mode menu, but ViewMode is based on scenarios; presets exist for everything from CAD to first-person-shooters, even if a 75Hz refresh rate rules out hardcore gamers. In general the OSD is a winner thanks to its snappy performance, but we lost count of the times we accidentally switched the monitor off as the power switch sits right next to the OSD's joystick.

ABOVE A feature-packed monitor, but it comes at a price



Another potential pitfall is that Eco Mode is on by default, so you may wonder why a monitor with a stated peak brightness of 550cd/m² looks so dim. Switch off Eco Mode and your world will brighten, with a measured maximum of 566cd/m². We hoped for DisplayHDR certification of 600 or higher, but instead it's stuck at 400. Still, films look great on this panel (a contrast ratio approaching 2,000:1 helps), and it includes a fine pair of 5W speakers that handle soundtracks and music with equal aplomb.

All this comes at a price, unless you compare it to Apple's Studio Display: if you want the height-adjustable stand to match the VP2788-5K's flexible offering it will cost you a cool £1,899.



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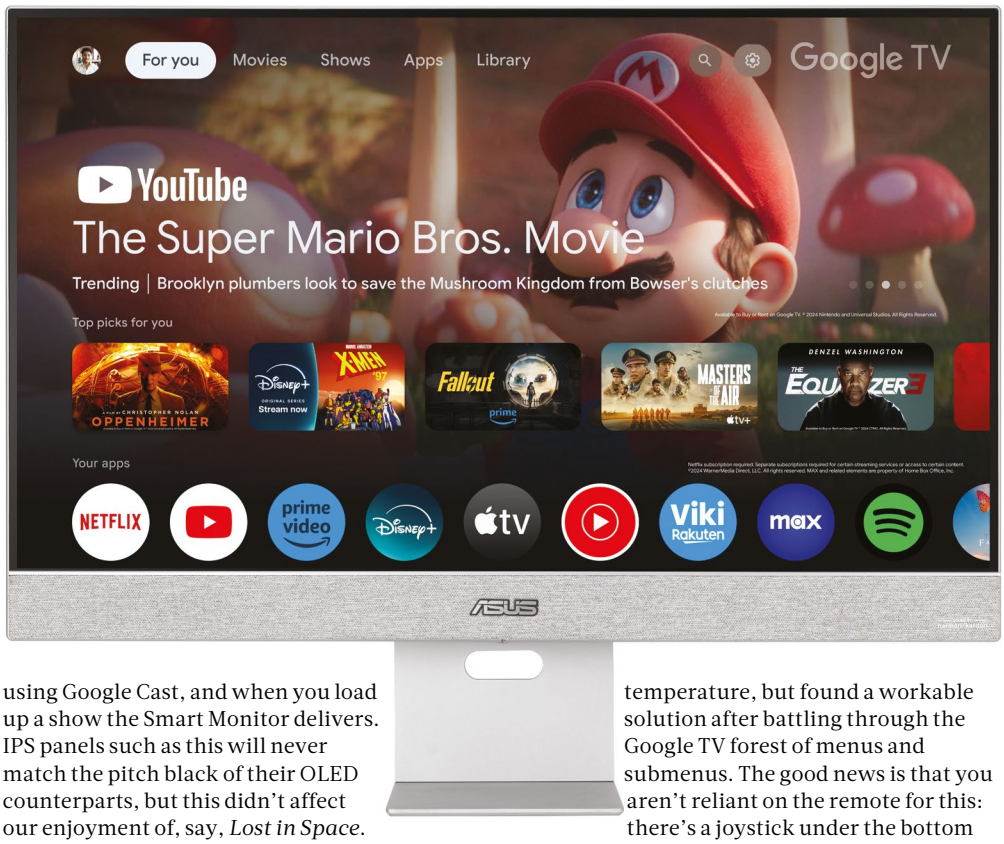
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Asus ZenScreen Smart Monitor MS27UC

An intriguing choice for hybrid workers and students, even if image quality can't match the best

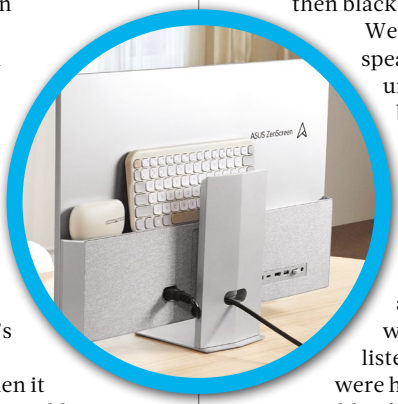
SCORE ★★★★☆

PRICE £333 (£399 inc VAT)
from argos.co.uk



The Asus ZenScreen MS27UC is part of a growing trend to inject streaming TV services into monitors, grouped under the hazy term "Smart Monitor". It's a boring name but a fascinating product category, because it appears to meet our changing habits: the office has moved to our homes, with different parts of people's accommodation doubling as a place of work during the day and somewhere to play at night. You can see why a monitor that can essentially double as a TV appeals in such scenarios, not to mention for students who spend so much time in their rooms.

Asus isn't alone in producing Smart Monitors, with both LG and Samsung established vendors in this space. Where it differs is by using Google TV as its operating system rather than LG's webOS (a direct descendant of Palm's webOS, which HP acquired in 2010 when it bought Palm and then sold on to LG in 2013) and Samsung's home-brewed Tizen OS.



Your preferences may differ, but we like Google TV for its simplicity and speed. Press Home on the supplied remote control and you jump to the main interface, which provides easy access and all the services you've signed up to – including Apple, Disney+, Netflix and Prime Video – alongside TV channels such as ITV's myriad services, Channel 4 and Channel 5. But no BBC. At the time of writing, this wasn't available on Asus's Smart Monitor despite it now being widely available on other Google TV hardware. We asked Asus when it would be added, but no definite answer was forthcoming.

Fortunately, you can easily stream to the ZenScreen from your phone using Google Cast, and when you load up a show the Smart Monitor delivers. IPS panels such as this will never match the pitch black of their OLED counterparts, but this didn't affect our enjoyment of, say, *Lost in Space*. Asus has also gained DisplayHDR 400 certification from VESA, which is good to see – even if it emphasises that if you buy a DisplayHDR 1000 screen then blacks will be richer still.

We're also fans of the speakers, a pair of 5W units built into the bottom of the screen. When sitting in front of the MS27UC you will be hit full blast by their power and fidelity, and whether watching films or listening to music we were happy. It's even capable of handling the subtleties of classical music.

Asus hands all control of the panel's image to Google TV, which means there isn't as much control over the colour palette as non-smart monitors. You can tweak the colour temperature and switch between sRGB, DCI-P3 and even Adobe RGB colour spaces, but this made minimal difference visually or when we measured them: you're stuck in what we would consider a slightly extended version of the sRGB space, equating to 78% of the DCI-P3 gamut.

As a daily monitor, its biggest plus is the 4K resolution. That means text looks sharp, even if you lean in closely, and helps when working on anything detailed. We were less impressed by the out-of-the-box settings for contrast and colour temperature, but found a workable solution after battling through the Google TV forest of menus and submenus. The good news is that you aren't reliant on the remote for this: there's a joystick under the bottom bezel that's just as quick to use.

ABOVE The ZenScreen will look right at home in any living room

PC PRO RECOMMENDED

LEFT You can store peripherals in the holder at the rear

BELOW The supplied remote offers access to streaming services



This monitor has extra talents, too. For example, smart home adopters will appreciate the ability to control smart heating, doorbells and the rest from this device. You can also activate Multi-View to share the screen between your PC and phone, and even set yourself entirely free from wires by using MiraCast or Chromecast.

We would always choose the lag-free options of direct inputs, however, and you have a choice of HDMI and DisplayPort alongside USB-C (delivering up to 90W). Two USB-A ports and a 3.5mm jack also sit at the rear, which is limited, but there is built-in Bluetooth for connecting a mouse and keyboard. And neatness freaks will also appreciate the holder for such peripherals that's integrated into the back of the monitor.

While we wouldn't go so far as to call the ZenScreen a work of art – although it can display paintings in its Ambient Mode – Asus deserves credit for this monitor's design. Everything is finished in smart silver, right down to the brutalist stand. There's a limited but still useful 100mm of height adjustment and 18° of backwards tilt, but no swivel. Fortunately it's quite light at 6kg.

Considering that the Dell 27 Plus 4K only costs £60 less, Asus is bundling a lot of extras for the money. We wouldn't put the ZenScreen MS27UC into the same category of image quality as the Dell, especially for colour coverage, but its myriad other talents earn it a Recommended award.

BenQ DesignVue PD2730S

If you'll exploit its quality and its advanced features, this 5K panel is well worth the hefty investment

SCORE ★★★★★
PRICE £833 (£1,000 inc VAT)
from scan.co.uk



One monitor looms large in the background when reviewing the BenQ DesignVue PD2730S: the Apple Studio Display (*see issue 332, p62*). They're both 5K screens, and both designed to complement Apple computers with Thunderbolt 4 outputs, but while the Studio Display costs £1,499 with the standard glass and stand – rising to £2,149 if you select the Nano-texture glass and height-adjustable stand – you can pick up the BenQ for a flat £1,000. That's also £199 cheaper than the similarly luxurious ViewSonic ColorPro VP2788-5K (*see p86*).

The great thing about this BenQ display is that, when it comes to image quality at least, you're making no compromises. It's pre-calibrated to hit the sRGB, Display P3 and DCI-P3 gamuts almost perfectly, along with matching the colour profile found on MacBooks (BenQ calls this M-book). It even comes with a licence for BenQ's Ultimate Palette calibration software, so you can fill one of the two user slots with your own favourite – this could be an Adobe Premiere video-editing profile, for example.

We put the DesignVue through an extra-comprehensive set of testing to see how it matched up to its various profiles, and were never disappointed. Its best result came in our sRGB gamut tests, where it locked to 94% of the space without any overspill, with DCI-P3 not far behind at 93%. And you can absolutely trust the colours you see, with its average Delta E always under 0.5.

BenQ states a peak brightness of 400cd/m², but that's only achievable if you head into the Advanced settings and switch Uniformity from on, its default, to off. In our tests, that changed its peak from 281cd/m² to 503cd/m² – quite a difference, although IPS panels at 250cd/m² still look fine in office environments. BenQ puts Uniformity on by default to smooth out the contrast and brightness across the panel, which we wouldn't normally recommend as contrast also drops as a result; here, though, it goes from 1,927:1 to 894:1, which is still a decent score. And BenQ's choice has a dramatic effect on the brightness uniformity too, with the average difference (of the 24 measured areas to the central area) dropping from 9.7% to 3.1%.



LEFT The Hotkey Puck G3 makes it easy to change settings

It's phenomenally easy to change the settings thanks to the wireless Hotkey Puck G3, which includes a dial and numerous shortcut buttons that can all be programmed. You can do this via the OSD, but we recommend downloading BenQ's slick Display Pilot 2 software, which makes such customisation more intuitive and sits ready in the taskbar. It's a shame that you can't upgrade the monitor firmware using this as well, but BenQ's Display Quickit utility does the job well enough.

This may all make using the DesignVue sound complicated, but it's worth investing the initial time to tune it to your needs as it can then be instructed to switch automatically between colour modes depending on the active software. You can also split the panel into two colour modes, one for each half. And there's more: connect over Thunderbolt 4 on a Mac and you can daisy-chain a second 5K Thunderbolt monitor through the output. BenQ also makes it easier than most to plug video input cables in, with the DisplayPort, HDMI and Thunderbolt 4 ports all lying in wait.

ABOVE The BenQ DesignVue makes no compromises when it comes to image quality

PC PRO LABS WINNER

Perhaps surprisingly for the price, there's no RJ45 port – so this isn't an out-and-out docking monitor (*see p81*) – but you do benefit from a USB hub comprising three USB-A ports and one USB-C, all of which sit at the bottom of the monitor for relatively easy pluggability. This is where you'll appreciate the 150mm of height adjustment, but it's a shame it doesn't tilt back further than 20°, while the 30° of swivel to either side isn't great for sharing your screen with neighbours. While we're nitpicking, we also hoped for more quality from the pair of 3W speakers, which lack bass and balance compared to the ViewSonic.

BELOW A Thunderbolt 4 port allows you to connect to a Mac



This reflects the two monitors' different strengths, with the ColorPro VP2788-5K being a better entertainer while the BenQ is a more natural choice for creative professionals. They're both excellent screens, and far cheaper than either the Apple Studio Display or Eizo's professional ColorEdge offerings.

Acer SH322QU Abmiphux

We can't criticise the price, but the low pixel density and limited features are hard to ignore

SCORE ★★★☆☆

PRICE £190 (£230 inc VAT)
from business.currys.co.uk



Acer is a proven master of delivering great-value products, and that's precisely what it achieves here: a 31.5in panel and USB-C connectivity for £230 is impossible to knock. And while others strip down the quality of the stand to achieve such a low price, the SH322QU provides a respectable 100mm of height adjustment and the ability to swivel 360°. The monitor even looks attractive, with slim bezels and housing.

Some of this svelteness is achieved by relying on a power brick rather than integrating the PSU, with the DC input sitting next to a grand total of four ports: one apiece for the audio jack, USB-C, DisplayPort and HDMI connectors. There's no USB hub, but you can at least charge a laptop over the USB-C port – so long as 65W is enough.

But the real compromise is the pixel density. Spreading a QHD (2,560 x 1,440) resolution across a 31.5in diagonal results in 93 pixels per inch (ppi), and that means you might notice a jagged edge to characters. It's bearable, but most people prefer a ppi above 100. There's also a notable drop off in contrast as you look to the edges of the panel, which isn't unique to the SH322QU but was reinforced by its average uniformity of over 10%. Ideally, we're looking for 5% or less. Even in the centre, it didn't hit its claimed 300cd/m² in our tests, but a peak of 289cd/m² wasn't far off.

ABOVE The 31.5in screen is just too large for a QHD resolution



In terms of colour coverage, this is a decent panel. In its default mode, it covers 76% of the DCI-P3 gamut while its average Delta E was a commendable 0.7. Whites look best in the sRGB and HDR modes, both of which are selectable via the simple but easy-to-navigate OSD; AOC could learn a lesson or two from Acer here.

Perhaps surprisingly in such a stripped-back monitor, Acer finds room in the budget for speakers. These aren't going to win any awards from our sister title *What Hi-Fi?*, but they're absolutely good enough for video calls and bearable (just) if you want to listen to music at low volumes.

If your budget is £250 and for some reason you need a big screen then this is a perfectly fine choice. However, we'd recommend the same resolution on a 27in panel such as the BenQ BL2790QT, especially as you then benefit from many more features.

AOC Graphic Pro U32U3CV

A couple of rough edges, but this great-value 4K monitor delivers excellent colour coverage

SCORE ★★★★☆

PRICE £417 (£500 inc VAT)
from amazon.co.uk



We associate AOC with all-out value screens, but it ups the ante with this 4K IPS monitor aimed at graphic designers. And it really is a top-notch panel, as can be seen from a table-topping set of figures in our tests for Adobe RGB coverage (79%) and DCI-P3 (90%). Colour accuracy isn't up there with the very best professional screens, with an average Delta E of between 1 and 2, but it's a brilliant performance for the price.

AOC has also upgraded its on-screen display, with far more settings – including a choice of colour spaces – and a nippier response to commands. Navigation still isn't as intuitive as pro rivals such as Eizo, but you'll get there. There are also lots of preset modes to choose from, such as Photographer and HDR Effect, and with VESA DisplayHDR 400 certification and a decent peak brightness of 431cd/m² it's a great choice for films (just don't expect miracles from the bass-light speakers). Less so games, as the 60Hz refresh rate is a distinct limitation.

Superb whites make this IPS panel an absolute joy when it comes to work, and while 34in widescreen panels with their 21:9 aspect ratio are a better choice if you typically view three or four tabs side by side, the 16:9 ratio works well for a central main window with slimmer tabs on either side. Plus we love the sheer sharpness of so many pixels packed into a small area.

ABOVE Superb whites and colour coverage make this a top choice



We're not totally convinced by the harsh right-angled stand as it steals desk space compared to rounded designs, but it is flat (so you can place a keyboard on and it won't wobble) and there's natural storage space for pens and the like behind. You can still swivel the main panel easily through 30° left and right, while the 150mm of height adjustment is plenty.

This is also a true docking station panel, with built-in networking and a trio of USB-A ports along with a second downstream USB-C port to complement the upstream one for connecting a laptop. This delivers an excellent 96W of power. Add a DisplayPort (1.4) and two HDMI 2.0 ports and the only thing lacking is a USB-B input for sharing peripherals with connected desktop PCs.

But, as is so often the case with AOC monitors, we come back to the price. The Graphic Pro U32U3CV delivers terrific image quality, designer-friendly presets and bags of connectivity for £500. It's a great buy.

HP P34hc G4 Curved Monitor

A high-quality panel, but this monitor shows its age when it comes to features – most notably a lack of networking

SCORE ★★★☆☆

PRICE £319 (£383 inc VAT) **from** hp.com

When it was released back in 2021, this monitor ticked all the right boxes – by which we primarily mean that it supported USB-C. But here we are in 2025 and its 65W output looks weak, albeit still enough to power typical office laptops, while it loses out on increasingly common wired networking ports.

Another sign of its age is that all the ports in its USB hub are USB-A, with no USB-C option, and they're tucked awkwardly at the rear. This is where you'll also find DisplayPort 1.2 and HDMI 2.0 connectors, plus a USB-B input so that you can share peripherals (keyboards, mice, external drives) plugged into the USB-A ports between computers.



Compared to rivals, the P34hc's peak brightness of 262cd/m² seems a trifle dim, but it's fine for offices and once you start using this monitor you'll simply appreciate the expanse of screen: 3,440 x 1,440 pixels across a 34in diagonal looks sharp and produces an epic amount of space on which to work. We also appreciated the high contrast ratio and 87% coverage of the DCI-P3 gamut, even if the 60Hz refresh rate won't impress after-hours gamers.

There's no sRGB mode and little control over the colour palette other than one customisable setting, but you can change the colour temperature from neutral (we measured this at 5936K) to Warm, Cool or the sepia-toned Night. There's also HP's Enhance+ mode, but this mainly controls sharpness and we quickly switched it off. Still, the OSD – based on four rear-mounted buttons – is easy to use if you want to play around. It's also worth downloading the HP Display Center app from the Microsoft Store, as this provides an easier way to control settings and provides firmware updates.

ABOVE The P34hc has decent image quality but is now outdated



HP didn't find space in the budget to include a webcam, but we did enjoy listening to music on the speakers, which emit a smooth, almost easy listening sound. It's easy on the eye, too, with a slim bezel and minimalist stand with equally minimalist features: 130mm of height adjustment, a respectable 21° of backwards tilt but no luxuries such as swivelling.

All of this means that, HP loyalists aside, there's little reason to choose the P34hc G4. It's a solid screen with a fine pair of speakers, but the Iiyama ProLite XCB3497WQSNPH offers so much more for the same price.

MSI Modern MD342CQPW

Arguably the best-value screen on test, with a high-quality panel and all the features most people need

SCORE ★★★★★

PRICE £249 (£299 inc VAT)
from currys.co.uk

The MSI Modern MD342CQPW pulls off the neat trick of being the cheapest 34in curved monitor on test while looking like the most expensive. The next trick: to actually be a high-quality 3,440 x 1,440 panel, with an excellent set of results in our technical tests. Far more expensive panels failed to cover 87% of the DCI-P3 gamut, while its average Delta E of 0.52 puts it right up there with the best. Those who prefer to work in the sRGB gamut – where whites look a shade whiter – will also find much to love, as switching to that mode locked it to 95% of the space with only 1% overspill.



Only its peak measured brightness of 261cd/m² (lower than the 300cd/m² MSI claims) shoved it down the charts, but we're not concerned by this: that's fine for an office monitor. And the MD342CQPW has plenty to offer after-hours gamers, too, with a 120Hz refresh rate, 4ms response times and support for AMD FreeSync Premium.

MSI makes compromises in all the right areas, too. You can't expect wired networking at this price, but the now ubiquitous USB-C port supplies a generous 98W of power to connected laptops, with one DisplayPort and two HDMI 2.0 connectors completing a fine set of inputs. Whatever you shove into the pair of USB-A ports can be shared with other computers thanks to a USB-B port, but that's your lot: no USB-C port, and note that they're all hidden away at the rear.

ABOVE A spectacular monitor for the money



The OSD isn't the easiest to navigate but there's little need when it comes to the panel. MSI provides modes such as Black-White, Office, Eco and Movie, but most people will be happy with the default. It's good to see both Picture-in-Picture and Picture-by-Picture in there, though, along with a trio of eye-health checks to guard against fatigue and provide advice (albeit mis-spelt) on how to adjust the screen height for maximum comfort. Although 110mm of height adjustment doesn't sound much it should be fine for most setups.

Despite the low price MSI squeezes in a pair of respectable speakers, albeit with almost non-existent bass, which makes you wonder why more expensive monitors don't do better. And that's how we generally feel about the MSI Modern MD342CQPW: that, for the price, it's simply spectacular. Sure, it could go brighter and it lacks USB-C ports and RJ45 networking, but it packs quality exactly where it counts.

Philips 34B2U6603CH

This Thunderbolt 4 monitor is an excellent choice for anyone on video calls all day, justifying its price

SCORE ★★★★½

PRICE £466 (£559 inc VAT)
from uk.insight.com



This monitor packs in pretty much every feature available. You'll enjoy 2.5GbE wired networking, a high-quality webcam, two excellent 5W speakers and, at the heart of it all, support for Thunderbolt 4. That means you can daisy-chain a second monitor over USB-C, although with a 34in panel packing 3,440 x 1,440 pixels there's already plenty of space to work. Two monitors would make a killer gaming setup, though, complete with 120Hz refresh rates and adaptive sync support.

It's a solid panel that covers 82% of the DCI-P3 colour gamut, with strong colours in default mode. Philips also provides an sRGB mode that locks to 88% of that space, but with a measured colour temperature of 7556K the whites aren't as pure as we hoped. Nor is this a panel for purists, with an okay average Delta E of 1.1 and a worst result of 9.85. We also measured a significant drop-off in brightness (around 20%) on the panel's left edge.

This can be reduced using the Smart Uniformity profile in the Philips SmartImage menu, along with EasyRead (mono), Office, Photo and Game presets (and more). Those are easy to cycle through using a shortcut, while the full nippy and simple OSD is navigable using four buttons on the bottom right edge of the bezel. This is where you can activate yet more features, such as sensors for people and ambient light.

ABOVE You'll not be left wanting for features if you plump for this Philips display



The left bezel edge houses three more buttons. One activates a busy light on top of the pop-up webcam unit, with a bright red LED strip to tell people not to interrupt you (this can sync with Teams, too). There's also a handy button to mute the mic, at which point a subtle white LED light then appears. But the biggest factor in Philips' favour is the webcam's quality: we would be more than happy to take calls on this all day.

There's auto framing if you want it, along with a tiltable webcam unit. Combined with an extremely flexible stand, with up to 180mm of height adjustment, you should find it easy to find the perfect position on your desk. The screen also tilts all the way back 30° and, incredibly for such a large unit, it swivels 360°.

If the Philips could have matched the ViewSonic for image quality and whites then it would be walking away with five stars, but all of its other strengths lift it above rivals for a well-deserved Recommended award.

ViewSonic VG3457CV

If you're stuck on video calls all day then consider this high-quality monitor, but it has its frustrations

SCORE ★★★★½

PRICE £427 (£512 inc VAT)
from visunext.co.uk



The 34in curved ViewSonic VG3457CV is designed to be a one-stop, do-it-all docking monitor. Along with the usual physical network port and USB hub, it provides a Zoom-certified 5MP webcam complete with microphone and fill-in lighting – not needed in good lighting, where this webcam excels, but it provided a helpful lift in darker situations.

You can tune the fill-in lighting with settings for brightness and warmth, and unlike the Iiyama ProLite XCB3497WQSNPH there is a limited amount of tilt. It's a pop-up webcam so hides away for privacy, but it's nice to see support for Windows Hello. However, it feels plasticky, and on the first sample ViewSonic sent us the camera didn't work – this makes us worry about durability, although the excellent five-year warranty covers the webcam as well.

ViewSonic has thought about the problems faced by regular video callers, with a shortcut on the bezel to mute the microphone complete with a red LED indicator. The four other shortcuts allow you to switch between screen settings based on scenarios (such as office use and gaming), mute the speakers, take control of the fill-in lighting and access the full OSD. Sadly, more work needs to be done by ViewSonic's UX team, as the OSD isn't as easy to use as rival offerings.

ABOVE Ideal for video calls, and with superb image quality



Another irritation is that it's difficult to push the panel beyond medium brightness, so keen is ViewSonic to keep it in Eco mode: the secret is to move out of the default View mode and into, say, Mac mode, at which point our measured peak leapt from 252cd/m² to 378cd/m². However, power consumption also jumped from around 30W to 42W.

The 3,440 x 1,440 panel itself is top quality. It looks sharp and is tuned to the DCI-P3 space, covering a punchy 87% for vivid colours with excellent accuracy. What's more, its whites are excellent. With a 100Hz refresh rate and measured contrast ratio of 2,213:1, it's even a solid choice for gaming too, while its speakers go loud and produce decent results. Not hi-fi good, but enough for background music during a working day.

Sat next to the Iiyama ProLite XCB3497WQSNPH, the ViewSonic looks expensive, while it lacks the advanced features of the Philips 34B2U6603CH. But make no mistake: the VG3457CV is a high-quality panel that is a great choice for Zoom fans in particular, only missing out on award due to the strength of the competition.

Iiyama ProLite XCB3497WQSNPH

Plots the sensible middle ground to produce a great-value monitor that includes everything most people need

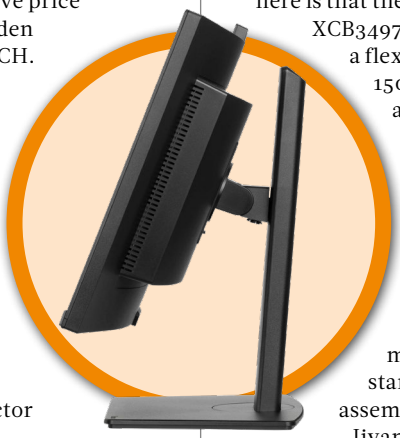
SCORE ★★★★★

PRICE £317 (£380 inc VAT)
from scan.co.uk



The Iiyama ProLite XCB3497WQSNPH is one of five monitors in this Labs to be based around a 34in curved panel with a 3,440 x 1,440 resolution, and we can understand why it's so popular. It's almost equivalent to having two monitors on your desk, with an extravagant 21:9 aspect ratio that provides ample room for four, even five, windows side by side.

The ProLite is our pick of them all for the simple reason that Iiyama covers all the most important bases at a more competitive price than the feature-laden Philips 34B2U6603CH. So you don't get Thunderbolt 4 or daisy chaining, but the USB-C connector can output up to 95W of power, and if you want to connect other computers you have two HDMI ports and one DisplayPort connector to choose from.



Unlike HP, Iiyama includes a physical network port, with a USB port comprising two USB-A ports and a single USB-C port. A USB-B port is also present if you want to share connected peripherals with the other system, although you will need to head into the OSD to dictate which video input this relates to (others use a smart KVM that does this job for you).

You'll also need to activate the camera via the OSD, which might be considered a sensible security precaution were it not for the very obvious privacy shutter. Video quality is the worst of the four webcams built into monitors this month, as is the microphone, but it will get you through a call in an emergency. Likewise, we wouldn't recommend throwing away your current speakers to make way for the 5W duo that sit here, but they're just about good enough – at a push – for listening to music.

The final downside compared to the Philips is that it's fixed, so the only way to adjust the angle is to move the panel, but the good news here is that the ProLite XCB3497WQSNPH includes a flexible stand: there's 150mm of height adjustment, a respectable 23° of backwards tilt and a surprisingly generous 45° of swivel in either direction. And while this isn't the most stylish of stands, the whole assembly feels well built.

Iiyama plots a sensible middle course when it comes to quality, aiming for the mainstream worker rather than the creative professional. The panel covers 85% of the DCI-P3 gamut, which means impactful if not eye-gouging colours, and it does so with solid accuracy: we measured an average Delta E of 0.83 and a maximum of 3.22, and while that won't wow any print designers it means you can trust the displayed colours.

ABOVE The curved 34in panel provides plenty of space for multiple windows

PC PRO RECOMMENDED

LEFT The flexible stand offers plenty of tilt and swivel options

BELOW Iiyama includes a physical network port, as well as USB-A, B and C



It's fortunate that this default profile is so pleasant on the eye – including respectable whites that benefit from pumping up the brightness to around 250cd/m², with a peak of 371cd/m² on offer – as Iiyama doesn't offer, say, an sRGB profile. You can adjust the hue and saturation, and play around with the i-Style presets that let you switch between Text, Cinema, Scenery and Game, but to limited effect. The latter, for instance, boosts the brightness and contrast while activating the overdrive to give you 5ms response times, but most casual gamers (avid gamers should buy a specialist screen) will be happy with the default performance in Standard mode thanks to the 120Hz refresh rates.

All these settings are only accessible via the OSD, with no fancy software on offer, and in truth it's clunky. Everything relies on the joystick that sits beneath the Iiyama logo at the bottom of the screen, which you use to navigate a selection of icons – press up when you find the one you want. You're then taken to the relevant part of the full OSD, after which you need to work out whether to press left, right, up or down to activate the option. It's confusing at first, but there is logic at play once you understand its quirks, and unlike some rival OSDs it is at least nippy.

Is this an exciting monitor that will set your pulse racing each time you gaze at it? Absolutely not. But it's well built, the image quality is great and best of all it provides a wide expanse of space on which to work and play.

How we test

Details of the exhaustive procedures we put each screen through

As with all our testing, where possible we use a mix of real-world and technical tests to determine the quality of the products. Here, that means using each monitor as our daily work screen to see not just how enjoyable it is to look at but its usability: how intuitive is the on-screen display, how well engineered is the stand, how convenient are the ports?

We also explore the OSD in depth to see what options it provides users. In particular, we will praise screens that allow people to switch between colour profiles – say from sRGB to DCI-P3. But only if that switch is effective, which is where our technical tests come in.

These use an X-Rite i1 Display Pro HL colorimeter in tandem with the display calibration and profiling software, DisplayCal. We measure each display's maximum brightness in cd/m² (equivalent to lumens), its contrast ratio and colour temperature. We also measure each panel's colour gamut as a percentage of the sRGB, DCI-P3 and Adobe RGB gamuts. We take these measurements in the default setting (as supplied), and those colour profiles if available.

We then test the evenness of the LED backlighting by measuring brightness and contrast across 25 points on the screen. In addition, we test each monitor's colour accuracy (using the sRGB profile if available) from a central point on the screen. This process measures how close the display colours are to their intended shade. The difference is measured in the unit of colour difference, Delta E: the higher the figure, the poorer the match.

Finally, we check how much power each monitor consumes at 200cd/m² and at its peak brightness.

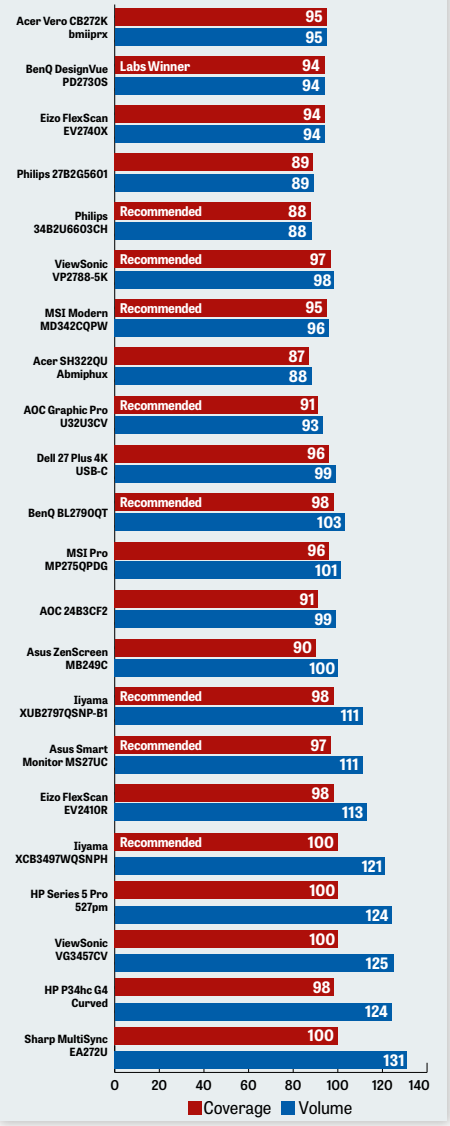


ABOVE An X-Rite i1 Display Pro HL colorimeter helps us determine a display's image quality

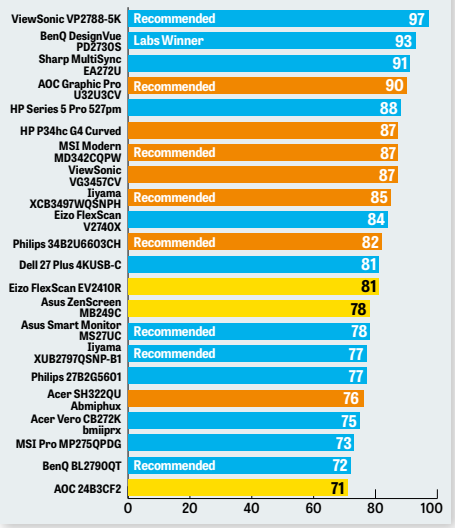
Quality test results

COLOUR TESTING Note that colour space testing was performed in the monitor's relevant mode (such as sRGB or DCI-P3) if available. If not, we used a 6500K colour temperature. If that wasn't available, we used the default mode. The ideal is for a monitor to achieve 100% sRGB coverage and 100% volume; a big difference between the two values shows the panel isn't tuned to that colour space.

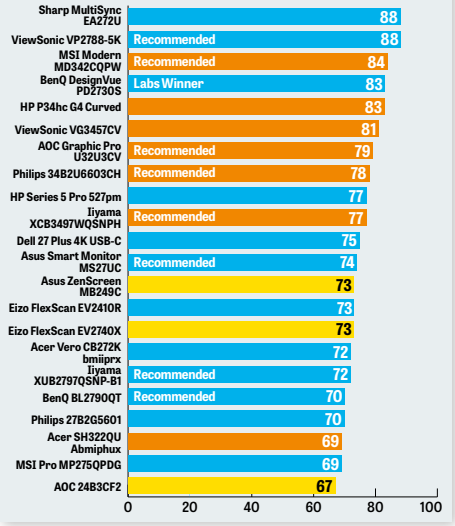
sRGB performance (%)



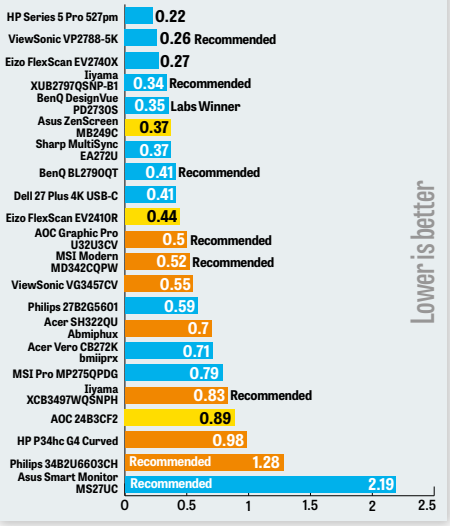
DCI-P3 coverage (%)



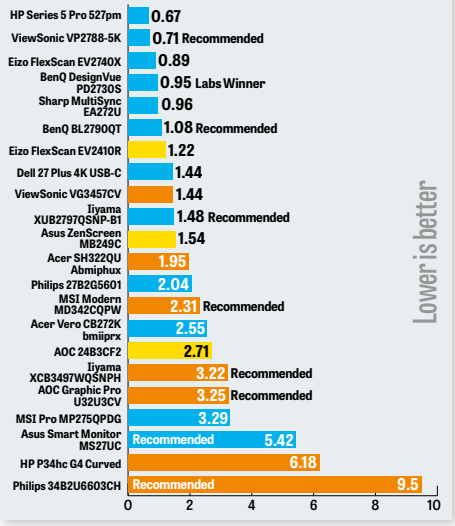
Adobe RGB coverage (%)



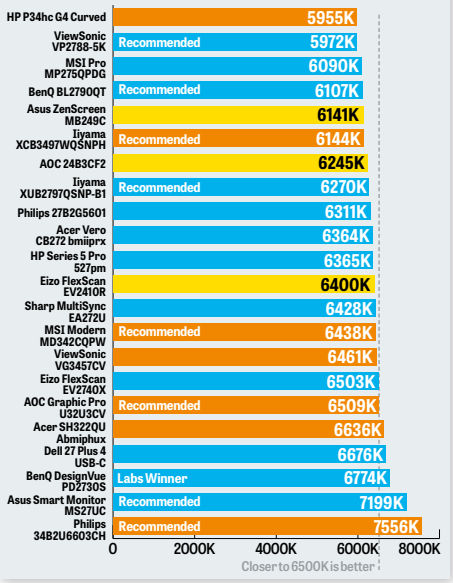
Average Delta E



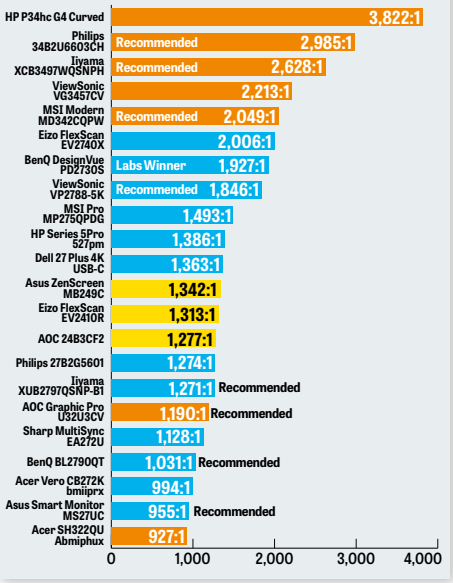
Maximum Delta E



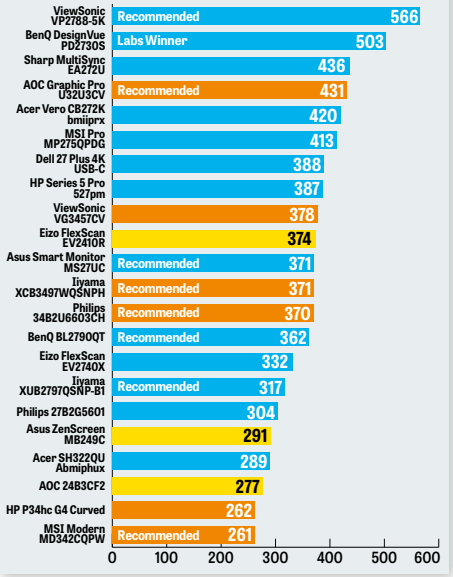
Colour temperature (against 6500K)



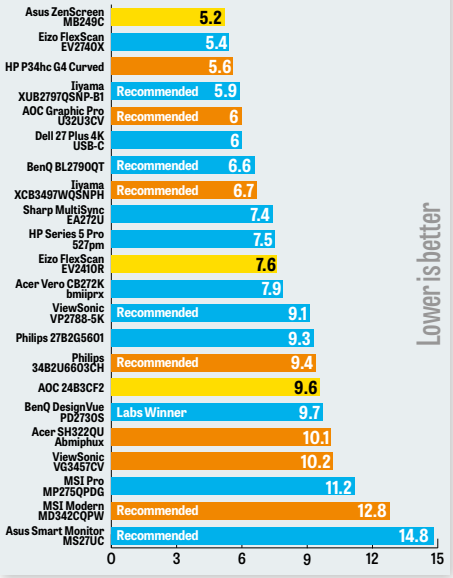
Measured contrast ratio



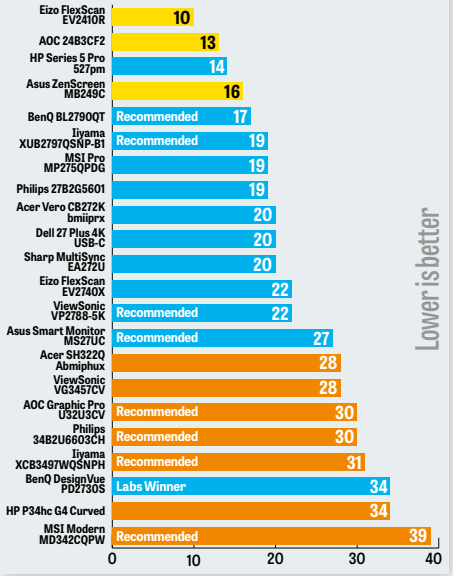
Peak brightness (cd/m²)



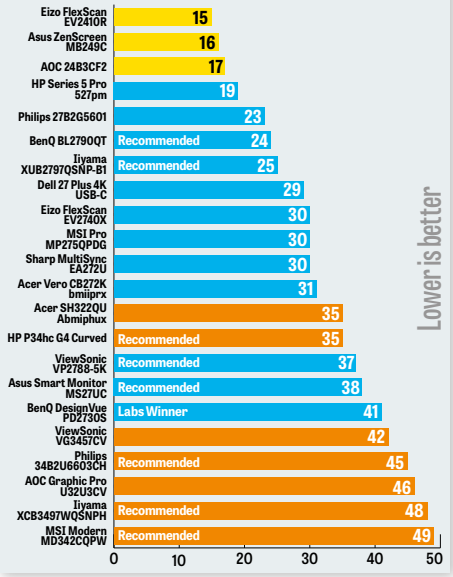
Average brightness variation (%)



Power consumption at 200cd/m² (watts)



Power consumption at peak brightness (watts)



View from the Labs

We live in a golden era of choice, but still take time to choose wisely

If you listen to the *PC Pro* podcast then you will have heard me wax lyrical about the comedy writer John Finnemore, perhaps most famous for writing the excellent radio show *Cabin Pressure* (starring Benedict Cumberbatch, Roger Allam and the brilliant Stephanie Cole) and his contribution to the Paddington films. But he also wrote a sketch about choice.

"First," the narrator intones, "there was no choice." "This is it," says a car salesman. "It's big, it's grey and it sometimes catches fire." The next step: not enough choice. "All right, there are two kinds," explains the salesman. "There are the big grey ones that sometimes catch fire, or these small brown ones that don't work."

"Then, for about five minutes, there was just enough choice," says the narrator. Cue the salesman. "All right, you can have a big one or a small one, and you can have it in red, blue or green. The red ones sometimes catch fire, the small ones don't work, and the big green one only works in Russian. And the small red one comes with a cup holder."

Naturally, the customer chooses the big blue one that works and doesn't catch fire. And then comes the phase facing us all: too much choice. This time, the salesman explains, "you can have a red one, a blue one, a purple one, an ochre one or an invisible one. They come in big, small, medium, extra medium, micro, giga and vast." I won't quote the rest of the sketch for fear of Mr Finnemore's copyright lawyers, but you get the gist – and can listen to the full sketch by loading up Series 3, Episode 2, of *John Finnemore's Souvenir Programme*.

Parallels with monitors, which do indeed come in sizes ranging from small to giga, should be obvious from this Labs, and one has a holder – for headphones. But weirdly, I think we now have just the right amount of choice. You can buy smart monitors, cheap and cheerful monitors, high-end professional monitors – and none of them will catch fire.

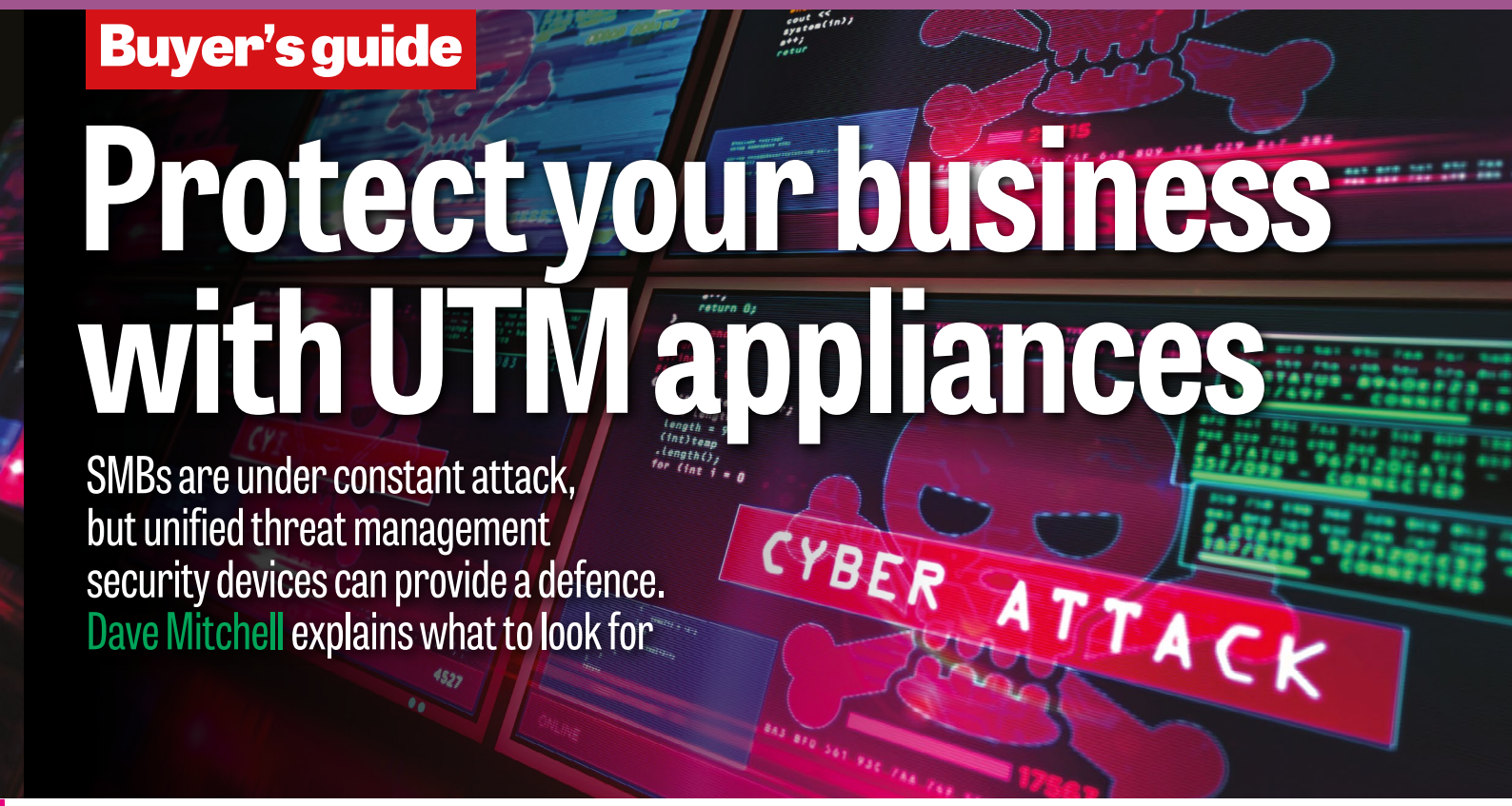
My only word of caution is to choose carefully. You will likely be staring at your choice of monitor for years to come, so it pays to put the time in before you make your choice. ●



Tim Danton is editor-in-chief of *PC Pro* and fell secretly in love with at least four of these monitors.
editor@pcpro.co.uk

Buyer's guide

Protect your business with UTM appliances



SMBs are under constant attack, but unified threat management security devices can provide a defence. Dave Mitchell explains what to look for

Small and medium businesses (SMBs) need to get serious about network security if they want to prosper.

Today's threat landscape is constantly evolving, with attacks rising at an unprecedented rate, thanks in part to AI being used by cybercriminals to create more advanced and automated attacks.

The numbers bear this out. The 2025 Cyber Report by ISP Beaming (**tinyurl.com/372beaming**) states that UK businesses experienced the highest number of Q1 cyberattacks in the nine years the company has been analysing this data. In the first four months of this year, UK businesses were subjected to an average of 183,221 cyberattacks each – that's nearly one every 43 seconds.

The financial fallout from a data breach shouldn't be underestimated, either. The UK government's 2025 Cyber Security Breaches Survey (**tinyurl.com/372cybsec**) states that the most disruptive breaches or attacks in the past 12 months incurred an average total cost to micro and small businesses of nearly £8,000.

It's quite clear for SMBs that it's a lot cheaper to protect their data than it is to compromise it. Unified threat management (UTM) appliances offer the perfect solution as they provide an incredible range of security measures at very affordable prices.

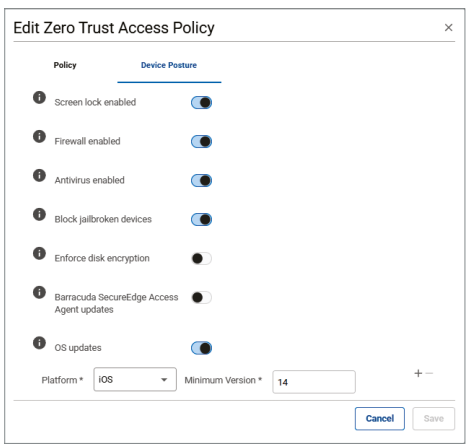
In this month's guide, we review security solutions from four well-established names: Barracuda, DrayTek, WatchGuard and Zyxel. We've selected products suited to environments ranging from small and remote offices up to larger networks and tested them in the lab to help you choose the best protection.

Living on the edge

UTM solutions are a great choice for SMBs as they integrate every security service into one easily managed device. They're designed to sit on the network edge where all inbound and outbound internet traffic passes through a single point, making it simple to apply company-wide security policies to every individual and device located behind it.

Before choosing a UTM product, you should map out your network architecture to get a clear understanding of where your entry and exit points are and what devices and data need protecting. Ascertain the amount of internet traffic being generated and choose a solution that has the power to handle your current load and sufficient capacity to cope with future demand.

"UTM solutions are a great choice for SMBs as they integrate every security service into one easily managed device"

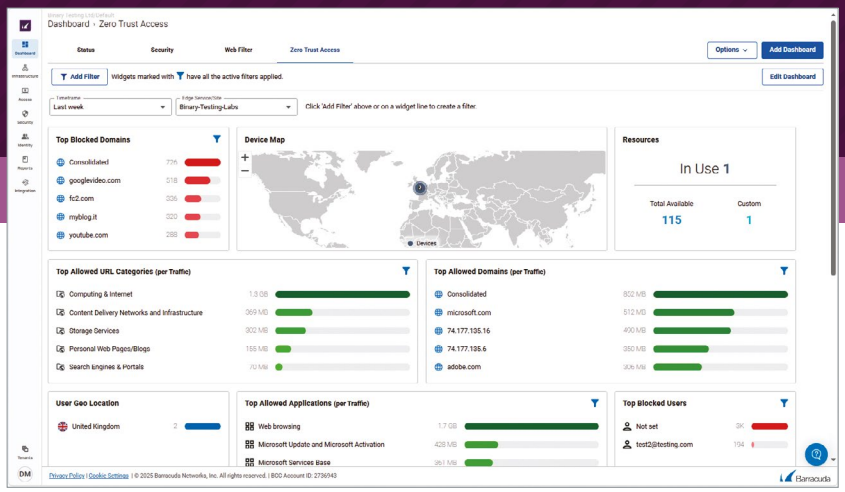


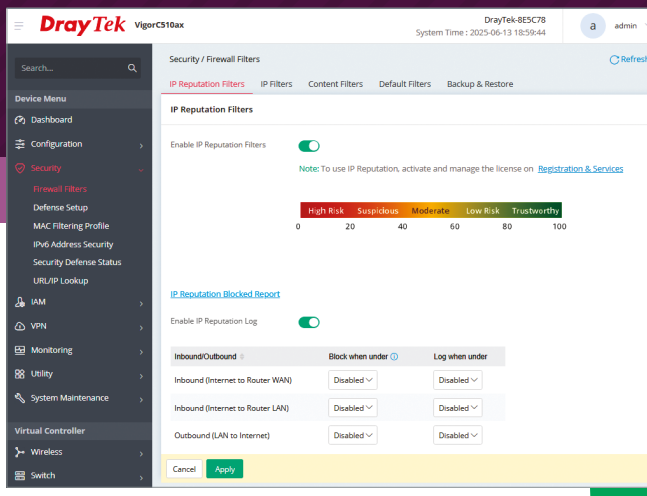
BELOW Barracuda's SecureEdge enforces zero trust network access policies

Check their datasheets, but don't be swayed by the raw firewall throughput rates as these are arrived at by testing with lightweight UDP packets and don't represent real-world usage. The performance numbers to look for are those with security services such as IDP (intrusion detection and prevention) and anti-malware enabled as they place a much heavier load on the appliance.

Protection detail

UTM appliances have evolved rapidly to keep up with the latest threats and offer a remarkable range of security measures. The biggest







ABOVE LEFT Barracuda's Cloud portal is used to remotely manage all SecureEdge services

ABOVE RIGHT DrayTek's IP reputation filter uses inbound traffic threat scores to block malicious IP addresses

LEFT WatchGuard's cloud portal map shows which countries inbound web traffic is coming from

decision facing SMBs is deciding which ones they need. Most vendors offer a range of subscription services so you can choose the features you want and stay within your budget.

Anti-malware is essential as this checks web traffic and downloads for malicious content and blocks it at the gateway so it doesn't get onto your network. Some solutions augment this with sandboxing, which protects against zero-day attacks by blocking downloads of new and unknown files and examining them in a safe cloud environment to see if they are safe to allow through.

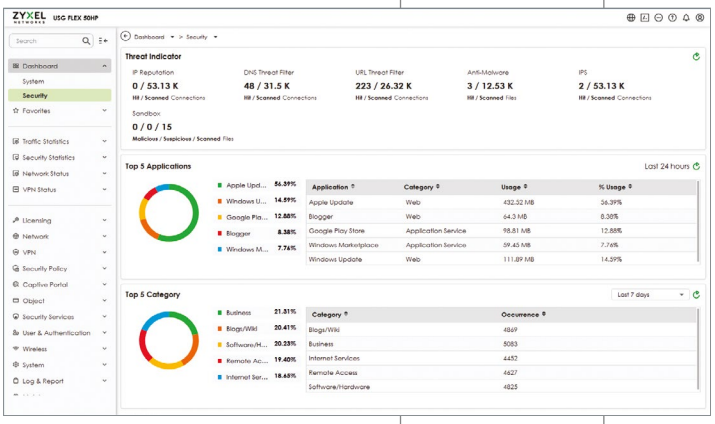
Web filtering is a valuable ally for improving productivity as you can decide which types of websites users are allowed to visit. All the best products inspect network traffic at the application layer and use thousands of signatures for managing access to common applications and categories such as social networking services.

Head in the cloud

Businesses that need to deploy UTM appliances to remote sites should consider vendors that offer cloud management. These provide cloud portals so you can remotely monitor and configure them regardless of their location, with the best vendors including this service for free.

Essential firmware upgrades and signature updates across multiple appliances are easier to manage as the cloud portal can run these automatically to ensure you're always on the latest versions. Zero-touch provisioning is another handy feature; after cloud registration and security policy assignment, the appliance can be sent to the remote site where all the end user has to do is plug it in and provide an internet connection.

Previously, you've had to choose between local or cloud management to avoid configuration issues. One appliance in this guide can do both as its Smart Sync feature ensures any changes made using one interface are always synced to the other.



ABOVE Zyxel's clever Smart Sync feature allows the USG Flex 50HP to be managed locally and in the cloud

Under the wires

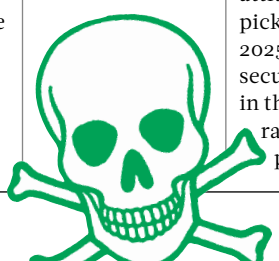
Most businesses will have a wireless network, and a security appliance can protect thee as well. If you already have wireless access points (APs), ensure they're deployed on the appliance's LAN side so it can inspect their traffic and apply security policies.

An easier option for small sites is to select an appliance with an integrated wireless AP. The biggest advantage is the appliance sees the AP as just another network interface so you can apply the same security policies to wired and wireless clients.

Businesses planning on a new implementation of a security appliance and wireless network should consider purchasing them all from one vendor. Cloud management will pay back handsomely on your investment as you can look after your appliances, security policies, wireless APs, SSIDs and guest networks from the cloud.

If your business can't tolerate any internet downtime, look for appliances that support mobile connections and offer failover services. One appliance in this guide is geared up for this as it has two SIM slots that provide primary and backup mobile network connections, and it also has an integral Wi-Fi 6 AP.

Any businesses that think they're too small to be of interest to cybercriminals are woefully misguided – it's precisely this cavalier attitude that makes them easy pickings. If you want to stay safe in 2025, you need to invest in a network security solution, and the products in this guide offer an incredible range of protection measures at pocket-friendly prices.

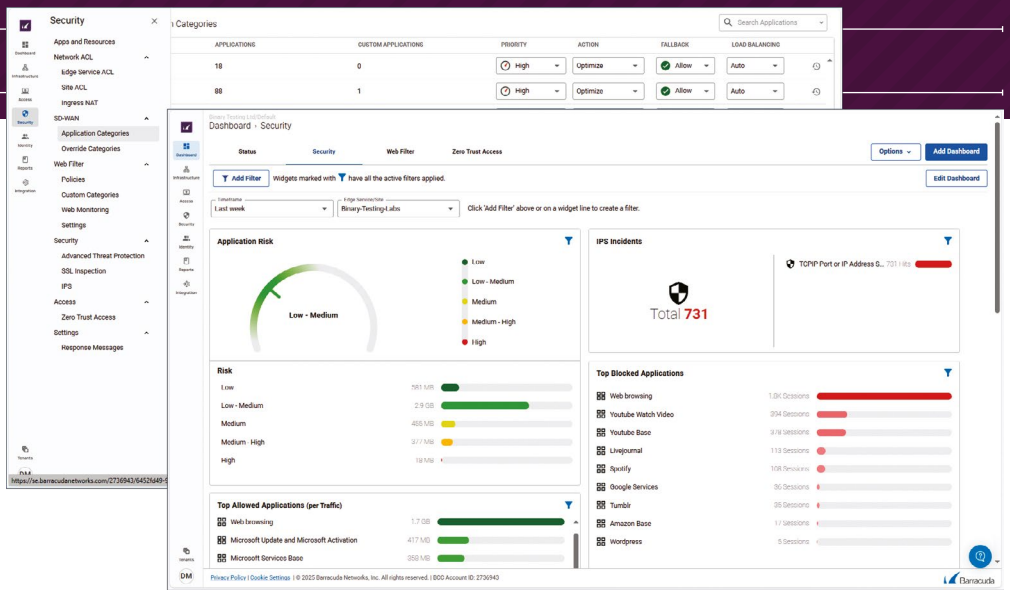


Barracuda SecureEdge

The flexible SecureEdge has a protection module for every occasion all wrapped up in one cloud management portal

SCORE ★★★★½

PRICE VT100 appliance, starts from £576 exc VAT per year **from barracuda.com**



Businesses that want total control over every aspect of their data access security will love Barracuda's SecureEdge. This modular cloud-first platform is a secure access service edge (SASE) solution designed to protect users, devices and applications – anytime and anywhere.

SecureEdge brings together on-site physical and virtual firewall appliances along with secure SD-WAN and ZTNA (zero trust network access) services. Security features are extensive: it provides SPI firewalling, advanced threat protection (APT) using Barracuda's global threat intelligence network, intrusion detection and prevention (IDP), anti-malware, SSL inspection and web monitoring, content filtering and ad-blocking.

SD-WAN features include application-based routing, the advanced TINA VPN service, adaptive session balancing and bandwidth protection, uplink optimisation and support for USB LTE modems for cellular connectivity. ZTNA uses a combination of TINA VPNs and secure client agents (SCAs) to provide policy controlled access to predefined private and cloud apps. That's a lot to get your head round, but a key feature is that the entire solution is managed from the Barracuda Cloud Control portal.

To start our SecureEdge journey, we deployed the entry-level VT100 virtual firewall appliance on a Dell XR11 Windows Server 2022 Hyper-V host. Based on Barracuda's CloudGen Firewall, the VT100 initially requires five virtual network interfaces assigned, but you only need a minimum of two for LAN and WAN duties. Next we visited the cloud portal, created our first site, activated the appliance with our contact details and registered it.

The SecureEdge Manager portal offers a customisable dashboard with a status overview of ZTNA, edge services and a map showing the geographical locations of all components. Views are also provided for application risk levels, IPS incidents plus blocked and allowed app categories, web-filtering activity and details of SCA clients.

Multiple web-filtering policies can be created using over 200 predefined URL categories neatly sifted into 19 groups. Enable SSL security inspection and you can use web-monitoring policies that apply up to four predefined suspicious keyword categories, such as cyberbullying, along with lists of custom keywords. Any use of these words is reported in a web monitor alert log that can be streamed to a Syslog server.

ABOVE ZTNA provides policy-based access to apps using Barracuda's Secure Client Agent

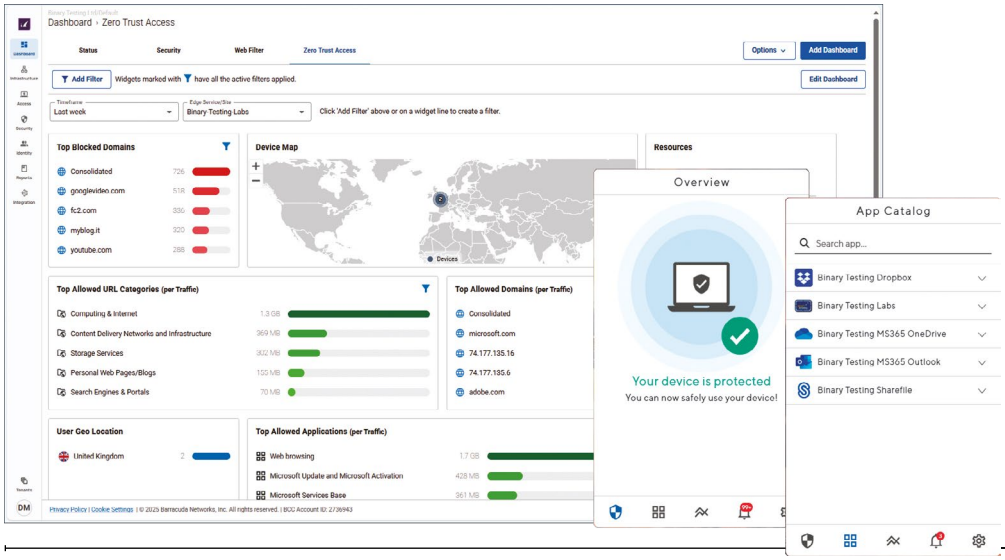
ZTNA policies require an edge service. We chose Barracuda's own SaaS offering, which costs £2,280 per year for 50Mbits/sec bandwidth and can be upgraded or downgraded on the fly. An alternative is to use a site device to provide private edge services; this has no additional charge and it can also act as an SD-WAN device.

You'll need an identity provider; we chose Barracuda's free email service. Other options include Microsoft Entra ID and Google Workspace. Creating ZTNA users is easy as the portal emails invitations with enrolment links to download the SCA, which is available for Windows, macOS, Android and iOS.

"Barracuda's SecureEdge is a highly scalable solution that offers an impressive range of network access and security features"

Policies control which resources ZTNA users are allowed to access, and can enforce compliance with a range of posture criteria including a requirement for a local firewall, anti-virus scanning and minimum OS version. For mobile users, you can require the screen lock enabled and set the policy to block jailbroken devices. Resources are defined in the portal's application catalogue and permitted users will see them in their SCA desktop interface for secure one-click access, along with details of the edge device they're using plus charts of blocked domains.

Barracuda's SecureEdge is a highly scalable solution that offers an impressive range of network access and security features. Easily managed from a single cloud portal, the site firewall provides excellent protection measures, ZTNA keeps your mobile and remote workers safe, and its modular design makes it easy to control costs.



BELOW All security components can be centrally managed from the cloud portal

REQUIREMENTS

VT100 appliance: supports VMware, Hyper-V and KVM • 2 x licensed vCPUs, 5 x vNICs.
SCA: Windows 10, macOS 13, Android 11, iOS 12 upwards

DrayTek Vigor C510ax

The ideal security router for small businesses and remote offices, with unbeatable WAN redundancy features



SCORE ★★★★★

PRICE £447 exc VAT from broadbandbuyer.com

If your business cannot accept any internet downtime, you've come to the right place: DrayTek's Vigor C510ax security appliance is bursting with WAN redundancy features. Its internal 5G LTE modem has two SIM slots for primary and backup mobile network connections, two of its five gigabit ports can be assigned to WAN duties, and its integral Wi-Fi 6 access point (AP) can failover to a local wireless hotspot.

Internet redundancy is configured by defining multiple WAN connections as an active or a backup link, where the latter is automatically brought online when the primary link fails or its traffic exceeds specific thresholds. Another option is to set all links as active and use load balancing to distribute traffic across them.

The Wi-Fi 6 AP can, of course, be used to provide standard wireless services. An AX3000 rating claims up to 574Mbits/sec on its 2.4GHz radio and 2,402Mbits/sec for 5GHz, plus it supports the Wi-Fi 6 high-performance 160MHz channels.

Up to four SSIDs per radio are supported, and the router can present a hotspot web portal for guest access with a range of authentication methods. The Virtual Controller feature brings meshed wireless networks into play, as defining the C510ax as a root device allows up to seven Vigor node APs to be added, with up to three hops between each one.

Four VPNs are supported, which can be used for site-to-site or remote worker connections. DrayTek's new EasyVPN feature simplifies configuration by allowing remote users to establish a secure link by entering their credentials and receiving a one-time password via email or SMS.

Router deployment is simple, with DrayTek's latest DrayOS 5 operating system presenting a freshly designed web interface that makes it even easier to configure. The dashboard opens with a status overview and graphic of the ports, with all security services accessed from a neatly organised sidebar menu.

Setting up a mobile connection was a breeze. The EE 5G SIM we placed in the top slot was detected automatically, and a WAN link was created for us. From the console's WAN section, you can nominate primary and failover members and apply priorities to each one.

The router's SPI firewall has a default security policy enabled that can be customised to suit or you can add your own policies with rules and filters. Basic web filtering using keyword matching comes as standard, with DrayTek's optional web content filtering (WCF) service providing 78 URL categories that can be blocked or allowed.

A 30-day WCF trial can be activated from your MyVigor customer account, with prices for full subscriptions starting at only £20 per year. This also enables the IP reputation filter service, which uses a scoring system to determine threat levels of inbound traffic and blocks malicious IP addresses.

DrayOS 5 delivers a wealth of new security features, with identity and access management (IAM) at the top of the list. This uses a zero trust philosophy that allows you to define access privileges and ensure users and devices can use permitted network services and resources only.

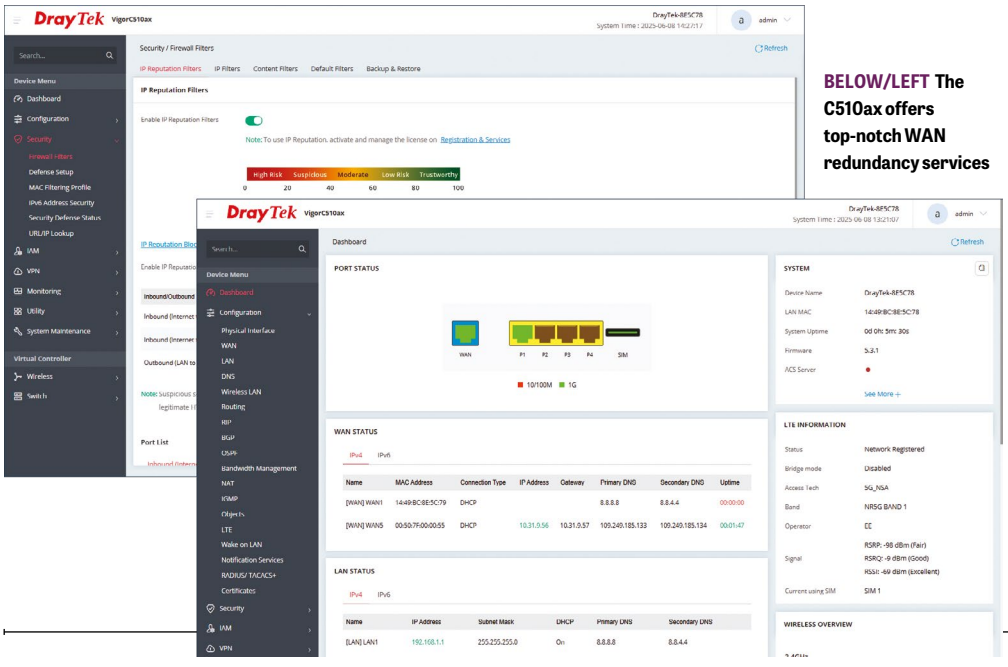
When creating IAM users, you assign a password, provide an email address, a mobile number for SMS if required and enable multi-factor authentication (MFA). Resources are assigned to IAM users and groups, with conditional access policies controlling access further with time schedules, source IP addresses and MFA re-authentication when a session timer runs out.

DrayTek's Vigor C510ax is ideal for small businesses and remote sites that demand always-on internet access. It's packed with WAN redundancy features, the latest DrayOS 5 software delivers a wealth of new security features, and it all comes at a great price.

ABOVE DrayTek's Vigor C510ax is bursting with security features

PC PRO ★★★★ A-LIST

"The Vigor C510ax is ideal for small businesses and remote sites that demand always-on internet access. It's packed with redundancy features"



BELOW/LEFT The C510ax offers top-notch WAN redundancy services



SPECIFICATIONS

Fanless desktop unit • 5G LTE modem • 2 x nano SIM slots • 5 x gigabit (WAN, WAN2/LAN, 3 x LAN) • Wi-Fi 6 • 2 x WLAN/2 x LTE aerials • external PSU • 207 x 131 x 42mm (WDH) • 2yr RTB warranty

WatchGuard Firebox T85-PoE

A powerful desktop security appliance offering tough security measures for SMBs and remote offices



SCORE ★★★★☆

PRICE Appliance with 3yr TSS subscription, £4,284 exc VAT **from** broadbandbuyer.com

Stepping in at the top of WatchGuard's desktop security appliance family, the Firebox T85-PoE is aimed at SMBs and remote offices with up to 50 users. It's capable of handling high demand, with its 1.8GHz quad-core NXP CPU boasting a raw firewall throughput of nearly 5Gbits/sec and a respectable 943Mbits/sec with WatchGuard's anti-virus (AV), intrusion prevention service (IPS) and application controls enabled.

Port choices are plentiful: it offers eight gigabit ports and provides PoE+ services on the last two – handy for powering wireless access points. In addition, the rear expansion bay supports WatchGuard's 10GbE SFP+ module (£183) or a 4G LTE module (£524), which presents a cellular WAN interface that can be used with the SD-WAN feature for internet failover.

WatchGuard simplifies licensing by offering only two options. The Basic Security Suite subscription enables gateway antivirus (GAV), anti-spam, web filtering, HTTPS inspection, IPS, app controls and WatchGuard's RED (reputation enabled defence) cloud-based URL filtering.

We've shown the price for a three-year Total Security Suite subscription, which activates every security feature including an advanced persistent threat (APT) blocker with cloud sandboxing and ThreatSync XDR, which provides collection, correlation and automated responses for Firebox threat events. DNSWatch monitors client DNS requests and blocks access to known malicious domains, while the IntelligentAV anti-malware service uses the Cylance AI-based file engine to scan files such as Office documents and PDFs after they've passed through the GAV scanner.

The appliance supports standalone mode, but businesses with remote sites will be pleased to know that both subscriptions include access to the WatchGuard Cloud portal. It's simple to enable: we registered the appliance with our WatchGuard support account, allocated it to our site and chose the cloud management and monitoring option, after which the local web console was disabled.

Another bonus of cloud management is zero-touch provisioning using WatchGuard's RapidDeploy service. Create a configuration file, upload it to your cloud account, send the appliance to the remote site and when the staff have connected it to the internet, it automatically downloads and applies the file for instant protection.

Cloud configuration is a breeze as all security settings for the appliance are presented in one web page. The content-scanning section provides access to both AV scanners, the APT blocker and spamBlocker for applying anti-spam policies to inbound SMTP, IMAP and POP3 traffic.

The network blocking section covers botnet detection, IPS, port and site blocks and detection of Tor (The onion router) exit points. From the content-filtering section you can create WebBlocker policies to manage access to 165 URL categories, while the Application Control service offers 1,265 predefined app and protocol signatures for creating granular access policies. Both can be applied to a firewall rule with one click.

VPN features are abundant, with the appliance supporting 60 branch office and mobile VPNs. WatchGuard's free mobile VPN with SSL client is available for Windows and macOS systems, and the latest Fireware firmware now supports strong SAML user authentication.

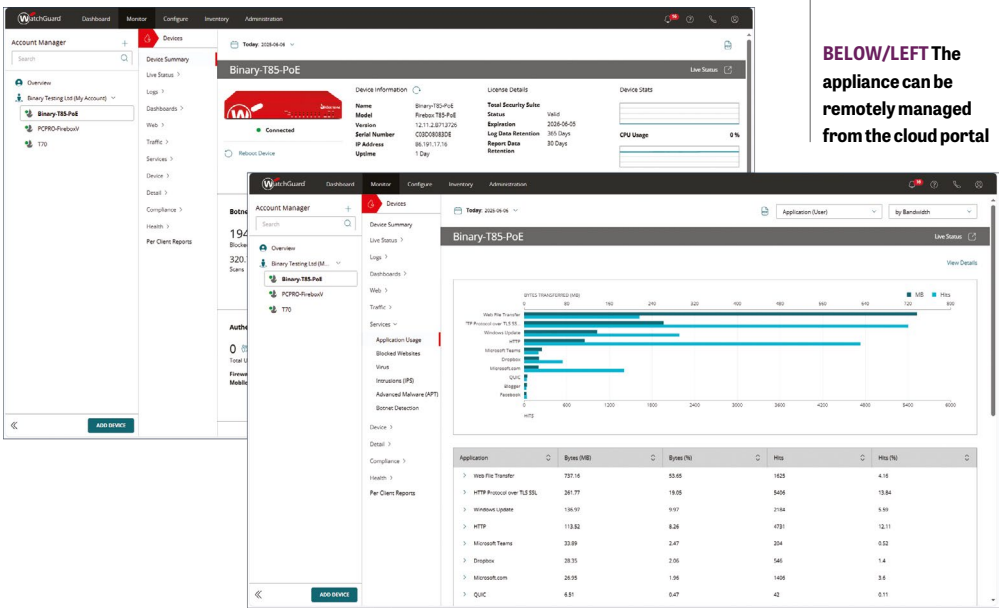
ABOVE **The Firebox T85-PoE is at the top of WatchGuard's security appliance range**

PC PRO RECOMMENDED

"The Firebox T85-PoE delivers a powerful gateway security package ideally suited to protecting SMBs and large remote sites"

Monitoring features are also impressive. Selecting a remote Firebox from the cloud portal furnishes you with heaps of information on live activity, VPN traffic, blocked websites, application usage, IPS, botnet detection and much more. You can keep a close eye on detected threats, with the portal's summary page showing all incidents and providing facilities to drill down for detailed threat analysis.

The Firebox T85-PoE delivers a powerful gateway security package ideally suited to protecting SMBs and large remote sites. It's packed with great features, the simplified licensing schemes are easy to understand, and WatchGuard's cloud portal makes light work of remote management and monitoring.



BELOW/LEFT **The appliance can be remotely managed from the cloud portal**

SPECIFICATIONS

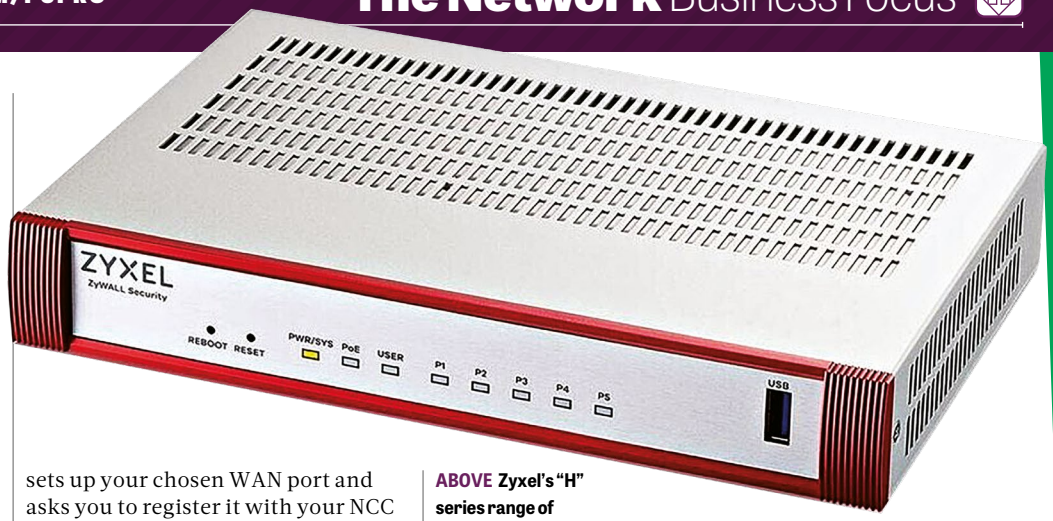
Desktop appliance • 4-core 1.8GHz NXP LS1046A CPU • 4GB DDR4 RAM • 128GB M.2 SSD • 8 x gigabit (WAN, 7 x LAN with PoE+ on ports 6/7) • 2 x USB-A 3.2 Gen 1 • RJ45 serial port • external 120W PSU • expansion module slot • warranty included in subscription

Zyxel USG Flex 50HP

This top-value device delivers heaps of protection features plus unified on-premises and cloud management

SCORE ★★★★★

PRICE Appliance with 1yr Gold licence, £316 exc VAT from store.zyxel.com



ABOVE Zyxel's "H" series range of appliances introduces lots of new features

Zyxel's USG Flex security appliances have traditionally offered plenty of network protection measures at low prices, and the new "H" series range takes these features a stage further. Along with the new uOS firmware and an improved hardware specification, they introduce Zyxel's Smart Sync, which allows them to be simultaneously managed on-premises and from the Nebula Control Center (NCC) cloud portal.

Coming in as the entry point of the new family, the 50HP on review will appeal to small businesses as it costs only £316. Even better, this includes a one-year Gold Security Pack subscription, which enables a heap of features including anti-malware, reputation and web content filtering, IPS, cloud sandboxing, the SecuReporter reporting service and an NCC Pro Pack upgrade.

The appliance presents five gigabit ports for WAN and LAN duties, with the latter providing 802.3at PoE+ services. If you don't need PoE, check out the 50H model, which comes with five standard gigabit ports and drops the price to £283.

Smart Sync simplifies deployment immensely as the appliance's local web console runs a wizard that requests an admin password change, sets up your chosen WAN port and asks you to register it with your NCC account. If you don't already have one, it offers an option to create a new account and define your first organisation and site.

From here on, you can manage the appliance from either console, and any changes made in one will be synced to the other. We tested this by modifying a security policy from NCC and, after 30 seconds, the local console displayed an alert and reflected the remote change.

It's easy to configure the security services, as they're accessed from one page in both the NCC portal and local console. The URL threat filter, IP reputation, sandboxing and anti-malware services are each enabled with one click; for the latter, you can request that specific file types such as executables and ZIP archives are checked against Zyxel's cloud threat intelligence database.

For web filtering, you choose from 105 categories, decide whether to allow, block or log access, and augment it with Zyxel's DNS threat filtering, which intercepts DNS queries and blocks known malicious domains. The application patrol service manages access to thousands of apps that have been sorted neatly into 26 categories.

The appliance applies a default set of security policies that include allow, deny or reject actions, along with traffic directions, sources and destinations. You can create multiple content filters and application patrol profiles and assign them to selected security policies.

Monitoring and reporting features are outstanding, with the local console providing plenty of information about firewall hardware utilisation and a threat indicator overview. The statistics section has entries for each security service, with graphs and charts showing all suspicious activity.

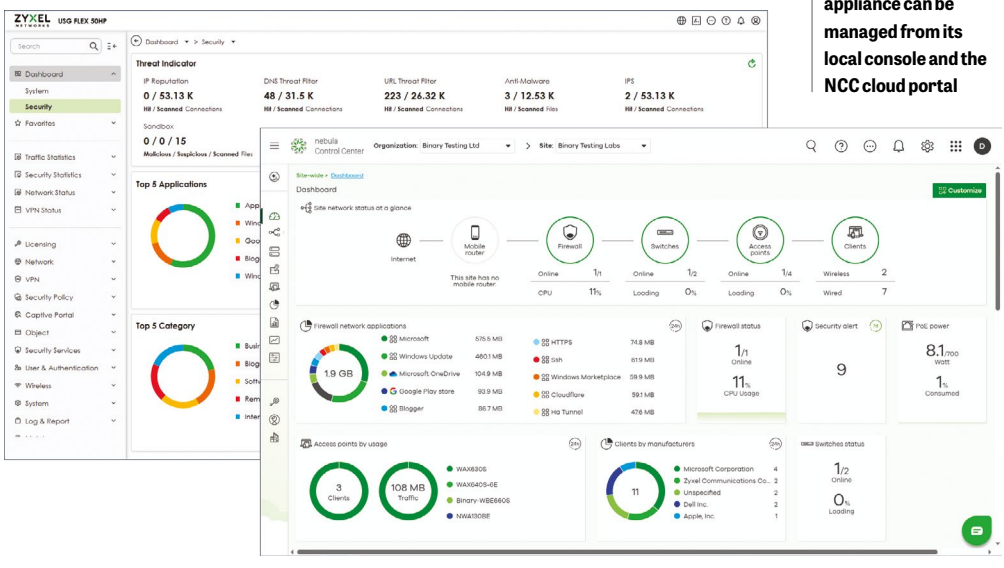


"The SecuReporter dashboard tells you everything about your security posture, with the AI-powered SecuPilot offering views of the most severe threats"

The customisable NCC dashboard offers status widgets for all Zyxel cloud-manageable devices. For the firewall, you can add widgets for the top ten network applications, CPU utilisation and security alerts. One click on the latter transports you to the SecuReporter portal.

The SecuReporter dashboard tells you everything about your security posture, with the AI-powered SecuPilot offering views of the most severe threats and sage advice on containment and remediation. The Analysis pages provide deeper insights into security issues, while custom daily, weekly and monthly reports can be sent to multiple email addresses.

Don't be fooled by its small size: Zyxel's USG Flex 50HP packs in an impressive set of security services for the price. It's ideal for protecting small offices and remote sites, and the slick Smart Sync feature means never having to choose between local or cloud management again.



BELOW/LEFT The appliance can be managed from its local console and the NCC cloud portal

SPECIFICATIONS

Fanless desktop chassis • 5 x gigabit (WAN, LAN/WAN, 3 x LAN) • PoE+ on LAN 5 • USB-A 3.2 Gen 1 • RJ45 console port • external PSU • 216 x 143 x 33mm (WDH) • 1yr Gold Security Pack licence • 5yr limited warranty

Draytek VigorAP 905

A great choice for SMBs that want self-healing wireless mesh networks and top features at a very low price

SCORE ✪✪✪✪✪

PRICE £83 exc VAT
from broadbandbuyer.com

DrayTek has a fine reputation for delivering affordable wireless networks, and its VigorAP 905 takes this to the next level. This Wi-Fi 6 access point (AP) supports three operational modes along with no fewer than four management choices, and it does it all for only £83.

This slim-line AP can be free-standing or wall-mounted, with its AX3000 rating claiming speeds of up to 2,400Mbits/sec on its 5GHz radio and 600Mbits/sec on the 2.4GHz radio. It supports the 5GHz 160MHz channels and presents up to 16 SSIDs spread equally across each radio.

The main LAN port is the 2.5GbE multi-gig variety, which requires an 802.3at PoE+ power source. Alternatively, you can use the external power adapter DrayTek generously includes in the box. It also provides four more gigabit LAN ports, which can be used to connect and network PCs or other devices through the AP.

The VigorAP 905 can function as a standalone AP, use DrayTek's meshing technology to create self-healing wireless networks or act as a simple range extender. It can be managed from its own web console, auto-provisioned using any DrayTek router that supports the Central AP Management feature, centrally managed on-site with DrayTek's free VigorConnect app, or remotely managed with the optional VigorACS 3 cloud service.

We found the AP easy to deploy in standalone mode. The web console's wizard sensibly requires the default admin password to be changed and offers to create a secure wireless network for both bands. The homepage dashboard provides an informative overview of your wireless networks, with an AP graphic showing port connection status, a graph for hardware utilisation, and pie charts for radio and channel usage.

For each SSID you can decide which radios are enabled and choose an encryption scheme up to strong personal WPA3 or enterprise WPA3, which requires a defined Radius server. Further security options include applying a schedule that determines when the SSID is active, a MAC filtering list, and client isolation, which stops those on the same SSID from seeing each other.

The Virtual Controller feature is used to create meshed networks, and if you select DrayTek's proprietary VigorMesh feature you can quickly create a wide-ranging wireless network using up to eight APs. One functions as a central mesh root, while others are added to the group as mesh nodes and take all their settings from it to present one set of centrally managed SSIDs.

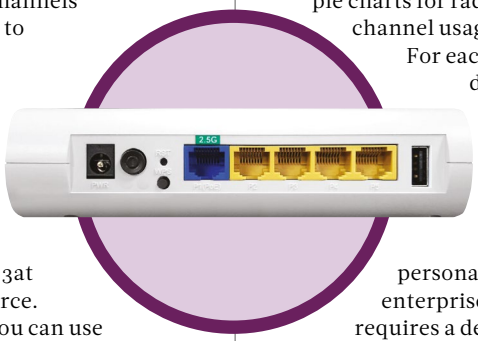
Nodes can connect wirelessly to the mesh root using their 5GHz radios as a backhaul, or they can link up over a wired connection. You can spread your wireless network far and wide as nodes can connect to other nodes with up to three hops between them and the root AP.

The VigorConnect utility provides centralised wireless network management and offers a quick start wizard that discovers all available APs. The entire site is managed from a root network under which all APs appear, you can use profiles to manage all wireless settings, and individual APs can have their operating mode changed with a couple of clicks.

To test wireless performance, we hooked the AP up to the lab's Zyxel XMG1930-30HP 30-port multi-gigabit PoE++ switch and used a Lenovo Windows 11 Pro desktop client equipped with a TP-Link Archer TBE550E Wi-Fi 7 PCIe adapter with a Dell Windows server on the 10GbE LAN. Starting with Microsoft's NTttcp utility, we recorded good raw TCP upstream and downstream speeds of 242MB/sec and 170MB/sec respectively.

Real-world large file copies between the client and server averaged a respectable 192MB/sec at close range. Moving the AP ten metres away and into an adjoining room with a wall in the way saw speeds drop to 161MB/sec.

The VigorAP 905 is ideal for businesses seeking a well-endowed Wi-Fi 6 AP with top-notch wireless meshing support. It's a breeze to deploy, wireless performance is good, and a price of only £83 makes it outstanding value. **DAVE MITCHELL**

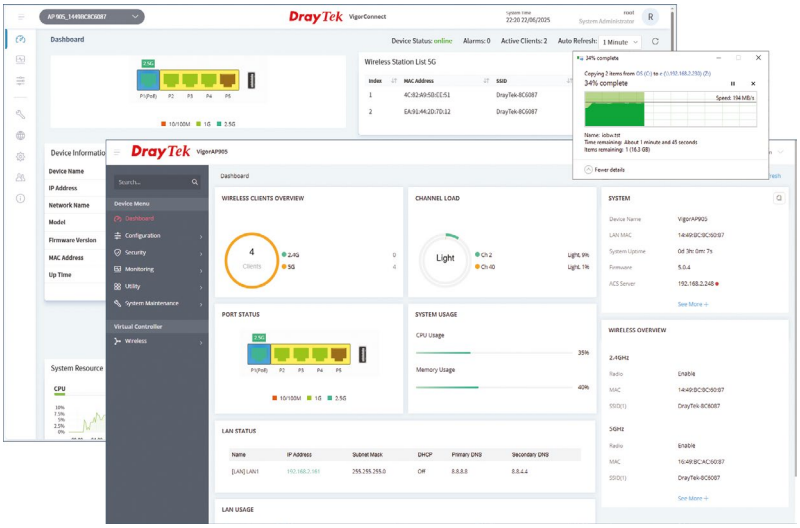


LEFT There are four 1GbE ports as well as the main 2.5GbE port



ABOVE Draytek's latest access point is a feature-rich bargain

"The VigorAP 905 is ideal for businesses seeking a well-endowed Wi-Fi 6 AP with top-notch wireless meshing support"



LEFT The VigorAP 905 can be managed using a variety of methods

SPECIFICATIONS

AX3000 dual-band 2.4GHz/5GHz 802.11ax ● 2 x 2 MU-MIMO ● 2 x external dual-band aerials ● 2.5GbE LAN/PoE+ ● 4 x 1GbE LAN ● USB-A 2 ● external PSU included ● wall-mount kit ● 115 x 40 x 158mm (WDH) ● 330g ● 2yr RTB warranty

Synology DiskStation DS925+

An affordable and flexible small business NAS with superb data protection features

SCORE ★★★★☆

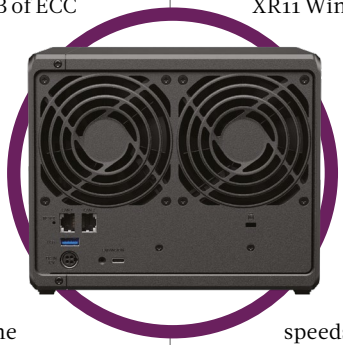
PRICE Diskless, £478 exc VAT from broadbandbuyer.com



ABOVE **The DS925+ is a powerful four-bay desktop appliance**

In keeping with Synology's two-year product refresh cycle, the well-respected but ageing DS923+ four-bay desktop NAS has finally received its marching orders. In comes the DS925+, which targets the same home office and small business sectors and offers a number of welcome improvements, as well as a few not so welcome changes.

The DS925+ is physically similar to its predecessor, with the main change being in the processing department, a quad-core 2.2GHz AMD Ryzen V1500B replacing the dual-core 2.6GHz AMD Ryzen R1600. Memory is unchanged, with the same base 4GB of ECC DDR4 expandable up to 32GB.



LEFT **The appliance comes with two 2.5GbE multi-gig ports**

Networking sees a modest boost, as this is one of Synology's first desktop NAS appliances to come with dual 2.5GbE multi-gig ports. Alas, 10GbE support is now off the menu as the DS925+ doesn't have the single slot expansion bay offered by the DS923+ for Synology's optional E10G22-T1-Mini card.

Underneath, two M.2 NVMe SSD slots can be used as a performance-enhancing cache or high-speed storage pool. Storage choices are more limited, as Synology has decided to enforce the mandatory requirement for its own-brand HDDs and SSDs on all new Plus models.

For testing, we installed four 4TB Synology HAT3300-4T HDDs, left the browser quick start routine to load the DSM 7.2 software and used the Storage Manager app to create an 11TB RAID5 array. One advantage of using Synology's own drives is that Storage Manager keeps them updated with the latest firmware – something few users would bother to do with their drives.

Performance is good, with a NAS share mapped over 2.5GbE to a Dell XR11 Windows server host returning raw Iometer sequential read and write speeds of 2.3Gbits/sec and 2.2Gbits/sec. Real world speeds were on the money too, with 25GB file copies between server and appliance averaging read and write speeds of 2.3Gbits/sec and 2.1Gbits/sec, while our backup copy test using a 22.4GB folder with 10,500 small files delivered 1.1Gbits/sec.

IP SAN performance was similar, with a 500GB iSCSI target mapped to the server delivering sequential read and write speeds both of 2.3Gbits/sec. We ramped up the pressure with a dual 2.5GbE MPIO link to the target and saw speeds increase to 4.6Gbits/sec and 4Gbits/sec.

To test SSD caching, we fitted two Synology 800GB NVMe SSD sticks and assigned them to our pool as a mirrored read-write cache. They're a worthy investment if you have workloads generating a lot of random write operations; without the cache, our iSCSI MPIO target returned write speeds of 0.6Gbits/sec, rising to 3.6Gbits/sec with the cache assigned, while IOPS went from 2,100 to 16,500.

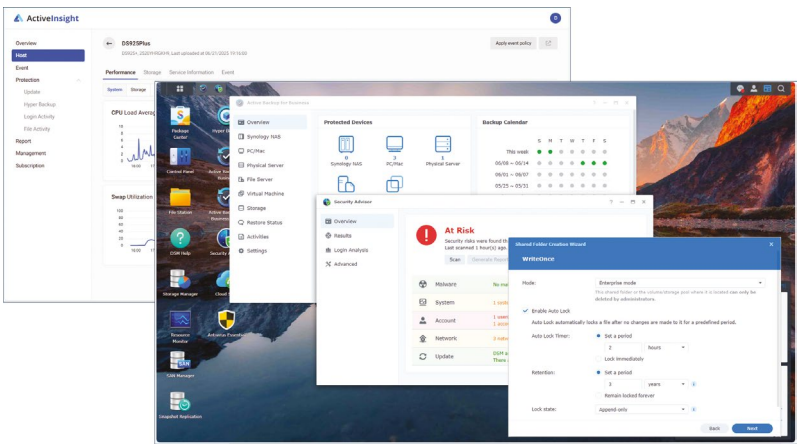
If you want the best data security services, you won't go wrong with Synology's DSM 7.2 software. As well as full volume and share encryption, its WriteOnce feature offers WORM (write once, read many) for NAS folders, with the Enterprise and Compliance policies enforcing file locking and custom retention periods for immutable storage.

"Synology's DSM 7.2 software can't be beaten for its wealth of data backup, security and ransomware protection services"

The Snapshot Replication app manages NAS and IP SAN snapshots and fast rollback services, plus it can create immutable snapshots. Backup features are excellent, with the Active Backup suite comprising three apps for securing servers, workstations, VMware and Hyper-V virtualised environments and remote Synology appliances, along with Google Workspace and Microsoft 365.

Hyper Backup looks after local, remote, Rsync, cloud and iSCSI LUN backups and can be monitored from the Active Insights cloud console if you've bought a premium plan. The free version supports three appliances and provides system, network and storage performance data with a one-month data retention period.

The DS925+ is a powerful desktop NAS appliance, although the removal of the 10GbE expansion slot is a step backwards. That said, it delivered excellent 2.5GbE performance in our tests, and Synology's DSM 7.2 software can't be beaten for its wealth of data backup, security and ransomware protection services. **DAVE MITCHELL**



LEFT **The appliance can be remotely monitored from Synology's Active Insight portal**

SPECIFICATIONS

Desktop chassis ● quad-core 2.2GHz AMD Ryzen V1500B processor ● 4GB DDR4 ECC RAM (max 32GB) ● 4 x LFF/SFF hot-swap SATA drive bays ● 2 x M.2 2280 NVMe SSD slots ● 2 x 2.5GbE LAN ● 2 x USB-A 3.2 Gen 1 ● USB-C expansion port for DX525 ● external 100W PSU ● 199 x 223 x 166mm (WDH) ● 3yr hardware warranty

Preparing for a network failure



It's a fact of computing life that things go wrong. Steve Cassidy explores the measures you can take to reduce recovery times when the Bad Thing happens

In business, it can be easy to sleepwalk into a crisis. That's especially true when it comes to your network. Just sticking with a system that works (for now) can be enough to get you into trouble. The lifetime of a business-grade network switch can be as short as a decade, so if you set up rock-solid infrastructure but don't take another look until the day it gets shut down by a dirty power cut, lightning strike or whatever, you might find it takes more than a reboot to get your business operating again. Let's look at some precautions and responses that can minimise the pain.

Don't rely on software fixes

Most network switches and routers run their own operating systems. You can usually manage them from a web browser, or an elaborate piece of intermediary software; often you can also log in and control them directly with a command-line interface.

But when that vital bit of hardware goes wrong, this software layer is likely to be a casualty (in fact, corrupted firmware may be the cause of your woes). Don't assume you'll be able to rely on built-in fault detection or remediation: you're safer working on the premise that you'll have to reload the firmware and rebuild your settings.

This is one of those areas where the cloud makes things worse. Most data centres use multi-tenant management arrangements, in which the fixing tool, monitoring tool and performance tool are all accessed through the same remote-access software platform. This means that if the latter is inaccessible, you have very little scope for hands-on emergency network surgery.

This realisation dawned on me in the early 2010s on Facebook. I noticed I was beginning to see more and more social media posts from friends and colleagues depicting an anonymous building, with a caption of "back here AGAIN". Because at the highest level of cloud management, there often comes a point when someone has to pick up their laptop with all the switch firmware configuration utilities and architecture images, drive out to some out-of-town data centre in the middle of the night, and start crawling around in the back of a network cabinet. If you're using hosted resources, it's best to accept that you may need to visit them from time to time.

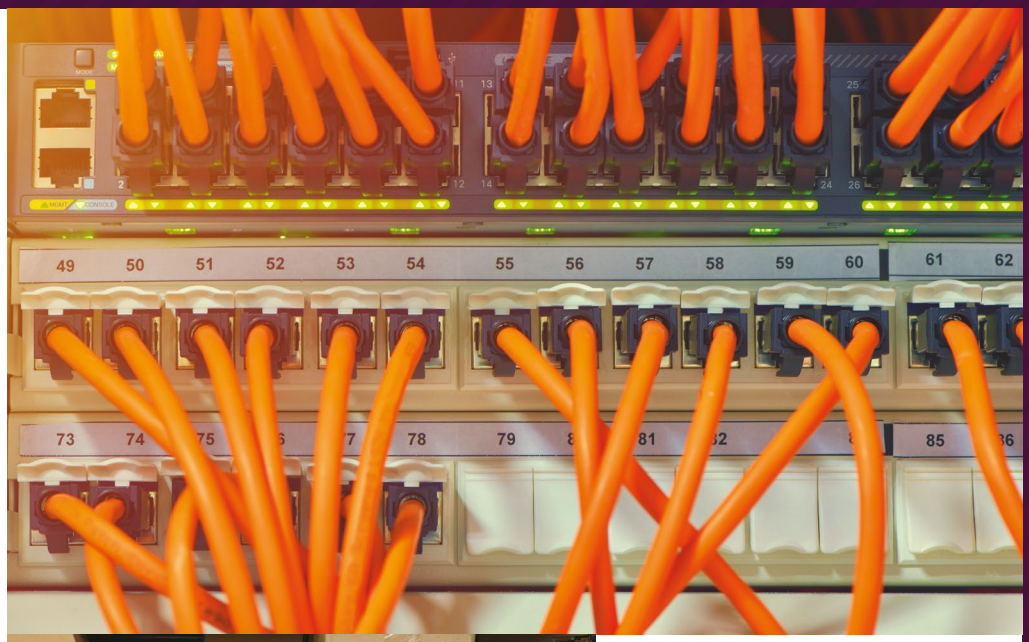


BELOW Even in the cloud era, there's still a need for human involvement

Deconverge

"Convergence" is a network buzzword, and a seductive idea: it basically proposes to run all types of network traffic over the simplest, most efficient physical infrastructure possible. So that's your phone calls, your accounts data, your database backups and your holiday photos all whizzing about on the same physical cables.

In theory there's nothing wrong with this idea. Thanks to 10GbE connections, and management software that's able to manage link bandwidth by traffic type, it all works impressively smoothly. Until it doesn't. Then, unfortunately, the more services you have running over the fewer bits of wire, the more devastating the effects of an outage can be. Sure, you might be smart enough to have your VoIP, CCTV and user data all divided up into their own separate VLANs, but a dodgy piece of fibre could take them all down at once.



RIGHT Running everything over one set of cabling is neat, efficient – and risky

Plan B needn't be complicated. I've seen small businesses whose network recovery kit is a shopping bag full of long copper patch leads. If the network hits a rock, a sheet of paper in the bag provides clear, simple instructions on how to unplug the converged backbone and patch each converged server – real or VM – directly to the internet router. With the links in this state, a server reboot establishes an alternative, minimal configuration until normal service can be restored.

Before you rush off to grab a plastic bag, however, note that the simplicity of the fix relies on some thoughtful pre-architecting. If your servers are in a scrappy state to begin with, the rapid re-plug approach probably won't work, and could in fact open up new issues or security concerns.

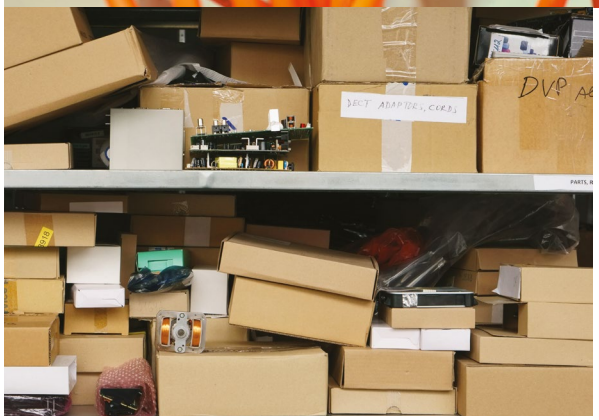
Don't chase unrequired targets

Much network design relies on pricey, high-profile fault-management systems, but these can cause problems as well as solving them. I've attended far too many panic meetings at client businesses whose network has shut down due to malfunctions or false alarms in their instant failover utilities, and their OSPF-compliant layer 3 switch configurations.

Indeed, the smarter a recovery system attempts to be, the bigger the opportunity for a screw up. If your business can survive without an instant automatic response to detected issues then I recommend you draw up a more relaxed, less specialised recovery process. A decent-sized firm can often cope with the odd hour of downtime a lot better than you might expect.

Again, I speak from experience. I remember one case where I was working with a client involved in the high-end fashion industry. A member of the team had been identified as a "bad actor", and was suspected of meddling with core systems. The decision was made to do a thorough sweep and reset of the system while he was out of the way, on a plane to Monaco to watch the Grand Prix.

This gave us an hour and 15 minutes to lock down the network before he landed and could attempt to log back in. Even though the firm had a market value in the hundreds of millions, we were to use that time to take everything down, plug in locally and then come back up with all passwords changed, and most of the websites backed up with all existing data. The net impact of the downtime was essentially zero; after all, the decision-making period on spending £50,000 on a wristwatch is measured in weeks, not seconds.



ABOVE A well-stocked shelf of spares can be worth more than a top-tier service contract

In short, working out what you really need in terms of contingencies for network issues has very little to do with the make-up of the network itself, and much more to do with the needs of your business.

Keep plenty of spares

It's easy to think of a service contract as an endless gateway to infinite resources. Of course, it's not like that in reality: network service companies may imply some big promises, but they don't want to be hoarding large spare stocks of old, rarely needed items. This isn't usually a problem when it comes to supporting and maintaining a fleet of laptops, but network equipment follows a much more problematic replacement interval, of ten years at an absolute minimum for core devices and high-capacity cable runs. And needless to say, switch designs will absolutely not remain frozen throughout that timespan; if you made use of a firmware configuration to bind together a selection of switch ports into a single "trunk" when first installed, your chances of being able to maintain that trunk when you start updating the switch hardware are going to be pretty slim.

"There's no faster or more reliable fix than replacing like with like, especially if you have a backed-up configuration file"

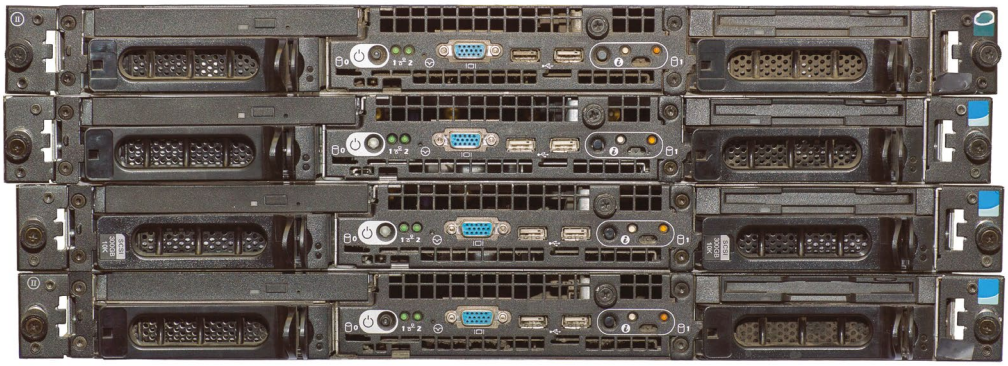
The trick, therefore, is to buy your spares at the time you commission your new network. I'm not talking about fault-tolerant active/active designs: I literally mean get in a couple of extra units and let them sit on a shelf gathering dust until they're needed. There's no faster or more reliable fix than replacing like with like, especially if you have a backed-up configuration file that can be uploaded directly to a newly-unboxed unit.

Compare the traditional support model, where an initial phone call prompts someone to jump on a scooter or into a cab, turn up later that afternoon to examine the ruins and order in the necessary replacement parts – if indeed they're still available. While it might horrify budget-driven IT directors, "buy 12, deploy ten" is the motto of the seasoned network person. And senior management won't be complaining when you're able to recover from a major outage in a matter of minutes rather than days.

Think about branches

If you're a multi-location business – perhaps with some retail outlets or warehouses – then this is a rare opportunity for me to diverge from my usual opinion. As a rule I'm all for setting up remote access to administrative utilities or even desktop apps, but a modest investment in local hardware can be highly worthwhile if it allows employees to be productive without a network.

And the investment can be more modest than you might think. More than once, while upgrading a business's central servers, I've moved the older, outgoing servers out to branch locations, rather than retiring them. There's very little cost in simply letting them carry on running after



ABOVE **Old servers can find a new lease of life running branch services**

the head office users are migrated to shiny new hardware.

Remember, though, that we're not talking about server disasters this month – we're talking about a loss of connectivity. In such a scenario it doesn't matter where your servers are located: if the network is down then all the latest transactions and document updates will be trapped inside your computing suite, with nobody able to do reach them.

The easy workaround is to make copies of your data sets temporarily available on a read-only basis. These copies might be out of date, and they might be located on- or off-premises: the important thing is the read-only status, as this allows people to do some useful work, without starting a parallel audit trail. Believe me, the last thing you want, once full access is restored, is to find yourself working with two different sets of work-in-progress. That can quickly get as confusing as the different timelines on *Star Trek* these days, and much more concerning for your business.

In practice, what tends to happen in the dust-settling phases of a multi-network architecture is that the fallback data set turns into the definitive copy. People don't like to hop back and forth; they prefer to continue working with the files and resources they were using when the network came back, so any unsynchronised information that wasn't accessible during the outage needs to be merged across.

This can be very easy to accomplish, but also very easy to mess up. Careless clicks cost jobs in this type of process; accidentally putting files in the wrong places, or overwriting data people were relying on, is the sort of thing that can be done very rapidly, and then fixed very slowly.

Plan to tear up the plan

The type of migration exercise described above could be greatly helped along by the existence of a business continuity plan. It's by no means a sure thing, though, for the simplest of reasons: how can you tell that the catastrophic failure you're going through actually aligned with the plans you've drawn up? Lots of companies believe that having any plan is better than nothing, but if your contingency procedures assume that a switch has gone down, when in fact the problem is with the firewall, your planning is likely to be a distraction at best. And if you try to make multiple plans to cover every conceivable outage scenario, it's almost worse, because then you'll find yourself having to pick and choose between plans at the moment of maximum stress.

You will gather that I am dubious about the value of "the plan", and I'm pleased to say I'm not alone these days. One good thing that came out of the pandemic was that businesses of all sizes, all around the world, had to deal with a challenge that almost none of them had planned for, and learnt that it's more useful to have systems that can be easily managed and reconfigured than a piece of paper detailing exactly how to return from a specific imagined scenario to whatever specific setup was considered desirable at the time.

The most useful thing to do with old, prescriptive emergency recovery plans is to turn them into planning aids of a different type – not as sets of rock-hard embedded targets, times and so forth, but as disaster-readiness audits, prompting questions of "could such and such an emergency be rectified or affected by going through the steps in this plan?" Put a tick and cross box beside each instructive paragraph, and the front-liners can build up a much more versatile, open-ended resource.

Cables are a consumable

We've been talking a lot about architectures and policies, but the most frequent source of humiliation during the troubleshooting process is also one of the simplest. So let me wrap up by reminding you of a very simple home truth about networking: cables fail. They get crushed under office chairs, they get pulled about one too many times, or they give up the ghost after a decade's isolation in the back of a patch panel rack. And when they do fail, they don't always do so in a nice clean and obvious way: they often start to suffer from intermittent, inconsistent errors that will drive you crazy.

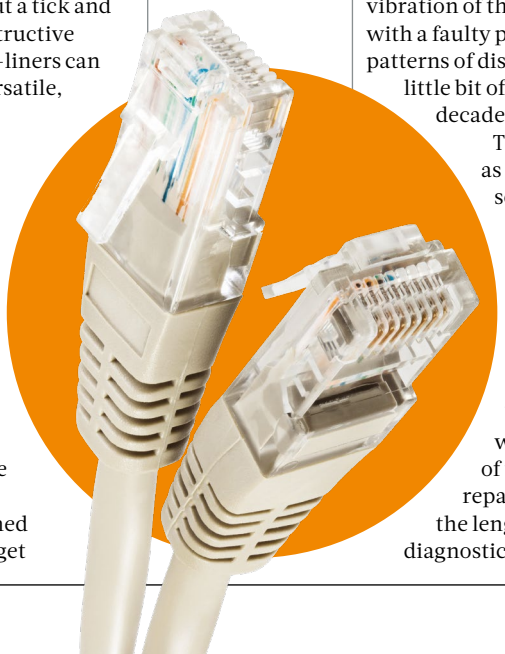
"The most frequent source of humiliation during the troubleshooting process is also one of the simplest: cables fail"

The ports they plug into fail, too. That includes the serried ranks of Ethernet ports on the front of all your network switches, the classic NIC boards in your workstations and servers and those tiddly USB-connected Ethernet adapters on your executive laptops. Once you've ruled out the patch cable, go on to test the interface port itself. This sort of failure, incidentally, is a good reason to avoid tying your secure VLANs to physical switch ports – or at least, not to do so without a very clear plan for how you're going to get in to change the binding if the trusted port dies.

A final thing to remember is that, even if the cable and the port are working as designed, people will bodge things if you let them. On sight, it's impossible to tell the difference between cheap, low-quality wall cabling and proper Cat6 patch cable. Internally, though, the filament strands inside the latter are tough and flexible enough to stand considerable abuse; wall cabling, conversely, is thick and comparatively stiff. It can last a lifetime – as long as it's laid politely and calmly out of the way of any human contact, in a cable tray or a piece of trunking. Otherwise its reliability cannot be guaranteed.

I am wholly confident that any mature business will have at least a few patch leads crimped up from the wrong kind of cable. And these darn things don't just break cleanly and fail: they snap, and then jiggle in and out of contact at the lightest twitch or vibration of the cable. The result is, as with a faulty patch cable, bewildering patterns of disaster, arising out of a little bit of penny-pinching from decades before.

BELOW **These simple, cheap little cables can be the cause of a lot of big, expensive problems**



Think of network cables as disposable items, somewhere between a kitchen towel and a bike tyre in terms of expected lifecycle. It almost always pays to start at the bottom: if you start every troubleshooting task by replacing the cable with a new one, the cost of the cabling will be repaid many times over by the lengthy, hair-pulling diagnostic sessions you'll avoid. ●

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Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

"Every good intention appears to have ten bad outcomes in the modern computing world"

While Apple deserves applause for embracing the third dimension across all its products, its virtualisation missteps are cause for concern

Where to start with the announcements and releases from Apple's WWDC conference? Rather than get mired in deep detail, there are a couple of important underlying issues.

The new look and feel, especially on iPhone and iPad, is gorgeous. The use of glass effects goes further than anything I've seen before. It isn't just a few frosty special effects and fake 3D, as some have suggested. Look closer and this is an entirely new world of graphical rendering and layering.

And the iPad's move to a properly windowed environment is arguably the biggest change in the product since it launched. My 13in iPad Pro M4 on its keyboard stand, along with the Pencil, has gained a new level of usability that moves it from an expensive content consumption device to a powerful content creation platform. Its early days with the developer beta, but I've seen enough to know that the changes turn this into an all-day workable laptop computer. The menu at the top, just like a Mac. The resizable windows, and proper stacking of multiple applications. It now has the look and feel of a desktop operating system.

Most important is the move to a design language that's wholly derived from the VisionOS platform. Apple is subtly moving away from flat plane presentation to a more 3D space, with Vision Pro (and its future descendants) as the platform that delivers the whole AR/VR immersive experience. But this is starting to be unveiled on laptop, tablet, phone and desktop, too.

Fear not: Apple isn't silly enough to introduce everything in a jarring way. Instead, you'll see a set of steps that move you to a properly harmonised 3D oriented set of capabilities, with each using whatever is appropriate to its platform. Hence the move to the "26" numbering across the board, to indicate the year for each rollout.

Vision Pro's software platform has also been released as version 26, but this is really v3. And like so many operating systems and tools over the years, it takes three versions to really pull things together.

Mind you, I was wholly in love with v2.5, released only a few months ago. But v3/26 takes things to another level. As one simple example, consider "personas". These are AI-generated head and shoulders avatars the OS makes for you to use in environments such as FaceTime, and potentially in Teams meetings and so forth. You set it up using the Vision Pro facing you, held at arm's length. It takes some videos and depth measurements using the Lidar depth cameras and then generates a truly frighteningly realistic 3D avatar. It can cope with me sticking my tongue out, perfect mouth movement for speaking, and full eye tracking including closing eyes, raising eyebrows and so forth. I've never anything this good before.

Other items? If you have two AVP users in the same place, they can use the same shared AR space. So you can share 3D models floating in front of you and work collaboratively. Objects placed in 3D space are geo-spatially locked so they stay there, even after a reboot. Place a framed Rembrandt on your office wall? It's still there tomorrow. If you walk out of the office, it's correctly occluded by doors and walls. I use it to drop a big clock on the wall in front of me when I'm working on my MacBook Air laptop, using the AVP to generate that enormous curved high-resolution laptop screen in front of me.

Most importantly, it shows Apple isn't shying away from the VisionOS platform and all that it's learned so far. There's much to cover here in the future so I'll stop for this month, but don't forget that AndroidVR is due by the end of the year, running on Samsung hardware. Something to look forward to at CES in January, I hope.



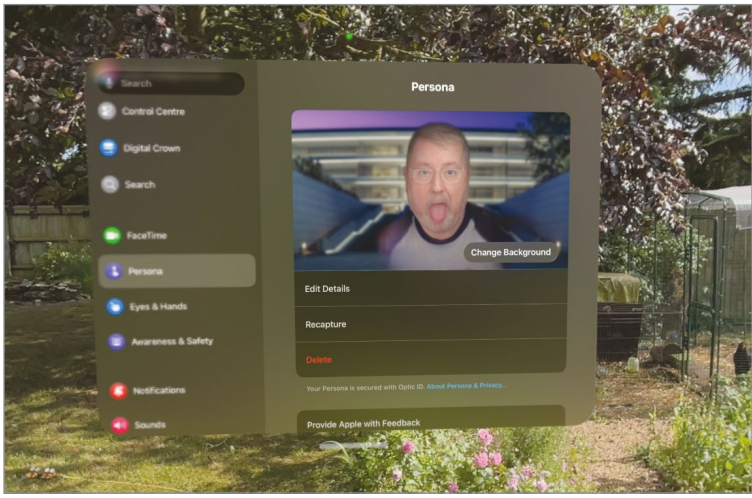
Jon is the MD of an IT consultancy that specialises in testing and deploying kit
@jonhoneyball

"The iPad now has the look and feel of a desktop operating system"

Virtualisation missteps

I'm a huge fan of virtualisation technologies: running a bare metal OS is something that should be done only when the benefits outweigh the downsides. No virtualised environment will ever be perfect, but sometimes the wrinkles can rankle.

I bumped into this last week using Parallels on my M4 Mac mini. I had set up macOS in a virtual machine to test some software. The first problem was getting into the App Store; every time I tried to log in, I got an error. My password was correct, but I changed it anyway. It simply refused to connect.



BELOW **The personas in VisionOS v3 are frighteningly realistic**



Jon Honeyball
Opinion on Windows, Apple and everything in between – p110



Lee Grant
Tales from the front line of computer repair – p112



Dr Rois Ni Thuama
Risk analysis from our expert in cyber-governance – p116



Davey Winder
Keeping small businesses safe since 1997 – p118



Steve Cassidy
The wider vision on cloud and infrastructure – p120

There was a clue in the System Settings on the virtualised OS that told me that, due to security limitations, I wouldn't be able to change things like Apple ID passwords. I expect this is to prevent you trying to debug, and break into, the conversation between the client OS and the cloud service, using the virtual machine container as a useful platform. But it seems that you can't log into the App Store at all for a macOS session running within a Parallels virtual environment. This caused my testing to come to a crashing halt, and I had to revert to installation on real hardware.

The reason for having it in a virtual machine is that I can stop the VM, freeze-dry it, move it over to a network server and come back to it in a few months. And it was at this point that I ran into the second issue.

A Parallels VM file is usually labelled ".pvm". This is a whole file system wrapped into an object that looks like a file. So within the package, which you can open and browse, there's a file containing the VM's file system, a file containing all the memory contents and so forth. And I can copy this 40GB file to a network store, which takes a minute or two across my 10GbE connection.

However, when you set up a macOS virtual machine on Parallels, it creates a file with the extension .macvm. It looks the same, you can browse it just like a .pvm file, but if you try to copy it to an SMB network server then the copy process falls over. It looks like the .macvm file has features that requires Apple File System (APFS) storage.

The annoying outcome is that I can't copy the files to network storage. If I zip them up, then I can copy the zip file, but I haven't yet tried unzipping an APFS zip file to see if it works. The only backup scenario that leaves me with is to use Time Machine, which I can run on the server. This works at file system block level, so it should recover everything just fine.

I'm in contact with Parallels, who are saying "hmm" and "ahh". So maybe we'll get a fix.

The App Store problem is down to Apple. The OS is clearly seeing that it's in a virtual machine and locks down certain features as a result. Maybe this could be unlocked in a developer mode, or some other method where my good intention could be proven? Unfortunately every good intention appears to have ten bad outcomes in the modern computing world.

Office 365 licences

You may recall how, a few months ago, I noticed that I was paying for a double-digit number of Office 365 E3 licences (*see issue 370, p110*), and how it seemed I could get a vastly cheaper offering that would have met all of my needs. I had various chat and email conversations with Microsoft support, and the path forwards was clear: take out the appropriate number of Microsoft 365 Business Standard (No Teams) licences at £7.90 exc VAT per seat rather than the E3 licences at nearly three times the cost. I could then move each user from the E3 licence to the Business Standard licence, freeing up an E3 licence each time. Once I'd done this, I could then cancel the E3 licences, go to the pub and enjoy a pint.

All of this was extremely simple and just worked. I moved a couple of non-critical accounts over to check that Exchange Server still worked, that I hadn't lost the mail accounts and that the Office apps licensing was still working. It seemed too good to be true. Which indeed it was, until I tried to cancel the multi-seat E3 licence.

I had forgotten that Office licensing is an annual contract, even though I pay for it monthly. So I can't cancel my E3 contract until November 2025. You can imagine my amusement at now having E3 licences I didn't want and Business Standard Licences I didn't need. Fortunately, a chat with support showed that you can cancel a new Microsoft licence within seven days with no penalty, so I cancelled the Business Standard licences and put a note in my diary to revisit this in early November. That will give me an overlap period so I can get the new licences made available, move everyone across, and then cancel the E3 licence before it renews for another 12 months.



ABOVE I have E3 licences I don't want and Business Standard licences I don't need

"The annoying outcome is that I can't copy the files to network storage"



BELOW *Sony Year by Year* has pride of place on my coffee table

Frankly, it would be so much easier if Microsoft allowed this to be handled on a monthly basis. It offers this for other products; it's about time that it was available for everything.

Sony brought to book

If you've been following consumer technology (and professional too, of course) for as long as me, you'll be aware of the profound impact Sony has made on the design language of these products. I could wax lyrically about this company for hours, and remember back to the days of the Sony Shop in Regent Street in the 1970s and 1980s, where they had everything in stock and sold nothing. It was just so you could look, try, play and then decide that this was the right product for you.

Sony set design trends that we still see today; you could claim that Apple has been influenced heavily by this design language.

So it was a delight to see a Kickstarter project detailing the history of Sony's design at **tinyurl.com/372sony**. The book arrived this week, complete with stylish slipcase and high-quality hardback binding that makes it a coffee table delight.

Not only that, I was sent a PDF of the entire contents too, so I can browse at my leisure on my iPad Pro.

I'd love the team behind it to produce a second volume covering the professional side of things. The impact of Sony's PCM family (F1, 1610, DAE1100 editor, 3324 and 3348) cannot be



overstated, neither can its impact on professional cameras. Every year Sony has a huge stand at the NAB show in Las Vegas, and it's a delight to talk to the teams there about how broadcast engineering is being moved forward. It's unlikely to happen, but I can dream.

Meanwhile, if you enjoy this stuff, this book is heartily recommended if you can find a way to order a copy (one of the downsides of Kickstarter is that if you don't pledge in time then you often miss your chance, as appears to be the case here). I turn the pages and think "I remember that!" as well as "Never seen that before".

Rohde & Schwarz

In my job, I have to keep on top of emerging standards. Although standards in mobile and radio might appear to change slowly, it's amazing how quickly the detail can evolve. One hugely important company in this space is Rohde & Schwarz, a leading manufacturer of electronics test systems from Germany. It is at the centre of just about all of this emerging technology to the extent that if you visit almost any RF certification lab, you'll find racks of R&S equipment.

This I why I keep an eye on its seminars and white papers. In a week or so, as I write this, it's broadcasting a seminar on Wi-Fi 8. Yes, I accept that 802.11be (Wi-Fi 7) products are only just hitting the mainstream, but Wi-Fi 8 is under development and will be known as IEEE 802.11bn/bq. These two standards cover the push forward on the 2.4GHz, 5GHz and 6GHz bands that we use today, together with a new implementation on the 60GHz millimetre wave range.

Hopefully this will be on the R&S site by the time you read this. In the meantime, keep an eye on its webinars and other material at **tinyurl.com/372rohde**.

UniFi devices and 192.168.1.20

A few of my core UniFi switches decided to go AWOL. This was on the management interfaces, which wouldn't be a particular problem during the working day, but the core switching went down as well. So it was all hands on deck. Reboots and resets were needed, and the switches started coming back up.

However, the management interfaces appeared to be on 192.168.1.20. Which is odd, because multiple devices had this same IP address, and it would be unusual behaviour for a rogue DHCP server to hand out the same IP address to multiple devices. A quick search found that UniFi devices do indeed come up on this IP address if they can't find a DHCP server. This is different to most other devices, which use the 169.254.x.x range that was specifically set aside for this purpose.

Some reboots, wiggling of cables and a strong mug of coffee later, and the network switches were in a position to be rejoined to the management network. And the traffic then floweth in abundance.

Excel dot function

I had no idea that about the new Excel "dot" function. In fact, I don't even know whether it can really be called new as I don't know when it was introduced. That's the problem with a tool like Excel: I do things in a certain way and have been repeating the same methods since the 1980s when Excel first appeared on the Mac, the days when Excel came on floppy disks together with an embedded runtime version of Windows 2.0.

The dot function changes the way that you view ranges, and the building of calculations over lists. Rather than try to explain it, I will simply give you the URL of the YouTube channel where I discovered the feature. Head to **tinyurl.com/372exceldot** and all will become clear.

If you're a power user in Excel, it's worth looking out for this. And the other new things that Microsoft has quietly introduced over the past decade. Luckily *PC Pro* has a feature covering this topic in an upcoming issue.

ABOVE **It's always a pleasure visiting the Sony stand at the NAB show in Las Vegas**

Roaming rates

When you visit a foreign country and have roaming enabled on your phone, you accept that there's a roaming charge associated with keeping connected. I'm not sure what the behind-the-scenes costs really are, but the telcos around the world have decided, entirely independently of course, that this should be the case.

Some data suppliers offer deals to help, where you might get a European roaming free pass for a certain number of days in a year, say. Or a data plan on a cheaper rate for a prescribed amount of data.

All of this is well understood. But there's one area where you must still be very careful. Imagine getting this SMS: "It's a maximum of GBP3.00/min to call, GBP1.25/min to receive a call, 50p to send a text & GBP6.00/MB." One look at the numbers will tell you that this is not a normal set of costs, where you accept a higher price for roaming. It's truly off the scale.

"This is not a normal set of costs, where you accept a higher price for roaming"

Such a cost structure happens when you hop on a ferry to go to the continent. A few days ago, I needed to

BELOW **Sea sick: beware roaming rates on ferries**



be in The Hague for a day of business meetings, and I needed to take a pile of stuff with me. I had to travel by car, and the overnight ferry from Harwich to Hook of Holland on Tuesday night got me into the office in Den Haag by 9am Wednesday. A return ferry on Wednesday evening arrived in Harwich at 6.30am, and I was back in the lab at 9am. It's not particularly cheap, but I saved on two nights of hotel thrown in and I had my car full of stuff with me. For food and boarding, think motorway service station quality: adequate but all the sparkle of a used tea bag.

I normally have roaming enabled on my phone because I need it when I land at a foreign airport. I've mentioned before my liking for T-Mobile's eSIM support in the USA, which gives me a temporary US phone number and a big pile of data, or Holafly for destinations where I only need data. Other virtual mobile operators offer eSIMs too, but these work for me.

So it was a stark reminder on boarding the boat and moving out into the North Sea that my roaming was enabled. My phone had roamed onto the cellular base station on the boat, and this connects via a satellite connection. The prices aren't set by Stena, but by the provider. And this area is not covered by any sort of European roaming agreement, so you have to pay.

Alternatively, ensure you connect to the Wi-Fi, either on the free tier or on a paid-for upgrade, and disable roaming until you arrive in the Netherlands. Then jump onto the local telco using roaming in the usual way.

I'm not sure why this service is still offered other than that if you get caught out, the bills can be huge. I remember on this crossing some years ago running up nearly £100 in spend before I released what was happening. To be fair to Stena, it does broadcast notifications across the ship telling you to turn off your roaming for the duration. Take heed or pay the price.

The real solution, of course, would be for mobile-enabled devices to have a block-list of roaming providers that are deemed to be too expensive other than for real emergencies. Even then, the direct phone-to-Starlink capabilities that are being deployed put paid to that use case, too.

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LEE GRANT

"Somehow big tech gets a free pass in matters of ambiguity and blatant arse-covering"

As we shine a light on why small hard drives tempted Hercules towards infidelity, ask yourself: how many iPads are too many for one family?

October is within touching distance, and it's now possible to hear the rumble of shredding machines being readied for the mass culling of millions of machines. A conversation with customers about the end of Windows 10 is a daily occurrence, but some customers believe that Microsoft's well publicised plans are not targeted at them. For example: "I paid three grand for this machine, it must be Windows 11 compatible."

It's hard to support Microsoft's strict hardware requirements for Windows 11. There are many well-equipped 7th gen Intel machines heading for the skip while plenty of low-spec devices, too awful to be given away as freebies in breakfast cereals, will survive.

Hilary's Acer Aspire 1 laptop was fuelled by an Intel Celeron N4500 processor and 4GB of RAM. Its smooth Windows 11 user experience has the fluidity of an elephant in chainmail dancing the Watusi. The machine was brought in because update 24H2 wouldn't install due to a lack of drive space. Hilary had uninstalled and offloaded so much data that the machine was barely worth owning, but the "not-a-fault" persisted. When I spotted the Acer's 64GB eMMC drive, I knew that a rough ride was coming.

The hardware requirements for Windows 11 (**tinyurl.com/372winhard**) list storage at 64GB or greater, but a footnote acts as a get-out-of-jail-free disclaimer: "There might be more storage requirements over time for updates." Might? If I said to Mrs Grant, "Darling, you meet my requirements, but over time, I might need to sleep with your sister," then I'd be picking up my teeth with a broken arm. Yet somehow big tech gets a free pass in matters of ambiguity, misdirection and blatant arse-covering.



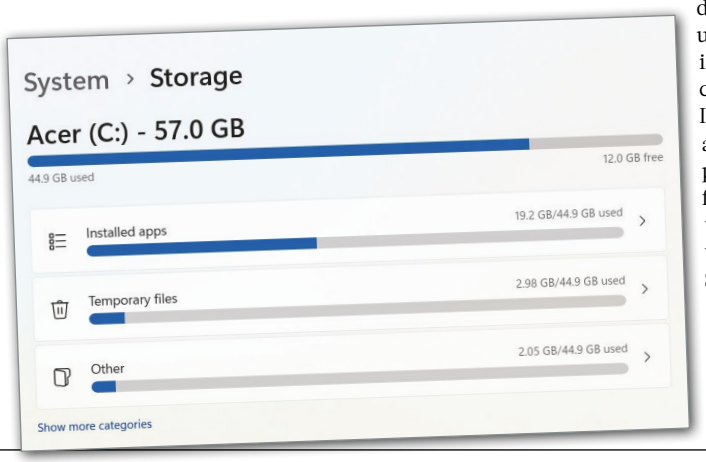
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"No-one alive today will live long enough to prove my hypothesis"

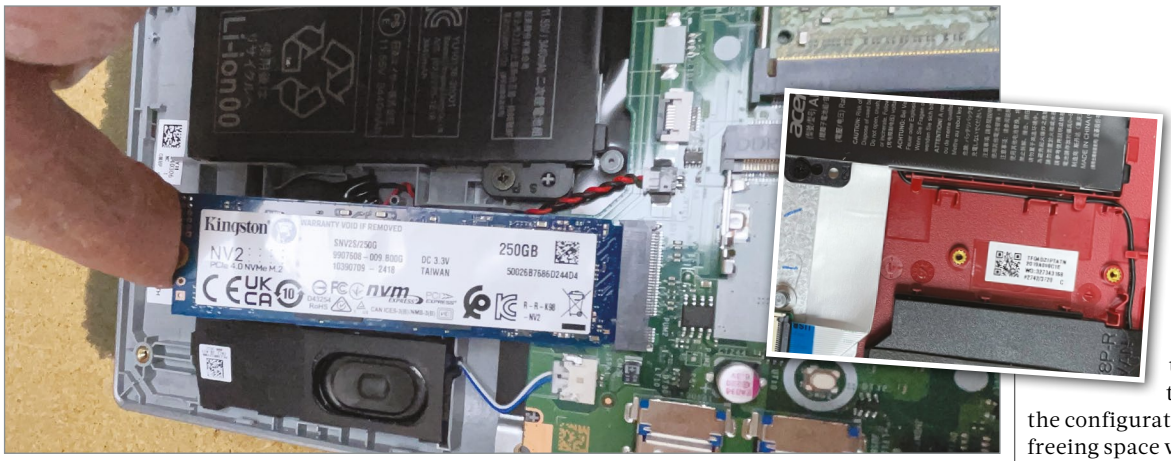
My annoyance isn't purely that Microsoft allows Windows 11 to be installed on machines with such small drives, it's also that Windows 10 had the same issues from its launch in 2015. A decade later, Microsoft's solutions to small drive upgrades still don't work.

"Setup needs space to update" demands the Microsoft warning screen, further demanding access to something with at least 10GB of space to use as temporary storage. Ignoring that Hilary had freed 12GB on the internal drive, I plumbed in a 2TB external drive (to be sure) and left the machine over the weekend. By Monday morning, the process had reached the giddy heights of 5%, remaining the same on Tuesday.

This has been one problem with this process since Windows 10. Although I have seen it work correctly once, it was on a machine with a more powerful CPU and a decent slug of RAM. My unscientific/unofficial notion is that low-powered machines can't cope with the volume of IO transfers between internal and external storage and the process stutters without failing, but no-one alive today will live long enough to prove my hypothesis. Should the planets align to complete the process, it's only a matter of time before the Sisyphean nightmare repeats when Microsoft launches the next upgrade.



BELOW 12GB of free space wasn't enough to upgrade to Win 11



The spectre of Steam

Hilary's fix wasn't purely concerned with getting update 24H2 onto the laptop, but to break the try/fail cycle for 25H2. Luck was on her side, as inside the machine was an M.2 slot. This is present for some versions of the Aspire 1, which cost more money to buy but only thruppence more for a cheap SSD to manufacture. I installed a 128GB drive into the machine, attempted a little cloning magic (it failed, miserably) and sent Hilary away with her machine upgraded and unlikely to suffer the same issue next time.

Another customer wasn't so lucky. Their version of the Aspire 1 had even lower production costs than Hilary's, belonging, I imagine, to Acer's "borderline immoral" range. This machine didn't have the M.2 slot, despite having the screw-hole to mount one. Mercifully, this customer wasn't too distressed, as they'd wanted an excuse to be rid of the wretched thing.

I'll happily evangelise about our need to repair, reuse and recycle, but Acer Aspire 1s, like the HP Streams before them, need to be rounded up then launched from a trebuchet into the heart of a blazing sun. Possibly along with the bonuses of the executives who signed them off, inflicting the junk onto the public.

This returns us to the ridiculous situation that Microsoft has created. While I was wrestling this Windows 11 compatible yet computationally inadequate Aspire 1 s**tbox into submission, I had to explain to another customer that their i7-7700K with 64GB RAM, RTX 3050 card and 2TB SSD didn't make the grade. The Windows 11 hardware requirements are moronic.

Warning: low sto-rage

Many *PC Pro* readers will recall the time when operating systems were distributed on 1.44MB floppy disks. A swift calculation reveals that Microsoft Update's required 10GB of space is a sniff over 3,500 floppies, and while we can collectively agree that disk 3,499 would be unreadable, let's take a moment to appreciate how enormous modern updates have become. It's also a trend that has infected the mobile sector.

Sally brought her iPad into the shop as iPadOS 18.5 wouldn't download and install. The OS stated it required over 12GB of free space on the device, which was around 37% of the iPad's 32GB capacity. To her credit, Sally had released 9.4GB but had run out of options. By her own admission, the device's primary function was Facebook and viewing photographs from a shared iCloud repository, so there wasn't a stack of movies, apps or music to work with.

Tucked away in the settings of an iPad is a breakdown of the apps that are hogging space, and atop Sally's list was Photos. It was hogging an update-blocking 3.74GB of space, curiously listed as "Documents & Data". As Sally didn't store her own photos on the device, I removed the three images she'd unknowingly downloaded from the shared folder, which made no noticeable difference to what the device claimed to be hoarding.

ABOVE While some models of the Acer Aspire 1 have an M.2 slot, others don't

"Some may scoff, but turning things off then on has saved the bacon of many"

One neat trick that Apple offers for certain apps is a function called Offload. This enables the temporary uninstallation of the app but leaves the configuration files in situ, freeing space while making the re-installation much easier for the user. Sadly, Offload doesn't work with the Photos app, nor is there a handy way to clear the cache. The nearest Apple's own documentation (**tinyurl.com/372photos**) gets to the subject is a handy guide on image and video management.

Unofficially, this problem has been around a while, and one method of getting this figure down is to restart the iPad. Some may scoff, but turning things off then on has saved the bacon of many. Sally's iPad restarted with free storage now into double figures, and after I'd offloaded Facebook and Amazon Music (no music downloaded), I was deflated to see the iPad's free capacity was now a smidge over 11GB. For once, fortune was on my side. I looked again at the update page but oddly, the update would now proceed. While Microsoft refused to install a 10GB update on a 12GB drive, Apple goes a step further by agreeing to install a 12GB upgrade on a 11GB drive. Baffling or brilliant, I didn't care. iPadOS 18.5 installed, the offloaded apps were onloaded and around 8GB of free space remained. I fear Sally may struggle to get iOS 26 onto the device.

More cynical minds may accuse Apple of consistently pushing huge upgrades to iPads with low storage. Interestingly, the lowest drive capacity on the new iPads is now 128GB, and I only know of this because, as I write, there are two of them to my left. Sally's update saga has been a running theme throughout 2025 in the Grant household.

Last Christmas, we upgraded the 32GB iPads for both of my daughters as the lack of free space was causing me earache. My wife secured two refurbed 9th gen 64GB iPads from BackMarket, which turned out to be brand new grey-import iPads, manufactured for sale in India. These worked well until their favourite game, *Genshin Impact* (**genshin.hoyoverse.com**), had an update, bloating itself to 36.66GB; that's over 26,000 floppy disks in old money.



BELOW Plenty of space is also required for iPadOS updates



The mix of this game, *Roblox*, *Procreate* (which stores user files within the app, rather than the iPad or iCloud), iPadOS's huge updates, Apple's parental controls fighting adults at every turn and general kids-being-kids stuff meant that updating anything on these devices was a task at which even Hercules would've thrown in the towel.

Eventually, hearing "Daaaad!" being yelled in the house triggered a Pavlovian response that I was about to endure more hours trying to get a Hatsune Miku game to run, hence the two brand new iPads. Why brand new and not refurb? The decision was economical rather than environmental, as the Grant Treasury was reeling after coughing for four iPads within 12 months. Despite our clearly-not-refurbed Indian 9th gen iPad imports being discontinued by Apple, they were under warranty, so when Apple offered a handsome trade-in of £125 each, hands were snapped off. Hopefully, the 128GB storage in these units will stave off "Daaaad!" yelps for a good few years.

ä Lenovo mystery

You may have heard that Washington has become the sixth state in the USA to pass Right to Repair legislation. This is fabulous news, especially for Washintonians who should, from early next year, be able to get their electronics repaired much more easily. The legislation dictates that parts must be made available by the manufacturer, and if you've been unfortunate to have read this column over the past few months, you'll appreciate that some OEMs are doing better than others in this regard.

Last month, a Lenovo ThinkPad arrived in the shop after the owner had attempted to drown the machine with a glass of water. The customer had acted fast, powering off the machine and getting it to me ASAP. Thankfully Lenovo's waterproofing had worked, and though the keyboard was goosed, everything else had avoided bath time. This variant of ThinkPad retains many of the design features of its predecessors, including the removable keyboard, so I hoped that a simple repair would be possible.

Lenovo is one of the better companies for repair information, offering service manuals and a selection of parts for purchase, but after I'd unearthed the product number of the fitted keyboard, I realised that something was amiss. Its FRU (Field Replaceable Unit) code, stamped on the rear, was 01YP625, which Lenovo lists as "Keyboard Internal, Swedish/Finnish". Looking at the keyboard, there wasn't an "ä" to be found. This was a standard British layout. I eventually tracked down FRU 01YP708, which Lenovo listed as out of stock but offered a "Notify me when it's available" option. Seeing as this laptop was made in 2018, I'm not holding out much hope for an email any time soon.

I don't want to give you the impression that Lenovo never comes good on its promise to notify when parts come into stock. Last Valentine's Day, another Lenovo arrived with a faulty "E" key and a pile of keycaps that the owner had bought during the attempts to fix it. Sadly, the keyboard needed replacing, and this required the entire palmrest/c-cover to be changed. Lenovo had the part available, so I batched off an estimate to the customer, but by the time they'd responded several days later the part was unavailable.

I triggered the "Notify me when it's available" option, then headed to an eBay supplier that stocks genuine parts for several major brands of laptops. Oddly, the same company will refuse to sell the same parts via their non-eBay store, which is as frustrating as it is baffling. When the keyboard arrived, it wasn't the "genuine new" as expected. There was a tear in the heat shield that had created a hole directly to the underside of the keyboard and the ribbon cable was folded, pitted and dirty. The final tell was that the static bag had been opened, as the Lenovo security tapes had been cut and were stuck haphazardly to the outside.

The response from the seller was: "This was from a new machine, stripped down. We do not have a replacement; we can provide a partial refund if you would like?" I pointed out that a part that had already been fitted shouldn't be listed as "new", while PayPal explained to them that a partial refund wasn't acceptable.

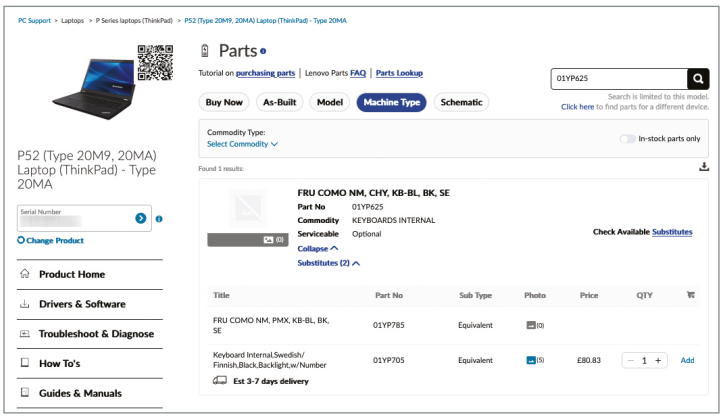
While all this was going on, I got back in touch with Lenovo and spoke to three different sales chatbots/people (pre-sales, post-sales and other-sales), and not one of them could tell me when they were getting the part or who at Lenovo could enlighten me. By this time, ten days had passed and the customer needed a repaired machine. I eventually sourced a replacement part, which arrived quickly, and although I'd been assured it was "new", I had a few doubts. However, it worked and the customer collected on day 13. On day 22, I received an email from Lenovo saying that the part was back in stock, which was good to know, too late to be useful. I could bang on about how Lenovo needs to do better, but if you're to take anything away from this, it's don't pour liquids into a laptop. Unless it's sulphuric acid into an Acer Aspire 1, obvs.

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ABOVE The lack of an "ä" key indicated that this was actually a British keyboard

"If you're to take anything away from this, it's don't pour liquids into a laptop"

BELOW The part was eventually available, but it was too late



ROIS NI THUAMA

"In uncertain times, clarity and accuracy aren't luxuries, but obligations"

Some AI companies are using the complexity of law as an excuse for their actions, but fundamentally theft is theft – and that applies to SMEs, too

I'm not a techie. I don't code. I like my tools to come with clear, concise instructions. I don't want to spend hours configuring a system, and if your product requires me to purchase a second product to function, it's going straight into the bulging tech drawer of obsolescence.

My role – as someone with three law degrees and a business-first mindset – is to cut through the noise. I translate the techno-babble, clarify the legal position, and give business leaders plainspoken, practical insight into the state of play. No fluff. No jargon. Just the law, as it stands, applied to the facts that matter to their business.

Being sufficiently equipped in the legal arena, I'm well positioned to make sense of the intersection between law and technology. Not every matter is complicated. However advanced or opaque the technologies may be, determining whether an act falls foul of the law is rarely so complicated as to justify the creation of new grey areas or for anyone to deliberately muddy the waters.

While some issues may be complex, that doesn't make them ambiguous.

So why am I setting out my stall quite so clearly?

For a number of reasons. First, small and medium-sized enterprises (SMEs) account for 99.8% of the business population. From a pool of 5.5 million private-sector businesses, 8,000 are large (250 employees or more), 38,000 are medium (50-249) and 5.45 million are small (0-49), with micro-businesses (0-9) making up the largest portion. If our nation is to prosper, it's critical that our businesses – and particularly our SMEs – are able to innovate, produce and protect their assets.

This isn't about sowing fear, uncertainty and doubt (FUD).



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"Determining whether an act falls foul of the law is rarely complicated"

It's about encouraging fearlessness, understanding and knowledge, though I admit that the acronym "FUK" is unlikely to catch on.

Second, we need to reach SMEs with a single, coherent message – one that's accurate, accessible and authoritative. It must come from a credible source, not a personality platform.

When podcasters and pundits cosplay as lawyers, waxing lyrical on legal matters without bothering to get the law right, it falls to us to step in. We must provide clarity in the face of the fire hose of misinformation, because for many businesses, the cost of confusion isn't just wasted time: it's operational risk, reputational harm and potential legal exposure.

Beyond the need for certainty, there is a deeper issue of trust. Trust is essential in any society. It enables us to reduce friction and lower the cost of doing business. When we rely on a trusted network – whether that's institutions, advisors or legal frameworks – we not only gain efficiency but also resilience.

We are grappling with a profound crisis of mis- and disinformation. In uncertain times, clarity and accuracy aren't luxuries, but obligations. Without them, trust falters.



BELOW Stealing data from an employer is a crime, whether you use a phone or not

Businesses in the UK are currently facing stark and escalating realities. They're exposed to criminals who operate beyond organisational perimeters and often beyond our jurisdiction, and those criminals are infiltrating systems and networks with increasing ease.

But perhaps more dangerously, businesses face internal threats from insiders: staff, contractors, even interns. The insider threat is uniquely insidious. Unlike external attackers, insiders often require no technical breach to harm the business. They already have access. Without strong, role-based access controls and monitoring, they may effectively hold the keys to the kingdom.

So it is we turn to the issue of theft and misuse of information. There's been much in the press lately on these matters: in particular, theft and the misuse of information by insiders in the matters of *Rippling v Deel* and *R v Hasaan Arshad*. And *Getty v Stability AI* provides us with an example of an external threat actor.

Corporate espionage as a service

Earlier this year, Rippling, a company headquartered in California, discovered that its global head of payroll, Keith O'Brien, based in Dublin, had spied for and harvested substantial volumes of sensitive and commercially valuable information for a direct competitor (Deel). He did this by browsing the firm's Slack workspace, navigating to the Sales channel, and using his phone to screenshot insights from the business development stream.

The fact that O'Brien used his phone is not relevant. He could just as well have transcribed the information onto wax tablets. What matters is that the information was taken by someone with access, acting against the interests of his employer. That is material.

Nor does it lessen the offence that Rippling retained the original data. Theft is not dependent on exclusivity of possession.

To simplify the point: recall the piracy warning at the start of DVDs and cinema screenings in the 2000s: "You wouldn't steal a car... a handbag, a TV, a movie. Downloading pirated films is stealing."

There was never a suggestion that by

downloading the film, the infringer had deprived the studio of the *only* copy. That was never the point. The point was – and still is – that by taking what isn't yours, you deprive the rightful owner of its value, of control, and of the proceeds of lawful use.

Cambridge 5, Manchester 1

As if to underscore the point, consider the recent criminal prosecution of Hasaan Arshad, a graduate of Manchester University, who removed copies of secret material from GCHQ while on an internship. The material was classified under the Government Protective Marking Scheme as "TOP SECRET" – a level reserved for information where compromise could lead to the widespread loss of life, threaten the internal stability of the UK or its allies, or cause exceptionally grave damage to the UK's military, intelligence, diplomatic or economic interests.

There was no suggestion that Arshad deprived the government of its only copy of the material. But that is not the point. Possession does not equal protection. While additional legal duties applied in this case, the fact that the owner (HMG) still retained the "original manuscript" does nothing to reduce the seriousness of the offence.

Arshad didn't sell, disclose or ransom the material. He made a copy, took it out of the building and uploaded it to his computer. This was enough to render all the material taken and anything linked to it as "valueless at best and positively dangerous at worst", to quote the judge's sentencing remarks.

Arshad abused his position of trust and was prosecuted under section 3ZA of the Computer Misuse Act 1990: unauthorised acts causing, or creating risk of, serious damage. He was convicted. In sentencing, the judge observed that, given the potential risk to life, the maximum sentence available under s.3ZA is life imprisonment. Arshad received a custodial sentence of six years for this offence. Fortunately for young Hasaan, I'm not on the bench. I'd have thrown the book at him.

Getty v Stability AI

Getty Images is a global visual media company and a major supplier of stock photography. Stability AI, a UK-based artificial intelligence company best known for its text-to-image model Stable Diffusion, is alleged to have used Getty's content without permission – specifically, to train and develop its AI models. Getty argues that this amounts to a clear breach of copyright, involving the reproduction of substantial parts of its protected archive.

In response, Stability AI has acknowledged using some Getty images, but advances the rather unusual argument that because the training and development of Stable Diffusion occurred outside the UK, no acts restricted by Getty's IP rights were committed within the jurisdiction.

This is a curious – and troubling – position. Stability AI is a UK company. It cannot sidestep its legal obligations by offshoring infringing conduct to a jurisdiction with weaker protections and then reimporting the resulting product into the UK market as though no infringement occurred.

To illustrate the absurdity:

"Did your client take the blueprints?"

"He did, m'lud. But in his defence, he built the prototype overseas. He only wants to sell the product in the UK."

Another spurious argument floated is the claim that enforcing Getty's IP rights would cause economic harm to Stability AI. Every business would flourish if no-one had to pay their suppliers. Until you're the supplier. But we all know that's not how business works.

And one doubts very much that Stability AI would look kindly on another company cannibalising its codebase or platform content to train a competing system. Perhaps it would be willing to release its models, training data and codebase freely to the public. But I suspect not.

AI innovation can flourish, but not if we allow parasitic businesses to undermine healthy ones – to asset-strip the productive and then market the spoils as "progress". The law provides protections for a reason, and assuming the law is correctly applied, it should protect legitimate innovators, not shield those who build off the backs of others.

This isn't about innovation versus regulation. It's about regulation protecting innovation, whether that's Rippling, Getty or, as in *R v Arshad*, His Majesty's Government.



ABOVE Films are protected by IP law for a very good reason

"Fortunately for Hasaan, I'm not on the bench. I'd have thrown the book at him"



BELOW Highly confidential material was stolen from GCHQ by an intern

Concluding remarks

Trust enables progress. When we have trust, we move further, faster. And in each of these cases – Rippling, GCHQ and Getty – trust was central.

Rippling built a global business on trust: trust in its people, its processes, its product. That trust was exploited and the business paid the price. GCHQ placed trust in a highly educated intern, granting access to matters of national security. That trust was also violated, with serious and far-reaching consequences.

In the case of Getty, trust underpins the basic expectation that others will respect intellectual property and engage in lawful, commercial negotiations. They won't simply scrape or extract what they have no right to.

In each instance, the breach of trust caused harm. Not just to the immediate victims, but to broader systems of cooperation, commerce and national interest. That is why it's imperative that the business sector has absolute clarity on the situation: it must protect itself, its investors and stakeholders who invest their time, toil and talent in building businesses and developing original work.

None of these cases is nuanced or ambiguous. Though the claimants sought redress using different legal levers, the core issue was the same. The defendants – Deel, Arshad and Stability AI – could have avoided legal trouble entirely by doing one simple thing: not taking property that did not belong to them.

The law *is* clear. Don't steal a car. Don't steal a handbag. And you certainly shouldn't be stealing information, images or content.

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DAVEY WINDER

“Right here, right now, we’ve got to use what we’ve got, no matter how imperfect”

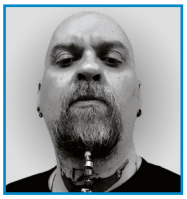
Is there a definitive method of dealing with the SMS attack threat? If you’re a Google Android user the latest version might just be it

Everyone who regularly reads this column knows that SMS text messages are not the recommended method of delivering two-factor authentication codes. There’s a good reason for that: in terms of security, it’s only one step above someone shouting them to you across the street. There’s the SIM swap threat, but for most people this is a somewhat overplayed hand in the game of risk poker; malware and phishing are far greater threats.

As there are so many better options, including authentication apps and passkeys, why play the game at all? Which is a rather long-winded way of saying I’m not addressing that issue today. I’m more concerned with the general risk of SMS threats that revolve around phishing, as that’s the number one method of initial access to compromise devices and passwords.

This can be exemplified by a nasty new bit of malware I came across recently, going by the name of Crocodilus. Although it sounds like a Roman emperor who liked to get things done in a snappy fashion, it’s actually a serious threat for users of Android smartphones.

Crocodilus has evolved, in just a couple of months, to include a function whereby it will add totally fake entries to your contacts that can be used in ongoing phishing attacks. How so? Well, if you get a message or call from an existing contact, even one you may not recognise immediately, you’re more likely to trust it. Now, what if that contact was something along the lines of bank security, or vendor support, where the bank and vendor are known to you? Of course, phishing protections can also be bypassed using this method if they rely upon known versus unknown sources as one flagging factor.



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Trusting who is calling or texting you is key to the attacker’s mindset. They work hard on achieving this trust through AI-generated threats and convincingly worrying scenarios that cause just the right amount of fear to trigger a knee-jerk reaction and not an incredulous one.

Google knows this, and that’s why, as well as employing anti-scam protections in Android 16 to prevent the disabling of Google Play Protect or changing app accessibility options during a call, for example, it’s also introducing something called key verification for Google Messages.

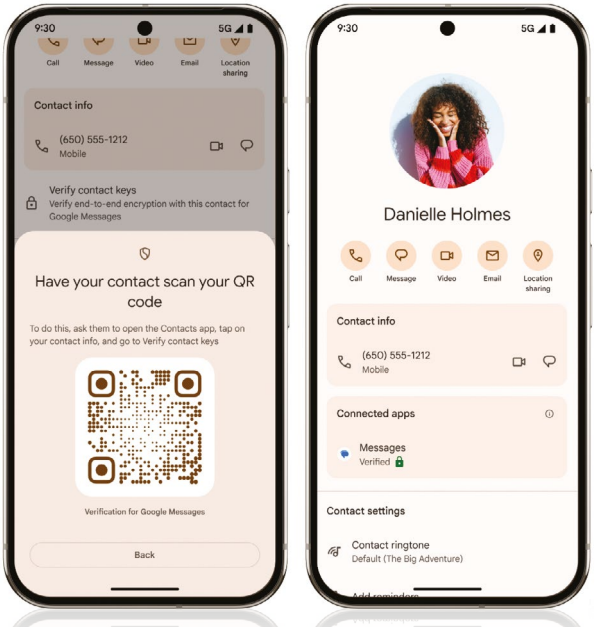
The Key Verifier update will add what Dave Kleidermacher, vice-president of engineering with Google’s Android security and privacy team, has said is an “extra layer of assurance that the person on the other end is genuine”. It does this by employing public encryption keys to protect end-to-end messaging, verifying contact keys in your Google Contacts, to provide a quick visual notification of identity verification.

“If an attacker gains access to a friend’s phone number and uses it on another device to send you a message,” he said, “their contact’s verification status will be marked as no longer verified in the Google Contacts app, suggesting your friend’s account may be compromised or has been changed.”

It’s far from perfect, not least as it can involve the scanning of a QR code (sigh), but the use of secret encryption keys and a visual reminder are both good things. But – and it’s a big but – it isn’t a proper solution to the problem of SMS phishing. And the trouble is that recent research suggests that SMS phishing has now overtaken email-based phishing as the social engineering weapon of choice.

So, what’s the definitive answer? There isn’t one, but there may be soon.

BELOW Google’s Key Verifier update uses encryption keys to verify contacts



Answering the SMS call

Let me introduce you to Paul Walsh, as he thinks he has it. Currently the CEO at MetaCert, Walsh was head of new technologies at AOL back in the 1990s. He helped launch AOL Messenger (leading to him being one of the first people impersonated by hackers on the web), and also co-founded the W3C standard for URL Classification and Content Labelling in 2004.

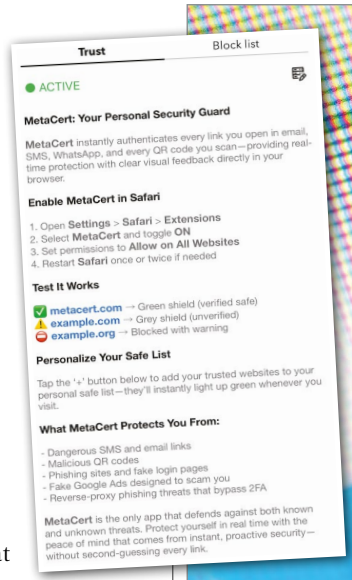
“I co-invented the very concept of classifying/labelling folders, user accounts, etc, on the web,” Walsh told me. He said he believes the ongoing battle against users has nothing to do with phishing evolving or getting more sophisticated, and everything to do with threat intelligence being fundamentally flawed when it comes to phishing protection.

Defences that look for malicious URLs in messages, for example, which in other words are relying upon historical data, are as good as useless, according to Walsh.

“New URLs evade existing intelligence by design,” he said. “They’re simply exploiting gaps in outdated security strategies.” Advising people to trust “trusted sources” is misguided and counterproductive, he maintains, telling me that advising people “to verify sender identity is equally useless as most phishing can perfectly mimic familiar contacts.”

Walsh reckons that this “is the single biggest problem in cybersecurity”, not least because of that shift from phishing primarily being email-borne to smartphones and messages emerging as the primary attack vector. The solution – the only solution, according to Walsh – is to treat every single URL as untrustworthy until explicitly verified otherwise. A zero-trust approach to phishing, in other words.




Trust
Block list
ACTIVE
MetaCert: Your Personal Security Guard
MetaCert instantly authenticates every link you open in email, SMS, WhatsApp, and every QR code you scan—providing real-time protection with clear visual feedback directly in your browser.
Enable MetaCert in Safari
1. Open Settings > Safari > Extensions
2. Select MetaCert and toggle ON
3. Set permissions to Allow on All Websites
4. Restart Safari once or twice if needed
Test It Works
metacert.com → Green shield (verified safe)
example.com → Grey shield (unverified)
example.org → Blocked with warning
Personalize Your Safe List
Tap the '+' button below to add your trusted websites to your personal safe list—they'll instantly light up green whenever you visit.
What MetaCert Protects You From:
- Dangerous SMS and email links
- Malicious QR codes
- Phishing sites and fake login pages
- Fake Google Ads designed to scam you
- Reverse-proxy phishing threats that bypass 2FA
MetaCert is the only app that defends against both known and unknown threats. Protect yourself in real time with the peace of mind that comes from instant, proactive security—without second-guessing every link.

MetaCert has created a bunch of internet standards to classify URLs verified as being safe and trustworthy, along with technology to block end users from visiting any sites that have not been so verified. "Not a single security company has a network-based solution for carriers to shield subscribers from SMS phishing," said Walsh, adding that MetaCert is in talks with major carriers in Europe.

I'm kind of torn, to be honest. On the one hand, there's a lot of inescapable truth in what Walsh is saying and the solution he has developed; only a fool would argue otherwise. But that solution isn't yet being adopted by carriers, so it isn't protecting smartphone users. The phishing landscape is changing, that's equally without doubt, and text messages and smartphone calls are at the centre of the new normal, but a solution that few people have isn't helping in the here and now.

If carriers were to adopt the MetaCert platform then I'm sure it would make a huge difference, but that's a big if and one that could take years to become a reality. Right here, right now, as Steve Cassidy's old school chum Fat Boy Slim might say, we've got to use what we've got, no matter how imperfect. And that means using the red flag markers that are oft repeated, taking a deep breath before getting sucked into whatever scenario is being presented, and understanding that AI-generated stuff can be very convincing indeed. There is, currently, no easy win.

Anubis, Egyptian God of the afterlife, kills files stone dead

Last month I devoted my column to analysing the retail ransomware attacks that had struck the likes of high-street giants Marks & Spencer and the Co-op. Don't worry, I'm not revisiting those attacks, but I do want to mention ransomware again.

This time, it's in the context of a threat that has been deployed by a relatively new threat actor to twist the ransom leverage knife a little deeper. At least I think that's the reasoning, as it's something of an odd one.

The threat actors involved run a ransomware-as-a-service operation; nothing unusual there, as this has fast become the standard option for this type of cybercrime. It is, however, worth a quick explanation of what RaaS is and how it works.

The "traditional" ransomware attack used to involve a group of cybercriminals, or even a solo threat actor, developing or adapting malware that they then used to attack a victim's network and demand money to decrypt the mess they had made. This evolved into a dual-threat model whereby files would be exfiltrated before encryption and used as additional leverage to get ransoms paid, with the threat of sale or publication of sensitive data if not. That's both a lot of work and a lot of risk for the group behind the ransomware itself. So why not spread both the work and the risk at the cost of making less money per successful attack, assuming the volume of such attacks increases exponentially? Welcome to ransomware-as-a-service.

The RaaS structure still revolves around a central group that develops the malware involved and an administrative dashboard to oversee attack operations. But it now includes "affiliates" who perform the actual work of gaining initial access to a network and deploying the ransomware malware. In effect, the ransomware arsenal is being rented out to vetted cybercriminal actors, likely without the technical skills or drive to create their own ransomware threat, who get the advantage of customer service, technical support, tutorials and more. They also get a king's share of any ransom payments made, as they're doing most of the work and taking most of the risk. That's the incentive for affiliates, a perceived easy route to riches.

ABOVE MetaCert has created standards to classify URLs as safe and trustworthy

"The whole RaaS threatscape is, when you think about it, an incredibly smart move"

Once a victim is infected, they get sent to a payment portal operated by the central group that most often deals with negotiations itself. The whole RaaS threatscape is, when you think about it, an incredibly smart move. Not only has it opened the door to attackers without high levels of skill to deploy ransomware against almost any target they fancy, but this diversification in terms of attacker, target and geolocation makes it even harder for law enforcement to track the culprits down.

The Anubis RaaS group has made a rather odd move, and one I've not seen before, in adding a file-wiper to the ransomware attack toolset. This employs a "/WIPEMODE" parameter as well as a "vssadmin delete shadows /for=norealvolume /all /quiet" command to delete volume shadow copies to permanently delete file contents and prevent any attempts at recovery if deployed. It is, ransomware analysts have told me, "designed to sabotage recovery efforts even after encryption".

All of which strikes me as downright bizarre. Why would you want to make decryption impossible if a ransom has been paid? Ransomware groups can only be successful if victims know that paying a ransom gets their networks back up and running and their data restored. Even



BELOW One RaaS group is threatening to wipe data even if the ransom is paid

Continued from previous page

the data-exfiltration and extortion model require there to be a trust between the attacker and victim that the former will keep their word and destroy that data, rather than sell it anyway, after money has changed hands. And destroying files is not of much consequence to any organisation that has adequate backups. It is, however, another threat that can be applied during a time of extreme stress.

The lesson here is pretty obvious, isn't it? Have a functioning incident recovery plan that includes tried and tested off-site and offline backups.

And finally...

Do you know what AI tools are being used in your organisation? Not the ones you're paying for, which you've hopefully vetted for potential security risks and decided that they bring value to the business. I'm talking about the ones being used in your organisation without such testing.

New research has found that the very people who are meant to be helping protect businesses, the cybersecurity teams employed to dig just that, could actually be contributing to AI-related risk by using tools that have no such approval. Please don't hate me, all cyber-professionals reading this, but sometimes usability and getting the job done outweigh proper risk evaluation. And that's what I suspect is happening here.

The Mindgard survey (see **tinyurl.com/372mindgard**) found that 86% of cybersecurity practitioners admitted to using AI, 24% via personal accounts or unapproved tools. What's more, 76% of respondents think their colleagues are even if they aren't themselves.

Most commonly, these appear to be tools used to aid in writing threat detection rules, generating training materials and reviewing code. Peter Garraghan, CEO of Mindgard, told me that "shadow AI isn't a future risk. It's happening now, often without leadership awareness, policy controls or accountability."

Might I suggest you add it your to-do list of things to check for that might screw up your security posture?

davey@happygeek.com

STEVE CASSIDY

"A tour of the features common in top-spec storage platforms is enough to induce confusion"

Storage synchronisation plays a vital role in today's small business, yet it's often misunderstood and mis-implemented. Here's how to do it right

Of all the classes of software we put our faith into, I believe the most misunderstood and often downright dangerous is the storage sync utility. With such a wide diversity of brands, the most important factor is the reputation of the sync software author. Looking at a market of at least 50-plus tools to move data at your request, the only way you can get an idea of the design limits and preferred deployment choices is by researching the dev team's coding history and social media presence.

My first reaction on seeing the number of apps available for file-synchronisation duties was simply, "who's in charge here?" There cannot possibly be over 50 separate use-cases for running a file sync program. Can there?" To put this number into perspective, these days we have half a dozen spreadsheets, maybe ten word processors. So how did we end up with 50 file sync applications?

It's all about the data. Some apps handle their information as a sizeable, monolithic file (read the boxout over the page on how it started). Others keep the files exactly as originally presented, surrounding them with flocks of pointers, xml files, tags and so on. To see what I mean, take a look inside your iTunes library some time. Emails are a nightmarish mess these days because they're essentially an 8-bit encoded and compressed representation in a 7-bit alphanumeric encoding block, accompanied by bang paths and other peripheral information you're not supposed to worry about. Naturally, anything that's accompanied by a pat on the head like that is going to be the one format everyone worries about the most.

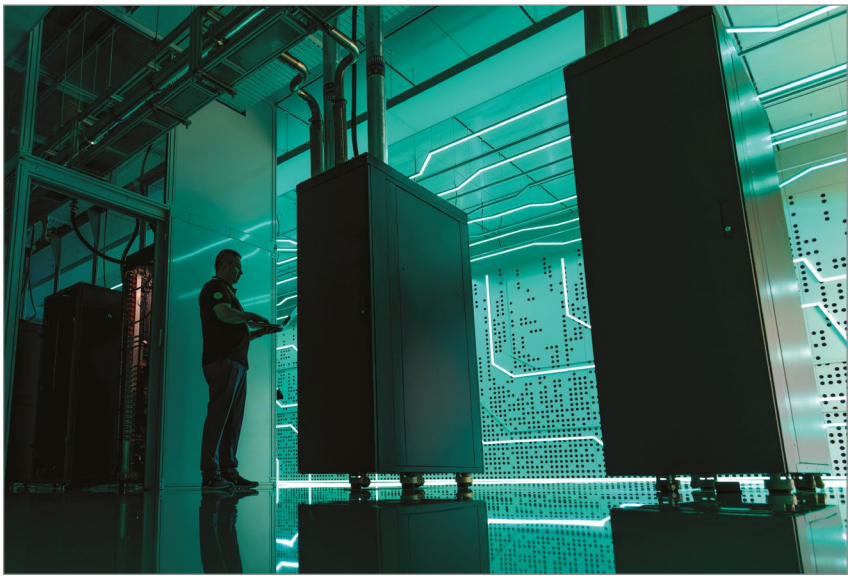


Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart
@stardotpro

"There cannot possibly be over 50 separate use-cases for running a file sync program"

Another problem comes from the enormous degree of diversity in scale when it comes to IT spending. Big data centres are in the habit of spending money on storage, and that has had the effect of pushing their storage architectures into shapes and places unfamiliar to the smaller business IT decision-maker. A short tour of the features common in top-spec storage platforms is enough to induce intense confusion over what works, and what doesn't, when dealing with a storage array that arrives on the back of a truck.

Time to simplify the confusion. First, let's talk de-duplication. This feature is yet to break through to the SME storage sector, which is quite odd since a scan of servers in even the smallest of businesses will show a remarkable degree of duplicated lumps of data: all it takes is a company letterhead stuffed into a Word template and suddenly 30% of your disk is keeping hold of nothing more than repeated copies of the



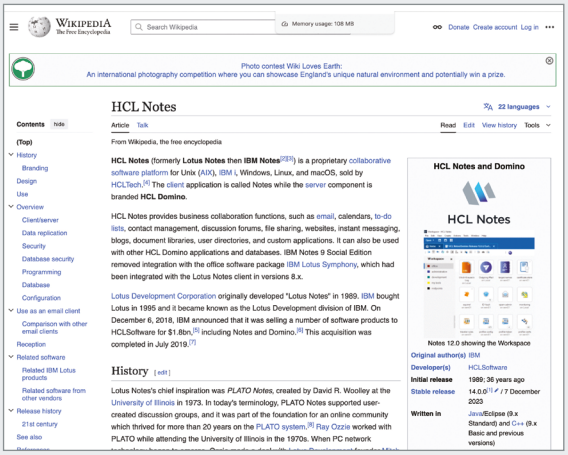
BELOW Large data centres spend a lot of money on storage

Lotus Notes, the forgotten sync

I used to write about my adventures with Lotus Notes quite a bit. I put together four global networks using this one piece of software; a couple were before the internet really got going, the other couple after.

It's a testament to the development teams at Iris (the original authors), Lotus (the licensee), IBM (the eventual owners) and HCL (the current developers) that Notes managed to survive the inception of the internet, because at least initially it was most famous for making improbable connections between client and server software. One of my networks was able to replicate an email message from a small town on the Black Sea coast of Bulgaria, to a safari holiday centre just off the southern tip off Lake Malawi, across flimsy dial-up modem links hopping to an internet hub in each country. The replication took about four minutes in total, of which I would guess that one minute was modems making that eerie whistling noise while connecting with one another.

The reason why this was so easy back in about 1996 was that Notes had total control over the replication environment. You created, stored, displayed, backed up and replicated all your documents, images and so forth within the codebase of Notes. As a result, the replication engine could issue a request to replicate to sync-savvy apps, which in their turn knew whether the lump of data was ready to be sent or not. This overall view, combined with the advantage of files in those days being un-bloated and unencrypted, meant that the capability of the code was neatly matched to the demands of the data presented for replication.



ABOVE Read about the long and varied history of Notes on Wikipedia

Notes still exists, but these days it's largely invisible to hoi polloi, buried as a crown jewel in IBM's software catalogue. You can probably figure out how remarkable IBM thinks it is because it's been ported to a fair chunk of its portfolio of mainframe computing engines; monsters of corporate and governmental information technology. I reckon I started out with Lotus servers back when a 486/66 was an enterprise processor, and I would love to see whether that era of code would run on a Raspberry Pi 5. Sadly, even if it did, the normal size of messages and replicated data these days would very likely bring it to its knees.

same bit pattern. This is impossible to fix without deep access to the file system, and some rather smarter storage platform to hold all the de-duplicated files and their associated pointers. That's easy to achieve in a deep-pocketed enterprise data centre, but rather more of a challenge to cobble together out of little NAS devices.

De-duplication also works better with object storage, in which the various clever bits of storage code run without the user-facing server operating system actually knowing that they're operating. In this kind of storage platform, chunks of data are evaluated for duplicate status by the disk controller part of the architecture; these chunks are quite likely to be smaller than the offending Word logo, and this increases the chances of a duplicate being spotted (or so I've been told).

Two files containing an identical set of chunks can shrink by 90%, with pointers replacing the actual chunks themselves. See? I said it would make your head spin.

The difficulty with this type of storage technology is that almost all other file utilities tend to break its key advantage. You can't de-duplicate identical files when one is stored "normally" and the other is inside a Zip archive. Likewise, the complex database of original chunks and duplicate pointers may have its own reasons for juggling things around just when your simple-minded sync comes along and wants to reconstruct a de-duped file for onward file copying.

I'd like to say that data awareness in the sync app is a good solution here, too, but the truth is that it's a tricky beast to get right even in an ideal sync configuration. That's because there are plenty of good reasons for changing a database the user is supposed to reach only via a custom viewer app.

You will also want to keep your sync utility closely coupled to your mail database manager app. I remember seeing at least one business-grade backup app that was, for an appropriate fee, capable of restoring one single email out of a backed-up message store. Yep, one. I thought at the time that email restoration would be a welcome innovation, but it seems to have been not quite useful enough to avoid the cut as major version releases have come and gone.

"What about the cloud? Surely everyone backs up to there these days?"

The cloud question

That's all very interesting, I hear you cry, but what about the cloud? Surely everyone backs up to there these days?

There is no "there", but let's not pursue that train of thought. The big problem in selecting cloud backup is essentially a replay of the same questions asked strictly on-prem, only with a lot of longer labels attached to the sources of pain. If you make extensive use of an SaaS cloud service, then you have the same trouble we saw with Outlook: that you might only get one file back from a sync'ed up archive, without even knowing if the provider had designed their cloud resources to support such an operation at all.



BELOW Restoring messages from an enormous PST file in Outlook can be tricky

The usual offered defence is that the costs of getting started in a cloud relationship were orders of magnitude smaller on the day it came online, and have progressively shifted to be an order of magnitude larger as the amount of use of the product has risen. Even if we go back to my client's little dilemma with his 17GB Outlook PST file, the presence of a pure cloud mail-hosting solution wouldn't have made either the selection of

a sync product, or the handling of a recovery in that product, any easier.

I know that some cloud operations on big files can be lightning-fast compared to the office laptop, but that comes at a price, because in a cloud VM space, even emptying the trash costs you money.

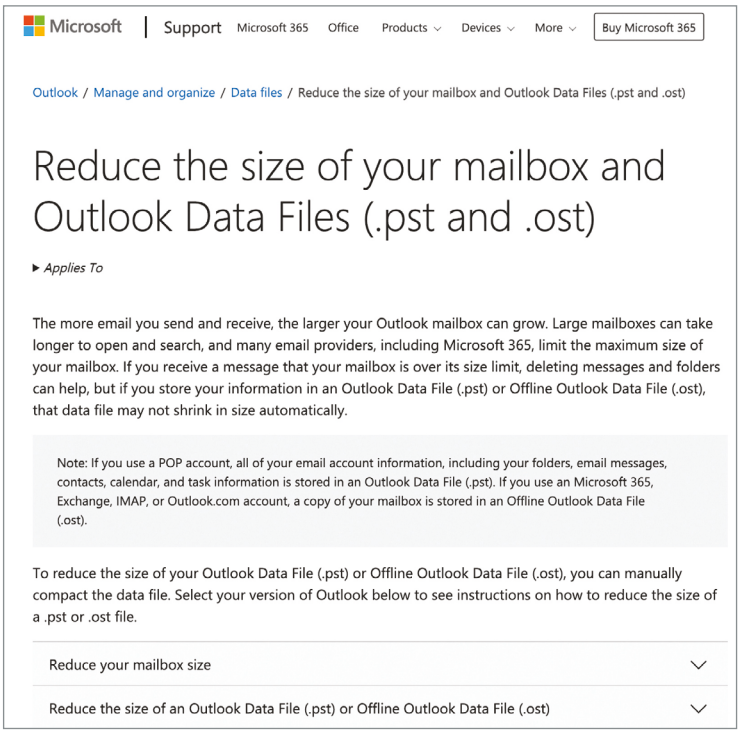
There's one last thing to be wary of in cloud connections for small businesses. Even single-person businesses. That is, you need some kind of hookup with an agent provider. Agents in this context sit on your machine and scoop up the files marked for synchronisation, according to your schedule and preferences. Most of the super-slow response backing up Outlook for my client was brought about by an agent doing as it was told, grabbing a load of files to push up the wire and being made to wait by an interruption at the far end. Software updates to the cloud VM are my favourite cause of this issue: a case where the network stack of the VM stopped responding mid-sync and produced a crash at the user's desk out of repeated attempts by the agent software to complete its scheduled run.

There seems to be a widely agreed dichotomy between software agents and user interaction: most of the cloud platform services are ported over from previously well-regarded Windows Server versions, and try to avoid interaction with users or administrators at almost any cost: how bad would it be to have a little control panel on a desktop PC with a traffic light stopped/stopping/go three-way control to push? Digging around in several different types of log file and the Event Viewer, all at once, doesn't present speedy or intelligent solutions while troubleshooting. Not every business needs to conduct all its synchronisation operations under a cloak of secrecy, be that either with the cloud or not.

My advice when it comes to cloud backup is to try to avoid reliance on an SaaS provider's own internal IT management. Make your cloud selection process include some tough questions about how they manage a request for data recovery from a subscriber, how long it's taken them to actually achieve such a request, and how they think their sync and recovery processes are used by their customers. With especially smug cloud sales types, I like to say that my sync & backup benchmark for ease of use was a tape-based system I added to a beleaguered small business server. I left the users alone with the tape archive software and, within three months, the receptionist/telephonist had become the data retrieval guru for the whole company. Not only did they change the tapes ready for the overnight backup, they'd take requests for file recovery by email and send what they recovered back through their internal email system.

The principal takeaway here is that in the modern business, there really shouldn't be a one-size-fits-all file sync application. Yes, you can aim for that if your archive, sync/store and backup solutions are your single biggest IT expenditure and include a three-month contract with an expert consultant well versed in setting it all up. Those whose priorities are a little different are going to have a much easier time of it making do with three or so sync utilities in use. One is concerned with the accounting software. Another handles local copies of cloud-resident data sets, either as whole VMs or as VM-to-physical server identical copies. The last one handles plain, boring files with no unusual attendant file formats or preferred storage configurations. Don't imagine that a preference for just one utility is a good way to get your data-copying process under control.

cassidy@well.com


Microsoft | Support Microsoft 365 Office Products Devices More Buy Microsoft 365

Outlook / Manage and organize / Data files / Reduce the size of your mailbox and Outlook Data Files (.pst and .ost)

Reduce the size of your mailbox and Outlook Data Files (.pst and .ost)

▸ *Applies To*

The more email you send and receive, the larger your Outlook mailbox can grow. Large mailboxes can take longer to open and search, and many email providers, including Microsoft 365, limit the maximum size of your mailbox. If you receive a message that your mailbox is over its size limit, deleting messages and folders can help, but if you store your information in an Outlook Data File (.pst) or Offline Outlook Data File (.ost), that data file may not shrink in size automatically.

Note: If you use a POP account, all of your email account information, including your folders, email messages, contacts, calendar, and task information is stored in an Outlook Data File (.pst). If you use an Microsoft 365, Exchange, IMAP, or Outlook.com account, a copy of your mailbox is stored in an Offline Outlook Data File (.ost).

To reduce the size of your Outlook Data File (.pst) or Offline Outlook Data File (.ost), you can manually compact the data file. Select your version of Outlook below to see instructions on how to reduce the size of a .pst or .ost file.

Reduce your mailbox size

Reduce the size of an Outlook Data File (.pst) or Offline Outlook Data File (.ost)

ABOVE Steve's rule: the duller the page, the more valuable the information on it

How it all started and why it all stopped

Regular readers may have noticed that we have been having a bit of a rocky period with Outlook. Not only me; not only Jon, whose patience with misbehaving software is legendarily short. Customers, too, were gradually admitting they didn't understand the recent changes in behaviour following the most recent software update.

The incident that started me thinking about the role of sync software in these circumstances was the boss-man in my high mountain client. He lives in Outlook and, as reports of misbehaving email installations started mounting up, I was more concerned by his silence than by the problems I knew his desktop PC setup was already facing.

Sure enough, his machine – a reasonably recent ex-corporate box, made a lot faster and quieter with a nice SSD upgrade – was almost unusably slow after about 3.30pm, most days. As was surfing the web, and the remote-access application that had been left unmolested since being commissioned in 2008. I knew from this final piece of his report that the problem was more likely to be traffic from a background task, though given the decent connection speed and the performance of the PCs, I was struggling to imagine a background task large and long enough to produce this level of bandwidth-hogging.

This business is going through some big changes, including in IT, and the penny soon dropped when I found a new cloud-sync utility in the program control panel, on the desktop and in the Scheduler app. This tiny piece of freeware was set off by the Windows Scheduler at 3pm each afternoon, backing up all the document folders, with a little side-swipe at the folder that presents the Outlook data files. A config I'd seen dozens of times before in pretty much every possible net-sync product in the app store, because who doesn't want their mail store written to a cloud backup?

I can tell you who. Someone with a single PST file that's grown to an impressive 17GB in size. I didn't have the patience to grind through the various size-management utilities, but I did see something like 250,000 messages and 150,000 attachments being brought up, as if this were perfectly normal.

Essentially the backup utility was re-synchronising 17GB of data, because tidying up the dusty corners of an Outlook PST isn't a clean operation from a data synchronisation point of view. Clearing out ancient messages opens free space up at the front of the file; last week's spam is stored right at the end, chronologically. A deletion session of those two widely separated bits of the file is very much a worst-case test of the smarts built into the sync software. In my client's case, his internet connection simply wasn't fast enough for the backup job on his Outlook file to complete on a planet with a 24-hour day/night cycle.

Review

Amstrad PCW 8256

David Crookes takes a look at the first entry in Amstrad's – and Britain's – biggest-selling computer series from the 1980s

SCORE ★★★☆☆

PRICE Around £150 from ebay.com

Right now, one of those memory erasers from the *Men in Black* movies would be a godsend. It would allow me to wipe clean the computing knowledge I've accumulated over the past 40 years and approach the computer in front of me from the perspective of someone who has never so much as touched a keyboard.

After all, the Amstrad PCW 8256 was squarely aimed at first-time computer users whether they were at home or in the office. How nice it would be to view it in the same way that so many others did following its release in 1985. Instead, I'm left wondering if this machine is going to be capable of igniting my curiosity and imagination. It was, to put it bluntly, never intended to be exciting.

Amstrad never made any promises of cutting-edge technology; no ambition to be a wonderful all-rounder. Rather, the 8256 simply offered something to look at, something to press and something to splash ink on to pieces of paper – and yet that combination of screen, keyboard and printer proved more than sufficient for so many people. As Amstrad boss Alan Sugar always believed it would, the PCW 8256 succeeded in changing the face of office work.

Lord Sugar, as he's now known, had the idea when he was flying between Tokyo and Hong Kong. He sketched his plan on the back of a Cathay Pacific serviette and he imagined the creation to have a monitor with a printer stuck to the top. That idea was sensibly ditched in favour of separate units, but the concept of a word-processing machine to compete against electronic typewriters stuck. And while Lord Sugar was never a visionary in the mould of Steve Jobs, he had a knack of knowing what would sell.

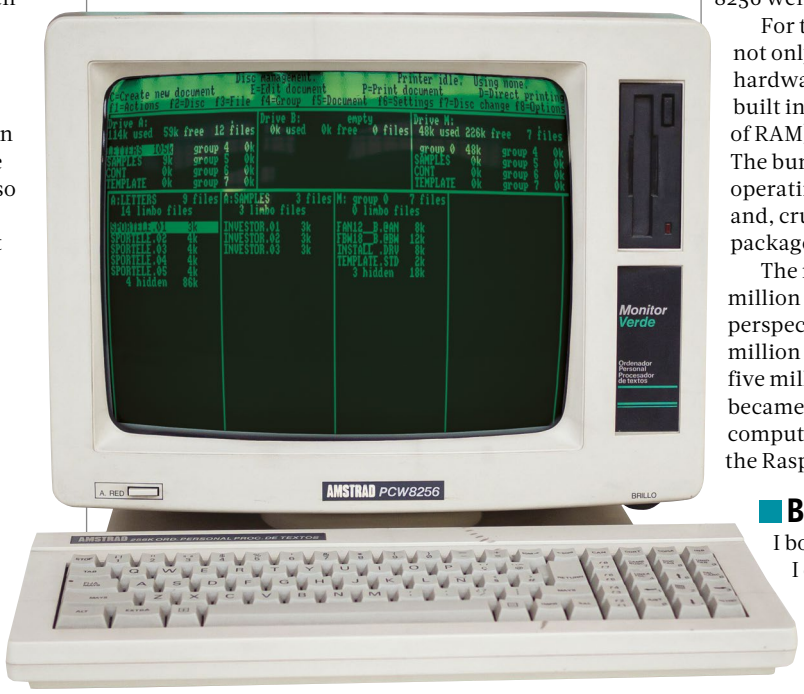
By this point, Lord Sugar had experience in the computer market. His CPC 464, 664 and 6128 computers – the first one being tape-based, the latter two using disks – were shifting many units and Amstrad, far from suffering the huge financial losses of its competitors, was making healthy profits.

Lord Sugar knew he was on to a winner, mimicking the strategies that had served him well when building hi-fi units– namely, providing the "masses" with everything they would need from a computer at that time. He ensured the components would be connected with as few leads as possible, allowed the whole shebang to be powered with a single plug and wanted users to make headway in no time.

He also believed he could deliver his new product at a price that would instantly prove attractive to potential computer users who were put off by the high cost of investing in an office-ready machine such as the IBM Personal Computer . That cost thousands of pounds, while the PCW 8256 went on sale for £399 plus VAT.

For the money, buyers would not only get the aforementioned hardware (with a 3in disc drive built into the monitor and 256K of RAM) but useful software, too. The bundle included the CP/M operating system, BASIC, Dr Logo and, crucially, a word-processing package called LocoScript.

The range went on to sell eight million units. To put that in perspective, the Apple II sold six million and the ZX Spectrum sold five million. The Amstrad PCW series became the best-selling British computer and retained that title until the Raspberry Pi topped it in 2016.



BELOW The PCW 8256 was nicknamed "Joyce" after Alan Sugar's secretary

Big expectations

I bought my machine on eBay. I cleared the boot and the back seat of my car, drove a good 20 miles to pick it up and expected to come back with a hulk of electrical

equipment and wires. As it was, the seller passed me a box that took up less than half the boot space, maybe only a shade more than a third. Being the fool that I am, I took it on trust that everything was in there... thankfully, it was.

After unpacking the box, it took less than two minutes to set up the computer. As Lord Sugar envisaged, the process couldn't have been simpler. The keyboard plugs into the side of the monitor, the printer into the back. As the power lead is fixed to the monitor, it was now simply a case of plugging it in and pressing the button on the front of the display.

The green screen monitor went, er, green and, well, nothing happened. Okay, not quite nothing. The printer whirred for a second or two. But I wasn't worried. I figured I needed to power it up with the floppy disk that came with the machine and, once inserted (the disks are double-sided), I had CP/M sitting pretty on the screen.

Now, of course, this instinct may not have kicked in without some prior computing knowledge but, as I later discovered, the spiral bound user guide would have had me covered. It started with the words "Don't switch on yet!", written large across the top of the first page (whoops!), but the important step was clearly shown on pages four and five. And the wording of those instructions hit home just why Amstrad's computer became a roaring success.

The manual assumed the user knew absolutely nothing about any aspect of computing. It went as far as explaining how to hold the disk – "by its labelled end" – and how hard to place it into the drive ("gentle pressure" and "whatever you do, don't force it").

But it wasn't patronising. While it may feel like that today, back then this would have been hugely refreshing. It cut through the mystique of computers and showed them to be approachable, useful tools. There were even tips on how to clean the thing. The more I read the manual, however, the more I realised there was a reasonable amount of power waiting to be unleashed.

Inside job

Now, I haven't unscrewed the panel from the back of the monitor. For the purposes of this review, I didn't want to tinker and mod the machine, just use it as intended out of the box. But from watching videos and reading past articles, it's apparent that there are very few computer components running the PCW.



ABOVE **You can still buy replacement ribbons for this printer online**

Strip away the monitor tube and high-voltage electronics and you're left with a tiny PCB containing 17 chips. There's a Zilog Z80 processor running at 4MHz, an 8041 printer controller chip, an NEC 7658 disc controller, a large gate array and eight chips for the 256K RAM. A further five chips are TTL drivers for the printer interface.

The reason nothing happens when you turn the machine on without a disc in the drive is because every program – including the OS, CP/M Plus – needs to be loaded from a disk.

The green screen monitor went green and, well, nothing happened

When you insert the CP/M Plus disk, a short program on the 8041 printer controller chip copies the boot code into RAM for execution. If you don't have disks for the machine, you've got little more than a door jammer.

At the very least, if you're considering buying a PCW 8256, you'd want that CP/M Plus system disk. It enables you to perform all of the basic (and a lot of advanced) functions expected of a computer. You'd use it to work with files, whether you're creating, copying or renaming them.

BELOW **The computer is concealed inside the monitor rather than as a standalone unit**



CP/M Plus will also allow you to format, copy and list files stored on disks.

The system disk also includes the GSX graphics library and developer tools such as the macro assembler MAC and the SID debugger. You also get access to the speedy, business-oriented Mallard BASIC interpreter produced by Locomotive Software, which has very similar syntax to Microsoft's MBASIC 5.2 – perfect for writing your own programs. If you have the full set of two bundled PCW disks (I only got one), you get Digital Research's Dr Logo programming language, too.

Importantly, the system disks include LocoScript and that's the whole essence of what the PCW is about (the "W" stands for word processor). It hadn't escaped Amstrad's notice that, apart from games, word processing was the main thing people used their computers for, and it just so happens that LocoScript is excellent.

Voyage of disk-overy

Before I delve into LocoScript, we need to talk software. One of the key problems I've found these past few weeks is poor availability of commercial software on disks, even on eBay. They're often expensive, too: don't expect to pick up software for a pound or two.

To that end, if you're serious about using this machine on a regular basis, then you should consider a Gotek. This floppy drive emulator uses virtual disk images (the ideal model is an SFR1M44-U100K). You can install a Gotek in the second slot on the Amstrad PCW 8256 monitor – the one that doesn't have the floppy drive in – by opening the back, removing the plate that has a few words on it ("green monitor") and making the connections.

Once done, you can load up a USB stick with a stack of software,

insert it into the Gotek before pressing buttons to select the files you need to run on the PCW. Given that Goteks can be picked up for about £50, it makes a lot of sense.

So what is available? Well, the PCW has an abundance of software, from database apps such as dBase II to spreadsheets such as SuperCalc II, plus numerous apps released into the public domain. You can also get to grips with desktop publishing using MicroDesign or Stop Press, or take charge of your finances with the likes of Sage's Popular Accounts.

Having CP/M Plus as the operating system means the machine is open to a large number of CP/M programs developed for other computers capable of running this OS, and gets around the fact that a good number of those were sold on 3.5in floppies. With a Gotek drive installed, you'll also have few problems getting hold of games (just remember that, in all cases, it's illegal to download ROMs without permission from the copyright holder).

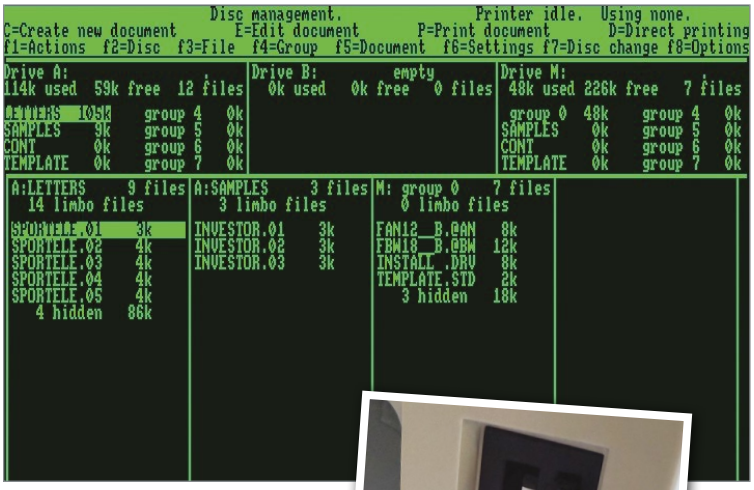
Anyway, the PCW had a decent sized library of titles, including *Head over Heels*, *Match Day II* and *Trivial Pursuit*. If you love text-based adventures, you'll be well served with games by the likes of *Level 9* and *Infocom*. These work especially well with the PCW's green screen monitor since they don't need flashy graphics.

Steaming ahead

For all of that, word processing was always the main attraction of the PCW, and to some extent it still is. The good news is that, while you could obtain the likes of SuperWriter, WordStar and Protext, LocoScript is more than capable of bashing out letters, essays and novels; and as it was written specifically for the PCW, it really does bring out the best in the computer.

For starters, it makes good use of the (cramped) keyboard with its specific word processing keys such as cut, copy and paste. You can press keys to find and exchange text; move through your prose by character, word, paragraph and page; and delete forward and back. The software also seeks to make life as easy as possible by having most functions within a series of pull-down menus activated by the function keys. But it's not as intuitive as you may think.

As the manual says, "there is no short cut to learning LocoScript". But if you quickly work through the 100 pages dedicated to the app, it will become second nature. It helps that there are templates to play around with while you get to grips with what LocoScript can do. You may even become used to the fact that the Return and Enter keys perform entirely different functions.





TOP The LocoScript main screen lets you create, view, edit and print your documents

ABOVE The 8256 has one disk drive while the subsequent 8512 had two, as well as twice as much RAM

In essence, though, it's a word processor running directly on the machine (not via CP/M) that provides staple formatting, justifying and editing tools. It supports word wrapping, displays headers and footers, and allows use of an area greater in size than the screen. And if you delete a file by mistake then it sits in limbo: so long as you don't keep overwriting the disc, you can get it back.

LocoScript also makes optimum use of the 12in monitor, which has 90 columns by 32 lines. That's more than the CP/M standard of 80 by 24, but the popularity of the PCW meant that some, but not all, CP/M programs made use of the extra space.

Of course, given there's a 9-pin dot-matrix printer attached to the computer, I was eager to find out how that performed. I used A4 paper, but there's an option to use tractor feed paper, too. In LocoScript, I opted to save and print, but it's possible to press the Ptr key to make use of a menu. Once the paper was fed, the printer sprung into action, and there it was: a printed page.

It didn't take long. Draft quality mode rattled off my document at 90 characters per second and added the various onscreen elements such as bold and italics. A subsequent re-print in high quality was slower (20 characters per second) but it resulted in a near-letter-quality output and something I would consider sending to someone.

I particularly enjoyed the direct printing mode. This works like a typewriter in that you hammer on a key and it's outputted to the printer in real-time. It's supposed to be good for filling in forms and I can see that working well, especially given that you can use the cursors to position the print head in the right spot.

If you don't like the printer, however, be aware that it's integrated into the PCW setup. That's not entirely a bad thing because it ensures everything works seamlessly, but it can feel restrictive. Amstrad supplied an extension unit allowing the use of Centronics parallel and RS-232C serial ports, but you'll have a hard job finding one of those today.



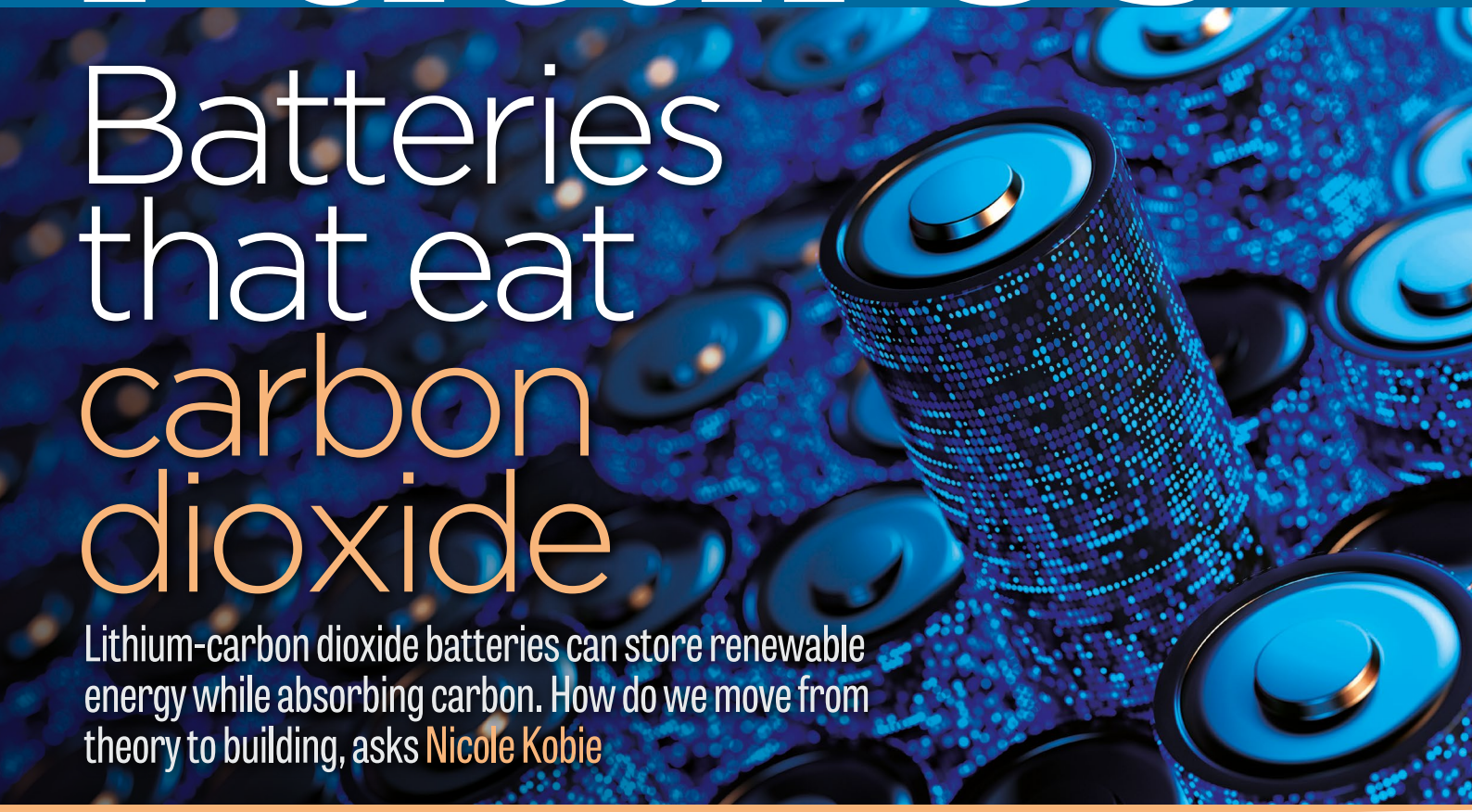
RIGHT The Amstrad user manual was aimed at people who had never used a computer before

Fresh eyes

Again, though, I wish I'd have been able to approach this computer with a blank slate; to be mesmerised by what it could do without any preconceptions of what I'd have liked it to be able to do. While the Amstrad PCW 8256 has the capacity to surprise a newcomer, it feels like a step back from even the computers I was enjoying as a child. I was curious to keep probing but, generally, it was a case of loading up applications rather than playing around.

Yet that was the point. The PCW's USP was its bundle of hardware and software for a killer price, giving users an inexpensive and easy way into computing with specific tasks in mind. It's telling that this focused approach means people today don't have the same pangs of nostalgia for the machine as they do for its rivals. One thing is clear. If you're going to be splashing out around £150 for a PCW 8256, there are just more exciting retro machines to dabble with.

Futures



Batteries that eat carbon dioxide

Lithium-carbon dioxide batteries can store renewable energy while absorbing carbon. How do we move from theory to building, asks Nicole Kobie

Carbon dioxide is a bit of a problem, what with changing the climate and all. But what if we had batteries that could not only trap this problematic gas, but also store renewable energy?

That is exactly what researchers at the University of Surrey are working to create: a lithium-carbon dioxide (Li-CO_2) battery. If successful, such batteries could not only help suck carbon dioxide out of the air but also offer better solutions to power electric vehicles, the energy grid and even missions to Mars.

But don't breathe a sigh of relief just yet: not only are these designs merely batteries in gas-filled jars in a lab, and at least a decade off in the future in terms of commercial viability, they also come with plenty of caveats. The question is, how do we get from here to smartphones that inhale CO_2 and exhale energy?

Building a better battery

Cars and laptops alike are powered by lithium-ion batteries, which move lithium ions back and forth to either power a device or recharge, using a lithium metal oxide such as lithium cobalt oxide as the cathode and a graphite as the anode.

While these work well enough to power gadgets around the world, this design comes with challenges, including costs, the use of conflict minerals, difficulty in recycling, and less charge capacity every time the battery is recharged. What's more, lithium-ion batteries have an annoying tendency to catch fire if damaged or overheated – you may remember Samsung having to recall the Galaxy Note 7 after it kept exploding back in 2016.

So this leaves us on the hunt for a better battery. In particular, researchers such as Daniel Commandeur, a Surrey Future Fellow at the University of Surrey; Siddharth Gadkari, lecturer at the same institution; and PhD student Mahsa Masoudi. The aim is to produce a battery that is cheaper, provides better performance and produces fewer environmental or ethical impacts. How nice if it's also less likely to explode. There are plenty of options, as we explore in "New batteries on the horizon" on p128.

Accidental improvement

A little over a decade ago, researchers in the United Stated and France were attempting to create a lithium-air battery; instead of moving ions, these batteries would be powered by a chemical reaction between lithium and oxygen.

Commandeur told *PC Pro* that there has been a lot of interest in lithium-oxygen or lithium-air batteries, as well as zinc-air. "It's a misnomer," he said. "They're working with oxygen rather than air, and often



BELOW Lithium-ion batteries can catch fire if damaged or overheated

actually for them to work well you need pure oxygen, rather than just drawing it in from the air."

Normally, he says, a battery would be made up of two solid electrodes inside a liquid, but this style of battery uses a solid electrode, liquid electrolyte (though sometimes solid state) and a gas inlet. "They poke all these holes in the batteries to allow the gases to flow in," Commandeur explained. "These are quite an unusual kind of battery. Metal gas batteries are in their infancy – it's quite a weird thing to do."

However, alongside oxygen, our air naturally has carbon dioxide, and when mixed with lithium that creates lithium carbonate. In a battery, such contamination causes issues including electrical resistance.

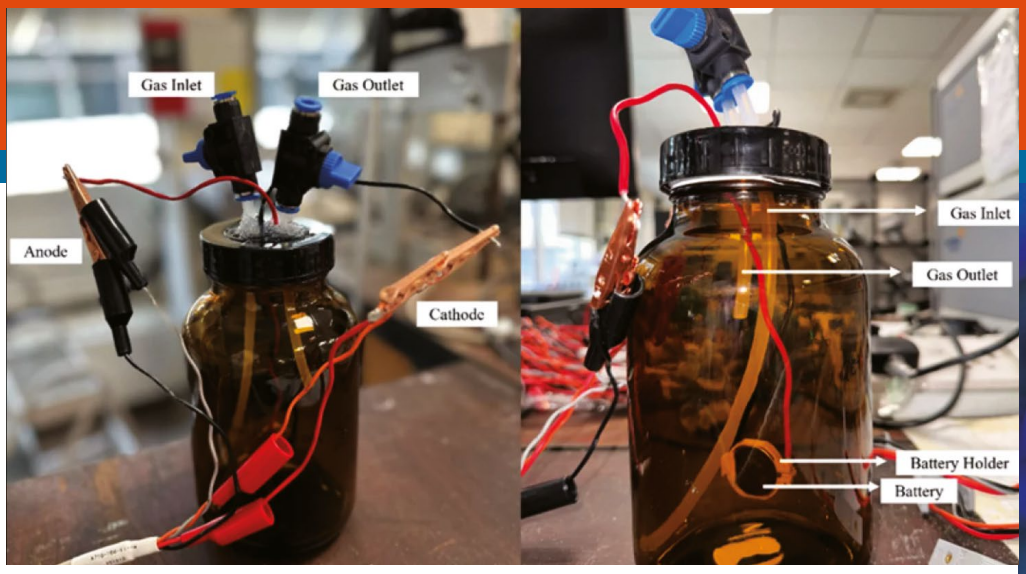
"There was a theory that these batteries weren't working as well as they could because there was too much carbon dioxide in there, and these liquid parts of the batteries preferentially absorb carbon dioxide – they're better at absorbing it than oxygen," said Commandeur. "So even with a little bit of carbon dioxide in the atmosphere, they found it was spoiling their batteries, so people were starting to look into how much carbon dioxide is too much."

As a result, researchers sought to reduce or eliminate carbon dioxide in lithium-air battery experiments – until a team of French and American scientists noticed that this so-called contamination had benefits. "They found something quite exciting, which was you put in a bit more carbon dioxide and the capacity of the battery, how much charge it can store... shoots up by quite a lot," said Commandeur.

In a paper in 2012, the scientists noted that it actually improved the battery's charge. And that sparked a new line of research into creating lithium-carbon dioxide batteries, with the first demonstration of a proof-of-concept design in 2015 followed by a fully rechargeable version in 2019. Since then, efforts have continued to improve the design, boost the performance and make it commercially viable.

How it works

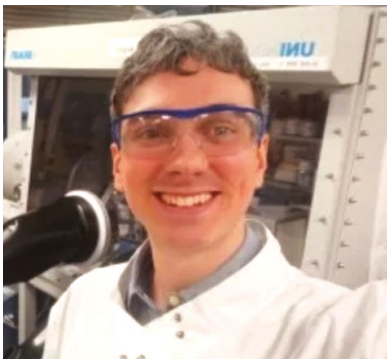
The lithium-carbon dioxide system works by creating a permeable battery that can allow carbon dioxide access to the liquid electrolyte, where it can react with dissolved lithium.



ABOVE **In the lab tests, batteries are placed in jars filled with carbon dioxide**

RIGHT **Siddharth Gadkari of the University of Surrey**





LEFT **Commandeur believes batteries could soak up carbon dioxide**

You put in a bit more carbon dioxide and the capacity of the battery... shoots up by quite a lot

The reaction between lithium in the battery and carbon dioxide in the air forms lithium carbonate. "It's a four-electron process," said Commandeur. "In simple terms, that means that rather than changing over one electron per reaction, it changes over four – effectively, you're doing four times the amount of charge storage per chemical reaction."

In a standard lithium-ion battery, only one electron is exchanged per reaction. By exchanging four, this design could massively expand performance. Commandeur adds: "This is the reason why those batteries theoretically have a much higher energy density than normal."

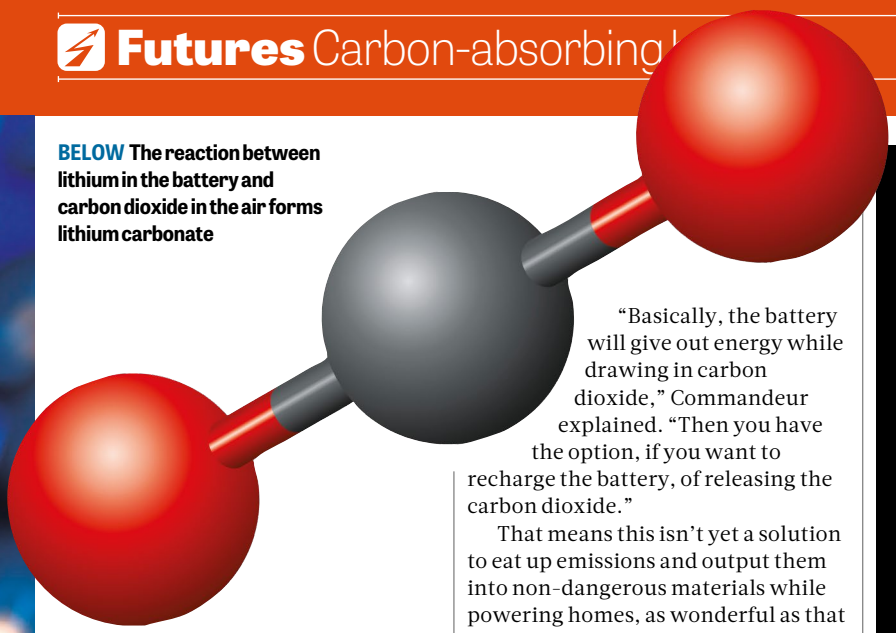
Existing lithium-ion batteries have an energy density of 250 or 300 watt-hours per kilogram, while the theoretical energy density for lithium-carbon dioxide is as much as 1,800Wh/kg. But, the researchers stress, that remains unproven. "Even though the theoretical energy density is quite high, even in lab scale studies people have not reached that; they are very much closer to lithium-ion or slightly higher," said Gadkari. "It will take a few years before it can actually reach that."

So far, the batteries have been tested under ideal lab conditions. "We take a jar, fill it with carbon dioxide, and put our battery in the jar," Commandeur explained. "Very rarely would you find circumstances with that amount of carbon dioxide.

"But what we want to look into now is what if we were to reduce the pressure of that carbon dioxide and make it a little bit more like realistic conditions," he added, perhaps more like the levels seen in a car exhaust or natural gas boiler – or even just in the levels seen in the regular atmosphere. "They're not going to work quite as well obviously as in ideal conditions," Commandeur said, possibly reducing the capacity of the battery.

There are more caveats, including seriously limited charging cycles. So far, researchers across the field have only managed 100 cycles with this style of design, well below the many thousands achieved by commercial batteries today. They believe that lithium-carbon batteries could be viable if they can last beyond 1,000 charges and prices can be cut by removing all scarce materials.

Alongside that, the researchers are developing a case that only lets in carbon dioxide. "It will be a lot more



BELOW The reaction between lithium in the battery and carbon dioxide in the air forms lithium carbonate

tricky than in a conventional battery, because we're dealing with the liquid-gas interface there," said Commandeur. "Inevitably, it will be about designing technology that allows the passage of carbon dioxide in while preventing the electrolyte from drying out – it's a big, big engineering challenge there."

Recharging challenges

There are other challenges, notably what happens during recharging. First, breaking down the lithium carbonate to recharge requires a boost of energy; that can be reduced using a catalyst, but they are expensive and often require rare metals.

In a recent paper, the Surrey team revealed success using an alternative catalyst to those expensive and rare metals: caesium phosphomolybdate, which they simply call CPM.

Not only is it cheaper, the CPM material kept the batteries stable for 107 recharge cycles – above the 100 or so previously achieved, but nowhere near the thousand required for commercial success – while storing two-and-a-half times as much charge as a comparable lithium-ion design. Next up is ditching the caesium in favour of an even cheaper alternative.

Welcome back, carbon dioxide

There's another problem raised by recharging these batteries: the process releases the carbon dioxide, meaning you're not permanently removing any from the atmosphere.

The battery uses carbon dioxide, mixing it with lithium to create lithium carbonate and energy. That process removes carbon dioxide from the atmosphere – but if you want to use the battery more than once, the recharging process uses electrical energy to decompose the lithium carbonate and carbon back into the original lithium and carbon dioxide. So, the carbon dioxide doesn't disappear.

"Basically, the battery will give out energy while drawing in carbon dioxide," Commandeur explained. "Then you have the option, if you want to recharge the battery, of releasing the carbon dioxide."

That means this isn't yet a solution to eat up emissions and output them into non-dangerous materials while powering homes, as wonderful as that would be. "It's not like 100% capture, because it's letting go of that captured carbon dioxide again in the charging/discharging process," said Gadkari.

That said, these batteries could be used alongside carbon capture systems to use all the carbon dioxide that's trapped and stored, as it would effectively be lab-like conditions in terms of gas purity. The lithium carbonate produced by the reaction is also a precursor material for making lithium-ion batteries. In other words, if you built the right system, you could use up carbon dioxide to store power and make more materials for more power.

"You can be quite imaginative with how these systems could be integrated," said Commandeur.

But all of that is a long way off; at least a decade, suggests Gadkari.

Why it's worth the work – and the wait

While the challenges are serious, this technology could be worth the wait. Though they're unlikely to ever be small enough to power your phone or laptop, one particularly good use could be balancing grids, such as storing renewable energy gathered at peak times to be used when the wind isn't blowing or the sun isn't shining. "The most important application is definitely grid-scale energy storage," Gadkari said. "Because of its high-energy density, it's attractive for large-scale grid storage, helping to stabilise our renewable energy storage."

These batteries could work with cars, not least because there's plenty of carbon dioxide available on road networks. "If we have a kilogram of catalyst in there, then we can basically absorb all of the carbon dioxide from a day's driving," said Commandeur.

Gadkari has even bigger goals. "The fantasy application is the Martian atmosphere, because it's 95% carbon dioxide. And whenever there are any Mars shuttles or Mars programmes or any kind of settlements, they will need batteries," he said. "These batteries can easily work there."

A safer battery that could clean up our own atmosphere and power space travel? Not bad for jars in a lab.

The fantasy application is the Martian atmosphere, because it's 95% carbon dioxide

New batteries on the horizon

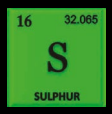
Lithium-ion batteries have plenty of benefits – good energy density, fast charging and light weight among others – but there are enough downsides that researchers have long been seeking alternatives. Lithium is costly to extract, requiring huge amounts of water, and the batteries remain difficult to recycle. Plus, if damaged they have a tendency to catch fire and even explode. Here are a few potential replacements that are already in the works.

Lithium-air/lithium-oxygen



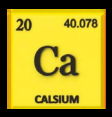
Like lithium-carbon dioxide, these batteries have a higher theoretical energy density than lithium-ion batteries. But they also face issues with degradation when recharging, complicated engineering, and the possibility of fires, especially if pure oxygen is used.

Lithium-sulphur



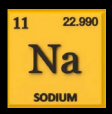
Proponents of a lithium-sulphur design claim it could deliver twice the energy density of lithium-ion designs while being much lighter. That makes them ideal for use cases where weight matters, so they've already been used in drones and satellites, and companies such as Lyten are working on versions for electric vehicles. In addition, sulphur is a cheap, easily accessible material.

Calcium-oxygen/air



This design has particular merit because calcium is widely available. A project based at a trio of universities in China has successfully created a rechargeable calcium-air battery that manages 700 recharge cycles using a gel electrolyte. Calcium-sulphur designs are also being considered.

Sodium-ion



These batteries replace the lithium with sodium, a smart move as salt is rather easy to source. Sodium-ion batteries show potential with fast charge times and safety, but further development is required. One concept design from Germany's Karlsruhe Institute of Technology uses seawater to carry a charge.

Glass electrolytes



One of the challenges of a lithium-ion battery is that the liquid electrolyte is flammable. Maria Helena Braga at the University of Porto has developed a solid-state electrolyte using glass; her work was backed by John Goodenough, the Nobel-winning creator of lithium-ion batteries, and that's good enough for us.

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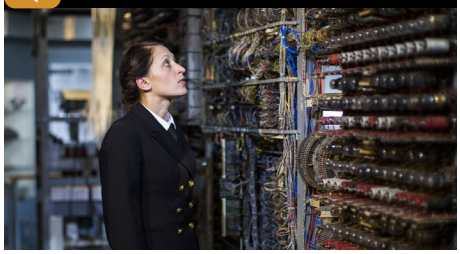
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Features



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Jon Honeyball wants to make you Wi-Fi Aware as a new standard comes into town

There's a potentially fun and funky new Wi-Fi protocol coming soon for your mobile devices. Called Wi-Fi Aware, it's a similar idea to the existing Wi-Fi Direct protocol – but while that technology has been largely ignored, this one has me genuinely excited.

Currently supported by both Android and Apple, Wi-Fi Aware is a peer-to-peer protocol that lets wireles devices find one another and communicate directly, without having to go through a base station or router. Any compatible device can broadcast a list of interfaces that it supports, and any other one can discover it and initiate a high-speed connection with very low latency.

Best of all, the technology allows multiple connections between multiple devices at the same time, so your phone can be connected to a number of different Wi-Fi Aware devices at once, without affecting its normal Wi-Fi operation.

This is a golden example of alliances doing something good. Wi-Fi Aware is a creation of the Wi-Fi Alliance, the cross-industry group that develops and manages Wi-Fi all standards. That's one reason it works across both major mobile platforms – the last thing anyone needs is a networking platform that's exclusive to iOS or Android, or any other OS come to that.

I can see a whole host of possibilities for this technology. The idea is for Wi-Fi Aware to work at the application layer, so apps can discover other instances of themselves. For example, the camera app on your phone could effortlessly locate other nearby camera devices and join them together for multi-cam recording – without their even needing to be connected to the main Wi-Fi network.

Outside of the home, Wi-Fi Aware could greatly simplify mundane annoyances like those awful portal logins we have to go through when trying to access the electronic menu at a fast food restaurant.

I particularly look forward to seeing how Wi-Fi Aware works in the world of transport. In the family car, the technology could let everyone connect to the entertainment system with a few taps. Looking a little further ahead, it's perfect for "robotaxi" riders too: hop into a self-driving car and your phone will automatically connect to the hi-fi, while also picking up the latest route updates, journey statistics and frequent-rider discounts.

Train travellers needn't be forgotten either. What a godsend it would be, when taking the train from Huntingdon to London, if I could pick up important bulletins without needing to rely on the appallingly bad in-train Wi-Fi service. I might at last be able to reliably discover how late my train was running, and to know when I was about to be tipped out onto a bus replacement service.

Assuming the range is good enough, Wi-Fi Aware could even be a useful technology for vehicle-to-vehicle connections. I enjoy riding my motorbike with friends, and today the experience of chatting over Bluetooth headsets falls into the "just about adequate" column. A proper Wi-Fi connection would give us enough bandwidth not just to improve the sound –it would allow me to inflict my music selection on everyone else. Joy!

I do recall that we were made some very similar promises by Bluetooth. That too is the product of an industry alliance, but the fact that the Bluetooth Special Interest Group (SIG) drew up its original goals way back in 1998 perhaps explains why even the latest versions of Bluetooth are held back by cripplingly slow data speeds.

And I hope Wi-Fi Aware does a better job than Bluetooth when it comes to peer-to-peer authentication. I don't want apps freely chattering away to their counterparts on other devices simply because we're in the same location. This was the idea behind Bluetooth beaconing, and too often the consequence was a hot mess of pinging pop-up notifications and adware spam.

But this begins to raise knotty questions about management. Even if I want a particular app to reach out to other instances of itself on local devices, I need to be sure the data being shared is acceptable to me. I must be the one to authorise what flows to the other devices. Given how badly most platforms manage this sort of thing, it will be fascinating to see what tools Wi-Fi Aware provides to help the user police connections –and that's before we think about the possibilities for malware and data theft.

> "I can see a whole host of possibilities for this technology – Wi-Fi Aware could greatly simplify mundane annoyances like those awful portal loginss"

I don't want to end on a low note. A lot of good work has gone into this specification, and it's great to see that it's already being built into the development platforms for both Android and iOS. The potential use cases for Wi-Fi Aware are almost limitless: I'm so excited, I'm even eager to see how supermarkets use it to bombard me with special offers as I wander past the fresh fruit.

Jon Honeyball is one of the founding editors of *PC Pro*. His favourite type of peer-to-peer networking involves a large gin and tonic. Email jon@jonhoneyball.com

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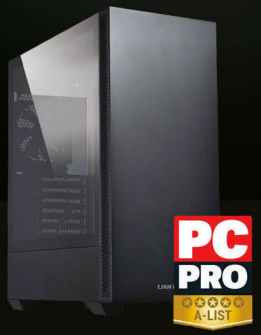
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