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Can this mesh network give
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Welcome!



I WENT FOR lunch a few months ago at my fallback Italian restaurant, one of a chain. I was looking forward to tucking into my normal lunch choice, reasonably priced and tasty – and just before ordering I noticed the price had increased by a couple of quid. I had my suspicions about the reason for the rising cost (the ‘B’ word), but also thought it could just be down to the cost of doing business in central London, with its ever-increasing prices.

Not long after, I visited my local branch of said restaurant chain and the price increases had hit there, too. The waitress told me they’d also stopped doing their cut-price lunch specials at that time.

While the restaurant didn’t reveal the reason behind the price hikes, all the signs were that this was part of the Brexit impact, with currency fluctuations leading to a rise in the cost of supplies and therefore a rise in the cost to consumers. I’d already experienced this first-hand when I travelled to the US and Portugal last autumn; on both trips, I spent more than my original budget as the falling pound meant a worse exchange rate against the dollar and euro respectively.

And now it seems the technology industry is starting to react to the changing

market conditions. Companies including Microsoft and Apple are putting up their prices, blaming what they refer to as the higher cost of doing business in the UK (page 14).

Whatever the eventual outcome of Brexit, it’s not ideal having to pay more for the same product – especially when we’re talking an extra £100 or £150. Our advice here would be, if you know you might be in the market for a new PC at some point this year, make your purchase sooner rather than later, to head off any further price hikes.

So we’ve set to work digging out the best computing bargains on offer, bucking the trend of rising costs. For our guide to spec’ing your perfect PC (page 80), we tested out dozens of available components. We then handpicked the best – both for your wallet and for performance – so you can upgrade your existing system or build a new one from scratch knowing you’re getting a great deal.

Our best-value system costs just £353, but is built using only top-rated components – CPU, RAM, HDD, motherboard and PSU – and an award-winning case to put it all in.

Happy bargain hunting!

Madeline Bennett, Editor

madeline@computershopper.co.uk

QUESTION OF THE MONTH

Vinyl is making a comeback. Which product would you like to see make a resurgence?

MEET THE TEAM



Madeline Bennett

“Daley Thompson’s Decathlon. But it has to be the authentic joystick version with the manic two-finger tapping”



David Ludlow

“The Sony Aibo – the world is crying out for robot pets”



Nathan Spendelow

“The NES power glove. Frustratingly flailing your arm about never looked so cool”



James Archer

“Phone batteries that just won’t die, no matter how many games of Snake you play”



Dave Neal

“The Sinclair C5. But self-driving models so that I can eat and roll”



Nicole Kobie

“Netbooks. Cheap and cheerful, light and long-lasting battery, what more do you want out of tech?”



Roland Moore-Colyer

“Nintendo 64. The nostalgia of huddling around a TV for multiplayer and blowing on game cartridges to get them working”



Simon Handby

“Orange LEDs. Are they all gallium arsenide phosphiding somewhere?”

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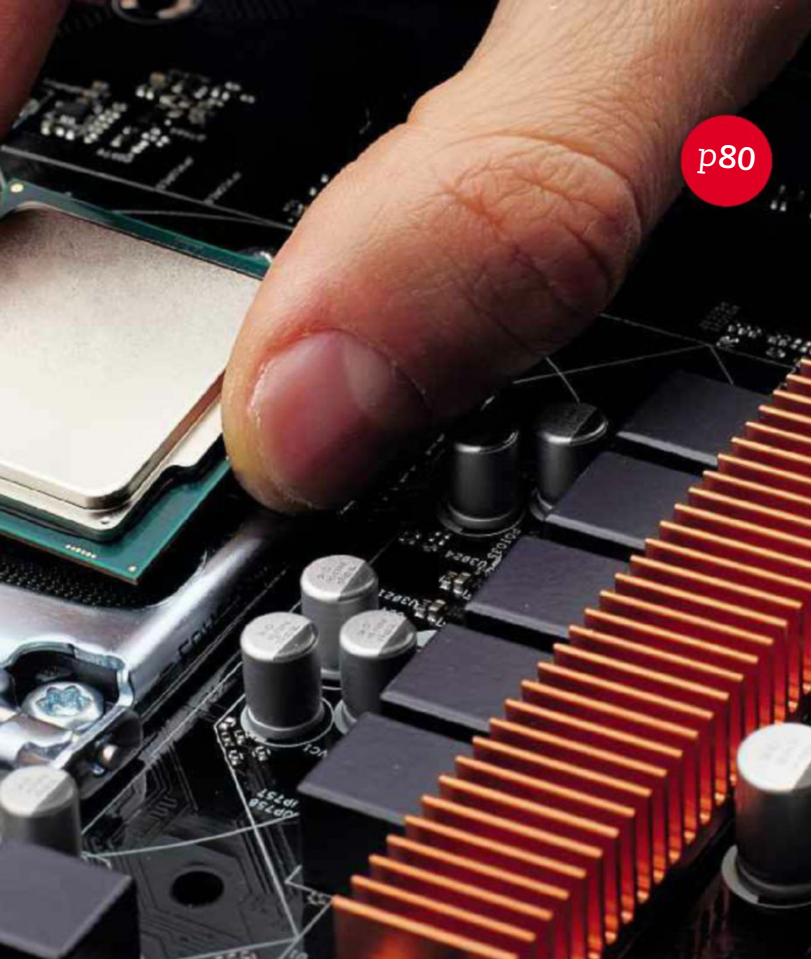
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* FREE SOFTWARE EDITION ONLY

Letters

There have been plenty of technological cock-ups on the big screen over the years, but everything on Psion's small screen was pretty near perfect

 letters@computershopper.co.uk

Psion of the times

@ Your latest Retro (*Shopper* 350) had me licking my lips with delight and pouring out my love for that five-letter word, Psion.

I was reasonably late to the Psion world, acquiring my first PDA, the Psion Siena, second-hand in 1999. Sadly it didn't last very long so I turned to the Psion Revo, which was glued to my pocket for the next five years in the same way that mobiles are now.

I used it for everything: calendar, contacts, emails, spreadsheets, and even wrote a whole novel (unpublished) on it while commuting to and from work. I could hold it with both hands and type at the same time with each thumb very fast.



I thoroughly loved my Revo. So much so that I bought a second Revo at half-price second-hand when the first one suffered from the weak point of such devices: the hinge and connecting ribbon cable. I held out for a good few years using the device, long after the Psion's synchronising software to my PC stopped supporting the version of Microsoft Office I had. Eventually, though, it was the lack of compatibility and another failing hinge that led to its demise for me.

I recently thought about my five favourite bits of tech of all time, and the Psion Revo is easily in that list. I've not loved any gadget as fondly since or found anything currently available that combines so much in a

handheld pocket device – and with a keyboard. I still mourn the end of Psion and hope for its resurrection.

Stephen

● We were also big Psion fans, and we'd love to hear the other four entries on your top tech of all time list.

Channel hopping

@ I have been a subscriber for some years now and find much of your advice invaluable in allowing me to keep my system up to date. In particular I used your articles on using redundant ISP routers as hubs to extend my in-house Wi-Fi (*Shopper* 345).



★ Star letter

Screening blue murder

@ I enjoyed your rundown of some of the technology howlers presented in films and television shows (*Shopper* 349). Of those you listed, my favourite has to be the *Jurassic Park* "I know this – it's a UNIX system". I thought I'd submit a few of my personal favourites that you didn't mention.

First, there's the overly complicated file manager that has to be accessed through a VR headset and data gloves in the film *Disclosure*. Michael Douglas has to walk through huge virtual hallways to find some virtual filing cabinets, open a virtual drawer and pull out virtual folders to be able to access documents. In the VR sequence in the film, he is digitally rendered so we know it's him, and his digital self is wearing some kind of VR helmet and special gloves – just in case we've forgotten.

My second submission for your viewing pleasure is the nonsense IP addresses presented in *CSI: Cyber*. The FBI cyber division techies should know there's something seriously wrong with their software tools that display strings such as



136.269.88.569 as a valid IP address. The screenshot I've attached (above right) comes from episode 10 of *CSI: Cyber*, and there don't appear to any valid IP addresses on screen – maybe to keep the producers safe from possible legal action if they used



real IP addresses. There are similar laughable moments in other episodes.

Rob Purvis

● Excellent additions to the terrible tech in the Tinseltown canon.

» 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 the MX300 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 six times faster than a hard disk, and will make your computer boot incredibly quickly and your applications load faster. With 525GB of storage, there's plenty of room for Windows and all your apps, too.



STAR PRIZE
525GB
SSD

I know this has been covered before, however I just subscribed to Sky Q, which is now having connection issues (investigations ongoing).

My property is full of brick walls and signals cannot penetrate more than one room. So I was pleased when I followed your instructions to use old routers as relays/repeaters, and not being overly IT competent – certainly where networks and Wi-Fi are concerned – I was elated when I got my systems to work, albeit using the routers connected to my main router via TP-Link.

I used different names for the SSID but fixed all routers to use the same channel. I have now found that the preferred method for seamless connection ought to be to use different channels but with the same SSID. What are your thoughts on this? Should I fix the channel selections, or is it better to allow the routers to autoselect the channels used?

Here's to many more years of interesting topics and advice.

D. Brown

The correct approach to get consistent Wi-Fi reception throughout a solid-walled house is to use the same SSID and password on each router, but different Wi-Fi channels. Think of channels as being like the lanes of a motorway – you want to spread the load, not bunch up in one lane. You should be OK if you set each router to select its channels automatically.

Armless fun

@ Great Moments in Computing 350 amused, but it is the Antikythera Mechanism (Antikythera is the island off which it was fished up from the deep). You wouldn't call a certain armless statue in the Louvre 'the Milos', would you?

Cluny MacPherson



Micro flight

@ As a regular reader of *Micro Mart*, I was saddened to see the final issue in the shop. *Micro Mart* was unique: practical, funny, informative and more importantly focused. Unlike a lot of other magazines on the market, it stuck to what mattered.

I know we live in tough times, and everyone says we look online now, but I prefer to read a real magazine, not squint at something on a tablet, or worse a mobile phone. So, here is the reason for me writing to you: I say, bring back *Micro Mart*, but make it a monthly magazine. We could enjoy the best of all worlds. I would subscribe.

Andrew S Redding

Thanks for writing in, Andrew, and welcome to *Shopper*. We were also disappointed to lose our sister title, but we hope that *Computer Shopper* goes some way to filling the gap.

To all our new *Shopper* readers and former *Micro Mart* subscribers, please do write in and tell us what you'd like to see more of in *Shopper* that you particularly enjoyed in *Micro Mart*, and we'll do our best to review those products and cover those topics.

Command line & conquer

@ Several times I have used Windows 10 commands printed in the magazine: for example there is one on page 126, *Helpfile 349*, in 'Not my Type'. In that reply, it is still not completely clear where spaces are. I usually have to have several goes copying such statements (the Command Help provided by Microsoft when a mistake is made is useful).

When I was in industry, we had a similar problem and decided to use a special character (it was the one called Inverted Bridge in Character Map, as it happens) to denote a space and combined this with a statement that all spaces that appeared in the code were denoted by it. This worked well. Would it do so for *Computer Shopper*?

Dr Neil Richmond

We put our heads together to work out the best way to deal with denoting spaces, and have decided to put any text to type in bold, to try and make it clearer. Hopefully this will make it easier to copy out the commands correctly.

Relative security

@ Plus one to Tim's letter in *Shopper 350*.

I imagine there are many Virgin Media customers like me who use F-Secure and would value a comparison with other anti-virus products.

I suspect most users only evaluate usability for themselves and don't form an opinion on how effective the product is until things go wrong. F-Secure came to the rescue recently when I was using a relative's computer with an expired anti-virus; a spare licence from my existing F-Secure subscription was readily installed.

George

Thanks for the feedback; we'll look to include F-Secure in our next security software test.

Time's up

@ I thought your readers would like to know that Microsoft has just made an update on my computer, and then I found it kept stopping. After some hunting, I found that in power saving, they've put in a setting for how long hard disks should be on for. After the update, this had been set to 40 minutes; I've changed this to a longer time.

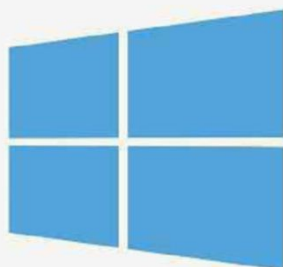
I also found that the shut down and go to sleep times had been changed to the shortest times, so I set these to longer times.

Hope this will be of use to other readers.

Alec Neville

We've also found that Windows 10 updates introduce some unwanted new features and settings. Hopefully our full rundown of these annoyances and how to stop them in *Shopper 350* provided some useful advice. ☑

In the next issue



» Windows 10 Creators Update

We pick the best features from the upcoming Windows 10 update and explain how to use them

» City hopping

We visit five cities that are years ahead of the rest of us when it comes to technology, and see how far off the UK is from this futuristic scenario



» 4K monitor shoot-out

We put the best Ultra HD displays through their paces and show you how to use Windows 10's high DPI settings

COMPUTER SHOPPER ISSUE 352 ON SALE IN NEWSAGENTS FROM 13th APRIL

War and piecemeal solutions

If we really want to stop cyber attacks, argues **Mel Croucher**, we need to forget about conventional military defence and invest in pizza and animated 1970s TV characters



MEL CROUCHER

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

AMERICA SPENDS \$600bn a year on defence. Yet an insane gang of hijackers can attack the Pentagon and Twin Towers with impunity. The UK spends \$46bn a year on nuclear weapons and Trooping the Colour, which are completely useless against a couple of Afghans armed with home-made rockets strapped to the back of a Toyota pick-up. And the Bad Guys don't even need to hijack aircraft or trucks any more. They can attack us from the comfort of their own bedrooms.

Governments tell us that cyber warfare is the new threat. And you know what? I tend to agree with them. If our mobile networks go down, there will be riots. If our supermarket checkouts go down, there will be cannibalism. Cyber attack seems a pretty good deal to me when it comes to waging war on the cheap, and if I was running the Ministry of Defence, I would forget about the armed forces altogether and divert my massive budget to combat the menace of computer hacking. But before I reveal how our own nation plans to fight off cyber

So Vladimir Putin has decided to do a deal with convicted hackers, and offer them senior positions in an offensive cyber unit as an alternative to serving lengthy jail sentences. The celebrated hacker Dmitry Artimovich has admitted that when doing a year's porridge in a Russian penal colony, Moscow set him free in exchange for signing up to the anti-hacking squad. This is nowhere near as much fun as the Yanks and their 3,000 clay figurines of Morph, but probably more effective.

KOREA OPPORTUNITIES

Over in South Korea, I'm told the government has doubled the size of its cyber command to 1,000 programmers, dedicated to fighting the evil techie hordes of Kim Jong-un's North Koreans. Their incentive is to offer full scholarships in return for seven years' military service.

But it's the Australians who I tip my dangly cork hat to. Down under, they've come up with a foolproof idea of how to motivate their young recruits. Their spy agency is called the Australian Signals Directorate, and their policy is to sponsor the annual hackers conference in Melbourne and feed the youngsters free pizza. And I think that's the key to winning the cyber war. We British must recruit children. We've all known for years that the best way to get to grips with the latest technology is to ask the nearest truanting school kid, and the same goes for cyber warfare. Why train all those expensive marines and master criminals and clay figurines, when you can get a kid to fight against the forces of evil for a slice of lukewarm dough with a cheese topping?

OK, so let me tell you what's happening in the UK. Brace yourself. Chief Superintendent Gavin Thomas is the president of the Police Superintendents' Association, so he knows a thing or two about hacking. The Chief Super says: "A 16-year-old who

hacks into your account should be fitted with an ankle-mounted Wi-Fi jammer as part of community sentencing, so he doesn't have access to the internet."

Now there's a plod with his finger on the pulse of cyber warfare! Let's not recruit the next generation of British schoolboys to prepare for the electronic onslaught. Only daft buggers like the Americans, Russians and Koreans are bothering with that.

TAGGING ALONG

Fitting electronic tags to young males is a great idea, and let's hope the Chief Super's proposals are adopted for all sorts of other crimes they're likely to commit. For example, boys who experience lustful thoughts should be fitted with a taser in their underpants to administer 50,000 corrective volts to their putative erections. And lads who take the name of the Lord in vain must be forced to wear virtual-reality headsets showing endless loops of Aled Jones hosting *Songs of Praise*. In fact, I suspect this policy is being made much more proactive. The Right Honourable Liz Truss is probably drafting legislation right now to fit 16-year-old boys with hooks instead of hands, which will remove their means for self abuse, or their ability to use a keyboard to troll decent law-abiding adults and hack our computers.

I'm sure this is the plan, because our spy headquarters at the GCHQ National Cyber Security Centre has announced the Cyberfirst Girls Competition for 13- to 15-year-olds of the female persuasion. Their hacking challenge is to investigate "suspicious cyber activity and try to identify criminals", and the winners will be rewarded not with pizza, but with £1,000 of IT equipment for their school. Presumably in the form of Wi-Fi jammers, electric chastity belts, holy headsets and stump hooks for all the boys in their class. It makes you proud to be British. ☑

Boys who experience lustful thoughts should be fitted with a taser in their underpants

attack, let me tell you what those foreign johnnies are up to.

The US Marines are withdrawing frontline troops and training 3,000 electronic warriors instead. Their boss, General Robert Neller, says of his new Cyber Command, "Most of these people start off as intelligence folks, and then they morph." I think Morph is a great idea to fight the evils of cyber crime, and using stop-motion animation clay figurines from the 1970s is a hell of a lot cheaper than tanks.

Meanwhile, Russian secret services got a poor response to their anti-hacking project, which was advertised on social networks.



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Everything can be hacked

Your PC is no longer the only target for hackers – you need to secure everything that's plugged into your home network, says **Cyber Insider**



WHEN WE THINK about IT security, the primary focus has always been our PCs. To be fair, this was the right route to take, as the PC was the primary focus for hackers. Times are changing, though: it's clear that hackers aren't just interested in attacking our computers, but want to attack every bit of kit we've got.

In early February, 150,000 printers sprang into life and printed the same message:

—> YOUR PRINTER HAS BEEN OWNED <—

stackoverflowin the hacker god has returned, / your printer is part of a flaming botnet, / operating on Putin's forehead utilising BTI's (break the internet) complex infrastructure...

hacked / hacked / lol just, / kidding

For the love of God, please close this port, skid.

FROM MICHAEL JENSCH, ROSENWEG, UNNA, DEUTSCHLAND.

The hacker, Stackoverflowin, later explained that he was just raising awareness that some printers automatically expose themselves to the internet, allowing anyone to print. It could have been much worse: a malicious hacker could have taken control of your printer and

printers and smart lightbulbs, is internet-connected. Practically all of these devices run a version of Linux, which means they're sophisticated enough to infect and complex enough to run the simple commands required for a hack. Worse still, many devices come pre-configured to connect to the internet and have default administrator usernames and passwords. Indeed, Mirai's main way to infect a device is by using a huge database of usernames and passwords to gain access.

Aside from wasted bandwidth, having infected devices on your network isn't good. Once one device has been compromised, the danger is that it's used against the rest of your network or your PC. This could lead to the loss of valuable information.

So what are we to do? The truth is that there's both a long-term and short-term answer to the problem.

TAKING A LONG VIEW

One of the main problems with internet-connected devices is that manufacturers have sacrificed security at the altar of convenience. They want their products to be as easy to use as possible, so they turn on features by default and use insecure usernames and passwords. It's simply not good enough.

Every company needs to take security seriously, from design to manufacturing. Unique usernames and passwords have to be enforced, and internet features shouldn't be turned on by default. Instead, only during setup should some features be enabled, with users required to enable security at the same time. Yes, this may make some products more troublesome to configure, but Stackoverflowin and Mirai have proved that simplicity cannot be trusted.

What's more, governments need to step in and ensure that, just as products are made to a specific set of safety protocols,


internet-connected devices need to be built to a particular set of security protocols.

IMMEDIATE ACTION

It's going to take a long time for manufacturers to change, but the problem exists now, so it's vital to protect yourself today. First, you can use the BullGuard Internet of Things Scanner (iots Scanner.bullguard.com). This checks to see if any of your devices are listed on the Shodan search engine, which scours the internet looking for smart devices. If it finds any, you're already a target for hackers. Regardless of the results, you should still secure your network.

Make a list of every device that's plugged into your network, including routers, printers and security cameras. From that list, use the manufacturer's manual to work out how to manage the device and connect to the web-based management portal (if available). Change all default usernames and passwords (you may only be able to modify the password). Ideally, give every device a different, hard-to-guess password. Next, use the manual to work out how to upgrade your device's firmware to the latest version. This will help patch any problems with your device, closing any existing vulnerabilities.

Finally, there's one big step that you can take: disable Universal Plug and Play (UPnP) on your router. This protocol lets devices on your internal network automatically reconfigure your router's security. It's ideal for simplicity, but UPnP is also perfect for hackers (more on this next month). Disabling UPnP may mean you have to configure some devices manually, but that's often the price of security.

The main takeaway from all this is that when you think of security, you need to examine your entire network, not just your computer. The hackers are already doing the same thing. 

Manufacturers have sacrificed security at the altar of convenience

made it part of a botnet, controlled by cyber criminals.

That may sound far-fetched, but it isn't. The Mirai botnet specifically targets internet-connected devices, infecting them and using them in attacks.

The problem is that nearly every device you buy now, from cameras and NAS devices to

RANTS & RAVES

Good news for nostalgic audiophiles: the vinyl revolution is gathering pace. But there's bad news for anyone who has to deal with government IT systems

Dave Neal

RAVES



"THAT'S A BIG CD", said my nephew Harry, when he noticed the vinyl record that I hadn't put away. It was a significant moment. I am old enough to remember when CDs were introduced. My nephew was born after the iPod was released. I can remember when compact discs first started to be advertised. I can remember the first one I bought, mostly because I bought it before I even had a CD player. I couldn't tell you the last one that I bought, because I haven't bought one for ages.

These days it is all digital downloads, and sweet, sweet vinyl. If you grew up in the 1960s, 1970s or 1980s, you didn't have much choice but to listen to the radio or to your parents' record collection. You came to treat vinyl as if it was made of wafer-thin china, and your dad's pair of headphones as though they were a

precious piece of NASA technology that had been part of the moon landings.

Vinyl was a thing to be taken seriously, even if it was all Des O'Connor and easy listening cover versions of easy listening songs.

Vinyl is making a comeback now, and albums are appearing back in the shops. They were the first things to go when so-called record shops started to slim down, around the time that the MP3 came around, and it is lovely to see it back.

There is a warmth to vinyl, both in the feel and in the listening, and there is something very magical about the routine and the process of unwrapping the platter, giving it a dust-removing puff of air and setting it spinning. I am further warmed by the news that last year UK vinyl sales reached a 25-year high: 3.2 million records were sold in 2016, a 53% increase over the previous year.

Which makes me feel a lot better about how early I had to get up on Record Store Day 2016 to share in the vinyl momentum. For those LP aficionados wanting to get involved this year, it's on 22nd April; details of independent shops taking part are available at recordstoreday.co.uk.

Madeline Bennett

RANTS



I HAVE A tale of woe to share with you about the dreaded topic of government IT. Much has been written and discussed about the public sector's lack of competence when it comes to technology – indeed, I have written many of these stories myself – but it still surprises me when I get first-hand experience of the alternative reality that is government computing systems.

My tale begins on a cold January morning. Through the door pops a letter from HMRC advising me I've been removed from the VAT Annual Accounting Scheme, due to a failure to make three interim payments by the due date. I am shocked, horrified and confused, almost to the point that I spill my first cup of the day.

Rewind back to 8th July 2016, when I received a letter from HMRC reminding me that my first interim VAT payment was due and could I please pay – which I did straight away, having received

the reminder letter. In early October, I received a similar letter and again made the required payment straight away.

I then let myself be lulled into a false sense of security, believing that when my third payment was due, I'd receive a reminder letter and cough up again. However, no third reminder letter arrived, and instead on 10th January I received the removal notice.

I spoke to a helpful HMRC staffer – after many attempts at getting through on the phone – who explained to me it's not down to him or HMRC to manage reminders and removal notices, it's 'the system'. Yes, I explained, I understand it's 'the system' and 'the system' is an authority to itself and cannot be questioned – as opposed to one built and managed by any government IT staff or partner. But if it is indeed automated, surely the third reminder letter should have been sent out before the removal letter? The response was simply: "But 'the system' is automated and sends the letters out at a set time."

Fortunately, I managed to talk HMRC round to reinstating me on the scheme. As for getting them to understand that 'the system' can be tweaked as necessary, and can make mistakes – my efforts failed as miserably as the cold January day. ☹️

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NEED TO KNOW

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

An embarrassment of breaches at Yahoo!

SAY WHAT?

2017 IS A bad time to be a Yahoo! customer. Although, to be fair, the past few years haven't been great. The company, which also provides email for Sky and BT, has revealed that its users' security has been breached yet again, and the numbers run into the millions.

The firm has alerted users to a forged cookies problem that could lead to accounts being compromised. The cookies can be traced back to a hack in 2013. Yahoo! said the cookies had been invalidated but added that its investigations are ongoing.

"As we have previously disclosed, our outside forensic experts have been investigating the creation of forged cookies that could have enabled an intruder to access our users' accounts without a password," Yahoo! reported.

"The investigation has identified user accounts for which we believe forged cookies were taken or used. Yahoo! is in the process of notifying all potentially affected account holders. Yahoo! has invalidated the forged cookies so they cannot be used again."

The firm has been coy about the incidents. It has been trying to sell itself to the US giant Verizon, but sources close to the company have claimed that an unauthorised third party – we'll call them a hacker – breached Yahoo! in August 2013 and stole the details of around one billion users. Officially, Yahoo! has not been able to verify this, having



only been informed about the breach by law enforcement. However, the company has its suspicions that if the incident did take place, then it is probably unrelated to another breach that the firm was able to verify itself.

This is the incident that Yahoo! disclosed in 2016, when the firm also announced a number of changes to accounts, including the wiping of encrypted security questions and other information. Yahoo! said the stolen user

account information may have included names, email addresses, telephone numbers, dates of birth and hashed passwords.

Security expert Brian Krebs balked at the idea of anyone having anything to do with the Yahoo! service after that, exclaiming: "For years I have been urging friends and family to migrate off of Yahoo! email, mainly because I watched for years as the company appeared to fall far behind its peers in blocking spam and other email-based attacks. I stand by that recommendation."

Krebs was not alone in pointing a critical finger at Yahoo!, and half a dozen US senators demanded that the firm explain itself at a government committee hearing. One senator said that he was "disturbed that user information was first compromised in 2014, yet the company only announced the breach last week", adding that the senators viewed the situation as "unacceptable".

Tech firms blame Brexit for price rises

SAY WHAT?

WE EXPECT THAT you've had enough of Brexit by now, and weren't expecting to greet it again in these pages. But Brexit, or the idea of Brexit, has had an impact on the computing industry, with decisions about business being made and prices being raised.

Brexit, when it comes to technology purchasing, is proving bad for buyers. Microsoft recently revealed that it is increasing the price of its Surface tablets for individuals and businesses that do not already have existing volume purchase agreements.

"In response to a recent review we are adjusting the British prices of some of our hardware and consumer software in order to align to market dynamics. These changes only affect products and services purchased by individuals, or organisations without volume licensing contracts," the company explained in a recent statement.

The hike has seen the price of the cheapest 128GB Surface Book jump from £1,300 to £1,449, an increase of just over 11%.

Microsoft is not alone. Firms including HTC, Dell, HP, Tesla, HTC and OnePlus have all added a Brexit tax to their devices. Audio specialist Sonos has added around 15% to its prices in order to tackle the decline in the value of the pound.

Sonos said, "We pay for everything we make in US dollars. Over recent months, there has been a significant change in the US dollar to GBP exchange rate. As a result, our existing pricing has become unsustainable and, like many other companies, we have to increase prices for all products priced in GBP."

The cheapest Sonos speaker, the Play:1, now costs £199, up £30; the most expensive Playbar has gone up by a whopping £100 to £699.

Apple has also increased Mac and MacBook prices across the board, and has upped the price of apps by 25% locally.

None of the companies has explicitly used the word Brexit when announcing their price increases, choosing instead to discuss the falling value of the pound. The pound did drop like a rock after the referendum in June, and the firms have explained that the price increases are designed to cope with the weight of that.

See Apple on the app increases: "Price tiers on the App Store are set internationally on the basis of several factors, including currency exchange rates, business practices, taxes, and the cost of doing business. These factors vary from region to region and over time."



SO WHAT?

THIS IS A terrible situation for a firm to find itself in. Yahoo! has not only been hacked, but it didn't know about it, and didn't inform its users quickly enough. This means that they were vulnerable for a very long time, which is bad practice.

Yahoo! has made some statements about the situations it has been finding itself in, most recently blaming a foreign government for the attacks.

"Yahoo! believes that information associated with at least 500 million user accounts was stolen and the investigation has found no evidence that the state-sponsored actor is currently in Yahoo!'s network," explained the firm's chief information security officer, Bob Lord.

"The ongoing investigation suggests that stolen information did not include unprotected passwords, payment card data, or bank account information; payment card data and bank

YAHOO! SAGA – KEY DATES

- August 2013 – Hackers steal one billion user account details
- Late 2014 – Hackers steal 500 million user account details
- September 2016 – Yahoo! reports 2014 data break-in
- December 2016 – Yahoo! reveals 2013 data breach
- February 2017 – Users warned about Yahoo! cookie problem

account information are not stored in the system that the investigation has found to be affected."

It must be tedious for Yahoo! to keep repeating this kind of comment, but it's more of a burden to be a Yahoo! customer. Security expert Graham Cluley has also suggested that people close their accounts – and

that was before the cookie calamity hit the news.

"The advice for the privacy-conscious is clear: close down your Yahoo! account. After all, how could you ever trust Yahoo! again?" noted Cluley when discussing a separate National Security privacy vulnerability.

"Remember this news report comes hot on the heels of Yahoo! revealing that criminals hacked into its systems two years ago and stole the account details of at least half a billion users, and that it chose not to reset users' passwords when it had the chance."

SO WHAT?

NO ONE LIKES a price increase, and to find out that as a nation we have voted for one will be irritating for many.

The price increases make financial sense at the vendor end, but in some cases represent poor value. Some reports about the increases at Apple found three-year-old technology with three-year-old specifications getting the increase.

Apple's Tim Cook has spoken out about Brexit, saying that things are not as bad as they seem, particularly in terms of the app market.

"There are now about a quarter of a million app developers in the UK working on apps for iPad and iPhone. So far they've already created over 100,000 apps. There is something great happening here," he told *The Independent*.

"You can really see the start-up community gaining momentum. That's important any time

“You can really see the start-up community gaining momentum. That's important any time, but with Brexit hanging over, it's even more important”

Apple CEO Tim Cook

happening'. It gives me a lot of energy to talk to developers, or meet students in classrooms who are using our technology to help learn faster and better. Watching them pursue their passion."

Despite Cook's soothing words, there is going to be a lot of uncertainty until the impact of the referendum and the exit takes effect.

Prices are not the only thing to be affected, and there are also concerns about the impact that Brexit will have on privacy. The UK will have to tackle precisely how best to transfer personal information overseas all on its own.

but with Brexit hanging over – from some people's point of view – it's even more important that these stories get out where people have something to look at and say 'You know, times are not really awful, there's some great things

FROM THE REVIEWS

► For the den



The new Nvidia Shield TV is a lesson on how to improve a product. It's not a complete overhaul – the original was a pretty good hybrid media streamer/Android games console in its own right – but it fixes almost all of our issues with its chunkier predecessor.

That bloated gamepad? Redesigned with a more comfortable model. The small library of streaming services and compatible games? Expanded with new channels to watch and AAA titles to play. That's not to mention its newfound ability to act as a smart home control hub.

(Page 22)

► For the wallet

It's taken the best part of a year, but there's finally a sub-£250 smartphone to rival the Moto G4: the Honor 6X. It's the cheapest handset yet to include a dual-lens camera and run respectably fast, both generally and in demanding apps such as games.

(Page 30)

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■ WHEN?

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■ WHERE?

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■ WHY VISIT?

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BOOTING UP

1 Internet balloons

Google can now tell its Project Loon balloons to hover in a particular area that needs high-speed internet access, thanks to a new algorithm

2 Nokia

The Finnish phone firm is rumoured to be bringing back the historic 3310



3 Nintendo NES Classic

The 30-game console is hackable and can play as many as 700 games, including SEGA titles

4 Crash helmets

Amazon has filed a patent for delivery by parachute

1 BlackBerry

The firm's OS has a 0% mobile market share

2 Spy dolls

German parents have been warned to destroy talking Cayla dolls over hacking fears



3 Mobile users

EE, O2 and Vodafone are to raise prices for millions of customers

4 Human beings

Elon Musk reckons that people will have to become cyborgs to survive

CRASHING

Facebook founder aims to save the world via his social network

FACEBOOK FOUNDER

Mark Zuckerberg has decided his company is perfectly placed to solve all the world's problems. The social networker has penned a 5,500-word essay outlining his thinking on how to solve everything from terrorism to cyber bullying.

"Today's threats are increasingly global, but the infrastructure to protect us is not. Problems like terrorism, natural disasters, disease, refugee crises, and climate change need coordinated responses from a worldwide vantage point. No nation can solve them alone," Zuckerberg notes.

He went on to outline the various initiatives Facebook has set up to deal with some of these problems.

"To prevent harm, we can build social infrastructure to help our community identify problems before they happen. When someone is thinking of suicide or hurting themselves, we've built infrastructure to give their friends and community tools that could save their life... To help during a crisis, we've built



infrastructure like Safety Check so we can all let our friends know we're safe and check on friends who might be affected by an attack or natural disaster... To rebuild after a crisis, we've built the world's largest social infrastructure for collective action."

Facebook is also working on artificial intelligence (AI) technology to prevent terrorist attacks.

"Right now, we're starting to explore ways to use AI to tell the difference between news stories about terrorism and actual terrorist propaganda so we can quickly remove anyone trying to use our services to recruit for a terrorist organisation. This is technically difficult as it requires building AI that can read and understand news, but we need to work on this to help fight terrorism worldwide," he explained.

Zuckerberg's lofty aim is to use Facebook to create a global community to come together and make the world a better place. Or just share pictures of kittens and their lunch while clicking on newsfeed ads, maybe.

Microsoft offers a virtual space for crashing drones and robots

MICROSOFT IS LOOKING to help developers create and model drone and robotic experiences in a virtual environment through GitHub and its own freshly launched Aerial Informatics and Robotics Platform. The idea is to make machines and robots safer before we come face to face with them.

The effort creates a sandbox environment where people can, if they want to, make drones and robots go around crashing into each other. Alternatively, they could use it to better understand machine learning. Much of the research needed is out of the reach of some of the community.

"Machine learning is becoming an increasingly important artificial intelligence (AI) approach to building autonomous and robotic systems," said Microsoft.

"One of the key challenges with machine learning is the need for many samples – the amount of data needed to learn useful behaviours is prohibitively high. In addition, the robotic system is often non-operational during the

training phase. This requires debugging to occur in real-world experiments with an unpredictable robot," the company added.

The Aerial Informatics and Robotics Platform aims to solve these two problems: the large data needs for training, and the ability to debug in a simulator. Microsoft says it will provide realistic simulation tools for designers and developers to generate the copious amounts of training data they need. Based on recent advances in physics and perception computation, they will also be able to create accurate, real-world simulations.

This is worthy stuff. Without this kind of testing, developers will only understand the impact of their AI and robotic technology when it is face to face with humanity.

"Together, this realism, based on efficiently generated ground truth data, enables the study and

execution of complex missions that might be time-consuming and/or risky in the real-world.

For example, collisions in a simulator cost virtually nothing, yet provide actionable information for improving the design," explained Microsoft.



IoT Mirai botnet continues to wreak havoc

SECURITY FIRM AKAMAI says the infamous Mirai botnet, which caused so much internet damage last year, continues to be used by hackers, and accounted for seven of the top 10 biggest distributed denial of service (DDoS) attacks in the last three months of 2016.

"As we saw with the Mirai botnet attacks during the third quarter, unsecured Internet of Things (IoT) devices continued to drive significant DDoS attack traffic," said Martin McKeay, senior security advocate and senior editor of the *Internet/Security Report*.

"With the predicted exponential proliferation of these devices, threat agents will have an expanding pool of resources to carry out attacks, validating the need for companies to increase their security investments. Additional emerging system vulnerabilities are expected before devices become more secure," McKeay said.

Akamai saw a lot of DDoS attacks in the last quarter of last year, but while Mirai was very prominent, it didn't produce the biggest attack. That came from a rival botnet that has been in operation for at least two years called Spike, which, unlike Mirai, did not capitalise on weaknesses in IoT security.

VITAL STATISTICS

60%

The amount of the world using the mobile internet in 2016 (GSMA)

7.3bn

CONNECTED DEVICES BY 2020 (SAMSUNG/PWC)

463 million

The number of smart homes by 2021 (Ovum)

84%

Companies who suffered an IoT security breach in 2016 (HPE)

500%

INCREASE IN SOCIAL MEDIA PHISHING ATTACKS OVER 2016 (PROOFPOINT)

100 million

Nuisance calls that Vodafone says it has blocked in six months

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GLOBE TROTTING

France

Hold on

A man has used a mobile phone to call the police following a car theft. No news there, you might think, but he did it from the roof of his moving stolen car while it was being driven around the French Swiss border.

Osama Aoukili launched himself on to the roof of the car because it was his dad's car, and he wasn't going to stand by. He and his mobile phone got away relatively unscathed, but the thief was apprehended. The car is described as an "ageing Renault Clio".



Denmark

Diplomatic core

The country of Denmark has a world's first, it claims: it has established the position of Tech Ambassador, a vacancy that is yet to be filled but is waiting for a person who can build international relations based around technology. "In the future, our bilateral

relations with Google will be just as important as those we have with Greece," said Anders Samuelsen, the Danish foreign minister.



Russia

Psyche killer

The Russian government has restricted access to a popular adult website called Brazzers.com because it is dangerous for the human psyche. While the UK is attempting to install its own porn filters, in Russia they have reasons of their own. The site is banned for having a "negative impact on the human psyche", and for "[violating] citizens' rights". Slightly at odds with this puritanical approach, Vladimir Putin previously said Russian prostitutes were "the best in the world" as allegations raged around Donald Trump's antics.



United States

Trump versus tech

More than 100 tech firms, including Apple and Google, have put their names to a statement opposing the Trump administration's moves to limit the movement of workers from

Muslim countries. "The federal government can and should implement targeted, appropriate adjustments to the nation's immigration system to enhance the nation's security," they said in a court document. "But a broad, open-ended ban – together with an

indication that the ban could be expanded to other countries without notice – does not fit the goal of making the country more secure. Instead, it will undermine American interests."

Cameroon

Media ban

The internet was banned for several weeks in English-speaking parts of Cameroon as part of government attempts to clean up people's use of social media. A statement from the Minister of Posts and Telecommunications said: "In today's digital era, the role of social media in issuing and disseminating

information and images in the public arena, especially in Cameroon, has become critical. A common citizen possessing an appropriate mobile phone is usually the start point, or a relay in the chain of dissemination of an image or information."



The whole wide world

Sleep in the dark

Researchers have found that the internet makes a trillion connections every 15 minutes.

Klaus Ackermann of the University of Chicago built a dataset to measure the growth of the internet, revealing the magnitude of its pinging. It also found the internet has affected sleep patterns. The report states, "In general, major cities tend to have longer sleeping times compared to surrounding satellite cities. While North America has remained largely static, European sleep duration has declined, and East Asian sleep duration has grown."



THE LOWDOWN

Raspberry Pi: from hero to Zero wireless

The latest iteration adds Wi-Fi functionality to the tiny British-made computer

SO WHAT'S THIS NEW PI - IS IT EDIBLE?

Unfortunately not. But on the upside, the Raspberry Pi Zero W adds wireless functionality to the cheap as chips – literally – Zero mini computing board.

Despite the fact that the Pi Zero W is small enough to slip into a wallet next to your bus pass, it is a wonder. As thin as cardboard, it includes a 1GHz, single-core CPU, 512MB of RAM, a Mini HDMI and a USB port, composite video headers and Micro USB power. Oh, and it costs under a tenner – £9.60, to be precise.

SOUNDS GREAT. WHEN CAN I GET MY HANDS ON ONE?

Now – assuming they haven't sold out immediately on launch, which is often what happens with the new Pi models. The Pi Zero W launched on 28th February (the Pi Foundation's fifth birthday).

You probably won't spend a better tenner this month or this year. We'll let Eben Upton, founder of the Foundation and creator of the Pi computer, explain what makes this such an exciting launch.

"This is a rather special one for us, if only because it illustrates Moore's Law in action. In five years we've come from 700MHz/256MB with wired networking at \$35 to 1GHz/512MB with wireless networking at \$10," he says.

"Compared to the baseline Zero, it's a more usable general-purpose computer, because the addition of wireless 'stretches' that single USB port. If you use Bluetooth peripherals you might not end up plugging anything into it at all: just stick it to the back of your TV and forget about it. There's also a sweet new injection-moulded case with interchangeable lids. We're quite excited about this one."

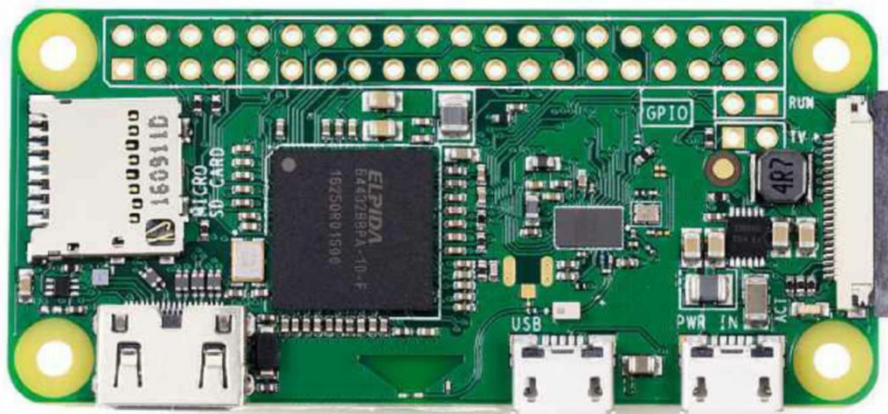
IS THE PI STILL ABLE TO BOAST THAT IT'S MADE IN BRITAIN?

Yes, the credit-card-shaped computer is still firmly wedded to these shores. As Upton explains, "We'll be building 25,000 units a week, all in South Wales, in the hope of catching up with demand as quickly as possible. It's pleasing that we've been able to build out our international distribution channel in time for the launch, so it (and the earlier Zero) should be on sale in Germany, France, the Netherlands and Japan, in addition to the UK, US and Canada."

WHERE WAS THE PI FIRST BAKED?

The very first Raspberry Pi computer launched on 29th February 2012, developed out of Cambridge University computing labs by a team including Upton. The single-board computer cost less than an ergonomic keyboard and was designed with the admirable goal of putting accessible computers into UK schools.

And it certainly achieved that goal. By February 2015, the Pi had established itself as the best-selling British computer of all time, having shifted five million units. By September 2016, it had doubled this number.



The Foundation has increased sales and demand by making small adjustments to the already small computer and by encouraging a very passionate hobbyist community.

Not only has the market been impressed, but the Queen has also taken note of what is happening in Cambridge. Upton was honoured in the same birthday honours list as Tim Peake as a Commander of the Order of the British Empire (CBE).

That is not the only thing that he and Peake have in common. The Raspberry Pi went with Peake when he travelled to the International Space Station and inspired a whole nation.

Google has also been impressed and gave the Foundation a grant in 2013 that enabled it to put 15,000 Pis into UK schools.

FIVE THINGS MORE EXPENSIVE THAN A RASPBERRY PI ZERO W

- Apple iPhone 7 case **£35**
- PlayStation 4 VR helmet **£350**
- Microsoft Surface Mouse **£24.99**
- Casio FX-83GTPPLUS Scientific Calculator **£11.99**
- Mrs Brown's Boys Xmas DVD collection **£12**

KIDS WILL BUY ANYTHING, THOUGH

The Pi isn't just for kids; it pops up in all manner of places. Its size and accessibility has seen it appear in robotics and gaming gear, and hobbyists have taken to it like glue takes to balsa wood. Next in line is artificial intelligence (AI), and again it's Google that's there in support.

"Google is going to arrive in style in 2017. The tech titan has exciting plans for the maker community. It intends to make a range of smart tools available this year. Google's range of AI and machine learning technology could enable makers

to build even more powerful projects," enthuses the Foundation.

"To make this happen, Google needs help from the maker community. Raspberry Pi fans are the best makers around, and it's their ideas that will give the tech company direction."

Google is looking for leads on where AI is going, and the Foundation, roughly five years into its history and with its loose collection of passionate, often garden shed-based users, is well placed to offer the web giant some direction.

ENOUGH ABOUT THEM, WHAT ABOUT ME?

If you haven't tried out the Raspberry Pi, you haven't filled your downtime as satisfactorily as you might have done.

The small computer only needs cables that you probably have already to set up, and it's easy to program, thanks to the large number of available guides and easy-to-follow packages, some of which have already appeared in *Shopper*, and we'll be following up with more in issue 353.



FROM THE LAB

In space, no-one can hear the fire alarm

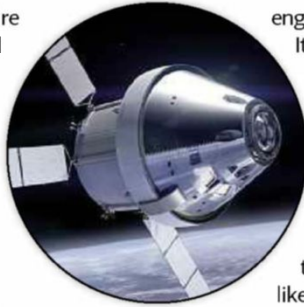
AN AUDIT AT Nasa has found that a fire that ultimately damaged craft destined for space burned for over three hours before anyone realised, after a bad security update caused computer systems to fail.

A report from the space agency's inspector general found that a security patch that had been applied to a large oven facility used in engineering was faulty. The upgraded systems caused monitoring software to fail, and the increased heat was not spotted.

"[A] security patch caused monitoring equipment in a large engineering oven to stop running, resulting in a fire that destroyed spacecraft hardware inside the oven," said the report.

"The computer reboot caused by the software upgrade also impeded alarm activation, leaving the fire undetected for 3.5 hours before it was discovered."

The report suggests that Nasa has traditionally relied on an assumption that its systems and their



engineers will take care of themselves.

It adds that over time the estate has become too complicated to sustain this approach and that the agency is faced with a change if it is to maintain secure control systems.

"As Nasa's Operational Technology (OT) systems become more sophisticated and connected to traditional IT networks, this isolation is likely to prove inadequate. For example,

we identified OT systems Nasa officials

believed were physically isolated but were actually connected to larger Agency networks," warned the inspector general.

"If not properly secured, such connections could provide unauthorised access through less trusted, internal Agency networks. Further, responsible personnel were not performing sufficient traffic monitoring, internal auditing, or intrusion detection on the OT systems and therefore lacked comprehensive awareness of their security posture."

Researchers reveal quantum hacking threat

THE UNIVERSITY OF Ottawa has found it would be possible to hack into an encrypted message sent over quantum computing systems. Fortunately, the team also discovered it would be possible to build a system to thwart the threat.

The researchers looked into the future risk of hacking after the 2016 US elections. They began thinking about how much more challenging a complex quantum network would be.

The team was able to ape the hacker method of intercepting content by cloning it. It cloned the

qubits, the photons of light that carry information. As a proof of possible trouble, it is alarming.

"Our team has built the first high-dimensional quantum cloning machine capable of performing quantum hacking to intercept a secure quantum message," said University of Ottawa Department of Physics professor Ebrahim Karimi.

"Once we were able to analyse the results, we discovered some very important clues to help protect quantum computing networks against potential hacking threats."

University of Warwick makes breakthrough in flexible technology

RESEARCH FROM THE University of Warwick may pave the way for really thin and very flexible wearable technology and solar panels. The research takes two-dimensional structures, thin strips essentially, with electrical properties called heterostructures, and stacks them together. This creates what is called a wonder material.

"Dr Neil Wilson in the Department of Physics has developed a new technique to measure the electronic structures of stacks of two-dimensional materials – flat, atomically thin, highly conductive, and extremely strong materials," says a university report.

"The technique uses the photoelectric effect to directly measure the momentum of electrons within each layer and shows how this changes when the layers are combined.



"Multiple stacked layers of 2D materials – known as heterostructures – create highly efficient optoelectronic devices with ultrafast electrical charge, which can be used in nano-circuits, and are stronger than materials used in traditional circuits."

Photoelectric properties could benefit the solar panel market with more efficient power conversion, while the thinness and flexibility has obvious appeal for the wearables market.

"It is extremely exciting to be able to see, for the first time, how interactions between atomically thin layers change their electronic structure," Dr Wilson said.

The research is a combined effort of the Universities of Warwick and Cambridge, the University of Washington in Seattle, and the Elettra research centre in Italy.

SOUND BYTES

“SEE YOU IN COURT”

US president **Donald Trump** goes full CAPS on Twitter as he reacts to a court decision about immigration by threatening to take the court to another court

“You know, times are not really awful, there’s some great things happening. It gives me a lot of energy to talk to developers, or meet students in classrooms who are using our technology to help learn faster and better. Watching them pursue their passion.”

Apple’s **Tim Cook** on Brexit fears

“Browsing history is a very sensitive set of data. It reveals people’s interests, concerns, worries and in many cases their every fleeting thought. It’s vital that people are able to trust they can be in control of that kind of information.”

Jay Stanley of the American Civil Liberties Union (ACLU) reacts to news that Apple stores deleted web histories in the cloud

“Rift and Touch were both a little delayed, so that was a disappointment. And if you want to accelerate development, we need to get the product to the market at a good pace.”

Facebook’s **Mark Zuckerberg** laments Oculus VR’s performance

“Intel’s business continues to grow and investment in manufacturing capacity and R&D ensures that the pace of Moore’s law continues to march on, fuelling technology innovations. This factory will help the US maintain its position as the global leader in the semiconductor industry.”

Intel pumps \$7bn into a next-generation hardware plant in the US



The iMac G3

1998 and the start of the iGeneration

REMEMBER THE DAYS when not everything everyone bought was an Apple product? It really wasn't that long ago.

There was a time in the not-too-distant past when Apple struggled to sell to anyone other than the design industry or showy marketing companies. Its presence in industry and enterprise was limited, and to many consumers Apple was perhaps better known as a means of keeping a doctor away.

In 1998, the firm introduced a new kind of Mac: the iMac. A non-beige box that the company could see ending up in the home, as part of the family, or indeed in a classroom as part of education. What's more, it came in all the colours of the rainbow.

You know you wanted one, or you knew someone that did. The machine came at a time when PCs were functional but boring. Boring in terms of design, that is. No-one, until then, had really thought that you could encase them in colourful swathes of plastic and turn them into something that wouldn't look out of place in a cartoon.

"These new product lines give people what they want most, a lightning-fast laptop and a striking new consumer Macintosh," said Steve Jobs, Apple's then interim chief executive, at the time of the launch.

"Apple leads when it expresses its vision through its products, exciting you and making you proud to own a Mac. Our design savvy and manufacturing efficiency will put a new generation of Macintoshes on the desktop and on the road. The same focus and



passion that brings these products to market has also made us a healthier company."

After its launch almost 20 years ago, the iMac G3 lasted for five years, its colourful glow only dimming in 2003. By its midway point, Apple was throwing more colour options at it, and calling it the "world's best computer for connecting to the internet".

JOBS FOR THE BOYS

"iMac is now more stunning and accessible than ever," said Steve Jobs in 2000, and by then the full-time chief executive.

"iMac is simply the world's best computer for connecting to the internet and making desktop movies in the home or classroom."

The iMac G3 was launched the year after Steve Jobs had returned to Apple, following a successful time at Pixar, and kickstarted the revolution that has created the Apple of today. It dropped the floppy drive, and used USB as its default connector. It was a nice machine for internet browsing. It was not liked by hardcore computer people, at least not openly, but was loved by the consumer market.

Suddenly Apple became a force again. The iMacs had the muscle to back it up, too. The

specifications are interesting, but we should take some time to consider the full colour range that the G3 provided. It runs as Bondi Blue, Blueberry, Grape, Tangerine, Lime, Strawberry, Graphite, Ruby, Sage, Indigo, Snow, Blue Dalmatian and Flower Power. You can tell that Apple is based in San Francisco.

The design is credited to none other than Jony Ive, who has come to be known as the man that puts the core into the modern Apple look and feel, and produced the designs for the iPod and iPhone.

Ive created a computer based around a 14in CRT that had a carrying handle. A carrying handle: what an innovation. This meant that you could, if you wanted to, carry it around. Presumably to your teenage mates' houses, assuming they lived very nearby, as it weighed a rather hefty 17kg. It even had dual headphone jacks for those cosy times.

SPECS APPEAL

Statistics-wise, the first model G3 had a 233MHz processor, ATI Rage IIc graphics, a 4GB hard disk, 32MB of SDRAM, an infrared port, built-in stereo speakers, and no floppy disk drive. Apple also redesigned the mouse, creating the hockey puck model that came with the G3.

The iMac G3 was credited with putting Apple back in the black. The latest iMacs and MacBooks the original machine spawned are now some of the most covetable products out there. ☐



REVIEWS

YOUR TRUSTED GUIDE TO WHAT'S NEW

ANDROID MEDIA STREAMER/GAMES CONSOLE

NVIDIA Shield TV (2017)

COMPUTER
SHOPPER
BEST BUY

★★★★★

£190 • From www.ebuyer.com

VERDICT

4K Amazon Prime Video, a smart home hub and improved controls mean the multitasking Shield TV excels

WHEN YOU'VE ALREADY built the best Android TV box on the market, where do you go next? That's the question Nvidia faced after releasing its Shield TV console/streamer back in 2015. It was – and remains – a great buy, its only drawbacks being a shortage of Android TV content, the lack of a bundled remote control and a bulky, ugly controller for games.

Two years on and Android TV is now a much more content-rich proposition, and what's more, there's a new Shield TV package that fixes the original's problems while adding some new features of its own.

Despite these additions – which we'll get to shortly – the internal hardware has hardly changed. You still get Nvidia's own, powerful Tegra X1 processor, alongside 3GB of RAM, Bluetooth 4.1 support, 802.11ac Wi-Fi, two USB3 ports and 16GB of internal storage. As with the previous model, Nvidia is also offering a £280 Pro option for the Shield, which includes a 500GB HDD, which is near essential for anyone who plans to do more than simply stream games or media content to their TV. The Shield TV Pro also includes a microSD slot, the omission of which on the standard Shield TV is one of its few disappointments.

STRAIGHT AND NARROWED

More impressive is that the Shield TV has shrunk by 40% compared to the 2015 model. It now measures a mere 159x98x26mm, meaning it's even easier to tuck away behind a TV if you'd rather not have it on show.

It is a gorgeous machine, though. It may be fully plastic now (the mixed metal/plastic build of the original is now reserved for the Pro version), but its faceted design is just as eye-catching, and that angular design look has also made its way across to the completely overhauled Shield TV controller.



This is a huge improvement on the original, no longer like an unsightly lump of plastic.

What's more, in a move that is sure to make the Shield a more attractive proposition to newcomers, Nvidia is now including the Shield Remote in the box in addition to that new game controller. Previously, Shield owners had to pay £35 for the privilege, which was not only unreasonably expensive, but those who sprung for it would also have been

and more refined than Nvidia's previous effort, and that makes it far more comfortable to use for extended gaming sessions.

As part of the redesign, Nvidia has also removed all the touch-sensitive navigation buttons from the pad, replacing them with physical ones located at the bottom of the controller, just below and between the two thumbsticks. These can take a bit of getting used to at first, especially as you'd expect

The Shield TV has shrunk by 40% compared to the 2015 model, meaning it's even easier to tuck away behind a TV

disappointed to find its rechargeable battery would die within a week or two of use.

The loss of SD card storage is a shame, and the alternative solution – expandable storage via USB3 flash drive – didn't perform well. Games such as *The Witness* and *Metal Gear Rising: Revengeance* had serious loading speed issues – issues that melted away once installed on the internal storage.

PERIPHERAL THINKING

The major appeal in picking up a new Shield TV is the revamped controller. While its polygonal skin looks great, what makes it a better controller is the build quality, including the feel of the sticks and buttons. Everything about the new controller feels higher quality

the home button to be the big Nvidia logo in the centre, rather than the button below the right thumbstick, but they're a world of improvement over the original.

The gamepad's battery life has also been improved, now lasting up to 60 hours per charge. The Shield Remote has also been tweaked for better stamina; it's now slightly thicker, in order to accommodate the two CR2032 batteries that give it up to a year's worth of battery life. That's a massive improvement on the old rechargeable remote.

GAME AND FORTUNE

Two years ago, Nvidia's Shield TV was built for gaming greatness, and while we knew from the start that its Tegra X1 chip was capable,



there were few games on Android TV capable of stretching the hardware. Now, after two years of working with developers, its catalogue of native Android games is growing, and they're absolutely incredible in motion.

Playing Metal Gear Rising: Revengeance on the Shield TV is almost unbelievable. Not only is a PS3/Xbox 360-era title running at 1080p at 60fps for the most part, but visually it actually looks more on par with the PC version. The same can be said of Borderlands: The Pre-Sequel, which pushes out a near-consistent 60fps at 1080p, something the original PS3/Xbox 360 build couldn't quite manage. While that may not impress PS4, Xbox One and gaming PC owners, keep in mind that the Tegra X1 is a mobile processor.

The Shield isn't just about native Android games, though. It's also a great place for streamed games content. It still supports Nvidia's impressive GeForce Now subscription service – which now includes titles from Ubisoft – but Nvidia has overhauled the back-end with Pascal-based GPUs, so you're now able to stream games from the cloud at resolutions of up to 4K. You'll need pretty decent broadband to do that (around 100Mbit/s), of course, but latency-free 1080p, 60fps gameplay can be had with a connection of around 25Mbit/s.

If you've got a gaming PC of your own, the Shield TV also lets you stream your entire games library to a TV in another room. There's also a Steam app that launches Steam Big Picture mode direct from your PC to your TV wirelessly, and all games can be streamed up to 4K with HDR support and with full haptic feedback, if a title supports it.

TELLY OF THE BEAST

Android TV has come on leaps and bounds in the intervening years since the last Shield TV launched, transforming Nvidia's powerful box from niche device into something with a whole lot more mainstream appeal. Amazon Prime Instant Video and BBC iPlayer are no longer absent, and the Netflix app has been upgraded with 4K and HDR content. There's Google cast support as well, again with 4K and HDR capability.

Of course, if you own a 4K TV, it's probably going to have its own streaming services built in, but the Shield TV's selection is wide enough to plug any possible gaps. We're also impressed that Nvidia has managed to get Amazon's apps on an Android-powered streamer – usually, Google and Amazon refuse to support each other's services.

The Shield TV is an enthusiast's dream, with support for Plex and Kodi and its various builds, plus the ability to sideload any app you want.

Finally, the Shield TV also wants to double as your smart-home hub. There's integration with Samsung's SmartThings tech for control over things such as remote cameras, lights and heating systems, and integration with Google Assistant is in the works, too.

Although still in development, we found this already works quite well; simple commands such as, "OK Google, start my day" (picked up via the always-on mic in the new controller) saw the Shield TV turn on room lighting, turn up the temperature on a Nest Thermostat and boil the kettle. Saying, "OK Google, I'm leaving" turned off the lights, reduced the temperature and powered down non-essential smart devices.

The problem is that this currently relies on the microphones built into the Shield TV's controller and remote control picking up your voice, which isn't the most practical solution if you want to use the system in other rooms of the house. To address this, Nvidia is to release a connected microphone called Nvidia Spot, which will act as a voice relay to the Shield TV.

In terms of hardware, Nvidia has pushed its Shield TV above and beyond the device it was back in 2015 – but there are plenty of software improvements, too. This means older Shield TV users can still benefit from some of Nvidia's upgrades, while newcomers get an excellent experience right out of the box.

RENAISSANCE BOX

In short, there's nothing better on the market right now. For gamers, it's an Android console that's capable of playing games with enough fidelity to keep up with mainstream consoles, has access to a vast library of streamable 4K titles, and hooks into your personal library of PC games. For more casual users, it can access every video-streaming service available, lets you cast content from your phone, and is incredibly quick when loading and switching between apps.

Shield TV is also pretty future-proof and, thanks to the upcoming Google Assistant integration, could well become the centre of your smart home. Why shell out on something like Google Home or Amazon Echo, when you can get all the same functionality via a powerful streaming box that sits under your TV?

It may share more than a couple of internal components, but those intervening years have propelled Nvidia's TV streamer/console hybrid to new heights, and while it's expensive, we can't recommend it enough.

Vaughn Highfield

SPECIFICATIONS

VIDEO OUTPUTS HDMI • **NETWORKING** Ethernet, 802.11ac

Wi-Fi, Bluetooth 4.1 • **DIMENSIONS** 159x98x26mm •

STREAMING FORMATS Plex, Kodi • **INTERNET STREAMING**

SERVICES Netflix, Amazon Instant Video, Google Play Movies

and TV, Google Play Music, YouTube, BBC iPlayer • **WARRANTY**

Two years repair and replace • **DETAILS** www.nvidia.co.uk •

PART CODE 945-12897-2505-000

CONNECTION PORTS

HDMI x1

USB3 x2

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AWARD WINNING PC SYSTEMS



YOYOTECH Warbird G2

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SHOPPER
RECOMMENDED£936 • From www.yoyotech.co.uk

VERDICT

Decent performance, great connectivity options and a fantastic lightshow

WE'VE TESTED A lot of PCs that have been spruced up with a spot of coloured LED illumination, but never one that puts on the kind of lightshow the Warbird G2 does.

First, there are the two front fans, which can be switched between seven colours via a button on the front or the included remote control. Then there's the Gigabyte motherboard, which is dotted with individual RGB LEDs around the PCI-E slots and CPU socket as well as having longer, thicker strips down the right and along the RAM slots. Even the graphics card, a 6GB GTX 1060, has a touch of white light shining out through the clear side window.

BRIGHT CLUB

Having this many light sources could look horrible if they were mismatched, but since the case and motherboard LEDs can be set to your liking (either through the remote control or Gigabyte's RGB Fusion software), it's not hard to get things looking nice and tasteful. At least, not when the remote plays ball; ours had difficulty in registering changes. The button on the case itself works fine, though.

Fortunately, the Warbird G2 is reliable where it counts. Its new Kaby Lake processor, the Intel Core i5-7500, is a step down from the overclockable Core i5-7600K that's become our mid-range chip of choice, but you'd be lucky to find the latter in a system under £1,000. The Core i5-7500 does just fine for everyday computing, as demonstrated by our

benchmark results: 111 in the image test, 113 in the video test and 109 in the multitasking test, producing a balanced overall score of 111.

It doesn't hold back the GPU, either. The £900 base model of the Warbird G2 includes the 3GB version of the GTX 1060, but our slightly pricier review model has the full-fat 6GB version. This gives it great gaming chops even at 4K. Dirt Showdown, running at Ultra settings with 4x anti-aliasing, averaged 118fps at 1,920x1,080 as well as 55fps at 3,840x2,160.

Performance in Metro: Last Light Redux was also in line with other GTX 1060 systems. At 1,920x1,080, the Warbird G2 managed a very playable 50fps when running at Very High settings with all other effects maxed out, and while 3,840x2,160 demands sacrifices, it's still possible without ruining the game's looks. At this resolution, we got 58fps on Medium settings with AF 4X texture filtering, Normal tessellation, and both SSAA and advanced PhysX effects disabled. That's a huge leap from the 12fps with everything at maximum.

SWITCHING THINGS UP

It's worth noting that you can get Yoyotech's Warbird RS C6 (*Shopper 348*) for a little more. This comes packing a far more powerful 8GB GTX 1070, as well as the older (but still slightly faster) Core i5-6600K processor.

Not that the Warbird G2 is a bad deal. In fact, it has an impressive set of bonus features on top of all the lighting, such as integrated SD and microSD card readers, and two fan-speed selector switches. These can control up to three fans each, though tested on the pre-installed intakes, there's not a great deal of noise difference between high and low settings, so we just left them on high.

You also get an SSD/HDD combo for storage, albeit with a relatively tiny 120GB solid state drive. It won't be long before you need to fall back on the 1TB HD.

However, there's little to complain about on the connectivity front. The front panel's two USB2 and two USB3 ports are good, but it's the motherboard's rear I/O panel that really impresses, with two USB2, four USB3, one USB3.1 and one USB Type-C ports, plus Gigabit Ethernet. What's more, two of the USB3 ports are of the



DAC-UP variety, so they can be used with high-end audio kit. The same goes for the C/SUB, rear and side speaker outputs, augmenting the standard 3.5mm audio jacks.

EXPAND AID

The internals are decent as well. The two dual-purpose 3.5in/2.5in toolless drive bays are taken up by the existing storage, but you could add another three 2.5in drives if you wished, plus two 5.25in optical drives or controller panels. The motherboard's two PCI slots are a bit old-fashioned, but there's scope for more modern upgrades with two PCI-E x16 slots (one spare) and two PCI-E x1 slots (both spare). We're happy to see an M.2 slot as well, what with NVMe storage falling in price.

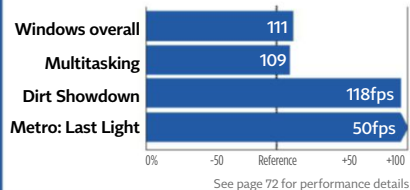
Next to the RS C6 and Chillblast's Fusion Hubble (*Shopper 350*), the Warbird G2 isn't quite the superlative system, but if you absolutely can't stretch to the £1,000 asking price of those two PCs, this is a very respectable jack-of-all-trades alternative.

James Archer



SPECIFICATIONS

PROCESSOR Quad-core 3.4GHz Intel Core i5-7500 • **RAM** 8GB DDR4 • **FRONT USB PORTS** 2x USB2, 2x USB3 • **REAR USB PORTS** 2x USB2, 4x USB3, 1x USB3.1, 1x USB Type-C • **GRAPHICS CARD** 6GB Asus GeForce GTX 1060 Turbo • **STORAGE** 120GB SSD, 1TB hard disk • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Three years RTB including one year parts and labour • **DETAILS** www.yoyotech.co.uk • **PART CODE** 10120204



HP Pavilion Wave



£730 • From www.currys.co.uk

VERDICT

A good-looking and great-sounding PC, this is one computer we'd be proud to have on display

EVER SINCE THE first PC came out, nearly every single one has come in a rectangular box, and few manufacturers have made any efforts to innovate on the design. So it's refreshing to see HP do something a little different with the Pavilion Wave: built into a triangular case with rounded edges, it looks very different to your average tower.

In fact, from a distance, you wouldn't even think the Wave was a PC at all. With its soft material finish, the Wave looks more like a fancy Bluetooth speaker rather than a traditional PC. The B&O sticker on the front certainly doesn't dispel that image. We rather like this design and the Wave is one of the few PCs that we'd happily have on display.

Rather than the high-end speaker branding being for show, the HP Pavilion Wave is designed with audio in mind. A single speaker at the top of the case fires upwards into a cone, distributing audio in a 360° arc.

SONIC BOON

Sound quality is rather impressive. With a single speaker, there's no stereo separation, but the Wave produces powerful audio. A surprising amount of bass, decent mid-range and no distortion at maximum volume make this PC easy to listen to. In fact, we'd go as far to say that in most cases there's no need for external speakers, and that the Wave is good enough by itself. That's some going for a small computer.

Our general worry with this kind of PC is that the small body comes at the cost of performance. Fortunately, the Wave is capable of running most applications with ease. Inside is a quad-core Intel Core i5-6400T, which runs at a base speed of 2.2GHz (it can Turbo Boost to 2.8GHz when there's enough thermal headroom). This is a low-power processor, designed for enclosed spaces. Unlike super low-power CPUs intended for ultra-portable laptops, the 6400T is a proper desktop CPU.

Combined with the 8GB of DDR4 RAM, the Wave scored 59 in our benchmarks. It struggled a little in the multitasking test, scoring 40, which shows that this PC isn't

ideal for powerful computing tasks, but regular use and photo editing will be easy.

Graphics are provided by the processor's integrated Intel Graphics 530 chip. This is fine for a bit of low-detail 720p gaming, but the GPU can't handle more demanding games at higher resolutions.

DRIVE MIND

HP has installed a 128GB SSD and 1TB hard disk. Both are configured as separate drives, so you'll need to manage the space carefully. We suggest using the SSD for Windows 10 and standard applications, and the hard disk for games, documents and large applications.

This combination has the advantage that the Pavilion Wave boots quickly and feels responsive while providing plenty of storage for most people's needs.

There's no way to upgrade the RAM or storage, as the HP Pavilion Wave is sealed. Inside, the design is rather clever, with one

A surprising amount of bass, decent mid-range and no distortion at maximum volume make this PC easy to listen to

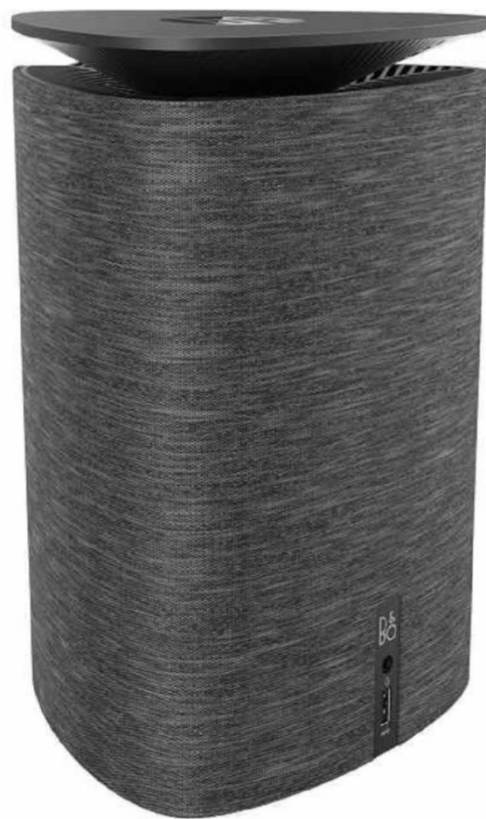
side of the triangle used for the hard disk; one side used for the motherboard, processor and SSD; and the last side used for the cooling system. HP has used copper pipes that extract heat and move it towards the thermal system. This, in turn, blows the extracted heat across cooling fins and out the top. Despite the fancy cooling, the PC is audible at all

times, with the fan constantly on. We didn't find the Wave too annoying, but we'd have preferred it to be silent when idle at the least.

Expansion is limited to the ports provided. At the front, there's one USB3 port, but you'll find two more at the back and a USB3.1 Type-C port, too. An integrated SD card is nice to see, and great for photographers.

For once, a PC manufacturer has done the right thing, and included a bundled wireless keyboard and mouse that use the

Wave's Bluetooth receiver, so there's no need for an ugly external



dongle. The keyboard is rather nice and has an internal battery that's charged via Micro USB. It's pretty much full size, although the number pad has been shifted right next to the main keys. We found it quick and fast to type on, with the keys proving to be very responsive. Only the half-sized Return key threw us off a little.



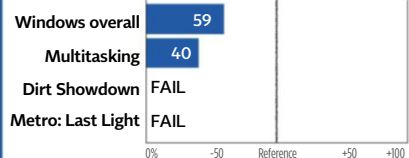
The bundled mouse isn't up to the same quality and isn't rechargeable. It's a basic affair with two buttons and a scroll wheel. It will do for light use, but better options are available.

There's nothing quite like the HP Pavilion Wave. If you're after an attractive PC that can handle all the jobs you throw at it, it's an excellent choice. If you're happy with a traditional, boxy tower PC, though, you can get better performance for less.

David Ludlow

SPECIFICATIONS

PROCESSOR Quad-core 2.2GHz Intel Core i5-6400T • **RAM** 8GB • **FRONT USB PORTS** 1x USB3 • **REAR USB PORTS** 2x USB3, 1x USB3 Type-C • **TOTAL STORAGE** 128GB SSD, 1TB hard disk • **GRAPHICS CARD** Intel HD Graphics 530 • **DISPLAY** N/A • **OPERATING SYSTEM** Windows 10 • **WARRANTY** One year RTB • **DETAILS** www.hp.com • **PART CODE** 600-a055na



See page 72 for performance details

DELL XPS 13 (2017)

COMPUTER
SHOPPER
BEST BUY

★★★★★

£1,229 • From www.amazon.co.uk

VERDICT

This next-gen improvement sees the Dell XPS 13 move from a tantalising purchase to an essential one

THERE ARE PLENTY of reasons to love the 2015 iteration of the XPS 13 (*Shopper 329*); back when we originally reviewed it, Dell's premium ultra-portable felt like the closest thing to a perfect Windows laptop. Even throughout the entirety of 2016, only the HP Spectre 13 (*Shopper 345*) could really rival it. Now, there's finally one more laptop that can go toe-to-toe with the old XPS 13 – and it's another XPS 13, in the form of an Intel Kaby Lake refresh.

Put the new and old models side by side, and there's barely a jot of difference between them. Unless you opt for the updated laptop's rose gold finish, rather than the gunmetal-grey finish shared with the 2015 specification, you'd be left to play an almost-impossible game of spot the difference.

Despite looking outwardly identical to its ageing predecessor, the XPS 13 is still a beautiful laptop. The lid tapers towards the front edge when it's closed, measuring just 15mm at its thinnest edge, and as it weighs in at 1.29kg, it's still plenty light enough to carry around every day.

LAKESIDE PROPERTY

Dell hasn't changed a thing about the laptop's connectivity, either. That solitary Thunderbolt-powered USB Type-C port can still be spotted on the left edge, and is accompanied by two regular USB3 ports, an SD card slot and 3.5mm headset jack.

The main improvement is hidden inside: the new XPS 13 now comes equipped with a seventh-generation Intel Core i7-7500U processor clocked at 2.7GHz. This quad-core Kaby Lake chip is quite the performer, scoring a total of 50 in our demanding 4K benchmarking tests – a result that makes it 9% faster than the previous model.

That's only a modest performance increase – indeed, it may have fared a little better if Dell has given us the maximum 16GB RAM model to review instead of the 8GB version – but it's no slouch. Our last-gen XPS 13 buckles under the pressure if we open too many Chrome tabs at once, but no such issues arise with Dell's latest.

Don't expect to do much gaming, though. While there's enough power to keep Minecraft ticking along, Intel's integrated HD Graphics 620 chip has only a limited amount of horsepower



at its disposal. It's marginally quicker than the previous generation, but you'll need to drop the resolution and detail settings if you want to get more recent games in your Steam library to run at a decent frame rate. Dirt Showdown, for instance, averaged only 32fps when running at 1,280x720 and High settings.

DRAIN STRIKES

Battery life, unfortunately, is actually lower than the old model. This is the third Kaby Lake-powered laptop we've tested so far, and already we're beginning to spot a worrying trend. Lasting just 7h 46m away from the wall socket is a baffling limitation, considering 2015's XPS 13 reached 11h 30m in the same

The touchpad is well sized, at least as far as the XPS 13's slender chassis permits. Windows 10 multitouch gestures were performed without any slip-ups, and it's easy to jump between multiple applications with relative ease. We weren't even tempted to plug in a USB mouse while working in Photoshop. It does seem to pick up fingerprints a little too easily, though.

LOOKING UP

One thing Dell really should have fixed is the XPS 13's awkwardly placed webcam. It's still located at the bottom left of the display, which means that getting a suitable angle for video chats is tricky; flattering it is not.

The display is a sight to behold. The super-skinny Infinity Edge bezel looks great, and image quality is gorgeous

test. There's a clear power-efficiency issue here, and we suspect that the power-hogging QHD+ screen could be the culprit.

That said, this display is certainly a sight to behold. The super-skinny Infinity Edge bezel looks great, and image quality is gorgeous. The 13.3in, 3,200x1,800 display covers 92% of the sRGB colour gamut, which makes for gloriously intense colours, and the contrast ratio of 1,109:1 provides oodles of detail from the darkest to the brightest corners of the screen. The only downside is that the display's peak brightness of 290cd/m² isn't quite bright enough for use outside on sunny days.

An optional touchscreen is also part of the package, but while it can be handy in some instances – such as juggling between multiple Chrome tabs – it's more of a luxury than a necessity. It also adds 90g to the non-touch XPS 13's starting weight.

Thankfully, there haven't been any significant changes to the keyboard. The keys are nicely spaced, and there's just the right amount of movement and feedback to be had with each keystroke. Backlighting is still standard, too.

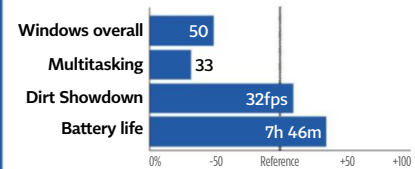
Overall, though, Dell's latest XPS 13 cements its position as the best Windows ultra-portable there is. Battery life remains a sticking point, but with this near-perfect mixture of price, performance and portability, there's nothing else to match it.

If you've already got the 2015 model, then there aren't quite enough improvements here to justify the expense of a direct upgrade. However, if you're searching for the most refined Windows laptop on the market, then the new XPS 13 is the one to buy.

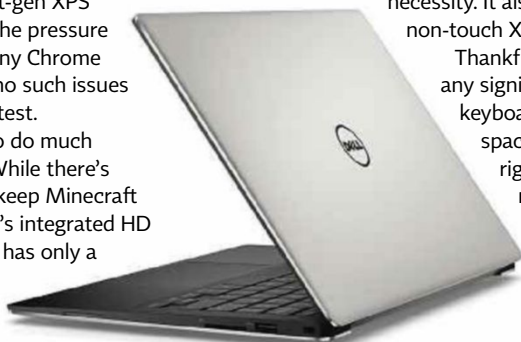
Nathan Spendelow

SPECIFICATIONS

PROCESSOR Quad-core 2.7GHz Intel Core i7-7500U • **RAM** 8GB • **DIMENSIONS** 304x200x15mm • **WEIGHT** 1.29kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 3,200x1,800 • **GRAPHICS ADAPTOR** Intel HD Graphics 620 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years RTB • **DETAILS** www.dell.com/uk • **PART CODE** XPS 13 9360



See page 72 for performance details



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HP Chromebook 13



£730 • From www.amazon.co.uk

VERDICT

Super-thin, powerful and seriously portable, HP's latest Chromebook 13 is in a league of its own

ANYONE MORE USED to Intel Core-powered Windows laptops might start reading this with a deep-rooted cynicism toward Chromebooks. While they can be temptingly cheap, opinions have been sullied over the years due to plastic-ridden, Celeron-powered devices with sub-par screens. HP's latest Chromebook 13 is here to rewrite your perceptions, and it does so – on the whole – quite magnificently.

Inside and out, HP makes few sacrifices. Its looks are bewitching, with its dark grey, brushed-aluminium chassis accompanied by a backlit keyboard. This sophisticated Chromebook leaves our previous favourites, the Acer Chromebooks 14 (*Shopper 344*) and R 11 (*Shopper 338*), looking even more basic.

Standing a mere 12mm tall when closed, HP's model is also one of the slimmest Chromebooks around. Combined with its dainty 1.2kg weight, the Chromebook 13 is stylish and feels reassuringly expensive – which is just as well, given the relatively high asking price.

ELITE UNIT

While the Acer Chromebook 14 will set you back a mere £200, you'll have to fork out £730 for this Intel Core m3-equipped model. This isn't a typical entry-level Chromebook, however, and should instead be considered a proper alternative to a Windows laptop.

The first piece of evidence for this is the screen. Aside from Toshiba's ancient IPS-equipped Chromebook 2, displays are seldom a selling point for Chromebooks, but HP ships the Chromebook 13 with a Quad HD+ IPS panel. This 13.3in, 3,200x1,800 display beams out at 358cd/m², perfect for sunny afternoons, while an sRGB coverage of 88% promises a good spread of colours. However, the display is marred by a seriously poor 474:1 contrast ratio, giving images a flat, washed-out look. It's by no means awful, but for this price we expected better.

However, to the untrained eye, the screen on the Chromebook 13 isn't bad – it's not great either, but still. At this price, we'd also liked to have seen a touchscreen. If nothing else, this would make

those ported Android apps on the Chrome Web Store much easier to use.

While it's hardly HP's fault, it's also worth pointing out that Chrome OS still struggles with resolution scaling. At any resolution higher than Full HD, it displays a laughably microscopic mouse cursor and such small app icons you need to squint to see them.

When it comes to the keyboard, the individually backlit keys are nicely spaced inside the 13in chassis, and although the low travel takes a bit of getting used to, the stiff switches make for crisp, responsive typing. The diamond-edged touchpad is generously sized, too, and responsive both to standard mousing and multitouch gestures. We're not huge fans of integrated buttons in general – dedicated buttons are more tactile and often have a more decisive action – but the Chromebook 13's are relatively easy to get used to and, by and large, inoffensive.

FASTER PLAN

The display might be disappointing in some regards, but it's good to see that the Chromebook 13 is crammed with nippy core components. For £610, you get a dual-core, 900MHz Intel Core m3-6Y30 processor, 4GB of RAM and 32GB of eMMC flash storage – making it a Chrome OS-powered laptop that's well ahead of the pack.

It scored 128 in the JetStream browser benchmark: the highest we've seen and over twice that of the HP Chromebook 14's 52.9 result. It felt wonderfully nippy in general use, flitting between multiple Chrome tabs without

breaking a sweat. If you're in need of a Chromebook that isn't already obsolete straight out of the box, it's a good start.

That Core m3 is a tad more power-hungry than its Celeron alternatives, draining the Chromebook 13's 5,000mAh battery in 7h 20m in our video-playback test. That said, you should be

able to eke out a full working day from a single charge, as long as you don't run the screen at maximum brightness.

As with most Chromebooks, the port selection is a tad restrictive, with only two USB3.1 Type-C ports (including one used for charging) and a single regular USB3.1 socket for peripherals and legacy device connection.

The good news is that you can use that spare Type-C socket to connect the HP Chromebook to a variety of high-speed peripherals, including external monitors. There's also a solitary microSD card reader, for expandable storage, embedded on the right-hand side.

WIRELESS IS MORE

As for networking, you'll have to stick with the onboard 802.11ac Wi-Fi adaptor (there's no built-in Ethernet socket) or buy an adaptor for use over USB. Finally, there's Bluetooth 4.2 for hooking up additional peripherals such as headphones, mice and keyboards.

HP's Chromebook 13 might seem a little overpriced but, in reality, it's a marvel. It's a standout Chrome OS laptop with great performance and a crisp, if low-contrast, Quad HD+ display, and the ultra-light chassis and all-day battery life make it a portable workhorse that's a joy to use.

If you're after something that can effortlessly butt heads with pricier Windows-powered laptops, there's nothing like it. Despite its display's shortcomings, this is the new Chromebook to beat.

Nathan Spendelow



SPECIFICATIONS

PROCESSOR Dual-core 900MHz Intel Core m3-6Y30 • **RAM** 4GB • **DIMENSIONS** 319x219x12.7mm • **WEIGHT** 1.2kg • **SCREEN SIZE** 13.3 • **SCREEN RESOLUTION** 3,200x1,800 • **GRAPHICS ADAPTOR** Intel HD Graphics 515 • **TOTAL STORAGE** 32GB • **OPERATING SYSTEM** Chrome OS • **WARRANTY** One year RTB • **DETAILS** www.hp.co.uk • **PART CODE** T6R48EA



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VERDICT

With fantastic performance at a great price, Honor's 6X shouldn't be ignored

REGARDLESS OF WHETHER Honor appreciates being pigeonholed as a budget smartphone brand, its latest device – the Honor 6X – may be its finest work yet.

It squeezes a 5.5in, Full HD screen into an all-metal body, and comes with 32GB of integrated storage and 4GB of RAM. The rear is curved, so it sits nicely in your hand, and the glass on the front also tapers slightly at the edges for a slicker look.

As for connectivity, the 6X has a dual SIM slot, perfect for travelling abroad or using as a dual work/leisure device. There's no USB Type-C connector for fast charging, with Honor opting for an older Micro USB port instead, but you do get an extremely fast-acting fingerprint sensor on the back, nestled below the twin-lens camera.

EYE CARE

The Honor 6X's screen itself isn't AMOLED, but instead a good-quality LCD unit. It measures pretty well, with a contrast ratio of 1,694:1 helping it produce wonderfully impactful images. Its peak brightness of 502cd/m² also means that you'll have problems reading it only in the very brightest of conditions.

The Honor 6X is the only phone we've seen in this price range to include a twin-lens camera

Its colour reproduction isn't quite so good, unfortunately. The screen covers only 89% of the sRGB colour gamut, which is far from brilliant. However, thanks to Honor's new 'eye comfort mode', which filters out blue light in the evenings and automatically adjusts brightness and colour temperature according to ambient light, it is easy on your eyes.

The Honor 6X is the only phone we've seen in this price range to include a twin-lens camera, in this case a 12-megapixel unit with a 2-megapixel secondary sensor. This allows it to take wide-aperture shots similar to the iPhone 7 Plus's bokeh mode, blurring everything beyond the point of focus. The quality isn't quite on a par with Apple's device (as you'd expect, considering the 6X costs nearly £500 less), but it's still good enough to give your shots a handy facelift.

Outdoors, the rear camera produces decent shots, capturing details particularly well. Indoor image quality isn't so good, with

photos losing vibrancy and gaining graininess, but generally the 6X still manages balanced, well-judged exposures in low light, and has a single LED flash to help cut through the darkness when conditions get really tricky. It certainly has a better rear camera than the similarly priced Huawei P9 Lite (Shopper 350).

If you do feel the need to tweak your images, you get both Pro still and video modes for fine-grained control over every aspect of your images, allowing you to tinker with the ISO and exposure values to your heart's content.

QUICKEN EASY

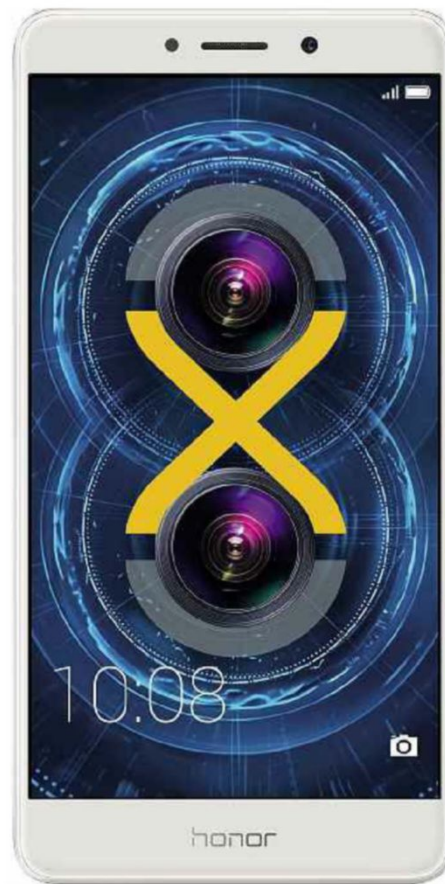
The Honor 6X is no slouch in everyday use, either. There's a 2.1GHz Kirin 655 octa-core processor inside, joining forces with 4GB of RAM. With a Geekbench single-core score of

784 and 3,319 for multicore, the 6X more or less matches the P9 Lite for smoothness and responsiveness. Multitasking also feels surprisingly stable – Honor says its smart file system reduces file fragmentation for faster response times, and it certainly feels that way.

It's a great performer once you crack open some Android games, too. It scored an average frame rate of 8.4fps in the GFXBench Manhattan 3 test, which is perfectly respectable for a budget phone, and both Threes! and Angry Birds 2 ran without a hitch.

Battery life is less impressive, but it's big at 3,340mAh in size and it didn't do too badly in our test, lasting 11h 18m while playing back video continuously in flight mode. For context, that's roughly an hour longer than 2016's Honor 5X, although it lags behind the current king of budget smartphones – the Moto G4 Plus – which lasted over two hours longer.

It wouldn't be an Android phone without a bit of overlay tinkering, and the Honor 6X is



no exception. Usually, this is the point at which we castigate Honor for insisting on preloading its own onerous launcher software, but Honor's EMUI is nowhere near as bad as it used to be.

While there's still some superfluous pre-installed software – namely a handful of naff games and unnecessary apps – you can at least

get rid of them. The downside is that the 6X doesn't ship with Android 7.0, but Honor is promising an over-the-air update in the coming months.

CHOICE CUTS

This price bracket is chock full of budget smartphones well worth considering, but the Honor 6X stands above most of them. Its design, outdoor camera quality and performance are great for the money, and battery life isn't bad either.

The Moto G4 and G4 Plus deliver more bang for your buck, having better battery life and a more pleasant-to-use camera. That said, when it comes to physical design, we prefer the 6X's bodywork – and getting a dual-lens camera on to a cheap handset is no small feat.

Still, much like the G4, what's really impressive about the Honor 6X is that it holds its own against smartphones that cost two or three times as much. In short, Honor has created a fantastically capable budget smartphone at a very tempting price, and it's impossible not to recommend it.

Nathan Spendelow

SPECIFICATIONS

PROCESSOR Octa-core 2.1GHz HiSilicon 655 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 12 megapixels • **STORAGE (FREE)** 64GB (52GB) • **WIRELESS DATA** 4G • **DIMENSIONS** 151x76x8.2mm • **WEIGHT** 162g • **OPERATING SYSTEM** Android 6.0 • **WARRANTY** One year RTB • **DETAILS** www.hihonor.com • **PART CODE** BLN-L24



See page 72 for performance details



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VERDICT

The larger, higher-resolution Swift 2 X is a decent Swift 2 Plus successor, but it's still no Moto G4

IT HASN'T BEEN long since Wileyfox launched its Swift 2 and Swift 2 Plus handsets (*Shopper 349*), but there's already a more upmarket version of the former. The Swift 2 X, for a big price jump to £219 (from £159), adds a larger, 5.2in Full HD display and an upgraded 16-megapixel rear camera. Since our primary issues with the Swift 2 family were their 720p displays and low-quality cameras, this puts the Swift 2 X – theoretically – in good stead.

It's still the same slightly rounded rectangle with a navy blue tinge and chamfered edges. In fact, aside from that screen size bump to 5.2in, it's more or less the same device we're already familiar with.

It's an elegant handset, nonetheless. While the original 2015 Swift was a plastic mess, the 2 X is far fancier, sticking with a clean, all-metal finish. The fingerprint scanner is still on the back, but it isn't as responsive as, say, Huawei's P9 Lite (*Shopper 350*).

SMOOTH THINGS OVER

The move to a 1,920x1,080 IPS panel also means the jagged-looking icons of the previous Swifts are gone, with a far more impressive 423ppi pixel density on display. A contrast ratio of 1,385:1 helps produce some lovely, detail-rich images, and with a peak brightness of 625cd/m², the 2 X's screen is a dazzling improvement over the dull Swift 2 Plus.

The fact that it covers only 86.6% of the sRGB colour gamut isn't great, though. Images aren't particularly saturated as a result, with what should be bright colours looking a touch on the dull side. Overall, though, this display is a big step up.

Despite the new sensor, we weren't impressed by the Swift 2 X's test shots, with the 16-megapixel camera producing some seriously drab pictures. Even outdoors with plenty of light, images looked dull, although graininess was largely kept at bay. The camera clearly struggled with exposure, too.

HDR mode is supposed to balance out exposures, reducing the occurrence of overexposure in bright areas and lifting it in shadows; enabling it here, however, saps details from images, casting a washed-out look across entire photos. If you want a budget smartphone with photography chops, stick with the Motorola Moto G4 (*Shopper 343*).

At least indoor shots are more presentable. Colours were more natural, with the dual-LED flash cutting through the darkness when necessary. Our colourful test shots showcased a surprising richness picked up by this otherwise disappointing camera.



The Swift 2 Plus's sluggish Snapdragon 430 chip clocked at just 14GHz; easily outperformed by its chief rival, the Moto G4. Sadly, this isn't an area on which Wileyfox has sought to improve, and so that same processor can still be found in the 2 X – and it's looking more dated than ever.

The Swift 2 X's Geekbench 4 scores – 629 in the single-core and 2,072 in the multicore test – were near identical to its 2016 cousin. This is reflected in the feel of the phone; even swiping between homescreens is painfully slow. Google Maps was horrendously sluggish, with the Swift 2 X struggling to keep up with rapid multitouch gestures.

Gaming performance isn't brilliant, either, with a 7fps average in the GFXBench offscreen Manhattan test. That's no better than the Swift 2 Plus, and only marginally better than the G4's 6.6fps. Simple games such as Threes! posed little risk, while Sky Force: Reloaded slowed down a little during frantic encounters.

CELL OUT

Wileyfox handsets have never been particularly impressive when it comes to battery life, and the Swift 2 X is no different, squeezing out a mere 9h 18m from its 3,010mAh battery. That's not a patch on the Moto G4's 13h 39m, and it's also down slightly on the Swift 2 Plus's time of 9h 32m.

At least there's USB Type-C charging with Quick Charge support. You can get roughly 75% charge after just under an hour plugged into the wall.

The Swift 2 X isn't a bad phone, but there's little that puts it ahead of the alternatives, especially considering its £219 price. Nowadays, that's verging on the mid-range.

Sure, it's broadly an improvement over the Swift 2 Plus it supersedes, with its proper Full HD screen, but it pales in comparison with the cheaper

and far more impressive Moto G4. For around £160, this still offers best-in-class performance and camera quality, and its 13-hour battery life makes an appearance in our best battery-life leaderboards. We know we end almost every budget smartphone review this way, but the point still stands: you'd be better off with a Moto G4.

Nathan Spendelow

SPECIFICATIONS

PROCESSOR Octa-core 1.4GHz Snapdragon 430 • **SCREEN SIZE** 5.2in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 16 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **DIMENSIONS** 143x73x8.2mm • **WEIGHT** 153g • **OPERATING SYSTEM** Cyanogen OS 13.1 • **WARRANTY** One year RTB • **DETAILS** www.wileyfox.com • **PART CODE** Swift 2 X





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VERDICT

An impressive 2,560x1,440 gaming monitor, with a 144Hz refresh rate and good all-round performance

THE NUMBER OF dedicated gaming monitors on the market continues to rise, and AOC's new AGON line of monitors adds another fair few to the list. The TN-panelled AG271QX is the first we've seen from the range, and with its aggressive red and black design, it certainly looks the part of a serious gaming display.

The specs suggest it has a lot to offer performance-wise, too. Running at 144Hz and 2,560x1,440, at £420 it's simultaneously expensive for a 1440p screen and significantly cheaper than our current favourite 27in gaming monitor, the Acer Predator XB271HK – that does have a 4K resolution, but the AOC's higher refresh rate (plus the fact that 1440p is less graphically demanding) makes it better suited to playing at high frame rates.

STUTTER THERAPY

The AGON AG271QX is stacked with features, chief among them support for AMD FreeSync. When it's hooked up to a compatible AMD graphics card, the AG271QX synchronises its refresh rate with the GPU's output, greatly reducing screen tear for smoother gaming.

What's particularly good about the AGON AG271QX in this regard is its range – some FreeSync monitors can only engage FreeSync within a limited refresh rate range, so games running at lower frame rates don't see the benefit. This monitor, however, has a FreeSync range of 30-144Hz, so the effect works even at 30fps. That's great if you've got a budget card or are playing a relatively demanding game.

It's also very well made, with a sturdy stand that offers full pivot, height and tilt adjustments, and it looks great, with a red and black theme and a matt-silver foot. The bezels are nice and thin as well.

On the side is a handy fold-out arm, which can be used to hook your headphones on to the right-hand side of the monitor. You'll find four USB3 ports at the rear, two to the right (one of which can be used to fast-charge your phone) and two beneath the screen. The monitor also has a pair of 3.5mm jacks for your mic and headphones, and video inputs include DisplayPort 1.2, DVI, VGA and a pair of HDMI sockets, one of which is MHL-compatible.

Despite being part of the AGON gaming line, the monitor shares the same onscreen display (OSD) as other AOC monitors, and that's a good thing: we've always found the AOC interface easy to use and feature-rich.



Within the OSD, you can adjust the gamma and colour temperature, and fine-tune the red, green and blue levels. There are also options for a low-input lag mode, overdrive and a blue-light filter if you're worried about late-night gaming disrupting your sleep.

SEEING STRAIGHT

The AG271QX employs a 2,560x1,440 TN LCD panel, which means its viewing angles aren't as fantastic as an IPS panel. On the plus side, its 1ms response time is impressive – more on this below.

In our tests, the monitor achieved 96.5% sRGB colour gamut coverage, a great result for a TN panel that suggests it may have been calibrated in the factory. Speaking of colours, we found colour accuracy was impressive, too. With an average delta-E of 0.8, media editors and designers can be confident that what they see onscreen will be a close match to real-world printouts and broadcasts.

Brightness is perfectly fine at 307cd/m² in sRGB mode (it will go brighter, but this mode limits brightness to 90%) and we measured the contrast ratio at 1,078:1. The latter isn't a bad result by any means, but it does lag behind VA panel monitors, which stretch out to 2,000:1 and beyond. If you're used to gaming on such a screen, the colours might look a little washed out to you, despite the high colour accuracy and gamut coverage.

Of course, the AGON AG271QX has one purpose – gaming – and at that, it's very good indeed. When playing Counter Strike: Global Offensive, a twitchy shooter, we found the AG271QX to be extremely responsive, and its Low Input Lag mode does exactly as it says.

The monitor's already minimal response time can be reduced still

further using overdrive, but we found that enabling the Strong Overdrive setting produced noticeable ghosting, which was unpleasant. Troublesome overdrive features seem to be a common theme with gaming monitors; even the much more expensive Asus ROG Swift PG27AQ (Shopper 346) saw added image artefacts with it switched on.

BALANCING ACT

If you're not going to be gaming competitively, the Medium Overdrive setting provides that sweet spot of relatively low response time and little to no ghosting, and this, combined with an impressively sharp 1440p panel, means games look great.

It's safe to say that gaming is the AOC AGON AG271QX's forte: it's very responsive and offers low input lag. It's ideal for those looking to upgrade from a Full HD 60Hz screen.

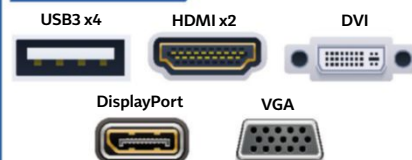
Still, what's impressive about this monitor is that – with the exception of its contrast and viewing angles – it's strong across the board. It's not only a great gaming screen but also a capable all-rounder, with accurate colours, fantastic build quality and design, plus a wide range of inputs and outputs.

Christopher Minasians

SPECIFICATIONS

SCREEN SIZE 27in • RESOLUTION 2,560x1,440 •
SCREEN TECHNOLOGY TN • REFRESH RATE 144Hz •
VIDEO INPUTS DVI, 2x HDMI, DisplayPort, VGA •
WARRANTY Three years RTB • DETAILS aoc-europe.com •
PART CODE 4038986185417

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BROTHER

MFC-J5730DW



£200 • From www.amazon.co.uk

VERDICT

A versatile, A3-capable small office MFP with decent print and copy quality, but the scanner is underwhelming

THE MFC-J5730DW IS the middle model in Brother's new range of office inkjet multifunction peripherals (MFPs), aimed at small and home offices. It's very well specified, supporting wired and wireless networking as well as walk-up scanning and printing. It has great paper-handling features in particular, with a 50-sheet automatic document feeder (ADF) supporting automatic duplex (double-sided) scanning and faxing. There's duplex printing and copying, too.

This MFP comes with two 250-sheet paper cassettes and a 100-sheet multipurpose feed at the rear. Although it's only a little bigger than a regular A4 inkjet, all three of these can hold A3 paper, making it particularly versatile. We loaded A3 paper in the bottom tray, A4 in the top tray and 6x4in photo media in the



paper has a shorter path to travel, so the MFC-J5730DW made less noise than we'd expect while printing black text at a decent rate of 16.5 pages per minute (ppm). This is a comparatively quick inkjet when printing colour, managing to reach 10.8ppm on our complex graphics test. We also recorded fast scan times, with even a 300-dots-per-inch

performance among light shades, but terrible loss of detail in dark areas: of 24 shades of grey, the last six were indistinguishable.

Brother's PC and mobile software is generally easy to use, and the MFC-J5730DW itself is controlled via an intuitive menu system on a large and responsive touchscreen. We particularly like being able to set up custom shortcuts, but it's frustrating that, as an office device, it can only print photos, not PDFs, from an inserted USB stick.

Although it's only a little bigger than a regular A4 inkjet, all three paper cassettes can hold A3 paper

multipurpose feed, and were able to complete all but our 10x8in photo tests without shuffling any paper about. On the downside, all three trays require you to load A4 or letter paper with a landscape orientation, which takes a bit of getting used to.

The unusual landscape paper feed has its advantages: moving along its short edge,

(dpi) scan of an A4 document needing just seven seconds. Combining quick print and scan actions, it's no surprise that copies were also fast. We timed 10 black-and-white pages at exactly a minute, with the same job needing almost two minutes in colour, which is still comparatively quick.

SHARP SHOOTER

The MFC-J5730DW manages to combine fast printing with good results: black text was fairly sharp, and colour graphics generally glitch-free and with accurate colours. While mono photocopies were good, however, colour copies looked a bit drab. We were far less impressed with this MFP's scan quality. Images were sharp, but the colours in business documents and photos were a little de-saturated and dull. Our professional scan target revealed decent

INKING BIG

Brother has increased the capacity of this MFP's ink cartridges by 25% compared to the outgoing 5000-series models, with its high yield black ink now rated for 3,000 pages and each colour good for 1,500 pages. Calculated for these, total running costs are a competitive 4.5p per A4 page of both text and graphics.

If you need to print in A3, the Brother MFC-J5730DW is a feature-rich, flexible MFP capable of serving a small but busy office. It's cheap to run and produces decent results, but while its scanner is fine for general office work, it's not ideal for more creative tasks.

Simon Handby



SPECIFICATIONS

TECHNOLOGY Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x1,200dpi • **MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x2,400dpi (24-bit) • **DIMENSIONS** 469x639x511mm • **WEIGHT** 24kg • **MAXIMUM PAPER SIZE** A3 • **WARRANTY** One year RTB • **DETAILS** www.brother.co.uk • **PART CODE** MFC-J5730DW

Mono speed	16.5ppm
Mixed colour speed	10.8ppm
Mono page cost	0.9p
Colour page cost	3.6p

0% -50 Reference +50 +100
See page 72 for performance details

Connecting Point A to Point B doesn't need BT.

High-speed data connectivity between buildings shouldn't be an ordeal, but dealing with your ISP can be enough to make you fed up. **ePMP™** from **Cambium Networks™** lets you make a connection – wirelessly – up to 200 Mbps, outdoors up to 10 miles. **No line rental, no service fees, and no hassle – for less than you think.**

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HOME WI-FI SYSTEM

BT Whole Home Wi-Fi

COMPUTER SHOPPER
RECOMMENDED



£300 • From shop.bt.com

VERDICT

A smart and easy way to upgrade your home's Wi-Fi, but the price is a little high

GETTING FAST AND reliable Wi-Fi all over your house used to be incredibly difficult, but times are changing, with a spate of whole home wireless products coming out. These products give you multiple wireless access points, linked together in a wireless mesh network, so you get coverage exactly where you need it.

The first product we saw was the Netgear Orbi (*Shopper* 348), and now it's BT's turn with its unimaginatively, yet highly descriptively, named Whole Home Wi-Fi. What's different about this product, compared to the competition and rather unusual coming from BT, is that Whole Home Wi-Fi doesn't have a router. Instead, you should see it as an upgrade kit for whatever router you happen to have at the moment. Once installed, BT's kit provides wireless access for your house, while your existing router takes care of dishing out IP addresses and your internet connection.

With the Whole Home Wi-Fi kit, you get three identical access points, which BT calls discs due to their circular bodies. Each disc is just 165mm across and sits neatly on the integrated stand, making them easy to



position anywhere. Around the back, there's a wall-mount slot that would take a screw head, but the fixed stand makes this impossible to use. BT has advised that the discs are not wall mountable.

WELL ROUNDED

Each disc has a single Ethernet port, plus a power button and reset switch. Only one disc has to be wired into your existing router, while the remaining two connect wirelessly, forming the mesh network.

As this is a product designed for the masses and is supposed to be easy to set up, configuration is done entirely through the BT Whole Home Wi-Fi app, which is available for Android and iOS. This app takes you step by step through configuring the initial disc to adding subsequent ones.

While the first disc is easy to locate, subsequent discs need a bit more work.

Due to the wireless connection, the ideal scenario is that a disc is placed halfway between an existing disc (wired or wireless) and the area where you normally have poor reception. To help out, the app gets you to move to the area where you want to place a disc and then tests the connection quality. You're then told what to do: move a little further away from another disc; install the disc here; or move closer to an existing disc.

The LED on the front gives you a quick visual guide to the connection state: blue is good, amber means there's poor reception, purple shows that the disc is updating, and red means there's no connection.

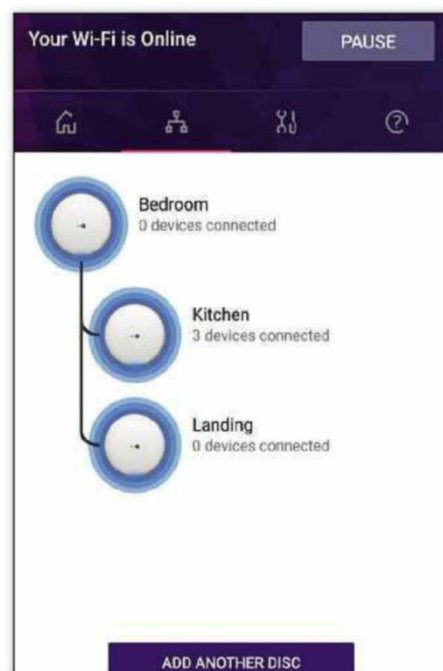
The setup routine takes you through installing the first disc and first satellite. Adding the third disc has to be done manually. The app tells you to plug this disc via Ethernet into your home network so that it can pull down the Wi-Fi settings; however, you can



▲ The app takes you through setting up a new Whole Home Wi-Fi system



▲ From the home screen you can get an overview of system health and which devices are connected



▲ The app shows you the current network layout and lets you add new discs to boost range further



skip this step in the triple pack, as all three come pre-set with the same Wi-Fi details.

We found the instructions easy to follow and soon had our discs ideally located to cover all three floors of the house and the garden.

MAKING FRIENDS

Once the discs are located in the right areas, you're ready to go, as BT preconfigures the Whole Home Wi-Fi with a secure network. Just as with BT's routers, each disc has a pull-out plastic insert at the back, which contains the default network name, network password and admin password.

While having a preset network makes initial setup easy, the downside is that you need to manually configure every wireless device to use the new network. A better way is to disable Wi-Fi on your existing router, and then configure the Whole Home Wi-Fi kit to use your old network's name and password.

Settings can be changed easily using the app, but you don't get a lot of control: you can change the network name and password, turn off the discs' LEDs, and that's about it. If you use a computer to connect to a satellite using a web browser, then there's a management console that exposes a few

more settings. Here you can choose a Wi-Fi channel manually, hide the network and change the 2.4GHz mode from 20MHz to 40MHz. We don't recommend touching the latter setting, as 40MHz 2.4GHz can suffer from interference. It's a shame that there's no guest network option, although you could potentially use this feature on your existing router if you really want it.

It's impossible to split the 2.4GHz and 5GHz networks, as Whole Home Wi-Fi uses Band Steering to direct a connecting device to the right band automatically. This choice is based on the connecting device's capabilities and range. BT also supports 802.11k/v Wi-Fi roaming, which helps direct connecting devices to the disc with the strongest signal. In short, Whole Home Wi-Fi wants to provide your devices with the fastest and most reliable connection automatically.

DATA PROJECTION ACT

So, how fast is it? Each disc has a 1,733Mbit/s 5GHz network (4x4 antennas) and 800Mbit/s 2.4GHz network (4x4 antennas). Some of the bandwidth has to be reserved for communication between discs, so you're unlikely to see the maximum speeds on offer.

In our tests, performance was still very good, and we saw throughputs of 236.31Mbit/s at close range, 212.05Mbit/s on the first floor and 176.6Mbit/s on the second floor. This falls a little behind the more expensive Netgear Orbi, and peak speeds can't match that of the Netgear Nighthawk X8 router (Shopper 345).

However, having three discs meant much better coverage overall, and we could get an excellent signal in the second-floor bathroom, right at the back of our house; using a single router, we can only usually get one bar of reception. Looking at the app, we could check which disc our phone was connected to, and found that it can take the Whole Home Wi-Fi a short while to move devices to the best disc. Moving to the bathroom, for example, it took a few moments for our phone to switch discs and pick up the best signal.

Once we'd locked on to the best disc, throughput was good, too, at 128.6Mbit/s. Outside in the garden, which is usually a dead spot, we managed to get 185.11Mbit/s, with 56Mbit/s at the bottom of the garden. With the Netgear Orbi's satellite in the same place, we got more than 200Mbit/s over the entire garden, although coverage on the top floor wasn't as good.

CENTRAL PLANNING

Orbi's real advantage is that its system has a Wi-Fi channel for the network backbone, providing dedicated bandwidth. This showed in its superior test results. The downsides of Orbi are that you have to replace your existing router, which isn't always possible; the access points are much bigger than BT's discs, and the system currently only supports the one; and the price is higher.

Whether or not the BT Whole Home Wi-Fi is for you depends on what you want to achieve in your home. If you can reposition your router in the middle of your house, you may find that you can get away with a single router. If that doesn't work, you want to eradicate a dead spot and can replace your router, then the Netgear Orbi offers more features and better performance.

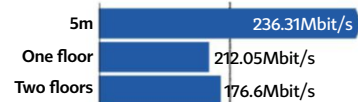
However, if you can't replace your router or you don't want the hassle of having to do so, then the BT Whole Home Wi-Fi is an excellent choice. It provides you with excellent and robust coverage and is simple to install, although the price is a little high.

David Ludlow



SPECIFICATIONS

MODEM N/A • WI-FI STANDARD 802.11ac • STATED SPEED 1,733Mbit/s (5GHz), 800Mbit/s (2.4GHz) • USB PORTS 0 • WALL MOUNTABLE No • WARRANTY Two years RTB • DETAILS www.bt.com • PART CODE 181209



See page 72 for performance details

LINKSYS Velop

£500 • From www.currys.co.uk

VERDICT

Neat and easy to configure, performance at the edge isn't quite as good as rival systems

IT SEEMS YOU can't move for whole home Wi-Fi systems at the moment, with the Linksys Velop following hot on the heels of the Netgear Orbi (*Shopper 348*) and the BT Whole Home Wi-Fi (page 38). Velop can replace an existing router, as the Orbi can, or it can be used to upgrade your existing wireless network leaving your router alone, as with the BT Whole Home Wi-Fi. On paper, this flexibility would seem to give Linksys the edge.

It's possible to buy the Velop in one of three configurations: a single device, a twin pack or a triple pack. The single device is a little pointless on its own and is intended as an upgrade for existing installations, giving you a quick way to extend a wireless network.

This range is good in principle, giving you much more flexibility than either Orbi (available as a twin pack) or Whole Home Wi-Fi (available as a triple pack). However, the price is a little hard to stomach, with a single device costing a whopping £200, two costing



£350 and three costing £500. Simpler pricing, with a price of £150 per satellite, would be good, with two for £300 and three for £450.

Linksys has done a nice job with the satellite's design, and the tall columns are easy to place around your home. Their unobtrusive finish also means that they'll blend into the background.

CABLE AND WIRED

Underneath are two Gigabit Ethernet ports and the power input, and a cable clip at the back helps you keep any cabling out of the way. The first device you connect needs to be plugged into your existing router or modem via Ethernet. Subsequent satellites don't need connecting at all, although you can use the Ethernet ports for connecting wired devices.

helps you with locating a new satellite, automatically checking the network connection and then giving you advice on whether you should move it or not. This process takes a few minutes per satellite and takes a little longer than the BT Whole Home Wi-Fi's similar process. The single LED on top of the router gives you a visual indication of signal strength, too. Annoyingly, you can't disable the lights using the app.

Initially, we configured our Velop system to connect to an existing router, but this shows a rather big problem: Velop insists on dishing out IP addresses and still uses the primary wired device as a router. It means that you end up with two networks, which can make handling port forwarding and other advanced features more difficult. With the BT Whole

Velop insists on dishing out IP addresses and still uses the primary wired device as a router. It means you end up with two networks, which can make some features trickier to use

Setting the system up requires you to use the smartphone app, which is available on Android and iOS. It takes you through the entire system configuration, starting by asking if you want to replace your existing router or connect Velop to an existing network. Once you've chosen, neat onscreen instructions take you through connecting the first device to your network and setting the Wi-Fi network name and password.

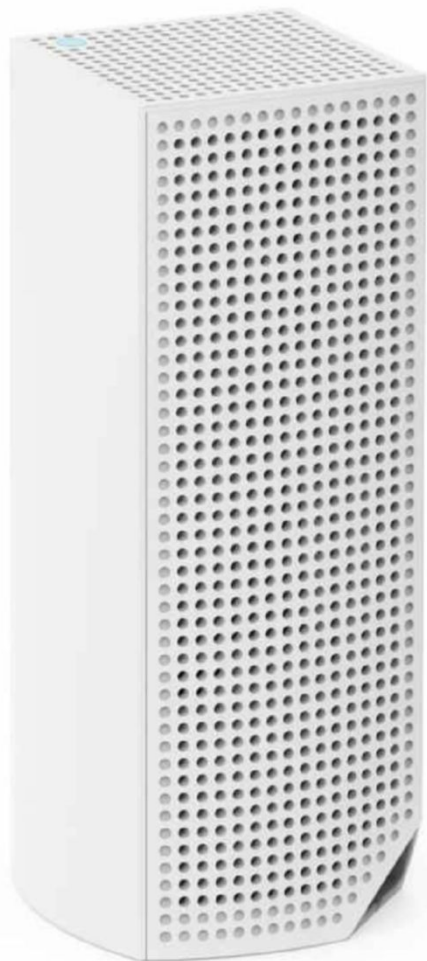
After that, the app helps you position the satellites around your home. Ideal placing is to go halfway between an existing satellite and the area in which you want coverage. The app

Home Wi-Fi, network settings and IP addresses are still handled by your main router, which makes a lot more sense.

FIRST RESERVE

There's no way of changing the way that Velop works and, in fact, the system doesn't even give you control of the DHCP settings. The only option you have is to tell the Velop to reserve an IP address for a device, which is handy where you want a static address for a device such as a NAS.

It's good to see a guest network built in, so you can give visitors restricted access





to the internet without having to dish out your main wireless password.

In a first for wireless routers, the Velop has Amazon Alexa integration. Using the Skill, you can use your Echo to ask Alexa for the guest network name and credentials, and the main network's name. It's a fun feature, although not one that makes the Velop a must-buy.

Linksys has used tri-band 802.11ac Wi-Fi, with two 867Mbit/s 5GHz networks and one 400Mbit/s 2.4GHz network. With multiple 5GHz networks, there should be more bandwidth available for the backbone used to connect the mesh network.

There's no way to choose which network to join as Linksys uses band steering to direct connecting devices to the most appropriate network, based on signal strength and capability. This makes sense: these types of products are about delivering the best, most reliable wireless experience with no hassle or user intervention.

SPOT TESTS

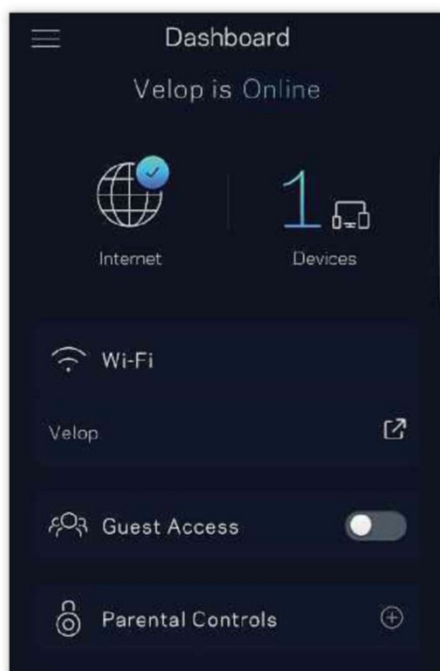
Performance in our testing was good. We managed 337.32Mbit/s at close range, 309.65 on the first floor and 196.32 on the second floor. Those are similar speeds to the Netgear

Orbi's performance and a little ahead of BT's Whole Home Wi-Fi. However, speeds in our traditional dead spots weren't quite as good.

In the top floor bathroom, we saw speeds of 42.51Mbit/s, which is an improvement on having a single router, but less than half the speed that we saw with BT's kit. Moving outside into the garden, we got 81Mbit/s in our usual dead spot and just 17.73Mbit/s at the bottom of the garden. With its satellite in a similar position, the Netgear Orbi gave us more than 200Mbit/s throughout the garden. BT's Whole Home Wi-Fi managed more than double the speed of the Velop, too. That's a touch disappointing, and we would have hoped for better throughputs, particularly with tri-band Wi-Fi on offer.

Ultimately, performance and features make the Velop a less interesting purchase than its competitors. If you can get by with two access points or you want to replace your existing router, the Netgear Orbi has more features and better performance. If you want faster coverage in more places or you can't replace your existing router, then the BT Whole Home Wi-Fi is better value, integrates nicely with existing networks and offered better speeds in our usual troublesome spots.

David Ludlow



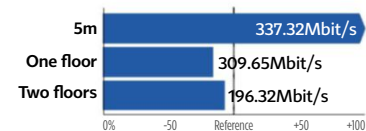
↑ The main screen shows you an overview of the system and lets you toggle the Guest network



↑ Channel Finder helps scan for less used Wi-Fi bands, to help improve performance

SPECIFICATIONS

MODEM Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** Dual 867Mbit/s (5GHz), 400Mbit/s (2.4GHz) • **USB PORTS** 0 • **WALL MOUNTABLE** No • **WARRANTY** Three years RTB • **DETAILS** www.linksys.com • **PART CODE** 184001



See page 72 for performance details

UHD SMART TV

SAMSUNG UE65KS8000

COMPUTER
SHOPPER



RECOMMENDED

£1,999 • From www.currys.co.uk

VERDICT

A giant UHD Premium TV with great all-round performance; gamers and sports fans will love it

THERE'S A GOOD reason why Samsung is arguably the world's number one TV manufacturer. Not only does the South Korean firm offer more models within its 4K TV lineup than any other brand, but Samsung screens routinely serve up good all-round picture quality at entry-level, mid-range and high-end price points alike.

We've seen this in the company's Best Buy-winning UE49KS7000 (*Shopper 350*), the UE55KS9000 (*Shopper 347*) and the Samsung UE48JS8500 (*Shopper 341*), and now there's one more for the pile: the UE65KS8000, a 65in HDR-capable television that delivers UHD Premium-certification quality for a whisker under £2,000.

LEVITATE MODERN

The design is attractive: the 65in flat panel is framed by an impressively slim black bezel featuring a brushed metallic trim around the sides. Together with the recessed Y-shaped pedestal stand, this almost makes it look like the UE65KS8000 is floating in the air – it would make a fine centrepiece for any contemporary living room. Even the rear looks supremely clean, too, and is free from any visible screws or rivets. Unlike some, this is a TV that's a pleasure to look at from any angle.

Extending the minimalistic theme is a breakout connection box – a Samsung trademark for several years now – that houses four HDMI ports, each of which can properly handle the latest HDR signal from 4K Blu-ray players. Two remote controls – a Smart wand and a more traditional button-laden one – are also included. Note that there's no 3D support on the UE65KS8000, as Samsung has dropped 3D across its entire TV range.

After a quick trip into the user menu to adjust some picture settings (there are quite a few of these, but Samsung stows them away under the 'Expert Settings' submenu to avoid confusing the average user), you're rewarded with beautiful picture performance. Black levels look convincingly deep for an LED LCD, and shadow detail just above black is faithfully retained. Colours appear very natural, too, maintaining good saturation without ever veering towards the overblown or cartoonish.

As an LCD-based display, the Samsung UE65KS8000's blacks and colours become washed out once you move beyond 30 degrees off-axis. In a pitch-black room, watching the TV from the sides would also bring attention to large vertical

chunks of backlight flaring surrounding bright objects against a dark background.

This is caused by the edge LED backlighting on the Samsung UE65KS8000, where the entire screen is illuminated through reflector plates from a single strip of LED modules along the bottom of the panel. For the best viewing experience, you'd be advised to always try to sit directly in front of the screen, and put on some gentle ambient lights.

RAPID RESPONSE UNIT

What the UE65KS8000 truly excels at is gaming responsiveness – a crucial benefit for gamers who play titles demanding fast reflexes, such as first-person shooters and racing games. Like almost every mid-range or high-end Samsung display since 2015, there's only around 20ms of input lag on the UE65KS8000, which comfortably makes it the fastest 4K TV we've tested.

Best of all, you can enjoy this low level of lag for playing HDR games such as *Gears of War 4* or *Forza Horizon 3*. The only mild annoyance is that you'll have to input HDR-friendly settings into the 'Game' picture mode manually, as by default it duplicates the same settings as the TV's standard dynamic range (SDR) mode. We fully expect that Samsung will fix this in a future firmware update, though.

Another strength of the UE65KS8000 is how it handles onscreen motion – something that will immediately endear it to sports fans. As a slight aside, the reason that old-school CRT and plasma TVs still rival today's TVs for motion clarity is because the way they display images – and more specifically, the natural decay of organic phosphors in the screen – creates blank frames, which refreshes our retinal persistence and gives the impression of smooth motion.

The UE65KS8000 takes inspiration from this and offers an LED Clear Motion

option in the Custom submenu of the Expert Settings section, which inserts blank frames to create the impression of clearer motion. Those who are particularly sensitive to flicker may not like it, but you can always turn it off.

The Samsung UE65KS8000 supports HDR10 format, but not Dolby Vision, which is one of its few notable limitations. We tested the TV with a wide range of 4K HDR material, ranging from Ultra HD Blu-rays to streaming *The Grand Tour* on the Amazon Prime Instant Video app, and the TV did a great job, displaying the reflective glints off cars and the richer colour spectrum without much difficulty.

SMART OF THE DEAL

Speaking of streaming, the UE65KS8000 comes complete with a fine selection of smart TV apps. Netflix, YouTube and Amazon Instant Video are all present and correct, along with terrestrial catch-up services including BBC iPlayer and ITV Hub. There's a built-in Freeview HD tuner, too.

In summary, while not a world-beater, the Samsung UE65KS8000 is a very good all-rounder, suitable for gamers, sports fans and those wishing to dip their toes into HDR. If you're looking for a king-sized 4K HDR TV for under £2,000, then this is one TV you definitely need to consider.

Vincent Teoh



SPECIFICATIONS

SCREEN SIZE 65in • NATIVE RESOLUTION 3,840x2,160 •
VIDEO INPUTS 4x HDMI • TUNER Freeview HD, Freesat HD
• DIMENSIONS 836x1,449x41mm • WARRANTY Five years
RTB • DETAILS www.samsung.com/uk • PART CODE
UE65KS8000

CONNECTION PORTS

HDMI x4

USB x3



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WWW.3CX.COM
+44 (20) 3327 2020



GOOGLE Chromecast Ultra



£69 • From www.currys.co.uk

VERDICT

It's cheap and beautifully easy to use, but the Chromecast Ultra is largely redundant

THE CHROMECAST ULTRA is a peculiar product. On paper, it ought to be a must-buy: it's the cheapest 4K HDR TV streamer on the market, and it inherits all the things that made the original and second-generation Chromecasts great.

Just like its predecessors, the Chromecast Ultra makes the business of streaming video and audio from your phone, laptop or tablet to your TV incredibly simple, and the library of Chromecast apps is enormous. With a few notable exceptions, if you can stream something to your phone, you can cast it to your TV via Chromecast.

It's also cheaper than any 4K Blu-ray player, including the Xbox One S; it's £10 less than the Amazon Fire TV with 4K UHD, which doesn't handle HDR; it's far more cost-effective than the new Nvidia Shield TV (page 22); and it's certainly a cheaper way to get Ultra HD TV than stumping up for a Sky Q or BT TV contract.

And yet, buying a Chromecast Ultra is likely to be a pointless act. The reason for this is simple: anyone who owns a 4K TV right now will almost certainly have all the major sources of 4K content covered via embedded smart TV apps.

UNNECESSARY MEASURES

What's more, most smart TVs will actually provide broader coverage than the Chromecast Ultra. The Philips 49PUS6401 we tested it on, for instance, has Netflix, YouTube and Amazon Instant Video apps, which covers all your major sources of streamed 4K content today. Philips' Netflix app doesn't support HDR, but the Chromecast Ultra lacks the Amazon app entirely. Weirdly – and annoyingly – Google hasn't yet unlocked its 4K content on Google Play Movies in the UK, either.

There are some niche cases in which you might want the Chromecast, possibly if you haven't got a 4K TV but want a more future-proofed streamer than the standard Chromecast. Alternatively, you might really dislike your smart TV apps and want to control everything from your smartphone instead. Expanding your library of 4K content sources, however, is not a worthwhile reason.



That's a shame, because technically, the Chromecast Ultra works just as well as its Full HD and audio-only counterparts. Getting it hooked up is a little more involved because, unlike previous Chromecasts, the Chromecast Ultra can't be powered via a spare USB port on your TV. Instead, it must be plugged into a wall socket via the bundled USB mains adaptor.

You do get the option of connecting via Ethernet in addition to Wi-Fi, though, via a port in the mains adaptor – useful if your Wi-Fi isn't reliable enough to stream 4K.

PUCK OF THE DRAW

Once you've done that, it's plain sailing. The disc-shaped Ultra is a little larger and thicker than the standard Chromecast, but it's just as easy to find a place for behind your TV, thanks to the integrated HDMI extension ribbon. The Google Home app is similarly simple, helping to get you casting 4K to your TV from your smartphone, tablet or laptop in minutes.

One thing to note is that with some TVs, you might need to set the Chromecast Ultra to 50Hz mode before using it. We weren't able to see the setup screen on the TV at all until we'd flicked that switch.

The beauty of the Chromecast system is that as you cast video, you can go back to using your phone as normal to answer phone calls, browse the web or use any other app. The Chromecast handles everything else, pulling the stream from the internet, decoding it and piping it through to your TV. You can still control the volume, pause the stream and scrub back and forth using your phone.

The only small frustration is that it can take a little longer – around 30 or 40

seconds – for streams to flick into full 4K. Once it does this, however, the quality of the image, especially HDR content, is great. The dark scenes in *Marco Polo* looked particularly moody and crisp, with candlelight gleaming fiercely out of the murky shadows.

You'll need around 25Mbit/s of broadband connection to stream in 4K, but this shouldn't be an issue for most people. It might be a problem if your TV is sitting in a Wi-Fi dead spot, but most modern routers should be capable of delivering the required bandwidth, even over moderate distances.

PLUG AND PLAY

We've always liked Google's Chromecast devices; they're easy to use, a doddle to set up, and they work beautifully well. The Chromecast Ultra isn't any different, but it's the first we're struggling to recommend.

To reiterate, it's nothing to do with the quality of the device – it's just that if you own a 4K-ready TV, you probably already have a greater breadth of 4K content services built into it. There's no need to fork out £69 (which, by the way, is more than double what the Full HD Chromecast costs) for something you already have. Of course, you could say the same about the Fire TV with 4K UHD, but at least that comes with Amazon Instant Video.

Jonathan Bray



SPECIFICATIONS

VIDEO OUTPUTS HDMI • **NETWORKING** 802.11ac Wi-Fi, Ethernet • **DIMENSIONS** 58x58x14mm • **STREAMING FORMATS** Chromecast • **INTERNET STREAMING SERVICES** Google Play Music & TV, Netflix, BBC iPlayer, YouTube • **WARRANTY** One year RTB • **DETAILS** www.google.com/chromecast • **PART CODE** GA3A00405A10

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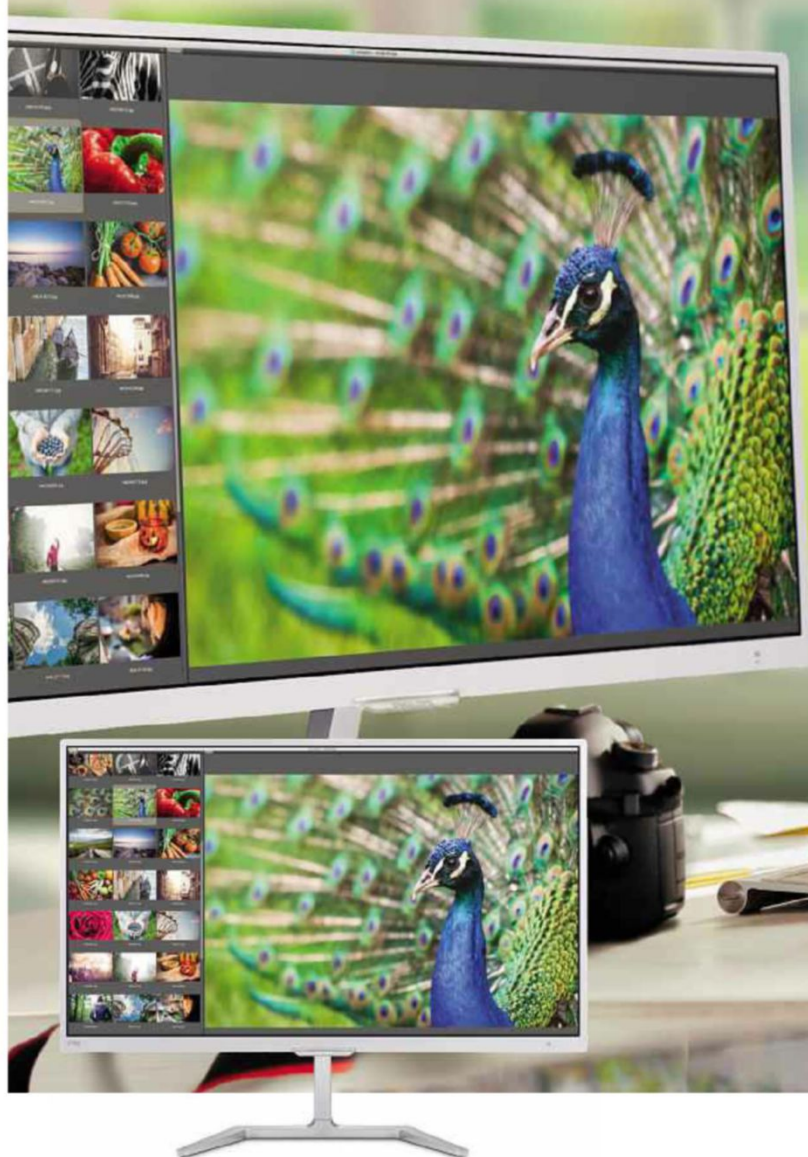


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PHILIPS

DOLBY ATMOS SOUNDBAR AND SUBWOOFER

PHILIPS Fidelio SkyQuake



£899 • From www.amazon.co.uk

VERDICT

Atmos without the atmosphere: the Philips Fidelio SkyQuake is expensive and disappointing

DOLBY'S ATMOS surround-sound technology is becoming both increasingly prevalent (even laptops and smartphones have begun integrating it) and steadily cheaper. The Philips Fidelio SkyQuake (previously known as the Fidelio B8/12) is the latest sub-£1,000 soundbar to join the fray, following the Samsung HW-K850.

An Atmos soundbar is still an investment, however, and the SkyQuake demonstrates that you don't currently get a huge amount for your money. Just like the HW-K850, it keeps the price down by not including any rear or side speakers – you just get the soundbar, a wireless subwoofer and a remote control in the box. That's slim pickings for almost £900.

ALTERNATE DIMENSIONS

Nonetheless, there's a reason Atmos costs so much: it adds another dimension to surround-sound audio height, much more clearly defining the origins of sound in a scene than just placing it on a left-right plane. Atmos soundbars make this work by bouncing sound off your ceiling with upward-firing speakers; the HW-K850 makes this work very well, creating a truly three-dimensional soundstage even without side and/or rear satellite speakers.

The SkyQuake is, in comparison, a disappointment. It offers a similar Atmos configuration to the Samsung, with a pair of upward-firing drivers providing the two height channels in a 5.1.2 setup. There are a total of 18 drivers in the soundbar, driven by 180W of amplification, and a single 8in driver in the subwoofer, driven by a 220W amp.

That all sounds impressive, yet sound effects lack the pinpoint positional accuracy of the HW-K850 and, more importantly, the three-dimensional quality of its rival soundbar is mostly lacking.

That's not to say the SkyQuake is a bad soundbar. Indeed, it offers some significant advantages over the HW-K850, mainly native compatibility with DTS Digital Surround signals (although not DTS-HD or Master Audio), whereas its rival only supports stereo DTS audio. It's also slimmer and sleeker, a consideration if you plan to position the bar in front of your TV.

We also rather like the Philips' matt-grey finish and remote control. The latter isn't as small and neat as the Samsung HW-K850's, but it's easier to use and feels more

responsive. The subwoofer is wireless, so you can position it wherever makes most sense, but it's imposingly tall and won't stow out of sight particularly easily.

TO THE WIRE

As for physical connectivity, the Philips is right up there with the HW-K850. You get two HDMI inputs with support for 30fps 4K passthrough, including one output that's ARC-enabled, so your TV can pipe audio back down to the soundbar. There's also a pair of S/PDIF outputs – one optical, one coaxial – plus a 3.5mm jack input and a USB port for connecting flash drives and MP3 file playback.

There's also NFC for easy pairing, and Bluetooth support for aptX, AAC and SBC codecs. Surprisingly, however, you don't get any kind of Wi-Fi connectivity, so you miss out on multiroom, Spotify Connect and DLNA server playback.

An Atmos soundbar is an investment, and the SkyQuake shows that you don't get a huge amount for your money

Of course, you're not going to be buying a soundbar just for Dolby Atmos. It also needs to play nicely with other surround-sound content, music and TV, and here the SkyQuake is a bit of a mixed bag.

Music is presented in an engaging manner, and the system delivers movie soundtracks with plenty of energy, while explosions and sound effects are administered with power and drive.

You can even add fake height to non-Atmos content by choosing between low, medium and high levels on the remote control. With live recordings, this can give music a touch more ambience, heightening background noises and widening the soundstage.

Be careful with this, though, especially when watching films: even without the Height effect applied, the soundbar has a tendency to over-accentuate high frequencies. With Height enabled to any degree, the SkyQuake sounds harsh at the top-end

and sound effects such as gunfire frequently overpower speech in the centre channel.

The subwoofer, although powerful, can't match the promise of its large dimensions. It simply doesn't reach down that low, rolling off as it does at 40Hz, and although it delivers film sound effects with plenty of impact, the deep bass rumble that the very best low-frequency speakers provide evades it entirely. You need to be careful where you put it, too.

OUTPLAYED

The biggest elephant in the room remains the Samsung HW-K850. It costs the same as the SkyQuake, yet produces audio that's infinitely superior, delivering a richer, more balanced sound, with far sweeter-sounding treble and a much more convincing Atmos effect.

The trouble with producing Atmos surround-sound products right now is that, although on the increase, they're still comparatively thin on the ground, and the

competition that does exist is extremely strong. If you're not as good as the competition, it's plainly obvious.

That's the problem for the Philips Fidelio SkyQuake. In isolation, it isn't a bad soundbar, but at this price it comes into direct competition with Samsung's HW-K850, and unfortunately it doesn't come close.

It doesn't sound as good; it doesn't produce as convincing a height effect; and it doesn't offer as comprehensive a list of features. It would have to be £200 cheaper to even start to offer a tempting alternative.

Jonathan Bray

SPECIFICATIONS

SPEAKERS 18 • **RMS POWER OUTPUT** 180W (soundbar only), 400W (soundbar and subwoofer) • **DIMENSIONS** 1,058x52x120mm (soundbar), 240x510x302mm (subwoofer) • **WEIGHT** 12kg • **DOCK CONNECTOR** None • **NETWORKING** NFC, Bluetooth 4.0 (aptX, AAC and SBC) • **WARRANTY** One year repair and replace • **DETAILS** www.philips.co.uk • **PART CODE** B8/12



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VERDICT

Comprehensively capable, the Fujifilm X-T2 is the best mirrorless camera on the market

THE FUJIFILM X-T1 was a high watermark for mirrorless camera design and has remained among our favourite cameras since its launch in 2014. Its video capture wasn't up to much, and rival cameras were faster, but sublime ergonomics meant taking photos was an absolute pleasure and inspecting the resulting photos was an equally rewarding experience.

The X-T2 builds on its predecessor with 4K video recording, faster performance, dual card slots and a new 24-megapixel sensor with 169 phase-detect autofocus points built in.

The X-T1's top plate was covered with dials and switches for direct access to drive mode and exposure-related functions; the X-T2's ISO speed and shutter-speed dials are a little chunkier and easier to grip. The lock buttons in the centre of each dial are now latching so you can leave them locked or unlocked depending on your preference, and there's a new mini joystick on the back for shifting the autofocus point.

The 3in screen tilts up and down as before, but on the X-T2 it also tilts out to the side by 45 degrees – handy for waist-level shooting when in portrait orientation.

LOOKING GLASS

The electronic viewfinder is the same as the one on the X-T1, and few other cameras can match its enormous 0.77x magnification. With a 2.4 million dot resolution, very short blackout time during capture, and the



ability to show the full gamut of camera settings and menus, we'd argue that this is at least as good as using an optical viewfinder on a professional DSLR.

As before, the magnesium body is weather-sealed to protect it from the elements. This time there are twin SDXC slots behind a door on the side of the camera, each supporting cards up to 256GB in capacity. On the other side there are USB3 and Micro HDMI sockets, a 3.5mm microphone input and 2.5mm wired remote socket.

There's also a PC sync socket on the front of the camera for triggering off-camera flash systems. Wi-Fi is included, with the companion app for Android and iOS devices providing remote shooting for photos and videos. This includes control over exposure compensation, autofocus point, ISO speed, white balance, flash, film simulation and self-timer settings. Managing the Wi-Fi connection is cumbersome, though.

The spec sheet looks even more impressive when you add the VPB-X-T2

vertical grip unit, or Power Booster Grip, to use Fujifilm's name for it. It costs £299 and holds two more batteries (bought separately for around £60 each), increasing battery life from 340 to 1,000 shots. It includes an additional shutter release button and various other controls for improved ergonomics when shooting in portrait orientation. The unit adds another 369g to the weight of the camera and some extra chunkiness to the existing grip on the camera.

HOLD STAR

These features are common for vertical grip units that are available for upmarket SLRs. This one goes further, with a power socket for the bundled mains adaptor, which can simultaneously charge both batteries or run the camera directly from the mains – extremely useful for long video shoots. The 3.5mm headphone socket built into the grip will please videographers, too.

The grip also boosts various aspects of performance. Continuous shooting increases from 8fps to 11fps, making this one of the fastest mirrorless cameras currently available. Fujifilm also claims improved performance in normal use, with blackout time down from 130ms to 114ms, autofocus speed down from 80ms to 60ms and shutter lag down from 50ms to 45ms. The viewfinder also becomes smoother, with a 100fps rather than 60fps refresh rate. Video recording increases to 30 minutes per clip, up from 10 minutes for 4K and 15 minutes for 1080p. Recordings span multiple 4GB QuickTime files, and after reuniting them in editing software there were no glitches in the video or audio.

STAY SHARP

These figures – particularly the 11fps continuous mode – make the X-T2 a serious contender for wildlife and sports photography. It surpassed expectations in our tests, hitting 11.3fps and lasting for 87 JPEGs or 27 Raw frames before slowing. Even at this point it still managed 5fps JPEGs or 3.5fps Raw with a fast card.





Continuous autofocus is available at this speed, with the camera slowing down a little whenever it had to update the focus.

Continuous autofocus is reliable, thanks to the X-T2's 13x13 grid of phase-detect autofocus points – this informs the camera not just whether the subject is in focus, but if not, by how much. Testing with the 100-400mm telephoto lens, the X-T2 did a passable job of tracking subjects around the frame and keeping them in focus. The results varied widely depending on the complexity of the scene, speed of movement and overall brightness, but we found that its success rate was around 40%. That's not too shabby, even if it doesn't match the Nikon D500 (*Shopper* 344) for high-speed subject tracking.

The X-T2 handled sedentary subjects better. Face detection is now available as a separate menu option to other autofocus settings, so you can choose to place the autofocus point at a specific part of the frame and have the camera switch to face-detection mode when it finds a face. It's also possible to focus on the left or right eye.

Shot-to-shot times in single drive mode are slow by today's standards, averaging 0.7 seconds. This fell to around 0.4 seconds by switching to back focus, where the shutter button simply takes a picture and autofocus is updated only when the AF-L button is pressed. For comparison, the Nikon D500 focused and took a picture every 0.2 seconds in single drive mode.

MOVIE MAKER

Other than some slight aliasing artefacts in 4K footage, video capture quality is a huge improvement on its predecessors. It's most impressive at fast ISO speeds, with less visible noise at ISO 3200 than the Panasonic GH4 or the Canon EOS 5D Mark IV. 4K videos are recorded as QuickTime files with AVC compression at 100Mbit/s and a choice of 23.98fps, 24fps, 25fps or 29.97fps frame rates. Full HD videos are at 42Mbit/s and add 50fps and 59.95fps frame rates. Aliasing in 1080p footage is also vastly improved over previous Fujifilm X series cameras.

This high picture quality needs to be backed up by some capable video features,

and here the X-T2's results are mixed. There's full control over shutter speed and aperture settings, but the ISO speed can't be adjusted during capture, while the remote app for Android and iOS devices doesn't allow any adjustment of any settings while recording.

HUES ON FIRST

Setting the shutter speed and aperture manually and the ISO speed to Auto meant the camera would adjust the exposure automatically by varying the ISO sensitivity,

that the X-T2's JPEGs are more dependable than most cameras' JPEG output.

DO IT YOURSELF

The Auto ISO mode could be more sophisticated, though. It can be customised with upper and lower ISO speed limits, plus a shutter speed that acts as a threshold for automatic ISO adjustments. It's a decent system, but other cameras can take the focal length or moving subjects into account when picking the best shutter speed. Without these options, the X-T2 puts more pressure

For stills, the X-T2's 24-megapixel sensor bites at the heels of full-frame sensors for noise levels and dynamic range

but it took around eight seconds to react to changing light conditions. Fujifilm's Film Simulation presets are available for video, but the F.Log profile that gives a flat colour profile – the ideal starting point for colour grading in editing software – is only available when recording to external recorders via the HDMI output.

Video autofocus can be set as fixed or continuous, and there's also a separate Movie AF mode with a choice of Multi or Area settings: the latter let us place the autofocus point and move it during recording, but it wasn't hugely reliable at locking on to subjects, and face detection is only available at 1080p. On the upside, manual focus for video is well implemented, with a numerical readout of the focus distance and a peaking mode that highlights areas of the scene that are in sharp focus.

For still shooting, the X-T2's new 24-megapixel sensor is a series best, biting at the heels of full-frame sensors for noise levels and dynamic range. Colour rendition is very pleasing, and automatic exposures are expertly judged.

We did notice some noise in JPEGs at ISO 400 to 800, but processing Raw files in Lightroom sidesteps this issue. Paradoxically, noise levels were kept under control all the way up to ISO 3200, and overall we'd say

on the user to find the right shutter speed to balance noise levels against motion blur.

It isn't perfect, but the X-T2 raises the bar considerably for video, while keeping all that we loved about the X-T1: great controls, superb stills quality and a robust, weather-sealed body. The improved performance also means it's a contender for action photography, particularly with the Power Booster Grip.

We'd have liked more reliable autofocus for burst stills and video shooting, plus a faster turn of speed in single drive mode. However, the bottom line is that this camera delivers the goods across a broad range of challenging shooting conditions.

Ben Pitt

SPECIFICATIONS

SENSOR RESOLUTION 24 megapixels • **SENSOR SIZE** 23.6x15.6mm (APS-C) • **FOCAL LENGTH MULTIPLIER** 1.5x • **VIEWFINDER** Electronic (2.36 million dots) • **LCD SCREEN** 3in (1.04 million dots) • **VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE)** 0.77x, 100% • **WEIGHT** 507g • **DIMENSIONS** 92x143x51mm • **WARRANTY** One year RTB • **DETAILS** www.fujifilm.eu/uk • **PART CODE** 16519273



See page 72 for performance details

TADO Smart Radiator Thermostat



£59 • From www.tado.com

VERDICT

Neat looking controls and great presence detection make this a great way to take full control of your home's heating

SMART HEATING SYSTEMS are proven to save money. Most just replace your existing thermostat with a smart version, replicating the heating system you have already. A better option is to have room-by-room control via smart thermostats. The first system to do this, Honeywell's Evohome, was very powerful, but comparatively expensive to get started with. With its Smart Radiator Thermostat, Tado has created a more flexible system.

There are two ways of installing the Smart Radiator Thermostat. First, you can keep your existing heating system and only replace your existing thermostatic radiator valves (TRVs) with Smart Radiator Thermostats. You can replace as many TRVs as you like, and there's no reason to do your entire home in one go. In this mode, the Smart Radiator Thermostats can't turn your boiler on or off for heat on demand, and heating is provided by your boiler control's schedule. However, you still control each room individually. As the Tado thermostat lets you set a room's temperature, it's a far more accurate method of control than a dumb TRV's simplistic settings.

JUST HEAT IT

The second option is to use the Smart Radiator Thermostat in conjunction with the Tado Smart Thermostat, either as a new installation or by adding to an existing one. Both the older v2 Bridge and the new v3 Bridge, which supports Apple HomeKit, are supported. In this mode, the Smart Radiator Thermostats can call for heat on demand, so dialling up the temperature in a room will

start the boiler. A kit with two Smart Radiator Thermostats and the v3 Bridge costs £179, with additional Thermostats costing £59 each.

Installing Smart Radiator Thermostats can easily be done if you have existing TRVs. Following the simple in-app instructions to register the new Smart Radiator Thermostats, you just unscrew the old TRVs. Then you screw in the new Tado adaptor (three adjustment rings are provided in the box to support all TRV types), and plug in the new Smart Radiator Thermostat. We had ours up and running in no time at all.

Once added into your home, you need to tell the app which zone (or room) you want a Smart Radiator Thermostat to be part of. You can add multiple Smart Radiator Thermostats into one zone, which is handy for rooms with multiple radiators. All Smart Radiator Thermostats in a zone operate on the same schedule, and a temperature change is applied to all devices. One device has to be set as the master for measuring temperature, so the system knows when to shut down.

IN THE ZONE

If you have a Tado Smart Thermostat, you should add it to the same zone as the Smart Radiator Thermostats located in the same room. It may make sense to add the Thermostat as the master device, as it lets you set decimal-precise temperatures; the Smart Radiator Thermostats let you increase or decrease the temperature in 1°C increments only. You can also use Smart Thermostats if your radiator is enclosed, throwing the Smart Radiator Thermostat's temperature sensor off; there's an offset option in the app to help with this, too, if the temperature reading is only slightly off.

We were impressed with the quality of the Smart Radiator Thermostats. The neat, soft-touch plastic Thermostats look great and are nicer to look at than the more industrial-looking Evohome valves. A dial on top springs the LED screen into action when it's turned, first showing the current temperature. You can then continue

turning the dial to turn the temperature up or down. How long the change lasts depends on the in-app setting: you can set it so that changes

are permanent, last until the next scheduled change or for a set period. Honeywell's advantage is that its TRVs are more powerful, have 0.5°C temperature increments and a unique window mode that turns the heating off if you open a window or door. Each thermostat is powered by two AA batteries, which should last for around two years.

Tado's real power comes from its app. From here you can set a different heating schedule per zone, and you can choose to have a different schedule every day, separate week and weekend settings, or just the same schedule every day. Annoyingly, there's no way to copy a schedule between zones, so you have to start from scratch for each one.

WARM WELCOME

There's also an Away mode schedule, which you use when Tado's excellent presence detection kicks in, turning off your heating when you're out and turning it on when you get back home. Tado's presence detection is one of the best, and has worked reliably for us every time we've used it. The app supports multiple occupants, so your heating will only turn off when everyone is out.

Alexa integration means you can control each zone using voice commands. Alexa's temperature changes are handled by the in-app setting you choose. We found it worked perfectly and was quick to make changes.

Sleek controls and a lot of flexibility make the Tado Smart Radiator Thermostat a clever way to control your home's temperature, particularly if you already have a Tado Smart Thermostat. However, Honeywell's Evohome is slightly more powerful, its TRVs have more settings, and the app is clearly designed for managing multiple zones, including copying schedules between devices.

David Ludlow



SPECIFICATIONS

COMPATIBILITY Requires radiators with TRVs • **APPS** iOS, Android and web • **DIMENSIONS** 76x52x52mm • **WEIGHT** 178g • **WARRANTY** Two years RTB • **DETAILS** www.tado.com • **PART CODE** SK-2SRT01V1B01-TC-UK-03

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PREMIUM FITNESS TRACKER

HUAWEI Fit



£152 • From www.amazon.co.uk

VERDICT

The Huawei Fit is a far more convincing fitness band than the Chinese company's previous effort – even at over double the price

LAST YEAR'S HONOR

Band Z1 (*Shopper 343*) was a likeable fitness tracker, albeit a very forgettable one – the kind of wearable that's fine in general but doesn't excel in any particular area. This may have had something to do with the fact that it tried to squeeze quasi-smartwatch niceties on to what could have been a dedicated workout aid.

Fortunately, Huawei (which owns the Honor brand) has fully embraced fitness for its latest wearable. You could argue that this is a response to how the wearables market is shifting; casual smartwatches are struggling, while trackers for fitness fanatics have become dominant. Even Apple has switched lanes, with the more sports-focused Apple Watch Series 2.

For Huawei, the move definitely pays off. There's no question as to who the Huawei Fit is aimed at – not just because of the name, either – and while it costs more than twice as much as the Band Z1, it's certainly a much more memorable device.

A VIRTUOUS CIRCLE

That said, the two devices do look physically similar. Both have monochrome displays to boost battery life, both have textured

rubber straps, and both have circular displays. All of these things may be true, but in every instance the Huawei Fit is better. The strap feels less plasticky and cheap, the monochrome screen looks sharper (its resolution is 208x208 pixels, compared with the Z1's 128x128), and the circular screen is used much more effectively. While the Z1 had a very obvious black box blocking things off around the edges, content goes right to the edge of the Fit's display, and sometimes neatly curves around it.

That's not to mention that it simply looks better, too.

The curved metal case goes all the way around, and the screen is protected by tough Gorilla Glass 3. It's light, sleek and extremely comfortable.

True, the monochrome nature of the display makes it look more Pebble than Apple Watch, but in the sports watch market that's a sacrifice worth making. The Huawei Fit promises up to six days of battery life, and that seems to be under very heavy use – we still had 50% charge after five days, which only included one serious workout, but was still occupied with passive step- and sleep-tracking, as well as normal time-telling usage.



On top of that, the Huawei Fit packs a heart-rate monitor, which is probably the chief reason for such a big step up in price. It stays active constantly throughout the day, giving you an idea of how your average heart rate changes over time. Despite this potentially delicate feature, the Fit is rated as swimproof to both 5 ATM and the IP68 standard – meaning it should survive water pressure of around 50 metres. That's handy for both a few lengths in the pool and your daily shower.

FINGERTIPS AND TRICKS

There are no buttons, so you're relying 100% on the touchscreen here. Aesthetically pleasing as that is, we feel it's a mistake in a fitness tracker. Running is going to get the screen wet, either through sweat or rain, and such conditions make touchscreens fussy.

Generally, though, it works well enough. You swipe downward to cycle through the menus, and then tap an option you see. Going back or removing notifications is done with a swipe to the right. It's basic, but it works. You can also set up the watch to have minimal smart functions – the app allows you to pick and choose what notifications to display, and the screen is just about big enough to read short messages. You can't use the Fit to reply, though.

More importantly, it's good at diligently recording step and sleep data. Accuracy-wise, it can record about the same number of steps as the Fitbit Surge, Fitbit's most expensive tracker, when taken on an identical journey. Huawei's device does seem more willing to assume you're asleep when you're just lying still, but is still consistent day to day.



Despite the Huawei Fit lacking a GPS tracker, as the Surge possesses, the two produced surprisingly similar tracking results from a 40-minute game of football: the former somehow counted nearly 500 additional steps, but the distance travelled was quite close and calories burned was practically identical.

DROP THE BEAT

The Fit also came closer to the results of our dedicated chest-strap heart-rate monitor; these are more accurate than the green-LED optical sensors found in smartwatches, so if the Fit can get close, it's done all right. Following our football game, it reported an average of 139bpm with a peak of 166bpm – that's still not consistent with the chest strap's average of 150bpm and 187bpm peak, but it sure beats the Surge's average of 104bpm and peak of 129bpm.

As with most trackers, the Huawei Fit works closely with its mobile app, Huawei Wear. It's pretty basic when compared with TomTom's and Garmin's offerings, but has most areas covered. The home screen gives you an overview of your step, calorie and distance tally for the day; your cumulative exercise for the week; the option to kick off a training plan; recent heart activity; and how you slept last night. Tapping on any one of these will give you more data, as you'd expect.

The exercise breakdown is pleasingly detailed. You get graphs of your steps per minute and your heart rate, but you can also break things down into raw numbers, namely duration, average pace, calories, average speed, average heart rate, average steps, total steps, pace, maximum oxygen intake and estimated recovery times. It also has a bar telling you how good a workout this has been, giving you a nice incentive to do better next time.

That, in all likelihood, will be detailed enough for most people. Where Huawei Wear lags behind its rivals is on connectivity and social features. The best fitness apps can plug into others, swapping data between them, and that feature is here, but in a really limited way. Huawei Wear currently offers just three choices: Up by Jawbone, Google Fit and MyFitnessPal. It's a strange and pretty unsatisfying selection.



How much you care about the lack of social features will depend on your attitude to fitness. Some people need a rival to spur them on or offer encouragement; others are fine just doing their own thing. There doesn't seem to be any kind of social integration in Huawei Wear:

The curved metal case goes all the way around, and the screen is protected by tough Gorilla Glass 3. It's light, sleek and extremely comfortable

just you and your stats. That's understandable given Huawei is a relative newcomer to this industry. Perhaps it simply doesn't have the community within its ecosystem to justify the feature yet.

POWER SHOWER

As mentioned, Huawei's battery estimate seems to be underestimating itself if anything (though you should always take such figures with a large pinch of salt) – a strong vindication of the decision to go with a monochrome screen, as well as forgo any GPS functionality. Unfortunately, the swimproof nature of the Huawei Fit means you're looking at another proprietary charger. It's a small white plastic dish that the watch clips into. No need to remove the straps – it will sit in there.

It's completely flat, so it won't be a makeshift night clock like other smartwatches.

That's a shame, but then again it's probably best not to use it as your bedside timepiece, given that it has great battery life as it is, and is supposed to be on your wrist tracking your sleep.

The charging speed is pretty average for a wearable. It takes about an hour to charge from 50% to full, so around two hours for a full recharge. Still, given the incredible battery life it has in action, you can't really complain too much over something you'll need to do less frequently than once a week.

FIT FOR PURPOSE

The Huawei Fit is an extremely likeable wearable. Huawei's decision to embrace fitness rather than generic smart functions is a good one, and this is a decent alternative to the offerings from Fitbit, Garmin and TomTom.

It's a shame that the price has had to increase to match the functionality, though. At £152, the Huawei Fit is close to £100 more than the Honor Band Z1's current pricing,

and is notably more expensive than even the Fitbit Charge 2 and TomTom Spark 3.

The Huawei Fit has a number of things in its favour: astonishing battery life, a swimproof body, and a round face making it look more like a classic timepiece. However, the pricing gives it some tough opposition, especially if you're into the more competitive side of keeping fit. Most notably, Fitbit, Garmin and TomTom have stronger communities, on account of having been in the game for longer. If you're a lone wolf, you likely won't care, but for some a fitness tracker loses its sheen without that layer of competition and support that you get from a large community of fellow users.

Ultimately, it comes down to personal preference, but this is a strong contender and a tracker you definitely won't be disappointed by. The price may make it seem like a tough sell, but it won't let you down.

Alan Martin

SPECIFICATIONS

PEDOMETER Yes • **HEART-RATE MONITOR** Yes • **DISPLAY** SIZE 1in • **OS SUPPORT** iOS 8 and later, Android 4.4 and later • **BATTERY LIFE** Six days • **WARRANTY** Two years RTB • **DETAILS** consumer.huawei.com • **PART CODE** 55021528

OCR CONVERSION SOFTWARE

ABBYY FineReader 14

COMPUTER
SHOPPER
BUSINESS BUY



£249 • From www.abbyy.com

VERDICT

Fast, accurate and packed with features, this is the best optical character recognition software we've seen yet

OPTICAL CHARACTER RECOGNITION, or OCR, is the process of a computer identifying printed characters and re-creating them digitally – so you can create, save and edit digital copies of paper notes and documents. ABBYY's FineReader series has arguably been the king of consumer-grade OCR software for a few years now, thanks largely to 2015's excellent FineReader 12.

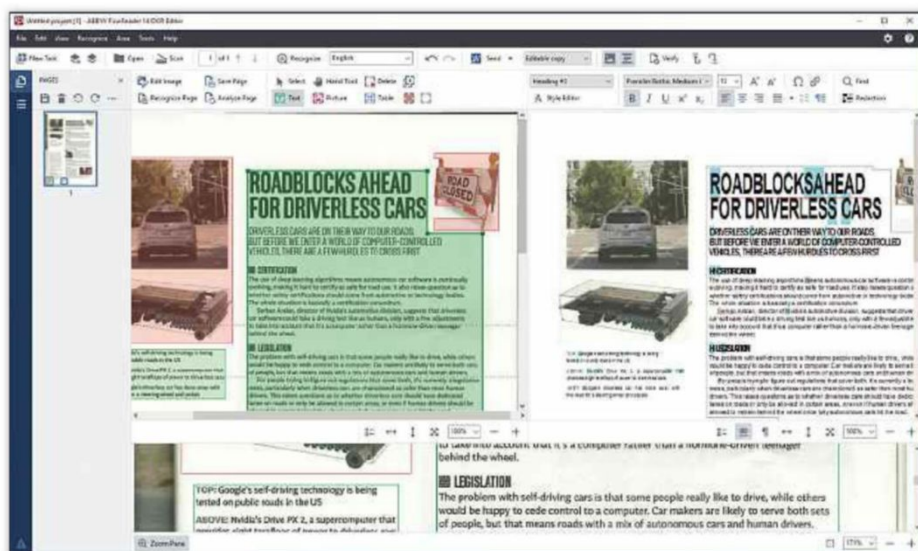
FineReader 14 (we don't know what happened to number 13 either – maybe it's superstitious) promises improved performance and a new suite of PDF editing tools, albeit at a steep starting price of £169. We reviewed the £249, SMB-targeting Corporate edition, which also adds a document comparison tool and automated processing – though happily, the core paper-to-digital conversion features appear to be identical across both versions.

FineReader 14 doesn't feel noticeably faster than its predecessor at converting documents into editable form, but it works quickly. It takes about five seconds to digitise a two-page, mixed text and colour PDF, and as in FineReader 12, you can start checking and editing the first few pages of a long document before the rest has finished processing.

PROOF, IF NEEDED

In fact, FineReader 14 does much of the work for you, with its spellchecker-like Verify tool. This highlights possible mistakes (where a character hasn't been correctly copied across) and takes you through them one at a time, so you can quickly fix them with the basic text-editing tools. It produces a lot of false positives, but in a way that's the preferable outcome – it's better for the software to be overly cautious than for it to miss errors.

It's very handy for getting the best results when converting, say, a PDF into a Word



↑ FineReader 14 does a pretty good job of interpreting even complex, image-heavy documents

document, but the main reason for buying OCR software is to digitise paper documents, and FineReader 14 makes this child's play. We simply had to place the document in our scanner, connect it to the PC, click Scan in the main menu and Scan to OCR Editor. You can also scan directly to Word, but it's safer to check it over in the OCR editor before saving the results as a .doc.

The processes involved with OCR mean – like speech-to-text – it is probably not going to be 100% reliable in terms of accuracy for a while. Nonetheless, FineReader 14 impressed us by how often it got everything right.

Unsurprisingly, it works best with simple text pages, with which it performs almost flawlessly. In our tests, the biggest mistake it made was confusing a hyphen for a – sign. Otherwise, it accurately replicated spacing, fonts, formatting (such as bold and underlined text), small tables and other symbols. There were no kerning mishaps (such as 'cl' being mistaken for 'd') either.

COPY RIGHT

It can struggle a bit more with complex documents. We scanned in a *Shopper* page with multiple text paragraphs, subheaders and colour images and there were a few mistakes in the converted file, including the headline lacking spaces between words and some small graphics of tyre tracks, which we'd used as bullet points, appearing as H1, H1, H or 8.

Otherwise, however, it was fine. There were no nonsense words in the processed text, typeface differences were preserved and images were all in the right place.

FineReader 14 also works decently with data tables, although it's not as good as it is with text documents. When we tried converting a large laptop specs sheet into an Excel table, several symbols went missing and cell colouring wasn't replicated, but the vast majority of data was still digitised accurately. With the Verify tool, fixing the mistakes was certainly faster and less tedious than manually entering all the data would have been.

The new PDF editor was also a nice surprise. It's a comprehensive set of tools for what is ultimately a secondary concern to the OCR: we could add mark-up notes, text boxes and images, draw lines and shapes, redact or remove passages, insert a signature or secure the PDF with added password protection.

It's almost on a par with dedicated PDF editing suites such as Foxit PhantomPDF, and will definitely do the job for basic touching-up and collaborative work. You can save the edited PDF as a Word, Excel or PowerPoint file, so you can continue working on it in more familiar software. There's support for several other file types, such as .html, .txtm and .odt, as well.

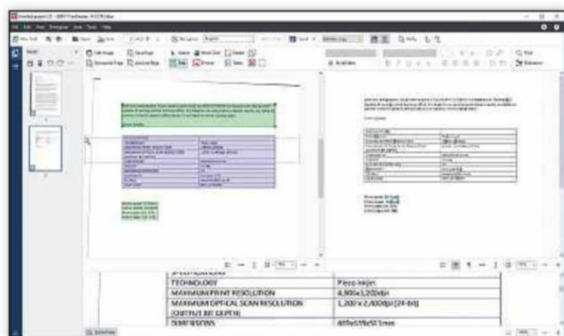
SEARCH FOR CLUES

The Corporate edition's Compare tool is a slightly different use of OCR: it analyses two versions of the same document and highlights differences between them. It's very thorough, being able to pick up inconsistencies as small as an errant comma, and makes it easy to search through differences by listing them in a panel on the right. You can compare across different file types, too – useful for checking if the Word and PDF versions of a document are consistent, for instance. Even image file types such as JPGs can work, as FineReader 14 will be able to read any text in the picture.

It's fitting that this is only in the Corporate edition, as we see it being used to compare versions of vital documents such as contracts. In fact, since the main differences between the standard and Corporate editions are the Compare tool and automated processing of larger documents, the standard edition will be a better deal for most home users. You'll save £80 and will still get the meat of what makes FineReader 14 so good: accurate OCR, easy file conversions and the new editing tools.

This is a great package for home users, but gets our Business Buy award for those dealing with huge or more important documents.

James Archer

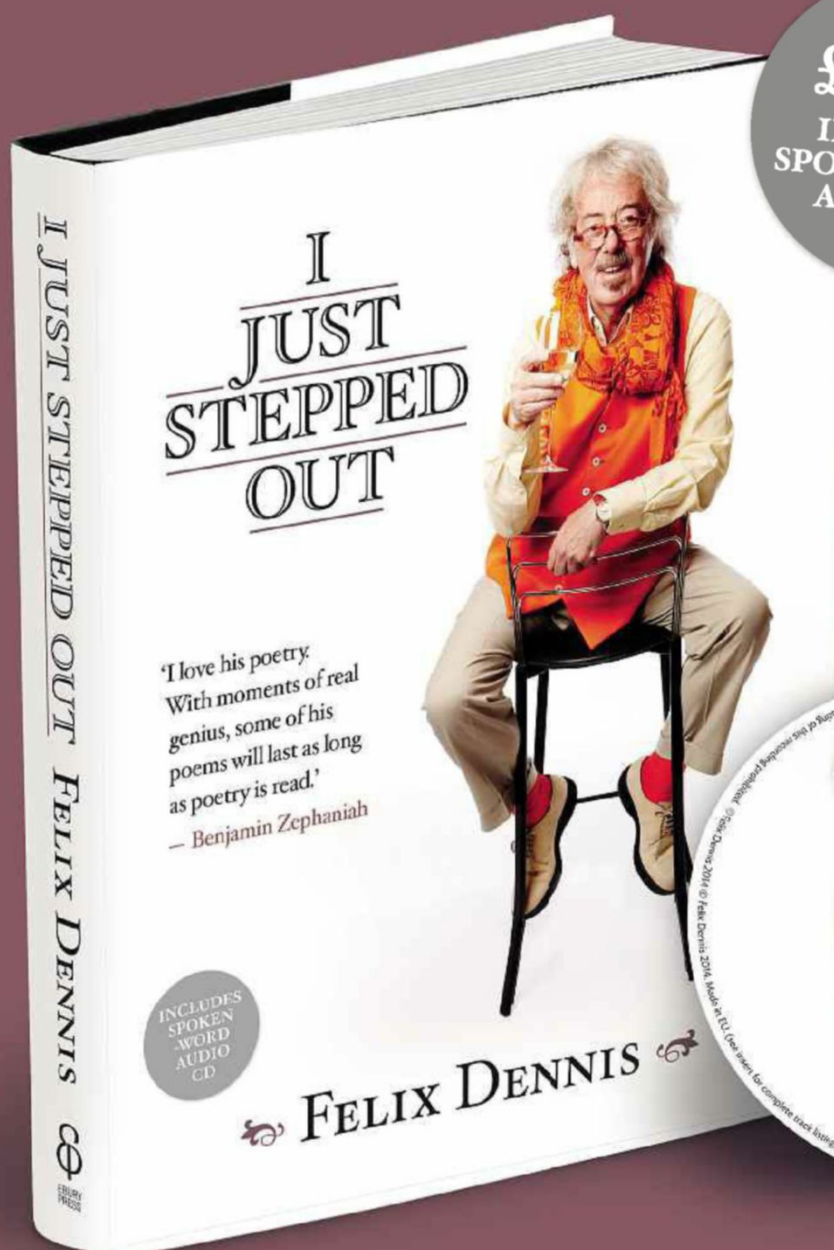


↑ You can compare different versions of the same document

SPECIFICATIONS

OS SUPPORT Windows 7/8/8.1/10 • MINIMUM CPU 1GHz • MINIMUM RAM 1GB plus 512MB per additional CPU core • HARD DISK SPACE 2.4GB • DETAILS www.abbyy.com • PRODUCT CODE FineReader 14

I JUST STEPPED OUT



RRP
£12.00
INCLUDES
SPOKEN-WORD
AUDIO CD

‘His poetry sings
like a summer
breeze through
the fairground.’

— Sir Paul McCartney



A startlingly honest and intense collection, *I JUST STEPPED OUT* is a kind of ‘last will and testament’ in verse. Written by Felix Dennis after his diagnosis with terminal cancer, these poems chart his physical, emotional and psychological journey.

Available now from Amazon and all good booksellers.



For more information on Felix Dennis go to: www.felixdennis.com

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 that 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 950 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 970.

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 quad-core or even a hex-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 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 the latest USB3 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

ALIENWARE Aurora

★★★★★

£1,339 • www.dell.co.uk

COMPUTER SHOPPER
RECOMMENDED

You'd be forgiven for associating Alienware with gaudy, overpriced gaming PCs, but the Aurora couldn't be more different. It's a refined yet powerful system, contained in a clever unfolding chassis that minimises bulk while leaving room for watercoolers or even a second GPU.



PROCESSOR Quad-core 4.7GHz Intel Core i7-6700 • **RAM** 8GB • **FRONT USB PORTS** 4x USB3 • **REAR USB PORTS** 6x USB2, 3x USB3, 1x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 256GB SSD, 1TB SSHD • **GRAPHICS CARD** 8GB Nvidia GeForce GTX 1070 Founder's Edition • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year onsite • **DETAILS** www.dell.co.uk • **PART CODE** D00AWR503 • **FULL REVIEW** Feb 2017

YOYOTECH Warbird RS C6

★★★★★

£1,000 • www.yoyotech.co.uk

COMPUTER SHOPPER
BEST BUY

A GeForce GTX 1070 makes the RS C6 even more powerful than its excellent cousin, the Warbird RS15, and its roomy chassis is more expandable as well. An overclocked Core i5 processor also makes short work of most tasks, while a big 1TB hard disk complements the nippy 120GB SSD.



PROCESSOR Quad-core 4.4GHz Intel Core i5-6600K • **RAM** 8GB • **FRONT USB PORTS** 2x USB2, 2x USB3 • **REAR USB PORTS** 2x USB2, 4x USB3 • **TOTAL STORAGE** 120GB SSD, 1TB hard disk • **GRAPHICS CARD** 8GB MSI GeForce GTX 1070 Aero • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Three years labour including one year parts and labour • **DETAILS** www.yoyotech.co.uk • **PART CODE** 1012019 • **FULL REVIEW** Feb 2017

CHILLBLAST Fusion Hubble

★★★★★

£1,000 • www.chillblast.com

COMPUTER SHOPPER
BEST BUY

One of the first PCs we've seen to take advantage of Intel's latest Kaby Lake processors, the Fusion Hubble excels at compute tasks thanks to its overclockable Core i5-7600K. A GTX 1060 also allows for nippy games performance, and you get a good-sized SSD, watercooling and a long warranty to sweeten the deal.

NEW ENTRY



PROCESSOR Quad-core 4.6GHz Intel Core i5-7600K • **RAM** 8GB • **FRONT USB PORTS** 2x USB2, 2x USB3 • **REAR USB PORTS** 2x USB2, 4x USB3, 1x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 250GB SSD, 1TB hard disk • **GRAPHICS CARD** 3GB Palit GeForce GTX 1060 Dual • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Five years labour including two years collect and return • **DETAILS** www.chillblast.com • **PART CODE** Fusion Hubble • **FULL REVIEW** Apr 2017

PALICOMP AMD Avenger

★★★★★

£500 • www.palicom.co.uk

COMPUTER SHOPPER
BEST BUY

It's not the most stylish or upgradable PC, but the AMD Avenger manages astounding frame rates in 1080p games for a £500 system. It has premium-grade storage, too, combining a 1TB hard disk with a speedy 240GB SSD.



PROCESSOR Quad-core 4GHz AMD Athlon X4 880K • **RAM** 8GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 4x USB2, 2x USB3 • **TOTAL STORAGE** 240GB SSD, 1TB hard disk • **GRAPHICS CARD** 4GB AMD RX 460 • **OPERATING SYSTEM** Windows 10 Home 64-bit • **WARRANTY** Three years RTB • **DETAILS** www.palicom.co.uk • **PART CODE** KAV3 • **FULL REVIEW** Aug 2016

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 15.4in screen and weigh around 2.4kg, 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 960M. Good gaming laptops tend to have large 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 an 11in or 13in 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 ultra-portable 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 Netbooks are a type of small, low-cost ultra-portable laptop. They're fine for light use, but avoid them if you want to do complicated tasks.

LAPTOPS

RAZER Blade Stealth



£1,250 • www.razerstore.com



Razer has stepped away from its



traditional focus on gaming devices to create the definitive ultra-portable laptop: it's thin, light, has a vibrant screen and gleans good performance from its Kaby Lake processor. The Chrome backlit keyboard is also hands-down the best laptop keyboard we've ever used.

PROCESSOR Dual-core 2.7GHz Intel Core i7-7500U • **RAM** 16GB • **DIMENSIONS** 300x104x43mm • **WEIGHT** 1.29kg • **SCREEN SIZE** 12.5in • **SCREEN RESOLUTION** 2,560x1,600 • **GRAPHICS** ADAPTOR Intel HD Graphics 620 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.razerone.com • **PART CODE** Razer Blade Stealth QHD • **FULL REVIEW** Mar 2017

LENOVO Yoga Book



£450 (Android), £500 (Windows) • www.currys.co.uk



The Yoga Book is a genuinely innovative



convertible: the fully virtual keyboard can give way to a smooth, flat writing surface, perfect for drawing or digitising notes. Both the Android 6.0 and Windows 10 models include an Intel Atom chip, and measure just 9.6mm thin.

PROCESSOR Quad-core 2.4GHz Intel Atom x5-Z8550 • **RAM** 4GB • **DIMENSIONS** 256x170x9.6mm • **WEIGHT** 960g • **SCREEN SIZE** 10.1in • **SCREEN RESOLUTION** 1,920x1,200 • **TOTAL STORAGE** 64GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** www.lenovo.com/uk • **PART CODE** ZG38C01299 • **FULL REVIEW** Feb 2017

ACER

Chromebook R 11



£229 • www.tesco.co.uk



The Acer Chromebook R 11 is the most attractive and practical budget Chromebook you can buy, with exceptional build quality, top processing and a lovely display.



PROCESSOR Dual-core 1.6GHz Intel Celeron N3050 • **RAM** 2GB • **DIMENSIONS** 20x295x203mm • **WEIGHT** 1.2kg • **SCREEN SIZE** 11.6in • **SCREEN RESOLUTION** 1,366x768 • **GRAPHICS** ADAPTOR Intel HD Graphics • **TOTAL STORAGE** 16GB eMMC • **OPERATING SYSTEM** Chrome OS • **WARRANTY** One year RTB • **DETAILS** www.acer.co.uk • **PART CODE** ND.20411.07Q • **FULL REVIEW** Apr 2016

HP Spectre 13



£1,100 • www.currys.co.uk



A beautifully designed ultra-portable, the Spectre 13 is a mere 104mm thin but manages to cram in an Intel Core i7 processor, granting it exceptional performance for its class. It has a fantastically vibrant, sharp screen as well.



PROCESSOR Quad-core 2.5GHz Intel Core i7-6500U • **RAM** 8GB • **DIMENSIONS** 325x229x10.4mm • **WEIGHT** 1.1kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS** ADAPTOR Intel HD Graphics 520 • **TOTAL STORAGE** 512GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** store.hp.com • **PART CODE** 13-v001na • **FULL REVIEW** Nov 2016

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 is mainly used on Lumia phones. Apple iOS and Google Android have the most apps available but Windows Phone is slowly catching up.

02 All smartphones have colour screens, but their resolutions vary. Basic models have 800x480 pixels, but text can be indistinct. Look for a display that has at least 1,280x720 pixels so it's easy to browse web

pages. 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 10 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 Z Play

★★★★★

£350 SIM-free • www.debenhamsplus.com



Another laudable take on the modular smartphone, the Moto Z Play combines excellent attachments with great base specs, respectable performance and outstanding battery life of nearly 24 hours in our tests.



PROCESSOR Octa-core 2.0GHz Qualcomm Snapdragon 625 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 16 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **DIMENSIONS** 156x76x6.9mm • **WEIGHT** 165g • **OPERATING SYSTEM** Android 6.0 • **WARRANTY** One year RTB • **DETAILS** www.motorola.co.uk • **PART CODE** XT1635 • **FULL REVIEW** Mar 2017

SAMSUNG Galaxy S7

★★★★★

£499 SIM-free; free on £31-per-month contract • www.debenhamsplus.com (SIM-free); www.carphonewarehouse.com (contract)



Samsung's latest flagship is the best Android smartphone money can buy. It's not cheap, but you get superb build quality, an excellent display, top-tier performance and outstanding battery life.



PROCESSOR Quad-core 2.3GHz Samsung Exynos 8890 • **SCREEN SIZE** 5.1in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERA** 12 megapixels • **STORAGE** 32GB/64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 142x70x7.9mm • **WEIGHT** 152g • **OPERATING SYSTEM** Android 6.0 • **WARRANTY** One year RTB • **DETAILS** www.samsung.com/uk • **PART CODE** SM-G930F • **FULL REVIEW** Jun 2016

APPLE iPhone SE

★★★★★

£329 SIM-free; free on £23.50-per-month contract • www.apple.com/uk (SIM-free); www.carphonewarehouse.com (contract)



While it lacks the 3D Touch capabilities of the more expensive iPhone 6s, this tiny successor to the iPhone 5s exceeds all expectations. It's fast, light and includes a lovely 12MP camera.



PROCESSOR Dual-core 1.8GHz Apple A9 • **SCREEN SIZE** 4in • **SCREEN RESOLUTION** 1,136x640 • **REAR CAMERA** 12 megapixels • **STORAGE** 16GB/64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 124x59x7.6mm • **WEIGHT** 112g • **OPERATING SYSTEM** iOS 10 • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** iPhone SE • **FULL REVIEW** Jul 2016

ONEPLUS 3T

★★★★★

£399 SIM-free • oneplus.net/uk



This replacement for the OnePlus 3 isn't quite as big a bargain, but it still takes the 3's place as the best-value handset on the market, even more capable of taking on premium flagships with its Snapdragon 821 processor and a huge 6GB of RAM.



PROCESSOR Quad-core 2.35GHz Qualcomm Snapdragon 821 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 16 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 153x75x7.4mm • **WEIGHT** 156g • **OPERATING SYSTEM** OxygenOS (Android 7.0) • **WARRANTY** One year RTB • **DETAILS** oneplus.net/uk • **PART CODE** A3010 • **FULL REVIEW** Mar 2017

LG G5

★★★★★

£399 SIM-free; free on £28-per-month contract • www.ebuyer.com (SIM-free); www.carphonewarehouse.com (contract)



The LG G5 has a removable battery, wide-angle camera lens and superb performance, while its clip-on upgrade modules can add speakers, a backup battery and a 360° camera.



PROCESSOR Octa-core 2.2GHz Qualcomm Snapdragon 810 • **SCREEN SIZE** 5.3in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERA** 16 + 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **DIMENSIONS** 149x74x7.7mm • **WEIGHT** 159g • **OPERATING SYSTEM** Android 6.0.1 • **WARRANTY** One year RTB • **DETAILS** www.lg.com/uk • **PART CODE** LG-H850 • **FULL REVIEW** Jul 2016

MOTOROLA Moto G4

★★★★★

£160 SIM-free; free on £14.50-per-month contract • www.johnlewis.com (SIM-free); www.tescomobile.com (contract)



The best budget smartphone you can buy. From its sharp, 5.5in Full HD display to its slick performance and high-quality camera, you get much more out of this handset than its low price suggests.



PROCESSOR Octa-core 1.5GHz Qualcomm Snapdragon 617 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 13 megapixels • **STORAGE** 16GB/32GB • **WIRELESS DATA** 4G • **DIMENSIONS** 153x77x7.9mm • **WEIGHT** 155g • **OPERATING SYSTEM** Android 6.0.1 • **DETAILS** www.motorola.co.uk • **PART CODE** XT1622 • **FULL REVIEW** Sep 2016

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 is slowly becoming more 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

LENOVO ThinkPad X1 Tablet

★★★★★

£1,574 • www.pcworldbusiness.co.uk

COMPUTER SHOPPER
RECOMMENDED

The ThinkPad X1 Tablet isn't just another Surface Pro clone; its attachable modules provide it with a huge amount of flexibility, from adding extra battery life and connection ports to transforming it into a portable projector. Even better, it's a fast, attractive 2-in-1 in its own right.



PROCESSOR Dual-core Intel Core m7-6Y75 • **SCREEN SIZE** 14in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERA** None • **STORAGE** 256GB • **WIRELESS DATA** 4G LTE • **DIMENSIONS** 291x210x8.6mm • **WEIGHT** 725g • **OPERATING SYSTEM** Windows 10 Pro • **DETAILS** shop.lenovo.com • **PART CODE** SP40G76043 • **FULL REVIEW** Nov 2016

HUAWEI MediaPad M3

★★★★★

£310 • www.ebuyer.com

COMPUTER SHOPPER
RECOMMENDED

Android slates may have fallen out of fashion in favour of 2-in-1s, but the MediaPad M3 shows they can still be worth your cash. The Kirin 950 chip delivers massive processing power, and the sleek design and vibrant screen deserve your attention as well.



PROCESSOR Octa-core 2.3GHz Hisilicon Kirin 950 • **SCREEN SIZE** 8.4in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERA** 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **DIMENSIONS** 124x215x7.3mm • **WEIGHT** 320g • **OPERATING SYSTEM** Android 6.0 • **WARRANTY** One year RTB • **DETAILS** www.huawei.com/uk • **PART CODE** BTV-DL09 • **FULL REVIEW** Feb 2017

APPLE iPad Pro 9.7in

★★★★★

£549 • www.apple.com/uk

COMPUTER SHOPPER
RECOMMENDED

A smaller, more portable form factor makes the newest iPad Pro the best yet. With the same great display and quick A9X processor as its larger predecessor, its notepad size and compatibility with the Apple Pencil make it particularly suitable for artists.



PROCESSOR Dual-core 2.16GHz Apple A9X • **SCREEN SIZE** 9.7in • **SCREEN RESOLUTION** 2,048x1,536 • **REAR CAMERA** 12 megapixels • **STORAGE** 32/128/256GB • **WIRELESS DATA** 4G (cellular version) • **DIMENSIONS** 240x170x6.1mm • **WEIGHT** 437g • **OPERATING SYSTEM** iOS 10 • **WARRANTY** One year RTB • **DETAILS** www.apple.com/uk • **PART CODE** 9.7in iPad Pro • **FULL REVIEW** Jul 2016

MICROSOFT Surface Pro 4

★★★★★

From £749 (£1,099 as reviewed) • www.microsoftstore.com

COMPUTER SHOPPER
RECOMMENDED

The most compelling 'laptop replacement' tablet yet. Thinner, powerful and equipped with a gorgeous screen, this is a fantastic Windows 10 tablet. The Surface Pen and optional Type Cover have been improved as well.



PROCESSOR Dual-core 2.4GHz Intel Core i5-6300U • **SCREEN SIZE** 12.3in • **SCREEN RESOLUTION** 2,736x1,824 • **REAR CAMERA** 8 megapixels • **STORAGE** 256GB • **WIRELESS DATA** 4G • **DIMENSIONS** 292x201x8mm • **WEIGHT** 1.37kg inc Type Cover and power brick • **OPERATING SYSTEM** Windows 10 • **WARRANTY** One year RTB • **DETAILS** www.microsoft.com/surface • **PART CODE** Surface Pro 4 • **FULL REVIEW** Jun 2016

AMAZON Fire HD 8

★★★★★

£90 • www.amazon.co.uk

COMPUTER SHOPPER
RECOMMENDED

This is the budget tablet to beat. With a build quality seemingly beyond its low-cost nature and long battery life, the Fire HD 8 has plenty to offer for a mere £90.



PROCESSOR Quad-core 1.3GHz MediaTek MT8163 • **SCREEN SIZE** 8in • **SCREEN RESOLUTION** 1,200x800 • **REAR CAMERA** 2 megapixels • **STORAGE** 16GB • **DIMENSIONS** 214x128x9.2mm • **WEIGHT** 341g • **OPERATING SYSTEM** Fire OS • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Fire HD 8 • **FULL REVIEW** Jan 2017

AMAZON Kindle Oasis

★★★★★

£270 • www.amazon.co.uk

COMPUTER SHOPPER
BEST BUY

The Kindle Oasis is expensive by eReader standards, but you absolutely get what you pay for: a well-built, long-lasting device with a sharp screen and brilliant clip-on cover accessory.



PROCESSOR Not stated • **SCREEN SIZE** 6in • **SCREEN RESOLUTION** 1,440x1,080 • **REAR CAMERA** None • **STORAGE** 4GB • **WIRELESS DATA** None • **DIMENSIONS** 143x122x8.5mm • **WEIGHT** 131g • **OPERATING SYSTEM** Kindle OS • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Kindle Oasis • **FULL REVIEW** Aug 2016

Choosing a... Digital camera

01 A basic digital camera will suit someone who wants to take pictures to view on their computer and create 7x5in prints. It should cost around £80, but there may be hidden downsides such as slow performance and very basic user controls.

02 Spend a little more and you'll get a higher resolution. A 16-megapixel sensor has the potential to produce sharp prints up to A3 size, but only if it and the lens are of a suitably high quality. Very high resolutions in compact cameras tend to boost noise more than detail levels, so many of the best models strike a sensible balance by using a 12-megapixel sensor.

Back-illuminated CMOS sensors tend to produce less noise than CCDs, but

check our reviews to find out how a particular model performs.

03 A 3x zoom lens provides you with reasonable scope for framing your shots, but a larger range can do wonders for your photography. Most compact cameras can manage a 5x zoom, while pocket-size ultra-zoom cameras can provide 24x zoom ranges.

Numbers such as 28-105mm tell you the wide-angle and telephoto limits of the zoom range. Big zooms require optical image stabilisation to avoid blur due to camera shake when zoomed right in.

04 Most cameras now have a 3in screen. Look out for 460,000-dot or

921,000-dot resolutions for a sharper picture. A touchscreen is useful for moving the autofocus point.

05 Leave some room in your budget for a memory card, as the bundled memory provided with a camera is never enough. A 16GB card costs less than £10. You may also need to buy batteries.

06 Don't forget that a camera's specification tells you very little about its image quality. You'll need to read our reviews for that. With a compact camera, we believe the user shouldn't have to grapple with complicated controls in order to take great pictures in a range of lighting conditions.

PHOTOGRAPHY

SONY RX100 V

★★★★★

£999 • www.jessops.com

NEW ENTRY



COMPUTER SHOPPER
RECOMMENDED

It may be small, but the RX100 V is seriously fast, and because it also captures a surprising amount of light, image and video quality are both top-notch.

SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 13.2x8.8mm (1in) • FOCAL LENGTH MULTIPLIER 2.7x • VIEWFINDER Electronic (2,400,000 dots) • LCD SCREEN 3in (1,228,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 2.9x (24-70mm) • 35mm-EQUIVALENT APERTURE f/4.9-7.6 • WEIGHT 298g • DIMENSIONS 60x104x41mm • WARRANTY One year RTB • DETAILS www.sony.co.uk • FULL REVIEW Apr 2017

FUJIFILM X70

★★★★★

£495 • www.slrhut.co.uk



COMPUTER SHOPPER
BEST BUY

The X70 is an unusual mix of retro and modern design with its exposure dials and articulated touchscreen, but its great image quality, good price and charming looks is a winning combination.

SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 23.6x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER None • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 1x (28mm) • 35mm-EQUIVALENT APERTURE f/4.2 • LENS MOUNT Fujifilm X Mount • WEIGHT 349g • DIMENSIONS 66x125x47mm • WARRANTY One year RTB • DETAILS www.fujifilm.eu/uk • FULL REVIEW Jun 2016

PANASONIC Lumix DMC-FZ330

★★★★★

£427 • www.ukdigitalcameras.co.uk

COMPUTER SHOPPER
BEST BUY

A bridge camera with a huge 25-600mm zoom range that maintains a fast F2.8 aperture across the whole focal range.



SENSOR RESOLUTION 12 megapixels • SENSOR SIZE 1/2.3in • VIEWFINDER Electronic (1,440,000 dots) • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 24x (25-600mm) • 35mm-EQUIVALENT APERTURE f/15.6 • WEIGHT 703g • DIMENSIONS 93x133x122mm • WARRANTY One year RTB • DETAILS www.panasonic.com/uk • FULL REVIEW Jan 2016

CANON G7 X Mark II

★★★★★

£479 • www.e-infin.com/uk



COMPUTER SHOPPER
BEST BUY

The successor to our favourite camera of 2015, the G7 X Mark II is another fantastic CSC. A capable 1in sensor, a tilting touchscreen, a comfortable grip and a big 4.2x optical zoom; this has all you need to take great photos even in low light.

SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 1in • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 4.2x (24-100mm) • 35mm-EQUIVALENT APERTURE f/5-7.7 • LENS MOUNT Canon EF-S • WEIGHT 319g • DIMENSIONS 64x108x42mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Oct 2016

CANON G9 X

★★★★★

£298 • www.e-infin.com/uk

COMPUTER SHOPPER
BEST BUY

A tiny compact that can keep up with heavier SLRs and CSCs when it comes to image quality, while squeezing in all the shooting settings and features you'll need.



SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 1in • FOCAL LENGTH MULTIPLIER 2.75x • VIEWFINDER None • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3x (28-84mm) • 35mm-EQUIVALENT APERTURE f/5.5-13.5 • WEIGHT 207g • DIMENSIONS 62x101x31mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Jun 2016

NIKON D500

★★★★★

£1,295 (body only) • www.e-infin.com/uk



COMPUTER SHOPPER
BEST BUY

You'll pay a lot for the D500, the headline model in Nikon's cropped-sensor SLR range, but with its stunning photos, long battery life and heaps of extra features (including useful wireless upload capability), it's worth every penny.

SENSOR RESOLUTION 21 megapixels • SENSOR SIZE 23.5x15.7mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER Optical TTL • LCD SCREEN 3.2in (2.4 million dots) • LENS MOUNT Nikon F mount • WEIGHT 860g • DIMENSIONS 115x147x81mm • WARRANTY One year RTB • DETAILS www.europe-nikon.com • FULL REVIEW Oct 2016

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

ASUS VC239H

★★★★★

£130 • www.box.co.uk

COMPUTER SHOPPER
RECOMMENDED

It's rare to see IPS panels on monitors this cheap, and in Standard mode, the VC239H delivers much better image quality than we've come to expect from budget displays.



SCREEN SIZE 23in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI • WARRANTY Three years RTB • DETAILS www.asus.com/uk • PART CODE VC239H • FULL REVIEW Mar 2017

AOC Q2781PQ

★★★★★

£309 • www.ballicom.co.uk

COMPUTER SHOPPER
RECOMMENDED

While a touch of ghosting means it's not ideal for gaming, the AOC Q2781PQ combines excellent desktop picture quality with a gorgeous thin-bezel design, plus a high resolution for clean multitasking.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, HDMI, DisplayPort • WARRANTY Two years collect and return • DETAILS aoc-europe.com • PART CODE Q2781PQ • FULL REVIEW Nov 2016

IIYAMA G-Master GB2888UHSU Gold Phoenix

★★★★★

£330 • www.overclockers.co.uk

COMPUTER SHOPPER
RECOMMENDED

It's unusual to consider a £324 monitor a bargain, but that's what this is: a 28in, Ultra HD display with a mere 1ms response time and support for AMD's anti-tearing FreeSync tech.



SCREEN SIZE 28in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY TN • VIDEO INPUTS VGA, 2x HDMI, DisplayPort • WARRANTY Two years collect and return • DETAILS www.iiyama.com • PART CODE ProLite GB2888UHSU-B1 • FULL REVIEW Aug 2016

ACER Predator XB271HK

★★★★★

£745 • www.amazon.co.uk

COMPUTER SHOPPER
RECOMMENDED

Compatibility with Nvidia's G-Sync tech allows this sturdy UHD monitor to provide smooth, stutter-free gaming at all times. Its 60Hz refresh rate isn't the highest, but it more than makes up for that in image quality, adjustability and resolution.



SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Two years RTB • PART CODE XB271HK • DETAILS www.acer.co.uk • FULL REVIEW Jul 2016

PHILIPS Brilliance 258B6QUEB

★★★★★

£300 • www.uk.insight.com

COMPUTER SHOPPER
BEST BUY

A USB Type-C port doesn't sound like the most thrilling feature on a monitor, but it gives the Brilliance 258B6QUEB a wonderful flexibility, allowing you to hook up any laptop, 2-in-1 or Type-C peripheral. Picture quality is very good, too.



SCREEN SIZE 25in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS VGA, HDMI, DisplayPort, DVI, USB Type-C • WARRANTY Three years RTB • DETAILS www.philips.co.uk • FULL REVIEW Mar 2017

AOC U3477PQU

★★★★★

£550 • www.currys.co.uk

COMPUTER SHOPPER
BEST BUY

Ultra-wide monitors are best suited to those who want to multitask on two full-size windows at once, but also kick back with a film or game in the evening. AOC's U3477PQU is the best example we've seen so far, with an incredible panel and excellent build quality.



SCREEN SIZE 34in • RESOLUTION 3,840x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS DisplayPort, DVI, HDMI, VGA • WARRANTY Three years RTB • DETAILS www.aoc-europe.com • FULL REVIEW May 2015

Choosing a... TV

01 A 32in Full HD TV costs around £200 and will suit smaller living rooms. TVs look much smaller in the shop than in your home, so measure the space available before you buy.

Curved TVs are becoming increasingly more common, but bear in mind that these typically take up more floor space than a traditional flat set.

02 A 1,920x1,080-resolution TV can display a 1080p image. You can still buy TVs with a 720p (1,366x768) resolution, but they're no cheaper and the image won't be as sharp. 3,840x2,560 Ultra HD resolution, or 4K, TVs are finally available at reasonable prices, although you'll still pay a premium for one over a 1080p model.

03 Consider the number of inputs you'll need to connect the rest of your equipment. Two HDMI ports should be the bare minimum, but many TV sets come with four HDMI connectors. You'll need HDMI 2.0 if you want a future-proof 4K TV, as this is the only way to get 60fps video playback from external sources at such a high resolution.

If you want to plug a PC into your TV, you'll need to use either HDMI or VGA inputs. Be aware that some TVs only let you use a PC on an analogue input, and others won't display the Windows desktop at the TV's highest resolution.

04 The contrast ratio tells you the difference between the darkest

and the brightest shades that the screen will be able to display. The higher the number, the darker the blacks and the brighter the whites. A screen with a high contrast ratio is more likely to show a wider range of detail.

05 HD content is now becoming fairly widespread, but if you want Ultra HD content your options are more limited. Most Ultra HD TVs have Netflix built into their smart TV systems, but only BT is currently providing live Ultra HD video, with BT Sport Ultra HD.

Ultra HD Blu-ray players are due to arrive in 2016, but in the meantime Amazon's Fire TV set-top box will stream its Instant Video service at Ultra HD resolutions.

HOME CINEMA

PANASONIC Viera TX-50DX802B

★★★★★

£999 • www.currys.co.uk

NEW ENTRY



COMPUTER SHOPPER
RECOMMENDED

The Viera TX-50DX802B not only looks great and comes equipped with an expansive suite of smart apps, but it also has its own soundbar, allowing for clearer, boomier movie nights.

SCREEN SIZE 50in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 3x HDMI (1x ARC), component, composite • TUNER Freeview HD • DIMENSIONS 895x559x203mm • WARRANTY Five years RTB • DETAILS www.panasonic.com/uk • PART CODE TX-50DX802B • FULL REVIEW Apr 2017

SAMSUNG UE32J6300

★★★★★

£425 • www.tvsandmore.co.uk



COMPUTER SHOPPER
RECOMMENDED

It might look expensive for the screen size, but the UE32J6300 is jam-packed with features, including one of the best smart TV systems around and every major UK catch-up TV service. It's the ideal small TV for a bedroom, kitchen or office.

SCREEN SIZE 32in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 4x HDMI, component, composite • TUNER Freeview HD • DIMENSIONS 428x370x91mm • WARRANTY One year RTB • DETAILS www.samsung.com/uk • PART CODE UE32J6300AK • FULL REVIEW Dec 2015

SAMSUNG UE49KS7000

★★★★★

£799 • www.cramptonandmoore.co.uk

NEW ENTRY



COMPUTER SHOPPER
BEST BUY

A good-quality 4K TV needn't cost the earth, as the UE49KS7000 proves. In fact, this Quantum Dot display earned the UHD Alliance's UHD Premium badge for its rich, detailed visuals.

SCREEN SIZE 49in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI • TUNER Freeview HD, Freesat HD • DIMENSIONS 1,445x908x295mm • WARRANTY Five years RTB • DETAILS www.samsung.com/uk • PART CODE UE49KS7000 • FULL REVIEW Apr 2017

PANASONIC DMP-UB900

★★★★★

£329 • www.johnlewis.com



COMPUTER SHOPPER
RECOMMENDED

Together with the Samsung UBD-K8500, this forms the vanguard of a new breed of Ultra HD Blu-ray players. Samsung's model is cheaper, but the DMP-UB900 has superior features, particularly where audio delivery is concerned.

BLU-RAY PROFILE 6.0 • 3D CAPABLE Yes • DIMENSIONS 435x199x68mm • NETWORKING Ethernet, 802.11ac Wi-Fi • WARRANTY One year RTB • DETAILS www.panasonic.co.uk • PART CODE DMP-UB900EB • FULL REVIEW Aug 2016

SONY HT-XT3

★★★★★

£299 • www.hificonfidential.co.uk



COMPUTER SHOPPER
BEST BUY

The HT-XT3 is a classy-looking soundbase that delivers great audio, with its integrated subwoofer helping to pump out seismic bass. It also provides a degree of future-proofing with its 4K pass-through support, and can be linked together with other Sony speakers for a multiroom audio setup.

SPEAKERS 2+2 • RMS POWER OUTPUT 350W (total) • DIMENSIONS 750x358x83mm • WEIGHT 10.5kg • DOCK CONNECTOR None • NETWORKING Bluetooth (SBC, LDAC) • WARRANTY One year RTB • DETAILS www.sony.co.uk • PART CODE HT-XT3 • FULL REVIEW Mar 2016

PHILIPS Fidelio XS1 SoundStage

★★★★★

£450 • www.amazon.co.uk



COMPUTER SHOPPER
BEST BUY

The Fidelio XS1 SoundStage is a beautiful-looking soundbase with sound quality that matches its stunning design. There are plenty of connections, including Bluetooth, and the wireless subwoofer delivers the lower frequencies with aplomb.

SPEAKERS 3 • RMS POWER OUTPUT 60W • DIMENSIONS 730x331x40mm • WEIGHT 5.3kg • DOCK CONNECTOR None • NETWORKING Bluetooth (SBC, aptX, AAC) • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE Fidelio XS1/12 • FULL REVIEW Jan 2016

From Apple to Zeiss, and everything in between



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magazinedeals.co.uk/tech

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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

BOWERS & WILKINS P7 Wireless

★★★★★

£320 • www.johnlewis.com

COMPUTER SHOPPER
RECOMMENDED

Bowers & Wilkins' second-ever pair of Bluetooth headphones are a triumph – they're exceedingly comfortable and sound superb, even without any active noise cancelling.

HEADPHONES SUBTYPE Over-ear headset • PLUG TYPE 3.5mm jack plug (optional) • WEIGHT 323g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS www.bowers-wilkins.co.uk • PART CODE FP38954 • FULL REVIEW Feb 2017



URBANEARS

Plattan ADV Wireless

★★★★★

£60 • www.currys.co.uk

COMPUTER SHOPPER
BEST BUY

Well-balanced sound, a comfy fit and a battery that lasts for days of solid listening makes the Plattan ADV Wireless a winner, especially at this price.

HEADPHONES SUBTYPE On-ear headset • PLUG TYPE 3.5mm jack plug (optional) • WEIGHT 191g • CABLE LENGTH 1.2m • WARRANTY Two years RTB • DETAILS www.urbanears.com • PART CODE Plattan ADV Wireless • FULL REVIEW Nov 2016



PANASONIC SC-All7CD

★★★★★

£319 • www.currys.co.uk

COMPUTER SHOPPER
BEST BUY

A focus on good old-fashioned CDs, in addition to the usual digital streaming services, makes the SC-All7CD one of the most versatile multiroom speaker systems you can buy.

SPEAKERS 2.1 • RMS POWER OUTPUT 40W • WEIGHT 3.4kg • NETWORKING Bluetooth • WARRANTY One year RTB • DETAILS www.panasonic.com • PART CODE SC-All7CD • FULL REVIEW Dec 2016



LG SH5

★★★★★

£179 • www.amazon.co.uk

COMPUTER SHOPPER
BEST BUY

Proof that great-sounding soundbar and subwoofer combos don't need to cost the earth, the LG SH5 is a sleek, stylish 2.1 set with plenty of modes and features.

SPEAKERS 2.1 • RMS POWER OUTPUT 320W • DOCK CONNECTOR None • NETWORKING Bluetooth 4.0 • DIMENSIONS 945x53x85mm (soundbar), 171x320x252mm (subwoofer) • WEIGHT 2.26kg • WARRANTY One year RTB • DETAILS www.lg.com/uk • PART CODE SH5 • FULL REVIEW Jan 2017



AMAZON Echo Dot

★★★★★

£50 • www.amazon.co.uk

COMPUTER SHOPPER
BEST BUY

This shrunk-down version of the Amazon Echo loses the 360-degree speaker, but retains all the same smart home functions and excellent Alexa digital assistant – all for a drastically lower price.

DRIVERS 1 • RMS POWER OUTPUT Not stated • WEIGHT 163g • NETWORKING Bluetooth, 802.11a/b/g Wi-Fi • WARRANTY One year RTB • DETAILS www.amazon.co.uk • PART CODE Echo Dot 2016 • FULL REVIEW Mar 2017



LIBRATONE One Click

★★★★★

£139 • www.amazon.co.uk

COMPUTER SHOPPER
RECOMMENDED

The One Click has one of the cleverer wireless speaker designs we've seen; it's surrounded by a rubber frame with both protective bumpers and a carry handle/hook. Hang it up or just let it stand, and you'll get rich, loud sound in 360 degrees.

SPEAKERS 2 • RMS POWER OUTPUT Not disclosed • DOCK CONNECTOR None • WIRELESS Bluetooth (SBC) • DIMENSIONS 120x41x205mm • WEIGHT 0.9kg • WARRANTY One year RTB • DETAILS www.libratone.com • PART CODE One Click • FULL REVIEW Oct 2016



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 Almost all action cameras will shoot Full HD video, and some 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, 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 deliberately 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

★★★★★

£80 • www.amazon.co.uk



COMPUTER SHOPPER
RECOMMENDED

This upgraded box has plenty of services your 4K TV might not have (much more so than the competing Chromecast Ultra), and you can play games on it, too.

VIDEO OUTPUTS HDMI 2.0 • **NETWORKING** 802.11ac Wi-Fi, 10/100 Ethernet • **DIMENSIONS** 115x115x17mm • **STREAMING FORMATS** UPnP, AirPlay, DLNA, Plex • **INTERNET STREAMING SERVICES** iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Prime Instant Video, TVPlayer • **WARRANTY** One year RTB • **DETAILS** www.amazon.co.uk • **PART CODE** Fire TV with 4K UHD • **FULL REVIEW** Apr 2017

SKY Now TV Smart Box

★★★★★

£40 • www.nowtv.com



COMPUTER SHOPPER
BEST BUY

Sky has made its flagship media streamer even better, adding a Freeview HD tuner and a flexible range of content passes (including movie and sport packages) to complement the usual on-demand and catch-up services.

VIDEO OUTPUTS HDMI 1.4 • **NETWORKING** 802.11n Wi-Fi, 10/100 Ethernet • **DIMENSIONS** 165x165x21mm • **STREAMING FORMATS** None • **INTERNET STREAMING SERVICES** Now TV, iPlayer, ITV Hub, All4, Demand 5, TuneIn, Sky News, Spotify • **WARRANTY** One year RTB • **DETAILS** www.nowtv.com • **PART CODE** Now TV Smart Box • **FULL REVIEW** Dec 2016

HUMAX HDR-1100S 500GB

★★★★★

£189 • www.currys.co.uk



COMPUTER SHOPPER
BEST BUY

The Humax HDR-1100S is an attractive

Freesat+ PVR that's easy to use and integrates catch-up TV seamlessly through Freetime.

TUNERS 2x DVB-S2 Freesat • **DIMENSIONS** 280x48x200mm • **NETWORKING** Gigabit Ethernet, 802.11n Wi-Fi • **INTERNAL DISK CAPACITY** 500GB • **WARRANTY** One year RTB • **DETAILS** www.humaxdirect.co.uk • **PART CODE** HDR-1100S-White • **FULL REVIEW** Dec 2015

GOPRO Hero 5 Black

★★★★★

£349 • www.amazon.co.uk



COMPUTER SHOPPER
RECOMMENDED

At last, GoPro's flagship action camera finally has built-in waterproofing.

That's the biggest in a sizable list of improvements over the Hero 4 Black, making this the superior purchase in spite of its higher price.

SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 12,000,000 • **MAX RECORDING RESOLUTION** 4K (30fps) • **AV CONNECTIONS** Micro HDMI • **DIMENSIONS** 45x62x32mm • **WEIGHT** 117g • **WARRANTY** One year RTB • **DETAILS** www.gopro.com • **PART CODE** Hero 5 Black • **FULL REVIEW** Mar 2017

PANASONIC HC-VX980

★★★★★

£548 • www.ukdigitalcameras.co.uk



COMPUTER SHOPPER
RECOMMENDED

This 4K-capable camcorder lets you capture 8-megapixel stills from 4K video. It has

fantastic image stabilisation and its HDR video mode can help with exposing difficult scenes. The newest model has been updated with more useful 4K cropping modes and slow-motion features, too.

OPTICAL ZOOM 20x • **SENSOR** 1/2.3in BSI MOS • **LCD SCREEN** 3in, 460,800 dots • **DIMENSIONS** 73x65x139mm • **WEIGHT** 351g • **WARRANTY** One year RTB • **DETAILS** www.panasonic.com • **PART CODE** HC-VX980 • **FULL REVIEW** Apr 2016

SONY FDR-X1000V

★★★★★

£310 • www.photospecialist.co.uk



COMPUTER SHOPPER
RECOMMENDED

Sony looks to take on GoPro with this miniscule action cam capable of recording 4K video at 30fps. The Hero4

Black wins out on image quality, but image stabilisation and a flexible range of shooting modes means Sony's camera still has lots to offer.

SENSOR 1/2.3in CMOS • **SENSOR PIXELS** 8,800,000 • **MAX RECORDING RESOLUTION** 4K (30fps) • **AV CONNECTIONS** Micro HDMI, 3.5mm microphone input • **DIMENSIONS** 24.4x51.7x88.9mm • **WEIGHT** 114g • **WARRANTY** One year RTB • **DETAILS** www.sony.co.uk • **PART CODE** FDR-X1000V • **FULL REVIEW** May 2016

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 £60 you can buy a much 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

BROTHER HL-L6300DWT

★★★★★

£414 • www.printerland.co.uk

COMPUTER SHOPPER
BUSINESS BUY

A combination of fast printing speeds and a good mix of connectivity and hardware feature makes the HL-L6300DWT a fine choice for offices. It's quieter than you might think as well.



TECHNOLOGY Mono laser • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 420x400x396mm • WEIGHT 17.1kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.brother.co.uk • PART CODE HLL6300DWTZU1 • FULL REVIEW Oct 2016

XYZPRINTING da Vinci Minimaker

★★★★★

£446 • www.toysrus.co.uk

COMPUTER SHOPPER
RECOMMENDED

It's not as fully featured as the da Vinci Jr 1.0w, but the Minimaker prints at identical speed and quality, and costs much, much less. In fact, it's the most affordable 3D printer we've ever used.



TECHNOLOGY Fused Filament Fabrication • MAXIMUM PRINT RESOLUTION 100 microns • MAXIMUM BUILD SIZE 150x150x150mm • DIMENSIONS 390x360x335mm • WEIGHT 11.5kg • FILAMENT 1.75mm PLA • WARRANTY One year RTB • DETAILS eu.xyzprinting.com • PART CODE 3FM1XXEU00D • FULL REVIEW Apr 2017

EPSON Expression Premium XP-530

★★★★★

£40 • www.amazon.co.uk

COMPUTER SHOPPER
RECOMMENDED

Other than a tiny screen and slightly high running costs, the XP-530 is a welcome addition to Epson's Expression Premium range. It prints and scans incredibly quickly, while maintaining high quality throughout.



TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • SCANNER RESOLUTION 2,400x4,800dpi • DIMENSIONS 138x390x341mm • WEIGHT 6.2kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.epson.co.uk • PART CODE XP-530 • FULL REVIEW May 2016

CANON Pixma MG5750

★★★★★

£50 • www.currys.co.uk

COMPUTER SHOPPER
BEST BUY

The MG5750 is good value with a great balance of features and quality. Its strong performance lets us forgive less-than-perfect controls.



TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x2,400dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.3kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.canon.co.uk • PART CODE 0557C006 • FULL REVIEW Apr 2016

HP Officejet 250

★★★★★

£214 • www.pcworldbusiness.co.uk

COMPUTER SHOPPER
RECOMMENDED

A pleasantly portable MFP, the Officejet Pro 250 not only has more hardware features than you might expect – including a handy adjustable screen – but it runs cheaply and at respectable speeds, too.



TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 600x600dpi • DIMENSIONS 91x380x198mm • WEIGHT 2.96kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.hp.co.uk • PART CODE CZ992A#B1H • FULL REVIEW Dec 2016

PLUSTEK eScan A150

★★★★★

£408 • www.ebuyer.com

COMPUTER SHOPPER
RECOMMENDED

A very easy-to-use document scanner that can scan both sides of a document at once, and lets you organise your scans onscreen before saving them to a computer, USB disk or Android device.



SCANNER TYPE Document scanner • MAXIMUM OPTICAL SCAN RESOLUTION 600x600dpi • DIMENSIONS 189x318x170mm • WEIGHT 2.8kg • WARRANTY One year RTB • DETAILS www.plustek.com/uk • PART CODE 0263UK • FULL REVIEW Feb 2016

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

TP-LINK Archer C3200

★★★★★

£150 • www.currys.co.uk

COMPUTER SHOPPER
RECOMMENDED

Besides being quite well priced for a tri-band router, the Archer C3200 is impressively fast and has a good-looking, folding six-antenna design.



WI-FI STANDARD 802.11ac • STATED SPEED 1,300Mbit/s • USB PORTS 1x USB3 • WALL MOUNTABLE Yes • WARRANTY Three years RTB • DETAILS www.tp-link.com • PART CODE Archer C3200 • FULL REVIEW Jan 2017

NETGEAR Orbi

★★★★★

£370 • www.maplin.co.uk

COMPUTER SHOPPER
RECOMMENDED

The Orbi system employs both a base router and a separate satellite router to effectively boost Wi-Fi speed and stability throughout your house – a great fit for larger homes.



MODEM Gigabit Ethernet • WI-FI STANDARD 802.11ac • STATED SPEED 866Mbit/s (5GHz), 400Mbit/s (2.4GHz) • USB PORTS 1x USB2 • WALL MOUNTABLE No • WARRANTY Two years RTB • PART CODE RBK50-100UKS • FULL REVIEW Feb 2017

NEST Cam Outdoor

★★★★★

£179 • www.amazon.co.uk

COMPUTER SHOPPER
RECOMMENDED

The Nest Cam Outdoor allows you to set up your own home security camera without any specialist wiring knowledge. Video quality is excellent, and the simple app makes managing it even easier.



VIDEO RESOLUTION 720p/1080p • CLOUD STORAGE Yes • NETWORKING 802.11n (2.4GHz) • WARRANTY One year RTB • DETAILS www.nest.com/uk • PART CODE Nest Cam Outdoor • FULL REVIEW Apr 2017

BT Smart Hub

★★★★★

£130 • www.bt.com

COMPUTER SHOPPER
RECOMMENDED

While most ISP routers are rubbish, the Smart Hub's swift speeds and competitive feature set practically make it a must-have for BT customers, especially those on a fibre connection.



MODEM ADSL2+/VDSL • WI-FI STANDARD 802.11ac • STATED SPEED Not disclosed • USB PORTS 1x USB2 • WALL MOUNTABLE No • WARRANTY One year RTB • DETAILS www.bt.com • FULL REVIEW Oct 2016

TP-LINK Archer VR2600

★★★★★

£200 • www.scan.co.uk

COMPUTER SHOPPER
BEST BUY

While it needs thus-far-theoretical 4x4 MIMO devices to reach its best speeds, this is still among the very fastest routers around, especially on the 5GHz band.



MODEM VDSL/ADSL • WI-FI STANDARD 802.11ac • STATED SPEED 1,733Mbit/s • USB PORTS 2x USB3 • WALL MOUNTABLE Yes • WARRANTY Three years RTB • PART CODE Archer VR2600 • FULL REVIEW Nov 2016

NETGEAR Arlo Q

★★★★★

£140 • www.argos.co.uk

COMPUTER SHOPPER
RECOMMENDED

1080p night-vision capability more than makes up for the Arlo Q's lack of wireless cameras, and the system is just as easy to use as the original Arlo range.



RESOLUTION 1080p 30fps full colour • ZOOM 8x digital • NIGHT VISION Yes • CONNECTIVITY 2.4GHz + 5GHz Wi-Fi • WARRANTY One year RTB • DETAILS www.arlo.com/uk • PART CODE VMCC3040-100UKS • FULL REVIEW Jun 2016

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. Some mechanical hard disks still come with SATA2 interfaces, but newer models and most solid-state drives (SSDs) have faster SATA3 interfaces. You'll need a motherboard with a SATA3 port if you want to benefit from SATA3's faster speeds; SATA3 disks will work with SATA2 ports but can only transfer files at SATA2 speeds.

02 SSDs can make the most of SATA3's extra 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.

03 Buy a hard disk that provides more capacity than you think you need, as your storage requirements are likely to grow. A 3TB disk strikes the best balance between capacity and low cost per gigabyte, but in general you should aim to buy the largest disk you can afford.

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

SAMSUNG 850 Evo 500GB

★★★★★

£150 • www.currys.co.uk

COMPUTER SHOPPER **RECOMMENDED** Samsung's 850 Evo is simply the fastest SATA SSD around, and it's available in a wide range of capacities. The 2TB model might be expensive at around £565 (from www.ebuyer.com), but it means saying goodbye to mechanical storage for good.



CAPACITY 500GB • **COST PER GIGABYTE** £0.30 • **INTERFACE** SATA3 • **CLAIMED READ** 540MB/s • **CLAIMED WRITE** 520MB/s • **WARRANTY** Five years RTB • **DETAILS** www.samsung.com/uk • **PART CODE** MZ-75E500BW/EU • **FULL REVIEW** Oct 2015

WESTERN DIGITAL Red 6TB

★★★★★

£217 • www.amazon.co.uk

COMPUTER SHOPPER **BEST BUY** The Red 6TB combines excellent performance with a high capacity and special firmware to make a hard disk that's perfect for use in NAS enclosures. It's guaranteed for three years, too, which should provide peace of mind.



CAPACITY 6TB • **PRICE PER GIGABYTE** £0.04 • **INTERFACE** SATA3 • **WARRANTY** Three years RTB • **DETAILS** www.wdc.com • **PART CODE** WD60EFRX • **FULL REVIEW** Nov 2014

SYNOLOGY Diskstation DS216+

★★★★★

£221 • www.ebuyer.com

COMPUTER SHOPPER **BEST BUY** Synology's fast two-bay NAS is particularly ideal for small businesses and workgroups, possessing AES-NI encryption and extensive support for a range of devices and servers.



3.5in HARD DISK BAYS (FREE) 2 (2) • **NETWORKING** 1x 10/100/1,000 Ethernet • **DLNA MEDIA SERVER** Yes • **PRINT SERVER** Yes • **DIMENSIONS** 165x108x233mm • **WEIGHT** 1.25kg • **WARRANTY** Two years RTB • **DETAILS** www.synology.com • **PART CODE** DS216+ • **FULL REVIEW** Jun 2016

ADATA SV620 240GB

★★★★☆

£69 • www.lambda-tek.com

COMPUTER SHOPPER **RECOMMENDED** If you want an external, rather than internal, SSD for your PC or laptop, the SV620 offers good value. It's fast and compact, and it's easy to forget about the slightly bendable plastic casing when there's a three-year warranty.



CAPACITY 240GB • **COST PER GIGABYTE** £0.29p • **INTERFACE** USB3 • **CLAIMED READ** 420MB/s • **CLAIMED WRITE** 440MB/s • **WARRANTY** Three years RTB • **DETAILS** www.adata.com • **PART CODE** ASV620-240GU3-CT1 • **FULL REVIEW** Dec 2016

TOSHIBA Canvio Connect II 2TB

★★★★★

£84 • www.currys.co.uk

COMPUTER SHOPPER **BEST BUY** There's plenty of choice when it comes to portable hard disks, but Toshiba's Canvio Connect II has an excellent bundled software package and impressive USB3 speeds. Considering the price, there's no reason not to have one.



CAPACITY 2TB • **COST PER GIGABYTE** £0.04 • **INTERFACE** USB3 • **WARRANTY** One year RTB • **DETAILS** www.toshiba.eu • **PART CODE** HDTCC820ER3CA • **FULL REVIEW** Nov 2015

SAMSUNG 960 Evo 250GB

★★★★★

£129 • www.maplins.co.uk

COMPUTER SHOPPER **BEST BUY** While it's not quite as quick as the 960 Pro, the 960 Evo is still the second-fastest NVMe SSD we've ever tested, and since it's much more affordable, it's the one most people should go for.



CAPACITY 250GB • **COST PER GIGABYTE** 52p • **INTERFACE** M.2/NVMe • **CLAIMED READ** 3,200MB/s • **CLAIMED WRITE** 1,500MB/s • **WARRANTY** Five years RTB • **DETAILS** www.samsung.com • **PART CODE** MZ-V6E250BW • **FULL REVIEW** Mar 2017

Choosing a... Graphics card

01 You really don't have to spend much to buy a decent graphics card that can drive multiple monitors. The AMD Radeon R7 250 costs less than £60, for example, and while it isn't suited to playing the latest games in Full HD, it is perfect for watching videos, browsing the web and playing basic games.

02 You'll need to spend more money if you want to play the latest games. A good mid-range gaming graphics card is the Nvidia GTX 950, which is powerful enough to play any of the latest games.

High-powered cards tend to be more expensive, so expect to pay over £300 if you want to play games in Ultra HD at the highest quality settings.

03 Check that your chosen card has the graphics outputs you need. Only low-end cards now have VGA outputs, but many come with a DVI-to-VGA adaptor. Depending on your monitor, you may also want an HDMI output or even DisplayPort.

Bear in mind that AMD's Eyefinity triple-monitor gaming mode requires at least one DisplayPort monitor, which means your AMD graphics card must have at least one DisplayPort output. Nvidia's Surround three-monitor mode needs only DVI and HDMI ports.

04 The amount of memory a card has is important if you want games to look their best at high resolutions. Get a card with 2GB of RAM at the very least, as this should

allow you to select the highest-quality textures in games.

05 A card's size, noise output and power requirements are the final considerations. Make sure your PC's case has enough room to accommodate your chosen card. Double-slot cards with large fans tend to be quieter than single-slot cards with small fans but will block other expansion slots on your motherboard.

Also check that your power supply can provide the power the card needs and that it has the right connectors. Many cards require a six-pin PCI Express power connector, and some also need an additional eight-pin connector.

COMPONENTS

GIGABYTE GeForce GTX 1050 D5 2G

★★★★★

£116 • www.overclockers.co.uk

COMPUTER SHOPPER
BEST BUY

Nvidia's GTX 1050 is the best-performing entry-level GPU, and Gigabyte has made some nice tweaks to its own version, including a near-silent fan cooler. It also sips power, with a tiny TDP rating of 75W.

GPU Nvidia GeForce GTX 1050 • MEMORY 2GB GDDR5 • GRAPHICS CARD LENGTH 172mm • WARRANTY Three years repair and replace • DETAILS www.gigabyte.com • PART CODE GV-N1050D5-2GD • FULL REVIEW Mar 2017



NVIDIA GeForce GTX 1060

★★★★★

£275 • www.geforce.co.uk

COMPUTER SHOPPER
BEST BUY

Based on the same Pascal architecture as the fearsome GTX 1080 and GTX 1070, the mid-range GTX 1060 is unmatched when it comes to marrying price with 4K and VR-readiness. It's surprisingly power-efficient, too.

GPU Nvidia GeForce GTX 1060 • MEMORY 6GB GDDR5 • GRAPHICS CARD LENGTH 250mm • WARRANTY Three years repair and replace • DETAILS www.geforce.co.uk • PART CODE GTX 1060 Founder's Edition • FULL REVIEW Nov 2016



INTEL Core i5-6600K

★★★★★

£230 • www.ebuyer.com

COMPUTER SHOPPER
RECOMMENDED

The Core i5-6600K is the first of Intel's latest processor generation, previously codenamed Skylake. The unlocked multiplier means you can push it further when overclocking, and energy efficiency has never been better, which means less power draw when using your PC.

SOCKET LGA1151 • CORES 4 • FREQUENCY 3.5GHz • INTEGRATED GRAPHICS Intel HD Graphics 530 • WARRANTY One year RTB • DETAILS www.intel.com • PART CODE BX80662I56600K • FULL REVIEW Nov 2015



NZXT Manta

★★★★★

£110 • www.scan.co.uk

COMPUTER SHOPPER
BEST BUY

A brilliant basis for any Mini-ITX PC build, the Manta is a versatile case with plenty of room for fans and storage drives, plus a distinctive curvy shape. Its convex side panels leave more room to hide cables, too.

CASE TYPE Mini tower • MOTHERBOARD TYPE Mini-ITX • SUPPLIED FANS 3x 120mm • MAXIMUM DRIVE BAYS 2x 3.5in, 3x 2.5in • DIMENSIONS 426x245x450mm • WEIGHT 7.2kg • WARRANTY Two years parts and labour • DETAILS www.nzxt.com • PART CODE CA-MANTW-M1 • FULL REVIEW Aug 2016



ASUS Prime Z270-A

★★★★★

£148 • www.ebuyer.com

COMPUTER SHOPPER
BEST BUY

New Intel chips mean new Intel chipsets, and the Prime Z270-A is a brilliant mid-range companion to any compatible Kaby Lake processor. Great hardware (including two M.2 slots), a user-friendly BIOS, RGB LED decoration – it's a superb package.

PROCESSOR SOCKET LGA 1151 • DIMENSIONS 244x305mm • CHIPSET Z270 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 3 • PCI-E x1 SLOTS 4 • PCI SLOTS 0 • USB PORTS 4x USB3, 1x USB3.1, 1x USB Type-C • VIDEO OUTPUTS 1x HDMI, 1x DisplayPort, 1x DVI-D • WARRANTY Three years RTB • DETAILS www.asus.com/uk • PART CODE Prime Z270-A • FULL REVIEW Apr 2017



CORSAIR Carbide Series Air 240

★★★★★

£89 • www.box.co.uk

COMPUTER SHOPPER
BEST BUY

This microATX case is very well made. It's light and compact, but its cuboid shape means there's plenty of room inside for all your components, so it's easy to work with.

CASE TYPE microATX • MOTHERBOARD COMPATIBILITY microATX, Mini-ITX • SUPPLIED FANS 3x 120mm • MAX 3½in DRIVE BAYS 3 • MAX 5¼in DRIVE BAYS 0 • DIMENSIONS 320x260x397mm • WEIGHT 5.6kg • WARRANTY Two years RTB • DETAILS www.corsair.com • PART CODE CC-9011070-WW • FULL REVIEW Apr 2016



SOFTWARE

DIGITALVOLCANO SOFTWARE

Duplicate Cleaner 4.0 Pro

★★★★★

£24 • www.digitalvolcano.co.uk



The free version of Duplicate Cleaner program is good, and upgrading to the Pro version makes it exceptional for ridding your PC of duplicate files.

OS SUPPORT Windows Vista/7/8/10 • HARD DISK SPACE 20MB • DETAILS www.digitalvolcano.co.uk • FULL REVIEW Sep 2016

Deduplicating software

ADOBE Premiere Elements 14

★★★★★

£80 • www.currys.co.uk



Lots of features to keep advanced users happy and even more to help new users make the most of it. It's the consumer video editing package to buy.

OS SUPPORT Windows 7/8/10 • MINIMUM CPU 2GHz with SSE2 • MINIMUM GPU DirectX 9 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65234288 • FULL REVIEW Jan 2016

Video editing

EXPRESSVPN

★★★★★

£13 per month • www.expressvpn.com



ExpressVPN allows you to easily dodge region restrictions on online content while encrypting your connection, and is fast enough to handle 4K Netflix streaming. Its great software support and huge number of endpoints makes it the most flexible service, too.

OS SUPPORT Windows, macOS, iOS, Android • DETAILS www.expressvpn.com • PRODUCT CODE ExpressVPN • FULL REVIEW Jan 2017

Virtual private network

MICROSOFT Windows 10 Anniversary Update

★★★★★

Free • www.microsoft.com



This update adds UI improvements, new features and apps for stylus users, and a host of bug fixes, making Microsoft's OS even more worthwhile.

OS SUPPORT Windows 10 • MINIMUM CPU 1GHz • MINIMUM GPU DirectX 9 or later with WDDM 1.0 driver • MINIMUM RAM 1GB (32-bit), 2GB (64-bit) • HARD DISK SPACE 16GB (32-bit), 2GB (64-bit) • DETAILS www.microsoft.com • PRODUCT CODE Windows 10 version 1607 • FULL REVIEW Nov 2016

OS update

STEINBERG Cubase Artist 8

★★★★★

£119 • www.gear4music.com



Music production software usually saves the best features for the priciest version, but that's not the case here, making Cubase Artist 8 an excellent investment for musicians aspiring to the highest standards.

OS SUPPORT Windows 7 or later • MINIMUM CPU Intel Core/AMD dual-core • MINIMUM GPU DirectX 10 • MINIMUM RAM 4GB • HARD DISK SPACE 15GB • DETAILS www.steinberg.net • PRODUCT CODE 45550 • FULL REVIEW May 2015

Music production

MAILBIRD Mailbird Pro 2.0

★★★★★

£10 per year or £36 lifetime • www.getmailbird.com



While the free version of this email client is good, upgrading to Pro is even better – you get a unified view of all your mailboxes, loads of themes and extensive integration with other apps and productivity software.

OS SUPPORT Windows XP/7/8/8.1/10 • MINIMUM CPU N/A • MINIMUM GPU N/A • MINIMUM RAM N/A • HARD DISK SPACE 50MB • DETAILS www.getmailbird.com • FULL REVIEW Nov 2016

Email client

GAMING

XBOX One S

★★★★★

£220 • www.amazon.co.uk



HDR support is great, but it's the 4K Blu-ray player that makes this sleeker, smaller Xbox One really stand out against the competing PS4 Slim.

PROCESSOR Octa-core 1.75GHz Jaguar • RAM 8GB DDR3 • FRONT USB PORTS 1x USB2 • REAR USB PORTS 2x USB2 • STORAGE 500GB/1TB/2TB • WARRANTY One year RTB • DETAILS www.xbox.com • PART CODE Xbox One S • FULL REVIEW Dec 2016



4K games console

Lego Star Wars: The Force Awakens

★★★★★

£3 • www.cdkeys.com



A charming brick-built retelling of the movie, Lego Star Wars: The Force Awakens retains the Lego series' family-friendly wit and co-op while introducing some much-needed new mechanics, like cover-based blaster battles.

FORMATS PS4, Xbox One, PC • OS SUPPORT Windows XP, Vista, 7, 8, 10 • MINIMUM CPU Intel Core 2 Quad Q6600/AMD Phenom X4 9850 • MINIMUM GPU Nvidia GeForce GT 430/AMD Radeon HD 6850 • MINIMUM RAM 4GB • HARD DISK SPACE 14GB • DETAILS www.lego.com • FULL REVIEW Oct 2016

Action adventure

Doom

★★★★★

£13 • www.cdkeys.com



A bloody and breathless FPS, Doom is a worthy entry into one of gaming's most hallowed series. Open-ended levels, agile enemies and gory but satisfying takedown moves make every demon battle rewarding.

AVAILABLE FORMATS PC, Xbox One, PS4 • OS SUPPORT Windows 7/8/8.1/10 • MINIMUM CPU Intel Core i3-550, AMD Phenom II X4 955 • MINIMUM GPU Nvidia GeForce GTX 670 2GB, AMD Radeon HD 7870 2GB • MINIMUM RAM 4GB • HARD DISK SPACE 55GB • DETAILS doom.com • FULL REVIEW Sep 2016

First-person shooter

SONY PS4 Slim

★★★★★

£209 • www.amazon.co.uk



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 B01GVQVH2 • FULL REVIEW Jan 2017



Games console

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dealer for price
and quality**



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to your door with
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back guarantee**

buyacar.co.uk

SEE OUR REVIEWS ON  TRUSTPILOT

"Amazing! They are
with you every step"

★★★★★

Lisa, 21 October

"Very impressed and was
smooth and hassle free from
start to finish"

★★★★★

David, 9 September

"Thank you and we would
buy through you again"

★★★★★

Clancy, 21 August

"I'm loving my new ride.
I would recommend
this service to anyone"

★★★★★

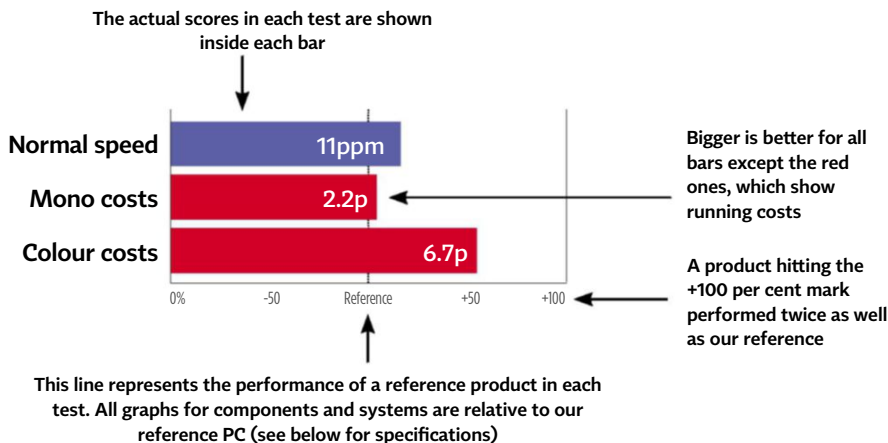
Tatiana, 8 September

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 below for a brief 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 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 24GHz 5m Mbit/s at 5m with 802.11ac laptop on 24GHz band

Laptop 24GHz 1 floor Mbit/s 1 floor up with 802.11ac laptop on 24GHz band

Laptop 24GHz 2 floors Mbit/s 2 floors up with 802.11ac laptop on 24GHz 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

Extra large 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, Mac OS X 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:

Avoid ★☆☆☆☆

Below average ★★☆☆☆

Good ★★★☆☆

Very good ★★★★☆

Excellent ★★★★★

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

Our guide to all the products reviewed in this month's *Computer Shopper*

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Intel Core i7-7700K

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BeQuiet! Dark Power Pro 11 850W **86**

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90

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Asus Z170-A

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MSI H110M Pro-D

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SUBSCRIBE AND SAVE



CALL 0844 844 0031 OR SEE PAGE 122

Free software guide

It's easy to access your free software. Just go to www.shopperdownload.co.uk/351 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@computershopper.co.uk.

**REGISTER YOUR SOFTWARE
BY 20th APRIL 2017**

Watchdog Anti-Malware 2

WATCHDOG ANTI-MALWARE 2 is a smart tool that uses multiple anti-virus engines to detect threats your regular security software might miss.

It's all very easy to use. To get started, just select the Smart (quick) or Deep (thorough) option, click Scan, and watch as Watchdog Anti-Malware goes to work.

The program crawls over your hard disks, and when it finds something suspicious, passes a fingerprint (not the whole file) to its cloud scanner for further analysis.

Watchdog Anti-Malware's Cloud Scanning Platform then checks the file using multiple



anti-virus engines, ensuring you'll detect threats that individual packages might miss, before returning its verdict to the program.

You don't have to worry about any of the technicalities, fortunately: all you'll see is a report where threats are listed as they're discovered.

When the scan is complete, you can browse the report, choose to delete individual items,

quarantine them, or possibly exclude them if you're sure they're safe, before cleaning up your entire system with a single click.

Watchdog Anti-Malware also offers simple real-time protection, analysing files before they're executed, and running a quick Smart Scan when your system starts. This worked well for us, but if you don't need that level of protection then it can be tweaked or disabled in the Settings dialog (you might run a Smart Scan every Monday, for example).

REQUIREMENTS Windows XP, Vista, 7, 8, 10 32/64-bit, 50MB hard disk space
WEBSITE www.watchdogdevelopment.com
NOTES Get your registration code from watchdog2.disc.computershopper.co.uk and then go to www.registerwatchdog.com to register for a licence key



REQUIREMENTS Windows XP, Vista, 7, 8, 10 32/64-bit, 50MB hard disk space
WEBSITE www.softorbits.com
NOTES Get your registration code within the application

Easy Photo Denoise 1.0

CAMERA TECHNOLOGY HAS come a long way in recent years, and even ordinary smartphone models can take great shots in almost any circumstances.

Night photos can be a challenge, though, as switching to high ISO settings often introduces digital noise, especially in darker areas of the shot.

Easy Photo Denoise cleans up your photos quickly and easily, removing annoying colour noise without wiping away the fine detail of your image (a common issue with standard denoise filters).

Simply drag and drop an image, and apply the default settings with a click. If you're not happy with the results, try again with a different preset.

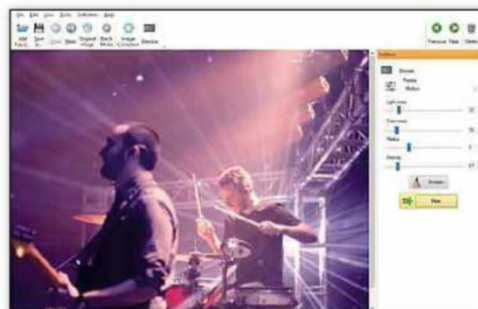
You're also able to fine-tune the effect by adjusting various sliders. The Light noise setting

compensates for variations in brightness, Colour noise works with random spots of colour, and Radius and Intensity adjust the strength of the filter.

There are a host of bonus image-tweaking features, including rotation, resizing and cropping, as well as adjustments for brightness, contrast, saturation, temperature, tint and gamma.

Once you've finished, your enhanced image may be saved as a JPG, or in one of many other formats.

Easy Photo Denoise also supports a Batch Mode for processing multiple files in a single operation. This could save you some time if you're working with several shots, assuming that you can apply the same settings to all of them (they're all taken of the same scene at the same time of day).



Abelssoft AntiLogger 2017



REQUIREMENTS Windows 7, 8 or 10
32/64-bit, 20MB hard disk space
WEBSITE www.abelssoft.net
NOTES Get your registration code within the application. Note that if you have previously registered an Abelssoft full product, you won't need to register again

ANTILOGGER IS A specialist malware hunter with one task: to detect and remove keyloggers, dangerous malware that can record everything you type.

The program's single-minded nature makes it very easy to use. There's no bulky interface to navigate, no dialogs to explore, not even a Scan button: simply launch AntiLogger and it checks all your running processes for potential danger.

After just a few seconds AntiLogger will let you know if it's found any 'loggers'. These include programs that might legitimately capture keyboard input, so don't be alarmed if something has turned up, just click Continue for more details.

AntiLogger's report screen tells you if it thinks a process might be malicious, but don't take this as 100% guaranteed. As with any other anti-virus tool, AntiLogger can be mistaken and

raise false alerts over entirely innocent programs.

The best approach is to browse the list, looking for programs you don't recognise. If you find something odd, then investigate it further, perhaps running an in-depth scan with your anti-virus package, or use the Remove button to strip it out entirely. If AntiLogger identifies

something you're sure is entirely safe, click Ignore and you won't be warned about it again.

AntiLogger's background scanner alerts you to problem processes as they're launched, but it's easy to change if you wish. Click the Settings icon, clear Run backgroundscanner on startup and the program will run on demand only.



Auslogics Disk Defrag Professional 4

DISK DEFRAG PROFESSIONAL is a powerful defragging tool that provides everything you'll need to keep your system running at peak performance.

The program provides multiple defrag algorithms. It can optimise access according to file access time, modification time or Windows' own prefetch layout, and you can manually define which files you'd like written to the fastest part of your drive.

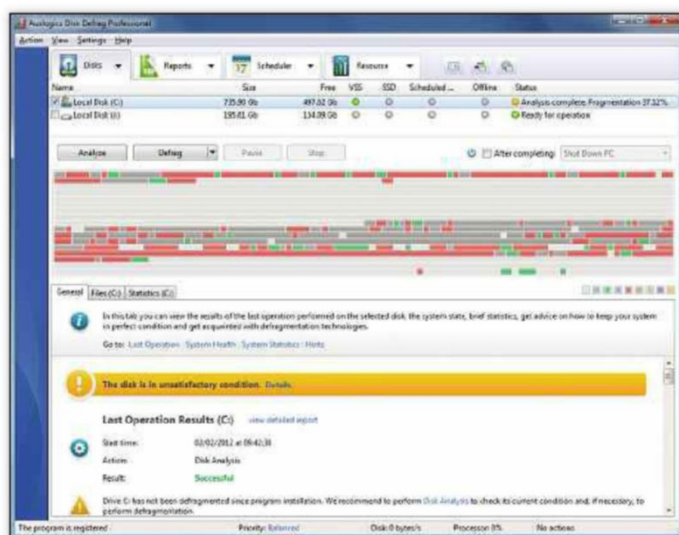
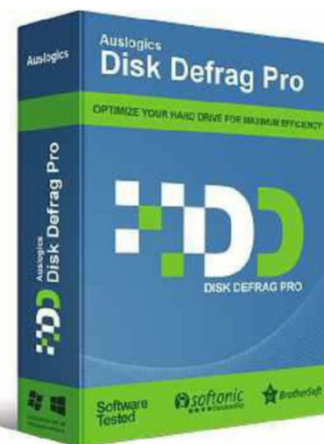
There are even more ways to run a defrag job. For instance, you might choose to defragment an individual file, a folder, or an entire partition; the program can run before Windows launches, enabling it to defrag system files that would otherwise be locked. A scheduler can also run unattended defrags whenever you like, or you can leave Disk Defrag Professional running in the background, so it can detect

and eliminate fragmentation just as soon as it appears.

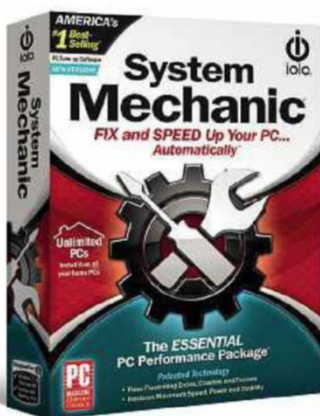
Don't worry about the program slowing down your PC, either. In just a few clicks you can limit the maximum use Disk Defrag Professional will make of your CPU or hard drive, and you can tell the program not to run at all when a particularly demanding application is running – so if you launch your favourite game, say, you can be sure it will get 100% of your system's resources.

If you don't want to pay for the commercial version, there's also a free build available, but unsurprisingly it's much less powerful. There's no choice of defrag algorithms, and no boot-time defrag or resource management. Scheduling is more basic, you don't get the fragmentation prevention mode, there are no detailed reports or performance charts, and no special algorithms for SSDs.

If you're in the market for a defrag tool, then, we'd recommend you install the trial version, if only for a while, just to get a feel for exactly what the program can do.



REQUIREMENTS Windows XP, Vista, 7, 8 or 10
32/64-bit, 50MB hard disk space
WEBSITE www.auslogics.com
NOTES To obtain your serial code, go to ddefrag48.disc.computershopper.co.uk



REQUIREMENTS Windows XP, Vista, 7, 8, 10
32/64-bit, 50MB hard disk space
WEBSITE www.iolo.com
NOTES Get your registration code at www.iolotechnologies.nl/english/6-month-free

Iolo System Mechanic 16

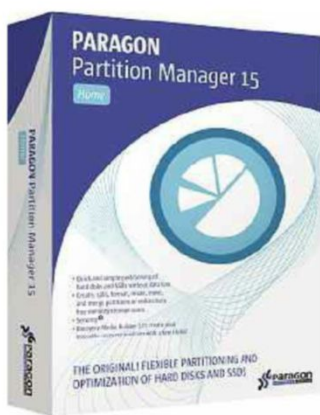
SYSTEM MECHANIC 16 is a brilliantly comprehensive tool that provides everything you'll need to clean and speed up your PC, fix system problems and protect your privacy.

If your PC isn't performing, for instance, then System Mechanic will help you defragment your hard disk; optimise your internet connection settings for faster downloads; defragment and compact the Registry; optimise the boot process by removing unnecessary startup programs; and provide a temporary performance boost by closing down selected background processes.

Each of these functions in turn delivers far more than you might expect. You don't just get a defrag module, for instance: System Mechanic 16 also uses the Program Accelerator, optimising applications by grouping related files together; enhanced AcceleWrite technology helps to improve the efficiency of your drives; and the SSD Accelerator keeps solid-state drives running at their peak performance.

It's the same across the suite, with powerful features and functionality everywhere you look. There are tools here

to defragment and compact the Registry; repair hard disk problems; enhance system security; locate unnecessary duplicate files; and recover from disaster if Windows won't boot. A Windows tweaking tool provides easy access to more than 100 key Windows settings, an Advanced Uninstaller completely removes apps to free up hard disk space – and you could still create a very capable maintenance suite from the other tools that we haven't had space to mention.



REQUIREMENTS Windows XP, Vista, 7, 8, 10
32/64-bit, 300MB disk space
WEBSITE www.paragon-software.com
NOTES Get your registration code at pm15home.disc.computershopper.co.uk

Paragon Partition Manager 15 Home

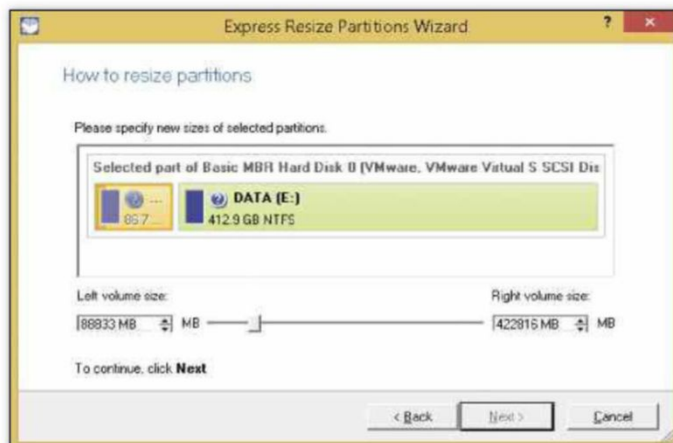
THERE ARE VARIOUS ways of upgrading your PC. You don't need to go out and buy a new machine – there are cheaper options. If you only have 4GB of system memory, consider doubling it to 8GB. If you have a small hard disk, why not purchase a larger drive?

The problem is that new hard disks either ship pre-configured with multiple partitions, with the manufacturer thinking they know how you want your drive set up, or with no partition at all. Once you format your drive, you need to configure it. A partition for Windows is a

dead cert and another for data is likely. You might want one for your media as well.

Formatting a drive is easy in Windows, but partitioning is more difficult. If you just want to create a simple partition or resize existing partitions, you may not require expensive professional-level partitioning software – hence Paragon Partition Manager 15 Home, which is designed for home users who just want to create, delete or resize existing partitions, and other useful drive-management features.

Partition Manager 15 Home will do more than just create new partitions. It also ships with basic disk-management tools such as the ability to migrate drive contents to a new drive, perform a simple backup, enable you to create a multi-boot system (for multiple OS use) and much more.



Chat and Communication

Evernote 6.4.2.3788 Store your notes, ideas and plans in the cloud, and synchronise them between computers.

UPDATED Mailbird 2.3.42

A free desktop email client for Windows.

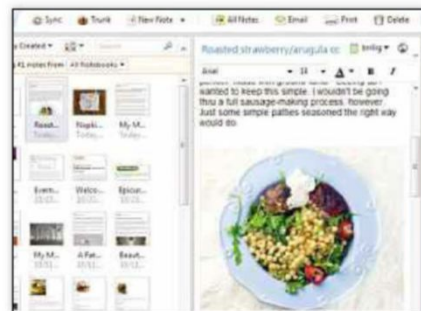
UPDATED Miranda IM 0.10.66

Chat with friends across multiple messaging platforms, including AIM, Facebook, IRC and MSN, all from one simple interface.

UPDATED Skype for Windows 7.32.0.103 Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

Trillian 5.6 Use all your instant-messaging accounts with one application. Supports Windows Live!, AIM, Yahoo! and Google Talk.

UPDATED WhatsApp Desktop 0.2.2732 A free PC and Mac version of the popular messaging app, allowing you to chat straight from your desktop instead of using the web app.



Customisation

UPDATED iolo System Mechanic Free

16.5.1.27 Speed up your system with iolo's PC optimisation suite.

NEW VERSION Rainmeter 4.0

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 6

Bring some of Windows 10's new features to your current operating system.

NEW VERSION Winstep Xtreme 17.1

Freshen up your system with this suite of desktop and UI replacement applications.



General

Genie Timeline Free 2016 Protect your most valuable files with this easy-to-use backup tool.

Paragon Partition Manager 14 Free

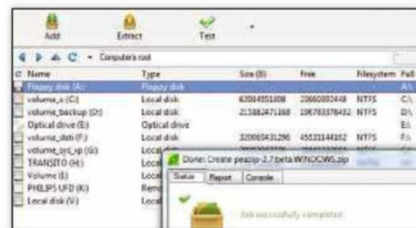
Create, format, split, merge and reorganise all your hard disk's partitions.

UPDATED PeaZip 6.3.0 A tremendously powerful archive-management tool.

Screenshot Captor 4.16.1 Create and manage screenshots the easy way.

UPDATED SUMo 5.1.1.351 Quickly scan your PC's installed applications and find any updates that are available for them.

ZipGenius 6.3.2.3116 A flexible file-compression tool with support for a huge number of compressed file formats.



Internet and Network

CarotDAV 1.13

Manage all your online storage services with one simple application.

UPDATED Cyberduck 5.3.3

A powerful but easy-to-use FTP client for uploading and downloading your files.

Easy Wi-Fi 4.0

Find free Wi-Fi hotspots while you're out and about.

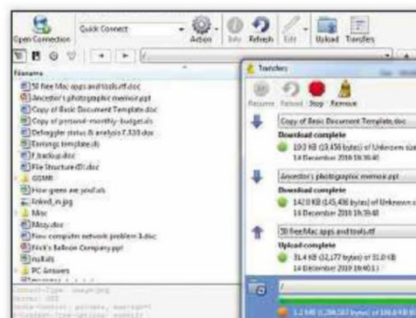
UPDATED FileZilla 3.24 A fast and reliable FTP client with lots of useful features.

UPDATED NetBalancer 9.8.5

Make the most of your internet connection by assigning download and upload priorities to web applications.

TeamViewer 12.1.1.7014

Remote-control your computer from anywhere in the world.



Tweaking and Performance

UPDATED CCleaner 5.26 Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

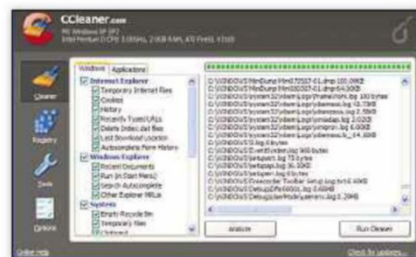
Defraggler 2.21 Ensure your system is defragmented properly and improve its performance.

Finestra Virtual Desktops 2.5.4501 Set up four or more virtual desktops on your PC.

IObit Advanced SystemCare Free 10.0.3.6 A complete computer security, maintenance and optimisation suite.

Revo Uninstaller Free 2.0.2 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.



Built on experience, custom-made for you.

VALUE | SERIES

SCAN VALUE PCS

A range of computers perfectly suited for the home or office. These affordable PCs are very flexible workhorses. They're capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so they're ready to ship for next-day delivery.

Custom
options
available



Scan V10i Home / Office PC

- Intel® Core™ i3 7100 processor
- 8GB Corsair DDR4 2133MHz memory
- 1TB SATA hard drive
- Windows 10 Home

£519 INC VAT

This mid-range PC includes the powerful dual-core Intel® Core™ i3 7100 CPU which runs at 3.7GHz, plus 8GB of system memory, Intel HD 530 graphics and a spacious 1TB hard disk running Windows 10.



Custom
options
available



Scan V15i Home / Office PC

- Intel® Core™ i5 7400 processor
- 8GB Corsair DDR4 2133MHz memory
- 1TB SATA hard drive
- Windows 10 Home

£589 INC VAT

This mid-range PC includes the more powerful quad core Intel® Core™ i5 7400 CPU which runs at 2.7GHz, plus 8GB of system memory, Intel HD 530 graphics and a spacious 1TB hard disk running Windows 10.



Custom
options
available



Scan Value G35i Gaming PC

- Intel® Core™ i5 7500 processor
- 8GB Corsair DDR4 2133MHz memory
- 3GB EVGA GeForce GTX 1060
- 1TB SATA hard drive
- Windows 10 Home

£819 INC VAT

The combination of a quad-core Intel® Core™ i5 7500 processor and the 3GB NVIDIA GeForce GTX 1060 graphics card ensures that the G35i can play any game you throw at it.



Custom
options
available



Scan Value G44i Gaming PC

- Intel® Core™ i5 7600K processor overclocked up to 4.4GHz
- 8GB Corsair DDR4 2133MHz memory
- 6GB EVGA GeForce GTX 1060
- 250GB SATA SSD + 2TB SATA hard drive
- Windows 10 Home

£1,069 INC VAT

For more demanding games, choose the G44i with a quadcore Intel® Core™ i5 7600K processor and next-generation NVIDIA GeForce GTX 1060 graphics, to ensure silky smooth gaming.



Windows 10. Do great things.



Finance available on
PCs above £300



2 or 3 Year
Warranty



Ready
to ship



Fully soak
tested



Scan 3XS
Overclocked

Award-winning 3XS Systems

CUSTOM SERIES

CUSTOMISE YOUR 3XS SYSTEM

The 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor-make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.

Custom options available



Scan 3XS Z170 Vengeance Gaming PC

- Intel® Core™ i7 7700K processor overclocked up to 4.8GHz
- 16GB Corsair DDR4 3000MHz memory
- 8GB EVGA GeForce GTX 1070
- 256GB Intel 600p M.2 SSD & 2TB HDD
- Windows 10 Home
- 3 Year Premium Warranty

£1,699 INC VAT

This high-end gaming system includes an Intel® Core™ i7 7700K CPU which has Hyper-Threading and is overclocked up to 4.6GHz plus a 8GB EVGA GeForce GTX 1070 graphics card, 16GB of 3000MHz Corsair Vengeance DDR4, an Asus Z170 Pro Gaming motherboard, 250GB SSD and a 2TB hard disk.



Custom options available



Scan 3XS Z170 Vengeance 1080 Gaming PC

- Intel® Core™ i7 7700K processor overclocked up to 4.8GHz
- 16GB Corsair DDR4 3000MHz memory
- 8GB EVGA GeForce GTX 1080
- 256GB Intel 600p M.2 SSD & 2TB HDD
- Windows 10 Home
- 3 Year Premium Warranty

£1,939 INC VAT

This high-end gaming system includes an Intel® Core™ i7 7700K CPU which has Hyper-Threading and is overclocked up to 4.6GHz plus a 8GB EVGA GeForce GTX 1080 graphics card, 16GB of 3000MHz Corsair Vengeance DDR4, an Asus Z170 Pro Gaming motherboard, 250GB SSD and a 2TB hard disk.



Custom options available



Scan 3XS LG15 Performance GTX

- Intel® Core™ i7 7700HQ processor
- 8GB Corsair DDR4 2133MHz memory
- NVIDIA GeForce GTX 1050 or 1050Ti
- 15.6in 1,920 x 1,080 screen
- 240GB SATA SSD
- Windows 10 Home

£1,019 INC VAT

The LG15 Performance GTX is a 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 1050 or 1050 Ti graphics card plus your choice of an Intel® Core™ i7 CPU and multiple hard disks and SSDs.



Custom options available



Scan 3XS LG15 Vengeance G-Sync

- Intel® Core™ i7 7700HQ processor
- 8GB Corsair DDR4 2133MHz memory
- NVIDIA GeForce GTX 1060 or 1070
- 15.6in FullHD or 4K screen
- 256GB M.2 PCI-E SSD
- Windows 10 Home

£1,359 INC VAT

The LG15 Vengeance G-Sync is a 15.6" thin and light high-end gaming laptop it includes NVIDIA GeForce GTX 1060 or 1070 graphics, and NVIDIA G-Sync technology that minimises tearing and stuttering in games, with your choice of Intel® Core™ i7 CPU, and multiple hard disks and SSDs.

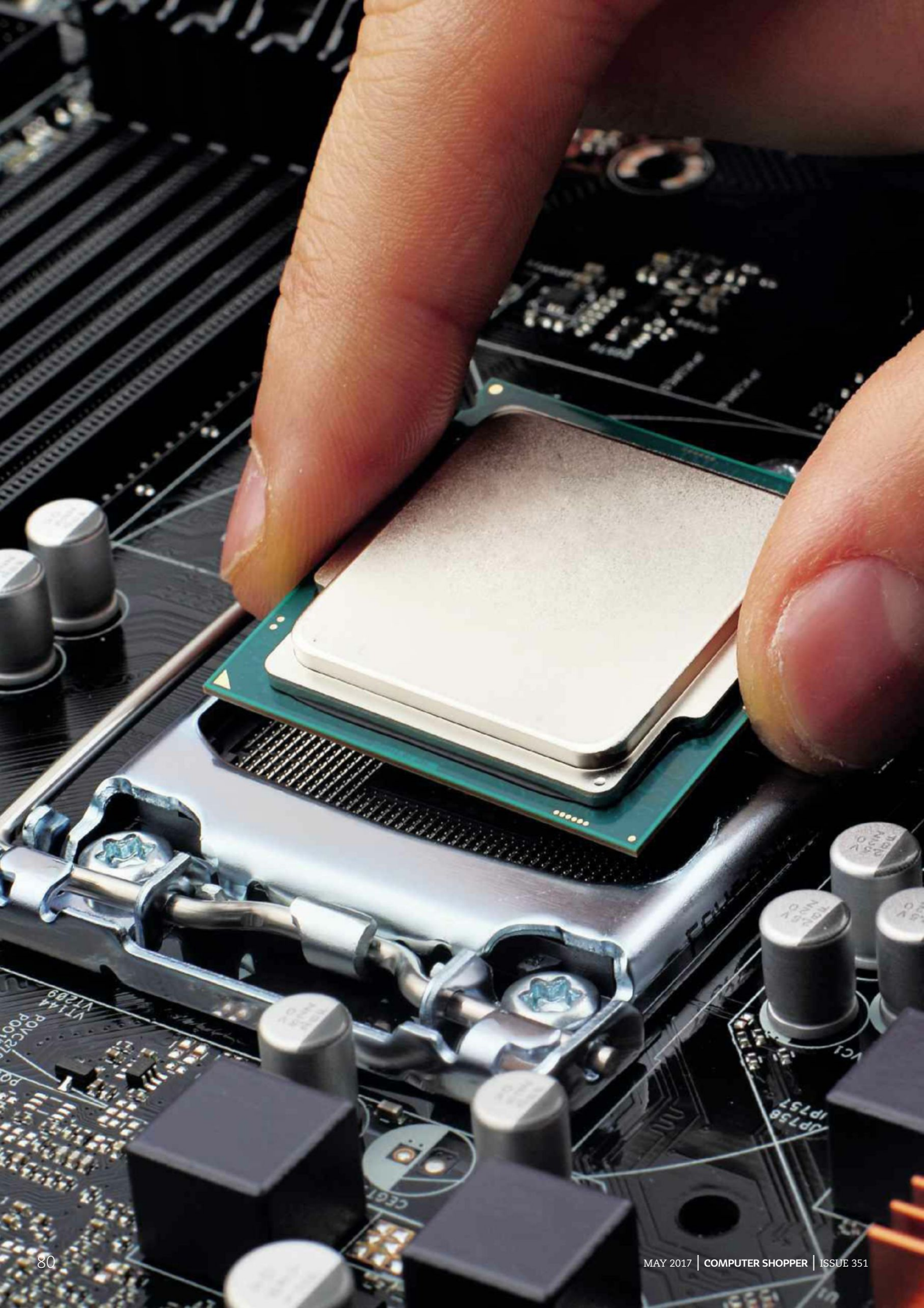


Scan computers recommends Windows.

Find out more today

s scan.co.uk/3xs · 01204 47 47 47

SCAN^s



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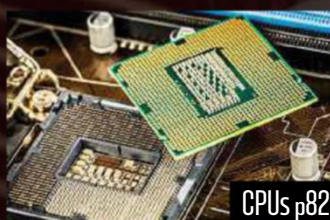
THERE'S NEVER BEEN
A BETTER TIME TO
BUILD YOUR OWN PC.
FOLLOW OUR BUYING
ADVICE TO FIND YOUR
IDEAL COMPONENTS

Building your own computer is the sure-fire way to ensure that you get a PC that suits your requirements. You can also choose better-quality components so that you know your PC is the best it can be. Choosing what to put inside your computer remains the hardest job, but we're here to help.

We're doing things a little differently for this guide. We've tested hundreds of products, but we're only showing you the best ones. That way, our pages are devoted to top-quality components to suit all builds and budgets (a complete PC starts at just £353). After all, what's the point of you reading a one-star PSU review, when you have no intention of buying it and we certainly wouldn't recommend it?

This month we're looking at CPUs, memory, motherboards, graphics cards, PSUs, hard disks and SSDs. To follow up, we've got a group test of PC cases, so you can find the best-looking and most practical case to fit your new components into. Happy building!

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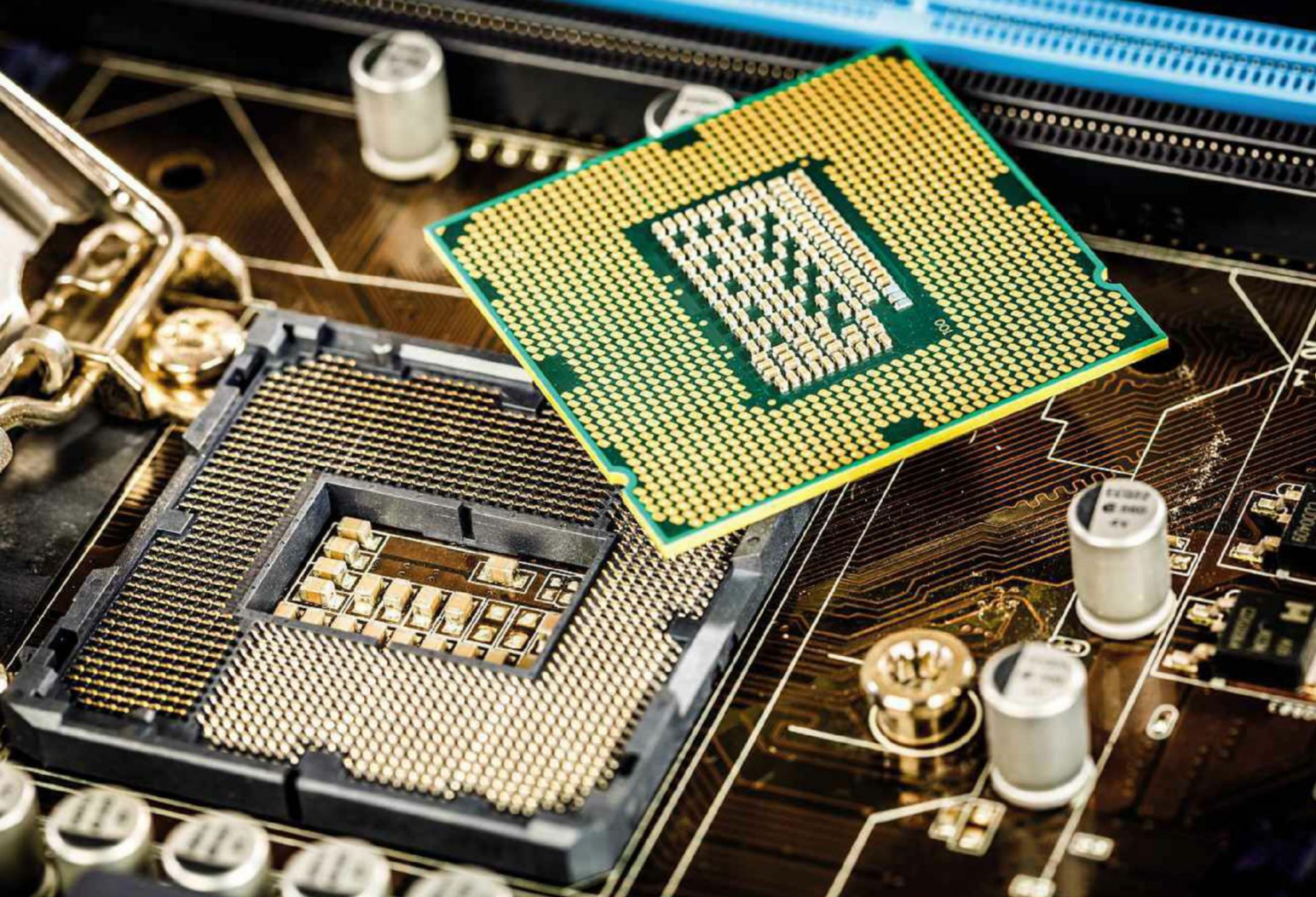
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PART OF THE PROCESS CPUs

Nothing is as important as the CPU when building a new computer. Here's a run-down on how to choose the right model for you

THE PROCESSOR IS the most important component in a computer. It defines how fast your PC will run, but it also dictates the type of motherboard you need, the type of RAM you have to buy and much more.

Here, we've recommended the best-value processors, but other models exist that are slightly faster or slower; it's worth checking prices to see if you can pick up a bargain.

CORE SPECS

Each manufacturer and product range has its own individual CPU architecture (more on this later), but all models share certain features. Understanding these will help you make the right decision and choose the model that best fits your needs.

First, there's the processor's clock speed, which is often used as an indicator of the CPU's speed. However, this can be misleading, as clock speed is only a useful gauge when comparing processors in the same range, particularly as many chips have a low starting clock speed, but can boost higher when they need to perform a powerful task. Instead, it's the processor's efficiency and number of cores that dictate how quickly it will run.

A core is a processor in its own right, so the more cores you have, the more performance your computer has at its fingertips. To use multiple cores you either have to run multiple applications at once, or use applications that take advantage of them. The latter are called multithreaded

applications, and are typically for processor-intensive tasks such as video editing.

Multithreaded support has become better in recent years, with many applications able to use eight cores easily. Even if you don't run a lot of these types of applications, multiple cores are useful: you can run a virus scan using one core, for example, while the others are used for web browsing and other tasks. All the processors we've reviewed here have at least two cores, but quad-core and eight-core models are also here.

Some Intel processors use Hyper-Threading technology, which doubles the number of cores available by adding one logical core per real core. Virtual cores help speed up applications and let the processor

do more, making it more efficient, but they're not as good as real physical cores.

Some processors in this group test (our table on page 85 confirms which ones) can automatically overclock themselves when they're cool enough. This means that you get a speed boost for free. Intel calls its technology Turbo Boost; AMD calls its version Turbo Core.

INTEL CHIPS

Intel's product line-up contains several generations of processors, but only two are worth considering for any PC builder: Skylake and Kaby Lake. Skylake is just over a year old and has the advantage that it will work with older and cheaper motherboards. Given that Skylake chips are only around 5% slower in our benchmarks than the equivalent Kaby Lake chips, they're the better choice for budget and mid-range buyers.

Kaby Lake is Intel's latest processor architecture, although it's really just a slight tweak on Skylake's architecture. These CPUs are the fastest that you can buy, although the big problem is that you really need a newer Z270 chipset motherboard. While older H110 and Z170 motherboards can often have a BIOS update to make them Kaby Lake-compatible, this isn't very practical. A BIOS upgrade requires a compatible processor to be installed, so you'd most likely have to pay a local computer store to do the job for you.

Across all of the ranges, the Intel chips share some common features based on the product name: Pentium, Core i3, Core i5 or Core i7. Pentium chips are dual-core models; Core i3 are dual-core with Hyper-Threading; Core i5 are quad-core and have Turbo Boost; and Core i7 processors are quad-core with Hyper-Threading and Turbo Boost. In all cases look out for chips with a 'K' in the name, as these have unlocked multipliers, meaning you can overclock them easily.

Finally, all the Intel chips we've reviewed have integrated graphics. Both Intel HD 530 (Skylake) and Intel HD 630 (Kaby Lake) graphics chips are suitable for light gaming at a resolution of 1,280x720; serious gamers will want to buy a discrete graphics card.

AMD CHIPS

AMD is set to revamp its product range with Ryzen, due to launch very soon. This should compete with Intel at the high end, but we can't recommend it at the moment. In fact, unless you really want to hold on to see how Ryzen performs, it's safe to build a new computer today. Ryzen isn't going to completely blow Intel out of the water, so if you build today, you'll still be happy. If you do want to wait, we should have a Ryzen review in next month's *Computer Shopper*.

For now, that means that AMD's current product line-up is really for the more budget-conscious buyer. FX chips, using AMD's AM3+ motherboards, are still good value and are relatively quick, with the eight-core models being excellent value.

RAM

RAM simply doesn't make any noticeable difference to performance speed in our tests. As a result, we don't see the point in reviewing RAM kits. Instead, it's more important to choose memory that suits your build.

First, you need to determine the amount, speed and type of RAM that you want. DDR4 RAM is now the most common for new PC builds and works with new Intel processors. Older, slower DDR3 RAM is suitable for old Intel processors and the current AMD range.

RAM comes in lots of different speeds. Currently DDR4 2,400MHz is the best value, with 3,200MHz the best choice for high-end, high-performance systems. For DDR3 systems, 1,866MHz RAM is the best value and will work with all types of computers. Your motherboard may not run your memory at the correct speed when you first plug it in, so you should enable the Intel Extreme Memory Profile (XMP) or AMD Memory Profile (AMP) in your motherboard's BIOS or UEFI to unlock the faster speeds.

You need to know how much RAM to buy. We recommend a minimum of 8GB for budget systems. Most people should buy 16GB, while 32GB remains rather overkill for all but the heaviest of users.

Most motherboards support dual-channel memory, which means you benefit by inserting memory in pairs. You can buy kits that contain two or four sticks of RAM to get you to 8GB, 16GB or higher. Currently, for the memory sizes that we're recommending, 2x 4GB (8GB) and 2x 8GB (16GB) are the best options. Check prices carefully, though, as we've seen instances where buying two 8GB kits (four sticks of RAM) was cheaper than one 16GB kit. Finally, check the maximum amount of RAM that your motherboard supports (our table on page 101 tells you) and don't go over this limit.

RECOMMENDATIONS

From long experience, it's best to buy branded RAM from recognised manufacturers: Corsair, Crucial and HyperX all make high-quality products. Here are some to start with.

DDR3					
Product name	Part code	Speed	Capacity	Price	Supplier
HyperX Fury White 8GB 1,866MHz	HX318C10FW/8	1,866MHz	8GB (2x 4GB)	£61	www.ebuyer.com
Corsair Vengeance Pro Series 1,866MHz	CMY16GX3 M2C1866C10R	1,866MHz	16GB (2x 8GB)	£105	www.ebuyer.com

DDR4					
Product name	Part code	Speed	Capacity	Price	Supplier
Corsair Vengeance LPX 8GB 3,200MHz	CMK8GX4 M2B3200C16	3,200MHz	8GB (2x 4GB)	£90	www.ebuyer.com
Corsair Vengeance LPX 8GB 3,200MHz x2	CMK16GX4 M2B3200C16W	3,200MHz	16GB (2x 8GB)	£123	www.ebuyer.com
Corsair Vengeance LPX Red 8GB 2,400MHz	CMK8GX4 M1A2400C14R	2,400MHz	8GB (2x 4GB)	£61	www.ebuyer.com
Corsair Vengeance LPX 16GB 2,400MHz	CMK16GX4 M1A2400C16	2,400MHz	16GB (2x 8GB)	£105	www.ebuyer.com

They don't have onboard graphics, though, so you have to factor in the price of a cheap graphics card. All FX processors have unlocked multipliers, so you can overclock them easily if you're feeling adventurous and want to boost performance.

All the other AMD processors we've tested are called Application Processing Units (APUs), which means that they combine graphics with a processor. There are three generations of A-series (processors starting with an A) APUs on the market. Trinity and Richland can both be used in Socket FM2 motherboards; the newer Kaveri processors require an FM2+ motherboard.

A-series chips aren't as powerful as Intel chips or the FX range, but their integrated graphics are very good. All but the cheapest processor can manage our Dirt Showdown benchmark, playing it smoothly at a 720p resolution. This means you can play decent games without having to buy a graphics card, making them brilliant all-rounders. These chips are either dual- or quad-core.

Finally, there are FM1 chips, which are AMD's budget offering. These require an FM1 motherboard. These chips are very slow, and the graphics are only really good enough for playing video. As such, we can no longer recommend them.

Best
for

The ultimate performance



While Kaby Lake processors have proved to be only around 5% faster than the older Skylake models, they're still the fastest you can buy. So, if you want the absolute best, the **Core i7-7700K** is the model for you.

Quick in every task, this model is unlocked, so that it can be pushed even further. Its efficient architecture ensures that the CPU stays cool, even at extreme clock speeds.

Buyers looking for a fast computer for less should choose the Skylake **Core i7-6700K**: it's almost as fast, but will work more easily with cheaper Z170 motherboards.

Best
for

High-end computers



The Core i5 range has long been a *Computer Shopper* favourite, as it strikes the perfect balance between cost and performance. The Kaby Lake-based **Core i5-7600K** is the best choice and is exceptionally quick. As this model is unlocked, it can be overclocked, with its efficient architecture helping to keep the CPU cool, even when running at a high clock speed.

For those that require similar performance, but want to use a slightly cheaper motherboard, the Skylake-based **Core i5-6600K** is the best choice, and it's only around 5% slower.

Best
for

Mid-range computers



Kaby Lake's problem is that the motherboards are all still very expensive. Mid-range buyers should go for Skylake, as the choice of motherboards is greater.

The best processor to buy is the **Core i3-6320**. This processor is excellent value and costs significantly less than our recommended Core i5 processor. The Core i3-6320 is still extremely quick and easily handles games, photo editing and video editing with aplomb. Where price is more important than sheer performance, this is the model that we recommend.

Best
for

Budget builders

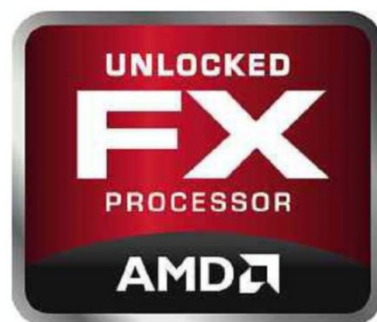


If you want to build a budget computer that's still capable of running pretty much every task, you need an Intel Skylake CPU. With a great choice of budget motherboards, the **Pentium G4500** is our processor of choice.

This dual-core chip doesn't have Hyper-Threading, but it's still surprisingly quick and costs way under £100. For a lightweight computer that won't feel too sluggish in use, it's the ideal model. What's more, if you buy a more expensive motherboard now, you could upgrade to a much faster CPU in the future, when prices have fallen.

Best
for

Mid-range AMD fans



In the wait for Ryzen, the best you can get out of AMD is a decent mid-range computer. There's nothing better in AMD's current line-up than the **FX-8350**, which will work with a well-priced AM3+ motherboard. Performance from its eight cores is pretty good, although the FX-8350 is outclassed by its Intel competition.

The saving grace is that the overall price of your computer will be lower, thanks to the wide availability of cheaper motherboards. The Intel Core i5 range is better, but the FX-8350 still has its place.

Best
for

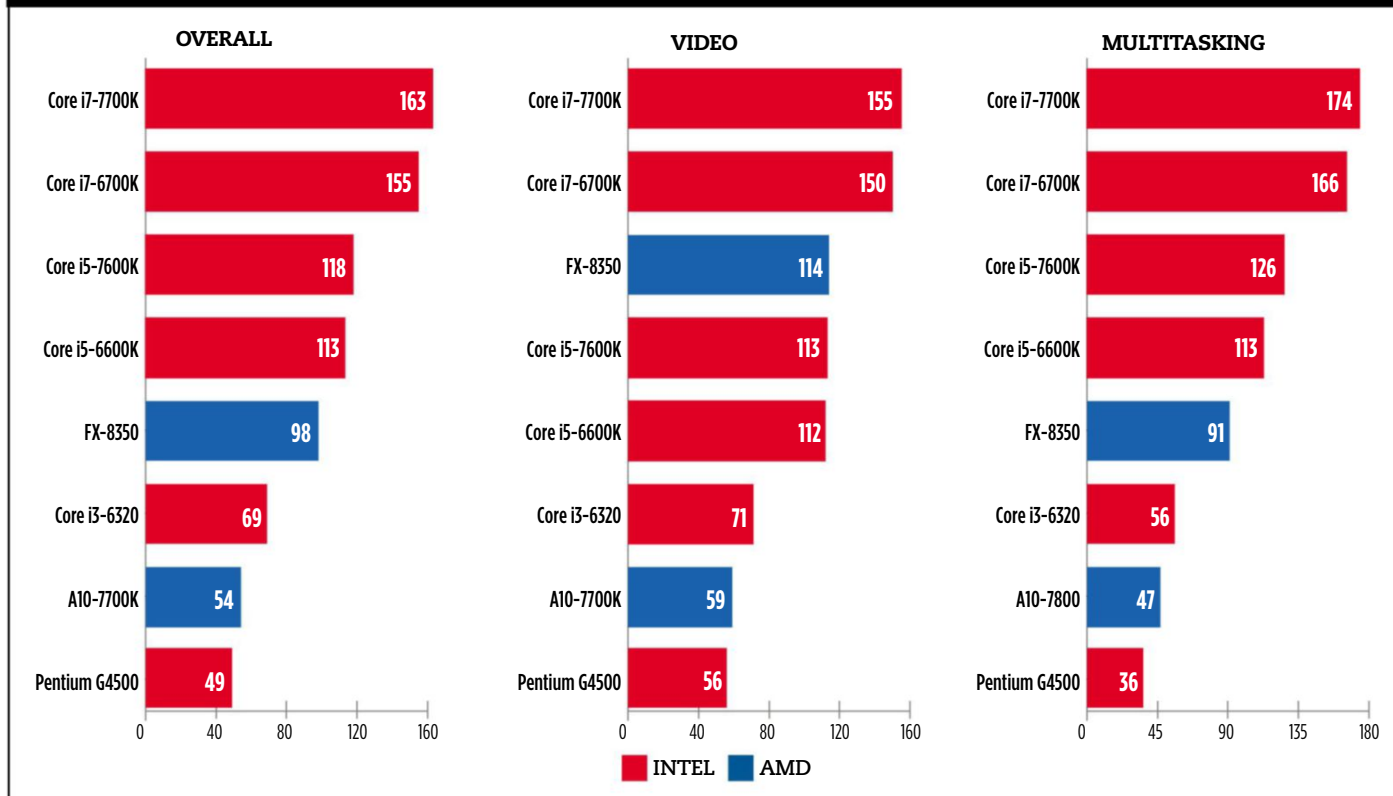
Budget AMD fans



The **A10-7700K** has now been discontinued, but it's still available and can be picked up for not much money. Even better, it's easy to find a well-priced motherboard to go with it. With decent integrated graphics and fair performance, the A10-7700K is a good choice for a budget computer. It will handle most standard tasks well without slowing down.

We recommend the Core i3 or Pentium above this processor, thanks to better upgrade options, but budget builders will still be happy with the A10-7700K.

BENCHMARK RESULTS



	SKYLAKE				KABY LAKE		AM3+	FM2+
Manufacturer	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	AMD	AMD
Model	Pentium G4500	Core i3-6320	Core i5-6600K	Core i7-6700K	Core i5-7600K	Core i7-7700K	FX-8350 Black Edition	A10-7700K
HARDWARE								
Socket	LGA1151	LGA1151	LGA1151	LGA1151	LGA1151	LGA1151	AM3+	FM2+
Cores	Two	Two	Four	Four	Four	Four	Eight	Four
Frequency (Boost)	3.5GHz	3.9GHz	3.5GHz (3.9GHz)	4GHz (4.2GHz)	3.8GHz (4.2GHz)	4.2GHz (4.5GHz)	4GHz (4.2GHz)	3.4GHz (3.8GHz)
Multiplier	x35	x39	x35	x40	x38	x42	x20	x34
External bus	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	200MHz	100MHz
Process	22nm	22nm	22nm	22nm	14nm	14nm	32nm	28nm
Level 1 cache	2x 64KB	2x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	256KB
Level 2 cache	2x 256KB	2x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 2MB	2x 2MB
Level 3 cache	3MB	4MB	6MB	8MB	6MB	8MB	8MB	None
Supported memory type	DDR4	DDR4	DDR4	DDR4	DDR4	DDR4	DDR3	DDR3
Power rating (TDP)	47W	51W	91W	91W	91W	91W	125W	95W
Integrated graphics	HD Graphics 530	HD Graphics 530	HD Graphics 530	HD Graphics 530	HD Graphics 630	HD Graphics 630	None	AMD Radeon R7
BUYING INFORMATION								
Price	£66	£150	£230	£325	£228	£338	£150	£77
Supplier	www.cclonline.com	www.scan.co.uk	www.ebuyer.com	www.ebuyer.com	www.ebuyer.com	www.ebuyer.com	www.scan.co.uk	www.cclonline.com
Details	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.amd.com	www.amd.com
Part code	BX80662 G4500	BX8066 2136320	BX80662 I56600K	BX80662 I76700K	BX80677 I57600K	BX80677 I77700K	FD8350 FRHKBOX	AD770K XBJABOX



POWER UP PSUs

Often overlooked, the PSU has a tremendous impact on how loud your PC is and how many devices you can install in it

WHEN CHOOSING WHAT you want in a new PC, the power supply probably isn't one of the first components that you'd pick out, but it should be, and it's well worth spending a bit extra to get something decent.

Bitter experience has taught the *Shopper* office that buying the cheapest power supply on offer is a bad way to go. Unbranded supplies are often unreliable and prone to breaking. Even worse, they often don't put out stable power, causing random PC crashes.

We've tested a range of supplies to ensure their stability and quality. Overleaf, you can find our recommended power supplies for all types of PCs. Before we delve into that,

here's everything that you need to know about choosing the right PSU for you.

SAY WATT?

All PSUs are rated by their maximum output power, written in watts. The good news is that PCs and components have become a lot more efficient over the years, and require less power. So, while 1.2kW PSUs were on sale a few years ago, you see nothing of the kind available now. In fact, most PC owners would be fine with a 500-550W PSU; this will cope with one or two graphics cards. If you have a lot of hard disks and a high-power graphics card, then a 750-850W PSU is right for you.

The best thing to do is work out how much power your PC will use and then choose accordingly (see box, opposite).

RAIL AGAINST

A PSU outputs its power on different rails, which run at different voltages and have a rating in amps that shows the total current they can provide. Different parts of your PC draw on various rails for their power. Power-hungry components such as the processor and graphics card, for example, draw a significant amount of power from one of the 12V rails. A rail's total rating figure is the total amount of current (Amps)



that can be drawn by that single rail: multiply that by the voltage to find the total power that the rail can provide.

A lot of power supplies have a single 12V rail for the entire PSU, whereas more expensive and higher-capacity models have multiple rails. The total power available for each rail may exceed the total capacity of the PSU, so you can't use each rail to its maximum. What's important is the over current protection (OCP). If a rail draws more current from a rail than is allowed, the PSU's OCP shuts the unit down. With a single rail, the current protection has to be set high, so a single device that fails can pull an exceptional amount of power through the rail, causing damage. With multiple rails, each with their own limit, OCP is triggered at a lower level and your devices are separated, giving you better protection. Typically, a single-rail PSU is fine for regular builds; multi-rail makes more sense in dual graphics card systems that have been overclocked.

When buying a branded power supply, you shouldn't have to be too worried, as they'll be able to provide close to their rated maximum wattage across their 12V rails.

LOAD	20%	50%	100%
80 Plus Bronze	81%	85%	81%
80 Plus Silver	85%	89%	85%
80 Plus Gold	88%	92%	88%
80 Plus Platinum	90%	94%	91%
80 Plus Titanium	94%	96%	91%

EFFICIENCY DRIVE

The efficiency of power supplies has dramatically improved, particularly with the branded models that we've recommended. Efficiency describes how much power is wasted when it is converted from input to output. Any 'lost' power is converted into heat. For example, a 500W power supply that is 85% efficient would need to draw 394W to power a 335W PC. By comparison, a 94% efficient PSU would need to draw 356W – 38W less to power the same computer.

At an average cost of 13.86p per kilowatt hour (kWh) at the standard rate (figures from the Energy Saving Trust), the first power supply would cost 5.4p per hour to run. Assuming eight hours of use per day, the first power supply would cost £157.68 a year to run. By comparison, the second supply costs 4.93p per hour to run, or £144.08 a year. That's a difference of £13.60 a year. On top of that, the more efficient supply generates less heat, keeping your PC running cooler.

Quality power supplies also comply to the 80 Plus certification, with Bronze, Silver, Gold, Platinum and Titanium awards for minimum efficiencies. The 80 Plus standards set efficiency targets at 20, 50 and 100% load. Our tests have shown the 80 Plus standard to be accurate, making choosing your own supply easy. However, don't buy a

PSU on efficiency alone, as it could take years of lower electricity bills to recoup the higher cost of a more efficient PSU.

WELL CONNECTED

Make sure that your PSU has enough power connectors for all of your PC's components. To run two powerful graphics cards, you'll need four 6+2-pin PCI Express connectors, for example. Plenty of SATA connectors are useful for mechanical hard disks, SSDs and optical drives. You may need a Molex connector or two for old devices and some case fans, although this is increasingly unlikely. Likewise, some older devices, such as fan controllers and front-panel card readers, need a Floppy connector.

Buy a modular PSU if you can (most are), as you only have to connect the cables you need, leaving your PC otherwise clutter-free.

SOUND ADVICE

Buying a quiet PSU can really help keep your computer's noise down. We recently upgraded a PC with a new PSU, as the old one had a rattly fan. Picking a semi-passive model (where the fan only spins if the PSU is under heavy load), we managed to get a PC that's a lot quieter. Check the sound rating in decibels (dB) before buying; our reviews tell you what you need to know.

How much power do I need?

Power supplies are generally more efficient at higher loads, so there's no point in buying one that's too powerful. The first job, then, is to work out what your PC's requirements will be and then buy a supply that gives you a bit of headroom.

The eXtreme Power Supply Calculator (outervision.com/power-supply-calculator) is our favourite tool to work this out. Using the simple drop-down menus, you can choose every component your PC has (or will have). Just click the Calculate button when done, and you'll see how much power your computer actually draws and the recommended PSU wattage.

You may be surprised at the results. Our Core i7-6700K PC with an SSD, hard disk, optical drive and Nvidia GeForce GTX 960 graphics card requires only 335W of power, with a recommended PSU of 385W. Given that you can't buy a supply of this size, a 500W or 550W supply would make the most sense.

Best for Silent PCs

SUPER FLOWER Golden Silent 500W

While a lot of modern PSUs are semi-passive, so their fans only spin under heavy loads, the Super Flower Golden Silent 500W PSU is completely passive. It's a little heavier than you might expect, as a giant heatsink sits where the fan would normally go.

The minor downside to the passive design is that the Golden Silent has a maximum output rating of 500W, so it won't be suitable for the most powerful computers.

Efficiency is excellent, with the supply carrying an 80 Plus Platinum rating. Finally, the PSU is modular (bar the motherboard and CPU cables, which you have to have connected), with plenty of connections for all your peripherals and drives. It's a little expensive, but if a quiet computer is the most important thing to you, this is the PSU to buy.



Best for Budget PCs

CORSAIR RM550X

Corsair's RM550X is a budget version of the company's i line, but don't let that put you off, as this is a top power supply unit. The headline feature is that this is a semi-passive PSU, so the fan doesn't spin at low usage, and slowly ramps up the more power is required. In use, on most computers, you won't hear this model at all.

This PSU is excellent value and is fully modular, so you only have to connect the cables that you actually need. This model has just two PCI-E graphics cards connectors, but the higher-rated models (650W, 750W, 850W and 1,000W) have more. There are plenty of other connectors for your regular peripherals and drives, though. This is our top choice for most builds, but buy one of the higher-rated models if you're looking to build a more powerful computer.



Best for Mid-range PCs

CORSAIR RM750i

Corsair's 80 Plus Gold RM750i is a step up from the company's X line (left). Its standout feature is that it ships with five 12V rails, rated at a maximum of 40A each. This mode can be helpful for dealing with power-hungry dual graphics card systems, adding extra protection. However, you can switch it back to a single 12V rail (62.5A) to deliver the full 750W that the PSU supports. This mode is good for general systems. However, as there are no practical downsides to multi-rail configurations, we recommend leaving it at the default setting.

This is a fully modular PSU, so you only need to connect the cables you want. All the connectors that you'll need are in the box, to cover even the biggest PC build, too.

The RM750i is a semi-passive PSU, which means that the fan only turns on when the load exceeds a threshold. In practice, it means that your PC will be exceptionally quiet. For most mid-to-high-end builds, this is a top PSU and one that comes highly recommended. There are also 650W, 850W, 1,000W models available for different loads.



Best
for

High-end systems

BE QUIET! Dark Power Pro 11 850W

If you want a supremely powerful and efficient PSU, then the Be Quiet! Dark Power Pro 11 850W is the model for you. This 80 Plus Platinum supply tops out the efficiency charts, helping produce less heat inside your computer.

There are four 12V rails, which give you that extra bit of protection, particularly if you're installing multiple powerful graphics cards.

The Dark Power Pro is a fully modular PSU, so you need only install the cables that you're actually using, keeping your PC clutter-free. All of the cables and connectors that you need are in the box, even if your computer is stuffed full of drives.

At low power consumption, the fan barely spins, making this PSU effectively silent. Even under heavy load, the fan is never noisy, meaning you can use this PSU in a quiet room.

For big builds or where you want the best, this is the supply to get. It's also available in 550W, 650W, 750W, 1,000W and 1,200W versions.



Manufacturer	BE QUIET!	CORSAIR	CORSAIR	SUPER FLOWER
Model	Dark Power Pro 11 850W	RM550X	RM750i	Golden Silent 500W
FEATURES				
Fan	135mm	135mm	135mm	None
Dimensions (WxDxH)	150x193x86mm	150x86x160mm	150x180x86mm	150x170x86mm
CLAIMED OUTPUT				
3.3V rail	25A	25A	25A	20A
5V rail	25A	25A	25A	20A
12V rails	4 (2x 30A, 2x 35A)	1 (45.8A)	5 (40A)	1 (41.5A)
12V rails max output	70A	45.8A	62.5A	41.5A
Maximum total output	850W	550W	750W	500W
80 Plus certification	80 Plus Platinum	80 Plus Gold	80 Plus Gold	80 Plus Platinum
CONNECTIONS				
Modular	Yes	Yes	Yes	Yes
PCI-E	4 (6+2 pin)	2 (6+2 pin)	4 (6+2 pin)	4 (6+2 pin)
Molex	8	4	7	5
SATA	8	6	8	6
Floppy	1	1	2	1
Motherboard connector	20/24-pin	20/24-pin	20/24-pin	20/24-pin
Four-pin 12V processor	Yes	Yes	Yes	Yes
Eight-pin 12V processor	Yes	Yes	Yes	Yes
BUYING INFORMATION				
Price	£190	£83	£130	£130
Supplier	www.ebuyer.com	www.ebuyer.com	www.scan.co.uk	www.cclonline.com
Details	www.bequiet.com	www.corsair.co.uk	www.corsair.co.uk	www.super-flower.com.tw
Part code	BN253	CP-9020090-UK	CP-9020082-UK	SF-500P14FG



COLD STORAGE

SSDs & hard disks

Storage is an essential part of any PC build, so step this way to find the best mechanical and solid-state disks

YOU'RE ALWAYS GOING to need a lot of storage in your PC, but sheer capacity is no longer good enough. If you want your computer to boot fast, load applications quickly and feel more responsive, you need to have a solid-state drive (SSD). Using flash memory, rather than spinning platters, these devices are exceptionally fast, making your

computer feel very responsive. Thankfully, SSD prices have been plummeting recently, so it's possible to pick up a good-quality drive for not much money.

The big problem with SSDs is capacity, with larger drives rapidly getting a lot more expensive. For that reason, you may still want to have a mechanical hard disk in

your computer. These types of drives are exceptionally good value and cost under 3p per gigabyte, which is astoundingly cheap.

Finally, the last type of drive is a hybrid drive, combining a mechanical hard disk with a fast SSD cache to give you the best of both worlds. These types of drives aren't as popular as they once were, thanks to falling SSD



To get next-generation performance, you need a motherboard that supports NVMe via an M.2 slot

as the platters themselves rotate at high speed, anywhere up to 10,000rpm. Data is stored on the surface of each platter, and the arm moves the heads over the surface of the disk to pick up data.

The mechanical nature of hard disk drives means that they can't compete with the speed of flash storage found in SSDs, which doesn't rely on delicate moving parts. It's also why hard disks are more susceptible to impact damage, making dropping a laptop with a hard disk likely to result in data loss.

SOLID-STATE DRIVES

SSDs are the best choice for your primary system disk. Thanks to their superior read and write speeds, they can make Windows load almost instantly, while applications will load much faster.

SSDs have blisteringly fast file-transfer speeds due to the lack of any moving parts. Rather than the disk platters found in HDDs, SSDs use NAND flash memory. NAND comes in some varieties based on how much data each of its cells can contain. There are the now less common Single-level Cell (SLC) type that can only store one bit, Multi-Level Cells (MLC) that can store two bits and Triple-level Cells (TLC) that can store three.

Being able to store more than one bit per cell enables manufacturers to pack more storage capacity into a smaller physical space, allowing the SSDs to reach ever-greater capacities while still fitting into existing drive bays. However, a balance needs to be struck, as using more bits per cell can result in compromised speed and reliability.

Technological innovations have also allowed SSDs to increase in capacity further. These include Samsung's 3D V-NAND system, which stacks cells both vertically and horizontally. However, SSDs lag behind HDDs when it comes to storage capacity, although 1TB drives are increasingly popular, and the cost per gigabyte is also a lot higher.

While a lot of SSDs connect to a SATA port (SATA3 is best for speed), we've reached the point where SSDs have maxed out this interface's speed. To get next-generation



↑ The size difference between M.2 (top) and SATA (bottom) SSDs can clearly be seen.

performance, you need a motherboard that supports Non-Volatile Memory Express (NVMe) via an M.2 slot. These drives look like expansion cards and plug directly into your motherboard, from where they also get their power. This combination allows a maximum throughput of 4,000MB/s; SATA3 tops out at just 600MB/s.

HYBRID DRIVES

As we've mentioned, hard disk drives still provide the best bang for your buck when it comes to sheer storage capacity, but the read and write speeds of SSDs simply can't be beaten. The obvious solution, therefore, would be to combine the two. That's what many manufacturers did, but these drives are declining in popularity. With the reduction in price of SSDs, hybrid drives just aren't the bargain that they once were. We recommend buying a dedicated SSD and supplementing that with a mechanical hard disk if required.

SIZE MATTERS

Storage drives typically come in two form factors: 2.5in and 3.5in. All SATA SSDs are 2.5in, but mechanical HDDs can come in either size (2.5in drives are for laptops and the larger 3.5in drives are for desktops). The average PC case will likely be able to accommodate both sizes.

prices, so you may only want to choose this option if space is an issue.

Here's everything you need to know about getting the right type of storage for your PC.

HARD DISK DRIVES

Hard disk drives (HDDs) are the original form of PC storage and have been around for a long time. These types of disks provide the highest storage capacity and are a lot cheaper than SSDs when priced per gigabyte. If you're just looking for lots of storage space for media, documents and large applications, then an HDD is your best option. We don't recommend using a hard disk for installing Windows, though, as you'll hamper system performance: the slowest SSD is many times faster than an HDD.

Hard disk drives are often referred to as mechanical drives due to the way they operate. Fundamentally, a hard disk consists of a mechanical arm and, depending on its storage capacity, one or more platters. The arm holds the read/write heads that move across the platter at extremely high speeds,

How we test

To test the read and write speeds of each disk drive, we use a script that copies files to and from the drive and measures the time taken. We copy the files to the disk from memory rather than from another disk drive, because RAM is faster than any hard disk or SSD so won't act as the limiting factor in the tests.

In our large-file tests, we copy a 100MB file to and from each disk 100 times to see how fast a drive is when dealing with big files such as video clips. We repeat the test with smaller files, although the impact on SSDs isn't so great; mechanical hard disks slow down a fair bit here, which is further proof that these devices are best for plain storage. Overleaf, we've printed the large files results, so you can see the maximum speed of each drive.



SPEC YOUR PC

Best
for

General PCs

CRUCIAL MX300

The Crucial MX300 is a top 2.5in SATA3 SSD, available in a great range of capacities, stretching from 275GB all the way up to a massive 2TB. The top capacities are expensive compared to buying a mechanical hard disk, but if you want a silent and fast computer, they're well priced for solid-state storage. More realistically, the MX300's 275GB or 525GB versions will make better choices for most people, acting as fast boot drives, and paired with a regular hard disk for capacity.

Performance is excellent across the board, with this SSD almost topping out SATA3's interface speed.



Best
for

Speed on a budget

SAMSUNG 850 EVO M.2

The 850 EVO is a little old, but it's still quick, and it's now extremely good value. If you have an M.2 slot on your motherboard, want a little bit more performance and don't want to pay through the nose for it, this is the drive for you.

It's available in just two capacities (250GB and 500GB), but it's priced at around the same as a SATA3 SSD, although it's considerably quicker. There's also a SATA3 version of this drive available, but it's not as quick and we recommend the Crucial MX300 instead.



Best
for

Performance

SAMSUNG 960 Pro

There's no doubting it, the Samsung 960 Pro is the fastest SSD that money can buy, by a long shot. Available in 512GB, 1TB and 2TB, the 960 Pro could be your only drive. The top-end storage options are rather expensive, so most people will be better off with the 512GB version, buying a mechanical hard disk or SATA SSD for more storage.

Thanks to its M.2 interface and brand new controller, performance is through the roof. If you want the best, this is the one. Look for the 960 EVO if you want to save a bit of cash at the expense of a little performance; the 850 EVO is a good compromise if you want value.



Best
for

Storage

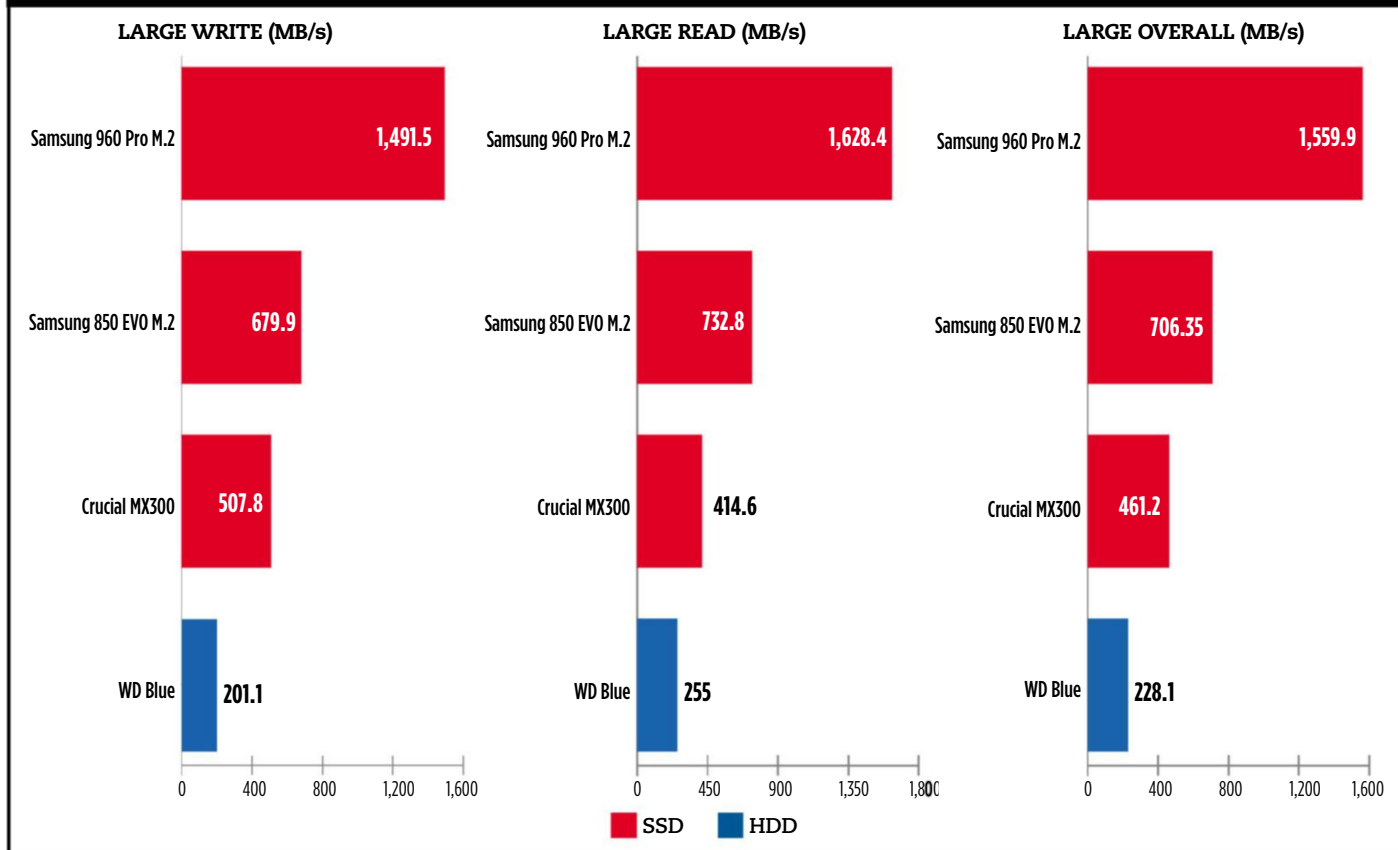
WESTERN DIGITAL Blue

The WD Blue drive is the replacement for the old WD Green series. There's nothing particularly exciting about this line of drives: they're cheap, reliable and handy if you just want loads of storage space. With capacities of 1TB, 2TB, 3TB, 4TB and 6TB, the WD Blue is a good choice for anyone who just needs to store a lot of data. Prices are excellent, too. Performance from these hard disks doesn't come close to that of an SSD, so pair this drive with one of our SSD choices for the best combination of performance and storage space.





BENCHMARK RESULTS



Manufacturer	CRUCIAL	SAMSUNG	SAMSUNG	WESTERN DIGITAL
Model	MX300	850 EVO M.2	960 Pro	Blue
HARDWARE				
Capacity	275GB, 525GB, 1TB, 2TB	250GB, 500GB	512GB, 1TB, 2TB	1TB, 2TB, 3TB, 6TB
Interface	SATA3	M.2	M.2	SATA3
Claimed read	530MB/s	540MB/s	3,500MB/s	Not disclosed
Claimed write	510MB/s	500MB/s	2,100MB/s	Not disclosed
BUYING INFORMATION				
Warranty	Three years RTB	Five years RTB	Five years RTB	Two years RTB
Prices	£84 (275GB), £130 (525GB), £262 (1TB), £533 (2TB)	£93 (250GB), £167 (500GB)	£332 (512GB), £679 (1TB), £1,139 (2TB)	£46 (1TB), £69 (2TB), £93 (3TB), £128 (4TB), £211 (6TB)
Supplier	www.ebuyer.com	www.ebuyer.com	www.scan.co.uk	www.scan.co.uk
Details	www.crucial.com	www.samsung.com/uk	www.samsung.com/uk	www.wdc.com
Part code	CT275MX300SSD1, CT525MX300SSD1, CT1050MX300SSD1, CT2050MX300SSD1	MZ-N5E120BW, MZ-N5E250BW, MZ-N5E500BW	MZ-V6P512BW, MZ-V6P1T0BW, MZ-V6P2T0BW	WD10EZRZ, WD20EZRZ, WD30EZRZ, WD40EZRZ, WD60EZRZ



GRAPHIC NOVEL

Graphics cards

The PC is probably the best gaming platform on earth, with a huge range of titles for all interests. To get the best experience, you need the right graphics card

BUY PRACTICALLY ANY CPU, and you'll find that it has an integrated graphics chip inside it. These chips are ideal for standard Windows use and can even cope with the occasional game, but if you want to play something a bit more involving, you need to buy a proper graphics card.

This is a completely swamped area of the market, with loads of different cards available, from the brand new to the old. With almost every price point plugged, it's hard to work out which card to buy. Over the page, you'll

find our top recommendations. We've focused on the cards that deliver a good gaming experience. Here we'll take you through everything you need to know about choosing the right card for your PC.

CHIP OFF THE OLD BLOCK

Graphics cards are manufactured by third-party vendors, such as Asus and Gigabyte, but the actual chips are made by just two companies: AMD and Nvidia. While AMD and Nvidia provide reference designs,

each manufacturer is free to make some adjustments of their own, such as overclocking a card. Overclocking, in our experience, makes little difference.

However, there are some changes that do make a difference, such as passively cooled cards that stay silent. These bigger architectural changes tend to increase the card's price, so only go for a radically different design if you have a particular requirement.

Most people should choose a card based on the type and model of the graphics chip,



and find the best price that you can. We've listed our favourite cards overleaf to help make the choice easier.

NVIDIA CARDS

Nvidia dominates the high end, with its latest Pascal architecture cards proving to be super efficient and very powerful. If you want the best performance, you need an Nvidia card.

All Nvidia cards support the PhysX hardware-accelerated physics technology, although few games actually support it, as AMD can't use the technology. As a result, games developers won't implement an exclusive technology.

Multi-Frame Sampled Anti-Aliasing (MFAA) uses the card's hardware to provide high-quality anti-aliasing, smoothing off jagged edges in games without a big performance hit (see box, right). Dynamic Super Resolution (DSR) renders games at a higher resolution than your monitor can support, before scaling the graphics down, in effect adding support for Super Sampling Anti-Aliasing (SSAA) in all games.

Nvidia cards support G-Sync. When used with a compatible display, G-Sync lets the monitor adjust its refresh rate to match the graphics card's frame rate, making for smoother moving images with no tearing.

AMD CARDS

AMD has lost ground in the high end, with its cards best for mid-range buyers. As with Nvidia, AMD has its own range of proprietary technologies that appear in a wide selection of games. The Mantle rendering engine is used to provide a performance boost over DirectX, while the TressFX hair simulation in Tomb Raider was optimised for AMD hardware. Again, proprietary technologies aren't that well supported, as games manufacturers don't want to alienate people with different graphics cards.

AMD has its own supersampling technology, called Virtual Super Resolution (VSR). This

GPU is, the size of the cooling system and the number of ports on the back of the card. Our PC case reviews (see page 102) state how much room is available inside for graphics cards.

Most mid-range graphics cards take up two expansion slots, to accommodate a heatsink and cooling fan. These cards are known as dual-slot and will obscure the PCI-Express slot directly beneath the one into which you plug the card.

OUTPUTS

Almost all modern graphics cards have at least one DVI port for connecting to a

Nvidia dominates the high end, with its Pascal architecture cards proving to be super efficient and very powerful

renders games at a higher resolution than your monitor supports, downscaling them to fit, for highly accurate anti-aliasing.

AMD's cards support FreeSync technology. With a supported monitor, FreeSync lets a display adapt its refresh rate to the frame rate being supplied, reducing tearing in games.

POWER UP

You need to make sure your power supply can handle your graphics card (see page 86). As the PCI-Express card slot doesn't provide enough power for most graphics cards, your PSU needs additional power connectors. Mid-range and low-end cards tend to need one six-pin PCI-E power connector; high-end cards need one eight-pin and one six-pin, or even two eight-pin connectors.

Graphics cards vary greatly in length and height, depending on how big the actual

monitor. HDMI outputs now appear on most graphics cards; you'll want at least one if you plan on connecting your PC to a TV.

Be aware that with older cards many HDMI connections will limit you to a 30Hz refresh rate at 2,560x1,440 or higher resolutions, which will make the Windows desktop feel jerky. The newer cards we've reviewed have HDMI 2.0 ports, which can output 4K resolutions with a 60Hz refresh rate. Also, on some cards with two DVI ports, one port may be a single-link model, which will only support displays with up to 1,920x1,200 pixels; dual-link DVI supports up to 2,560x1,440 at 60Hz.

If you want to connect to a 3,840x2,160 (4K) monitor or one with a very high refresh rate, you're best off using a DisplayPort output, as this interface standard supports very high resolutions and refresh rates.

Anti-aliasing explained

Aliasing is the unavoidable effect that comes from using square pixels to draw diagonal lines. As screen resolutions increase, the effect becomes less prominent, but on today's 1,920x1,080 and 2,560x1,440 monitors aliasing (jagged edges) is still a major issue.

There's a range of different anti-aliasing techniques that reduce the effect, but these vary by game and by graphics card manufacturer. We use three different methods when testing graphics cards: Fast Approximate AA (FXAA), Multi Sampling AA (MSAA) and Super Sampling AA (SSAA).

FXAA is the least intensive form of anti-aliasing, as it doesn't actually analyse the 3D models on the screen. Instead, it applies a smoothing effect to the entire scene as a post-processing filter. However, this means it blurs objects and textures that should be left alone, reducing the sharpness of the image. If your graphics card is powerful enough, it's worth opting for one of the other anti-aliasing modes listed below.

MSAA requires more GPU resources, as it targets just the jagged lines for smoothing by detecting the edges of polygons. It's the method you should use if your graphics card can't cope with more demanding forms of anti-aliasing.

Finally, SSAA uses a brute force approach. At a basic level, the process involves rendering the scene at a higher resolution than your monitor natively supports, then downscaling it to display correctly on your screen. Enabling 4x SSAA on a game running at 1,920x1,080 essentially forces the graphics card to render at 3,840x2,160, effectively quadrupling the workload. It's the most intense anti-aliasing method out there, but it preserves visual clarity and is worth turning on if your graphics card can handle it.

Best for 4K gaming

NVIDIA GeForce GTX 1080

If you want the best graphics card available, the GeForce GTX 1080 offers unparalleled performance. Using the Pascal architecture, it's a card that's powerful and efficient. Indeed, it stays very quiet under normal use, only spinning up its fans when the card comes under load.

Performance is fantastic, with the card blasting through our tests. In fact, the GTX 1080 is so good that it's overkill if you only have a 1080p monitor. Rather, this is a card for high-resolution displays, especially 4K monitors. It's also ready for VR.

Running at a resolution of 3,840x2,160 we measured a frame rate of 98fps in Dirt Showdown and 60fps in Tomb Raider. Only the ever-demanding Metro caused problems, running at 21fps.

No other graphics card can come close to replicating the GTX 1080's performance. If you have a high-resolution monitor and want the best, this is the card for you.



Best for Most people

NVIDIA GeForce GTX 1060

When Nvidia released the GTX 1060, it made a staggering claim: this mid-range card would have similar performance to the previous generation's fastest card, the GTX 980. We're pleased to say that this is true. This really is the graphics card for most gamers.

Full HD gaming is simple for this card, but it also does well at a resolution of 2,560x1,440, smoothly running all of our test games. Even 4K resolutions aren't completely beyond the GTX 1060, although you may have to turn down detail settings to get smooth frame rates.

If you want detailed 4K gaming, the much more expensive GTX 1080 is the card for you, but if you want fast gaming at a great price at all other resolutions, buy this graphics card.



Best for Those who want AMD

AMD Radeon RX 480

AMD has given up the top-end to Nvidia, but it has some great mid-range cards, such as the Radeon RX 480. Although the Nvidia GeForce GTX 1060 is a better choice for most people, if you have a FreeSync monitor then this is the card for you.

Performance is very similar to the GTX 1060's, with similar frame rates when running at 1,920x1,080. Higher resolutions are possible with this card, with smooth frame rates at 2,560x1,440. At 4K, the card managed 55fps in Dirt Showdown, 31fps in Tomb Raider and just 10fps in Metro. Dialling down some settings should make all 4K gaming possible.

Nvidia's GeForce GTX 1060 has the slight edge when it comes to efficiency and power, but the RX 480 is still a wonderful card.



Best for Budget gamers

NVIDIA GeForce GTX 1050

If you're just an occasional gamer and want a graphics card that can handle most modern titles at a Full HD resolution, the GTX 1050 is the card for you. This graphics card did well in the majority of our graphics tests, only struggling slightly in the demanding Metro test. This was nothing that dialling down a few settings couldn't fix, either.

The GeForce GTX 1050 has the added advantage that it's very small, with just a single fan on it. When the graphics card is cool enough, the fan doesn't even spin, making this graphics card silent for the majority of the time.

At this price, this card can't be beaten, making the GTX 1050 our budget choice and the best option for smaller builds.



How we test

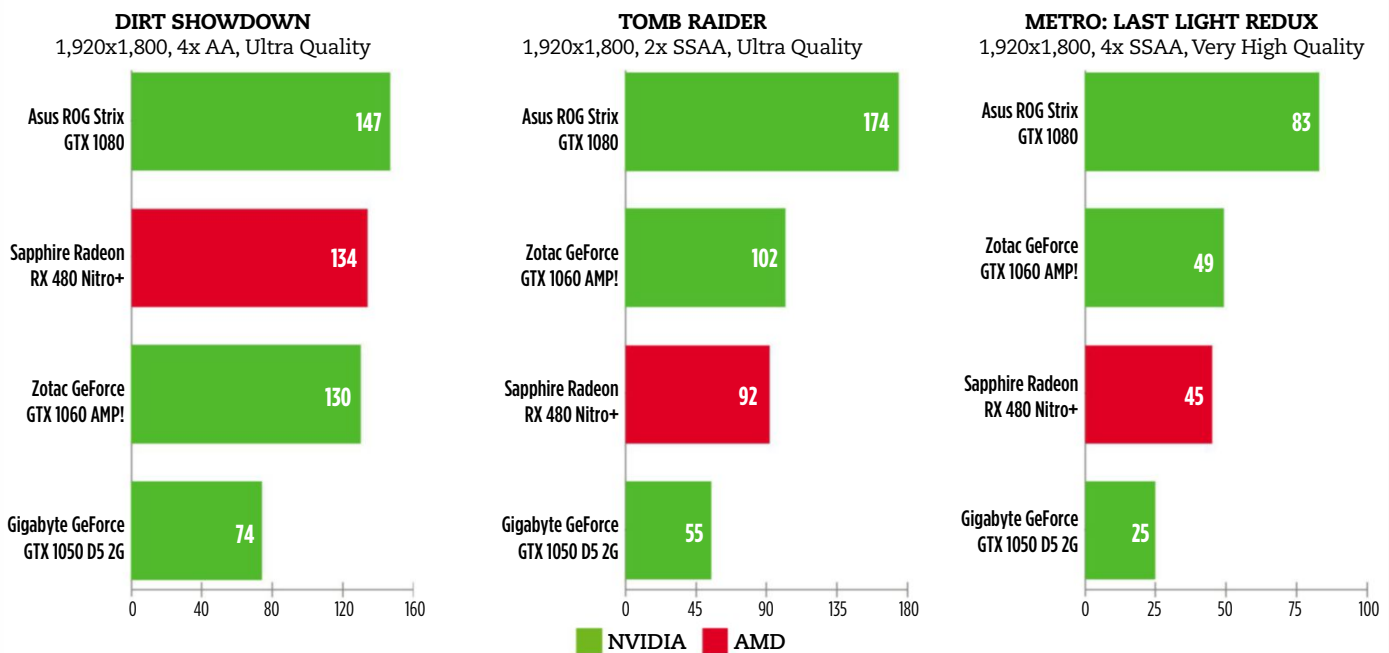
We test all our graphics cards on an Intel DZ87KLT-75K motherboard with an Intel Core i7-4770K processor and 16GB of RAM. This system is powerful enough to ensure the CPU or memory isn't holding back the graphics card and artificially slowing down frame rates. We then use a range of different games, which vary in graphical intensity, to measure performance.

Dirt Showdown is our least challenging title, so should play well on mid-range GPUs without dropping below a smooth 60fps; racing

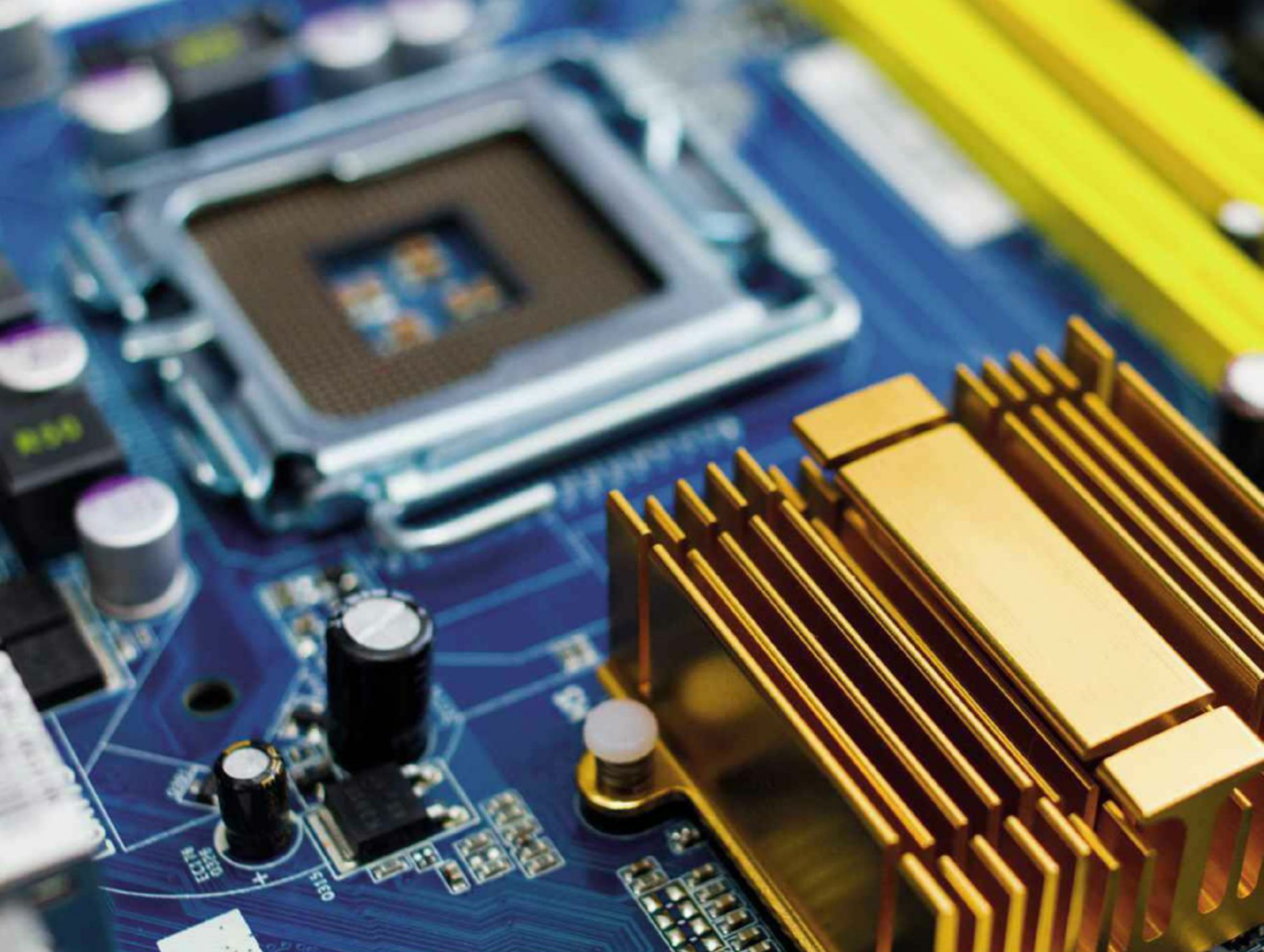
games, in particular, benefit from high frame rates. The game also scales well to 2,560x1,440 and 4K resolutions when running on more powerful cards. 2013's Tomb Raider reboot uses very demanding Super Sampling Anti-Aliasing (SSAA), which will tax mid-range cards, while Metro: Last Light Redux makes heavy use of tessellation to challenge all but the most powerful graphics cards. We've printed the results of the graphics cards at 1,920x1,080, so you can see how well they stack up against each other.



BENCHMARK RESULTS (frames per second)



Manufacturer	ASUS	GIGABYTE	SAPPHIRE	ZOTAC
Model	ROG Strix GTX 1080	GeForce GTX 1050 D5 2G	Radeon RX 480 Nitro+	GeForce GTX 1060 AMP! 6GB
HARDWARE				
Slots taken up	2	2	2	2
GPU	Nvidia GeForce GTX 1080	Nvidia GeForce GTX 1050	AMD Radeon RX 480	GeForce GTX 1060
GPU cores	2,560	640	2,304	1,280
GPU clock speed	1,670MHz (Gaming Mode), 1,695MHz (OC Mode)	1,379MHz	1,208MHz	1,556MHz
GPU clock boost speed	1,835MHz (Gaming Mode), 1,809MHz (OC Mode)	1,493MHz	1,306MHz	1,777MHz
Memory	8GB GDDR5X	2GB GDDR5	8GB GDDR5	6GB
Memory interface	256-bit	128-bit	256-bit	192-bit
Max memory bandwidth	320GB/s	112GB/s	256GB/s	192.2GB/s
Memory speed	10,010MHz	7,008MHz	8GHz	8GHz
Graphics card length	298mm	172mm	243mm	210mm
DVI outputs	1	1	1	1
D-sub outputs	0	0	0	0
HDMI outputs	2 (HDMI 2.0)	1 (HDMI 2.0)	2 (HDMI 2.0)	1 (HDMI 2.0)
Mini HDMI outputs	0	0	0	0
DisplayPort outputs	2	1	2	3
Mini DisplayPort outputs	0	0	0	0
Power leads required	1x 6-pin PCI Express, 1x 8-pin PCI Express	0	1x 8-pin PCI Express	1x 6-pin PCI Express
Accessories	Aura RGB Lighting	None	None	None
BUYING INFORMATION				
Price	£646	£110	£229	£275
Warranty	Two years RTB	Three years RTB	Three years RTB	Three years RTB
Supplier	www.scan.co.uk	www.scan.co.uk	www.ebuyer.com	www.zotac.com
Details	www.asus.com/uk	www.gigabyte.com	www.amd.com	www.geforce.co.uk
Part code	Strix-GTX1080-A8G-Gaming	GV-N1050D5-2GD	11260-07-20G	ZT-P10600B-10M



BOARD GAMES

Motherboards

Your motherboard is one of the most important components in your PC, determining the type of processor and range of expansion devices you can use. Here's how to make the right choice

ALTHOUGH YOU'LL PROBABLY start your PC-building journey by choosing your CPU first, the motherboard is the next most important choice. Buy the right motherboard, and you'll be able to connect all of the devices that you need; get it wrong, and you'll have a sub-standard computer. Fortunately, we're here to help with our complete buying guide and top recommendations.

In all our reviews, we've noticed that the motherboard plays very little part in system performance, so we're not printing any

graphs. Instead, we've tested a large number of boards and are recommending our choices based on build quality, features and price.

What's important is making sure that your chosen model has all the features you need. Our table on page 101 lists everything, so you can make the right decision. Here's what else you should look out for.

MEMORY TEST

Thanks to the latest two generations of Intel processors (Skylake and Kaby Lake),

DDR4 memory is the standard type now used, and all the Intel motherboards that we've recommended have DDR4 memory slots. Should you buy an older Intel motherboard or a current AMD motherboard, you'll need DDR3 RAM instead.

In all cases, it's important to check that your motherboard has support for the maximum amount of RAM that you want to install. A board with four RAM slots will give you more flexibility than a board with just two slots. In addition, if you opt for a



four-slot board now, you'll most likely have room for expansion in the future, too.

Most modern motherboards support dual-channel memory, where you eke a little more speed out of your RAM when you use two or four sticks of memory. You'll need to consult your motherboard's manual to ensure that you're using the right slots when installing your RAM sticks.

Finally, check the maximum speed of RAM that your motherboard supports. By default, your RAM will be run at a lower speed, until you go into the BIOS and enable either XMP (eXtreme Memory Profile) or AMP (AMD Memory Profile).

SIZE MATTERS

All the boards here fit into two form factors: ATX and microATX. ATX boards are larger, giving you more expansion slots and a bit more room to work on; microATX boards are smaller and generally a little cheaper.

You need to make sure that you buy a board that fits inside your chosen case: an ATX motherboard needs an ATX case, as it will not fit in a microATX case; a microATX motherboard will fit into both case sizes.

STORAGE

All your storage devices, from hard disks and SSDs to optical drives, need to be connected to the motherboard. Look out for SATA3 ports (sometimes called SATA 6GB/s), as these will let you get the most from a traditional SSD.

Some motherboards may have an M.2 port, which lets you plug a small M.2 SSD directly into the motherboard. As well as saving space, M.2 is faster than SATA. Some boards have SATA Express ports for new PCI-Express-based SSDs. All of these may be useful if you're building a super-fast top-of-the-range system, but the performance of SATA3 with a regular SSD is good enough for most people, and these SSDs are great value.

Intel processors

SOCKETS

Intel's current sockets are LGA1150 (Haswell and Devil's Canyon) and LGA1151 (Skylake and Kaby Lake). You need to line up the processor you buy with the type of motherboard you buy, as the two sockets are incompatible with each other.

To make things more complicated, Intel's product ranges are all called Celeron, Pentium, Core i3, Core i5 and Core i7, regardless of the socket used. If in doubt, you can use ark.intel.com to look up the exact specifications of your processor to make sure that you're buying the right type of processor.

CHIPSETS

There are some other caveats with Intel processors. For Skylake, it's easy enough as any current LGA1151 motherboard using the Z170 or H110M chipset will do the job. These chipsets will often also support Kaby Lake processors, but they may need a BIOS upgrade first. This requires a supported processor to be installed in the motherboard, so you'd most likely need to get a local repair shop to do the job. For that reason, Kaby Lake buyers should stick with the latest Z270 chipset motherboards.

For LGA1150 buyers, an H97 or Z97 chipset will do the job. In all cases, check the motherboard manufacturer's website for a definitive compatibility list.

Mechanical hard disks and optical drives do not benefit from the faster SATA standard, so you can connect them to older SATA2 ports, if available (they will work with SATA3 if that's all that's available).

are for running multiple graphics cards via Nvidia SLI or AMD CrossFire technologies.

You'll also find x1 slots and, potentially, some x4 slots for other expansion cards, such as a Wi-Fi card. Smaller cards can be

The performance of SATA3 with a regular SSD is good enough for most people

EXPRESS YOURSELF

PCI Express slots are the most common for expansion purposes. The larger x16 slots are for graphics card slots. Confusingly, if a motherboard has multiple x16 slots they may not all run at x16 speed, and it's common for one to run at x4 or x8 speed. You should always use the fastest-rated slot for your main graphics card; the slower slots

plugged into bigger slots if you're struggling for room. Legacy PCI slots are now quite rare.

GRAPHICS OUTPUTS

If your CPU has integrated graphics, look for a motherboard that has the graphics outputs that you'll need. It's common to find a motherboard that has HDMI, DVI and VGA outputs; HDMI can be converted to DVI (and vice versa) using cheap adaptors if you want to run multiple monitors.

SOUNDING OFF

All motherboards have audio outputs through 3.5mm jacks, optical audio (S/PDIF) or HDMI. If your board has only three 3.5mm jacks, you can output to 5.1 surround-sound systems, but you can't connect an input, such as a microphone, at the same time. The alternative is to look for a motherboard with six 3.5mm jacks or use a digital output (S/PDIF or HDMI) instead.

PLUG AND PLAY

All motherboards have USB connectors on the back and have headers to connect extra ports in your case. USB3.1 ports are the fastest, followed by USB3. These are both ideal for external storage devices. Older USB2 ports are fine for simple devices, such as keyboards and mice. We prefer having lots of USB3 headers, as it makes it easier to connect USB3 ports at the front of your case for your fast external storage.

AMD processors

SOCKETS

Of the AMD processors that we reviewed, there are three types of socket, each incompatible with the others. They are AM3+, FM2+ and AM1. Fortunately, compatibility is easy to work out.

With an FM2+ motherboard, you can fit any existing FM2+ processor, but you can also fit older FM2 processors if you have one of those. In a similar way, AM3+ motherboards will take AM3+ FX processors, but you can also fit an older AM3 processor, should you have one that you want to use.

Finally, AM1 is very simple as there's just the one set of processors to choose from. Its advantage is that the motherboards and processors are extremely cheap.

CHIPSETS

FM2+ has a range of chipsets available for it, starting with the cheapest A58 boards (AMD recommends A4 and A6 processors are used with this); moving up, there's the A68H (AMD recommends A4 and A6 CPUs again); above this sits the A78 (A6 and A8 recommended) and the A88X (A8 and A10). The top-end A88X isn't that expensive, so check prices before you buy.

AM3+ chips have four 9-series chipsets available: 970, 980G, 990X and 990FX. We think that 970 boards still offer the best balance of value and performance.

Best
for

High-end builders

ASUS Prime Z270-A

If you want to build a brand-new computer with the latest technology, the Asus Prime Z270-A is the motherboard for you. With full support for Intel's latest Kaby Lake processors, this motherboard is the ideal companion if you want to buy the best CPU.

Two M.2 slots give you the option of installing a lot of super-fast storage, all without the need for any cables. Three PCI-E x16 slots ensure that there's plenty of gaming prowess, too. Throw in all the expansion ports you could need, an excellent UEFI BIOS and plenty of overclocking options, and you can't go wrong with this motherboard.



Best
for

Mid-range builders

ASUS Z170-A

The Asus Z170-A is our favourite LGA1151 Z170 motherboard, and it's excellent value. By default, it supports all Skylake processors, although a BIOS upgrade is available giving Kaby Lake support.

The Asus Z170-A includes everything that you'd expect from a modern motherboard, including triple PCI-E x16 slots, four DDR4 RAM slots, and plenty of USB ports and headers. Interestingly, this motherboard has a legacy PCI slot, which could make it good choice if you have an older expansion card that you want to install.

Finally, throw in an M.2 slot and you've got a motherboard that can handle the latest, greatest storage type. If you can't quite stretch to a Z270 motherboard, this is the next-best choice.



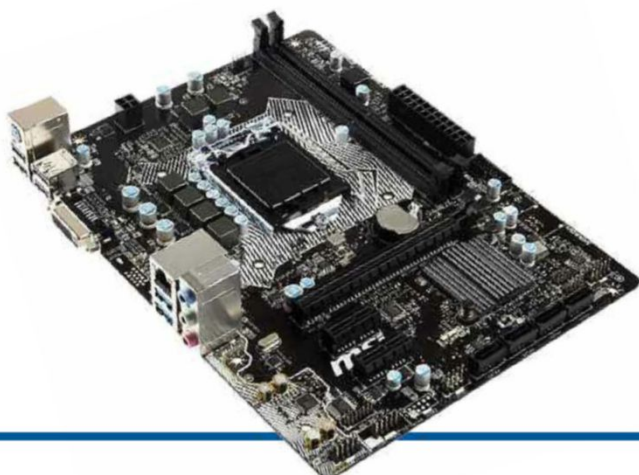
Best
for

Budget builders

MSI H110M Pro-D

Budget Intel motherboards are relatively hard to come by, but the MSI H110M Pro-D certainly fits the bill. This microATX motherboard is excellent value, and it supports all Intel Skylake processors. A new BIOS update supports the latest Kaby Lake CPUs, too. If you can find a way to upgrade it, then this is a good budget platform for the latest CPUs.

There are some limitations, though. Only two DDR4 slots is a little disappointing, so buy the right amount of RAM from the outset. There's also only one fan header on the motherboard, so you may want to buy an external fan control for any case fans that you have. These issues aside, this a great budget board.



Best
for

AMD FM2+ builders

ASUS A88XM-Plus

AMD's ageing FM2+ platform remains a good choice for budget builders who want a simple CPU that can do everything. Four DDR3 RAM slots are good to see, and there are plenty of expansion slots, too. Gamers may be put off by the slower PCI-E x16 slot, but everyone else will be fine. This motherboard lacks some of the extra things you find on Intel boards, including an M.2 slot. However, SATA3 ports mean you can install a relatively fast SSD. If you've got your heart set on an FM2+ processor, then this is the motherboard to buy.



Best
for

AM3+ builders

MSI 970A-G43

AMD's AM3+ platform has been around for a long time, which means that good motherboards are now excellent value. None is quite as good as the MSI 970A-G43, though. This motherboard has plenty of expansion options, lots of USB ports and four DDR3 memory slots.

You lose out on some of the premium features associated with the latest Intel chipsets, including an M.2 slot. With SATA3 ports, though, you can still install a relatively fast, SSD.

For those looking to build a relatively cheap PC that's still pretty quick, the MSI 970A-G43 is the right motherboard to choose.



	LGA1151			AMD AM3+	AMD FM2+
Manufacturer	ASUS	ASUS	MSI	MSI	ASUS
Model	Prime Z270-A	Z170-A	H110M Pro-D	970A-G43	A88XM-Plus
HARDWARE					
Processor socket	LGA 1151	LGA1151	LGA1151	AM3+	FM2+
Form factor	ATX	ATX	MicroATX	ATX	MicroATX
Chipset	Z270	Z170	H110M	970	A88X
Supported memory type	DDR4 (3,866MHz)	DDR4 (3,400MHz)	DDR4 (2,133MHz)	DDR3 (2,133MHz)	DDR3 (2,133MHz)
Memory slots	4	4	2	4	4
Maximum memory	64GB	64GB	32GB	32GB	64GB
Motherboard power connectors	1x 24-pin ATX, 1x 8-pin 12V	1x 24-pin ATX, 1x 8-pin 12V	1x 24-pin ATX, 1x 4-pin 12V	1x 24-pin ATX, 1x 8-pin 12V	1x 24-pin ATX, 1x 4-pin 12V
PCI-E slots	3x PCI-E (1 at x16 speed or dual x8, plus 1 at x4 speed), 4x PCI-E x1	2x PCI-E x16 (x16 speed or dual x8), 1x PCI-E x16 (x4 speed), 3x PCI-E x1, 1x PCI	1x PCI-E x16, 2x PCI-E x1	2x PCI-E x16 (one runs at x4), 2x PCI-E x1, 2x PCI	2x PCI-E x16 (one runs at x4), 1x PCI-E x1, 1x PCI
Motherboard fan headers	6	7	1	3	3
SATA ports	6x SATA3, 2x M.2	6x SATA3, 1x SATA Express, 1x M.2	4x SATA3	6x SATA3	8x SATA3
Wired network ports	1x 10/100/1,000Mbit/s	1x 10/100/1,000Mbit/s	1x 10/100/1,000Mbit/s	1x 10/100/1,000Mbit/s	1x 10/100/1,000Mbit/s
Motherboard sound (ports)	Realtek HD Audio (5x 3.5mm analogue, optical S/PDIF)	Realtek HD Audio (5x 3.5mm analogue, optical S/PDIF)	Realtek HD Audio (3x 3.5mm analogue, optical S/PDIF)	Realtek HD Audio (6x 3.5mm analogue, optical S/PDIF)	Realtek HD Audio (3x 3.5mm analogue)
USB ports	4x USB3, 1x USB3.1, 1x USB Type-C	2x USB, 2x USB3, 2x USB 3.1	4x USB, 2x USB3.1	8x USB, 2x USB3	4x USB, 2x USB3
USB headers	3x USB3	2x USB, 2x USB3	2x USB, 2x USB3.1	6x USB, 2x USB3	6x USB, 2x USB3
Video outputs	DVI, HDMI, DisplayPort	DVI, VGA, HDMI, DisplayPort	DVI	None	DVI, VGA, HDMI
Other ports	1x PS/2	1x PS/2	1x PS/2	1x PS/2	2x PS/2
BUYING INFORMATION					
Price	£155	£136	£50	£59	£69
Warranty	Three years RTB	One year RTB	One year RTB	One year RTB	One year RTB
Supplier	www.cclonline.com	www.ebuyer.com	www.scan.co.uk	www.cclonline.com	www.cclonline.com
Details	www.asus.com	www.asus.com	www.msi.com	www.msi.com	www.asus.com
Part code	Prime Z270-A	Z170-A	911-7996-037	970A-G43	A88XM-Plus



THE CASE RACE

PC cases

Need a suitable vessel for your custom PC system? From space-saving Mini-ITX models to heavyweight multi-motherboard hulks, we put 12 chassis through their paces

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YOU'VE GOT THE motherboard. You've picked out the processor. You've readied the power supply, decided on your storage and maybe even shelled out on a proper graphics card. There's just one thing left to do before your perfect PC is completely specced out: it's time to choose a case.

This is likely to be one of the cheapest components in a system build, but it's still worth taking the time to mull over your options and look for something absolutely ideal. For one thing, it's the part of the PC you'll see the most, so there's no sense in settling for a chassis you'll come to dislike.

Perhaps more importantly, the case will dictate the terms of which other components can be combined with it – when building a

PC, there's even an argument to start with the case. Whether it's the size of the motherboard, length of the graphics card, or number of bays and trays for storage drives, a case's limitations (and opportunities) could have just as much influence on your eventual PC spec as your own wishes.

To help avoid getting stuck with an under-equipped box, we've tested 12 desktop cases across a range of price points. We've judged them on build quality, upgradability, ease of use and any special features.

BUILD IN ACTION

PCs may not be portable like laptops, but that doesn't make build quality any less important. A well-constructed chassis should be able to

passively reduce the noise of whirring components, survive any accidental toe-stubbing or item droppage, and preferably do it all while looking good.

Yes, there's nothing wrong with a little vanity when considering a case's physical design, provided they don't go too far and end up as a glowing, hideously busy-looking lump of plastic, like certain gaming-focused models. Done tastefully, visual touches such as internal LED lighting and glass panelling can be a great way of showing off a custom system.

On a more strictly functional level, it's always good for a case to be made with cable routing in mind. A quality combination of routing holes and loops for securing all the PC's wires in tight bundles will have two excellent benefits: first, your build will look even better; and second, the fact that the airflow isn't blocked by unruly cables means that the PC can run cooler and quieter. It will be easier to clean, too.

PARTS AND PARCEL

Back to the notion of the case dictating its compatible components: the most important thing to consider is motherboard size. If you've already bought a full-size ATX board but the case you want only fits smaller microATX and Mini-ITX models, your PC build plans are already dead in the water.

The good news in this regard, besides the widespread support for ATX motherboards in the first place, is that cases are usually compatible with smaller form factors than their maximum. So if you already have, say, a microATX mobo, but want to move to a full ATX case, you can – with the option to upgrade to a larger board later.

Speaking of upgrades, more premium-minded users should pay attention to stats like the number of drive bays, GPU clearance and CPU cooler clearance. The decline of CDs and DVDs means a 5.25in drive isn't as essential as it once was, but you'll definitely want at least a couple of 2.5in and 3.5in bays or mounts for SSDs and hard disks. You'll also need to make sure there's room for your desired graphics card – over 300mm is fine for all but the most expensive models – and CPU heatsink. 160mm is the minimum for most decent tower-style coolers, but you can get away with less for a low-profile fan cooler or water-cooling pump.

ADORING FANS

Cooling is another thing to be mindful of. Many high-end cases will be packed with mounts for fans, radiators and liquid cooler reservoirs, making them better for more powerful and thus hotter-running systems – but don't fret if you're on a budget.

You can adequately chill a basic or mid-range PC with just a couple of case fans – though our recommendation is to have two intake fans at the front, to draw cold air in, and one exhaust fan at the back, to blow hot air out. Several cases we've covered adopt this very layout, but it's quite cheap to add fans if the case's pre-installed offerings fall short.

Our recommendation is to have two intake fans at the front of the case, to draw cold air in, and one exhaust fan at the back, to blow hot air out

Case fans come in two sizes, 120mm and 140mm. You can probably guess that the former are cheaper and thus more likely to come pre-installed, while the latter are pricier but can shift more air for better performance.

FREE TINKER

The best PC cases don't just sit there – they have measures in place to make your life easier when it comes to installation and maintenance of your computer.

On a basic level, this partly comes down to just how easy it is to get your hands in to add or remove parts without having to squash your fingers in tight crevices or squint from a lack of light. Look closer, and you might find features such as removable dust filters, quick-release external panels or toolless, push-release drive bays. All these are welcome additions aimed at making cleaning and customising just that little bit

more painless, and they shouldn't be discounted if you've got the budget.

BONUS BUTTONS

Finally, you can see how far your money will stretch by looking at any bonus features. A common place to find these is on the I/O panel, where all the buttons and ports are – useful inclusions can range from extra USB ports (two is the standard, but four is much more convenient) to fan speed switches and controls for the case's LEDs.

Modular parts can also be worthwhile, especially if you intend to add space-hogging components such as watercooler radiators or massive, heavy graphics cards. The Cooler Master MasterCase Maker 5t, for instance, can have its storage drive cage shift backwards to make space for upscale cooling systems, plus optional fold-out shelves that can support the weight of a long GPU.

BEST CASE SCENARIOS FOR...

...A GAMING PC

NZXT Source 340 Elite

It isn't the kind of case to house enormous open-loop liquid-cooling systems, but that's only a niche concern. As far as most users will be concerned, the Source 340 Elite packs in a lot of great features for something so compact. It's wonderfully neat, can take all-in-one watercoolers and has a clever magnetic puck for storing a headset – not to mention the added HDMI port and USB connectors, making it perfect for playing in virtual reality. It has a surprisingly decent number of storage drive slots, too, so you won't have to worry about gigabyte-hogging game files too much.



...A WORKSTATION

BITFENIX Shogun

Serious compute-heavy workloads demand a strong CPU and plenty of RAM, and for that, EATX motherboards are perfect. Wider than standard ATX, these offer extra memory slots and often support top-of-the-line chipsets such as Intel X99. The Shogun is spacious enough to contain such a motherboard, and with its superb storage capacity, it's a fine choice for any PC that needs to handle both data-crunching and huge files. It's not the best-looking chassis in our eyes, but it won't seem out of place in an office or home study either.



...A HOME CINEMA PC

RAIJINTEK Metis Plus

There are plenty of devices for streaming movies and TV shows from your PC to a big-screen TV, but you could always simplify even further by having an affordable, miniature PC sitting right there in your living room. The Metis Plus helps fulfil this role admirably: it's small enough to fit in a media cabinet, and thanks to some smart internal geometry, you can keep at least a couple of hard disks' worth of content saved. Add a basic CPU and low-profile cooler for quiet operation, plus a Mini-ITX board with an HDMI port, and you're good to go.



BE QUIET! Silent Base 800



£121 • From www.ebuyer.com

VERDICT

A premium case with excellent cooling and storage support, only slightly let down by some less thoughtful design quirks

AS YOU CAN probably guess from the name, German component maker Be Quiet! likes its cases to be more hush-hush than most. To this end, the Silent Base 800 comes with a few little additions to minimise any humming and whining.

For example, both side panels and a good chunk of the front of the case are all covered internally by sheets of soft, sound-insulation material. The included fans (more on these later) are also affixed with rubber washers in order to reduce vibration, and the 3.5in drive mounting brackets go even further by being made entirely of rubber, under the same principle. Even the empty 120mm fan mounts in the centre of either side panel can be plugged when not in use, helping to trap any escaping noise.

It's worth noting that all these inclusions only quieten your PC, not actually silence it, as the degree of noise your system emits is more dependent on the actual powered components. Nonetheless, they do help to an extent, and it's nice to see such thought and effort going into the worthy pursuit of noise dampening.

FULLY LOADED

Not that the Silent Base 800 is all about modesty. In fact, by mid-tower standards it's

a bit of a beast; with the feet attached it's even taller and wider than the mighty BitFenix Shogun, and despite being one of the older cases we've covered here, it's still pretty expensive.

The dampening design alone might not justify the cost, but you do get a few other things for your money. The pre-installed fans are some of the most well made we've seen in a PC chassis, with their strong, ridged blades, and they've been wisely fitted: two at the front and one at the back, creating a cycle which drags cool air over your hot components before venting the resulting warm air out of the rear. That's the exact kind of airflow you want in a PC, and the Silent Base 800 offers it right out of the box.

It's nice to see such thought and effort going into the worthy pursuit of noise dampening

There are plenty of expansion opportunities for the cooling setup as well. The top of the case will hold either two 120/140mm fans by themselves, or watercooling radiators up to 280mm long. Both left and right side panels have those 120mm mounting points, and there's room in the base for either a 120mm or 140mm fan to round things out. For the few who wish to use an external open-loop liquid-cooling system, there are also three rubber grommet holes on the back panel to pipe it in.

We also found it possible to add a 120mm radiator to the front fans, though this involves removing the hard disk cages. There's actually a fantastic selection here: three lesser-spotted 5.25in drive bays, seven 3.5in slots and two 2.5in mounts behind the motherboard tray.

Even better, it's all highly configurable. The HDD bays are split across two cages, both of which can be removed,



and the upper cage can actually fit inside the empty 5.25 cage – ideal if, say, you want to install a front-mounted radiator or reservoir but need to maintain hard disk support (and can live without any 5.25in drives). Each 3.5in cage has its own mount for another 2.5in drive, too, though this occupies the uppermost 3.5in slot.

CHOKED OUT

All this, plus respectable cable management and both USB2 and USB3 ports (two apiece), might make it seem as though there's little to fault about the Silent Base 800. Sadly, that's not quite the whole truth.

Frankly, it's bulkier than it actually needs to be; between the top and bottom panels there are at least a couple of inches of dead space, even with fans and radiators installed, and the way the feet face diagonally outward needlessly expands the case's footprint.

Yet somehow, in the one area where openness is important, it manages to be too compact. As good as the fans are, intake is also compromised by the insulated front panel, which leaves almost nowhere for the fans to suck air in from. They'd be able to shift much more cold air at potentially lower, quieter speeds if given a bit more clearance.

There are worse problems to have – it's not like the intake fans are sealed in a perfect vacuum, after all – but they do take the shine off what is otherwise an impressively well-built case.



BITFENIX Aurora



£75 • From www.overclockers.co.uk

VERDICT

BitFenix's Aurora tower flicks between mediocrity and greatness, depending on where you look

WHEN WE THINK of cases that can take Extended ATX (EATX) motherboards – which are significantly wider than the more common ATX form factor – we usually think of ones much larger than the modestly proportioned BitFenix Aurora.

The colourful name is fitting, since besides EATX compatibility, it also comes with one of BitFenix's RGB Chroma covers for your SSD. This small strip of plastic and LEDs affixes over the bottom of the main chamber's sole 2.5in drive mounting plate, and lights up the drive with your choice of colours and flashing/pulsing effects. It supports Asus's Aura system as well, so if you have an Aura-ready graphics card, motherboard or standalone lighting strip, you can sync all their LEDs at once.

The attachment itself is a bit fiddly to get on – the fact that it's almost completely absent from the instructions doesn't help – but it does look good, and the illumination helps you see through the Aurora's heavily tinted tempered glass window. Both side panels are made from this same premium material, though naturally there's not much worth looking at on the right side.

MOUNTING RANGES

A single 2.5in drive doesn't sound like much, but luckily there are two more mounting plates around the back of the motherboard tray, for a total of three. You also get four 3.5in bays for your hard disks, split evenly

across two removable cages (one in the base of the chassis, one at the top). This is a very acceptable, if not outstanding, amount of storage potential for the size.

Cooling support is good as well. The front and top of the Aurora can hold 120mm and 140mm fans alike, plus radiators up to 280mm in size. Only the rear mount is limited to a single fan, 120mm, and if you can supply your own mount, both the front and top can also be used to fit a reservoir for custom open-loop liquid-cooling systems.

The interior is nicely open and airy in general, with a huge GPU clearance of 400mm (you can easily get high-end cards measuring no longer than about 300mm, so you'll have no issues here) and plenty of room for your hands to get to work on your PC's components.

OMISSION STATEMENT

However, while BitFenix has been generous in many regards, the Aurora does suffer from a



removing components, and the front I/O panel cables are just left loose.

As an aside in the Aurora's favour, this panel is one of its better features, offering a healthy mix of two USB2 and two USB3 ports,

The Aurora's build quality isn't up to what we'd expect for £75. The curving top and front panels look great, but they're made from a cheap plastic that flexes in places

few noteworthy omissions. For starters, despite the extensive capacity for cooling, the only included fan is a single 120mm exhaust. With no intakes out of the box, that poor little fan has a big job to, having to clear out all the hot air without it being replaced by the cool.

Cable management also feels fairly basic for the price. There are several large, rubber grommets routing holes, but you're mainly reliant on some tiny loops through which to hook the included cable ties. There are no reusable straps, which are much more convenient when adding and

and the mic and headphone jacks. There's also a reset button and a handy LED controller button for the Chroma SSD cover, which can quickly switch it between different hues.

DISCO TECH

Sadly, there's no space left for a 5.25in drive, so DVD-RW and Blu-ray players are a no-go. Furthermore, adding a 280mm radiator and fan combo to the front mount requires the removal of the top 3.5in drive cage; whether this is a fair trade will depend on use, but that's still half the HDD capacity gone.

Finally, the Aurora's build quality isn't quite up to what we'd expect for £75. The curving top and front panels look great, but they're made from a cheap plastic that flexes in certain places. That's a big contrast from the upmarket glass sides. Our review model also had slightly uneven feet, so it rocked when pushed.

It's still a very usable mid-tower with some high-end touches, but although the Aurora delivers on cooling and spaciousness, the NZXT Source 340 Elite and Phanteks Eclipse P400S are better-built all-rounders.



BITFENIX Shogun

COMPUTER
SHOPPER
RECOMMENDED



£145 • From www.overclockers.com

VERDICT

It's expensive, but the EATX-capable Shogun is a highly configurable case with all the trimmings

BITFENIX SAYS THAT the Shogun continues "the theme of simplicity" of arguably its most recognisable chassis, the Shinobi. That, however, was a £50-ish budget product; with the Shogun's fearsome £145 asking price, the BitFenix name and references to the Sengoku period might be all they share.

Indeed, there's very little that's cheap and cheerful about the Shogun, from its thick, tempered glass panels on either side to its support for hefty Extended ATX (EATX) motherboards and two pre-installed Chroma SSD bays (as seen on the BitFenix Aurora, though that only has one, which you need to fit yourself). Measuring 250x525x565mm, it's of a rather imposing stature in general.

Of course, just because it's big doesn't mean that it's dumb. There are some impressively smart design ideas here, such as a removable EATX shield – such a large motherboard obscures the main cable routing holes, so slotting in the shield adds a few more off to the right. They've got the same rubber grommets, too, for extra grip on your wiring.

LET THERE BE LIGHT

We again find the LED-lined Chroma storage bays to be a very welcome inclusion. In the Shogun, they're securely attached to a long metal mount running along on the bottom-

left side, adding both a touch of panache and customisation potential via the RGB LEDs. They go particularly well with Asus ROG components, as they share the Aura lighting control for synchronising colours and effects across your PC.

In fact, swathes of the Shogun's interior can be tweaked to your liking, by virtue of its modular design. Using nothing more than a single screwdriver we could move and remove drive cages, slide fans up and down and even set up little GPU trays, which help prop up plus-sized graphics cards at the opposite end to the PCI-E slot. To be honest, we've never had problems with drooping cards, but it's good for peace of mind if you ever move the PC around.

Leave all the drive cages in, and the Shogun can house a whopping six 2.5in SSDs plus six 3.5in hard disks

The beauty of modular cases is that you can just ditch what you don't need, which can improve airflow, give you more room to work or just make for a neater build. Leave all the drive cages in, though, and the Shogun can house a whopping six 2.5in SSDs plus six 3.5in hard disks. What's more, the 3.5in drives

don't require tools – unless you want them to hold 2.5in drives instead, which bumps up the total capacity to a ludicrous 12 SSDs. You'd need the riches of an actual shogun to fill them all, sure, but the flexibility on offer is a big strong suit.

Then again, we're surprised that there's not a single 5.25in drive bay, despite what looks like a cutaway for it on the front panel. The Shogun is tall enough that it could have easily fitted at least one.

There's no skimping when it comes to cooling, however. Besides the

one exhaust fan and two front intake fans (all 120mm), both the front and the top of the case can fit either a 240mm or 280mm radiator (and/or the equivalent fans). Special mention goes to the roof mount, which can stretch to a 360mm radiator, if so desired.

Cable management is also excellent, with the aforementioned routing holes and EATX attachment, plus reusable straps lining the rear channels instead of cheap plastic ties. Follow some of the existing cables and you'll find a well-equipped I/O panel, containing two USB2 and USB3 ports apiece, mic and headphone jacks, a reset button and a controller button for the Chroma LEDs.

COOL IT

There are a few other misdemeanors, but they're fairly minor. Since both the front and rear fan mounts can hold 140mm units, we'd have preferred these instead of the 120mm fans that come already installed.

What's more, although it's not outright ugly, in our eyes the Shogun has taken a bit of a dip in its styling. Tempered glass is always handsome, but the rounded edges and vast width of the case give it an altogether more bloated aesthetic than the relatively sleek, sharp Shinobi.

Nonetheless, we quickly grew to like the Shogun. Considering the price and bulk, it's overkill for a first-time build, but anyone dead set on an EATX motherboard – or likely to need many, many terabytes of storage space – won't find it wanting.



COOLER MASTER

MasterCase Maker 5t



£220 • From www.ebuyer.com

VERDICT

It's spectacularly expensive, but at least the Maker 5t makes an effort to earn its price tag

THE COOLER MASTER MasterCase Maker 5t is, for all intents and purposes, the modular flagship Maker 5 with tempered glass windows – hence the 't'. These add an appropriately top-end look to a chassis that was already imposing, but not ghastly – a good fit for design-conscious, well-moneyed gamers in particular.

We do have to bring attention to that price, which is an enormous amount to hand over for a PC case. Especially so when it only comes fitted with two 3.5in drive bays, a fraction of what many cheaper alternatives have managed.

Everything else about the Maker 5t, however, exudes opulence. From the stealth bomber fascias to its thoughtful, highly modular layout, it's clear that Cooler Master hasn't just slapped a £220 price tag on a bog-standard box. It's even packaged rather nicely; accessories are stored in an all-black metal tin, not throwaway cardboard, and all the screws and standoffs are wrapped separately by size in what could best be described as a plastic bandolier.

SEEING RED

Returning to the case itself, open up the side windows with the included key (no fiddly thumbscrews here) and you'll find a spacious

ATX-capable interior. A red PSU shroud extends all the way to the front, save for a gap for the front fans and possible radiator, and on top of it lie two 2.5in drive slots.

Since the two 3.5in trays (which are also kept under the shroud) can hold smaller SSDs as well, that's a potential total of four 2.5in bays, and you get two 5.25in bays as well – if you use these to install a disk drive or system monitor, they can be accessed by lowering the front panel downwards, like a drawbridge.

It's deep enough to accept CPU coolers up to a hefty 190mm in height, and there's plenty of room for a long graphics card, too, with 410mm of clearance. The Maker 5t contains a couple of little shelves to help prop up larger GPUs; as with the BitFenix Shogun, they're seldom going to be essential, but you can easily fold them away (or remove the rack entirely) if they're not in use.

Everything about it exudes opulence. Cooler Master hasn't just slapped a £220 price tag on a bog-standard box

Indeed, modularity and customisation are at the core of the Maker 5t. The 3.5in drive cage, red LED lighting strip and even the humble 140mm exhaust fan can all be moved and adjusted to accommodate your needs.

Adding a radiator to the front fans, for instance, can mean the removal of storage slots on other cases, but here you can just move the whole cage back a few centimetres to make room.

That's just what you can do right out of the box, too. There are loads of other add-ons to buy separately, from extra drive cages to illuminated PSU covers and vertical graphics card holders. There are numerous drawbacks to this – it means spending even more cash, you can

only buy from Cooler Master's own online store, and all prices are in euros – but they seem fairly priced for what you get. We can't think of any mainstream cases that

offer the same level of customisation potential as the MasterCase series.

GRANDEUR WELCOME

Even without all the extra stuff, this is a seriously well-equipped chassis. In addition to the two 140mm fans at the front, you can add up to 280mm radiators at the front and top, and there's a fan speed and LED controller hub included behind the motherboard tray. You also get magnetic outer panelling for easier removal and cleaning, a heavy-duty integrated carry handle on top, two USB2 and two USB3 ports, and LED effect and two-speed fan switches.

The basics haven't been forgotten, either. Cable management is mostly superb, with a deep rear routing channel, re-usable straps and multiple rubber grommets for maximum tidiness and airflow. Our only complaint is the positioning of the LED/fan control hub; it can get in the way of wires that need to run up to the top of the motherboard.

The Maker 5t is a good luxury purchase, make no mistake – but unfortunately that also means it's going to be just too expensive for most people. On the other hand, if you're willing and able to spend this much on a single PC case, you might as well go for something like this.



FRACTAL DESIGN Core 1500



£50 • From www.scan.co.uk

VERDICT

A decent budget case that doesn't always play nicely with more expensive components

FRACTAL DESIGN'S CORE range is all about pure, no-frills functionality on a reasonable budget, and the Core 1500 – one of the smaller models – is no exception.

This does mean that, in the grand scheme of PC case design, there aren't any real standout features to it – though we don't want to sound dismissive here, because there's lots to like about it as well.

Here's the basic of the basics: the Core 1500 is a microATX/Mini-ITX case with straightforward steel construction and a compact mid-tower form factor. In fact, at 195x450x370mm, it's both shorter and narrower than the Mini-ITX-only NZXT Manta, so should easily find a place on top of or beneath any decent-sized desk.

Unlike true small form factor cases such as the Raijintek Metis Plus, however, the internal layout is comfortably familiar. We could easily fit a full-sized ATX power supply into the base, and a couple of separated drive cages at the front provide relatively ample storage possibilities. Each cage can hold two drives – your choice of 2.5in or 3.5in in each tray – and if you'd prefer something more out of the way, there's one more 2.5in drive mounting point on the other side of the internal chassis.

SPLIT THE DIFFERENCE

The trays aren't toolless, which is perhaps to be expected for dual-purpose units, but the grand total of five storage bays is rather respectable for such a small case. Separating them was also a wise choice on Fractal

Design's part, as it ensures a GPU clearance of 380mm, a maximum length you'd be extremely hard-pushed to fill.

Happily, the Core 1500 includes a couple of 5.25in bays as well. Whether it's shrunk-down budget cases or luxury towers, this is an oft-overlooked feature that will save you the trouble and clutter of an external optical drive, so we're very glad to see this compatibility with DVD-RW and Blu-ray drives.

Another nice bonus is the inclusion of a 120mm intake fan to complement the usual



The three-speed fan controller switch is useful if you're only doing basic browsing and want to minimise the noise

120mm exhaust; this setup ensures a constant, cyclical airflow that will help your whole system run cooler. On that subject, the Core 1500's arguably most premium feature comes in the form of a three-speed fan controller switch at the rear; useful if you're only doing basic browsing and want to minimise the audible whirring.

On the front I/O panel, things largely return to just the essentials: two USB3 ports, microphone and headphone jacks, and power and reset buttons.

Expanding the array of fans is certainly possible. On top of what's already fitted, there are two 140mm mounts in the Core 1500's roof, a second 120/140mm mount at the front, one 140mm mount on the left side panel (no big, open windows here) and, in the base, mounts for either a 120mm or a 140mm fan. This last one requires the removal of the lower drive cage, though.

All-in-one watercooling radiators are also supported,

albeit only to a degree. You could put a 140mm radiator in the roof mount, for instance, but there's not actually enough clearance with the top of the motherboard to add a set of fans of well – and we don't recommend an uncooled radiator.

SPIN DOCTORING

Another possibility is putting the radiator and fans in the front mount, though again, this means taking out either one (if it's a 120mm unit) or both (if it's a 240mm unit) of the drive cages, which could leave you with just a single 2.5in mount for your entire system storage. If you are desperate for liquid cooling, the simplest thing is to just add a 120mm radiator to the exhaust fan.

Cable management is also extremely basic. There are no channels of reusable straps or rubber grommets, just a small handful of miniscule cable tie loops around the bottom routing hole.

None of these flaws outweighs the Core 1500's strengths, especially when considering the inherent limits of its price and size (watercooling potential will always be the opportunity cost of a compact chassis). The main thing preventing a more wholehearted endorsement is the Kolink Aviator V (opposite) – for a few pounds less, you could have support for larger motherboards, LED decoration, more I/O ports, an extra intake fan and the possibility of a far less troublesome 120mm radiator installation.



KOLINK Aviator V

COMPUTER
SHOPPER
RECOMMENDED



£47 • From www.overclockers.co.uk

VERDICT

Matched with the right motherboard, the Aviator V has a lot to offer at a relatively small price

THE AVIATOR V is an updated version of Kolink's standard Aviator mid-tower chassis. That's already one of the better-equipped budget PC cases out there, costing £45 and including such features as three pre-installed fans, toolless optical drive bays and red LED decoration, and for a modest bump up to £47 the Aviator V offers one rather tempting addition: a full-size acrylic side window.

This window doesn't have the premium sheen or feel of glass, but is plenty sturdy and has a pronounced tint. This means it works best with components that have their own built-in lighting (such as higher-end graphics cards and certain watercooling pumps). In any case, it still provides wider visibility and a classier touch than smaller, bezel-laden windows.

On the other, all-metal, side of the Aviator V, the panel expands outwards a bit, leaving more room for cables and airflow. The remaining top and front panels are made from gently curved black plastic with a glossy finish; it's a pretty good look for the price, neither unattractively basic nor ridiculously over-designed. As mentioned,

the two front intake fans are adorned with red LEDs, which shine through the plastic for a more subtle effect.

SLOT MACHINE

The front I/O panel comprises one USB2 port, two USB3 ports, 3.5mm mic and headphone jacks and, happily, an SD/microSD card reader. There are also built-in fan controllers and a microphone mute button, all flanked by a couple of extra red lights.

As for storage, you get space for up to three 3.5in hard disks, plus one 2.5in SSD, which can sit at the top of the cage.

The side window works best with components that have their own built-in lighting, but it provides wider visibility and a classier touch than smaller, bezel-laden windows

You'll need to supply your own mounting brackets, as there aren't any included in the box, but this does give you the chance to fill

one or more of the 3.5in bays with a smaller solid-state drive via an adaptor.

Despite a lack of support for 140mm fans, cooling is reasonably good thanks to the two intake fans and single rear exhaust fan. You can squeeze a watercooling radiator up to 240mm long into the top or front as well.

Being a mid-tower case, there's enough space for ATX motherboards or smaller, as well as bulky air coolers and long graphics cards. A respectable seven rear slots for PCI/PCI-E components means you could have two GPUs while still leaving room for Wi-Fi and sound cards.

However, the Aviator V is quite short from front to back – short enough that if you install a full-width (245mm across) motherboard – common among ATX and microATX form factors – it will cover over the upper two cable routing holes, leaving just one at the bottom. You could use the gap between drive cages as a de facto routing hole, but even this leaves the front I/O cables poking out over the motherboard RAM slots – an unfortunately unsightly possibility, considering the Aviator V's main upgrade is a giant window.

SIZE MATTERS

An even bigger issue with larger motherboards is that the chassis' CPU window (the cut-out hole underneath) won't align with the actual socket; this makes it impossible to fit any CPU cooler that requires a backplate. When using narrower, 191mm-wide motherboards, the socket and window line up perfectly, so make sure you've got or are getting one of these before pairing it with the Aviator V. Boards of this width also leave the upper cable routing holes open.

As long as you bear this in mind, the Aviator V can be a perfect fit for budget-minded builds. Despite costing an extremely reasonable £47, it has everything you need in terms of expansion, cooling and connectivity, as well as quite a few little luxuries, whether it's the integrated card reader or the eye-catching acrylic window.



NZXT Manta



£110 • From www.scan.co.uk

VERDICT

Fetchingly and flexibly, the NZXT Manta is an outstanding case for Mini-ITX systems

UNLIKE MANY OTHER Mini-ITX cases, including the Raijintek Metis Plus, the NZXT Manta adopts a more traditionally tower-like form factor – save for its main distinguishing feature, the convex side, front and top panels.

This affords it a truly unique look, without any overly flashy decorations. There is a pretty massive side window, but otherwise the Manta manages to pair its shape with a likably minimalist aesthetic. Even the power and disk status LEDs have been combined into one thin, sleek light strip at the front.

The curved panels also give a bit more room for any cables tucked behind the motherboard. On that note, the Manta wins points for its cable management as well – big, open ports cut out of the chassis make it easy to thread even the chunkiest braided and ribbon cables through, out to the back and out of sight. A metal shroud – branded with a light-up NZXT logo – also covers up the bottom section of the cases' innards, hiding the PSU completely.

GOOD FOUNDATIONS

Inside is a very conventional tower layout; the PSU sits at the bottom, the two 3.5in and three 2.5in drive bays are at the front, and nothing obscures or overlaps anything else. You do have to go around the other side to access the power supply and 3.5in drive bays, due to the shroud, but there

are worse inconveniences. Generally, everything is where you would expect it to be, and there are no awkward corners or sharp edges to worry about, either.

It has all the basics covered, then, but where the Manta really excels is its assortment of extra features. The rear 120mm exhaust fan, for instance, can be shifted a few centimetres vertically from its default position, in case you need extra room for something like a hefty watercooling unit. In addition, both the front and



It's all very well built, too. Despite being made of plastic, the front and top panels feel solid, thick and sturdy, with no discernible flex

roof support your choice of 120mm or 140mm fans, plus a 280mm radiator.

NZXT has left the top empty but pre-installed two 120mm fans at the front, complete with a dust filter. While the plastic front panel is completely solid, two long strips of metal mesh – one on each side – allow air in so it can be pumped through

the case by the intake fans. Similar mesh strips run alongside the top corners, so hot air can rise outwards in addition to being sucked out by the exhaust.

Another nice touch is the LED lighting hanging over where the I/O panel would show. Like the illuminated NZXT logo, this can be toggled via a button on the case rear, and makes it easier to fiddle with USB inputs or 3.5mm jacks if your PC is kept somewhere with low lighting – in a corner or on the floor, say.

As per usual with Mini-ITX cases, you get two PCI slots at the back – this will only cater for one good-quality graphics card, with nowhere else for a sound card or Wi-Fi card, but since Mini-ITX motherboards usually only include one PCI-E x16 expansion slot, this is to be expected.

STRONG SILENT TYPE

It's all very well built, too. Despite being made of plastic, the front and top panels feel solid, thick and sturdy, with no discernible flex. The same can be said of the metal side panels and the side window. The little LED module for the I/O panel is attached by an integrated clip, which means it can come off with sufficient force, but snapping it back on is easy enough.

The Manta does have a few issues, but they're all minor crimes of omission rather than outright failings. Despite the pretty good selection of 2.5in and 3.5in drive bays, there's nowhere to mount a 5.25in optical drive, and we'd have liked a couple more USB ports at the front, too – for many users, the two USB3 ports that reside next to the standard microphone and headphone jacks could get cramped very quickly. It's also curious that only 120mm fans have been pre-installed, when the mounts can fit 140mm models.

That being said, the Manta is still a superb Mini-ITX case, the versatility and distinctive styling of which affords it some serious desirability – as well as our Best Buy award.



NZXT Source 340 Elite



£90 • From www.novatech.co.uk

VERDICT

The Source 340 Elite is a compact tower case that's bursting with useful upgrades over the standard model

THE ORIGINAL SOURCE 340 was never the best-value case, nor the most extensively equipped, yet we've always had a soft spot for it on account of how good an all-rounder it is. We've been just as fond of its upgrade, the Source 340 Elite, ever since seeing it on the CCL Theia VR (*Shopper 348*).

At the time, we remarked how well suited the Source 340 Elite was for the role of a VR-ready rig, and that still holds true. The main attraction is an added HDMI port on the front I/O panel; this forms part of an internal HDMI extension lead, which can extend out of the back of the case to plug into your PC's graphics card, saving you the trouble of having to reach down the back whenever you want to hook up or disconnect your VR headset.

The I/O panel has also received a couple of extra USB2 ports, in addition to the two USB3 ports that were already on the standard Source 340. This, again, affords the convenience of being able to plug in a VR headset's USB cable right at the front of your PC, while still ensuring a good quantity of connectors remain spare.

LAYING IN STORE

Another addition is a third 2.5in mount on the internal shroud, bumping the total up to three. The 3.5in drive cage will hold two hard

disks, and if you need even more storage space, there are some screwholes in the base of the Source 340 Elite that will let you add either another 2.5in drive or another 3.5in drive. This is far from the greatest amount possible, but it's not bad for the case's size, and will suffice for the majority of users. The same could be said for the number of rear PCI slots: seven is fine for most ATX motherboards, since only very high-end models will need eight or more.

Yes, this is a nicely space-conscious case considering it can take full-size ATX boards, measuring a very manageable 474mm tall and 432mm long. That said, you can squeeze in a watercooling radiator/fan combo up to

There are plenty of other things to appreciate, but perhaps our favourite thing about the Source 340 Elite is how conducive it is to a neat PC build

280mm long at the front of the case; it's a tight fit, but an impressive feature if you don't want to settle for a 240mm unit.

Speaking of fans, there aren't any pre-installed intakes, but a set of two 120mm exhaust fans at the top and rear of the case do a good job shifting hot air nonetheless. The top fan mount can actually take a 140mm unit, which we'd have liked to see included, but at least it's not left empty.

There are plenty of other things to appreciate, from the sturdy steel construction to the classy matt black finish (which, on our test model, included flashes of red on the front panel and interior chassis – you can also get white, blue or fully black versions). Still, perhaps our favourite thing about the Source 340 Elite is how conducive it is to a neat PC build.

There are plenty of good-sized routing holes



all around the motherboard area, for instance, and the vented shroud ensures most of the PSU cables are hidden away. Behind the right side panel, there's also a series of push-release routing clips; these keep the wires under control while making it simpler and less wasteful to rework the system than cable ties, which need to be snipped open, discarded and replaced each time.

TEMPERED, TEMPERED

Tidiness is particularly important as the Source 340 Elite comes with a lovely toughened glass side panel, which provides an even clearer view inside than the standard 340's smaller plastic window. It's a fine upgrade, as is the magnetic puck that comes in the box.

This sticks to the case and acts as a hook for your VR or audio headset, and since it's hollow, you can wrap up the cables and conceal them within. If they don't fit, you can even split the puck in half and stick each segment further apart, so there's a greater distance to wrap around. It's all rather ingenious, which is something we don't normally say about a block of rubber.

The standard S340 remains a great case, but the Source 340 Elite's many enhancements make it worth the £25-odd price premium, especially if you're building a PC for virtual reality.



PHANTEKS Eclipse P400S

COMPUTER
SHOPPER
RECOMMENDED



£69 • From www.overclockers.co.uk

VERDICT

Out-of-the-box noise dampening and plenty of fan mounts make this a superb case for keeping things cool but quiet

THE ECLIPSE P400S is the 'silenced' version of the P400, which – whether on purpose or by accident – seems destined as a rival to NZXT's Source 340 family of mid-towers.

It's certainly easy to make comparisons: next to the Source 340 Elite, the Phanteks Eclipse P400S has similarly compact dimensions, support for ATX and smaller motherboards, an internal PSU shroud and seven PCI/PCI-E slots.

Phanteks' case has a good few tricks of its own, though. The defining one is its soundproofing: the front panel and both side panels are all lined with a thin layer of soft material to absorb the hum of case fans and component coolers. It doesn't silence your PC completely – there are still plenty of holes in the rear panel for sound to escape from – but the insulation is handy for taking the edge off louder fans.

LIGHT TOUCH

While it doesn't look terribly interesting when everything is powered down, there is a tasteful strip of LEDs at the front side base, which provides a nice touch of visual flair. We'd recommend placing the case on a desk, rather than sitting it on the floor, in order to fully appreciate it, but the best part is that you can choose from one of 10 colours. Most LED-decorated cases stick to just one.

Switching colours is done via a button hidden underneath a lip at the front. In another welcome touch, changing the strip colour will also change the power button LED, so you get a bit of synchronised illumination at the top of the case as well. This button is joined by a reset button and a three-speed fan speed switch for the case fans; our only complaint here is that there's no visual indicator of which speed setting is engaged, so you have to literally play it by ear.

In terms of what's included, you get one 120mm intake fan at the front and another as the rear exhaust. As a basic setup, it's ideal for ensuring a proper air circulation, though it's the scope for expansion where the Eclipse P400S really shines. At the front, you can have up to two 140mm fans and even a 280mm radiator, or if you open a hatch on



graphics cards up to 395mm, which is further good news for high-end users. Storage capacity is more modest: there are just two 2.5in mounting trays and the aforementioned two-bay 3.5in cage, so upgrade potential is

The front panel and both side panels are all lined with a thin layer of soft material to absorb the hum of case fans

the shroud, up to three 120mm fans (a 360mm radiator is also a possibility, but would require completely removing the 3.5in drive cage below).

The roof of the case also allows for another two 140mm or 120mm fans, although you can't pair these with a radiator due to a lack of clearance with the motherboard. On the plus side, these two fan mounts come with a choice of solid noise-dampening covers or individual dust filters, all of which are magnetically fastened for easy removal.

Although the Eclipse P400S is quite squat for its class, at 465mm tall, it's long enough to accommodate

fairly limited. Like the Source 340 Elite, there's no 5.25in drive bay, either.

DEAD NEAT

The Eclipse P400S is much better on cable management, largely thanks to the convenient Velcro straps at the back. There are also a generous seven routing holes around the top, bottom and right of the motherboard, and while the two 'main' holes are relatively small, they'll still snugly fit a 24-pin ATX connector (and will hold it firmly in place with rubber grommets).

We only really have a couple of other concerns. First, we're not fans of the Swiss cheese design of the PSU shroud; it kind of defeats the point of hiding the cables when you can see through all its holes. Second, the grand total of two USB3 ports on the front I/O panel feels quite stingy for a case which otherwise isn't shy about tossing in premium features.

Nonetheless, this is another great mid-tower case that forms a cheaper, more cooling-friendly alternative to the Source 340 Elite. Our last piece of advice would be to pay the paltry £1 extra for the side window model, rather than the one you see here – that way you'll actually be able to admire the spoils of its cable-routing prowess.



PHANTEKS Enthoo Mini XL



£133 • From www.cclonline.com

VERDICT

The Enthoo Mini XL is an interesting chassis that can contain two PCs at once, yet bizarrely fails to support this as standard

TEMPTING AS IT is to focus on that oxymoronic name, the Enthoo Mini XL has a doozy of a party trick to consider instead: it can accommodate two motherboards, and thus effectively two PCs, at once.

To fit both inside its mid-tower proportions, you are limited to one microATX or Mini-ITX board plus one Mini-ITX, but that also leaves room for separate power supplies (one SFF and one full-size ATX), one mounted sideways along the bottom and one in a separate chamber behind the upper motherboard tray.

It's a clever layout, and with six dual-purpose 3.5in/2.5in toolless drive bays plus another two 2.5in bays behind the lower mobo tray, there's easily enough storage space for two systems in one. That's not to mention the three 5.25in external drive bays, one of which can be fitted with an adaptor for yet another 3.5in drive.

HIDDEN FEES

There is one problem with all this dual-PC capability, however: none of it is possible straight out of the box. You need to buy a separate, £20-ish Mini-ITX Upgrade Kit, which includes the requisite mounting plate for the upper Mini-ITX motherboard, another which replaces the rear 280mm exhaust fan

mount to provide cutaway holes for the PCI and motherboard I/O panels, and a second front I/O unit that offers two USB3 ports (the same as the case itself, which naturally serves just one of the potential motherboards).

The kit isn't bad value in itself, but it would have made much more sense to just bundle it with the Enthoo Mini XL as standard, even if it meant a slight price bump. Without it, you're left with a chassis that can't handle anything more than one microATX board and yet is bulkier and more expensive than the average ATX case.

Let's look on the bright side for a moment. Cooling is handled marvellously – you start off with a great set of two intake fans and one exhaust, all 140mm

There is one problem with all this dual-PC capability:
none of it is possible straight out of the box

wide, and there's space for loads more. Specifically, you could get up to three 120mm or two 140mm fans in both the top and bottom, two 120mm or 140mm fans in the front and rear, two 120mm fans on the right side panel and two 120mm fans attached to the 3.5in drive cages. That's a potential grand total of 14 case fans – a huge amount by any standard.

The top and back can take most 280mm radiators as well. To add the same at the front, you'd need to remove both 3.5in drive cages, though since you can do the aforementioned 3.5in-in-the-5.25in-bay trick, this doesn't necessarily mean having to forgo high-capacity hard disks.

The Enthoo Mini XL's added width (a result of the space allocated to a second PSU) also has the bonus effect of making it easier to squeeze in elaborate open-loop liquid-cooling

systems. Unlike the upgrade kit, everything you need for this is included in the box, such as the pump and reservoir brackets, and they're easy enough to install.

SMALL FISH, BIG POND

However, all this support for high-end hardware only compounds the issue of who exactly the Enthoo Mini XL is aimed at. With the dual motherboard aspect treated as an optional extra instead of a key feature, it's only really valuable in this basic state to the extremely niche section of users who want to push their PC to the limit (with the help of liquid cooling and a plethora of storage), but for whatever reason have opted for a microATX or Mini-ITX motherboard. For the more common customers of these tiny form factors, who may or may not even make use of a single graphics card, it's remarkable overkill.

Since it has the potential to be a much more standout case – albeit with a bit of extra spending – we can't give the Enthoo Mini XL a bad mark overall, especially since the abundance of cooling and storage support would be nice to have in any PC configuration. That said, anyone intending to build just the one system should definitely look elsewhere, whether it's at a cheaper and more compact chassis such as the NZXT Source 340 Elite, or the similarly configurable yet ATX-compatible BitFenix Shogun.



RAIJINTEK Metis Plus

COMPUTER
SHOPPER
RECOMMENDED



£53 • From www.overclockers.co.uk

VERDICT

This dinky Mini-ITX chassis makes creative use of its limited available space

THERE ARE MANY reasons for choosing a small form factor (SFF) case, such as the adorably tiny Metis Plus, over a traditional tower. Besides their minimal footprint, they're easily portable and can fit much more comfortably into the average AV cabinet, making them ideal for multimedia PCs.

Indeed, it's hard to go smaller than the 277mm long, 254mm tall Metis Plus without crossing over into palm-sized mini PC territory; this doesn't lock down your component choices so firmly, so you can still swap parts in and out. That said, its size does mean it relies on some geometric trickery to fit everything inside, which in turn makes for a slightly more complex build process.

The PSU, for instance, is mounted at the front of the case with its cables facing upward, so that the power socket and on/off switch are only exposed on the Metis Plus's underside. Installing one involves removing two of the rubber feet in order to access the screw holes beneath, and plugging in what is essentially an internal extension lead, which runs to the case's own power socket on the back.

OH FLIP

The strangeness continues when it's time to install the motherboard, which needs to be mounted upside-down, due to the rear PCI slots being placed above the rear I/O panel (not to mention the fact that you access the main internal cavity from the right side of the case, not the left, as on a tower).

As a result, all your motherboard's external ports will be upside-down as well.

Still, for every oddity like this, there's a genuinely clever example of space-saving design. One example is the storage drive mounting bracket in the roof of the case, which can hold both one 3.5in hard disk and one 2.5in SSD at once.

A series of screw holes in the base also allows for your choice of either one additional 3.5in drive, or two 2.5in drives. In terms of capacity, that's almost on a par with a good mid-tower, such as the Phanteks Eclipse P400S.



170mm, a far cry from the NZXT Manta's 363mm limit. You're pretty much stuck with low-end and a handful of mid-range GPUs where there's a shortened partner card model available. This will nonetheless take up both

Genuinely clever examples of space-saving design include the storage drive mounting bracket in the roof of the case, which can hold both one 3.5in HD and one 2.5in SSD at once

Heat build-up can be an issue in small PCs, where there's less room for it to disperse, but happily there's a proper 120mm exhaust fan fitted as standard. In addition, there's an empty 120mm fan mount up top, to either introduce more cool air or help blow out the hot.

Back on the subject of the power supply, the Metis Plus impresses with its ability to take full ATX-specification PSUs – no need for a special SFF model. That could come in very handy if you're migrating an existing system from a larger case.

Unfortunately, the Metis Plus's dimensions aren't entirely without their drawbacks. The most significant is the maximum graphic card length: because of where that storage drive mount is placed, you can't have anything longer than a mere

of the two PCI slots; a standard amount for Mini-ITX, but still not much at all.

There are also no real cable routing channels, so while it includes a side panel window, all you'll see is roughly tied cables and your Tetris-like stack of components.

NEW HEIGHTS

Conversely, CPU cooler clearance is decent, at 160mm. That's just enough room for a small tower-style heatsink and fan, though if you're feeling ambitious, you could even install an all-in-one watercooler with a 120mm radiator in place of the rear exhaust fan. This could subsequently be moved to the empty mount in the roof instead.

All in all, the Raijintek Metis Plus is not too shabby for the price at all. Despite the harsh GPU size limit, it's more upgradable than it looks, it has a nice-looking aluminium construction (which also keeps it quite light), and it covers the connectivity bases with two front USB3 ports.

The NZXT Manta walks all over it when it comes to ease of use and compatible hardware – we'd much sooner have the Manta for a gaming PC or miniature workstation – but post-launch price fluctuations mean the Metis Plus now costs only half as much. As the backbone of a media centre PC or basic work machine, then, it has charm to spare.



RAIJINTEK Paean



£140 • From www.overclockers.co.uk

VERDICT

This glassy bench table case will grab your attention, but it's better for regular tinkerers than everyday users

LIKE THE STYLE of poem for which it is named, the Raijintek Paean is all about honouring something: namely, the PC system inside of it. With its semi-open design and tempered glass side panels, it's very much a case for showing off your personal selection of components.

It's actually a bench table case, which for the uninitiated is a chassis built to make it particularly easy to swap parts in and out – ideal for, say, quickly testing a stick of RAM to see if it still works, or benchmarking multiple GPUs in succession. This focus on access and functionality over aesthetics means that most bench tables would look more at home in a workshop than in a living room, bedroom or study, but the Paean tries something different.

It's genuinely good-looking, with its acres of tinted glass and iodised aluminium chassis in the middle. This splits up the case into two chambers: one holds the power supply and any storage drives (you can have up to three 3.5in and three 2.5in drives simultaneously, a pretty good mix), while the other contains the motherboard and, if required, a watercooler reservoir. Motherboard sizes up to ATX are supported, and there's plenty of scope for expansion, with eight PCI/PCI-E slots.

The Paean is also quite flexible in that, like a games console, it can either stand upright or be laid down flat on its side – and you can attach the front I/O panel (generously equipped with four USB3 ports)

in a few different places, so it's always easy to reach regardless of how you've got everything set up.

Don't worry about laying it down on one of its glass sides, either, as it comes with some stick-on rubber feet to give a bit of ground clearance. This does make it vaguely resemble an expensive TV stand, mind.

COOL CUSTOMER

No case fans are bundled with the Paean, but you can fit a radiator up to 360mm long into either one of the two chambers. This gives the Paean an advantage for water-cooling aficionados, as most traditional tower cases tend to have a 240mm limit. Besides, in a semi-open case like this, where the air inside isn't enclosed, it's not nearly as important to have case fans in the first place.

You'll have to get very hands-on with the Paean right out of the box, as it doesn't even come pre-assembled

However, there are still some issues with using the Paean as the basis for an everyday home PC. For starters, it's pretty huge, measuring 286x586x417mm when upright, so you'd need either a very large desk or ample floor space to accommodate it. It's expensive, too, at £140.



Also, while there's a good assortment of routing holes between the two chambers, there's no way of actually hiding your system's cables – you can't exactly stash them behind the motherboard or underneath a shroud, as the glass panels (tinted though they may be) let you see every inch of the internals. This is compounded further by the



fact that the I/O panel's cables are unnecessarily long, leaving slack when plugged in. Tidying potential is thus limited to how deft you are with cable ties, though to be fair, Raijintek includes five adhesive clips that you can use to route wires around the case.

DAMAGE LIMITATION

The semi-open design is also a fully open invitation for dust to come and coat your components, not to mention the possibility of drinks and/or small objects falling inside and doing damage. We won't bash the Paean (or, by extension, bench table cases in general) for thus-far hypothetical problems, but as for the dust, maintaining the clean, sharp looks will require more upkeep than a typical enclosed tower case might.

Indeed, you'll have to get very hands-on with the Paean right out of the box, as it doesn't even come pre-assembled – you have to screw all its panels, mounts and brackets together yourself. Far from being a bench table for the style-conscious masses, then, this case remains best for benchmarkers and component testers who might be looking for something with a bit more class than usual, though even they will need to remove the glass panels with an Allen key before doing any tweaking. For straightforward home computing, we'd prefer something simpler, smaller and more traditional.

Award			RECOMMENDED			RECOMMENDED	
Manufacturer	BE QUIET!	BITFENIX	BITFENIX	COOLER MASTER	FRACTAL DESIGN	KOLINK	
Model	Silent Base 800	Aurora	Shogun	MasterCase Maker 5t	Core 1500	Aviator V	
Rating	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	
HARDWARE							
USB2 ports	2	2	2	2	0	1	
USB3 ports	2	2	2	2	2	2	
Mic and headphone jacks	Yes	Yes	Yes	Yes	Yes	Yes	
Front panel extras	None	Reset button, LED controller button	Reset button, LED controller	Fan controller, LED controller	Reset button	Fan controller, SD card reader, microSD card reader	
Case type	Mid-tower	Mid-tower	Mid-tower	Mid-tower	Mid-tower	Mid-tower	
Motherboard compatibility	ATX, microATX, Mini-ITX	EATX, ATX, microATX, Mini-ITX	EATX, ATX, microATX, Mini-ITX	ATX, microATX, Mini-ITX	MicroATX, Mini-ITX	ATX, microATX, Mini-ITX	
Fan mounts	7x 120mm, 3x 140mm	5x 120mm, 4x 140mm	6x 120mm, 5x 140mm	5x 120mm, 5x 140mm	4x 120mm, 5x 140mm	5x 120mm	
Supplied fans	3x 120mm	1x 120mm	3x 120mm	3x 140mm	2x 120mm	3x 120mm	
Max 2.5in drive bays	4	3	12	4	5	1	
Max 3.5in drive bays	7	4	6	2	4	4	
Max 5.25in drive bays	3	0	0	2	2	2	
PCI slots	7	7	7	7	4	7	
PSU size	ATX	ATX	ATX	ATX	ATX	ATX	
Max CPU cooler height	170mm	160mm	175mm	190mm	162mm	170mm	
Max graphics card length	400mm	400mm	410mm	412mm	380mm	370mm	
Dimensions (WxDxH)	266x495x559mm	215x490x520mm	250x525x565mm	242x544x574mm	195x450x370mm	211x400x480mm	
Weight	9.31kg	10.58kg	14.15kg	13.5kg	5.2kg	Not stated	
BUYING INFORMATION							
Price	£121	£75	£145	£220	£50	£47	
Warranty	Three years repair and replace	One year RTB	One year RTB	One year repair and replace	Two years repair and replace	One year RTB	
Supplier	www.ebuyer.com	www.overclockers.co.uk	www.overclockers.co.uk	www.ebuyer.com	www.scan.co.uk	www.overclockers.co.uk	
Details	www.bequiet.com	www.bitfenix.com	www.bitfenix.com	www.cooler-master.com	www.fractal-design.com	www.kolink.com	
Part code	BG001	BFC-ARA-300-KKWSK-RP	BFC-SOG-600-KKWSK-RP	MCZ-C5M2T-RW5N	FD-CA-CORE-1500-BL	CA-025-KK	

Prices correct at time of going to press

	BEST BUY	RECOMMENDED	RECOMMENDED		RECOMMENDED	
	NZXT	NZXT	PHANTEKS	PHANTEKS	RAIJINTEK	RAIJINTEK
	Manta	Source 340 Elite	Eclipse P400S	Enthoo Mini XL	Metis Plus	Paean
	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★☆	★★★★☆
	0	2	0	0	0	0
	2	2	2	2	2	4
	Yes	Yes	Yes	Yes	Yes	Yes
	None	1x HDMI out	Fan controller, LED controller, reset button	LED controller	None	None
	Mid-tower	Mid-tower	Mid-tower	Mid-tower	Small form factor	Bench desk
	Mini-ITX	ATX, microATX, Mini-ITX	ATX, microATX, Mini-ITX	MicroATX, Mini-ITX	Mini-ITX	ATX, microATX, Mini-ITX
	5x 120mm, 4x 140mm	1x 120mm, 3x 140mm	6x 120mm, 4x 140mm	14x 120mm, 4x 140mm	2x 120mm	3x 120mm
	3x 120mm	2x 120mm	2x 120mm	3x 140mm	1x 120mm	None
	2	4	2	8	3	3
	2	3	2	7	2	3
	0	0	0	3	0	0
	2	7	7	4	2	8
	ATX	ATX	ATX	ATX/SFF	ATX	ATX
	160mm	161mm	170mm	210mm	160mm	140mm
	363mm	364mm	395mm	410mm	170mm	310mm
	245x426x 450mm	203x432x 474mm	210x470x 465mm	260x480x 540mm	190x277x 254mm	286x586x 417mm
	7.2kg	8.13kg	7kg	13.8kg	2.8kg	14kg
	£110	£90	£69	£133	£53	£140
	Two years parts and labour	Two years parts and labour	Five years repair and replace	Five years repair and replace	One year RTB	One year RTB
	www.scan.co.uk	www.novatech.co.uk	www.overclockers.co.uk	www.cclonline.com	www.overclockers.co.uk	www.overclockers.co.uk
	www.nzxt.com	www.nzxt.com	www.phanteks.com	www.phanteks.com	www.raijintek.com	www.raijintek.com
	CA-MANTW-M1	CA-S340W-B3	PH-EC416PSC_BK	PH-ES414M_BK	OR200055	OR200062

VERDICT

PC cases are a perfect example of tech hardware being more than the sum of its parts. Take our pick of Mini-ITX chassis, the NZXT Manta, for example: in isolation, its high price, rather unremarkable range of connectivity and lack of standout extras could make it seem a less worthwhile investment, but as a whole, it's a beautifully built product that can do almost anything a larger case could.

The same goes for our award-winning ATX mid-towers, the Phanteks Eclipse P400S and the NZXT Source 340 Elite. Neither of these models have the most drive bays or fan mounts in purely numerical terms, but they're such comprehensively good all-rounders that we found ourselves ceasing to care.

If anything, this group test shows that attempts to create more ambitious, unusual case designs can be a risky business. The Raijintek Paean is genuinely eye-catching, but can also be impractical, while the Phanteks Enthoo Mini XL's hesitation to fully embrace its dual-motherboard design means that it's compromised until you fork out for a separate upgrade kit.

While neither of these are poor cases overall, our advice would be to save yourself the trouble – and some money – and just go for something more straightforward. As we've seen, simple doesn't have to mean boring. 📺



CHARGING AHEAD

WITH SO MANY OF THE WORLD'S LEADING PHONE AND LAPTOP MANUFACTURERS BEING HIT WITH PROBLEMS OF EXPLODING DEVICES, SARA YIRRELL EXPLORES A NEW KID ON THE BLOCK LOOKING TO CAUSE A STIR IN THE RECHARGEABLE BATTERY SPACE

The horror stories are easy to find online with a quick search, and are regularly covered in the papers. Simply type 'exploding battery' into a search engine and any number of articles showing the blackened shells of smartphones, tablets or laptops will appear.

It is a problem that has hung over many of the main manufacturers in recent years, none more so than Samsung, which was forced to permanently scrap production of its Note 7 phablet, after a number of its replacement handsets (issued for the same reason) overheated and burst into flames (see 'Flaming nightmares', page 120).

But the other scourge of modern life is the constant battery anxiety syndrome. Batteries on personal devices appear to lose charge at an alarming pace, and the time it takes to recharge a flat battery seems to outweigh the amount of time the device actually runs for.



However a team of scientists from Oxford University, in partnership with technology firm Zap&Go, have been working to address both these problems simultaneously. They have been developing new carbon-ion batteries, which are faster charging and will not overheat.

The team, which has been working on the project since 2013, debuted their products at the CES extravaganza in Las Vegas held in early January, describing the technology as the first with the potential to combine the fast-charging characteristics of a supercapacitor with the performance of a lithium-ion battery.

The technology is based on carbon nano materials including the wonder material graphene, which is one of the best conductors. The carbons are mixed into a conductive ink, which is then coated on to ultra-thin aluminium foils in a sandwich of 40 to 50 leaves. These are then soaked in an ionic electrolyte and sealed into a flat pouch.



↑ Cordless power tools could be among the early beneficiaries of new battery technology



↑ Zap&Go's new carbon-ion batteries will be used to power everything from scooters to speakers

Zap&Go is planning to release the technology in a number of formats later this year, including cordless power tools, robot cleaners and electric bikes. It has recently secured a further £10m investment, and is set to move into a 15,000 square foot pilot production facility at the Harwell Science and Innovation Campus in Oxford by the end of 2017. The team plans to iron out any issues ahead of mass production in 2018, and also to speed up the development of the third generation of the technology to make the supercapacitor smaller and lighter.

Speaking to *Computer Shopper*, Simon Harris, investment director at Zap&Go, explains: "It is quite a bold and ambitious project; the number of objects and devices that are powered by rechargeable batteries is practically uncountable these days."

He says that the world is demanding cordless power for numerous reasons, the main one being to dispense with the much-hated and limiting power cord.

"But there are many drawbacks with traditional lithium-ion batteries; mainly that they pack up if they are repeatedly charged, and also that the battery life itself isn't that long to cope with modern day demands," he explains.

What's more, Harris says, the issue of some batteries overheating and causing their devices to combust is a major factor, along with the fact that this latest technology is better for the environment.

CHARGE OF THE LIGHT BRIGADE

Zap&Go already has a track record in technology development, with its five-minute charger taking the market by storm in 2014. The Ultra-Fast Charger could charge up to three mobile devices simultaneously via two standard USB ports and a Qi wireless charging pad. It captures 1,500 milli-Amp hours (mAh) in just five minutes, enough to take an iPhone 5 battery from empty to 100% and an iPhone 6 battery to 75% full.

The fact that the battery pack itself charges quickly, rather than forcing the battery of the device to charge quickly, meant the risk of overheating was zero, and with just five minutes of power, the charger provides over two hours of on-the-go charge time.

The charger technology earned Zap&Go a place on the coveted Red Herring Top 100 list in 2016, which highlights the most exciting startups from Asia, Europe and the Americas, after putting them through a rigorous selection process based on 20 criteria. Hundreds of companies fail to make the grade each year.

Harris adds: "The advances we are making with this [latest] technology is to speed up charge times, and lengthen the life of the batteries. Our technology doesn't have the shortcomings [of its predecessors]. We are currently looking at a number of places where this technology can be used either on its own or in partnership with lithium batteries. Our plan is to bring to market an alternative source of power to the current rechargeable batteries to speed up charge times."

While the firm is concentrating on releasing the batteries for initial use with drills, vacuum cleaners and robots, it is hoping to secure investment from larger IT players through licensing deals to fuel development of the batteries for smaller devices.

FLAMING NIGHTMARES

SOME OF THE HIGHER-PROFILE EXAMPLES OF WHEN LITHIUM-ION BATTERIES HAVE CAUSED THEIR HOST DEVICES TO GO UP IN SMOKE



SAMSUNG

In September 2016 the Korean manufacturer was forced to recall around 2.5 million of its Note 7 phablet phones globally after an increasing number of reports emerged that they were catching fire. Just one month later the firm announced it had permanently scrapped production of the Note 7 device after replacement models issued to customers also began catching fire.

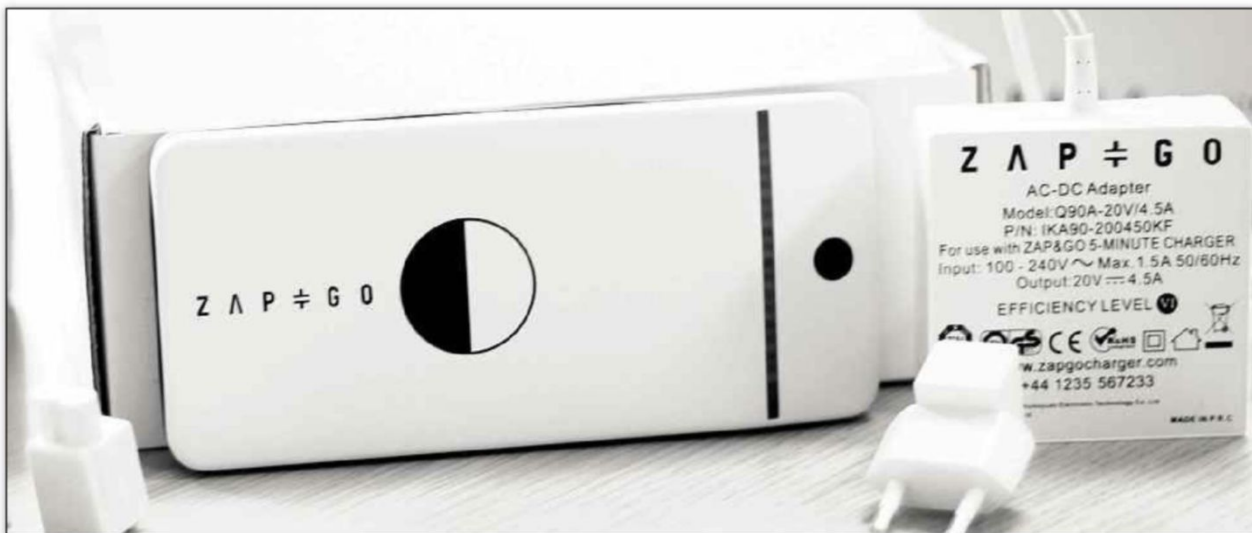
There was even an incident in October in which a Southwest Airlines plane travelling from Kentucky to Maryland had to be evacuated before take-off due to one of the batteries combusting. Samsung eventually admitted it was unable to fix the issue.

HP/COMPAQ AND SONY

HP issued a recall in the summer of 2016 after admitting some of its laptop batteries could become a fire hazard. Anyone who bought a ProBook, Envy, Presario, Pavilion Notebook or any other HP and Compaq models between March 2013 and August 2015 were warned they could be at risk and needed to claim replacement batteries. At the same time, Sony also issued a recall for its Vaio laptops sold between February and October 2013 after similar issues were reported.

The battery issue has dogged HP for many years, with the manufacturer issuing similar recalls in 2011, 2010 and 2009, all because of lithium-ion batteries.






"At the moment the batteries are too large for devices such as phones and laptops. We have a bit more room to play with in a vacuum cleaner and a drill than we do in a phone. But that is the aim. To get there in stages with the help of partners," Harris says.

Carl West, supply chain director at analyst firm GfK, says the rechargeable battery space is going to be an interesting one to watch in the coming year as consumer demands and expectations continue to rocket.

"We are quickly approaching the day that every time we get in a car, bus, taxi, plane or sit for dinner, a haircut or a film there will be a fast, wireless charger to hand. This type of technology stops us rationing our gadget interaction. It might mean we carry fewer cables and battery packs, which means less clutter to forget when we step out of the house," West explains.

And manufacturers are going to be capitalising on this trend, he predicts.

"With a strong focus on battery life optimisation by tech manufacturers in 2017 and the fact that portable power packs were one of the fastest-growing tech accessories in 2016, it is only natural there is growing demand for faster battery charging," West says.

"Recently we have seen development in wireless charging technology that allows more access points to charge around the home and when travelling. With smartphones, laptops and consumer tech decreasing in size, it's often the battery capacity that suffers. Having faster and more widespread charging means a more agile consumer. Battery power limits data use, app investment, productivity, internet browsing, calls and messaging. Keeping the battery power up also keeps the revenue streams open." 



TOP: Zap&Go aims to make charging smartphones quicker

ABOVE: Simon Harris of Zap&Go believes the days of lithium-ion batteries are numbered

APPLE

Apple was also not immune to battery problems, with unsubstantiated reports in China emerging in October 2016 that some iPhone 6 and 7 models had started to overheat, explode or catch fire. No recalls were announced at the time, and Apple was reported to have investigated the claims.



LENOVO

In 2015 Lenovo issued a global battery replacement recall for its popular ThinkPad range, again due to a reported risk of the batteries catching fire. It was estimated that upwards of 200,000 batteries were recalled worldwide.



DELL (AND SONY AGAIN)

The Texan-based vendor was also hit hard in the pocket over the exploding battery issue. Back in 2006 it was forced to recall over four million laptops worldwide after it discovered a battery, manufactured by Sony, was prone to overheating and could cause the laptop to burst into flames. Models affected included the Inspiron, Latitude and Precision mobile workstations, and XPS laptops. An estimated 9.6 million batteries were recalled in 2006 by Sony, delivering a huge 38% blow to the manufacturer's annual profit forecast that year, costing it upwards of \$429m. Ouch.



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A straight answer for quote marks

I have a large Word document that was scanned and converted to text using optical character recognition. This worked relatively well, but there are some 'sillies' left in there.

One of the areas that is causing me the most problems is text in quotation marks. The OCR program has converted the quotes to a mix of straight (') and smart (') quotes, and because of the layout of the original material, has inserted spaces after the opening quote and before the closing quote, so I'm left with sentences such as:

" Oh for the wings of a dove. "

I therefore have two problems: first, how can I convert straight to smart quotes when the text has already been entered? And second, how do I deal with the extra spaces? The problem I have is that if I try to use Find and Replace to get rid of the extra spaces, it ends up removing the 'wrong' space, so that the word following the quote is joined to the quote. So in the example above, I'd end up with:

as" Oh for the wings of a dove. "The

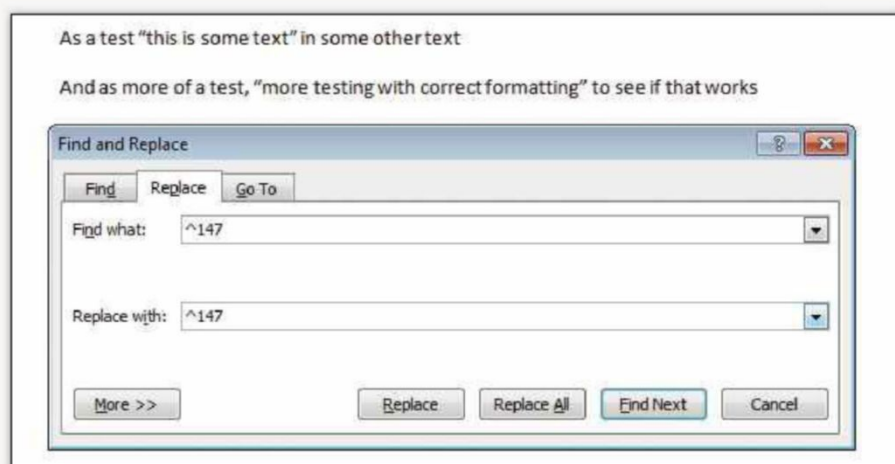
How can I overcome this without going through and editing the document one line at a time? I'm using Word 2010.

Barry Green

From your description, you're attempting to remove the spaces before and after the quote at the same time. The problem is that Word doesn't know which are the real 'extra' spaces, and which are there to correctly separate quotations from other text.

I'll show you a reasonably automatic way to do the change, but I should also be honest and tell you that if I were in your shoes, what I'd do would be a number of rather simple Find and Replace operations, looking in turn for all the occurrences of a double quotation mark followed by a space, then for all those with a space followed by a double quotation mark. In each case I'd use Find Next to move through the occurrences, replace the wrong ones and skip the ones that weren't a match.

Having replaced the 'straight' quotation marks, you could then do a Find and Replace looking for the character 0147 followed by a space. This is the code for the smart opening



↑ You can use Find and Replace to change straight quotes to smart quotes in Word

quotation mark, and you'd enter it into the Find/Replace dialog using the code ^0147. The Replace entry would be just the code ^0147. Finally, do a Find and Replace for closing smart quotes preceded by a space, using the code ^0148 preceded by a space. You should by this time have converted all the quotation marks to smart quotes, and also got rid of all the spaces following an opening quote and preceding a closing quote.

If you want a more automatic way of working, here's a macro that should go through and find the spaces before and after quotation marks. It relies on the fact that quotes occur in pairs, so if you count your way through the document, odd-numbered quotes are opening quotes, and even-numbered quotes are closing quotes.

The problem with this assumption is that if your OCR program has set some quotes to be smart and some to be straight, the counting might not work. Similarly, if you have any 'orphan' quotes, they could throw the counting out. Because of this, make sure you've saved a copy of your document before you start in case the replacing gets into a mess.

```
Sub countquotes()  
Dim doc As Document  
Dim i, qcount As Integer  
Set doc = ActiveDocument  
qcount = 0  
For i = 1 To doc.Range.Characters.Count
```

```
    If doc.Range.Characters(i) =  
Chr(34) Then  
        qcount = qcount + 1  
        If Int(qcount / 2) = qcount / 2  
            Then  
                'closing quote  
                doc.Range.Characters(i) = Chr(148)  
            Else  
                doc.Range.Characters(i) = Chr(147)  
            End If  
        End If  
    Next  
MsgBox ("finished")  
End Sub
```

This macro simply moves through the document one character at a time, and looks at the current character to see if it's a quotation mark, which is Chr(34). If it is, one is added to the count of quotation marks in qcount. The If statement:

```
If Int(qcount / 2) = qcount / 2 Then
```

checks to see if qcount holds an even number. If it does, then qcount/2 will be the same value as the Integer of qcount/2. An even count means this is a closing quote, so the current character is replaced by the smart closing quote, Chr(148). If the current qcount is odd, it's an opening quote, so the character is replaced by Chr(147), the opening quote.

No receipts required

I recently had to reinstall Outlook and set it up again. I downloaded all my mail to my inbox, meaning I had hundreds of 'new' emails, all marked as unread. I selected the inbox, right-clicked, and chose the option Mark All as Read. There were obviously quite a lot that had a read request set on them, as Outlook immediately began sending hundreds of Read Receipts.

The problem was that I had actually read those messages in my old copy of Outlook, and I didn't want people to get a second Read Receipt, so I cancelled the Send operation using Cancel All in the Send/Receive menu. The problem is that this also stops Outlook receiving messages.

I've turned off the option to send Read Receipts from the File, Options, Mail, Tracking menu, but Outlook is now stuck and can't send messages. I can't see any Read Receipts in the Outbox, but if I let it send messages, the hidden Read Receipts go out again.

George Phillips

Read Receipts are indeed invisible in the Outbox, so you can't select them for deleting



◆ You can use MFCMAPI to delete hidden Read Receipts in Outlook

From the options you're offered, choose Session, Logon, and click OK to log into Outlook. If you have multiple accounts, double-click the name of the account you want to work on, otherwise double-click the one that has the value for the Default Store column set to True. You want to open the contents table, at which point you should see a screen that either says

Root Container or Root-Mailbox (if you're using Exchange as well as Outlook).

Select Actions, Open Folder, Outbox. There should be items there with the subject prefixed with "Read:". These are your hidden read receipts. Select the messages. Now from the Actions menu, choose Submit, Abort Submit. You then need to delete the messages using Actions, Delete Message. From the options you're offered, choose the rather frightening one labelled: Permanent delete passing DELETE_HARD_DELETE (unrecoverable). Press OK and the read receipt will disappear.

Dates and measures

I need to compare two date fields in Access. The first is in a linked SQL table, where the date was created using the SQL data type DateTime. The second is a date time format created in Access. The dates should be different because while the dates are the same, the seconds in the time part of the field differ. However, Access says the two values are the same.

Sophie Langdon

The problem lies with the source of the first date from a SQL Server DateTime field. This

is treated differently in Access, and can't be queried using comparison operators such as =, >, or <. It also can't find matching records for times in queries, and can return the records that are the opposite of your criteria.

You have to use the DateDiff function, so to check whether the actual dates had a difference in days, you'd use:

```
DateDiff('d', [DtFromSQL], [DtFromAccess])
```

replacing DtFromSQL with the name of your SQL derived date column, and DtFromAccess



◆ Use DateDiff to compare dates in Access

with the date from the Access column. You can also compare the time element using DateDiff, so to see the difference in seconds between the dates, you'd use:

```
DateDiff('s', [DtFromSQL], [DtFromAccess])
```

What's in a name?

I have an Excel workbook that contains two cells that contain values that uniquely identify the document. I want to have an option to save the workbook under a name that is made up of the combination of those two cells (the customer name and quote number). I want to create a file in the My Documents folder, so if the customer name is Fred Bloggs and the quote number is 1,296, I'll get a file called Fred Bloggs 1296.xls in My Documents. How can I go about this?

Harry Ellender

Assuming the customer name is in cell C2 and the quote number is in cell D2, you could have a macro like this:

```
Sub savecust()

Dim strWkbkName As String
strWkbkName = ActiveWorkbook.
Sheets("Sheet1").Cells(2, 3).Value
& " "
strWkbkName = strWkbkName &
ActiveWorkbook.Sheets("Sheet1").
Cells(2, 4).Value
ActiveWorkbook.SaveAs
Environ$("UserProfile") & "\My
Documents\" & strWkbkName, _
FileFormat:=xlOpenXMLWorkbookMacroEnab
led

End Sub
```

This simply takes the values in cells C2 (row 2, column 3) and D2 (row 2, column 4), and puts them into the variable strWkbkName. The Cell function expects the row number first, and the number of the column second. The name is then used to save the workbook in My Documents.

The exact location of My Documents varies depending on which user is logged in, but the element that changes will be something like C:\Users\Kay, where 'Kay' is your username. Fortunately, you can retrieve this in Excel using the function Environ\$ with the parameter UserProfile. Environ\$ is a handy function that you can use to find out information such as the username, system root, number of processors, domains and home drives. ☐

Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help



Send your problems to help@computershopper.co.uk

Guest what Windows 10 can't do?

My PC runs Windows 10 Pro. No matter how I try to create user accounts, they don't work. When I try to log in to them I get the message, "The User Profile Service failed the sign-in. User profile cannot be loaded."

I have tried to enable the built-in Guest account in various ways, including from a Command Prompt (Admin) session. Everything appears to have worked, but there's no Guest option on the login screen. What's going on?

Pete Clough

We're not clear if you're trying to enable guest access as a workaround to the first problem. A couple of issues can cause problems with creating new accounts, but the most likely one is that the default user profile – used as a template when creating new accounts – is corrupt. If you're aware of a time when creating a new user did work and you still have a backup from that time, try restoring the contents of C:\Users\Default, replacing what's currently there, then see if you can successfully log in to a new user account.

If this doesn't work, or you don't have a backup, you'll need to fix it manually. Open an Explorer window and navigate to C:\Users. Click View, select Options (at the far right of the title bar) and choose Change folder and search options. From the View tab, find Hidden files and folders in the list, select Show hidden files, folders and drives, and click OK.

You should now see a folder called Default. Right-click it, choose Rename, and rename it to Default.old, providing

```
Administrator: X:\windows\system32\cmd.exe
Microsoft Windows [Version 10.0.14393]

X:\windows\system32>xcopy c:\Users\Simon\NTUSER.DAT c:\Users\Default /h
File not found - NTUSER.DAT
0 File(s) copied

X:\windows\system32>xcopy d:\Users\Simon\NTUSER.DAT d:\Users\Default /h
File not found - NTUSER.DAT
0 File(s) copied

X:\windows\system32>xcopy e:\Users\Simon\NTUSER.DAT e:\Users\Default /h
Overwrite E:\Users\Default\NTUSER.DAT (Yes/No/All)? y
E:\Users\Simon\NTUSER.DAT
1 File(s) copied

X:\windows\system32>
```

◀ You'll have to reboot to a Command Prompt to copy the protected NTUSER.DAT file

administrator permission if asked. Now create a new folder in C:\Users and name it Default, then create the following folders within the new Default folder: Desktop, Documents, Downloads, Music, Pictures and Videos. At each step, provide permission if prompted.

You also need to copy the system file NTUSER.DAT from your own user profile directory (probably C:\Users\Pete) to the new Default directory, but unfortunately this file is locked when you're logged in. You can get around this by restoring a copy of the file from a recent backup to a new location such as your desktop, then manually copying it to C:\Users\Default. If you're using this method, first retrace the steps above to change the folder view settings, but this time scroll down and untick Hide protected operating system files (Recommended). You'll need this to actually see the NTUSER.DAT file once it's been restored.

You can skip the above step if you don't have a backup, as instead you'll need to use the Command Prompt. Restart your PC from the Start Menu, holding down the Shift key. Within a few seconds you'll see an options screen: choose Troubleshoot, then Advanced options, then Command Prompt. On rebooting provide your login information when prompted, then type the following command and hit Enter: **xcopy C:\Users\Pete\NTUSER.DAT C:\Users\Default /h** (if your user account isn't called Pete, change the relevant part).

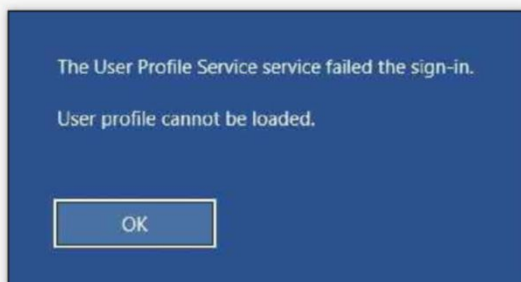
You should see the confirmation message 1 File(s) copied. If you see

File not found it's probable either that you got the address of your user folder wrong (see above), or that in the Command Prompt environment your system drive has been allocated a drive letter other than C:. Try repeating the command above, but changing the root directory to D, E or F, for example: **xcopy D:\Users\Pete\NTUSER.DAT D:\Users\Default /h**. Once you have successfully copied this file, close the Command Prompt window and then click Continue to boot the PC into Windows. You should now find that you can successfully log in to any new user accounts you've created.

Regarding the Guest account, Microsoft has now effectively disabled this in Windows 10. Although you can find instructions to enable it, none that we've tested work properly. If you do need another account for guests to use, we'd recommend simply creating a new standard user.

To do this, select the Settings icon from the Start menu, choose Accounts, then Family & other people from the left-hand pane. Click Add someone else to this PC, then select I don't have this person's sign-in information, followed by Add a user without a Microsoft account. Call the user something self-explanatory such as Visitor (Guest is reserved), and click Next to create the account without a password.

It's not an ideal solution as the account won't be as tightly locked down as the Guest account of old, but at least the user shouldn't be able to install any software or mess up too many things.



↑ Problems with C:\Users\Default can stop you signing in to new user accounts

I just need to print!

It's great if a printer can produce pin-sharp photos in vibrant colour, output *War and Peace* in under a minute, use ink that costs no more than the paper and take up less desk space than a shoe box. But what I really need is for my printer to actually print, however frequently or infrequently I use it. My Canon Pixma iP4000 – a *Computer Shopper* Best Buy from goodness knows when – did a brave job. But after years of sporadic printing the heads seem to finally be beyond cleaning: now all I get is black.

I need to get a new printer, then, but which type? Should I invest in a laser, or are inkjets more reliable these days? Do laser printers have their own issues? If lasers aren't a match on photo quality I could always send my snaps to an online print service. But, please, I do want my printer to print when I need it to. Advice please.

Martyn Sandford

Our printer guidance usually starts with a question about the type of printing you will do most, but it's clear that above all else you need something that's able to sit idle for a long time. Without doubt, laser printers have the edge here. Left unused for a couple of months, the worst that will happen to a laser printer is a coating of dust, whereas – as you've discovered – an inkjet's heads may dry up and require tedious, ink-intensive cleaning.

Modern inkjets do have a lot to recommend them, however. They're usually



↑ Inkjet printers such as HP's PageWide Pro 477dw give lasers a run for their money

cheaper to buy and run than an equivalent laser printer, they use less electricity, take up less space, make less noise and – on the right paper – they produce better photos. On plain paper, inkjet prints lack the sheen and sharpness you get from a laser, but office-orientated models still give credible results.

Our recent experience with small-office inkjets such as HP's PageWide and Epson's WorkForce Pro ranges is that their speed, reliability and quality is broadly comparable to their laser alternatives. Our test equipment rarely sits idle, however, so although we're yet to experience ink drying or blockages on these models, we can't confidently say that it's no longer an issue. In short, we increasingly choose inkjets above lasers, but the latter might still prove unbeatable in cases such as yours.

Snail mail

On 20th January 2017 I received an email from a friend in Greece. Nothing unusual in that, except that the friend had sent the email on 5th November 2016. Any idea why this might have happened? I am concerned because I use email to reserve a lot of accommodation in Greece: responses disappearing into limbo could cause all sorts of problems.

Cluny MacPherson

Email delays of a few hours aren't uncommon, but the sender usually gets a notification that the server is struggling to deliver the message.

A 11-week delay, however, is remarkable – by far the longest we've encountered.

We'd usually expect to trace such a delay back to a mistake by the sender: usually either forgetting to hit Send, or powering down the PC with the mail still sitting in the outbox. From examining the email header that you sent, however, it's clear that a Yahoo! server did indeed receive the message from your friend on the day it was sent, but that it went no further until the day you received it.

Our best guess is that something caused an issue within Yahoo!'s network that delayed

this particular mail. It's impossible to know what this was or why it happened, but it's likely to have been minor; a big problem would have been noticed sooner. Whatever happened, your own ISP wasn't responsible for the delay, but although other problems are unlikely, it would be prudent to confirm your outstanding reservations in case the problem did affect other mails.

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Received: from [98.138.226.180] by nm2.bullet.mail.ne1.yahoo.com with NNFPMP; 20 Jan 2017 03:38:06 -0000
Received: from [98.138.87.10] by tm15.bullet.mail.ne1.yahoo.com with NNFPMP; 20 Jan 2017 03:38:06 -0000
Received: from [127.0.0.1] by omp1010.mail.ne1.yahoo.com with NNFPMP; 20 Jan 2017 03:38:06 -0000
X-Yahoo-Newman-Property: ymail-3
X-Yahoo-Newman-Id: 719393.17457.bm@omp1010.mail.ne1.yahoo.com
X-Mail-OSG: bMVsRf8VM1nx2ZMCYQs6yC6eeEuV5Q0nk0SG3_7jVlghp5sOSDA.MzFUQYPO0
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Received: from jws200150.mail.ne1.yahoo.com by sendmailws122.mail.ne1.yahoo.com; Sat, 5 Nov 2016 16:06:37 +0000 (UTC)
```

↑ The header information shows this email experienced an 11-week delay

Mind your language

I'm running Windows 10 on my main PC, a highly specified desktop that I use for coding and gaming. About two days after I reboot the computer, my keyboard will randomly switch from a UK to a US layout – usually I'll first notice when I'm typing an email or Twitter address and realise that the @ symbol has swapped places with the ". Strangely, Windows still insists that it's the UK layout.

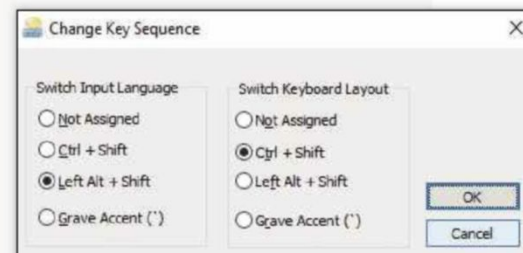
Fortunately I know the US layout well so I can work around it until I've finished what I'm doing, but it's an annoying fault that I can only cure by rebooting the PC. Can you suggest a better fix?

Jeremy Henson

Windows has long supported multiple keyboard layouts, most usefully for people who need to switch between input languages. Unfortunately it's quite easy to hit the standard Ctrl-Shift shortcut and switch by mistake, particularly if you also use Visual Studio, which has many three-key shortcuts based on Ctrl-Shift.

For those who actually use a second keyboard layout, the easiest fix is to disable the shortcut and instead use the language bar to switch. Search for Control in the Start Menu and open Control Panel, select Language, click Advanced settings in the left-hand pane, then under Switching input methods click Change language bar hot keys. In the Text services and Input Languages applet, click Change Key Sequence, change Switch Keyboard Layout to unassigned and click OK to save your changes.

For most UK users, however, the US keyboard layout is an annoyance that's often installed by default. To remove it from Windows 10, enter Control Panel and select Language, as above. Select English (United States) and click Remove on the bar above. If it's currently displayed at the top of the list, you'll need to click Move down before the Remove option is enabled. ☐



↑ Even if you need multiple keyboard layouts, you might still want to disable the Ctrl-Shift shortcut

Advanced Projects

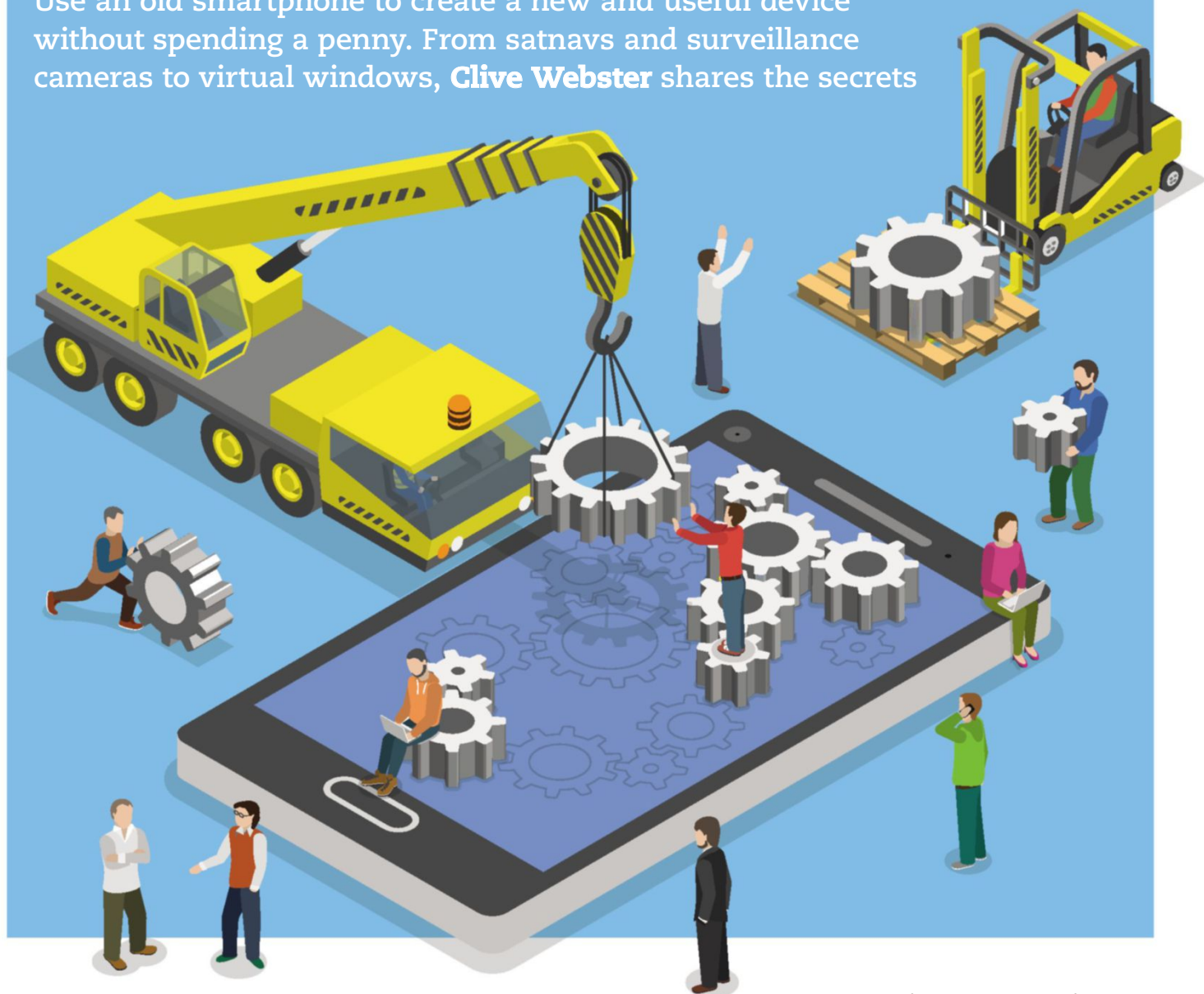
Clive Webster has been tinkering with computers ever since Windows 98 forced him to manually install his drivers

clive@computershopper.co.uk



Repurpose an old smartphone

Use an old smartphone to create a new and useful device without spending a penny. From satnavs and surveillance cameras to virtual windows, **Clive Webster** shares the secrets



AN OLD SMARTPHONE or tablet might not be fast enough for your favourite games or apps anymore, but it's still an amazing device packed with sensors and gadgetry. The camera might not be up to scratch for family photos, but it's plenty for a surveillance camera or baby monitor. The GPS on an old phone still works even if the phone has no SIM card installed, so chuck your car's paper map book and use an offline map app to navigate. Even a smartphone or tablet that never leaves your desk or kitchen counter has many uses, from decorative to indispensable.

So why not put a retired smartphone or tablet to new use with some free apps and a little trickery?

SYSTEM SUPPORT

Exactly what you can do with an old smartphone depends on whether it runs Apple's iOS or Android operating system (OS), as the hacks we're going to show you are totally dependent on app support. We've therefore sliced this feature accordingly: by function, and then by OS, so you can quickly find the information you want and avoid information that's irrelevant.

Before starting, you'll need to update your smartphone to the latest available version of its OS; you should also stop it synchronising your music, video and so on.

SURVEILLANCE CAMERA/ BABY MONITOR

Your phone has a camera, a microphone and Wi-Fi: it is a Wi-Fi surveillance device. Better yet, the free apps we cover can send you alerts when motion or sound is detected, and let you view a live stream from anywhere in the world. Some even let you use other

parts of your phone; using the speaker turns your phone into a video intercom, for example. There are many apps that turn a phone into a surveillance camera, but these are our favourites. If you haven't got a stand for your smartphone, check out *Manything's* free paper stand (see manything.com/printable-stand.html).



The free version of Pavel Khlebovich's IP Webcam looks like a long list of settings, but it has all the capabilities you'll need, and the options and procedures are very well explained. You can even automatically upload video clips to Dropbox for free.

Download IP Webcam from the Google Play store and launch it. You'll see a long list of settings, most of which are fairly self-explanatory. If you want to upload video to Dropbox or to stream live video over the internet, you'll need to install a plug-in: tap Plug-ins and then the Install and manage scripts button. Once the plug-ins list has loaded, tap the download button for Uploader.

You might also want to dabble with Email on motion, which will email you a photo once motion (mo) is detected (det). Once the plug-ins are installed, return to the Plug-ins menu (tap the back arrow at the top-left) and tap the cog icon of each plug-in to configure them.

For Uploader, we tapped Install Dropbox uploader, and were taken to the Play store to install IP Webcam uploader for Dropbox. Once installed, tap Return and then Select



uploader to choose Dropbox. The rest of the process is obvious: provide your Dropbox login, assign a folder for the videos and so on. If you wish to view the video stream over the internet, you'll need to install the other uploader plug-in and then enter details for your FTP (or SFTP – Secure FTP) server. Once a plug-in is configured, remember to tap the Off button to toggle the plug-in to On.

You must open the Motion and sound detection menu to enable motion detection (and sound detection), and then enable data logging in the Data logging menu. Use the Cloud streaming option in the main menu if you want to watch the live video stream over the internet; you'll need an Ivideon account and to use the Ivideon app (for Android or iOS) on your viewing device.

As this is an old phone that you're repurposing, you should enable Stream on



↑ Rest easy: an old smartphone makes an ideal baby monitor

device boot in the main settings menu. As this setting says, you should then disable the screen-lock feature of your phone; this will delete the encrypted data on the phone. You can now tap the last settings option, Start server.

The screen should turn into a live view of the camera, with two buttons in either top corner. The Actions... button lets you fiddle with options such as the focus, or running the app in disguise mode (where the screen shows the Google home page). The other button walks you through how to connect to the video and audio, and is very helpful and straightforward.

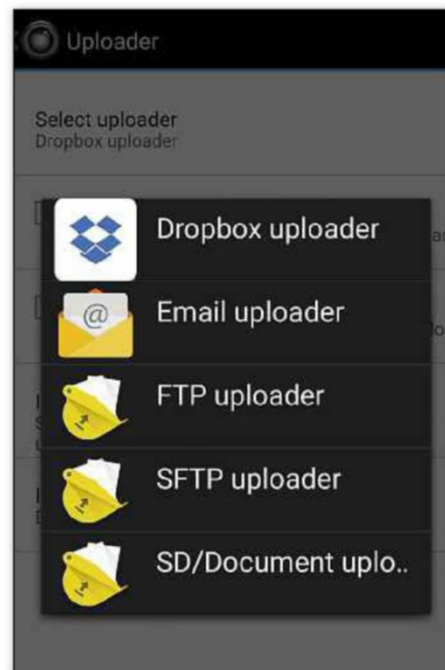
To calibrate your new security camera, open a web browser on a device connected to the same local network as your old phone and head to the IP address provided; in our case, 192.168.1.108:8080. To enable the video feed on the web page, select a video renderer (Flash is the least laggy) and audio player (HTML5 Opus should be best). As IP Webcam doesn't use zones, and so can't ignore parts of the video picture, don't have outdoor plants in shot: they will blow in the wind and lead to recordings of nothing much happening. To refine your motion and audio trigger levels, click the Open sensor graph button.

This live feed is rather overwhelming, so untick all the sensors except for Motion amount. Then experiment by walking through your video feed and seeing how high the line graph goes. We found the default of 250 to be fine. Refresh the web



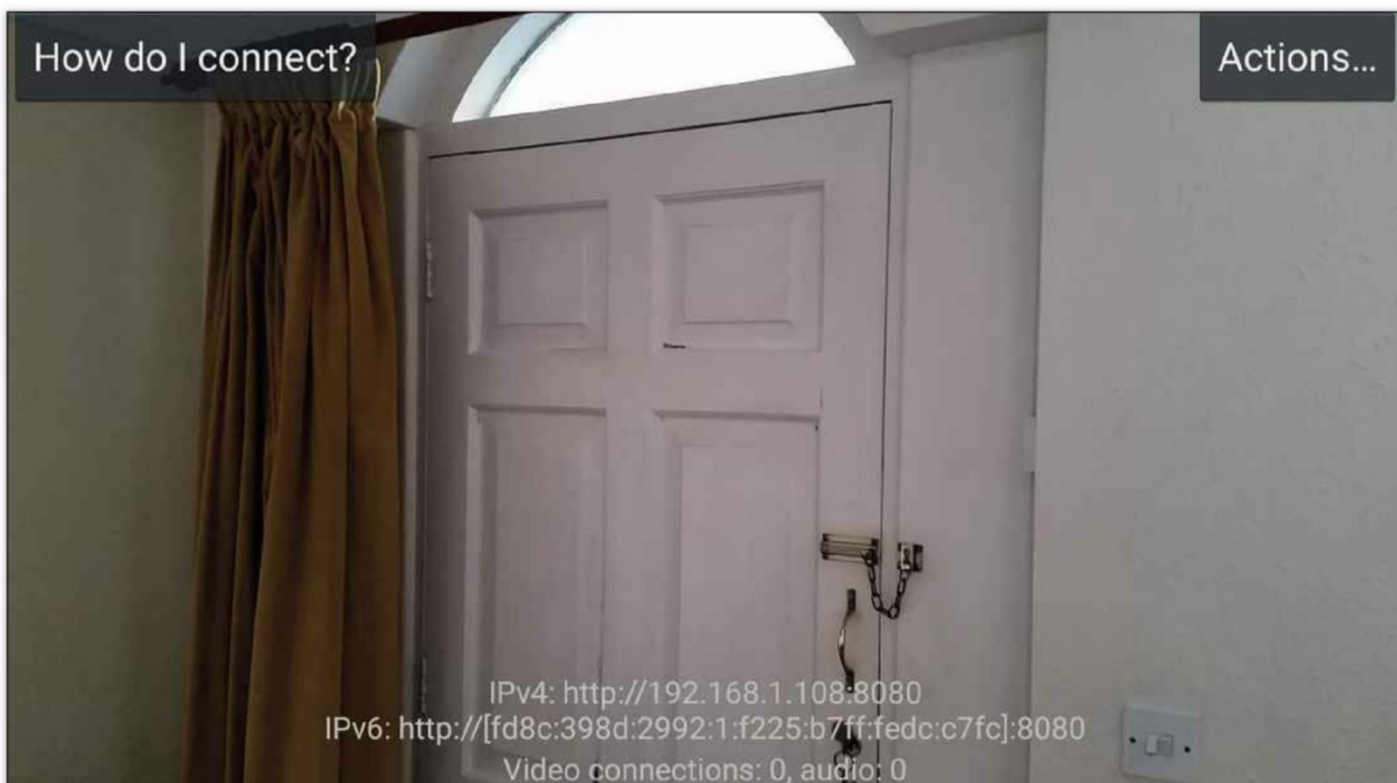
↑ IP Webcam is easy to use and has all the features you could want

page and untick all but the sensor_sound_event sensor; this is the trigger for audio-based recording. We found the default of 200 a little high – it's equivalent to someone smacking a desk at 30cm – so we dialled the Audio trigger amount down to 100 and clicked Apply. In a quiet house at night, the low audio trigger should start a recording in good time to capture a decent image. An audio trigger level of 200 might be useful for a baby monitor, however.



↑ You can upload IP Webcam video clips to Dropbox for free with Uploader

Should you want to talk through your old phone, you'll need the tinyCam Monitor app on your viewing device (Android only). This makes an old phone running IP Webcam a potential smart doorbell, alerting you to motion detected and allowing you to tell the supposed courier that you can see they have no parcel under their arm. Once everything is installed, change your Play store password just in case someone swipes the old phone; it will just be sitting there unguarded, after all.



↑ Five minutes of fiddling with the well-explained settings and IP Webcam has turned your old phone into a fully featured Wi-Fi surveillance camera



↑ The iOS surveillance app Presence can be set up and ready to go in under a minute

There's no free iOS app that matches IP Webcam's features, but Presence offers the best compromise as it has 50MB of free cloud space and only lacks sound-based triggers. On the upside, Presence is a doddle to set up.

Install the app on your old phone and create a Presence account, then tap Yes when asked if this device will be a camera. Switch to your current smartphone or tablet and install the Presence app. Log into your Presence account, tap No when asked if this new device should be a camera and you'll see



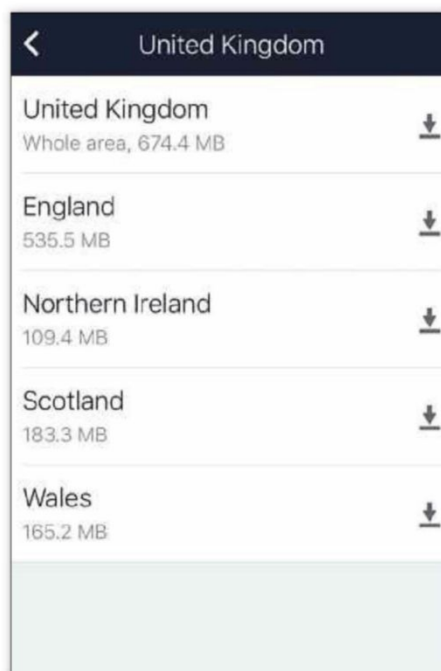
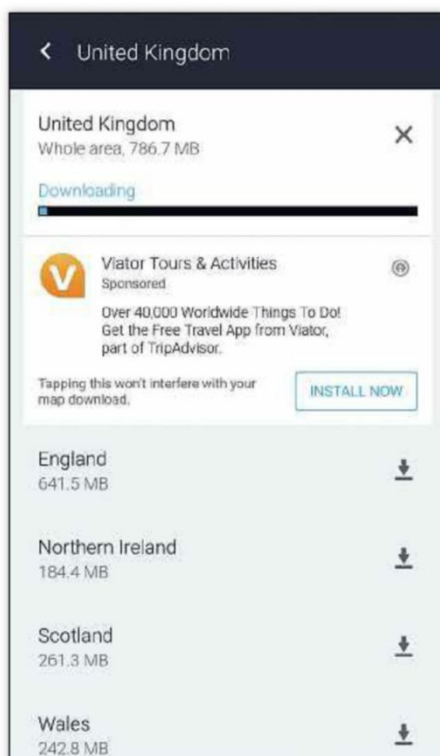
↑ Whatever you do, don't do this while you're driving – but you can repurpose your old smartphone to act as an offline road atlas to keep in your car

a menu. Tap your old phone (under the Cameras & Devices section) and you'll be taken to the live view from your old phone. You have made a Wi-Fi surveillance camera with notification alerts. Tap on the Options to tweak the camera's settings.

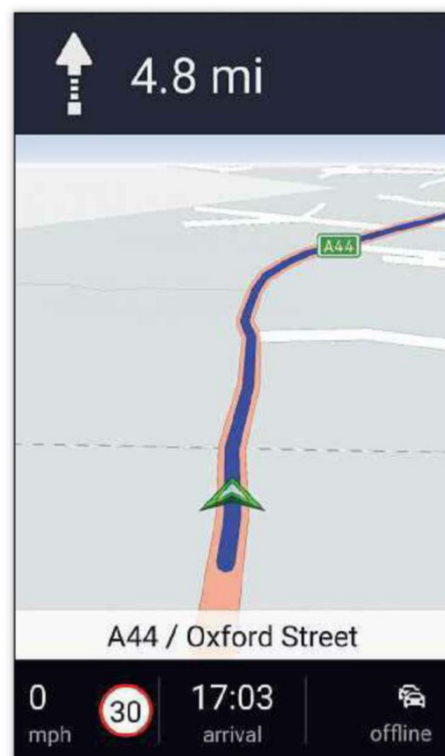
If you're worried about someone nicking your old phone, use Guided Access mode. Search the Settings menu and then assign it a passcode. Launch Presence and triple-press the Home button to lock the phone to this app; a thief will need to enter your Guided Access passcode to even minimise Presence.

DIGITAL MAPBOOK

The great thing about that tatty old Philips mapbook in your car is it doesn't require a fast mobile data connection to turn the page. However, there are free offline map apps that allow you to download maps for the entire country (or the entire world, if you like) at home. You can then search, or even navigate, using these pre-loaded maps as you drive or walk about. And as these maps include the ability to find nearby petrol stations, sights, car parks and cashpoints there's no reason to use a paper map at all.



↑ Don't rely on a flaky mobile data connection for as-you-go maps – use the offline maps app HERE WeGo instead



Other uses for an old phone

Maybe you don't need a surveillance camera or an emergency satnav, but still have an old phone you'd like to use for something? Here are some fun and useful ideas

VIRTUAL WINDOW



If the view from your desk, kitchen or living room isn't particularly inspiring, why not use an old phone or tablet as a virtual window? Install Webcams (by EarthCam) to show a live stream from some of the most amazing webcams in the world. Whether it's Times Square or the Abbey Road zebra crossing, Hawaii surfers or the Aurora Borealis over Iceland, your virtual window is probably an improvement over next door's overgrown back garden.



ALARM CLOCK



There are some clever apps to make waking up more pleasant or more effective. Timely Alarm Clock (Android) has a fade-in for the alarm sound and looks gorgeous. Good Morning Alarm Clock (iOS) uses the microphone of your phone to determine when, within half an hour of your desired wake-up time, you're sleeping lightly and can be wakened most easily.



KITCHEN ASSISTANT



The standard Android interface is a little fiddly to deal with if you're up to your elbows in dough or holding a chicken. Using Nova launcher you can change how your phone's interface looks, arranging icons and making them bigger or placing similar apps in a 'drawer' that pops open when you tap it. A customised phone or tablet can be a useful interactive reference book and entertainment centre.

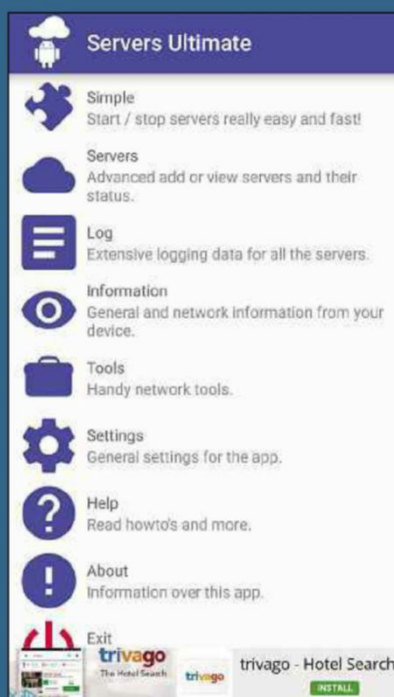


LOW-POWER SERVER

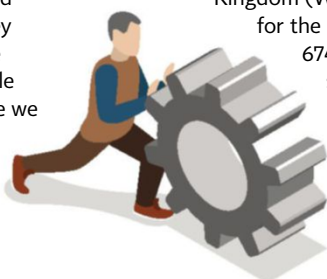


NAS devices are handy things, whether you're streaming video or audio to a smart TV or Wi-Fi speaker or just backing up documents and photos. However, they can cost a couple of hundred quid these days. Why not just use an old phone instead? Install Servers Ultimate and you can do just that.

Tap Simple in the menu to start a DLNA server (to stream media) or an SMB server for files, then download the corresponding free Server Pack add-on and follow the instructions to create your low-power NAS.



Our favourite offline map app is HERE WeGo, a development of Nokia Maps. The app works the same on iOS or Android. We rejected Google Maps' recent offline capabilities as the app only downloads your local area by default; you can download offline maps on a per-journey basis, but essentially Google still thinks we all have reliable 3G/4G reception everywhere we go and unlimited mobile data consumption. Dear Google: we do not.



Once you've downloaded HERE WeGo from the relevant app store, open the menu (the three horizontal lines at the top left) and tap Download maps. Search through the menus to find the maps you want; for example, tap Europe then UK then United Kingdom (Whole area) to download a map for the entire UK. The whole UK map is 674MB, so there should be plenty of space even on a budget handset.

Once downloaded, the crucial setting to enable is Use app offline. Because GPS works whether a phone has a SIM or

not, navigating with HERE WeGo on an old phone works fine. Just add a passcode to your old phone, shut it down and hide it in your glovebox (with its charging cable) and you've got an accurate, searchable map and satnav waiting to go. ☺

NEXT MONTH

MAKE A SMART LIGHT

Say goodbye to toe-stubbing trouble on nocturnal trips to the bathroom with our Arduino-based DIY night-light

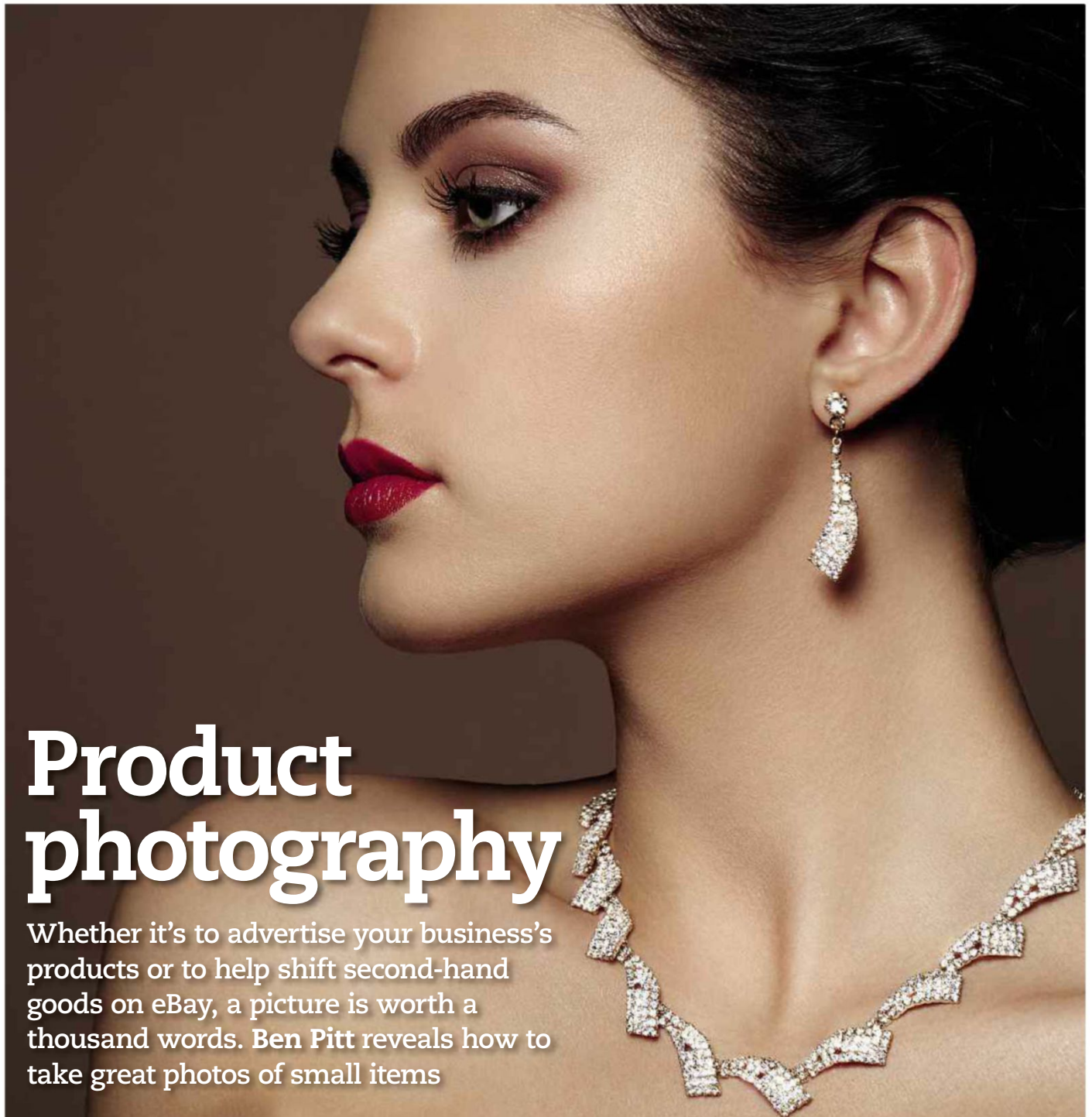
Multimedia Expert

MULTIMEDIA EXPERT

Photographer, musician, sound engineer, designer and video producer **Ben Pitt** guides you through a multimedia project



ben@computershopper.co.uk



Product photography

Whether it's to advertise your business's products or to help shift second-hand goods on eBay, a picture is worth a thousand words. Ben Pitt reveals how to take great photos of small items

TAKE A STROLL around the virtual shopping aisles of eBay, Etsy or Amazon Marketplace and you'll see how important high-quality product photography can be. Attractive photos not only make the product look its best, but also demonstrate that you take customer satisfaction seriously. Poor-quality photos suggest the opposite.

Whether you're selling your old phone, homemade cushions or your company's latest high-tech product, the attractive photos are a crucial part of closing the deal. It doesn't matter how well you've looked after your phone and kept it free from scratches; if the photo looks murky and grubby then everyone will assume the phone is in a similar state.

Not so long ago, consumers had the luxury of visiting a shop, holding products in their hands and inspecting them carefully before buying. With so much retail now happening online, photos have to work that much harder to convince people to part with their cash. Close-ups reveal the texture of fabric and the quality of stitching in clothing. A variety of angles help customers understand exactly what they're buying.

Fortunately, it's not too tricky to produce high-quality images. Whereas most forms of photography involve finding and refining your creative vision, product photography has a much more objective, quantifiable aim. In most cases, the product should look neat, clean and evenly lit. If you want it to be free from distractions you can shoot it on a plain white background. In some cases you might want to shoot it in a more realistic setting, showing how the product is used. These so-called lifestyle shots allow for more artistic licence, but there are still some basic dos and don'ts that are worth following.

PICK A CAMERA

A high-quality camera will make the job easier, but this is an area where a smartphone or cheap compact camera can produce high-quality results. You'll want to avoid grainy noise, though, and that means setting the camera's ISO speed to its lowest setting (which isn't possible with some models) and using some kind of tripod to hold it steady while using a long exposure. Smartphones don't have tripod threads, but you can pick up a basic clamp-style phone-to-tripod adaptor for around £5.

Using a dedicated camera will let you experiment with different zoom positions, and a camera that can shoot in Raw mode will give you more scope to adjust colours on the PC later. A camera with a large sensor will give cleaner images and a shallower depth of field, blurring the background and foreground to draw attention to a particular detail. However, for most types of product shots it's standard practice to keep everything in sharp focus. If you're using a camera with a large sensor you'll need to compensate by using a narrow aperture.



↑ This basic light tent includes diffusing panels to create a soft light that envelops the subject

Smartphones usually have a fixed aperture, but their small sensors mean everything will be in focus when you like it or not.

LIGHTEN UP

Portrait photography uses light and shade to bring out the contours of the face, but for product photography the aim is to bathe the subject in light so there are no harsh shadows. There will always be exceptions, but this is the general rule so let's start here.

There are various ways to achieve this goal. You might do it with natural light through a

window, with lamps or with flashguns.

It's important not to mix your light sources, though. Each type of lighting has a slightly different colour and mixing them will result in odd colour casts. That might be a useful creative effect in other situations, but it doesn't fit in with our aim here of straightforward accuracy.

If you're using natural light, avoid direct sunlight as it creates harsh shadows. Indirect sunlight through a window can work well, though. It's nice and bright, and because the light is passing through a large area – the window – rather than coming from a point source, it creates soft shadows. It will still be darker on the side of the subject that's furthest from the window. This can be brightened by putting something reflective on the opposite side of the subject. White card or tin foil does the job, but you can improvise with whatever you have to hand.

If you're using artificial light, whether it's household lamps, off-camera flashguns or video lights, you'll probably need two or more to get an even distribution of light. We covered off-camera flash in *Multimedia Expert*, *Shopper 349*, so refer back to that article to find out what equipment is involved. For this article we used a couple of household lamps. They're not nearly as bright as flashguns, but that's not a problem when using a tripod and a long exposure. The advantage of a continuous light is that you can preview the effect of moving them around as you compose the shot.

You'll also need a way to diffuse the light so it's coming from all directions rather than from a couple of point sources. Some studio lights come with attachments called softboxes specifically for this purpose. These are pieces of white fabric, usually about 50cm across, which attach to the front of the lights. Rather than



↑ This multicoloured background feels more in keeping with the subject matter for this shot



↑ The photo of a camera was captured using a couple of desk lamps, a piece of curved paper and two sheets of A4 printer paper

the lightbulb itself being the light source, the surface area of the softbox becomes the light source. This is similar to the difference between direct sunlight and indirect sunlight through a window.

Placing two softboxes either side of a subject will give an even, diffused light. The closer you can get them to the subject, the more diffused the light will be. You don't need to illuminate the back of the subject, so it makes sense to bring the softboxes round to the front a little to avoid a band of shadow down the middle of the subject.

If you don't have studio lights and softboxes, there are various DIY alternatives. Sheets of fabric or white tracing paper do a similar job, but be extremely careful not to place hot light bulbs near anything flammable. We used sheets of photocopier paper, which did the job. Folding them into a U shape meant they could be freestanding and placed carefully near the subject. The combination of relatively dim household lamps, paper diffusers, a narrow aperture and low ISO speed resulted in exposure times up to a couple of seconds, but that's not a problem as long as the camera is supported securely.

A lot of product shots are taken on a white background to avoid distractions. Some products, such as jewellery, can be shot from above on a white surface, but for others, you'll need to create an infinity curve. This is where the flat surface that your subject is sitting on curves up at the back to become the wall behind the subject. The easiest way to do this for small items is with a large piece of white paper or card. Hold it in place with a couple of pieces of tape.

Alternatively, invest in a light tent. These resemble small tents and combine softboxes on the sides and roof, a base that curves up towards the back and an opening at the front to poke your lens through. Small light tents

are available from Amazon and elsewhere for as little as £15. They often come with a choice of coloured backgrounds, and some include lights or even incorporate strip lighting into the roof of the tent. A light tent doesn't give you as much control over the quality of light, but it makes it easy to envelope the subject in a soft, even light.

SETTING THE SCENE

Whether you've opted for a light tent, lamps or a window, you'll need plenty of space. Even for small items it's useful to be able to place lamps, diffusers, reflectors and baffles wherever you need them, so having plenty of space around your stage is always helpful.

If you want a plain white background, it's virtually impossible to avoid casting a shadow directly below the subject. That's not necessarily a problem, but if you want to minimise it, try lifting the product a little by placing it on something that won't be visible in the shot. Blu Tack works well, or spools of thread for larger items. Some objects need a bit of help to get them to sit at the correct angle; Blu Tack is great for this, too.

For a more high-tech appearance, rest your product on a sheet of glass or some white Perspex. This has a semi-reflective quality that can add some glossy sophistication to a shot, although it'll suit some products more than others. If you don't want a reflection of the entire product, it's easy enough to fade to white in editing software later.

Some products will look better with a different colour behind them. This is particularly true for products that are predominantly white, which risk getting lost on a white background. Sometimes a white background just seems too sterile. A richer colour can help convey a mood, such as deep red for sensuality and indulgence. Achieving a block coloured background in anything other



↑ A simple infinity curve made from the back of an A2 poster gives a smooth background, but the two lamps have cast shadows and there's not much light on the front of the camera



↑ Introducing diffusers – in this case two sheets of paper – softens the shadows and gives a more even distribution of light



↑ This is the same shot after some enthusiastic editing in Lightroom and Photoshop to get rid of dust spots, adjust colours, selectively darken and lighten certain areas, and convert the background to pure white. We've kept a bit of shadow directly below the camera, though

than white or black is tricky, but there's no harm in having a subtly graduated backdrop from a coloured infinity curve. Two colours – one for the flat surface and another for the wall at the back – can work well, too, but try to pick colours that complement the subject.

Sometimes it's worth injecting some character into shots by incorporating props. The general principle here is to make the product look aspirational, putting it into a setting that would really appeal to potential customers. That might mean showing a bottle of wine next to an elegant wine glass, sat on a table in a fine dining restaurant. It's not so much the look of the bottle that you're selling, but the experience of drinking it. For jewellery, you might show the items being

worn by a model or placed on a rustic table or some luxurious fabric. You don't want the props to detract from the thing you're selling, though. Different types of products lend themselves to different treatments, so search online for other examples and figure out which ones work best and why.

READY TO SHOOT

With your concept pinned down and all the equipment and props in place, it's time to focus on the execution.

Mount your camera on a tripod and set the ISO speed to its minimum value. This is usually 100, but for some cameras it's 125, 160 or 200. Turn on the lights you'll be using, turn off any other lights and close the curtains if necessary. Place some white paper or card in front of the camera and use this to calibrate the manual white balance mode. This tells the camera what colour should appear as white in photos.

Turning off lights won't work if you're using flashguns, as you'll be plunged into darkness. In this case, you can leave other lights on as the flashguns will be far more powerful. Set the white balance to the Flash preset.

If your camera has a large sensor, consider switching to aperture priority and selecting a narrow aperture to keep everything in sharp focus. Higher values mean a narrower aperture, so $f/11$ is a good starting point, but take a test shot and zoom in to check that you're happy with the results.

If you're shooting on a white background, it's likely that the camera will be fooled by the predominance of white and underexpose the



Household lighting and automatic camera settings mean murky colours, blurry details and lots of noise

image. You can address this by adding about +1 EV of exposure compensation. Switch to Raw mode if your camera supports it, as this makes it much easier to apply further changes to exposure levels later on.

Select the self-timer mode with a two-second delay. This is useful for long exposures as it prevents the camera wobbling at the start of the exposure. Adjust the camera's position and the zoom setting so that you have plenty of background; it's easy to crop later, but much harder to extend the background. A wide-angle zoom position exaggerates perspective, which can look dramatic in some



Still the same lighting, but setting the ISO speed to 200, aperture to $f/14$, and exposure compensation to +1 EV improves matters considerably

cases, but more often looks a bit odd. A focal length of around 50mm or longer will give a more natural sense of perspective.

Make sure the autofocus point is lined up with the subject. For bulkier subjects where it's tricky to keep the whole thing in focus, it's worth being strategic about the exact point you focus on; aim for a point that's midway between the furthest and the nearest parts of the subject from the camera.

Make sure the product is clean, especially if it's second-hand. For small subjects, it's amazing how much dust is visible in a photo even when it's barely visible to the naked eye.



No matter how much you clean something, there's always a bit of dust. Luckily it's easy (if not particularly quick) to remove in Lightroom



↑ Two desktop lamps either side of the subject make it more evenly lit, but there are still harsh shadows



↑ Diffusing the light from the lamps (in this case by shining them through pieces of paper) creates a more even light with no discernible shadows



↑ Processing the previous shot in Lightroom gives us our final image

We'll cover how to airbrush dust out below, but it's also worth giving the subject a polish and dust before taking the shot. A soft-haired paintbrush is ideal for the job.

If your subject contains more than one element, take time to arrange it neatly so it forms a satisfying shape. Tidy up any trailing cords, either by curling them out of view around the back or by arranging them as neatly as possible in the composition. It might be helpful to use a bit of tape or Blu Tack to hold things in place, but be careful to keep it obscured from view.

The light sources should be out of the frame, but you may get lens flare if there's a direct line of sight from the light source to the lens. Consider placing something in between the two to block this light. A piece of black card does the trick, but it can get pretty cumbersome with lots of things balanced around the room. Studio photographers use articulated clamps that attach to tripods and go by the name of magic arms. They're available from around £10 from Amazon.

NAILING THE SHOT

It's finally time to take a picture, but the process doesn't end there. Subtle movements of the camera, lamps and diffusers can make a big difference. For shiny objects, keep an eye out for reflections of you and things behind you. Direct reflections of the light source can be a problem as the highlights on the subject become too bright and the details are lost. Moving the lamp or re-angling the subject should provide a workaround.

Professional product photographers will spend a lot of time adjusting the position of each element to create an attractive balance of light and shade across the subject. The general principle is to create an evenly lit shot, but those subtle variations will bring out the shape of the subject. If there's a logo on the product, try to adjust the light and shadows to enhance the contrast in this area.

Small mirrors are useful for throwing some extra light on to a specific area, either because

it's looking a bit gloomy or because you want to draw attention to it. Another trick is to darken the edges of the product so there's a high-contrast outline against the white background. You can achieve this by placing other small objects nearby to cast a shadow. It's a good idea to take about a dozen shots and gradually improve the lighting; the last shot is usually the one you'll end up using.

Once you've got the shot, rotate the product or adjust the camera height and angle to capture it at a different angle. It usually takes at least three shots to give people a clear understanding of what a product looks like. If there's an interesting detail, zoom in or bring the camera in close to pick out that detail. These detail shots sometimes suit a wider aperture with a shallow depth of field, as it focuses the viewer's attention on the specific element you're interested in.

POST PRODUCTION

It's worth getting your image as close as possible to the finished result in camera, but there's lots you can do in software, too. Adobe Lightroom excels for this, but you can use any decent photo editor.

Calibrating the white balance in the camera should get rid of any colour cast, but it's not a bad idea to do it again in software, just to make sure. In Lightroom (or Photoshop Elements' Raw processing module), select the eyedropper tool and click an area that should be white or grey.

Adjust the exposure and contrast levels to produce a punchy, high-contrast image, but try to avoid areas of the subject becoming solid white or black. In Lightroom, boosting the Contrast and Shadows controls often works well. The Clarity control boosts the contrast compared to nearby pixels, but err on the side of caution to avoid it looking artificial. Lightroom's Adjustment Brush is useful for darkening, brightening or boosting the clarity of certain areas of the frame. It's a similar process to placing mirrors and other objects to create highlights and shadows;

doing it for real will look more natural, but simulating it in Lightroom is quick and precise.

Removing dust spots is a slow process but really smartens up a photo. Select Lightroom's Spot Removal Tool or Photoshop's Spot Healing Brush Tool, adjust the brush size to slightly larger than the specks of dust and click on them to remove them. These tools do an excellent job of cloning seamlessly from other parts of the image.

If you've shot on a white background, it can be tricky to make it pure white without also overexposing the highlights on the object itself. Meanwhile, it's almost impossible to completely eliminate shadows below the object. It doesn't really matter if the background is slightly off white, although you may want to achieve consistency across a set of photos.

If you do want a pure white background, the easiest way to achieve this is to cut the image out in Photoshop or Photoshop Elements (Lightroom doesn't support this feature). Use the various selection tools to select the area you want to keep, and then create a mask of the selection using the button in the Layers panel. That way you can add or subtract from the mask rather than permanently delete the background. When creating a block-white background, we prefer to keep a bit of shadow just below the subject to stop it looking like it's floating. You can do this with a soft-edged brush to soften the mask just below the subject.

Finally, export as a high-resolution JPEG, ready to share online or in print. Even if the images will appear quite small on a website, people will want to click to inspect them at a higher resolution. Hopefully they'll be won over by what they see. 📷

NEXT MONTH

VECTOR ILLUSTRATION

Drawing with nodes and curves opens up lots of creative possibilities. We give you the lowdown on what's involved

Zygote

A bank robber's stupidity may have brightened his mood a little, but the prices charged for canine tech devices are enough to get **Zygote** hot under his computerised dog collar

IDENTITY CRISIS

Alvin Lee Neal is a registered sex offender from San Diego, California. He was recently sentenced for walking into a Wells Fargo bank and handing a note to the teller that read, "You're being robbed". He then made off with just over \$500.

The maximum penalty for this crime is 20 years in jail, but the US District Attorney sent him down for less than four. Maybe His Honour felt sorry for him for being so stupid. In order to gain access to the bank counter, Mr Neal had to swipe a smart card through an electronic reader, and log in his name, address and date of birth.

Meanwhile, in the Central Florida District Court, James Leslie Kelly is suing his local computer store. Mr Kelly was in a Verizon IT outlet for 90 minutes when he accessed another man's account and stole \$300 of products and services, for which he was sentenced for grand theft and criminal use of personal information. He is now suing Verizon for negligence because they "missed multiple opportunities to catch him, and failed to stop the identity theft". Being an ambitious sort of chap, he is claiming no less than \$72m.

BOG STANDARD

Madoka Kitamura is president of the Japan Rest Room Industry Association, and he is responsible for making the millions of Japan's computerised toilets as user-friendly as possible.

"We welcome foreign tourists with clean toilets and spread them to the world," says Mr. Kitamura, which is nice, and Zygote is relieved to know that robot toilets will be cleaning up their act. It seems the control panels on Japanese bogs have been far too complex for Westerners to handle, and the various icons and diagrams too impenetrable for us to get to grips with. Which is why they are

now being standardised with a series of simple universal pictograms. After all, how will it be possible to confuse such basic functions as Timer, Audio, Lid Automation, Seat Elevation, Eco Setting, Power Flush, Bowl Clean, Air Dry, Bidet Jet, Temperature and, of course, Stop, for when the sheet hits the pan.

BARKING MAD

The Inupathy dog collar costs £140 and has been developed to allow us humans to better understand canine emotions. The computerised collar is linked to a smartphone app, and displays doggy's heart rate and prevailing mood as a display of blinking lights.

Zygote uses an alternative, lower-priced device, which is known as a dog biscuit. If the dog's tail is wagging, then the mood is good. If the dog's tail is not wagging, it is either asleep or about to rip your face off for forcing it to wear an Inupathy dog collar.

Dog owners can also beautify their pet with a Kérastase intelligent grooming brush, which is a snip at less than £170. It uses sensors, a gyroscope and an accelerometer, and the brush emits bad vibrations if your technique goes awry. It also has a Wi-Fi link to local weather reports so it can monitor wind,

rain, humidity and ultraviolet rays, all vital information to keep your dog's coat looking its best. Sadly, Zygote has discovered that the device is useless at predicting the location of fox poo, which no amount of automated brushing can possibly deal with.

As for canine and human oral hygiene, the toothbrush manufacturer Oral-B offers its Genius smart device to detect which areas of the mouth suffer from neglect. To make it work, users cannot gaze into a mirror, but have to stand facing yet another smartphone app while they brush their teeth, and pay from £110 to £235 for the privilege. This is, to coin a phrase, gobsmacking.

CRASH TEST DUMMY

Self-driving car design has received a shot in the arm. Autonomous auto developers are using OpenAI, a hyper-realistic virtual city that allows robot cars to recognise real-time driving situations. It includes 14 different weather conditions and over 250 types of vehicles, from the latest Tesla Model S to a pushbike. In other words, or in other worlds, new self-driving cars can be tested to destruction without risking life and limb.

And destruction is what it's all about, because the virtual city used in the OpenAI urban

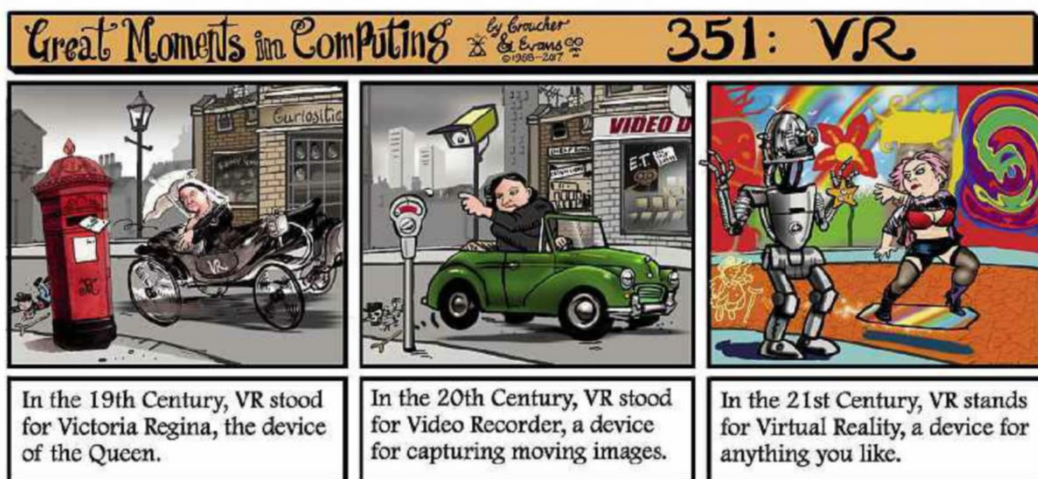
simulation is none other than San Andreas, the ultra-violent environment that was developed for the most expensive video game ever, Grand Theft Auto V.

Zygote awaits news of robot cars following the gameplay and turning into rampaging avengers, homicidal maniacs and sexual deviants, with the excuse that they can't help it because they suffered a deprived childhood and abuse at driving school.

IT'S A GAS

After the unfortunate incidents of last year, Zygote has been afraid to upgrade to the latest Samsung smartphones in case they decide to spontaneously combust. So it is most reassuring to learn that fire-extinguishing materials are to be built in to the next generation of pyromaniac lithium-ion batteries.

The good news is that only a tiny amount of the flame-suppressant compound is needed, so there is a negligible increase in the weight of the smartphone battery. But the bad news is that while doing its job as a fire extinguisher, the triphenyl phosphate polyvinylidene hexafluoropropylene involved gives off an amusing amount of toxic gas. Zygote is happy to have been saved from pants-on-fire syndrome, but may not live to tell the tale. ☑



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