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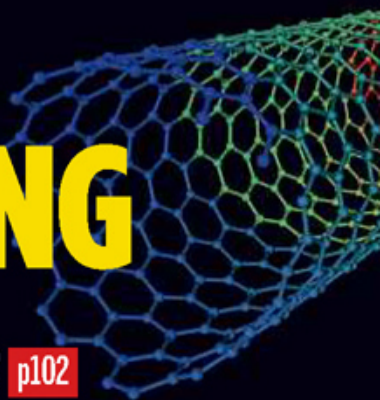
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As I sit and write this, it's just a few days before Christmas, and just over a week away until the end of another decade.

Whatever the 2020s bring us, one thing is for sure: technology will be at the heart of it. I'm not referring to the oft-repeated predictions for the future – I don't think we'll all be zipping around in flying cars (or even self-propelled Hyperloop transportation pods going at over 700mph – sorry, Elon Musk); nor am I thinking of all our homes being staffed by a team of robots, doing the cleaning and folding the washing.

Back in reality, it will be ever easier to access services and go about our daily lives thanks to technology advances. While currently that might be setting up a smart light to fool burglars or tapping your mobile phone to pay for your latest copy of *Shopper*, over the next decade we could see the widespread rollout of technology that harvests energy as we walk along pavements to light up your town; or drones delivering medical supplies to get life-saving essentials such as drugs or blood where they need to be quicker.

For those of you inspired by the start of a new decade, we've got a fascinating exploration of the possible future models of computing in this issue (p102). From neural networks and mechanical computers to slime mould and computers based on light rather than electricity, it's highly likely that some of these paradigms will be commonplace by 2030.

But for now, we look forward to delivering your regular monthly update of the best new technology products out there and which kit you should be opening your wallet for. Happy new year!

Madeline

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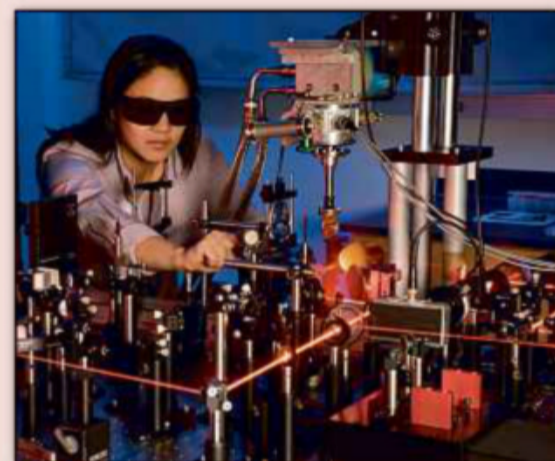
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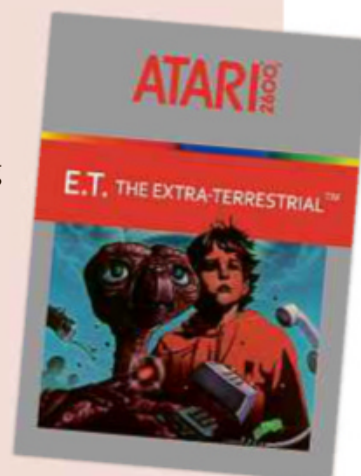
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Letters

Few things in life are as satisfying as breathing new life into an old machine with a couple of cheap and simple upgrades, as this month's star letter writer can attest



letters@computershopper.co.uk

Amazing Grace

@ Great article on Cobol from Kay Ewbank (*Shopper* 383). I read that Grace Marie Hopper helped develop the language in her belief that programming should not be limited to white coats. Another of her beliefs was that women are better programmers because they tend to finish the job. This, however, does



not seem to be reflected in the industry today – or is it?

Despite all the good that the likes of Grace (and Ada Lovelace) did, I don't see a lot of women like Kay involved; I hope I'm wrong!

James

● We heartily agree with those sentiments, James. As well as Kay, we've got a

female editor, and here at *Computer Shopper* we keep a close eye on the trends around women in technology.

Unfortunately, you're correct in your view that there aren't many women around in tech – current numbers are around 20% of the total workforce. However, there are lots of schemes up and running now to encourage more women to join the industry, so hopefully the number will start to rise at some point.

★ Star letter

@ Way back in 2010, I decided to replace my previous home-built PC with a new complete system. Based on a good *Shopper* review, I bought an Acer Aspire M7810 Desktop PC. With its 3.2GHz Intel i5-650 processor, two 640GB SATA drives, 4GB of RAM, 64-bit Windows 7 and an Nvidia GTS 250 graphics card, it was a much higher spec than I needed, but I wanted a future-proof system.

After a while I added an old (2003!) Dell 17in VGA monitor as a second display using a VGA-to-DVI adaptor and this worked well alongside the DVI-connected Acer original. I also took advantage of the cheap upgrade to Windows 10 when it was offered.

The system was initially excellent, but in recent years the machine became much noisier. More annoyingly, the screens momentarily blanked out when changing focus to videos or photos. Finally, and really irritatingly, the whole system began to freeze, especially but not only when I had several windows open. I tried all the usual suggestions to address reliability problems, but to no avail.

Looking through the event logs, I noticed there were numerous warnings relating to the Nvidia software stopping and resetting, which seemed to roughly correlate with the screen blackouts, although it was less easy to identify any clear pattern concerning the complete system freezes. I contacted Nvidia, whose only suggestion was to try a single display, which I did but to no avail.

Although I suspected that the problems were down to defective Nvidia hardware or software, I couldn't be sure and didn't have

any old graphics cards available to use as a temporary test replacement. Somewhat disconsolately, while browsing through *Shopper* 383 and contemplating replacing the entire system, I noticed the glowing Best Buy review for the Radeon RX570 graphics card at a very attractive price of £130. At that price – and since it didn't involve Nvidia software or hardware – I thought it was worth a punt.

Accordingly, I ordered a Radeon RX 570 RS XXX Edition 8GB GDDR5 PCI-Express Graphics Card from AWD-IT at the even better price of £125. When the card arrived I realised that, unlike the model reviewed in *Shopper*, it only had one DVI port, so I couldn't easily connect my second old VGA monitor. AWD-IT support suggested buying an adaptor cable, which I investigated briefly, but I almost immediately realised that buying a new but old-spec cable to attach an ancient monitor to a highly capable graphics card would be the height of madness. I decided



instead to buy a new wide screen and, turning again to *Shopper* recommendations for guidance, I bought an Iiyama ProLite XUB2792UHSU for £494 from Amazon.

Last week, I installed the new card and attached the new monitor using the Display Port connector supplied with the card. The transformation is outstanding. The display is crystal clear, the system is whisper-quiet, and the past blackouts and freezes but a bad memory.

I am left rather red-faced that I took so long to identify and rectify the problem. Having been involved with IT since 1982 when I was using Z80 machine code to program a Sinclair ZX81 and subsequently working as a programmer, systems analyst, systems manager and IT strategist, I really should have fixed my own stuttering home system years ago. The only thing I did right was to keep my *Shopper* subscription going after retirement.

Simon Battley

» Write in and win

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with a 500GB MX500 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This SSD is 45 times more energy-efficient than a typical hard drive, and has sequential read and write speeds up to 560/510MB/s and random reads/writes up to 95K/90K IOPS, making it the perfect replacement for the ageing hard drive in your sluggish PC.



STAR PRIZE
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Navi savvy

@ Regarding Paul Scott's sat nav problems (*Helpfile 382*), I was in a similar situation myself. I would suggest you take a look at Navmii. It's free, you can download all the maps easily before you leave home, and it's pleasingly miserly with any data use.

Another bonus is that it keeps on working even when you're in an area with no data connection. It was a lifesaver in France and Belgium earlier this year.

Kev Crocombe



Exclusion zone

@ Hurrah for my favourite computer mag! Thanks to Mel Croucher for laying it on the line that vulnerable people are being hurt by digital exclusion (*Shopper 384*), and government is only making it worse.

I just wish I had a solution. Free (basic) broadband might be the way to go.

Paul Martin

Scare stories

@ Recent correspondence on the 'Chemical effect' (*Letters, Shopper 383*) fills me with despair. We are inundated with scaremongering stories of shortages all the time – peak oil/coal, loss of water sources, food and so on – and they have all been shown to be exaggerations, and no prediction has ever come true.

The use of resources doesn't 'lose' anything; it hardly goes off-planet, does it? If anything, all we're doing is removing the need for repeated strip-mining and industrial processing to get at those resources in the first place; ie; we're concentrating those resources. For those materials that end up costing more due to availability issues, we will invent alternatives. We always have.

A future world will revolve around repurposing and recycling, as this will be the most cost-effective means of



↑ Should we be focused more on recycling rather than extracting materials from the ground?

progress, and we all know the world is built around finance.

Stop with the scaremongering, please.

DC Gill

● At present, there is a huge amount of unused technology and electronics kit sitting around not being recycled or reused, and so production requires sourcing more of the same materials. Even if we're in no danger of running out any time soon, one view is that promoting reuse could be just as efficient, or more so, than the current approach.

Hot or not?

@ I've been using a Hotmail email address for what seems to be 99 years, mainly via Opera Mail on my PC and Microsoft Outlook for Android.

Imagine my surprise when accessing my email via Microsoft Live.com. When I logged out, I was diverted to MSN.com and received a pop up saying, "We rely on advertising to provide you with free content". I have bought and paid rip-off prices for Microsoft products, including \$200 for an upgrade to Windows 7 Pro, which Microsoft decided wasn't genuine even though I have the disc.

The likelihood of me spending any money or subscribing to an ongoing Microsoft product is next to zero. Maybe they could ask Bill Gates for a sub to tide them over.

Gerald Bull



In the next issue



» **Get smart**
Make life easier with a truly connected home



» **Eye in the sky**
We explore the technology behind satellite imagery, and the many benefits it brings

» **Make a PVR**
Recording TV can still be more reliable than streaming, so we show you how to build your own



» **Listen up**
We test and compare the best headphones for your perfect audio experience



COMPUTER SHOPPER ISSUE 386 ON SALE IN NEWSAGENTS FROM 13th FEBRUARY

Secrets of the underworld

From surreptitiously recording victims' voices to chopping off their fingers to unlock their phones, **Mel Croucher's** drinking buddy has a wealth of ways to make crime pay



MEL CROUCHER

Tech pioneer and all-round good egg
letters@computershopper.co.uk

IT'S BACKGAMMON NIGHT at the Hole in the Wall, and someone is missing. Old Monty is not propping up the bar, and I assume the worst. But when I ask around it seems that Monty is neither dead nor in jail, but sunning his arse in Miami Beach, which is more or less the same thing in my opinion. Anyway, it's all thanks to Google's Pixel 4 smartphone, and it involves a long story which I will now explain for you in concise and simple terms. Here goes.

Old Monty used to work for IBM, until they fired him. Then he worked for BT, until they fired him. And finally he worked for the Bell-Fruit Gaming Corporation, who also fired him, but not before he slipped a creative back-door patch in the electromechanical logic circuit of their Noel Edmonds Deal Or No Deal one-armed bandit. This allowed him to trigger the jackpot by pressing Hold-Lo with his left hand, Hold-Hi with his right hand, Spin with his nose and the Collect knob with his own knob. But when the Noel

knew that nobody in their right mind would reveal their date of birth, pet's name, first school or holiday plans to a stranger playing backgammon in the Hole in the Wall, but Facebook users are not in their right minds, especially those with banking apps in their pocket.

BOOGIE WONDERLAND

Banking apps with voice-recognition security were child's play to Monty. He boasted that he could get Siri to play *Boogie Woogie Bugle Boy* by Bobby Blue just by farting in the bath. Anyway, when HSBC introduced 'my voice is my password' access to telephone banking accounts, its software relied on complex voice biometrics of sound, rhythm, pattern, dialect, style, pitch, frequency and spectral magnitude. But Old Monty didn't bother with any of that rubbish; he just got his victim to play the 'my voice is my password' game, and recorded them repeating the phrase several times before nicking their phone.

When Apple introduced fingerprint scanning on the iPhone 5, Old Monty toyed with the idea of exploiting his famous magic trick accident to cut off a victim's index finger. This would allow him to access the target phone while the sucker was otherwise engaged in A&E, but the landlord banned the use of his paper-trimming guillotine because he said it cluttered up the bar. So Monty had to fake living fingerprints instead.

He would spot some loudmouth drinking a revolting fruit beer from a small bottle, and nick the empty bottle along with their phone. This was a justifiable punishment in my opinion. Back in his bedsit, Monty used superglue vapour to reveal the fingerprint grease pattern, then he photographed and printed it on to a foil slide, squirted it with wood glue, waited for the glue to dry, cut it out and stuck it on his

own finger. Sometimes it worked, sometimes it didn't, but either way he enjoyed sniffing the glue.

THE EYES HAVE IT. UNLOCK!

Which brings me to facial recognition, and the latest chapter in Monty's criminal career. He complained that it was all but impossible to spoof a living three-dimensional face, and his tactic of swiping a phone and asking the victim to 'close your eyes, no peeking, and I'll buy you a pint' didn't work at all. If they peeked, they'd spot him holding up their own phone in front of their face and deck him, and if they kept their eyes shut the phone simply wouldn't recognise them. Monty tried scanning the obituary column before turning up at the chapel of rest pretending to be a grieving relative in need of a private moment with the deceased. But corneal opacity tends to glitch facial recognition, even when the face is perfectly still because of rigor mortis. Besides, friends and relatives had usually nicked the phone already.

Monty was stumped, unlike his putative finger amputees, and as more phones became secured by facial recognition, the poorer he became. That's of course until good old Google came to the rescue with the new Pixel 4. He welcomed the arrival of its Face Unlock system with unbridled joy, because unlike Apple's eyes-open 'alert' failsafe, the Pixel 4 vomits its secrets even when the camera scans a face with eyes closed. Monty ran adverts on social media along the lines of, "Looking for fun? Then come and join our backgammon club. Must like real ale, exotic lingerie and own a Google Pixel 4." Cheers Monty, wherever you are!

Anyway, there's no one here who wants to play backgammon with me tonight, so it's probably time to get off Old Monty's bar stool, go home and – um, hang on a minute, I can't seem to find my phone. 📱

As more phones became secured by facial recognition, the poorer Monty became

Edmonds Deal Or No Deal model fell out of favour, Monty fell on hard times and sank to spoofing access codes on stolen mobiles in order to blag Deliveroo meals, Uber rides and the occasional Secret Escapes beach holiday.

Those alphanumeric security codes were tiresome for Monty to break, and it would often take him hours after meeting a new victim at the bar. His opening gambit was to wait until they consulted their phone and say something like, "I can never remember my PIN, so I use 1234. How about you?" Then he would challenge them to a game, let them win and become their Facebook friend, because he

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The bionic woman

It's now possible to create artificial limbs, eyes, ears and hearts thanks to 3D printing. **Kay Ewbank** looks forward to the day when technology can replace her creaking parts



KAY EWBank

Software guru and Shopper legend
letters@computershopper.co.uk

BACK IN THE 1970s, there was a popular TV series called *The Six Million Dollar Man*. It had a great opening sequence in which, following the test pilot hero's plane crash, the government scientists decide that "we have the technology to rebuild this man", which they proceeded to do using cybernetic parts that give him superhuman strength and speed. In each episode he'd perform amazing feats and save the day. It was great, and I wanted some bionic bits so I could be heroic, too.

I've been waiting for medical science to catch up ever since, and it's getting a bit urgent. For a start, right now I could do with some bionic leg muscles to make it a bit easier to stride up hills that have mysteriously got steeper over Christmas, and the bionic eyes would be good, too, to avoid me having to pay a fortune for glasses.

While my chances of getting the *Six Million Dollar Man*'s strength and speed remain unlikely, it's amazing what is being developed, especially using

website where people can interact with the manufacturers to order a 3D-printed hand. The patient enters the measurements of their arm, says what colour they want their hand to be, and 10 hours later the hand will be printed with the sensors built into it ready for use with moving fingers and wrist, the ability to grasp things, and clever controls for tasks such as holding a cup for a length of time.

LIFE THROUGH A LENS

The arm is by no means unique. There are a number of research projects into 3D printing of eyes (or at least parts of eyes). Researchers at Newcastle University have printed an artificial cornea that could eventually be used for cornea replacement. To do this, they designed a curved, jelly-like surface, then printed the lens as a film on top of it. Anyone who's ever cursed when the nozzles get blocked on the inkjet printer and felt they had it tough, spare a thought for the researchers who described as 'tricky' finding the right recipe for an ink that's thin enough to squirt through a 3D printer's nozzle, but will set into the right jelly-like consistency.

Other researchers at the University of Minnesota have 3D-printed light receptors on a curved surface. This process uses silver particles to put a base layer on to the curve, then printed photodiodes that convert light to electricity using semiconducting polymer materials, all in about an hour, and can then recognise light and shade, so holding out the prospect of providing sight for blind people. The research is still a long way from creating a full bionic eye, but this is the same team that has developed bionic skin that gives robots the ability to feel, and 3D-printed a bionic ear that covers a coil antenna in a living outer layer created from silver nanoparticles and cartilage-forming cells.

Meanwhile, researchers from Rice University, Texas, showed off a 3D-printed 'lung-mimicking air sac, that can suck air in and out earlier this year, and the same team also successfully transplanted 3D printed tissues containing liver cells into mice in a first step to repairing injured livers.

HEART OF THE MATTER

Another group, this time at Tel Aviv University in Israel, has printed a 'vascularised engineered heart'. This is the first time anyone has successfully engineered and printed an entire heart complete with cells, blood vessels, ventricles and chambers. The heart was made from human cells and 'patient-specific biological materials'. The materials serve as bio-inks for printing the heart. The version created was only the size of a rabbit heart, but the researchers say there's no reason it couldn't be made larger.

While transplants based on a 3D-printed heart are quite a way off, a related technique that creates patches of 'cardiac tissue' made up from the patient's own cardiac combined with 3D biomaterials is closer. The 3D biomaterials act as temporary scaffolds, mechanically supporting the cells while they are matured in vitro. The patch would then be transplanted into the patient's heart. Over time, the biomaterials gradually degrade, leaving a functional living patch that regenerates the heart.

While many of these projects are still at the research phase, 3D-printed knees and hips are already in use, and the new custom arm-printing website is up and running.

The Six Million Dollar Man may have been science fiction, but 3D printers are turning it into a reality. One day, I may get those bionic muscles after all. 🇬🇧

Until now, I'd written off 3D printers as being very slow toys

3D printers. I have to confess that until now, I'd written off 3D printers as being very slow toys that take forever to produce something you don't particularly want (plastic survival whistle, anyone?) and that you can buy online and have delivered in about the same time it takes to print. However, it turns out I was wrong.

Just recently, scientists from the University of Warwick printed a bionic arm in just 10 hours using a 3D printer. That's impressive enough, but what's even better is that the team, along with their industrial partners, have developed a



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Roland Moore-Colyer

RAVES



WHEN APPLE LAUNCHED the iPad Pro a few years ago, it championed the idea that it was a tablet for getting stuff done without the need for a laptop, even its own MacBook. The folks at Cupertino cooked up an advert that had a teenager using an iPad Pro ask “What’s a computer?”, suggesting that the iPad Pro was so capable that you wouldn’t need a PC.

But while the latest iPad Pro models are very impressive, they simply don’t have the functionality of a laptop or a desktop. And I’m saying this while writing on an iPad Mini.

Apple seems to have realised this, releasing two major computers in 2019. The first, the MacBook Pro 16in (see page 26), is a 16in laptop with a lovely display, fantastic speakers and a scissor keyboard mechanism that replaces the oft-maligned Butterfly

mechanism in the older MacBook Pro models. Apple basically made a laptop people have been asking for, seemingly listening to feedback rather than forging its own path.

Then the firm released the Mac Pro, a machine that looks like an oversized cheese grater, but is in fact a massively powerful PC designed for professionals. Its top spec costs over £50,000.

The Mac Pro features a rather slick modular design and some clever component packaging, showing that Apple can not just build good PCs but also add innovation. This helps set a standard for others to follow, thus bringing even more innovation to the PC world.

While Apple looked like it was turning its back on PCs, last year showed the firm is still a computer maker, and a pretty good one at that. That’s a good thing, as Apple seems to be playing catch-up in the smartphone arena, releasing iterative iPhone models rather than something properly exciting.

So seeing Apple use its famed ‘Think different’ creativity in the computer world is very much welcome. If the firm could just make a new MacBook Pro 13 with slim bezels and the new scissor keyboard, I’d be really happy.

David Ludlow

RANTS



REMEMBER THE DAYS when you’d buy something and that was it, it was yours until it broke? Today, it’s all about subscription charges. We used to have subscriptions for general services, such as mobile phones and premium TV, but companies have realised that getting solid amounts of monthly money is better than a one-off payment, and are increasingly moving to this model.

Fancy the latest version of Lightroom? You’re out of luck if you want to pay for it and use it for a few years, as you now have to subscribe to the service. Likewise, if you want Office 365, it’s time to stump up for the monthly fee, as there’s no option to buy it outright.

Companies say this move is good for consumers as you get the latest version automatically; customers are quite happy running a version for a few years, getting our money’s worth out of it.

Then there are home security cameras. Rather than saving footage locally to a NAS, which you can hide out of the way, cameras now save recordings to the cloud. The advantage is that there’s no local

storage to steal, so criminals can’t steal the evidence; the downside is that you have to pay monthly and, as soon as you stop, your recordings go forever.

Then we’ve got the likes of entertainment services. Paying just under a tenner doesn’t seem like much for Spotify, given how many tracks you get, but would you buy £10 of music a month normally? And as soon as you stop paying for Spotify, ‘your’ music is no longer yours to access. That’s not really a true subscription, is it? Imagine if you decided to cancel your *Computer Shopper* subscription (not that you’d want to) and I popped round to collect your old magazines and told you that you couldn’t have them any more.

Yet more companies are starting to pile in. If you like TV, then get ready for things to get really expensive. You’re going to need to subscribe to Now TV, Netflix, Amazon Prime Video, Apple TV and Disney+ to watch everything. And then there’s the insulting BritBox, which takes all the content you’ve already paid for using your licence fee, and then charges you monthly to watch it again.

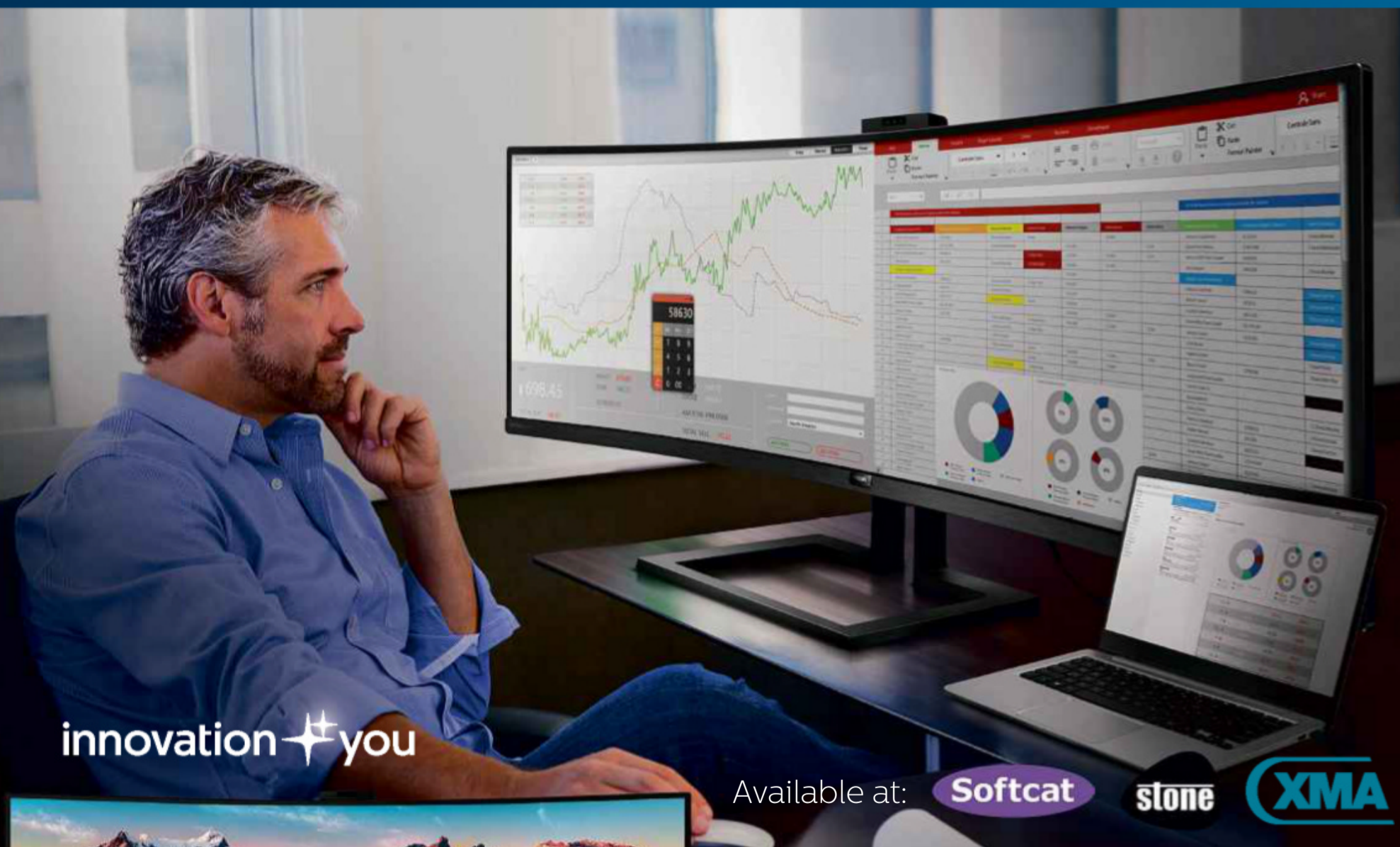
With all subscription services, the idea is that you can cancel and resume on a whim, so you need only pay for what you’re using, but who does that? The net result is that subscriptions may look cheap to start with, but they soon add up and become significant monthly outgoings, leaving you with nothing when you do cancel. Something has to change, and paid-for options need to come back. ☒


PHILIPS

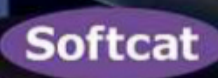
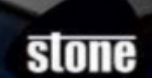

Monitors


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
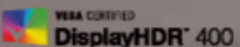




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NEED TO KNOW

The biggest stories from the tech world, and what they mean for you

Microsoft unveils new PC-like Xbox Series X console

SAY WHAT?

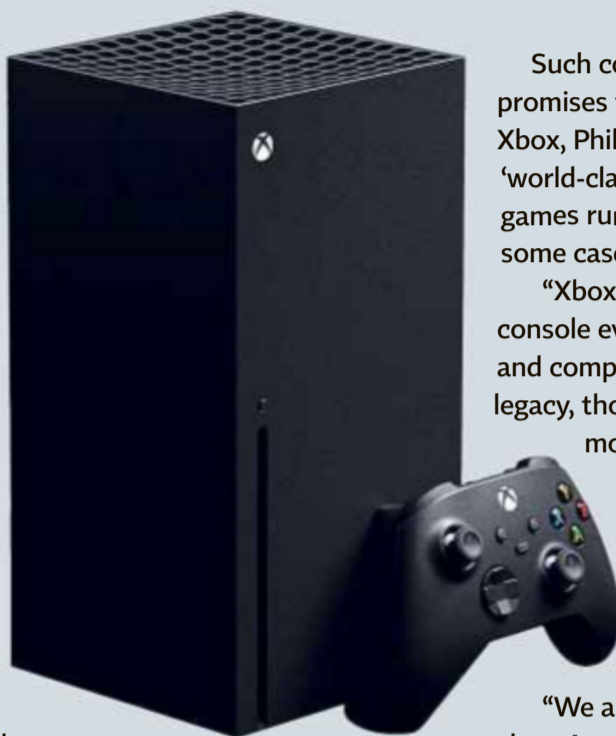
WHEN CHRISTMAS 2020 comes around, there's a good chance that a next-generation Xbox might be on many people's list. That's because the Xbox Series X will have been released by then, ushering in a new console generation for Microsoft's gaming division.

Formerly known as Project Scarlett, Microsoft revealed a small handful of details on its next-generation Xbox at E3 2019 in Los Angeles back in June. But before 2019 came to a close, the firm took the covers off not only the console's name, but also its design.

For those expecting something akin to a slick bit of industrial design, prepare to be disappointed, as the Xbox Series X resembles something of a black rectangular box or a rather dull smart speaker. It's hardly pushing the boundaries of tech aesthetics, but then neither did the Xbox One or Xbox One X.

But there's logic behind this block-like design. To keep the console cool but also quiet, it uses a single large fan that effectively vents the heat out of a large grille on the top or the side of the console, depending on how it's orientated.

If such a design sounds familiar, that's because it is, as we've seen something similar with the trendy dustbin-like previous-generation Mac Pro computer, which expelled its heat out of a central funnel-cum-vent.



Such cooling will be needed, as the Xbox Series X promises to be a powerful console. Microsoft's head of Xbox, Phil Spencer, claimed that the console will deliver 'world-class visuals', and will target 4K resolution in games running at 60 frames per second (fps), and in some cases could hit 120fps and even an 8K resolution.

"Xbox Series X will be our fastest, most powerful console ever, and set a new bar for performance, speed and compatibility, allowing you to bring your gaming legacy, thousands of games from three generations and more forward with you," Spencer said.

We already know that the Xbox Series X will use an AMD-based chipset with a Zen 2 Ryzen processor and RDNA architecture-based graphics accelerator. However, Spencer said it will also come with some other next-generation features.

"We are minimising latency by leveraging technology such as Auto Low Latency Mode, and giving developers new functionality like Dynamic Latency Input to make Xbox Series X the most responsive console ever," he explained.

"Xbox Series X is also designed for a future in the cloud, with unique capabilities built into the hardware and software to make it as easy as possible to bring great games to both console and elsewhere."

Intel quits mobile modem market to focus on 5G

SAY WHAT?

INTEL NOT ONLY makes processors, it also makes components such as mobile modem semiconductors for the likes of Apple to use in its smartphones.

But in December, Intel quit making mobile modem chips, selling that side of its business to Apple for \$1bn. The reasoning for doing so was placed firmly at the door of Qualcomm, which is a major provider of modem chips for mobile gadgets alongside its Snapdragon chipsets.

"Intel suffered the brunt of Qualcomm's anti-competitive behaviour, was denied opportunities in the modem market, was prevented from making sales to customers, and was forced to sell at prices artificially skewed by Qualcomm," according to Intel's vice-president and general counsel Steven Rogers.

"The victims were Qualcomm's own customers (original equipment manufacturers, or OEMs), the long list of competitors it forced out of the modem chip market, including Intel, and ultimately consumers."

Rogers said Intel "fought for nearly a decade to build a profitable modem chip business" with its modem chips finding their way into "industry-leading" iPhones, the latest being the iPhone 11.

"But when all was said and done, Intel could not overcome the artificial and insurmountable barriers to fair competition created by Qualcomm's scheme, and was forced to exit the market," he added.



This may sound like sour grapes, but it's not all doom and gloom: Intel has now turned its focus to making 5G modem chips. Or to be more correct, it will work on the design, certification and integration of the chips, while its partner, fellow chip-maker MediaTek, will make the chips.

Gregory Bryant, Intel executive vice-president and general manager of the company's client computing group, was unsurprisingly pretty upbeat about 5G and the partnership's potential.

"5G is poised to unleash a new level of computing and connectivity that will transform the way we interact with the world," Bryant said.

"This partnership with MediaTek brings together industry leaders with deep engineering, system integration and connectivity expertise to deliver 5G experiences on the next generation of the world's best PCs."

Those 5G modem chips are slated to pop up in 2020 in laptops from the likes of Dell and HP, which should allow such machines to tap into 5G networks as their rollout increases across the UK, hopefully ushering in a new decade of fast mobile connectivity.

This is promising news, as laptops that come equipped with 5G modems could spell the end of trying to connect to Wi-Fi hotspots with patchy connectivity or a lack of proper security, making life that bit easier when trying to get stuff done on the move.

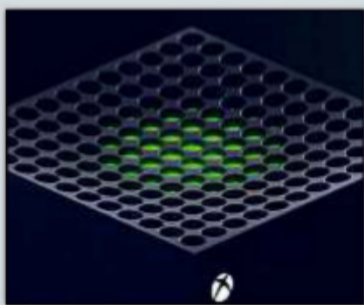
SO WHAT?

YOU MAY THINK the Xbox Series X looks a bit like a small form-factor PC – and you'd be right.

Given it's using a custom take on CPU and graphics card architecture found in PC components, the Xbox Series X has more in common with a desktop than previous consoles. Sony's PlayStation 5 will also be using a custom AMD chipset, similar to the Xbox Series X's.

This isn't hugely surprising as both the Xbox One and PlayStation 4 also used AMD chips. But the consoles shouldn't be dismissed as poor cousins to PCs.

Both consoles are expected to have the ability to support ray-tracing as well as high resolutions at smooth frame rates. There are powerful gaming PCs that can run games fluidly at 1440p and 4K resolutions, but they're far from cheap. And running a maxed-out game at 4K with ray-tracing requires a monstrously powerful and expensive Nvidia GeForce RTX 2080 Ti graphics card.



As such, the promise of ray-tracing and 4K at 60fps in an affordable compact box is likely to be tantalising for gamers.

For PC fans, meanwhile, the Xbox Series X and PlayStation 5 should also be of interest. A new console generation tends to benefit the PC world as the multiplatform nature of many games means people with powerful PCs often need to wait until new console hardware comes along to usher in games that can tap into the power of their machines.

The PlayStation 4 made smooth gaming at Full HD the minimum standard, for example, meaning powerful PCs could take those games and run them at higher frame rates.

Furthermore, the tricks developers learn to get the most out of the consoles' AMD chips will likely carry over to PC games. For example, ray-tracing techniques worked to run on the Xbox Series X could be engineered to run on PC hardware even if it isn't natively supported.

SO WHAT?

AS COMPUTER SHOPPER readers, you're probably more interested in Intel's work on its Core line of desktop and mobile processors than its modem chip woes and ambitions. But the chip maker's push into 5G modems is more noteworthy than you might think.

A suite of laptops have had the option of LTE mobile broadband connectivity for a few years, but there are no 5G-ready laptops yet. That's not surprising, as the rollout of 5G is in its early stages.

But the spread of 5G in the UK should accelerate in 2020, meaning access to superfast mobile broadband becomes more widely available.

Some of the most high-profile laptops with LTE connectivity are machines from Microsoft's Always Connected PC programme. These tend to use Qualcomm chips and modems, which can tap into the connectivity tech Qualcomm is

known for. But the performance delivered by a Qualcomm system-on-a-chip and its ability to run Windows 10 apps has been found wanting. Intel-based laptops don't have this problem, thanks to their underlying x86 architecture.

So the latest Intel CPUs, such as the 10th-generation Ice Lake mobile chips with Iris Pro graphics, partnered with an Intel and MediaTek 5G modem, could yield laptops that don't compromise on performance or connectivity.

As Intel has its Project Athena programme, which aims to set a new standard for ultraportable laptops

(see 'The Lowdown', page 17), we can expect to see a whole slew of laptops that neatly balance performance and connectivity this year.

That means Intel will keep fighting AMD in the CPU market, as well as looking to hit back at Qualcomm in the laptop connectivity arena.

“ 5G is poised to unleash a new level of computing and connectivity that will transform the way we interact with the world”

Gregory Bryant, Intel VP

BOOTING UP

New lease of Half-Life

In an unexpected announcement, Valve revealed the return of Half-Life, only it's not a sequel to Half-Life 2, but rather a VR game based on the character of Alyx Vance, hence its title of Half-Life: Alyx



US-Away

Huawei managed to make the Mate 30 Pro flagship phone without using a single component made in the US, effectively showing how the US trade ban on the Chinese firm won't stop its smartphone efforts

More core

AMD has confirmed that it will release a 64-core, 128-thread third-generation Threadripper 3990X processor in 2020, aimed at professional high-end content creators rather than PC enthusiasts

Turning a Page

Google founders Sergei Brin and Larry Page have stepped back from their position at the top of Google's parent company Alphabet, leaving Google CEO Sundar Pichai to take over

Jon gone

Apple design guru Jony Ive has had his likeness and name removed from the Apple executive leadership page after



departure from the company

Baffling Boris

Prime Minister Boris Johnson has been flirting with the idea of banning Huawei tech from UK 5G telecoms infrastructure, but he was seen using a Huawei Mate P20 Pro phone in public

Axed accounts

Twitter has announced a mass cull of accounts that are no longer being used, potentially freeing up Twitter handles for folks who failed to get the one they wanted in the first place

BA grounded

British Airways suffered another IT meltdown, with thousands of passengers having their travel plans disrupted

CRASHING

FROM THE LAB

Robot dogs used by Massachusetts police to sniff out bombs

FOUR-LEGGED ROBOTS from Boston Dynamics are being used by the Massachusetts State Police as a form of mobile observation device to sniff out bombs and enter dangerous environments.

Previously known as the SpotMini, Boston Dynamics first showed off the dog-like robot a few years ago, with a smaller take on a previous quadruped robot with an articulated arm for grabbing and manipulating objects; the robot could open a door and get through it, for example.

The original Spot was more of a demo, while the SpotMini was compact and refined enough to be pushed out to organisations keen to put robots to use. This was a move by Boston Dynamics to see how the SpotMini, which has since been renamed to just Spot, could be used in commercial situations.



It now appears that one of those situations is for mobile law enforcement. According to an agreement obtained by the American Civil Union of Massachusetts, Boston Dynamics has leased the Spot robots to police, but did not explain what the robots were being used for.

Boston radio news service WBUR was told by a police spokesman that the Spot robots were being used to support state troopers when dealing with suspicious packages, investigating areas where armed suspects might be hiding out, and carrying out remote inspections in dangerous environments.

“Robot technology is a valuable tool for law enforcement because of its ability to provide situational awareness of potentially dangerous environments,” a police spokesman said.

Microsoft patent hints at vapour chamber cooling in its future gadgets

MICROSOFT HAS PATENTED a set of cooling systems that work to conduct heat through a flexible vapour chamber across the hinge used in ‘foldable’ devices such as dual-screen smartphones and laptops.

The company entered the so-called foldables market in October when it unveiled the dual-screen Surface Neo and Surface Duo. It’s now seeking to improve the performance and build of future iterations through next-gen cooling technology.

Microsoft is planning to transfer the heat between regions of dual-screened devices through a vapour chamber, which runs across the full span, feeding into a flexible hinge that can withstand repeated bending cycles, according to the filing.

“One disclosed example provides an electronic device comprising a first portion and a second portion connected by a hinge region, and a

vapour chamber extending from the first portion to the second portion across the hinge region,” the patent notes.

In this example, the vapour chamber is coated with two layers of titanium, joined together to form the space through which heat can transfer. There will also be a working fluid within this space, as well as a third layer comprising features that are designed to conduct the working fluid through capillary action.

There are several other slight modifications of this technology that can be worked into devices of the future, with Microsoft now keen to enhance its portfolio with the recent additions of the Neo and Duo devices. There are also patented variations that can be used in devices such as the HoloLens, with the firm’s quirky augmented reality headset almost certain to get a future revamp given the embryonic nature of the technology.

Porsche design for a galaxy far, far away

IF YOU’VE EVER wondered what it would look like if a car maker of today tried to design a spaceship for the *Star Wars* universe, then wonder no more, as Porsche has teamed up with LucasFilm to create such a craft.

Dubbed the Tri-Wing S-91x Pegasus Starfighter, the fighter-grade spacecraft has the rugged and practical aesthetic synonymous with the craft and technology found in *Star Wars*. This is in stark contrast to Porsche’s normal concept



designs that are more akin to machines one would expect to find in an idealised future, with clean, smooth lines.

The Tri-Wing S-91x Pegasus Starfighter has a few nods to Porsche cars, with its lights resembling those of the car maker’s Taycan electric car, and light strips at the rear of the ship similar to the brake light strip in the new 992 911 sports car.

The Tri-Wing S-91x Pegasus Starfighter made its first appearance at the premiere of *Star Wars: The Rise of Skywalker* in December.

SOUND BYTES

“Apple Boy Steve once looked into space... he saw Pablo Escobar with a phone beyond anybody’s imagination”

An advert for the Escobar Fold 1 phone, developed by Pablo Escobar’s brother

“I hope you also know that I am a perfect candidate to disrupt this system, and I fully intend to do so”

Cyber security luminary John McAfee wants to be the next US president

“You can invite people who want to be creative, who don’t want to be toxic, and you create an environment in which people can express themselves and build up a relationship”

Father Robert Ballecer, tech blogger turned God fan, has a Minecraft server set up to be more welcoming than usual

“With the debut of AI in Go games, I’ve realised that I’m not at the top even if I become the number one through frantic efforts”

Master Go player Lee Se-dol admits defeat in the face of DeepMind’s AlphaGo AI prowess

THE LOWDOWN

Project Athena

Intel's new standard for laptops that aims to make life easier for consumers

PROJECT WHAT?

Project Athena. It's basically a standard Intel has cooked up for laptops, which will be given a badge certifying that they reach a certain standard laid out by the chip maker.

Take the term 'ultrabook', which was and still is used to describe ultraportable laptops with an Intel mobile processor. That was coined by Intel as a way to describe a certain type of laptop without digging too much into the nitty gritty details of the onboard silicon and other specs.

That's what Project Athena is attempting to do for the very latest and upcoming laptops; it's effectively creating an 'ultrabook 2.0'.

WHY BOTHER?

These days, buying a laptop can be quite a complicated task. Where once there were simple clamshell laptops, now there are thin and light machines, chunkier mobile workstations, 2-in-1 laptops-cum-tablets, hybrid devices such as the Surface Pro 7 and so on.

Choosing the right laptop for the right task can be a rather arduous process of poring over specs and cross-referencing different components against other electronic innards. Take the Dell XPS 13 range as an example; there's a suite of different configurations ranging from screen and memory options to processor models and storage.

And many more laptop makers do the same as Dell, meaning the market is awash with loads of laptops to choose from, with all manner of different spec configurations.

Project Athena aims to simplify that process by certifying that laptops meet a particular standard for balancing performance and portability.

SO WE WON'T NEED TO WORRY ABOUT SPECS ANY MORE?

Not quite. There'll always be the question of what you plan to use your laptop for, which will dictate what you should get. A powerful gaming laptop, for example, isn't likely to be the slimmest and lightest machine, while a super-slim ultraportable isn't going to do a great job when it comes to tearing through graphically intensive 4K video editing.

But it should make things easier when it comes to picking an ultraportable laptop with the Project Athena certification, which will pop up in the form of an 'Engineered for Mobile Performance' badge from Intel on approved laptops. The badge will mean the laptop in question has been put through Intel testing to ensure it delivers a certain standard of responsiveness, performance, connectivity, battery life, form factor and built-in artificial intelligence tech.

WHAT SPECS MEET THE STANDARD?

Good question. At its core, a Project Athena machine will need to have the latest 10th-generation Core i5 or i7 processors to guarantee a level



of performance set by Intel. The chip will need to be partnered with at least 8GB of RAM and a 256GB NVMe SSD with Intel Optane memory being an option.

With this specification, the laptop will need to deliver responsive performance on battery power, not just plugged in. Speaking of which, battery life will need to clock in at a minimum of 16 hours of local video playback and nine hours of 'real-world use', while also charging up to four hours of capacity in 30 minutes or less.

Project Athena laptops will also need to boot up fast, with Intel expecting a 'wake from sleep' time of one second or less, and for certified machines to have biometric login options.

Connectivity is also very important to the Project Athena standard, with laptops needing to have Thunderbolt 3, Wi-Fi 6 and the option for Gigabit LTE cellular connectivity. Artificial intelligence features are also part of the standard, with machines expected to support things including far-field voice services; think Amazon Alexa support and voice-command recognition.

Finally, the form factor needs to be either a clamshell or 2-in-1 design with slim display bezels, a 1080p or better touchscreen display, backlit keyboard, precision trackpad and pen/stylus support.

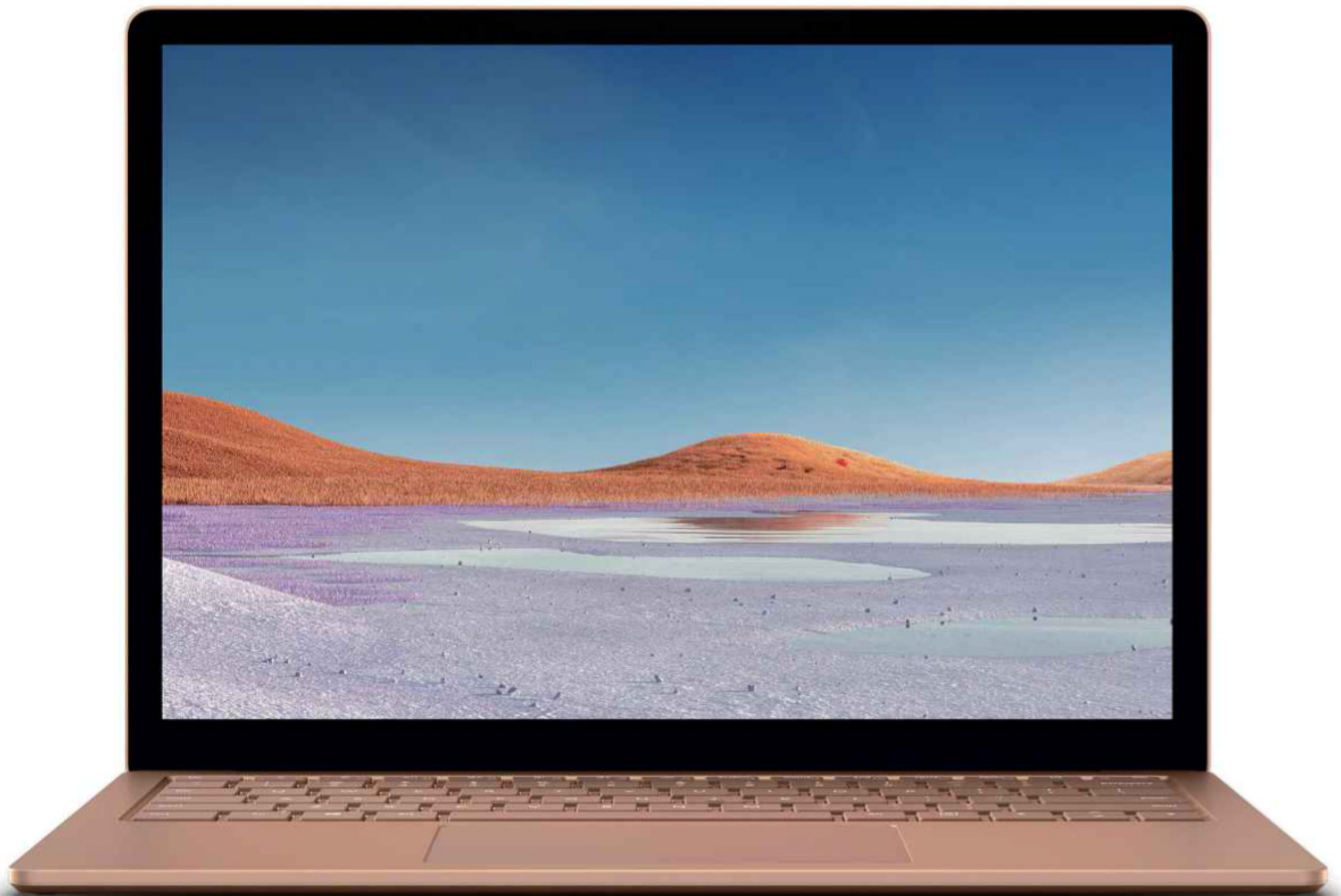
IT SEEMS PRETTY COMPREHENSIVE...

Yes, Intel isn't messing around here. We're quite glad to see the company trying to set these standards, as missing a few details on a spec sheet when it comes to getting a laptop can mean you get a decent core spec but then have a machine with dated connectivity or poor power management.

Project Athena should go some way to making getting a laptop a doddle. And with Dell's XPS 13 2-in-1 and the Lenovo Yoga C940 both meeting the standard, there are Project Athena-certified machines available right now, with more expected to pop up throughout 2020. 🇬🇧

REVIEWS

YOUR TRUSTED GUIDE TO WHAT'S NEW



WINDOWS 10 ULTRAPORTABLE

MICROSOFT

Surface Laptop 3 13.5in

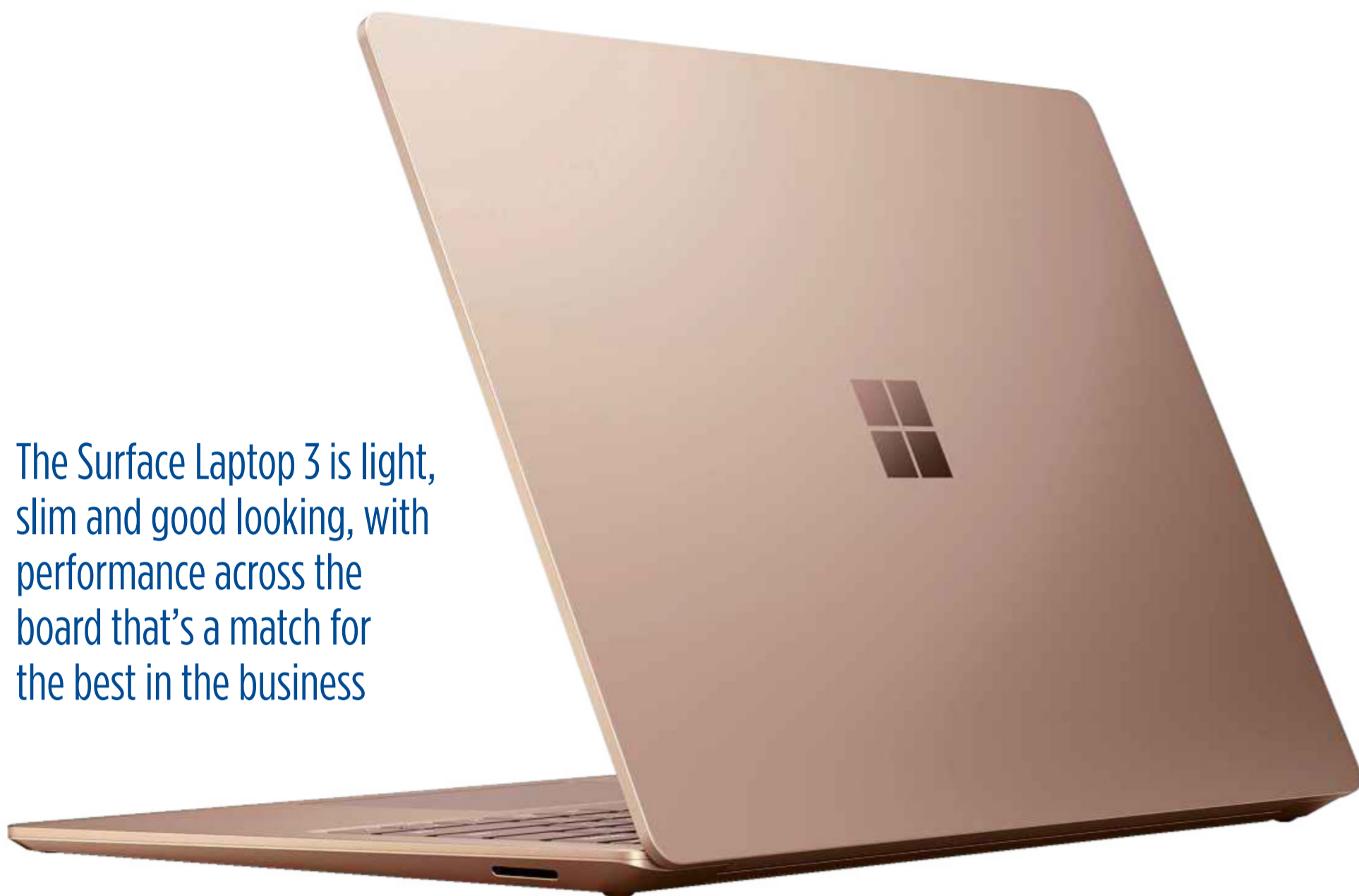


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VERDICT

A fast, lightweight, good-looking laptop that rivals the MacBook Air at a competitive price

The Surface Laptop 3 is light, slim and good looking, with performance across the board that's a match for the best in the business



MICROSOFT'S HARDWARE DIVISION has done some fine work over the past few years, and the Surface Laptop is arguably the best thing it has produced so far. It has its flaws, but when the MacBook Air (*Shopper 373*) was left to stagnate for years without an update, the Surface Laptop (*Shopper 356*) and Surface Laptop 2 (*Shopper 372*) valiantly filled the hole for a reasonable price.

Now that Apple has reintroduced its popular ultraportable, however, does the latest iteration of the Surface Laptop still hold the same appeal?

TEN TIMES

The Surface Laptop 3 looks a lot like the previous generation, especially in the 13.5in model's case (for the first time, there's also a larger 15in model, too). Both versions have some notable new features. For one, to go along with the introduction of Intel's latest 10th-gen CPUs in the 13.5in model, Microsoft has at long last added a USB Type-C connector, replacing the single-purpose Mini DisplayPort output.

It also now has an SSD that's upgradable (albeit only by engineers) rather than being soldered directly to the motherboard, and a new dual far-field microphone array designed for clearer videoconferencing.

Add those changes to what was already a rather excellent laptop, with a tall 3:2 display and a quality keyboard and touchpad, and you have yourself a very viable rival to the MacBook Air. On that note, it gets off to a good start on price: while the MacBook Air starts at £1,099, the entry-level Surface Laptop 3 is just £999.

That money gets you a 1.2GHz Intel Core i5-1035G7 processor, backed by 8GB of RAM and 128GB of storage, and as you move up through the specifications, the savings compared to Apple only increase. We specifically tested the Core i7-1065G7 model with 16GB of RAM and 256GB of storage, a configuration that costs £1,549. The equivalent MacBook Air, meanwhile, is £400 more expensive.

There's a good spread of configurations available, too, so you're bound to be able to find something that suits your needs.

SHELL GAME

The size and shape of the Surface Laptop 3 are, to the millimetre, identical to those of the Surface Laptop 2. That's fine, because it's a thoroughly likeable design.

Just like the MacBook Air, it's wedge shaped, tapering from a fairly thick 14.5mm at the rear to a thinner 10mm at the front edge. It looks angular, with less gently rounded corners and edges that are cut away on the left and right edges, and it's also a little heavier, wider and deeper than the Air. At 1.3kg, however, this is not a laptop you're going to worry about carrying around with you.

The Surface Laptop 3 also comes in five different colours and two different finishes. We looked at the new Sandstone colour, but you can also order most models in Platinum, Cobalt Blue or Black. Note that the

Black and Sandstone models don't have the hydrophobic Alcantara fabric on the wristrest, for those who prefer a wipe-clean finish.

Then, there's that upgradable SSD. Be warned, however: Microsoft says this isn't a user-upgradable machine, and that only qualified professionals should be prising off the rubber feet and unscrewing the bottom plate to get at the storage slot. That's a shame when the new Surface Pro X 2-in-1 has a small hatch that can be flipped off for super-simple access to the SSD.

It's also a shame that Microsoft didn't add more than a single Type-C port. Still, it's good that there's still a full-sized USB Type-A port next to it, so you can easily connect older peripherals without having to mess around with adaptors and dongles.

TOUCH OF BRILLIANCE

As with previous Surface Laptops, the keyboard is excellent. There's nothing fancy about it – no low-profile butterfly switch keys here – just a well-spaced, Scrabble-tile layout with keys that have plenty of travel and soft yet firm feedback. It's a joy to type on: you'll be up to speed in no time, and three levels of backlighting ensure you'll be able to type in darkened meeting rooms and lecture theatres.

Likewise, the touchpad is superb. It's a diving board-style design that's hinged at the top and doesn't have separate buttons, but it's reliable and works perfectly.

Clicking doesn't feel hollow, squishy or heavy as it does on so many rival machines;





it's just right, and one of the best touchpads we've used on any laptop.

The display, too, is as sharp as you need at this size, with a resolution of 2,256x1,504 and a pixel density of 201ppi. This gives it a square-ish 3:2 aspect ratio, which feels a lot better suited to office work than the 16:9 screens many competing laptops use, such as the Dell XPS 13 (*Shopper 376*).

It looks great, too. Its maximum brightness of 365cd/m² isn't exceptional, but it's fine for most conditions in which you'll probably be using the laptop, and the display also reaches a superb 97.5% sRGB coverage.

SPACE RACE

It's just a pity that the screen doesn't go beyond sRGB, as the MacBook Air has now moved to the larger P3 colour space. If you switch to Enhanced mode in the laptop's display settings you get slightly boosted contrast, but that's still a long way off a proper wide-gamut display.

The speakers, meanwhile, are relatively impressive for a laptop. They go surprisingly loud and rarely distort nastily. They don't have much in the way of body, so we wouldn't want to listen to anything but the very simplest acoustic tracks on them, but for podcasts and talk radio they're absolutely fine.

For performance, we previously tested the Core i5 version of the Surface Laptop 2, so can't make direct comparisons between the previous generation and the new Core

i7-powered laptop we received. However, our benchmarks show that it's quicker than the 2019 Dell XPS 13 we tried out, which used an 8th-gen Core i7. That scored 95 overall in our 4K benchmarks, while the Surface Laptop 3 scored 104.

Both the i5 and i7 models also have vastly improved graphics over the previous generation. The GFXBench Car Chase onscreen benchmark showed a clear advantage for the Surface Laptop 3, with its Iris Plus GPU producing 41fps, over both the MacBook Air and the Dell XPS 13, which scored 10fps and 31fps respectively.

THE JOY OF 6

It's also good to see that you're covered when it comes to Wi-Fi future-proofing with Intel's Wi-Fi 6 AX201 wireless card providing wireless connectivity. Notably, Wi-Fi 6 is enabled by the 10th-gen Intel chip, and the 15in Surface Laptop 3 uses completely different AMD Ryzen CPUs that lack Wi-Fi 6 support. You're therefore getting potentially much faster speeds on the smaller, cheaper variant.

Finally, battery life is pretty decent, too. The Surface Laptop 3 lasted 8h 10m in our continuous video rundown test, with the laptop in flight mode and the screen adjusted to a brightness of 170cd/m². That's not significantly better than its rivals but, equally, you won't do any better elsewhere.

The Surface Laptop 3 is a very good laptop. It's light, slim and good looking, with

performance across the board that's a match for the best in the business. It's more practical than previous models, with non-Alcantara options that won't get grubby, and a good spread of specifications means you can choose a model that suits your requirements and not pay more than you need to.

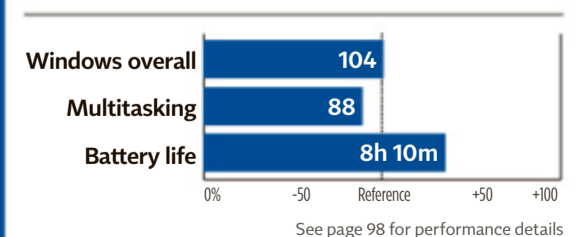
There is the odd area of weakness. It's high time Microsoft moved to wide-gamut displays on its hardware and, ideally, we'd have liked to see a Thunderbolt 3-equipped USB Type-C port, rather than plain old USB 3.

But these are small complaints. If you want a laptop for work and a little play, the Surface Laptop 3 is a brilliant option with very few noteworthy shortcomings.

Jonathan Bray

SPECIFICATIONS

PROCESSOR Quad-core 1.3GHz Intel Core i7-1065G7 • **RAM** 16GB • **DIMENSIONS** 308x223x14.5mm • **WEIGHT** 1.3kg • **SCREEN SIZE** 13.5in • **SCREEN RESOLUTION** 2,256x1,504 • **GRAPHICS ADAPTOR** Intel Iris Plus Graphics • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.microsoft.com • **PART CODE** VEF-00064





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ACER ConceptD 500



£3,200 • From store.acer.com

VERDICT

The ConceptD 500 is a stylish and monstrously powerful PC for content creators; even at this price, it's worth it

ACER HASN'T SO much dipped a toe in professional editing and content creation hardware as leapt in boots-first. ConceptD is an entirely original range of premium PCs, laptops and monitors, including such bold products as the ConceptD 9 – a cross between a laptop and a Surface Studio, with its rotating touchscreen suspended on articulating arms – and this, the ConceptD 500 workstation.

True, at £3,200 it's a major investment, but it has the specs to match. There's the octa-core, 16-thread Intel Core i9-9900K processor, a dedicated Nvidia Quadro RTX 4000 graphics card, 64GB of RAM, Windows 10 Pro and not just a 1TB SSD but dual 2TB hard disks as well. This isn't even the most kitted-out version, either: £3,500 nets you double the HDD storage, on top of everything else. There are also significantly cheaper specs, starting with the £2,100 version, which has an Intel Core i7-9700K CPU, 16GB of RAM and GeForce RTX 2070, so is more of a gaming PC in smart-casual clothing.

MAKE LIKE A TREE

That comes with an emphasis on smart. The ConceptD 500 looks, despite having a conventional mid-tower form factor, unlike any other PC on the market.

A big part of this is the faux wood panel on top, which looks and feels convincing enough to pass as the real thing, but the clean white case and distinctive triangle-pattern air vent further contribute to the suitably grown-up aesthetic.

It's all nicely built, too. A lot of Acer products can feel plasticky next to more robust alternatives from the likes of Asus and MSI, but the ConceptD 500 has a much sturdier constitution. It's not exactly a silent runner, as the CPU cooler will noticeably whirr under load and the GPU occasionally produced some coil whine, but it's no worse than the Asus ProArt PA90 (Shopper 384) in this regard. This compact, cylindrical PC could also make some

considerable noise, in spite of its more advanced watercooling system.

The PA90 at least offers the same Core i9-9900K for less cash – the spec we tested was £2,779 – but then this also comes with half the RAM, as well as less storage space and a slower Quadro P4000 GPU. However, the PA90 still came out slightly ahead in our CPU-reliant 4K benchmarks. The ConceptD 500 scored 182 in the image-editing test, 286 in the video-encoding test and 346 in the multitasking test, for 299 overall. These are all great scores, but the PA90 managed slightly better video and multitasking results, for 311 overall.

Since both systems scored 182 in the single-core image test, we reckon the PA90's more aggressive cooling helps it engage higher boost clock speeds under load. Then again, it's only a 4% difference, which isn't the kind of gap you'd notice unless you were timing tasks with a stopwatch. The ConceptD 500 is inarguably a potent media-editing and production PC, thanks to the massive RAM allocation and high core/thread count of the Intel processor.

SERVICES RENDERED

The RTX 4000, despite its similar name to the P4000, is also the superior graphics card. It's built for hardware acceleration in 2D and 3D graphics creation software rather than gaming, like Nvidia's GeForce GPUs, but even in the latter the ConceptD 500 outperformed the PA90. At 1,920x1,080, it produced 153fps in Dirt Showdown and 81fps in Metro: Last Light Redux, with both games running on their highest quality settings; the PA90 managed 139fps and 62fps respectively. It was the same story at 2,560x1,440, as the ConceptD 500 scored 140fps in Dirt and 47fps in Metro, to the PA90's 121fps and 35fps.

For this kind of money you could still get a much more powerful PC just for



gaming, but we also ran the Luxmark GPU-only test, in which the ConceptD 500 scored 5,647 – a brilliant result that shows how good the RTX 4000 is at serious rendering work.

The SSD, too, performs superbly. Even besides the fact that it's a vast 1TB drive, we measured a sequential read speed of 3,004MB/s and a sequential write speed of 2,678MB/s. That's absolutely among the top tier of storage speeds you can get from a PCI-E 3.0, M.2-mounted SSD like this one.

Having two large hard disks is also a boon, and not just for capacity. You could potentially set these up in a RAID array, so anything saved on one drive is automatically mirrored on the other, creating instant backups for any important work.

The only shame is that you can't add any more disks. There are only two 3.5in trays inside the chassis, and both are full. There are no spare M.2 slots or 2.5in bays, either. We can forgive this lack of upgrade space, however, as what you get out of the box should be sufficient for years.

LOCK BOX

We will say that the interior of the ConceptD 500 isn't quite as modern as the exterior. The grey metal and top-mounted PSU are distinctly old-fashioned, and there is even what appears to be a 5.25in tray cage, even though there's no gap for optical drives on the front. It's also somewhat time-consuming, though not technically difficult, to open: you





have to pull out two plastic covers at the back, undo the screws underneath, remove a large bracket, undo another pair of large screws fastening one of the side panels, and then finally slide off the panel. Only the last two steps are necessary, frankly.

That said, it's a lot easier to get into and tinker with than the PA90, in the sense that it's possible without specialist screwdrivers. While looking a bit old hat, the layout is also at least conventional and familiar, so adding expansion cards is easy once you've got the side open.

For this purpose, there are two PCI-E x16 slots (one is occupied by the RTX 4000, but the other is spare), one PCI-E x1 slot and one legacy PCI slot. As with storage, it's not a massive concern that all four RAM slots are filled – 64GB is an enormous amount of memory – and while an extra M.2 slot might have been nice, it's worth remembering that one is filled by that extremely quick SSD, while the other is home to a networking card that enables 802.11ac Wi-Fi connectivity.

UNDER COVER

That's some very handy extra flexibility, should you be unable to connect via the Ethernet port at the back. This sits alongside two USB2, USB3 and USB3.1 ports apiece, plus a standard three 3.5mm audio jacks, a PS/2 connector and one USB3.1 connector, so it's a reasonably varied I/O panel even if it's not as drenched in USB ports as you might expect for the price. There is, however, a USB Type-C connector on the GPU, which can be used for outputting video instead of the three DisplayPort outputs alongside it.

In addition, there's always the front panel, if you need a few more peripherals connected.

This includes two USB2 ports, one USB3.1 port, microphone and headphone jacks, and an SD card reader. Photo editors will appreciate that last one in particular, as it's possible to grab photos straight from a camera's memory card. We're not so keen on the little plastic cover that sits on top of this panel, however; it's meant to keep the top panel attractively flush, but it just ends up getting in the way whenever you want to quickly connect a USB drive or pair of headphones.

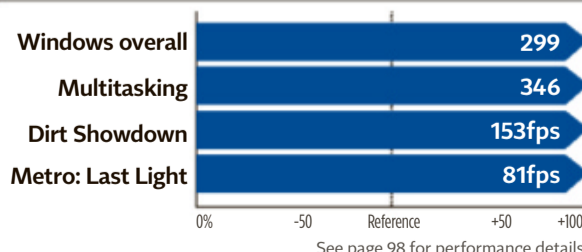
HIGH CONCEPT

That's a minor annoyance, however, on a PC that's much more likely to put a smile on your face. Acer has successfully identified what makes a great workstation – beefy CPU, high-spec storage, plenty of memory – and chosen the right components for the job. We'd sooner choose it than the PA90, too, for the ConceptD 500's more muscular GPU and bigger, faster storage drives.

James Archer

SPECIFICATIONS

PROCESSOR Octa-core 3.6GHz Intel Core i9-9900K • **RAM** 64GB DDR4 • **FRONT USB PORTS** 2x USB2, 1x USB3.1 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **GRAPHICS CARD** 8GB Nvidia Quadro RTX 4000 • **STORAGE** 1TB SSD, 2x 2TB hard disks • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 Pro • **WARRANTY** Three years RTB, including 30 days collect and return • **DETAILS** www.acer.com • **PART CODE** DT.C03EK.006



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MICROSOFT Surface Pro 7



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VERDICT

Improved in some ways and weakened in others, the Surface Pro 7 is a tablet in increasing need of a rethink

BETWEEN THE REDESIGNED Surface Laptop 3 and the new ARM-based Surface Pro X, the latest standard Surface Pro tablet isn't exactly the most exciting member of Microsoft's 2019 hardware line-up. Major changes amount to Intel's 10th-gen Ice Lake chips and the addition of a USB Type-C port; otherwise, the Surface Pro 7 is largely unchanged from the Surface Pro 6 (*Shopper 372*).

That's not entirely a bad thing, however. The Surface Pro series has long represented the best implementation of 2-in-1 design around, with a 3:2 aspect ratio, a 12.3in screen providing plenty of space, and the fully adjustable kickstand making it easy to find a comfortable angle. The Surface Pro 7 remains light – 775g for the tablet on its own and 1.1kg with the keyboard attachment – and still has the Windows Hello-compatible camera on the front, for effortlessly signing in via facial recognition.

COVER UP

It's a shame that the keyboard is still sold separately. This is less of a bother for the Surface Pen stylus, but the Type Cover keyboard is essential for fulfilling the Surface Pro 7's potential. Luckily, it's as great a keyboard as it ever was, with positive tactile feedback and a responsive touchpad. The Surface Pro 7 is also compatible with older and third-party Type Covers, which can be had for £40 – less than half the retail price of the latest version.

Microsoft has also relented by replacing the Mini DisplayPort with a multifunctional USB Type-C port. This can carry data, output

video and charge the tablet all at once, so it's a significant upgrade and helps make up for the relatively small number of total connections: a USB3.1 port, headphone jack and microSD card slot are the only others, so you won't be able to attach a load of peripherals and external storage drives at the same time.

The display is completely unchanged from the Surface Pro 6, so it's still a 12.3in panel with a super-sharp resolution of 2,736x1,824. It's touch-sensitive and compatible with the Microsoft Surface Pen for sketching and taking notes, as it always has been.

Tested in its sRGB mode, the Surface Pro 7 proved incredibly colour-accurate, managing a delta-E of just 0.84, which is low enough for professional image editing. Its gamut coverage of 92.8% isn't quite as exceptional, but it's still enough for punchy, vibrant colours, and with a peak brightness of 400cd/m² and a high contrast ratio of 1,317:1, this display performs brilliantly overall.

Moving on to the other big change, our review model included a quad-core, 1.3GHz Intel Core i7-1065G7 with Iris Plus graphics. Along with 16GB of RAM and a 256GB SSD, this spec is the third-highest of a possible seven, with the cheapest Core i3-1005G1 model costing £799, and the top Core i7 16GB/1TB SSD model a cool £2,249.

processor, as it's probably a slightly better fit for the cooling properties of the Surface Pro 7's chassis. Either that, or just go for a laptop such as the Dell XPS 13 (*Shopper 376*) or the 13in Apple MacBook Pro. Even a Dell XPS 13 running previous-generation Intel silicon will get you better performance than this.

Battery life presents more troubling news. Although Intel's 10nm Ice Lake chips are supposed to be more efficient, the Surface Pro 7 lasted for 7h 20m in our video loop benchmark, 42 minutes less than the Surface Pro 6. That's another big disappointment.

DIMINISHING RETURNS

Microsoft might well argue that it hasn't neglected the Surface Pro 7. It's added a USB Type-C connection and upgraded the internals, but all the evidence points to a hybrid that's badly in need of an update.

The design is still as nice as ever, but it's beginning to look dated. Meanwhile, the new silicon inside seems to be limited by the chassis, and then there's downgraded battery life to cap it off. Microsoft couldn't even be bothered to borrow the neat docking system for the Surface Pen from the Surface Pro X: it still mounts magnetically to the side of the tablet, whereas the Pro X has a handy pen-sized slot at the top of the keyboard. At best, this is a marginal update.

Jonathan Bray



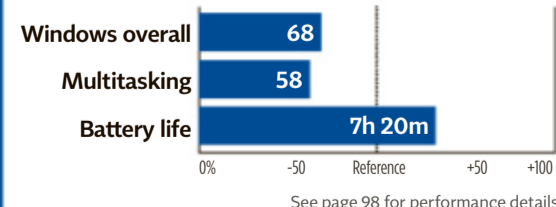
SLIPPING BEAUTY

We were excited to get more time with Ice Lake, but performance proved to be disappointing. It feels perfectly responsive to use, but cooling seems to be an issue, because in our demanding 4K media benchmarks, which test the CPU, storage and cooling systems of a laptop, the Surface Pro 7 performed no faster than the Core i5-based Surface Pro 6. If anything, it's slower: its overall score of 68 is actually a single point below that of the Core i5-8250U model of the Surface Pro 6 we tested.

This suggests you're probably better off saving some money and opting for the lower-power

SPECIFICATIONS

PROCESSOR Quad-core 1.3GHz Intel Core i7-1065G7 • **RAM** 16GB • **DIMENSIONS** 292x201x8.5mm • **WEIGHT** 775g • **SCREEN SIZE** 12.3in • **SCREEN RESOLUTION** 2,736x1,824 • **GRAPHICS ADAPTOR** Intel Iris Plus • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.microsoft.com • **PART CODE** VNX-00002





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APPLE MacBook Pro 16in

£3,789 • From www.apple.com/uk

VERDICT

This mildly upsized MacBook Pro is expensive, but high-performance laptops don't get much better than this

THE INTRODUCTION OF a 16in MacBook Pro isn't technically as much of a departure as it might seem. The 15in model released last year actually has a screen that measures 15.4in diagonally, and since this one is exactly 16in, it's only 0.4in bigger.

Still, it's easy to embrace even small improvements when this new MacBook Pro is among the most portable and compact high-power laptops money can buy. It's a mere 16mm thick, 246mm deep and 358mm wide, and while its 2kg makes it no featherweight, considering the power squeezed inside – including an octa-core Intel Core i9-9980HK processor – that's not enough to be offputting.

FLY AWAY

Layout-wise, it's similar to the 15in model, which is to say it's fairly minimalist around the edges. There are four Thunderbolt 3 ports and a single 3.5mm audio jack, which might disappoint anyone wanting full-size USB ports or the return of the SD card slot, but at least you're getting maximum transfer speeds and versatility from those multiple Thunderbolt connectors.

Open the lid and you're faced with a standard-sized keyboard flanked by a pair of broad speaker grilles, topped with Apple's TouchBar and an enormous Force Touch touchpad immediately underneath. We're glad to see the physical Escape key is back, after it was removed from the 2017 MacBook Pro, and Apple has also wisely returned to an inverted T arrangement for the cursor keys.

In fact, the keyboard has been overhauled completely, using traditional scissor switches instead of the low-profile butterfly switches

of other recent generations. We never had the same distaste for butterfly switches as some users, but this is still an improvement, mainly thanks to the deeper key travel distance.

The touchpad, too, stands out. Its integrated buttons use pressure sensors instead of a traditional click mechanism, which comes in handy for creative apps such as Adobe Illustrator and Photoshop that support pressure-sensitivity for brushes and selections.

The slightly enlarged screen, meanwhile, comes in at a 3,072x1,920 resolution. Like all MacBook screens, it's been factory-calibrated and is better for it, hitting a fantastically low delta-E of 0.49 and full 100% coverage of the sRGB colour gamut. Peak brightness and contrast are both great as well, measuring 471cd/m² and 1:364:1 respectively.

Video editors will also be pleased to discover that it's now possible to adjust the refresh rate of the built-in display to match that of their content so it doesn't stutter during playback. You can choose between 60Hz, 59.94Hz, 50Hz, 48Hz and 47.95Hz.

The only disappointment is a lack of HDR support, although there are no such oversights when it comes to audio quality. The six-speaker setup delivers sound quality that's frankly astonishing for a laptop, with bundles of body, clarity and volume, and even the three-strong microphone array impresses as well. It's good enough for recording voice-overs and podcasts, let alone being a convenient mic for Skype calls and suchlike.

RICH LIST

The catch for all this, if you haven't already seen that number at the top of the page, is the price. We didn't even test the very top spec of the MacBook Pro 16in and it still comes in at the better part of £4,000; the absolute cheapest, with a Core i7 chip, 16GB of RAM, an AMD Radeon Pro 5300M GPU and 512GB of PCI-E SSD storage, will set you back £2,399, while the most you can spend is a terrifying £5,769.

Our model isn't as far off as the price gap might suggest: it has the same CPU

and Radeon Pro 5500M GPU, but with 32GB of RAM instead of 64GB and a 1TB SSD instead of 8TB. It's as fast as it sounds, too: its overall score of 249 in our benchmarks is a new record, and the SSD recorded a sequential read speed of 2,764MB/s and a sequential write speed of 2,890MB/s. For getting work done, nothing is better – but you'll have to pay for the privilege.

Beefier components often mean lower battery life, and it's true that the MacBook Pro 16in's 7h 22m in our benchmark is more average than anything, but then it could have been even worse had Apple not fitted such a huge battery. It has a gargantuan capacity of 99.8Wh, which isn't enough to match the Microsoft Surface Book 2's 11h 33m, but is still quite the technical achievement.

BIGGER AND BETTER

Say what you like about Apple, but it certainly knows how to put together a high-quality, high-powered laptop. The MacBook Pro 16in is up there with the very best: it's solidly built and fast across the board, and it comes with some genuinely welcome improvements.

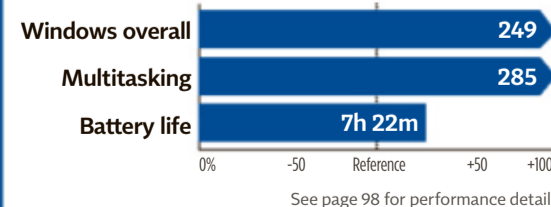
There are laptops that it would make more financial sense to buy instead – the Surface Book 2 and Dell XPS 15 are both more affordable powerhouses – but the MacBook Pro 16in is undeniably a top-quality luxury option.

Jonathan Bray



SPECIFICATIONS

PROCESSOR Octa-core 2.4GHz Intel Core i9-9980HK • **RAM** 32GB • **DIMENSIONS** 358x246x16.2mm • **WEIGHT** 2kg • **SCREEN SIZE** 16in • **SCREEN RESOLUTION** 3,072x1,920 • **GRAPHICS ADAPTOR** AMD Radeon Pro 5500M • **TOTAL STORAGE** 2TB • **OPERATING SYSTEM** macOS • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** MacBook Pro 16in



WINDOWS 10 GAMING LAPTOP

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VERDICT

Clever design, excellent cooling and a powerful spec make the Legion Y740 a top gaming laptop

COMPETITION IS FIERCE in the gaming laptop arena. The Legion Y740 is a 15in gaming contender trying to bring plenty of power to bear without being back-breakingly heavy.

Lenovo has refrained from an emphasis on the sharp angles and red accents synonymous with many gaming laptops, instead opting for a tasteful grey finish. This classy design extends to its materials, with a mix of aluminium and hard plastic giving it a premium feel. It's not as slick as a Razer Blade (*Shopper 380*) but, aside for a little flex in the lid, it's a solid, refined build.

Although it measures 361x267x20mm and weighs 2.2kg, the Legion Y740 is still pretty easy to carry around if you pop it in a decent backpack; just be prepared to carry around its reasonably chunky power supply too.

Having most of the ports at the rear – one mini-DisplayPort, HDMI and Ethernet port apiece, plus two USB3.1 ports – allows for a clean setup if you're connecting the Legion Y740 to an external monitor and peripherals. There's also a USB3.1 port on the right side, with a USB Type-C Thunderbolt 3 port and 3.5mm audio jack on the left.

Rounding off the design is a pair of Dolby Atmos speakers on the base. These are well balanced for downwards-firing speakers, but can't compete with the top-mounted speakers of the Razer Blade 15.

BIT ON THE SIDE

The Legion's full RGB-lit keyboard has more than a hint of Lenovo's ThinkPad, with square keys that are ever so slightly rounded. ThinkPad keyboards are always lovely to type on, and the same applies here. It offers a tactile and accurate typing experience, even when hammering the keys.

That said, the underlying switches can feel a tad mushy when playing action-orientated games. A set of macro keys, placed on the left of the keyboard, could be of great use to strategy and multiplayer fans, although their positioning might take some getting used to. We repeatedly hit them by accident when aiming for the Shift or Escape keys.



The 1,920x1,080 display rightly goes for speed over maximising resolution. It's still sharp enough, and the 144Hz refresh rate allows for smoother-looking gameplay, especially in conjunction with G-Sync preventing tearing.

The screen performs well, both in games and more generally. With a contrast ratio of 1,208:1 and a maximum brightness of 440cd/m², there's nothing stopping the Legion Y740 from delivering vivid colours in games and movies. Speaking of colours, the panel covers 90.1% of the sRGB gamut and manages an average delta-E result of 1.93, both of which are enough for gaming.

MAX POWER

A neat design and slick screen are all well and good, but a gaming laptop is nothing without capable innards. With a hexa-core Intel Core i7-9750H topping out at 4.5GHz, 16GB of RAM and a GeForce 2070 Max-Q with 8GB of video memory, the Legion Y740 has the silicon to run pretty much any modern game thrown at it.

With the High preset and SSAA off, Metro: Last Light Redux produced 162fps – more than high enough to fill out the 144Hz refresh rate – and even in the SteamVR Performance Test, Lenovo's laptop scored 10.9. That's only 0.1 off a perfect score, so you'll have no problem running VR games at high settings. The CPU is great for productivity tasks, too: it propelled the Legion Y740 to an overall score of 196 in our own 4K benchmarks.

As the Legion Y740 has a GeForce RTX series graphics card, it can tap into the same ray-tracing and deep learning supersampling (DLSS) abilities of the desktop RTX 2070.

Ray-tracing delivers more realistic real-time lighting effects in games, while DLSS uses machine learning to apply jagged-edge smoothing on supported titles without the same performance impact as conventional anti-aliasing.

In the game Control, which implements these technologies better than any other title, the Legion Y740 ran with all settings turned up, DLSS taking care of anti-aliasing and

ray-tracing set to high, all at playable frame rates, though not quite 60fps.

All in all, the Legion Y740 delivers superb performance for its size. Thanks to the Legion Cold Front cooling system with four vents, dedicated cooling for the processor and graphics card, as well as a vent and a heatsink for the keyboard, the laptop never gets too hot, and is a lot cooler to the touch compared to other gaming laptops. Fan noise is noticeable, but not obnoxiously so.

Storage comprises a 256GB SSD, with a 1TB hard disk providing extra capacity. It's a quick SSD too, achieving sequential read speeds of 2,526MB/s and write speeds of 854MB/s in the AS SSD benchmark.

OVER TOO SOON

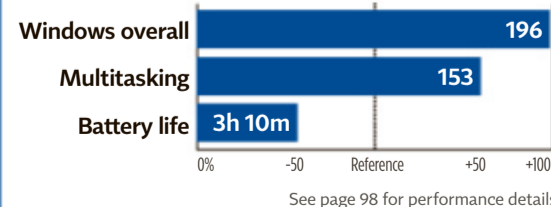
Battery life is the only real weak link here, with the Legion Y740 lasting just 3h 10m in our video playback test. Poor battery life is par for the course with gaming laptops, so this lack of endurance isn't surprising.

At £2,000, the Legion Y740 is far from a cheap machine, but the fantastic gaming performance and tasteful design go a long way towards justifying the price. With limited battery life and oddly placed macro keys, it's not flawless, but learn to live with these imperfections and it's one of the best gaming laptops available for the money.

Roland Moore-Colyer

SPECIFICATIONS

PROCESSOR Hexa-core 2.6GHz Intel Core i7-9750H • **RAM** 16GB • **DIMENSIONS** 361x267x20mm • **WEIGHT** 2.2kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** 8GB Nvidia GeForce RTX 2070 Max-Q • **TOTAL STORAGE** 256GB SSD, 1TB hard disk • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.lenovo.com • **PART CODE** 81UH000KUK





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AM4 PROCESSOR

AMD Athlon 3000G



£42 • From www.scan.co.uk

VERDICT

While unmistakably an entry-level chip, the 3000G's value and overclockability might surprise you

DESKTOP PROCESSORS HAVE progressed far enough that the notion of putting a mere dual-core CPU into your desktop PC might sound less like shrewd money-saving and more like tight-fisted silliness. The Athlon 3000G, however, shows that sometimes you really can do more with less.

Like any Athlon chip, this accelerated processing unit (APU) sits well below AMD's successful Ryzen series of mainstream CPUs. Regardless, it shares many of the latter's qualities. There's Simultaneous Multithreading (SMT), producing two extra virtual cores for a total of four threads, and Ryzen's power-efficient Zen architecture is in use here as well. And while there's no boost clock, the 3.5GHz base core speed can be overclocked manually thanks to an unlocked multiplier.

THE FULL SET

It's extremely rare for cheap chips to come unlocked, especially when the price is as low as this. At £42, the Athlon costs less than half of both the Ryzen 3 2200G and Intel's Core i3-8100 (both *Shopper* 376). As an AMD APU, it also has integrated graphics, albeit only in the form of a Vega 3 GPU; the Ryzen 3 2200G packs more powerful Vega 8 graphics.

It's extremely rare for cheap chips to come unlocked, especially when the price is as low as this

Even so, removing the need for a separate graphics card further strengthens the Athlon 3000G's potential as an entry-level desktop chip; not only is it extremely inexpensive in its own right, it can save you cash on other PC components as well.

There are a few caveats to consider, however. First, you may have noticed we mentioned this processor is based on the Zen architecture, not the newer, improved Zen+ or Zen 2, so while it's technically a new part, it's based on tech from a few years back. Second, we needed to perform a BIOS update for our Gigabyte Aorus X370-Gaming 5 motherboard before the Athlon 3000G would work with it, despite the X370 chipset being made specifically for Zen-based chips. If you're building a whole new PC, you should therefore check the motherboard you're buying comes running a sufficiently recent BIOS version.

Still, the fact that this uses the same AM4 socket as the Ryzen family means that

compatible boards are plentiful. The use of an architecture from 2017 isn't a big deal in practice, either – in fact, the single best thing about the Athlon 3000G is how far it performs beyond expectations.

At a stock 3.5GHz, it scored 79 in our 4K benchmark suite's image-editing test, along with 66 in the video-encoding test, 56 in the multitasking test and 66 overall. That might not sound very high if you're used to reading *Shopper's* Ryzen reviews, but considering the on-paper specs, it's an impressive showing. For comparison, the previous-generation Athlon X4 950 costs about the same and is also clocked at 3.5GHz, but scored only 53 overall, despite having four physical cores and a 3.8GHz boost clock.

In terms of more recent budget competition, the Ryzen 3 2200G and Core i3-8100 are both much faster, scoring 100 and

112 overall respectively, but again, they also cost more than twice as much. Proportionally, then, the Athlon 3000G still does well.

GET ONBOARD

As for the Vega 3 graphics, it's not up to 1080p gaming by itself. *Dirt Showdown* produced only 15fps with Very High settings, and that's the least demanding benchmark game we use. It's fine for general desktop surfing, however, and you can play some games if you don't mind dropping to 720p. Using 1,280x720 and the High preset, for example, *Dirt* ran like a completely different game, averaging a smooth 55fps.

Paired with a dedicated GPU, you can expect some bottlenecking, but mainly in games that are specifically CPU-intensive. *Dirt*, which fits that description, produced 87fps at 1080p (and back on Very High) with a GTX 1060, which is well below the 130fps that card can get with a quad-core Intel Core i7-4770K.

Conversely, *Metro: Last Light Redux* managed 48fps, only a single frame per second behind the Core i7 configuration.

Overclocking works well, too. We easily pushed the Athlon 3000G to 3.8GHz on air cooling, no voltage changes required. Other reviewers have reported being able to reach as high as 4GHz, but we couldn't get this sufficiently stable even after tweaking voltages. However, 3.8GHz was enough for a much improved image test score of 94, as well as smaller improvements to the video, multitasking and overall results: 72, 66 and 73 respectively.

Gaming on Vega is still a 720p affair – *Dirt* at 1080p only rose to 16fps post-overclock – but at 720p it averaged 61fps, an improvement of over 10%. With the GTX 1060, *Dirt* at 1080p rose to 94fps, although *Metro* stayed static at 48fps.

Nonetheless, overclocking is worth doing, especially as doing so only raises temperatures slightly. Idle temps barely rose from 27° to 30°C, and load temps only increased by the same amount: 50°C at 3.5GHz rose to 53°C at 3.8GHz.

G WHIZZ

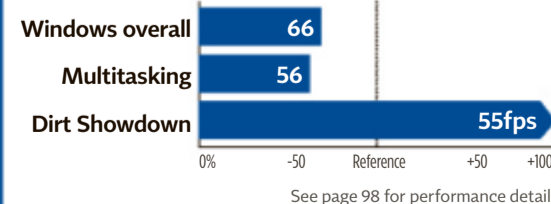
It's still better to go with the Ryzen 3 2200G if you can afford it, but there's nothing as powerful or as flexible as the Athlon 3000G below £50. On those grounds alone, it's worthy of a recommendation, and overclocking support, low temperatures and decent gaming performance are all welcome bonuses.

James Archer



SPECIFICATIONS

SOCKET AM4 • CORES 2 • FREQUENCY 3.5GHz •
INTEGRATED GRAPHICS AMD Radeon Vega 3 •
WARRANTY Two years RTB • DETAILS www.amd.com •
PART CODE YD3000C6FHBOX



AM4 MOTHERBOARD

ASROCK B450 Pro4



£80 • From www.amazon.co.uk

VERDICT

It might not use a shiny new chipset, but the B450 Pro4 has the features of a much more expensive motherboard

WITH THE RUMOURED B550 chipset still missing in action, even months after AMD marked the launch of its 3rd-gen Ryzen CPUs with the high-end X570 chipset, B450 remains the way to go for cheap Ryzen-based PC builds. On most motherboards, it even works with the latest chips following a BIOS update.

The B450 Pro4 is very cheap indeed, but it's also a spacious ATX board that has everything most desktop systems will need – plus, crucially, a few surprise luxuries.

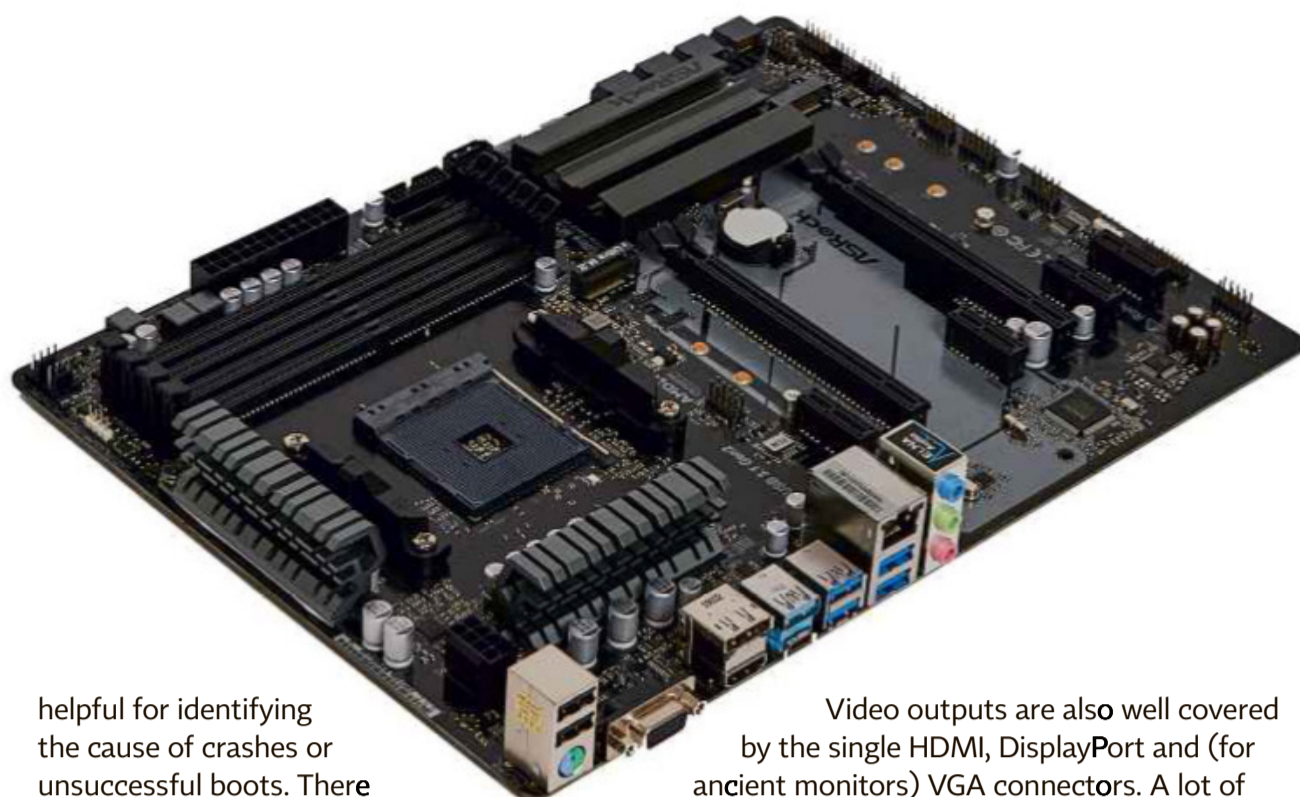
FULLY LOADED

First, it has a full set of four DDR4 RAM slots, not just two, like a lot of budget boards settle for. There are also two M.2 slots, both of which use the PCI-E 3.0 standard for faster SSDs than the SATA ports would allow. Again, this is a step up from the vast majority of the B450 Pro4's rivals, which lean towards a single high-speed NVMe slot.

There's also a very decent line-up of PCI-E expansion slots: two PCI-E x16 and four PCI-E x1 slots, with no space of the ATX form factor wasted. The B450 chipset's lower PCI-E lane count means using the M.2 slots will disable other components – filling the top slot precludes using the second x16 slot, while the bottom M.2 slot can disable the third and fourth SATA ports – but even taking this into account, it's a pretty wide range that won't leave you wanting for expansion card space or storage connectivity.

The B450 Pro4 hasn't aimed for a premium design in its own right. It adopts an unremarkable black and grey look, with basic heatsinks and a plain I/O shield for the rear ports. However, it allows you to deck out your system with some flashy decorations by offering two 12V RGB headers and one 5V addressable RGB header, yet more features we'd sooner expect on a £150 model than an £80 one. The total of five cooling headers is less out of the ordinary, but still enough for an all-in-one watercooler and several case fans.

The main downsides of this budget model are the lack of onboard toys, especially a POST code display. These are immensely



helpful for identifying the cause of crashes or unsuccessful boots. There aren't any onboard power or reset buttons, either, although those mainly come in handy for repeated overclocking rather than everyday troubleshooting.

WATCH THE CLOCK

Speaking of which, one of the benefits of B450 over Intel's equivalent B360 chipset is that the former supports overclocking, making it a viable platform for those who want to try

Video outputs are also well covered by the single HDMI, DisplayPort and (for ancient monitors) VGA connectors. A lot of Ryzen chips don't bother with integrated graphics, but for AMD's Vega GPU-equipped APU chips – including the new Athlon 3000G opposite – this motherboard could be ideal, particularly as its low cost ties into the appeal of APUs as a lower-power, lower-price alternative to having a graphics card.

Completing the set are the sole PS/2, Ethernet and audio jacks. The latter are simple 3.5mm line in, line out and headphone

The B450 Pro4 has one of the most complete I/O panels we've seen on a sub-£100 motherboard

their hand at squeezing some extra power from their CPU without having to invest in a full set of top-end hardware. The B450 Pro4 is no exception, and hopping into the UEFI BIOS reveals all the settings necessary for raising core speeds and voltages.

There aren't as many options for fine-tuning as you'd get from an X470 or X570 board, but that might be preferable for novice tweekers; there's enough here to get started without it all becoming overwhelming.

What's more, the B450 Pro4 is a surprisingly stable platform. Our previous favourite low-cost AMD motherboard, the MSI B350M Mortar (*Shopper 354*), could comfortably push a Ryzen 7 1700 up to 3.8GHz, but ASRock's easily got it to 3.9GHz, only needing a modest voltage increase to 1.35V. We never saw the B350M Mortar sustain 3.9GHz without crashing.

The B450 Pro4 also has one of the most complete I/O panels we've seen on a sub-£100 motherboard. With two USB2 ports, four USB3 ports and a USB3.1 port, there's little chance of running out of space for peripherals and storage, and it's especially good to see a reversible USB Type-C port in there as well.

out ports, so there's no optical S/PDIF or subwoofer connections, but along with other absent features such as integrated Wi-Fi and DAC-UP USB ports, these are forgivable omissions given the price.

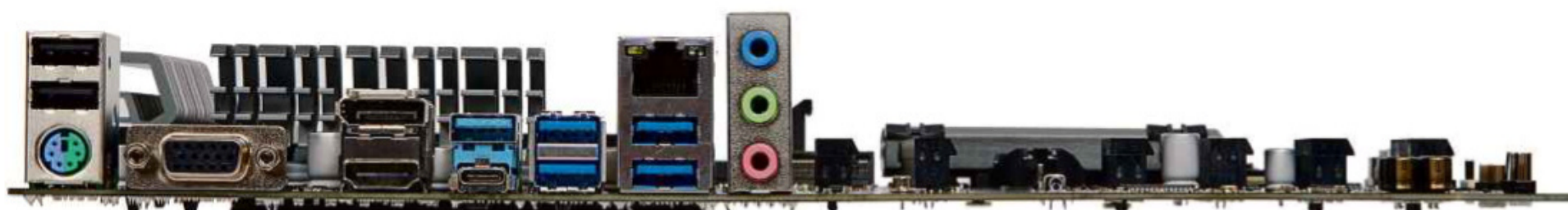
MOTHER LODGE

We wouldn't say that sums up the B450 Pro4 – to do so would understate both its performance and its otherwise considerable range of features – but on the few occasions where something might seem missing, it's only ever premium hardware that you'd never expect to get for £80 anyway. At least until B550 shows up, then, this is as good as it gets for affordable AMD motherboards.

James Archer

SPECIFICATIONS

PROCESSOR SOCKET AM4 • DIMENSIONS 305x224mm • CHIPSET AMD B450 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 2 • PCI-E x1 SLOTS 4 • PCI SLOTS 0 • USB PORTS 2x USB2, 4x USB3, 1x USB3.1, 1x USB Type-C • VIDEO OUTPUTS 1x HDMI, 1x DisplayPort, 1x VGA • WARRANTY One year RTB • DETAILS www.asrock.com • PART CODE 90-MXB8B0-A0UAYZ



EXTERNAL HARD DISK

WD Black P10 Game Drive



£130 • From shop.westerndigital.com

VERDICT

A very decent, if rarely remarkable, portable hard disk for games and files alike

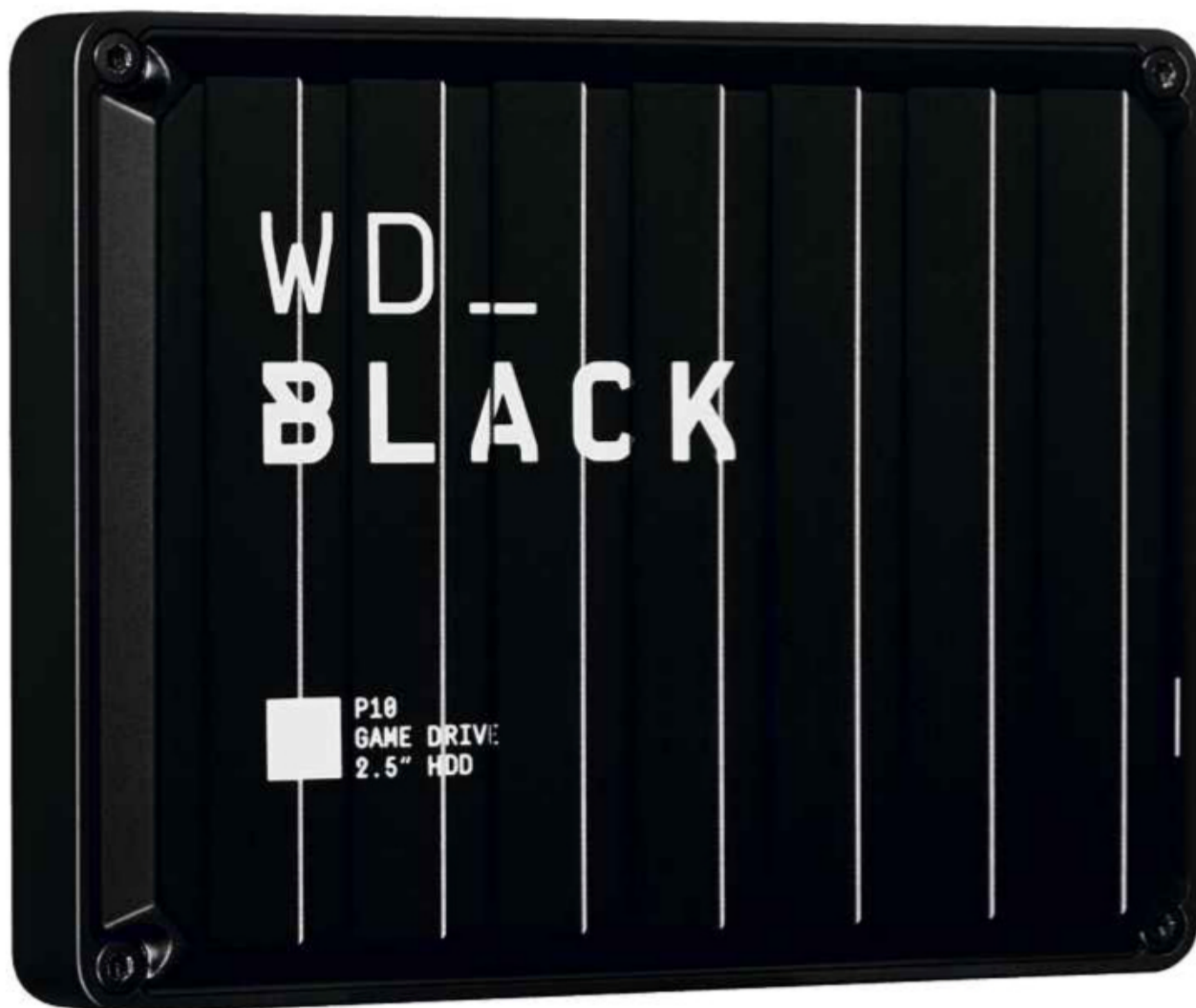
AT THE IFA tech show in September, we had our first in-the-flesh look at WD's new Black range of external drives. Like the internal, M.2-based Black SN750 (*Shopper 376*), these drives come with a focus on gaming, and once again it's not exactly clear why, as good gaming storage only really needs high capacity and fast read speeds. Still, that also means that a hard disk or SSD that works well with games will also work well with everything else, so even the grumpiest of play-haters might find something to work with here.

The Black P10 Game Drive is the most conventional external hard disk of the bunch. It's a portable USB3.1 drive, and is compatible with PCs as well as Xbox One and PlayStation 4 consoles – whereas the similar Black P10 for Xbox One is only certified for Microsoft's console (and also comes bundled with a two-month Xbox Game Pass Ultimate subscription).

BIG PLAYS

The idea is that you keep entire games installed on the external drive, something that might sound like a good idea if you bought a console with just 500GB of internal storage and want to keep more than a few titles to hand. The Black P10 Game Drive commits a little harder to larger capacities than the Xbox-only model, with 2TB, 4TB (tested here) and 5TB options, compared to 1TB, 3TB and 5TB. Interestingly, the only shared capacity – 5TB – is cheaper with the standard version, costing £135 to the Xbox version's £140.

In terms of cost per gigabyte, the 2TB model's 4.5p isn't terribly appealing, but the 3.2p of the 4TB model is better, as is 2.3p for the 5TB model. While these prices put the Black P10 Game Drive towards the high end of hard disks, we wouldn't call it unreasonable: you're getting USB3.1 connectivity, which is significantly faster than the USB3 standard used by cheaper drives, and build quality is high. The metal-clad Black P10 Game Drive



feels hardy and robust, which is particularly important for hard disks compared to more naturally shock-resistant SSDs.

The upside of the 2TB model is that it's both thinner and lighter than the 4TB and 5TB models: it's 12.8mm thick and weighs 140g, compared to 20.8mm and 230g for the larger capacities. We wouldn't say either of these are too chunky for a hard disk, however.

The Black P10 Game Drive fits the bill on capacity and design, then, leaving performance as the last barrier to clear. WD only quotes 'speeds' up to 140MB/s, without specifying read or write speeds, but with USB3.1 that sounds feasible for either. Nonetheless, we put it to the test in CrystalDiskMark, using one of the USB3.1 ports on our testing PC.

In the sequential test, which usually maxes out a drive's true read and write speeds, the Black P10 Game Drive didn't quite hit 140MB/s, but came close with a 136MB/s read speed. Its sequential write speed wasn't massively far off either, at 129MB/s, and both are notably faster than the 118MB/s that WD's more mainstream My Passport HDD managed in both tests.

PAGE YOURSELF

These are respectable results, even at the high price. However, like pretty much all external drives we've tested, the random 4K test proved extremely trying: here the Black P10 Game Drive could only manage a 0.6MB/s read speed and an 11MB/s write speed, showcasing the disadvantages of making do with mechanical storage instead of paying more for an SSD.

Speeds jumped back up in our huge file test, which paints a more realistic picture

of the performance you can expect by using real Windows transfers instead of synthetic tests. Here, WD's drive averaged a 121MB/s read speed and a 119MB/s write speed, which is again pretty good.

These speeds also barely dropped once we switched to the tougher large files test, which involves bulk-moving several music files instead of a single video file. Read speeds averaged out to 116MB/s, while write speeds averaged to 114MB/s; the Toshiba Canvio Premium (*Shopper 377*) was quicker in both, but this drive is even more expensive while not being as well-made.

Last up was the small files test, in which the Black P10 Game Drive produced an 86MB/s read speed and a 93MB/s write speed. This is the only benchmark in which write speeds outpaced read speeds, which makes sense for a 'gaming' drive as read speeds will determine things like load times.

THE NEW BLACK

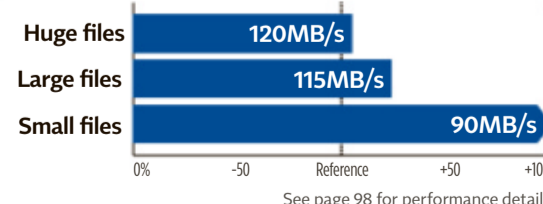
Again, however, high speeds will benefit all sorts of PC software, not just console games, and generally the Black P10 Game Drive is as quick as it needs to be. That means it's not fantastically fast either, but it does shift files faster than the My Passport, which also happens to be more expensive.

James Archer



SPECIFICATIONS

CAPACITY 4TB • **COST PER GIGABYTE** 3.2p • **INTERFACE** USB3.1 • **CLAIMED READ** 140MB/s • **CLAIMED WRITE** 140MB/s • **WARRANTY** Three years RTB • **DETAILS** www.westerndigital.com • **PART CODE** WDBA3A0040BBK



MESH WI-FI SYSTEM

TP-LINK Deco P9



£199 • From www.amazon.co.uk

VERDICT

A smart idea to make mesh networking more reliable, but this router didn't deliver the breathtaking speeds we were hoping for

MESH SYSTEMS ARE our preferred method of putting Wi-Fi into any home, eliminating dead spots and getting you a strong wireless signal everywhere. But what if you run into problems with thick walls or you need to place a wireless satellite a long way from the router? In these cases, mesh systems tend to fail as they can't get a strong enough wireless signal to work properly, leaving you with the option of having to run an Ethernet cable between mesh satellites.

With the Deco P9, TP-Link offers a different option: each satellite has built-in Powerline networking, letting the satellites connect using Wi-Fi or your home's power cables. The idea is to give you a strong Wi-Fi network without having to run any additional cables.

BOX FRESH

The P9 comes as a three-satellite kit, which TP-Link says is enough to cover 6,000 square feet. Each satellite is an identical tall box. They feel a bit light and empty, but look neat enough dotted around the home.

Each satellite has two Gigabit Ethernet ports. The first satellite you turn on must be connected to your broadband router, which leaves you with a single Gigabit Ethernet port for wired devices, so you'll most likely want to buy a switch to extend support.

We like the hybrid concept of the Deco P9, with Powerline networking there to give a boost where Wi-Fi can't reach

For the satellites, you can use both Ethernet ports for wired devices, although you also have a second option: Ethernet backhaul. If you find that Powerline connectivity isn't working as well as expected, you can join a satellite using Ethernet. That's potentially handy if you need even more range, such as getting Wi-Fi to an outbuilding.

Once all your devices are configured, you can give your wireless network a name and set the password you want to use.

The Deco P9 is configured and managed entirely through the smartphone app. It's a simple app to use, with a clear layout, but it doesn't quite give you full control over your wireless network, and there's no option to set which wireless channels you want to use. Instead, the P9 automatically chooses the wireless channels it thinks are best.



In addition, as is common for mesh systems, the P9 presents a single Wi-Fi name for both the 2.4GHz and 5GHz networks, pushing clients to the best channel based on performance and ability. There's an option to turn on Fast Roaming, which is worth experimenting with; this pushes clients to connect to the nearest P9 satellite, which helps improve performance on devices that you move around with.

ALL UNDER CONTROL

Parental controls let you create profiles for each family member, grouping together each person's devices. For each profile, you can select the age type (child, pre-teen, teen or

adult) to define which categories of websites can be viewed, plus you can set time limits for use and bedtimes. Each profile can also be individually paused, which is a handy way to get attention. This Deco system doesn't have the antivirus options that some of TP-Link's other systems have, however.

The Deco P9 has AC1200 wireless, with 867Mbit/s 5GHz networking and a 300Mbit/s 2.4GHz network. The 1,000Mbit/s Powerline networking is used exclusively for the connection between satellites.

Testing the system, we found that performance was around average at close range but tailed off significantly at longer distances. At close range, we got upload speeds of 223Mbit/s and download speeds of 287Mbit/s. These speeds are just behind the Google Wi-Fi. Moving to the first floor, we got

upload speeds of 115Mbit/s and download speeds of 125Mbit/s. On the second floor, speeds fell away with upload speeds of 99Mbit/s and download speeds of 136Mbit/s.

POWER DOWN

To look at how useful Powerline was, we put a satellite at the end of the kitchen, as far away from the router as possible and obstructed by an external wall and two internal walls. Both satellites were connected directly to a wall socket with no extension cables. Performance in the kitchen was basic, with upload speeds of 30Mbit/s and download speeds of 43Mbit/s.

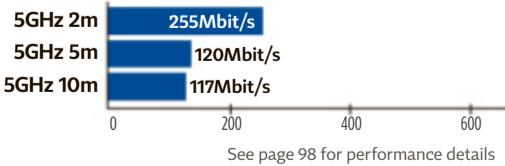
It's worth pointing out that Powerline networking is very susceptible to the quality of cabling, so you may experience better performance in your own home than we did.

We like the hybrid concept of the Deco P9, with Powerline networking there to give a boost where Wi-Fi can't reach, yet the performance in our home wasn't as good as we'd hoped for. For £60 more, you can buy the Netgear Orbi RBK50 (*Shopper 375*), a tri-band system that uses a dedicated wireless channel to connect satellites. We've seen this system punch through a really thick stone wall in a house, and there's Ethernet backhaul if you need it.

David Ludlow

SPECIFICATIONS

MODEM Gigabit Ethernet • WI-FI STANDARD 802.11ac • STATED SPEED 867Mbit/s (5GHz), 300Mbit/s (2.4GHz) • USB PORTS 0 • WALL MOUNTABLE No • WARRANTY Two years RTB • DETAILS www.tp-link.com • PART CODE Deco P9



MULTIFUNCTION PERIPHERAL

EPSON Expression Home XP-4100



£55 • From www.johnlewis.com

VERDICT

Epson's XP-4100 does a lot for the money, until you factor in the ink

EPSON'S EXPRESSION HOME XP-4100 is a smallish inkjet multifunction peripheral (MFP). Despite being relatively affordable, it's well specified for home users, supporting wireless networking and automatic duplex (double-sided) printing. On the front panel there's a decent-sized colour screen, although this doesn't respond to touch gestures. Instead, it's paired with some satisfyingly clicky control buttons. There's no front-panel USB port or memory card slot for direct photo prints, however, and with no fax modem or automatic document feeder, it's not aimed at home office use.

Epson printers are usually easy to install, and the XP-4100 was breezing through its setup routine until it started checking for new firmware. The software recommends you switch the printer off and on again before an update, but doing so caused it to forget its Wi-Fi configuration, so it subsequently needed to be re-joined to our network. At this point, the printer itself said there wasn't an update available, but the install program found and applied one without further issue.

MODESTY BLAZE

Epson quotes print speeds of 10 pages per minute (ppm) in mono and 5ppm in colour, and the XP-4100 lived up to this modest billing. Black text drifted out at 8.9ppm, although switching to draft quality



The XP-4100 isn't a bad MFP, and its competitive price makes it seem like good value. Sadly, however, things go horribly awry when you consider its running costs

accelerated it to 14.4ppm. Colour printing was similarly relaxed, reaching only 2.9ppm in our complex colour graphics test. We duplexed 10 sides of colour graphics on to five sheets of paper at a rate of 2.2 images per minute (ipm), which is not much slower than single-sided graphics printing.

Print quality was mostly about what we'd expect for an affordable Epson printer, with decent text and strong graphics with accurate colours, free of any obvious inkjet glitches. Unfortunately, we couldn't say the same for duplex prints, which were noticeably faint. You can adjust the ink density and drying time for duplex jobs, which helped address the issue. At 13 seconds each in black and 35 seconds in colour, photocopies were fast enough, and their quality was fairly good.

Scans weren't too slow even over a wireless connection, with a preview needing 11 seconds, and a 300 dots-per-inch (dpi) A4

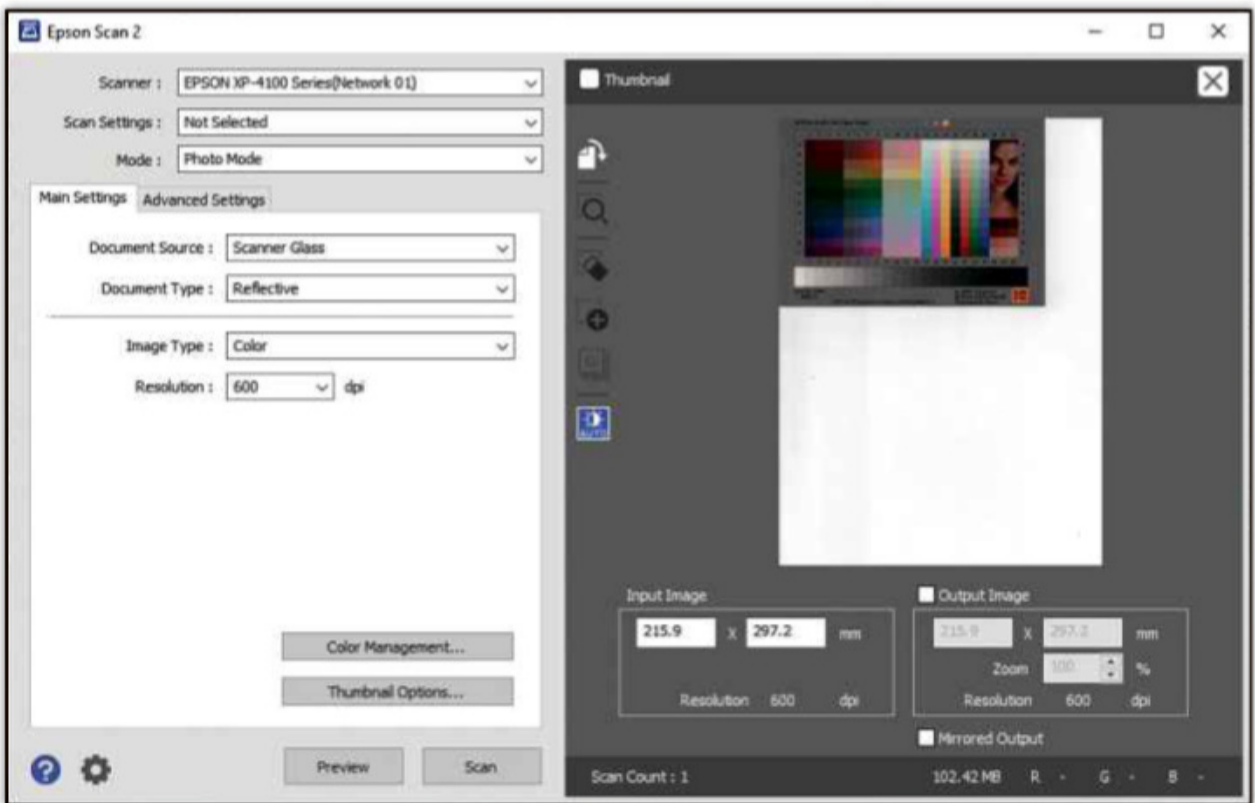
scan completing in 25 seconds. Even a 1,200dpi capture of a 6x4in photo completed within a minute: acceptable, if not exactly fast. The results were very good, with accurate colours and an extremely impressive dynamic range: we could distinguish every shade in our colour input target.

RUN FOR IT

The XP-4100 isn't a bad MFP, then, and its competitive price makes it seem like good value. Sadly, however, things go horribly awry when you consider its running costs as well. There are standard and XL cartridges, but the latter are rated for 500 black pages, or just 350 in colour. As always, the longer-lasting cartridges are better value, but even then this MFP has the highest cost per page we can recall of any inkjet MFP: an A4 page of mixed text and graphics will cost 17.3p, of which the black component is a jarring 4.9p.

Unfortunately, this suggests that the XP-4100 might be prodigiously expensive to own unless you barely use it. It's a decent MFP for the money, but factor in the running costs and it's just not worth it.

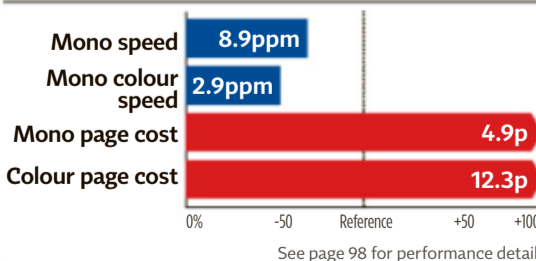
Simon Handby



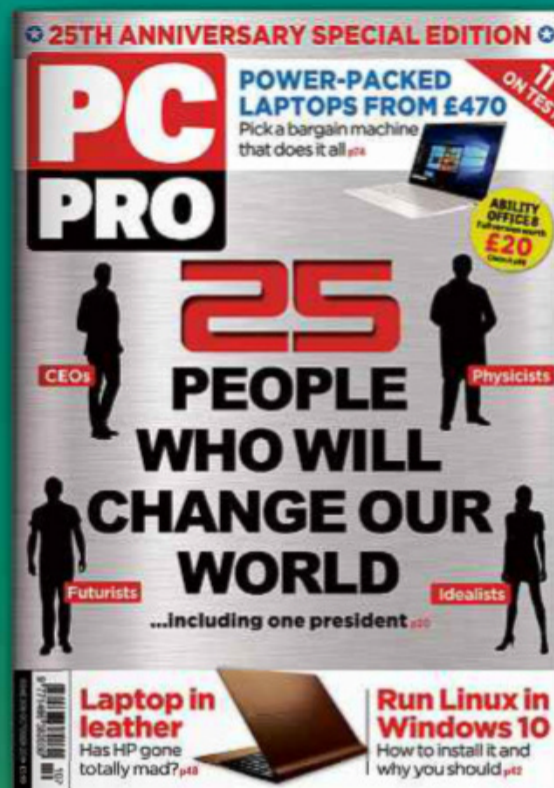
↑ The XP-4100 is easy to set up, once you've managed to update the firmware

SPECIFICATIONS

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440dpi • **MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x2,400dpi (24-bit) • **DIMENSIONS** 170x375x300mm • **WEIGHT** 4.3kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** www.epson.co.uk • **PART CODE** C11CG33401



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FULL HD PORTABLE MONITOR

LENOVO

ThinkVision M14

COMPUTER SHOPPER
BEST BUY

★★★★★

£221 • From www.ballicom.co.uk

VERDICT

This phenomenally thin portable monitor marries strong design with a surprisingly high-performing IPS panel

PORTABLE MONITORS REMAIN a nice idea that has yet to be fully realised by a single, must-have product. The AOC I1601FWUX (Shopper 368) made a decent attempt for attractively little money, but at the cost of some deeply mediocre image quality.

Thankfully, Lenovo's ThinkVision M14 finds much greater success. At 14in and £211, it's smaller and more expensive than the I1601FWUX, but by making far fewer compromises it ends up as the better choice.

FINE LINES

One of its greatest strengths is, fittingly, portability. The M14 weighs 570g and, if anything, it feels even lighter than that. It can be carried quite comfortably with a two-finger pinch, let alone a pair of hands or a bag. It helps that the monitor is so incredibly thin – 4.4mm at its narrowest point, and still only 12mm when the little integrated stand is folded in – and can slip easily into the included felt carry-case. Some very narrow bezels help keep the dimensions down, too.

The stand also beats that of the I1601FWUX by using a more freely adjustable hinge, rather than a folding, tablet-style sleeve. Instead of being fixed at a single angle, then, the M14 can be positioned anywhere between bolt upright and completely flat, making it much easier to get comfortable with.

On the underside of the stand is another, smaller hinged flap that props the screen upwards slightly. Angle adjustment would have been a big advantage on its own, but Lenovo has gone ahead and added a touch of height adjustment too.



It's also on the stand where you'll find the M14's ports and controls. This is the only area we'd say Lenovo has skimmed on. Rocker-style buttons for brightness and a button for the low-blue-light mode (which gives the screen an ugly but less eye-straining orange tint) are both welcome inclusions, but they also represent the sum total of the display options. There's no conventional onscreen display (OSD) menu, like you'd get on a desktop monitor, and that means no profiles, contrast controls or colour balance tweaking.

Connectivity is more fleshed out. While the two DisplayPort-enabled USB Type-C inputs don't sound a lot, having one on each side means you have a choice of where to plug in your laptop or 2-in-1; using the left port, for instance, will prevent the cable getting in the way of right-handed mouse users.

These ports also support what Lenovo calls pass-through power. Inserting a power adaptor into a Type-C port can simultaneously power the display and charge a laptop or other device connected to the other Type-C port. Getting the most out of this, however, involves meeting some very specific hardware requirements. The adaptor must support the PD (Power Delivery) 2.0 standard and be plugged into the right-side port, leaving the left port for the video device. Frankly, it's easier to simply plug in a laptop with its own charger, and since pass-through only works for power, you can't use these two ports for external storage.

ONE TO WATCH

Still, it's better to aim high and miss than to merely offer the bare minimum, and you can always just use the data ports on your connected laptop or handheld anyway. Ultimately, then, there's no real harm done to the M14's otherwise excellent design. We haven't even mentioned build quality, which is much sturdier than its slimness would suggest, including on the hinges.

The screen component of the M14 is a 16:9, Full HD (1,920x1,080) IPS panel. At 14in diagonally, it's slightly smaller than the 15.6in I1601FWUX, but there's still sufficient space, and the resolution is

neither so low as to look blurry nor so high as to make any onscreen text too small.

It's also hard to worry about a 1.6in difference when the M14 is so far ahead on picture quality. This is best demonstrated by its incredible colour accuracy: we measured an average delta-E of just 1.3, on par with professional-grade desktop monitors and far superior to the I1601FWUX's dreadful 6.5.

We wouldn't go as far as to call it an ideal photo/video-editing monitor, as sRGB gamut coverage comes in at 89.9%, which is reasonable but not outstanding. Still, this also makes for a more vivid-looking screen than that of the I1601FWUX, which only managed 52.3%. Similarly, the M14's peak brightness is a fairly average 311cd/m², yet looks much better next to the I1601FWUX's duller 223cd/m², while contrast is a very respectable 1,200:1. The matt finish does a good job of seeing off reflections, and viewing angles are nice and wide; another benefit of using IPS.

TRAVELLING COMPANION

In the end, the M14 isn't quite the all-supreme champion that portable monitors have been missing, but it's definitely the one that comes closest so far. Display quality exceeds expectations, and the sleek design is both stylish and smart. Maybe the ports aren't as versatile as we're used to from the Type-C platform, but no portable monitor is – or even needs to be – a hub of connectivity. Where the M14 succeeds, it succeeds by a distance, and is therefore worth the money even without any pass-through shenanigans.

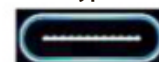
James Archer

SPECIFICATIONS

SCREEN SIZE 14in • **RESOLUTION** 1,920x1,080 • **SCREEN TECHNOLOGY** IPS • **REFRESH RATE** 60Hz • **VIDEO INPUTS** USB Type-C • **WARRANTY** Three years RTB • **DETAILS** www.lenovo.com • **PART CODE** D18140FX0

CONNECTION PORTS

USB Type-C x2



4K MONITOR

ACER ConceptD CP3271KP



£1,000 • From uk-store.acer.com

VERDICT

The stylish CP3271KP is a good professional monitor that comes frustratingly close to being a great one

THE CONCEPTD RANGE doesn't just span articulated laptops and wood-topped desktops like the ConceptD 500 on page 22. Monitors are another part of Acer's attack on the professional market; hence we have the ConceptD CP3271KP, one of the company's most highly specced desktop screens outside of the gaming-focused Predator series.

It's a 27in, 4K (3,840x2,160) IPS panel, and while it's extremely expensive for its size, Acer is at least promising HDR 400 compatibility and professional colour accuracy. Like the ConceptD 500, it also appears to have been designed for those who want to bring a touch of class to their workspaces: there's a similar faux wood finish on the circular base, and the thin metal stalk of a stand is certainly nicer to look at than any fat pillar of black plastic.

ON THE MOVE

More importantly, it's highly adjustable. There's -5° to 35° of tilt adjustment and up to 180mm of height adjustment, and it rotates as well – though peculiarly, the entire base moves on a spinning platter, rather than just having the screen spin on an axle. It's functional, however, and the only missing thing is the ability to flip the whole screen 90° to use it in portrait mode. It can, however, be VESA-mounted using the supplied plate and screws.

We'd recommend doing that if it's a viable option, as there is one design flaw with the stand: it wobbles. Not to the point where you can shake the screen just by, say, typing on a keyboard or tapping on the desk, but whenever we wanted to make a rotation of tilt adjustment it definitely felt a bit looser than we'd expect for £1,000.

Build quality is fine elsewhere. The anti-glare hood panels attach securely, and the wood effect feels more like a quality material than a cheap veneer. There's a good mix of connections, namely two HDMI inputs, two DisplayPorts, two USB3 ports and two USB3.1 ports. Most of these are hidden on the rear, although the USB3.1 ports are on the left edge for easier access.

Some 4W speakers are included too, and they're capable enough for Windows

sounds and voice calls. You should invest in some desktop speakers for working with music and video, however.

Also on the back is the power button, three shortcut buttons and a joystick, which can be used to navigate the CP3271KP's pleasantly straightforward onscreen display (OSD). We found it annoyingly easy to hit the power button when aiming for the top shortcut button – they're the same size and shape – but that's about it for faults, as the joystick works well and the OSD itself strikes a great balance between user-friendliness and depth of features. This includes multiple image profiles, and the ability to create a custom profile yourself.

We began our colourimeter tests with everything on the standard default settings, with the exception of brightness being set to maximum. The CP3271KP very quickly impressed, managing 99.6% sRGB colour gamut coverage, a 1,068:1 contrast ratio and a peak brightness of 469.6cd/m² – enough both to see off any glare that the hood and matt panel finish might have let through, and to fulfil the promise of HDR 400.

JUST A SHADE OFF

The only potential issue was the average delta-E of 2.78, which isn't bad in general terms but isn't quite low enough to achieve photo-editing-quality colour accuracy.

This lowered slightly to 2.72 once we enabled the HDR 400 mode, while brightness, gamut coverage and contrast all rose slightly, to 476cd/m², 99.8% and 1,073:1 respectively. This mode also adds a very subtle sharpening filter, which can be toggled manually.

Finally, we tried the sRGB profile, which finally got average delta-E down to a professional-grade 1.33.

However, it bizarrely lowered sRGB gamut coverage to 91.5%, while also dropping contrast slightly to

1,050:1. Peak brightness was also lower, at 465.1cd/m², but that's still a good result.

It's unfortunate that you essentially have to choose between wider gamut coverage or higher accuracy; these should, rightfully, be two sides of the same coin. The NEC MultiSync EA271U makes a much more successful attempt at balancing the two, with 97% coverage and a delta-E of just 0.5. It's cheaper, too, at £800.

FANNING THE FRAMES

What makes this unfortunate is that Acer's monitor performs so well outside of this one contradiction. It even has a smooth 120Hz refresh rate and Nvidia G-Sync support, though the latter won't be as commonly useful here as on a gaming monitor. It can also overclock to 144Hz, but this requires jumping through a few too many hoops: it only works with AMD graphics cards, so G-Sync must be turned off in the process, and you need to connect with two DisplayPort cables at a time.

Such weirdness can be overlooked when performance, adjustability and connectivity all meet high standards, and the CP3271KP is generally a strong showing from a manufacturer with relatively little experience making top-end pro monitors. The MultiSync EA271U, however, is simply better value.

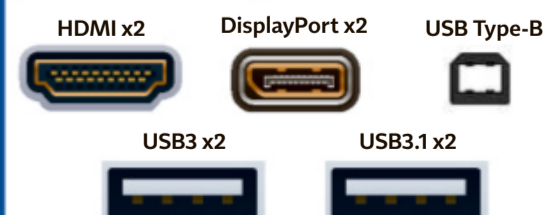
James Archer



SPECIFICATIONS

SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY IPS • REFRESH RATE 120Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Three years RTB • DETAILS www.acer.com • PART CODE UM.HC1EE.P01

CONNECTION PORTS



49in IPS TV

LG 49UM7400



£379 • From www.johnlewis.com

VERDICT

The 49UM7400 isn't perfect, but there's lots to admire at the price, especially HDR performance

ASK ANYONE CRUISING into middle age and they'll tell you 49 is the new 36. And that's equally true of TV screen sizes: 49in once seemed unreasonably large for a television, but nowadays it's an unremarkable size.

What's more, while our desire for a bigger screen is on the up, the price we have to pay for it is ever decreasing. The LG 49UM7400 has the sort of specification that would have cost more than twice as much a few years ago.

GIVING DIRECTIONS

This is a 3,840x2,160 HDR TV that uses an IPS LCD panel. It's part of a range built to mop up sales from those customers who aren't early adopters, don't want an enormous TV and who aren't about to spend a month's salary on a new set, but who nevertheless don't want to go without the niceties we've all come to expect even from mid-range TVs like this.

In that respect, it has pretty much everything. You get a smart TV interface with apps for all the major streaming services, and there are also 43in and 55in models if you want the same tech in something slightly smaller or bigger. The use of an IPS panel also means the 49UM7400 has wider viewing angles than TVs that use VA technology.

However, you can't expect much in the way of design flourishes or premium materials at this sort of price, and sure enough the LG doesn't deliver any. The 49UM7400 supports its relatively chunky chassis and bezel on a plastic crescent-shaped stand. Annoyingly, the stand itself proves relatively difficult to attach thanks to some less than enthusiastic screws.

All the connections are at the left rear of the display, and these include three full-bandwidth HDMI 2.0b ports and an optical S/PDIF output for getting audio into an AV receiver or soundbar.

The WebOS smart TV platform here is very similar to that found on LG's very well-regarded and quite a bit more expensive



OLED screens. Netflix, YouTube, Amazon Prime Video and Freeview Play, which includes BBC iPlayer, are all available here with HDR support. The user interface can get laggy on occasion, however, which is annoying.

Wider viewing angles aside, the IPS panel isn't all good news. As is typical of the technology, it produces shallower black tones than a VA panel would; they're greyish and milky rather than deep and inky, and the picture is inevitably robbed of depth. The global – rather than local – dimming contributes to this, too, although the LG's low-end gamma response helps to resolve some shadow details that otherwise might end up disappearing.

Fresh from the box, even the most accurate picture preset has a green tint. Colours can be adjusted for a more natural look, but it's never truly accurate because of the screen's RGBW subpixel configuration.

Screen uniformity, however, is very good by prevailing standards. There's no banding, and only very minor dirty screen effect. The right edge of the screen of our review model was marginally darker than the left.

As this is a 60Hz panel, it can't deploy motion interpolation to reduce motion blur, which can be mildly problematic. Select Real Cinema from the picture mode menu, however, and 24fps movies are delivered smoothly with not a hint of judder.

PIXEL IMPERFECT

When it comes to upscaling, the 49UM7400 is good rather than great. Standard-definition content is prone to more noise and jagged edges than LG's mid-range televisions usually are, which is likely another consequence of the RGBW subpixel configuration. RGBW is also the probable cause of a mild shimmering effect when the screen is trying to resolve single-pixel lines on 4-K resolution content, too. There's a Smooth Gradation preset in the user menus, but its effect is minimal.

As far as HDR goes, there's no Dolby Vision support, but at this price that shouldn't come as a shock. Peak brightness of 340cd/m² means there's a relative lack of HDR impact; the 49UM7400 actually adheres to the HDR

luminance standard pretty accurately, but only until 200cd/m² or so. 4-K-derived colours in particular look rather muted – the LG's P3 colour gamut coverage is an unimpressive 82% – and while Dynamic Tone Mapping helps retain specular highlight details, this is at the expense of overall brightness and some shadow detail. Nevertheless, at this price the 49UM7400 is a relatively accomplished HDR performer.

As a gaming monitor, it's downright stellar. Select Game from the picture modes, and input lag for both 1080p SDR and 4-K HDR content is a negligible 12ms. The 49UM7400 supports Auto Low-Latency Mode (ALLM) too, so will automatically engage Game mode when a compatible console is fired up.

In terms of audio, the 49UM7400 actually delivers unusually potent levels of both bass and volume. There's barely a hint of stereo separation, however, and the resulting sound is both muddled and muddled.

PUNCHING SIDWAYS

Some impressive technologies distinguish the LG 49UM7400 from many other budget sets, in particular the dynamic tone-mapping, super-low input lag and smooth 24-fps reproduction despite the 60Hz panel. It's all impressive stuff at the price. Ultimately, however, it's let down somewhat by its lower-contrast IPS panel, and that means it will have a tough time competing against the increasingly talented budget opposition.

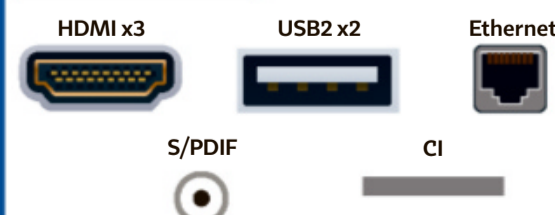
Vincent Teoh



SPECIFICATIONS

SCREEN SIZE 49in • NATIVE RESOLUTION 3,840x2,160 •
VIDEO INPUTS HDMI • TUNER Freeview • DIMENSIONS
704x1,110x249mm • WARRANTY Five years RTB •
DETAILS www.lg.com/uk • PART CODE 49UM7400

CONNECTION PORTS



MEDIA STREAMER AND SMART SPEAKER

AMAZON Fire TV Cube



£110 • From www.amazon.co.uk

VERDICT

With the full Alexa feature set onboard, the Fire TV Cube is smarter than the average streaming box

THE ORIGINAL FIRE TV Cube never saw release in the UK, but one year and a product generation later, a new version has successfully arrived on British shores.

This is, once again, three devices in one. First and foremost, it's a streaming device, capable of playing all your favourite BBC, ITV, Channel 4 and Channel 5 shows, and Amazon Prime and Netflix if you're prepared to pay their subscriptions. It will do this in 4K, with HDR and Dolby Vision if they are available.

Where it differs from Amazon's other Fire TV products is that it can also function as an Alexa smart speaker. Other streamers might integrate Alexa-powered voice controls, but this is the only one that is a fully fledged smart speaker in its own right.

Finally, it can act as a universal remote for any other devices connected to your TV, including soundbars and set-top boxes.

BOX OF TRICKS

It would be hard to guess that such a nondescript black cube can keep so many plates in the air. Regardless, Amazon has clearly given a lot of thought to balancing its discreet design with functionality; there are even optional IR blaster and Ethernet adaptor extras, although there's no HDMI cable included in the box, so you'll need to provide your own.

The remote is small, but does the job with its limited number of buttons. As with other Fire TV devices, there's a circular pad in the middle for navigating menus and so forth. Crucially, there are also volume controls, as Amazon wants to take over your soundbar.

It handles this well, too. Pairing a speaker during setup is easy, and Alexa seamlessly controls both it and the TV by accurately parsing voice commands. We were soon talking to the Fire TV Cube to mute and adjust the volume as needed.

The only problem arises if there's another Alexa speaker somewhere within earshot, as they'll both respond to the wake word. That can be fairly annoying, and is only fixed by turning off one or manually setting distinct wake words.

There are also limits to what the Fire TV Cube can control. It can't



control connected games consoles, other than switch to the relevant input channel, although you'd need a separate input – a controller – to play games anyway, so it's not that much of an issue.

Also, unlike the Fire TV Stick 4K (*Shopper* 375), the Fire TV Cube is ridiculously fast and responsive. That's hardly surprising given its overkill internals: a hexa-core 2.2GHz processor backed up by 2GB of RAM is more than enough for streaming media, even in 4K, and while it's not quite as overpowered as the Nvidia Shield TV, Amazon isn't trying to make a gaming platform here.

What it is making is a platform to push its own products, so while Netflix and terrestrial channels are available to download, expect them to play second fiddle to Amazon TV shows, which are peppered around the menus to encourage you to keep that Prime subscription alive.

STREAM BUILDING

Generally, the range of apps is good, with music from Spotify and Tidal joining the expected Amazon Music. There's an Audible app, as well as support for various radio stations, while YouTube sits alongside Apple TV and Netflix. The only big omissions we spotted were BT Sport and Now TV.

Unfortunately, we had a whole heap of problems getting 4K content to run from Amazon's own shows, with everything defaulting to 1080p despite the TV detecting it was 4K at startup. Amazon's advice was to make sure the internet connection was fast enough and to ensure we were using a cable capable of supporting

HDCP 2.2, both conditions we had already met, so the cause remains a mystery. Netflix played 4K content just fine.

As an Echo device, it's not too bad. Even tucked into a TV stand behind a perforated door, it never struggled to hear the wake word and, while sound quality is only so-so when the TV is off, music requests are played through the TV speakers when it's on, so you might find it does the trick as a dedicated living-room smart speaker. It was even able to deliver a live feed from a Ring video doorbell to the big screen.

FAIR AND SQUARE

As streaming products go, it's hard to fault the Fire TV Cube. It unifies the key devices hooked up to your TV and presents a fast, shiny interface to pick out most of the content you might want to stream. The Alexa integration is particularly impressive, and doesn't feel like a gimmick at all.

At £110, however, it's not quite award-worthy. If you have a smart TV, then you'll likely have much of the functionality already, and if you have an Echo device, then a simple universal remote will complete the trio of major functions. Wait for a sale, then, unless you're desperate for a true all-in-one streamer.

Alan Martin



SPECIFICATIONS

VIDEO OUTPUTS 1x HDMI • **NETWORKING** 802.11ac Wi-Fi, Ethernet (requires adaptor) • **DIMENSIONS** 77x86x86mm • **STREAMING FORMATS** UPnP, AirPlay, DLNA, Plex • **INTERNET STREAMING SERVICES** Amazon Video, Netflix, Apple TV, BBC iPlayer, ITV Hub, All 4, My5 • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Fire TV Cube



SOUNDBAR

VIZIO SB362An-F6E



£137 • From www.amazon.co.uk

VERDICT

It may be basic, but the SB362An-F6E delivers very high sound quality for the money

VIZIO, THE TOP soundbar manufacturer in the US, is a name perhaps less familiar to consumers in the UK. The firm has been around since 2002 and is prolific in its native country, but it's waited until 2019 to make its move in the UK, with the launch of three TV audio systems.

The SB362An-F6E sits in the middle of this new UK range, and it's typical of Vizio's approach, aiming to deliver decent sound quality and features for not much cash.

FINDING THE ANGLES

It's not luxuriously made and, as you'd expect of a sub-£150 soundbar, it's predominantly built from plastic. Even so, it does look pretty good and has a visually interesting shape, like a flattened hexagonal cylinder or squashed Toblerone, with fabric covering the main body of the device. Underneath that fabric in the centre is a series of white LED lights, all arranged in a horizontal line, and on the right end of the bar is a series of controls for adjusting volume, input and power.

At 914mm wide, the SB362An-F6E is compact and a natural companion to a TV between 32in and 45in in size. It's not too tall, so there's little need to worry about it obscuring your view of the screen, and it can be wall-mounted, with the required brackets included in the box.

Setup is as straightforward as it gets: all you need to do is plug the SB362An-F6E into the mains and hook it up to your TV via the optical or 3.5mm port. There's also a USB port, which supports WAV and MP3 formats, and **Bluetooth connectivity, which is perfect for playing back music from your phone.** Cables

are provided, as is a user-friendly infrared learning remote, which makes it possible to use the Vizio remote to control volume and mute on your TV when the soundbar is switched off.

QUALITY STREET

In terms of sound quality, the first thing that really hits you about the SB362An-F6E is its clarity, balance and scale. A simple 2:1 setup, this isn't the most extravagant soundbar on the market, and the audio doesn't completely envelope you as it does with full surround-sound systems, but it is remarkably easy to listen to for the most part. Within its limitations, the SB362An-F6E delivers positional audio reasonably convincingly.

The soundstage is fairly wide, too, and there's also support for Dolby Digital audio via the optical connector, not to mention DTS Virtual X. Enable the latter via the remote control and the SB362An-F6E will attempt to simulate the effect of overhead sound, a bit like Dolby Atmos. In practice, this had the effect of adding some depth to the sound, but it also added a touch of harshness to vocals and speech. We were happy to go without it.

The SB362An-F6E includes two 'subwoofers' within its frame. These can't match the low-end grunt of a dedicated sub – the drivers are simply too small – but the bass that this all-in-one bar produces is surprisingly good, and it complements the mid-range and treble without drowning it out.

This isn't a device that will shake the floorboards and rattle the upstairs windows. Instead, it strikes a balance between improving **your own television's built-in audio and taking it to home cinema levels.**

Despite its simplicity, you get plenty of room for adjustment. For starters, there are two EQ modes, one specifically for movies and one for music, with the Movie mode producing a more expansive sound and the Music setting a slightly cleaner overall presentation.

Should you wish to go further, there's also the option to tweak the bass and treble on the remote and scale it up or down to taste. This is particularly useful for boosting dialogue if need be, as well as giving a little extra thunder to action films, but it's easy to get carried away and overdo things. Ramp up the treble too much, for instance, and the bar sounds too harsh, so we'd recommend you keep your adjustments small.

The only thing to completely dislike about the SB362An-F6E is the lack of a proper display. Inputs, bass, treble and volume levels are all indicated via that simple horizontal line of white LEDs, and figuring out what's what can get confusing.

SOUND BARGAIN

At this low price, however, there isn't much that competes with the SB362An-F6E on value and sound quality. The £80 Creative Stage 2.1 can enhance your television's output and comes with its own subwoofer, but is half the size of the Vizio soundbar and doesn't kick out audio with quite the same scale. Meanwhile, the Polk Command Bar (Shopper 380) offers Alexa voice control, comes with a separate wireless subwoofer and sounds more rounded than the SB362An-F6E, but it's about £100 more expensive.

In other words, it's hard to argue against the Vizio SB362An-F6E. It may not be the most stylish soundbar, and some features might be restricted, but sound quality is excellent and it's incredibly simple to connect and set up. If you don't have much to spend on enhancing your TV's sound, this is the soundbar to buy.

Mark White



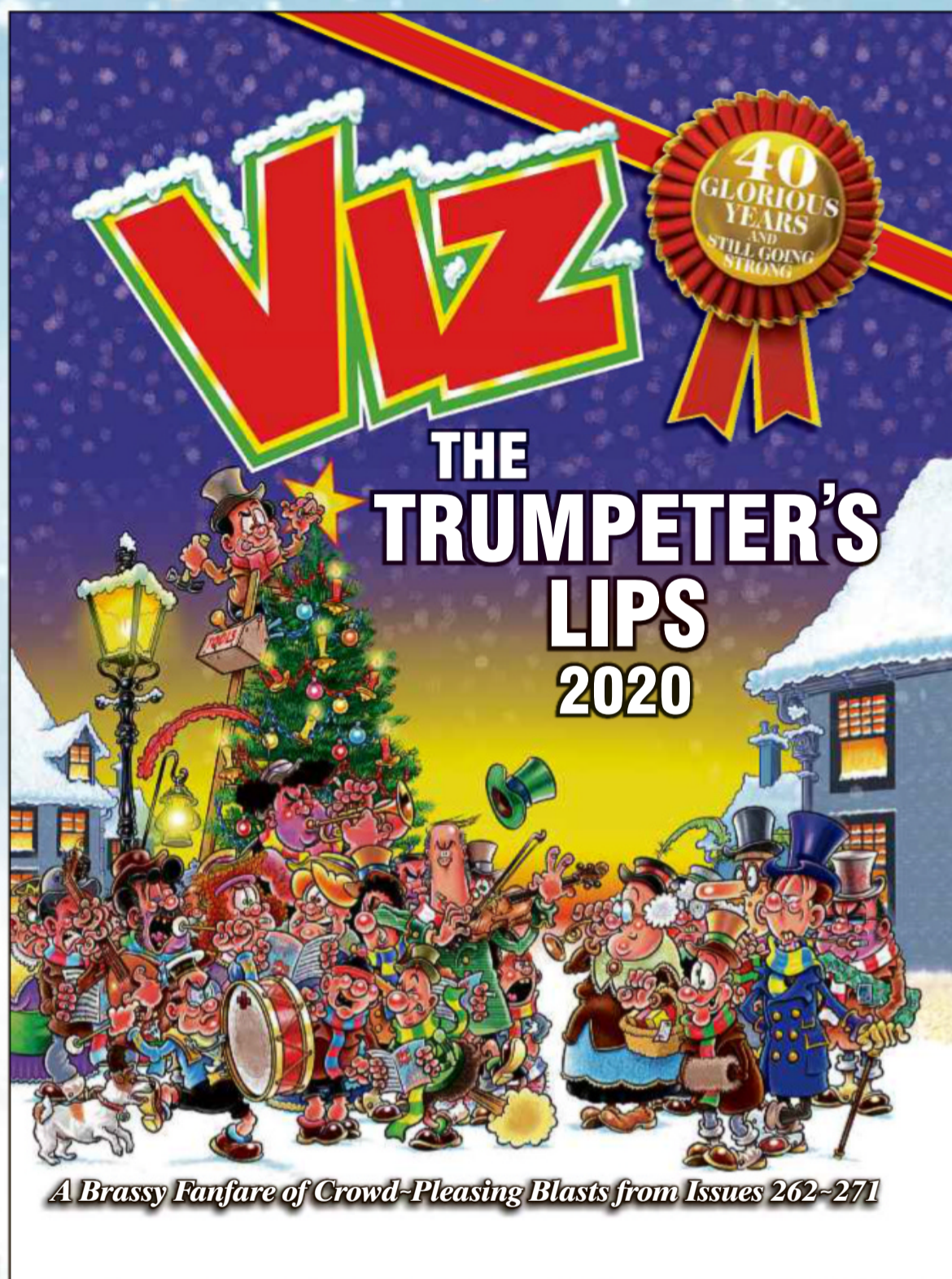
SPECIFICATIONS

DRIVERS 4 • **RMS POWER OUTPUT** Not stated •
DIMENSIONS 53x914x132mm • **WEIGHT** 2.5kg •
DOCK CONNECTOR None • **NETWORKING** Bluetooth •
WARRANTY One year RTB • **DETAILS** www.viziosoundbar.uk • **PART CODE** SB362AN-F6E

VIZ

2020 ANNUAL

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Possibly some bad ones.

ACTION CAMERA

GOPRO Hero 8 Black

COMPUTER SHOPPER
BEST BUY

★★★★★

£329 • From www.amazon.co.uk

VERDICT

GoPro's flagship camera goes big on little enhancements, adding loads of convenient features in the process

THE GOPRO HERO series has proven successful enough that major changes aren't strictly necessary, but while the new Hero 8 Black keeps things familiar for GoPro devotees – it's a similar shape and size as the Hero 7 Black (*Shopper 372*), and has a similar menu system – it does its best to shake things up within those restraints.

Once again, it's waterproof to 10m without needing a case, but unlike the Hero 7 Black it doesn't need to be snapped into a plastic frame before being attached to a mount. That's because it has a pair of fold-out mounting fingers embedded in its base: flip them out, slot them into your helmet, chest- or tripod-mount and you're ready to go.

This might add a couple of millimetres to its height and width, but it's still more compact than a Hero 7 Black in its mounting frame. There's another big upside, too: you can now remove the battery without having to unclip the camera and pull it out of its frame. It's a far more elegant design in general, and that's not even mentioning how the lens housing protrudes less from the front, reducing wind turbulence when you're moving.

SHAKE OUT

It's not all direct upgrades: there's no longer a Micro HDMI input, and the new shorter lens housing means any filters you may have purchased for previous models now won't fit. Neither will any cases, thanks to the slightly enlarged dimensions.

Still, you'll be able to take advantage of the Hero 8 Black's improvements to video quality. Electronic stabilisation, for example, has been upgraded to what GoPro calls Hypersmooth 2.0. You have to hit the Boost button to see a big improvement over the Hero 7 Black's previous smoothing tech, but doing so means footage takes on an uncanny, almost



gimbal-like smoothness, at the cost of a more compressed look overall. It's very impressive, although Boost mode isn't available at the highest 50fps and 60fps frame rates. That said, Hypersmooth 1.0 wasn't available at all at these frame rates previously, so being able to use unboosted smoothing is still an upgrade.

TimeWarp, GoPro's timelapse feature, has become TimeWarp 2. This adds an Auto mode that takes the guesswork out of which speed to set your timelapse video at, basing settings on your motion and the scene you're capturing. This worked extremely well for us, producing perfect timelapses of everything from a simple stroll to a hectic mountain bike run.

There's a host of smaller new features too, our favourite of which is the presets facility. This allows you to set up to 10 user capture modes and name them for quick recall. When you're out shooting and would rather not be memorising settings and scrolling through multiple screens to get to the options you need, this is extremely helpful, and you can also customise certain onscreen controls.

QUIK FIT

It's worth noting the significant changes GoPro has made to its accompanying mobile app. Thankfully, Quik – the semi-automated editing software – is finally part of the main app instead of a separate one, and we generally found remote-controlling the camera and previewing video framing to be much more reliable with the Hero 8 Black than it was on previous generations.

The same goes for the UI on the camera itself. Despite having the same processor as the Hero 7 Black, the new model somehow feels faster, and certainly less prone to freezing. However, the sheer number of modes and settings remains baffling, and wrapping your head around it all will take some time if you haven't owned a GoPro before.

With the same 12-megapixel sensor, lens and S1 image processing chip, it won't surprise you to find that the overall image

quality on offer isn't all that different from that of the Hero 7 Black. As such, the recording resolutions are the same, too.

The camera can record 16:9 video at 4K, 2.7K, 1440p, 1080p and 720p resolutions, mostly at 60fps; only the widest SuperView field of view restricts you to 30fps. Slow-motion clips can be shot at 2.7K at 120fps, and 240fps at 1080p or 720p.

And you can capture at bit rates of up to 100Mbit/s in 4K and 2.7K modes, too, which is the highest bit rate GoPro has ever deployed on its action cameras. That's equivalent to 200Mbit/s in MP4, and is a 22Mbit/s improvement over the Hero 7 Black's 78Mbit/s. Regular, or Low, bit-rate videos are recorded at 60Mbit/s in 4K and 2.7K. Video quality is excellent throughout, with consistently well-judged exposures, solid colour reproduction and a high level of detail across all modes.

GOOD LISTENER

Audio quality is great, too, with the Hero 8 Black's new lens housing design working remarkably well to cut wind noise when you're on the move. With the microphone positioned on a rucksack strap, we found voice pickup would become a touch muffled when moving at speed, but the wind reduction was remarkably effective.

While none of its improvements is outright groundbreaking, then, the Hero 8 Black makes enough small improvements to represent a very big upgrade. The DJI Osmo Action (*Shopper 382*) is cheaper, but GoPro's latest takes its place as the king of action cameras.

Jonathan Bray

SPECIFICATIONS

SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels •
MAX RECORDING RESOLUTION 4K (60fps) •
AV CONNECTIONS None • **DIMENSIONS** 49x66x28mm •
WEIGHT 126g • **WARRANTY** One year RTB • **DETAILS**
www.gopro.com • **PART CODE** CHDHX-801-RW

GARMIN Vivoactive 4

COMPUTER SHOPPER
BEST BUY

★★★★★

£260 • From www.amazon.co.uk

VERDICT

More an exercise in refinement than revolution, but the Vivoactive 4 does more than enough to succeed

JUST IN TIME to replace the long-in-the-tooth Vivoactive 3 (*Shopper 362*), Garmin's Vivoactive 4 brings along an overhauled design and a startlingly wide range of new features.

It comes in a couple of different sizes, too. We're focusing on the 45mm Vivoactive 4, but there's also a 40mm 4S version for smaller wrists. Both exhibit improved looks compared to the Vivoactive 3: narrower borders and glass that's subtly curved at the edges make for a watch that looks more sophisticated than its predecessor. In the 45mm Vivoactive 4's case, it even manages this with a larger screen, up from 1.2in previously to 1.3in here. The screen isn't an AMOLED panel, but rather a transreflective memory-in-pixel display that's easily legible in bright sunlight and, importantly, always on.

CARRY A TUNE

Music playback is undoubtedly the standout feature. This was absent on the original Vivoactive 3, only being introduced later on the Vivoactive 3 Music spin-off, but here it's included as standard. Not only can you transfer music files directly to the watch, but also connect to third-party services such as Spotify, Amazon Music and Deezer. Although you'll need a Premium subscription to do this, it's far more convenient than transferring personal music files, which requires you to install the Garmin Express app on your PC.

Downloading songs from Spotify feels a bit clunky at first, but it soon feels much quicker and easier, and with a suitable pair of Bluetooth headphones you'll be able to listen to music on runs and bike rides without needing a smartphone or MP3 player.

As for other new features, both the Vivoactive 4 and 4S get the Body Battery function that was first introduced on the Vivosmart 4 fitness tracker (*Shopper 374*). This uses sleep quality, stress level and activity data to score your current energy reserves out of 100, letting you know at a glance when to exercise or when to rest. It sounds gimmicky, but we found that

it works well, and can potentially be helpful in planning a workout schedule.

Another addition is the Pulse Ox sensor. This gives you an insight into your blood oxygen levels during sleep and on demand, which can be useful for determining if you've acclimatised to your altitude on hikes. It's difficult to say how practical this feature is in day-to-day use, unless you're concerned you might suffer from a condition such as sleep apnoea. Your heart rate is generally a better indication of overall fitness levels.

Hydration tracking is more useful, even it's ultimately just a convenient way of manually logging what you drink, and there's a new menstrual cycle tracking feature as well.

As with practically every other Garmin sports watch, the Vivoactive 4 lets you track your position using GPS, Galileo and GLONASS satellites. In addition to all the regular modes such as running, cycling and pool swimming, the Vivoactive 4 offers an eclectic range of other sports-tracking modes such as golf, skiing, strength, cardio and yoga.

It has all the similarly priced devices in Garmin's Forerunner range well beaten in terms of the sheer number of sports it will track, then. Sadly, however, there's no open-water swim or triathlon mode.

FIT FOR PURPOSE

While we had no problems whatsoever with GPS accuracy, it's worth noting that the Vivoactive 4 is compatible with Bluetooth and ANT+ cycling speed/cadence sensors and footpods, both of which can improve the reliability of distances logged on any sports watch, especially if you regularly exercise in areas with a patchy signal.

Similarly, you can use the Vivoactive 4 with an external heart-rate monitor, although again there's no reason to upgrade right away since the Vivoactive 4 does a perfectly good job on its own. It regularly



came within three or four beats per minute of a chest strap we had paired to a Fenix 5 Plus, which is very accurate for a standalone wrist-mounted tracker.

The main new sports feature for the Vivoactive 4 isn't a mode as such, but rather its new animated guided workouts. Simply open a sports mode from the watch, swipe up, and you'll see the option for Workouts. Tapping this in the Strength mode reveals a number of different options, such as 30-minute Blast and Maximise Your Upper Body. When you start the workout, an animation appears on the screen showing you how to perform the exercise.

AND EVERYONE'S INVITED

It's a great idea, and something that works nicely alongside Garmin Coach. Set up via the Connect mobile app, this tool lets you create personalised training plans for races from 5K up to half-marathon distances. Although that might sound like a feature for seasoned runners, it's equally well suited to newbies who wish to set a goal of merely finishing, rather than doing so within a certain time.

With all these well-executed features and decent battery life – we got around four to five days out of it with occasional GPS use – the Vivoactive 4 is an excellent smartwatch/fitness tracker hybrid. It fixes the issues we had with the Vivoactive 3, and adds many more qualities besides.

Edward Munn



SPECIFICATIONS

PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.3in • RESOLUTION 260x260 • OS SUPPORT Android, iOS • BATTERY LIFE Five days • WARRANTY One year RTB • DETAILS www.garmin.com • PART CODE 010-02174-02



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FITNESS BAND

SAMSUNG Galaxy Fit e



£31 • From www.amazon.co.uk

VERDICT

Unobtrusive and easily usable, the Galaxy Fit e is great value for money

THE SAMSUNG GALAXY Fit e is a cheap and cheerful fitness tracker that walks in the shadow of its more expensive sibling, the Galaxy Fit. At a glance, it's hard to tell the two apart, but the Fit e tightens its belt by taking the fundamental design of its stablemate and binning a few key features.

GPS is the big one, but at least there's everything here for basic tracking. It has a tiny 0.74in, 128x64 monochrome PMOLED display, and an equally small 70mAh battery to power a heart-rate sensor and an accelerometer.

SEE THE LIGHT

Happily, it doesn't look as cheap as it is. The Fit e is sleek, durable and lightweight, and though the clasp is slightly fiddly, the strap is comfortable and secure. It's a masterclass in simplistic design and, at a mere 15g, it's easy to forget you're wearing it.

You can wake the Galaxy Fit e's tiny display with a turn of the wrist, or by double-tapping on the bottom of the watch face. It's easy to wake by accident; the display often burst into life as we rolled over in bed, much to our retinas' chagrin.

As something of a silver lining, these accidental night-time activations proved that on full beam, the Fit e's display is exceptionally bright for its size. Only in direct sunlight is it even remotely difficult to read.

However, even with a dimmed screen, battery life isn't particularly impressive. The most we got out of it was seven days, and that was with low brightness and the heart-rate sensor disabled; with both on, it was four days. That would be fine for a fitness smartwatch, but for a little band like this, we expect more: the Honor Band 5 (*Shopper* 384), for example, chugs along for up to 14 days with a similarly small 100mAh battery.

This is no touch display, so you'll have to give it a whack to cycle through the menu. Tapping the watch face takes you through your daily step count, calories burned and time slept, as well as your current heart rate and the weather, if you have those functions enabled. As with the homescreen, you can adjust the order of these menu items (or add or remove them entirely) in the app. You'll also receive message and email alerts, both onscreen and via a brief vibration.

To set up the Fit e, you'll need to install the Galaxy Wear app. From there, you can adjust the settings mentioned above, as well as set alarms and check the remaining battery (something you can't do from the tracker itself, weirdly).

If you want the full fitness tracking experience, however, you'll also need to install the Samsung Health mobile app, which allows you to track activities via GPS, as well as record your food and drink intake, calories burned and weight.



Samsung Health lets you export workouts to most major fitness or social media apps, including Strava – something that's not possible with the Xiaomi or Honor equivalents. If you go in for the social aspect of fitness apps, Samsung's Together platform also lets you add friends, compete with them in head-to-head challenges and take part in community events, such as reaching a total step count over the course of a month.

There's even a section with meditation programs, sleep-aiding soundtracks and a news feed that pulls through relevant articles from the health and wellbeing sector. It's a comprehensive, easy-to-navigate fitness app, and it's complemented nicely by the Galaxy Fit e.

When connected to your phone, the Fit e supplements workouts logged via the app with heart-rate data. Without a connection, however, it only tracks steps taken, calories burned and distance travelled. Should you leave it on at night, it will also log the quality of your sleep.

SNOOZE HOUND

While the breadth of the Galaxy Fit e's tracking capabilities is a fraction of that of, say, the Garmin Vivoactive 4 on page 43, what is included works well. Step counting and heart-rate monitoring are both reasonably accurate, and sleep tracking is a particular highlight for the money. It accurately picks up moments of restlessness and doesn't require any user input to begin recording, although you can also log your sleep manually if you forget to wear the band at night.

Of course, this is nothing that the Honor Band 5 can't do, but that's also a brilliant-value fitness tracker for beginners; there's nothing wrong with merely matching greatness instead of exceeding it. Throw in an excellent app in Samsung Health, and the Galaxy Fit e is a fine choice.

Will Georgiadis

SPECIFICATIONS

PEDOMETER Yes • **HEART-RATE MONITOR** Yes • **DISPLAY** SIZE 0.74in • **RESOLUTION** 128x64 • **OS SUPPORT** Android, iOS • **BATTERY LIFE** One week • **WARRANTY** One year RTB • **DETAILS** www.samsung.com • **PART CODE** SM-R375NZKAPHE

SAMSUNG Galaxy A90 5G



£640 • From www.amazon.co.uk

VERDICT

A mostly high-quality Android handset, but once again the commitment to 5G feels premature

2019 WAS SUPPOSED to be the year of 5G, but with extremely limited coverage and compatible handsets leaning towards the ultra-high end, it's not been easy to take advantage of those faster mobile data speeds. The Galaxy A90 5 aims to break down at least one of those barriers: although it's still an expensive smartphone, it's hundreds of pounds cheaper than the Galaxy S10 5G.

The A90 5G still has all the good looks of a premium Galaxy phone. The bezels are minimal and the back panel is comfortably curved glass, and outside of a lack of wireless charging, the design does well for practicality, too. There's a microSD card slot, supporting cards up to 512GB, as well as an in-display fingerprint sensor.

To save a bit of money, the A90 has a Full HD+ (2,400x1,080) screen rather than pushing for 4K resolution. This is fine: 1080p is sharp enough even on a 6.7in screen, and it helps with battery life as well as cost. What's more, it performs brilliantly, with 99% sRGB colour gamut coverage, and auto-brightness can reach as high as a dazzling 458cd/m².

SNAP BACK

Unusually for a European-released Samsung phone, the A90 5G arrives with a Qualcomm Snapdragon chip rather than Samsung's Exynos equivalent. In this case, it's the Snapdragon 855, which is soon to be replaced by the Snapdragon 865, yet remains lightning fast: in Geekbench 4, the Galaxy A90 scored 3,373 in the single-core test and 10,728 in the multicore test. That puts it behind the much pricier Galaxy S10 5G for single-core power, but slightly ahead for multicore.

Gaming performance is also functionally identical. In the GFXBench Manhattan 3 offscreen test, the A90 5G scored 98 to the S10 5G's 96fps, and both produced 60fps in the onscreen test. This is all a relief; the lower price compared to the S10 5G hasn't hurt CPU or GPU performance at all.

Even better, the Galaxy A90 5G actually lasts longer than its stablemate from a single charge, partially thanks to that lower-resolution display. In our battery benchmark it managed an excellent 23h 38m, outperforming the 20h 41m of the S10 5G.

The Galaxy A90 5G comes with a triple camera array consisting of a main 48-megapixel, f/2.0 lens, supported by an 8-megapixel wide-angle lens and a 5-megapixel depth sensor (both f/2.2).

HAPPY SNAPS

Despite the comparatively narrow aperture, the A90 5G takes a pretty good picture. Outdoors, it captures fine details just as well as the OnePlus 7T (*Shopper* 383), and indoors we'd say the A90 5G is very slightly better: it seems to capture colours and details just that tiny bit more faithfully.

Video performance, however, is a weak spot. The A90 5G lets you tinker with the way that video is recorded, letting you capture footage at 720p, 1080p or 4K resolution, with the option to up it to 60fps at 1080p. Doing so loses stabilisation, which wasn't exactly stellar in the first place, and essentially makes footage unusable. We also witnessed some unfortunate blurring on the 60fps footage, which is a pity as the quality of images was pretty reasonable, despite some crushing of the blacks.

The lack of stabilisation, however, is unforgivable. We know that the Snapdragon 855 is capable of recording stabilised

footage at 4K, so the weak performance here is just sloppy.

There's also the question of whether 5G is worth investing in yet. Right now, the answer is still no; even in central London it can be hard to find somewhere with 5G coverage, and even when we did, the peak 308Mbit/s download speed we measured is well below the technology's 10Gbit/s maximum. This also dropped as far as

163Mbit/s in some areas, so while even the slowest 5G is much faster than 4G, it's also rare and inconsistent.

UNTIMELY MANNER

Fortunately, the Galaxy A90 5G is still a good smartphone even without its apparently key feature. With the Xiaomi Mi Mix 5G (*Shopper* 381) still unavailable in the UK except on contract, we'd say this is the best-value option if you want an unlocked 5G handset.

Still, there's no escaping the fact that the underlying infrastructure just isn't there yet, and you'll spend the majority of your time on 4G and Wi-Fi anyway. For similar money you could have the OnePlus 7T Pro (*Shopper* 384) or the standard Galaxy S10 (*Shopper* 379), the latter of which has dropped below £600 from some vendors. 5G remains promising, but it will be worth waiting six months and re-evaluating: by the summer, there should be more phones to choose from and, crucially, better coverage.

Alan Martin



SPECIFICATIONS

PROCESSOR Octa-core 2.8GHz Qualcomm Snapdragon 855 • **SCREEN SIZE** 6.7in • **SCREEN RESOLUTION** 2,400x1,080 • **REAR CAMERAS** 48 megapixels, 12 megapixels, 5 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 5G • **NFC** Yes • **DIMENSIONS** 165x76x8.4mm • **WEIGHT** 206g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** www.samsung.com/uk • **PART CODE** SM-A908BZKABTU

Battery life



See page 98 for performance details

APPLE iPhone 11

COMPUTER
SHOPPER
BEST BUY

★★★★★

£729 • From www.apple.com/uk

VERDICT

While not quite as fabulous as the iPhone 11 Pro, the standard model is still superb

DITCHING THE PREVIOUS generation's XR model, the iPhone 11 sees Apple bringing its cheapest smartphone back into the fold. The look and feel of the phone, though still distinct, is definitely a lot closer to the iPhone 11 Pro (Shopper 383) and iPhone 11 Pro Max than the XR was to the XS and the XS Max.

Case in point, it has the same rear camera plinth as its more expensive siblings, and once again the entire rear is made from one piece of glass, so there's no ugly trim surrounding that square. However, it's also not quite as pretty: the only part that's matt glass is the camera bump, and instead of a polished stainless steel frame like the Pro and Pro Max, the iPhone 11 has anodised aluminium running around its perimeter.

LIQUID COURAGE

Waterproofing is also inferior, albeit not to the extent it would affect everyday use. The iPhone 11 can survive depths up to two metres for 30 minutes, whereas the iPhone 11 Pro manages four metres for the same time. The more impactful points of divergence are the lack of a telephoto camera, and the display.

There's no OLED panel here: the iPhone 11 has a more basic IPS screen, at a sub-Full HD 1,792x828 resolution. It performs well in of itself – we measured a peak brightness of 625cd/m², sRGB coverage of 95.8% and contrast of 1,563:1 – but next to the iPhone 11 Pro, vibrancy and detail are visibly lower, particularly when you're watching HDR video content.

Happily, the iPhone 11 is just as powerful as the rest of the range, thanks to it having the same Bionic A13 processor. Its Geekbench 5 results of 1,334 in the single-core test and 3,417 in the multicore test place it well above the Samsung Galaxy S10 (Shopper 379), and it maxed out its 60Hz refresh rate with 60fps in the GFXBench Manhattan onscreen test.



Battery life is reasonably good, too. Surprisingly, this phone has a larger battery than the iPhone 11 Pro (3,110mAh against 3,046mAh), and thus lasted over an hour longer in our video playback test, only running dry after 18h 36m. That's a big improvement on the iPhone XR, too.

TWO'S COMPANY

The lack of a telephoto lens doesn't hurt much either, as the iPhone 11 has a brilliant camera regardless. The main lens and the ultra-wide-angle lenses – both of which are 12 megapixels – can capture fully stabilised 4K video at 60fps, and the A13 chip has the grunt to enable a pseudo-HDR effect by having the sensor record at 120fps, capturing each alternate frame at different exposure levels and combining them. It's very clever indeed.

The iPhone 11 is outstanding for stills as well, especially with the new night mode, and when it comes to unzoomed images there's no difference in quality whatsoever between the iPhone 11 and the 11 Pro.

It's a similar story for video, although you need to take some of Apple's marketing wheezes with a hefty pinch of salt. While zooming in, video is smoother than on any other smartphone we've used, but it's been that way on iPhones for a while now. The difference between the iPhone 11 and the 11 Pro is that you can enable in-zoom lens switching in 4K 60fps video. On the XR and XS, you could only enable this up to 4K 30fps.

Once you do this, however, you'll see a small jump when transitioning from one camera to the next – from 0.9x to 1x zoom and back again – and you'll also see a noticeable difference in quality between the two cameras. Again, this isn't a problem for Apple per se, particularly



in comparison to other smartphones whose video zooms are significantly more steppy than the one on the iPhone 11 models.

I IN THE SKY

You've probably worked out by now that the Apple iPhone 11 is a pretty good phone, even if there are distinct differences between it and the iPhone 11 Pro. Specifically: the display isn't anywhere near as good, it doesn't look quite as nice, it isn't as waterproof and it lacks the telephoto camera.

And yet, £729 for this isn't half bad for an Apple phone, and there's certainly far less of the 'ouch' factor of the £1,000-plus Pro models. While you certainly can buy an Android phone that can do most of what this can with better battery life and more camera lenses for the same or less, the iPhone 11 still holds its own when it comes to outright performance and camera quality.

It's also miles better than the iPhone XR and not hugely more expensive, even after Apple reduced the price of the XR to £629.

Jonathan Bray

SPECIFICATIONS

PROCESSOR Hexa-core 2.65GHz Apple A13 Bionic • **SCREEN SIZE** 6.1in • **SCREEN RESOLUTION** 1,792x828 • **REAR CAMERAS** 12 megapixels, 12 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 151x76x8.3mm • **WEIGHT** 194g • **OPERATING SYSTEM** iOS 13 • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** iPhone 11

Battery life



See page 98 for performance details

ANDROID 9.0 SMARTPHONE

MOTOROLA Moto G8 Plus



£240 • From www.amazon.co.uk

VERDICT

The very first Moto G8 model is big and bright, with a heavily upgraded camera

ODDLY, THERE'S NO Moto G8 to accompany this Moto G8 Plus; Motorola has taken the unusual step of launching a plus-sized version of a smartphone that doesn't yet exist.

Still, there's reason to be interested. The Moto series has been arguably the best single family of budget smartphones for years, and the Moto G8 Plus updates things with a Qualcomm Snapdragon 665 processor and redesigned camera setup centred around a 48-megapixel sensor.

The 6.3in screen dominates the front, with reasonably thin bezels all the way around. There are no sharp angles to speak of, and this continues on to the rear, which gently curves to meet a smooth polycarbonate back that feels extremely comfortable to hold.

The only design misfire is how the rear camera is laid out. It's split into two sections: the lower section contains two cameras, the flash and the laser autofocus sensor, and this is crowned with a separate single, circular lens that sits in the very top-left corner. It's a strange look and, with the circular Moto logo fingerprint reader in the middle, makes it all look weirdly lopsided.

Still, that's a minor thing, and far less important than the other little extras Motorola has included. There's a 3.5mm headphone jack, which is great to see, and it supports microSD cards of up to 512GB to augment the 64GB of built-in storage. It's only splashproof rather than waterproof, but the essentials are there.

GLARE TACTICS

The Moto G8 Plus has a large 6.3in, 19:9 aspect-ratio display, running at 2,280x1,080. It's only IPS, not AMOLED, but it's a good screen all things considered. In the Natural profile, it covers 88.5% of the sRGB gamut, and although the 935:1 contrast ratio is nothing special, the peak brightness of 605cd/m² is very high indeed. You won't have any problems reading the screen even on the sunniest of days.

The Snapdragon 645, meanwhile, is an octa-core processor with cores split evenly between 2GHz and 1.8GHz. It's backed by 4GB of RAM and 64GB of internal storage, and makes the Moto G8 Plus feel suitably slick in normal use. There's been a modest performance boost over the Moto G7 Plus, judging by the new model's Geekbench 4 scores: 1,531 in the single-core test and 5,639 in the multicore test are both decently up on the preceding handset's respective 1,326 and 4,869.

It should be noted, however, that the Pocophone F1 (*Shopper 373*) only costs £230 and absolutely destroys both Moto phones, having scored 2,454 and 8,427 in the same tests. It's also by the far the best budget gaming option, with 59fps in the GFXBench Manhattan onscreen test; the Moto G8 Plus scored 19fps, so it will run basic games well, but can't compete with the F1 on challenging 3D games.

The Moto G8 Plus's 4,000mAh battery propels it to a winning result in our video rundown test, however. With a final result of 17h 55m, it outlasts the G7 Plus by about seven-and-a-half hours, and the Pocophone F1 by just under two-and-a-half hours.

DRASTIC ACTION

The biggest upgrade of all is that rear camera. First, a quick recap of what it offers: there are three lenses on the back, only two of which are for stills: a 48-megapixel main snapper, which is supported by a 2-megapixel depth sensor for arty bokeh shots. There's also an 8-megapixel ultrawide sensor, but this is just used for video.



In our initial outdoor shots, we were surprised that the Moto G8 Plus was only slightly improved – brightness is up, while the level of detail is about the same – but the new model's larger aperture really comes into its own for low-light indoor photography. Not only are the G8 Plus's photos sharper, with less noise, but colour accuracy is better too.

In terms of video, the Moto G8 Plus offers plenty of options, but not all of them are hugely practical. Its main party trick – and it's a good one – is the action cam mode, which lets you shoot landscape videos while holding the phone in portrait mode.

This mode is available in either HD or Full HD at 30fps or Full HD at 60fps. Why the breakdown? Because if you go for 60fps, you lose image stabilisation, and the resulting footage is essentially unusable unless you pop your phone on a tripod or use a gimbal.

GREAT G8 MATE

If you record video in landscape mode, 4K is unlocked as an option, but as this mode also lacks stabilisation it's not video you'd especially want to show anyone. Which is a pity, as the footage is nicely detailed when it's not twitching about.

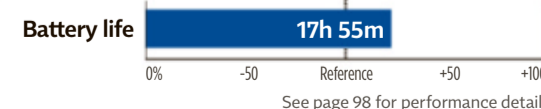
In all, the Moto G8 Plus is another fine addition to the Moto G series. There's stiff competition from the Pocophone F1, but Motorola's handset is good looking, pretty nippy and very adept at taking photos.

Alan Martin



SPECIFICATIONS

PROCESSOR Octa-core 2GHz Qualcomm Snapdragon 665 • **SCREEN SIZE** 6.3in • **SCREEN RESOLUTION** 2,280x1,080 • **REAR CAMERAS** 48 megapixels, 2 megapixels, 8 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 158x76x9.1mm • **WEIGHT** 188g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** www.lenovo.com • **PART CODE** PAGE0000GB



E-READER

AMAZON Kindle Kids Edition



£100 • From www.amazon.co.uk

VERDICT

The Kindle Kids Edition adds a protective case and a damage guarantee to a familiar device

IN THE PAST, if you were a parent and wanted to get your children reading books on a Kindle, you'd have to make do with simply setting up a child's profile and then choosing which books you want to add to their library.

Now, however, Amazon has released the all-new Kindle Kids Edition. Following in the footsteps of the Fire Kids Edition tablets, it comes with a year's subscription to Fire for Kids Unlimited content, plus the peace of mind of a protective case and a two-year guarantee against accidental damage.

Otherwise, this is exactly the same device as the regular Kindle model launched in 2019 (*Shopper* 378). That means it has the same 6in E-Ink touchscreen display, as well as a front light for reading in the dark.

The Fire for Kids Unlimited subscription, meanwhile, gives your little ones access to thousands of children's books at no additional cost. However, there's no way to access the audiobooks, educational apps, films and TV that you also get with the same subscription on a Fire Kids tablet.

SHIELDS UP

Granted, the E-Ink screen isn't made for video content, and it's just as good for reading as it is on the standard Kindle. There's no ambient light sensor, so screen brightness must be changed manually, but the display always stays readable in any lighting conditions.

The only real design difference, then, is that it comes with a choice of either a pink or blue protective case. This feels well constructed and suitably protective, if not made with easy cleaning in mind: the soft-touch texture on the inside of the front cover, in particular, looks as though it will quickly gather dirt from grubby hands. In a rather nice touch, however, it contains a magnet that not only keeps it firmly shut but also wakes and puts the Kindle to sleep when opened and closed.

When you first use the Kindle Kids Edition, it invites you to set up your child's profile and activate the Fire for Kids Unlimited subscription. After this, children can start browsing books right away from the subscription service using categories that include Characters & Themes, New Books and Popular Books.

There are plenty of included titles, including the full Harry Potter series and

out-of-copyright classics such as *Treasure Island* and *The Wind in the Willows*. However, it's not an exhaustive selection; we couldn't find Philip Pullman's *His Dark Materials* trilogy or JRR Tolkien's *The Hobbit*, to give just a couple of big literary names.

Moreover, while the display is great for text, more visual-heavy publications such as the *Beano Annual* are simply more suited to the Fire 7's colourful screen. There's nothing to stop you buying any title from the Kindle store and adding it to your child's library, of course, but it's a shame that Amazon hasn't made it easier to see what the subscription includes before you part with your hard-earned cash.

LEARNING CURVE

As a reading device, however, it's worth repeating that the Kindle Kids Edition works very well. In the same way as the regular Kindle, you can easily customise the size of the font, and the handy Word Wise feature lets you show hints for difficult words on the page, potentially helping your child to build their vocabulary without having to look up words individually.

If a word isn't flagged via Word Wise, they can still long-press it to check its definition, and any words looked up in this way are added to the Vocabulary Builder. From here, words can be revisited at any time and marked when mastered. It's these kinds of features that make the Kindle Kids Edition arguably better suited than any printed book to helping children develop their reading skills, especially when there are none of the distractions you'll find on a tablet.

It's also possible to check in on your children's progress both on the device and via the Parents Dashboard on your smartphone

or a web browser. Doing this via the Kindle offers more in-depth stats, letting you check the total time spent reading each book as well as the number of pages read per day. There are also daily targets and game-style achievements, to help motivate young users into reading more.

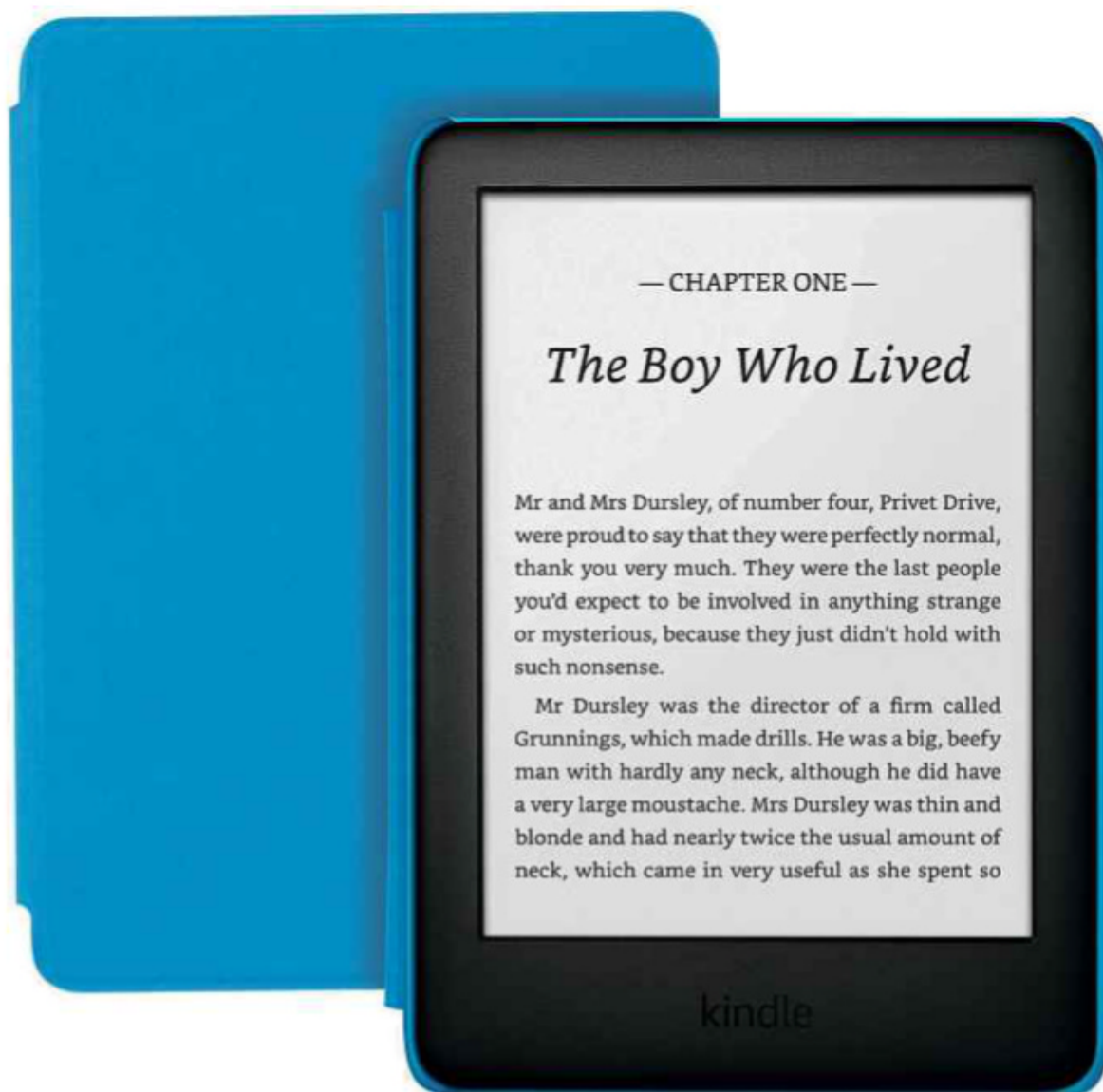
Should you ever want to use the Kindle Kids Edition yourself, you'll be pleased to discover that it works just like any other Kindle when you've quit the Fire for Kids mode. This means you can access the Kindle Store, Goodreads, and even download and listen to Audible Audiobooks, which are sadly missing from the children's app.

YOUTH WORKER

As an e-reader to share with a child, then, the Kindle Kids Edition is a good option. The main problem is that practically all its features can also be found on the regular Kindle. Whether it's worth paying £30 extra for, then, depends on how much you value the two-year accidental damage cover, protective case and one year's content subscription.

Remember also that a Fire for Kids Unlimited subscription entitles your child to far more content on a Fire 7 Kids Edition tablet at the very same price. Unless you're desperate to keep your children away from the bright blue light of a tablet, the Fire Kids Edition will likely be the more appealing device for both parents and children.

Edward Munn



SPECIFICATIONS

SCREEN SIZE 6in • SCREEN RESOLUTION 256ppi • STORAGE 4GB • DIMENSIONS 162x119x14mm • WEIGHT 288g • WARRANTY One year RTB • DETAILS www.amazon.co.uk • PART CODE Kindle Kids Edition

Choosing a... PC system

01 A basic PC costing around £350 will be able to run everyday office, multimedia and education software and will easily cope with surfing the internet. It might even be able to run some modern games.

Many PCs can be sold either with or without a monitor. If you don't like the display the manufacturer is offering, you can always use your current one, or buy another one separately.

02 If you want to play games, you'll have to upgrade the graphics card. Budget cards such as the Nvidia GeForce GTX 1050 will cope well with many 3D games, but to play the latest 3D games smoothly (and enjoy the best-quality graphics) it's worth upgrading to a more powerful card such as the Nvidia GeForce GTX 1070.

03 All modern PCs come with at least a dual-core processor and are capable of most tasks. Anyone who regularly undertakes demanding tasks such as video editing and encoding should consider a hexa-core or even an octa-core processor.

04 There are plenty of good reasons to upgrade the PC's memory or hard disk. If you'll use your PC for gaming, video editing or other demanding tasks, you'll need at least 8GB of RAM and a large hard disk; 1TB should suffice. Many new PCs have an SSD, which speeds up the time it takes for your PC to boot and for programs to load.

05 Having plenty of USB ports is always useful, as most computer

peripherals attach to these ports. Most new PCs come with USB3 or the latest USB3.1 ports, which provide faster data transfers when used with supported devices than the older USB2 standard.

06 Most new PCs now come with Windows 10 pre-installed. Don't be too easily swayed by the inclusion of other software, though, as it may be that you'll never use it.

07 While most PCs come in cases of a similar size, some have more compact mini tower or mini PC cases. These smaller PCs will fit under your TV or on your desk more easily, but bear in mind that they're significantly harder to upgrade than full-size machines.

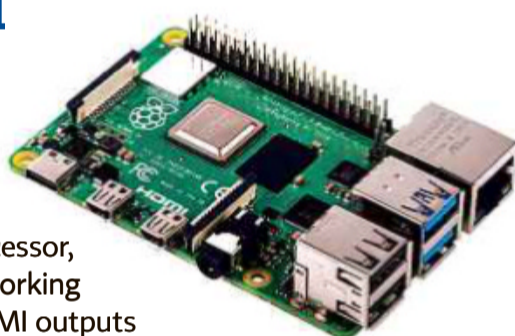
PCs

RASPBERRY PI

4 Model B

★★★★★

£34 • thepihut.com



COMPUTER SHOPPER
BEST BUY

A faster processor, quicker networking and dual HDMI outputs

make the Pi 4 a much better desktop computer than previous Pi models, and it hasn't lost any appeal as a cheap hobbyist board, either. 4K video implementation could be better – we had issues getting smooth playback in Raspbian – but that's the only noteworthy concern.

PROCESSOR 1.5GHz quad-core Broadcom BCM2711 • **RAM** 1GB • **USB PORTS** 1x USB Type-C (power), 2x USB2, 2x USB3 • **STORAGE** MicroSD card slot • **DISPLAY** None • **OPERATING SYSTEM** Raspbian • **WARRANTY** One year RTB • **DETAILS** www.raspberrypi.org • **PART CODE** Pi 4 Model B • **FULL REVIEW** Sep 2019

ACER Chromebox CXI3

★★★★★

£528 • uk.insight.com

COMPUTER SHOPPER
RECOMMENDED

An absolutely tiny Chrome OS system, the Chromebox CXI3 is compact enough to attach to the back of a monitor. Even better, it has more power than most Chromeboxes, thanks to its Core i5 processor, and is loaded with useful ports in spite of its minimal size. It's cheap, too, although we'd recommend investing in a better mouse and keyboard than the bundled peripherals.



PROCESSOR Quad-core 1.6GHz Intel Core i5-82500U • **RAM** 8GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 3x USB3, 1x USB Type-C • **TOTAL STORAGE** 64GB SSD • **DISPLAY** None • **OPERATING SYSTEM** Chrome OS • **WARRANTY** One year RTB • **DETAILS** www.acer.com • **PART CODE** DT.ZOSEK.001 • **FULL REVIEW** Aug 2019

CCL Paladin

★★★★★

£1,620 • www.cclonline.com

COMPUTER SHOPPER
BEST BUY

The Paladin is stuffed with AMD's latest technology, including the excellent octa-core Ryzen 7 3700X CPU and a 4K-capable Radeon RX 5700 XT graphics card. Storage is another highlight: the SSD isn't a PCI-E 4.0 model, which the motherboard is compatible with, but it's still very fast and offers an enormous 1TB of space by itself.



PROCESSOR Octa-core 3.6GHz AMD Ryzen 7 3700X • **RAM** 16GB • **FRONT USB PORTS** 2x USB2, 2x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 1TB SSD, 2TB hard disk • **GRAPHICS CARD** 8GB AMD Radeon RX 5700 XT • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years collect and return • **DETAILS** www.cclonline.com • **PART CODE** GAME-PBME 0202 0304 0100 0200 0000 0000 0200 01 • **FULL REVIEW** Nov 2019

PALICOMP AMD Abyss

★★★★★

£700 • www.palicomp.co.uk

COMPUTER SHOPPER
BEST BUY

At this price, you'd seriously struggle to find a more comprehensively capable desktop system than Palicomp's AMD Abyss. It can multitask with serious applications just as well as it can run games, and with its large, fast NVMe SSD, it won't be slowed down by storage. There's a lot of room for future upgrades, too.



PROCESSOR Hexa-core 3.6GHz AMD Ryzen 5 2600X • **RAM** 8GB • **FRONT USB PORTS** 2x USB2, 1x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 512GB SSD, 1TB hard disk • **GRAPHICS CARD** 8GB AMD Radeon RX570 Armor 8GB OC • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years RTB • **DETAILS** www.palicomp.co.uk • **PART CODE** RYZ6 • **FULL REVIEW** Apr 2019

Choosing a... Laptop

01 A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming or processor-intensive tasks such as video editing. Many laptops at this price have a 15.6in screen and weigh over 2kg, so they're best used around the house and for occasional journeys.

02 If you want to play modern games, you'll need a laptop with a dedicated graphics chip such as the Nvidia GeForce GTX 1060M. Good gaming laptops tend to have large 15.6 or 17in screens and weigh around 3kg, so they're best suited to use at home.

03 If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best

portability, buy one that has a 13.3in or 14in screen. In general, the smaller and lighter the laptop, the more expensive it is, especially if it has plenty of processing power.

04 Battery life is extremely important for a laptop, particularly if you'll be carrying it around. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultraportable that you carry everywhere, eight hours and above is more desirable.

05 Laptops use mobile versions of processors to conserve power, and these lag behind desktop chips when it comes to performance. For a budget Windows laptop, an Intel Core i3 processor will do the job, but if you

want better performance, you should look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

06 Most budget and mid-range laptops use a mechanical hard disk for storage. You'll want at least 500GB, but 1TB or more is better. Solid-state drives (SSDs) have faster performance, making your computer quicker to boot and more responsive. They have lower capacities, though. You'll need at least 128GB.

07 Convertibles and 2-in-1 laptops can change from laptop mode to tablet mode. We've listed our favourite models later on in this guide in the Tablets section.

LAPTOPS

HP Envy 13

★★★★★

£779 • store.hp.com

COMPUTER SHOPPER
BEST BUY

There are plenty of great ultraportables available these days, but most of them cost well over £1,000.

The Envy 13 is an extremely attractive alternative: it's slim and light, weighing just 1.2kg, but it has plenty of power and high-end features including a fingerprint reader and dedicated graphics, and what's more, it's relatively affordable.



PROCESSOR Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB • **DIMENSIONS** 307x212x14.9mm • **WEIGHT** 1.2kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Nvidia GeForce MX150 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** www.hp.com • **PART NUMBER** ah0001na • **FULL REVIEW** Sep 2019

ACER Aspire 5

★★★★☆

£599 • www.currys.co.uk

COMPUTER SHOPPER
RECOMMENDED

The Aspire 5 is the epitome of the sensible mid-range laptop. It's not ultra-stylish and it doesn't have a professional-quality display, but for the price it offers reliable performance in a variety of workloads, and it will last a full day on battery power without much trouble.



PROCESSOR Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB • **DIMENSIONS** 382x263x21mm • **WEIGHT** 2.2kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.acer.com • **PART CODE** A515-51-50YS • **FULL REVIEW** Oct 2018

DELL Latitude 3300

★★★★☆

£629 • www.dell.com

COMPUTER SHOPPER
RECOMMENDED

Dell's affordable and well-built Latitude 3300 is made for students, but the fact that it has strong specs for the price can be appreciated by anyone looking for a general-purpose laptop. The quad-core CPU keeps performance up, and this particular model has a superior 256GB SSD to the even cheaper versions' eMMC drives.



PROCESSOR Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB • **DIMENSIONS** 330x231x22.9mm • **WEIGHT** 1.56kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel UHD Graphics 620 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Pro • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** www.dell.com • **PART CODE** n013l330013emea • **FULL REVIEW** Jan 2020

ASUS ROG Strix Scar III

★★★★☆

£2,600 • www.box.co.uk

COMPUTER SHOPPER
RECOMMENDED

The ROG Strix Scar III compromises nothing in its pursuit of top-quality portable gaming. While this means a high price, it also means a 240Hz display, an incredibly powerful Core i9 processor and Nvidia's high-end RTX 2070 GPU. Despite not being a true thin-and-light gaming laptop, it's not too heavy and unwieldy, either.



PROCESSOR Octa-core 2.3GHz Intel Core i9-9980H • **RAM** 32GB • **DIMENSIONS** 360x275x24.9mm • **WEIGHT** 2.57kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** 8GB Nvidia GeForce RTX 2070 • **TOTAL STORAGE** 1TB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** www.asus.com • **PART CODE** G531GW-AZ055R • **FULL REVIEW** Oct 2019

Choosing an... Internal hard disk

01 A basic 1TB internal hard disk should cost around £40. This will be fast enough for general use and will provide enough storage for most users.

Make sure the hard disk you choose has the appropriate interface type for your PC. Most hard disks and solid-state drives (SSDs) use the SATA3 interface, which enables faster speeds than the older SATA2. Pretty much every motherboard released in recent years will have multiple SATA3 ports, allowing you to connect several storage drives at once.

02 SSDs can make the most of SATA3's high bandwidth for fast file transfers. They use flash memory similar to that found in USB flash drives, and although they tend

to provide less capacity than mechanical hard disks, they're significantly faster. More expensive SSDs use the NVMe standard, which is even faster than SATA3, but require an M.2 slot on the motherboard.

03 Buy a hard disk that provides more capacity than you think you need, as your storage requirements are likely to grow. A 2TB disk strikes the best balance between capacity and low cost per gigabyte.

04 If you want more disk space or you want to protect your data against disk failure, think about buying several hard disks to create a RAID array. These use multiple hard disks to create one large logical disk with better performance, or to

duplicate your data for better protection. RAID arrays require hard disks of the same size. In theory, they can be from different manufacturers, but it's better to buy identical disks if you can.

05 A hard disk's spindle speed determines how quickly it can transfer data. A spindle speed of 7,200rpm is common in desktop drives and is fast enough for most purposes. Desktop hard disks with 5,400rpm spindle speeds are quite slow but use less power and generate less heat and noise.

To strike the best balance between speed and storage capacity, use an SSD as your system disk and store your files on a larger mechanical disk.

STORAGE

SYNOLOGY DiskStation DS418j

★★★★★

£278 • www.broadbandbuyer.com



When a tiny two-bay NAS won't cut it, the fast, high-capacity DiskStation DS418j

is an excellent upgrade, especially as it can automatically convert old hard disks to be compatible with this NAS's hardware and features.

3.5in HARD DISK BAYS (FREE) 4 (4) • NETWORKING 1x 10/100/1,000 Ethernet • DLNA MEDIA SERVER Yes • PRINT SERVER Yes • DIMENSIONS 184x168x230mm • WEIGHT 2.21kg • WARRANTY Two years RTB • DETAILS www.synology.com • PART CODE DS418j • FULL REVIEW Jan 2018



PNY ProElite 1TB

★★★★★

£149 • www.amzn.to/38sQrSJ



A tiny, very nimble portable SSD

that's both faster and cheaper than Samsung's similar T5 drive. Just make sure to connect via a USB3.1 port to get the best performance.

CAPACITY 1TB • PRICE PER GIGABYTE £0.15p • INTERFACE USB3.1 • WARRANTY Three years RTB • DETAILS www.pny.eu • PART CODE PSD0CS2060S-1TB-RB • FULL REVIEW Feb 2020



ADATA XPG SX8200 Pro 1TB

★★★★★

£114 • www.box.co.uk



The Adata XPG SX8200 Pro is outrageously

good value for the performance it delivers. It's as fast as or faster than top-tier SSDs from Samsung and WD, but costs far less across all its capacity options.

CAPACITY 1TB • COST PER GIGABYTE £0.11p • INTERFACE M.2/NVMe • WARRANTY Five years RTB • DETAILS www.xpg.com • PART CODE ASX8200PNP-1TT • FULL REVIEW Apr 2019



ADATA SD600Q 480GB

★★★★☆

£67 • www.alternate.co.uk



Put aside your fears about external SSDs being too expensive compared to hard disks – this 480GB drive is excellent value, and decently quick.

CAPACITY 480GB • COST PER GIGABYTE £0.14p • INTERFACE USB3 • CLAIMED READ 440MB/s • CLAIMED WRITE 430MB/s • WARRANTY Three years RTB • DETAILS www.adata.com • PART CODE ASD600Q-480GU31-CBL • FULL REVIEW Aug 2019



SAMSUNG Portable SSD X5 1TB

★★★★★

£438 • www.scan.co.uk



For when you absolutely need to shift files as quickly as possible, there's the X5. Its use of the Thunderbolt 3 interface makes it the fastest external SSD ever.

CAPACITY 1TB • COST PER GIGABYTE £0.44p • INTERFACE Thunderbolt 3 • WARRANTY Three years RTB • DETAILS www.samsung.com/uk • PART CODE MU-PB1T0B/WW • FULL REVIEW Dec 2018



KINGSTON A2000 1TB

★★★★★

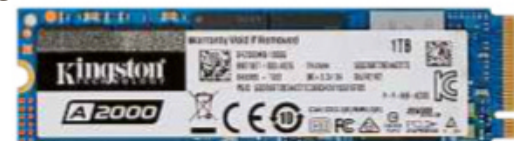
£136 • www.amzn.to/2oW7PgN



The A2000's maximum speeds don't

look all that hot, but this SSD performs exceptionally well in the kinds of non-sequential transfer tasks you're more likely to actually undertake in your day-to-day computing.

CAPACITY 1TB • COST PER GIGABYTE £0.12p • INTERFACE M.2/NVMe • CLAIMED READ 2,200MB/s • CLAIMED WRITE 2,000MB/s • WARRANTY Five years RTB • DETAILS www.kingston.com • PART CODE SA2000M8/1000G • FULL REVIEW Dec 2019



Choosing an... Intel motherboard

01 It's essential that you buy the right type of motherboard for your processor. For example, Intel's Skylake, Kaby Lake and Coffee Lake processors all use the same LGA 1151 socket, but because each CPU generation introduced new chipsets, you'll need to get a Z370 motherboard for a Coffee Lake chip, a Z270 board for a Kaby Lake chip and so on.

02 All current Intel processors have built-in graphics chipsets, so if you want to use your chip's built-in graphics, make sure the motherboard has the video outputs, such as DVI, HDMI and DisplayPort. If you want to play the latest games, you'll need to fit a dedicated graphics card in the motherboard's PCI

Express x16 slot, although this may block one of your other slots.

03 Normal tower cases can accommodate ATX motherboards, which provide the most expansion slots. A microATX motherboard will let you build your PC in a smaller case, but if you opt for a microATX board, make sure it has all the features you need built in as there won't be much room for expansion cards.

04 If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI Express x4 slots and extra PCI Express x16 slots. PCI Express x1 and x4

cards also work in PCI Express x16 slots. If you need a lot of storage, a motherboard with plenty of SATA2 and SATA3 ports is essential. SATA2 is fine for optical drives and hard disks, but to make the most of an SSD you need SATA3.

05 All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output. All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

COMPONENTS

AMD Ryzen 9 3900X

★★★★★

£497 • www.ebuyer.com

COMPUTER SHOPPER
RECOMMENDED

Forget the Intel Core i9-9900K – this 12-core monster of a CPU performs far better for similar money. There is a drawback, in that it's not very overclocking-friendly, but that's partly because it's so fast to begin with. Pair it with some good RAM, and you're already most of the way to a capable home workstation.

SOCKET AM4 • CORES 12 • FREQUENCY 3.8GHz • INTEGRATED GRAPHICS None • WARRANTY Two years RTB • DETAILS www.amd.com • PART CODE 100-100000023BOX • FULL REVIEW Nov 2019



AMD Radeon RX 5700

★★★★★

£290 • shop.amd.com

COMPUTER SHOPPER
BEST BUY

AMD's 7nm GPU is cheaper than the GeForce RTX 2060 and the RTX 2060 Super, yet is just as comfortable with gaming at 1080p and 1440p. This price only seems to apply for the reference design rather than partner versions, but the blower-style cooler is the only real downside.

GPU AMD Radeon RX 5700 • MEMORY 8GB GDDR6 • GRAPHICS CARD LENGTH 268mm • WARRANTY One year RTB • DETAILS www.amd.com • PART CODE Radeon RX 5700 • FULL REVIEW Oct 2019



AMD Ryzen 7 3700X

★★★★★

£290 • www.amzn.to/2nFtHMC

COMPUTER SHOPPER
BEST BUY

This octa-core chip has all the single-core strength of the Ryzen 9 3900X, with multitasking power that still puts it well beyond its Intel rivals. Low pricing and power efficiency are additional highlights: the Ryzen 7 3700X only draws up to 65W, a tiny amount for this many cores.

SOCKET AM4 • CORES 8 • FREQUENCY 3.6GHz • INTEGRATED GRAPHICS None • WARRANTY Two years RTB • DETAILS www.amd.com • PART CODE 100-100000071BOX • FULL REVIEW Dec 2019



THERMALTAKE View 37

★★★★★

£110 • www.scan.co.uk

COMPUTER SHOPPER
BEST BUY

A spacious, feature-rich chassis for both ATX- and EATX-based builds, the View 37 comes with a gull-wing side window that's perfect for showing off your handiwork.

CASE TYPE Mid-tower • MOTHERBOARD TYPE ATX, EATX, microATX, Mini-ITX • SUPPLIED FANS 2x 140mm • MAX DRIVE BAYS 7x 3.5in, 11x 2.5in • DIMENSIONS 525x261x538mm • WEIGHT 11.8kg • WARRANTY Three years RTB • DETAILS www.thermaltake.com • PART CODE CA-1J7-00M1WN-00 • FULL REVIEW Dec 2018



ASUS ROG Strix Flare

★★★★★

£115 • www.game.co.uk

COMPUTER SHOPPER
BEST BUY

Besides being a comfortable and responsive gaming keyboard, thanks to its reliable Cherry MX Red switches, the ROG Strix Flare is loaded with useful features and extras: there's a set of dedicated media controls and a USB2 pass-through port, among others.

KEYBOARD SHAPE Full size • NUMBER PAD Yes • CONNECTION 1x USB2 • MEDIA KEYS Pause/play, mute, skip, volume • USB PORTS 2x USB2 • WARRANTY One year RTB • DETAILS www.asus.com/uk • PART CODE 90MP000MO-BOEA00 • FULL REVIEW Oct 2019



MSI MPG Z390 Gaming Edge AC

★★★★★

£137 • www.scan.co.uk

COMPUTER SHOPPER
BEST BUY

From built-in 802.11ac Wi-Fi and Bluetooth to high-end audio connectivity, the MPG Z370 Gaming Edge AC is stuffed with features. Add in a good price, easy overclocking and a well-designed BIOS, and it's perfect for premium Intel-based builds.

PROCESSOR SOCKET LGA1151 • DIMENSIONS 305x244mm • CHIPSET Intel Z390 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 3 • PCI-E x1 SLOTS 3 • PCI SLOTS 0 • USB PORTS 2x USB2, 2x USB3, 1x USB3.1, 1x USB Type-C • VIDEO OUTPUTS 1x HDMI, 1x DisplayPort • WARRANTY One year RTB • DETAILS www.msi.com • PART CODE MPG Z390 Gaming Edge AC • FULL REVIEW Apr 2019



Choosing a... Display

01 A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on for the best picture quality. Its colour accuracy may not be very good, either.

02 A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a graphics card with a DisplayPort output (mini or full-size) to use this input on your monitor.

03 A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have a resolution of at least 1,920x1,080 (1080p), which provides lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display. Some 27in and 30in screens have 2,560x1,600 or even 4K resolutions. You'll need a graphics card with a dual-link DVI output and a dual-link DVI

cable or either HDMI or DisplayPort to use a monitor at these resolutions.

04 If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also be able to see more fine detail in images with high contrast levels. Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

DISPLAYS

LG 34GK950F

★★★★★

£1,000 • www.overclockers.co.uk



LG's curved ultrawide monitor is as versatile as it

is vibrant. HDR is supported (if only to the DisplayHDR 400 standard), colours are accurate, and both AMD FreeSync and Nvidia G-Sync can smooth out games.



SCREEN SIZE 34in • RESOLUTION 3,440x1,440 • REFRESH RATE 144Hz • SCREEN TECHNOLOGY IPS • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Three years collect and return • DETAILS www.lg.com • FULL REVIEW Jun 2019

Iiyama G-Master Black Hawk G2530HSU-B1

★★★★★

£130 • www.amzn.to/2PyKdYJ



A fine alternative monitor to the AOC G2460VQ6, also with a 75Hz refresh rate as well as FreeSync support for tear-free gaming on AMD graphics cards. The slim-bezel design is good for the money, too.



SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS HDMI, DisplayPort, VGA • WARRANTY Two years onsite • DETAILS www.iiyama.com • PART CODE G2530HSU-B1 • FULL REVIEW Mar 2019

EIZO ColorEdge CG279X

★★★★★

£1,692 • www.wexphotovideo.com



This professional-quality monitor benefits from automatic calibration,

ensuring practically perfect colour accuracy and wide coverage of the sRGB, DCI-P and Adobe RGB gamuts. It's a worthwhile investment for editing photos and videos.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS VGA, HDMI, DisplayPort, DVI, USB Type-C • WARRANTY Five years RTB • DETAILS www.eizoglobal.cpm • FULL REVIEW Jun 2019

AOC CQ32G1

★★★★★

£310 • www.ballicom.co.uk



AOC has a habit of making great-value, large-screened VA monitors,

and the CQ32G1 is another to add to the list. A 144Hz gaming display first and foremost, it's as fast and good-looking as it needs to be, and supports both AMD FreeSync and, unofficially, Nvidia G-Sync.



SCREEN SIZE 31.5in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • REFRESH RATE 144Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY One year repair and replace • DETAILS eu.aoc.com • FULL REVIEW Nov 2019

ACER Nitro VG270UP

★★★★★

£370 • uk-store.acer.com



A great all-round gaming monitor without the premium price. Both FreeSync and

G-Sync are supported, and the IPS panel combines a 144Hz refresh rate with vibrant colours, high accuracy and the kind of responsiveness you'd normally only get from a TN panel.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 144Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Two years RTB • DETAILS www.acer.com • FULL REVIEW Dec 2019

Iiyama ProLite XUB2792UHSU

★★★★★

£289 • www.amzn.to/2TTIMac



If you don't need all the bells and whistles of a curved ultrawide, the ProLite

XUB2792UHSU nails the basics at a very attractive price. 4K sharpness, high brightness and full sRGB colour gamut coverage add up to a superb monitor.



SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS DisplayPort, HDMI, DVI • WARRANTY Three years onsite • DETAILS www.iiyama.com • FULL REVIEW Nov 2019

Choosing an... Inkjet printer

01 You should be able to buy a decent inkjet printer for less than £40.

High-quality printing is possible on such a printer, but it will be slow. The actual print speed of an inkjet can be half the quoted (maximum) speed for text documents, and even slower when printing graphics. Budget inkjet printers such as these are designed only for light use and can be expensive to run.

02 For £80 to £90 you can buy a more capable printer that's either faster and better built or better at reproducing photos. If documents are your priority, you'll want a high minimum speed and low print costs. Look for inkjets that can handle all your office media, such as envelopes and labels.

03 If photos are your priority, speed is less important. Choose a printer that reproduces subtle tones well. You can't determine this by looking at the specifications – only hands-on testing will do, so remember to check our reviews before you buy.

Borderless printing (up to the edge of the paper) should also be possible. Pay particular attention to running costs: photos use three times as much ink as regular colour documents.

04 Heavy-duty office inkjets can cost up to £1,000 and their build quality is improving. They use large individual ink tanks, which can cut running costs. Printers with automatic duplex (double-

sided) printing or A3 capabilities are now much more affordable.

05 Pricier photo printers let you print from memory cards plugged straight into the printer, so you don't need to use a PC. An LCD preview screen offers greater control for this method of printing. Many inkjet printers now have a PictBridge USB port, which you can use to print images directly from most digital cameras.

06 If you're really serious about photography, consider buying an inkjet that can produce borderless prints up to A3 size. The best devices can print photos that look nearly as good as those from professional labs.

PRINTERS & SCANNERS

EPSON WorkForce WF-7710DWF

★★★★★

£155 • www.amzn.to/2JVaD3B



COMPUTER SHOPPER
BEST BUY

The WorkForce WF-7710DWF allows you to print at the larger A3+ paper size, as well as fax and scan at A3, so it's great for home office users who require a bit more flexibility from their MFP.

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x2,400dpi • **DIMENSIONS** 340x567x452mm • **WEIGHT** 18.7kg • **MAXIMUM PAPER SIZE** A3+ • **WARRANTY** One year RTB • **DETAILS** www.epson.co.uk • **PART CODE** C11CG36411 • **FULL REVIEW** Nov 2018

EPSON EcoTank ET-M3180

★★★★★

£394 • www.printerland.co.uk



COMPUTER SHOPPER
RECOMMENDED

If you need to pump out black-and-white documents, the ET-M3180 is a great alternative to a bulky laser MFP. This ADF-equipped printer and scanner is impressively fast and, like the rest of the EcoTank range, has incredibly low per-page running costs.

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 2,400x1,200dpi • **DIMENSIONS** 375x347x346mm • **WEIGHT** 7.2kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** Three years onsite • **DETAILS** www.epson.co.uk • **PART CODE** C11CG93402BY • **FULL REVIEW** Nov 2019

EPSON Expression Photo XP-8600

★★★★★

£106 • www.amzn.to/2WNU54e



COMPUTER SHOPPER
BEST BUY

The Expression Photo XP-8600 focuses on creative use, and does a great job of it, too. At this kind of price, nothing else comes close on the quality of printed photos.

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440dpi • **SCANNER RESOLUTION** 1,200x4,800dpi • **DIMENSIONS** 142x349x340mm • **WEIGHT** 6.7kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** www.epson.co.uk • **PART CODE** C11CH47401 • **FULL REVIEW** Jan 2020

CANON Pixma TS205

★★★★★

£29 • www.ebuyer.com



COMPUTER SHOPPER
RECOMMENDED

It has a basic feature set and isn't very fast, but the Pixma TS205's print quality makes it a bargain. Replacement ink cartridges are the biggest expense, but that's fine if you're only printing at home occasionally.

TECHNOLOGY Thermal inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x1,200dpi • **DIMENSIONS** 131x426x255mm • **WEIGHT** 2.5kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** www.canon.co.uk • **PART CODE** 2319C008 • **FULL REVIEW** Sep 2019

CANON imageFormula DR-C230

★★★★★

£271 • www.ebuyer.com



COMPUTER SHOPPER
RECOMMENDED

This sheet-fed document scanner is perfect for getting through stacks of documents without having to manually scan each page. It's pleasantly fast and pairs with Canon's powerful CaptureOnTouch Pro software, which does a fine job of processing your scans.

TECHNOLOGY Dual CIS sheet-fed scanner • **SCANNER RESOLUTION** 600x600dpi • **DIMENSIONS** 231x291x530mm • **WEIGHT** 2.8kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** www.canon.co.uk • **PART CODE** 2646C003 • **FULL REVIEW** Feb 2018

EPSON EcoTank ET-7750

★★★★★

£539 • www.currys.co.uk



COMPUTER SHOPPER
RECOMMENDED

Like all EcoTank MFPs, the ET-7750 offsets its high price with low running costs, and this specific model delivers sharp, solid colours that suit photo printing well.

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440 • **SCANNER RESOLUTION** 1,200x2,400dpi • **DIMENSIONS** 168x526x415mm • **WEIGHT** 10.5kg • **MAXIMUM PAPER SIZE** A3 • **WARRANTY** One year RTB • **DETAILS** www.epson.co.uk • **PART CODE** C11CG16401CE • **FULL REVIEW** Sep 2018

Choosing a... Wireless router

01 Wireless routers each use a number of Wi-Fi standards, so you shouldn't have any trouble connecting your computer or phone wirelessly if you get an 802.11n or 802.11ac router. Nearly all routers support 802.11n, so even a cheap model should provide decent performance.

You can expect a transfer speed of around 40Mbit/s at a distance of 10m from any modern 802.11n router. The very latest routers use the 802.11ac standard, which provides tremendously fast transfer speeds. Some devices still don't support the 802.11ac standard, so check the specifications before you buy.

02 If you subscribe to an ADSL broadband service, you should buy

a wireless router that has a built-in ADSL modem. This will cost more than the equivalent cable router, but it allows you to connect your router directly to your broadband connection without having to use a separate modem.

03 Most 802.11n wireless routers use the 2.4GHz frequency band. This has good range but it can be prone to interference if it's positioned close to a lot of other 2.4GHz devices, such as other routers and baby monitors. If you have trouble getting a consistent signal or you want faster speeds for video streaming, for example, it's worth buying a dual-band router that can use both the 2.4GHz and 5GHz bands.

Alternatively, a high-gain antenna can boost signals and improve ranges and throughputs to the entire house. You can also add a high-gain antenna to a PC's network adaptor. If wired network speeds are a priority, you should look for a router with a Gigabit Ethernet connection.

04 Many routers come with built-in USB ports that let you connect a USB drive and use the router as a network storage device. If you want to share a USB printer over your network, look for a wireless router that has a USB print server.

Finally, if you're interested in making voice calls over the internet, buy a router with built-in VoIP support (and phone sockets) because this can save you money.

NETWORKS

BT Complete Wi-Fi

★★★★★

£5 per month • www.bt.com

COMPUTER SHOPPER
RECOMMENDED

There are better-featured mesh systems available, but the Complete Wi-Fi is decently quick on both the 5GHz and 2.4GHz bands, and is well worth it for BT Plus customers in particular.

WI-FI STANDARD 802.11ac • **STATED SPEED** 1,733Mbit/s (5GHz), 385Mbit/s (2.4GHz) • **USB PORTS** 1 • **WALL MOUNTABLE** No • **WARRANTY** Under rental contract • **PART CODE** BT Complete Wi-Fi • **FULL REVIEW** Mar 2019



TP-LINK Archer C5400

★★★★★

£209 • www.currys.co.uk

COMPUTER SHOPPER
RECOMMENDED

Although this isn't the fastest £200-plus router, it's still speedy, and comes with an impressive array of features, from parental controls and filters to BT YouView support and smart home integration.

MODEM Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 2x 2,167Mbit/s (5GHz), 2x 1,000Mbit/s (2.4GHz) • **USB PORTS** 1x USB2, 1x USB3 • **WALL MOUNTABLE** Yes • **WARRANTY** One year RTB • **PART CODE** C5400 • **FULL REVIEW** May 2018



YUBICO YubiKey 5 NFC

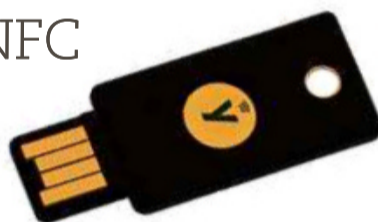
★★★★★

£38 • www.yubico.com

COMPUTER SHOPPER
RECOMMENDED

Like the YubiKey 4 before it, this USB stick conveniently stores all the cryptographic data you need to add two-factor authentication to a PC or laptop; and this time, there's NFC, allowing you to use it with mobile devices via a single tap.

USB TYPE Type-A • **OS SUPPORT** Windows 10, macOS, iOS 11 and later, Android • **WARRANTY** One year RTB • **DETAILS** www.yubico.com • **PART CODE** YubiKey 5 NFC • **FULL REVIEW** Apr 2019



NETGEAR Nighthawk AX8

★★★★★

£280 • www.scan.co.uk

COMPUTER SHOPPER
RECOMMENDED

If you want to get in early on Wi-Fi 6/802.11ax, this is a good router to do it with. It's no more difficult to set up than an 802.11ac model, but successfully delivers the newer standard's higher speeds.

MODEM Gigabit Ethernet • **WI-FI STANDARD** 802.11ax • **STATED SPEED** 4,800Mbit/s (5GHz), 1,200Mbit/s (2.4GHz) • **USB PORTS** 2 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** www.netgear.com • **PART CODE** RAX80 • **FULL REVIEW** Jan 2020



D-LINK DIR-1960

★★★★★

£113 • uk.insight.com

COMPUTER SHOPPER
BEST BUY

The DIR-1960 is a simple yet speedy router that can optionally be turned into a mesh system (provided you buy the additional satellites, of course). Either way, you can also take advantage of built-in Alexa and Google Assistant controls.

MODEM Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 1,300Mbit/s (5GHz), 600Mbit/s (2.4GHz) • **USB PORTS** 1x USB2 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** www.d-link.com • **PART CODE** DIR-1960 • **FULL REVIEW** Nov 2019



NETGEAR Orbi Outdoor RBS50Y

★★★★★

£250 • www.amzn.to/2MZg5YB

COMPUTER SHOPPER
RECOMMENDED

This weatherproof Wi-Fi extender is a perfect addition to mesh systems that can't quite cover a garden. It has similar internal specifications to the brilliant Orbi RBK50, meaning high speeds and reliable connections.

WI-FI STANDARD 802.11ac • **STATED SPEED** 1x 866Mbit/s (5GHz) 1x 1,733Mbit/s (5GHz), 1x 400Mbit/s (2.4GHz) • **USB PORTS** 0 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** www.netgear.co.uk • **PART CODE** RBS50Y • **FULL REVIEW** Jul 2019



Choosing a... Smart thermostat

01 A smart thermostat can save you a lot of money by intelligently controlling your heating.

Most smart heating devices are designed to be used with hot water central heating systems, with the boiler directly controlled by the system. These typically require a relay to be wired into your boiler, with a wireless thermostat giving you direct control. Smartphone apps then tie into the system to give you remote control. While it's possible to fit controls yourself, you may want to pay an experienced plumber to do the job: expect to pay around £150 for a typical installation.

If you have electric heating, there are very few choices, and the big names (Nest, Honeywell and so on) do not directly support these systems.

02 Want smart hot water control? If you want to remotely set schedules and disable hot water while you're away, choose your smart system carefully, as many don't have this option. Hot water control usually requires a second relay to be wired into the boiler.

03 What kind of heating system do you want? There are two main choices: a central system and one with individual radiator controls. The former replaces your existing thermostat, and lets you set one temperature for your entire house. The latter requires each radiator valve to be replaced with a smart valve so that each room and radiator can have its own individual control.

This option is more expensive to install but will provide you with greater savings.

04 Do you use a smart personal assistant? Make sure that your smart thermostat supports the one that you use. Amazon Alexa, powered by the Echo and Echo Dot, is the best-supported system; Apple's HomeKit, powered by Siri, isn't so well supported; Google Assistant, built into Google Home, is just gaining traction and supports Nest only.

05 If you want your smart heating system to do more, look for IFTTT support. With this handy system, you can set automatic rules, such as turning the heating off if the outside temperature rises.

SMART HOME

AMAZON Echo Dot with Clock

★★★★★

£35 • www.amzn.to/2LLc9aG

COMPUTER SHOPPER
BEST BUY

This is literally 'just' an Echo Dot 3rd Generation with an added LCD clock, but considering it's no more expensive and offers the same combination of capable speaker and versatile smart home controller, that's absolutely nothing to complain about.

DRIVERS 1 • **RMS POWER OUTPUT** Not stated • **WEIGHT** 300g • **NETWORKING** Bluetooth, 802.11n • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Echo Dot with Clock • **FULL REVIEW** Feb 2020



NEST Cam IQ Outdoor

★★★★★

£329 • www.johnlewis.com

COMPUTER SHOPPER
RECOMMENDED

While this is an expensive replacement for the old Nest Cam Outdoor, its image quality is without equal. Facial and sound recognition have also been improved, and it's now much harder for thieves to remove the camera from its mount.

VIDEO RESOLUTION 4K sensor, 1080p recording • **CLOUD STORAGE** Yes (subscription required) • **NETWORKING** 802.11ac • **WARRANTY** One year RTB • **PART CODE** Nest Cam IQ Outdoor • **FULL REVIEW** Jul 2018



TADO Smart Thermostat

★★★★★

£110 • www.amzn.to/2ZxwlfZ

COMPUTER SHOPPER
BEST BUY

A flexible and stylish-looking smart heating system, the Tado Smart Thermostat distinguishes itself with a clever geolocation feature that turns on your heating when you enter a room and switches it off, saving money, when you leave.

REMOTE THERMOSTAT Yes • **HOT WATER SUPPORT** Yes • **INDIVIDUAL RADIATOR CONTROL** Yes • **VOICE ASSISTANT SUPPORT** Alexa, Google Assistant, Siri • **APPS** iOS, Android and web • **FULL REVIEW** Jan 2018



NEOS Smartcam

★★★★★

£20 • shop.neos.co.uk

COMPUTER SHOPPER
RECOMMENDED

The Smartcam is a tremendous bargain of an indoor security camera. In many ways, it's not all that advanced – footage is only shot at up to 15fps, for instance – but the 1080p resolution, night-vision mode and free cloud storage make for a nifty little package.

VIDEO RESOLUTION 1080p • **CLOUD STORAGE** Yes (free) • **NETWORKING** 802.11n • **WARRANTY** One year RTB • **PART CODE** NS-CAM-02 • **FULL REVIEW** Jun 2019



GOOGLE Nest Hub Max

★★★★★

£219 • store.google.com

COMPUTER SHOPPER
BEST BUY

Besides the addition of a camera – which can be turned off – this is mainly just a larger Google Home Hub. Luckily, that also means it's a fantastic smart display, with a higher resolution and better-sounding speaker.

DRIVERS 3 • **RMS POWER OUTPUT** Not stated • **DOCK CONNECTOR** None • **WIRELESS** 802.11ac Wi-Fi, Bluetooth 5.0 • **DIMENSIONS** 183x250x101mm • **WEIGHT** 1.3kg • **WARRANTY** One year RTB • **PART CODE** Nest Hub Max • **FULL REVIEW** Jan 2020



RING Video Doorbell 2

★★★★★

£150 • www.box.co.uk

COMPUTER SHOPPER
BEST BUY

This is the best of the new breed of smart, camera-equipped doorbells: it's easy to install, comes with a bundled chime, and has fairly low subscription costs for storing footage in the cloud.

VIDEO RESOLUTION 1080p • **CLOUD STORAGE** Yes • **NETWORKING** 802.11n • **WARRANTY** Two years parts and theft protection • **PART CODE** 8VR1S7-0EU0 • **FULL REVIEW** Dec 2018



Choosing a... Smartphone

01 A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone, Google's Android, which is used by various handset manufacturers, and Windows Phone, which has few options, especially since Microsoft has discontinued support for its OS. Apple iOS and Google Android both have thousands of apps available.

02 All smartphones have colour screens, but their resolutions vary. Basic models have 1,280x720 pixels, but text can be indistinct. Look for a display that has at least 1,920x1,080 pixels so it's easier to read text

and watch Full HD videos. Don't worry too much about built-in media players or Office document editors; you can always install apps to replace these with better versions later.

The image quality of smartphone cameras has improved tremendously in recent years, and resolutions have increased to as high as 20 megapixels.

03 Very few modern smartphones have a physical keyboard for entering text; they almost exclusively use touchscreens now. Physical keyboards can aid heavy emailing, but today's touchscreen keyboards work just as well.

Android smartphones and iPhones running iOS 9 or above allow you to install

a variety of custom onscreen keyboards so you can find one that suits you.

04 Be careful when choosing a contract. Look for one that includes a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services.

Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, letting you connect your laptop to the web over your mobile data connection. There may be an extra charge for this.

SMARTPHONES

MOTOROLA Moto G7 Power

★★★★★

£160 SIM-free; £14-per-month contract • www.carphonewarehouse.com



There's no shortage of Moto G7 variants to choose from, but the Moto G7 Power is easily the best value. It focuses on battery life and is thus one of the longest-lasting smartphones ever - and its performance, display and rear camera are all rather good for the price, too.



PROCESSOR Octa-core 1.8GHz Qualcomm Snapdragon 632 • **SCREEN SIZE** 6.2in • **SCREEN RESOLUTION** 1,520x720 • **REAR CAMERA** 12 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **NFC** No • **DIMENSIONS** 159x76x9.3mm • **WEIGHT** 193g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** www.motorola.co.uk • **PART CODE** PAE90019GB • **FULL REVIEW** Jun 2019

SAMSUNG Galaxy S10+

★★★★★

£660 SIM-free; £30 up front plus £44-per-month contract • www.amzn.to/2E8lmVE (SIM-free); www.carphonewarehouse.com (contract)



The dazzling 3K display dominates a sleek, luxurious-feeling design, while the Exynos 9820 processor delivers some of the fastest raw performance on any Android handset, ever.



PROCESSOR Octa-core 2.7GHz Samsung Exynos 9820 • **SCREEN SIZE** 6.4in • **SCREEN RESOLUTION** 3,040x1,440 • **REAR CAMERAS** 12 megapixels, 12 megapixels, 16 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 158x74x7.8mm • **WEIGHT** 175g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** www.samsung.com • **PART CODE** SM-G975FZKDBTU • **FULL REVIEW** Jul 2019

VODAFONE Smart V10

★★★★★

£105 SIM-free; £20-per-month contract • www.vodafone.co.uk



Vodafone's budget handset will surprise you: for something that barely costs more than £100 to buy outright, it's rather speedy and has a main camera that can compete with mid-rangers. The slim-bezel look is very welcome, too.



PROCESSOR Quad-core 2GHz Qualcomm Snapdragon 429 • **SCREEN SIZE** 5.9in • **SCREEN RESOLUTION** 1,560x720 • **REAR CAMERAS** 13 megapixels, 5 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **NFC** No • **DIMENSIONS** 151x70x8.2mm • **WEIGHT** 145g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** Two years RTB • **DETAILS** www.vodafone.co.uk • **PART CODE** Smart V10 • **FULL REVIEW** Oct 2019

GOOGLE Pixel 3a

★★★★★

£399 SIM-free; £26-per-month contract • www.carphonewarehouse.com



The Pixel 3a is a welcome return to mid-range smartphones on Google's part. It's essentially a cheaper version of the flagship Pixel 3, which means a bit less horsepower but the same clean, stock Android and superb camera.



PROCESSOR Quad-core 2.8GHz Qualcomm Snapdragon 845 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 2,160x1,080 • **REAR CAMERA** 12.2 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 146x68x7.9mm • **WEIGHT** 148g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** store.google.com • **PART CODE** Pixel 3 • **FULL REVIEW** Aug 2019

SAMSUNG Galaxy Note 10+

★★★★★

£999 SIM-free; £57-per-month contract • www.carphonewarehouse.com (SIM-free); www.tescomobile.com (contract)



From its cameras to its display, everything about the Note 10+ drips with ultra-premium quality. It's quite possibly the best Android phone on the market, albeit at a steep cost.



PROCESSOR Octa-core 2.4GHz Samsung Exynos 9825 • **SCREEN SIZE** 6.8in • **SCREEN RESOLUTION** 3,040x1,440 • **REAR CAMERAS** 12 megapixels, 16 megapixels, 12 megapixels • **STORAGE** 256GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 162x77x7.9mm • **WEIGHT** 196g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** www.samsung.com/uk • **PART CODE** SM-N975FZSDBTU • **FULL REVIEW** Dec 2019

APPLE iPhone 11 Pro

★★★★★

£1,049 SIM-free; £10 up front plus £69-per-month contract • www.carphonewarehouse.com



Apple continues to produce breathtakingly expensive flagships that nonetheless end up being worth the money. The iPhone 11 Pro is faster than any Android handset, has a superlative rear camera array and introduces a host of improvements to iOS.



PROCESSOR Hexa-core 2.65GHz Apple A13 Bionic • **SCREEN SIZE** 5.8in • **SCREEN RESOLUTION** 2,436x1,125 • **REAR CAMERAS** 12 megapixels, 12 megapixels, 12 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 144x71x8.1mm • **WEIGHT** 188g • **OPERATING SYSTEM** iOS 13 • **DETAILS** www.apple.com/uk • **PART CODE** iPhone 11 Pro • **FULL REVIEW** Jan 2020

Choosing a... Tablet

01 All tablets rely on an operating system (OS) to run apps. You have three main choices: Apple's iOS, which runs on the iPad; Android, which Google licenses to various manufacturers; and Windows 10, which has become common in hybrid tablets and convertibles. If you own an Apple or Google smartphone, you can download your apps, music and so on to a tablet that runs the same OS, so it makes sense to stick with a compatible device.

02 It's important to pick a tablet that has a good-quality, high-resolution screen. Many budget tablets have 1,280x800-resolution displays, but better tablets have Full HD 1,920x1,080 panels, and we're

starting to see tablets that have even higher screen resolutions. Some are as high as 2,560x1,600 or even 4K. Entry-level tablets typically use TN panels, which don't have particularly good viewing angles. The viewing angles of IPS panels are much better.

03 If you want to listen to music, watch films and play games, make sure your tablet has plenty of storage. Many tablets come with 8GB or 16GB of internal storage, although some budget models have less. You'll typically pay more for a higher storage capacity. Many tablets also have microSD slots that let you add extra storage, although you won't find one on an iPad. This is a cheap way of boosting storage capacity.

04 Tablets rarely include a SIM card slot. This means you'll have to rely on Wi-Fi to get online, although some tablets let you access the internet through your smartphone. If you want mobile access to the internet, look for 3G- and 4G-ready devices. These almost always cost more than Wi-Fi-only models, but they're great if you use your tablet while commuting or travelling.

05 Your choice of tablet determines the apps you can use on it. You may find that some of the apps you want are available on iOS but not Android, and vice versa. Windows 10, meanwhile, runs traditional desktop applications.

TABLETS

AMAZON Kindle Oasis (2019)

★★★★★

£230 • amzn.to/2mp6ldb

COMPUTER SHOPPER
BEST BUY

With the addition of a blue light filter, the latest Kindle Oasis is as good an e-reader as you can get.

Besides being easier on the eyes when reading at night, it has the physical page-turn buttons that cheaper Kindles lack, and the screen can auto-rotate according to how you're holding it.

PROCESSOR Not stated • **SCREEN SIZE** 7in • **SCREEN RESOLUTION** 300ppi • **REAR CAMERA** None • **STORAGE** 8GB • **WIRELESS DATA** Wi-Fi, Bluetooth • **DIMENSIONS** 159x141x8.4mm • **WEIGHT** 188g • **OPERATING SYSTEM** Kindle OS • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Kindle Oasis (2019) • **FULL REVIEW** Nov 2019



APPLE iPad 10.2in

★★★★★

£349 • www.apple.com/uk

COMPUTER SHOPPER
RECOMMENDED

After the previous iPad pivoted to an education focus, the latest model changes course again,

aiming to become a more affordable 2-in-1 than the iPad Pro range. It works, too: the enlarged screen, Smart Connector for keyboards and high performance make for a relatively affordable laptop alternative.

PROCESSOR Quad-core Apple A10 Fusion • **SCREEN SIZE** 10.2in • **SCREEN RESOLUTION** 2,160x1,620 • **REAR CAMERA** 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G (cellular model) • **DIMENSIONS** 215x174x7.5mm • **WEIGHT** 483g • **OPERATING SYSTEM** iPadOS • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** iPad (2019) • **FULL REVIEW** Feb 2020



APPLE iPad Pro 10.5in

★★★★★

£529 • www.apple.com/uk

COMPUTER SHOPPER
BEST BUY

While it's still stuck with a mobile OS, rather than the productivity-friendly macOS,

there's no arguing with the latest iPad Pro's raw power. An A10X Fusion chip makes it much faster than the 9.7in model in both multitasking and single-threaded applications.

PROCESSOR Hexa-core 2.36GHz Apple A10X Fusion • **SCREEN SIZE** 10.5in • **SCREEN RESOLUTION** 2,224x1,668 • **REAR CAMERA** 12 megapixels • **STORAGE** 64/256/512GB • **WIRELESS DATA** 4G (cellular version) • **DIMENSIONS** 251x174x6.1mm • **WEIGHT** 469g • **OPERATING SYSTEM** iOS 11 • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** 9.7in iPad Pro • **FULL REVIEW** Oct 2017



MICROSOFT Surface Go

★★★★★

£509 • www.microsoft.com

COMPUTER SHOPPER
RECOMMENDED

If you've been craving a tablet with the flexibility of a Surface Pro, without

the usual expense, the Surface Go is a perfect fit. It's smaller and uses a less powerful Intel Pentium CPU, but it's still a much more work-ready 2-in-1 than any Android slate.

PROCESSOR Dual-core 1.6GHz Intel Pentium 4415Y • **SCREEN SIZE** 10in • **SCREEN RESOLUTION** 1,800x1,200 • **REAR CAMERA** 8 megapixels • **STORAGE** 128GB • **WIRELESS DATA** No • **DIMENSIONS** 245x175x8.3mm • **WEIGHT** 522g • **OPERATING SYSTEM** Windows 10 S • **WARRANTY** One year RTB • **DETAILS** www.microsoft.com • **PART CODE** MCZ-00002 • **FULL REVIEW** Jan 2019



SAMSUNG Galaxy Tab S3

★★★★★

£360 • www.ao.com

COMPUTER SHOPPER
BEST BUY

Yes, it's incredibly expensive for an Android slate, but the Galaxy Tab S3 is pure luxury: the AMOLED display looks exquisite, the stereo speakers sound great, and Samsung's S Pen stylus is included as standard.

PROCESSOR Quad-core 2.2GHz Qualcomm Snapdragon 820 • **SCREEN SIZE** 9.7in • **SCREEN RESOLUTION** 2,048x1,536 • **REAR CAMERA** 13 megapixels • **STORAGE** 32GB • **WIRELESS DATA** None (4G optional) • **DIMENSIONS** 2937x169x6mm • **WEIGHT** 429g • **OPERATING SYSTEM** Android 7.0 • **WARRANTY** One year RTB • **DETAILS** www.samsung.com/uk • **PART CODE** SM-T820 • **FULL REVIEW** Aug 2017



AMAZON Kindle (2019)

★★★★★

£70 • www.amzn.to/2x9nnhM

COMPUTER SHOPPER
BEST BUY

Some key upgrades make the base Kindle a much more tempting prospect. There's a new reading light on the front, plus Bluetooth connectivity and the ability to download and listen to Audible audiobooks.

PROCESSOR Not stated • **SCREEN SIZE** 6in • **SCREEN RESOLUTION** 256ppi • **REAR CAMERA** None • **STORAGE** 4GB • **WIRELESS DATA** Wi-Fi only • **DIMENSIONS** 160x113x8.7mm • **WEIGHT** 174g • **OPERATING SYSTEM** Kindle OS • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Kindle (2019) • **FULL REVIEW** Aug 2019



Choosing a... Soundbar

01 If you don't have space in your home cinema setup for a set of surround-sound speakers, a soundbar is the next best thing. Whether you opt for a soundbar (which typically sits in front of your TV stand) or a soundplate (which sits underneath your TV), you'll be getting significantly better audio than the weedy speakers today's flatscreen TVs provide.

02 If you want to cut down on cable clutter, look for a soundbar with multiple HDMI inputs and outputs as well as Audio Return Channel (ARC). Not all soundbars use HDMI, with many making do with digital optical audio connections instead. This means you'll have to connect Blu-ray players, games consoles and set-top

boxes to your TV and run all audio through a single cable. Also look for phono inputs for connecting older devices and 3.5mm audio jacks for tablets or smartphones.

03 As with any speaker, the number of speaker drivers inside a soundbar should give a good indication of its audio capabilities. Although this won't tell you everything about sound quality, you should still look out for separate mid-range drivers and tweeters, as these should be able to deliver a wider frequency range than full-range drivers alone.

04 Bluetooth support is a must if you want to listen to music from a smartphone or tablet without wires.

Most soundbars now include Bluetooth as standard but, if your device supports it, it's worth looking for a mobile soundbar that includes aptX. This less-lossy codec is capable of higher-quality streaming than the standard A2DP profile.

AirPlay streaming is less common, but iPhone owners should keep an eye out for it.

05 For a little extra bass, be sure to look for a soundbar with a separate subwoofer. Many soundbars include a wired sub, but for extra convenience you should look for a model with a wireless subwoofer instead. These can be placed anywhere in a room near a power socket, without having to run a cable back to the soundbar itself.

HOME CINEMA

PHILIPS 55PUS6753/12

★★★★★

£486 • www.amzn.to/2NJYgKc

COMPUTER SHOPPER
RECOMMENDED

This Philips set doesn't have the best

implementation of HDR we've seen on a TV, but otherwise, the 55PUS6753/12 is a fantastic 4K screen for a relatively low price.



SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 3x HDMI, 5x component • TUNER Freeview HD • DIMENSIONS 781x1,244x266mm • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE 55PUS6753/12 • FULL REVIEW Dec 2018

SAMSUNG HW-N850

★★★★★

£745 • www.box.co.uk

COMPUTER SHOPPER
BEST BUY

There's no ultra-high-tech trickery

here: just a soundbar, subwoofer and their combined 14 drivers blasting out pristine-quality audio, with Samsung's usual high standards for connectivity.



SPEAKERS 14 • RMS POWER OUTPUT 372W • DIMENSIONS 1,230x83x136mm (soundbar), 203x400x416mm (subwoofer) • NETWORKING 802.11n Wi-Fi, Bluetooth • WARRANTY One year RTB • DETAILS www.samsung.com/uk • PART CODE HW-N850 • FULL REVIEW Feb 2019

SONY

KD-55XF9005

★★★★★

£799 • www.johnlewis.com

COMPUTER SHOPPER
RECOMMENDED

Direct-lit backlighting, excellent upscaling and beautifully smooth motion make the KD-55XF9005 a worthy alternative to high-end OLED TVs, even though it only has a VA panel.



SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI • TUNER Freeview HD • DIMENSIONS 771x1,228x258mm • WARRANTY One year RTB • DETAILS www.sony.co.uk • PART CODE KD-55XF9005 • FULL REVIEW Aug 2018

POLK AUDIO Command Bar

★★★★★

£237 • www.amzn.to/33TdAv4

COMPUTER SHOPPER
BEST BUY

This is a genius combination of soundbar and smart speaker, and for a low price too. It's great for films, TV and music, and you can use Alexa as a voice-activated remote control.



SPEAKERS 3 • RMS POWER OUTPUT 260W • DIMENSIONS 1,091x102x51mm (soundbar), 367x188x368mm (subwoofer) • WEIGHT 2.3kg (soundbar), 3.9kg (subwoofer) • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi • WARRANTY Three years RTB • DETAILS en.polkaudio.com • PART CODE COMMANDUK • FULL REVIEW Oct 2019

PHILIPS 65OLED803

★★★★★

£1,999 • www.currys.co.uk

COMPUTER SHOPPER
RECOMMENDED

If you've got the budget for an OLED TV, this is a great pick. The panel technology's built-in strengths, such as perfect blacks and wide viewing angles, are aided by Philips' exemplary image processing engine, resulting in truly wonderful picture quality.



SCREEN SIZE 65in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI, 1x Component • TUNER Freeview HD • DIMENSIONS 824x1,449x280mm • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE 65OLED803/12 • FULL REVIEW Apr 2019

SONOS Beam

★★★★★

£329 • www.amzn.to/2RjpMef

COMPUTER SHOPPER
RECOMMENDED

The Beam could join a home cinema

setup on sound quality alone, but it's loaded with smart features, too. It can adjust sound output to the size and layout of a room, for example, and form a multiroom system with other Sonos speakers.



SPEAKERS 5 • RMS POWER OUTPUT Not stated • DIMENSIONS 651x100x69mm • WEIGHT 2.8kg • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi, Ethernet • WARRANTY One year RTB • DETAILS www.sonos.com • PART CODE BEAM1UK1 • FULL REVIEW Apr 2019

Choosing a... Bluetooth speaker

01 Bluetooth speakers come in all shapes and sizes, so you'll need to decide what you want to do with the speaker before you buy. If you don't plan to take your music outdoors or around the house, look for a wired speaker. These are typically cheaper than speakers with built-in batteries.

If you do want a portable speaker, however, pay particular attention to how much it weighs. Ruggedised models should be able to survive accidental drops, water spills and unexpected rain showers.

02 Many of the cheapest Bluetooth speakers use the lossy A2DP Bluetooth protocol, which is prone to compressing your music and discarding detail compared with the original recording.

It's hard to tell the difference when listening to pocket-sized speakers, but if you're looking for a speaker to fill a room, an aptX-compatible device is a better option. This Bluetooth protocol retains more detail than the A2DP profile, although you'll need to use it with a compatible smartphone in order to get the benefits.

03 As with any audio product, the number and size of speaker drivers can have a significant impact on the quality of sound you get from a Bluetooth speaker. Typically, the presence of multiple drivers enables the manufacturer to tune each one for specific frequencies, directing high-end sounds towards a tweeter and sending the mid-range frequencies to the main driver.

Single-driver speakers with larger driver cones can be just as capable of producing fantastic audio, however.

04 Most Bluetooth speakers have at least one auxiliary input for a wired 3.5mm audio jack, in case you want to listen to music from a device that doesn't have Bluetooth.

There are other extra features to look out for, though. Speakers with built-in batteries may have a USB port for charging your smartphone, or a built-in microphone to turn it into a speakerphone when a paired smartphone receives a call. Not all speakers have physical controls; many rely on your paired device's controls for adjusting the volume or muting playback.

AUDIO

CREATIVE Outlier Air

★★★★★

£70 • uk.creative.com

COMPUTER SHOPPER
BEST BUY

A marvellous set of true wireless



headphones, the Outlier Air combine a lively and dynamic sound with a comfy (if large) design and long battery life. Bluetooth aptX support is worth the money in particular.

HEADPHONES SUBTYPE In-ear headset • PLUG TYPE None • WEIGHT 10g • CABLE LENGTH N/A • WARRANTY Two years RTB • DETAILS uk.creative.com • PART CODE Outlier Air • FULL REVIEW Jul 2019

SONY WH-1000XM3

★★★★★

£269 • www.amzn.to/2HHUG1J

COMPUTER SHOPPER
BEST BUY

Bose's QuietComfort headphones have at last been toppled from the ANC



throne. The WH-1000XM3 headphones don't just sound outstanding, with very effective noise cancellation, but they're smartly designed and come with a host of extras.

HEADPHONES SUBTYPE Over-ear headset • PLUG TYPE 3.5mm jack plug (optional) • WEIGHT 255g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS www.sony.co.uk • PART CODE WH-1000XM3 • FULL REVIEW May 2019

IKEA Symfonisk

★★★★★

£99 • www.ikea.com

COMPUTER SHOPPER
BEST BUY

Ikea, with a little help from Sonos, has produced two great-sounding wired speakers. The cheaper 'bookshelf' model is slim and subtle, but it's worth paying extra for the 'lamp' model, which both sounds fuller and doubles as a working lamp.



SPEAKERS 2 • RMS POWER OUTPUT Not stated • WEIGHT Not stated • NETWORKING Wi-Fi • WARRANTY One year RTB • DETAILS www.ikea.com • PART CODE Symfonisk • FULL REVIEW Nov 2019

SONOS Move

★★★★★

£358 • www.amzn.to/2LGv5Yc

COMPUTER SHOPPER
BEST BUY

Although this is much bigger and less portable than most Bluetooth speakers, it's worth taking with you when you can. It sounds absolutely superb, and supports Trueplay, so can automatically adjust its output to fit the acoustics of its surroundings.



SPEAKERS 2 • RMS POWER OUTPUT Not stated • DOCK CONNECTOR None • NETWORKING 802.11n Wi-Fi, Bluetooth • DIMENSIONS 240x160x126mm • WEIGHT 3kg • WARRANTY One year RTB • DETAILS www.sonos.com • PART CODE MOVE1UK1BLK • FULL REVIEW Jan 2020

UE Boom 3

★★★★★

£99 • www.johnlewis.com

COMPUTER SHOPPER
BEST BUY

This IP67-rated Bluetooth speaker is a comprehensive upgrade on the Boom 2: it's more durable, looks better, has longer wireless range and sounds even better.



SPEAKERS 4 • RMS POWER OUTPUT Not stated • DOCK CONNECTOR None • NETWORKING Bluetooth (SBC) • DIMENSIONS 184x73x73mm • WEIGHT 608g • WARRANTY Two years RTB • DETAILS www.ultimateears.com • PART CODE 984-001360 • FULL REVIEW Jan 2019

BOWERS & WILKINS 607

★★★★☆

£399 • www.veybridge-audio.co.uk

COMPUTER SHOPPER
RECOMMENDED

Inspired by the classic 600 series, the wired 607s deliver an exciting and enthusiastic sound profile that reveals the tiniest details in every recording.



SPEAKERS 4 • RMS POWER OUTPUT 125W • WEIGHT 4.7kg per speaker • NETWORKING None • WARRANTY One year RTB • DETAILS www.bowers-wilkins.eu • PART CODE 607 • FULL REVIEW Jun 2019

Choosing an... Action camera

01 Action cameras are typically much smaller than a regular camcorder, as they are designed to be mounted to a bike, board or car, or worn on your person. As the name suggests, they are designed primarily for shooting action footage, but because of their small size they are ideal for strapping on to your pet's collar or your children's toys for a different perspective.

02 Even basic action cameras will shoot Full HD video, and many will even shoot 4K, but frame rate is arguably more important than resolution when it comes to action video. Higher frame rates will mean smoother clips, and super-high frame rate videos can be played in slow motion to emphasise exciting shots.

Keep an eye out for 4K/30, 4K/60, 1080p/60 and 720p/120 models for the widest possible choice of resolutions and frame rates.

03 Most action cameras rely on flash memory for storing your video, letting you swap out memory cards on the fly when you fill one up with clips. More expensive devices can have integrated flash memory as well as a card slot, but it's typically cheaper to buy the basic version of a camera and pick up memory cards separately.

04 Not all action cameras have LCD displays; in fact, many don't include a screen in order to extend battery life.

If you want to be able to see exactly what you're pointing the lens at, keep an eye out for cameras with companion smartphone apps, or wrist-mounted viewfinders that also let you start and stop shooting remotely.

05 Action cameras typically have a huge range of accessories, with specific mounts and harnesses for different activities and sports. If the camera itself isn't water resistant, a weatherproof case will protect it from the elements, while a tripod mount will let you lock it firmly in place.

Spare batteries are essential for longer shoots, and some decent video-editing software will help you to produce a more polished result.

VIDEO

AMAZON Fire TV Stick 4K

★★★★★

£50 • www.amzn.to/2Y6q8wh

COMPUTER SHOPPER
RECOMMENDED

From set-top box to dangling dongle and now an ultra-compact stick, Amazon's 4K media streamer gets sleeker with every generation. It's also been updated with a new remote, which includes a microphone for Alexa voice commands.



VIDEO OUTPUTS HDMI 2.0 • **NETWORKING** 802.11ac Wi-Fi • **DIMENSIONS** 108x30x14mm • **STREAMING FORMATS** UPnP, AirPlay, DLNA, Plex • **INTERNET STREAMING SERVICES** Amazon Video, Netflix, BBC iPlayer, ITV Hub, All 4, My5 • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Fire TV Stick 4K • **FULL REVIEW** May 2019

DJI Osmo Pocket

★★★★★

£279 • store.dji.com

COMPUTER SHOPPER
RECOMMENDED

A cleverly made alternative to action cameras, the DJI Osmo Pocket isn't intended for extreme sports, but its mechanical stabilisation ensures smooth, great-looking footage for life-logging videos.



SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** USB Type-C • **DIMENSIONS** 122x37x38mm • **WEIGHT** 116g • **WARRANTY** One year RTB • **DETAILS** www.dji.com • **PART CODE** CP.ZM.00000097.01 • **FULL REVIEW** Apr 2019

DJI Osmo Action

★★★★★

£246 • www.photospecialist.co.uk

COMPUTER SHOPPER
BEST BUY

If you want most of the features of a GoPro action camera at a lower price, consider the Osmo Action. It's waterproof without a case, can shoot at 4K and 60fps with stabilisation, and reaches the same high standard of video quality as the Osmo Pocket, as they have the same sensor.



SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAX RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** None • **DIMENSIONS** 42x66x35mm • **WEIGHT** 134g • **WARRANTY** One year RTB • **DETAILS** www.dji.com/uk • **PART CODE** CP.OS.00000020.01 • **FULL REVIEW** Dec 2019

GOPRO Hero 7 Black

★★★★★

£284 • www.amzn.to/32hWxC9

COMPUTER SHOPPER
BEST BUY

The Yi 4K+ is cheaper, but no other action camera comes close to the video quality of the Hero 7 Black. That's largely down to its new electronic image stabilisation, which keeps footage looking unbeatably smooth.



SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** Micro HDMI • **DIMENSIONS** 45x62x32mm • **WEIGHT** 116g • **WARRANTY** One year RTB • **DETAILS** www.gopro.com • **PART CODE** CHDHX-701-RW • **FULL REVIEW** Feb 2019

APPLE TV 4K

★★★★★

£179 • www.apple.com/uk

COMPUTER SHOPPER
RECOMMENDED

This big update adds 4K content (including, for the first time, Amazon Video support). The best part is that if there's a 4K version of content you've previously purchased in HD, Apple will upgrade it free of charge.



VIDEO OUTPUTS HDMI 2.0a • **NETWORKING** 802.11ac Wi-Fi, 10/100/1,000 Ethernet • **DIMENSIONS** 35x98x98mm • **STREAMING FORMATS** AirPlay, others via apps • **INTERNET STREAMING SERVICES** iTunes, Apple Music, Netflix, Amazon Instant Video, Now TV, BBC iPlayer, ITV Hub, All 4 • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** Apple TV 4K • **FULL REVIEW** Jan 2018

GOPRO Max

★★★★★

£479 • www.currys.co.uk

COMPUTER SHOPPER
BEST BUY

At last, a 360° camera that is all things to all users. The GoPro Max manages to be both usable for beginners and sufficiently advanced for more experienced videographers, shooting super-smooth footage with plenty of extra features to try.



SENSOR 2x 1/2.3in CMOS • **SENSOR PIXELS** 2x 16 megapixels • **MAXIMUM RECORDING RESOLUTION** 5.6K (30fps) • **AV CONNECTIONS** None • **DIMENSIONS** 64x69x40mm • **WEIGHT** 163g • **WARRANTY** One year RTB • **DETAILS** www.gopro.com • **PART CODE** CHDHZ-201-RW • **FULL REVIEW** Feb 2020

Choosing a... Compact system camera

01 If you're ready to step beyond the basic controls of a compact camera, or you want greater flexibility than an ultra-zoom can offer, a compact system camera (CSC) is the next logical upgrade. With interchangeable lenses, manual controls and stellar image quality, these cameras give proper digital SLRs a run for their money.

02 There are three competing types of CSC mount, and the one you buy determines the number of compatible lenses and accessories you have available. Samsung's NX-mount is arguably the most limited in terms of lens selection, and the company has confirmed that it's shutting down its European camera business, so it's best to avoid these altogether if possible.

Sony's E-Mount has a slightly wider range, but Micro Four Thirds offers the widest variety. Both Panasonic and Olympus cameras use this mount, and the lenses are interchangeable between manufacturers.

03 Micro Four Thirds cameras are typically more compact than other types of CSC because the image sensor is physically smaller – with a 22mm diagonal, it's roughly 30% smaller than an APS-C sensor. The APS-C sensors that Sony and Samsung use in their CSCs are the same size as those in traditional digital SLRs.

04 Like digital SLRs, CSCs come at a wide range of prices. Available from as little as £200, there's a CSC to suit every

budget. Most come with at least one kit lens, but if you already have lenses for a particular CSC mount, you can buy the body on its own and save money.

05 Once you've settled on a particular mount, you should pay attention to a camera's features. Articulating screens and integrated viewfinders will help you compose shots, while extra physical controls and a hotshoe mount will give you flexibility for manual shooting.

Touchscreens are great, but they're no replacement for physical dials when it comes to changing shutter speed and aperture. An integrated flash is much more convenient than a detachable one, as you can never forget to take it with you.

PHOTOGRAPHY

CANON EOS R

★★★★★

£2,969 • www.johnlewis.com

COMPUTER SHOPPER
RECOMMENDED

This is Canon's first mirrorless full-frame camera, but you wouldn't know it. Image quality is among the very best, and the included kit lens does a fantastic job. You can also get it body-only and attach your own RF-mount lenses.



SENSOR RESOLUTION 30.3 megapixels • SENSOR SIZE 36x24mm • FOCAL LENGTH MULTIPLIER 1x • VIEWFINDER Electronic (3.6 million dots) • LCD SCREEN 3.2in (2,100,000 dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.76x, 100% • WEIGHT 580g • DIMENSIONS 98x136x84mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Sep 2019

FUJIFILM X-T3

★★★★★

£1,459 • www.amzn.to/2LGwj5K

COMPUTER SHOPPER
RECOMMENDED

A fantastically versatile mirrorless camera, capable of taking perfect stills as much as it is recording high-quality video. There are plenty of pro-level features, too.



SENSOR RESOLUTION 26.1 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 2.7x • VIEWFINDER Electronic (3.69 million dots) • LCD SCREEN 3in (1.04 million dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.75x, 100% • WEIGHT 539g • DIMENSIONS 93x133x59mm • WARRANTY One year RTB • DETAILS www.fujifilm.com • FULL REVIEW May 2019

NIKON Z6

★★★★★

£1,849 • www.jessops.com

COMPUTER SHOPPER
RECOMMENDED

If you can't quite afford the exemplary Z7, then the Z6 is the perfect alternative. It's every bit the mirrorless all-rounder, and while it has a lower-resolution sensor than the Z7, this allows it to shoot at a faster rate.



SENSOR RESOLUTION 24.5 megapixels • SENSOR SIZE 35.9x23.9mm CMOS • VIEWFINDER Electronic (3.69 million dots) • LCD SCREEN 3.2in (2 million dots) • VIEWFINDER MAGNIFICATION (35MM-EQUIVALENT, COVERAGE) 0.8x, 100% • WEIGHT 1,175g • SIZE (HXWXD) 101x134x68mm • WARRANTY One year RTB • DETAILS www.europe-nikon.com • FULL REVIEW July 2019

POLAROID Originals OneStep 2

★★★★★

£99 • www.amzn.to/2DQhr05

COMPUTER SHOPPER
RECOMMENDED

The OneStep 2 brings back the simple joys of instant photography. Although the stock can get quite pricey, your shots will look just as they would on a classic Polaroid – perfect for sharing or simply sticking to the fridge.



PHOTO SIZE 3.1x3.1in • BATTERY LIFE 15-20 packets of film • PORTS 1x Micro USB • WARRANTY One year RTB • DETAILS www.polaroidoriginals.com • FULL REVIEW Jan 2018

SONY A6400

★★★★★

£1,255 • www.amzn.to/2KO1PPj

COMPUTER SHOPPER
RECOMMENDED

Sony's tiny mirrorless camera doesn't sacrifice quality in the name of portability. The 1,200-zone metering system helps produce balanced photos, and the A6400 particularly excels at speed-shooting, so it's definitely worth a look for action photography.



SENSOR RESOLUTION 24.2 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER Electronic (2.36 million dots) • LCD SCREEN 3in (921,000 dots) • LENS MOUNT E-mount • WEIGHT 403g • DIMENSIONS 67x120x60mm • WARRANTY One year RTB • DETAILS www.sony.com • FULL REVIEW Oct 2019

SONY A9

★★★★★

£2,999 • www.wexphotovideo.com

COMPUTER SHOPPER
RECOMMENDED

Even a price this high makes sense for the A9. Its combination of a clever stacked CMOS design and all-round good build make this an elite stills camera. Video footage is excellent, too.



SENSOR RESOLUTION 24.2 megapixels • SENSOR SIZE 35.6x23.8mm • FOCAL LENGTH MULTIPLIER 1x • VIEWFINDER Electronic (3,680,000 dots) • LCD SCREEN 3in (1,440,000 dots) • LENS MOUNT Sony E-mount • WEIGHT 588g • DIMENSIONS 96x127x63mm • WARRANTY One year RTB • DETAILS www.sony.co.uk • FULL REVIEW Jan 2020

Choosing a... Wearable

01 Wearable tech can include anything from chest-strap heart-rate monitors to augmented reality glasses, but the two most common types are smartwatches and fitness trackers. Both are designed to sit unassumingly on your wrist, and are almost always meant to be used in tandem with a paired smartphone.

02 Smartwatches are typically more complex and expensive, though more closely resemble a traditional wristwatch. You can use them to receive and reply to text messages and emails, quickly check maps and even play games – like a smartphone, most smartwatches allow you to install your own choice of apps.

03 Fitness trackers are much more dedicated to healthy pursuits. Step counters, heart-rate monitors and even sleep tracking are all common, and the data collected is fed back to you so you can see how your workout routine or calorie intake is going.

Many smartwatches also contain health-tracking features, but fitness-specific wearables tend to be cheaper, smaller and lighter.

04 When it comes to battery life, it's important for any wearable to last a full day, but if it's a smartwatch then you can get away with having to charge it overnight. With fitness trackers, it's better if it lasts for several days off

a single charge, so you can wear it to bed and benefit from sleep tracking.

05 Look out for waterproofing as well. Wearables that don't mind a few lengths of the pool can be used for swimming or just timekeeping, and at the very least we expect a fitness tracker to be able to deal with rain or sweat.

06 Different smartwatches use different operating systems, which determine which apps you can install on your device, as well as compatibility with smartphones. Android Wear and Tizen smartwatches will work with both Android and iOS phones, but Apple's watchOS will only pair with an iOS handset.

WEARABLES

HONOR Band 5

★★★★★

£30 • www.amzn.to/36nRxNz

COMPUTER SHOPPER
RECOMMENDED

This is a perfect fitness band if you're just starting out on an exercise routine. It's light, long-lasting between charges and accurate at measurements, a combination you won't often see on something so cheap.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.95in • RESOLUTION 240x120 • OS SUPPORT Android, iOS • BATTERY LIFE Two weeks • WARRANTY One year RTB • DETAILS www.hihonor.com • PART CODE KYG3649645453002TV • FULL REVIEW Feb 2020

APPLE Watch Series 5

★★★★★

£399 • www.apple.com/uk

COMPUTER SHOPPER
BEST BUY

The latest Apple Watch is, once again, not a major overhaul, but the always-on display is a nice little upgrade. The new compass also helps with navigation, and the Health app redesign helps display fitness stats more clearly.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.78in • RESOLUTION 448x368 • OS SUPPORT iOS • BATTERY LIFE 18 hours • WARRANTY One year RTB • DETAILS www.apple.com/uk • PART CODE Apple Watch Series 5 • FULL REVIEW Jan 2020

POLAR Vantage M

★★★★★

£180 • www.amzn.to/2HEqMLJ

COMPUTER SHOPPER
RECOMMENDED

A much-improved design sees the Vantage M become a sleeker and more comfortable running watch than the preceding M430, and multisport tracking goes a lot deeper, too – there's even swim tracking.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.2in • RESOLUTION 240x240 • OS SUPPORT Android, iOS • BATTERY LIFE 30 hours • WARRANTY One year RTB • DETAILS www.polar.com • PART CODE Vantage M • FULL REVIEW May 2019

FITBIT Inspire HR

★★★★★

£69 • www.amzn.to/2VsxcRA

COMPUTER SHOPPER
BEST BUY

There's no better sub-£100 fitness tracker for casual users than this. The Inspire HR's simplicity and stylishness give it immediate appeal, and you'll stay for the top-quality mobile app.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.7in • RESOLUTION 128x72 • OS SUPPORT Android, iOS • BATTERY LIFE Five days • WARRANTY One year RTB • DETAILS www.fitbit.com • PART CODE FB505RGPK-EU • FULL REVIEW Jul 2019

GARMIN Fenix 5 Plus

★★★★★

£399 • www.johnlewis.com

COMPUTER SHOPPER
BEST BUY

You'll have to pay a pretty penny for it, but the variety of features on the Fenix 5 Plus is without peer. One of the most exclusive is its support for full-colour maps, along with the ability to create routes straight from your wrist.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.2in • RESOLUTION 240x240 • OS SUPPORT Android, iOS • BATTERY LIFE 18 hours • WARRANTY One year RTB • DETAILS www.garmin.com • PART CODE 010-01988-11 • FULL REVIEW Nov 2019

MOBVOI TicWatch E2

★★★★★

£124 • www.mobvoi.com

COMPUTER SHOPPER
RECOMMENDED

At this price, there's simply no better smartwatch/fitness tracker hybrid than the TicWatch E2. Built-in GPS, IP67 waterproofing and an upgraded battery are all on board, and it's more responsive than most Wear 2100 wearables.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.4in • RESOLUTION 400x400 • OS SUPPORT Android, iOS • BATTERY LIFE Two days • WARRANTY One year RTB • DETAILS www.mobvoi.com • PART CODE TicWatch E2 • FULL REVIEW Jun 2019

SOFTWARE

ADOBE Premiere Pro CC 2019

★★★★★

£20 per month • www.adobe.com



This strong update of Premiere Pro CC adds improved Lumetri Color controls and neat integration with the Premiere Rush mobile app, among other tweaks.

OS SUPPORT Windows 10 version 1703 and later, macOS 10.12 and later (10.13 required for hardware acceleration) • **MINIMUM CPU** Intel 6th-gen and later, AMD equivalents • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 8GB • **HARD DISK SPACE** 8GB • **DETAILS** www.adobe.com • **PRODUCT CODE** Premiere Pro CC • **FULL REVIEW** Jul 2019

Video-editing software

KASPERSKY Security Cloud

★★★★★

£50 • www.kaspersky.co.uk



It's just as effective as Kaspersky Total Security, but Security Cloud goes a step further by learning your bad security habits and warning you about them.

OS SUPPORT Windows 7/8/10, OS 10.11/macOS 10.12, Android 4.1 and later, iOS 10/11 • **MINIMUM CPU** 1GHz • **MINIMUM GPU** None • **MINIMUM RAM** 1GB (32-bit), 2GB (64-bit) • **HARD DISK SPACE** 1,020MB (Windows), 1,110MB (Mac) • **DETAILS** www.kaspersky.co.uk • **PRODUCT CODE** Security Cloud • **FULL REVIEW** Jan 2018

Security software

NORDVPN

★★★★★

£9 per month • www.nordvpn.com



There are cheaper VPN services available, but none has the flexibility and multi-level security features of NordVPN. It's become much faster than previous versions, too.

OS SUPPORT Windows, macOS, iOS, Android, DD-WRT router • **DETAILS** www.nordvpn.com • **PRODUCT CODE** NordVPN • **FULL REVIEW** Sep 2018

Virtual private network

CYBERGHOST VPN

★★★★★

£2.10 per month • www.cyberghostvpn.com



In addition to safeguarding your privacy, CyberGhost VPN is particularly well suited to unblocking content on different streaming services. Connecting to new servers could be a bit faster, but once you're connected, everything is nice and stable.

OS SUPPORT Windows, macOS, iOS, Android • **DETAILS** www.cyberghostvpn.com • **PRODUCT CODE** CyberGhost VPN • **FULL REVIEW** Nov 2019

Virtual private network

McAfee Internet Security 2019

★★★★★

£16 • www.amzn.to/2X5sQBL



Impressively, the 2019 version takes McAfee Internet Security from an industry damp squib to one of the most reliable security suites on the market. Malware detection is vastly improved and performance is better, too.

OS SUPPORT Windows 7/8/8.1/10, macOS 10.12 and later; Android 4.1 and later, iOS 10 and later • **MINIMUM CPU** 1GHz • **MINIMUM GPU** DirectX 9 • **MINIMUM RAM** 1GB • **HARD DISK SPACE** 500MB • **DETAILS** www.mcafee.com • **FULL REVIEW** Apr 2019

Security software

APPLE macOS 10.14 Mojave

★★★★★

Free • itunes.apple.com



Mojave's small UI improvements and minor added features would disappoint on their own, but together they add up to a great update. It's free, too, so there's no reason not to make the switch.

OS SUPPORT OS X Mountain Lion or later • **MINIMUM CPU** Not stated • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 2GB • **HARD DISK SPACE** 12.5GB • **DETAILS** www.apple.com • **FULL REVIEW** Jan 2019

OS update

GAMING

NINTENDO Switch Lite

★★★★★

£199 • www.amzn.to/2Cig3Tx



The Switch Lite can't be used with a TV like the standard Switch, nor can you detach its controllers, but with a lower price, more compact design and all the same power, it's still a great handheld console.

PROCESSOR Octa-core 1.9GHz Nvidia Tegra X1 • **RAM** 4GB LPDDR4X • **FRONT USB PORTS** None • **REAR USB PORTS** 1x USB Type-C • **STORAGE** 32GB • **WARRANTY** One year RTB • **DETAILS** www.nintendo.com • **PART CODE** Nintendo Switch Lite • **FULL REVIEW** Jan 2020



Handheld games console

OCULUS Go

★★★★★

£149 • www.overclockers.co.uk



No longer do you need a decked-out PC or premium smartphone to enjoy VR. The Oculus Go crams all the hardware you need into the headset itself, making virtual reality entertainment as immediate and accessible as it's ever been.

DISPLAY LCD • **RESOLUTION** 2,560x1,440 • **REFRESH RATE** 72Hz • **PROCESSOR** Octa-core 2.4GHz Qualcomm Snapdragon 821 • **RAM** 3GB • **WEIGHT** 467g • **DETAILS** www.oculus.com/go • **PART CODE** Go 32GB • **FULL REVIEW** Sep 2018



VR headset

NINTENDO Labo VR Kit

★★★★★

£70 • www.studio.co.uk



This addition to the cardboard-based Labo series turns your Nintendo Switch into a platform for a myriad of inventive VR minigames. Kids in particular will enjoy constructing the goggles and controllers themselves.

AVAILABLE FORMATS Nintendo Switch • **DISK SPACE** Not stated • **DETAILS** labo.nintendo.com • **PART CODE** Nintendo Labo VR Kit • **FULL REVIEW** Aug 2019



VR headset and games

SONY PS4 Slim

★★★★★

£228 • www.amzn.to/2rAk1VL



Sony has made the PlayStation 4 even better with a slimmer, neater chassis and superior power efficiency. It's as cheap as the PS4 has ever been as well.

PROCESSOR Octa-core 1.6GHz AMD Jaguar • **RAM** 8GB GDDR5 • **FRONT USB PORTS** 2x USB2 • **REAR USB PORTS** None • **STORAGE** 500GB/1TB/2TB • **WARRANTY** One year RTB • **DETAILS** www.playstation.com • **PART CODE** B01GVQVQH2 • **FULL REVIEW** Jan 2017



Games console

Free software guide

It's easy to access your free software. Just go to www.shopperdownload.co.uk/385 and register with the code from the card insert. Please be aware that you need to have bought the 'Free Software Edition' and not the '£4.50 Edition' to access the downloads

GETTING STARTED

The download instructions on the card insert (opposite) show you how to connect to the download site. Make sure you type in the web address exactly as shown. You'll need your coupon code the first time you log on to the site.

ANY PROBLEMS?

If you need help with any of the software this month, please send an email to support@creativemark.co.uk. We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

WHY DOWNLOADS?

In order to provide us with free software, publishers now require us to offer the applications as a download and require online registration. You need to use the unique code printed in the box on the card insert to register and download the software in this issue. The unique code means we stop the deals leaking online, so only *Shopper* readers get the software.

NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 'Free Software' print version of the magazine. If you have this edition and still don't have a card, please contact letters@computersshopper.co.uk.

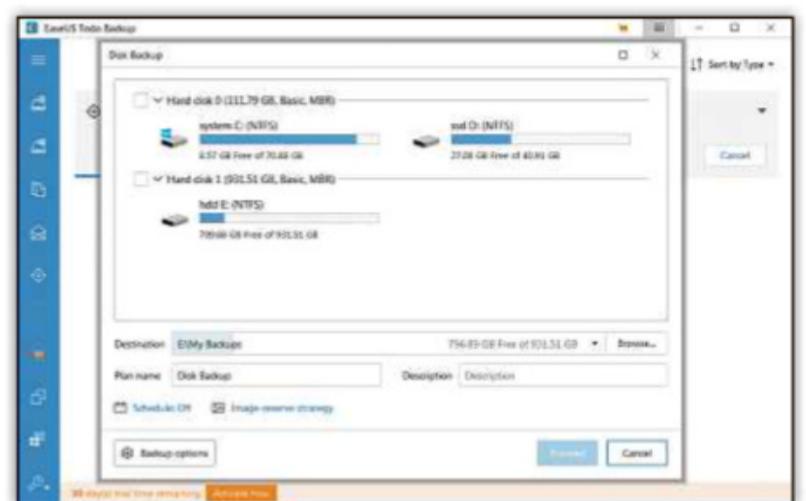
**REGISTER YOUR SOFTWARE
BY 20th FEBRUARY 2020**

EaseUS Todo Backup Home 11

THESE DAYS, YOU need two types of backup: one for your files and documents, and the other for your system. EaseUS Todo Backup Free attempts to straddle both spheres, and does so with reasonable success.

The great news about EaseUS Todo Backup Free is that it's actually a rebadged version of Todo Backup Home, which was previously sold as a commercial product. It's capable of backing up everything from selected files and file types to entire partitions or drives (there are also cloning tools included for upgrading from one drive to another), with scheduling options and support for incremental updates so backups are kept as small and efficient as possible.

There are lots of recovery and restore options, too, such as the ability to browse disk and partition backups for individual files and folders, plus an



option for creating a WinPE-based recovery disc that allows you to use the program outside of Windows, making it perfect for drive upgrades or recovering crashed systems.

It's all straightforward to use and works admirably. There are some gripes – although it's possible to back up certain email-based files using the file types option, we'd prefer a more explicit email backup option along with selected program settings and Registry settings. Otherwise, however, it's a very good all-in-one package.

REQUIREMENTS Windows 7, 8, 10; 200MB hard disk space
WEBSITE www.easeus.com
NOTES Get your registration code at todo11.disc.computersshopper.co.uk

Audials MusicTube 2020

THERE ARE COMPOSITIONS we remember from youth or in passing that are simply too hard to find, however much we want to buy the track. This is particularly true with rare tracks, live performances from our favourite bands and similar.

More often than not, you'll find that the track has been uploaded to YouTube by a fellow enthusiast. You can stream as often as you like, but what if you want to store the track locally?

This can be tricky as there's no way of downloading audio from streaming sources.

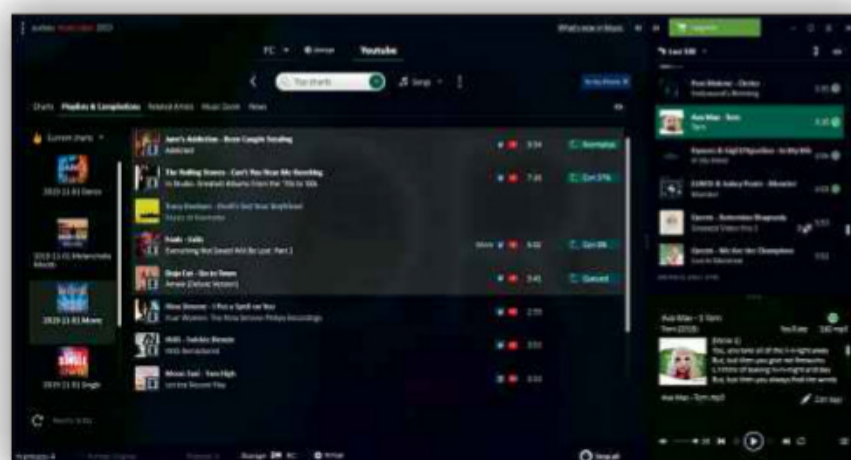
Audials MusicTube 2020 is a module for the Audials One software suite that will enable you to find tracks online, stream them and, if you want, download them to your computer. Of course, you're not limited to streaming services, as MusicTube will bring together various sources, including tracks stored on your PC, iTunes and other locations.

You can search by audio track or music video. Once you find the track you want, you can play it as you would with any other music player, add the song to your collection (for playback later) or download it to your PC. You can even use MusicTube to download your favourite videos, which will be converted to a format you can play on your computer.

It's worth noting that since MusicTube is a component of the Audials One software suite, you'll need that installed first.



REQUIREMENTS Windows 7, 8, 10;
250MB hard disk space
WEBSITE www.audials.com
NOTES Register within the application





Cleverfiles Disk Drill 2

DISK DRILL IS a free tool for finding and recovering anything from whole partitions to accidentally deleted files. It supports a wide range of file systems, including FAT, exFAT or NTFS, HFS+ and Linux EXT2/3/4.

The program requires installation, which ironically poses a risk as you might overwrite data you're trying to recover in the process. After that, however, it's all very straightforward: click Recover for your chosen drive, wait for the results, optionally preview any images you've found, then select whatever you need and recover the files with a click.

As with all undelete tools, the recovery process can take some time, but Disk Drill handles this better than most. If it's tying up too many system resources, you can pause the scan and resume it later. Or you can save the current scan session, close the program, then reopen it later and carry on where you left off.

If you don't have time to fully scan a drive, Disk Drill also provides an option to create a backup

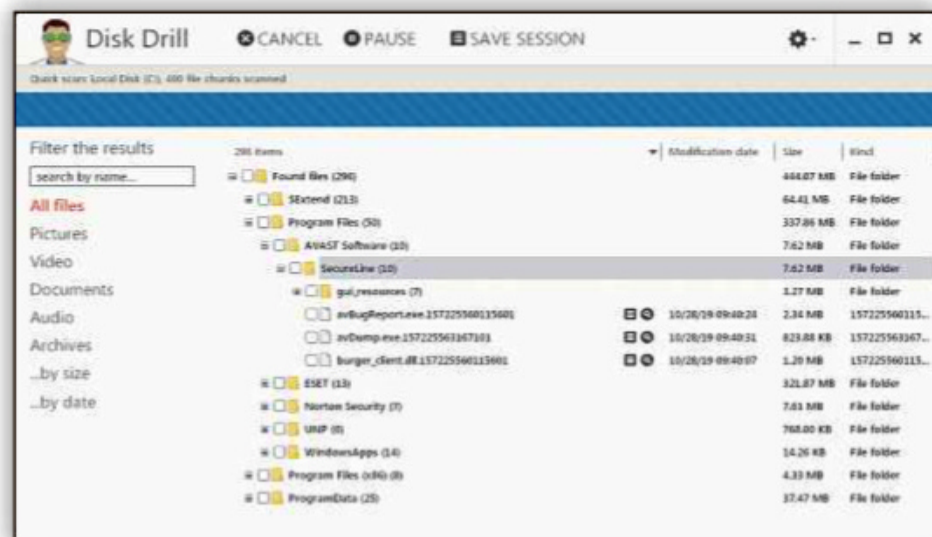


image. That probably won't be practical for a full-sized hard drive – the file is going to be huge – but it might be handy for external drives.

There's also a surprising extra in Disk Drill's Recovery Vault. Tell the program to protect a drive and it saves copies of anything deleted from your chosen folders. If you accidentally wipe something, then it can be recovered much more quickly from the Vault, and there's no chance of some vital file being accidentally overwritten.

REQUIREMENTS Windows XP, Vista, 7, 8, 10;
75MB hard disk space
WEBSITE www.cleverfiles.com
NOTES diskdrill2.disc.computershopper.co.uk

IObit Software Updater Pro 2

UNLESS YOU DOWNLOAD Windows 10 apps from the Microsoft Store, most installed software won't auto-update. Web browsers will notify you of a new update, your security software will auto-update and so will Windows itself, but most other tools sit happily on your system and you might never know when a key update is available unless you go checking.

IObit Software Updater is a free tool that will scan your system, check for all your

installed software, compare this to an online database and then warn you if an update is available.

There are limits to its capabilities: the database is quite small, and finds only essential updates. It also recommends updates for software that auto-updates, such as Google Chrome, as well as software that might be embedded in the Registry but isn't currently installed on your system.

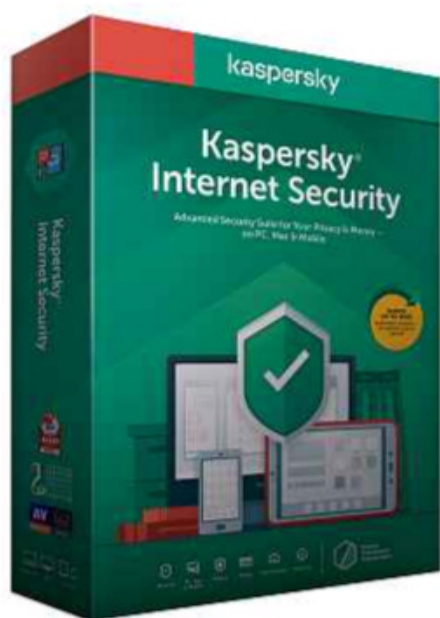
Software Updater also offers a number of recommended tools

that you can download from various categories; you can choose which of these you follow through with, so you won't be installing unwanted applications.

The program can also create a system restore point, in case you update software which then causes your system to become unstable. You can also schedule automatic updates and add programs to your ignore list, so that programs you're not interested in updating won't appear in the list.



REQUIREMENTS Windows XP, Vista, 7, 8, 8.1, 10; 10MB hard disk space
WEBSITE www.iobit.com
NOTES Get your registration code at updater2.disc.computershopper.co.uk. Includes six months of updates



Kaspersky Internet Security 2020

KASPERSKY INTERNET SECURITY 2020 is a powerful suite of malware-hunting, anti-hacker web safety tools.

There's antivirus, browsing protection, a firewall, exploit protection, a vulnerability scanner, parental controls, webcam and audio protection, online transaction protection, and even more tools designed to keep both your privacy and personal information safe.

These features have real value, too. Independent testing labs such as AV-Comparatives typically rate Kaspersky as offering some of the best protection around; it's consistently been one of the highest-scoring anti-malware providers for several years now, and is quick to update its protections when new threats arise.

The Software Updater checks for updates to common applications (including Adobe Reader, Flash, Java, Chrome and Firefox, among others), and can optionally install them without you having to see or do anything at all.



The Secure Connection feature is a privacy-oriented virtual private network, automatically kicking in when you use Wi-Fi hotspots, internet banking sites and other potentially sensitive services.

The Installation Assistance tool also looks out for adware and other pests that can get silently installed with certain free software, while the Software Cleaner helps you decide what to remove.

REQUIREMENTS Windows 7, 8, 10;
2GB hard disk space
WEBSITE www.kaspersky.co.uk
NOTES No need to activate. Includes three months of free updates



Abelssoft WashAndGo 2020

THE MORE YOU use a PC, the more cluttered it becomes, weighed down by leftover temporary files, orphaned Registry keys and a host of other junk.

WashAndGo can help to reverse all this, restoring your system's original performance and stability – and not just by the usual basic steps, such as emptying the Recycle Bin and clearing your browsing history. Instead, the program uses a **deep knowledge** of Windows and hundreds of applications to locate every surplus file and Registry key, giving your system the most thorough clean you'll find anywhere.

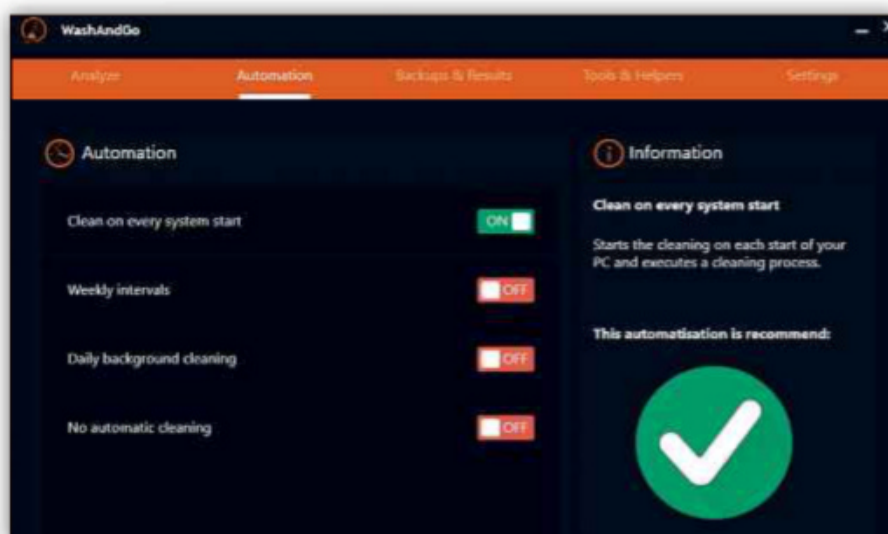
Install and launch WashAndGo and you'll **quickly** find out more, as the program analyses

your system and reports on the results. This starts with the obvious junk, the Recycle Bin, crash dumps and temporary files, but it can also dig out leftover files and registry keys from current and formerly installed applications.

We're often suspicious of applications that ask to delete so much information, since accidentally getting rid of the wrong thing can cripple your PC. Fortunately, WashAndGo allows you to stay in full control of the entire process. If you view its report and decide that you don't want to clear any Java files, for example, simply clear a tickbox and they'll be left alone.

Unusually, the program will also by default back up any files it deletes, keeping them for two weeks. If for some reason WashAndGo causes a problem, all you have to do is restore the backup.

Once you're confident in the process, you can have WashAndGo run automatically. You can have it clean your system when Windows starts, once a day, or at some preferred schedule of your own. And once this is set up, there's no need to worry about system junk any more: WashAndGo handles it all in the background, while you get on with more important matters.



REQUIREMENTS Windows 7, 8, 10;
50MB hard disk space
WEBSITE www.abelssoft.net
NOTES Get your registration code from within the application

Chat and Communication

Evernote 6.21.2.8716 Store your notes, ideas and plans in the cloud, and synchronise them between computers.

UPDATED Mailbird 2.7.5.0

A free desktop email client for Windows.

Miranda IM 0.10.80

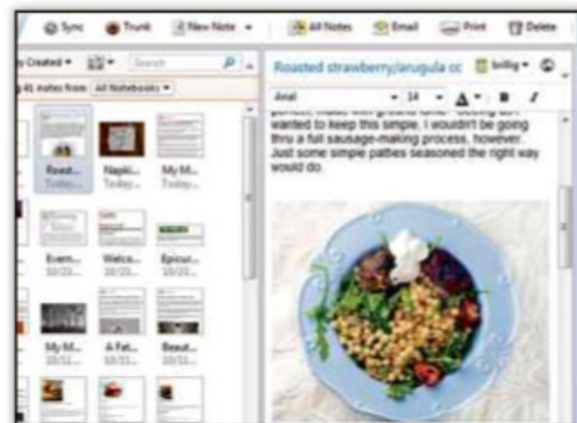
Chat with friends across multiple messaging platforms, including AIM, Facebook, IRC and MSN, all from one simple interface.

Skype for Windows 8.54.0.91

Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

Telegram 1.8.15 This free IM app synchronises your conversations across multiple devices, and can spruce up chats with stickers and GIFs.

UPDATED WhatsApp Desktop 0.3.9308 A free PC and Mac version of the popular messaging app, letting you chat from your desktop.



Customisation

iolo System Mechanic Free 19.1.4.107

Speed up your system with iolo's PC optimisation suite.

Rainmeter 4.3.1

Customise the desktop with your choice of tools and shortcuts.

Windows 8 Transformation Pack 9.1

Emulate the look of Windows 8 on an earlier version of the operating system.

Windows 8 UX Pack 9.1

Get a glimpse of the Windows 10 UI without committing to a full OS upgrade.

Windows 10 Transformation Pack 7.0

Bring some of Windows 10's new features to your current operating system.

Winstep Xtreme 19.2

Freshen up your system with this suite of desktop and UI replacement applications.



General

Genie Timeline Free 2017 10.0.1.100

Protect your most valuable files with this easy-to-use backup tool.

Paragon Partition Manager 16 Free

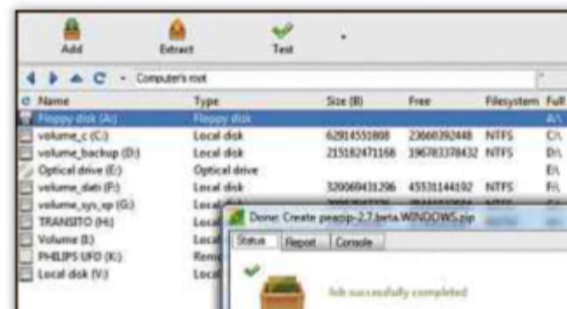
Create, format, split, merge and reorganise all your hard disk's partitions.

NEW VERSION PeaZip 7.0.0 An extremely powerful archive-management tool.

Screenshot Captor 4.31.2 Create and manage screenshots the easy way.

UpdateScanner 2.2.0.0 Scan all the software on your PC, find out if an update is available, then install it immediately.

ZipGenius 6.3.2.3116 A flexible file-compression tool with support for a huge number of compressed file formats.



Internet and Network

CarotDAV 1.15.6

Manage all your online storage services with one simple application.

UPDATED Cyberduck 7.2.1.31913

A powerful but easy-to-use FTP client for uploading and downloading your files.

Glasswire 2.1.166.0

Keep tabs on your network usage with this simple monitor.

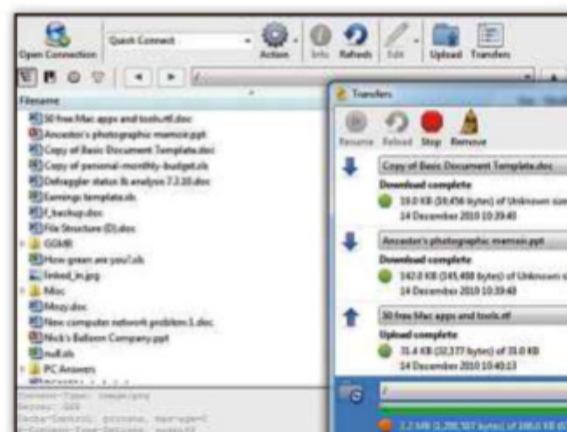
UPDATED FileZilla 3.46.0 A fast and reliable FTP client with lots of useful features.

NetBalancer 9.14.1

Make the most of your internet connection by assigning download and upload priorities to web applications.

NEW VERSION TeamViewer 15.0.8397

Remotely control your computer from anywhere in the world.



Tweaking and Performance


CCleaner 5.63 Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

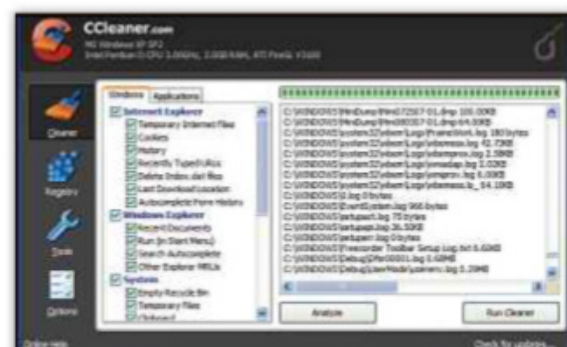
Defraggler 2.22 Ensure that your system is defragmented properly and improve its performance.

Finestra Virtual Desktops 2.5.4501 Set up four or more virtual desktops on your PC.

UPDATED IObit Advanced SystemCare Free 13.1.0.184 A complete computer security, maintenance and optimisation suite.

Revo Uninstaller Free 2.1.0 Remove installed applications completely, including all their folders, system files and Registry entries.

Simple Performance Boost 1.0.5 Tweak the Windows Registry to give your PC a performance boost. 



HOW SECURE ARE YOU?

IS YOUR SECURITY SOFTWARE UP TO SCRATCH? WHAT ELSE PUTS YOU AT RISK? DAVID LUDLOW REVIEWS THE LATEST SECURITY PRODUCTS AND TELLS YOU HOW TO BEAT THE HACKERS

The threat landscape is changing. It used to be that all you had to worry about was whether your antivirus software was up to date on your computer, and of sufficient quality to defend against attacks. Today, things are different. While it's important to run security software on your computers, there are more dangers that you need to be aware of, from the danger of a smart TV being hacked to losing control of an online account and beyond.

Simply put, there's no longer a single security solution that will protect you against everything. In this guide, we're here to help. We've got the latest protection scores for all the main security suites, as well as in-depth advice on how to protect yourself from other attacks.

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SECURE YOUR HOME

YOUR HOME ISN'T JUST FULL OF TRADITIONAL COMPUTERS – INTERNET-CONNECTED SMART DEVICES ARE JUST AS VULNERABLE TO ATTACK, UNLESS YOU TAKE OUR STEPS TO PROTECT THEM

Our homes are now full of smart devices, from TVs and speakers to security cameras. While these devices can make life easier for us, they're all effectively computers running an operating system. Typically, security hasn't always been of the highest priority for manufacturers of these devices, opening up the risk that one of these devices will be compromised by cybercriminals.

Having any device in your home hacked can pose big risks. Take a camera, for example. If one is hacked, it means that people can spy on you in your own home. Cameras can be everywhere: even the FBI has warned people to stick tape over their smart TV's webcams, as it believes that there's a real risk of these devices being hacked.

The second danger is that a hacked device can take part in a botnet, performing attacks on other computers on the internet. We've already seen the example of Mirai, which infected 600,000 IoT devices at its peak, including them in a criminal botnet.

Finally, a compromised device on your home network can be used to probe and attack other devices, often with greater effect as the outside protection of your router's firewall has already been bypassed.

PLUG AND PREY

Protecting connected devices isn't as straightforward as it is with a laptop or desktop computer, where you can install software directly. In effect, you're stuck with any controls that a device has available on it, and that's it. That doesn't mean you're without options, however, and we can show you how to make your home network safer.

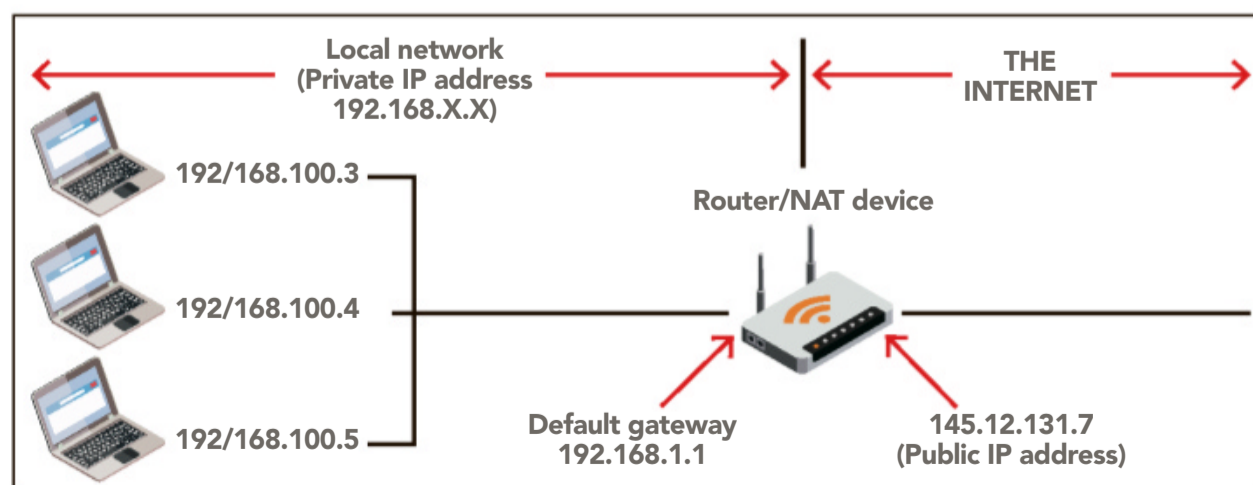
First, it's important to understand a bit about how devices connect to the internet.



ABOVE: Smart devices may make life easier, but they also increase the security threats we face

With all home broadband connections, your home has a single internet-visible IP address (sort of like a postal address). All devices have to share this using a technology called Network Address Translation (NAT).

When you connect to a service online, such as a website, you use a TCP port number. For example, standard websites are on port 80, and secure HTTPS websites are on port 443. When a device makes an outbound request to a website on port 80, the router assigns a reply port number. Any data that comes back on that port is sent to the requesting device. In this way, you can have multiple devices using the same internet connection, without everything getting muddled up.



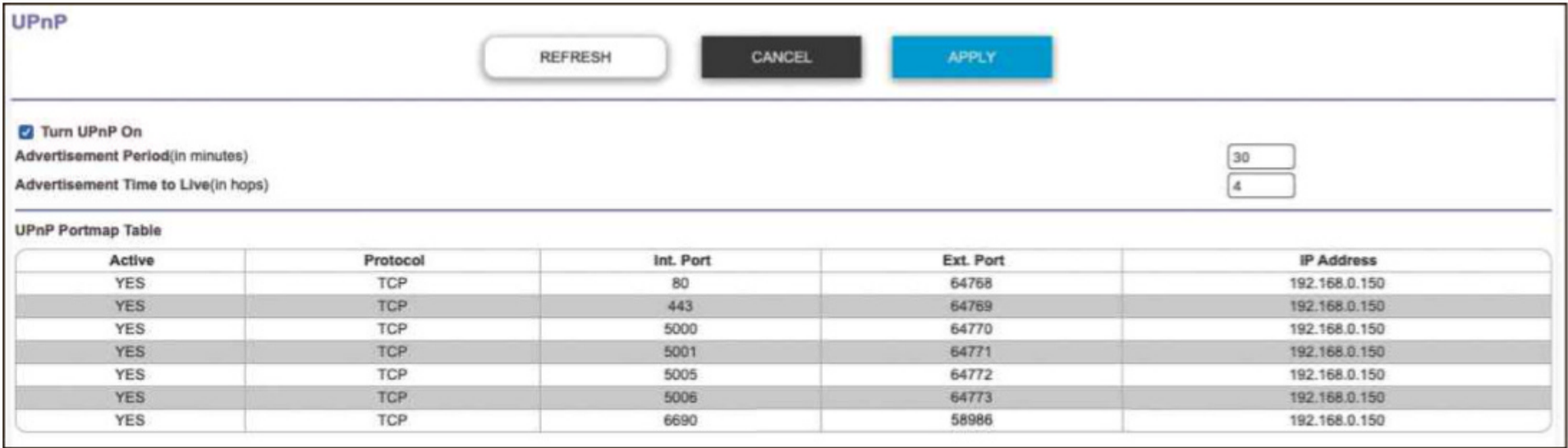
ABOVE: NAT lets multiple devices share a single internet address

Using NAT adds an extra layer of security, too. None of your computers or devices can be accessed directly from the internet: a random incoming request on a random port won't force the router to send data through.

What about devices that need to accept incoming signals from outside, such as a network camera that you want to control remotely? In this case, you need to set up a permanent way for this to happen. Port forwarding is a manual option, where you tell the router where to send data that comes in on a specific port. For example, you could set up your home to accept incoming connections on port 8080 to go to an internal web server that you're running on a Windows PC on port 80.

Port forwarding can be fiddly to set up, but there's also a technology called Universal Plug and Play (UPnP). With this enabled, devices inside your home can automatically configure the router for port forwarding without you having to do anything. That saves time, but it also means that UPnP can make devices internet-visible and open to a scan or attack: an attacker can scan your internet IP address to see which ports respond.

With Mirai, for example, the botnet looked for internet-connected devices that were vulnerable. It specifically looked for Linux-based systems, which includes many smart devices, and then tried the default username and password to gain access to the operating system, where it could then take over.



ABOVE: Routers will let you disable UPnP

More recently, Hacker Giraffe exploited a problem with Chromecast and smart TVs that exposed them to the internet via UPnP, to play a YouTube video from social media star PewDiePie. That might not sound so bad, but what if the hijack played a video that got Alexa to call a number to let a hacker listen to what's going on, or be really annoying and set an alarm to go off at 4.30am every morning? Any device that actually gets infected can then pose a bigger risk, as it can use UPnP to open up more ports and devices in your home for further attack.

How, then, do you protect yourself against this kind of attack? Fortunately, there are several steps you can take. The first is to disable UPnP in your router. This can stop some devices working until you manually configure port forwarding, but the extra security can be worth it.

To do this, go into your router's web-based management console and look for the UPnP setting, which is often buried in the Advanced settings. With our Netgear Orbi router, the UPnP page has a clear Turn UPnP On tickbox; removing the tick turns the service off.

Usefully, our router also shows the list of existing UPnP ports and the IP address that requested them. In our case, all UPnP requests are for the device at 192.168.0.150. A quick check of the DHCP address reservation lists shows that this is our Synology router. So, we actually have a choice here. We can disable UPnP to prevent future devices opening ports, but we can also leave it turned on but disable the features in the Synology NAS that have allowed this, such as remote web access and the file-sharing service in our case.

If we disable UPnP, then we have to remember to re-create the rules that are there manually if we want to keep using the services we have turned on.

UNPLUGGED

The next step that you should take is to audit the devices you have that are internet-connected, and then work out if you want to



ABOVE: If your router has additional security settings, you may want to turn them on to protect your home

leave them this way. For example, if you have an old smart TV but you no longer use its smart functions, then you may as well unplug it from the internet. Do this for everything in your home.

Next, for any device that you've left plugged in, you need to perform your own security audit. What you need to do is look at how the device is accessed and controlled, and change passwords where you can. For example, if you have an older security camera that you set up manually, are you still running the default username and password on it? If you are, it's time to change them.

However, this may not always be possible. For example, smart TVs don't give you the same options, so you're pretty much stuck with what you've got in the box.

Finally, take a look at your router to see if it has options for security that you can turn on. With modern systems, such as the Orbi, you can turn on malware checking for a monthly fee, which will look out for malicious attempts to hijack or control

RIGHT: If a device can't be attacked directly, your account can be targeted

devices on your home network. It's hard to put a figure on the efficacy of these systems, but that extra layer of defence will prevent some attacks happening and gives you that extra layer of security.

CLOUDED VIEW

Many of today's smart devices are controlled via a cloud service, through a smartphone app. For example, if you're away and turn up your Nest Thermostat, the request is funnelled through Nest's cloud service.

In some ways, this is more secure than having a direct connection to the device you're controlling, but what happens if your Nest account (or other accounts) is hacked? This will then give hackers direct control over devices in your home.

Samantha and Lamont Westmoreland from Milwaukee discovered what happens when their Nest account was hacked. They found that their heating was being turned up and that the camera in their house would speak to them and play vulgar music.

Google has said that this is the result of a compromised account, rather than a direct attack on its hardware, but it demonstrates the importance of protecting your cloud accounts: see the next page for more information on how to do this.



PROTECT YOUR ONLINE ACCOUNTS

WITH EVERYTHING IN THE CLOUD, HACKERS ARE NOW TARGETING ONLINE ACCOUNTS TO STEAL YOUR DATA AND PRIVACY. HERE'S HOW YOU CAN DEFEND YOURSELF

Malware targeted directly at computers used to be the biggest threat most of us would encounter. Today, the prevalence of the cloud means that a lot of us have private information available through online accounts. Many of our smart devices are controlled through these accounts, too.

From a hacker's perspective, the easiest answer to improved security in many cases is not to try to attack an individual's computer, but to go after big companies and individual online accounts. Once an account has been compromised, a cybercriminal can get hold of personal information, change settings and even potentially order products. This means that all the security software in the world can't help, as the hackers aren't going anywhere near your computer or devices.

If there's a flaw in a service's security, then there's often not much you can do to protect yourself. Before you give up, however, there are plenty of things you can do to minimise risk. Here's what to look out for.

USE DIFFERENT PASSWORDS

We're all guilty of using the same password time and time again. While this makes things easier to remember, it also makes it easier for hackers. If a company is attacked and cybercriminals get away with lots of usernames, email addresses and passwords, this information is often sold online.

The details can then be used to try and get access to other accounts. If you've used the same password everywhere, then this kind of attack can be very effective.

To see how much you're at risk of this, you can use *haveibeenpwned.com*. Simply type in your email address, click the Pwned? button and the site will tell you if you appear in any of the discovered lists of stolen user data.

Searching for our email address, we saw that we were at risk from seven breaches, including 500px, Adobe, Bitly, Dropbox and Houzz. That's a lot of potential trouble.

You can also use the Passwords section of the site to enter your password(s) to see if it has been spotted in the wild. If it has, you're definitely in trouble.

Breaches you were pwned in

A "breach" is an incident where data has been unintentionally exposed to the public. Using the 1Password password manager helps you ensure all your passwords are strong and unique such that a breach of one service doesn't put your other services at risk.

500px

500px: In mid-2018, the online photography community 500px suffered a data breach. The incident exposed almost 15 million unique email addresses alongside names, usernames, genders, dates of birth and either an MD5 or bcrypt password hash. In 2019, the data appeared listed for sale on a dark web marketplace (along with several other large breaches) and subsequently began circulating more broadly. The data was provided to HIBP by a source who requested it to be attributed to "BenjaminBlue@exploit.im".

Compromised data: Dates of birth, Email addresses, Genders, Geographic locations, Names, Passwords, Usernames



Adobe: In October 2013, 153 million Adobe accounts were breached with each containing an internal ID, username, email, encrypted password and a password hint in plain text. The password cryptography was poorly done and many were quickly resolved back to plain text. The unencrypted hints also disclosed much about the passwords adding further to the risk that hundreds of millions of Adobe customers already faced.

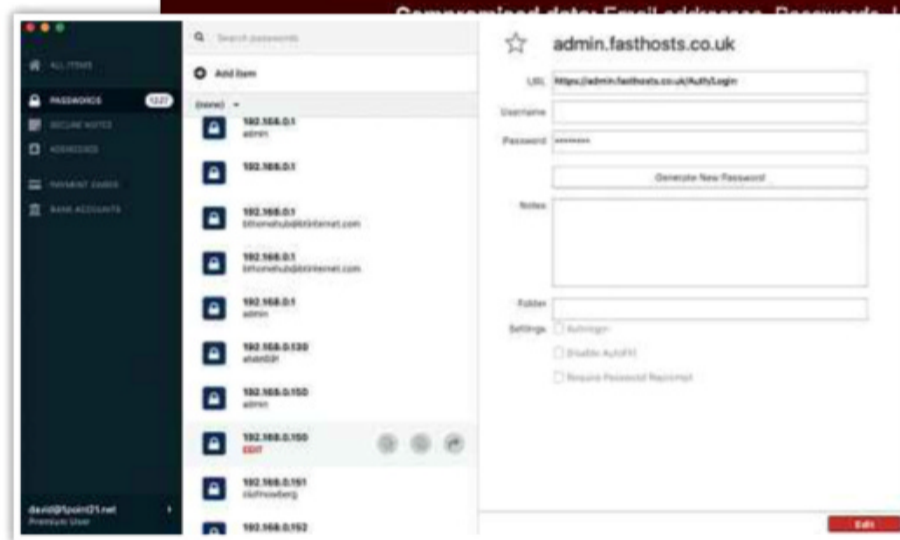
Compromised data: Email addresses, Password hints, Passwords, Usernames



Bitly: In May 2014, the link management company Bitly announced they'd suffered a data breach. The breach contained over 9.3 million unique email addresses, usernames and hashed passwords, most using SHA1 with a small number using bcrypt.

Compromised data: Email addresses, Passwords, Usernames

which exposed the stored credentials of tens of millions of users. The breach required password resets for customers they had over 68 million records was subsequently



ABOVE: A password manager is an essential tool to protect your online accounts

The single best way to protect your accounts is to use unique and strong passwords for every service that you use. That way, even if one account is breached, your other ones are safe because they use different passwords.

You can do this manually by using long passwords for each site, potentially recording each password in a book. However, we recommend paying for a password manager, such as LastPass, which runs on Windows, macOS, iOS and Android. The software can securely generate and store passwords for every website and app you use.

For desktop users, the software can generate passwords when you create accounts, storing the results. It's more of a

ABOVE: Have I Been Pwned? is a great way of finding out how secure you are

manual process on a smartphone, due to limitations in the operating systems, and you have to open the password app, add a new entry and then create the password. However, the hassle is worth it, as you get secure passwords synchronised across all your devices.

Just don't forget the master password to your password manager, as you'll then be locked out of everything: this one is worth writing down and storing somewhere safe.

USE TWO-FACTOR AUTHENTICATION

As well as using a password, use two-factor authentication on any account that supports it. This requires you to enter not only your password but also a unique one-time code. This code can be generated by an app, sent via text message or even emailed to you. The advantage of this type of system is that if a criminal gets hold of your password, they still can't access your account without providing the second code that's required.

DEALING WITH SCAM PHONE CALLS

Scam phone calls have been around for a long time now. You know the one: you get a phone call from your 'internet provider' or 'Microsoft' telling you that your computer has been hacked. The aim of the call is usually to get you to install some software on your computer that gives the hackers remote control so they can start to steal data from you, or show you false information on the screen to get you to pay for a virus clean-up.

We've probably all become more aware of this type of attack, and the anti-malware software that we've tested later on usually picks up the tools that are used. As a result, hackers have stepped up a gear. We've seen first-hand how hackers can call using a fake incoming caller ID. For example, you might see a number that looks like your bank's and answer it, and then you're told that it's your bank's anti-fraud team. The initial call, appearing to come from the correct number, can easily throw you off, which is what the criminals want. They then ask for data protection information before they speak to you, which they can then use themselves to break into your account. In this way, the criminals aren't even trying to trick you into doing anything on your computer, focusing entirely on connecting to your online account.

This kind of attack is far trickier to spot, particularly as big institutions often will



phone and ask for verification information before they can start. We've been saying for a long time that customers need to be able to set up a telephone password that the caller has to use first. That way, you can verify that who's calling you is legitimate, and then you can divulge your data protection questions in safety.

In the absence of this, there are a few things to look out for. First, never give out any two-factor authentication codes over the phone. For example, if the caller says that to verify your identity you need to provide the code that has been texted to your phone, what they mean is that they've triggered the code to be sent and they'll type it in to get access to your account.

Second, be very wary of any information that you're being asked for, such as customer information or the full answer to a standard security question, as opposed to giving the sixth letter

of your telephone password, for example.

The best option in many cases, unless you're specifically waiting for a callback or telephone call at a set time, is to hang up and then call back the company using the number on their website or latest bill. That way, you can get through safely. In our case with the fake caller ID from the bank, when we called back and got through to the fraud team we quickly found out that this was a scam that we'd avoided.



Each site and service has a different setup routine to enable two-factor authentication, so you'll need to follow the information provided to add this extra protection.

The service that you use defines the options that are available. The best ones, such as Google and Facebook, let you use an app on your phone to generate your codes. The Google Authenticator app is good, but if you have LastPass, you can use its Authenticator app to synchronise your codes securely to the cloud. If you lose your phone, you can get a new one and restore your code generators.

All sites that let you generate a code will also give you several backup codes that you should download and print out. You can use these in an emergency should you lose your phone and need to get access.

For even more security, look out for sites that support the YubiKey or other USB security key. These keys can be carried around with you and plugged into a USB port. When a site or service asks for a code, you can just use the button on the YubiKey to send the data. However, it's worth having a backup option, such as a code generator, just in case.

We use LastPass protected by both a long and complicated password and a YubiKey: only this combination will unlock our other

passwords. Make sure that you never divulge a two-factor code to anyone to prevent fraudulent access to your accounts.

WHAT TO DO IF YOU'RE HACKED

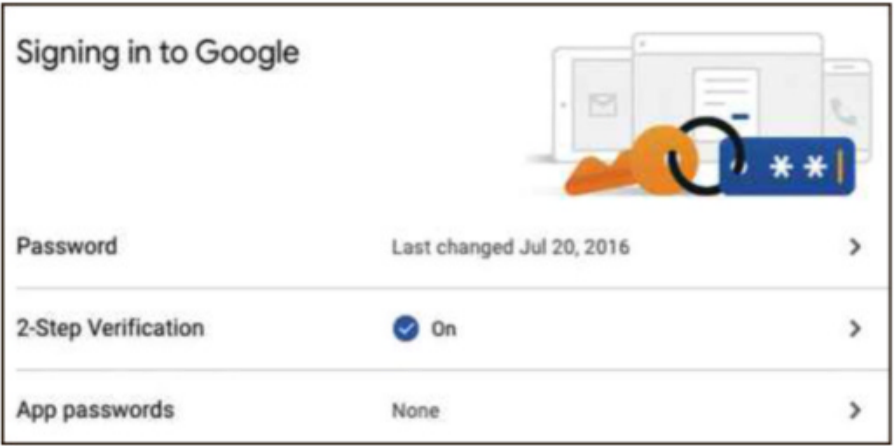
So what happens if you're hacked, and how do you know? For the latter, you may get an email from the company telling you of a security breach and that your details may be at risk. You may be told that your password is secure.

However, in many cases, you don't get much information, bar some warning signs. For example, we've had a few emails with two-factor codes come in for an old VPN account where the password had been breached. This tells us that the password had been compromised but that our two-factor system had prevented further access. Look out for these emails or warnings of suspicious activity, as they hint that your password has been compromised.

RIGHT: Two-factor authentication gives you an extra layer of protection

When you get any warnings, direct or otherwise, it's wise to go to the account in question, log in and create a new secure password using a password manager. This will protect you against further problems.

If you've used the same password on other websites as well as the compromised account, you'll need to log into these accounts too, and then change the password for something more secure. If you use a password manager, it will warn you if you've stored weak or repeated passwords for any websites. Take these warnings seriously: you should update and replace old, weak passwords and those that you have used on multiple occasions. This could prevent you from having a bigger problem in the future.



SECURITY SOFTWARE BUYING GUIDE

NOT SURE WHAT YOU SHOULD LOOK FOR IN A SECURITY SUITE? WE'RE HERE TO HELP

Although Windows 10 has improved security dramatically, it's still important to have proper security software to block the multitude of threats that your computer is exposed to as you use the internet. Protection is doubly as important on laptops, where they can leave the safety of your home and connect to strange networks.

To help you find the best security software, we're doing things a bit differently. Using testing from SE Labs (selabs.uk), an independent security company that's run by former *Shopper* stalwart Simon Edwards, we've got results for 15 products, taking in every major free and paid-for security suite.

Looking at the protection scores, which show how many threats were successfully stopped at any stage, the results this year are quite staggering: out of the 15 products, six scored a perfect 100, four 99, three 98, one 95 and, at the bottom of the pack, one scored 81.

This shows that protection levels have improved dramatically since we last group-reviewed security software, with the majority of products doing a solid job. To find out a bit more about each bit of software, we're deep-diving into the score results to find out the quality of protection for each.

When you've finished reading the results, you'll know which software is best at protection and whether or not you should stick with what you've got or switch to another package. Even so, results are only part of the picture, and features, quality of product and price all have an important part to play.

So, using our first-hand knowledge of each product, we've put together our chosen list of



ABOVE: It's vital to install protection on a laptop if you take it away from home and connect to other networks

software. These are the all-rounders that have the best price, features and protection. However, if you're already running software that gives the level of defence that you need, our results could confirm that you're good to stick with what you've got.

VERSION AVERSION

The test results that we're using come from between July and September 2019. Each test was performed after upgrading the software to the latest version, including downloading

the most recent malware database files. It's worth pointing out that the level of threats changes over time, as does the performance of products. What we have here is a snapshot of a particular time; it's a brilliant indicator of how good each piece of software is,

LEFT: You can often pick up antivirus packages cheaper online than from the manufacturer

but we have to put in the caveat that performance can vary over time.

It's also worth mentioning product versions. Typically, each manufacturer will have multiple versions of its security software, each with different features. For example, Kaspersky Anti-Virus gives you basic security protection, but if you upgrade to Kaspersky Total Security, you get Safe Kids for blocking bad content, a password manager, and the encrypted Money browser to protect online transactions.

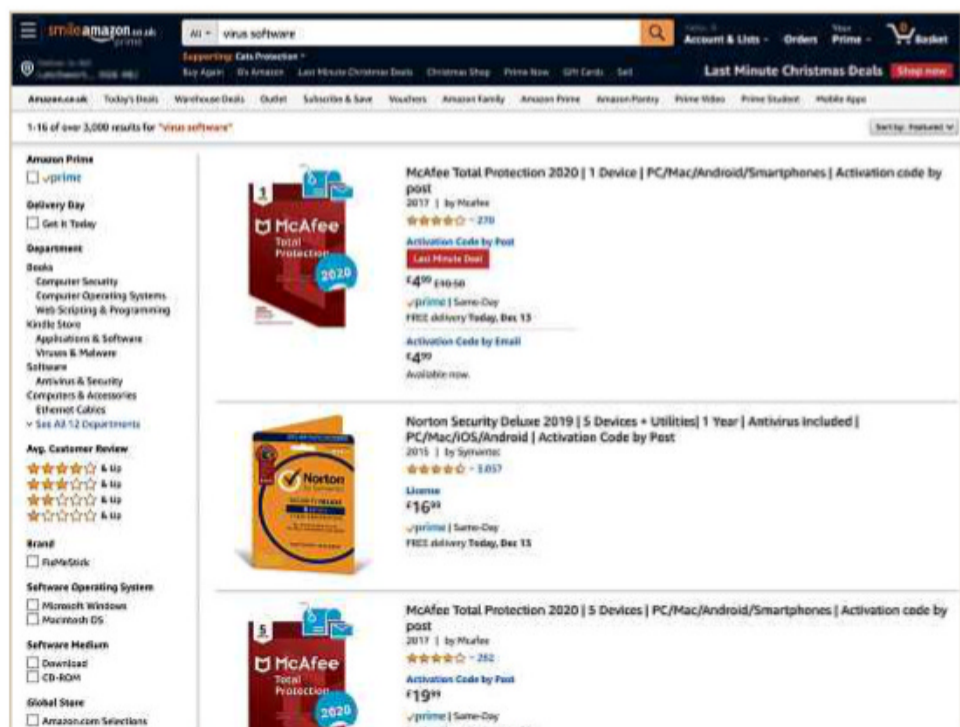
The base level of protection remains the same throughout all versions, so it's really about looking into the extra features that you may or may not need. To keep things simple, we've listed the best version based on price and features in our table.

THE PRICE IS RIGHT

Security software is purchased with a licence that gives you access to software and virus-detection updates for a set period, usually a year. When the licence expires, your software no longer updates and you're locked at a protection level that becomes more and more outdated as the time passes.

You'll often get a better deal by buying 'boxed' software from retailers such as Amazon but not from the security vendors themselves.

In the box, you'll get a licence code, which you can use to unlock the software that you



download from the internet. It can save a lot of money, too. For example, Kaspersky Total Security costs £23 from Amazon for a three-device licence; if you buy through Kaspersky, it costs you £35.

Be wary of renewal prices, as these are usually charged at full price through the security vendor. However, if you shop online, you can find that you can buy a brand-new licence at a lower cost, which is well worth doing. With the licence code that you get, you can either enter it into the software to unlock another year's use, or you may find that you have to uninstall and reinstall to achieve the same effect.

However, given the savings on offer, going for the cheaper and slightly more complicated option is well worth it. We recommend that you set a calendar reminder a month or so before your renewal is due so that you can buy the new software you need and have it ready before your old software expires.

FREE RIDE

There are plenty of free anti-virus applications available, including Windows Defender, which is built into the Windows 10 operating system. So should you just use one of these, or should you stump up the cash for a more feature-packed paid-for version?

Free security software can be very good. In fact, this year, Microsoft Windows Defender scored a Protection Score of 99 out of 100, and the other free software wasn't far behind. For basic protection, the free software is undoubtedly better than nothing.

That said, the paid-for software delivered better results, and you get more features, particularly with the higher-priced packages. For example, if you want to protect your children from malware and bad websites both on a computer and mobile phone,



ABOVE: Many security suites offer protection for mobile phones as well as PCs and laptops

free software just won't cut it, but the paid-for packages will give you these features.

PHONE HOME

Many security suites are also available for smartphones, and you'll often find that if you buy a multi-licence key you'll get support for phones alongside desktops and laptops. Smartphones are built to be more secure than desktops, so are generally less vulnerable, as it's virtually impossible for a website, for example, to install malicious software on to a phone. However, that doesn't mean that your Android phone or iPhone is completely secure, and antivirus software can offer that extra level of protection.

It's the extra features that you get that can make the software useful. For example, if you want web filtering to extend to mobile phones in your household, this is the way to do it. Security apps also tend to give extra features,

such as call filtering, where you can choose who can and can't be called, and additional security features, such as remote wiping and secure tracking.

With phone apps, it's worth looking at the full feature set and working out what you do and don't need, rather than focusing on security alone.

FULL PROTECTION

There's a growing number of security suites that are built to install on routers, such as Netgear Armour, which is designed for the Orbi mesh system and some other high-end routers. With Netgear Armour, you get an additional level of protection, with the blocking of fake and malicious websites, a security scan of your home network to detect vulnerable devices, device management with warnings for unauthorised devices trying to access your network, and protection from ransomware.

This can help protect IoT devices, such as your smart TV, as well as other devices where you can't install a security client. Offerings differ between router manufacturers, but the yearly subscription charge usually includes software that you can install on clients, too. For example, for £60 a year, Netgear Armour gets you Bitdefender Total Security for any Windows, macOS, iOS and Android devices that you own.

This can work out to be very good value, but you need to take into account the quality of the software that you get. We don't have test results for Bitdefender here, but AV-Comparatives rated Bitdefender's protection at a maximum of three stars, with the software blocking 99.7% of threats.



ABOVE: You invariably get a better deal by buying boxed software

SECURITY SOFTWARE ON TEST

WE FIND OUT HOW EACH SOFTWARE PACKAGE PERFORMS AND HOW WELL IT STANDS UP TO DIFFERENT LEVELS OF ATTACK

Testing security software means turning to the experts. This year all our tests were performed by SE Labs (selabs.uk), run by Simon Edwards, who used to work for this very magazine.

SE Labs uses the Anti-Malware Testing Standards Organization (AMTSO) standard for testing. That means all the products have been tested thoroughly in such a way that the results demonstrate real-world performance.

All products are tested using a double form of attack. First, there are threats collected in the wild, which means the kinds of threats to which your computer is exposed. These should be relatively straightforward for a product to deal with. Second, products are exposed to targeted attacks, similar to those that cybercriminals would use. In effect, the tests are there to see if the software can protect against both known attacks (traditional malware) and direct attacks, which are becoming more popular.

All software is tested in real-world terms, with a full internet connection so that software can use any cloud services and download updates. Testing malware without a live internet connection massively distorts results and, given that most infections take place when you're online, this testing makes sense.

PROTECTION DETAILS

After being exposed to a threat, the computer is analysed fully to see what happened. There are three main outcomes: the threat was blocked immediately; the threat was neutralised, which means that a threat made it on to a computer but the malicious software was killed before it could do damage; or the machine was compromised and the dangerous software was allowed on to the computer.

On top of this (not shown in the graph on the opposite page), it's possible for software to detect a threat that it doesn't have the capabilities to defend against. This still counts as a compromise, but having a warning would at least let you try and clean your computer afterwards.

We've plotted the details in the graph on the opposite page. As you can see, the top of the graph is very tight, with F-Secure Safe and Trend Micro Internet Security blocking all threats. Comodo Internet Security, Kaspersky Internet Security, Sophos Home Premium and Symantec Norton Security all blocked 99



ABOVE: The security suites on test were exposed to real-world threats and targeted attacks to rate their efficacy

threats, and neutralised the remaining one. As we move down the graph, the protection rate is still good, but the software was compromised in at least one incident, while the blocking rate drops. Right at the bottom, we have to point out G-Data Internet Security, which was compromised five times, and Webroot Antivirus, which was compromised a staggering 19 times.

LEGITIMATE SOFTWARE

As well as blocking real threats, it's important that security software allows legitimate software to be installed. To test this, a series of legitimate software is installed, downloaded if possible from the manufacturer's website, and ignoring any software that has adware in it.

The software was sorted into categories based on how prevalent it was: blocking Google Chrome is way worse than stopping an obscure utility. From these categories, security software lost scores from a perfect 736 based on the type of software that it blocked. All the security suites allowed all legitimate software, bar F-Secure Safe and downwards on the

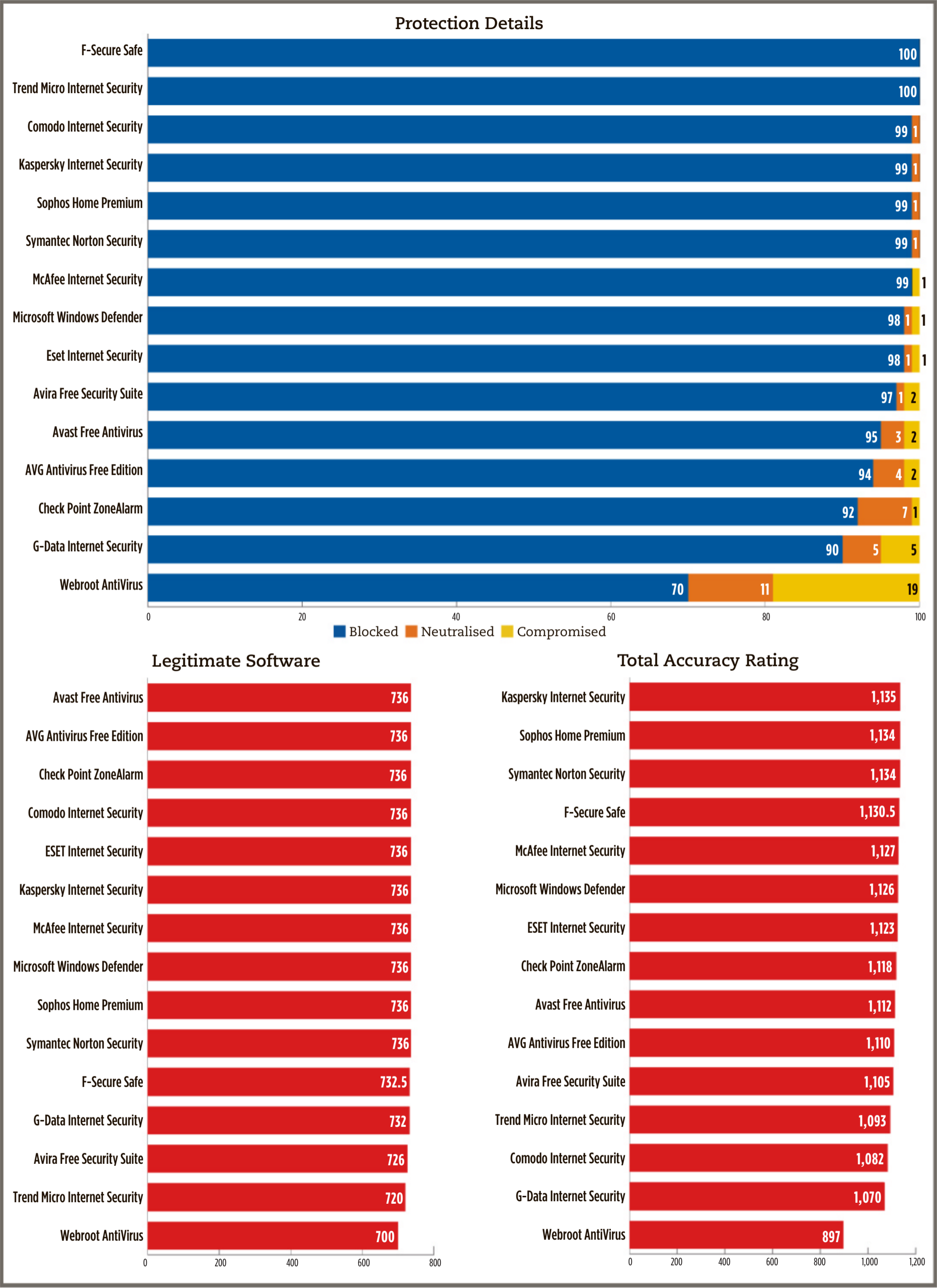
graph opposite, bottom left. Once again, Webroot was bottom of the pack.

TOTAL ACCURACY

To work out a total accuracy rating, the software was scored based on how well it defended against an attack, with software that blocked scoring highly and software that allowed a computer to be compromised getting heavily penalised. In addition, the scores for legitimate software were included. These totals allow you to see how well each bit of software stacks up.

As you can see from the results, it's close at the top, with the top four products (Kaspersky Internet Security, Sophos Home Premium, Symantec Norton Security and F-Secure Safe) offering very similar overall protection. Below this, results are good, but it's worth checking out the graphs to see if any of the software was compromised.

It's no surprise that Webroot Antivirus came bottom, with its combination of poor detection and poor legitimate software detection massively holding it back.



THE BEST SECURITY SOFTWARE

PROTECTION IS IMPORTANT, BUT THERE ARE OTHER FEATURES TO CONSIDER WHEN CHOOSING SECURITY SOFTWARE. HERE, WE ROUND UP OUR TOP CHOICES BASED ON PROTECTION, FEATURES AND PRICING

While the quality of the protection you get is the most important thing about security software, it's not necessarily the only thing you should consider: there's also price, features and the number of supported devices to take into account.

This year, we've been very impressed by the calibre of the security software that we've tested. When looking at the paid-for software, F-Secure Safe, Trend Micro Internet Security, Comodo Internet Security, Kaspersky Internet Security, Sophos Home Premium and Symantec Norton Security all protected against every single threat. Just below that, McAfee Internet Security and Eset Internet Security only allowed a single piece of malware through their defences; Check Point ZoneAlarm did, too, although it was far less successful at outright blocking attacks. Based on this, if you currently have any of these applications, then you can consider yourself safe, and

may only want to change your package when your subscription is up for renewal.

For those running free software, Microsoft Windows Defender was the surprise winner, only being compromised once, while Avira Free Security Suite, Avast Free Antivirus and AVG Antivirus Free Edition were all compromised twice. As such, Windows Defender is the best basic protection application at the moment, but the competition isn't far behind. You'll get better protection by paying for software, but if you don't want to, the free software we've tested here has a decent level of protection.

Beyond raw protection, we took several factors into account for free and paid-for packages, allowing us to come up with our final recommendations. First, we looked at how the software dealt with legitimate software: how annoying was each application at blocking applications that should be

allowed? Then, we looked at the Total Accuracy, which includes more nuanced scoring for how an application blocked or neutralised a threat, and how it cleaned up afterwards, and included the legitimate software scores, too. This gives us a better overall picture of not just how good the security software is, but also how it feels to have to use it.

Our table on page 82 has all of the specs for the security software. Each security package is sold in several different versions, so to get the possible features that we've listed, you may need to upgrade to a different package. To try to make things easier, we've looked at price, features and support, and have then recommended what we believe is the best version near the bottom of the table. If you need additional features or support for more devices, you can buy an alternative version. With that said, here are our top choices.

FREE SECURITY SOFTWARE

MICROSOFT Windows Defender

COMPUTER SHOPPER ★★★★★
RECOMMENDED Free • Included with Windows 10

It feels strange to be recommending Windows Defender, given how poorly the software has performed in previous years. Now, however, the story is different, and Windows Defender had the best results of any of the free software we tested, blocking 98 threats, neutralising one and only being compromised once.

One of the issues with Windows Defender was that it used to be very heavy-handed when dealing with legitimate software, but that statistic has changed this year, too, with the software scoring high and allowing legitimate applications to be installed. As a result, the Total Accuracy Rating score of 1,126 puts Windows Defender sixth out of all the software we tested.

Given the simple interface and the fact that Windows Defender is built into Windows 10, PC users can rest safe with this application. If you need more features and the best overall protection, take a look at one of the paid-for suites, but Defender is otherwise a great choice.



AVAST Free Antivirus

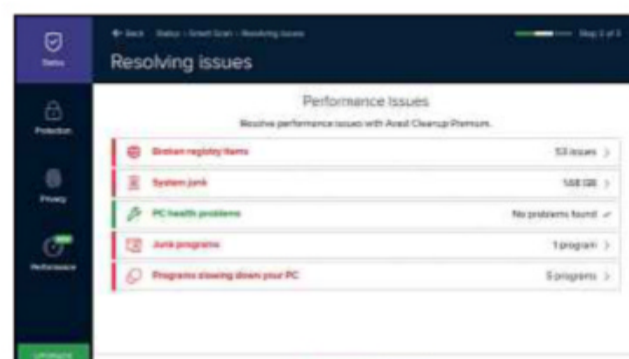
★★★★★
Free • From www.avast.com

While Windows Defender was our surprise top-choice for free software, Avast Free Antivirus wasn't far behind. Given that Windows Defender is best on Windows 10, if you have a different operating system, you'll need a different free security suite.

This package blocked 95 threats, neutralised three and allowed two to compromise the test system. It didn't filter out any of our legitimate software, and as a result gave us a Total Accuracy Rating of 1,112 – the best of the rest of the free software.

With this latest version, the software is far less annoying, and the irritating pop-ups that tried to persuade you to buy the paid-for version are gone. In fact, the new interface now makes it far clearer as to what's in the free version compared to the premium one. It's slightly frustrating that performing a scan also looks for performance issues, which require an upgrade to fix, but that's a minor complaint.

If you need protection for an operating system other than Windows 10, Avast Free Antivirus is a good choice, but you'll get better protection if you upgrade to a paid-for suite.



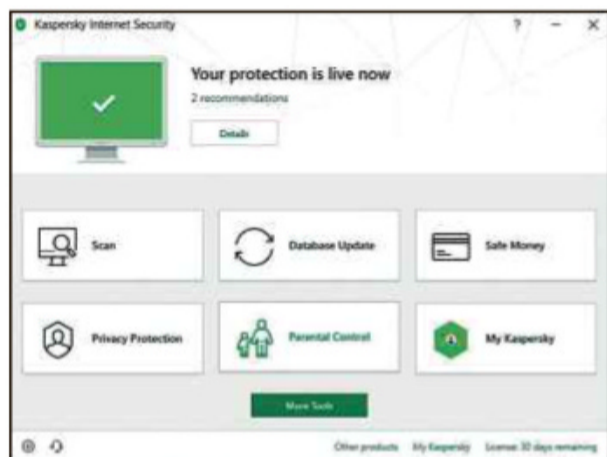
PREMIUM SECURITY SOFTWARE

If you're going to get the best protection and range of features, you'll have to pay the annual fee to get them. While the competition was very close this year, we've picked our top three security packages based on features, performance and price. Just make sure that you buy the appropriate version for your needs and number of devices.

KASPERSKY Internet Security

COMPUTER SHOPPER ★★★★★
BEST BUY £23 • From www.amazon.co.uk

Kaspersky Internet Security has long been one of our favourite security suites, and it remains so this year. We believe that the Total Security package is the best-value option for most people, but there are a range of other options with different features that you should look at.



The main thing with Kaspersky is the quality of protection. In terms of raw results, Kaspersky blocked 99 threats, neutralised one, and was never compromised. It scored perfectly when it came to legitimate software, too. Taking a more nuanced look at how it defended and how it dealt with legitimate software, Kaspersky scored 1,135 for Total Accuracy, placing it – just – at the top of the table.

As good as the protection is, it's the quality of the software that really shines through. The main interface is clean, with plenty of white space, making it easy to find the features you want. There are some neat features in there, too, including Trusted Applications mode. This blocks all software that isn't on the company's whitelist, building in a high-level of security for the less savvy user. The Money Browser is a neat option, launching a secure browser when you buy anything.

There's also a software cleaner, a webcam protection module to stop spying, a software updater and a parental control suite. Pretty much whatever you need is included in this suite, making Kaspersky more valuable than simply a tool to prevent malware getting on to your computer.

Even better, Kaspersky is one of the few products that's still available through online

retailers, so you can get a real bargain on it, too. If you're looking for premium protection, this is the software to buy.

SOPHOS Home Premium

COMPUTER SHOPPER ★★★★★
RECOMMENDED £25 • From home.sophos.com

Sophos is another name that we hadn't expected to do quite so well, yet Home Premium impressed us with its level of protection. As with Kaspersky, Sophos Home Premium blocked 99 threats and neutralised one, and never allowed the test machine to be compromised. It scored perfectly in the legitimate software test, too, allowing everything to be installed without fuss.

Looking at the Total Accuracy score, which takes a more nuanced look at how the software defends against threats, Sophos Home Premium scored 1,134, which is just a single point behind Kaspersky.

Built on technology from the company's business division, Sophos Home Premium uses an online dashboard to monitor and control installations of the software. That's handy if you've got multiple devices in your home that you want to manage, but it's not quite as friendly for some people as having everything available in the app.

There are some other powerful tools in the suite, including CryptoGuard, which monitors your system for any encryption of the sort used by ransomware. Parents will be pleased to see the parental controls option to filter what children can look at. There's also built-in privacy protection to guard against a hacker accessing your webcam or microphone.

We like the Potentially Unwanted Program (PUP) module, too, which looks out for useless bundled utilities that often come as an 'extra' when you install free software.

A powerful security suite, Sophos's cloud control may be a benefit to many, letting one family member manage all devices no matter where they are, although this reliance on an internet connection may put some people off.

Kaspersky Internet Security is the friendlier software, but Sophos isn't far behind, and its protection is excellent. It's good value, too, with this version covering 10 devices, making it a good choice for homes with a lot of devices.



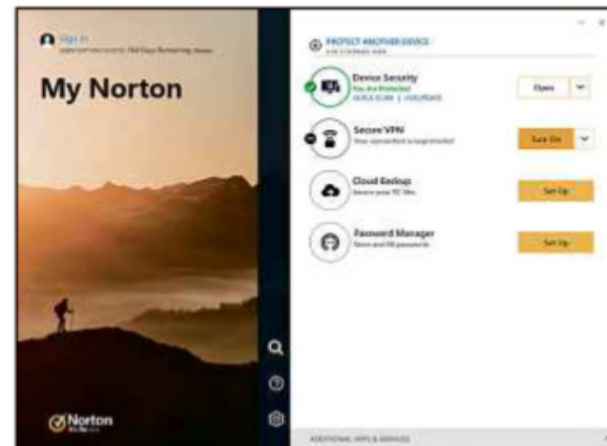
SYMANTEC Norton Security

COMPUTER SHOPPER ★★★★★
RECOMMENDED £19 • From www.amazon.co.uk

Norton is another very familiar name in internet security, and this year the software continues to do well. It's Norton 360 Deluxe that we recommend as the best package, which you can pick up for £19 on Amazon, including support for up to five devices. That's quite incredible value.

When it came to protection, Norton did very well, with the Total Accuracy Score of 1,134 matching that of Sophos and sitting just behind Kaspersky. Norton allowed all legitimate applications to be installed, and it blocked 99 threats, neutralised one, and didn't allow the test system to be compromised.

Norton has been through a bit of a confusing time recently, with Norton 360 originally being discontinued in 2014 and replaced by Norton Security, which is now being replaced by the new Norton 360. As with the old version, Norton 360 is about giving you a stack of features both covering security and general PC use.



What you get is a bit of mixed bag. There are no complaints about the unlimited VPN, for example (most other vendors have a traffic limit unless you pay extra). However, the 50GB of online backup isn't particularly generous, and if you want more, you're better off going with an established system such as Dropbox or Google Drive.

Also included with Deluxe are parental controls, SafeCam for PC (this protects your webcam against hacking), a password manager and the 100% Virus Protection Promise, which offers your money back if you get a virus that Norton's experts can't remove.

As good as all these additional features are, the interface is a little cluttered, and trying to find all the options isn't as easy as with some other applications. If you want all the features, such as the VPN, Norton is excellent value, but the simpler Kaspersky Internet Security is a touch easier to use, and Sophos Home Premium is better value if you need more devices covered.

Manufacturer	AVAST	AVG	AVIRA	CHECK POINT	COMODO	ESET	F-SECURE
Version tested	Free Antivirus	Antivirus Free Edition	Free Security	ZoneAlarm	Internet Security	Internet Security	Safe
Rating	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
OS DETAILS							
Windows support	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10
FEATURES*							
Antivirus	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firewall	No	No	No	Yes	Yes	Yes	Yes
Parental controls	No	No	No	No	No	Yes	Yes
Gaming mode	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BUYING INFORMATION							
Free version	Yes	Yes	Yes	Yes	Yes	30-day trial	30-day trial
Recommended version	Free Antivirus	Antivirus Free Edition	Free Security	ZoneAlarm Extreme Security	Internet Security	Ultimate Protection	Safe 3 devices
Price*	Free	Free	Free	£36	\$9.99 (£7.60)	£50	£60
Devices protected	Unlimited	Unlimited	Unlimited	5 devices	3 devices	3 devices	3 devices
Details	www.avast.com	www.avg.com	www.avira.com	www.zonealarm.com	www.comodo.com	www.eset.co.uk	www.f-secure.com
Supplier	www.avast.com	www.avg.com	www.avira.com	www.zonealarm.com	www.comodo.com	www.eset.co.uk	www.f-secure.com

		BEST BUY		RECOMMENDED	RECOMMENDED	RECOMMENDED		
Manufacturer	G-DATA	KASPERSKY	McAfee	MICROSOFT	SOPHOS	SYMANTEC	TREND MICRO	WEBROOT
Version tested	Internet Security	Internet Security	Internet Security	Windows Defender	Home Premium	Norton Security	Internet Security	AntiVirus
Rating	★★★★☆	★★★★★	★★★★☆	★★★★☆	★★★★★	★★★★★	★★★★☆	★★★☆☆
OS DETAILS								
Windows support	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10	Windows 7, 8.1 and 10
FEATURES*								
Antivirus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firewall	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Parental controls	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Gaming mode	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
BUYING INFORMATION								
Free version	30-day trial	30-day trial	30-day trial	Yes	30-day trial	30-day trial	30-day trial	30-day trial
Recommended version	Internet Security	Total Security	Internet Security	N/A	Home Premium	Norton 360 Deluxe	Maximum Security	AntiVirus
Price*	£40	£23	£9.99	Free	£25	£19	£25	£22
Devices protected	1 device	3 devices	3 devices	Unlimited	10 Devices	5	10 devices	1 device
Details	www.gdatasoftware.co.uk	www.kaspersky.co.uk	uk.mcafee.com	windows.microsoft.com	home.sophos.com	uk.norton.com	www.trendmicro.co.uk	www.webroot.com
Supplier	www.gdatasoftware.co.uk	www.kaspersky.co.uk	www.amazon.co.uk	Included in Windows 10	home.sophos.com	www.amazon.co.uk	www.trendmicro.co.uk	www.webroot.com

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COME INTO FOCUS

Cameras

Choose your next camera wisely with our guide to the best compact, DSLR and mirrorless cameras. Some are cheap, some are premium, and all will be a big upgrade on your smartphone camera

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STRIDING IMPROVEMENTS IN smartphone camera technology might have dulled the appeal of simple point-and-shoot cameras, but if you really want top-quality photos and video, even the best mobile devices can't compete with a dedicated snapper.

Of course, there's still the matter of finding the right model that meets your needs. Some cameras, for example, might be great at stills photography but are short on video features. Others may go for simplicity with a built-in lens, but if it's flexibility you're after, it can be better to go with something that has a versatile mount for attaching different types of lenses (or 'glass', in photographer parlance).

We've gathered 10 quality cameras that should help you make up your mind; you'll find these on test from page 86 onwards.



Alternatively, keep reading for our guide on what to watch out for when buying a camera.

TIME TO REFLECT

First up: what kind of camera do you want? The three main types are digital single-lens reflex (DSLR), mirrorless and compact. DSLR cameras are defined by how they combine a digital sensor – that all-important component that captures the light reflected by the lens, producing the image – with a mirror-based system for feeding the image to the viewfinder.

Mirrorless cameras, on the other hand, either use fully electronic viewfinders (EVFs) or lack one entirely, instead relying fully on a rear-mounted screen to preview the image. Since both these solutions are digital, there's no need for the space-consuming mirror and prism system used by DSLRs, allowing mirrorless cameras to be smaller and more portable.

Compact cameras also forgo mirrors, but are distinct from what we'd call mirrorless cameras because they tend to have a smaller sensor than DSLRs, as well as being physically smaller. Because they can offer both superior sensors and a less bulky frame, mirrorless cameras are the fastest-growing of the three, but a compact might be better if you're after a camera for travelling. The optical viewfinders of DSLRs also tend to be more responsive than EVFs, and they usually have much better battery life.

LIGHT WORK

Why exactly do larger sensors take better photos? It's actually quite simple: the larger a sensor is, the more light it can capture, which means photos taken in low light will be clearer, and a greater range of tones in the white/black spectrum can be reproduced.

That's why, although cameras are usually advertised with how many megapixels their sensor can capture, it's also important to look at sensor size. It's no coincidence that the two most expensive cameras reviewed here, the Nikon Z6 and Sony A9, both have massive 35.9x23.9mm sensors. In fact, having greater surface area on a sensor is a big part of upping the pixel count.

More pixels doesn't necessarily translate into better all-round image quality, but it is integral to sharpness, and if you ever want to create large prints of your photos, having more megapixels will allow for a larger, less visibly pixellated image.

DIAL AND ERROR

All dedicated cameras have some form of physical controls on the rear, but it won't always be a case of more is more. Experienced photographers will naturally appreciate having a full suite of dials and knobs to fine-tune every shot, but beginners might find a basic setup more suitable than a potentially confusing mass of buttons. In the latter case, then, it might be more worthwhile to find a camera where the controls are designed more for ergonomics and ease of use than professional-grade flexibility.

Still, a lot of the functions controlled by these inputs can be easy to grasp even if they take some time to master. We're particularly fond of touchscreens: in addition to displaying a preview of the photo or video frame you're about to shoot, most touch-enabled displays allow you to reposition the autofocus simply by poking at where you want it on the screen.

It's also useful if the screen is articulated, or at the very least capable of tilting up or down. Both will make it easier to nail your shots when shooting from a very high or low angle, specifically from positions where you can't get your eye close enough to see through the viewfinder or to make out the image on a flat screen.

NOISE COMPLAINT

You can probably imagine what qualities make for a good-looking image: faithful colour reproduction and balance, clear lighting, and subjects that are in focus with no unintentional blur. None of the cameras we've featured here takes poor photos, but some are better than others at capturing moving objects or shooting in low light.

Speaking of which, a lack of light is among the biggest threats to effective photography. Digital photos can be covered in a distortion effect called visual noise if the sensor isn't getting much light, hence why larger sensors are ideal. You can try to brighten up low-light shots by manually

adjusting the ISO value, which is basically the sensitivity of the sensor, but raising it too high ironically causes noise to appear. The best cameras, therefore, are capable of taking clean low-light shots without having to crank up the ISO to problematic levels.

LOCKED ON

A lot of digital cameras include an autofocus (AF) motor and sensor that – no prizes for guessing – automatically focus the camera on a subject, or on an area you pick up on a touchscreen. This is great for newcomers and experienced photographers alike, although performance will depend on how many autofocus points the sensor has. The more points, the more accurate autofocus can be. Lesser cameras can also have trouble keeping a moving subject in focus, so it's worth spending more if you want to try sports or wildlife photography.

Another useful feature for more specialised photography is burst shooting. This rapidly captures multiple frames, possibly from even before you hit the shutter release. This is also handy for capturing a moving subject, as you don't have to worry so much about getting that one perfect shot: just take loads at once and pick the best one later. The camera might take some time processing all these digital images, however, so there may be a delay before you can shoot again.

LENS WITH BENEFITS

If you buy a camera without an integrated lens, you lose some convenience and money-saving potential in exchange for vastly improved versatility. It's good to start with a general-purpose kit lens, but you can also get ultra-wide-angle lenses, massive optical zoom lenses and macro lenses for close-up shots, swapping them to tailor your hardware for different subjects and shooting conditions.

Be sure to note which kind of lens mount your camera uses, however. Manufacturers tend to use their own proprietary mounts, or shared but uncommon formats such as Micro Four Thirds. Luckily, the majority of mount types all have a good variety of lenses available, so this likely won't be the deciding factor in your choice of camera.

MOVIE MAKER

It's not just stills photography we'll be looking at; all 10 cameras here can also shoot video. DSLR and mirrorless cameras have long been viable alternatives to dedicated video cameras, especially if they come with video-focused features such as a microphone input jack.

Besides the expected differences in video quality, it's also worth looking at which shooting modes each camera offers. 4K at 60fps is the gold standard in terms of technical proficiency. Although you might only want to record at Full HD, you should still look out for which frame rate options there are. That goes for slow motion modes, too. Higher frame rates makes for smoother, slower and potentially more impactful footage.

CANON EOS M200



£499 • From www.amazon.co.uk

VERDICT

A user-friendly, well-made camera, albeit one that's mainly for beginners

GRADUATING FROM YOUR smartphone snapper to a 'proper' camera can be intimidating: too many features and controls and it can get overwhelming, too few and there would be little point.

Enter the EOS M200. A relative snip at £499, it has an APS-C sensor that dwarfs that of any smartphone, and is compatible with all of Canon's compact, lightweight EF-M mount lenses, or its DSLR lenses via an EF-EOS M adaptor. It has a handful of body-mounted buttons, allowing beginners to turn it on and start shooting, but it also offers plenty of manual controls for photographers who either know what they're doing or are keen to learn.

GROWING ATTACHMENT

The EF-M mount has a relatively decent number of lenses, certainly in terms of the kind of glass that advancing amateurs will want. The M200 we reviewed came with the 15-54mm f/3.5-6.3 IS STM lens; other useful options include the 55-200mm f/4.5-6.3 IS STM or the 32mm f/1.4 STM for street photography. The M200 feels as though it's built for vloggers, which could explain why all the EF-M lenses use STM (Stepping Motor) focusing – ultra-smooth, ultra-quiet lenses that allow you to use tracking autofocus mid-take.

Of course, all the lenses in the world won't matter if the camera isn't user-friendly. The M200 looks, apart from the detachable lens at the front, like a compact camera. The top plate has a shutter button with a click wheel wrapped around it, a pop-up flash, and a very restricted version of the PASM mode dial you'll find on fully fledged DSLRs. The mode dial allows you to choose between shooting videos, full auto stills, or its 'special scene mode', in which you can let the camera know you're shooting a landscape, sports and so on.

The option to shoot in shutter or aperture priority, or full manual mode (including the option of manual aperture and shutter with automatic ISO) is also there, although its relatively well hidden.

The back of the camera is just as simple. The 3in touchscreen monitor has a resolution of 1.04 megapixels, which is respectable – and fortunate, because there's no viewfinder. It's an excellent monitor that made framing up easy, even in bright sunlight. Vloggers will love how it tilts: it can flip vertically so it's facing forwards, making this a great camera for video stills and selfies.



Next to the display is a tiny smattering of buttons, which can fire up the menu and start video recording. Open the menu system and Canon users will find a familiar system, with reassuringly complete options. For instance, you can set the AEL button on the direction pad to trigger autofocus, allowing you to use back-button focus – a good example of the kind of advanced feature available on the M200 with just a little digging.

There are a few useful toys apart from that 180° flipping screen, such as Wi-Fi and Bluetooth. We're used to seeing these on virtually every Canon camera nowadays, but they're particularly apposite here, given that the M200 is likely to be picked up by photographers used to being able to share directly from their device.

GO LOUD

The sensor is an APS-C model with 24.1 megapixels, which is towards the top of end of resolutions you'll see on a sensor this size. It gives you loads of latitude for cropping, and our technical tests revealed a camera of real quality. To ISO 1600 it takes very clean, noise-free photos, with images only falling apart after about ISO 6400.

There is noise present at other ISOs, sometimes making itself felt at somewhat

surprising settings. At ISO 500, for example, we were a little taken aback to find pronounced levels of noise in fairly well-lit scenes. That's a shame, as it means the M200's high resolution and theoretically croppable images actually can't be zoomed in as much as you might like before you start encountering noise.

It holds up reasonably, but not incredibly well, to other APS-C cameras. We compared its ISO results to those of the Nikon D3500, for example, and preferred the D3500's finer noise at ISO 1600.

Otherwise, however, the M200 acquits itself well. Colours are neutrally reproduced, and overall quality is visibly better than you'd get on even a top-end smartphone.

The video options are also pretty good. Although the 25fps 4K setting prompts an almost useless level of cropping – a 1.6x crop is added to the already substantial 1.6x crop of the APS-C sensor – Full HD comes to the rescue. You can shoot at 50, 30 or 25fps and quality is great, with fast face detection and little evidence of the rolling shutter effect.

Slow motion filming is available at up to 100fps, but only if you drop the resolution to HD-Ready (720p). When we tried shoehorning the M200's 720p footage into a 1080p timeline we were less than impressed; the footage doesn't seem to scale that nicely.

FIRST STEP

The EOS M200 is an interesting camera. It's certainly an affordable one, and it's quite possible that for vloggers who are happy with talking-head footage at 25fps from a reasonable selection of decent lenses, it might just be the best camera out there. At the same time, image quality could be better, so budding photographers who want to appreciate every little detail in their shots should consider other APS-C cameras such as the Nikon D3500.



CANON PowerShot G5 X Mark II



£849 • www.johnlewis.com

VERDICT

A minuscule camera that shoots the best stills and videos you're going to get from something this size

MASS-MARKET COMPACT cameras may be in decline, but Canon is betting that the high-end combination of a small, convenient body with good image quality might show there's life in them yet.

The G5 X Mark II follows the three-and-a-half-year-old G5 X (*Shopper* 338), and keeps things interesting by redesigning the predecessor as it heads out to pasture. Gone is the faux DSLR shape with the EVF hunched over the middle of the lens; instead, the EVF is now a spring-loaded number recessed in the camera.

There are a few changes inside, too. Resolution is fractionally down on the original G5 X: where the Mark I had 20.2 effective megapixels, the Mark II has 20.1. The sensor is the same size as that in the original G5 X, but it's now a stacked CMOS unit, which means, in theory, faster data readout and therefore better performance.

SPINNING MENTALITY

The result of hiding the EVF is that the G5 X Mark II looks a lot more like a traditional compact, albeit one with a lens that protrudes a little from the body, even when it's retracted. The protruding lens is functional, however. As on the original G5 X, there's a multifunction ring that can be used to set shutter or aperture value. The body is otherwise pared back and pleasing to hold, although Canon has saved room for a strong selection of physical controls.

The exposure compensation wheel is particularly useful, especially with the G5 X Mark II offering live exposure simulation, as it means you can get your exposure dead-on in camera rather than leaving yourself with processing work to do afterwards.

The rear of the G5 X Mark II is occupied chiefly by its touchscreen. At 3in, it's not the biggest, but it's comfortable, and its 1.04-million-pixel resolution makes it an accurate gauge of sharpness.

The pop-up EVF is novel and, at first, a little confusing, although once you learn how to open it you can see the 0.39in, 2.36-million-pixel viewfinder is well designed. Canon has wisely avoided attempting to shoehorn all the information from the main touchscreen on to the EVF, so you only get the necessities.



It works especially well with the excellent implementation of touch to focus, with which you can pull the autofocus point around by dragging your finger on the touchscreen. It quickly became our preferred way of working, not least when bright sunlight made the rear monitor hard to see.

The lens is practical: a 5x zoom, equivalent in 35mm terms to 24mm at wide angle and 120mm when zoomed in. Aperture-wise, you get f/1.8 at wide angle and a stop slower, f/2.8, zoomed in. An f/2.8 120mm lens helps keep ISO under control in a range of circumstances.

Speaking of controlling ISO, the G5 X Mark II ranges from ISO 125 all the way up to ISO 25,600, which is some going for a 1.0-type sensor. At the lower end of that range, image quality is exemplary. 'DSLR-like' is only a slight exaggeration but, shooting in the G5 X Mark II's Raw mode, we returned sharp, clear images with absolutely loads of detail. Ramping up the ISO returned extremely impressive results, and noise only becomes an issue beyond ISO 3,200.

READY TO BURST

You can even shoot stills at 30fps, and while this comes with a lengthy wait while the camera sorts the data you've thrown at it, it's handy for those looking to catch split-second moments. The G5 X Mark II saves about 20

frames before you push the shutter, so even if your reactions aren't fast enough, you stand a good chance of capturing the moment.

Autofocus performance is excellent, with face recognition and subject tracking working well in our tests. For those partial to manual focus the option is there, although focus pushes forwards and backwards very slowly, so you'll need your subject to be stock still to use it. Focus peaking is a useful inclusion, but works only in manual focus mode.

As for video modes, 4K is welcome even if 25fps is the only available frame rate. Full HD can be shot at 50 or 100fps for a slow-motion effect, and quality is excellent. There's an automatic timelapse builder, which shoots still files then collates them into a finished video.

The tilting, flipping monitor on the back allows you to shoot selfie videos, which will be appreciated by vloggers. All in all, the G5 X Mark II is a more than capable video performer for a compact. Don't forget that it's competing with some fine alternatives, not least the Fujifilm X-T30, which shoots cinema 4K at a wider range of frame rates on a bigger sensor and through a wider range of lenses.

POCKET POWER

That's not to take away the fact that the G5 X Mark II is a very capable compact camera. Still images are outstanding at a much wider range of ISOs than we'd expect, and it's impressive that it can shoot quality 4K video in such a small body.

If you're after a camera about the size of a box of matches, and want the best possible image quality and control, the G5 X Mark II is about the best you could hope for. If you're prepared to tolerate more weight and a more cumbersome body, you're better advised to opt for a DSLR, but meet the G5 X Mark II on its own terms and it might be the best compact camera ever made.



FUJIFILM X-T3

COMPUTER
SHOPPER
RECOMMENDED

★★★★★

£1,459 • From www.amazon.co.uk

VERDICT

The X-T3's wide range of features and agreeable price make it great for photographers and videographers alike

FOR ALL THE different DSLR and mirrorless cameras on the market, very few manage to excel at everything. Stunning still shots, top-quality video and high-end usability are easy to find individually, but all three rarely come in a single package.

The X-T3, however, shows that Fujifilm has pulled off this feat. It has a large APS-C sensor shooting 26.1-megapixel stills, 4K video recording with 10-bit, 60fps and LOG shooting support, and more dials than the floor of a Rolex factory, all for a highly appealing price.

SWITCH HUNT

The arsenal of controls might even look intimidating at first, but they're what make the X-T3 so eminently usable. You get dedicated dials for ISO, shutter speed and exposure compensation on the top of the camera, then two more dials on the front and rear right-hand shoulders of the camera as well. X-series lenses have a dedicated fly-by-wire aperture ring as well, so between all those dials and a pair of Function buttons, you can really set up the X-T3 to shoot however you want.

Although it's not as beginner-friendly as intentionally simplified cameras such as the Canon EOS M200, it's a haven for photographers who want to fine-tune their own exposures. Both drive mode and metering mode are controlled by extra physical switches around the top dials, which again aids experienced users.

The body of the camera itself weighs in at 539g including a battery and a memory card, and it feels supremely solid. The top plate of the camera is metal, which helps, but the switches and dials click solidly, which adds to the feeling of sturdiness. The body is weather-sealed, and all in all the X-T3 feels like a camera capable of going the distance.

Our solitary gripe is the screen. It tilts and pivots, which is great, but only feels as robust as the rest of the camera when it's closed. Opened up, it's quite flimsy.

We can forgive that, however, because the screen itself is one of the finest on any camera. This 3in, 1.04-million-pixel display is bright, clear and vibrant, making framing and image review simple and pleasant. Indeed, it's only outdone by the X-T3's 0.5in OLED viewfinder. 3.69 million pixels make it incredibly fine-grained and therefore easy to judge focus. We used the X-T3 with both its kit lens, the XF 18-55mm F2.8-4 R LM OIS, and with Fujifilm's XF



90mm F2, which has very tight depth of field, and really appreciated the accuracy with which we were able to focus manually.

The only notably missing feature is in-body stabilisation, so you'll need to spend a little more on lenses with stabilisation built in. At least you have plenty of lenses to choose from, with Fujifilm's X-mount range spanning cheap telephotos to professional-standard kit.

SHARP OBJECTS

On the subject of pro features, open the memory card door and you'll find a pair of slots, capable of taking two cards working either simply as overflow, or as a mirrored pair, backing up your work as you go.

That's another fine touch, but not nearly as fine as the photos this camera takes. The kit lens is sharp and produces good contrast, and ISO performance is excellent. Two ISO 1600 images were basically indistinguishable from each other, noise-wise, and then ISOs 1600 and 3200 were difficult to tell apart. Beyond ISO 6400 there's a marked drop in colour fidelity, but it's impressive that an APS-C camera at this price produces usable images with ISO cranked up this high.

Even better is the range of video modes. The X-T3 can shoot 4K footage at up to 60fps in 10-bit, and a recent firmware update added HDR support and dual film simulation. That means you can record 4K LOG footage with LUT applied on an external monitor, making this a viable option for filmmakers.

Quality is superb, but it's this ability to shoot in F-log – Fujifilm's own LOG mode – that makes the difference, as it will allow you to get the most out of colour grading. A high-speed 1080p mode is also available, for shooting at up to 120fps.

All the basics are covered, too. There are 3.5mm jacks for headphones and a mic, as well as Bluetooth and Wi-Fi for ease of image transfer and remote photography.

X FACTOR

There are an absolute thimbleful of drawbacks, chief among which is battery life. With a CIPA rating of under 400 images, and a video recording time of just 40 minutes in 4K, at least one spare battery is a must. A useful-looking add-on is the X-T3's battery grip, a £300 addition that allows you to use the X-T3 with three batteries installed at once. Alternatively, you can supply power via the USB-C port.

Picking out downsides beyond that is tricky. For stills photographers, bigger sensors are available for roughly the same outlay elsewhere, but even so, with superb ISO performance, build quality and handling – particularly for experienced photographers – the X-T3 is excellent. The obvious front-runners in the DSLR race offer far bigger lens libraries, but even so there's enough available for the X-mount that most photographers will be perfectly happy. This is simply a terrific camera, particularly if you're a jack of all trades.



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FUJIFILM X-T30



£849 • From www.wexphotovideo.com

VERDICT

By distilling features from the X-T3 into a smaller, lighter and cheaper body, the X-T30 is everything you need in a travel camera

FUJIFILM'S APPROACH OF applying the same features from more advanced models to cheaper cameras has produced some greats. Just as the X-T20 was a pared-down X-T2, so the latest X-T30 is essentially a baby X-T3.

With the same 26.1-million-pixel APS-C X-Trans CMOS sensor and X-Processor 4 combination as the X-T3, the X-T30 should be capable of delivering the goods, quality-wise. The APS-C sensor may be smaller than the full-frame chips in cameras like the Nikon Z6, but Fujifilm clearly reckons this size of sensor is the perfect balance between portability and image quality: big enough to capture lots of light, but not needing a huge body to house it. The autofocus mode and fast burst mode are also shared between both Fujifilm cameras.

SHRUNKEN TREASURE

Most of the notable differences are in the design. The X-T30 is smaller and lighter, which makes it great for travelling, but there have been a few compromises. A good example is the lack of a dedicated ISO dial; another is its single SD card slot, which is unlikely to be a major problem for most enthusiasts, but for those who like to back up on the go, it's something to think about.

The good news is that there's still a number of direct access control dials and buttons to satisfy tactile users. There's a drive mode dial on the left of the top plate, while two more dials for shutter speed and exposure compensation are on the right. Something you won't see on the more advanced X-T3 is an Auto switch, but there's a big one on the X-T30 – good for those who want the camera to take over exposure with a flick of the finger.

The X-T30's viewfinder is smaller and has a lower resolution than that of the X-T3 – 0.39in to the X-T3's 0.5in, and 2.36 million pixels to the X-T3's 3.69 million. However, it's more than usable and, unless you're using an X-T3 at the same time, stands up well in isolation. It's joined by a 3in touchscreen that tilts up and down to help with slightly awkward angles, although, unlike the X-T3's screen, it doesn't tilt outwards to help with portrait-format images.

In practice, the 20fps burst mode is capable of keeping up with reasonably predictable subjects, but a little less with erratic or very fast subjects.

The X-T3's superior buffer depth, which allows it to take more than twice as many shots in a single burst than

the X-T30, makes it the better choice for sports and action shooting. For the occasional fast-moving subject, however, the cheaper camera is a good little performer.

Image quality is, as we now expect from the sensor, fantastic. Fujifilm images are generally characterised by a filmic quality, with vibrant yet natural colours and great dynamic range. That remains true for the X-T30. It also works well in low light, and doesn't suffer too badly from having a smaller-than-full-frame sensor.

In extremely dark conditions, images shot at ISO 12800 remain usable (with low noise and not too much evidence of image smoothing). Where light is low but not extremely so, you can just about push to ISO 25600 if you're intending to share at small sizes and need to facilitate a quicker shutter speed. In an ideal world, you'll stick to ISO 3200 or below for the best image quality.

STILL FOLLOWING

Focusing in most conditions is very swift and generally accurate. In very low light, the camera can hunt a little before it locks on to the target, but it's extremely rare for a false confirmation to be displayed, even if

that means you have to give it a couple of goes to get there.

Film Simulation modes are a great bonus with Fujifilm cameras. The X-T30 is equipped with a full range of options including Provia (the default setting), Velvia, Astia, Classic Chrome and Acros (monochrome).

The lack of image stabilisation in the body is a bit of a disappointment. Instead you'll have to rely on quick shutter speeds, or work with lenses with stabilisation built in, such as the excellent 18-55mm f/2.8-4 kit lens. With impeccable sharpness and a wide maximum aperture, it's an ideal everyday lens. You can also buy the X-T30 with a 15-45mm kit lens, which is small but doesn't perform as well.

It's fair to say that the X-T30 is unlikely to be the first choice for serious videographers, but for those who like to create the odd movie, there's DCI 4K available in frame rates up to 30fps. Standard 4K is also available up to 30fps, while Full HD and Full HD slow-mo modes are also present.

TURN THE SCALES

There's little to dislike about the X-T30; it distils many of the best elements of the X-T3 into a smaller, lighter and cheaper camera.

That said, when compared to the last-generation X-T20, the differences are not huge enough to demand an immediate upgrade.

Autofocus improvements mean an exception if you're likely to be shooting lots of moving subjects, but for static shooting it's not a major leap forward.

It's also something to consider if you're trying to choose between the X-T30 and the more expensive X-T3. Consider what's important to you: for your extra cash, the X-T3 gives you an additional memory card slot, more body controls, a sideways tilting screen and a better burst depth. If you can live without all of those things, the X-T30 gives you the same image quality. For many, that will be enough.



NIKON D3500



£299 • From www.wexphotovideo.com

VERDICT

A superb budget DSLR that's ideal for beginners, even if it's not a huge improvement on the D3400

PROPPING UP THE foot of Nikon's DSLR offerings, the D3500 is the model Nikon hopes will tempt newcomers away from the current crop of superb mirrorless cameras.

It replaces the two-year-old D3400 (*Shopper* 352), and while it's only had a small weight reduction, 415g is still impressive. The D3500 is only 124mm wide, so it's not much different in the hand to many mirrorless cameras. The rubber cover on the grip isn't exactly the last word in luxury, but at the very least this isn't a camera that will slip out of your hands.

WIDE AWAKE

Compared to many DSLRs, the screen – a 3in, 921K-pixel affair that neither tilts nor pivots – is frill-free. It's not touch-sensitive, either, but is bright, clear and makes easy work of getting your settings figured out. Our only bugbear is that there's no sensor to tell the screen to shut off when you lift up the camera; the screen turns off when you half press the shutter button, but is otherwise on all the time.

Battery life, on the other hand, is a highlight. Fully charged, it will fire 1,500 exposures; around 300 more than the D3400.

Videographers should note the lack of a mic input – even at this price, it doesn't seem unreasonable to expect one – but otherwise, the D3500 is a very usable camera. The buttons are a little clicky but easy to hit, and the control dial on the top feels positive, so you'll be able to use it even when wearing gloves.

Then again, we'd have liked to see a Function button as well. Its omission leaves no direct way to access ISO settings, so you'll have to either dig them out through the menu or rely on the auto ISO mode.

Still, the D3500 can be a good camera for those looking to up their game, or progress from smartphone photography to something a little more advanced. The Guide setting on the mode dial, for example, is a useful way to figure out how the visual effect you want, such as a blurred background, relates to which settings. It's a really useful, integrated way of telling the camera roughly what you're doing and having it make an educated guess as to what the settings should be.

Downloading images from the camera to a smartphone is useful for those who want to be able to share DSLR images directly from their smart device, although we found transferring full-size images took absolutely forever. Attempting to copy a full-size, top-quality, 11.7MB JPEG tested our commitment and we stopped the timer at three minutes with the transfer



incomplete. Taking the app's suggestion to downsize the image to two megapixels before transferring produced a more manageable transfer time of 16 seconds.

At least image quality is impeccable, and right up there with the Canon EOS M200. Keep the ISO under control and the camera's image quality is only limited by the lens you attach. Colours were always accurate and, naturally, you can always opt to shoot Raw files to gouge the maximum from your files in post-production. Notably, the D3500's APS-C sensor weighs in with 24.8 megapixels, which is pretty much the most you'll get on an APS-C camera of any price.

LIGHT HEADED

ISO performance is very good. The range from ISO 100-800 produced test images that were more or less indistinguishable from each other, and noise at ISO 1600 was pretty nicely controlled – certainly well enough to expect good quality prints. Beyond ISO 1600 things inevitably got muddier, with ISO 6400 probably being the usable maximum.



One final area in which the D3500 elevates itself above its competition is its 5fps burst mode. This might not be enough to cover a professional sporting event, but for portraits and events it's fine. The buffer is limited: in JPEG mode we found the burst mode was good for 15 images, followed by a fairly lengthy digestion process. In Raw mode we could only shoot eight frames continuously before the camera paused to process.

The main reason to be disappointed with the lack of an audio-in jack is because the D3500 is a very competent video camera too. There's a good range of options for mid-range video makers, with the D3500 offering 1080p in 60, 50, 30, 25 and 24fps. You don't get 4K and you don't get high enough frame rates to shoot slow motion, but for general vlogging duties the options easily suffice.

Usability for beginners is straightforward: point the camera at a subject, press the red button and the camera does the rest. If you want more control over your footage – shutter and aperture, for example – you need to enable the Manual movie settings. This allows you to control exposure when shooting movies but, annoyingly, prevents you from changing the aperture setting in live view mode.

ROOKIE MOVE

It's a shame, because video quality is excellent, and we like the range of frame-rate options, but without an easy way to manage exposures or incoming audio, the D3500's appeal to videographers is limited despite its excellent image quality.

If you already own the D3400, this is not a worthwhile upgrade. Indeed, it's hard to name many DSLRs from which this would be a significant step up. However, with image quality that does Nikon's brand justice, an affordable price and best-in-class battery life, the D3500 is nonetheless a great place for photography newcomers to start.

NIKON Z6



£1,849 • From www.jessops.com

VERDICT

Nikon's mainstream mirrorless camera gets just about everything right

THE NIKON Z6 and Z7 were announced simultaneously, and while the Z6 is the cheaper of the two, it still manages to be a superbly capable mirrorless camera.

The Z6 houses a 24.5-megapixel, full-frame sensor, just shy of half the 45.7-megapixel resolution of the Z7. The build and handling of both models is, to the millimetre and gram, identical, with the same tilting screen, high-res electronic viewfinder and controls.

There's a decent array of buttons and dials, most of which are within easy reach of your right thumb. That leaves your left hand free to comfortably hold the lens. A useful display on top of the camera shows key settings such as aperture, drive mode, battery level and card space remaining. A joystick protrudes from the back of the camera and is extremely handy for changing the autofocus point when shooting through the viewfinder.

This, too, is excellent: it's made up of 3.69 million dots and is extremely bright and clear. It's joined by a tilting, 3.2in touchscreen. The variable-angle screen is useful for shooting from low and high angles, but is slightly less useful than a fully articulating screen for shooting video or portrait format images.

You only get one XQD memory card slot, which is a bit of a shame considering the price; at this level you should definitely be looking for professional-grade features such as on-the-go backups. The XQD format is also relatively expensive, so you'll need to factor this into your budget.

QUICK ON THE MARK

Auto-focusing is where the Z6 and Z7 diverge. The Z6 has a 273-point hybrid autofocus system, which sounds like a lot, until you consider the Z7's 493 points. Still, the Z6's points cover almost the whole frame and should satisfy most photographers.

The lower-resolution sensor brings a couple of benefits. First, it facilitates a faster frame rate than the Z7, giving you a pro-level 12fps to work with for moving subjects. Having fewer pixels crammed on to the sensor should also make the Z6 slightly better equipped for low-light shooting, too, although judging from our time with the Z7, the pricier camera can hardly be improved upon.

If you already own Nikon lenses, you can use them with the Z6 via its FTZ mount adaptor. We've tried it with a variety of different lenses and it maintains full autofocus and usability. Expect to pay around an additional £270 for the adaptor or a little less if you get

one with your Z6 as a bundle.

The Z6 has the same level of weather-sealing as the Nikon D850, which makes it well equipped to face the perils of shooting outdoors. It feels extremely well built and more than up to the task of brutal outdoor shoots.

GOING SPARE

Although there are many advantages to mirrorless cameras, battery life is an area where they still struggle to compete with DSLRs: the Z6 has a fairly paltry official rating of 310 shots. In real-world usage, you'll probably get more, especially with careful power management, but it's worth investing in a second battery if you tend to get particularly snap-happy. The Z6 can be charged via USB, so carrying a power pack with you is another option.

Unless you crave super-high resolution, the Z6 arguably makes more sense than the Z7, not least because image quality is superb in a wide range of shooting conditions.

Dynamic range is excellent, while colours directly from the camera are natural but well saturated. Detail may not be on a par with the

Z7, but it's still very good; unless you're pixel peeping at 100%, or have a penchant for extreme crops, you'll probably be hard-pushed to spot the difference at normal printing sizes. In fact, in low-light situations, the Z6 actually puts in a slightly better performance.

Focusing is swift and accurate, locking on to most subjects with ease. As light levels drop, the Z6 will hunt a little more, but it's rare for it to miss altogether. Shooting moving subjects revealed the Z6 to be pretty competent, keeping up with fairly easy-to-follow subjects moving predictably.

Having image stabilisation baked in is helpful for getting sharp shots at relatively slow shutter speeds; another bonus for low-light shooters. Using automatic white balance resulted in generally accurate colours, while leaving the Z6 in all-purpose (matrix) metering did a good job of producing exposures that were well balanced.

As is now pretty much the norm, the Z6 shoots video in 4K. You can opt for 30, 25 or 24fps, or there's up to 120fps slow motion available if you switch to 1080p. There's also the option to attach an external recorder to output 10-bit 4K footage; do this, and you'll be able to shoot N-LOG footage as well, in the name of more flexible grading. Video shooters will be pleased to see both an external microphone and a headphone socket.

GENERATION Z

The Z6 was one of the standout mirrorless releases of 2019. It's a great all-round performer for advanced enthusiasts who shoot lots of different subjects, and would even make a good second camera for professionals shooting with other Nikon models, including the Z7, or DSLRs such as the D850 or the D5.

There are a couple of drawbacks, such as limited battery life and a single XQD card slot, but overall, the Z6 is a very capable and desirable camera.



OLYMPUS PEN E-PL9



£369 • From www.amazon.co.uk

VERDICT

This entry-level model from Olympus is a fun camera for vlogging and holiday snaps

A BASIC MODEL at the bottom of Olympus's mirrorless line-up, the PEN E-PL9 is designed to tempt those looking to upgrade from their smartphone's integrated camera. As such, it includes a full complement of automatic and creative modes, as well as more advanced modes for those keen to learn.

As always with the PEN range, Olympus has gone big on styling, with the E-PL9's gorgeous retro look making it as much a fashion statement as a photographic tool. However, it doesn't represent a huge upgrade from the older E-PL8: many of its specifications and features are identical, including a 16.1-megapixel Micro Four Thirds sensor, 3-axis in-body image stabilisation and the 3in tilting touchscreen.

BACK IN A FLASH

4K video is a big addition, however, and it's facilitated by an upgrade to Olympus's TruePic VIII image processor: the same used by some of Olympus's higher-end cameras such as the OM-D E-M10 Mark III and the OM-D E-M1 II.

Although the E-PL9 has roughly the same dimensions as the E-PL8, the grip is deeper, which makes it a little more comfortable. The mode dial has also been slightly enlarged, and the flash is integrated now (a small, inconvenient external flash was supplied with the E-PL8). This comes at a price, however: there is still a hot shoe for a beefier external flash, but the accessory port is gone, so unlike the E-PL8, you can't add the optional electronic viewfinder.

The camera's size – just 117mm wide and 68mm tall – means it pairs well with Olympus's compact 14-42mm retractable zoom lens, as well as some of the smaller primes in the Olympus line-up. A good example is the 17mm f/1.8 lens. Being a Micro Four Thirds mount, you can attach Panasonic lenses, too.

Since there's no option to attach a viewfinder, the tilting touchscreen is the only way to compose, so it's a good thing the 3in, 1.04-million-dot display is decent. It can be pushed to face all the way forward, making it handy for accurate selfie composition, although because the screen faces forwards underneath the camera, you can't simultaneously mount it on a tripod.

A range of different exposure modes can be accessed via the mode dial on the top of the camera, including fully automatic,

semi-automatic and manual. A new mode for the E-PL9 is the advanced photo mode, which gathers together a number of creative options, such as multiple exposure, HDR, focus bracketing and so on. Frustratingly, silent mode can only be found within advanced photo mode; there's no way to shoot silently in the normal modes.

Unlike some cameras aimed at travel photographers, the E-PL9 doesn't feature USB charging, which seems a bit remiss. Instead, you need to use the dedicated charger, which comes in the box.

GET THE POINT

More happily, the E-PL9 has more autofocus points than the E-PL8, which is good news for catching off-centre subjects. The E-PL9 uses contrast detection – rather than the faster phase detection – AF, but it's pretty snappy in most instances, perhaps taking just a little longer in darker conditions. Beginners may prefer to leave the camera to choose an appropriate AF point and, in our tests, the E-PL9 generally got it right.

The E-PL9 can produce some very nice shots, especially in good conditions. Image quality is slightly improved over the E-PL8, perhaps thanks to the newer image processor, but it's not something you're likely to notice unless pixel peeping to the extreme.

In good light, images are bright and punchy, with a pleasing level of saturation

resulting in attractive colours. In lower light, the smaller sensor reveals itself compared to cameras with bigger sensors.

The 14-42mm kit lens is adequate as a walk-around lens, and if your main concern is grabbing holiday snaps, it's fine. Get a bit more into your photography and you'll crave additional lenses – apart from anything else, better lenses will get more from the sensor, as well as allowing you to fit lenses with bigger apertures for better low light performance.

There are also some nice creative options. The multiple exposure mode is easy to use and quick to get to grips with, while the digital filters are pretty fun. Being able to quickly use things such as focus bracketing and create long exposures is great for those new to photography who want to try what might otherwise be difficult-to-crack techniques.

As for that newly added 4K video, the camera can produce good footage, but the best results come if you swap the kit lens for something better. There's also no microphone input, which will limit the E-PL9's appeal to more serious videographers.

BEGINNERS WELCOME

There's a lot to criticise about the E-PL9. No viewfinder, no USB charging and a relatively modest set of specs may have some sneering. Remember, though, that this – like the Canon EOS M200 and Nikon D3500 – is specifically targeting smartphone users who might never have owned a serious camera. A viewfinder, after all, is hard to miss if you've never used one before. Its small size and weight also make it great for those travelling light, while still allowing users to expand with additional lenses.

Overall, this is a great little camera for those who are new to photography, or for those who have a little more experience but want something ultra-light and portable for their travels. The Nikon D3500 is better overall, but Olympus's camera has its charms, too.



PANASONIC Lumix G90



£899 • From www.parkcameras.com

VERDICT

Despite being pitched as a mid-range travel camera, the latest Lumix is a great all-rounder

SITTING IN THE middle of Panasonic's Lumix G series line-up, the G90 will appeal to photographers and videographers alike. It's also a sign that Panasonic hasn't abandoned the Micro Four Thirds format, which is good news for keen amateurs looking for a small, flexible camera at a reasonable price.

The G90 is available body-only, but there are a few kit lens bundles as well. We tested with the 12-60mm lens, while the 14-140mm lens is arguably the more practical option for travellers, but costs about £70 more.

DEEP COMPACT

There's plenty that puts the G90 ahead of other models in its price bracket. It's physically smaller, and the small sensor brings with it a focal length multiplier of two, allowing you to magnify far-off subjects without huge lenses. There's also a fully articulating touchscreen, plus the very useful 4K Photo mode.

The G90 has a chunky grip and a centrally placed viewfinder, making it immediately familiar to those coming from traditional DSLRs. The G90 is smaller and lighter than its pricier relative, the G9, but still feels serious in the hand and is comfortable to use.

One welcome carry-over from the G9 is weather sealing. It also feels as though it can withstand the odd knock, with its magnesium alloy body giving it satisfying heft.

Although suitable for beginners thanks to its well-performing automatic mode, there are lots of direct access dials and buttons across the G90, which will please more experienced photographers. On the top is a large mode dial for quickly moving between various exposure options, plus a secondary dial for choosing a drive mode or selecting the 4K Photo mode. Two control dials at the front and rear can be used to adjust settings depending on the shooting mode you're in.

Many of the buttons and dials are customisable, and a button on the back directs you to a quick menu where you can adjust the parameters of commonly used settings without delving into the main menu.

The G90 also inherits the G9's 20.3-megapixel CMOS sensor, and just like the G9, there's no anti-aliasing (AA) filter, which theoretically means more detailed images. It also shares the ISO range of 100 to 25600 and the 3in, 1.04-million-dot articulating touchscreen. Only the viewfinder is a downgrade, having 2.36 million pixels to the G9's 3.68 million.

A final killer feature is Panasonic's 4K Photo mode, as seen on other Lumix

cameras but nonetheless welcome. Essentially, it allows you to record short video clips and extract a still in camera. This means that you can shoot at 30fps and freeze the action at the perfect moment, the drawback being that final images are restricted to 8-megapixel JPEGs. If you'd prefer full-resolution images or Raw files, the G90's more traditional burst modes run at up to 9fps with autofocus locked from the first frame, or at 6fps with continuous autofocus.

DOESN'T MIX THIRDS

Considering the G90 uses the same sensor as the G9, we were pretty sure of being able to take decent images, and we weren't disappointed. You won't get the same image quality as you would from cameras with larger sensors, although the price and size of the G90 might make slightly worse images a price many will be happy to pay. Colours are nicely saturated without going overboard, while overall sharpness is very good.

That said, the results from our low-light tests were reasonable rather than outstanding. Output at the maximum ISO of 25,600 was best forgotten, but ISO 12800 was just about usable in an emergency. Otherwise, those who are likely to be shooting in

less-than-ideal light will be better off spending more on fast lenses rather than reaching for higher ISOs.


Although the G90's fastest frame rate is a little limited at 9fps (or 6fps if you want continuous autofocus), it makes up for that with the 4K Photo mode, giving you a much more flexible 30fps. It's great for kids, pets and other unpredictable subjects, and while the limitation of 8-megapixel JPEGs will be a drawback for more advanced photographers, for those looking to capture the decisive moment for sharing online, it's a great feature.

Vloggers are likely to be drawn towards the G90 thanks to its small form factor, reasonable price and ability to shoot 4K. There's no crop factor to consider, and footage quality is pleasingly smooth. High-speed modes allow you to film at up to 120fps in 1080p, while the headphone and microphone sockets – along with the ability to shoot V-Log footage – elevates it well above the beginner level, too.

MOVING PICTURES

Overall, the G90 is a tightly packaged, appealing piece of kit with a pretty wide image quality sweet spot. Those going on the road for a while will be able to pack it, along with half a dozen lenses, in a small bag and be equipped for just about every situation you're likely to come across, as well as being practical for photography closer to home.

Images straight out of the camera are bright, punchy and sharp. It can't match its full-frame rivals for low-light performance, but we wouldn't expect it to. Indeed, given that the G90 and G9 share a sensor, the G90 is arguably

the one to go for if you're mainly into static subjects. If action shots are your thing, the extra performance of the G9 makes it worth the extra cash. For those looking for a solid performer that copes well with a number of different tasks and sits snugly in the mid-range – both stills and video-wise – the G90 is a great option. 



SONY A6400



£1,225 • From www.amazon.co.uk

VERDICT

Well priced but without sacrificing quality, Sony's pint-sized mirrorless camera packs a punch

SONY'S MARCH ON the mirrorless camera industry continues with the A6400, a much more affordable relative to the professional A7 and A9 models. At £1,225 it's not exactly entry-level, but that money gets you a lightweight wisp of a 24.2-megapixel camera that offers 424 autofocus points and can shoot up to a speedy 11fps, not to mention the 18-135mm kit lens. Body-only, it's only £629.

MANY EYES

Even with this lens, the A6400 is wonderfully compact: at just 120mm wide and 67mm tall, the body is barely any bigger than a high-end compact camera. It's easy to handle; the front grip could be a little deeper, perhaps, but it's comfortable and feels well balanced with the kit lens installed. As this is an E-mount camera, there's no shortage of other lenses available, including four-figure professional glass.

Whatever lens you attach, the A6400's small size belies a fantastically usable camera. A thumbwheel on the back, as well as a dial next to the mode dial, makes using manual modes straightforward. Pretty much all of the buttons can be repurposed to do things other than their defaults, too, which helps with getting things set up to your liking.

The 3in, 921,000-dot display can be angled up and down to provide easier framing when shooting at low or high angles. It doesn't swing outwards but it can face forwards, and you can use its touch capability to set the autofocus point with a prod. It also acts as a trackpad when the camera is held to your eye, allowing you to drag the autofocus point around with your thumb – a fantastically intuitive system.

There's an integrated electronic viewfinder positioned, unusually, on the far left-hand side of the camera. You can opt to run it at either 50 or 100fps, with the latter dubbed High quality and theoretically offering better motion handling. In practice, we ran the A6400 in both modes and could barely tell the difference.

That aside, the viewfinder is a good one: a 1cm, 2,359,296-pixel unit that's great fun to use. Its off-centre positioning will be unusual to DSLR habitués, but it's quick to get used to and frees up the right side of the touchscreen for autofocus repositioning.

Battery life is reasonable rather than outstanding. Rated at 360 shots using the viewfinder, or 410 using the less power-hungry LCD screen, we found the A6400 good for about a day's worth of relatively

intensive photography. Take a merciless approach to the power-saving menu and you could probably stretch it out to a few days.

Picture quality is excellent. Dynamic range is good, and the A6400 returned sharp, printable images. Left to its own devices, the 1,200-zone evaluative metering system worked well and produced nicely balanced images, though with exposure simulation available in the viewfinder, we found ourselves reaching for the A6400's manual mode more often than not.

PUT A RING ON IT

Autofocus works well, and the excellent coverage of autofocus points, which covers pretty much the entire frame, makes it easy to set up. Those with a penchant for manual focus will find – as with most mirrorless cameras – that the manual focus ring on the lens is a little frustrating to use compared with the precise optics of a DSLR lens, but with both focus point magnification and focus peaking, getting a sharp image manually is simple enough.

One area in which the A6400 really excels is its continuous shooting speed. At full throttle, Sony says it shoots 11fps and, in our tests, it shot 44 Raw files in a little under four-and-a-half seconds before pausing to buffer, for a final speed of 10.2fps. If you're happy to shoot JPEGs, you can spray with

even wilder abandon: the A6400 shot 113 top-quality JPEGs in 10.8 seconds before buffering – a rate of 10.5fps.

Both of these top speed results are with the autofocus locked from the first frame and, using tracking autofocus, the best speed we saw in JPEG was a still nippy 8fps. If you're a regular action shooter, the A6400 will keep up just fine.

The A6400 handles higher ISOs nicely but, inevitably, not as well as a good full-frame camera. It's competitive up to ISO 1600, although the higher reaches of that range showed a little grain. Add a stop and images at ISO 3200 showed significant noise, and the stop beyond that – and everything beyond – should be considered for emergency use only.

There are no issues with shooting in good light, however, and the A6400's video features and quality were another pleasant surprise. XAVC 4K shooting at 25fps is possible, providing you've got a UHS-I or UHS-II U3 card, while Full HD footage offers a choice of 25, 50 or 100fps. You can also shoot in-camera proxies and in S-log, making the A6400 yet another very capable camera for vloggers, or an excellent camera for those who want to produce high-quality, flexible video without spending a fortune.

HOT SHOT

The A6400 is a real crowd-pleaser of a camera. It's small enough to be properly portable, but with excellent image quality and enough power to keep photographers

happy whether they're shooting static landscapes or ferocious action. The lens library can't be faulted, particularly for advanced photographers or would-be pros, and the A6400 is very capable when it comes to video.

It's not perfect – quality at high ISOs isn't quite there (although the A6400 is great in its comfort zone), and battery life could be better. Still, for all-round performance, handling and value, the A6400 is – right now – the camera to beat at this price.



SONY A9



£2,999 • From www.wexphotovideo.com

VERDICT

A combination of smart design and technical trickery, the Sony A9 is a terrific high-end camera for stills

THERE ARE MIRRORLESS cameras, and then there are mirrorless cameras. At the consumer end of the scale, they offer the best of both worlds: large image sensors capable of good image quality in a package that in many cases is all but pocket-sized.

The top end of the market is a different place. High-end, full-frame mirrorless cameras throw caution to the wind, blending exotic sensor technology with supercomputer processing power to produce cameras that are nearly impossible to trip up, virtually silent in operation, and capable of incredible images that will withstand the most aggressive reproduction.

The Sony A9 is a prime example. It has a 24.2-megapixel, full-frame sensor, and is capable of shooting up to 20fps. Impressively, this number includes mid-burst autofocus and auto-exposure adjustment, theoretically letting you track subjects not only as they move through space but also as they move through different light. There's also in-body image stabilisation, all housed in a weather-sealed, magnesium-alloy body designed to survive all but the most wilful abuse.

GO ANYWHERE

Despite all this premium technology, the A9 is far from bulky – it's pleasantly small, if anything – and extraordinarily practical. The mode dial, drive mode, autofocus mode and exposure compensation all get their own physical controls, along with two variable-use dials within easy reach of your index finger and thumb.

The 3in touchscreen doesn't rotate, but can be angled up and down, and it's more than bright and sharp enough to review shots. The electronic viewfinder is also a stellar example of its type, being indistinguishable in its display of fine detail from an optical viewfinder, but with the added benefit of live exposure simulation.

The sensor might not be the last word in resolution, but it's not short on pixels either, and can pull off some impressively fast tricks. The headliner is its maximum continuous Raw frame rate, which at 20fps is most of the way to cinematic frame rates and, amazingly, is faster than the Canon EOS-1D X Mark II's 14fps (16fps in its electronic shutter mode) by 6fps.

It helps that the sensor is the first full-frame CMOS sensor with a stacked design, in which the pixel sites are bonded to image-processing and DRAM layers, allowing the sensor to read out data extremely quickly. Yet it doesn't just

shovel raw data quickly: because autofocus and exposure are performed on the sensor, the A9 is able to continuously calculate both up to 60 times per second, even while the camera is shooting. Both in theory and in practice, that makes the A9 much better at staying focused on a moving subject.

The A9's technical qualities are for naught if it can't take decent pictures, but Sony's sensational snapper doesn't trip up here, either. We tested it with Sony's FE 16-35mm F2.8 GM wide-angle lens, and were impressed by the overall sharpness, colour rendition and contrast, straight off the camera.

The results of our ISO tests were frankly ridiculous. With the image zoomed out, our test shots were indistinguishable from each other between the A9's lowest ISO and – incredibly – ISO 12800. Even with our tests zoomed all the way in, between ISO 100 and ISO 3200 there was no telling images apart.

NIGHT OWL

This all means it's possible to shoot a huge range of shutter speeds or apertures in less-than-ideal light. Our test images remained broadly acceptable until ISO 25600, and were just about tolerable at ISO 102400. The absolute maximum ISO of 204800 is a party piece best avoided, but make no mistake: the A9 is a low-light beast.

The A9's versatile Sony E-mount also makes it compatible with a huge range of



lenses, from macro to superzoom. Sigma's Art line is also available with an E-mount, further boosting the A9's appeal to professional photographers.

The closest thing this camera has to a weakness is its set of video features, albeit only in the sense that these are good rather than great. It records in 4K, of course, in 24, 25 and 30fps, and Full HD at up to 100fps (120fps in NTSC). Video quality – as suggested by our results testing the A9 in stills-only mode – is excellent, and niceties such as the audio-in jack provide videographers with a degree of flexibility. However, there's no LOG mode for recording flat footage for grading in the future, which restricts the A9's video appeal somewhat.

CLOUD 9

Every camera you buy will have some sort of ceiling on what you can do with it. On low-end cameras, this ceiling becomes apparent pretty early – limitations in terms of frame rates, autofocus points and body controls all make themselves felt, and can cost you shots. With the Sony A9, the camera's ceiling is somewhere in the stratosphere. Its autofocus holds on with tremendous tenacity, its continuous burst mode is breathtakingly fast and, although the camera perhaps looks sparingly appointed when it comes to physical controls, these looks are deceiving: this is one of the easiest, fastest to use cameras we've ever come across.

On top of all that, it takes great images, it's compatible with a vast range of lenses, and its resistance to high ISOs makes it a good choice for when you absolutely have to turn in the goods irrespective of the light.

On the downside, the A9 is very expensive, and battery life continues to be a challenge even for the best-designed mirrorless cameras. As such, it doesn't quite have the same appeal as the much more affordable Sony A6400. Still, for a camera with the power to more or less vanish while you return sharp image after sharp image, even in poor light and with dynamic subjects, it's hard to think of very many better options.



CAMERAS



Award			RECOMMENDED		
Manufacturer	CANON	CANON	FUJIFILM	FUJIFILM	
Model	EOS M200	PowerShot G5 X Mark II	X-T3	X-T30	
Rating	★★★★☆	★★★★☆	★★★★★	★★★★☆	
HARDWARE					
Sensor resolution	24.1 megapixels	20.1 megapixels	26.1 megapixels	26.1 megapixels	
Sensor size	22.3x14.9mm	13.2x8.8mm	23.5x15.6mm	23.5x15.6mm	
Focal length multiplier	1.6x	2.7x	1.5x	1.5x	
Viewfinder	None	Electronic (2.36 million dots)	Electronic (3.69 million dots)	Electronic (2.36 million dots)	
Viewfinder magnification (35mm-equivalent, coverage)	N/A	1x, 100%	0.75x, 100%	0.62x, 100%	
LCD screen	3in (1.04 million dots)	3in (1.04 million dots)	3in (1.04 million dots)	3in (1.04 million dots)	
Articulated/tilting	Yes	Yes	Yes	Yes	
Touchscreen	Yes	Yes	Yes	Yes	
Lens mount	Canon EF-M	N/A	Fujifilm X-mount	Fujifilm X-mount	
Card slot	1x SD	1x SD	2x SD	1x SD	
Battery life	315 shots	230 shots	390 shots	380 shots	
Connectivity	1x Micro USB, 1x Micro HDMI	1x USB Type-C, 1x Micro HDMI	1x USB Type-C, 1x Micro HDMI, 1x 3.5mm mic, 1x 3.5mm headphone, 1x 2.5mm remote control	1x USB Type-C, 1x Micro HDMI, 1x 3.5mm mic	
Wireless	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	
GPS	Via mobile	Via mobile	Via mobile	Via mobile	
Hotshoe	None	None	Fujifilm TTL	Fujifilm TTL	
Accessories	Cover cap, wrist strap	Wrist strap	EF-X8 flash unit, shoulder strap, body cap	Shoulder strap, body cap	
Weight	299g	340g	539g	383g	
Dimensions	67x108x35mm	61x111x46mm	93x133x59mm	83x118x47mm	
BUYING INFORMATION					
Warranty	One year RTB	One year RTB	One year RTB	One year RTB	
Price (including tested lens)	£499	£849	£1,459	£849	
Supplier	www.amazon.co.uk	www.johnlewis.com	www.amazon.co.uk	www.wexphotovideo.com	
Details	www.canon.co.uk	www.canon.co.uk	www.fujifilm.com	www.fujifilm.com	
Part code	M200	G5 X Mark II	16589254	16619982	

Prices correct at time of going to press

VERDICT

If you’re just starting out in photography and don’t want to spend too much on your first camera, the Olympus PEN E-PL9 is pretty good, but the Nikon D3500 delivers the proper DSLR experience for a quid shy of £300, and that includes a kit lens. The D3500’s excellent image quality, long battery life, ease of use and relatively compact size more than make up for the lack of touchscreen and 4K video.

Spend more, and the Canon PowerShot G5 X Mark II and Panasonic Lumix G90 both make fine mirrorless options. Even better, however, is the Sony A6400: our Best Buy winner is wonderfully balanced, with a high standard of photo quality, video features, design and build quality throughout. That said, a particular highlight is its ability to shoot stills in fast bursts, so it’s especially good at

<div></div>						
	RECOMMENDED				BEST BUY	RECOMMENDED
	NIKON	NIKON	OLYMPUS	PANASONIC	SONY	SONY
	D3500	Z6	PEN E-PL9	Lumix G90	A6400	A9
	★★★★★	★★★★☆	★★★★☆	★★★★☆	★★★★★	★★★★★
	24.2 megapixels	24.5 megapixels	16.1 megapixels	20.3 megapixels	24.2 megapixels	24.2 megapixels
	23.5x15.6mm	35.9x23.9mm	17.3x13mm	17.3x13mm	23.5x15.6mm	35.6x23.8mm
	1.5x	1x	2x	2x	1.5x	1x
	Optical pentamirror	Electronic (3.69 million dots)	None	Electronic (2.36 million dots)	Electronic (2.36 million dots)	Electronic (3.68 million dots)
	0.85x, 95%	0.8x, 100%	N/A	1.48x, 100%	0.7x, 100%	0.77x (100%)
	3in (921,000 dots)	3.2in (2 million dots)	3in (1.04 million dots)	3in (1.04 million dots)	3in (921,000 dots)	3in (1.44 million dots)
	No	Yes	Yes	Yes	Yes	Yes
	No	Yes	Yes	Yes	Yes	Yes
	Nikon F-mount	Nikon Z-mount (supports F-mount with optional adaptor)	Micro Four Thirds	Micro Four Thirds	Sony E-mount	Sony E-mount
	1x SD	1x XQD	1x SD	1x SD	1x SD	2x SD
	1,550 shots	310 shots	350 shots	290 shots	360 shots	480 shots
	1x Micro USB, 1x Mini HDMI	1x Micro USB, 1x Mini HDMI	1x Micro USB, 1x Micro HDMI	1x Micro USB, 1x Micro HDMI, 1x 3.5mm mic, 1x 3.5mm headphone, 1x 2.5mm remote control	1x Micro USB, 1x Micro HDMI, 1x 3.5mm mic	1x USB Type-C, 1x Micro HDMI, 1x 3.5mm mic, 1x 3.5mm headphone, 1x 2.5mm remote control
	Bluetooth	802.11ac Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth	802.11n Wi-Fi, Bluetooth
	Via mobile	Via mobile	Via mobile	Via mobile	Via mobile	Via mobile
	Standard ISO	Standard ISO	Standard ISO	Micro Four Thirds	Sony MIS	Sony MIS
	Shoulder strap, body cap, eyepiece cup	Shoulder strap, body cap, eyepiece cup	Shoulder strap, body cap	Shoulder strap, body cap	Shoulder strap, body cap, eyepiece cup	Shoulder strap, body cap, eyepiece cup
	415g	1,175g	380g	481g	403g	588g
	97x124x69.5mm	134x101x68mm	68x117x39mm	94x130x77mm	67x120x60mm	96x127x63mm
	One year RTB	One year RTB	One year RTB	One year RTB	One year RTB	One year RTB
	£299	£1,849	£369	£899	£1,225	£2,999
	www.wexphotovideo.com	www.jessops.com	www.amazon.co.uk	www.parkcameras.com	www.amazon.co.uk	www.wexphotovideo.com
	www.nikon.co.uk	www.nikon.co.uk	www.olympus.co.uk	www.panasonic.com	www.sony.com	www.sony.com
	VBA550K002	VOA020K001	V205092BE000	DMC-G90EF-K	ILCE6400MB.CEC	N_ILCE9.CEC

capturing subjects in motion, whether it's an athlete, a speeding car or some skittish wildlife.

Special mention also goes to the Fujifilm X-T3. While its cheaper cousin, the X-T30, is also a very respectable camera, the X-T3 excels at video; it's one of the few mid-rangers that can shoot 4K footage at 60fps, and has dedicated ports for a mic and headphones, too.

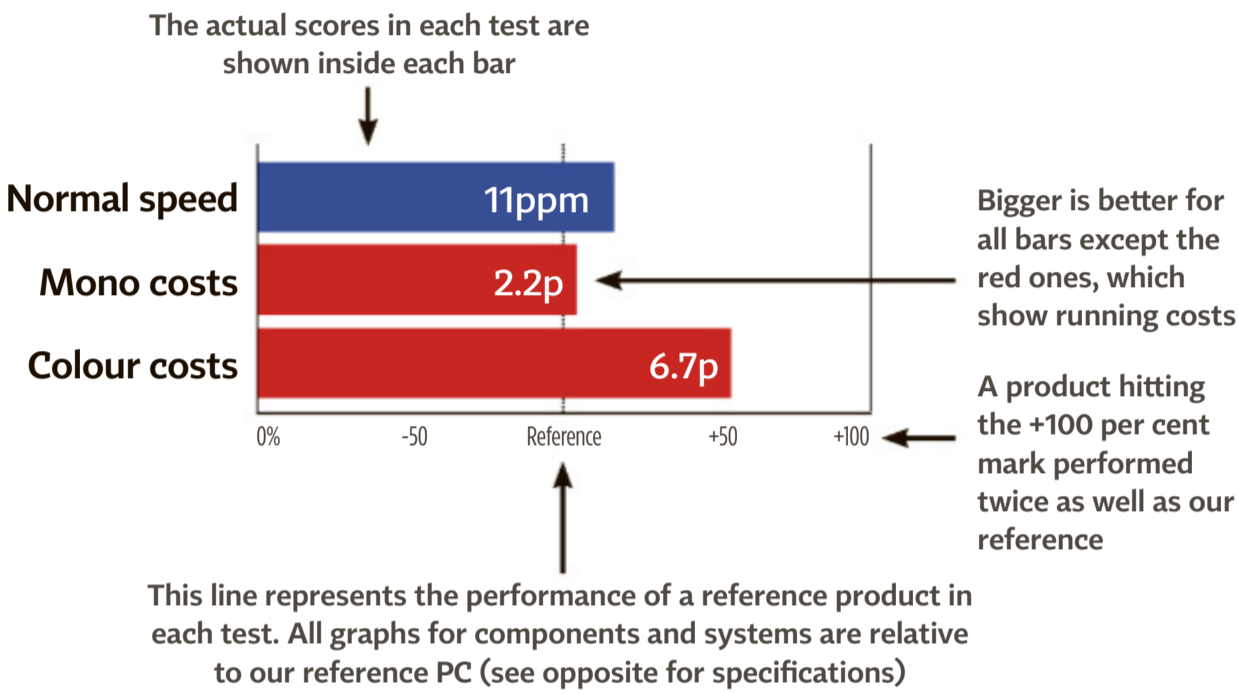
Lastly, for those willing to splurge on the best, the Sony A9 is a bona fide pro-level camera with all the tricks you'd expect from one. That means dual memory card slots, compatibility with a huge range of top-grade lenses, and a gigantic sensor that ensures great-looking shots in all lighting conditions. At £2,999, it's by far the most expensive camera here, but this high price is thoroughly justified. 📷

How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

COMPUTER SHOPPER'S REVIEWS use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the *Reviews* section, as shown on the right. Look in the 'Summary of tests' table (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See opposite for a description of our benchmarking software and game tests.



SUMMARY OF TESTS

PC SYSTEMS & GAMING LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux (1080p)	Frames per second at 1,920x1,080, SSAA, Very High detail
LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback
SMARTPHONES/TABLETS	
Battery life	Run time in minutes for continuous video playback
PRINTERS AND MFPs	
Mono text speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono page cost	Running costs expressed as pence per page
Colour page cost	Running costs expressed as pence per page

DIGITAL CAMERAS	
Battery life	Number of shots from full charge
CAMCORDERS	
Battery life	Run time in minutes for recording
ROUTERS	
Laptop 2.4GHz 5m	Mbit/s at 5m with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 2.4GHz band
Laptop 5GHz 5m	Mbit/s at 5m with 802.11ac laptop on 5GHz band
Laptop 5GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 5GHz band
Laptop 5GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 5GHz band
NETWORK-ATTACHED STORAGE	
Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files
HARD DISKS	
Huge files	Average MB/s for read/write of a single 2.5GB file
Large files	Average MB/s for read/write of 2.5GB of large files
Small files	Average MB/s for read/write of 2.5GB of small files

PROCESSORS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
MOTHERBOARDS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
GRAPHICS CARDS	
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4x MSAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

BENCHMARKS



SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, macOS and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a hybrid, laptop or desktop, from both sections of the magazine.

3D BENCHMARKS

DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.

METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



RATINGS & AWARDS

Computer Shopper rates products out of five:

★★★★★
Excellent

★★★★☆
Very good

★★★☆☆
Good

★★☆☆☆
Below average

★☆☆☆☆
Avoid!

The best products can win the following awards:

BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.



RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.



BUSINESS BUY

The very best products for work win our Business Buy award.



Product Reviews

Your guide to all the products reviewed in this month's *Computer Shopper*

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Sophos Home Premium
Symantec Norton Security
Trend Micro Internet Security
Webroot AntiVirus

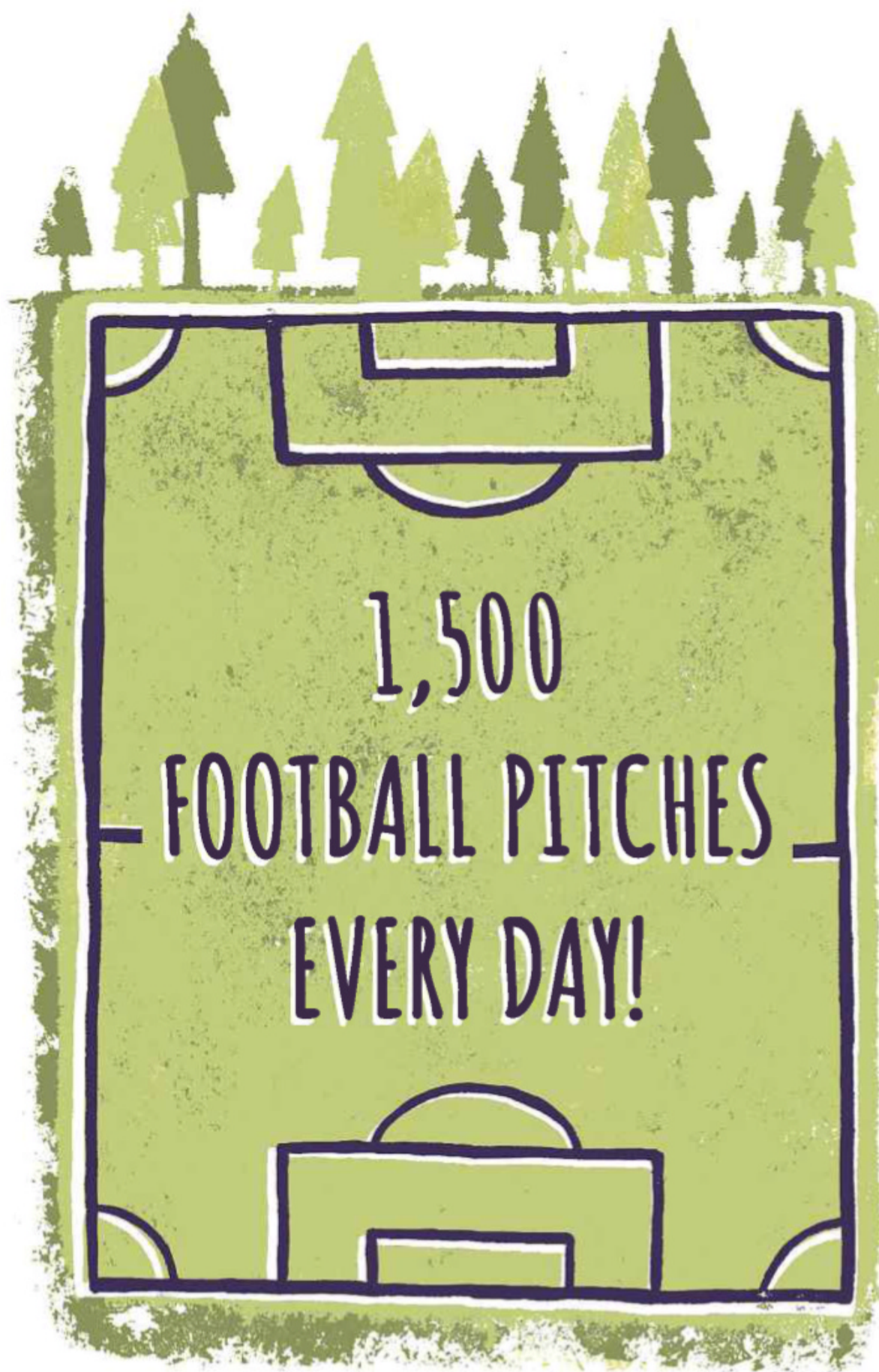
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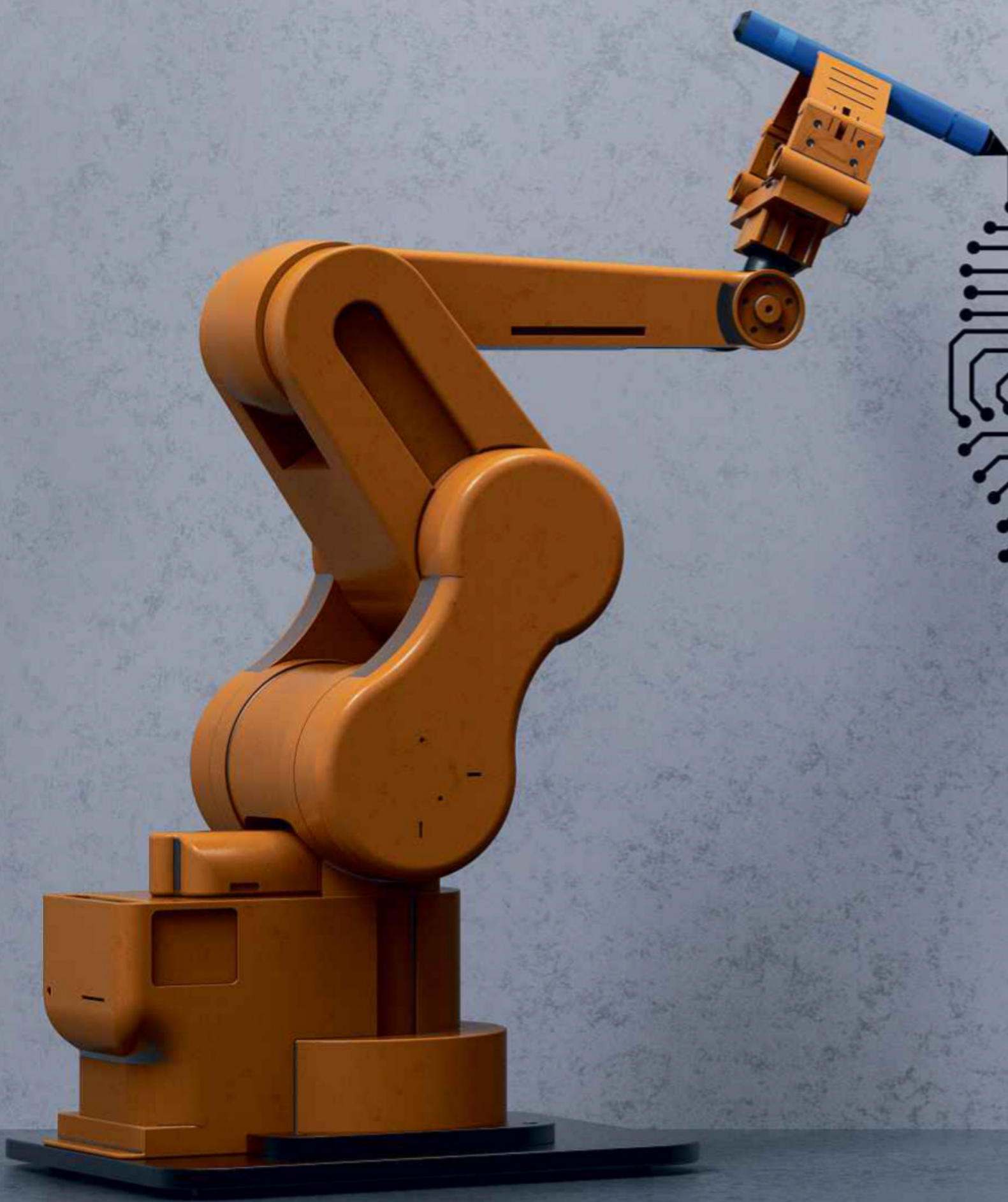
Love magazines? You'll love them even more knowing they're made from natural, renewable and recyclable wood.

UNFAO, Global Forest Resources Assessment 2005-2015

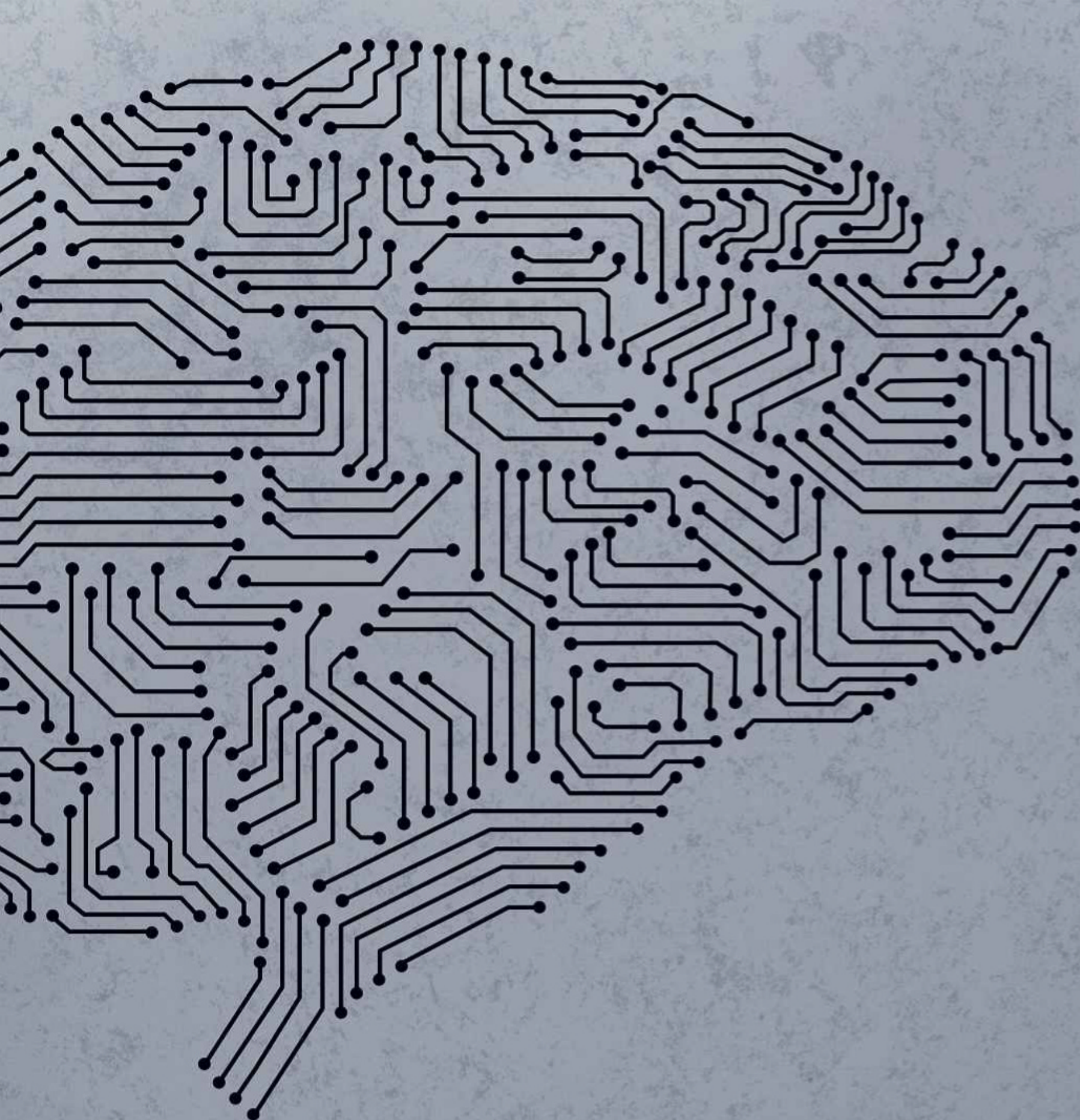
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The future of computing



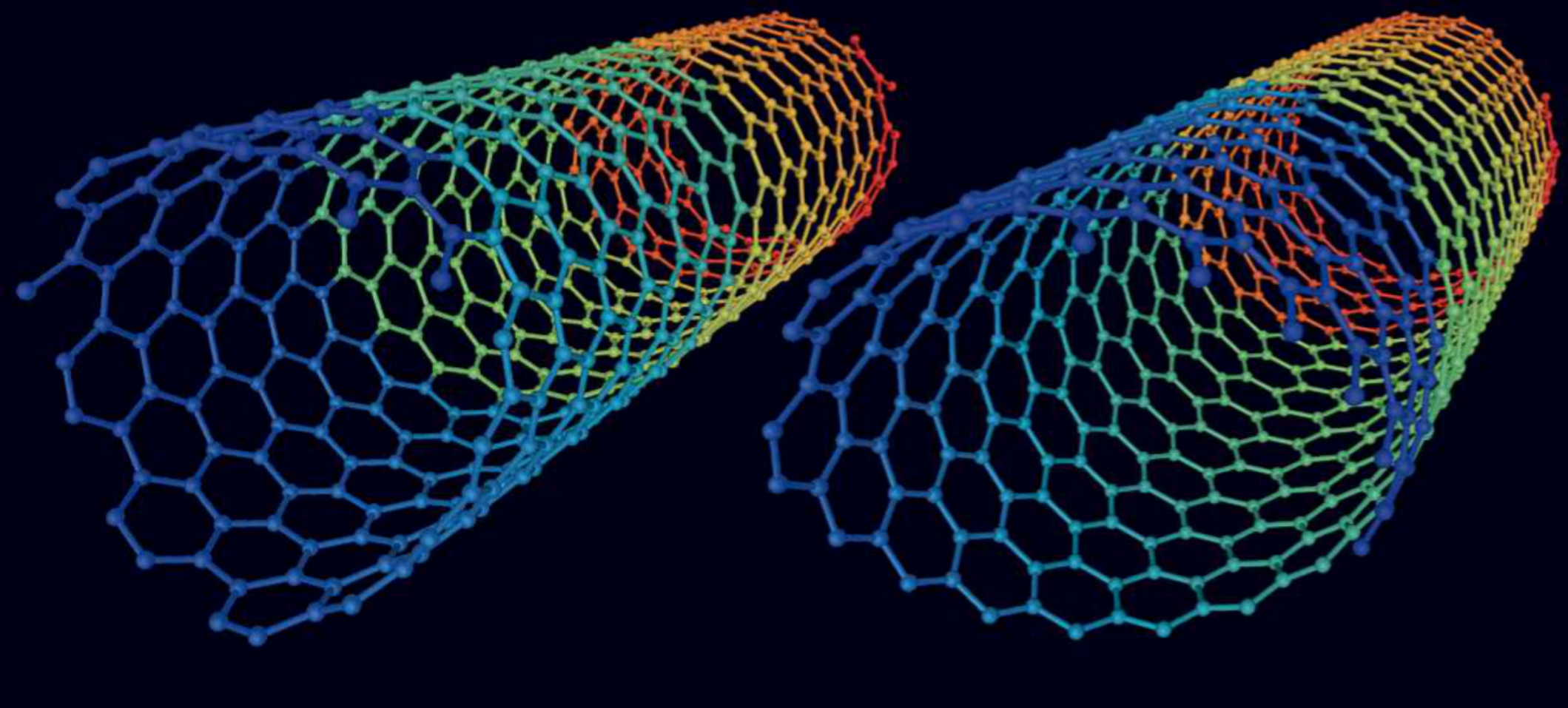
Processors may have become faster, but the basic method of computing hasn't changed for decades.

Mike Bedford investigates alternative computing paradigms and considers whether any might upset the status quo one day



f you were to take a straw poll on the underlying characteristics of today's computers, we can make a good guess about some of the ways they'd be described. While the replies would differ depending on the level of technical awareness of the respondent, common answers would surely include electronic, digital, silicon, universal, sequential, stored program, and von Neumann architecture. Indeed, all of these words and phrases go some way to describing the processors that power our PCs. But this raises an interesting question. Given the fact that the electronic digital stored program computer has been the dominant force for over 70 years, and processors based on silicon chips have been around for almost 50 years, does today's technology represent the pinnacle of achievement, or is there an alternative approach waiting in the wings?

The fact is, around the world researchers are studying many new and exciting models of computation, and even trying to revive some old ones. Some could be described as evolutionary, but many are truly revolutionary. Some are technologies that you might reasonably expect, while others are weird in the extreme but, for all that, might have a part to play in the future of computing. So if you're intrigued at the idea of a slime mould computer, prepare to be amazed as we take a look at alternative computing paradigms. ➔



New materials

There's been a lot of talk in recent years of Moore's Law coming to an end and, with it, an end to the continual year-on-year performance gains we've known for half a century. All isn't lost, however. Eventually, some of the novel paradigms we investigate here might well go some way to providing future speed improvements.

In the shorter term, however, scientists are considering whether gains can be achieved by the more conservative approach of keeping with the same basic principles, but replacing silicon. Make no mistake, though: even that will require substantial innovation in materials science and semiconductor engineering.

Silicon, of course, is a semi-metallic element that can be made into the semiconductors needed to fabricate transistors by a process called doping, which involves adding small quantities of other elements. It's not the only element that can form the building blocks of electronics, however; in fact, germanium, one of silicon's close neighbours in the periodic table, was used in some of the first transistors.

While there are several other elements that could, in theory, also be used as semiconductors, much of today's research is involved with alloys such as InGaAs – that's a mixture of indium, gallium and arsenic – which hold the promise of faster and more energy-efficient transistors, which will lead to faster, less power-hungry chips.

Perhaps the greatest potential for the future of electronics, while also posing one of the greatest challenges, is the application of some of the up-and-coming new forms of carbon such as graphene and carbon nanotubes. And here, would you

ABOVE: Some of the newer allotropes of carbon, such as carbon nanotubes, offer the promise of high-speed transistors when silicon eventually runs out of steam

believe, the prospect of clock speeds as high as 1THz – that's 1,000GHz – has been bandied around.

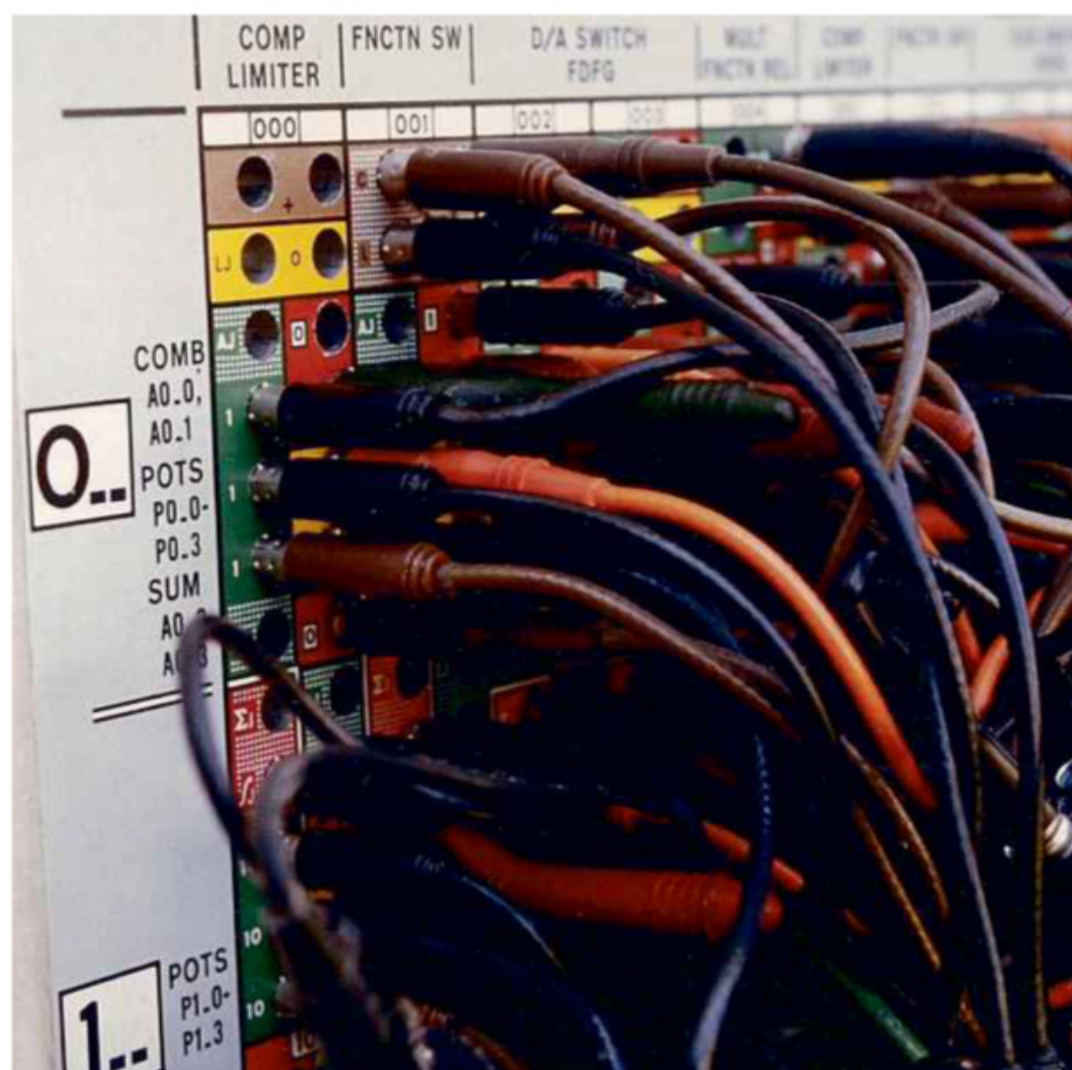
Analogue computing

The idea of a future for analogue computing – and specifically electronic analogue computing – might seem surprising since it represents the past, being a predecessor to the digital computer, but it might indeed play a part in the future.

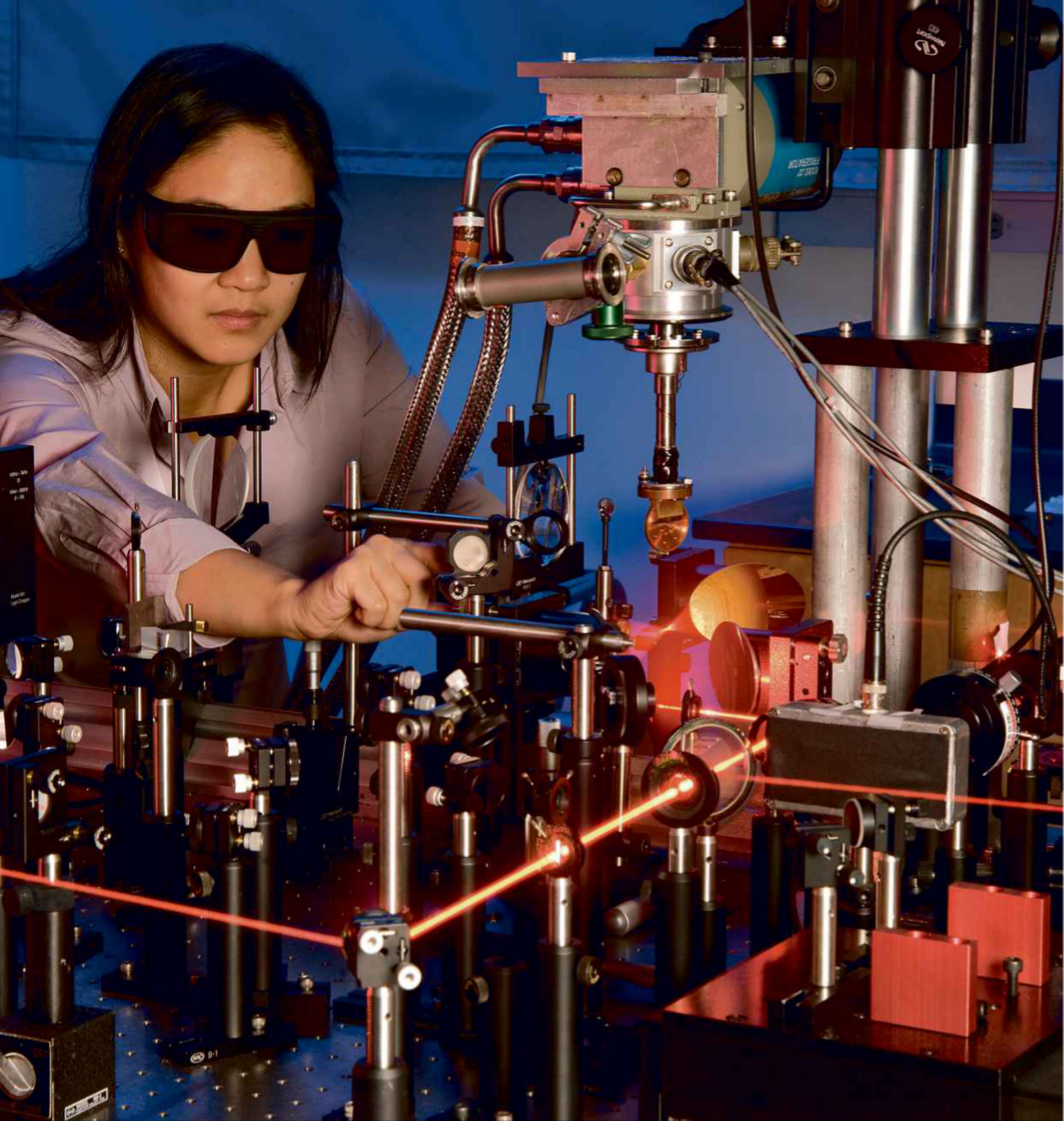
Analogue computers aren't universal, like today's digital computers, since they're specifically intended for solving differential equations. Hence they were used even in the early days

of digital computing for scientific computing applications, including simulation. They were so much faster than digital computers, and could still be today, but they had some serious drawbacks that saw them sidelined as digital computers improved. One drawback was their limited accuracy, but perhaps the greatest disadvantage was that programming them was a very laborious process that involved making physical connections between the various computing elements.

Today, the second of these drawbacks can be largely circumvented, and this has resulted in a resurgence of interest in the technique. Given a set of



RIGHT: Analogue electronics is one of several outdated technologies which many experts believe deserves a new lease of life



A glimmer of light

For pretty much as long as electronic computers have been with us, a concept that appears to offer huge performance gains has been the subject of so much hype, even though we've seen precious little in the way of progress. This alternative model of computing involves using light instead of electricity and, on the face of it, it appears to be an ideal solution. After all, light travels faster than electricity, and it also has the potential for much greater clock speeds.

Much of the debate has centred around the digital concept of computing that we use today and, as such, it requires the optical equivalent of the electronic transistor. And it's here where the problem lies. The fact is that, to date, nobody has

ABOVE: Despite the potential of light for computing, researchers have struggled to turn laboratory experiments into a practical processor

produced an all-optical switch that's a practical proposition for mainstream computing.

Optical computing using a very different model of computing looks more promising, however. Optical techniques might play a part in paradigms such as quantum and neural computing, and there's no lack of research here.

This isn't just pie in the sky. Wakefield company Optalysys has recently brought an optical co-processor to market. Intended for AI applications and other demanding tasks such as simulation and weather forecasting, the optical device implements a neural network and, according to the company, offers much better performance than a CPU/GPU combination.

differential equations, an associated digital computer can work out the required connections and even make those connections itself. Accuracy still remains an issue, but advocates suggest that some applications can make do with limited accuracy. So an analogue processor could work alongside a traditional digital processor, with the ideal technology being selected automatically for each task.

Alternative electronic architectures

Another evolutionary concept is to remain with conventional electronic circuitry, perhaps even sticking with good old-fashioned silicon, but to make major changes to the architecture. Whether new architectures will replace current microprocessors or just sit alongside them remains to be seen, but most pundits are suggesting the latter, at least in the short term.

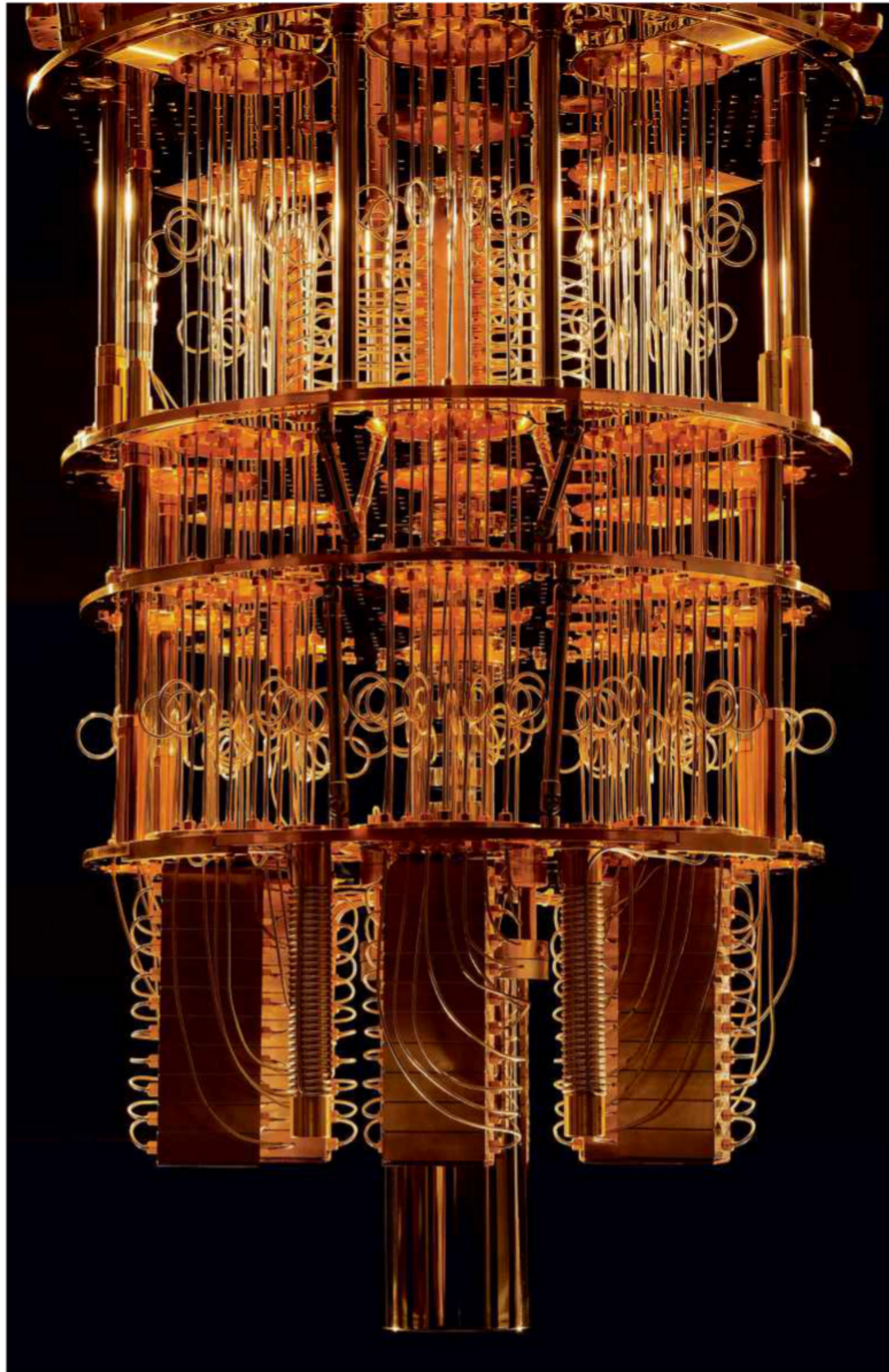
This has started already, as GPUs initially developed for improving graphics performance, especially in gaming, are now being used as key elements in high-performance machines for scientific applications. Another example is artificial neural network (ANN) co-processors. ANNs are one of the more revolutionary paradigms and could, in theory, be produced using analogue electronic circuitry. In the short to medium term, however, neural networks are being implemented digitally in silicon chips that work together with more conventional microprocessors.

One of the more ground-breaking potential new architectures is being promoted to break the so-called von Neumann bottleneck. One of the major factors that throttles performance in today's processors, the von Neumann bottleneck refers to the time-consuming requirement to move data from memory into the CPU to be processed, before shuttling it back again afterwards. The revolutionary concept that could offer some relief here is to carry out processing within the memory itself.

The quantum promise

We've been promised quantum computing for decades but, with Intel, Microsoft and IBM now on board with active research projects, perhaps mainstream applications are within sight. It's bizarre in the extreme – being based on concepts such as superposition, which means that a bit can represent both a 0 and a 1 at the same time – but the performance gains on offer are phenomenal.

With conventional computers, to double the speed while keeping



ABOVE: According to IBM, in five years quantum computing will go beyond the research lab and become mainstream

everything else the same requires twice the amount of hardware. With a quantum computer, it's necessary only to add an extra bit, or qubit as it's called. So, for example, while the much-heralded change from 32 to 64 bits in mainstream chips gave us a welcome performance boost, in the world of quantum digital computers, such a change would have resulted in the speed increasing by a factor of four billion. But all of this is fiendishly difficult to achieve, since it requires the

circuitry to be held at temperatures that are even lower than interstellar space, while being totally shielded from external radio signals and all other forms of interference.

While the general-purpose digital quantum is probably a few years off yet, it's interesting to note that Canadian company D-Wave has had a machine on the market for several years. Used by Google and NASA, this machine isn't the quantum equivalent of today's digital

Neural networks

Animal brains work in a very different way to digital computers and, for this reason, they excel at some tasks, such as pattern recognition, where our computers tend to struggle. What's more, they don't actually require programming, in the normal sense of the word, as they're taught to carry out a task through a process of learning. For this reason, artificial neural networks, or ANNs, have been studied for decades.

Neural networks can be considered as the ultimate in parallel computing. Each processing element, or neuron, is extremely simple, doing little more than generating a weighted sum of its inputs, generating an output if that sum exceeds a threshold. The power comes from their vast number and the even greater number of connections between them, and the function of a particular network is defined by the weighting factor of each neuron's inputs.

Historically, most of this research has proved fruitless, but recent work, for example at Manchester University, has made considerable progress. However, while the underlying principles of this work are the same as those that occur in the human brain, the inherently analogue nature of biological neurons has, to date, been emulated digitally, albeit with very specialised hardware.

In terms of the number of neurons and their interconnections, ANNs don't yet come anywhere close to the human brain. Yet there is no shortage of applications where experts expect them to surpass conventional computers. Included here are self-driving cars, autonomous drones, intelligent surveillance systems and even humanoid robots to act as home helps.

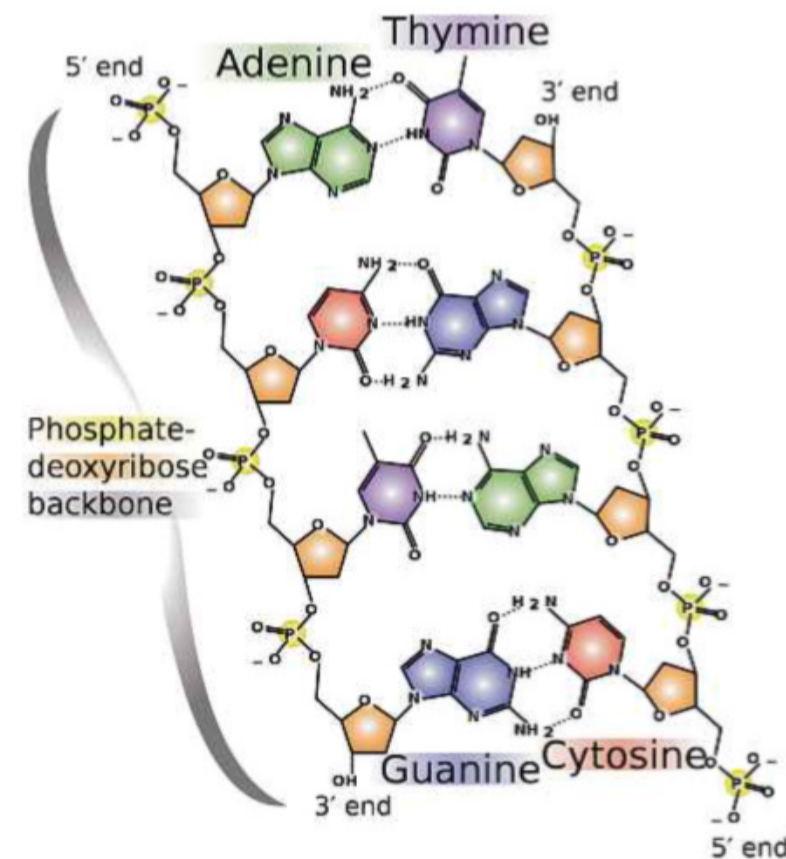
RIGHT: Although today's emphasis is on digital implementations, the inherently analogue nature of mammalian neural networks offers the benefits of massively parallel computing

computers, but instead uses a technique called quantum annealing. More akin to analogue than digital computing, this model of computing has been used for optimisation problems and image analysis.

Manual methods

Mathematician Lewis Fry Richardson's contribution to computing pre-dated the first digital computers, but it was remarkably forward thinking, pre-empting as it did the methods used today in weather forecasting, and even the concept of massively parallel computing. Where it differs from all the other models of computing presented here is that it relied on the human brain instead of any artificial method of processing. There's no way it has a future, but that makes it no less fascinating on our whistle-stop tour of computing paradigms.

Richardson's idea, which has been dubbed his weather factory and was published in 1922, used people, equipped only with slide rules and other basic calculating devices, to produce a numerical weather forecast. Each human calculator sat inside a



ABOVE: The four bases allow data to be represented by DNA modules, and selective chemical reactions permits computation

calculations. A pulpit, on top of a pillar in the centre of the globe, was home to a conductor, to use an orchestral metaphor, who maintained uniform speed of operation throughout the hall.

The molecule of life

The idea of computing by mixing chemicals in a test tube might sound odd in the extreme, but it's a good description of the early work in the field of computing with DNA, the double helix molecule that has been called the chemical of life.

DNA molecules represent information, which is encoded in the sequence of so-called bases, or chemical groupings, along their backbone, an order that can be engineered artificially. What's more, that sequence of bases dictates which DNA strands will react chemically with each other, therefore suggesting their potential for computation. But the real advantage is that just a few grams of DNA contain a vast number of molecules, thereby opening up the possibility of massively parallel computing. This concept was first demonstrated 25 years ago. It was used



Computing with cogs and gears

Mechanical computers might be a blast from the past, but that doesn't mean they have no place in the future. The most famous mechanical computer, of course, is Charles Babbage's Analytical Engine. First described in 1837, and never actually completed, this remarkable contraption has since been recognised as embodying many of the concepts in today's computers, even though it was built of cogs and levers instead of electronic circuits. Needless to say, it would have been immeasurably slower than electronic computers.

Now, however, scientists at the University of California Los Angeles and the Lawrence Livermore National Laboratory (LLNL) have created a Microelectromechanical Systems (MEMS) computer, which is based on logic gates, much like the processor in

ABOVE: The two-century old idea of mechanical computing – as postulated by Charles Babbage – might just impact the 21st century, thanks to MEMS techniques

your PC. The processor might only be clocked at a few megahertz, compared to a few gigahertz for electronic devices, but it's not being positioned as a solution for general-purpose computing. Instead, it's suggested, these devices are ideally suited to creating 'sentient' materials that can respond to changes in their surroundings, even in extreme environments.

According to an LLNL spokesperson, this approach "could prove useful in rovers sent to hostile environments such as Venus, or in low-power computers intended to survive nuclear or electromagnetic pulse blasts that would destroy electronic devices. In a Venusian rover, scientists could implement a control system so if the rover got too hot, the material could open its pores to allow in more coolant, with no electricity needed."

to solve the Travelling Salesman problem, which is notoriously difficult for conventional computers, and while the answer might have been computed quickly, the whole process of preparing the chemicals, bringing about the chemical reactions, and reading out the result took several days.

Things haven't stood still, as recent work on non-deterministic computers at the University of Manchester illustrates. A classic example of how this works is solving a maze. Each time a junction is reached, rather than following one of the two paths at a time, as a conventional program would, the code specifies that either path could be taken, and the inherently parallel nature of architecture allows both to be taken simultaneously, using DNA's ability to replicate.

Biological

Given that computers are much faster than the human brain for so many problems, it seems reasonable

to assume that electronics is superior to biology. However, this hasn't stopped researchers from investigating the potential of biological material for computation. What's more, even material from primitive organisms is capable of simple arithmetic calculations.

For example, scientists have used neurons taken from a leech to implement what they called a 'wetware computer'. It was able to add together two numbers and, while this might seem trivial, it's a whole lot more than a leech can do.

Stranger still is computing with slime mould. According to the Oxford Dictionary, this is "a simple organism that consists of an acellular mass of creeping gelatinous protoplasm containing nuclei, or a mass of amoeboid cells". Not a promising start, you might think, but you'd be wrong. Recently, researchers at the University of the West of England in Bristol demonstrated logic gates built from

slime mould, thereby suggesting the possibility of universal computing.

Alternatively, the same researchers have investigated the inherent capabilities of slime mould to solve certain very specific problems. Slime moulds form a network of tubes to move toward a food source along the shortest path. In being able to find the shortest paths, therefore – a challenging problem in conventional computing – scientists believe that slime mould holds promise for applications in communication networks, robot path planning, and much more besides.

The expert view

Painting a broad picture of the diversity of alternative computing paradigms is relatively straightforward, but coming to a view on which might replace or augment computers as we know them is another matter entirely. We spoke to Bruce MacLennan, associate professor of Computer Science at the University



of Tennessee, to get some answers. MacLennan was involved in the architectural design of the Intel 8086 in the late 1970s, and has had 40 years of experience in researching and teaching unconventional computing paradigms.

To the obvious starting point of whether MacLennan envisaged any alternative technology replacing silicon any time soon, we got the expected response.

“I do not anticipate silicon-based digital computation being replaced any time in the foreseeable future; it will be difficult to find another technology that is as flexible and well developed,” MacLennan asserts.

However, that doesn’t mean remaining with the status quo.

As he explains, “Increases in speed and density must continue to slow, and eventually stall, due to fundamental physical limits. Therefore, I think future computing will involve a mix of computing technologies, both conventional and unconventional.

“Conventional digital processors will be complemented by co-processors designed for different computing paradigms – for example, neural network and analogue – and implemented with non-silicon and/or non-digital technologies. Unconventional computing paradigms will also be used on their own in domains and environments in which they have a distinct advantage. Therefore, I think the future will bring an expansion of the range of computing paradigms and technologies.”

On the question of which technologies might work alongside conventional CPUs, MacLennan started by discussing fundamental principles.

“To develop post-Moore’s Law computing technologies, we will need to assimilate our ideas of computing more closely to the physical laws that implement them. Too many layers of abstraction between computational and physical processes limit both speed and density,” he says.

However, that didn’t mean that he had no particular technologies in mind.

“Among other consequences, since the laws of physics – even quantum physics – are fundamentally continuous, analogue computation has to play a larger role. This closer alignment of computation and physics also means that we should think of

ABOVE: There can surely be fewer unlikely ways of computing than slime mould

BELOW: Bruce MacLennan foresees a bright future for unconventional computing techniques



fundamental physical processes as computational primitives, as is done in quantum computing. The physics can do the computing for us,” he notes.

MacLennan points to massively parallel analogue computation as one of the most promising options. This includes electronic analogue computation, as well as other computational media, such as optical.

“I am also optimistic about quantum computing, which I view as a species of analogue computation, since qubits represent continuous combinations of discrete states. One challenge is to develop a scalable implementation technology, but several promising approaches are under investigation, and I expect we will have identified a scalable technology – analogous to the integrated circuit – within five to 10 years,” MacLennan adds.

But it’s not all about speed, as his final prediction makes clear.

“I also see other unconventional computing paradigms being used where they have distinct advantages, such as speed, power, information density, adaptability, self-repair, support for novel models of computation and operation in specialised environments. Sometimes, speed and density are not important, and we may prefer a technology that is slower but has much lower power requirements,” he concludes. ☐

RETRO

COMPUTING HISTORY
REMEMBERED + REBOOTED



From trash to treasure

Sellam Abraham began collecting retro computers when they were perceived to be junk, and once amassed the planet's largest collection, as **David Crookes** explains

It was 24th September 1989, and front-end loader operators were working hard at a vast landfill site in Logan, Utah. They were being watched by employees of Apple as they smashed their way through a mound of computers, breaking them into pieces before eventually laying them to rest.

On Apple's orders, none of those 2,700 machines could survive. Nobody, they decreed, would be able to go back once the operation was complete and bag themselves a dusty, muck-covered Apple Lisa. For each of the computers had been deemed surplus to

↑ Sellam Abraham lost most of his collection, but he remains a keen enthusiast of vintage computers

requirements just six years after launch. The \$4,000 computers had been proving hard to sell, so they were being dumped in the most unceremonious of ways to allow Apple to receive a tax write-off on the unsold inventory.

Today, the reaction would be one of loss among many computer enthusiasts, but such controlled obsolescence of hardware and, indeed, software is unlikely to have been rare in days gone by. We know of many headlines

such as Atari's disposal of thousands of 2600 console cartridges – including the terrible film-to-game conversion E.T. the Extra-Terrestrial – in a New Mexico landfill in 1983.

But all over the world, thanks to an industry that was seeing multiple launches each and every year, landfills are bound to be hiding many more forgotten treasures. And that's not counting the scores of other perfectly usable computers that were consigned by users to cupboards and lofts, or sold for very low prices since they were perceived to be of very little value.



↓ Sellam Abraham's first computer was a Mattel Aquarius, which was launched in 1983

"MOST OF THE STUFF BACK THEN WAS CONSIDERED JUNK AND OBSOLETE VERY QUICKLY"

"Most of the stuff back then was considered junk and obsolete very quickly," says Sellam Abraham, who used to go by the surname Ismail. And he should know, because in the mid-1980s, his teenage self had already begun collecting computers, telling his mother that they would one day be cherished and form the basis of a museum.

HISTORY CHANNELLED

"It just became an addiction. I'd tell my mum that I thought these things would be important for future historians when I had my closet filled with old computers – these big clunky things. She would ask me to sell them and I said, 'no, no, they're going to be important one day'. I didn't really believe it myself, but I just wanted to get her off my back," he explains.

Abraham was one of the first collectors of retro technology, grabbing what he could at a time when the computers, peripherals, software and documentation he was amassing were barely cold in their graves. He had become interested in computers at the age of eight, skipping over to the technology section of any department store his family would visit.

"I'd spend all my time there, familiarising myself with these computer things," he says.

Eventually, he got a computer of his own – a Mattel Aquarius, which was launched in 1983. He later upgraded to an Apple II, sparking a life-long love of both machines. But nostalgia and

➔ Thousands of copies of Atari's game E.T. the Extra-Terrestrial ended up in a landfill site in New Mexico

fascination drove him just as it does with vintage computer enthusiasts today. The main difference is that retro collectors are now 10 a penny, which has been driving up prices at car boot sales, charity shops and online marketplaces such as eBay. Back then, people were practically giving computers away.

"I was at a car boot sale in 1993 when I saw someone selling all of the computers that I used to play with in those department stores," Abraham recalls.

"I had to walk around the corner and compose myself because I didn't want to

tip off the seller that I was so excited to acquire them."

He went back to that seller with a straight face and expressed his interest.

"He asked which ones I wanted and I said I wanted them all," Abraham laughs.

"We then worked out a deal of about five bucks apiece which, for 23 computers from Atari, Commodore and Texas Instruments, worked out at \$100. I brought them all home, cleaned them up and tested them out. I then packed them all away in anti-static packaging and stored them away like a time capsule."

EASY PICKINGS

Living in Silicon Valley, where he would later gain employment as a programmer, Abraham found it easy to come across unwanted machines.

"It was just the perfect environment and the perfect time, because people were literally throwing the stuff away. I was coming across all kinds of incredible things and it became a little addiction. I'd visit thrift stores and car boot sales, as well as all kinds of surplus electronic stores in Silicon Valley. I just started to acquire like mad," he says.

By the end of the 1990s, Abraham had about 1,000 vintage computers occupying a 4,500-square-foot warehouse in Livermore, California, where he lived at the time. In addition, he had manuals, brochures, posters, printers, software and other peripherals, growing his collection to more than 3,000 by the mid-2000s, when he ended up taking 10,500 square foot of space in a warehouse in Stockton, California. It put him in possession





↑ Sellam Abraham has a prototype Apple II computer, which can fetch upwards of \$10,000

of the largest privately held collection of retro computers on the planet.

"I had a huge library of books and magazines, T-shirts, mugs, games and just about everything related to computing. There was lots of ancillary stuff in the collection from the communications industry and everything was stored on one of 220 pallets. It was unrivalled at the time," he says.

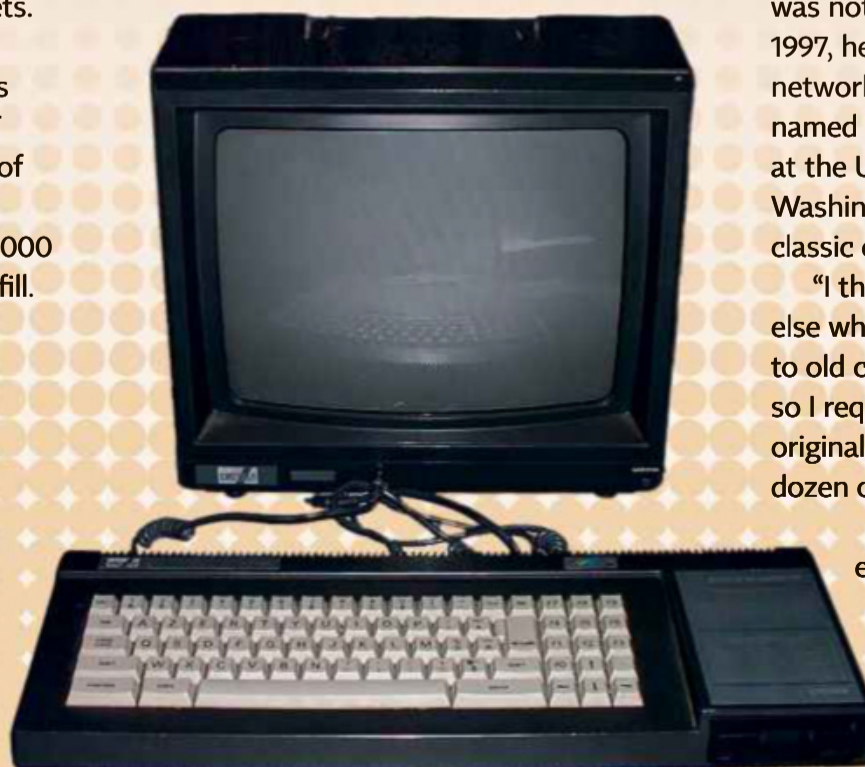
Indeed, around that time, the emphasis was still very much on disposal. In 1997, IT consultancy the Gartner Group said 65% of old corporate equipment in the UK, for instance, was being kept in storage, but 3,000 tonnes of equipment was heading to landfill.

There were some efforts to recycle, with companies and charities benefitting from some of the old stock. But they were picky about what they wanted. April Groves, who worked for a recycling organisation called Bytes Twice, told *The Independent* newspaper in 1997 that computers needed to run Windows at the very least.

"If it's an individual household with an old Amstrad in the attic, then the tip is still the only place for it," she said.

ONE MAN'S TRASH

Today, a boxed, cared-for Amstrad CPC 6128 with its monitor would fetch in the region of £300. Old Commodore 64s and ZX Spectrums can attract as much as £100, while Sam Coupés can be listed on auction sites for as much as £1,000 depending on their condition.



← A boxed, cared-for Amstrad CPC 6128 with its monitor can nowadays fetch in the region of £300



↑ From a time when Apple software came on cassettes, with a cable running from a tape player into the Cassette In jack of the Apple II

There's also no shortage of places to buy and sell, with Facebook groups dedicated to the trading of computers, collectors' markets rife and even special websites such as Sell My Retro (www.sellmyretro.com), which aim to keep costs as low as possible.

The power of finding like-minded souls was not lost on Abraham, however. Around 1997, he was very active on the Usenet network, and he came across a fellow named Bill Whitson who, at the time, was at the University of Washington in Washington State and putting together a classic computers mailing list.

"I thought, oh wow, there's somebody else who is strange like me who is holding on to old computers for no reason whatsoever, so I requested to join and became one of the original members, along with a couple of dozen others," Abraham says.

"We were all kind of surprised to find each other because it had just been a little secret obsession for each of us."

"I GOT THE IDEA FOR THE VINTAGE COMPUTER FESTIVAL AND HELD THE FIRST ONE IN 1997 IN CALIFORNIA"

The mailing list became Abraham's home, and his mind was buzzing with ideas.

"I got the idea for the Vintage Computer Festival and held the first one in 1997 in Pleasanton, California," he says (the event is now international and runs annually). He also began a consulting business called Vintage Tech, since he was constantly being approached by people who needed access to old computers or who were looking for specific software.

"That's when I discovered the lucrative business of renting stuff to attorneys for patent litigation," he adds.

Abraham, therefore, became pioneering since he was putting his old tech to new uses very early on. One of his first cases involved a patent lawyer who was defending eMachines against Compaq over the design of a flip door that would cover a computer's ports. He also worked on getting a 25-year-old Xerox Star computer working again for another patent lawsuit.

"But I also sat down and thought about other services I could provide using my collection, and I began to rent computers to movie studios and take requests to convert data and discs so that the information could be read on modern machines."

One of his Teletype machines appeared in the 2006 film *The Hoax* starring Richard Gere, while older Apple computers were borrowed for documentaries.

"I was also doing appraisals and sales brokering, including one for a highly publicised Apple I auction before they were a big deal. By



↑ Introduced in late 1982, the low-cost HP 9816 featured an integrated monitor

2006, I had brokered the sale of six Apple Is, with the highest price being the equivalent of \$30,000," he recalls. He also had an Apple Lisa in his collection and looked upon with it pride.

of the blinking lights that made the PDP-1 such an eye-catching machine.

Some requests were strange, however.

"There was a cemetery in Oakland, California, that had 60,000 punch cards with the names of the dead on them going back to the 1950s and 1960s, and it needed to extract the data so that the staff would know who was buried where," Abraham says.

"I was able to use my equipment to convert the information to a new digital database and developed a system that would read 200 cards a minute."

He also worked with the Mel Fisher Maritime Heritage Society and Museum in Key West, Florida, which had in its possession digital photographs of the salvaged wreck, the *Nuestra Señora de Atocha*. They were saved on to floppy disks and backed up to VHS but, just as the Spanish galleon had been sunk in 1622, so the museum bosses were worried the data was lost.

REVIVING THE PAST

Abraham founded an electronics recycling business, too, and he was building replicas of the PDP-1, a computer created by Digital Equipment Corporation in 1959. His version would, like the original, play Spacewar, and have little joysticks and all

◆ A stamp commemorates the *Nuestra Señora de Atocha*, digital photos of which Abraham recovered





▲ Another of Abraham's prototypes, this time the Macintosh LC II, which was launched in 1992

"They needed a way of reading them, and I could help," Abraham says, having made use of the necessary floppy and tape drives to convert them to rewritable CDs.

"I also worked with punch tapes, magnetic tapes and other special formats, and I had one of the largest archives of computer

documentation on the planet. If I needed a manual, I'd likely have it."

His dream was to build a world-class archive for study and research into computer history.

"I had a vision for an institute where people, researchers, hobbyists and whoever

could show up, search a database and find the equipment they needed, pull it from the shelf, bring it to a workstation and set it up before getting hold of any documentation they needed," he says.

Alas, it was never to be, and Abraham's dream was never realised.

NEWS

● ARE YOU A PAD OR A MOUSE?

Retro accessory maker 8BitDo has created a new mouse that is sure to have Nintendo fans squeaking with delight. The peripheral's design has been inspired by the old Nintendo Entertainment System (NES) gamepad, placing round red

buttons on top to resemble eyes and a usable rubber D-pad on the side.

Created in collaboration with designer Daniel Jansson, who came up with the idea 10 years ago, the D-pad allows you to move up and down when you're viewing a website, as well as back and forth between pages. Doing so means it takes some of the functionality of the absent scroll wheel, although a 3D touch panel in between the top buttons also

allows for up and down on-screen movement.

On a practical level, the N30 wireless mouse runs off a single AA battery, which should last for between 100 and 120 hours. It costs £28 and is also compatible with both Windows and macOS.

You can find out more information by going to tinyurl.com/385retro2, or check out Daniel's explanatory video at tinyurl.com/385retro3.

● SONIC BOOMING ON AMSTRAD CONSOLE

We're seeing a spike in games that are really pushing the abilities of the Amstrad range of 8-bit machines, and the latest is an unofficial conversion of Sonic the Hedgehog for the GX4000 console and Plus computers.

Created by a coder going by the name of NoRecess along with a few other Amstrad enthusiasts,



Sonic GX features 40 colours on a full-screen running at 50Hz. A video of the work-in-progress suggests it will be silky smooth, and it also looks very faithful to the original.

According to the developers, the game is pencilled in for a release later in 2020. It won't be made available on a cartridge but as a download, which can be installed on an SD card and run on a cartridge-replacement device called the C4CPC.

For more details, see tinyurl.com/385retro4.





↑ Specialist websites such as Sell My Retro are dedicated to vintage computers

DYING PASSION

In 2012, following the economic downturn, Abraham fell behind with the rent on a warehouse he had been using for three years, which led to the landlord forcing him to leave. Since he showed up late to the eviction court hearing, a default judgment was made and, in the ensuing set of legal battles, he only managed to retrieve around 20% of his collection.

The rest ended up in the hands of a rival electronics recycler and, despite attempts to prevent the company from disposing of his items, they ended up being auctioned on eBay. Today, Abraham is in the process of selling the items he rescued eight years ago, his love of collecting now gone.



↑ This joystick – model JS-1 – was made by the Mountain View computer company, Cromemco

“It had been a passion to have these things and I’d invented a purpose for them, but it ended up gathering dust and I felt I needed to get rid of it all,” he says.

He is keeping his Apple II and Mattel Aquarius items (including four Apple II prototypes and a very rare Mattel Aquarius II, which reached the market in very small

numbers) because both computers remain close to his heart, but everything else is slowly being sold, with the remaining items documented in a spreadsheet at tinyurl.com/385retro1. When these have been placed in new hands, he’ll then turn his attention to the thousands of books and magazines he possesses.

● MAKE A MECHANICAL 60s COMPUTER

From 1963, a company called ESR began manufacturing a mechanical digital computer using polystyrene parts. Digi-Comp I was sold in kit form for \$4.99 (the equivalent of around \$40, or £30, today), and it was possible to play rudimentary games and perform sums using its three connectable flip-flops, a thin vertical wire and

a lever, making it a nice introduction to computing. The originals are rare, but digital preservationist Mike Gardi has created his own tribute, mashing it up with a Digi-Comp II, a Minivac 601 and a Geniac Redux. He has also detailed how you can make your own using printed parts and an array of different components, which you can see by visiting tinyurl.com/385retro5.

Gardi, who was given a Digi-Comp as a child, has also provided a PDF of the original manual alongside the STL files. He said he used it to get to grips with Boolean logic, binary arithmetic and some basic coding, so if you’re not already familiar with the concepts, you may

find creating this device is educational as well as nostalgic.

● RETRO GAMING BOOK RELEASED FOR PI

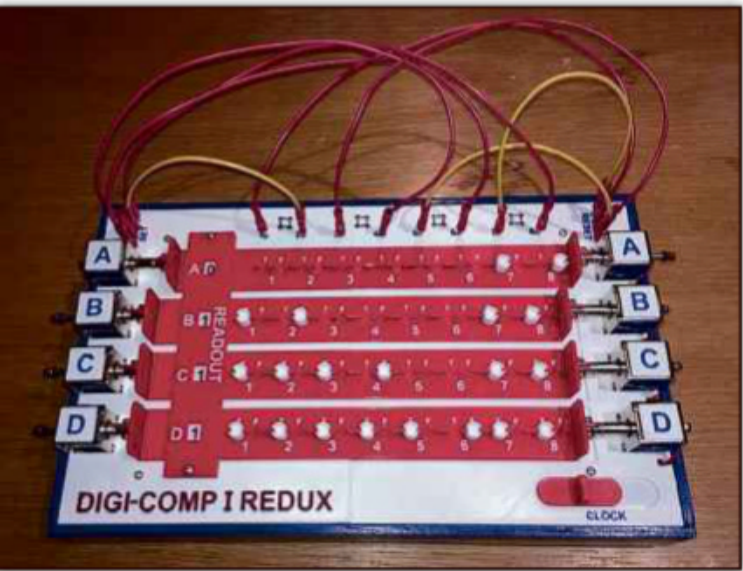
The Raspberry Pi computer has become a firm favourite among retro computer enthusiasts since, thanks to free software packages such as RetroPie, you can easily emulate lots of vintage systems, from the Commodore Amiga and Dragon 32 to the Oric and ZX Spectrum.

A new book from the Raspberry Pi Foundation explains how you can set up a retro games console using Lakka. Over the course of its 164 pages, it also delves into the world of emulation, explains how you can create your own arcade cabinet, and has lots of other projects, including the making of a portable Pi-based console.

There is also a large section on making your own games, and

you can even learn how a broken computer can be revitalised by popping a Raspberry Pi inside.

Retro Gaming With Raspberry Pi costs £10 but you can download it for free as a PDF, too. Go to tinyurl.com/385retro6 for both options.





↑ A small part of Abraham's vast collection, which includes Commodore 64s, Atari printers, joysticks and software

"I have several hundred boxes of magazines and books, but I don't know where to begin. Listing issue by issue will be too tedious, but they include the manual archives of the Charles Babbage Institute going back to the late 1940s with the UNIVAC. I'm still considering whether I want to hold on to those a little bit longer," he explains.



↑ This early modem from 1981 allowed direct coupling at the telephone handset jack, direct coupling to the phone line or acoustic coupling through the telephone handset

Indeed, Abraham is looking to remain active in the retro community in some capacity. He is going to be reviving Vintage Tech as a consultancy business, and is also planning a retro YouTube channel.

"I also want to create a website for people to buy and sell vintage computers, and create a database of every computer and peripheral out there," he adds.

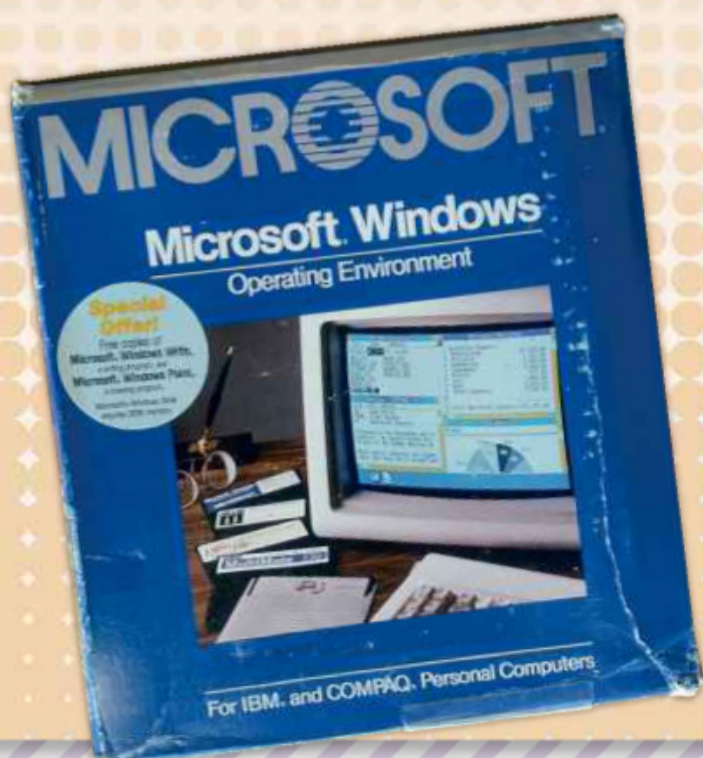
He is doing so at a time when retro has arguably never been more popular.

"I actually thought that collecting vintage computers would go the same way as the

nostalgia for old tube radios in that the interest would disappear once the generation which grew up with them died," he says.

"But what is interesting is that a younger generation are becoming fascinated with old technology that they never experienced when they were growing up. They're seeing it as an intriguing cultural and mystical time in history when all of this amazing stuff was being invented and created. Vintage computer festival events are more successful than ever and Facebook has a vibrant community. Collecting isn't for me any more but I think people are going to be acquiring their own collections for many more years to come." **CS**

← The very first Microsoft Windows operating system, which was released in November 1985



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A bit confused

I am still running Windows XP as I need to use some old 16-bit programs, such as AmiPro 3.1. I also need to run some programs that I wrote in Visual Basic versions 3 and 6. I assume these are 32-bit, having been compiled on Windows XP.

I have an Asus T100TA tablet with Windows 8.1, which runs these programs with no problems. I also have a Windows 10 tablet, which won't run them unless I install an XP virtual machine on it. However, as I also need to be able to use some later software such as Word and Excel, I couldn't do so on this tablet without exiting one system for the other.

If I purchase a second-hand laptop running Windows 8.1, can I guarantee that it will be able to run both my legacy

programs and newer ones, even if it is using a 64-bit processor? Or does it need to be 32-bit? I note that the spec for the processor in my Asus tablet says that it is 64-bit anyway: is it all down to the version of Windows the computer is running?

Bob Taylor

To some extent, you're confusing the bit-width of the computer with that of the operating system (OS) and the software running on it. Almost all PCs sold since the mid-2000s have 64-bit architecture capable of running 64-bit software. You can choose to install either a 64-bit or 32-bit OS; the vast majority of today's PCs run in 64-bit. In the case of Windows 10, a 64-bit installation will natively support 32-bit or 64-bit

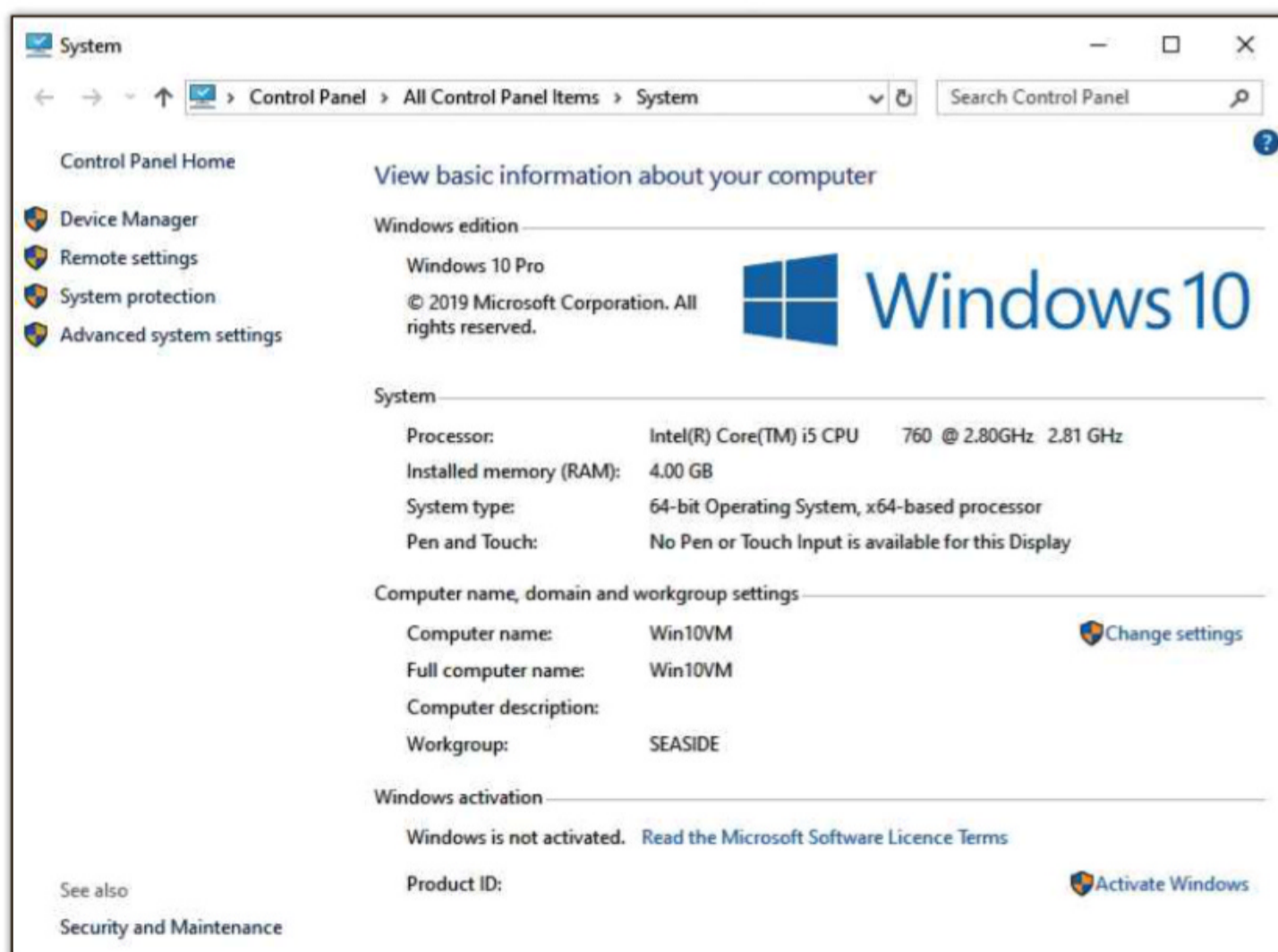
applications, whereas a 32-bit installation will support 32-bit and 16-bit software only.

From the details you give, it seems likely that your Asus tablet is running a 32-bit version of Windows 8.1, hence its ability to run your legacy 16-bit software. It's most likely that your Windows 10 tablet won't run the 16-bit apps because it has the 64-bit version of the OS, although there could be a separate compatibility issue. You can verify the bit-depth of your Windows 10 installation by long-pressing This PC, opening the context menu, choosing Properties and looking under the System heading.

If you're running the 64-bit version of Windows, the only way you'll be able to run legacy 16-bit software is by creating a virtual machine (VM) and ensuring that you install

a 32-bit OS on it. It doesn't need to be Windows XP; you already know that your apps are compatible with Windows 8.1, so there's a good chance they'll work on a 32-bit installation of Windows 10. Remember that you need a separate licence for whichever OS you install on a VM, as the host PC's licence doesn't cover it. Creating a VM won't affect your ability to run modern 64-bit software such as Word on the host itself: if you have enough RAM, you'll be able to leave the VM running and minimised while you use other apps on the host.

If you're running the 32-bit version of Windows 10, there's a compatibility problem not related to the bit-depth of your software. You could try to get around it by finding the executable file of the app you're having trouble with, long-pressing it, selecting Troubleshoot compatibility, then using the Program Compatibility Troubleshooter to attempt to find a solution.



↑ Your PC's bit depth appears under System. 64-bit Windows doesn't support 16-bit apps

Just an inkling

Printer manufacturers all warn that compatible inks may damage their printers, but is this true? I'm happy to pay a small premium for OEM inks, but when the price difference is so great I'm inclined to question the manufacturers' motives. I read today that HP is to increase the cost of its printers, apparently because too many users are buying cheaper compatible inks so it isn't making up for the low profit margin on printer sales. What's your advice on it?

Rob Hindle

The battle between original and third-party ink manufacturers is a longstanding one. While we can't tell you which inks you should buy, we can start with some facts. First, you're not obliged to buy a printer manufacturer's own ink and paper, and using third-party inks will in itself not invalidate your warranty.

Beyond that, it gets murkier. A manufacturer can refuse to honour its warranty if there's damage that may have been caused by a third-party ink. Manufacturers have also tried to make support for advanced or optional features such as cloud services conditional on the use of OEM ink, so even if there's no failure you could still miss out.

We have limited experience of testing third-party supplies, but our results have

➔ If cheap ink is all important, we'd recommend buying a refillable ink tank printer

been mixed. While many products have worked well, some ink cartridges have dripped when being prepared and fitted to the printer, and we've had one refilled toner cartridge disintegrate, spilling toner into the printer. One third-party ink brand in particular caused several blocked nozzles, but we rescued the situation by returning to OEM inks and performing a few maintenance cycles.

In our experience, print quality is best from OEM inks, with some third-party brands markedly inferior, particularly in photos. We've also experienced yield that fell well short of the OEM equivalent, which leads to possibly our biggest concern: that despite being outperformed by OEM inks, third-party and refilled cartridges aren't necessarily cheaper.



Overall, our advice is to stick with OEM ink where outright print quality is important. If you're considering saving money with third-party inks, make sure you divide their cost by their rated life – you may be surprised when you compare this cost per page for original and third-party supplies.

If you're choosing a new printer, you should consider an Epson EcoTank or one of Canon's refillable ink Pixmas. These cost much more to buy, but they're the cheapest way to print with original inks.

Haven't found what I'm looking for

In my computer I have a system drive, and a data drive split into 10 logical partitions. I wanted to resize one of the partitions on the latter, but to my surprise I found that I couldn't do this with the tool I've previously used for this kind of thing. It turned out that this was because the drive had somehow been converted to a dynamic, rather than basic, one.

The easiest solution I could find was to copy off all of the data, re-create the drive's partitions, then copy everything back. It took a while to move all 575GB of data twice, but everything appeared to work as before until I tried to search for a file. Search found the filename I was looking for, but double-clicking it just navigated to My PC in Explorer, rather than opening the file I wanted.

I followed a tip to rebuild the index, but since doing that, the search function doesn't find anything at all. Interestingly, the results when searching Outlook are equally useless, showing at best a very small subset of what they should find. Have you any idea why search no longer functions and how I might recover it?

Mike Long



It sounds as though the search index hadn't had time to update itself before you tried the first search. While it contained the result you were after, this 'stale' record didn't actually point to the current location of the file, so it couldn't be opened when you double-clicked it.

➔ Building the search index can take an age, especially if you're still using the PC

Without knowing the timeline, it's hard to work out what might have happened since. With lots of data, it's possible that you wrote to us before Windows had managed to finish recreating the search index – it can take many hours, particularly if the computer is busy doing other things. Given that Outlook uses the same search indexing service, the fact that you're getting only partial results there would appear to make this more likely.

You can check the progress of the re-indexing by opening the Start menu, typing **control** and running Control Panel from the results, then choosing Indexing Options. Here you'll see Indexing complete once the process is finished. You'll also see a list of the drives being indexed. If you don't see all your drives, click Modify, tick the boxes for any unselected drives, then click OK. Again, it may take a while for the new drives to be indexed, but search should be back to normal once they are.

If that, then now what?

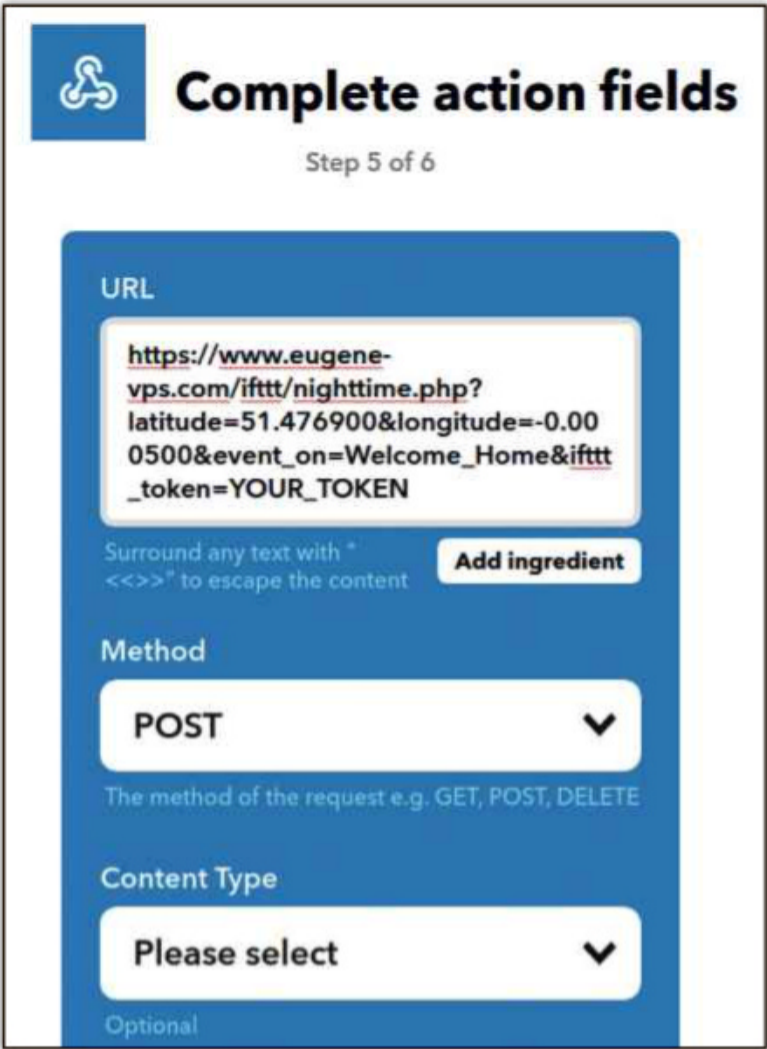
Last month (*Helpfile 384*), you helped me use If This Then That (IFTTT) to turn off my TP-Link Kasa smart lights when our Tado smart thermostat detects that the last person has left the house. Encouraged by this, I decided to create a Welcome Home scene where the hall lights go on, and configure it to activate when the first person returns. It works great, except that the lights ping on even if it's midday and we don't need them. Is there a way to add a condition to the IFTTT applet, along the lines of, 'If we return home and it's between certain hours, activate Welcome Home'?

Nick Barnes

You can introduce conditions to IFTTT actions, but it quickly gets complicated. You can add JavaScript filters that modify a trigger's behaviour, for example preventing it completing during certain hours, but a better solution would be to link the trigger to sunset and sunrise. You'd think that would be easy, but the only way we could get this working reliably was with the help of an API created by the Reddit user UsedJeans.

To get it working, you need to configure an IFTTT trigger that sends a web request to the API, and another that acts on the reply. Start by logging into IFTTT, searching for Webhooks, clicking Services, then connecting the Webhooks service to your account. Now visit the settings for the service, and copy your token ID, the long collection of numbers and letters at the end of the URL shown on the page.

Visit ifttt.com/create and create a trigger for when the Tado service switches to Home mode; you can base this on any zone.



Create the associated action in Webhooks, writing in the following URL:

https://www.eugene-vps.com/ifttt/nighttime.php?latitude=51.476900&longitude=-0.000500&event_on=Welcome_Home&ifttt_token=YOUR_TOKEN

You'll need to add in your Webhooks token at the end, and you may wish to change the

Has the sun gone down? You may need to query a third-party API

latitude and longitude to somewhere nearer than the Greenwich Observatory, although we'd advise against making these so accurate that they indicate your exact location. Now change the Method box to POST and click Create action.

The final step is to create the second IFTTT trigger, this time using the Webhooks service and 'Receive a web request'. Use Welcome_Home for the Event name, create the trigger, and create the associated action in the Kasa service to activate your Welcome Home scene.

You should now find that when you return home, Tado triggers a Webhooks action to query the API. If the sun has set in your location, the API returns a web request that is picked up by the Webhooks trigger, which in turn activates Welcome Home mode in Kasa.

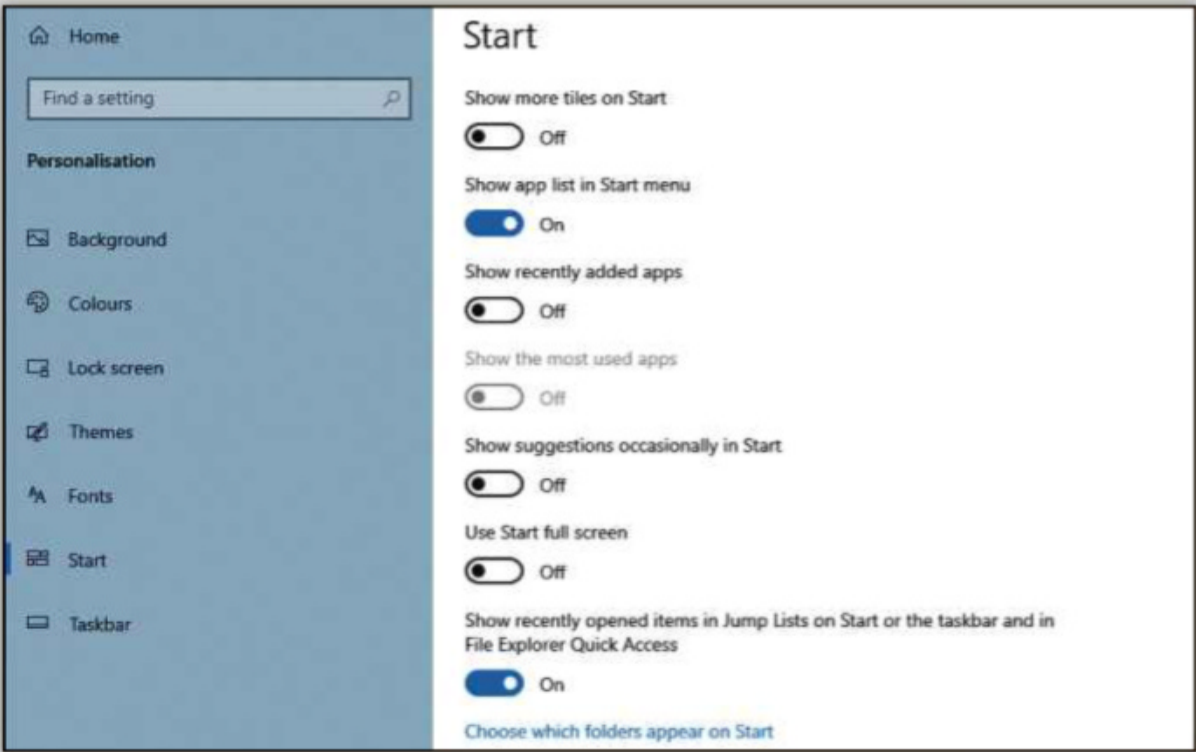
If this doesn't work properly, troubleshoot each applet by looking in their settings page. This will tell you if they have run at all. If only the first applet with the Tado trigger has run, check that you typed the URL correctly and added your own Webhooks token. Check also that the event name you used in the URL matches the one you used in the second applet's Webhooks trigger. Bear in mind this solution depends on a third-party API; if it disappears, it will stop working.

Stopped starting?

My Windows 10 PC has developed an odd problem whereby everything has disappeared off the Start menu. I've noticed that, at the top of the left-hand section, there are now icons for Pinned tiles and All apps, and clicking the latter brings up the apps I'd expect to see normally. I don't use the pinned apps feature, so I'd just like to see all of the Start menu's contents when I open it. Is there a way to bring it back?

Terry Moffatt

Fortunately, this is an easy problem to fix, although the option is somewhat hidden. Open the Start menu and click the gearwheel to bring up Windows Settings, then search for App List. Click Show app list in Start menu, then look in the Start menu options screen to enable the feature. Now you'll see the full Start menu again, and the Pinned tiles and All apps icons will have disappeared. 📺



You can switch off the Start menu's app list. But why would you?

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Choose from thousands of cars, apply for finance online with us and value your existing car - all from the comfort of your home.



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All members of staff are lovely and willing to help.



SHANNON

Pleased with service

The process of getting the car was very easy and secure.



DANIEL

Easy Peasy!

No trawling garage showrooms! Already recommending to friends & family.



KAREN

Purchased VW Golf

I was nervous about buying on the internet. Needn't have worried.



SIMON

READ MORE REVIEWS ON TRUSTPILOT

Advanced Projects

Clive Webster has been tinkering with computers ever since Windows 98 forced him to manually install his drivers

clive@computershopper.co.uk



The best unknown websites

The internet might be full of stuff and nonsense, but there are also brilliant pages, trustworthy sites and amazing web apps out there – if you know where to look. **Clive Webster** is your guide to the digital unknown

THE INTERNET. THE sum of human learning and understanding, a repository of progress, the ultimate melting pot of creativity and innovation. And all so clogged with junk, spam, fake news, info-trash, pseudos, trolls, ignorant arrogance and every last vile perversion of humanity.

And pedants. Who have already slated this entire article by geeksplaining that, actually, the internet describes the physical structure of networked computers and that we're actually referring to the World Wide Web. Sometimes you just need to skip the hassle of the online world and go directly to great content: here it is.

THERE ARE LOTS of well-known, well-respected websites out there; we hope you've bookmarked many of them for quick access. Moving beyond those trusted few sites can be problematic, however. First, you've got to find sites that look useful, and search engines are arguably becoming less reliable due to results being skewed by sponsored links, SEO hacks and click-bait articles.

Even if you find a site that looks reasonable, it might take a while to judge whether it's actually useful or just well-designed garbage. We're looking at you, *goop.com*. And also at whatever websites keep recommending ladies put strange things in awkward places – why on earth did *The Independent* feel it necessary to write an article titled, 'Don't put ground wasp

nest on your vagina'? Why did *The Mirror* feel the need to remind us that ice lollies are for mouths only, no matter how hot it gets? See tinyurl.com/385projects1 and tinyurl.com/385projects2 if you don't believe us. We promise that the following recommendations contains only fun distractions, trustworthy information, useful tools and absolutely no bunkum.

SHOPPING

SECRET SHOPPING

BrandAlley	www.brandalley.co.uk
Sarenza	www.sarenza.co.uk
Secret Sales	www.secretsales.com

SHOPS AND SHOPPING

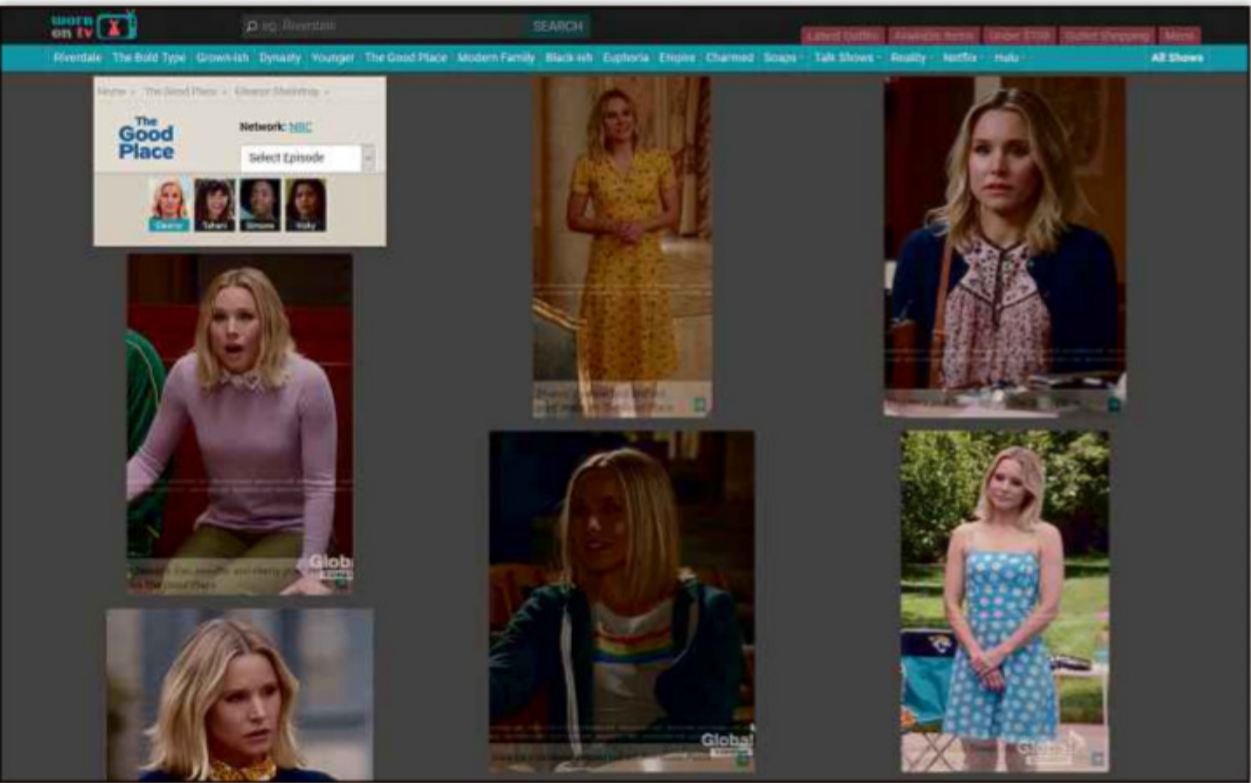
Board Game Prices	boardgameprices.co.uk
Boxoh	www.boxoh.com
Camel Camel Camel	uk.camelcamelcamel.com
Cool Hunting	coolhunting.com
Ethical Market	ethical.market
Ethical Shop	ethicalshop.org
Green Gardener	www.greengardener.co.uk
Hive	www.hive.co.uk
This Is Why I'm Broke	www.thisiswhyimbroke.com
Worn on TV	wornontv.net

ONLINE SHOPPING HAS become one of the key reasons for firing up a web browser, but there's so much more than Amazon (or, if there isn't, consider using the Smile option to support charities). Secret sites have become so popular they now advertise on telly, and it's easy to see why. The bulk buying power of large memberships delivers huge savings.

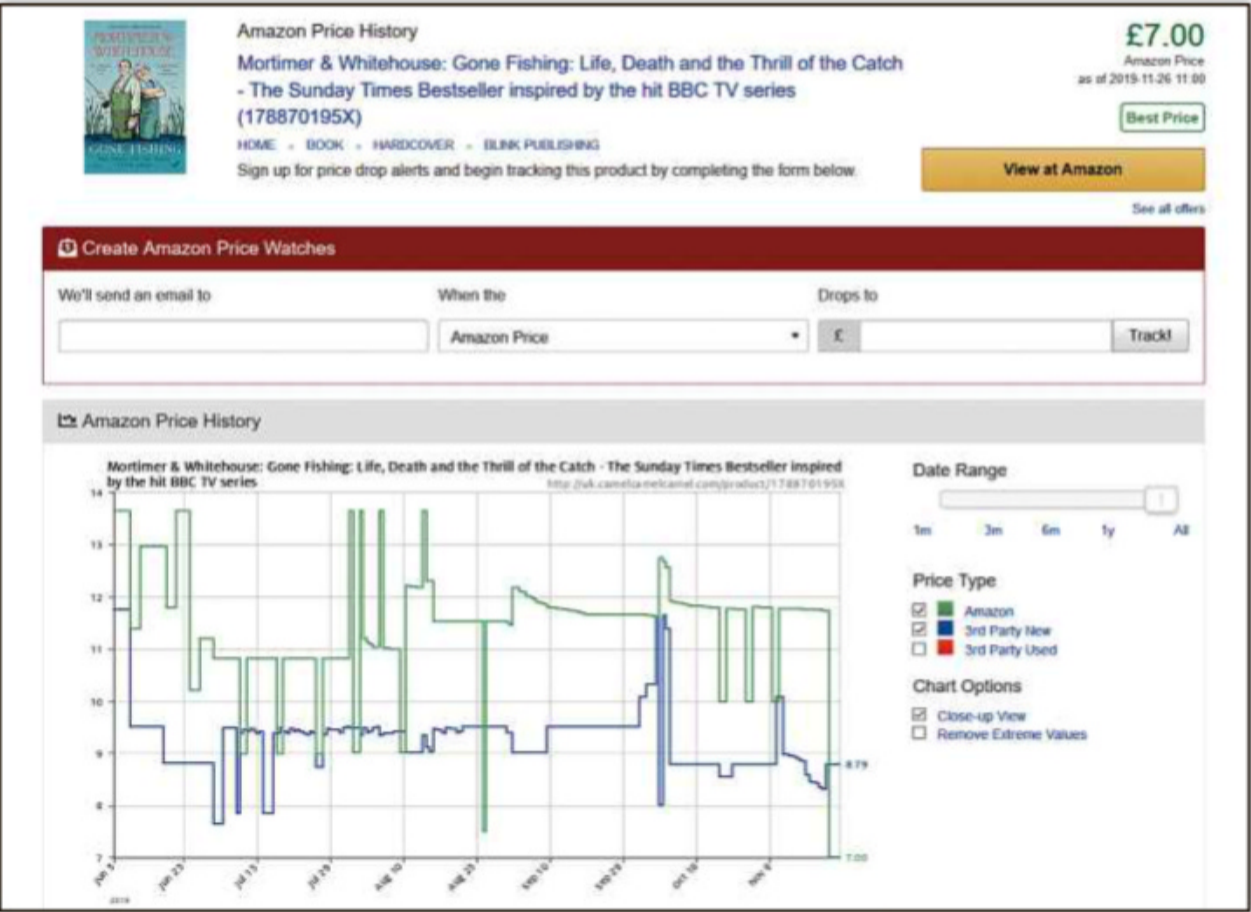
The catch is, once that bulk purchase has been made by the site operator, they really need to shift it: enter pressure selling, and constant emails and alerts about new deals and offers. If you do sign up for a 'secret' shop, know what you're looking for and only buy things you need. The three sites listed cover various aspects of 'lifestyle'. BrandAlley focuses on clothes, Secret Sales on clothes and beauty, and Sarenza on shoes.

Our list of 'standard' sites includes a few marketplaces for sustainable or environmental products, plus Hive, which donates a cut of each sale to a local (physical) bookshop. Cool Hunting styles itself as a cutting-edge tech, design and culture publication that does direct sales. Or possibly it's just a shop with a prominent editorial element.

More comprehensible and impressive is Worn on TV, which tells you where to buy the clothes of your favourite TV characters. Not the actual garments, but if you want to look like Eleanor from *The Good Place* or rock



Worn on TV lists where to buy clothes that your favourite characters have worn in specific episodes



The oddly named Camel Camel Camel tracks Amazon prices over time, and compares them with third parties. Maybe that flash sale isn't so flash?

some of the outrageously 80s stylings of *Stranger Things*, this site knows where to go. Board Game Prices points you to the cheapest place to buy a board game – possibly a complementary copy of D&D? Boxoh could then help you track the delivery, superimposed on a Google Map.

Camel Camel Camel is the strangest and most enlightening tool. It tracks products on Amazon, letting you see whether the current price is low or high, both against its price history on Amazon and on third-party sites. It can be quite an eye-opener; turns out that Amazon isn't necessarily the cheapest.

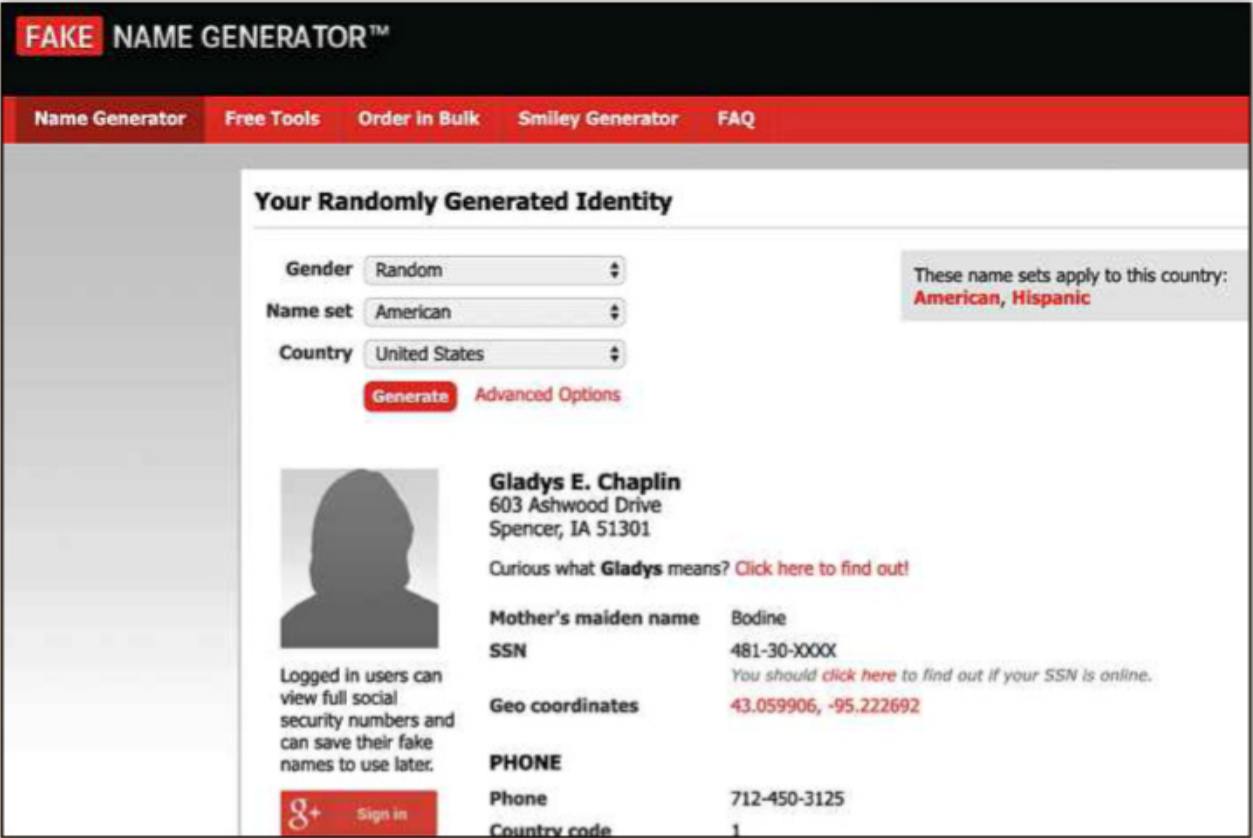
STAY ANONYMOUS ONLINE

10 Minute Mail	10minutemail.com
Fake Name Generator	www.fakenamegenerator.com
Scrim	scr.im

“PLEASE REGISTER TO use all the features of this free tool or app.” Words that should make you feel nervous – why do they want your email address? Who are they going to sell it to, how much sales spam will they send you, will they store your personal details securely? Good questions.

Instead of giving up your actual email address, you can use 10 Minute Mail to make a temporary fake address that lasts long enough to click the verification email. Equally, use Fake Name Generator to create an anonymous online profile.

And if you do ever need to post your email online, use Scrim to make it harder for a scraper or spider to harvest it and pass it on to spammers and hackers.



↑ Stay anonymous when you’re online by creating a random identity

FILE TRANSFER

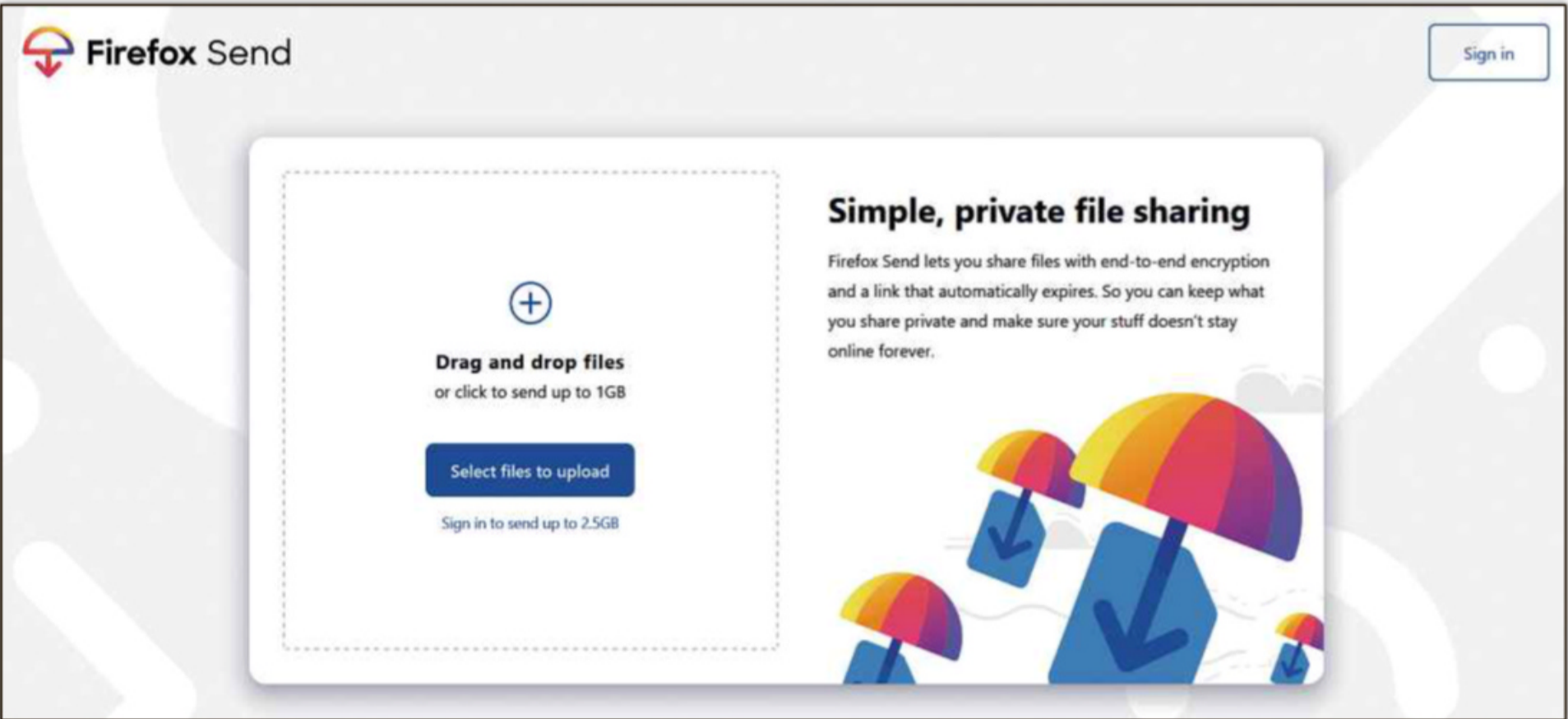
Firefox Send	send.firefox.com
We Transfer	wetransfer.com
Wobzip	wobzip.org

MOZILLA RECENTLY LAUNCHED its free file transfer service, which allows you to send files of up to 1GB for free, or up to 2.5GB if you register. If you already use Firefox, this might be all you need. For huge files, you'll still need to use the paid We Transfer Pro service and its 20GB limit. Either service is a lot easier than setting up an FTP server or clogging up your Dropbox or OneDrive storage.

Wobzip is an interesting online tool that can unzip almost any file, including .rar, .7z and .cab. The file size limit is only 200MB, but it's useful if you can't install an unzip tool on your PC.



↑ You can transfer files up to 2GB for free with We Transfer



↑ Mozilla’s new Firefox Send tool lets you send large files quickly and easily, but We Transfer is still the best for sharing massive files

WORKING TOGETHER

Creddle	credde.io
Doodle	doodle.com
GoProof	www.goproof.net
Join Me	www.join.me
Let Me Google That For You	lmgty.com
Online OCR	www.onlineocr.net
Quire	quire.io
Slido	www.sli.do
Stormboard	stormboard.com
Visual CV	www.visualcv.com

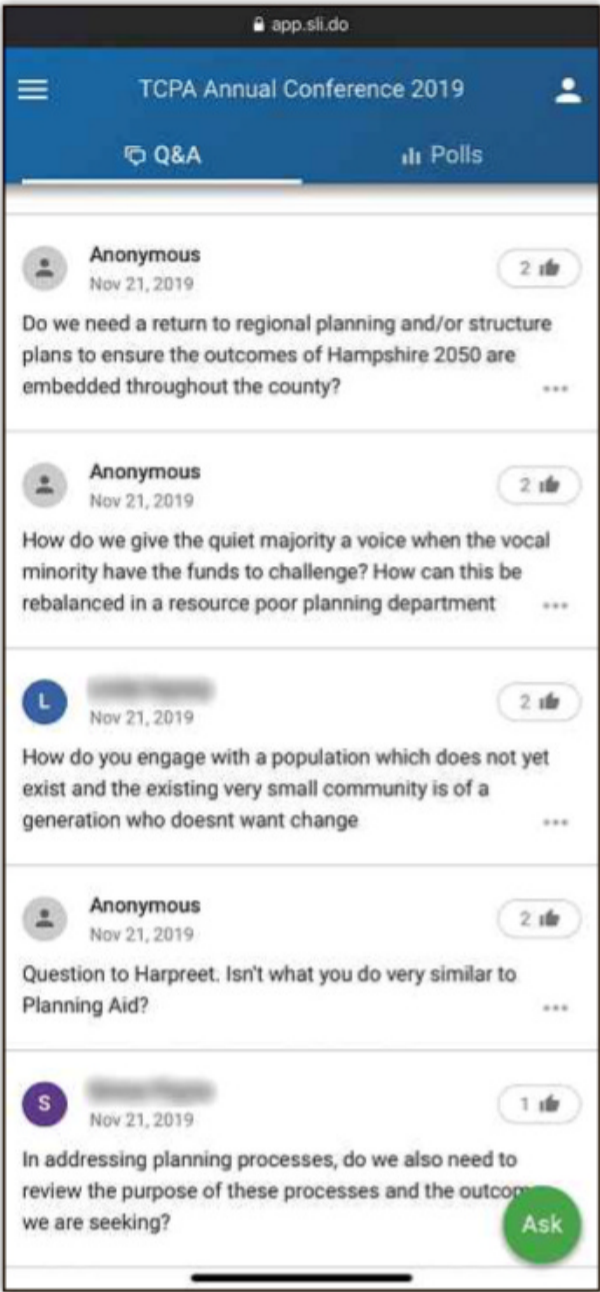
THE RISE OF the app hasn't completely killed the collaborative website or web app. There are all kinds of tools to help meetings happen and flow, from Doodle polls to find a meeting time that suits all attendees, to Sli.do and Stormboard for collaborating and interacting.

Sli.do is essentially a messageboard tied to a presentation. The host hands out a code to all attendees, and they can post questions and chat without distracting the presenter. Stormboard creates a shared whiteboard for smaller groups to brainstorm and sketch.

A virtual whiteboard might also be useful for distributed meetings, the sort we've been promised will be normal for the past 20 years. Perhaps it's the climate emergency rather than faster connectivity that finally shifts behaviour from face-to-face meetings.

Join Me is a useful tool for those inevitable 'Let me just show you what I mean' moments, as it lets you share your screen with other people. GoProof is handy for jointly proofing documents or feeding in creative input: upload your PDF, invite colleagues and you can see who has made what comments or suggestions. You could do that live, or just throw out the link for a few days and collect everything back together for a second draft.

Quire is a great workflow management tool for groups, laying out tasks in tiered lists, and allowing you to assign people, set deadlines and add notes. If you're more

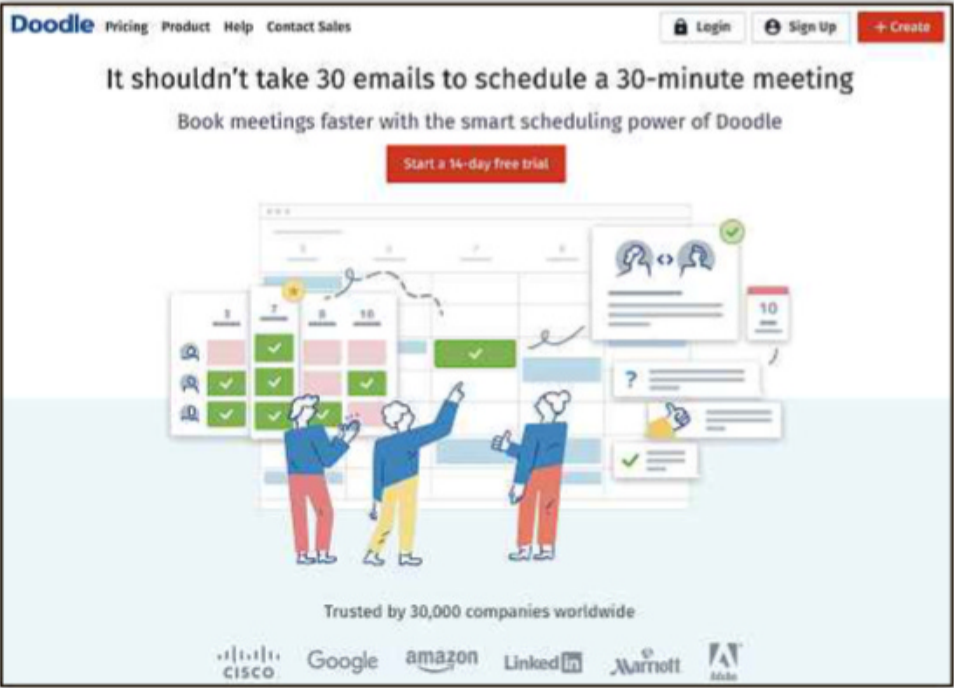


Use Sli.do to have discussions during a presentation without distracting the presenter

visual, you could consider Trello, which uses 'boards' (like virtual Post-It notes) for tasks. Being the resident brainbox of a group, firm or organisation can be draining; you can only answer so many questions before frustration sets in. Better to send passive-aggressive Let Me Google That For You links. This heavily sarcastic tool creates a link from the search term you enter, which launches a web page explaining how to enter a search term into Google. Once your colleagues are

used to finding out information on their own, you might feel redundant (or possibly be made so), so use Visual CV or Creddle to make a professional CV easily. Visual CV uses your LinkedIn profile, but you'll have to start from scratch with Creddle.

Organise meetings quickly with the help of Doodle



TRAVEL

Flight Stats	www.flightstats.com
Hotel WiFi Test	www.hotelwifitest.com
Scribble Maps	www.scribblemaps.com
Seat Guru	seatguru.com
Skiplagged	skiplagged.com
Train Tickets	www.traintickets.com

FLIGHT STATS AND Scribble Maps are pretty obvious tools, allowing you to check flights and create a custom Google map to help people get from one place to another. The other tools are more about planning your own trips. Clearly Wi-Fi speed will be your priority when picking your hotel – who needs a pool, gym or choice of pillows when you can stream 4K Netflix or work at a reasonable speed? Hotel WiFi Test allows you to book hotels with the fastest connections in town.

You'll need to cross-check that information with Skiplagged (no, we don't know how to pronounce it either – Ski-plagged? Skip-lagged?) or Train Tickets. Both of these services exploit the range of possibilities when going from A to B to find the cheapest way to do so. Train Tickets works out if it's cheaper to book one ticket for the whole journey or separate tickets for the component parts, potentially by swapping service provider for a middle part of the journey.

Skiplagged's trick is essentially the opposite. Rather than book a direct flight, it might be cheaper to book a longer flight with a layover in your actual desired destination and then just not take the last leg of the journey.

Once you've booked your flight, use Seat Guru to find the best seats on the plane. Colour-coding tells you which seats to choose and which to avoid. The obvious considerations are factored in, but also plane-specific ones such as some business class seats not having access to a window, or seats with armrest entertainment (at the front of sections) being narrower than usual and not having under-seat storage.



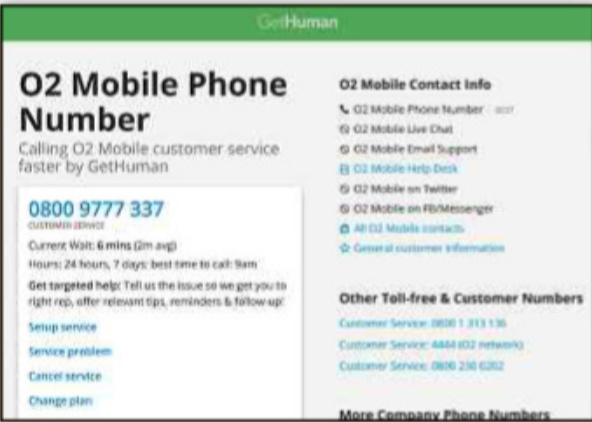
Save money on long train journeys with a quick and simple search on Train Tickets

INFORMATION

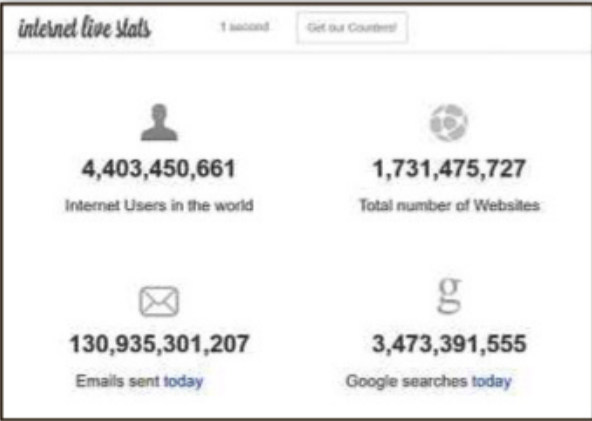
Ancient History Encyclopedia	www.ancient.eu
EDIS Alert Map	hisz.rsos.eu/alertmap/index2.php
Fact Check	www.factcheck.org
Get Human	gethuman.com
Have I Been Pwned?	haveibeenpwned.com
Internet Live Stats	www.internetlivestats.com
Manuals Library	www.manualslib.com
Periodic Table	periodictable.com
Snopes	www.snopes.com

WE CAN ONLY assume that Snopes and Fact Check are little-known among the wider population; probably most *Shopper* readers have heard of both, but these fact-checking sites are invaluable in this age of misinformation, confirmation bias and online echo chambers. Similarly, it's always worth checking your email addresses on Have I Been Pwned to check for breaches and see if you should update your passwords. If you then need to speak to a person at a company, use Get Human to find the best phone numbers to use to avoid automated switchboards and find the best times to call.

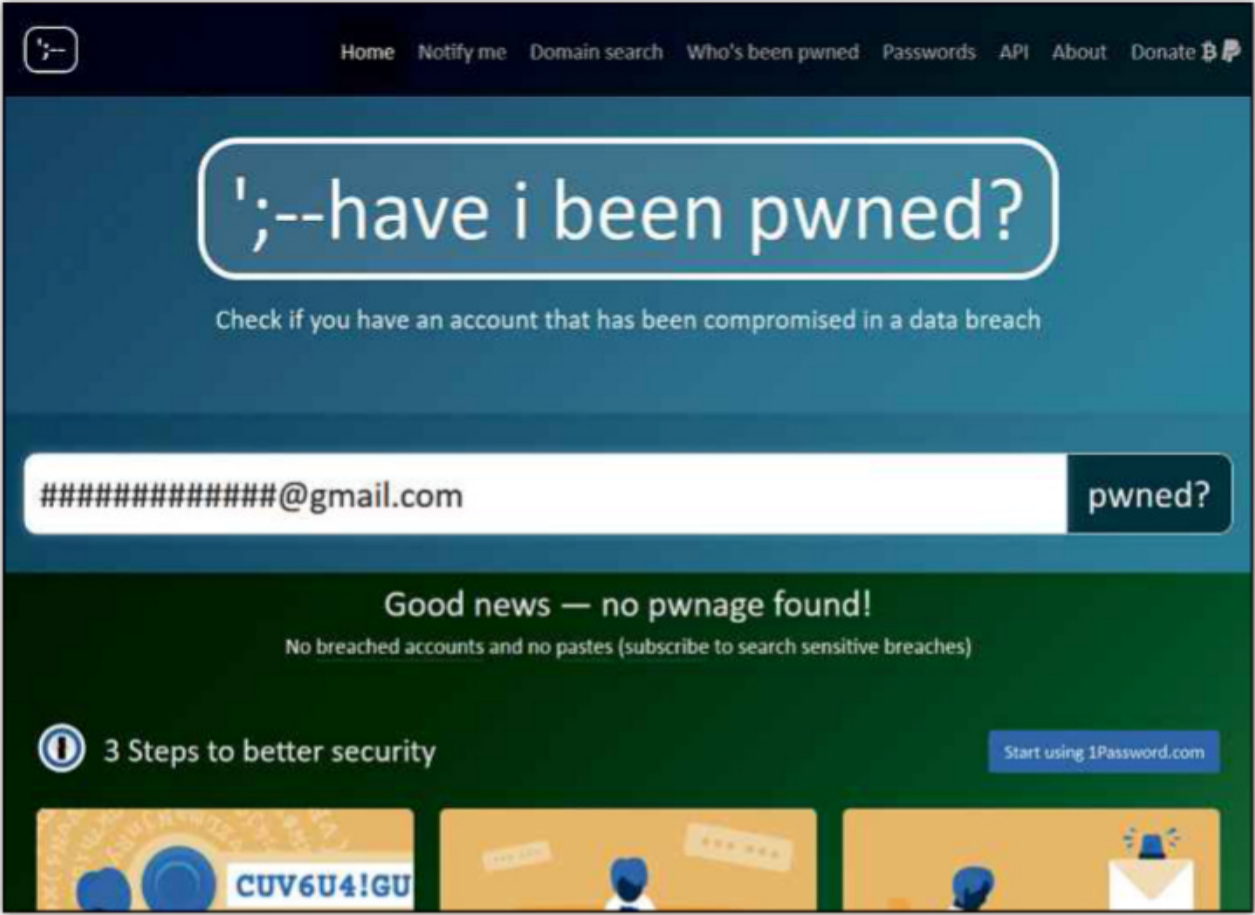
It's pretty obvious what information the other sites offer, but take a look at the EDIS Alert Map when you next have a few minutes. This maps all the disasters currently afflicting the world, and the proliferation is often alarming – half of the USA seemed to be ablaze at the time of writing.



Use Get Human to find the best numbers to use when contacting a company



See how huge the internet has become with Internet Live Stats



Have I Been Pwned? will tell you if your email address has been involved in a security breach or hack. If it has, you should update your passwords



The EDIS Alert Map shows you all the disasters currently occurring in the world



The Ancient History Encyclopedia isn't just for classics students – there are travel articles and other informative elements, too

LEISURE

A Good Movie to Watch	agoodmovietowatch.com
A Soft Murmur	asoftmurmur.com
Nautilus	nautilus.us
The Moth	themoth.org
The Oatmeal	theoatmeal.com

WITH THE 20-ODD streaming services we're now meant to subscribe to, actually finding something to watch can be a challenge, so A Good Movie to Watch might help. Just remember to select UK Netflix before getting excited, and note that new services such as Disney+ and Apple TV+ aren't listed. If you're trying to relax (or maybe focus) with some ambient background sounds, A Soft Murmur lets you blend standard sounds such as rain, waves and a coffee shop.

Nautilus (or nautilus.us, to be accurate) is the online face of Nautilus magazine; think of it as The Economist of the science world. The Moth also aims to be thought-provoking, but does so through online radio shows, talks and podcasts. And for a bit of downtime, The Oatmeal is still king of the online comic strips.



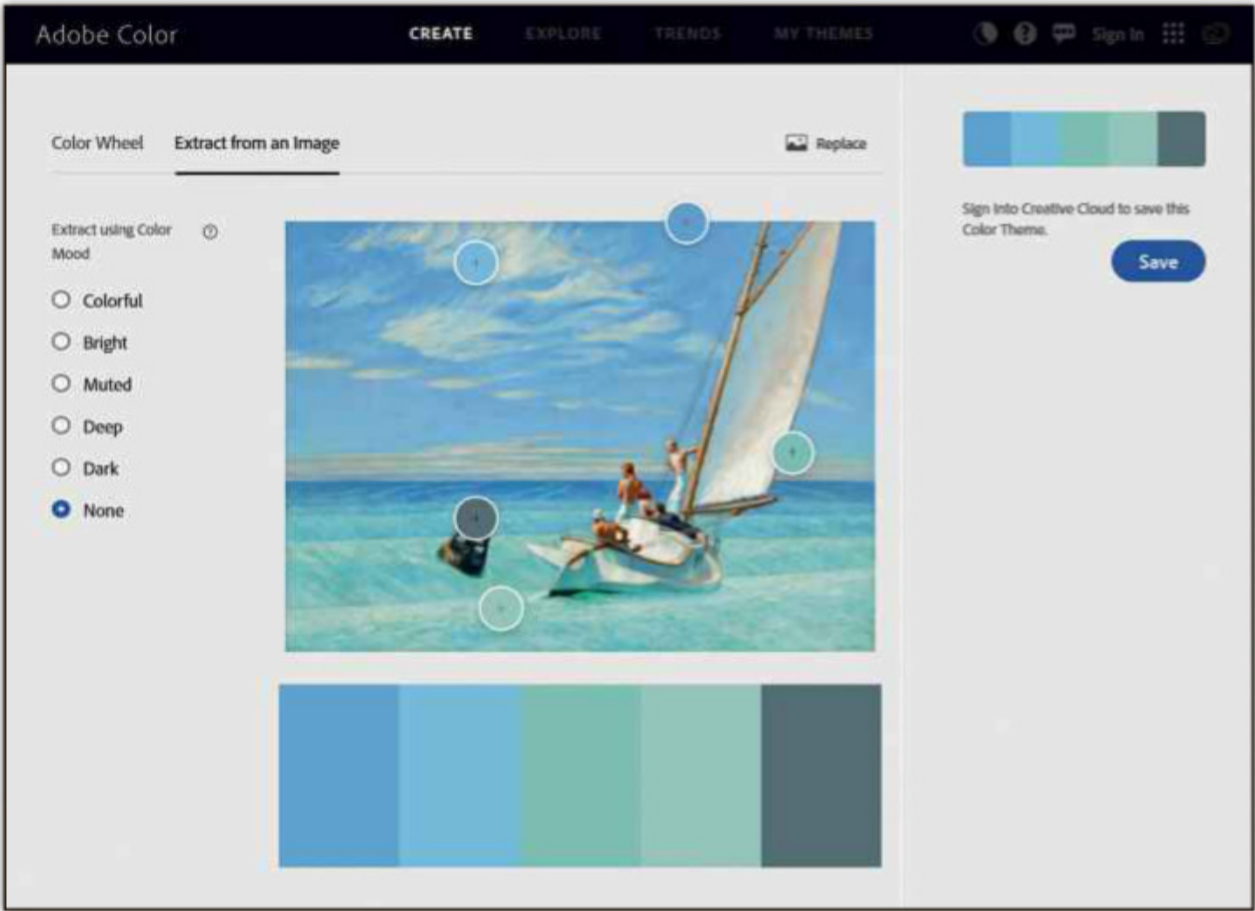
Blend some background noises to help you relax or focus with A Soft Murmur

DESIGN

Adobe Color	color.adobe.com
Homestyler	www.homestyler.com
Next City	nextcity.org
Photopea	photopea.com

WHETHER YOU'RE LOOKING for a colour scheme for a publication or a room, Adobe Color can help you build a palette. Just upload an image and Color will extract the main colours. You could then use that palette in Homestyler, a 3D interior design web app that can help you visualise renovations, extensions, remodelling and redecoration plans. Photopea is an online photo editor that can handle almost any file format; it might be useful just to reformat an XCF or CDR file if you're in a bind.

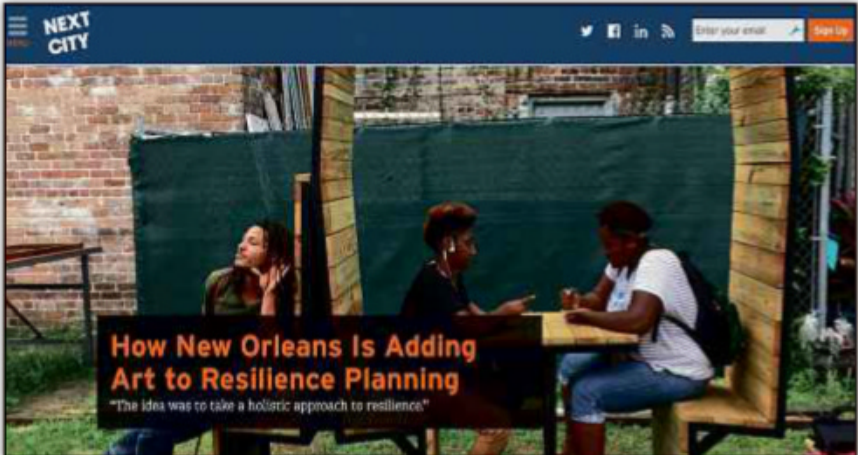
Next City is more of a magazine (or manifesto?) for genuinely 21st-century urban planning and design. It's very much an American project, but with plenty of high-quality articles and ebooks offered on a free or donate basis, it's worth a browse.



Adobe's Color tool creates a colour palette from an image



Edit your images online with the Photoshop-compatible Photopea



Next City's mission is to inspire social, economic and environmental change in cities through journalism and events around the world

NEXT MONTH

MAKE YOUR OWN PVR

Recording TV can still be more reliable than streaming. We show you how to build your own recorder



Zygote

Contactless payments may have put millions of pounds in Transport for London's coffers, but they're costing the rest of us dear, as **Zygote** explains

BUYER BEWARE

Electronic money is dominant. So says the latest British Retail Consortium review of spending statistics. Payments by smartphone, touch card and in-app purchases are commonplace, and so is shopping for big ticket items online. Cash transactions accounted for only £1 in every £5 spent last year, and the decline of coins and banknotes is speeding up.

This is fine for the majority of people, but Zygote is concerned about workers reliant on direct tipping, beggars on the streets, and anyone who needs cash as a failsafe because of fraud, loss, abusive relationships or any other reason when digital services are denied. And if you reckon none of this affects you, then think again. The cost imposed by a retailer for a cash transaction is around 1.5p, but the minimum cost facing that same retailer for a digital transaction is over 6p, rising to more than 18p for some credit and charge cards. We are all paying the price.

KINKY BOOTS

Sergiy Usatyuk is a very naughty boy. He has been running a service called Exostresser for clients who want to launch distributed denial-of-service (DDoS) attacks on target websites and grind them to a halt. Their victims include schools, video-game producers and the Catholic church, and a staggering total of 3,829,812 attacks have caused more than four-and-a-half thousand days of downtime.

Sergiy is the son of Professor Peter Usatyuk of the University of Illinois, Chicago, and his spawn launched his wayward DDoS booter services career aged 15. The law waited until his 21st birthday before banging him to rights, and US Attorney Robert Higdon has classified Exostresser as a 'weapon' when imposing a fine of \$500,000, plus a jail term of 13 months to be followed by a three-year supervisory order.

THE MOUSETRAP

Computers have a nasty habit of mistaking a digital image for something else, like when they classify pork sausages as pornography. Now researchers at the Baylor College of Medicine in Texas have found a way to get rodents to model neural networks for teaching computers to recognise images more accurately. They say, "We presented natural images to mice and measured the responses of thousands of neurons from cortical visual areas," which is nice.

They further declare, "Next, we used predictive models trained on responses from the mouse visual system, and calculated the similarity for millions of pairs of images." Which is also nice.

What's not quite so nice is seeing all this from the point of view of the mice. A large number of Mickeys and Minnies have had their bodies squished into a treadmill, their heads bolted forwards with their eyes forced open, and a load of electrodes stuffed into their brains. The resulting data is used to model the artificial neural network, and Zygote would very much like to report that this barbarity is worthwhile. Unfortunately, the words of the Texas researchers must speak for themselves.

"While our results show the benefit of adopting more

brain-like representation in visual processing, it is unclear which aspects of neural representation work. We think that is the most important question, and we need to understand the principle behind it."

In other words, they have no idea what they are doing, or why.

TUBEWAY ARMY

Once upon a time, Londoners paid to travel around using a slice of plastic called an Oyster card. It cost a fiver to join the system, and cards could be topped up for a minimum of £10 discount journeys, up to a £90 maximum investment. Almost 90 million Oysters have been sold since they were introduced back in 2003, but five years ago contactless payments came along, and the official figure from Transport for London (TfL) is that 66 million Oyster cards have remained unused for at least a year. The average refund and deposit balance on these neglected cards is £8.46. So you don't need Zygote's trusty calculator to work out that the operators are sitting on way over £500 million because their customers simply can't be bothered to cash in their unused cards. Perhaps TfL will consider investing this windfall to make much-needed improvements to the network.

FAMILY TREES

Huang Zhisheng is the founder of a life-saving artificial intelligence service operating from the Free University Amsterdam. He calls it the Tree Hole Rescue, named after an Irish folk story about an unhappy man who confides his secrets to a tree.

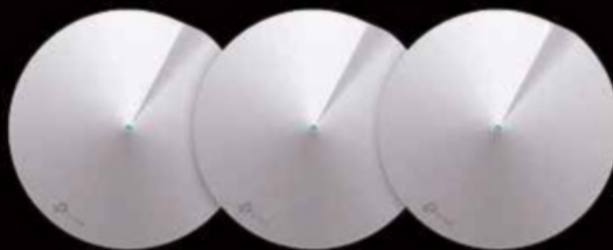
His program monitors postings on Weibo, a Chinese social media platform with around 460 million active users, and what it does is to flag up words associated with suicide. It ranks the intensity and frequency of these words from one to 10, with 10 flagging a suicide in progress, nine that it is imminent, eight to six indicating levels of cause for concern, and below this threshold volunteers simply adjust how often they keep a watching brief.

Amazingly, it works. In Nanjing, a student named Li Fan got into debt, experienced severe depression and posted that suicide was the only way out. 5,400 miles away, a Tree Hole Rescuer alerted volunteers in China who reported the matter to local police, and they managed to save the unconscious Li Fan.

This is one of more than 700 similar success stories among Weibo users, and Zygote very much hopes that the system is emulated for our own social media. ☑



STREAMING WITHOUT LIMITS



Choose Deco mesh routers for high-speed, seamless, whole home Wi-Fi



Robust Parental
Control



3-Year Built-In
Antivirus



Quality of
Service



facebook.com/TPLINKUK

tp-link.com/uk



twitter.com/tplinkuk