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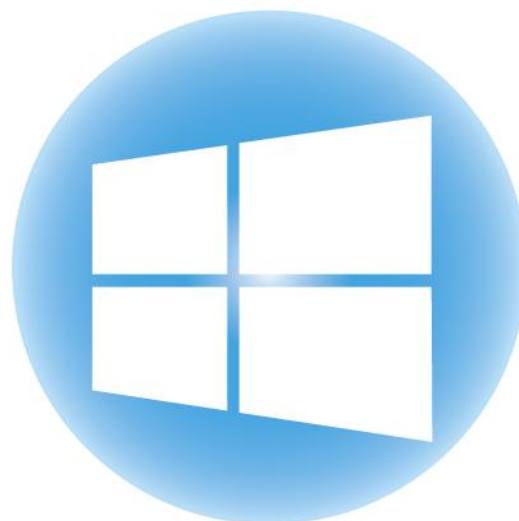
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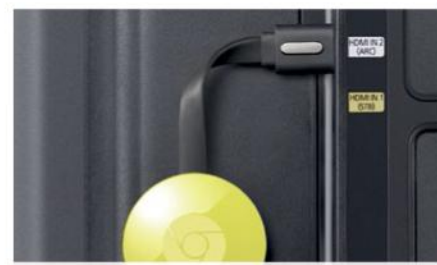
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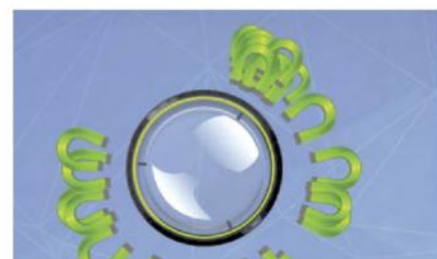
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JELLY ROLLS

of doom

Having just listened to Samsung's report describing the outcome of its investigation into the now famous Galaxy Note 7 faults, it's hard not to be impressed with the thoroughness of the investigation. At its large scale test facility thousands of Note 7's were subjected to testing designed to recreate every conceivable form of electrical abuse. Samsung's new fast charging – an initial suspect in the Note 7 drama – was given the all-clear after testing with a multitude of first and third-party chargers and using varying currents. The Type-C ports was subjected to up to 4000 volts of power during testing.

From these and many more tests it was determined that the Note 7's electronics were not at fault. This left the battery, which may have seemed obvious as the likely culprit but the controlling electronics for such a cutting edge device were just as likely to have played a role, and were equally valid for the thorough testing regime.

I think the big takeaway from all this is the spotlight it shone upon lithium ion batteries as a technology. These power sources will be with us for many years, if not decades. It's Elon Musk's big bet for his Tesla Gigafactory, pumping out lithium ion batteries for cars and Powerwalls. So, if a company with the experience and expertise of Samsung can ship a dangerously faulty battery design in its most premium product, then it's even more likely we will see it happen again from manufacturers with less credibility.

The actual fault stemmed less from sloppy manufacturing than from a push to pack more juice in a smaller form. To meet its target of a 3500mAh capacity yet in a slimmer than ever before battery pack in order

to make the Note 7 as undeniably beautiful as it was, Samsung needed to reinvent the battery manufacturing process. The result was a much thinner separator between the cathode and anode, and it's this separator and the manufacturing process that caused the problems. Lithium ion batteries are produced in a 'jelly roll' construction, which is apparent when you view one side-on, and you can see how the separator is rolled upon itself many times. Overhang at the edges in some units shorted out the battery causing the overheating, and in some cases the thinness of the jelly roll caused spot welds to protrude through the other side of the surface and make contact with the adjacent part of the roll, also causing a short.

I personally find this really interesting because it's not often we get such insight into manufacturing processes. But most of all I'm struck by the potential danger present in all lithium ion batteries – and what worries me is that if a giant like Samsung can encounter these issues then what of the great many cheap batteries made by companies we've never heard of?

Samsung has promised to share its data with the wider industry, and if that helps raise safety standards that's the best thing to come from all of this.



Ben Mansill
Editor

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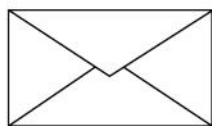
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Write, right?

READER TIP: FREE RESTORE POINT SPACE ON YOUR SYSTEM

Greetings to the PCTA folks. You have helped me and mine several times in the past year. Thank you!

Time to return the favour. I have three PCs: a Venom for gaming, a NUC for experience and this aged Acer used every day for communications. All have SSDs I have installed as the System Drive, essential these days.

Win 10 by default turns off System Restore, but as it has saved me from complete rebuilds on several occasions, I turn it on and allocate 10% of disk space for the function. Having been caught by losing the Operating System AND data during the 'not if but when' reinstall Windows, I generally partition the SSDs for the Operating System and Data in separate drives. Has also saved me a lot of time over the years, but puts space pressure on the smaller SSDs.

I recently encountered the Mystery of the Missing Bytes, and despite cleaning up the disk, the problem remained. Chrome complained it could not update, so time to dig deeper. Only 8GB of the 128GB assigned to the Operating System partition remained.

Typing 'Restore Point' into the Search Box returns the System Setting page, and looking at the Configuration, I found that Win 10 had very generously assigned itself 100% of the disk for saving restore points. I have seen this happen before and suspect a Windows Update resets the allocation. No doubt Microsoft's warped sense of punishment for using System Restore instead of File History. I use both, AND backup to a NAS. The result was that as I used my Acer daily, it accumulated a huge repository of Restore Points.

So, time for the suppository to clear out the excessive System Restore

data. As always, it is buried but easily accessible. Using File Explorer, open Properties on the System Disc, Access Disk Cleanup and after it does its stuff, choose the Cleanup System Files and after that is done, Open the More Options tab, choose the option to delete all System Restore files except the latest. Let it run, but if you have not used Disk Cleanup for a while, or never, it can take hours. I have also had it do the job, but not close at the end. Cancel and rerun to confirm the cleanup.

OK, System Restore files are gone. Now go back to the search box and ask for Restore point. In the settings page, open Configuration and set the disk allocation to how much you are prepared to assign to this function – 10% in my case. While there, create a Restore Point as your computer should be working properly, and is a known place to return to in case of a problem.

How well did it work? In this instance, I now have 69 GB free on the Operating System partition. Chrome is happy and so am I.

I would recommend using Windows Disk Cleanup like this after major Windows updates. I'm a great fan of CCleaner, but it does not clean out the Windows System files.

There is another Microsoft 'Easter Egg' embedded in Disk Cleanup - it often advises me that 3.9 or 4.0 TB of System Files will be released. I wish! Still, it works, even with clunky hangs.

Chris Mills

Ben Mansill replies: *Nice tip, thanks for sharing that with us Chris! We have a few tips ourselves in this issue covering Windows Update, and how to get it behaving as you'd like. That starts on page 30.*

A MATTER OF BALANCE

Jon Honeyball it at it again, with his views on windows touchscreens. (PC & Tech Authority Feb 2017). Maybe his laptop has weak hinges that move when he pokes the screen, but if he poked his phone with the same force perhaps it would fall to the ground? I use Windows 10 touchscreens on my Surface Pro 3, 20-inch HP all in ones on the walls at work, and on my Asus 16-inch ultrabook.

I admit on the Ultrabook the screen moves a little, but you have to get used to touching not poking or prodding with force. The Surface Pro 3 with kickstand doesn't move at all, neither do the all in ones. I suppose with keyboard and mouse it is not ergonomic to use three input methods (keyboard, mouse and touchscreen) as you have only two hands, but when in desktop mode all three devices work fine with keyboard and mouse, when in tablet mode, touch is also fine, giving best of all worlds.

The pen that comes with the Surface Pro 3 is fantastic, aftermarket pens for Windows touchscreens are readily available. Try it!

He also mentions the eye watering prices of some new laptops by Microsoft and Apple. My Surface Pro 3 is the 128GB core i5 model which now has a Samsung Pro 256GB microSD card in it, more than fast enough and storage enough. Its main limitation is the low powered USB port, but I obtained a USB 3 Y adapter from Germany and can now connect any USB powered device including 1.5TB hard drives.

Philip Dawson

Ben Mansill replies: *I, too, am a fan of the Surface's kickstand, as are many competing tech manufacturers if you look at how many clones are appearing.*

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TECH NEWS

The latest trends and products in the world of technology

WINDOWS REARMED FOR HYBRID ASSAULT

Windows is back on ARM architecture, but can Microsoft get it right at the second attempt?

Microsoft will rekindle its attempts to use ARM-based chips for Windows devices following a deal with Qualcomm that it says will enable “cellular PCs” to run a full range of Windows software.

Microsoft’s previous attempts to engage with ARM have proved little more than disastrous. Windows RT was widely shunned by manufacturers, after consumers were left bewildered by early devices’ inability to run x86 software. ARM-based phones also power Windows Mobile, but its market share has dwindled to the brink of non-existence.

Seemingly learning from past failures, Microsoft is pushing the fact that its latest ARM venture will embrace legacy Windows software. “For the first time, customers will be able to experience the Windows they know with the apps, peripherals and enterprise capabilities they require, on a truly mobile, power-efficient, always-connected cellular PC,” the company said in a statement.

PCs powered by Snapdragon could be designed to support x86 Win32 and Universal Windows apps, including Adobe Photoshop, Microsoft Office and Windows 10 gaming titles.

However, experts believe that the world has already moved on from Microsoft’s legacy apps, which may make the chief selling point redundant. “I’m not convinced this is as desirable as people think,” said Michael Cherry, lead analyst for Windows and mobile at research firm Directions on Microsoft. “How useful is running Photoshop on a small, touch-enabled device? Maybe when docked and using Continuum this might be useful, but it’s all theoretical at this point.

“The real question is, outside of the Office suite, how many x86 Win32 apps are you still using today? Did you even consider a device’s ability to do this the



last time you bought a phone or tablet?”

Microsoft did rebuild its own Office apps for Windows RT, but that wasn’t enough to win over customers before RT versions of the Surface tablet were quietly dropped with the launch of the third-generation devices in 2014.

EMULATION OVERHEADS

As x86 software will need to run through

▲ If powered by Snapdragon, PCs could support x86 Win32 and Universal apps

an emulator, there are concerns that the applications will struggle to run smoothly on the mobile-orientated processors, even on the powerful Snapdragon 835 chips expected in devices. “Emulation of Windows Apps hasn’t been particularly successful,” said Cherry. “Windows has a HAL [hardware abstraction layer], which

HAVEN’T WE BEEN HERE BEFORE?

When Windows RT was announced at the Consumer Electronics Show in 2011, then-CEO Steve Ballmer promised that the operating system would “be everywhere, on every kind of device, without compromise”. Alas, it turned out to be on virtually no devices and with plenty of compromises.

Soon after RT devices went on sale in late 2012, reports emerged of high return rates at retailers, as customers not only struggled to get to grips with the new Modern interface, but failed to realise that their new “Windows” tablet couldn’t run traditional Windows software. Microsoft promised its own store staff an average of 15 hours of training prior to the launch of Windows 8 and RT to ensure that they could help customers understand the difference between the two. If it took that long to explain it to staff, little wonder customers were left confused...

Since Windows 10, RT has been left to drift. Elements of the Windows 10 Start menu were ported to Windows RT, but it hasn’t received any big updates in the past 18 months. Now we know why.



“The plans could lead to new form factors as Microsoft seeks partners to make PCs more like phones”

has allowed it to be ported to DEC Alpha, PowerPC, MIPS and ARM chips. Many of these used emulation to support legacy apps. How many are in use today?

“Emulation essentially means the OS will pretend to be something else in order to run applications. There will be incompatibilities that will take processing power to push through. It will likely only ever be sort of as good as running the apps natively. [It’s] never likely to be better than native.”

While we won’t know for sure whether these fears are justified until devices appear, Qualcomm says the chips designed for Windows will boast low-power consumption, LTE connectivity, advanced multimedia support and thin, fanless designs.

NEW FORM FACTORS

The plans could lead to new form factors, as Microsoft seeks partners to make PCs more like phones. “Partners will be able to build always-connected devices without hindering form-factor design,” said Microsoft. “Specifically, partners can take advantage of eSIM technology to build devices without an exposed SIM slot, making it easier for people to activate a data plan right on their device.”

That may ease some of the pain for Microsoft as people move away from traditional PCs. “It will be important for the diversifying categories of ‘post-PC’ devices,” said Caroline Gabriel, research director at the Rethink Technology Research. “These are taking on many of the roles of the traditional PC, as that enters its long, slow decline, and so they’re often still reliant on core Windows apps such as Office.”

“The unexpected success of Microsoft’s more recent Surface model shows that Windows still has an embedded advantage in many markets, particularly enterprise ones. But to secure itself mobile success at long last, at least on larger-screened devices,

Windows must have a wide variety of products on offer, not just the Surface and a few convertibles.”

The first PCs running Windows 10 based on Snapdragon processors are expected to go on sale in 2017. ●

CORRECTION

We reviewed Fractal’s lovely new Define C case in PC&TA 230, but mistakenly ran a picture of an older Fractal case. Bad on us. Here’s the right picture. The reviewer also gave the Define C a Recommended award but that wasn’t shown on the review page. More bad. Sorry readers! Sorry Fractal!



FOUR STORIES NOT TO MISS

1 CORTANA TO GET AN OVERHAUL

Microsoft is set to push its Cortana digital assistant into more devices. Cortana will be used to power Amazon Echo-like speaker systems, and could be rolled out in embedded applications such as customer-facing sales systems. A revamped Cortana could also be voice-activated on sleeping hardware.



2 FITBIT PICKS UP BEACHED PEBBLE

Parts of smartwatch firm Pebble have been sold to Fitbit for around US\$40m. The company has stopped shipping hardware, cancelled warranties and may end support for existing hardware, angering its Kickstarter backers.

3 GOOGLE TAKES WRAPS OFF IOT OS

Google has announced Android Things, a version of the OS designed for low-end hardware – upgrading a project

previously called Brillo. It should enable developers to build smart devices using Android APIs and Google Services, with support for Intel’s Edison, the Raspberry Pi 3 and NXP Pico. It also aims to resolve some of the glaring IoT security issues.



4 FACEBOOK EYES CHINA WITH CENSORING SOFTWARE

Facebook has developed a tool that could be used to pre-filter content in China. Facebook, which said it was unable to filter fake news during the US election, would be able to suppress content that would otherwise see it blocked by China’s Great Firewall.



GAMING NEWS

Just for the fun of it

CLONE WARS

Cheap Chinese VR is coming. Ben Mansill balances reward with frustration



At last year's Computex, VR was the be all and end all. It was everywhere, and 'VR Ready' danglers hung off everything from graphics cards (to be expected), to NAS products (whaa...?). But at the heart of it all was Oculus and Vive. A few exhibitors had lesser players on display – we saw a couple of OSVR prototypes, and not much else. Clearly with VR the potential is huge for sales, so it was no surprise to hear from industry people that when China surges into VR everything will change.

And it has, and here it is, now. Prowling through the VR product pages of Gearbest – a Chinese company that sells PC gear and consumer electronics on behalf of local brands, as well as its own – not dissimilar to Alibaba's model – there are dozens of VR HMDs (Head Mounted Displays) on offer. However, almost all are not compatible with Oculus, Vive or Steam VR. They are intended for movie watching. A browse through the online movie store for one brand revealed exactly what sort of movies. Of around 150 movies available from this shop, 149 were Japanese girls dancing, and one of a young man working out in a gym. Yep. No comment here on that is necessary.

But moving past that, if we can, is the expected emergence of Chinese VR HMDs that are actually game-capable.

That's happening now, and while there are only two HMDs of the dozens on sale that support Steam VR, one of these warranted further investigation. Thus, I have in front of me a Pimax 4K UHD HMD. It only arrived yesterday and I spent close to five hours last night having a play – and by that, I mean struggling to get it working. I'll have a full review in the next issue of PCTA and

“a huge advantage over the Vive and Rift – and that's not the 4K. It's the price. \$505”

I sure am looking forward to getting it working properly because the potential is great.

As you can tell by the product name, it's 4k. This is the big thing. If you've ever used a Vive or Rift the resolution is immediately apparent as the big issue.

While Full HD resolution is enough to create presence in a virtual world, you can see big lumpy pixels, which isn't nice for reading small text or seeing crisp detail in the distance. I

like racing sims, but as cool

as Oculus and Vive are for this kind of gaming, looking ahead to oncoming corners presents a mush of fuzz – not the sharp clear

track edges you need.

The Pimax screens deliver 3840 x 2160 res, but at 60Hz, compared to 90Hz for Vive and Rift. After hour four, when I was finally successful getting a game running, that may not be a problem. I need to do further experimentation but having a much higher resolution screen is a reasonable payoff for the lower refresh. That won't hold true of all games, but for 'cockpit games' where your viewpoint is relatively stationary it doesn't – initially at least – appear to be a problem. But, to get to that res and refresh some cheats are required, namely supersampling the res via Nvidia or AMD controls because the Pimax 4k uses an HDMI 1.4 cable for connectivity, which limits the refresh rate to a wholly unacceptable 30Hz when running 'true' 4K.

The Pimax lacks positional tracking and hand wands, so at this stage is useless as a Vive clone – it's better for sitting down games, and those which don't need you to move your head around. View is, of course, still tracked.

So it's technically interesting and a good first step, but despite its shortcomings still has one huge advantage over the Vive and Rift – and that's not the 4K. It's the price. \$505. That's well under half the price of the mainstream HMDs. Yes, the software is crude, and there's currently no way to center the view in game (though after an email I sent to the company they promised to include that in the next software version!). Testing this thing looks to be quite a project. But when China gets the game compatibility right it will herald a new era in VR. Full review next issue!





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CHIP NEWS

With the cost of Fiji being so cheap AMD is going all in on Vegas, meanwhile Pentium gives us a reason to care again. **Mark Williams** looks at what's new in the world of chip news

CPU

PENTIUM GETS EXCITING AGAIN

With the seventh Intel core series having launched some might consider the i3 7350K to be the shiny new star in Intel's line-up. An i3 that's finally unlocked? It

certainly gets the blood pumping, but at the cost of \$270 it still isn't cheap.

Instead, consider the new Pentium G4560 or G4620. "Why would I possibly consider those?" I hear you scoff? Well, both cost less than \$100 and both now

come with hyperthreading, putting them into i3 territory. So, if budget or TDP is of concern in your next build don't be afraid to check out the new Pentium line-up.

GPU

PRO DUO DROPPED ON PURPOSE

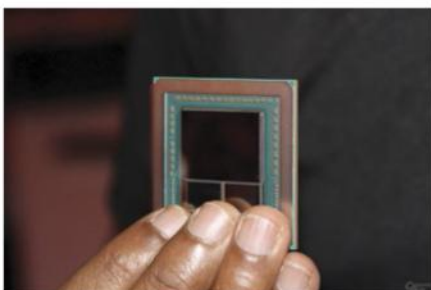
AMD's current prosumer product; the dual Fiji GPU Radeon Pro Duo, with no forewarning or notice from AMD has dropped in price from its launch price of US\$1500 down to just US\$800.

With Vega so close to launching (current word is it'll happen at the upcoming Game Developers Conference) it seems clear AMD is trying to either clear out stock for the new offerings or because of relative performances needs to lower the price of this product to match the capabilities of what it can do versus the upcoming Vega line-up.

AMD'S GOING TO VEGAS

At CES AMD released some more information about Vega and the all new architecture it's based on, plus we also got our first glimpse of what the Vega GPU physically looks like including the on board HBM2 memory chips. There was also a Vega card in a demonstration system which someone managed to convince AMD to take the side panel off from revealing a bland looking Radeon card that was clearly just a prototype as it unusually had a USB3 port

▼ The Vega GPU (with two HBM2 stacks)



directly on the card along with some extraneous circuitry which was explained as a connector for engineers to access special measurements and readouts on the prototype Vega card for diagnostics.

As for what AMD disclosed at the event, it was all very high level hand wavy stuff with not many hard numbers, but intriguing none the less.

The biggest feature AMD were touting is the High Bandwidth Cache Controller (HBCC). The best way to think of this is how IGPs or entry level graphics cards work with memory, i.e. they basically rely solely on system RAM for their pool of memory as they have no or very little dedicated VRAM. AMD's HBCC takes this to the next level but for top end cards too, allowing Vega to not only use VRAM and system RAM for graphics data sets but even also allowing access to mass storage like SSDs or network storage with the total combined addressable allocation space reaching 512TB!

Sure, games won't need that kind of memory space any time soon but in the professional sector where FirePro's and Quadro's thrive, this could be a

▼ AMD's prototype Vega card in a demo PC at CES



game changer and kind of ruins the need for AMD's very own SSG range of professional cards it launched not long ago (the ones with an SSD piggybacked onto the card).

AMD also revealed that it has reworked the geometry pipeline, giving it double the performance. Much needed as AMD has always lagged behind Nvidia on the geometry front, particularly when it comes to tessellation.

The compute units (CU's) have also had a complete rework and renamed NCU's (Next-gen CU's). The new NCU's can operate at higher clock speeds and have higher IPC throughputs relative to the current gen CU's. The NCU's double precision rates will also be configurable, ranging from 512 8-bit ops per clock through to 128 32-bit ops per clock.

The last thing of note architecturally is that the ROPs will now be direct clients of the L2 cache which in particular will boost performance in games that use deferred shading.

The last bit of Vega news is slightly old but wasn't leaked until recently. Leaked roadmaps from September last year have given us a peak at what AMD's GPU future holds. Apparently, Polaris (aka RX460/480) isn't long for this world with Vega 11 replacement cards due this year, and beyond that Navi 11 in 2019.

The second half of this year will also see a dual GPU Vega card, presumably to replace the Radeon Pro Duo.

2018 is when things get interesting again with allegedly Vega 20 due in that time frame sporting a GPU made on a 7nm process, PCIe 4.0, double the amount of HBM2 stacks and some new tech for Crossfire GPU to GPU communications.

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MOST WANTED

Get your gear on



Dr Zaber SENTRY Console-sized PC

We love super-compact PCs that can still take a proper GPU. Most go for a cube shape or look like a NAS of some kind. The Sentry mimics a games console, and is deliberately designed to slot effortlessly into an existing home theatre setup.

MOST WANTED: The Sentry will take a full-sized (double-slot) mid-range GPU and a power supply big enough to power it. The interior layout is extremely compact, but also straightforward to work inside, making upgrades easy. Cleverly, the GPU is separated from the mini-ITX motherboard, which helps with heat management.

NOT WANTED: The compact size means the CPU will need a low-profile active cooler, which will make the system relatively noisy. In horizontal configuration, the Sentry needs a blower-style GPU cooler too. But if positioned vertically, the position of the GPU makes it virtually an "open case" design, so a three-fan cooler will be much quieter. Despite a self-supporting frame design, noise from fans is likely to be the Sentry's biggest flaw.

Hardlight VR Suit

The extremely valid complaint that a VR headset ain't all that great unless you also get hand controls is well understood. But is even having hand controls enough? The Hardlight Suit (vest and sleeves, really) provides both location-specific haptic feedback and position tracking for the upper body. It's compatible with the major VR headsets and has its own API for developers.

MOST WANTED: A headset-only VR system can at times feel like not much more than playing games on a really, really big screen (while wearing a snorkelling mask). The ability to look in one direction, shoot in another and feel hits or environmental effects from a third would do much to boost immersion.

NOT WANTED: Be honest: it looks a bit laser-tag. The relatively bulky design is likely to cause fatigue after extended sessions, and the sleeves look prone to twisting and tangling. It also needs developers to build compatibility for it in their games, which is a big ask.

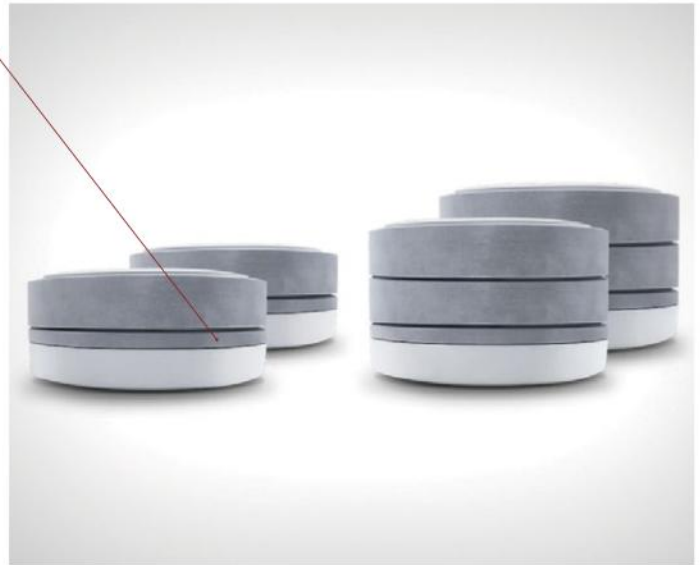


Daplie Cloud

Most of us put all our documents and photos up on the cloud without a second thought. But maybe a second thought is warranted; after all, Google could pull the plug on Photos any time it wants. Then what? Daplie's The Cloud is a compact "home server" that comes with a personal domain and "plug and play" simplicity. To expand storage, just add more servers.

MOST WANTED: The Cloud comes in 1TB or 4TB units and links to other Clouds to expand space. Similarly, it can link to a Cloud in a different location to provide a backup.

NOT WANTED: Your files are vulnerable to the failure of the unit and there's a yearly fee to pay for a "personal domain" - ie the web address that lets you access the Cloud when you're out of the house. Of course, this does mean your files are truly private, unlike the "free" web access that comes with some NAS products, which is still ultimately controlled by the manufacturer.



Compower Compact AC Power Bank

Face it: you need a good quality power pack for your devices. It's not up for debate. This is the world now, and a bang full of electricity is just a necessity. The problem? Device-specific powerbanks mean carrying multiple batteries. The solution? A 22,000 mAh power pack that can charge anything and everything. And we mean everything.

MOST WANTED: The range of outputs on the Compower is impressive. DC, AC (up to 100W), four USB3.0 ports with different amperages, a USB3.0 port, a dedicated plug to attach jumper cables to start a car, even wireless charging. It's all here, and can all be monitored on the LCD display.

NOT WANTED: It is a bit of a brick at 950g, but that's the reality of 22,000mAh of power. Obviously recharging it will take a while, and there are four 5500mAh in the cell, so it relies heavily on proper cell management to prevent failure.

Moodo

Feel like your Wi-Fi isn't being fully utilised? Worried your smart speakers and smart LED bulbs and smart lock and smart AC aren't enough? Then you need Moodo! It's a Wi-Fi enabled, app controlled ambient scent generator! That's right, pop in little perfume capsules and make your house smell like... things. There's science that says ambient scent affects your mood, so why not see if that's true?

MOST WANTED: In a way that's vaguely reminiscent of Nestlé's pod-based coffee system, Moodo uses pods with names like "Divine Rose" and "Midnight Thrill" which are grouped into scent themes like "Gardens of Isphahan" (no, really) and "Oriental Delight" and "Beach Party" and "Fresh Vibrations". And imagine explaining this thing to guests!

NO WANTED: Imagine having to explain this thing to guests! Moodo is a good example of the app-ification of something that already exists in a simple, cheap and easy-to-access form, ie scented oil burners and incense sticks.



System news

MARK WILLIAMS PONDERES SOME OF THE LATEST TECH TO COME OUT OF CES

With CES having just wrapped up I wanted to cover some of the products and technologies that caught my attention. Interestingly it all seemed to revolve around displays for me, and it seems all the new screen tech also got John from TI computers excited. We'll have some more complete coverage of CES for you to drool over next issue.

First cab off the rank is Razer. It's been known to embark on some crazy and whacky product ideas in the past and this year was no different.

Project Ariana is a projector that Razer has developed as the next step in their Chroma (synchronised RGB lighting) technology. In a nutshell, using your regular monitor as your central viewport, the Ariana projector effectively expands your viewing real estate onto the walls and general surroundings turning your effective screen real-estate into a whole wall. But with the monitor in the centre you still get the fine granular details with the projection all around it giving you a handy peripheral vision advantage.

Razer's other cool toy was so popular that someone managed to steal both prototypes from under Razer's noses on the show floor and were both found in China two days later up for action to the tune of \$22,000! I'm talking of course about Razer's Project Valerie which is the world's first triple screen laptop. Offering up a triple 4K (yes,

12K!) viewing experience with two side monitors that automatically deploy and retract back behind the central screen. It is a site to behold.

The Sony A1 series Bravia TV was also something that caught my attention. And not because of the amazing bezel-less OLED panel or the fact that it has two separate processors, one dedicated to running the Android OS and the other for simply driving the display which adapts to (as every panel out of the factory has slight variances) and corrects the output image per its panels detected output. No, it was the fact that it has no speakers! Well I lie, it has a subwoofer in the stand, but aside from your bass sounds, all the audio comes through the glass of the TV screen itself. It manages this by using two sets of vibrating actuators (for stereo) behind the panel to vibrate the panel to produce sound you can hear.

By no means is this new technology, I have previously bought a family member a gift that was basically a cylinder you put on any surface you liked; wood, metal, glass, tile, and using vibrations would play your music using that surface as the speaker, with different materials giving the music differing timbres. But seeing it applied in a TV is a rather neat idea as the whole glass panel becomes the speaker allowing Sony to completely remove the sound bar where the speakers normally hide (for a totally bezel-less design).

SHOP TALK

What new products or technologies got you excited from this year's CES show?

John, TI Computers:

"This would have to be the new gaming displays. Not only they have the dramatic breakthrough to enter 144Hz refreshment rate on the 4K UHD displays, the development of VR gears has also gone wireless and even up to the massive 8K combined resolution. Definitely something gamers will be very excited about. Display technology wise, we have noticed the new FreeSync 2 Technology by AMD that brings better HDR experience and smoother tearing-free gaming experience even with a more mainstream GPU. Last and not the least is of course the synchronized AURA RGB effects from all vendors. These new technologies give us more flexibility to prepare our gaming systems to our hardcore gamer customers. I can foresee 2017 to be a very good year for the desktop PC

Lastly there's the Asus ROG Swift PG258Q, which along with the Benq we are reviewing on page 50, hits 240Hz refresh rates. Sure, it's only a TN panel, and only 1080p resolution, but that buttery smoothness even with G-sync off stands in a class of its own, well above your standard variable refresh rate 144MHz gaming screens.

> Like the look of this? Someone *really* did, and stole this, and another triple-screen prototype gaming laptop from the Razer stand at CES



Market snapshot

A SAMPLING OF PC SYSTEMS AVAILABLE THIS MONTH

Decent home box

PLE Computers Home Premium Custom PC

\$1,199 • <http://tinyurl.com/zlyp3vk>

During the Skylake to Kabylake transition period you'll see some previous gen systems still offered along with the newest generation. This is one of those cases. While PLE offer a similar system to this but with a new Kabylake i3 7100 CPU, this system looks to be the slightly better deal. Sure, the i3 7100 is 5% faster but you'll pay \$50 more for it and end up with a system that has half the SSD capacity. On the other hand, the motherboard on PLE's Kabylake offering might set you up better for the long term. Either way both are closely matched and a good option for use as the family computer or light gaming. With CPU and GPU well matched the only outlier is mass storage.



KEY SPECS

CPU: Intel i3 6100 • **Cooler:** OEM • **Motherboard:** Asus H110M-E • **Graphics:** ASUS GeForce GTX1050 2GB • **Memory:** 8GB DDR4 Kingston ValueRAM 2133MHz • **Storage:** Samsung 850 EVO 250GB SSD, Western Digital Blue 1TB HDD • **Power Supply:** FSP Raider Edition 450W • **Case:** Fractal Design Core 1000

A balanced build

TI Computers Deluxe Gaming 7700K

\$1,999 • <http://tinyurl.com/zx6a8ol>

One of the first PCs to roll out with a Kabylake generation CPU, and comes pre-overclocked to boot! This is a very solid system as a base to build up upon over time. Although the GPU isn't the highest end, for 1080p gaming it'll rock your socks easily. And that motherboard, Optane ready and even has a DVI port out the rear IO panel, you don't see that too often despite being probably the most used connector around still, good thinking Asus.

Well-proportioned memory and storage round out this very competitive system.



KEY SPECS

CPU: Intel i7 7700K @ 4.6GHz OC • **Cooler:** Noctua D15 • **Motherboard:** Asus Prime Z270-P • **Graphics:** Asus GeForce GTX 1060 • **Memory:** 16GB DDR4 2133MHz • **Storage:** 256GB Intel SSD, 1TB HDD 7200rpm • **Power Supply:** Cooler Master 750W • **Case:** Cooler Master CM693

Solid

NetPlus Micro Computers GExpert Pro Computer Package

\$2,249 • <http://tinyurl.com/zvy3wld>

This is a complete system package which aside from the system box includes a 24-inch monitor plus a wireless keyboard and mouse combo. The system box has some respectable specs to get your gaming on too, we recommend choosing the i5 6600K CPU option, just as fast as the non-K i7 6700 but has unlocked multipliers to push it to higher speeds than the i7 6700.

RAM and the HDD are sized ok for the price however the SSD for the operating system at 128GB is a little anaemic, games would pretty much have to live on the HDD. Aside from that one limiter this is an otherwise solid system.



KEY SPECS

CPU: Intel i5 6600K • **Cooler:** OEM • **Motherboard:** Z170 based • **Graphics:** Nvidia GTX 1060 3GB • **Memory:** 16GB DDR4 2133MHz • **Storage:** 120GB SSD, 1TB HDD • **Power Supply:** CoolerMaster B700 v2 700W • **Case:** CoolerMaster

To infinity!

Scorptec Infinity 1080 Gaming PC

\$3,349 • <http://tinyurl.com/zgt58qh>

I. Love. This. Case. The semitransparent mirror thing going on at the front with the LEDs is simply mesmerising. If you can tear yourself away from the hypnotic front end, the guts of this thing are equally mesmerising. Sporting the new top end i7 7700K and a Z270 motherboard that supports Intel's upcoming Optane SSD tech you'll be set for a long time to come. It also comes with RAM that has a bit of overclocking overhead if you're so inclined. The SSD while great can be temperamental due to the small SLC cache it needs to push everything through which will show if you do large writes often. Apart from that minor detail, with water cooling and a GTX 1080 for butter smooth frame rates you can't ask for much more.



KEY SPECS

CPU: Intel i7 7700K • **Cooler:** Corsair H115i • **Motherboard:** MSI Z270 KRAIT GAMING • **Graphics:** MSI GeForce GTX 1080 SEA HAWK X, 8GB • **Memory:** Corsair Vengeance LPX 16GB 2666MHz DDR4 • **Storage:** Intel 600P Series 512GB SSD • **Power Supply:** In Win Classic 750W • **Case:** In Win 805 Infinity Black

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SOFTWARE LICENSING AND FORCED UPGRADES

A PCTA readers discovers that the software he bought is not what the developers want him to use



Have you been caught using a version of a favourite application and found, when you needed some technical support, that your software was no longer supported or that you were pushed into an upgrade?

One of our readers, David, hit some of these issues recently. David is a retired specialist adult educator who still works with people who have acquired or congenital brain injury. He gives his programs to clients for free.

INSTALLING AN OLD VERSION

David purchased a programming language called LiveCode some time. After some initial issues, he settled on version 5.5.5 which overcame the bugs he found in the original version he purchased.

When version 6 was introduced, he installed a trial version but as he didn't need the new features he removed it only to find his version 5.5.5 installation had vanished. After some effort, the LiveCode developers provided him with a password that would allow him to reinstall the version he had already purchased.

A few months Later, David's hard drive failed and he needed to reinstall LiveCode but the password he had would not work. He emailed them and asked them for a new one explaining that he did not need the more recent version. Instead they sent him an email charging \$500.00 for the latest version and offering to make it a lifelong offer.

The full price for LiveCode which is now at version 9, to independent developers, is US\$999 per year.

Requests to simply be allowed to install version 5.5.5 were ignored. However, versions going back as far as 4.5, through to developer previews of version 9 are available from LiveCode's website. What makes this even more annoying is that since version 6, LiveCode is also available as free and open source software. So, an upgrade could be free and not require

“LiveCode’s developers have destroyed some of his work. He saw this happen before his eyes”

any payment for David as he gives his software away for free.

It would have been nice if LiveCode's support people had made David aware of this option.

With critical applications, my advice is to make sure you have a robust backup and recovery process in place. In my view, that means taking system images at regular intervals so you can reinstate an entire system quickly or, in some cases, work from a bootable external drive.

My suspicion is a block-level image of the original hard drive, restored to the new disk when it was installed, would have overcome the poor service given by LiveCode's support.

But that's of little consolation to David.

IT GETS WORSE...

When David installed version 5.5.5 he had it on both his main computer and a laptop. Fortunately, he still had a working installation to fall back on. Or so he

thought. “Some years ago, I gave them permission to enter my computer to help me set up a training course they were running. When I finished it I thought that they were now blocked out. So, I resorted to my laptop and the version there. It had worked well for years but now I found that programmes I had written and got working well, would no longer work,” said David.

He says LiveCode's developers have destroyed some of his work. He even saw some this happen before his eyes as variables were blocked and other features he'd developed changed right in front of him.

My advice regarding backups stands and I'd be very wary of granting anyone access to my computer remotely.

We all become attached to specific versions of software or applications. “Progress” marches on and developers cajole or thrust us onwards to newer versions so they aren't caught supported legacy software.

The good news is virtualisation software is relatively inexpensive these days so it's possible to create a virtual machine to run a specific program. Virtual machines can also be transferred from computer to computer easily so hardware upgrades can be less painful.

David's closing words: “My advice to businesses, individuals, schools and universities is don't have anything to do with LiveCode. I'm now looking around for another language to use”.

NEED HELP? EVER HAD AN ISSUE AS A CONSUMER? INVESTIGATOR CAN HELP.

If you've had an issue or had something happen and you think investigator could help, email your problem to investigator@pcandtechauthority.com.au



Anthony Caruana

has worked for almost every major masthead in the Australian IT press. As an experienced IT professional – having worked as the lead IT executive in several businesses, he brings a unique insight to his reporting of IT for both businesses and consumers.

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“My new favourite business acronym, it stands for Highest Paid Person’s Opinion”

products including Intel’s own Nervana platform providing libraries to stimulate AI development, while the barrier to entry is so low now that anyone with a credit card can tap into cloud-based AI computing resources to develop their own products.

They keynote by Andrew McAfee, co-director of the MIT Initiative on the Digital Economy and principal research scientist at MIT’s Sloan School of Management, struck a chord when he talked about the impact of technological change on society, particularly with automation, and that “the big job losses have been in the middle and we’re seeing a real expression of dissatisfaction by people feeling marginalised and left out. This presents a real challenge for a healthy and democratic society and it’s a trend we need to be worried about.”

He also introduced the term HIPPO, observing that “in most organisations, a lot of the decisions are made by HIPPOs. This is actually my new favourite business acronym. It stands for Highest Paid Person’s Opinion. And it is honestly how most business decisions get made.”

HIPPOs, he explained, considered research and numbers and then made a decision based on this combined with experience, gut, and deep intuition. But, he continued, “the HIPPO has a mortal enemy in the business world. It’s the geek. One thing about geeks, they go where the evidence takes them. The hard homework for a geek is to get their personal judgement, intuition, beliefs and biases out of the equation and just try very hard to listen to the data, and to go where the data is taking them.”

This, McAfee said, created less hierarchical and more egalitarian organisations when geeks were at the helm, taking bold chances based on evidence and data and bringing people along for the ride, something exemplified by the Larry Page, Sergey Brin, and Elon Musks of this world.

So don’t give up hope fellow geeks, we will inherit the earth, eventually.

You can read more about Reimagination at reimagination16.acs.org.au, and look out for this year’s event this November.

REIMAGINEERING

Ashton Mills on the trends Reimagination revealed

Recently at Reimagination 2016, held in Sydney in December, it was refreshing to hear from a range of experts in topics such as entrepreneurship, innovation, artificial intelligence, and the role of government in the development and adoption of new technologies.

Panellists including Pip Marlow, Managing Director of Microsoft Australia; Karen Stocks, Former Managing Director of Twitter; and Dr Ian Oppermann, CEO and Chief Data Scientist at NSW Data Analytics Centre spoke alongside polities including the Hon Victor Dominello MP, Minister for Innovation and Better Regulation; the Hon. Philip Dalidakis, Victorian Minister for Small Business, Innovation and Trade; and the Hon Stephen Conroy, Former Minister for Broadband -- who, it must be said, provided one of the more interesting insights into government when he spoke about the sometimes risk-averse culture of government silos, a mindset that we need to overcome -- and that going with the safe option isn’t necessarily

the best, exemplified by IBM and the eCensus failure late last year.

Artificial intelligence was a hot topic, with Professor Michael Blumenstein, UTS’s head of the school of software in the Faculty of Engineering and IT, stating that AI “will be able to provide business and government with something that they have not had before: very accurate insights into the future” referring to the ability to process vast amounts of data, and making it possible to spot trends and make predictions that haven’t been possible until now. Blumenstein noted that the rapid development of AI technologies will catch many organisations by surprise -- but by turns, early adopters stand to gain a significant advantage.

Kate Burleigh, Managing Director Intel Australia/NZ, talked about the democratisation of AI with various

✓ Andrew McAfee -- Geeks go where the evidence takes them



Ashton Mills

has been writing about technology for 20 years and still gets excited for the latest techy gear. He’s also the Outreach Manager for the Australian Computer Society (www.acs.org.au), you can email him on ashton.mills@acs.org.au.

ASUS ROG XG STATION 2

Empower laptops with ultimate gaming grunt!



Asus design and engineering is superb

Laptop gamers rejoice! Thanks to the huge bandwidth in Thunderbolt 3 you can now have desktop class GPU performance without having to invest in a separate desktop PC. With the Asus ROG XG Station 2, which implements this technology, you can have the thin laptop you need to travel between home, work or school and the GPU firepower necessary to play the latest games and enjoy VR gaming with no lag.

Just like the familiar process of plugging in an external hard drive, you can now connect an external GPU for when you need it, instead of carrying it around with you all the time, taking up space and weight in your laptop.

THUNDERBOLT 3 IS GO!

The huge bandwidth in Thunderbolt 3 makes this possible, with over 40Gbps available to transfer the vast amount of data between your GPU and the rest of computer. The Asus ROG XG Station 2 supports the latest Nvidia GTX 1000-series cards, even the mighty GTX 1080, as well as AMD's latest GPUs, to turn your PCI Express GPU of choice into an external

✓ Asus Aura Sync compatibility makes for a spectacular appearance



Thunderbolt 3 GPU. With support for the latest GPUs, things like 4K gaming at 60 frames per second, or deep immersive virtual reality become possible - something difficult to achieve in a power and heat constrained laptop chassis alone.

A 600W 80 Plus Gold PSU provides plenty of juice for even the beefiest GPU and the Asus ROG XG Station 2 even supports putting the GPU to sleep when the Thunderbolt cable is disconnected from the computer, saving energy when your laptop isn't there.

TOO EASY

Installation is a piece of cake. Just slide open the Asus ROG XG Station 2, remove I/O plate, pop the graphics card in, connect VGA power, close the lid and plug it to a power socket and your laptop's Thunderbolt 3 port. Done. You don't even need to connect power to your notebook. PC.

You can also choose to use your laptop display if you don't have a separate monitor - it can also output directly onto your laptop's internal monitor if it utilizes either Nvidia Optimus or Intel graphics.

ASUS AURA SYNC

Got a machine that has Asus Aura Sync? The Asus ROG XG Station 2 supports it! Modify the colour of the LEDs on your GPU with a wide array of dazzling effects, just as you would on an internal GPU. On the front of the ASUS ROG XG Station 2 there's a gnarly looking Plasma Tube that crackles with electricity, letting everyone know there's loads of gaming horsepower within.



With looks like this, who *wouldn't* want this powerhouse sitting on their desk?

If you're interested in a laptop that supports the Asus ROG XG Station 2, Asus has you covered, too. Ideally Intel Kaby

Lake based systems with Thunderbolt 3 support manufactured from 2017 onwards will be compliant to XG Station 2. For backward compatibility, two very portable Transformer Book - the T303UA and T305CA, also receive updates to support the Asus ROG XG Station 2. In fact, you can also use it to upgrade the GPU for gaming notebooks as well. Quite amazing.



◀ All the ports on your graphics card are easily accessible

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WHERE: Melbourne's Monash University, Caulfield Campus

WHEN: May the 3rd, 6pm onwards

WHAT: Upgrade Australia 5.0, a unique PC event that sees the best hardware vendors showing off their latest and greatest technology as well as free food and drink

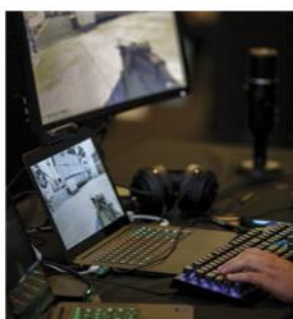
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KEEP PERSISTENT
PC PESTS AT BAY

Auto-playing adverts, intrusive feedback requests, messages that prompt you to update unwanted software – it can often feel like your PC is under siege.

In theory, we're supposed to have more control of our systems and privacy than ever before, but in practice all those control panels and opt-out options count for nothing when software developers and web advertisers keep finding new ways to circumvent them. In fact, some of the biggest names in PC manufacturing, security and software – even Microsoft itself – seem hell-bent on running roughshod over our preferences and invading our PC screens.

It's time to take our PCs back. On the following pages, you'll find not only details of the most intrusive PC invaders but also simple, practical advice on how to stop them. We go far beyond the usual responses to offer effective counter-measures for today's irritations and the means to take back control of your beloved PC.

AXE AUTO-PLAYING ADS

Is there anything less life-enriching than a video ad that autoplays the moment a web page loads? After all, if you wanted a movie trailer or a speculative report on what might be in the iPhone 8, you'd have probably searched for it specifically.

In the good old days, autoplay ads were relatively easy to disable. If you had a browser extension that blocked Flash content, you had no more ads, or you could set how plugin content ran in your browser.

It's still possible to keep such irritations at bay. In Chrome, click the options button, then Settings. Scroll down to "Show advanced settings" and click the link. Now scroll down to the Privacy settings and click the "Content settings" button. Finally, scroll to Plugins and select "Let me choose when to run plugin content".

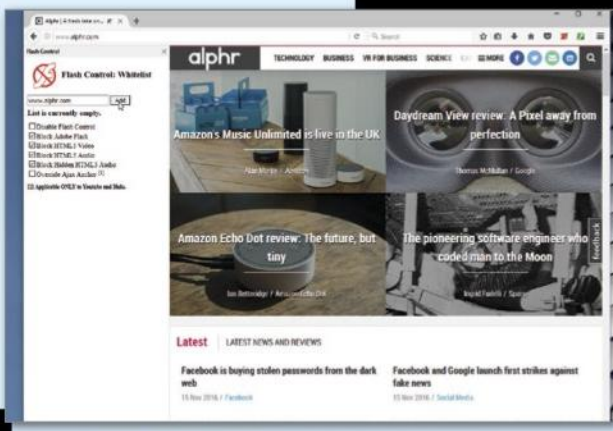
In Firefox, type "about:config" into the address bar and press Enter. Agree to the warning before typing "autoplay" into the Search box. One of the results will be a preference called "media.autoplay.enabled", which will be set to True. Double-click to change it to False.

In Edge, click the Options button, select Settings and scroll down to Advanced Settings. Click "View advanced settings", then switch Use Adobe Flash Player to Off. Be warned: this will prevent all Flash content from playing.

Alternatively, Chrome and Firefox users can use a Flash blocker extension to keep the fiendish videos at bay. The advantage is that you can use whitelists and blacklists to selectively block and unblock Flash content for pages or websites. On Chrome, the Flashcontrol extension provides a solid level of control. On Firefox, try the similarly named, but unrelated, Flash Control.

Unfortunately, web advertisers and other purveyors of annoying autoplay ads have become smart. Flash is now out of favour and they're embedding HTML5 video ads within the page. Being HTML5, these are tougher to outlaw, requiring an extension to tackle autoplay of HTML5 video specifically. Luckily, the Firefox Flash Control extension has it covered, enabling you to block or enable autoplay at a click, or you can use the dedicated Toggle HTML5 Video extension. On Chrome, Disable HTML5 Autoplay does the same thing, with a toggle to enable and disable autoplay then reload the current page, plus logs of attempts at media playback from the page.

▼ Old-school Flash-blockers will stop Flash videos auto-playing, but not HTML5 video. That's where extensions such as Chrome's Disable HTML5 Autoplay come in



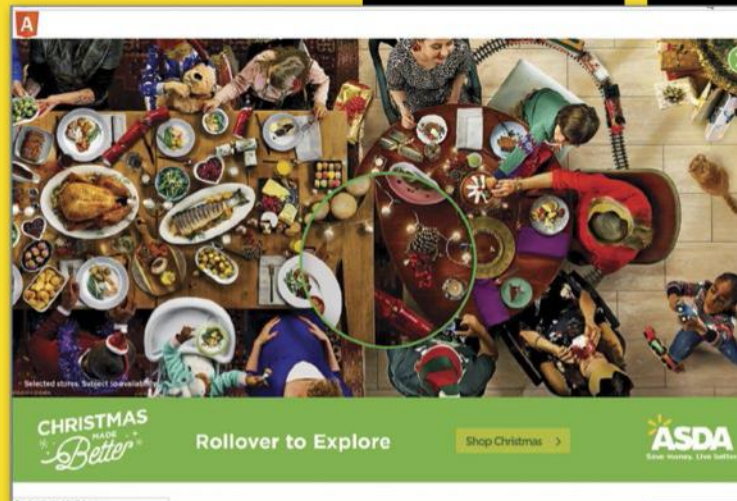
STOP POP-UPS AND OVERLAYS

Pop-ups are another persistent menace that should have gone the way of Netscape. In fact, all the major browsers now have options to prevent them from appearing.

In Chrome, go to Settings | Advanced Settings and click the "Content settings" button under Privacy. Scroll down to Pop-ups and ensure that "Do not allow any site to show pop-ups" is selected. In Firefox, click the hamburger button (three short, parallel lines), Options and select Content in the left-hand panel. Select "Block pop-up windows". In Edge, go to Settings | View Advanced Settings and make sure "Block pop-ups" is turned on.

Once again, web developers have found a workaround in the overlay. These annoying ads appear over the web page you're trying to read, often obscuring the content until actively closed - if you can even find the close button. Since browsers read the overlay as just another HTML5 element, they escape detection and can make sites all but unusable.

▼ Overlays can render whole sites unusable. A solution is BehindTheOverlay in Chrome and Firefox, which gets rid of them with a single click



Extensions are again the answer. One way to tackle the overlay problem is to use Adblock Plus in concert with the Element Hiding Helper extension. Install both, then click on the arrow next to the Adblock Plus icon and choose "Select an element to hide". Now click on the overlay and it should be hidden in future - although, with several types of overlays out there, you may need to find a few before you banish them all.

The downside of this technique is that you block all the advertising content on the web and you're arguably starving the sites you use of advertising income. Instead, think about a more specialised extension. Chrome and Firefox have the BehindTheOverlay extension, which removes the despised page element with a single click. Chrome also has the Auto Overlay Remover extension, which disables them automatically. In the event that it disables one that's useful, you can click the button to add it to a whitelist or a "Delayed start overlay" list, where the overlay will appear but only after a timed delay.

In Edge, you can use Adblock Plus - but there's no Element Hiding Helper extension and the beta hasn't received great reviews. If you want real control of your browser, switch to Firefox or Chrome.

AVOID UNWANTED AUDIO

While generally a by-product of autoplay video, unwanted audio is a menace in its own right, with web ads, clips and teasers all hitting you with online noise pollution, or actively drowning out the active tab. In both Firefox and Chrome, muting this stuff is easy – simply right-click on the speaker icon in the noisy tab and select Mute Tab – but surely there's a more automated way?

Your first option is Smart Tab Mute: a Chrome extension that has since been adapted for Firefox. This automatically mutes background tabs when you have an active tab playing media content and has a whitelist feature to ensure that some domains used for important communications are never muted.

A rival extension, prosaically titled Auto Mute Tab When Multiple Tabs Open, ensures that only one tab stays audible at a time. It also provides keyboard shortcuts to mute all tabs (Ctrl + Shift + 0), unmute all tabs (Ctrl + Shift + 9) and toggle the mute status of the active tab (Ctrl + Shift + 8).

Perhaps the strongest option is MuteTab, which provides greater control over how tabs with sound, are handled. This includes blacklist and whitelist features to enable or disable sites from playing sound and customisable keyboard shortcuts to mute and unmute all tabs or background tabs. Firefox's MuteTab extension isn't so rich in options, but has the facility to auto-mute new tabs or silence tabs with a single click.

CUT THE YOUTUBE CLUTTER

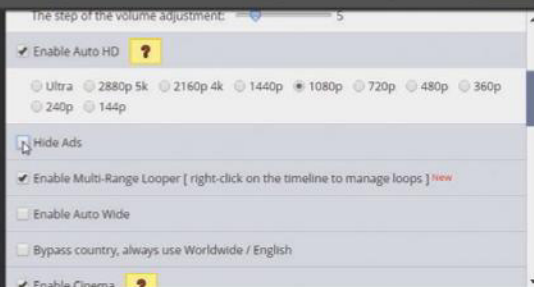
Because Magic Actions was reviewed and approved by Chrome Apps Store, Firefox, Opera and our team members.

Where is Magic Settings?

If you have already installed Magic Actions – you can control and customize many preferences right here, just see below. Keep in mind, when you modify some options, such as Auto HD 4k, Stop Autoplay, Speed Booster or Use MP4/AVC, the changes do not apply for tabs that you had opened previously.

Magic Actions v6.9.1.6 - Change Your Settings

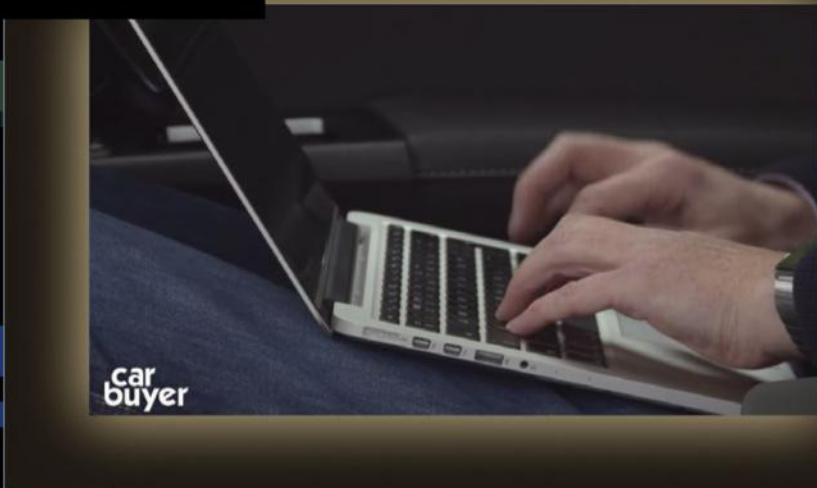
Rate 5★



➤ Get a cleaner, leaner YouTube free of clutter with the handy MagicActions for YouTube. You can disable ads and comments, not to mention recommendations

Magic Actions can do! You can look at the [Help & Tips](#) and the other support pages to learn more.

Advertisement



You visit YouTube to watch a video, not to have it spoiled by ads that cover half of the picture; nor comments, recommendations or other forms of YouTube clutter. This is where another extension, MagicActions for YouTube, comes in. Versions are available for Chrome, Firefox and Opera, and through a simple checkbox-powered control panel you can block ads and annotations, stop autoplay and hide a range of other page elements, including the ever-annoying “Related videos” overlay.

As a bonus, MagicActions can be set to automatically show videos in a more focused, highly configurable Cinema view and play them at a specific resolution, including 1080p and 2160p. Just watch out for the installer's deplorable attempt to install the Click&Clean privacy extension during setup.

UNTICK THE WRONG BOXES

You know how it is. You invite a friend to a house party, then they turn up with someone who drinks too much, eats all the nibbles, tells jokes that would have made Graham Kennedy blush, and breaks the wing mirror off your car as they stagger down the path. Well, some software installation routines do roughly the same thing for your PC, pre-ticking optional checkboxes to change file associations, search engine preferences, your browser's homepage, or even your default browser. It's a habit known in the trade as potentially unwanted modifications (PUMs). Others might install extra apps, utilities and browser toolbars, or even games. We call these potentially unwanted programs (PUPs).

Luckily, while you probably won't hire a doorman for your party, you can keep all these unwanted guests from your PC using Unchecky. This helpful app automatically unchecks the boxes for unrelated offers and warns you when you're about to allow an additional program to install. You can still install the extra program if you choose, but Unchecky acts as an extra pair of eyes to ensure you don't blithely leave boxes ticked in your haste to install software. What's more, Unchecky is regularly updated to cover more apps and installers, so it should keep these unwelcome PC partycrashers out in future.

Other utilities also detect unwanted programs and undesired modifications. For instance, Malwarebytes (see right) checks for potentially unwanted programs and modifications during scans.

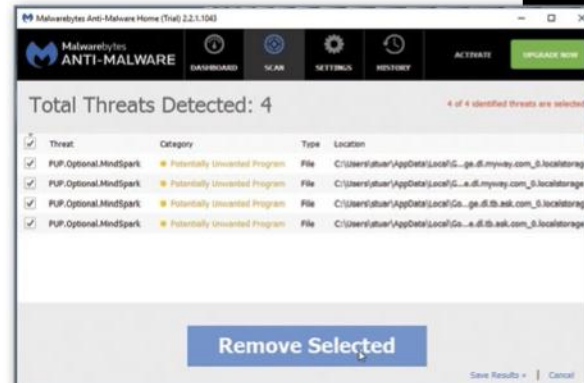
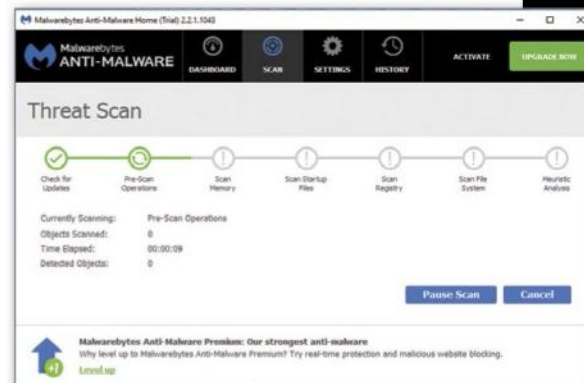
KEEP SPYWARE AND ADWARE AT BAY

No malware should be welcome on your PC, but spyware is particularly insidious, lurking on your system while feeding personal and business data - not to mention information on your activities - back to persons both unknown and unauthorised. Adware isn't as malicious but can still be troubling, displaying unwanted ads, collecting data about you and the websites you visit, and even changing the results when you perform a search.

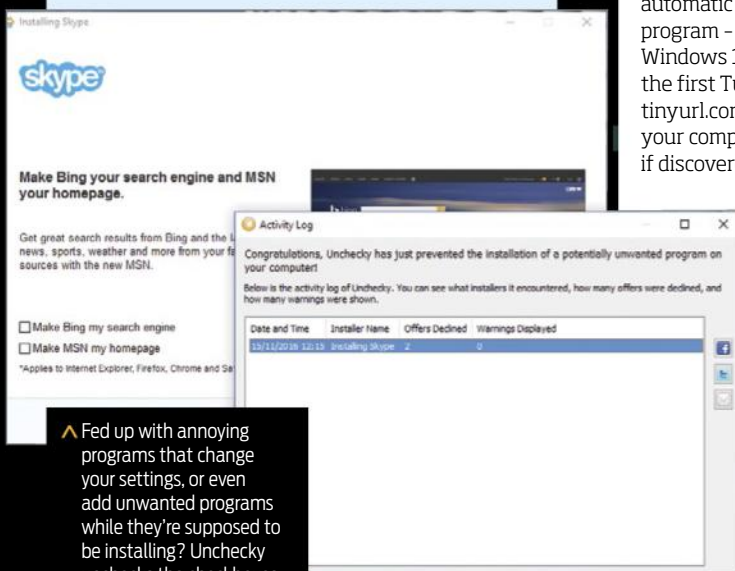
Needless to say, installing anti-malware software or using Windows 10's built-in tools will help. Go to Settings | Update & Security | Windows Defender and ensure that "Real-time protection" and "Cloud-based protection" are turned on. However, it's worth maintaining a second line of protection, even if you don't suspect you're being troubled by the devilish duo.

Your first port of call is Microsoft's own Malicious Software Removal Tool. If you subscribe to automatic updates through the Windows Update program - you don't really have a choice in Windows 10 - this downloads and runs in the background automatically after the first Tuesday of each month. You can also download it on demand from tinyurl.com/pz23aoa and run a quick or full scan manually. The tool checks your computer for infection by specific forms of malware, then removes it if discovered. It's a useful line of protection as it's designed to counter the newest, most virulent, or hardest to stop malware.

For a really thorough check, however, install the free version of Malwarebytes from www.malwarebytes.com/mwb-download/. This scans for malware on top of any existing antivirus product you have installed, detecting and cleaning infections that Windows Defender and other antivirus products miss. It updates itself regularly and is worth running periodically, even if you have real-time protection from another party. On installation it will update its malware database, after which you should click the Scan button at the top of the window and run a Threat Scan or Custom Scan. Just be aware that, by default, it will enable a free trial of the Anti-Malware Premium product during installation. If you're not already using Unchecky (see left), you'll have to turn this off yourself.



▲ Scan with Malwarebytes Anti-Malware regularly and you have a great second line of defence against spyware and adware



▲ Fed up with annoying programs that change your settings, or even add unwanted programs while they're supposed to be installing? Unchecky unchecks the checkboxes for you and lets you know

BATTLE NOISY BLOATWARE

Bloatware not only fills your hard disk, it also sends out intrusive notifications and update requests. What's more, some manufacturers reinstall bloatware you've deleted, or re-enable unwanted options or services that you've disabled.

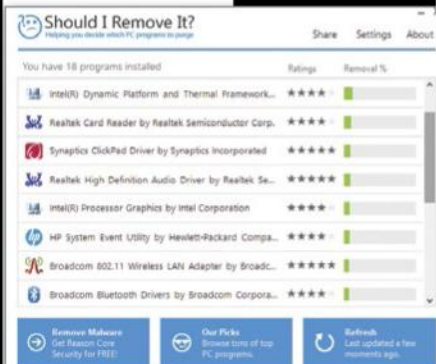
Uninstall apps by right-clicking on them in the Start menu or Apps List and clicking Uninstall. Desktop applications can be removed by visiting Settings | System | Apps & Features, clicking on a bloatware app and clicking Uninstall. We also recommend pressing Ctrl + Alt + Del while on the desktop, launching the Task Manager, clicking the "More details" arrow and then hitting the Startup tab. See if any solution centre applets or processes are launching when your PC boots. If so, click on the app then click Disable.

The problem can be differentiating between manufacturer tools and utilities you don't need and those that are necessary to make hardware such as a webcam or audio system work correctly. Typing names into a search engine can help, but specialist utilities are also available.

Arguably the best is Should I Remove It? (shouldiremoveit.com), which combines a tool that cleans your PC of unwanted programs with detailed resources that help you decide whether or not a program should be uninstalled. Just let it run its initial scan, then click on each identified program. You can click the "What is it?" button for details, or the Uninstall button to simply remove it.

Be warned that the download and thank you pages for the program contains numerous links to unrelated utilities. Ironical, all things should be removed.

✓ Should I Remove It? offers the tools and knowledge you need to rid your PC of the space-hogging bloatware and intrusive built-in manufacturer utility apps that loiter on your hard drive



DROP SUGGESTIONS

You buy or upgrade Windows because you need to get things done, not because you want to throw more money at Microsoft. Why, then, put up with nonsense such as the Get Office 365 app and its notifications or suggested apps in the Windows Start menu? Why sit through tips on how to use Cortana when you'd rather have a simple search?



▲ Do you really need an app that pushes you into signing up for Office 365? No. To get rid of "Get Office 365", simply right-click on the app's Start menu tile and then select Uninstall

You can easily change how and when you receive notifications through the Notifications & Actions control panel under Settings | System. Turn off "Get tips, tricks and suggestions as you use Windows". Go to Settings | Personalisation | Start, and you can set "Occasionally show suggestions in Start" to off as well.

To rid those annoying Office messages, simply ditch the Get Office app. Click the Start button, scroll through the Apps List, right-click on the app and hit Uninstall. Meanwhile, if Cortana's taskbar titbits are annoying you, you'll find an option to silence her by clicking in the Search bar, then on the Settings icon. Slide the Taskbar titbits switch to off.

COVER YOUR WEBCAM

Whether the culprits are Russian cybercriminals, hacker collectives or the good old NSA, fears of webcam hacking don't seem to be abating. How can you maintain control of what your webcam sees and sends when it isn't in active use? There are obvious physical measures, such as unplugging your USB webcam if you use a desktop PC, or taping over your laptop's webcam - the measure recommended last April by James Comey, director of the FBI. But are there less drastic, more convenient measures to keep the spies from peeking in?

Beyond following basic good security practices - such as running antivirus software, maintaining strong password security, avoiding suspect emails, attachments, apps and links - there are some more specific steps you can take. One is to use Windows 10's privacy controls. Go to Settings | Privacy | Camera and turn your "Camera on or off", or set which specific apps can access the camera. While you're at it, you can do the same for your microphone through Settings | Privacy | Microphone.

You may, however, be looking for a more substantial measure - such as disabling the camera altogether. In Windows 10, type "Device Manager" into the Cortana search bar then tap Return. When the Device Manager loads, scroll down until you find Imaging devices, then click the arrow to open up the category if necessary. Now right-click on your webcam and select Disable. You'll need to repeat the process and Enable it the next time you need to use it, but you've made it a lot harder for others to access. If you don't ever use it, you could uninstall it. Both steps can also work for your microphone, usually found under "Audio inputs and outputs".

Some laptops also allow you to disable webcams from within the BIOS. The method will differ from manufacturer to manufacturer, although it's usually a case of tapping Del or F2 during your laptop's initial startup then checking through the different BIOS screens to see whether there's an option. Just remember that you'll need to return to the BIOS and re-enable your webcam if you want to use it later.

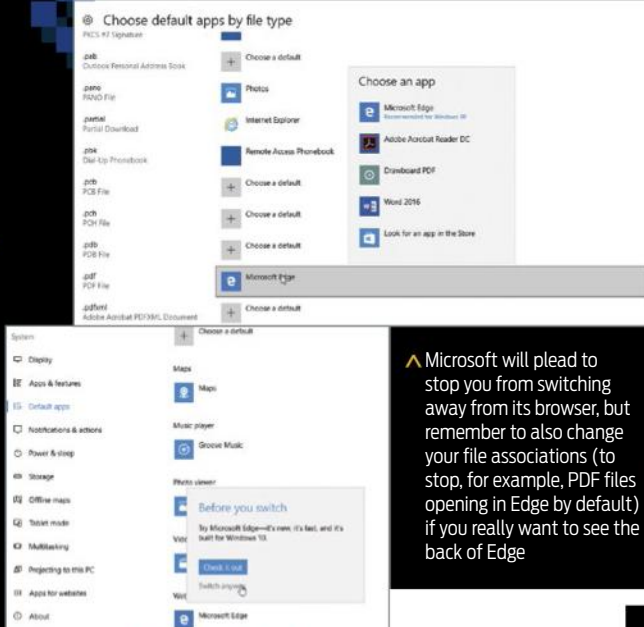
Finally, it's worth deleting any apps that use the webcam if you don't use them regularly. Many manufacturers install them in a PC bloatware suite, but an underused, poorly updated app with access to your webcam is a security vulnerability. If you haven't already uninstalled it manually, or purged your PC with Should I Remove It? (see left), do so now.

CUTTING EDGE OUT OF THE PICTURE

So, you don't like Microsoft's built-in browser. Would you rather use something else? Well, Windows 10 isn't going to make things easy for you. Not only will you have to install Chrome or Firefox manually, you'll have to change your default browser from Edge to your choice and endure Microsoft's urging not to do so along the way.

In theory, changing the default browser is easy. Go to Settings | System then click "Default apps" on the left-hand side. Click on Microsoft Edge under Web browser, select your preferred browser, then click "Switch anyway" to tell Microsoft that, no, you really don't want to stick with Edge.

Sadly, you'll soon discover that Edge might not be done quite yet. In fact, it will remain the default option to open some file types, including PDF. If so, click on the "Set default apps by file type" link at the bottom of the page, then scroll down the list until you see the PDF file type. Click on Microsoft Edge then select your preferred option. You can also reset any other defaults the built-in apps have hijacked. After all, do you really want Films & TV handling all your video formats, or Groove Music all your music files?



FIX THE FEEDBACK

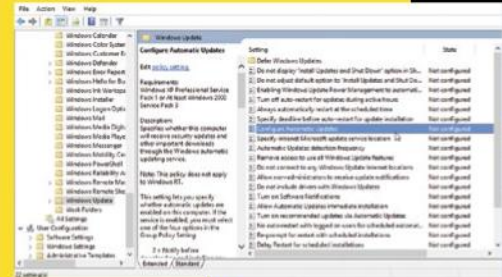
You might like Windows 10, but do you really want to spend time reporting back on its pros and cons? If the answer is "no" then you can do without the Windows Feedback Tool. To stop its harassment, go to Settings | Privacy | Feedback & Diagnostics. Set the "Windows should ask for my feedback" option to Never.

SUDDEN RESTARTS

We all understand why Microsoft enforces updates for Windows 10. People say they want control, then leave their PCs unpatched and insecure, hostage to every script-kiddie and budding botnet-builder on the web. At the same time, it's infuriating when you need to get some work done but Windows has decided that you'll have to update first.

We go into great detail on how to deal with this in our separate feature on fixing Windows Update (see p30). For extra power, however, Windows 10 Professional and Enterprise

users can tap into the Group Policy Editor. Type "gpedit" into the Cortana search box to launch it, then expand Administrative Templates under Computer Configuration in the left-hand pane. Now expand Windows Components and open the Windows Update folder. Double-click Configure Automatic Updates then click the Enabled radio button. You can now use the Configure automatic updating dropdown to pick between "Auto-download and notify for install", "Notify for download and notify for install" or "Auto-download and schedule for install".



Windows 10 Pro owners can use Group Policy Editor to control how and when the OS updates

FALL OF THE FIREWALL?

There used to be two rock-solid recommendations for Windows security: install a good antivirus package and couple it with a solid third-party firewall. These days, you'll find people arguing that Defender provides adequate antivirus capabilities, but where does that leave the firewall? On the one hand, Windows Firewall does a good job of blocking incoming connections and can be configured to control outgoing connections too. That's why many PC security suites skip the firewall component altogether.

However, some experts argue that malware continually attacks the same two unblockable ports, and that when it comes to client-side attacks - those aimed at individual client computers, their browsers and their apps - firewalls are mostly impotent. So is it time to ditch them? Not yet, says David Emm, principal security researcher

at Kaspersky Lab. "[A firewall] blocks unauthorised network connections to a computer, thereby reducing the risk of infection, and blocks unauthorised activity of programs on the computer." It's a point shared by Gareth Lockwood, EMEA consumer product specialist at Norton. "Honestly, they're more relevant today than ever," he said, explaining that in a world where successful malware attacks exploit vulnerabilities in OSes and browsers, using advanced network security is crucial. Blocking incoming connections and cloaking open ports will take you so far, but to be effective the firewall must act as an intrusion prevention system (IPS), screening network traffic for patterns of behaviour that might signify an attack. The cloud can help here too, sharing data from millions of users to find these patterns quickly when a new threat emerges.



WINDOWS SPECIAL

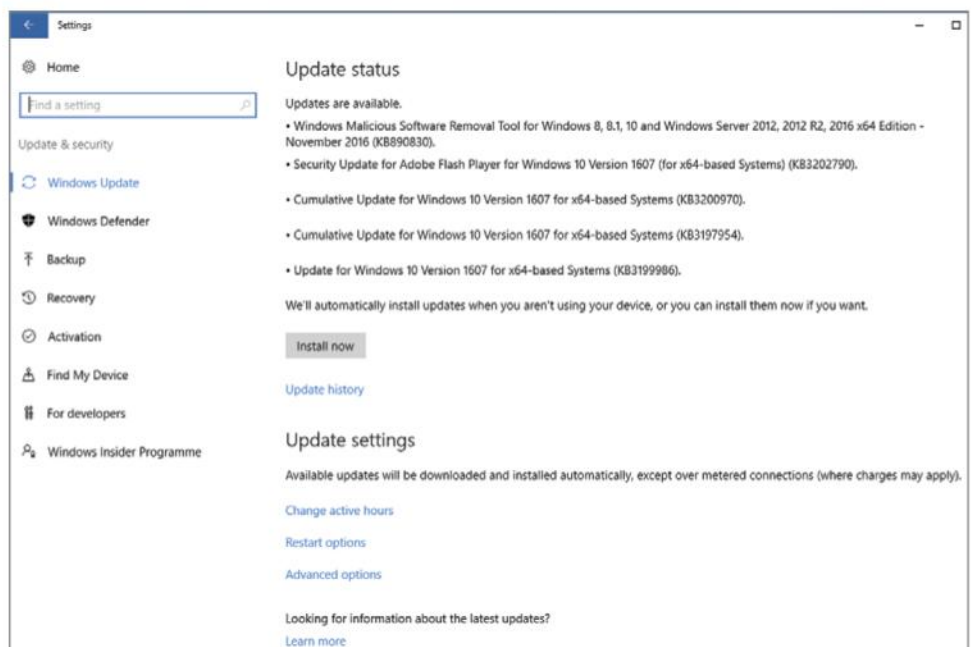
Take control of WINDOWS 10 UPDATE

IT'S VITAL TO KEEP YOUR PC UP TO DATE – BUT IN A WAY THAT WORKS FOR YOU. **NIK RAWLINSON** EXPLORES HOW TO TAILOR WINDOWS UPDATE TO YOUR REQUIREMENTS

Windows Update has a reputation for choosing the worst possible time to interrupt your work. And in Windows 10 it's become far less flexible than it used to be. In a world where threats are both more serious and common than they once were, it's arguably become necessary to take a hard-line approach to security patches.

All the same, you may have good reason to treat updates with caution. Some users, for example, found that autumn 2016's Anniversary Update disabled their computers' webcams. It may make sense to wait and see what effect a patch has on other users' machines before you roll it out onto your own. If you like to control exactly what's downloaded – and when – it's time to take control of Windows Update.

Before we go any further, though, we must emphasise that keeping Windows patched and up to date is important. It isn't hyperbole: running an outdated operating system leaves you vulnerable to data loss and identity theft. Therefore, when making any changes to Windows' default settings, you should weigh any gains in convenience against the potential dangers.



▲ The schedule for updates can be relentless – it's time to take control

THE WINDOWS UPDATE SCHEDULE

The first step in managing Windows Update is understanding what it's sending you, and when. On a regular PC with a direct connection to the internet, Windows 10 will download updates as soon as they're available. Microsoft usually rolls out a cumulative update on the second Tuesday of each month, colloquially known as Patch Tuesday or Update Tuesday.

If a serious hazard is discovered, an "out of band" patch may be issued: if you keep an eye on Microsoft's Download Center (microsoft.com/en-gb/download) you can get a head start on the masses, as such updates tend to show up there first. You may also find details about them on the Microsoft Knowledge Base (support.microsoft.com) or on TechNet (technet.microsoft.com).

Minor updates are issued every other month, starting in January, with major ones coming down the line in alternate months. (The Windows Defender malware database is an exception, and is typically updated every day.)

Windows Update uses Microsoft's Background Intelligent Transfer Service (BITS) to download updates in the background. It's designed to use your connection only when it's idle, so you shouldn't notice impact on your working or browsing speed. Nonetheless, when there's a lot to download, Windows Update can hit your broadband connection hard over the course of a month. If you have a low data cap with your ISP, Update could gobble up a big proportion of it, without you having any control of what comes down the line and when.

MINIMISING THE DOWNLOAD BUNDLE

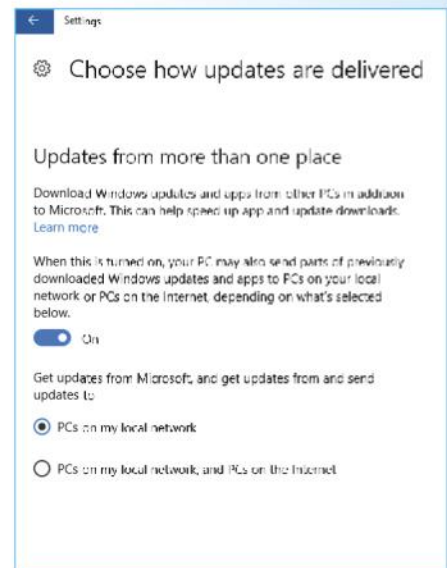
To help reduce the load on businesses, Windows 10 introduced a system whereby computers on a network fetch copies of updates from their neighbours where possible, rather than retrieving their own copy over the internet. System admins running Windows Server 2003 and later can also deploy updates across the local network from a central location with Windows Server Update Service (microsoft.com/wsus).

At home, you can configure your PC to fetch updates from other PCs on the internet, rather than solely from Microsoft. This won't reduce your bandwidth consumption, but you may see updates arrive more quickly when a wider range of nearby sources is available. The trade-off is that this allows remote users around the world to use your upstream bandwidth to retrieve updates from your machine – which is probably why the option is disabled by default. To change this, open Settings | Update & Security | Advanced Options | Choose how updates are delivered.

It isn't generally possible to pick and

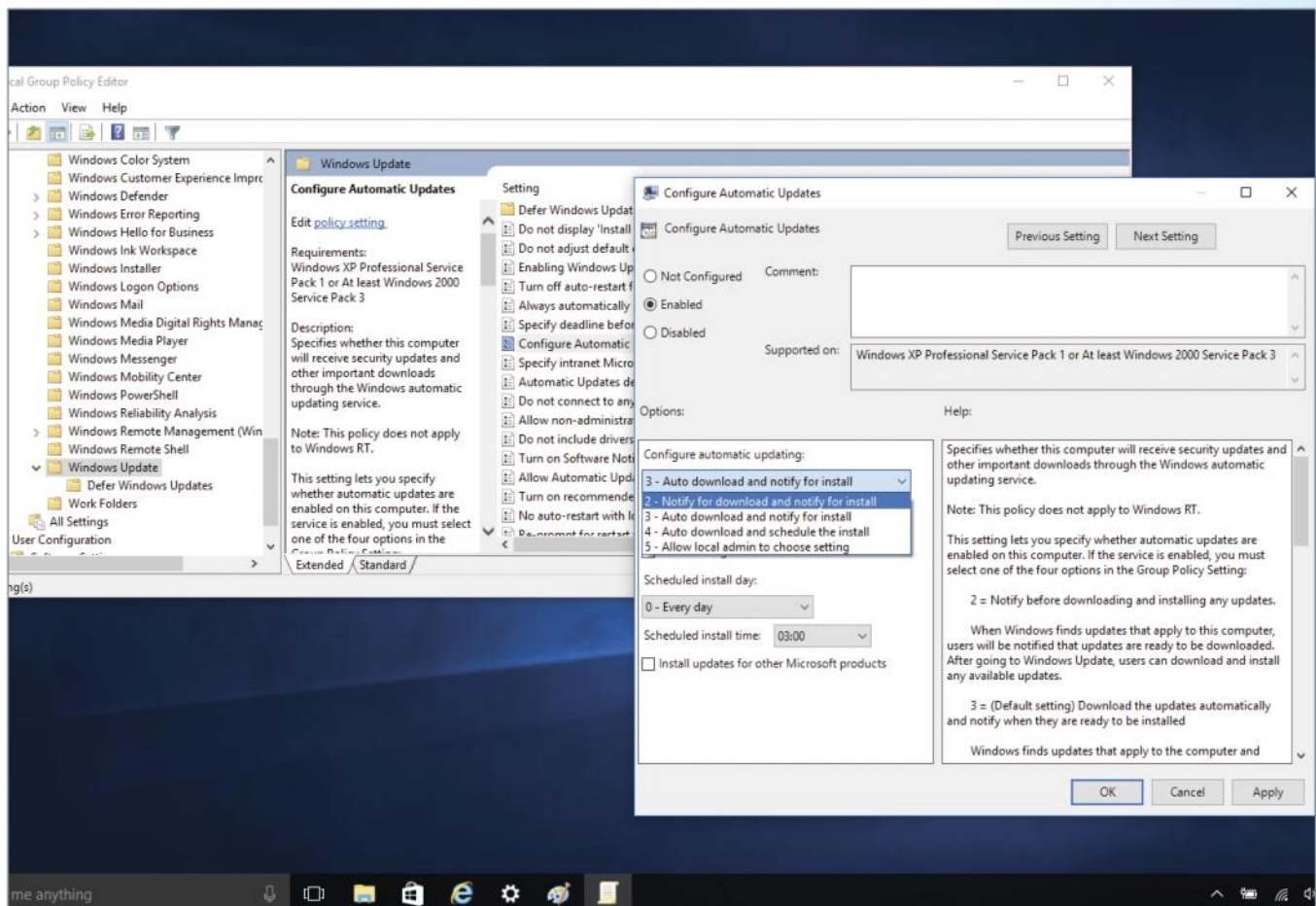
choose what gets downloaded each month, but if you're using a Professional, Enterprise or Education edition of Windows 10, you can strip the payload down to its basics by postponing new features. This option is chiefly intended to allow businesses time to test and update applications and training procedures, but there's no reason why you can't do the same on your own desktop. To apply this setting, open Settings, go to Update & Security and pick Advanced Options. Tick the box next to "Defer upgrades", and new Windows features will be held back, sometimes for months, while security patches continue.

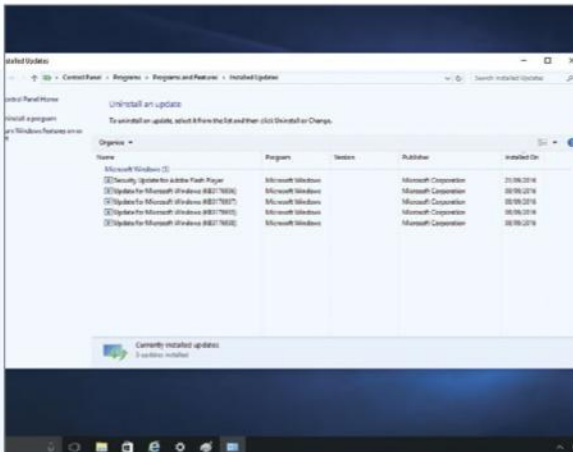
It's also worth noting that if you don't get along with a particular update, it's often possible to uninstall and roll back. You'll find the option under Control Panel | Programs | Programs and Features | Installed Updates. If you leave your settings the same, however, don't be surprised if the exact same update comes back down the line a few days later.



^ You can extend Windows Update to download updates from other PCs across the internet

^ Tricking your PC into thinking your Ethernet connection is metered requires a Registry edit





MANUAL CONFIGURATION

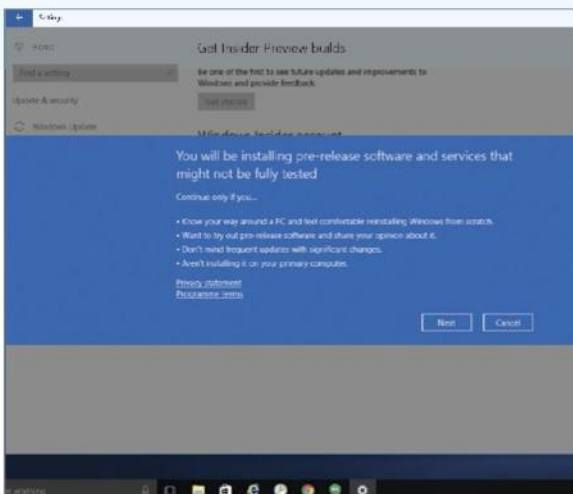
You won't find many update options in Settings – but in Windows 10 Professional and Enterprise, you can access additional controls via the Local Group Policy Editor. To open it, launch gpedit.msc from the search box, navigate through Computer Configuration | Administrative Templates | Windows Components | Windows Update, and double-click on the setting entitled Configure Automatic Updates.

Select Enabled at the top of the window and you'll see several dropdown menus become available in the Options window below. Choose "2. Notify for download and notify for install" – and control of Windows Update will once more be

in your hands.

It's also a good idea to authorise Windows to log back in after rebooting: this allows it to complete the installation process in your absence, so you won't be waiting around once you come back to your PC. Enable this through Settings | Update & Security | Advanced Options: you'll be automatically logged out once updates have been applied, to keep your account safe in your absence.

If you're using Windows 10 Home then your best option is to tell Windows that you're using a metered connection (see below). This will halt Windows Update until you disable the option.



The Windows Insider programme delivers pre-release builds of the operating system for advanced users

SETTING A METERED CONNECTION

For wireless networks, it's easy to configure your connection as metered. Head to Settings | Network & Internet | Wi-Fi. Click "Manage known networks", select the network and click Properties, then hit the "Metered connection" switch.

To set a wired Ethernet connection as metered, you must change the Registry. Open Registry Editor, then navigate to HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\DefaultMediaCost.

First, authorise yourself to edit these Registry settings. In the left-hand pane, right-click DefaultMediaCost and pick Permissions from the menu, followed by Advanced; then, in the new window, the "Change" link beside

TrustedInstaller.

Enter the name of your Windows user account in the "Enter the object name to select" box, click Check Names, click OK to close the window, and then OK again on the previous dialog to return to Permissions for DefaultMediaCost.

Now give yourself permission to edit the Registry key you need to tweak by clicking Users in the "Group or user names" box and ticking the box beneath "Allow" on the "Full Control" row below. Close the window and return to the Registry Editor.

Finally, double-click Ethernet in the right-hand pane and change the setting in the "Value data" box to 2 to set the wired connection as metered. You can download a script to perform this action from tinyurl.com/zkssac9.

UUP: THE FUTURE OF WINDOWS UPDATE

While it may not be obvious, Microsoft is currently rolling out a major upgrade to the Windows Update system. The Unified Update Platform (UUP) has been pushed to mobile devices and PCs signed up to the Windows 10 Insider Programme, and will be coming to the rest of us soon.

The big idea behind UUP is to reduce the size of each update payload by installing "differential download packages", which contain only the changes that have been made to the OS since the last update. So, if you regularly keep your machine patched then it will, in effect, only be sipping

at the download stream rather than gulping huge quantities of data once or twice a month. Microsoft estimates that this will reduce the download size of major updates by 35%.

The selecting and bundling of the required components is handled by Microsoft's servers, so your computer will also have less work to do when it comes to unpacking and installing updates, which should yield a reduction in battery usage too. Whether the improvement will really be noticeable remains to be seen, however. Microsoft's aim is to make the switch to UUP entirely transparent, so that it appears nothing has changed.

END OF THE ROAD FOR OLDER WINDOWS

No developer can be expected to continue supporting old releases forever, and each version of Windows comes with a cut-off date for support. The current timetable for Windows 10 promises mainstream support – which may include new and upgraded features – through to October 2020. After that it's "extended" support only, which means security updates will continue but all other development will stop. After 2025, any support you need will be at a charge. Based on Microsoft's past behaviour, we can assume that the next major update to the OS will extend those dates, but we've no official word on that.

For Windows 8.1, mainstream support expires in January 2018 and extended support continues until 2023. If you're running Windows 7, you're already into extended support: security updates will end in 2020, so you should, perhaps, start thinking about an upgrade strategy.

HOW TO SUPPRESS AUTOMATIC REBOOTS

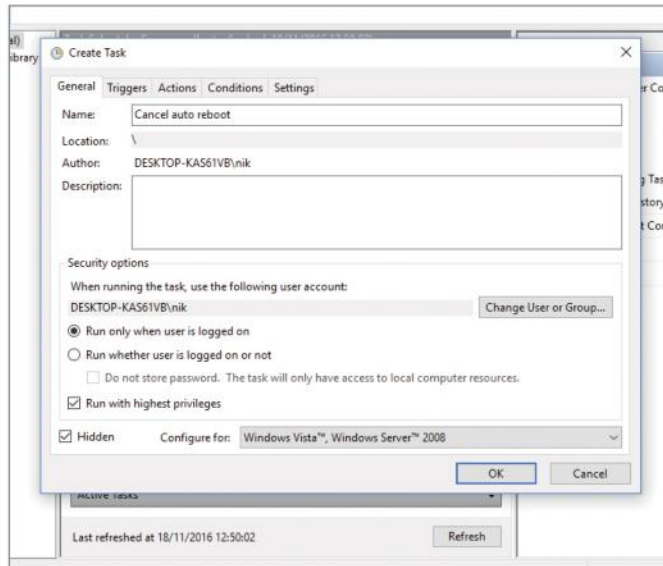
Security updates often affect key operating system components, so Windows usually needs to reboot when installing an update.

If you're sitting at your computer when an update arrives, you can easily suppress the restart until a more convenient time, but if you've left something running – such as a Bitcoin miner or a video-rendering task – you may return to find your PC sitting at the login screen waiting for you to enter your credentials. Very frustrating.

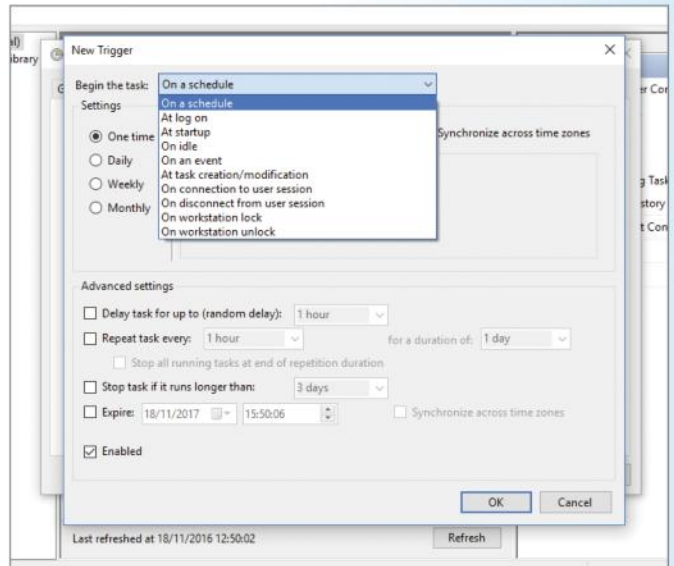
You can reduce the danger of this by setting Windows Update to install updates only outside of your “active hours”. To specify what

these are, open Windows Update Settings, click “Change active hours” and set the start and end times. Sadly, there's no option to choose specific days, so you can't – for example – install updates only at weekends.

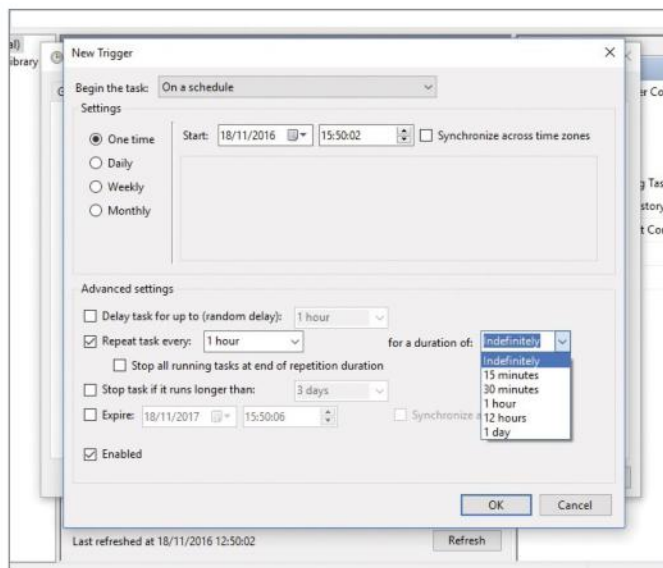
You may therefore prefer to disable automatic reboots altogether. This isn't something Microsoft officially supports, but it's easy to implement by creating a scheduled task that runs in the background every hour and automatically cancels any pending reboots. Here's how.



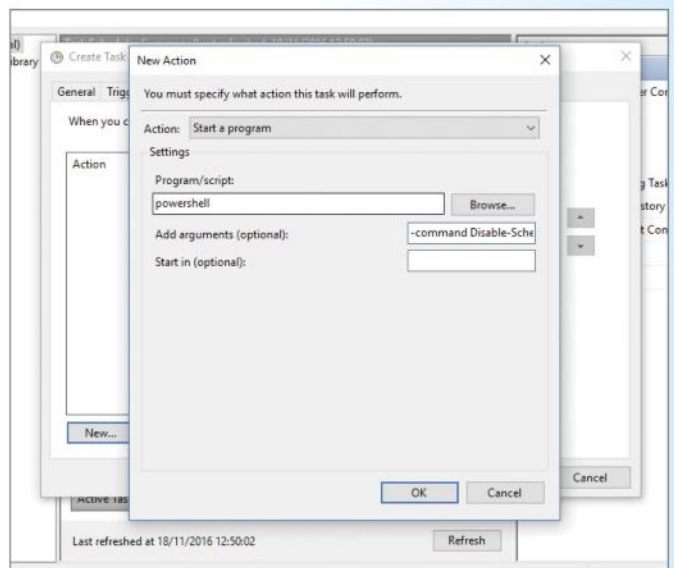
1 Open the Task Scheduler desktop app and create a new task by clicking Action | Create Task... Give it a name such as “Cancel auto reboot” and click the box beside “Run with highest privileges” to give it Administrator access. We recommend hitting the Hidden checkbox, too, so it doesn't open a command prompt window.



2 Windows needs to know when to run the task: switch to the Triggers tab and click “New...”. Tasks can be fired when certain things happen (such as when you log on) or to a timed schedule, as configured on the “Begin the task” menu. We want our task to run at regular intervals, so leave this set to “On a schedule”.



3 Windows Update is a single-minded beast, and will continually try to instigate a reboot, so you need your task to launch at regular intervals. Tick the box beside “Repeat task every:” and make sure the interval is set to “1 hour”. Then change the option beside “for a duration of:” from “1 day” to “Indefinitely” and click OK.



4 On the Actions tab, click “New...”, and in the “Program/script:” box, enter “powershell”. In the “Add arguments” box, type “-command Disable-ScheduledTask \Microsoft\Windows\UpdateOrchestrator\Reboot”. Don't include the quote marks in either instance. Click OK, then OK again to close the Create Task dialog. Job done.



TI ROG GAMING 7700K

\$3,280 (including GST)

- Clean ROG certified glass frame, powered by **ASUS AURA SYNC**. Personalize spectacular synchronized lightening effects with ease.
- Professionally overclocked Intel® Core-i7 7700K on ROG STRIX-Z270E-GAMING. Unleash the full potential of your system without the noise.
- Hear better and game better with high precision 120dB SupremeFX gaming audio powered by Sonic Studio III.
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- 16GB of system memory, 512GB of NVMe hot storage, and 2TB of cold storage, powered by ROG RAMCache for long lasting high performance storage.
- Trusty TI Computer after service.

Specifications:

CPU	Intel® Core- i7 7700K Overclocked
Cooler	Noctua D14 Super Silent Overclocking Cooler
MB	ROG STRIX-Z270E-GAMING motherboard
VGA	ROG STRIX-GTX1080-A8G-GAMING 8G GDDR5X OC version
Audio	ROG SupremeFX 120dB Professional Gaming Audio
Chassis	ROG Certified Inwin 805C Infinity
Power	750W 80 Plus GOLD Power
RAM	16G DDR4 2400MHz Kingston HyperX
Storage	512GB Intel® M.2 NVMe SSD + 2TB 7200rpm RAMCached
OS	Windows 10 Home 64
Extras	Intel® Gigabit LAN AC1200 MU-MIMO USB3 SATA3 NVMe RAID Amazing Customizable Aura Sync Effects TI Professional System Tuning



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TI PRIME GAMING 7700K \$2,215 (including GST)

CPU	Intel® Core-i7 7700K Overclocked
Cooler	Noctua D15 Super Silent Overclocking Cooler
MB	ASUS PRIME-Z270-P Motherboard
VGA	ASUS GTX1070 8G GDDR5X
Audio	ASUS Gaming Audio
RAM	16GB DDR4 2133MHz Kingston
Storage	256GB intel® M.2 NVMe SSD + 1TB WD 7200rpm
Chassis	Cooler Master CM693
Power	750W PSU
ODD	SATA DVD-RW
OS	Windows 10 Home 64 bit
Extras	Gigabit LAN USB 3.0 SATA 3.0 NVMe RAID TI Professional System Tuning

TI PRIME GAMING 7600K \$1,599 (including GST)

CPU	Intel® Core-i5 7600K Overclocked
Cooler	Cooler Master Hyper 212 Super Cooler
MB	ASUS PRIME-Z270-P Motherboard
VGA	ASUS GTX1060 GDDR5X
Audio	ASUS Gaming Audio
RAM	16GB DDR4 2133MHz Kingston
Storage	240G Kingston SSD + 1TB WD 7200rpm
Chassis	Cooler Master K282
Power	750W PSU
ODD	SATA DVD-RW
OS	Windows 10 Home 64 bit
Extras	Gigabit LAN USB 3.0 SATA 3.0 NVMe RAID TI Professional System Tuning



ASUS MOTHERBOARDS, GRAPHICS CARDS AND PERIPHERALS

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Why SD cards refuse to flop

STEWART MITCHELL INVESTIGATES WHY SD CARDS CONTINUE TO SURVIVE, DESPITE REPEATED ATTEMPTS TO KILL THEM OFF

They've been banished from phones, tablets and MacBooks, and they cause consumers no end of confusion with myriad formats. Yet, the SD card continues to shrug off the repeated threats to its existence, with manufacturers such as Samsung having to eat humble pie and reintroduce SD card slots in their flagship phones.

Now, yet another new format is set to make SD cards even more pivotal in smartphone storage (see boxout). Why can nobody kill off these tiny chunks of storage?

CHAOTIC EVOLUTION

Understandably for a 16-year-old technology, SD cards have changed significantly since they first arrived at the turn of the millennium. Capacity has obviously increased significantly as storage density has improved, while card sizes have shrunk to the size of a toddler's fingernail. The initial SD card standard supported cards of up to 2GB, which was increased to 32GB with SDHC and then pushed up to 2TB with the SDXC, although all of them are largely referred to as SD cards in top-level marketing.

The situation is further complicated by a change in the underlying file formats used for writing information, making various cards and readers incompatible. "SDXC memory cards use the newer exFAT file system that's more efficient for SDXC's large capacities, while SD and SDHC memory cards use the FAT32," states card maker Lexar. "This is the reason the new SDXC format isn't backwards compatible with host devices that only take SD (128MB to 2GB) or SDHC (4GB to 32GB) cards."

This is made even more complicated by the fact that manufacturers and retailers continue to headline with capacity,



▲ Over the years, SD cards have increased in capacity and shrunk in size

▼ Apple would never countenance external storage for its iPhones

which only tells half the story. Slower cards mean poor performance if access rates can't keep up with app or media demands. "It's very confusing for consumers," said Ben Wood, head of research at analyst CCS Insight. "There are so many different classes and variables."

The SD Association (SDA) downplays the confusion, patronisingly suggesting that: "Before you buy a pair of shoes, you need to know your shoe size, so why would you buy an SD memory card without knowing what the various speed classes mean and the best uses for each class?"

The SDA breaks down cards into three classes: Video Speed Class (V), UHS Speed Class and SD Speed Class, but each of these is further stratified. The SD Speed Class includes C2, C4, C6 and C10 classes; the UHS Speed Class has U1 and U3 options; while the Video Speed Class is broken down into V6, V10, V30, V60 and V90 subclasses. It isn't exactly comparable to buying a pair of size 10 shoes from Clarks.

HARDWARE RESTRICTIONS

The cards themselves aren't the only variable, because controllers within handsets may also restrict data throughput or prove unable to support high-density cards, although such details are often buried in product manuals. "Although these new high-speed cards are available, you need to have a handset that supports them," said Wood.

"That can either be from the card's controller, in terms of being able to read and write at the correct speed, but also being able to cope with the higher-capacity cards. So cards might go up to huge densities but the reality is that not all phones will support those.

"It should be flagged on the memory cards, saying: 'You need to carefully check the devices you're going to use this on as to whether it's capable of supporting it'."



WAVERING SUPPORT

On top of the regular iterations of the format, Android handset makers and Google have also flitted between supporting expandable SD card storage and scrapping it in favour of faster, simpler on-board capacity. Android, for example, allowed apps to access the external storage, then it didn't, then it allowed consumers to "adopt" external cards as internal memory with the

“Manufacturers have argued that supporting cards adds another layer of complication that can lead to dissatisfaction”

Marshmallow update.

“The cards have always been available for people to store and enjoy their music, pictures, documents, and Android’s changes make it more clear about how microSD memory cards can be used to store and run apps,” the SDA told PC & Tech Authority.

Handset and tablet manufacturers have further complicated the SD ecosystem by temporarily removing card slots. “Samsung dropped external storage and then tiered its prices based on the amount of internal storage on the device,” said Ian Fogg, director of mobile at research firm IHS Markit. “With the S7, the company revived the microSD slot and that was very much based on feedback it received – it was a feature that was important to users and would help Samsung differentiate.”

The SDA claims that nine out of ten phones contain an SD card slot, but there is of course one firm that would never countenance support for external storage. “Apple is the notable exception and the general view is that it’s largely driven by commercial reasons,” said Wood. “It prices the iPhone largely on the memory configuration that people have and that’s a very effective way for it to maximise its margin on the devices.”

“If it allowed people to use removable storage, all of a sudden people could get a lower-capacity iPhone and then top it up with an extra memory card,” said Wood. “If you buy a 32GB iPhone and look at the difference between that and a 128GB one, and how much an SD card would cost to make up the difference, it’s an order of magnitude.”

APP-CLASS CARDS

Some of the confusion over SD cards in mobiles and tablets could soon be removed by a new class – yes, another one – dedicated to Android apps.

According to the SDA, Specification 5.1, or App Performance Class, should “eliminate buyers’ frustration with identifying app-running compatibility on their Android devices and microSD memory cards”.

The A1 symbol will be printed on packaging for both handsets and media, and show phones and cards

can handle the read-write speeds to make apps run smoothly from external memory.

“It’s positive news for people with an Android phone,” said CCS Insight analyst Ben Wood. “It will also tell you if the card you’re using doesn’t have the necessary performance, so it works well for manufacturers since they won’t have people using SD cards and having a disappointing experience. I’m surprised it hasn’t happened sooner.”



▲ Samsung received positive feedback when it brought back the microSD slot with its Galaxy S7 phone

Manufacturers have also argued that supporting cards adds another layer of complication that can lead to consumer dissatisfaction. “The downside with removable storage is that it adds complexity to the device and means that users who aren’t savvy may do things that cause the phone to behave unexpectedly,” said Fogg. “They may not realise where they’ve stored things, or remove the SD card at the wrong time; [they might] put it into another device and find the phone doesn’t work.”

DEATH ON THE DESKTOP?

It isn’t only mobile phone designers that have upset users by excluding SD card slots. Apple recently angered its customers by removing the SD card slot from the new MacBook Pro, despite the laptop’s popularity with photographers. Apple said the decision was in part because SD was “a bit of a cumbersome slot – you’ve got this thing sticking halfway out”, but the current alternatives and adapters hardly add elegance.

Rival PC makers also disagree with Apple’s stance on slots. “A major part of our business is photo-editing workstations, which we ship with SD card readers as standard,” said Ben Miles, sales director at PC builder Chillblast. “We wouldn’t dream of taking an SD card reader out of a photo-editing workstation; it’s an essential bit of kit for that market.”

In PCs, however, manufacturers can use card readers that overcome many of the compatibility issues with multiformat readers. “Everybody has their own standards – microSD and Memory Stick Duo and Duo Pro, and all these other formats,” said Miles. “We ship our systems with an all-in-one card reader that covers everything, so that regardless of what technology the customer has, they can hopefully read anything. Occasionally, there will be one that isn’t compatible with this new media. It’s frustrating that they don’t consolidate the forms into a single medium, but the SD card is becoming more and more standardised.”

If measures such as the new Application brand (see App-class cards, left) and clearer marketing at the point of sale can simplify this process, then the SD card might well have another 16 years in front of it. ●

IN THE LABS

You won't find better reviews anywhere in Australia!

The thing about GPUs

BEN MANSILL ON THE ORDER OF THINGS, DECISIONY THINGS

All graphics cards are not created equal. But as we all know, they're equal enough make the initial phase of the buying process driven by GPU, not brand. You say to your mates.

It's all about the GPU. We know that. So that's why with our Labs group test the whole idea was to get one of each of the main GPUs. We weren't driven by brand, which is why not every main player is included. But just because, say, MSI don't feature cards here means nothing in terms of our respect for the products it makes.

Which is why as tech fans we all look to the news from AMD and Nvidia first, and then to which individual card offers the extras we like most. These could be factory overlocks, maybe a game bundle, or interesting features like extra connectivity for VR or outputs that suit your particular rig. Good cooling plays a big role, too, as we all know - reference cards are nice for those who just can't wait, but did anyone ever really buy an Nvidia Founder's Edition 1080 for any reason

other than impatience? It certainly wasn't for the cooling benefits of that shroud...

When we do standalone reviews of graphics cards it's because something has caught our eye that needs closer attention.

M.2 SSDS ARE THE BEST

No, they're not. M.2 is a *form factor*, not a *protocol*. Far too often I hear people talking about getting an M.2 SSD to make their PC amazing. It is not M.2 that you should be referring to. M.2 has been around for many years, and the vast majority on sale today are based on the SATA protocol - as in, relatively slow and old - but of course are still much faster than a hard drive. The *NVMe protocol* is what's the best, and is the term that should be used when describing utterly kickarse new SSD drives. Let's all try and remember that. The new Samsung 960 Evo and Pro, as well as Intel's 750 (which has a U.2 interface) and OCZ's RD400 are NVMe. Most also happen to be M.2 - which is why so many people are equating M.2 with next gen performance,

and they think that M.2 is the new amazing thing. Again, it is not. But what it is, is complicated, so I have no issue with people making this simple mistake.

Confounding things a bit more is the *interface*. Which, in the case of these lovely new NVMe SSDs, is PCI Express Gen 3 x4. And you are welcome to also refer to speedy new SSDs as PCI Express Gen 3 x4. But that is a cumbersome set of letters and numbers, which is why we like NVMe better. But not M.2, which is tidier yet, but not specific enough.

Additional and unwelcome confusion comes into play with the NVMe SSDs that use PCI Express add-in cards as a *form factor* - in addition to the PCI Express *interface*. In this instance, they are cards that go into a PCIe slot, as opposed to M.2, which is a little card the size of your finger that goes into a dedicated plug on your motherboard.

So, there you have it. It is confusing, I know. By the way it's pronounced "m dot 2". I know... crazy.



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EDITORIAL & PRODUCT SUBMISSION: PC & Tech Authority welcomes all information on new and upgraded products and services for possible coverage within the news or reviews pages. However, we respectfully point out that the magazine is not obliged to either review or return unsolicited products. Products not picked up within six months of submission will be used or donated to charity. The Editor is always pleased to receive ideas for articles, preferably sent in outline form, with details of author's background, and - where available - samples of previously published work. We cannot, however, accept responsibility for unsolicited copy and would like to stress that it may take time for a reply to be sent out.

WHAT OUR A-LIST MEANS

Our A-List award is reserved for the best products in each category we review. With a winner and an alternative pick in each, that's 92 products you know are first class.

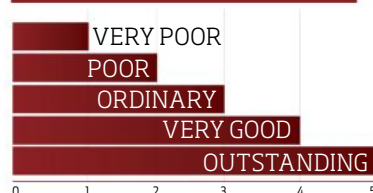


WHAT OUR AWARDS MEAN

PC & Tech Authority's comprehensive Real World testing sorts out the best products from the pack. Any product recommended by PC & Tech Authority is well above average for features, value for money and performance.



WHAT OUR RATINGS MEAN



HOW WE TEST

Our benchmarking tests are the best in the business. Read on to find how they work...

2D TESTS

Desktop PCs and laptops are tested using our own custom bench testing suite, which has been carefully designed to test all aspects of a system and rate them in a way that's useful to you.

Our benchmarking cover three main tests: a typical video editing test, a demanding 4K video editing test and a multitasking test that stresses all aspects of the system.

We look at the time it takes for each test to run, which is then compared to our reference PC to produce a normalised result. This score is shown on a graph, and to help you understand just where the PC we're reviewing sits in the grand scheme of things, we will often include other system's scores.

The median score of 100 is based on our reference system:

PC & TA REFERENCE PC. SCORE: 100

*Intel Core i5-4670K CPU; 8GB of DDR3 RAM;
AMD Radeon R7 260X graphics card*

On occasion we will run publically available bench testing software, predominantly PCMark 8 from Futuremark. This is run in the Home setting, in Accelerated mode. You can get PCMark 8 as well as 3DMark (below) from www.futuremark.com

3D TESTS

For video cards, as well as Integrated Graphics Processing Units, we use:

- **3DMark Firestrike**
- **Shadow of Mordor**
- **GRID Autosport**

3DMark is designed specifically to test video cards, and you can download and run the same tool as us to help you gauge where your own GPU ranks compared to what we are reviewing.

The two games were selected because they are relatively well balanced in performance between AMD and Nvidia, favouring neither. Both feature a wide range of DirectX 11 shaders. GRID Autosport is fairly easy on GPUs, while Shadow of Mordor is quite demanding, so each provides a helpful gauge for you showing what to expect from a GPU in your favourite games. We will update these to cover DX12 once that API gains traction.

Tests are run using three resolution ranges, depending on where the GPU sits in the market:

Entry level: 1920 x 1080

Mid-range: 1920 x 1080 – 2560 x 1440

High-end: 2560 x 4K

BATTERY TESTS

Screen brightness is set to 120cd/m2, playing a 720p video on loop until the device runs out of power.

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Acer Spin 7

THE WORLD'S THINNEST CONVERTIBLE.

Thanks to Intel's latest CPUs needing less power than ever, we're seeing an ultraportable market awash with spectacularly thin laptops that still deliver excellent performance at a price point that won't demolish your bank account. Between Dell's XPS 13, Razer's Blade Stealth and even Apple's latest MacBook, we've been spoilt for choice when it comes to laptops that are barely thicker than your average magazine. The latest to join this range is Acer's Spin 7, but unlike the rest it's also fully convertible, with a screen that is attached via dual 360-degree hinges.

This means it can operate in four modes – laptop, tablet, display or tent, making it far more flexible than many of the other ultraportables on the market. Unlike its competitors though, Acer has gone for a rather plain design, lacking the slick laser cut edges or bronze chassis of the others. There's a nice silver edge around the glossy touchpad, but that's about as stylish as thing gets – it's definitely not going to become a status symbol that others will notice.

It's also a little bigger than the competition when it comes to screen size. According to Acer, it sports

a "14-inch narrow bezel screen on a 13-inch chassis". Using a trusty ruler, we measured the diagonal size at 35cm, but the edgeless design makes it look even bigger. It's a 1920 x 1080 IPS panel that pumps out exceptionally vivid colours and a healthy dose of brightness. To do so they, Acer has resorted to a glossy finish, which many of you will know doesn't play well outdoors or in extra-bright environments. That's the trade-off for such an exceptional image quality though. It's also fully 10-point touch compatible, and the touch-accuracy is superb. There's also no sign of the grid-like lines that covered old-school touch-screens, though that's also true of the competition these days

As expected, Corning's Gorilla Glass has been used to ensure it'll handle a few knocks and bruises, while the chassis appears to be fully aluminium. As a result, it's a real lightweight, measuring in at just 1.2kg. Sure, that makes it about 220 grams heavier than some of the most portable laptops around, but it's still

light enough that you'll barely notice it in your handbag or briefcase. There's an external power pack, but it's not a behemoth, weighing

an extra 200 grams. This is connected via one of the two USB 3.1 Gen 1 ports – it'd be nice if the industry adopted a standard way of declaring the speed of each port, as some companies claim USB 3.1 is 10Mbps. In this case, the "Gen 1" tag declares that they're only actually capable of 5Gbps... which is still a darned sight faster than USB 2.0.

Acer has made a bit of a big deal about the Dolby-certified audio, but to be frank we found the twin stereo speakers rather prone to distortion at higher volume levels. It's not that surprising though, as this thing is incredibly thin. Measuring just 10.98mm in height makes it the slimmest convertible on the market (for now – we've seen another 2-in-1 that is even thinner due to launch very soon), which doesn't leave a lot of depth for quality speaker drivers.

A single 720p front facing camera is mounted above the display for video conferencing, which does the job, but we'd really like to see laptop makers move over to 1080p to match the displays that these videos are usually pumped out on. The integrated microphone is fully compatible with Microsoft's Cortana assistant, though as many Aussies will know, Cortana isn't exactly the best voice recognition software around.

Powering it all is Intel's CoreTM i7-7Y75 CPU, which boosts up to 3.6GHz when necessary. It's only dual core, but the addition of Hyper-Threading, alongside a healthy 8GB of DDR3L memory and a 256GB SSD (237GB usable) delivers excellent performance. Our overall PCMark 8 Home Accelerated score of 3046 puts it slightly below par with other laptops in this weight/size range, but not by a huge margin, likely because it's using a SATA 6 SSD instead of M.2. Battery life was not successfully tested as the machine crashed on each of the three day-long runs we attempted.

We can't deny how lightweight and configurable this convertible is... and yet it's not quite as spiffy nor good value as some of the competition. However, the fact that it's able to operate in several modes means you get a lot more options for the higher price.

Bennett Ring

KEY SPECS

\$1999 • www.acer.com.au

14-inch IPS 1080p display • Intel CoreTM i7-7Y75 CPU (twin-core, Hyper-Threading, 3.6GHz Turbo speed) • 8GB DDR3L memory • 256GB SATA 6 SSD

OVERALL



▲ Tent mode: perfect for media viewing on a cramped economy class tray table

Asus Transformer Mini T102HA

THIS COMPACT 2-IN-1 HAS THE SURFACE 3 IN ITS SIGHTS, BUT HAS A FEW TOO MANY IRRITATIONS TO DEFEAT IT



Laptop makers are lining up to shoot down Microsoft's Surface tablets, with the Asus Transformer Mini locking the Surface 3 in its targets, right down to its 1.44GHz quad-core Atom processor.

It's littered with ports. You'll find micro-USB for charging the device, mini-HDMI, USB 3, microSD ports and a 3.5mm headphone jack – all you need for everyday usage.

Around the back, a Surface-style kickstand converts the tablet into a laptop. I'd have liked to see rubber edges around the kickstand, to prevent it from sliding around, but had no issues using it either on my lap or on a wooden desk. Where it suffers compared to the Surface is build quality: it feels flimsy.

Then again, and unlike the Surface, the Transformer Mini has a keyboard and trackpad included in the price. This connects using a magnetic strip at the bottom of the tablet. Through ingenious design, the laptop's keyboard hoists itself up to the main body of the device, giving it a slant. This typing position feels more natural, but it is possible to lie the keyboard flat.

Heavy-fisted typists won't like the amount of keyboard flex when bashing keys, and with a plastic construction, compact design and plenty of rattle when you type, the keyboard isn't the Transformer Mini's finest feature. I found the touchpad temperamental due to its poor implementation of a multitouch input and cheap-feeling left/right-click buttons. In use, the cursor would disappear, then the trackpad would

pick up my left hand as a touch-input rather than a left-click action.

On the right-hand side of the keyboard, you'll find a small fabric loop that holds the bundled stylus pen in place. It works well, too. The pen comes with two customisable buttons and has a stylish brushed aluminium design.

Around the rear, a circular fingerprint sensor lets you log in using biometrics – convenient on such a portable device. The front hosts a 2-megapixel camera, which is useful for video calls, but the biggest surprise was how much power the stereo speakers provided.

Despite arriving long after the Surface 3, the Transformer Mini's display has a low 1,280 x 800 resolution – acceptable, rather than good, for a 10.1in screen. The same could be said of the IPS display's quality. With a 782:1 contrast ratio, a black level of 0.61cd/m2 and a low 73.7% sRGB coverage, it's a poor performer compared to its competitors (the Surface 3 has a 888:1 contrast ratio, 0.46cd/m2 black levels and 97.6% sRGB coverage). On the plus side, it can reach a bright 481cd/m2. This allows you to use the Mini outdoors in direct sunlight, although the glossy panel is highly reflective.

There's another bright side to this laptop, too: phenomenal battery life. It lasted more than 11 hours in our video rundown test. Combined with a weight of 790g, and compact dimensions of 259 x 170 x 14mm (WDH), this is a truly portable laptop.

The trade-off is a lack of speed,

▲ Asus bundles both a keyboard and stylus pen, but can't match the Surface 3 for build quality

▼ Does that kickstand design look familiar to you?



as shown in our benchmarks: an overall score of 12 is irrefutably low. It's multitasking that dragged it down – the Atom processor isn't helped by 4GB of RAM – with a photo-editing score of 22 indicating that apps running on their own will be smooth. Indeed, in general use Windows 10 ran well. Notably, though, the Surface 3 – released way back in March 2015 – was a smidgen faster with a score of 15 in our benchmarks, and it lasted for equally as long in our battery tests.

With the Surface 3 also boasting a superior screen and better all-round build quality, it retains an edge over the Transformer Mini – and once you factor in the price of the keyboard, the 128GB models are almost identically priced.

Nathan Spendelow

KEY SPECS

\$699 • www.asus.com/au

Quad-core 1.44GHz Intel Atom x5-Z8350 processor • Intel HD Graphics 400 • 4GB RAM • 10.1in, 1,280 x 800 resolution IPS display • 64GB eMMC storage • microSD slot • 2MP webcam • 802.11ac Wi-Fi • Bluetooth 4 • USB 3 • micro-USB • micro-HDMI • Windows 10 Home • 8,500mAh battery • 259 x 170 x 14mm (WDH) • 790g (with keyboard) • 1yr RTB warranty

OVERALL



➤ The stereo speakers are a highlight of the Transformer Mini





Lenovo Y710 Cube

SMALL, SEXY, AND SUPER-FAST... BUT NO SSD AS STANDARD?

Lenovo might be better known for its office and productivity PCs, but it's been making a go of the gaming market in recent times. Their latest shot at gaming greatness is the Y710 Cube, an almost-mini-PC that packs some decent hardware into a very small box. It's not quite small enough to tuck away behind your TV, but it's a far-cry from the tall towers most gamers are used to.

As you can see, it's certainly a stylish creation, with the angular lines and accented LED lighting systems that set gaming rigs apart from boring black towers. Yet it's not over the top in our humble opinion – you won't mistake your gaming room for a nightclub when all of the LEDs are illuminated. The actual dimensions are 393mm by 315mm by 252mm, but that also includes the 625W PSU; there's no need for a separate power brick. At the top of the case is a handle that makes lugging it around to LAN events a breeze.

A couple of high-speed USB ports and mic-in/headphone out adorn the top of the front, while the rear has many more connection options. These consist of four USB 3.0, twin USB 2.0, VGA, HDMI, Ethernet and a single PS/2 connection. There's also Killer Wireless AC 1535 802.11ac Wi-Fi built in, using a

2x2 antennae configuration. In addition to this are the video outputs offered by the graphics card, which consist of a single HDMI 2.0b, DVI-I and triple DisplayPort 1.3/4 ready.

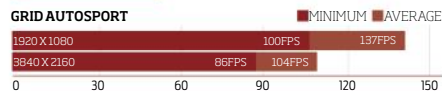
Removing the side panel reveals an extremely cramped interior – there's very little room to move if you want to do any major customisation. The motherboard appears to be a Mini-ITX board, and it's based on Intel's H170 chipset. As expected, the machine is available in a huge variety of configurations, and the model we

✓ The compact size makes it easily portable at the expense of room to easily upgrade inside



BENCHMARKS

GRID AUTOSPORT



SHADOW OF MORDOR



3DMARK FIRESTRIKE SCORES:

4K - 9129 1080p - 15852

reviewed came in at a price of \$2,999. For this you get Intel's 6th Gen Core i7-6700 CPU, and that's the only option for the CPU. Given the recent release of the 7th Gen CPU we'd expect to see an updated model in the near future; currently this machine is limited to the 4GHz Turbo of this quad-cored, Hyper-threaded chip, which is more than enough for today's games. Alongside this is 16GB of 2133MHz DDR4 memory.

The main horsepower however is delivered via Nvidia's GeForce GTX 1080, which appears to be a basic Nvidia-branded model. As we all know, this delivers oodles of performance, and makes up a good third of the price of the review unit. If that's overkill, you can opt for a Radeon R9-370X or Nvidia GeForce GTX 1070 instead, which will shave a big chunk of change off the price. Our machine game with a single 2TB mechanical hard drive for your long-term storage needs, yet there wasn't any sign of an SSD, which is an optional extra. At this price even a small 256GB SSD should be a given, and we really noticed the performance difference when it came to desktop operation and game loading times.

Given the fact that the case sides are all basically giant grills, we were pleasantly surprised by the lack of fan noise, which came in at 44dB. However, there is a slightly high whine emitted by one of the cooling fans. Given the level of hardware within, the performance was top-notch, even delivering playable 4K performance in Shadow of Mordor.

There's no denying that there are slightly better value systems on the market, but they're substantially bigger and louder than the Y710. If you value a smaller gaming system that is easy to lug around, and doesn't sound like a hair-dryer, Lenovo has delivered the goods, although the lack of an SSD is a bummer.

Bennett Ring

KEY SPECS

\$2,999 - www.lenovo.com

Intel 6th Gen Core i7-6700 CPU • 16GB 2133MHz DDR4 memory • 2TB HDD • Nvidia GeForce GTX 1080

OVERALL



USB Hub... but not as you know it!



VOLANS HM04

4 Port USB3.0 Hub Tailor-made
Design for iMac



Asus ZenBook 3

NOT QUITE AS SLICK AS THE MACBOOK IN ITS SIGHTS, BUT STILL A TEMPTING WINDOWS 10 ULTRAPORTABLE

The Asus ZenBook range has always been – let's put it politely – a homage to Apple's MacBook Air. Nowadays, though, that brand is no longer a byword for thin-and-light portability, so the new ZenBook 3 takes its inspiration instead from the 12in MacBook.

If the MacBook is the target, the ZenBook 3 certainly hits the mark. Look past the brushed swirl on its aluminium-alloy lid and you could almost get the two laptops mixed up. Even the colour options are eerily familiar. Alongside the distinctive Royal Blue trim, as pictured above, the ZenBook 3 can be ordered in a pale Quartz Grey or the ever more popular Rose Gold.

The ZenBook 3 isn't a precise duplicate, though. Measuring 11.9mm deep, it's very slightly slimmer overall than the MacBook. At 910g it's 10g lighter, too, and while the chassis is a very similar size, the overall shape is a little more stretched, to accommodate a 12.5in 16:9 display (as distinct from the MacBook's 16:10 panel).

SPEED BOOST

While the ZenBook 3 resembles the MacBook outwardly, its internals are more ambitious. In place of a Core m3 CPU, Asus has gone for a Kaby Lake dual-core Core i5-7200U, which is what we've reviewed here. A more powerful i7-7500U is also available. While this isn't as powerful as a desktop Core i5, it's a decent performer, and it's impressive to see it crammed into such a tiny frame.

Partnering this is 8GB of RAM and a 512GB SATA SSD as standard. This drive isn't as speedy as the MacBook's PCI-E storage, but it's fast enough to keep everything feeling responsive. It all adds up to a laptop that's more capable than its size would suggest. The Core i5 model achieved an overall score of 43 in our benchmarks – a big performance advantage over Apple's Core m3-based MacBook, which managed only 24.

There's even a moderate degree of graphical power on hand, thanks to Intel's seventh-generation HD Graphics 620 GPU. You won't be playing Doom with all the bells and whistles enabled on this little laptop, but an average of 52fps in the GFXBench 1080p Manhattan benchmark indicates there's plenty of juice for casual games such as Minecraft or The Sims. For comparison, the MacBook

achieved only 31fps in the same test.

SLIM PICKINGS

Before you get your wallet out, there are drawbacks of which you should be aware. First, like the MacBook, the ZenBook's only connector is a single USB Type-C port, a consequence of that super-thin design. A dangly adapter is included in the box, allowing you to hook up USB-A, USB Type-C and HDMI cables, but without this you can't connect a peripheral and charge the device at the same time. That could be an issue, because battery life isn't great. In our tests, the ZenBook 3 lasted 6hrs 52mins away from the mains, which is a long way behind the 10hrs 12mins achieved by the MacBook. That probably has much to do with the active internal cooling system demanded by the Core i5 processor: the MacBook's Core m3 gets by with passive cooling.

The keyboard has nice big keys, with an impressive 0.8mm of travel, but I'm not a fan of the slanted yellow labels on the Royal Blue test unit Asus sent in, which to my eyes cheapen the overall design. It also has more give in the middle than I'm comfortable with, and lacks a positive clicking action.

Finally, let's talk about the screen on the Asus ZenBook 3. Mostly, the news here is good: we measured its peak brightness at 360cd/m², effectively on a par with the MacBook's 367cd/m², and the 1,000:1 contrast ratio gives superb solidity to text and pictures. Colour reproduction isn't bad at 85% of the sRGB gamut, although the MacBook is ahead on 92.6%.

Its resolution, however, is a bog-standard 1080p, giving the ZenBook 3 a

✓ The Royal Blue finish is the most distinctive of Asus' colour choices – but it won't be for everyone



pixel pitch of 176ppi – far lower than the 227ppi of the MacBook's Retina display. As a result, the Asus ZenBook 3 doesn't quite achieve the pristine smoothness of Apple's screen. It's by no means blocky, though. Unless you put the two laptops side by side, you're unlikely to find any cause for complaint.

I should also mention that this isn't a touchscreen. This is for the best considering how light the whole unit is: try to prod the display and the entire chassis rocks backwards. Not that I can complain about a laptop that weighs 910g.

FINAL CHAPTER

If you're in the market for an ultraportable then you'll no doubt have eyed up the 12in MacBook. However, you may well have been unsure whether the Core M processor will meet your needs – or, indeed, unsure about switching to macOS.

The ZenBook 3 makes a very interesting alternative. It's just as compact and almost as beautiful; it runs Windows, and it offers significantly better performance.

There are trade-offs, for sure. One of the MacBook's killer features is its exceptional battery life, and the ZenBook 3 doesn't come close. The keyboard and trackpad don't have such a premium feel, and the single USB Type-C port feels like a missed opportunity, even with the adapter in the box. If you're not sold on the Apple MacBook Air, the ZenBook 3 provides a variation on the theme that could be exactly what you're looking for.

Darien Graham-Smith

KEY SPECS

\$2,299 (i5); \$2,699 (i7) • www.asus.com/au
Dual-core 2.5GHz Intel Core i5-7200U or 2.7GHz i7-7500U processor • Intel HD Graphics 620 • 8GB RAM • 12.5in, 1920 x 1,080 resolution LED display • 512GB SATA SSD • VGA webcam • 802.11ac Wi-Fi • Bluetooth 4 • USB Type-C • Windows 10 Home • 40Whr battery • 296 x 191 x 11.9mm (WDH) • 910g • 1yr RTB warranty

OVERALL





Panasonic Toughpad FZ-A2MK1

TOUGHER THAN A BRICK DUNNY

There's a reason why Panasonic's Toughbook range of ruggedized PCs are used by some of the world's most elite special forces. When it comes to surviving a life less travelled, be it in tropical jungles, dusty deserts or icy-cold climates, nothing comes close to the reliability of these devices. The Toughpad FZ-A2MK1 takes Panasonic's experience with indestructible construction and brings it to the Android tablet market. This is without doubt the toughest 10.1-inch Android tablet around, but the result is a price that is exponentially higher than standard 10.1-inch tablets.

When it comes to the conditions this thing can handle, it's been tested to a variety of specifications. It carries IP-X5 water resistance, which means it can handle being sprayed with water projected from a 6.3mm nozzle with no harmful effects. It can operate in temperatures between -10C and 50C, or stored in conditions varying from -20C to 60C, perfect for those high altitude

parachute drops into the middle of the warfield. It's also got a dust resistance rating of IP-6X, the highest possible, making it impenetrable to the fine grit found on mining sites. As for drop testing, the rating of 120cm might not sound that impressive, but we reckon it'll probably handle even higher drops, as Panasonic is known to be fairly conservative with its protection ratings. Despite all of the added protection, it's still relatively light, weighing in at a mere 880 grams.

The rest of the system hasn't suffered as a result of the ruggedized construction. The 10.1-inch touch-screen is a Full HD 1920 x 1080 screen, and is extremely bright, measuring up to 800cd/m2. Combined with the matte finished screen, and it's easy to read this under the harshest blazing sky. Intel's Atom x5-Z8550 processor handles the hard work; this little quad-cored beast cranks up to 2.4GHz, yet only sips a mere 2W under most workloads. This results in a claimed real-world battery

life of up to 9 hours, but our PCMark Android battery test pegged it at 260 minutes. Built into this CPU is Intel's HD Graphics 400, so don't expect it to churn through especially demanding 3D applications. The 4GB of memory might sound slight by PC standards, but is pretty average for this sized tablet. One area that is lacking though is the built in storage, with just 32GB of eMMC storage. Thankfully this can easily be expanded via the Micro SD SDXC Memory Card slot. The Android 6.0 Marshmallow operating system makes it compatible with a huge range of applications. Our PCMark Android Work 2.0 benchmark clocked in at 4641, which is very respectable compared to other 10.1-inch tablets, and places it in the same ballpark as a Samsung Galaxy Tab S2.

Every port comes with a cover to keep the nasties out, and there are the requisite connections to do the basics. A single HDMI output delivers video, while there are two USB ports. One is the standard USB 3.0 Type-A, while the other is USB 3.1 Type-C. A single headphone connector is your only audio option, though the tablet does also include integrated speakers that are surprisingly loud and clear.

The version we reviewed, which costs \$2199, lacked a few of the optional extras. There's a 4G/LTE mobile broadband with 12 channel GPS module, or you can opt for a more affordable singular GPS module. There's also a hot-swappable battery operation for those longer field missions, as well as a desktop dock that delivers extra connectivity. If you want Ethernet, you're going to have pay extra for that – most users will be happy with the integrated 802.11ac Wi-Fi, though there's no information on what kind of antennae configuration it uses, which leads us to believe it's likely a 2x2 setup.

There's no denying this tablet is damned expensive, but if its durability means you don't need to keep replacing broken tablets every few months, that cost will be easy to justify. It's overkill for most of us, but those who need a tablet that can take a beating should take a close look at this brute.

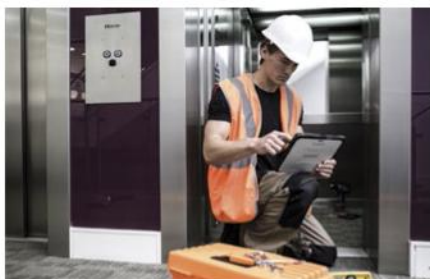
Bennett Ring

KEY SPECS

\$2199 • www.panasonic.com

Intel Atom x5-Z8550 Processor (quad-core, 2.4GHz) • 4GB RAM • 10.1-inch Full HD multi-touch screen • 32GB eMMC main storage

OVERALL





Shuttle DX30 Barebones mini-PC

A PLEASANT LITTLE 4K SURPRISE

When we first received the pitch email about this product, we were quick to dismiss it. Positioned as a mini-PC designed to power retail displays, it seemed to be rather irrelevant to our audience – we're pretty sure that specific audience reads "Point of Sale Monthly". However, after taking a quick glance at the specs, we realised we'd found a hidden nugget of gold that would actually work pretty damn well as a media PC, for an incredibly low price. Let's explain why this mini-PC is actually much more capable than something designed to deliver images to large displays in the middle of a shopping centre.

At the heart of this tiny box is Intel's new Apollo Lake architecture, in the form of a J3355 CPU Processor. This was released in the tail-end of 2016, making far less of a splash than the new Kaby Lake processors, and it falls under the Celeron brand. Now, according to Intel's very own website, all Celeron processors shouldn't be capable of delivering 4K video. However, the SoC Celeron chip in the DX30 does indeed support hardware acceleration of a wide-range of video codecs; H.264, VC-1, WMV9, HEVC and VP9. It seems that the Intel website might need an update...

Compared to most desktop CPUs, this chip looks like a very underpowered critter. With a Turbo frequency of just 2.5GHz and a maximum TDP of a mere 10W, this is no i5-killer. But the secret ingredient here is Intel's integrated HD

500 (Gen 9) graphics, which have been overhauled since the last version; Intel claims a 45% performance upgrade over the previous generation. The two video outputs come in the form of HDMI 1.4 and DisplayPort 1.2. The good news is it that even this aging DisplayPort 1.2 port can handle a single 4K stream at 60fps, though the HDMI 1.4 is limited to 4K at 24Hz. Unfortunately there's no support for HEVC Main10 with this CPU, unlike Kaby Lake, which means it won't be able to handle Netflix's 4K streaming service, thanks to its stringent security.

The other outputs on the rear of this tiny box (194mm long by 160mm wide by 43mm tall) consist of four USB 2.0 outputs, a PS/2 port for your keyboard, Gigabit Ethernet, and twin RS232 outputs (one of which also handles RS422 and RS485). On the front side are twin USB 3.0 Type A connections, perfect for hooking up your remote control dongle. Thanks to the chips extremely low power usage, it uses a fanless cooling system, so there's absolutely no noise from the system when it's in operation.

Like most Shuttle boxes, you're going to need to add a few extras to get it off the ground. Firstly, there's no memory, with twin DDR3L SO-DIMM slots ready to handle memory speeds of up to 1866MHz with a maximum capacity of 8GB. So that's another \$80 or so to the equation. There's also no hard drive, and you've got two options for fulfilling this need. A standard SATA 6Gbps connection will

handle a 2.5-inch drive, while there's also an M.2 slot for speed demons. The good news is that utilising the M.2 port doesn't require you to remove the integrated 802.11b/g/n card, which has its own dedicated port. An external power pack is included, but it's tiny, so you won't need to worry about hiding it. In fact, the entire box is small enough to fit onto the back of most TVs, provided they come with a compatible VESA mount.

If there's one issue with using this as a media player, it's the Realtek ALC662 sound chipset. According to Shuttle, this is only capable of 2-channel high definition audio, but heading to the Realtek website reveals that it's actually ready for 5.1 channels. Again, it seems somebody needs to update their website...

With a total cost of ownership of about \$400, this is a nice little jewel that we've uncovered. It's totally silent, very small, and ready for 4K playback, making it an ideal media player to stream your 4K content over your home network.

Bennett Ring

KEY SPECS

\$279 · www.global.shuttle.com

Intel Celeron J3355 CPU Processor (2.5GHz Burst Frequency, 10W TDP) · 1 x HDMI · 1 x DisplayPort · Requires DDR3L SO-DIMM memory (twin channels, maximum capacity 8GB at 1866MHz) and hard drive (2.5-inch SATA 6Gbps or M.2).

OVERALL





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Wacom Intuos Pro Paper Edition

NICE HARDWARE, NOT SO MUCH THE SOFTWARE

For artists and designers used to drawing directly onto paper, the Wacom Intuos Pro (Paper Edition) must appear to be an attractive entry level digital illustration tool. But the traditional “scan a drafted sketch then paint it digitally” approach using standard affordable drawing tablets has generally satisfied those creatives who prefer the feel of a pen scratching on paper.

So what exactly does the Wacom Intuos Pro Paper Edition offer beyond what a standard tablet and a decent scanner has already been doing for us? Admittedly the product idea is appealing. I can draw directly onto paper and this special Wacom ink pen automatically transmits that sketch directly to my computer. How cool! Only...it isn't nearly that easy, straight forward or satisfying. First the good stuff though, the hardware is really cool.

The Paper Edition of the Intuos Pro improves on Wacom's standard tablet design. There seems to be very little wasted surface area and the ratio of drawing space to plastic expanse of tablet is finally entering the realms of sanity (so many inches of wasted plastic and so little

drawing space on those older tablets!).

Plus the edition comes with a whole suite of new toys. The package is divided up into two halves. The left half contains all the materials associated with the paper ink drawing functions of this tablet and the right side of the packaging supplies all the tools you would usually find included in the standard suite of Wacom drawing tablets. If you were hoping to find some documentation explaining how the paper transfer works or what you need to do to start working effectively quickly... you won't find it in this box. What is provided is a tiny foldout of illustrated instructions (Ikea style) that provides little more than a “plug this into that; in this order; then logon to this website for reasons” diagram.

If all goes well, plugging your new Intuos Pro Paper Edition directly into your laptop or computer should result in all necessary software getting downloaded automatically. Otherwise Google “Wacom Intuos Pro Paper Edition Drives” and “Wacom Inkspace Application”.

In order to use this tablet for its intended



purpose of drawing directly onto paper and having that drawing transfer across digitally, you'll need to install Wacom's Inkspace App, either during initial setup or after a bit of Googling. And this is where I have to question the logic behind such an expensive device that effectively operates just to replace the scanner in the “sketch a page” and “paint the page digitally” equation. Because Inkspace is a horrible program. For one, you will be stuck in a loop of tutorial screens that you can't close, cannot minimise and will only be able to get rid of once you've figured out how to create your first drawing.

Apparently Inkspace performs some kind of check to see whether or not it should lock you up in tutorial screen limbo: “is there a drawing file created? Yes? Then this user is wise and does not need our finely crafted tutorial presentation” or “is there a drawing file created? No? Then surely this user has never touched the program before and we must educate them continuously!”

It's possible to get out of this loop, but before you can use your new digital drawing you have to export it from Inkspace and then open it in your drawing program of choice to be able to edit and work with it. You know, exactly as you would if you had just scanned the sketch.

This tablet would have scored even lower for the reasons listed above except for the potential for this to be a great mid-tier tool for artists who want to capture that drawing on paper feeling, but can't yet afford the Mobile Studio Pro or Cintiq Companion tablets.

Ethan Strange

✓ Because I keep banging on about how this particular tool provides very little that a sketchpad and scanner doesn't, here's an example of what the same sketch looks like from one transferred into Wacom's Inkspace via the Paper Edition drawing tablet and from scanning that same sketch in at 300dpi on a colour scanner



**Wacom Intuos Pro
Paper Edition [Medium]**

**Scanned Sketch
300dpi, A4 colour scanner**

KEY SPECS

\$549 • www.wacom.com

338 x 219 x 8 mm • 8 ExpressKeys • Built-in Bluetooth connectivity

OVERALL



4G LTE

Vigor2860L Series

Mobile Internet Solution for Small-to-Medium Businesses

4G LTE Multi-WAN router with SIM card slot (150/50 Mbps),
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- 6 x Gigabit LAN ports with 50,000 NAT sessions
- Load Balancing or Failover backup with ADSL/VDSL/Cable/Ethernet Broadband
- Built-in 802.11n Wireless for Vigor2860Ln
- Supports IPv6 standard
- Object-based SPI Firewall with Content Security Management (CSM)
- Supports QoS functions

- 32 x VPN and 16 x SSL-VPN tunnels with Load Balance and Redundancy
- Central VPN Management
- 1 x USB port supports 3G/4G modem, FTP server, network printer or temperature sensor
- Central AP Management
- Supports Smart Monitor Traffic Analyzer (up to 30 nodes)
- Supports VigorACS SI Central Management (TR-069)

4G LTE Specifications

- LTE/4G category 4
- 150 Mbps downstream and 50Mbps upstream
- 4G LTE band 800/900/1800/2600 MHz
- HSPA+ Band 1/8



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Benq Zowie XL2540 e-Sports monitor

ONLY FOR THE SERIOUS SPORTS GAMER

A huge component of marketing PC hardware is the numbers game. The bigger the number, the better the product. Benq's new XL2540 blows other monitors out of the ballpark with one figure in particular – the astonishing refresh rate. This speed-demon cranks out the frames at an incredible 240Hz, which the fastest we've yet seen. The question is whether or not such a high-speed is really necessary, even in the hyper competitive world of e-Sports?

Measuring 24.5-inches across the diagonal, it's not an exceptionally large monitor, though the 1080p resolution means it's not too hard to spot the pixel structure. A matte finish matches the relatively plain yet attractive stand and bezel design. Unlike many of today's monitors, it doesn't utilise an edge-to-edge screen, with a rather thick 12mm bezel around the edges. A pair of plastic flaps are included that can be attached to each side, so your competitor can't glance over at your screen mid-match. It's also a handy way of obscuring any annoying light sources that might be at the venue, or take your mind off the hundreds of

people in the crowd ahead. The stand itself is fully height and angle adjustable, making it easy to position in the exact ideal position.

As with Benq's prior high-speed monitors, it uses Blur Reduction technology, but is now referred to as Dynamic Accuracy technology. We used the benchmarks at www.blurbusters.com to see how well this worked. It turns out that this technology is highly reliant upon being served 240 frames per second by your GPU. Any lower and blurring becomes extremely apparent. Unfortunately it seems that Benq has removed the ability to lower the strobing of the backlight, unlike past models, which means this blur is here to stay if you can't hit 240 fps.

The panel in use is a TN panel, picked solely for its ability to hit a 1ms grey to grey response time. While other monitor technologies are getting close to this, they're still not up to the necessary speed required to hit 240Hz. Unfortunately the use of a TN panel also brings several drawbacks with it. Nearly every display we've tested in the last 12 months has

been based on IPS technology, and the difference in colour quality and contrast is night and day.

We used the LCD tests at www.lagom.nl to check these out and noticed several immediate issues. Firstly, the contrast test shows that brighter blues and greens tend to meld together, lacking the clear differentiation found on IPS panels. Colours in general are also not as vivid or punchy as competing IPS displays. While

“Benq's new XL2540 blows other monitors out of the ballpark with one figure in particular – the astonishing refresh rate”

the white level test showed this display can handle subtle changes in brightness, it didn't fare as well in the black level tests, with darker blocks of colour all merging into one. Turning the display's Black eQualizer feature on relieves this symptom, but at the cost of making the rest of the image appear slightly washed out.

As with Benq's last gaming monitor, a small hub is included that sits on your desk, called the S-Switch. This makes it easy to change various pre-programmed profiles on the fly with the click of a button. We only wish the On-screen Display was a little more intuitive to use, based on old-school tactile buttons which change in purpose depending on which part of the menu you're using.

At \$699, this is one of the most expensive 24-inch displays on the market, but it's targeted at an extremely specific audience – those who need the ultimate in twitch gameplay. Whether or not the difference between 144Hz and 240Hz will make a real world difference is debatable – but for those who are playing for tens of thousands of dollars it's worth trying out the difference. However, you're going to need to maintain a consistent 240 frames per second, and the drop in colour quality means it's not suitable for general gaming.

Bennett Ring

KEY SPECS

\$699 • www.benq.com.au

24.5-inch 1920 x 1080 display; 240Hz refresh rate; 1000:1 contrast ratio; 1ms gtg response time

OVERALL



Kano Computer Kit Bundle

THE "BUILD IT YOURSELF" BILLING MAY NOT BE 100% ACCURATE, BUT THESE KITS ARE REDEEMED BY EXCELLENT SOFTWARE

Kano, an education-focused company, had a huge hit on Kickstarter with its original Computer Kit, promising to provide everything you could need to "build your computer bit-by-bit".

The truth is somewhat different. Inside this, Kano's second Computer Kit Bundle, you'll find that the computer you're "building" is actually a fully assembled Raspberry Pi 3 single-board computer, with only power and its microSD card required to get it up and running.

The bundled full-colour manual – which Kano dubs a "storybook" in keeping with its desire to engage children – walks you through the "building" process using simple terms and clear illustrations. Insert the microSD card, snap together the two halves of the included case, and then the most daunting step: connect the power cables for a small speaker and amplifier that's set into the lid of the case onto the 5V and ground pins of the Pi's general-purpose input-output (GPIO) header. After that it's simply a case of inserting the bundled wireless keyboard's USB dongle into a free slot, plugging the speaker into the 3.5mm audio-visual jack, and connecting power and a display.

It's the need to provide your own HDMI-compatible display that Kano addresses with the second half of its bundle: the Screen Kit. Emblazoned with the promise that you'll "make an HD screen," it's more accurate to say you'll snap the pre-assembled screen into a plastic stand, fasten a PCB with buttons onto the rear of the case using the supplied sticky

▼ There's no getting away from the fact that this is essentially a rebadged Raspberry Pi 3



hook-and-loop tape, connect a linking wire, then snap your cased Kano to the rear before connecting USB power and a short HDMI cable.

Initially, then, the Kano experience is underwhelming, even allowing for the accessible nature of the "storybooks" and their occasional divergence into theory and foundational knowledge. Thankfully, this feeling is soon swept away when you power up the kit and are greeted by Kano OS, in what looks like an EGA DOS prompt from the 1980s.

For younger users, this part will require adult supervision: the first boot walks the user through basic Linux terminal concepts, changing directories and running a program, using a Matrix-themed hook. When the program is executed correctly, the terminal is replaced by a top-down 8-bit-style roleplaying game reminiscent of Nintendo's finest, in which the player must progress towards the goal to load Kano OS proper.

Following this, and directly on subsequent boots, the Kano OS interface appears. Available in an icon-heavy default and more traditional desktop environment flavours that are switchable at will, this provides quick access to the bundled software as well as a means of managing a user account. This can be tied into Kano's cloud servers for achievement tracking and software sharing.

The bundled software is heavily slanted towards coding. Many of the default apps are prefixed with "make" to emphasise this practicality, using a Scratch-inspired drag-and-drop interface suitable for younger programmers. Make Art, as the name implies, offers a turtle-style artistic experience; Make Apps is more open-ended; Make Minecraft

works around the bugs of the Alpha-status Minecraft Pi Edition to allow users to easily build their own programmatic creations within its blocky world.

The jewel in the crown is Kano's Story Mode. An extended version of the RPG from the initial boot introduction, this guides the player through various computing concepts in a way that's both endearing and engaging. There's an equivalent for the command line, too, dubbed Terminal Quest.

Sadly, all this – and the bundled stickers for customising your Kano cases – fails to justify the cost of the kit. At US\$299 for the bundle, or \$149 each if the Computer Kit and Screen Kit are bought individually, the Kano kit is considerably more expensive than a Raspberry Pi 3, official touchscreen and accessories – and lacks their touch capability.

Kano's decision to release the Kano OS, built on Debian Linux, as a free download that can be installed onto any Raspberry Pi means that, for less than half the price of the Kano kit bundle, you can have a touch-enabled version lacking only the storybooks, stickers and built-in speaker. That makes it tough to recommend.

Gareth Halfacree

KEY SPECS

US\$299 • www.kano.me

Raspberry Pi 3 (quad-core 1.2GHz Broadcom BCM2837 processor, 1GB RAM, 8GB storage) • 10.1in 1,920 x 1,080 screen • 8GB SD card • HDMI cable • custom case and display chassis • DIY speaker • wireless keyboard and trackpad • "Storybook" manuals and stickers • Kano OS • 1yr RTB warranty

OVERALL



OnePlus 3T

DESPITE A HIGHER PRICE THAN THE ONEPLUS 3, AND A DEARTH OF NEW FEATURES, THE 3T IS STILL A GEM OF A PHONE

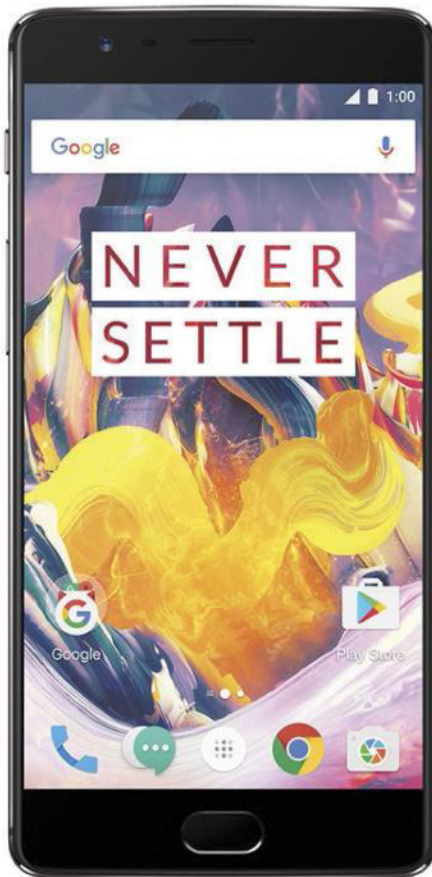
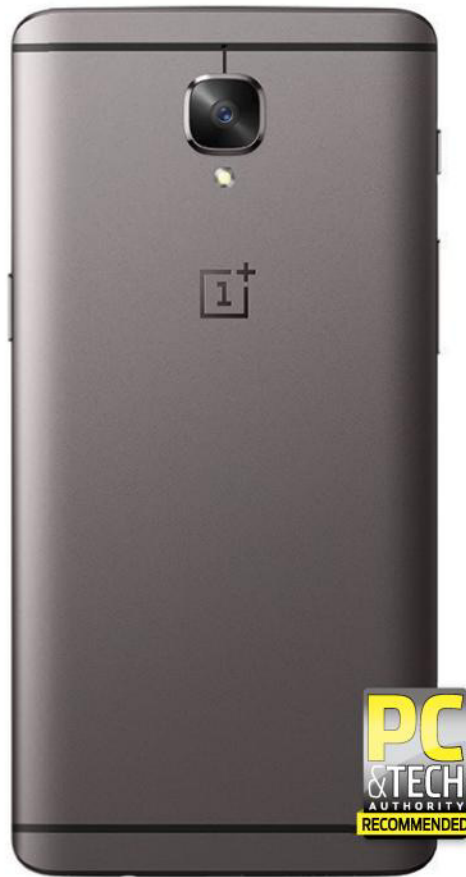
The OnePlus 3 set a new standard for reasonably priced smartphones when it was launched in June 2016. Offering an incredible combination of premium specifications and a \$500 price, it carved out a whole new category; it was so good it had no close rivals.

Now, however, the OnePlus is ending the honeymoon with the OnePlus 3T, a replacement flagship smartphone with a faster processor, a bigger battery and, on paper, a vastly improved front camera – but also a much higher price.

So what's new? From a physical perspective, hardly anything. Like the "S" versions of Apple's iPhones, all the important improvements have taken place beneath the surface. That's fine by me: I liked the design of the OnePlus 3 when I first saw it, and I'm still a fan. The OnePlus 3T is almost identical to its forebear, available in the same range of colours, with an attractive anodised metal chassis with grippy, chiselled edges.

This is an area where the OnePlus 3T forges ahead of even more expensive phones such as the Google Pixel XL and the iPhone 7 Plus (although perhaps not the Samsung Galaxy S7 and S7 Edge). Those chamfered sides create more friction between the skin on your palms and fingers and the phone's aluminium shell, meaning you're less likely to drop it.

The one external difference between the OnePlus 3T and the original is its slightly flattened rear panel, and a tougher sapphire crystal lens cover for the camera. Otherwise, it's as you were: a dual-SIM tray resides on the right-hand side, just above the power button; on the left edge lives the phone's three-way, do-not-disturb switch and volume rocker; and



the bottom hosts a six-pinprick speaker grille, the phone's USB Type-C port and a 3.5mm headphone jack (thankfully, not jettisoned for the sake of modernity).

BOOSTED SPEC

Not that a huge amount has changed inside, either. A 2.35GHz Qualcomm Snapdragon 821 processor replaces the 2.15GHz Snapdragon 820, but there's still 6GB of RAM and Adreno 530 graphics. That isn't much for a \$200 price boost, although the new 128GB storage option is tempting if you can stretch to \$720. Is it worth the extra over the original? Well, no, but this will soon be a moot point. Stocks of the OnePlus 3 are already running out.

And, judged on its own merits, this is still an extremely generous specification for the money. There's no other smartphone at this price that comes close. We like the Lenovo Moto Z Play for its superlative battery life and clever modular accessories, but it can't match the OnePlus 3T for power (see the graphs, opposite).

▲ Can you spot the difference between the 3 and the 3T? Other than the price, that is

Don't expect a big speed leap over its predecessor. Qualcomm says by offloading more of the HDR+ processing from the CPU to its Hexagon DSP, the camera should capture HDR images more quickly – but that's about it. In use, both phones feel equally responsive and can play any modern mobile game without breaking a sweat.

In benchmarks, there's a difference between the 3T and its predecessor, but overall it's still a good distance behind the Samsung Galaxy S7 and its octa-core Exynos 8890 chip. The picture improves if you factor in price, of course. The graph displaying Geekbench 4 points per pound shows just how far the OnePlus 3T's price shifts the balance.

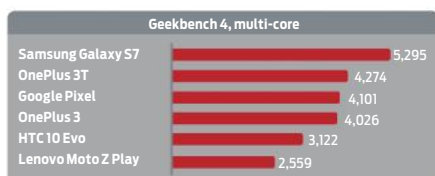
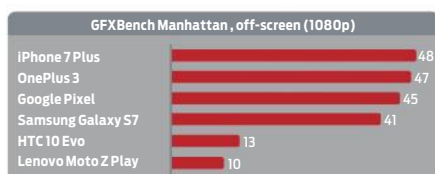
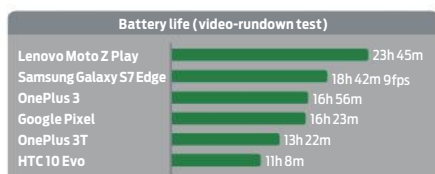
Here, the soon-to-be-no-more OnePlus 3 leads the pack, the OnePlus 3T is a clear second, with the Samsung Galaxy S7 a distant third. As for graphics performance, the two OnePlus phones are almost identical, which is hardly surprising given that they both use the Adreno 530 graphics chip. The Samsung Galaxy falls behind in the onscreen test because its 2,560 x 1,440 display requires much more graphics grunt to drive.

BATTERY OF TESTS

Battery life is a touch better in the 3T than

✓ It's good to see the 3.5mm headphone jack is retained for this mini-update





the 3, with a larger 3,400mAh battery in place, but this is one area where the benchmarks are misleading. The OnePlus 3T actually returned less impressive results than its predecessor, lasting 13hrs 22mins to the OnePlus 3's 16hrs 56mins, but this anomaly wasn't backed up in everyday usage. Here, I consistently found the 3T lasted a couple of hours longer.

One indisputable fact is that, once the battery runs dry, the OnePlus 3T charges fast. OnePlus claims the phone will deliver "a day's charge in half an hour" when connected to the mains, which sounds impressive until you examine it closely. Exactly how long a given amount of charge is likely to last you will depend on how you use the phone, where you use it, what the network conditions are and so on.

However, I can report that it's impressive. Starting with a capacity of 49%, half an hour connected to the mains ramped up the charge to 92%, with the phone hitting 100% capacity 24 minutes later. So, that's almost half the battery in half an hour; pretty darn good, but probably only a day's use if you're really careful with it.

It's also worth bearing in mind that the Dash Charge system the OnePlus 3 uses is proprietary and not

compatible with any other system, such as Qualcomm's Quick Charge. To get these rates of charge you'll have to use the power adapter and cable supplied in the box.

REFINED DISPLAY

I wasn't particularly keen on the screen on the OnePlus 3, at least not to start with. The colours were too lurid and unrealistic for my liking, and certainly far from accurate.

OnePlus fixed that with a software update, adding the option to select an sRGB colour mode in Developer options, and the OnePlus 3T takes things a step further by introducing a new Screen Calibration section in the phone's Display settings. Users can now choose from Default (a slightly less lurid version of the OnePlus 3's original colour profile), sRGB and Customise options.

It's good to have those options, but the display's vital statistics remain unchanged. You're getting a 1,920 x 1,080 AMOLED screen with a maximum brightness of 421cd/m2 and perfect contrast, and it's an excellent display in any of these modes. It's crisp, colours are vibrant, and its new sRGB mode delivers a decent 93.2% coverage of the colour space.

The only slight disappointment for those thinking of investing in a VR headset is that the 1080p resolution (401ppi) won't look anywhere near as sharp up close to the eye as a phone with a higher resolution such as the Google Pixel XL. For everyone else, though, the OnePlus 3T's display is as sharp as you need it to be.

STRIKE A POSE

I won't go into the rear camera much here other than to say it's decent.

It's basically the same as the OnePlus 3, with an f/2.0 aperture, phase-detect autofocus and optical image stabilisation ticking most of the key boxes for features. The only thing it lacks is laser autofocus for the very best performance in low light, but generally it's a good performer.

The big news is this: the front camera is exactly the same resolution as the one at the rear; 16-megapixel selfies can now be yours, as long as you don't mind your imperfections being captured in painfully sharp detail. Do you really need all of those pixels, though? I'd rather have a camera that took better photos.



Taking a selfie indoors, the front camera had trouble balancing areas of light and dark within the frame. Even in more favourable conditions, the images it produces are often overexposed, afflicted by wonky colour balance and, on close examination, a touch soft as well. I'm not impressed.

For comparison, the Pixel XL produces selfies that are much more competently exposed (although sometimes a little dark), and with colours that are more true to life. It just goes to show that a higher pixel count doesn't always mean superior image quality.

That's a shame, because – as mentioned above – the rear camera is pretty darned good, and capable of producing realistic, well-balanced images that capture the moment rather effectively.

A RELUCTANT WINNER

The OnePlus 3T is a smartphone that feels a little unnecessary to me. It isn't a major upgrade on the OnePlus 3, with the only improvements of note being the front-facing camera and increased battery capacity. Even if the battery life does prove to be a small step forward, it isn't an awful lot of upgrade for your additional cash.

There isn't even the temptation of Android 7 Nougat right now (which I find baffling), although the OnePlus 3T will be upgraded to Google's latest OS before long, the company promises.

Does this mean I won't be recommending OnePlus' flagship smartphone anymore? No, and the reason is simple: the OnePlus 3 was such a great buy that the company would have had to almost double the price before diminishing its appeal.

So, as it stands, the OnePlus 3T is still a great buy. It isn't quite the outright bargain the OnePlus 3 was, but the OnePlus 3T's speed, screen quality, decent camera and practical design mean it's set to take over as our favourite "reasonably priced" smartphone just as soon as the OnePlus 3 is no longer available.

Jonathan Bray

KEY SPECS

\$699 (64GB) • www.oneplus.net

Quad-core 2.35GHz Qualcomm Snapdragon 821 processor • 64/128GB RAM • Adreno 530 graphics • 5.5in, 1,920 x 1,080 resolution AMOLED screen • 64/128GB storage • 16MP/16MP rear/front cameras • 802.11ac Wi-Fi • Bluetooth 4.2 • NFC • USB Type-C • OxygenOS based on Android 6 • 3,400mAh battery • 75 x 74 x 153mm (WDH) • 158g • 1yr RTB warranty

OVERALL



HTC 10 evo

THIS 5.5IN PHONE MAKES TOO MANY SACRIFICES FOR THE SAKE OF COST, WITH ONLY ITS CLEVER EARBUDS AS CONSOLATION

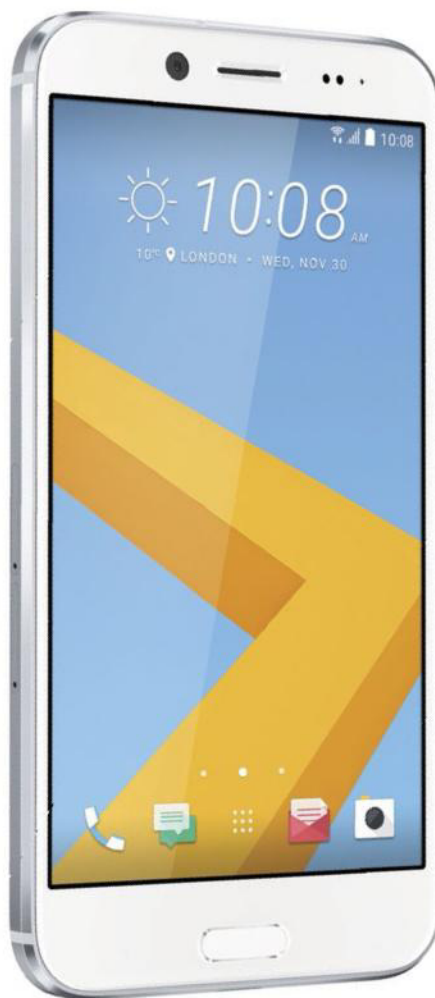
Let me save you some time: unless you love listening to music on your phone, there's little to commend the HTC 10 evo over the otherwise far superior HTC 10. Even then, you might resent retiring your regular headphones, because there's no 3.5mm jack here: instead, HTC relies on the single USB Type-C connector, declaring the bundled earbuds are the world's first "dual adaptive earphones that tailor sound to your ears' unique structure".

When you configure the earbuds, they send small sound waves into the ear canal, and then measure how these noises are reflected through the built-in microphone. This allows music and sound effects to be tailored to your ears' shape via a profile stored on the phone. Clever.

Once configured, the sound does genuinely improve, with more detail immediately noticeable. Better still, whenever you're playing audio, a notification sits at the top of the phone: tap it, and it will recalibrate for your environment, meaning your audio experience will be tailored to your ears, wherever you are.

The other advantage this phone has over its sibling is dust-, water- and splash-resistance to the IP57 standard. That's a big improvement, bringing the handset in line with the Samsung Galaxy S7 and iPhone 7, among others. There's also a microSD slot, with support for cards up to 2TB, to complement the 32GB of storage.

What follows, however, isn't so positive. Yes, the evo shares many design cues with the flagship phone, including a fingerprint scanner on the bottom edge, and that's to its credit. But



while the HTC 10 was a 5.2in handset, the evo swells to 5.5in. Sadly – and I like a phablet – it isn't a pleasure to hold, feeling too wide and angular to sit comfortably in the hand.

On paper, the 2,560 x 1,440 IPS panel should be as great as the HTC 10's, and it's certainly brighter, reaching 521cd/m2 compared with the HTC 10's 449cd/m2. But while the HTC 10's display delivered a 1,793:1 contrast and covered 99.8% of the sRGB space, the HTC 10 evo drops to 1,040:1 and a mediocre 78.4%. The result is a duller, less vibrant onscreen image. At this price, you can do better, as the OnePlus 3T shows.

Things get worse when you start using the handset. No fresh install of Android should lag on the intro screens, or slow down when using the built-in keyboard.

The evo does both.

Looking at the specifications, the culprit becomes clear: a 2GHz Qualcomm Snapdragon 810

processor. There was a time when the 810 was a decent mobile chip – class-leading, in fact. Trouble is, that time was around 2014. With 3GB of RAM, the evo struggles to match current top-end phones.

Then we come to the HTC 10 evo's stamina. It's no Lenovo Moto Z Play, that's for sure. At 11hrs 8mins in our standard test (a looped 720p video played in airplane mode with the screen set to a brightness of 170cd/m2), it's an hour weaker than the original HTC 10 and half that of the Play.

For a \$710 phone, the camera disappoints. And again, on paper, it looks good: 16 megapixels, optical image stabilisation and an aperture of f/2.0. Colours emerged well balanced and bright, and the camera app is fast to load and easy for beginners to tinker with, while there's a myriad of advanced features for pros. But the results lack the sharp detail and focus of great cameras, with shots appearing murky unless you manage to stay unnaturally still.

As a consolation prize, the front-facing camera takes good selfies and is great for video calls, with a healthy resolution of 8 megapixels.

Evo is supposed to stand for "evolution" but while this phone is demonstrably different from the HTC 10, it's almost always through strides backwards. It's slower, less comfortable to hold, and has a weaker screen and battery. It actually has more in common with 2015's HTC One M9 than the HTC 10, and that was a flagship we struggled to recommend at the time. It also loses the useful headphone jack, but without any of the design panache that would make such a sacrifice worthwhile.

The HTC 10 evo isn't awful, and the earbuds are effective, but at \$710 it offers poor value for money. If that's your budget, buy the similarly priced OnePlus 3T instead – or alternatively, find a good deal on the HTC 10.

Alan Martin

BATTERY LIFE



KEY SPECS

\$710 • www.htc.com

Octa-core 2GHz Qualcomm Snapdragon 810 processor • 3GB RAM • Adreno 430 graphics • 5.5in, 2,560 x 1,440 resolution IPS display • 32GB storage • microSD slot • 16MP/8MP rear/front cameras • 802.11ac Wi-Fi • Bluetooth 4.1 • NFC • USB Type-C • IP57 certification • Android 7 • 3,200mAh battery • 77 x 81 x 154mm (WDH) • 174g • 1yr RTB warranty

OVERALL



◀ The evo shares many of the same design cues as the stylish HTC 10

Bang & Olufsen BeoSound 1

THE FINEST SOUNDING - AND LOOKING - BLUETOOTH SPEAKER YOU'LL EVER LAY EARS ON, AND SO IT SHOULD BE AT THIS PRICE

Mention the name Bang & Olufsen and the first thing that springs to mind are those achingly expensive lifestyle systems from the 1980s – vertically wall-mounted CD players, all finished in piano black and brushed aluminium, with smoothly motor-driven tempered glass doors. This was the high-end audio system of choice, and a long way out of reach for the cash-strapped teenager I then was.

Step forward 30-odd years and Bang & Olufsen is still ploughing the same esoteric furrow. The days of the vertical CD player are long gone, however, and the company's trademark product is now the exotic, cone-shaped 360-degree speaker; the BeoSound 1 brings that technology to the realm of portable wireless speakers.

So, what do you get for your thousand pounds? Visually, a very attractive, lean and minimalist piece of audio furniture. If your kitchen is casually scattered with Alessi accoutrements, you'll feel right at home. The BeoSound 1 is space-age, sophisticated and stylish all in one, and the way its top portion appears to almost float, suspended above the larger base, lends it an almost magical allure.

If it's minimalist in form, it's far from short on features. On the speaker's flat black top sits a featureless circular touchpad, used to pause, skip and play your music; surrounding it, forming a part of the outer metal casing, is a heavily damped volume-control ring; and hidden within, there's support for the full gamut of streaming services and standards.

Just as you'd hope, Apple AirPlay, Spotify Connect and Google Cast are all supported, plus it's possible to pair directly via Bluetooth for casual listening. The speaker can be added to Bang & Olufsen's multiroom speaker system, and you can control it via the firm's BeoMusic app as well, where there's integrated control over Spotify, Deezer QPlay and Tunes, and the ability to stream from DLNA-networked music sources.

Inside, a pair of drivers produces your audio – one 1.5in full-range driver in the top part of the speaker firing down at a 360-degree deflector plate, and a 4in bass driver at the very bottom. The pair deliver a frequency response of 35Hz to 24.3kHz, and the 360-degree drivers work well to fill

a room, without any sense that the sound is coming from one particular point.

There's also an integrated rechargeable battery capable of delivering a claimed 16 hours of playback at moderate volume (four hours at maximum), and since it has an integrated power supply, you can hook it up to the mains with any standard figure-of-eight mains cable.

Setup is simple if you're an iPhone or iPad user – simply run through the usual process for AirPlay speakers – and pairing via Bluetooth is effortless. The BeoMusic app is nicely designed and easy to use, but it doesn't work well in landscape orientation, so is better installed on an iPhone than an iPad Pro.

If you have no iOS devices, however, you're out of luck. Although the BeoMusic app is available on the Google Play Store, it's actually still a beta release – and is due to stay so until March 2017. This goes some way towards explaining why I couldn't get it to recognise the speaker on either the OnePlus 3T or Huawei P9 with which I tested it. Still, with Google Cast and Spotify Connect both available to Android devices (which worked well on test), that should prove a problem only if you're planning on streaming tracks from a network DLNA source.

Once you've queued up a few of your favourite tracks, the BeoSound 1 is a joy to listen to. Just like its appearance, it has a rarefied sound that seems to almost add detail to music. There's more space, atmosphere, separation and soundstage than any portable Bluetooth speaker I've heard. Brad Mehldau's solo piano rendition of "Blackbird" is reproduced with such subtlety and texture that you almost feel you can reach out and rub the soundwaves between your fingers. Bass-heavy electronica gets your foot tapping, and there's such a wonderful warmth and personality to vocals that to close your eyes is to put yourself right in the studio with the singer.

Bass has weight, authority and control, and yet it too displays impressive depth and richness. The BeoSound 1 might be expensive, but it sure does caress the ears.

This is normally the part where I agonise over whether a product is good value for money, whether it justifies a premium price, or is better than its budget price



The BeoSound 1 isn't only a Bluetooth speaker; it's a talking point

might indicate. With the BeoSound 1 such considerations are moot to the point of being ridiculous.

A price of \$1,600 for any Bluetooth speaker – no matter how good – is beyond the pale. While it's the nicest portable speaker I've ever listened to, more traditional setups will deliver greater scale and superior clarity for less money.

If you do have the cash to spare, however – perhaps you need a speaker for room 16 at your third home in the Gold Coast – it makes one heck of a statement; a gloriously ostentatious Bluetooth speaker from the doyenne of lifestyle speaker systems. I want one.

Jonathan Bray

KEY SPECS

\$1,600 • www.bang-olufsen.com
Bluetooth speaker • 35 to 24,300Hz • MP3, WMA, AAC, ALAC, FLAC, WAV, AIFF • supports AirPlay, Bluetooth Audio Streaming, Google Cast, DLNA, Spotify Connect • Deezer, Spotify and Tunes integrated • lithium-ion battery • 802.11n Wi-Fi • 10/100 Ethernet • Bluetooth 4 • 162 x 162 x 327mm (WDH) • 3.5kg • 1yr warranty

OVERALL





of the Pro drives, and have a three-year warranty rather than the Pro drives' five-year warranty. Also, while the increased data density makes for a cheaper drive, it reduces write speed.

To mitigate this, the Evo drives employ SLC caching to increase short-term write speed. So while the 1TB drive can

“With prices of SSDs bouncing around, it's worth making a shortlist of your chosen drives and striking when the price is right”

hit a claimed maximum 1,900MB/sec sequential write speeds, it drops to 1,200MB/sec after the 42GB of SLC cache is filled. That's for the 500GB version. The 250GB model maxes out at 1,500MB/sec write and drops precipitously to 300MB/sec after 13GB has been written.

This has a knock-on effect when it comes to random read and write performance. The 500GB drive manages 330K IOPS for a few seconds, but quickly dropped to an average of 100K IOPS in our Iometer test. That's still mighty fast, mind. Otherwise, in all our tests, the 960 Evo lived up to expectations, hitting the speeds Samsung claims and only trailing slightly behind the 960 Pro.

Now, during testing we encountered an oddity – a pleasingly surprising oddity. While Samsung claim a top sequential read speed of around 1,900MB/sec for the 1TB 960 Evo, we recorded an average of 3,400MB/sec. That's just shy of the 960 Pro's maximum speed of 3,500MB/sec! Furthermore, write speeds also well exceeded claimed speeds, consistently recording 1,900MB/s, compared to a claimed maximum of 1,500MB/s. This was on a testbed based on a Skylake i7 on a Z170 motherboard. Testing with default Microsoft Windows SSD drivers and then Samsung's own drivers yielded the same results.

Even stranger, in this same testbed sits the supposedly superior 960 Pro,

Samsung 960 Evo SSD

A MORE SENSIBLE BALANCE OF PERFORMANCE AND PRICE THAN THE 960 PRO, BUT WATCH OUT FOR VOLATILE PRICES

In the December issue (see issue 229, p44) we reviewed Samsung's new 960 Pro drives and concluded they were amazingly fast, but overkill for most people, especially for the price. Well, Samsung's 960 Evo has now arrived to provide a similar level of performance for a far more sensible price – and we can forestall any speculation by saying it's a winning combination. With a few caveats.

Like the 960 Pro family, the 960 Evo drives use the M.2 NVMe specification. They're once again small, black and covered by two smart-looking stickers (the latter aren't just there for show; they help with thermal performance too). You also benefit from the same 256-bit AES encryption – you can portion off a section of the drive to be password-protected and hidden from the OS, for instance – and the Samsung Magician tool that lets you check the drive's health and upgrade firmware.

Where the two families start to diverge is price, although this remains volatile, if you'll excuse the pun. The cheapest 960 Pro drive – the 512GB version – cost

\$449 when we went to press last month. Compare that to \$329 for the 500GB Evo. And remember there's no 256GB model, so \$449 is your “price of entry” into the 960 Pro family. By comparison, you can buy the 250GB version of the 960 Evo for around \$179. Where the Evo range can't match its sibling is top capacity: a 1GB 960 Evo is the most you can hope for, which is half the Pro's 2GB.

As with previous Samsung Evo SSDs, the 960 Evo family is distinguished from the Pro range by the use of TLC NAND, where three bits of data are stored in each memory cell rather than two as in the 960 Pro. Consequently, the Evo drives are rated to write only half the total data





and its results matched the 960 Evo when we first ran benchmarks. That in itself is less of a surprise as the 960 Pro was delivering numbers that matched the manufacturer's claims, but a little later on in the testing process we cloned the Windows OS to the 960 Pro and that caused its speeds to actually drop! Now, the OS 960 Pro records just shy of 2,900MB/sec, with the 960 Evo faster at 3,400MB/sec read! We queried this with Samsung and were told that cloning a SATA drive to an NVMe drive can cause this – but we were cloning from an NVMe SSD – Samsung's earlier 950 Pro, no less. We can't explain these results, and it may be a peculiarity of the testbed configuration but everything is stock on that testbed so this little mystery remains up in the air. Annoyingly, it means that we can't, then, assure you that you will see such oddities, or will simply see advertised speeds with no issues.

As with the 960 Pro, the real-world impact of all that performance is minimal. In the app-loading test of PCMark, our manual game load tests and Windows boot tests all showed virtually no increase over SATA SSDs. As a result, it's worth considering spending your money on a slower drive with a larger capacity if application performance is your top priority.

In particular, you may want to consider the SATA version of the Samsung 850 Evo. It fell behind in any benchmark looking for consistent write speeds – for example, it hit 30.7MB/sec in PCMark 7's import pictures benchmark, compared to 34.6MB/sec for the 960 Evo – but you have to question whether such differences will be noticed in real-world use. Likewise, its cold boot-time was 18.3 seconds to 17.7 seconds, leaving 0.6 seconds of extra wait time. Boot times were almost identical with the 960 Pro,

which may in part be explained by the similarity in read speeds between the 960 Pro and 960 Evo that we saw in our testing, but mostly because the boot bottlenecks lie elsewhere.

With prices of the drives bouncing around, it's well worth making a shortlist of your chosen drives and striking when you see the right combination of price and capacity for your needs. If you can find the 960 Evo 500GB for around \$300, it strikes a near-perfect balance of performance and price, while still maintaining decent capacity. When it comes to sheer bang-per-buck, this is the SSD to buy.

Edward Chester & Ben Mansill

KEY SPECS

\$649 (1TB); \$329 (500GB); \$179 (250GB)

• www.samsung.com/au

M.2 SLC NVMe SSD • Samsung Polaris controller • TRIM support • SMART support • AES 256-bit user data encryption, TCG Opal • up to 3,200MB/sec sequential read • up to 1,800MB/sec sequential write • Samsung Magician software • 3yr warranty or 200 terabytes written • 1.5 million hours reliability (MTBF)

OVERALL



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- ✓ THE ONLY AUTHORISED SEAGATE DATA RECOVERY SERVICE PROVIDER IN AUSTRALIA AND NEW ZEALAND

Expert data recovery from **Damaged Hard Disk Drives, SSD, RAID, NAS, Mobile Phones, USB Flash Drives and Memory Cards.**



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Xiaomi Mi Wi-Fi

MORE THAN A MERE BUDGET ROUTER

It might be relatively new to the Aussie market, but Xiaomi has been taking the rest of the world by storm with its innovative yet inexpensive products. The Mi Wi-Fi is the latest such gadget, and it's a rather impressive piece of kit to say the least. Combining an 802.11ac router with a 1TB hard drive, all at a ridiculously low price, this thing is likely to fly off shelves once word spreads.

Considering the large size of most Wi-Fi routers, the tiny dimensions of the Mi Wi-Fi is the first thing you'll notice, it's approximately 170mm tall by 120mm deep by 64mm wide. It's got an incredibly simple design, with none of the huge external antennae normally associated with 802.11ac routers. Yet this doesn't seem to have hampered its ability to broadcast at lightning fast speeds. It's packing a 2x2 antennae configuration that wiped the floor with several routers we've tested that are several hundreds of dollars more expensive. Our initial speed test was run at a distance of approximately 15 metres, with several concrete walls in the way. We used speedtest.net to see if it could max out our NBN fibre to the home connection, and measured an impressive 18Mbps down, 3Mbps up. However, there's an optimisation tool that is part of the free Smartphone application (available for both Android and iOS) available for the router. Running this caused the device to search for the best channel and protocol, switching to the 2.4GHz network as

it had automatically detected interference on the 5GHz channel. The speed jumped to a whopping 45Mbps down, while the upload speed increased to 7Mbps. Considering the huge range we tested this at, not to mention the number of concrete walls it had to penetrate, this is fantastic performance.

This is partially thanks to the Broadcom BCM4709 ARM Cortex-A9 dual-core CPU inside, paired with 256MB of RAM. As an 802.11ac router, it's a dual band router, one on the 2.4GHz band, the other on the 5GHz band. The former delivers up to 367Mbps of bandwidth, while the latter delivers up to 800Mbps, giving a total theoretical maximum of 1167Mbps.

On the outside you'll find a single USB 2.0 port, twin Gigabit Ethernet ports and a single WAN port. The USB port can be used to connect an external hard drive, printer or 3G modem. Residing within is a 1TB hard drive, making this a handy little media server. We were able to stream three HD video streams simultaneously from this device – wirelessly to both a smartphone and laptop, as well as

a wired connection to a PC, and there was nary a stutter or glitch on any device. To put it bluntly, we were astonished at the performance considering the range it also exhibited. We wish there was a 4TB version, as 1TB will be rather easy to fill, but that's likely a limitation of the 2.5-inch hard drive's form factor. At least you

can use the USB 2.0 port to attach an external drive for extra storage capacity.

As mentioned previously, the free Smartphone app is fantastic for automatically optimising the performance of this router, but also delivers the usual controls for your router. There's QoS optimisation, Firewall maintenance including blacklisting devices, scheduled reboots and Wi-Fi sleep modes, and automatic photo backup.

We were expecting the software to be a little rough around the edges but we were wrong. Not only does setup take mere minutes, but both the web-based and smartphone interfaces are incredibly easy to use. It's even possible to stream content remotely to your device, without the need for any complicated settings, though performance does nose-dive, as it doesn't appear to transcode the content in the process.

Given the excellent performance, tiny size and fantastic pricing, we simply can't help but give this the highest score possible. Xiaomi may not be a household name in Australia yet, but if it keeps releasing innovative products like this, it soon will be.

Bennett Ring

KEY SPECS

\$179 • www.xiaomi-mi.com
Broadcom BCM4709 Dual-core CPU (1GHz ARM Cortex-A9)
• 2x2 internal antennae • 802.11ac/n/g/b/a • 3 x Gigabit Ethernet (1 dedicated to WAN) • 1 x USB 2.0 connector

OVERALL





ASRock Fatal1ty H270 Performance motherboard

ASROCK PUSHES THE H270 TO THE LIMIT

When Kaby Lake launched, we weren't exactly blown away by its raw CPU performance, nor its overclocking abilities. While its media engine received a nice upgrade, the CPU cores themselves didn't seem to have made much ground. What was more exciting was the release of the Z270 chipset, which offered up many more PCIe lanes and widespread support for USB 3.0 Type C and high-speed M.2 drives. This month sees our first review of the next chipset in the Kaby Lake arsenal, the H270. Aimed at a slightly more affordable, mainstream market, what has Intel taken away from the Z270 to save on costs?

When it comes to High Speed IO lanes, both chipsets are identical, with 30 each. However, as we'd anticipated, the number of PCIe 3.0 lanes has dropped a little. The Z270 shipped with 24, while the H270 trims this back to 20. In reality, this means it can support one less M.2 PCIe 3.0 x4 SSD, which isn't a huge deal. What is more concerning is the lack of configurations for the PCIe 3.0 lanes. The motherboard we're reviewing comes with

twin full length PCIe lanes, one of which runs in x16 mode while the other runs in x4 mode. This means there's no support for Nvidia's SLI, but AMD's CrossFire will work fine. Four more x1 slots are included for your less demanding peripherals.

There's also no official support for overclocking on the H270 chipset, yet ASRock has enabled overclocking on this board. The total number of USB 2.0 ports supported by the H270 is identical to the Z270, at fourteen, yet the number of USB 3.0 ports has dropped slightly, down to eight from ten. They also both support a maximum of six SATA 6Gbps ports. Other than that, it's all much of a muchness. Both support the same amount of memory, though the H270 defaults to 2133MHz instead of the 2400MHz of the Z270. This is an extremely minor drop though, so performance should be basically identical to the Z270, as there are no other changes.

Now that we've dug deeper into the minor differences between the two chipsets, let's see how ASRock has implemented the H270 into an affordable

gaming motherboard. We've already covered the physical PCIe slots, but what about storage options? ASRock has stuck with the default number of SATA 6Gbps slots, with six in total. However, they've generously delivered twin Ultra M.2 slots, while video outputs are taken care of by HDMI, DVI-D and D-sub.

The LED lighting system isn't overly complex, with lights on the power circuitry heatsink, PCH heatsink, and the audio system shield. Speaking of audio, the Realtek ALC1220 is beefed up with high-end capacitors and a dedicated TI® NE5532 headset amplifier, all of which is controlled by Creative's SoundBlaster Cinema 3 software. Intel's I219V Ethernet controller delivers network connectivity.

As mentioned earlier, ASRock has enabled overclocking of K-class CPUs on this motherboard, and it also supports 2400MHz memory, which should put its performance right in line with more expensive Z270 boards. Given that Intel wasn't too happy about manufacturers enabling overclocking on the H170 chipset, it's a pleasant surprise to see that ASRock doesn't seem too fussed about including it on the successor.

Triple USB 2.0 ports reside next to another two USB 3.0 Type A connectors and a single USB 3.0 Type-C connector. This doesn't appear to be Thunderbolt enabled; to get this, you'll need to attach an optional Thunderbolt AIC to one of two connectors on the board.

As usual, ASRock has over-delivered when compared to the competition, and has even pushed the edge when it comes to features like overclocking. Unfortunately we weren't able to benchmark this motherboard due to a lack of a CPU at the time, but we're confident it'll keep up with higher-priced Z270 boards given our experience with ASRock products in the past and the factory memory overclock. If you're looking for a new gaming board but don't want to spend more than \$200, you really can't go wrong with this home for your CPU.

Bennett Ring

KEY SPECS

\$190 • www.asrock.com
H270 chipset • 6 x SATA 6Gbps; 2 x Ultra M.2 • SoundBlaster Cinema 3 Audio • Intel Gigabit Ethernet.

OVERALL



Cisco RV134W VDSL2 Wireless-AC VPN Router

A BASIC, BUT SOLID, SMALL BUSINESS FOCUSED VDSL2 MODEM FROM ONE OF THE MOST WELL-KNOWN NETWORKING BRANDS

As the NBN rolls out around Australia, more of us are becoming familiar with VDSL2 - the technology used by NBN in Fibre to the Node (FTTN) installs. This means homes and businesses in an area switching over to the FTTN NBN, need a new modem. Because of this, Cisco has released the RV134W VDSL2 Wireless-AC VPN Router.

Cisco, if you're unaware, are the 800-pound gorilla of computer networking. Their switches, routers, security gateways and Wi-Fi equipment is used by ISPs, governments and large corporations around the world. Cisco's gear literally powers the core of the Internet. The RV134W is a little slice of that, designed for use by demanding home users or small businesses.

Specs wise, the RV134W contains 2.4GHz and 5GHz, 2x2:2 802.11ac wireless radio, a 4 port Gigabit Ethernet switch, an Ethernet WAN port and a VDSL2 WAN port. All typical fare for a Wi-Fi modem router these days. What's not typical about the RV134W is its restrained and modest exterior design. No creepy spider looking UFO things, just a sleek matte black rectangle. There's a stand in the box that'll let you keep it upright if you have more vertical

space than horizontal space available. Also in the box is a slim power adapter, 1m RJ45 Ethernet cable and a 1.5m RJ11 cable, along with a quick start guide and warranty info.

Speaking of warranty, the RV134W says it has a limited lifetime warranty. Sounds great, doesn't it? But it's not a lifetime warranty at all. Reading the fine print, the warranty is actually for 5 years after Cisco decides to stop selling the RV134W. Still an excellent warranty, far beyond the competition, but for Cisco to say the RV134W has a "lifetime" warranty is a little misleading.

Four Wi-Fi antennas are built-in to the unit, meaning no external or removable antenna sockets, unlike Asus and Netgear's top end models. The unit is sleeker and more compact as a result, but at the expense of possible Wi-Fi signal strength. Not that there's a particular issue with signal strength on the RV134W - it's fine, but an external antenna that can be replaced allows for more choice in the antenna suitable for the environment.

Installed is a relatively small 256MB of RAM, compared to the 512MB on higher end consumer routers from ASUS and Netgear. Not much of an issue for most people, but if you're making heavy use of firewall rules, port forwarding and QoS, then the amount of RAM matters and the RV134W may struggle.

Setting up the RV134W is extremely easy. Just plug it in to an Ethernet port on your computer, set your IP to 192.168.1.2 and log in to the web interface on 192.168.1.1, where the quick start wizard will get you going. If you don't have a computer with

Ethernet available though, you're out of luck - that's the only way to set it up. Unlike most similar priced consumer routers, there's no smartphone app for monitoring of configuration.

For the pro users, the RV134W also supports configuration from the command line, acting very much like any other Cisco IOS device (despite not using IOS itself). If you have any familiarity with Cisco's switches and routers, you can bypass the web interface all together or turn it off completely and configure the RV134W just from the command line. There's even a console cable connection, if you've somehow managed to lock yourself out of the router.

The VDSL2 portion of the RV134W is very robust. Compared to the Draytek Vigor2860Vac, connected to the same copper line, VDSL sync speeds were approximately 10% higher on average, compared to the RV134W. Take this anecdote with a grain of salt though,



✓ Is your area NBN-ready? If you don't have NBN yet, and your area is FTTN then a modem like this is what you'll be needing



as everyone's copper line situation is different and so much can influence what speeds can be achieved. If at some point you upgrade from VDSL to fibre, the VDSL modem can be disabled and the gigabit Ethernet WAN port utilised instead.

The RV134W supports all the usual stuff you expect a router of this calibre to support, such as a stateful packet inspecting firewall, port forwarding, quality of service bandwidth management, dynamic DNS (noip and DynDNS) and VLANs. Unlike most consumer level routers however, it adds a bit of extra depth to those features.

The firewall on the RV134W is extremely flexible, which can be configured via access rules and have those rules applied to specific computers on your

network - not just the network as a whole. Access rules can be activated to operate at specific dates and times, allowing

the internet to effectively turn itself off, say, at night, when an office is empty, or to block email being sent at night for example. The deep packet inspection features of the firewall include blocking Java, ActiveX, proxies and cookies, network wide, before they infect or damage computers.

The USB port on the RV134W can be used to connect a 3G or 4G modem, providing either redundant Internet access if the VDSL2 or Ethernet WAN connection is disrupted or used as the primary Internet connection. In a quick test, a rather old, but still functional, Vodafone/Huawei K4605 3G modem was not recognised by the RV134W. An Optus/Huawei E3276s 4G modem however, was detected and worked well.

Unfortunately, Cisco does not publish a list of USB modems compatible with the RV134W, unlike other manufacturers such as TP-Link. You would think a company as large as Cisco would be able to provide this information up front, so an appropriate USB modem can be purchased. Alas, they do not.

VPN support was also disappointing, with the RV134W not having the ability to connect to a PPTP/IPSec VPN or OpenVPN server as a client. The only client mode VPN supported, is site-to-site IPsec VPN with a pre-shared key and manual remote and local IP address setup. Not much use if you want to connect to the very common OpenVPN or PPTP type of VPN server.

Asus' high end routers for example,

support OpenVPN and PPTP as a client, right out of the box. Surprisingly, the RV134W does not support Cisco's own VPN protocol, AnyConnect, which is extremely popular with large corporations. Not including Cisco's own VPN on its own hardware, even if it is a relatively entry level unit, is an unusual oversight. One would assume they'd like to drive adoption of their own protocol? At least VPN pass-through is supported, allowing an outbound VPN connection to connect unhindered, even if NAT port forwarding is enabled.

As a server though, VPN support on the RV134W is solid and easy to set up. It'll work as a PPTP server and users can authenticate with a username and password. It's not very advanced, but it gets the job done and is relatively

secure. Again, it would have been nice to see basic AnyConnect server support too, seeing as it's Cisco's own protocol.

The Cisco

RV134W VDSL2 Wireless-AC VPN Router has a lot of competition in this price range. For the roughly \$400 street price, you could also buy a Draytek Vigor2860ac, Netgear D7800, Asus DSL-AC68U, Linksys XAC1900, TP-Link Archer VR2600 and probably a dozen others. Why should you spend the extra cash on the RV134W compared to those other units?

Unless you've already got an existing Cisco infrastructure setup, or need the long 5-year warranty, there isn't anything special or compelling about the RV134W to justify it over more featured or cheaper VDSL2 Wi-Fi routers.

That doesn't mean the RV134W is a bad router, it's just middle of the pack. It gets the job done quietly, with little fuss, but also with no frills. The RV134 works fine, but lacks some of the ease of use and features found in other models, has a 2x2:2 802.11ac Wi-Fi radio compared to the 3x3:3 radios in the competition and is priced relatively high versus other models. You'd need to be a Cisco diehard to buy the RV134W.

Anthony Agius

KEY SPECS

\$399 · <http://au.ingrammicro.com>

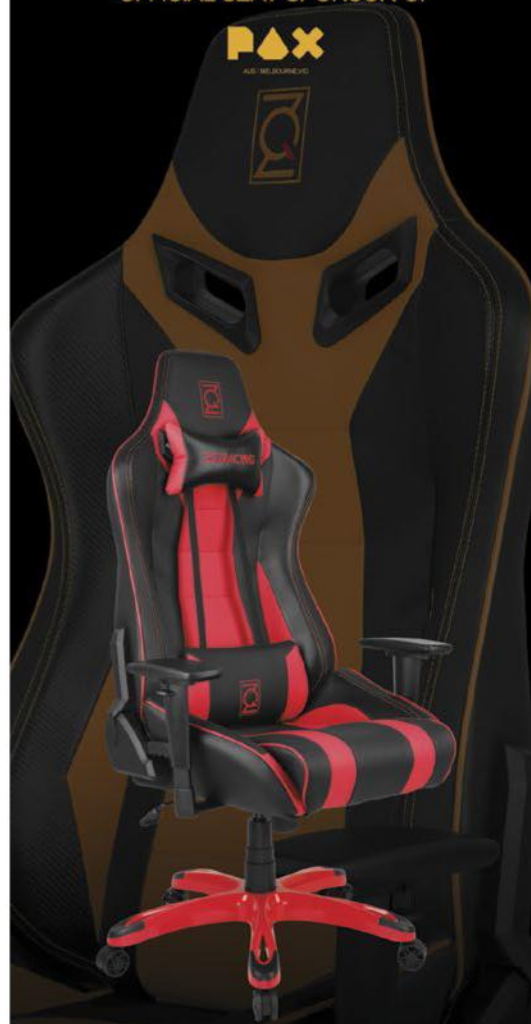
VDSL2 connectivity, built-in four-port Gigabit Ethernet switch · 2x2 802.11ac Wi-Fi · USB 3G/4G/LTE, internal antennas · IPsec VPN security · 5-year warranty.

OVERALL



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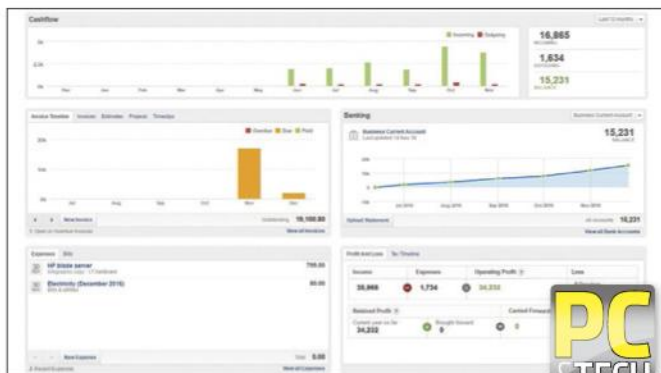


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Accounting software



FreeAgent Limited Company

FreeAgent is a cloud-based bookkeeping package designed to make accounting simple for small businesses. We reviewed the Limited Company edition at \$20 a month, which covers your whole company with no limit on the number of users.

Setup was as easy as promised. With the help of a wizard-based routine to input all the necessary company details, we were up and running within about 30 minutes. We uploaded our historical transactions and our contacts as CSV files with no problem at all.

The only snag was uploading a bank statement as a CSV, with the initial file rejected due to formatting. In the end, we opened it up in Notepad and formatted it manually. Once uploaded, though, reconciliation was made easy, with FreeAgent identifying most transactions from our statement.

You can manually enter transactions into your chart of accounts, but it's easier to use FreeAgent to record your business activities. Create a project, add an estimate, turn the estimate into an invoice, mark the invoice as paid – and hey presto, the transaction appears in your chart of accounts. You can enter expenses as you incur them, or set up recurring debits.

When you create an estimate or an invoice, you can enter amounts manually or track units sold (products or time). The program even includes a timer: once you've finished a task, stop the timer and add the time worked to the relevant project.

How FreeAgent handles taxes depends on the version used. The Sole Trader version calculates how much income tax and BAS you can expect to pay by pulling through your self-employed income and expenses from your accounts. The Partnership version does the same, but it calculates the profits for each partner based on their tax allowances, personal income, and other factors. In the Limited Company version, FreeAgent calculates your personal self-assessment, corporation tax, and your PAYG and BAS obligations.

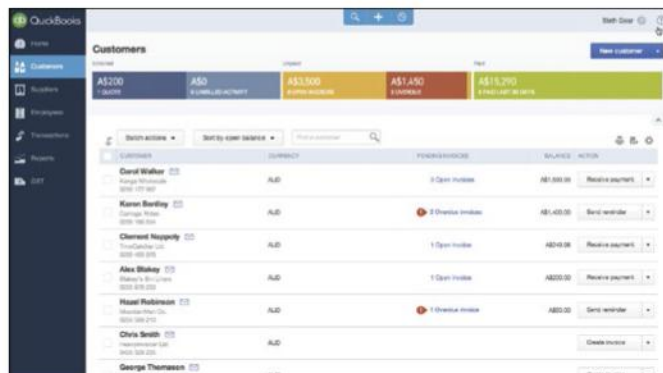
FreeAgent is the easiest of the programs to use. For small companies that want pain-free bookkeeping, it does the job well.

OVERALL



KEY SPECS

\$20 per month,
from freeagent.com



QuickBooks Online Plus

QuickBooks Online Plus is Intuit's top-of-the-range cloud-finance package for small businesses, costing \$24.50 per month for five user accounts. With it, you can track your finances, work out tax and manage bills and other expenses.

You enter transactions as they occur and QuickBooks adds them to your accounts as you go. The main dashboard provides a one-screen summary of your finances, including how much money you're owed and how much is overdue (it's always handy to identify the culprits at a glance).

You can view your chart of accounts from the settings, but unless you're a bookkeeping geek, it's easier to use a combination of your dashboard and your bank records. These records are updated automatically as you enter sales and expenses. You then reconcile them manually, by cross-referencing with a bank statement, or automatically by connecting to your online bank account. It works – and it's easy.

QuickBooks is particularly good at customer-facing parts of finance. You can generate invoices in seconds, send them instantly, and issue reminders with a single click. The whole workflow – from estimate to invoice to receipt of sales – is simple. Like some of the best cloud CRMs, QuickBooks also has its own third-party app store. It's underpopulated, but we were really excited to see a PayPal processing app in there, only to find it isn't yet available here.

Payroll costs extra in QuickBooks, but it's only \$4 per active employee per month, so hardly a big deal if you employ only a few people. If you employ more than ten, the fees will rack up. But QuickBooks not only automatically runs your payroll, updating your chart of accounts, it also updates the ATO with your data every month. The program also calculates your GST, if you're GST registered, tracking the GST you collect and then generating the data required for your return. However, QuickBooks doesn't help you prepare your ATO self-assessment – only the QuickBooks Self Employed version does that and it still leaves you to submit the return manually.

QuickBooks is excellent at what it does. But with its unlimited users, as well as payroll and self-assessment built in, FreeAgent is currently the better deal.

OVERALL

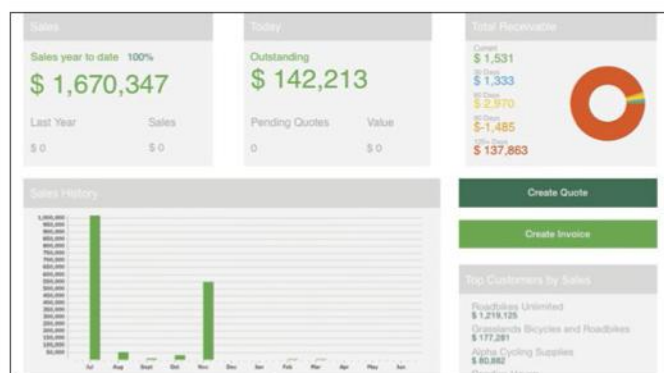
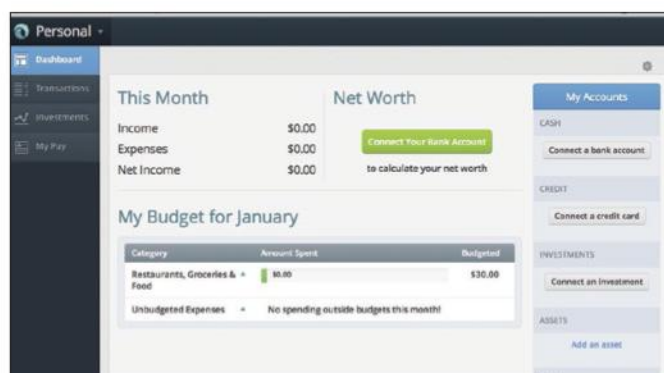


KEY SPECS

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shootout

KARL WRIGHT DRAWS UP A LEDGER OF POSITIVES AND NEGATIVES FOR FOUR POPULAR ACCOUNTANCY PACKAGES



Sage One Accounting

Sage One Accounting is the premium version of Sage's small-business accounting software. You can produce estimates and invoices, track sales and outstanding debts, file your GST returns and record expenses. Like QuickBooks, Sage also has an integrated third-party app store — useful for adding industry-specific functions.

As with the other bookkeeping programs, Sage One lets you create estimates, log sales and send invoices. As jobs are generated, and estimates accepted by the client, they're entered into the ledgers. You can see a breakdown of your spending using the Trial Balance Report. The Sage One Dashboard offers at-a-glance snapshots to instantly see who your top customers are, who owes you money and a useful cash-flow forecast.

The Accounting version of Sage One lets you raise not only invoices, but quotes and estimates too. And it's easy to turn either a quote or an estimate into an invoice. You can also customise all three document types with your logo and details.

To speed up this process, you can predefine products — setting both a sale and wholesale price. When you want to create a quote, select which products to include with a click. Sage One doesn't include any inventory control, though; you'll need to buy a separate app for that.

But there's plenty more that Sage One can do. You can connect it to your online bank account, making reconciliation easy. And you can use it to submit BAS returns directly to the ATO. Simply enter your ABN number and your year-end date — Sage One automatically crunches the numbers. You can then save as a draft or submit directly to the ATO from within the software.

Sage One won't do your self-assessment or corporate tax returns, but will make your tax returns easier — as all of the information required for your return will be accurately recorded. If you have an accountant, you can give them access so that they can do it for you. But you can't generate your self-assessment and submit it from Sage One. Similarly, if you want payroll, you'll have to subscribe to an additional Sage product.

These extras push up the price, so work out exactly what you need before pressing ahead.



Wave Apps

Wave Apps is a free bookkeeping package that lets you record transactions. Like the others, it builds a set of ledgers based on nominal accounts — all you need to do is tell it when you spend or earn money. But there's a catch — Wave is a US app and although some features have been localised, others haven't. Payroll, for instance, is only set up to work for the US and Canada. This is also one of the two "extras" that Wave charges for, but, aside from this and payments, the free price really is true.

Happily, Wave has localised the currency options. You can enter transactions manually, or upload a bank statement. We tried both and they worked without any problems. In fact, uploading a bank statement was easier with Wave than with any of its competitors; the program matched all columns correctly and the operation was done in seconds (we had to do reformatting with FreeAgent, for instance).

To keep your accounts up to date, all you have to do is work in Wave Apps: create an estimate, turn it into an invoice and Wave enters the invoiced amount into your accounts. Wave also integrates well with other services. Not only did we import our contacts from Google Apps, we used our Google Apps email to send invoices from within Wave.

If we have one criticism, it would be that the program is more difficult to find your way around than some of its competitors. For instance, to raise an estimate you need to go into the Invoices screen. And customers are created in the settings menu of the Accounting screen. It's an odd organisational scheme.

Wave isn't set up specifically to handle GST, but it's flexible enough for you to simply create your own sales tax rate. Just add sales tax to applicable purchases or sales, and run the sales tax to find out how much GST you owe. But there are no modules for working out Au self-assessment, corporation tax, PAYE or BAS contributions. You'll need to take the data in Wave and use it to work these out.

There are many good things about Wave, but the primary one is its price. If you're a freelancer or a sole trader, then you may not find its limitations a problem.



Labs Briefs

Asus ROG Centurion

\$469 • www.asus.com/au

The Centurion is Asus' second stab at making a true 7.1 surround headset, and the experience shows. Although still very large and heavy by necessity – each earcup holds five different drivers – the comfortable padding on the earcups and sprung headstrap makes the Centurion comfortable over long periods. Rather than plugging straight into the PC, the Centurion instead plugs into a base station with built in amp that allows users to control and tweak individual channels or choose from presets highlighting various ranges so as to highlight footsteps, explosions, gunshots and the like, as well as splitting input into discrete channels for surround sound. Audio quality is good, and there is a nice directionality to the surround sound but that quality comes with a very hefty price tag. The RRP for the Centurion is a massive \$469, and even with an average street price that will probably be around \$100 cheaper it's still a staggering amount to pay for a headset tethered to your PC.

Daniel Wilks

OVERALL



Seagate Backup Plus Portable Drive 5TB

\$299 • www.seagate.com/au

Storage has come along in leaps and bounds in the last couple of years. It wasn't too long ago that large capacity portable drives were huge, slow and required external power. That's definitely not the case with the Backup Plus 5TB drive. It only measures a slim 20.5x114.5x78mm and connects via a single USB3 connection. The drive is about as speedy as you'd expect for a large capacity spinning platter drive running on a USB3 connection, delivering read/write speeds of 133MB/s and 73MB/s respectively through our testing with AS SSD. The drive comes pre-loaded with easy to use Seagate Dashboard backup software, allowing for quick backups of PC file, mobile data and social media. The drive also comes with a two year 200GB subscription to Microsoft OneDrive (though you will have to pay for subscription after the two years is up). The Seagate Backup Plus is a good, affordable and fast external drive. The only thing standing against it is the lack of any built in security features and relatively short two year warranty.

Daniel Wilks

OVERALL



Asus ROG Spatha

\$219 • www.asus.com/au

While many hardware vendors seem to be embracing the aesthetic of smaller and sleeker when it comes to mouse design, with the flagship mouse of a new range, Asus has gone in the other direction. The Spatha is enormous and heavy, but that's not necessarily a bad thing. Designed for MMORPGs, the Spatha is covered in buttons but is still very comfortable in the hand. The mouse is usable both wired and wirelessly, with the latter using a pairing/charging station and limiting the polling rate of the mouse to cut down on wireless lag. In wired mode, the Spatha is capable of a rather incredible, if somewhat impractical 2000Hz polling rate (1000Hz wireless), with up to 8200 DPI. It's strange to see the numbers so high given the target market of the mouse and the fact that it's big and heavy enough to be unsuitable for twitch gaming. Still, it's pleasant enough to use.

Daniel Wilks

OVERALL



TP-Link Smart Wi-Fi LED Bulb

\$44.95 to \$79.95 • www.tp-link.com.au

The coolest, least-necessary category right now is the smart LED bulb. led the charge with Hue, and many others Now TP-Link offers its version: a range of LED colour one, a cool-to-warm white one, and a dimmer-only one) that uses the household's existing Wi-Fi network to allow control via smartphone. Tap to set colour, brightness, create lighting schedules, choose "moods", all the usual functions are here.

TP-Link makes a big deal of how these bulbs don't need a "bridge", though obviously there are some disadvantages to the lights not having their own network – for instance, once set up, Philips Hue doesn't need your router to operate.

The biggest limitation right now? That the first models will be Edison-screw only, and with a full-size bulb form-factor. It occurs to us the kinds of people who like smart bulbs probably already have GU10 halogen downlights. Still, the TP-Link bulb is a good fit for older lamps – and lamps have always been better at mood lighting.

Anthony Fordham

OVERALL





Ttesports
By Thermaltake

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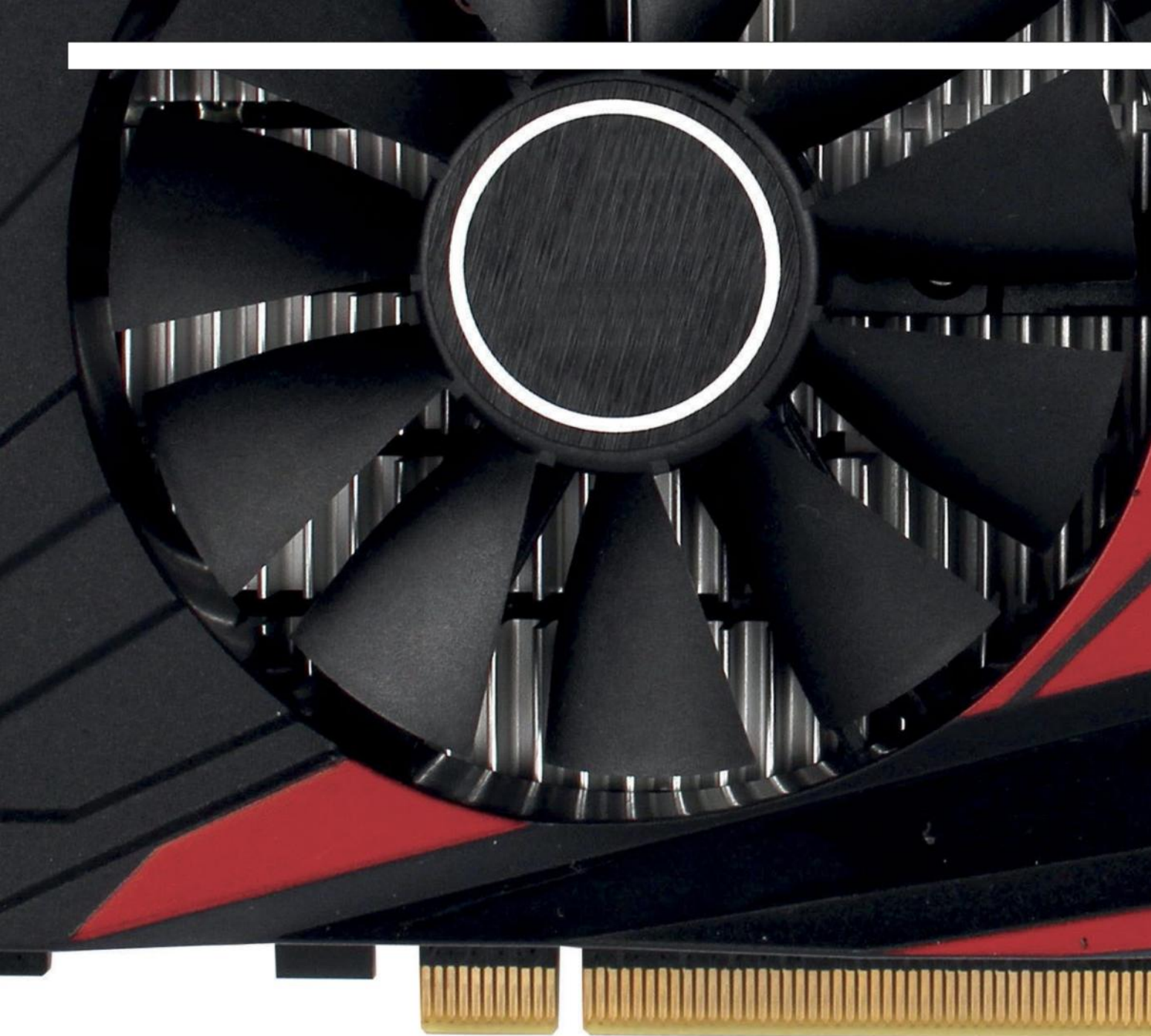
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ASUS

Graphics cards are as relevant today as they've ever been. To be sure, a discrete GPU is no longer a technical necessity. Most modern CPUs have enough built-in graphical power to handle desktop applications, and even a bit of casual gaming.

However, today's graphics cards are a world apart from those integrated GPUs. They have to be: modern games are typically set in vastly complex 3D worlds, with cinematic lighting and immersive effects. It's no exaggeration to say that computer game design is one of the major creative industries of the 21st century. If your hardware isn't powerful enough to render the

visuals as they were meant to be seen, you simply aren't getting the full experience.

This month, we've picked out 17 of the latest graphics cards – ranging from the very bottom of the market up to the very top – and tested them extensively, to discover which models match the demands of modern games. We've also put them through their paces in the nascent world of virtual reality, to ensure you're ready for the coming revolution.

So whether you're on a budget or looking to invest in a luxury experience, we have something for you – all you need is a PCI-E socket and a pair of eyes.

NO MSI?

The idea behind this group test was to focus on the GPUs available, and test a sample of each. As you know this is the first step when deciding which graphics card to buy. Once you have zeroed in on your ideal GPU the hunt begins for a card that has the right GPU, but the focus then shifts to aspects like price, bundled games or software, factory overlocks and cooling. Heck – for many people one brand might be their favourite so that's what they usually go with.

So, this group test is not aiming to examine the wide variety of cards available, simply the GPUs. Hence, we selected cards that, generally speaking, are as vanilla as possible. However most of the cards bought in Australia aren't standard reference designs brands, which is why the souped up models from companies such as MSI aren't included.

Choose the perfect graphics card

CHOOSING THE RIGHT GRAPHICS CARD CAN SEEM LIKE A DAUNTING QUEST - BUT IT'S EASY IF YOU KNOW WHAT YOU'RE LOOKING FOR

1: DON'T BE BLINDED BY BRANDS

Browse online for graphics cards and you'll find a panoply of brands, from Asus to Zotac. But the choice isn't as complicated as it may first appear. Every mainstream graphics card is built around a standard graphics chip – a GPU – from either AMD or Nvidia. There are around 20 different models widely on sale, and we've tested all of the major variants, with prices stretching from \$50 to \$1,030.

That doesn't mean that brands are irrelevant. One maker may equip a given GPU with a tiny cooler, so it will fit inside a compact case and make minimum noise. Another manufacturer's take on the same GPU might have a powerful fan that lets it run at top speed for long periods without overheating.

Some card manufacturers also overclock their GPUs. And, last of all, for reasons to do with marketing

and manufacture, two different manufacturers may charge quite different prices for substantially the same card. So even once you've decided upon a GPU, you should shop around to see which precise card suits your needs.

2: HOW MANY STREAM PROCESSORS?

The architecture of a modern GPU is based on stream processors, texture mapping units and render output units. The stream processors do the fundamental work of building 3D scenes out of millions of polygons. As

you'll see from our feature table overleaf, the number of processors built into a card can vary enormously. The more processors a card has, the more calculations it can carry out at once, helping it to produce highly complicated scenes at very quick rates.

Once the stream processors have assembled a scene, the texture mapping units handle the business of "painting" images onto the models, and finally the render output units translate the finished 3D scene into a 2D image to be sent to the display.

Truth be told, the bare numbers aren't particularly illuminating. More stream processors generally means better performance, but other factors come into play too, including core speed and video memory. What's more, the two GPU manufacturers use quite different internal designs for their processors: AMD has its "Graphics Core Next" architecture, now into its fourth generation, while Nvidia's latest cards use its "Pascal" core. Each design has its strengths and weaknesses, so two cards with the same number of stream processors may have different capabilities. When it comes to gaming, the only really meaningful metric is performance.

3: HOW MUCH MEMORY?

Every graphics card comes with an

CAN I USE MORE THAN ONE GRAPHICS CARD?

It's long been possible to physically connect multiple graphics cards together to help with rendering. AMD's proprietary technology that enables this is called CrossFire, while Nvidia's approach is called Scalable Link Interface (SLI).

Historically, however, multi-GPU computing has been a bit of a pain: only certain cards have supported it, and to keep everything in sync you've needed to use identical GPUs. Nvidia has also required you to clip on a physical connector to join your cards together. This technology is still supported – see our feature table for details of which cards support it.

With DirectX 12, however, a better way has arrived. A feature called "explicit multi-GPU" puts control in the hands of the programmer, allowing the game itself to divide up work across all available GPUs as it sees fit, with no need for special hardware support. And there's no need to use identical cards: we've seen reports of experimenters successfully setting up dual-graphics systems using one AMD card and one Nvidia card – something that would have been unthinkable a generation ago.

However, remember that adding a second GPU won't magically double your graphical performance. The benefit depends very much on how the game is written, and on the specifics of your hardware. If, therefore, you're partnering a high-end graphics card with a budget GPU, you might find that the lesser card simply isn't powerful enough to provide any benefit.



“For reasons to do with marketing, two different manufacturers may charge quite different prices for substantially the same card”

onboard cache of video RAM (VRAM); on a low-end card, this might be 1GB of RAM, while on a premium model it could be as much as 8GB. The GPU uses this as workspace to build up each frame, and store any textures and other resources it's using.

VRAM can't be upgraded, so it's important to choose a card with enough memory for your needs. But how much is that? If you're running at a low resolution, and not doing any tricks such as anti-aliasing or physics modelling, 1GB is plenty. For high-end gaming, it's

“These days, your typical PC comes with a 500W power supply, which is clearly ample for even the most extravagant card”

a different story: certain games won't run at 4K resolution on a card with less than 4GB of VRAM. Others may fall back on your regular system memory; this is far slower than dedicated VRAM, and will have a nasty effect on your “gaming experience”.

That's not to say that VRAM is uniformly fast. The cheapest cards use regular DDR3 memory, with comparatively “narrow” buses that limit the amount of data that can be transferred back and forth (see the “memory bandwidth” row in our feature table, overleaf). Upmarket cards bring super-fast GDDR5 memory, with much

wider connections to the GPU, allowing them to work on more data at faster speeds. To confuse matters further, some cards are offered in multiple VRAM configurations too.

Ultimately, whether you need the maximum quantity and speed of VRAM depends on the demands of the software. The best way to work out whether you need the larger allocation is to check benchmark scores and see for yourself if it makes a difference in the games you play.

4: DIRECTX AND OTHER APIS

If you just want to play games, you needn't worry too much about API versions: all of this month's cards support the latest DirectX 12 games, as well as older DirectX 11 titles. DirectX 12 allows games to take advantage of more efficient graphics processing techniques. They can, therefore, create more ambitious visual effects than older games, written for the earlier DirectX 11 API.

A wrinkle worth explaining is that the DirectX3D component of DirectX 12 doesn't insist on a GPU supporting all the new DirectX 12 features: each card implements a “feature level”, corresponding to a DirectX release. Certain cards only support a DirectX 11 feature set – but since these are low-end cards, you wouldn't expect maximum detail from them anyway.

All the cards on test support the OpenGL API for graphics rendering, and OpenCL for writing programs to run on the graphics card. This won't affect your gaming experience, but it's helpful for programmers wanting to write cross-platform games that aren't entirely tied to DirectX.

5: POWERING UP

If you're tempted by a high-end graphics card, you may be wondering whether your power supply will be capable of driving it.

As you can see from our graph a premium graphics card can easily triple the peak power draw of a PC. Happily, wattage is unlikely to be a problem: a modern PC typically comes with a 500W power supply, which is clearly ample for even the most extravagant card. You'll only need more if you want to install multiple cards.

The question is how exactly the power gets to the card. The PCI-E bus can provide up to 75W, which is enough for most lightweight and mid-range cards. But once you move into the realm of high-performance GPUs, you'll need to supplement this by connecting a six-pin 75W power connector, or an eight-pin 150W connector, via your power supply. The most demanding cards ask for both.

Every power supply provides these connectors: they're connected directly to the PSU on some, while “modular” designs use detachable cables that you'll need to plug in at both ends. Make sure they're routed to the right place and you're golden.

HOW WE TEST

We've awarded each graphics card on test a score out of five. Principally, this reflects its performance, but it also takes into account how reasonable or otherwise its price is.

How do we measure performance? There's only one way to test a graphics card: run games on it. For this Labs, we benchmarked all 17 of our cards using titles both old and new – namely Dirt: Showdown (2012), Tomb Raider (2013) and Metro: Last Light Redux (2014) from the DirectX 11 era, plus Hitman (2016) and Deus Ex: Mankind Divided (2016) to test DirectX 12 performance.

We tested in 1080p with high detail, and at 4K resolution (3,840 x 2,160) with maximum detail; for low-end cards we tested at 720p as well. You'll find details of additional tests for virtual-reality gaming on p82.

While the graphics card does the bulk of the visual work, modern games can drive the CPU hard as well, not to mention making weighty demands on system RAM. For our testbed, we used a Core i5-6600K processor, supporting turbo speeds up to 3.9GHz, and 16GB of DDR4 memory.



	LIGHTWEIGHT GRAPHICS				MAINSTREAM GAMING				
				RECOMMENDED					
	Palit Nvidia GeForce GT 710	Palit Nvidia GeForce GT 730	Sapphire AMD Radeon R7 240	Asus AMD Radeon R7 250	PowerColor Red Dragon AMD Radeon RX 460	Gigabyte Nvidia GeForce GTX 1050	Palit Kalm Nvidia GeForce GTX 750 Ti	Asus Expedition Nvidia GeForce GTX 1050 Ti	
SCORE	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	
Price	\$50	\$60	\$76	\$80	\$160	\$170	\$270	\$222	

CORE

Stream processors	192	384	320	384	896	640	640	768	
Texture mapping units	16	32	20	24	56	40	40	48	
Render output units	8	8	8	8	16	32	16	32	
GPU frequency (MHz)	954	902	730	1,000	1,090	1,354	1,020	1,290	
GPU boost frequency (MHz)	N/A	N/A	780	1,050	1,200	1,455	1,085	1,392	
Overclocked	✖	✖	✖	✖	✖	✖	✖	✖	

RAM

RAM amount	1GB	2GB	1GB	1GB	2GB	2GB	2GB	4GB	
RAM type	DDR3	DDR3	GDDR5	GDDR5	GDDR5	GDDR5	GDDR5	GDDR5	
RAM speed (Gbits/sec)	1.8	1.8	4.6	11.5	1.7	7	5	7	
Memory bandwidth (GB/sec)	14.4	14.4	72	74	112	112	80	112	

CAPABILITIES

Direct3D feature level	11_0	11_0	11_1	11_1	12_0	12_1	11_2	12_1	
OpenGL version	4.5	4.5	4.3	4.3	4.5	4.5	4.5	4.5	
OpenCL version	1.2	1.2	1.2	1.2	2	1.2	1.2	1.2	
Maximum displays	3	3	3	3	5	3	4	3	
Maximum resolution at 60Hz	2,560 x 1,600	2,560 x 1,600	4,096 x 3,112	4,096 x 3,112	4,096 x 2,160	7,680 x 4,210	4,096 x 2,160	7,680 x 4,210	

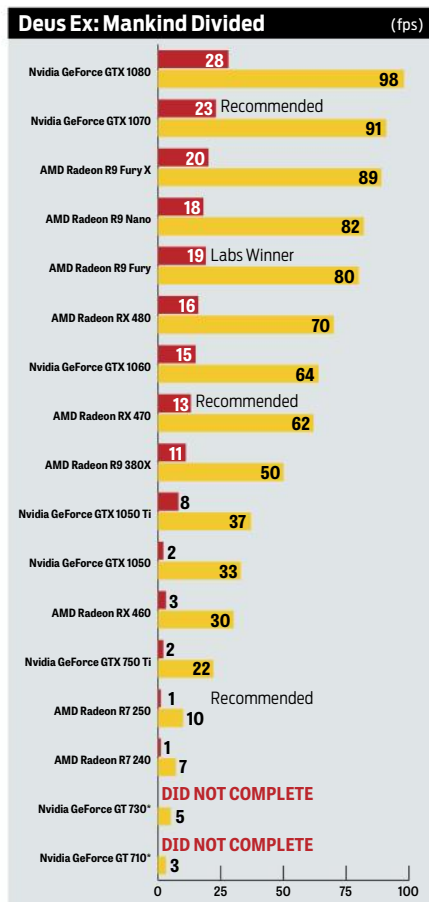
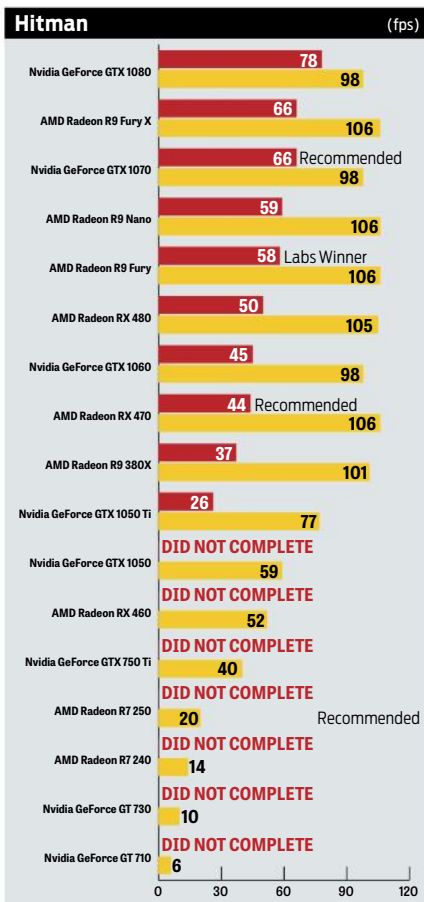
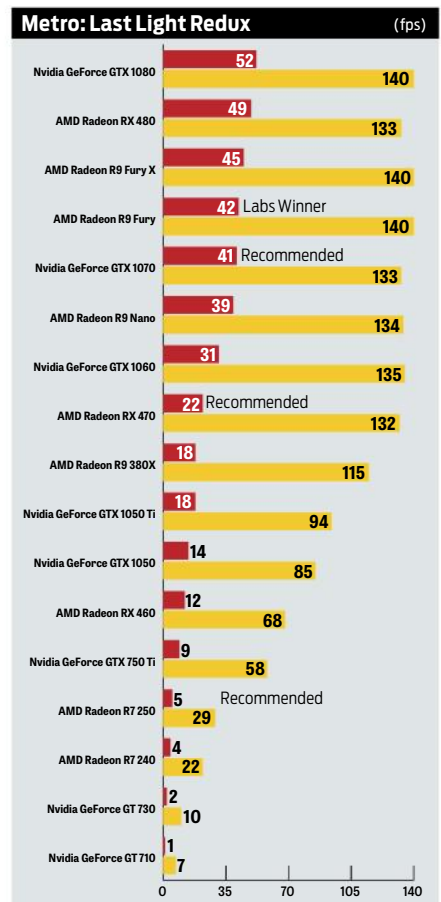
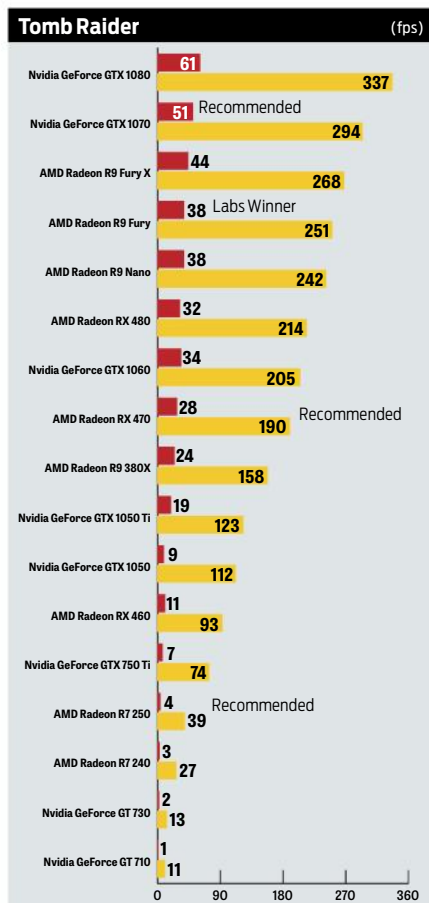
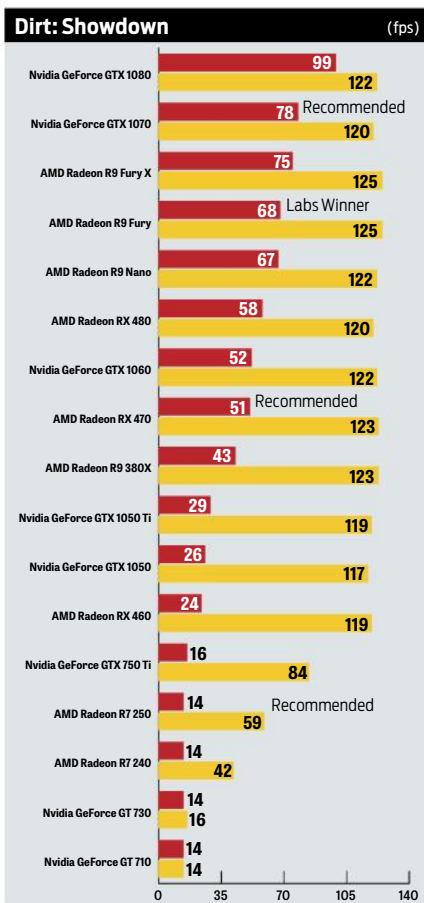
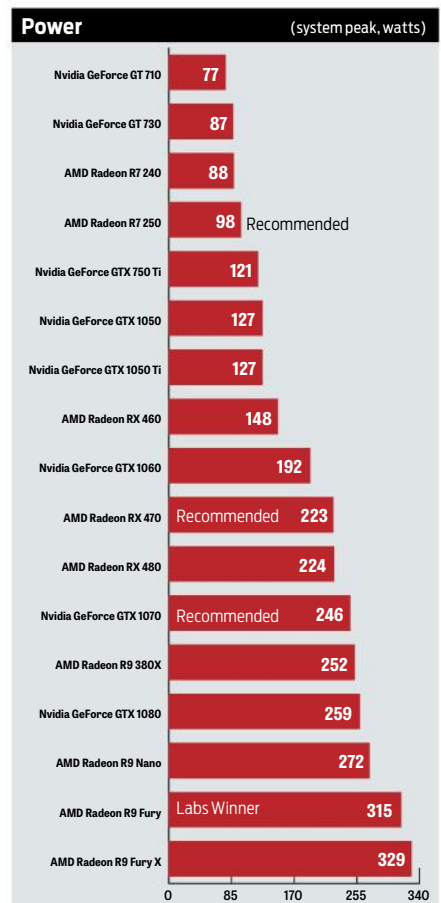
DIMENSIONS AND CONNECTORS

Power connectors	None	None	None	None	None	None	None	None	
Video connectors	DVI-I, HDMI, VGA	DVI-I, HDMI, VGA	DVI-I, HDMI, VGA	DVI-D, HDMI, VGA	DVI-D, HDMI, VGA	DisplayPort, DVI-D, HDMI	DVI-D, DVI-I, mini-HDMI	DisplayPort, DVI-D, HDMI	
Maximum multi-GPU support	✖	✖	2	2	4	✖	✖	✖	
Backplate slots occupied	1	1	1	1	2	2	1	2	
Length	117mm	117mm	151mm	152mm	212mm	172mm	183mm	212mm	



	HIGH-END GAMING					ENTHUSIAST GRAPHICS			
	RECOMMENDED		LABS WINNER				RECOMMENDED		
	XFX AMD Radeon RX 470	PowerColor AMD Radeon R9 380X	XFX AMD Radeon R9 Fury	Zotac AMP! Edition Nvidia GeForce GTX 1060	Asus Strix AMD Radeon RX 480	Gigabyte AMD Radeon R9 Nano	Zotac AMP! Extreme Edition Nvidia GeForce GTX 1070	XFX AMD Radeon R9 Fury X	Asus Strix Nvidia GeForce GTX 1080
	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆
	\$270	\$400	\$530	\$370	\$440	\$640	\$600	\$680	\$1,030
	2,048	2,048	3,584	1,280	2,304	4,096	1,920	4,096	2,560
	128	128	224	80	144	256	120	256	160
	32	32	64	48	32	64	64	64	64
	926	1,020	1,000	1,556	1,310	1,000	1,632	1,050	1,759
	1,226	N/A	N/A	1,771	N/A	N/A	1,835	N/A	1,898
	✓	✗	✗	✓	✓	✗	✓	✗	✓
	4GB	4GB	4GB	6GB	8GB	4GB	8GB	4GB	8GB
	GDDR5	GDDR5	HBM	GDDR5	GDDR5	HBM	GDDR5	HBM	GDDR5
	7	5.9	1	8	8	1	8	1	8
	211	184	512	192	224	512	256	512	320
	12_0	12_0	12_0	12_1	12_0	12_0	12_1	12_0	12_1
	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
	2	2	2	1.2	2	2	1.2	2	1.2
	6	6	6	4	6	6	4	6	4
	4,096 x 2,160	4,096 x 2,160	4,096 x 2,160	7,680 x 4,210	7,680 x 4,320	4,096 x 2,160	7,680 x 4,210	4,096 x 2,160	7,680 x 4,210
	6-pin	2 x 6-pin	2 x 8-pin	6-pin	8-pin	8-pin	2 x 8-pin	1 x 6-pin + 1 x 8-pin	1 x 6-pin + 1 x 8-pin
	3 x DisplayPort, DVI-D, HDMI	DisplayPort, DVI-D, DVI-I, HDMI	3 x DisplayPort, HDMI	3 x DisplayPort, DVI-D, HDMI	3 x DisplayPort, DVI-D, HDMI	3 x DisplayPort, HDMI	3 x DisplayPort, DVI-D, HDMI	3 x DisplayPort, HDMI	2 x DisplayPort, DVI-D, 2 x HDMI
	4	2	4	✗	4	4	2	4	2
	2	2	2	2	2	2	2.5	2	2
	247mm	267mm	305mm	215mm	298mm	154mm	325mm	203mm	298mm

Red = 4K, ultra detail. Yellow = 1080p, high detail

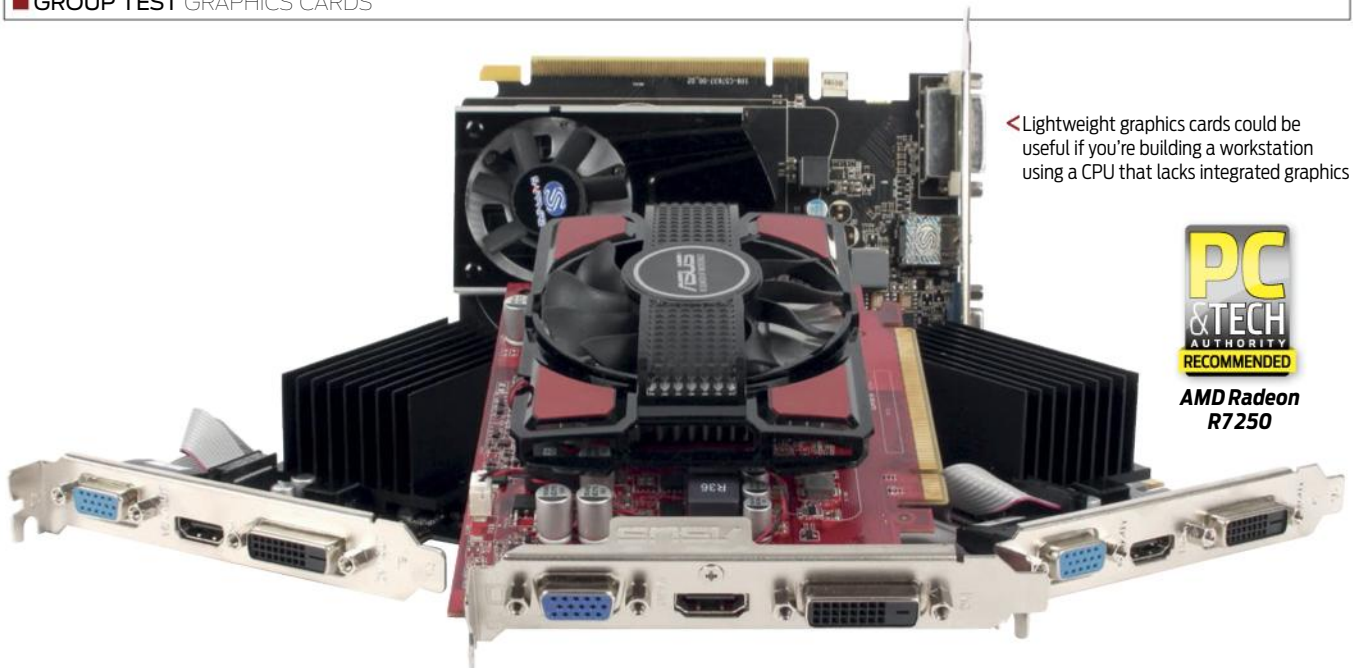


fractal
design



Performance without restrictions
Define C series





Lightweight graphics cards could be useful if you're building a workstation using a CPU that lacks integrated graphics

**PC
& TECH
AUTHORITY
RECOMMENDED**
**AMD Radeon
R7250**

Lightweight graphics Under \$100

The Nvidia GeForce GT 710 (\$50) may well be the cheapest graphics card we've tested, but it's fully DirectX 12 certified, with the same OpenGL and OpenCL support as you'll find on Nvidia's premium cards.

Still, we doubt you'll run anything more demanding than Minesweeper on this card. You might imagine you could run demanding games by switching to low-res graphics and minimal detail – but this isn't the case. Across all of our gaming tests, the best we could coax out of the GT 710 was an average 20fps in Dirt: Showdown – achieved by stepping down the resolution to 1,280 x 720 and switching all settings to Low. The reason isn't a mystery: the GT 710 is equipped with just 192 stream processors and a measly 1GB of DDR3 VRAM.

However, the GT 710 could be useful if you're building a workstation using a CPU that lacks integrated graphics. The GT 710 supports up to three monitors and can handle 4K resolutions if you drop down to 30Hz. The Palit-branded card we tested was compact, with a passive heatsink for silent running.

If your CPU has integrated graphics, you're better off skipping the GT 710. It isn't simply a question of saving money: Intel's recent GPUs are more powerful. The HD Graphics 530 in our test PC smashed the GT 710 in Dirt: Showdown, achieving a frame rate of 82fps with the same settings.

If you're set on a discrete graphics card, you may be tempted to step up to the Nvidia GeForce GT 730 (\$60). Confusingly, it's available in three configurations, offering a number of processing cores, as

well as quantities and types of memory.

The model we tested was again from Palit, and again it came on a dinky board with a passive cooler, making it look identical to the GT 710. Inside, however – befitting the price difference – it's loaded with twice as many stream processors, and double the DDR3 graphics memory.

Sadly, this didn't double frame rates. At the lowest settings, Dirt: Showdown averaged 26fps, and while newer games such as Hitman saw an improvement of around 50%, this couldn't make them playable. It's hard to see the point of the GeForce GT 730: it isn't powerful enough to open any additional doors.

A more promising prospect is the AMD Radeon R7 240 (\$76). It has 320 stream processors, with 1GB of bona fide GDDR5 VRAM delivering five times the memory bandwidth of Nvidia's budget offerings.

The benefit varies from game to game. Our Sapphire-branded R7 240 merely pushed Deus Ex: Mankind Divided up to an average of 12fps at the lowest settings,

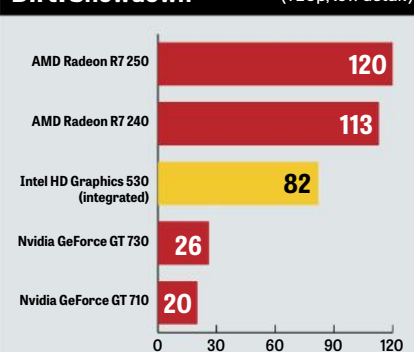
versus the 10fps we'd seen on the GT 730. But performance in the 1080p Tomb Raider benchmark more than doubled, leaping from 13fps on the Nvidia card to 27fps on the R7.

Best of all, Dirt: Showdown was transformed, averaging 113fps at the lowest settings. Even when we switched to 1080p and enabled high detail settings, the card churned out a playable average of 42fps.

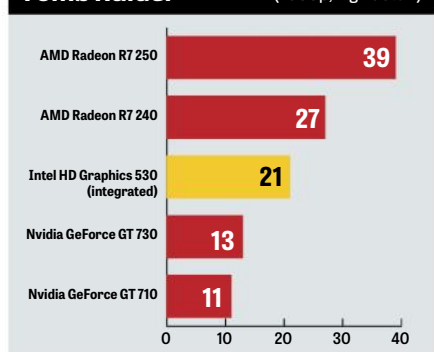
OUR RECOMMENDATION

No prizes for guessing that the AMD Radeon R7 250 (\$80) is the big brother of the 240. It's still very cheap by graphics card standards, but benefits from more stream processors running at higher speeds. That's enough to make some older games start to feel smooth: in 1080p, with high detail settings, we saw an average of 59fps in Dirt: Showdown, and 39fps in Tomb Raider. Newer titles remain out of reach, but for the price it's hard to complain about that.

Dirt: Showdown (720p, low detail)



Tomb Raider (1080p, high detail)



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Mainstream gaming

\$160 to \$270

Stretch your budget to the \$160 mark and you're entering the realm of "proper" graphics cards, capable of delivering impressive visual experiences. The AMD Radeon RX 460 (\$160) is a big step up from the company's budget R7 models. Compared to the R7 250, the stream processor count has more than doubled, to 896 individual cores. The memory allocation is up too, to 2GB of GDDR5 as standard. We tested a PowerColor "Red Dragon" card, but other brands will offer identical specifications.

The RX range also supports DirectX 12, rather than the 11.1 level of the R7 series. That bespeaks a GPU that's designed to keep up with the latest technologies, and so it proved in our tests, where the RX 460 made current DirectX 12 titles perfectly playable. In *Deus Ex: Mankind Divided*, it averaged 30fps in 1080p resolution with high detail. If that feels choppy to you, there's plenty of headroom if you're willing to ease back the settings: in 720p and low detail, the

game sped along at 86fps.

Things were even better with *Hitman*: the RX 460 allowed us to enjoy the game at an average of 52fps, again at 1080p with high detail. This was very pleasing, as the sumptuous graphics are a big part of the game's atmosphere. Trying to play it at a low resolution with limited detail misses the point.

The demanding *Metro: Last Light Redux* DirectX 11 benchmark confirmed that the Radeon RX 460 is a cut above the cheaper cards. While none of our mainstream contenders managed more than 30fps at 1080p resolution, the RX 460 turned in a smooth 68fps.

It's a similar story with the Nvidia GeForce GTX 1050 (\$170). As the name indicates, this is a big step up from the GT 730: it's part of Nvidia's latest 10-series family, which extends up to the flagship GTX 1080. Of course, it's the junior member, offering a comparatively modest 640 stream processors, but while that's fewer than the AMD RX 460, it's important to remember that AMD and Nvidia cores aren't directly comparable. The GTX 1050's cores are

also clocked higher than AMD's, with a maximum frequency of 1,455MHz versus the Radeon's 1,200MHz.

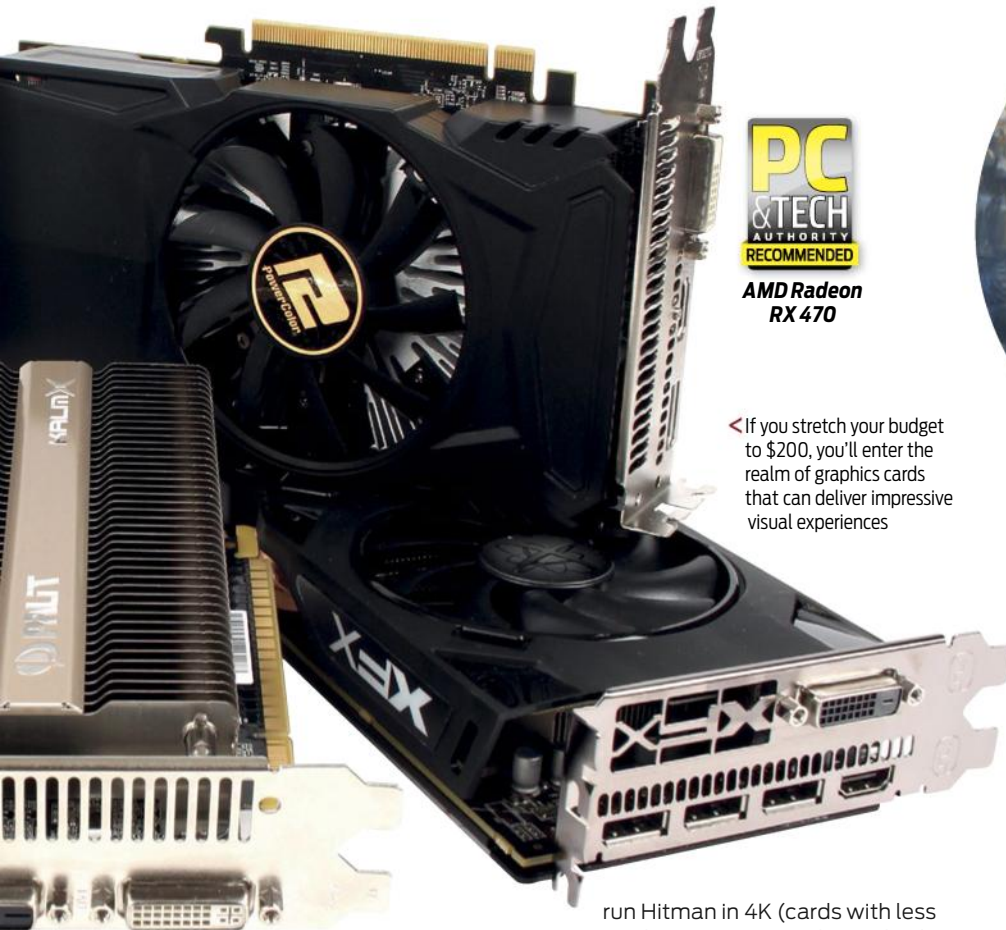
Once you plug the card in and actually start playing some games, it's apparent that the GTX 1050 is slightly faster than the RX 460. Across all of our 1080p tests, it achieved frame rates averaging 14% higher than its rival. The 1050's best showings came in older games – in *Tomb Raider* it was 20% faster than the AMD RX 460, and in *Metro: Last Light Redux* it was 26% ahead.

It kept a lead even in DirectX 12 games, achieving 9% faster performance than the AMD card in *Deus Ex: Mankind Divided*, and 14% faster in *Hitman*. The only blip was *Dirt: Showdown*, where the two cards achieved all but identical scores. So if you're looking for a mainstream card that's closer to \$150 than \$200, the GTX 1050 is about as good as you're going to get.

Don't, by the way, be tempted by the Nvidia GeForce GTX 750 Ti (\$270), a last-generation card that's still hanging around at retail. The "Ti", in Nvidia's jargon, indicates a souped-up spec from the original GTX 750, so you might imagine that this GPU could still hold its own in the mainstream. A glance down



*The RX 460 makes
DirectX 12 titles perfectly playable*



**AMD Radeon
RX 470**

◀ If you stretch your budget to \$200, you'll enter the realm of graphics cards that can deliver impressive visual experiences



*The RX 470 offers slick
1080p gaming at 60fps
in DirectX 12*

There may be edge cases, but overall we simply can't get excited about spending the extra few dollars.

OUR RECOMMENDATION

Sometimes you get what you pay for, and while it's the most expensive card in this category, the AMD Radeon RX 470 (\$270) is well worth the money. As our figures show, it has more in common with high-end cards than its mainstream companions.

In terms of specs, we're looking at 2,048 stream processors – three times more than other cards in this price bracket – coupled with 4GB of GDDR5, offering nearly twice the bandwidth of its compadres. The XFX card was slightly overclocked too, for good measure.

What that does for you is clear from our benchmarks: super-slick 1080p gaming at 60fps and above in modern DirectX 12 games. There's even the possibility of 4K on old titles: we saw 28fps in Tomb Raider with ultimate detail, and 51fps in Dirt: Showdown. Be aware that the RX 470 draws more power than most mid-range cards (our total system load peaked at 223W) and needs a six-pin power connector.

the specs reveals this card is inferior to the 1050 in several ways. While it has the same number of stream processors, they're clocked more slowly, and there's less memory bandwidth, with a telltale lower Direct3D feature level.

Inevitably, this translates to inferior gaming performance. In Metro: Last Light Redux, the GTX 750 Ti managed just 58fps, compared to the 1050's 85fps; in Deus Ex: Mankind Divided, it averaged 22fps versus the 1050's 33fps. This card might have offered a good balance of price to performance a year or two ago, and it has some interesting features – the Palit Kalm model we tested is the most powerful single-height card here, and the most powerful passively cooled one. All the same, nowadays this card would need to be significantly cheaper to make sense, and even then it won't be up to running modern DirectX 12 games at a decent pace.

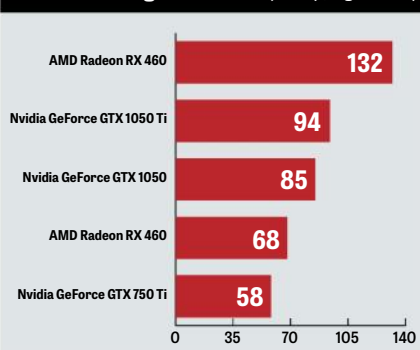
If you're interested in the "Ti" concept, you don't need to jump back to an older card to check it out. The Nvidia GeForce GTX 1050 Ti (\$220) is an upgraded version of the GTX 1050 with 20% more stream processors and twice the VRAM – that is, 4GB of GDDR5.

Notably, that makes it possible to

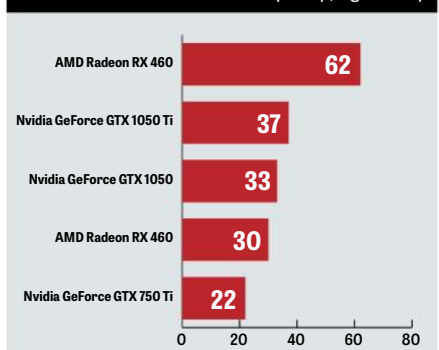
run Hitman in 4K (cards with less graphics memory are limited to lower resolutions), and the 1050 Ti gives this a good stab: we saw an average of 26fps with Ultra settings, so you shouldn't have to cut things back too far to make the game playable.

Aside from that, though, it's hard to say that the GTX 1050 Ti offers enough of an improvement over the regular GTX 1050 to justify the price premium. Yes, every game we tried was smoother, often by around 10 to 15%. However, this isn't enough to transform the experience: if a game runs fine on the GTX 1050, it's going to feel very similar on the 1050 Ti. And if it's unplayable on the 1050, the extra speed probably isn't going to rescue it.

Metro: Last Light Redux (1080p, high detail)



Deus Ex: Mankind Divided (1080p, high detail)



High-end gaming

\$370 to \$530

When you're spending more than \$350 on a graphics card, you expect certain things. Every game should be smooth and playable at 1080p, and 4K gaming becomes a reasonable expectation, if not something you can take for granted. As prices creep up toward the enthusiast end of the market, manufacturers start expending more effort customising their offerings: it's worthwhile shopping around to see if one manufacturer's card is faster or quieter than another's, or if it has a more attractive set of coloured LEDs.

Such aesthetic fripperies aren't universal considerations, however. PowerColor's AMD Radeon R9 380X (\$400) is an unremarkable-looking thing, powered by two six-pin plugs. Beneath the twin fans lurks a specification that's very similar to the cheaper Radeon RX 470, including 2,048 stream processors and 4GB of GDDR5 VRAM. There are variations on the theme here and there – this one has a fixed clock speed and a slightly lower memory bandwidth – but basically it's a case of spot the difference; surprise, surprise, the two cards come out with pretty similar benchmark results.

That makes the R9 380X a capable card. There's enough power here to make Hitman enjoyable at 4K with ultra detail – we saw an average frame rate of 37fps – and to make Dirt: Showdown race along at 43fps, again in 4K with maximum detail settings. Deus Ex: Mankind Divided was playable at 1080p almost without a hiccup, at an average of 50fps.

The question is whether the difference is pronounced enough to justify the extra cost. And the answer is that it certainly isn't – because the R9 380X is actually slower than the cheaper RX 470, lagging behind it in every one of our tests. Although barely more than a year old, the 380X has quickly ended up in the same unhappy situation as the last-generation Nvidia GeForce GTX 750 Ti, undercut and outpaced by a more recent arrival.

It's a happier story for the Nvidia GeForce GTX 1060 (\$370). The card costs \$100 more than its nearest rival, the AMD Radeon RX 470, but for that money you get a generous 6GB of GDDR5 VRAM – unless you choose the cheaper 3GB version – as well as a faster 1,708MHz GPU core, which on our test card had been given a gentle nudge up to 1,771MHz.



▲ Past the \$300 mark, manufacturers expend more effort customising their graphics cards

Next to the sizeable Radeon R9 380X, the GTX 1060 looks rather diminutive, but it packs a punch. Once again, it turned out a set of scores not a million miles from those of the Radeon RX 470. An average frame rate of 64fps in Deus Ex: Mankind Divided at 1080p was barely ahead of the 470's 62fps average; ditto a 45fps average in Hitman at 4K, compared to the AMD card's 44fps.

But the GTX 1060 is no clone. When the going got tough, the faster clock speed and more generous VRAM showed their worth. In Metro: Last Light Redux, the AMD and Nvidia cards performed almost identically at 1080p, with frame rates of 132fps and 135fps respectively. But when we pushed the settings to 4K with maximum detail, the GTX 1060 managed to keep the frame rate up to 31fps, while the RX 470 fell to 22fps.

It might seem that the advantage is limited to certain games and settings, those specific strengths of the GTX 1060 make it a much more viable card for virtual-reality gaming than the Radeon. Even if you're not bothered about that right now, it's a consideration worth

bearing in mind: whichever card you choose, there's a good chance VR gear will become more widespread and affordable within its lifetime.

Looking further up the price range brings us to the AMD Radeon RX 480 (\$440). The model number speaks for itself: this is the big daddy of the RX range, and the specification doesn't hold back, with a whopping 2,304 stream processors and 8GB of GDDR5. The standard clock speed is 1,266MHz: our Asus Strix card



The R9 380X is a capable card that packs enough 4K power



AMD Radeon
R9 Fury

The Radeon R9 Fury is an exceptionally powerful card

shoved that up to 1,320MHz for an extra boost.

As you'd hope, that all spells strong performance. Hitman purred along at an average 50fps in 4K with maximum detail, and while it wasn't possible to play Deus Ex: Mankind Divided at that resolution, we enjoyed a fluid 70fps in 1080p with high detail settings.

Like the GTX 1060, the RX 480 showed its strength in Metro: Last Light Redux, with a fantastic average frame rate of 49fps at 4K. Again, that marks this out as a potential VR powerhouse – although

the GTX 1060 is slightly better equipped for that role, so you might have to weigh up your priorities.

OUR RECOMMENDATION

From the price, you might assume that the AMD Radeon R9 Fury (\$530) would rank in the middle of the bunch in terms of performance. In fact, it's an exceptionally powerful card, originally launched at a steeper price, that's now become a bargain.

That's at least partly down to AMD's "HBM" (high-bandwidth memory)

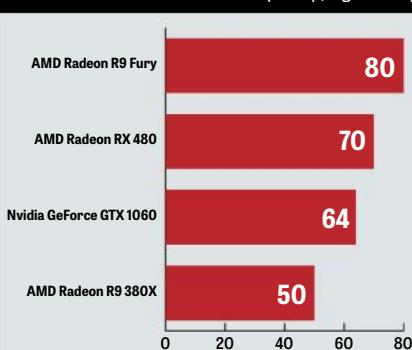
technology, which uses stacked DRAM cells to achieve huge memory bandwidth (quoted as 512GB/sec), without the cost and complexity of conventional super-wide buses. For good measure, AMD has also equipped the R9 Fury with a ludicrous 3,584 stream processors, giving it more raw parallel processing power than any card we've seen – apart from its two brothers, which we'll look at overleaf.

Suffice it to say, it works. As our graphs show, it was comfortably out in front in our DirectX 12 games, and in DirectX 11 the R9 Fury mostly kept up a pace that the other cards at this price simply couldn't match. Its only weakness was the 4K Metro: Last Light Redux test, where its 4GB of VRAM held it back to an average rate of 42fps. Even so, that's well ahead of the 6GB GTX 1060.

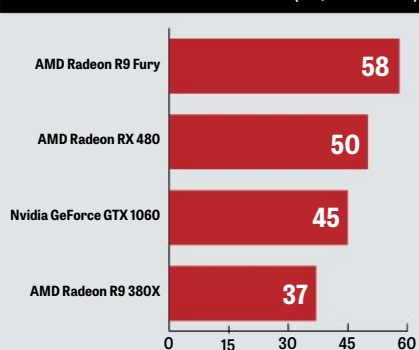
The card itself is enormous: the XFX model we tested was 305mm long, with three fans, and powered by two eight-pin power connectors. While benchmarking it we measured a huge peak power draw of 315W – only one card this month proved more power-hungry, and that one had a liquid-cooling system (see overleaf).

But it's only right that this hugely powerful card should come in such an imposing package. It's a larger-than-life GPU that delivers tremendous bang-per-buck, making it our favourite high-end card, and also our favourite graphics card at any price.

Deus Ex: Mankind Divided (1080p, high detail)



Hitman (4K, ultra detail)



Enthusiast graphics Over \$600

You read that price correctly – with the exception of a few souped-up, special edition cards, there's almost nothing to buy right now between \$500 and \$600. The size of the price gap makes it clear that, with these final four cards, we've aspired our way into a market where price is a secondary consideration.

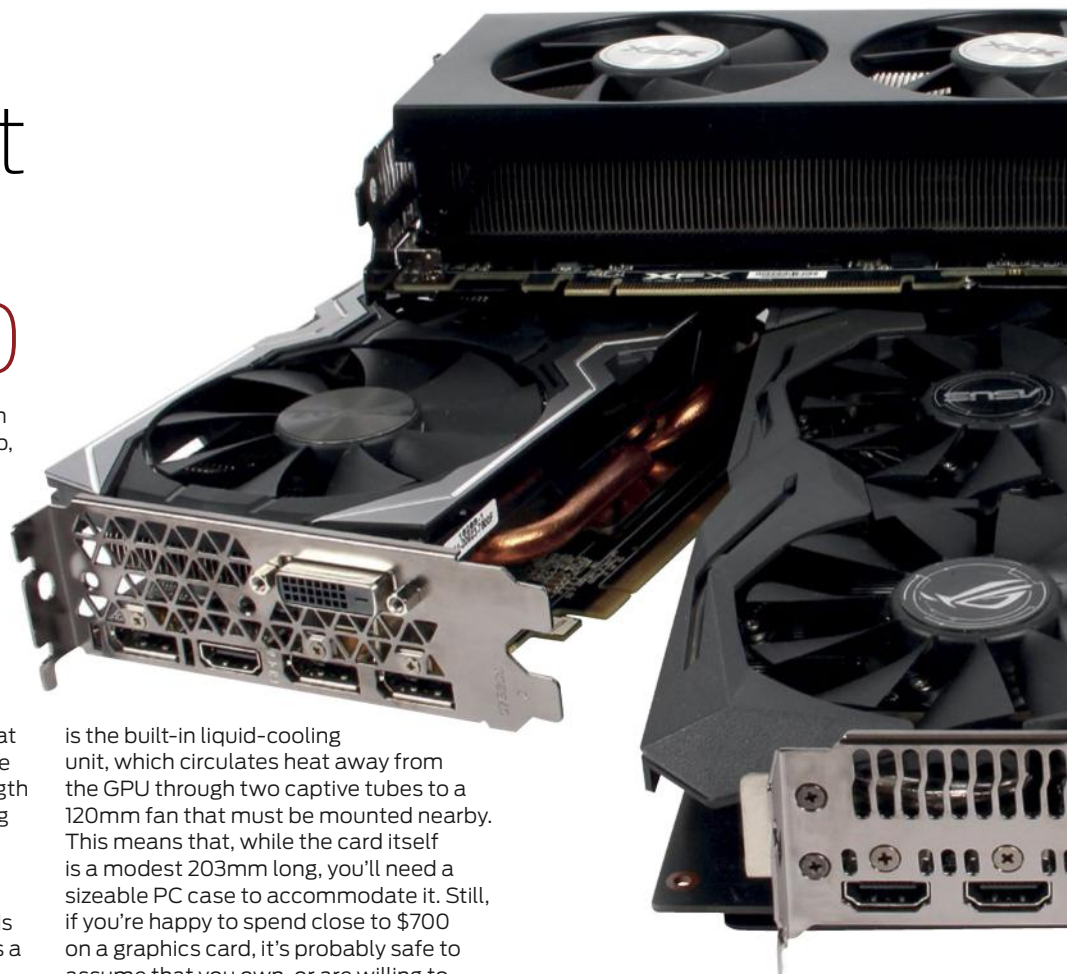
Within this echelon your cheapest option is the AMD Radeon R9 Nano (\$640). If you thought the R9 Fury was too darn big, this card could be just what you're looking for. The Gigabyte card we tested measured a mere 154mm in length – around half the size of the Fury, taking up barely more space than the humble Radeon R7 240. It also requires only a single eight-pin power connector, and while we can't claim its power demands are modest, its peak draw of 272W was a shade lower than the Fury's 315W.

Despite all this scaling down, the R9 Nano maintains the trademark 4GB of HBM, and it manages to cram in 14% more stream processors, upping the count to 4,096. However, the difference this makes is effectively nil: in our benchmarks the R9 Fury and R9 Nano ranked neck and neck. If you want to prise the two apart, we'd note that the Nano lagged a few frames per second behind the Fury in our DirectX 11 games, perhaps due to the denser, less well-ventilated design.

Had the R9 Nano been the same price as the Fury, we'd prefer it simply because of its more convenient size. Unfortunately, it hasn't seen the same sort of generous discounting that the R9 Fury has. You're looking at \$640 for this card, versus \$530 for the chunkier model that delivers more or less identical performance.

A card that might result in a little more head-scratching is the AMD Radeon R9 Fury X (\$680). The price on this one is absolutely crazy, especially since it offers an almost identical specification to the R9 Nano, matching its 4,096 stream processors and 4GB of VRAM. The only architectural difference is that the core runs at 1,050MHz, rather than the 1GHz of the other R9 models.

What makes the R9 Fury X distinctive



is the built-in liquid-cooling unit, which circulates heat away from the GPU through two captive tubes to a 120mm fan that must be mounted nearby. This means that, while the card itself is a modest 203mm long, you'll need a sizeable PC case to accommodate it. Still, if you're happy to spend close to \$700 on a graphics card, it's probably safe to assume that you own, or are willing to acquire, an outsized gamer-grade chassis.

There's no denying that the fan makes a difference. In *Deus Ex: Mankind Divided*, at 1080p, the Fury X managed 89fps – an improvement of more than 10% over the regular R9 Fury. In *Hitman*, it boosted 4K performance from a respectable 58fps to a convincing 66fps. The Fury X also achieved a score of 9.6 in the SteamVR readiness test, placing it a rank above the R9 Fury for virtual-reality gaming, and second only to Nvidia's powerhouse 1070 and 1080 GPUs.

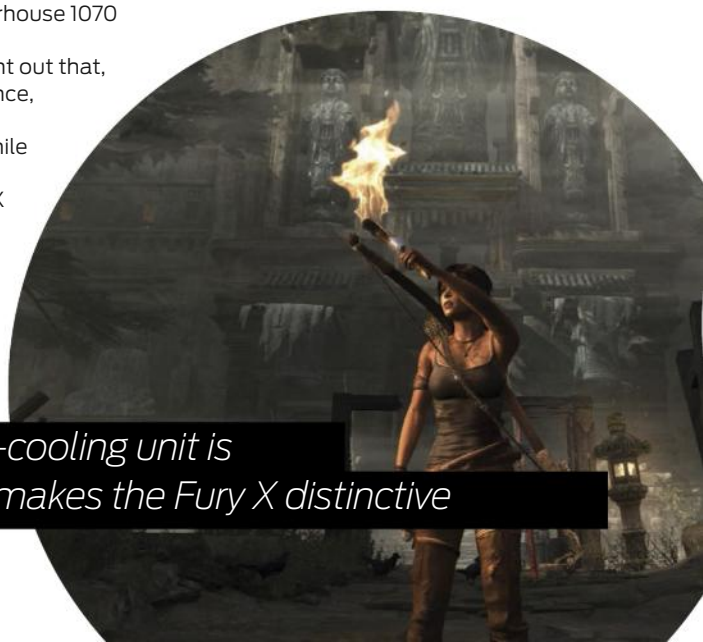
It's hardly necessary to point out that, in terms of gaming performance, you're seeing a modest boost over the standard R9 Fury, while paying nearly two and a half times the price. But the Fury X isn't supposed to be a value proposition: it's aimed at those who are willing to pay whatever it takes to eke out a few extra frames per second. Quibbling with the price seems pointless. The

real issue is that Nvidia offers not one but two cards with even better performance.

The one that competes directly with the Fury X is the Nvidia GeForce GTX 1080 (\$1030) – for now, the flagship of Nvidia's consumer graphics card range. As befits a top-line card, Nvidia hasn't held back in any department: the 1080 comes with 2,560 stream processors, and 8GB of GDDR5, with an ultra-wide bandwidth of 320GB/sec.

Only AMD's

*The liquid-cooling unit is
what makes the Fury X distinctive*

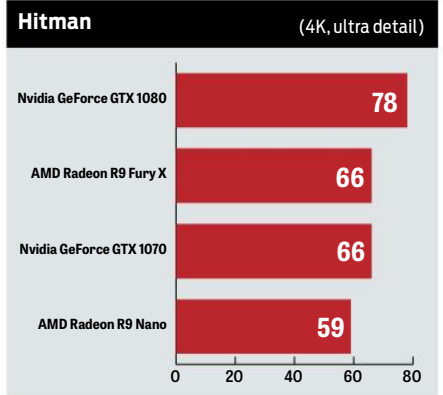
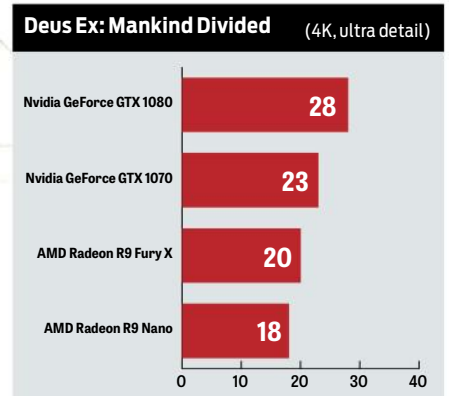




< In the world of enthusiast graphics, the price is secondary to eking a few extra frames per second



Nvidia GeForce GTX 1070



R9 chips offer faster memory access, thanks to their HBM design, but since those are limited to 4GB, the GTX 1080 is the more versatile card. As a cherry on top, our Asus Strix card came with an overclocked core, up from a maximum of 1,733MHz to 1,898MHz.

The performance all of this delivers is unanswerable. The GTX 1080 was the only card this month that made Deus Ex: Mankind Divided playable in 4K with maximum detail settings, with an average frame rate of 28fps. Hitman, with

the same settings, screamed along at 78fps. The taxing Metro: Last Light Redux clocked in at an average of 52fps with ultra detail. And even in the 4K, ultimate-detail Tomb Raider test – with TressFX technology blowing Lara Croft's hair around in individual strands – the GTX 1080 averaged a solid 61fps.

Simply put, the GTX 1080 outguns every other graphics card on the market today (leaving aside Nvidia's boutique Titan X card, which costs upwards of two grand). If that's what you're looking for, the price will be almost academic; the fact that it offers more bang-per-buck than the Fury X will be the icing on the cake.

Just for fun, we also tried running our most demanding benchmarks across two GeForce GTX 1080 cards, working together in an SLI multi-GPU configuration. While our frame rates didn't double, we were impressed to see improvements in several games. In Deus Ex: Mankind Divided, the second card raised 4K performance to 37fps, while in Metro: Last Light Redux the frame rate leapt from 52fps to 97fps. For the true speed freak, even higher performance is attainable.

OUR RECOMMENDATION

While there's nothing out there to match

the all-conquering GeForce GTX 1080, the Nvidia GeForce GTX 1070 (\$600) nips close at its heels. The cost is more or less the same as that of the R9 Nano, but the design certainly isn't: our Zotac AMP! Extreme Edition was this Labs' largest card, measuring 325mm in length.

That's partly to accommodate an overclocked core – the standard Nvidia spec drives the card's 1,920 stream processors to a maximum of 1,683MHz, but Zotac's take pushes them as high as 1,835. There's also 8GB of VRAM and twin eight-pin power connectors to keep everything stable.

Despite its size, there's nothing lumbering about the GTX 1070's performance. In our 4K DirectX 12 tests it faced down every card AMD has to offer, averaging an excellent 23fps in Deus Ex: Mankind Divided and 66fps in Hitman. Only Nvidia's own GeForce GTX 1080 did better.

It was a similar story in our DirectX 11 tests: in Metro: Last Light Redux the GTX 1070 fell slightly behind the R9 Fury X, averaging 41fps to the Radeon's 45fps, but otherwise it gave a convincing silver-medal performance. If you have to balance your ambitions against your budget, it's an extremely tempting deal, coming close to the power of the GeForce GTX 1080 for \$430 less.



The GTX 1080 outguns every other card on the market today

Virtual -reality gaming

DARIEN GRAHAM-SMITH STEPS INTO VR

When choosing a new graphics card, you may have given little thought to the idea of virtual-reality gaming. After all, we've yet to see an essential VR game: it's easy to imagine that you'll be onto your next graphics card before virtual gaming becomes relevant.

But the tipping point may come sooner than you think. The PSVR accessory for the PlayStation 4 was a big hit at Christmas, bringing the idea of VR into the mainstream. For PC gamers, the HTC Vive and Oculus Rift headsets offer a mature and effective VR experience. And while A-list games are still the missing link, the catalogue is growing. Right now on Steam you'll find dozens of fun VR games and experiences. It may take only one or two major releases to turn VR into the next big thing.

SYSTEM REQUIREMENTS

The good news is that VR isn't as demanding as you might expect. Officially, the HTC Vive calls for an AMD RX 480 or Nvidia GTX 1060 card. A super

high-end GPUs is better, of course, but not necessary.

That makes sense when you think about it. Both the Vive and the Oculus Rift have a native resolution of 1,080 x 1,200 per eye, for a total display area of 2,160 x 1,200. This isn't much above 1080p, so we're talking about a pixel count that's well within current norms.

The only complication is that, to keep things fluid as you move around your virtual world, it isn't good enough to aim for a 30fps frame rate. Both PC headsets have a refresh rate of 90Hz; ideally, you want a card that can keep this up consistently. Otherwise, you're in danger of motion sickness as the world lurches about you.

If you're not sure if your card qualifies, there's plenty of help at hand. The free SteamVR Performance Test tool will benchmark your PC by rendering a short stereoscopic video at the appropriate resolution and frame rate, and tell you whether or not you're ready for VR.

Inevitably, the result isn't a simple yes or no. While you can't change the resolution of a VR game, you can tweak the detail settings to suit your hardware, just as you can with a regular game. That means you can play VR games even on a low-end card, as long as you don't mind chunky graphics and minimal visual effects. What the Steam tool gives you is a score out of 11, on which we found HTC's minimum recommended cards represented a score of between 7 and 8. The graph opposite shows how all 17 of



▲ The Oculus Rift offers a mature and effective VR gaming experience for PC owners

our cards stacked up, when tested in our Core i5-6500K system.

VR GAMING PERFORMANCE

Running an assessment tool is one thing: strapping on the headset for real is another. To get a sense of what VR gaming is like on each of the cards, I set up the HTC Vive and immersed myself in *Serious Sam VR: The Last Hope* – a simple first-person shooter.

Subjectively, the experience was pretty good on all but the most underpowered cards. I set detail options to high,

“You can play VR games even on a low-end card, as long as you don't mind chunky graphics and minimal visual effects”

then mirrored the VR display onto the desktop, and measured the frame rate with the free PresentMon tool. You'll see the full results opposite: while only the most expensive cards managed to keep up 90fps with these settings, even mainstream cards delivered a smooth experience, with no juddering hiccups to disorientate and take me out of the moment.

While *Serious Sam VR* is a fun shooter, I'd also have liked to test a more ambitious DirectX 12 VR title. Unfortunately, such content is thin on the ground right now – but there is a good simulation available. *Deus Ex: Mankind Divided* comes with a stereoscopic 3D mode that, with the help of a free Steam utility called Bigscreen, can be relayed into your VR headset. This doesn't give you the full immersive experience – you can't look left and right by turning your head – but it does reveal the performance impact of stereoscopic rendering.



◀ The HTC Vive comes equipped with a pair of “wands” that replicate your hands onscreen



The issue is that, in 3D mode, Deus Ex won't generate more than 30fps. Every card from the Nvidia GeForce GTX 1050 Ti up was able to handle this with ease in stereoscopic 1080p with high detail. For my tests, therefore, I switched to 4K resolution and ultra detail. This meant rendering more pixels than the Vive can actually display, but this isn't necessarily an unrealistic representation of a real VR workload. Many VR games use "supersampling" to achieve a cleaner image, by rendering the screen at a higher resolution, then downsampling it for display.

As our graphs show, none of the cards

were able to hit 30fps in 3D with these demanding settings. However, in most cases, the scores we saw were within 15% of each card's 2D performance. That gives us a handy rule-of-thumb estimate of how well a card can be expected to handle VR games, based on its performance in regular flat-screen games.

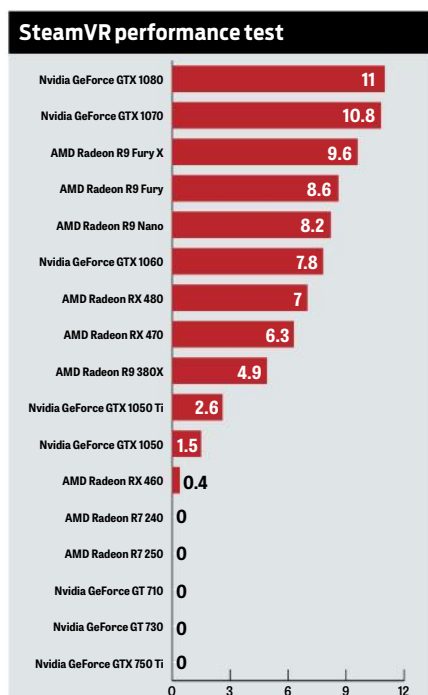
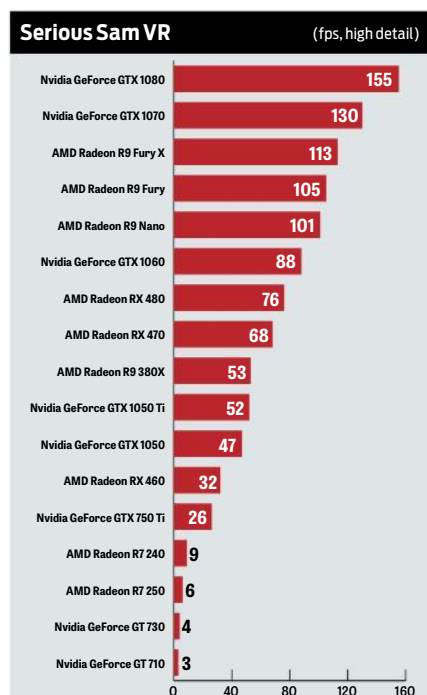
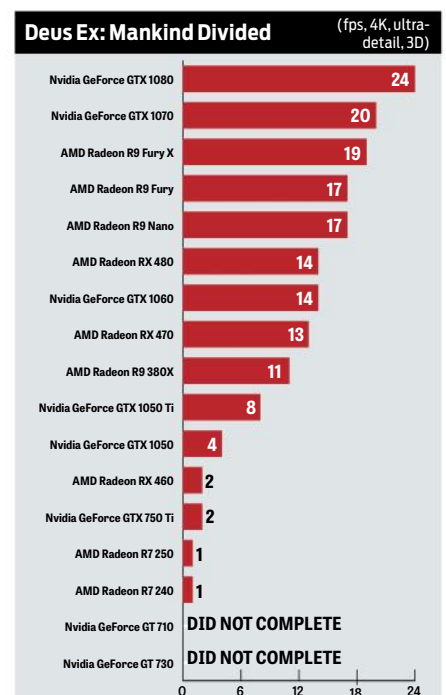
Clearly, virtual reality doesn't require you to splash out on a top-of-the-line graphics card. The big expense, if you're ready to take the plunge, is the headset. The Oculus Rift will set you back US\$599, or US\$798 including the Touch controllers, while the HTC Vive comes in at a stiff \$1,399 (Australian dollars).

However, that price does include a pair of control "wands", which are virtually represented on the screen, giving you a sense of what your hands are doing. The Oculus equivalent is sold separately from the headset.

You also need to think about the practicalities of using the system. While the Oculus Rift uses a single desk-mounted pedestal, the HTC Vive comes with a pair of receivers that you're supposed to mount in the corners of your room. These allow the system to track not only your movements, but your location: if you can clear an area of around 2sqm, you can move around in the virtual world by physically stepping this way and that. There's a "standing only" option, but even then you'll want space to extend your arms and whip around when you spot a malevolent zombie rushing up at the edge of your peripheral vision. This isn't something you can play in a crowded environment.

Although it may seem too obvious to repeat, remember that once you're wearing the headset, you're almost entirely shut off from the outside world. The stereoscopic displays cover your eyes and, for the full atmospheric experience, headphones block up your ears. If your baby is crying, or your dog is underfoot, you may not know about it. VR can be an amazing experience, but there are numerous considerations to take into account; choosing a suitable graphics card is only the start.

VR test results



View from the Labs

COMPUTER GRAPHICS ARE NO LONGER JUST ABOUT PIXELS AND POLYGONS: THE VISUAL ASPECT OF MODERN GAMES IS AN EXPERIENCE IN ITSELF

Confession time: I've never really been one to get excited about computer graphics. Over my years here, I've frequently overheard the gamer's desks swooning over some new graphics architecture, and each time I've allowed myself a superior chuckle. Sure, HDR lighting and ultra-realistic particle physics are technically impressive – but at the end of the day, it's all superficial stuff. What's important is the gameplay, right?

Perhaps that instinct is to do with my age. My formative gaming experiences were on the ZX80, a platform whose graphical capabilities extended only to large monochrome squares. The emphasis was naturally on gameplay, because heaven knows you weren't going to be drawn in by the visuals.

But things have changed. Some years ago, I remember hearing Nvidia CEO

Jen-Hsun Huang point out that computer graphics have grown beyond PC gaming to become an essential part of the movie industry. In light of the increasing capabilities of mainstream graphics hardware, he predicted that the visual techniques wowing cinema audiences would quickly transfer to the small screen.

I scoffed at the time, and wrote his words off as mere marketing bluster. Imagine, comparing a humble PCI-E card to a professional rendering farm!

But Huang was right. Just look at the atmospheric lighting in *Deus Ex: Mankind Divided*, or at the virtual camerawork in *Hitman*. This isn't mere technical pixel-pushing: it's cinematography.

Indeed, cinema-grade animation is well within reach of a modern GPU. The original *Toy Story* (1996) was reportedly "shot" at a resolution of 1,536 × 922, with

each frame taking up to four hours to render; today's high-end graphics cards turn out sumptuous scenes at 3,840 × 2,160 – in real-time.

Yet if games have come to resemble movies, it isn't just about the visuals. The games I remember from my youth typically comprised a series of action sequences, strung together by a flimsy premise. Today's titles are much more story-driven, with detailed, twisting plots to rival any Hollywood thriller. Often, there's even an easy mode, to help you work through the story and reach the denouement without getting stuck. And as VR transports us into immersive virtual worlds, it's a safe bet that narrative is going to be even more central.

Perhaps the younger me had a point. Maybe, ten or 20 years ago, high-end graphics really were a showy extravagance. But I can no longer sneer that gaming is all about gameplay: today it's a rich visual and narrative experience, of which gameplay is just one aspect. A capable GPU lets you enjoy that experience to the full – and I'm certainly not going to turn my nose up at that.

GPU computing

WEREN'T OUR GRAPHICS CARDS SUPPOSED TO BE MAKING US MORE PRODUCTIVE?

You'll notice that this month's Labs focuses almost entirely on gaming. So you might well be wondering: can't we harness the huge computational power of these cards for productive applications?

It isn't an unreasonable question. Not many years ago, there was much optimistic talk about the potential of "general-purpose GPU computing" – GPGPU, for short. Today, developers can freely offload calculations onto the graphics hardware, via DirectX, OpenCL or Nvidia's CUDA platform.

Unfortunately, GPU computing has its limitations. For example, the 4,096 stream processors in an AMD Radeon R9 Fury X card represent a huge amount of aggregate power – but each core can only perform quite simple calculations, and breaking down the workload accordingly can add considerable complexity to your program. What's more, you'll only see the full benefit only if you're carrying out



4,096 independent calculations at once. If you want to add a to b and then divide the result by c, it doesn't matter how many cores you have – you can't start the second operation until you've finished the first.

This doesn't mean GPU computing is useless. Where the workloads are suitable, it's being used in dozens of fields, from chemistry to high finance. On the desktop, programs such as Adobe Premiere Pro can use the GPU to speed up effects and processes such as deinterlacing, even if the actual rendering is handled by the CPU.

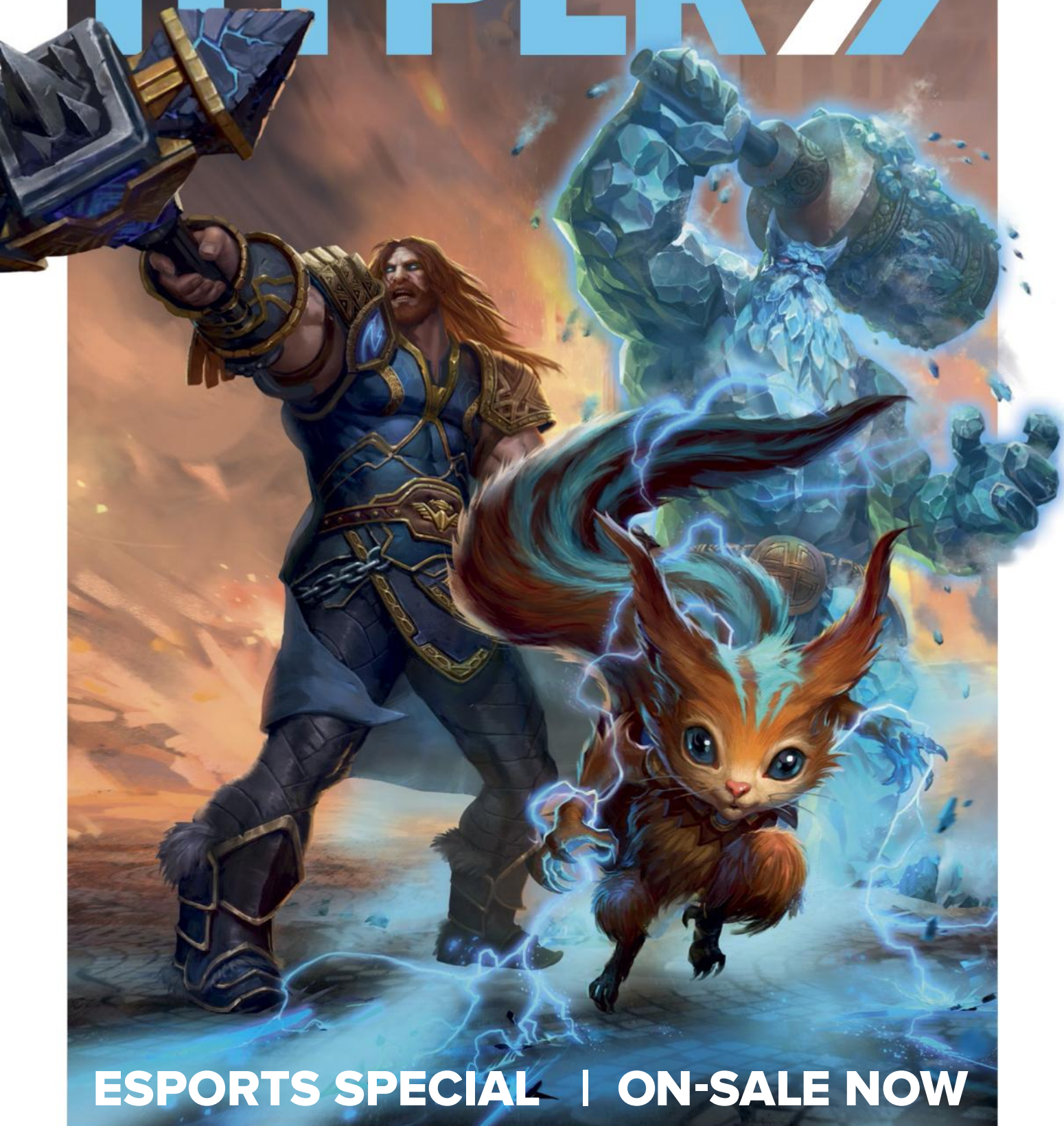
For the most part, though, desktop applications use GPUs for what they're

▲ A decent GPU can speed up effects rendering in Adobe Premiere Pro

best at: rendering graphics. Adobe Photoshop, for example, uses the GPU to zoom smoothly in and out of images; Lightroom uses it to generate full-resolution previews. After Effects uses it to render 3D objects and generate fast previews of your work. Chrome uses GPU acceleration to render web pages.

So developers aren't ignoring GPU computing: it just turns out not to be as "general purpose" as we once hoped. There are benefits, but outside of a few specific workloads, you won't see much difference between a budget graphics card and a high-end one. ●

HYPER»



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CASH IS KING. LONG LIVE THE KING?

Will digital currencies and e-payments finally kill off the paper and coins we use for money? **Nicole Kobie** reveals why cash isn't dying - yet

You pay for bus journeys with a wave of your phone, settle a dinner bill with friends via email, and haven't stepped foot into your bank's local branch in years. So why do you still have change jingling around your pocket and paper money clogging up your wallet?

Is it time to kill cash? Many hope so. Leaders at Nasdaq, Visa and others have eyed up "digital dollars" traded via blockchain – the digital ledger system behind Bitcoin – as a way of speeding up payments; Sweden's central bank is currently considering issuing a digital currency; and Barbados already has a version of its dollar based on the blockchain.

But Richard Goold, partner and global head of Tech Law at Ernst & Young, doesn't believe we'll ditch the coins and paper soon. "People have been predicting the death of cash for a very long time – well over 50 years," he said. "And, credit cards, Bitcoin (and other cryptocurrencies) and fintech payment

systems are giving rise to an increasingly common debate on the future of physical currencies."

There are two ideas at the crux of the question. First, there's the currency itself, with cash no longer backed by gold but still a physical token of value. And then there's how we manage it, with more and more transactions making use of e-payment systems.

DIGITAL CURRENCIES

The arguments for digital currency are many: it could cut fraud, it's more transparent, and it's easier to use. But as old-fashioned as they seem, those round bits of metal and rectangles of paper have their benefits. "Cash is untraceable and easy to carry around, and it isn't only criminals and fraudsters who like these factors – the physiological link of having hard cash gives a sense of security that will be difficult to break for many," Goold said.

Gareth Lodge, an analyst at Celent, has



even bigger questions. "There are some questions around digital currencies," he said. "Who backs it and how do you have the confidence and faith in that currency?" It may be appealing to ditch government control of money, but consider who you're handing that power to instead. "It could leave itself open to all sorts of issues around being manipulated," Lodge added.

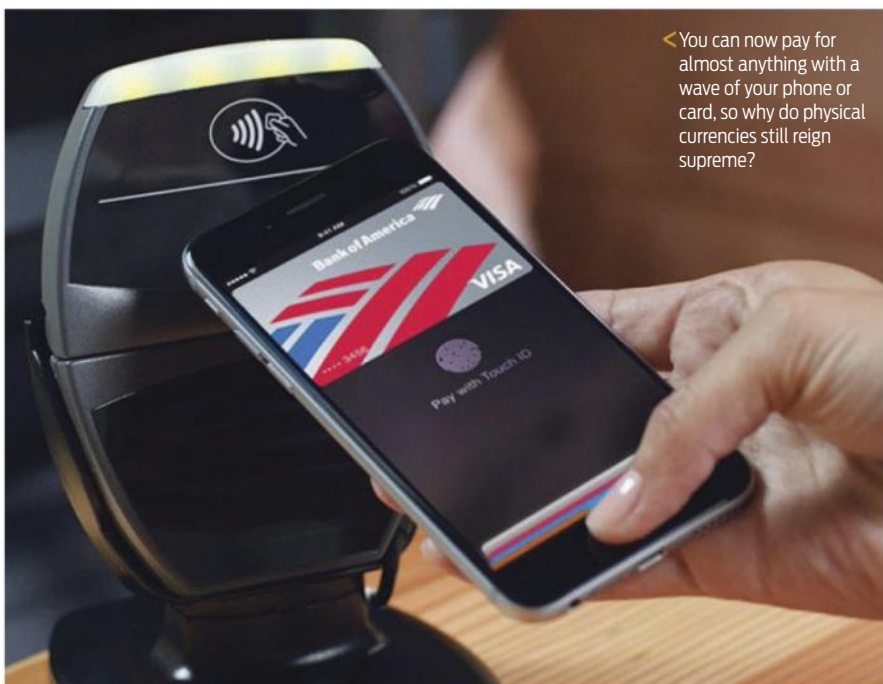
Others disagree. People do like the security of physical objects, but many of us happily ditched paper books for ebook readers and paper letters for email, noted Amos Meiri, CEO of digital currency startup Colu. "It's the same with digital currencies – initially, they'll exist alongside standard paper currencies, but eventually they'll take over as their advantages become apparent and

"All-digital currencies will greatly reduce the amount of black money on the market, on which no taxes are paid"

society demands it," he predicted.

"We definitely view digital currencies as the future of payments," he said. "It may take a bit of time for people to adjust to the idea and let go of the concept of paper money, but years from now we'll look back and muse at the fact that we ever used something as untrackable and insecure as paper to record value."

Meiri argues that the benefits of digital currencies outweigh the downsides. "Digital currencies, especially those



utilising the blockchain, provide security and visibility to the payment process, as well as a frictionless method that cuts out the middleman (and the fees paid to those institutions)," he said.

"Aside from this, an important benefit for currency issuers such as governments is that the use of all-digital currencies will greatly reduce the amount of black money on the market, on which no taxes are paid." People who get paid under the table now and then may disagree, but Meiri added: "The advantages are just so vast that there will be no turning back."

MODERN PAYMENTS

Even if we don't ditch the dollar for Bitcoin, how we interact with money is becoming increasingly digital. Goold noted that "the use of cash will decline", but it's been falling for some time: physical cash makes up 45% of transactions, down from 64% in 2005, according to statistics from ATM operator Link.

"The arguments for digital currency are many: it could cut fraud, it's more transparent, and it's easier to use"

Lodge said that the way we move money around is likely more important to everyday users than how it's structurally organised and created. "I think there are all sorts of opportunities around distributed ledger and blockchain technologies, particularly where the processes are complex already, so cross-border payments in particular," he said. Technologies such as blockchain could be used to guarantee and track payments, making it easier to both spend money and send it overseas, whether to buy a service from an Australian startup or a birthday gift for a distant niece.

Money evolves slowly, but change is happening. "We talk about debit cards being, after cash, the largest payment type globally," Lodge said. "But it's an overnight success that's taken 40 years to get here." The same follows for PayPal, with Lodge pointing out that "98% of it runs over existing payment channels anyway, and it has less than 10% market share, even now."

"To move the needle on any of this is a long-term game," he explained. "People's attitudes, and even just the practicalities of it, mean it happen overnight."

There is space

change in certain markets, though. "I do think that banking for the 'unbanked' through fintech platforms and systems will have a big impact on parts of the world over the coming decade," explained Goold, referencing areas of the world where many people don't yet even have bank accounts. "I also think that we will continue to see the inexorable rise of large technology companies increasingly having payment systems that challenge today's status quo."

While digital-only banks and smartphone-based payment systems mean we may not need to carry paper cash in our pockets for much longer, we'll still be using the same currencies we know now in the years and decades to come – and you can take that prediction to the bank. Assuming you remember where your local branch actually is, of course.



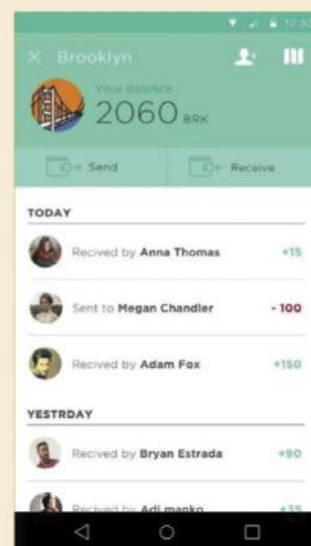
HOW COLU MAKES CASH LOCAL

Bitcoin is the best-known digital currency, but it isn't the only option. Startup Colu is set to launch its own version, which it is gradually rolling out into global territories.

Local currencies are a secondary form of cash that can only be used in a specific area, often offering a discount. They run alongside a national currency, and are frequently created to encourage shopping at smaller retailers or with local companies. "Colu has created an app-based platform that provides digital, local currencies," explained Amos Meiri, CEO of the Israeli startup. "The mobile app, downloaded by consumers, acts as a conduit between users and merchants which can quickly and securely receive and send direct payments, based on secure blockchain technology." Unlike Bitcoin, the Colu cash is linked to standard fiat currencies, so it should be less volatile.

Getting people to ditch cash for a new currency isn't easy, however. "The key obstacle to adoption at this point is awareness – many people just aren't aware of the existence of digital local currencies," said Meiri. "Lately, though, there's been a growing trend of European countries such as Sweden to discuss the possibility of launching digital currencies on a national level." The startup has already worked with the Barbadian government to create a version of its dollar on Bitcoin, and trialled a pair of currencies in Tel Aviv neighbourhoods.

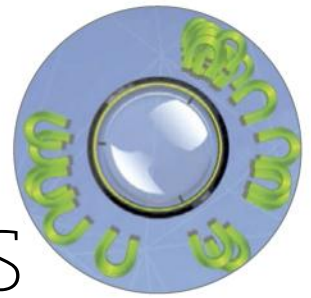
Aside from encouraging local shopping, people could also earn spendable points by volunteering, recycling or reporting infrastructure issues such as potholes to the local council. "Colu is making money more meaningful by building urban communities from the wallet up," he said.





SEEING THE FUTURE: HOW AI PREDICTS ELECTIONS AND HORSE RACES

MogIA forecast the unexpected result of the US election, while UNU knows which horse will win a race. Here's how predictive AI is giving new insight into the future



The US election result came as a surprise to many – the President-elect included – but not MogIA. The predictive artificial intelligence system out-figured most professional pollsters, calling Donald Trump's electoral success at the beginning of November.

A rival system called UNU picked Hillary Clinton to win the popular vote, which she duly did, and it correctly predicted another notoriously difficult to call American race, the Kentucky Derby.

Both systems work by listening to people. MogIA scans public social networks, while UNU surveys respondents, taking that human opinion and “amplifying” it into a system called “swarm intelligence”.

AI using neural networks seek to mimic the brain's network of cells, explains Louis Rosenberg, founder of UNU-creator Unanimous AI, while “swarms” gather intelligence via a network of people.

“It's an emergent intelligence, moderated by computer software, but leveraging the wisdom, insights, and intuition of human agents,” he said. “And it turns out that these artificially intelligent ‘human swarms’ are very smart. They outperform individuals. They outperform experts. And they outperform simple methods of tapping the intelligence of groups, like polls and markets.”

It's more than averaging human selections – as existing polls do. With the Kentucky Derby, UNU built a swarm of 20 people. If the system had simply gone with the most popular picks, it would have picked only one of the top four finishers. “We amplify the intelligence of individuals into a unified emergent intellect that exceeds natural capacity,” he said.

POPPING FILTER BUBBLES

Dr Chris Brauer, director of innovation at Goldsmiths, University of London, explained that AI is essentially maths in action. “Weather forecasts improved dramatically with investment in weather stations, satellites, data, and processing power.

“Similarly, forecasting will improve in any complex socio-technical system such as political elections when the system

continually improves and looks out for new data sources and forms – and has the power to process and analyse these inputs in meaningful ways. Next to this, polling looks like a man standing in front of a map pointing at clouds with a stick.”

Humans could perform better, but our hopes and assumptions get in the way, he noted. “One benefit of these emerging AI prediction platforms is their ability to burst through filter bubbles,” said Brauer. “This may seem paradoxical, since many are blaming smart algorithms for creating filter bubbles in social media. But when it comes to predictions, too often our models accept and embed flawed assumptions. AI systems are better than human beings at dealing with what we'd normally term unknowns.”

SMART SWARM?

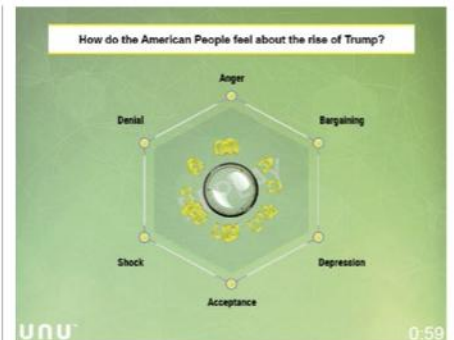
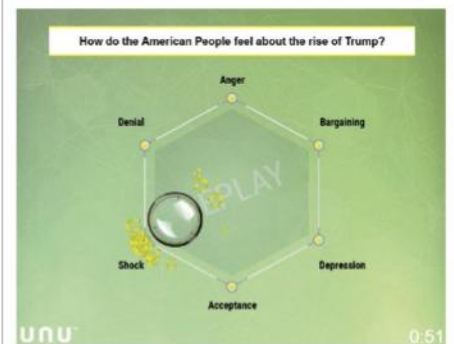
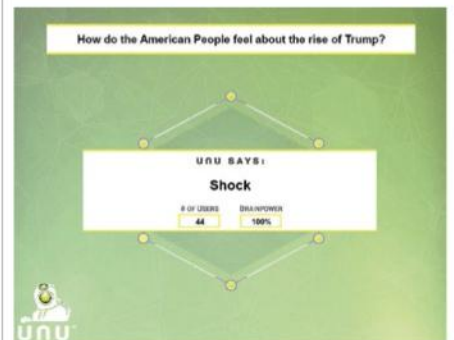
Just how smart are these predictive systems? Rosenberg said his swarm intelligence outperforms between 90% and 99% of the individuals in the swarm.

“We also compare swarms to standard polls, and outperform them in almost all situations,” he said, pointing out that most polls have more participants than a swarm.

But there are limitations. “Our system performs best when asked complex problems that have many possible outcomes,” Rosenberg said. “For simple questions that have only two possible outcomes, our performance is good, but becomes more similar to a poll.”

And there are downsides to looking to machines for answers without understanding their limitations. “These predictive AI systems aren't foolproof or objective by design,” Brauer said. “In many ways, the frailties of algorithmic bias are more threatening than human biases since there's a presumption of innocence.”

Trust in human authorities – such as governments and journalists – has long been falling, but that doesn't mean machine-learning algorithms are entirely benign or lack bias. “When we encourage learning systems to adapt autonomously in the wilds of data and human behaviour, we invite machine discretion and ethics,” he said. “One day a machine is predicting



UNU uses “swarm intelligence” to predict outcomes based on users' own data and behaviour

the winner of an election; the next day that victor is turning to the machine for advice.”

BETTING ON AI

Aside from picking horse races and beating pollsters, UNU and swarm intelligence have been tapped for market research and consumer forecasting, such as reactions to movie trailers, as well as examining financial markets and medical diagnoses.

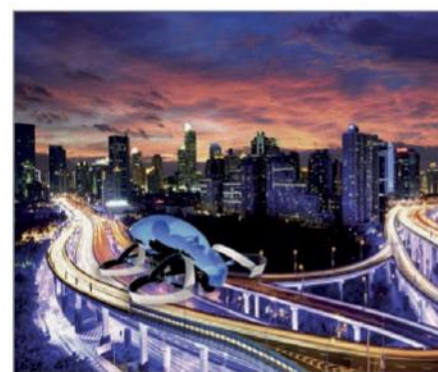
Will such AI put the bookies out of

BITE SIZE BRIEFS

Outside the box tech that raised our eyebrows this month

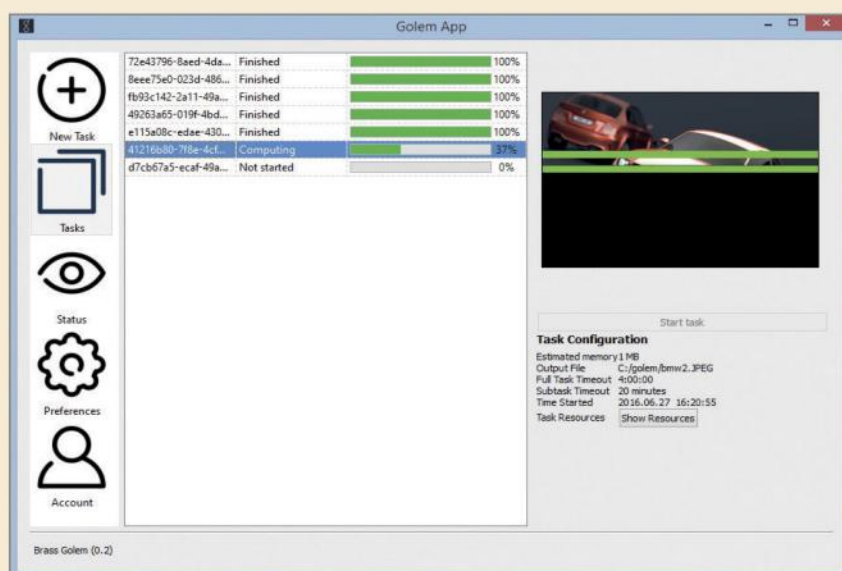
FLYING CAR TO LIGHT TOKYO OLYMPIC TORCH

The Tokyo 2020 Olympics won't only highlight the best in sport but also the best in technology: move over Steve Redgrave, this time the torch will be lit by a flying car. The vehicle is in the design stage, with developer Cartivator saying it will be a single-seater and use four rotors for vertical takeoff, while also still being able to navigate roads. While the car is being created with the Olympic opening spectacle in mind, founder Tsubasa Nakamura said the aim is to bring flying vehicles to the masses, opening up a "new era where everyone can fly freely".



INTEL REBOOTS SHAKESPEARE'S THE TEMPEST

Shakespeare wrote his tale of shipwreck and revenge back in 1611, but that doesn't mean it can't be modernised. Intel has worked with the Royal Shakespeare Company to integrate technology into its latest staging of *The Tempest*, using real-time motion capture and holographic avatars to build the illusions created by spirit Ariel and magician Prospero. While such digital wizardry may be the future of theatre, audiences weren't always convinced, so accustomed are we to CGI. The Royal Shakespeare Company may be wiser to leave the theatre as a welcome screen break.



WHAT IS... GOLEM?

We can let out our spare rooms and rent our cars, but what about the processing power going spare in our PCs? Golem aims to put it to use, offering up compute cycles to companies, academics and anyone else who needs spare processing power, while letting us earn a few extra pounds from our under-used machines.

WHAT IS GOLEM?

It's Airbnb for your computer: a worldwide, distributed supercomputer. Rather than let strangers into your spare bedroom, you can let them into your PC. If you need resources, you buy the processing power; if you have spare resources, you can offer them for rent.

SOUNDS FAMILIAR.

Similar ideas have been trialled for charity. Julian Zawistowski, the CEO of developer company Imapp, said there were "a lot of inspirations [behind Golem], but perhaps SETI@home and BOINC are the most important ones". These schemes let volunteers hand over processing power – the former to hunt for aliens; the latter for research into climate change and disease.

WHAT CAN YOU USE GOLEM FOR?

The public alpha currently only supports a specific type of rendering (Blender), but a first release is planned for next year and Golem will be capable of any type of processing in the future.

IS IT SECURE?

The trading is managed by blockchain, the distributed ledger technology developed

via Bitcoin, so transactions will be secure. In terms of data, Zawistowski said all computation is done in a sandbox and transfers can be encrypted. "It's as secure as any public cloud," he said.

HOW MUCH COULD I MAKE?

It depends on your PC's processing power: a laptop may only earn a few dollars, while a gaming rig could earn much more.

TIME TO RETIRE!

Not so fast – you'll be paid in Golem Network Tokens (GNT), a digital currency à la Bitcoin that you'll have to trade for spendable cash.



THAT'S LESS INTERESTING.

It isn't all about money. There's power in the idea, particularly its potential to rebuild the internet in a truly decentralised way. If the network is big enough, it could offer an alternative structure, letting services be run and content delivered in a distributed way rather than via corporate data centres.

SO IT'S GOLEM VERSUS GOOGLE, THEN?

It's unlikely to usurp the big players, but it's in keeping with the original idea of the internet to have decentralised nodes for sharing data. This would let users set up services or distribute content without middlemen such as Google – but that's a long-term goal.

WHERE DO I SIGN UP?

Head to golem.network to register as an alpha tester.



Tom Clancy's Ghost Recon: Wildlands

BRING HIGH-TECH WARFARE TO THE BADLANDS

Tom Clancy's Ghost Recon has, since its inception, essentially been an outdoor companion to the Rainbow Six franchise. Whereas Rainbow Six concentrated on the tension and moment to moment thrills of room to room tactical combat in a realistic modern day setting, Ghost Recon instead took the action a few years into the future and gave players more environments to explore. As the series progressed from its first iteration in 2001, Ghost Recon pushed further and further into the realms of science fiction, culminating with the 2012 release of Ghost Recon: Future Soldier, a game set in 2024 and featuring future tech such as walking robots and adaptive camouflage armour. Ghost Recon: Wildlands brings the action back to the modern day, and from what we've played so far is all the better for it.

Set in modern Bolivia, Wildlands posits a scenario in which the Bolivian government kowtows before the brutal tactics of drug cartels, turning the country into the world's leading producer of cocaine, with connections with Mexico giving the Bolivian cartels a pipeline to both North America and Canada. The United States, always willing to fight a war on drugs but not willing to turn Bolivia into a diplomatic nightmare, send in a covert team of four Ghost Recon operatives to aid the insurgency against

the Santa Blanca cartel and hopefully destabilise the operation enough that it can be permanently dismantled.

Bolivia makes for an interesting setting for a tactical squad based first person shooter. The game world itself is open – a first for the Ghost Recon series – and getting around it takes some getting used to. The terrain is a mixture of flat lowlands, heavily forested areas and mountains, crisscrossed by treacherous dirt roads. Once a location has been investigated using goggles or a drone, players can fast travel to said location, but getting close in the first place either necessitates a very long run or commandeering one of the many vehicles in the game, from motorbikes through to helicopter gunships. From what we've played so far, the handling of the vehicles, whilst still enjoyable, is a little off. The ground vehicles seem to have digital rather than analogue acceleration, so you're either going at a snail's pace or flat



out, and the helicopter controls felt rather janky overall. The travel times also felt a little too long moving between missions, but this could be because the developers intend players to explore between story missions rather than head from one to the next in a linear fashion.

The map is full of story missions, info-drops, side missions, points of interest, supply drops that can be tagged for the rebels to pick up. These only appear as question marks until investigated or highlighted through some other means (interrogating a cartel member, finding some intel and the like). Once a location is reached, intel; recon can be done in one of two ways; with binoculars or via drone. Both modes of scouting tags enemies so they appear on the mini-map making it easier for other players in co-op, or the three AI squad mates that follow the player in single player mode to target and eliminate enemies. Although nearly every mission ends in gunplay, Wildlands is a game about patience rather than bullet ballet. Careful use of cover, stealth and movement is far more likely to win the day than simply spraying and praying.

Completing missions, locating supplies and helping the rebels reward the player with experience that can be used to level various skills, making them more adept as shooting, using drones, moving silently and the like, and also unlocks new weapons that can be equipped. Each weapon is highly moddable, with players being able to choose different shoulder stocks, barrels, grips, sights, under-barrel attachments and the like, allowing players to customise their soldier to really suit their individual play style.

Even with the issues with the vehicles, Ghost Recon: Wildlands is still shaping up to be a great open world tactical shooter. We're looking forward to getting stuck in when it hits shelves March 7.

Daniel Wilks

KEY SPECS

www.ghost-recon.ubisoft.com/wildlands

Genre: Tactical Shooter • Developer: Ubisoft • Publisher: Ubisoft • Platform: PC, PS4 Xbox One

Space Hulk: Deathwing

GAMES WORKSHOP'S THRILLING BOARDGAME MAKES AN EXCELLENT SHOOTER

Space Hulk, both as a miniatures-game and its various video-game adaptations, has a long history. The original game was released in 1989, and pitted heavily armoured Space Marines in large suits of Terminator armour against multi-limbed alien monstrosities called Genestealers. Like many early GW properties, it borrowed more than little from popular culture – in this case, the hit film *Aliens*. Motion trackers let you track blips that at any moment could convert into one or more aliens, and an array of heavy weaponry was all that stood between you and getting torn limb from limb.

There have been video games based on the franchise since the early nineties, on everything from the Amiga and Saturn up to modern PCs. And there's even a card game – Space Hulk is one of GW's more enduring properties.

Space Hulk: Deathwing takes the basic premise – a small number of elite, heavily armed marines against hordes

of skittering aliens – and turns it into a remarkably atmospheric first person shooter.

Your mission is simple – kill bugs, basically – but there's a lot of other incidental stuff to do in between the waves of deadly aliens and their disturbing, hybrid, offspring (the Genestealer lifecycle is... odd). The Dark Angels chapter has been tasked with dealing with a vast space hulk – a conglomeration of ancient starships that has appeared suddenly in a vulnerable star-system – but also finds an old Dark Angel vessel in its heart. While the rest of the Chapter goes about securing the entire ship, your task is to recover this ancient relic.

You'll need to stop and restart engines, clear out alien nests, and even gather up the ancient panoply of a long fallen Dark Angel warrior. Oh, and you're not just any marine sergeant, either, but a member of the Chapter's elite Librarium – which, in Warhammer 40,000 parlance, means you're a powerful psychic warrior as much as an actual powerful warrior. You also have two other marines at your back – one is your basic battle brother, while the other is a trained physician, an Apothecary. You can change their load-out – and your own – both before each mission, and through a limited number of psychic portals you can summon that let you return to your own vessel while in a mission.



While the gunplay is solid, and the psychic and hand-to-hand attacks are all meaty, the real joy (which is a weird word for how grim this game is, but that's Warhammer fans for you) is in just how well-realised the interior of the space hulk is. It's all soaring, sepulchral chambers adorned with statues venerating both the heroes of ages past and the more unnerving aspects of the Machine-God, worshipped by the ancient ship's crew. Candle-lit shrines and tattered devotional seals sit side-by-side with glowing augmented reality displays and seething plasma reactors. And when the Genestealers swarm this by turns terrifyingly open or terrifyingly closed in locations become even more fraught. Aliens scream, your weapons chatter, and you're constantly checking every corridor for movement.

And, for once, your squadmates seem to be pretty competent! This often a sore point for such shooters, but your battle brothers are more than capable of killing the enemy in their own right, and will even scan corridors and hatches while you're busy opening or sealing a door.

It's entirely possible that if you're not a fan of the setting, that Deathwing could be more than a little repetitive, and it must be said that the game has some rather ropery voice-acting and writing. But the game captures the taut atmosphere of the original, while also showing the Warhammer 40,000 universe in a way that few games have managed to capture, outside of Relic's excellent Space Marine.

And hey – those xenos won't kill themselves, you know!

David Hollingworth

KEY SPECS

www.spacehulk-deathwing.com

Genre: Action/FPP • Developer: Cyanide • Publisher: Focus Home Interactive • Platform: PC (consoles to follow)

OVERALL



COLOUR WORTH SEEING

The A-List

THE VERY BEST GEAR YOU CAN BUY

LAPTOPS GALORE

It is the season of a great many new products and we've had a focussed eye on the laptop scene, in particular. While many great products have come our way recently we're holding true to the ones we have because they're still the most suited for each task.

Stay tuned though, we expect some new entrants soon, the way things are looking!



PC DESKTOP

ALL-IN-ONE

Apple iMac 27in with Retina 5k display

★★★★★

PRICE \$2,799

SUPPLIER www.apple.com/au

The Apple 27in iMac with Retina 4K display is great. The best all-in-one computer around, and by a furlong.

SPECIFICATIONS Quad-core 3.1GHz Intel Core i5 processor; Intel Iris Pro graphics 6200; 8GB RAM • 1TB HDD • 27in 4096 x 2304 Retina 5K IPS display • SDXC card slot • 4 x USB 3 • 2 x Thunderbolt 2 • Gigabit Ethernet • 802.11ac Wi-Fi



PERIPHERALS

WIRELESS ROUTER Linksys Max-Stream AC5400 MU-MIMO router

★★★★★

SUPPLIER www.linksys.com

Outstanding range and signal strength, able to stream eight media sources simultaneously and ready for MU-MIMO now and in the future.

SPECIFICATIONS 1.4GHz dual-core CPU; tri-band (1000 Mbps 2.4GHz + 2166 Mbps 5GHz + 2166 Mbps 5GHz); 802.11ac/n/g/a/b; 8 Gigabit LAN ports; USB 3.0 + 2.0

DESKTOP STORAGE CalDigit T3 with Thunderbolt 2

★★★★★

SUPPLIER www.amazon.com

The T3 is an expensive RAID device, but when you factor in the drives and the capacity included, it's good value.

SPECIFICATIONS 6/9/12/15TB external hard disk with RAID; Thunderbolt and Thunderbolt 2; 135 x 241 x 116mm; 4.5kg.



NAS Synology Diskstation DS216+

★★★★★

SUPPLIER www.synology.com

For most people the Synology DS216+ is all the NAS they'll ever need.

SPECIFICATIONS 2x SATA 3.25"/3.5" drive bays • Intel Celeron Dual Core 1.66GHz CPU • 1GB DDR3 RAM • eSata, 2x USB 3.0 & 3x USB 2.0 • 1x Gigabit Ethernet

ALL-IN-ONE PRINTER Canon Pixma IP 8760

★★★★★

SUPPLIER www.canon.com.au

This Canon can do it all, and at a reasonable price.

SPECIFICATIONS 9600 x 2400dpi print; 2400 x 4800ppi scan; USB 2; 802.11n WLAN; 150-sheet tray

LASER PRINTER Dell B1160w

★★★★★

SUPPLIER www.dell.com.au

The best all-rounder in our printer group test, with excellent text printing and decent costs.

SPECIFICATIONS 1800 x 600dpi resolution; USB 2; Wi-Fi; 150-sheet input trays; 331 x 215 x 178

LAPTOPS



VALUE Asus T100HA

★★★★★

PRICE \$399**SUPPLIER** www.asus.com.au

Performance that delivers everything typical day to day computing demands short of intense gaming, combined with a fantastic screen and a solid and we think, rugged design makes this the value king.

SPECIFICATIONS 10.1in IPS panel • Intel Quad-Core x5-28500 processor • 64GB eMMC SSD • 2GB LPDDR3 memory



GAMING Asus GL502VS

★★★★★

PRICE \$2,595**SUPPLIER** www.asus.com.au

Asus has built a very solid machine around an incredible new GPU. This has totally revolutionised the performance we can expect from a laptop, putting many regular desktops to shame.

SPECIFICATIONS GeForce GTX1070 GPU • Intel i7-6700HQ CPU • 8GB DDR4 • 15.6-inch IPS display • 1TB HDD • 256GB SSD



PROFESSIONAL Microsoft Surface Book

★★★★★

PRICE \$2,069 – \$4,454**SUPPLIER** www.microsoft.com.au

Truly beautiful, undeniably powerful and without doubt the best professional laptop you can buy.

SPECIFICATIONS 13.5in 3000x2000 IPS display • Intel i5-6300U/i7-6600U CPU • 8/16GB RAM, optional Nvidia GPU • 256/512GB PCIe SSD • 802.11ac Wi-Fi • Bluetooth 4.0, 2x USB 3.0 • Mini DisplayPort



ULTRA PORTABLE Dell XPS 13

★★★★★

PRICE \$2,499**SUPPLIER** www.dell.com

There's no denying how sexy Dell's latest XPS is. Premium. Sexy. Stylish. Lightweight. Damn does this Ultrabook impress. Along with a multitude of ports, the extra battery life is a very pleasing bonus.

SPECIFICATIONS Intel 7th Generation Core i7-6500 • 8GB memory • 256GB SSD • 13.3-inch QHD+ with Touch

HANDHELDS

SMARTPHONE OnePlus3

★★★★★

PRICE \$432**SUPPLIER**www.oneplus.net

Quick, beautiful, long-lasting and an incredible price; you won't find a better phone for the money.

SPECIFICATIONS Quad-core 2.2GHz Qualcomm Snapdragon 820 processor • Adreno 530 graphics • 6GB RAM • 5.5in 1,080 x 1,920 AMOLED display • 64GB storage • dual SIM • 16MP/8MP rear/front camera • 802.11ac Wi-Fi



TABLET Apple iPad Pro 9.7in

★★★★★

PRICE \$849 (32GB, Wi-Fi)**SUPPLIER** www.apple.com/au

This is a tablet you'll want to use all the time, and there's no higher praise for any piece of technology than that.

SPECIFICATIONS 64-bit Apple A9X custom processor with M9 motion coprocessor • 2GB RAM • 32/128/256GB storage • 9.7in 2,048 x 1,536 IPS display



EBOOK READER Kindle Paperwhite

★★★★★

PRICE \$119**SUPPLIER**www.amazon.com

The premium Kindle goes the extra mile, with a more attractive design, lower weight, and better contrast.

SPECIFICATIONS 6in 1,072 x 1,448 E Ink Carta display • 4GB storage • single-band 802.11n Wi-Fi • optional 3G • 1-yr RTB warranty • 117 x 91 x 169mm (WDH)



SMARTWATCH Apple Watch 2

★★★★★

PRICE \$529**SUPPLIER**www.apple.com/au

The Apple Watch is the best smartwatch on the market – and the Series 2 can now claim to be among the best fitness trackers too.

SPECIFICATIONS 340 x 272 AMOLED • GPS • heart rate sensor



SOFTWARE

SECURITY Kaspersky Total Security

★★★★★

SUPPLIER www.kaspersky.com

Kaspersky Total Security is the only security package on test that achieved both perfect protection and false-positives scores.

BACK UP Acronis True Image 2015

★★★★★

SUPPLIER www.acronis.com.au

The 2015 version adds full-system backup and dual backup.

OFFICE SUITE

Microsoft Office 365 Home Premium

★★★★★

SUPPLIER

www.microsoft.com.au
The easiest to use Office to date.



WEB DEV Adobe Dreamweaver CS6

★★★★★

SUPPLIER www.adobe.com.au
This edition makes PHP and CMS its core focus.

AUDIO Cubase 7.5

★★★★★

SUPPLIER www.steinberg.net

The addition of better filters solidifies this program's continued place on the A-List.



VIDEO Sony Vegas Movie Studio HD Platinum 11

★★★★★

SUPPLIER www.sony.com.au

May not have the bells and whistles of other consumer editing packages, but its tools are efficient.

PHOTO Adobe Photoshop Lightroom 6

★★★★★

SUPPLIER www.adobe.com.au
Lightroom 6 doesn't add up to a revolutionary update, but it improves on what was already an exceptional piece of software.



The Kitlog

TOUGH CALLS

Despite the fact that the AMD Radeon R9 Fury won best 'High-end gaming' card in this month's group test, we're leaving our recommendation for the Game Box as is, with the excellent AMD Radeon RX 480.

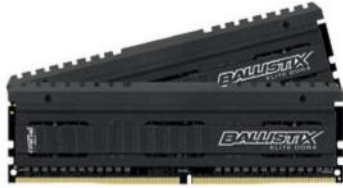
The sad reality is that the Fury just wasn't a sales success so they are now difficult to find in Australian shops. Not impossible, just difficult. If you see an R9 Fury at a nice price it comes with our recommendation. Its performance is well beyond its price – so take advantage of it selling poorly and, thus, has seen a disproportionate price drop. It's a heck of a bargain!

SAMSUNG 960 EVO

As our review on page 56 makes clear, the Samsung 960 Evo is a dynamite performer and the price is decent, too. But we're not adding it to the Game Box just yet because the price is still in the high zone you see when a product is new to the market, and as nice as it is, the money saves by going with a standard SATA drive makes that the smart choice. When prices fall we will certainly look again at putting the 960 Evo here.

As far as the Perfect PC goes, well, it has to be the 960 Pro. Nothing can touch its speed, and we don't worry about price so much for the Perfect PC.

THE GAME BOX

CPU	 <p>INTEL CORE I5 6600K PRICE \$319 Gaming generally doesn't make use of hyper-threading which makes this the CPU of choice for this box.</p>
MOTHERBOARD	 <p>ASUS Z170 PRO GAMING PRICE \$229 Our Skylake Value Award winner, it packs in a complete set of features yet is priced reasonably. Good audio also means we don't need a sound card.</p>
MEMORY	 <p>8GB OF DDR4 PRICE \$65 The speed and brand makes so little difference to performance we can't recommend one over another.</p>
VIDEOCARD	 <p>AMD RX 480 8GB PRICE \$380 This is the new mid-range GPU champ. Opt for the \$50-cheaper 4GB version if you run a 1080p screen. An Nvidia GTX 1060 or 1070 are nice step-up choices.</p>

THE PERFECT PC

CPU	 <p>INTEL CORE I7 6700K PRICE \$459 Intel's top-shelf unlocked i7 CPU.</p>
MOTHERBOARD	 <p>GIGABYTE GA-170X GAMING G1 PRICE \$715 The most complete 100-series motherboard you can buy today.</p>
MEMORY	 <p>32GB OF DDR4 PRICE \$200 For a general-purpose build 16GB is all you need, but go big if you know you need more.</p>
VIDEOCARD	 <p>NVIDIA GTX 1080 PRICE \$929 Asus ROG Strix GTX 1080 Gigabyte G1 Gaming GTX 1080 MSI GTX 1080 Gaming X 8G</p>

TOTAL: \$2,943 RIG ONLY: \$1,661

COOLER

COOLERMMASTER
NEPTON 140XL**PRICE** \$85

Easy to install AIO CPU cooling, relative quiet and performance to rival twin-radiator units.

CASE



BITFENIX RONIN

PRICE \$106

BitFenix continues to deliver great budget cases that look terrific and are easy to build in.

SYSTEMDRIVES

SAMSUNG 850 PRO 512GB

PRICE \$319

This SSD offers greatly improved durability. Supplement it with a hard drive of your choice if needed.



KEYBOARD

COOLER MASTER
QUICKFIRE XTI**PRICE** \$149

Good looks, solid and reliable build and many gaming features.



DISPLAY

ACER XB271HU

PRICE \$929

G-Sync'd frames up to 165Hz in a generous 27in size yet with a super thin bezel.



ASUS PG279Q

PRICE \$1,199

The same core specs and capabilities of the Acer, with an added SD card reader.

MOUSE



TT ESPORTS LEVEL 10 M

PRICE \$85

Mouse perfection. Lovely on-screen and on-pad movement, super accurate and delightful to use.

AUDIO

HYPERX
CLOUD REVOLVER**PRICE** \$119

For the price they sound almost as good as \$500 audiophile cans



POWER SUPPLY

COOLER MASTER G750M

PRICE \$129

Outstanding value for money, it's powerful enough for even performance PCs packing twin GPUs.



TOTAL: \$7,106 RIG ONLY: \$4,919

COOLER

CORSAIR H100i GTX
WATER COOLER**PRICE** \$159

Excellent cooling that is easy to install with advanced monitoring.

CASE



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PRICE \$255

If you absolutely must have what is very nearly the best case we've seen, this is the one.

SSDS

SAMSUNG 960
PRO 2TB SSD**PRICE** \$1,799

Significantly faster than any other SSD on the market.



KEYBOARD

LOGITECH G610

PRICE \$139

Stunning looks and a delight to type on.



STEELSERIES APEX M500

PRICE \$135

A similar alternative to the G610.



HDDS

ANY HDD

PRICE \$99 (2TB)

Supplement the SSD with cheap HDD storage.



MOUSE



CM STORM REAPER

PRICE \$49

Very solid and feels fantastic under the hand with sweet on-screen movement.

AUDIO



ASUS PA329Q

PRICE \$1,999

32-inches of 10-bit colour at 4k res, 100% RGB for professionals, and a luxurious delight for gaming and general use.

POWER SUPPLY

CORSAIR HX1000i

PRICE \$305

Corsair's mighty HX1000i pumps out extremely reliable power, even when under full loads.



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Seagate has recently released a suite of new hard drives that combine performance and reliability. We have three to give away, so this month you could win one of these beauties:

Seagate Barracuda Pro 10TB - SRP \$789

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Ironwolf Pro 10TB - SRP \$799

Ironwolf 10TB - SRP \$689

For everything NAS, there's IronWolf and IronWolf Pro. Always on and always working, IronWolf is enhanced with AgileArray technology for optimal reliability and system agility. Multi-user technology and extreme workload rates allow IronWolf to perform and scale up with your enterprise.

PCTA ISSUE 230 WINNER (LG 34UC79G ULTRAWIDE MONITOR): C BARRY, SA.

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THIS MONTH, WE OFFER YOU A RANGE OF SOFTWARE! CHECK IT OUT BELOW!

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+ SERIAL CODES + BLANK
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A FILE? + INSTALLATION ERROR

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SHELL + CUTEPDF + DEEPBURNER +
DEFRAGGLER + FLUX + FOXIT READER
+ GREENSHOT + APPLE ITUNES
+ LIBRE OFFICE + OPEN OFFICE +
MALWAREBYTES' A/M + SANDBOXIE
+ VLC MEDIA PLAYER

MAC

+ ALFRED + BETTERTOOLSTOOLS +
APPLE ITUNES + DROPBOX + FLUX +
GOOGLE CHROME + MOZILLA FIREFOX
+ PLEX + SKYPE + TEAMVIEWER + VLC

INTERNET

+ VUZE + DROPBOX + GOOGLE
CHROME + MOZILLA FIREFOX + MOZILLA
THUNDERBIRD + SKYPE + STEAM

INSTRUCTIONS: Open Windows Explorer,
navigate to your DVD drive and double-
click Index.html in the root directory. **DISC**

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Replacements, Level 5, Building A, 207 Pacific
Highway, St Leonards NSW 2065

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or the data on them. There are no explicit or implied warranties for
any of the software products on the discs. Use of these discs is strictly
at your own risk.

FULL VERSION

ABELSSOFT BACKUP

Abelssoft Backup 2016 is a
straightforward tool which takes the
hassle out of protecting your most
important files.

The focus on simplicity is obvious right
away. The program doesn't open with an
Explorer-type view of your data, a map of
your drives, a cluttered ribbon or anything
faintly complicated: just two buttons to
create or open a new backup job.

REQUIREMENTS:

- Windows 7, 8, 10 32/64-bit
- 40 MB hard drive space

LIMITATIONS:

- Registration Required
- <http://www.abelssoft.net/>

REGISTRATION & INSTALLATION:

- Download and run backup_cs_
uk_04_2017.exe
- During our testing, we were not
prompted for a serial key, however, here
are the registration instructions given
to us:
- Get your registration code within the
application. If you have registered a
previous Abelssoft full product, you
don't need to register again.
- For support of this software, please
direct your queries to: <https://www.abelssoft.de/en/contact>

FULL VERSION

CYBERLINK PHOTO DIRECTOR 7

PhotoDirector 7 is a powerful tool for
organising, editing and sharing your
digital images.

Launch the program and you'll find it's
split into various sections.

"Library" is where you import, view,
rate, tag and generally organise your
photos. There are plenty of time-saving
tools on hand (face tagging, the ability
to exclude duplicates when importing),
but it's all very straightforward and easy
to use.

REQUIREMENTS:

- Windows 7, 8, 10 32/64-bit
- 500 MB hard drive space

LIMITATIONS:

- Registration required @ [http://phd7.
disc.pcauthority.com.au](http://phd7.disc.pcauthority.com.au)
<http://www.cyberlink.com/>

REGISTRATION & INSTALLATION:

- Download and install
PhotoDirector_7.0.7504.56589_GM4a_
Deluxe_PTD161128-01.exe
- To obtain your serial code, point your
browser to the following address:
<http://phd7.disc.pcauthority.com.au>
- Register/login accordingly and you will
be directed to a new page.
- If you're a new user and experiencing
difficulties logging in, open a new
browser tab/window and point to
<http://phd7.disc.pcauthority.com.au>
and login from there.
- Click on the blue button labeled, "GET
SERIAL CODE" and your serial key will
be generated.
- During the installation process, you will
be prompted for Product Key.
- Enter in the details accordingly and
press "OK".
- Congratulations! You have unlocked
CyberLink Photo Director 7!
- For support of this software, please
direct your queries to: [http://www.
cyberlink.com/support/search-
product-result.do?prodId=211&prodTyp
e=0&prodVerId=1195](http://www.cyberlink.com/support/search-product-result.do?prodId=211&prodType=0&prodVerId=1195)

6-MONTH FULL VERSION

PANDA INTERNET SECURITY 17

Panda Internet Security 17 is a capable
security suite with protection for
Windows, Android, iOS and Mac.

The Windows module offers a good
range of features: accurate antivirus,
browser protection (via an optional
toolbar), a firewall and wi-fi protection
to detect and block intruders. The Data
Shield prevents sensitive information
falling into the wrong hands, parental
controls keep your kids safe online, and
there's a virtual keyboard to bypass
keyloggers.

REQUIREMENTS:

- Windows 7, 8, 10 32/64-bit
- 200MB hard drive space

LIMITATIONS:

- Full version, 6 months of updates. No
registration required.
<http://www.pandasecurity.com/>

REGISTRATION & INSTALLATION:

- Download and install PANDAIS.exe
- For support of this software, please
direct your queries to: [http://www.
pandasecurity.com/australia/support/](http://www.pandasecurity.com/australia/support/)

FULL VERSION**DISK WIPER 15 PROFESSIONAL**

Paragon Disk Wiper is a handy tool which will securely delete your drive's free space, a complete partition or an entire hard drive, overwriting it multiple times to ensure that nothing can be recovered. And this could be useful in several different situations.

REQUIREMENTS:

- Windows 7, 8 or 10 64Bit
- 200 MB hard drive space

LIMITATIONS:

- Registration required @ <http://diskwiper15.disc.pcauthority.com.au/>
- <https://www.paragon-software.com/>

REGISTRATION & INSTALLATION:

- Download and install Paragon-401-PRE_WinInstallSNx64_10.1.25.328_001.exe
- To obtain your serial code, point your browser to the following address: <http://diskwiper15.disc.pcauthority.com.au/>
- Register/login accordingly and you will be directed to a new page.
- If you're a new user and experiencing difficulties logging in, open a new browser tab/window and point to <http://diskwiper15.disc.pcauthority.com.au/> and login from there.
- Click on the blue button labeled, "GET SERIAL CODE" and your serial key will be generated.
- During the installation process, you will be prompted for Product Key.
- Enter in the details accordingly and press "OK".
- Congratulations! You have unlocked Disk Wiper 15 Professional!
- For support of this software, please direct your queries to: <https://www.paragon-software.com/support/services/>

FULL VERSION**PHOTO BACKGROUND REMOVER**

SoftOrbits Background Remover is a smart tool which intelligently removes the background from a photo, leaving you with just the foreground object.

There are plenty of similar tools around, but SoftOrbits Background Remover is much, much easier to use.

The process can be entirely automatic. Click Open, choose your target image, click Remove, and wait. In just a few seconds the program analyzes your image, tries to detect the foreground object and removes everything else.

REQUIREMENTS:

- Windows 7, 8 or 10
- 50 MB hard drive space

LIMITATIONS:

- Registration required.
- <http://www.softorbits.com>

REGISTRATION & INSTALLATION:

- Download and execute BackgroundRemover_Setup_pt13.exe
- Follow the prompts during the installation process. You will be prompted with a screen that will ask for your license key. Click on the "Get free activation key" button.
- A webpage will appear, please fill out the forms accordingly.
- Once you have registered, your license key will appear.
- Copy and paste back into the installer application and click "Activate Now!".
- Complete the installation process.
- Congratulations! You have successfully activated Photo Background Remover!
- For support of this software, please direct your queries to: <https://www.steganos.com/en/service>

FULL VERSION**STEGANOS ONLINE SHIELD**

Steganos Online Shield is a VPN service and a privacy protector which bundles a host of tools to keep you safe online.

The core VPN can quickly connect you to servers in 15 countries, including Austria, Canada, France, Germany, Great Britain, Italy, Japan, Netherlands, Poland, Romania, Russia, Spain, Switzerland, Turkey and USA.

REQUIREMENTS:

- Windows 7, 8 or 10
- 50 MB hard drive space

LIMITATIONS:

- Registration required @ <https://www.steganos.com/specials/pcauthority0317/sos>
- <http://www.steganos.com/>

REGISTRATION & INSTALLATION:

- Download and execute sosintwr.exe
- Go to <https://www.steganos.com/specials/pcauthority0317/sos> to retrieve your license key and fill out the forms
- Proceed with the installation process and run the application.
- The wizard will provide an option for "I already have a serial number", click this and copy and paste the serial key from the email that was sent to you.
- Congratulations! You have successfully activated Steganos Online Shield!
- Support: www.steganos.com/en/service

FREE FULL VERSIONS: Each month, we offer *PC & Tech Authority* readers full registrable versions of some software on the DVD. See the installation instructions in the DVD menu to complete registration, if applicable. **IMPORTANT:** Full product registration closes on 26/03/17



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No 232 March 2017

FEATURES + ABELSOFT BACKUP + CYBERLINK PHOTO DIRECTOR 7 + PANDA INTERNET SECURITY 17 + DISK WIPER 15 PROFESSIONAL + STEGANOS ONLINE SHIELD **HELP** + DISCLAIMER + DAMAGED OR FAULTY DVDS + USING THIS DVD + INSTALLING SOFTWARE **EDITORIAL** + BURNING AN ISO IMAGE + PC&TA EDITORIALS **TROUBLESHOOTING** + SERIAL CODES + BLANK REGISTRATION WEBSITE + CAN'T FIND A FILE? + INSTALLATION ERROR **WINDOWS** + 7ZIP + CCLEANER + CLASSIC SHELL + CUTEPDF + DEEPPURNER + DEFRAGGLER + FLUX + FOXIT READER + GREENSHOT + APPLE ITUNES + LIBRE OFFICE + OPEN OFFICE + MALWAREBYTES' A/M + SANDBOXIE + VLC MEDIA PLAYER **MAC** + ALFRED + BETTERTOUCHTOOLS + APPLE ITUNES + DROPBOX + FLUX + GOOGLE CHROME + MOZILLA FIREFOX + PLEX + SKYPE + TEAMVIEWER + VLC **INTERNET** + VUZE + DROPBOX + GOOGLE CHROME + MOZILLA FIREFOX + MOZILLA THUNDERBIRD + SKYPE + STEAM

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JON HONEYBALL

"A BUTTON ALLOWS YOU TO SEND PRAISE OR BRICKBATS; I'M MAKING SURE THEY REALISE MORE ONGOING TESTING IS REQUIRED"

In a far from Excel-ent month, Jon battles with bugs, wars with Wi-Fi and fights with fonts. But he does have something nice to say about RDX

It's been a very bitty month – a strong feeling of running hard to stand still. Too many things broke, or were found to be in alpha when they claimed to be late beta. A truly extraordinary amount of time spent trying to hunt down weird and unstable changes in user interfaces. It really doesn't help when the development team is so close to its project that they're blind to the issues. I see this myself. When generating large sheets of Excel tables containing thousands of results in the lab, it's all too easy to succumb to "Excel blindness", where way too many errors are missed simply because you don't see them.

The defaults in Excel don't help, either. If you have cells containing textual comment, then the way that the text of one cell will cheerfully run into the next empty cell means it's quite hard to determine whether or not the second cell has content. There are many cell-formatting tricks in Excel, of course, including wrap text, shrink to fit and merge cells, but there isn't one that says "keep the text in this cell and don't spill".

Despite having used Excel for some 30 years now, it's entirely possible that I've missed this feature on the current build of Excel for Mac, so please email me if this is the case. The workaround I have to use is to flood-fill the worksheet with cell entries of "" (that's a single quote). Excel takes that to mean "there is something here" but doesn't display the "" itself.

An example. Having built some monster sheets recently, with upwards of 20,000 cells used on each tab, I needed to create a summary sheet. Obviously, using cell links was the correct way forward. And

it would have been, except Excel for Mac has a horrible bug whereby it doesn't clean up the references correctly if you insert rows and columns.

On a table of similar and repeating information, this can be difficult to spot. You have to go to the Formulas tab and choose the Show Formulas button to replace the cell contents with the formula – in this case, the cell link to another tab. Then you can run your eyes up and down the summary sheet looking for insertion errors created by Excel. I didn't expect this to happen, but it's the sort of thing you get when you're running on the Fast Track of Excel development. Why stay on the Fast Track? As regular readers will know, because I hope and pray it allows me faster access to the solutions to some of the more egregiously unpleasant bugs.

Talking of which, here's another one.

✓ Excel has a tendency to "spill" text into other cells

Have multiple tabs in the workbook; have each tab at a different view zoom; copy and paste some cells from one tab to another – immediate crash and termination of Excel. I found that if I set the zoom level to be the same on each tab, then the copy and paste would work just fine. Incredibly frustrating and time-consuming when you're dealing with a product that's been shipping for the majority of my life.

Despite this, Excel is still my tool of choice, and I have to report that the Office team is being quite reactive to feedback. There's a button built into the top button bar on each app that allows you to send praise or brickbats, and I'm making sure they realise that more ongoing testing is required.

As for the rest? Giving feedback about what doesn't work is part of what we do, so there's little choice but to buckle down and feed in the reports. It can feel like a thankless task, though.



JON HONEYBALL

Jon is the MD of an IT consultancy that specialises in testing and deploying hardware
@jonhoneyball

	1	2	3	4	5	6	7	8	9
1									
2									
3									
4			A long sentence which spills over the other cells						
5			A long sentence which spills over the other cells						
6			A long sentence which spills over the other cells						
7			A long sentence which spills over the other cells						
8			A long sentence which spills over the other cells						
9			A long sente		More text	More text			
10			A long sente		More text	More text			
11			A long sente		More text	More text			
12			A long sente		More text	More text			
13			A long sente		<- has ' in it to force Excel to keep it clear				
14			A long sente		<- has ' in it to force Excel to keep it clear				
15			A long sente		<- has ' in it to force Excel to keep it clear				
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▲ Apple knows what users want: easy to set up Wi-Fi

APPLE SAYS BYE-BYE TO WI-FI

News has hit the wires that Apple is pulling out of Wi-Fi hardware, specifically the AirPort range of bases and the Time Capsule devices. I confess I'm not surprised by the news, because Apple has really done nothing in this space for years. From being a leader, it stopped development work and stagnated.

There could be many reasons for this. Apple's devices are high cost and probably relatively low volume. To do the job well, you have to put your efforts into the radio chipset hardware, and maybe those people have been otherwise busy with more profitable devices within the Apple R&D space. Plus, Wi-Fi has become a commoditised space, where any old rubbish seems to be good enough. Clever stuff like mesh has taken off in a big way with professional users, but Apple has never played in that space in a realistic fashion, and is miles away from what Cisco Meraki is doing, for example.

And maybe there is the simple issue that we need to wait for the next big thing, which might well be 5G. I spent two days this month with the technical wizards at Rohde & Schwarz, who ran a

seminar on where 3G/LTE is going, the challenges that will arise, and how we're going to measure, evaluate and interface with all of the issues. It looks like 5G will allow scalability right down to the pico-cell level for in-room operation. If so, then the possibilities are strong enough indeed that we can fix the significant issues with Wi-Fi too.

So here's my thought process. Apple is now one of the strongest players in the mobile field, and its chipset work is, without doubt, at the leading-edge. It still doesn't manufacture, preferring to hand out that task to the likes of Samsung and TSMC – no doubt to ensure that competition brings the very lowest of costs. We know Apple is happy to work on its own chipset designs, away from the core CPU – witness the new CPU coming in the wireless headphones. Wouldn't it be interesting if Apple had re-targeted all its wireless engineering effort into the new chipset, to be followed up by a leading-edge implementation of 5G to appear just as soon as the spectrum space

and regulatory frameworks are finalised?

If that's the case, then there's cause for celebration. Apple is one of the few firms savvy enough to recognise that ease of Wi-Fi setup, along with secure encryption, is a must-have for most buyers. And, therefore, these buyers had no interest at all in buying the somewhat overcomplicated offerings from other vendors, which had appeared to master the art of obfuscation and confusion. Look at how many home Wi-Fi unit vendors recognised that double-NAT in the home would only lead to confusion, and ensured

“It really doesn't help when the development team is so close to the project that they're blind to the issues”

their products correctly recognised when they were connected to an already-natted network? Yes, that was Apple leading the way.

Oh, and thanks to Rohde & Schwarz for the latest in its ongoing series of technical seminars.

RDX UPDATE

Just a little update on my use of RDX. Long-time readers will remember that I discovered RDX a few years ago, when I first tried a unit from HP. Since then I've installed a number of these desktop USB units around the lab. The disks aren't cheap at around \$400 for 2TB, but 2TB is a useful size for a “storage brick”. I have several small Peli cases that take one or two of the disks in a safe and secure container, and these are protected in the panner of my motorbike. So transporting them back and forth to home as a fully encrypted backup store of current work in progress is easy. Plus, I like to store the somewhat dodgier things we have to handle, such as malware test files that I want to keep well away from any computers, including our various test networks.

Would I buy RDX again? Yes, although it seems that few manufacturers are pushing forward with the standard, and prices aren't falling quickly.

✓ I'm a fan of RDX; I'd be a bigger fan if the prices came down





NEW WI-FI NETWORK ORDER

On my desktops, I can set the order in which Wi-Fi networks are joined. In macOS, it's trivially easy: go to System Preferences|Network, choose the Wi-Fi adapter, then hit the Advanced button. The Preferred Network panel displays the list of networks, and you can simply drag and drop the networks into the order you want, with the highest priority at the top.

On my iPhone, this isn't possible. There's no way of instructing iOS about the order in which networks should be joined. This is annoying, because at home I have two FTTC (Fibre to the Curb) lines from two separate vendors. Each is located at opposite ends of the house. But I often want to join just one network because it's the one to which I've connected all the IoT devices, including the Hive heating system and Philips Hue lights. But if I'm at the other end of the house, my phone joins the line that's physically closer.

I trawled around the Apple network in an attempt to see if there were some settings I was missing. I eventually found support.apple.com/en-gb/HT202831, entitled "How iOS decides which wireless network to auto-join". It says:

"When iOS evaluates SSIDs to auto-join, it prefers known networks, higher levels of security, and stronger relative signal strength (RSSI).

iOS will try to connect to networks in this order:

- The private network it most recently joined
- A private network
- A hotspot network

If iOS finds more than one network, it evaluates SSIDs by security level and chooses one based on the following order:

- Private network: EAP
- Private network: WPA
- Private network: WEP
- Private network: Unsecure/open
- Hotspot network: HS2.0/Passpoint
- Hotspot network: EAP
- Hotspot network: WPA
- Hotspot network: WEP
- Hotspot network: Unsecure/open

If iOS finds multiple networks of identical type and security level, it chooses the SSID with the strongest RSSI."

So given that I have strong encryption in place, the only thing that's going to drive the choice is the RSSI level. And that's not what I want.

Why can't Apple allow me to say, "no, choose this one first"? Or even have an option that's "when all other choices have been used, go for alphabetical order".

That way, I could at least have one called AnNSABase and MyGCHQBase – just to upset the neighbours, you understand. And then AnNSABase could be chosen over MyGCHQBase, even if the latter had a stronger signal.

THE MARVEL OF FONTS

Wondered where your Cambria and Calibri fonts have disappeared to on your Apple macOS device? I did, too, when opening some old documents in Pages and receiving the warning that the fonts had gone.

Trying to find out what had happened took me on a rather long and winding road. As best as I can find out so far, the fonts came from Microsoft. And they came with Office. These fonts were delivered as fonts themselves, only up to the last version of Office for Mac. If you buy the current version of Office for Mac, you can still use them – but other apps can't. So what has happened?

"On my iPhone, there's no way of instructing iOS about the order in which networks should be joined"

It looks like uninstalling the old version of Office removed the fonts. But that doesn't explain the current situation. I've read that the fonts are actually supplied within the current version of Office and are available there for those Office apps to use. But you can't use them with other apps. Whether or not this is a licensing issue is difficult to determine. However, it's the sort of ball-ache that rightly gets users quite upset.

The solution? Well, you won't be surprised to find that there are multiple places on the interwebs where you can download a ZIP file of the TrueType fonts that have been lifted from a copy of Windows.

I can't condone such a thing, of course, and I have also read that the licensing of the fonts, even on Windows, is there for "office and business-style operation" – not for full DTP work. Whether or not this is true is hard to ascertain.

There is, however, a truly sneaky way around this. Given that the Office 2016 apps can use the fonts, and they come with them, the fonts themselves must be within the app itself. If you go to \Applications and find Microsoft Excel and then right-click on it and choose Show Package Contents, you start to drill into the file system that exists within the

"Microsoft Excel" application package. Drop into the Contents|Resources|Fonts folder and there they are in all their glory. You could, I suspect, copy these out into the fonts storage resource on macOS. Or even put in a hard link to the folder if you really wanted to.

Whether this is legal is open to question. After all, you have these fonts because you have a licence to use Microsoft Office, and they're supplied with Office. I didn't spot anything in the setup/readme/licensing documentation that told me that use of these fonts elsewhere was explicitly forbidden. And if such use was forbidden, you'd think that Microsoft might have encrypted them or used some other sort of locking solution. Obviously, I can't recommend that you use these fonts supplied by Microsoft in such a way, and it's up to you to decide – in conjunction with Microsoft's lawyers – what is the right and proper thing to do.

FONT SHOPPING

What is certainly true is that you can buy the fonts from Microsoft. Yes, you can buy and download the fonts and have a full and complete licence to wave at any Licensing Stormtroopers that might land on your site under the guise of doing an "audit". Just go to microsoft.com/typography/fonts and you can purchase from there. That's US\$294 dollars for the Calibri family when ordered this way from Monotype, and the licence is "for enterprises, web developers, for hardware & software redistribution or server installations."

If you want the font "for personal, professional or business use on workstations" then it's US\$183 for the font family. For web use, "for use with CSS @font-face rule in websites", well, I'd tell you the price but it looks like the HTTPS certificate for "webfonts.fonts.com" is broken. I'd expect it to be cheaper still.

Typography is a modern art form.

Tools such as FontForge, FontCreator, Fontographer and Glyphs allow you to dive into this fascinating world of splines, hinting, glyphs and so forth. It's incredibly rewarding designing something here – although too often, all you've done is highlight one's own limitations in artistic design and flare.

But many years ago I became a little obsessed with typefaces, and even managed to build, from scratch, a new typeface for a client who had a specific requirement. I note that it was a huge inspiration to Steve Jobs, too, when he was a student. Dive in and take a look – there's a whole world of delight to find if you enjoy maths, design and art. ●

PAUL OCKENDEN

"WE'RE WATCHING A BOX SET IN ONE GO - THE ONLY BOX A TAKEAWAY PIZZA VITAL TO SUSTAIN SUCH A VIEWING MARATHON"

Paul looks at a common source of buffering problems with streamed TV, and dives into the world of mesh Wi-Fi. Or not

The world seems to have gone streaming mad. This time last year, the number of people watching Netflix and Amazon Prime Video was relatively small. A few techie people were watching video over the internet, but to the average person in the street it remained an alien concept. Something they wouldn't contemplate, and certainly not a facility they'd pay for.

A year later, however, and streamed content seems to have exploded. Even the (some would say "crusty old") Radio Times featured a Netflix show as its main front cover image recently. The streaming services don't publish their viewer numbers, but the recent viewing boost is obvious to anyone who uses social media. You'll also overhear people in coffee shop queues talking about The Crown, The Grand Tour, and other online-only blockbusters. We find ourselves watching a whole box set in one session, but the only box is from the takeaway pizza vital to sustain such a viewing marathon.

If you listen carefully, though, as well as talking about the high production values and the huge budgets available for these new shows from Netflix and Amazon, you'll also hear some people complaining about buffering and connection problems. I'm going to stick my neck out here and guess that these are mainly those watching via a dongle (Amazon Fire TV Stick, Chromecast, Roku Streaming Stick, or one of the many Android sticks available).

A further guess is that these people might have TVs where the HDMI port isn't on the edge of the set so that the dongle protrudes, but somewhere around the back so that stick and its associated

power supply wiring is neatly hidden from view.

There appear to be two main issues that can cause these buffering and network connection and quality problems. The first is that some TV sets emit a serious amount of RF noise. The worst offenders seem to be plasma screens, or older LCD sets that have fluorescent – rather than LED – backlighting. We're effectively talking here about sets that are more than four or five years old, or perhaps more recent models from "bargain" brands. Let's not get too snobbish about this, however, since some more modern sets – even those from the big and expensive names – can also spit out copious amounts of nasty RF.

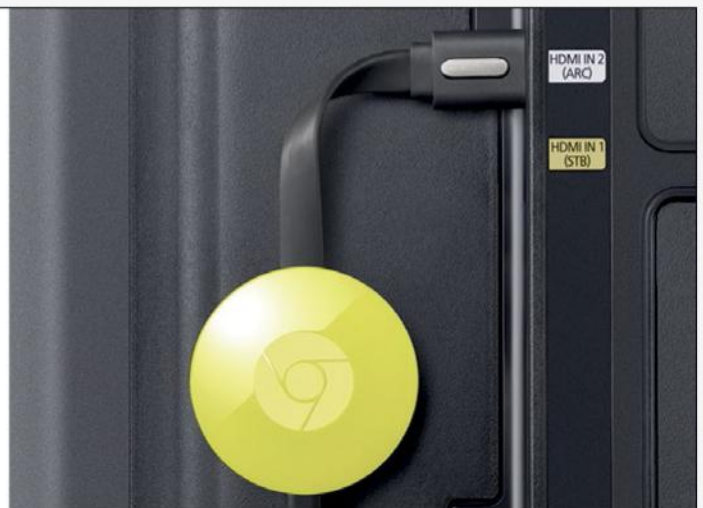
The second problem is that when an HDMI dongle has to be plugged in around the back of the TV, the set itself will act as a shield, blocking the Wi-Fi signal. That's pretty obvious when you think about it. The TV contains copper circuit boards, speakers, aluminium shielding, heatsinks, and other metallic components, all of which will resist the passing of the 2.4GHz or 5GHz Wi-Fi transmissions.

To make matters worse, when the

issues of RF interference and signal shielding combine, the connection quality suffers tremendously. Plus, there's another factor, which in some instances can make matters worse still – that's when you power the dongle using a flying lead to a USB socket on the TV set, rather than using a separate plug-in "wall wart" power supply. Some sets have a significant amount of electrical noise superimposed on the 5V power supplied by their USB sockets, and alongside the other two problems can make the electronics in the dongle struggle to maintain a decent wireless connection.

Incidentally, it's no use relying on the stick's built-in Wi-Fi signal meter, as often it isn't the signal level that's the problem, but the quality. In technical terms, what we're looking at here is a poor signal-to-noise ratio (often known as SNR). You can still have a terribly poor Wi-Fi signal despite it showing lots of bars on the signal meter, if that Wi-Fi signal is being swamped with noise. Incidentally, the same can apply to any device with a simple signal meter. Ever had trouble making a call or downloading data, despite having lots of bars of signal on

> Your TV set might be shielding your streaming dongle from your Wi-Fi network



PAUL OCKENDEN

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▲ A \$10 HDMI extension cable might be all you need to solve your buffering issues

your phone? That, too, is probably local interference reducing the SNR.

The solution to the TV issue is obvious. Simply buy a good-quality HDMI extension cable, and plug the dongle into the end of that. It gets the dongle out from behind the TV; this might upset your sense of the aesthetic, but it will also no longer be hidden from your Wi-Fi network. An extension lead about 1m long is ideal – something like the AmazonBasics one for around \$10.

By the way, never get lured into buying expensive HDMI cables. Despite what it might say in the blurb, a better cable can't improve your picture quality. The signal that the cable carries is digital: ones and zeroes. A more expensive cable can't alter that binary data to give you a better picture or sound.

The HDMI extension cable will allow you to position the dongle well away from the TV, in a place where it receives a perfect Wi-Fi signal. Just experiment; if you find your Netflix or Amazon stream still buffering, move the dongle. To the left or right of the set, or even above it – you'll often get a better picture higher up.

All that said, I've used most of these sticks and other media-streaming boxes on the market, and very early on came to the conclusion that you're better off using an external box rather than a dongle. So the Amazon Fire TV rather than the stick version, or the Roku 3 rather than the firm's Streaming Stick. There's no non-dongle version of the Chromecast available, of course, but if you're slightly techie then an Android Kodi box probably comes close (and offers much more too).

I've found the standalone devices tend to have somewhat more grunty CPUs beneath their skins than their dongle siblings, making the UI more responsive. They also have better Wi-Fi antennas inside, so are less likely to suffer from buffering. Better still, all of the good ones have Ethernet ports, so you can plug them directly into your network,

or perhaps use a powerline adapter if you can't run cables. Although I need to add my usual caveat: please don't use powerline networking – also called homeplugs – if you have anyone living nearby who is a radio ham, since the signals from your home wiring can play havoc with their hobby.

Before ditching your stick, though, do try an HDMI extension cable. It's a cheap fix, and many will be surprised at what a difference it makes.

HEALING THE MESH

Much like the increased chatter about streamed TV shows, I've also noticed that in techie circles the discussion of mesh networking is starting to become something of a fashion. Particularly in the context of consumer-level products. It's nothing new, of course: one of my earliest jobs involved building a mesh network, but it's one of those things that even decades on I'm still not allowed to talk about – so we'd best leave that one well alone!

When people talk about mesh networks, what they normally mean is wireless mesh networks. Mesh networking is common in wired networks. Shortest-path bridging means that many switched Ethernet networks are meshed, and indeed the internet itself runs on mesh principles, with multiple paths available between nodes. It's so ubiquitous that the word "mesh" is rarely used when it comes to wired networks; the term almost always refers to wireless technologies.

So what is a (wireless) mesh network? Well, think about the wireless router that you have in your home or your office. Now imagine taking a laptop and walking to a far corner of the property, where the wireless signal is weak or non-existent. This lack of signal is because every Wi-Fi device on the network is talking directly to the router, so requires a strong RF connection between these two points.

You can imagine these as lines drawn on a plan, and once you've done this for the many devices you have connected to your Wi-Fi network, you'll understand why this is known as a "star" topology.

But imagine an alternative scenario, where every device could talk to every other device; and devices could relay traffic for each other. That way, when your laptop could no longer get a direct connection to your wireless router, it could still have net access by bouncing a connection through your TV and your connected smart thermostat. This is what we mean by a "mesh" topology.

"The solution to the TV issue is obvious: simply buy a good-quality HDMI extension cable, and plug the dongle into that"

This would be lovely, wouldn't it? If only something like this had been built into the 802.11 spec from day one, we might be living in a world of very different Wi-Fi today.

We're unlikely to ever see Wi-Fi endpoints relaying traffic in this way, but mesh techniques have been making their way into Wi-Fi infrastructure components. At the high-end, there was Meraki (now owned by Cisco) and others offering enterprise solutions, while at the "get your hands dirty" end of the marketplace there were a number of open-source solutions that usually involved flashing custom firmware on to popular wireless routers.

But now there's a more friendly style of mesh networking trying to replace the routers in our homes. Initially, Luma and Eero led the way, but now everyone's favourite search-engine provider is joining the party with Google Wi-Fi; Ubiquiti is releasing its AmpliFi system aimed at home users.

Some of these are more successful than others. Luma and Eero, in particular, seem to have many satisfied customers. But if you Google for details on the mesh facilities offered by the Sky Q setup, your search results will probably be overwhelmed by people complaining that it doesn't work very well.

In all of these instances it isn't the final devices (laptops, TVs, and so on) that form the mesh; it's the access points that you need to install in key places around your house. These act as repeaters both



▲ The Orbi router and satellite don't look out of place around the home

for the main router and also for each other, passing traffic backwards and forwards.

Mesh networking isn't the only player in town, though. Netgear has just released a product called Orbi, and although it might be described by many as a mesh Wi-Fi product, it isn't. Orbi, at least in its current guise, uses a star topology.

The version of the product I have here is basically two boxes: the main router and a satellite. As is typical with most newly released high-end kit, there's no DSL or VDSL provision, so the majority of UK users will need to use an external modem (or flip their existing router into modem mode, making sure the Wi-Fi is disabled). Both boxes are effectively wireless access points, each offering 400Mbps/sec 2.4GHz and 866Mbps/sec 5GHz Wi-Fi connections.

With a two-box solution it really makes no difference whether the underlying network is star- or mesh-based – in both instances, it's simply one box talking to another. In fact, Orbi uses a dedicated 5GHz channel with its own 4x4 MIMO configuration. This backhaul link runs at 1,733Mbps/sec (it's basically dedicated streams using four of the five available high-band channels). This is one way that Orbi is different to using a conventional router plus Wi-Fi extender setup. Another difference is that you effectively have one wireless network, with one SSID, one username and one password. This differs from how the majority of conventional wireless extenders work.

Wireless extenders don't use a

dedicated backhaul, and neither do most mesh networks – the relayed data just runs across the normal 5GHz and 2.4GHz channels for user data. So in a two-box setup (and, frankly, that's all you'll need in most Australian houses) the Orbi has considerable benefits. I haven't been using the system long enough to deliver a "real world" verdict, but from my initial tests both the stability and the throughput are good. I get a rock-solid and fast connection right around my

"These boxes certainly aren't the weird, sci-fi-looking objects with multiple angular antennas"

house, as well as in the garden, garage, and so on. So, far, my only complaints are the aforementioned lack of DSL/VDSL support, and also that there's no guest network provision. Other than that it's one of the most well thought out version one products I've seen in a long while.

Of course, you can have more than one satellite if you need to cover a huge area, but bear in mind the current star topology. Each satellite needs to be able to connect to the main router. Also note that the 1,733Mbps/sec backhaul is shared among all of the satellites, although bandwidth is allocated dynamically as needed, so the satellite

with the most traffic gets a bigger bite of the cherry.

What I welcome is that the main router and satellite units are relatively pleasant-looking boxes. They certainly aren't the weird, sci-fi-looking objects with multiple angular antennas that you'll often find with Netgear's top-of-the-range wireless router products (and, indeed, much of the competition). The latter might look uber-geeky, but they aren't the kind of device you'd want on a shelf in the lounge. Orbi fits in nicely and unobtrusively.

Some of the competitor products rely on the manufacturer's cloud service for control and configuration – thankfully, with Orbi everything is standalone. You don't even need to use an app (actually there isn't an app at the moment, although apparently one is in the works). The web-based user interface will be familiar to anyone that's used another recent Netgear product. Known as "genie", it splits tabs into Basic and Advanced, and most items are reasonably self-explanatory. There's nothing to be scared of, despite the hi-tech nature of the product.

I'll report back in a few months once I've given the Orbi system a proper workout, but for now it's looking like a great solution for anyone struggling to get Wi-Fi into every corner of their home. ●



CARL DAVIES

"AN AGILE COACH OPERATES LIKE A DURACELL BUNNY, DRUMMING UP ENTHUSIASM TO HELP TEAMS IMPROVE"

Agile isn't simply a project delivery process, says Carl; it's about shaping a team culture that leads to success

At my previous company, I'd been involved in several successful Agile deliveries: software released in less than six months that delivered exactly what the customer wanted in a truly collaborative, cost-effective manner. Customers often eulogised about how "refreshing" they found the Agile experience. This convinced me there was mileage in Agile delivery. Initially, I was almost comically evangelical. So in 2011, I broke away from a permanent role as a head of information services to become an independent Agile coach.

Day to day, it's my job to navigate teams and individuals into a balanced Agile practice that fits their situation. It's also important to spend time with senior management to help them digest and adjust to Agile ways of working. I'm juggling a mix of salesmanship, mentoring and role-modelling, as I encourage teams to strike a healthy balance between theory and practice. An Agile coach operates like an anchor and an infectious upbeat Duracell bunny, drumming up enthusiasm and helping teams constantly improve.

THE AGILE MOVEMENT

If you've been involved in software development at any point since the late 1990s, you've probably encountered the concept of Agile project delivery.

Agile methods range from the super-heavyweight, such as Scaled Agile Framework (SAFe), to ultra-lightweights such as Scrum. Heavyweight methods are geared towards enterprise implementation and sport an array of roles, artefacts and processes. They inevitably involve some degree of

certification and external advice, which requires investment and a leap of faith because ROI is by no means guaranteed.

At the lighter end, Scrum accounts for around 60% of all Agile implementations. This method is explainable in a matter of hours and is seriously downsized. There are just three roles and five key events.

In a nutshell, Agile methods condense product development activities into short, back-to-back delivery cycles. These "sprints" are ideally between 1-4 weeks, strictly adhered to and designed to attract maximum feedback. A sprint is all-encompassing. It incorporates the whole product lifecycle: clarifying requirements, product design, development and testing are all bundled in. Each sprint plan targets the release of a useful "increment" (a valuable working slice of features). An experienced Agile team will develop a longer-range product roadmap and release plan, because in the real world there are specific target dates to hit.

In Agile, desired features are sourced from a shortlist of prioritised "user stories" (condensed, user-orientated requirements). It's the product owner's job to represent the customer – he/she prioritises user stories from a much larger backlog of potential features. The most valuable features should be delivered first.

Agile methods are big on responding and adapting to changing customer demands; hence the short bursts of delivery. Teams are geared up to test real products with real customers. The frequent "inspections" of the product lead to new insights and possible feature "adaptions", which seed the next sprint.

Agile techniques incorporate daily stand-up meetings and retrospective sessions that empower teams to suggest improvements to working practices. Agile is on a mission to evolve and constantly improve delivery teams. Speaking of which, when we look at Scrum there

are only three roles: the product owner, scrum master and the wider delivery team.

Agile techniques can be used to deliver all kinds of products and services, not just software.

WHAT AGILE IS... AND ISN'T

There's a common misconception that Agile is a simplified project delivery process, a set of instructions you can quickly learn and repeat. That's half the story. Agile is big on values. It models the behaviours a delivery team should adopt to be successful. The aim is to make teams collaborate, stay open-minded, critical of their own performance, customer-focused and respectful to each other. Getting the team culture right is the secret sauce that makes an Agile team successful.

One of the biggest benefits of Agile is its shorter concept-to-cash cycle. The rapid iterations of software we see in Agile give businesses the chance to test the market at an early stage (and even start cranking sales). This is called the minimal viable product (MVP) – a proof-of-concept product that's formed with just enough features to attract customer feedback. Think of the Tesla Roadster, which, although imperfect, proved that battery cars were viable.

If the MVP successfully meets user needs, we expand features. If the MVP fails, then it's time to "pivot" and test another product, or to back out early before too much cash is burned. Being open about failure is considered a virtue in the Agile world; by responding to failure we reach a better outcome in the long run.

TOUGH TIMES AHEAD

A shift to Agile is rarely painless. The behaviours we're embedding need infusing into your company culture. Realistically, this takes years, not months. The exemplar businesses we refer to,



CARL DAVIES

founded his agency Perfect Agile in 2011 to help business leaders implement Agile more effectively.

such as Toyota, Spotify and Google, are committed to indefinite and continuous change. They've been shaping an Agile culture over decades.

I'm sceptical when leaders expect instant results. Achieving organisational agility (as it's called) isn't a Clark Kent/Superman phone box transmogrification. Instead, there's a palpable risk that we end up with a David Banner/Hulk nightmare. Attempts to "big bang" a shift to Agile across the whole company can become nasty. The benefits outstripped by immense resistance within can cause serious collateral damage to morale and delivery.

To successfully roll out Agile methods, I'd suggest empowering a handful of carefully selected and well-supported projects: small and self-contained deliverables that already have infrastructure in place. Ideally, these teams need to be composed of positive, trusted and flexible team members, who are also proven high-performers. To get a positive buzz in the organisation you'll need "exemplar" successes that staff on the ground are benefitting from. The team members enjoying initial success will inevitably enthuse about their experiences. The good news will soon go viral, creating a virtuous circle of new folk who are willing to give Agile techniques go. It's a case of start small and adapt if the formula isn't working.

IS AGILE GOOD FOR ALL TYPES OF PROJECTS?

Don't let consultants or "gurus" persuade you that Agile is the best process for every scenario. It shines where there's a level of uncertainty with the final solution and we need to shape a product or service closely to customer/internal customer needs. This is the Agile "Goldilocks zone". If you don't have a clue about customer requirements, or the vaguest concept on the technical solution, Agile won't help you out of chaos. You'll need to ask more questions and come back when the situation is clearer.

If the task in hand is familiar and you've successfully followed a plan before, then don't throw it away! You're in a place where gathering requirements gradually using Agile is probably an inefficient strategy. If a plan is known to work, then make sure it still fits, tweak and re-use it. I advise that managers selectively apply the Agile process where the project need fits its strengths.

THE POST-IT NOTE THING

There's a misguided idea that Agile is all about the Post-it Note. And yes, during the first few weeks of learning Agile, Post-it Notes are invaluable. Using them in a

physical space gives a learning team the wide-open canvas they need to express, shape and reach consensus on requirements or process designs. They can plan spontaneously, without the constraints of software limiting how information is visualised. There's no substitute to Post-it Notes for developing the openness and immediate feedback we're promoting with Agile.

However, there's a tipping point. After a handful of sprints, I recommend teams adopt software tools and large screens for "backlog" management and reporting. Once the Agile process is learned, Post-it Notes become a burden for longer-range planning and to build any project statistics against.

BOTTOMS UP

The most striking mind shift in Agile is the concept of servant leadership. Here, managers are no longer expected to micro-manage delivery. Instead, the leadership hierarchy is flipped upside down and leaders serve for their teams. In return, analysts, developers and testers are expected to self-organise. In effect, the majority of the team is gifted the autonomy to make decisions and improvements. This is just one example of how radically different team behaviours are modelled in Agile – and a hard pill to swallow for hierarchical organisations.

This "bottom up" mode of decision-making may appear revolutionary, but it's been practiced by Toyota for years as part

of its Toyota Production System. It's very new to many Westernised companies.

So when I speak to teams, servant leadership can be a vibrant source of frustration for managers. They often speak of committing to the servant leadership model by coaching and empowering their teams, only to be suddenly usurped by a JFDI work request from a senior manager, which forces them to seize back control immediately

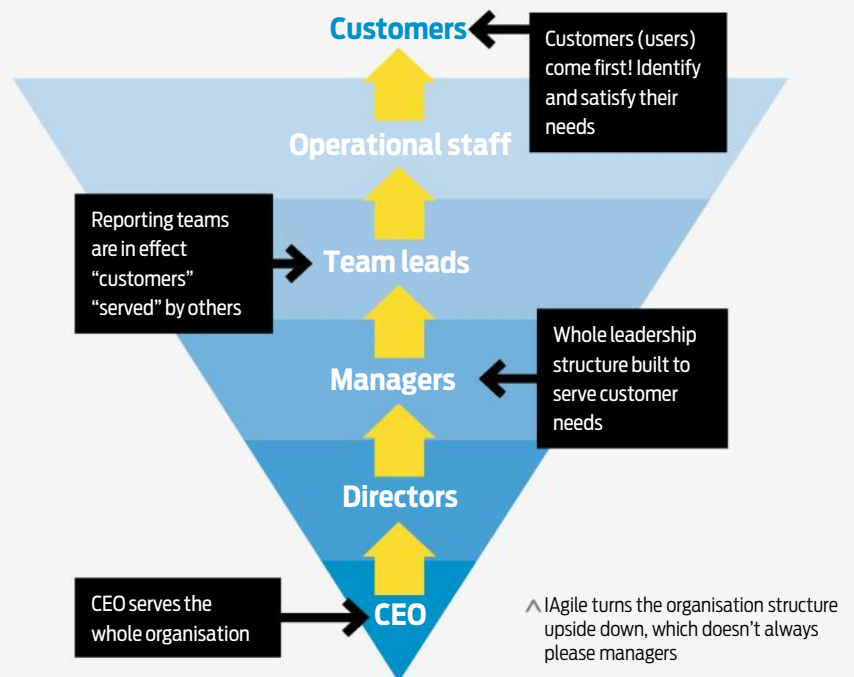
MORE SOFTWARE FASTER?

"So," I'm often asked, "all this Agile stuff means we're going to be able to get more software, faster?" To which I explain that's missing the point.

The idea that adopting Agile makes developers code faster and testers work at double-speed is a myth. Agile isn't an artificial stimulant. Sure there are some recommended techniques to make sure we "build quality in" and don't need to write code twice – such as pair programming and "refactoring". The truth is that Agile helps get products to market quicker through the art of keeping things simple and the MVP I referred to earlier.

Agile teams only build features necessary to solve the problem in hand. No bloat. We're not operating at a higher clock speed here; just processing less information. That means the right software arrives quicker. Possibly less software, but that valuable 20% delivered is going to crack 80% of the problem – and that's the key message of Agile. ●

Servant Leadership Model





DAVEY WINDER

"USERS OF SOCIAL NETWORKS OFTEN TREAT MAKING FRIENDS AS A NUMBERS GAME; THE SAME APPLIES TO LINKEDIN"

How to harden your LinkedIn profile and spot the fake requests before the damage is done. Plus, why you might just want a Double VPN

Talk of social networks and most people will immediately think you mean either Facebook or Twitter. However, talk of social networking for business and there's only really LinkedIn. Once all but written off, LinkedIn has been acquired by Microsoft for US\$26.2 billion and has half a billion members. In the 11 years I've been a member of the site, I've made useful business contacts and picked up a good few contracts. Its value to me, and many small-business owners, is that it connects me to other business folk.

And there's the problem: it also connects you to cybercriminals. Bad guys know a good thing when they see it, and they can see it in LinkedIn profiles. Access your Facebook or Twitter account and a social engineer might find some personal information to help target your email provider when it comes to resetting a password. Access your LinkedIn profile, and that of your connections, and they might find information that will leverage a way into the organisation you work for, or another along the supply chain. The latter is always going to hold more value to the serious criminal.

So how do the bad guys use LinkedIn to socially engineer a hacking attack? One of the most common methods is by way of a faked connection request. In the same way that users of social networks can often treat making new friends as a numbers game, the same applies to LinkedIn. Only more so. New users seem particularly keen to build a large network as quickly as possible in order to present themselves as well-connected. This means their guard is down, and users will accept connections from anyone.

Most often the target is a man, and

the request from an attractive-looking woman (with stock photography from the internet in the profile) posing as a recruiter or some marketing role. These fakes are often easy to spot, not least because the grammar used is poor and not what you'd expect from a professional. Sometimes they can look realistic – and ordinarily I'd be against adding into your network any contacts from people you don't know, full stop. However, that's kind of what sets LinkedIn apart from other social networks; you might be seeking to add new business contacts to your network to find potential new clients, or maybe even a new job.

Treating every connection request as a criminal act in the making just isn't sensible, although treating them all with a healthy contempt is. By which I mean that you should apply a modicum of common sense before hitting the Accept button. I look at the profile image, and if it looks a bit too glitzy or glamorous, I drop it into Google and do an image search. If that image appears all over the place, you can be pretty sure it's a fake request. If my suspicion remains raised, I'll check out the full profile, which might be industry keyword-heavy. If this is the case, to the point where it's obvious and interferes with the flow of the language, then that's another red flag. Sure, it could be a marketing bod who knows how to game the LinkedIn search algorithms and wants to appear high up the lists when people look for certain skills, but it probably isn't.

The saying that size isn't everything doesn't apply to LinkedIn security; the smaller the number of connections, the higher the chance it's a scammer trying to connect with you. This isn't always the case, sure, but it's a flag that always gets my attention and should do for you as well. And sticking with size issues, if the profile is ridiculously small and incomplete then run away screaming. I'd say that 90% of the people who will try to fool you are too lazy to take the time to create convincing profiles, and it does take time

to do it properly. Luckily, it only takes a glance to spot a potential faker that can't be bothered.

HARDEN YOUR LINKEDIN PROFILE

It's tempting to think that these internal fakes are the hardest kind of scam to spot, but actually external threats can be just as convincing. The LinkedIn phish spam tends to take the form of connection confirmations (from someone you may not recognise – the reason being that you haven't connected with them), or offers to get free access to LinkedIn Premium. Like all such spam, these will have embedded links that take you to familiar-looking login screens that are actually credential scrapers.

Your job – and you really should choose to accept it – is to make that of the hacker as hard as possible. This can be achieved by hardening your LinkedIn profile. It's probably a lot easier than you think and has little impact on how you use LinkedIn day to day. Profile hardening is all about making the attack surface as small as possible. Start by hovering the mouse over your thumbnail image, towards the top-right of the LinkedIn screen, and selecting Privacy & Settings from the menu that appears.

From the next screen, open the Privacy options and head for "Who can see your connections". Opting for "Only you" is the safest bet, since it prevents other users from seeing who you know – and why would they need to know that anyway?

Make yourself less visible by selecting Followers (under "Blocking and hiding"), then set who can see you and follow your public updates to "Your connections". Scroll down to the bottom of the Privacy section, where you'll find the two-step verification feature; enable it. This makes it much harder for anyone to compromise your account, even if they have your login credentials. And don't forget that they probably do have your credentials, or at least ones that were in



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1994 – Present (22 years)

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Previous IT Pro, Cloud Pro, SearchSecurity

Education Haberdasher Hatcham Askes

View profile as ▼

◀ LinkedIn has already proven itself attractive to hackers
LinkedIn has already proven itself attractive to hackers



place in 2012 when more than 160 million logins were stolen by hackers. I'd hope that you've changed your login and switched on 2FA since then!

Moving to the Communications options, I've seen it suggested that you should change the "Who can send you invitations" setting from "everyone" to only those who already know your email. Honestly, I can't see how this hardens your profile: getting hold of your email isn't likely to involve rocket-science levels of sneaking. If it makes you feel safer though, by all means do it.

I'd recommend customising the "Messages from members" section, which enables you to let other members know what kind of messages you're most interested in. In my experience, the career opportunities and business deals are most targeted by the social engineers. If neither of these are of interest to you, then uncheck the boxes. I've never been asked for a genuine personal reference, nor am I offering jobs to folk, so those boxes remain unchecked for me as well. Not that any of this will prevent someone from approaching you using this method – but it will raise a red flag that they're doing so against your preferences.

The next step in profile hardening is to revisit your profile and choose the option of viewing it as a member of the public will see it. This is useful for getting a grasp on the information you're passing on to anyone who can be bothered to look. Read it through carefully, and read it through the crime-tinted spectacles.

TRICKS OF THE HACKING TRADE

I first started writing about things pertaining to online security three decades ago now. Some of the advice I gave then still applies today. For example, be on the lookout for spelling mistakes, grammatical

errors and things that don't make sense in emails that request that you click links or open attachments.

These errors are mainly down to English not being the native language of the sender. Sometimes, however, they're deliberate. One trick of the trade used by spammers and scammers alike in order to evade email phishing filters is exploiting how similar different letters can look to the human eye. So while a software algorithm might be on the lookout for an upper case "I", it will let a lower case "l", or L, slip through as being unsuspicious. The reason being that in some fonts, specifically Arial and Helvetica, the two characters look almost identical. "LinkedIn" and LinkedIn will therefore appear identical to the recipient, but very different to the machines that are meant to be protecting us from harm.

DO YOU WANT DOUBLE VPN?

As regular readers will know, I already encrypt my data up the wazoo and back again. With strong encryption technology readily and cheaply available, from full-device encryption through to hardware and software encryption for data on the move, it isn't too difficult to keep things private. But the emerging possibility that authorities may move to retain internet activity data, and make it available for inspection without warrant, makes my suggestion that everyone do their best to thwart it by using solid VPNs even more pressing.

One VPN that's taking this seriously is NordVPN, which has introduced a Double VPN service for users suffering more draconian laws. The service isn't yet available to Australians, but it is rolling out globally so could just be a matter of time. Regardless, it's a fascinating approach. If the VPN and Tor service

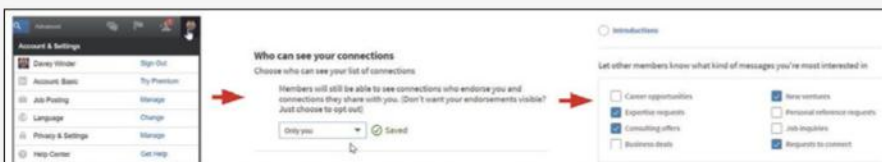
it offers isn't enough – whereby you connect to a VPN that connects to Tor that connects to the internet – then you can instead connect to one VPN that then connects to another VPN that in turn connects to the internet.

This Double VPN service encrypts your traffic from your computer to VPN server A (in your home country), which gives one IP address to anyone logging such things, but then encrypts the traffic again as it connects to VPN server B (in a different country), giving another IP before connecting to the internet. Each connection is encrypted within two layers of AES-256-CBC encryption, and the connections are mixed between TCP and UDP for additional security. NordVPN is particularly good for mobile use, with the Android app using OpenVPN providing AES256 with 2,048-bit Diffie-Hellman keys and IKEv2/IPsec, AES-256-GCM with SHA2-384 combined with Perfect Forward Secrecy and 3,072-bit Diffie-Hellman keys.

NordVPN itself operates on a zero-logging policy, so not only is your traffic double-encrypted, but there are no logs to grab either. NordVPN is owned by Panama-based TelFinCom, and while Panama is strong on canals it's weak on data-retention legislation, so that's cool as well. If you're after privacy, security and anonymity then NordVPN seems to fit the bill.

It isn't cheap, nor does it offer free trials by default, plus there are speedier VPNs on the market. However, in automatic mode it always finds a speedy server and I haven't noticed any slowdown to warrant any complaints. As for cost, well I discovered you can get a free three-day trial by emailing support@nordvpn.com and requesting it. The best value comes with a two-year licence and a money off offer which, at the time of writing at least, brings the cost down to US\$72. ●

◀ Hardening your LinkedIn profile is all about making the attack surface as small as possible





STEVE CASSIDY

"ROLLS-ROYCE SHOWCASED A 20FT-TALL JET ENGINE - NOT EASY TO RELATE THAT TO THE MICROSOFT PRODUCT PORTFOLIO"

Dell's takeover of EMC may seem of little consequence to small businesses, but Steve begs to differ - and shares the big news from VMworld

The best way to attract visitors to a stand in a crowded convention hall, it seems, is by equipping it with an obvious exhibit. In the case of Rolls-Royce at the recent Microsoft Future Decoded event, it decided to showcase a 20ft-tall jet engine. Not easy to relate that to the Microsoft product portfolio - and to make matters worse, I must confess that I bunked off the interview I was due to have with the chap from Rolls-Royce.

My defence is that the event itself was so different from past years that I was left flabbergasted. For one thing, it was very noisy. Not the pumping music of game consoles or fit people in Lycra hopping about in front of a Kinect - but the show itself. I figured out that the Rolls-Royce stand was right beside the lecture space; not a separate theatre, just a corral of low vinyl cubes, equipped with an ear-piercing PA system and Madonna microphones for the speakers. After an entire morning of listening, I knew my chances of making sense of anything competing with a PA system such as that were pretty slim.

We were denied Stephen Hawking (promised in the invite) due to ill-health, but the rest of the delivery fitted into the "sit back and think" category. Except for the presentation from Microsoft partner Risual, which featured wooden effigy puppets of its founders (I think), presumably in response to some impenetrable internet meme I don't yet know about.

And in the show hall, there were little epithets, up on the wall; motivational sayings - quite controversial ones for the modern era. Don't propose a technology, one said, without first estimating its likely social impact. Walking straight out of a

presentation heavy with references to the fourth Industrial Revolution and our place in it, this slogan hit me right between the eyes. I didn't want to listen to the Rolls-Royce man talk about its use of BI or Azure; I wanted to absorb this huge shift in outlook instead.

I don't mean a pun about email there, either: I mean a ground-up reappraisal of what computing means to us, and how we should be thinking about it. Contrary to what the mainstream press may have said in response, I thought the speech demonstrated an ease with concepts in IT and security that are rarely found.

THE IOT SOLUTIONS WORLD CONGRESS

Hot on the heels of the news of a huge attack on the world's biggest name resolution servers by a "botnet of toasters", I received a last-minute invite to The Internet Of Things Solutions World Congress (iotsworldcongress.com). I had high hopes for this show. It's only its second year, but the roll-call of

names was for me a near-perfect mix, from obscure brands deep in the B2B world, hidden from sight (Tech Mahindra, anybody?), right through to General Electric and various European suppliers of devices previously thought too simple to be worthy of a CPU, let alone an internet connection.

Then there were the omissions: no ARM, for one thing. I can understand if the firm has a lot on its plate, but if you're an IT nerd then it's odd to visit a show with the world's most popular processor maker not in it.

Is it, though? IoT is a much larger and more diverse gathering of interests and brands than is IT. The fantasy idea that devices with fully fledged internet presence and capabilities would suddenly be so small that they vanish into the wallpaper pattern had just enough time to sink into the public consciousness, before it then

✓ The 20ft-tall Rolls-Royce engine certainly made an impression at Future Decoded; but what was it doing there?



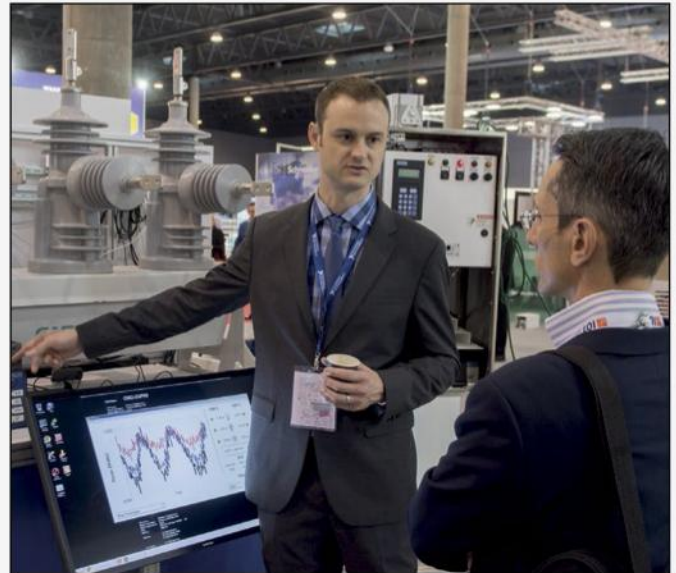
STEVE CASSIDY

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- ▲ What does computing mean to us? Chancellor Philip Hammond shared his interesting views
- The Internet of Things has many industrial uses, as showcased at the IOT Solutions World Congress in Barcelona



became rather diluted by the whole toaster/botnet thing. Do we really need our toasters to have their own email addresses and software update cycle?

Not according to the guys at IoT World. Their preceding product development process was right down at the component-soldering level. Suddenly, the limelight is shifting towards them and they've been drafted in to almost all the available buzzword categories. Smart cities? You need IoT. Big data? It comes from immense numbers of unstoppable, sorcerer's apprentice-style IoT devices. AI? You need to look through all that information that you've gathered, without knowing what you'd be doing with it. That feels like an overloaded tour of every hot trend, neat trick, expensive platform and cloud design in the whole business.

Except that as you look around the show, it becomes clear that this isn't really a collection of hot startups, wedded to the millennial technology wave of "web" this and "browser" that. These are the guys who have been running industrial control and data-collection systems for decades: they're already aware of the many problems the toaster-hacker community is discovering, as these guys have been coding for, building and supporting industry for decades.

This is where Tech Mahindra comes in. I had no idea of its interests or history until I sat down with Karthikeyan Natarajan. His title is "Global head", which I guess is appropriate when your business is writing the IoT platform code that ties fleets of devices together with clouds of servers, also running your code.

We talked a fair bit about the toaster botnet issue. His view was that it isn't especially hard to engineer out those

risks. But after I was a little mean in teasing out the issue, he did admit that his company had had a runaway traffic issue once – flagged up by its ISP, long before the code or the customer spotted the matter.

Even though one might think that standards bodies and the rules of the road for the internet ought to result in software deployments that don't do that sort of thing, the truth from an experienced player in that marketplace is that stuff goes wrong, and it's human relationships and commercial, personal links that often stop a minor problem from escalating into a major incident. This isn't really cloud-centric, software-defined networking. It's more about running a chatroom with your ops, dev and ISP teams, all permanently signed in when the going gets tough.

As ever, it's hard to get people to identify the source of an "incident", or what they did to resolve it. That said, this is the gold in understanding what to do and what to avoid doing when venturing into a new field.

I wandered around the rest of the show. There were two broad themes that seemed to emerge: gateways and cold-start recodes. Everyone had some kind of gateway: in this field it's a smallish, generally Atom-powered tin-box PC, well equipped with brackets, hooks and screw-mount holes. One side is Ethernet, displaying the look and feel of something we think an IoT device should look like. It picks up IP addresses, talks across the net, and lots of them have web-based management pages.

The actual sensors are on the other side of the box, and they aren't as IoT implies. After all, some can be as simple as a couple of wires. It's the gateway's job

"Do we really need our toasters to have their own email addresses and software update cycle?"

to implement the level of intelligence that the specific deployment requires, and you can do a lot of decision-making in a small tin box these days. Given that millions of out-of-control, low-brain individual sensors are the nightmare scenario of IoT according to many, the idea of one gateway fronting and summarising the output from hundreds of devices is clearly more appealing.

The other big thing – cold-start recoding – is simply a matter of throwing away the last quarter-century of progress in computing altogether. If you assume that botnets, vulnerabilities, exploits and so on are a direct result of open-source and globally standard compute platforms, then it follows that a closed-source, proprietary OS may sidestep much of the grief. And that the negative value of grief caused already outweighs the positive value of open-source platforms.

GE sits partway into that world, in that it has done something that's relatively new and free of historic impediments. GE Predix isn't totally closed, but it is proprietary: a cloud-based scalable platform for the back-end of all those machines and gateways chattering away in your factory. Proprietary used to be a criticism; judging by GE and Huawei's stands, those days are over.

Ah yes, Huawei. The giant Chinese technology and telecommunications



▲ There were plenty of big names at the show, including Intel and SAP, but ARM was nowhere to be seen

firm has lots of telecoms experience (up to and including its own cable-laying ships), lots of experience building small devices, and a passing familiarity with the industrial sector, one might expect a large presence in a show such as this.

But when I turned up for a conversation with one of its executives, almost all the signs I'm used to looking for were not present. No vast stand made out of chromed plastic, or trying to look like an airline lounge; not even its own stairs or meeting room suites. There's a certain visual vocabulary about these things, and the Huawei stand didn't give off those macho vibes.

In fact, I almost gave up and walked off. When you're an infrastructure player in this market, you're not given the same opportunities for flashy displays as the end-user exhibitors – no 20ft-tall jet engine here; no crimson speedboat (as IBM did at CeBIT one year).

So I was left to observe the little displays about Huawei's "lightweight OS", yet another cold-start recode solution to the woes of doing IoT with software that has altogether too much history. Unlike the PR pros, I hadn't found a picture of my interviewee either, so I was quietly fuming when I was finally found. They were very sorry, they said, but Dr Wu Chou had been taking a visitor to the stand, and the chap had some quite detailed questions that he'd been replying to.

We shook hands and sat down, and I got my brain calibrated for a conversation with a CTO. These are infinitely preferable to conversations with marketing people (sorry guys!), because a CTO knows where the pain comes from and which parts of it he can alleviate – finally, my chance to get into the whole toaster/botnet topic with someone who has a bit of a stake in that game!

Oh my. How to make a fool of yourself in short order. I hadn't glanced at the English-language side of the good doctor's business card; there it lists his role inside Huawei, and adds a label of "IEEE Fellow". If you're sharp-eyed after that then you get to see that he's domiciled in Stanford, Connecticut. That isn't a normal location for the CTO of an industrial IoT device manufacturer. It's more appropriate for someone who works with bodies of global importance – for example, the World Wide Web Consortium, headed by Sir Tim Berners-Lee, or maybe even the HTML5 standards task force. Actually, these are highly relevant examples, because Dr Wu Chou of Huawei is on both of them. That makes four separate jobs that I could count.

We talked for an hour and a quarter about the likely growth and evolutionary changes to the IoT marketplace, and how that feeds back into the bodies looking at shaping the wider future of the internet. Feeding back the concerns of IoT men used to working with two wires, a thermocouple and some pliers into the HTML5 language standards document is a feat of such stunning intellectual vertigo that I may not quite have followed all his answers and suggestions for future options with perfect clarity.

What seemed very clear, though, was the way that shows such as this link together some highly unexpected bits of the overall industry concerned with large-scale IoT, rather than focusing on the consumer-orientated public failures that are often mistakenly represented as "Internet of Things issues". For guys such as Dr Wu, there are no serious problems with well-designed IoT, even now, because standards to address the whole sector are in their earliest phases of definition. Want to be able to put a relative priority on a lot

of IoT data flooding a link? Add it to the standard, or look at the role of a gateway versus a whole swarm of allegedly autonomous sensors.

It wasn't until I stood up from that meeting, and watched my interviewee return to what he had been doing, that I really understood what I was looking at. I'd been waiting around because a random delegate had wandered up to the stand and started asking questions, which purely by accident had been picked up and answered by one of the most senior figures at work on our civilisation's communications methodology: standards, systems, languages – you name it. There was no basic marketing case to be made for that type of person to hang out at a show such as this, other than to be there to listen, rather than to speak. Dr Wu was doing what I had been doing – he was there with the company name-badge and the low-key stand to absorb everything going on around him.

Since returning, I've discovered that Huawei was the principal sponsor of the event. That's a measure of commercial value, never mind a bit of marketing uplift here or there.

As George Clooney said in one of my favourite movies: "it's like Ivana Trump on the subway". While the various early product deliveries are being presented as spamming fridges and botnet toasters, the heavyweight research and systems design players are taking a good look at what the market is saying – both in terms of delegates from the industries poised to do great things, and in terms of software suppliers looking to find homes for their products.

I have a funny feeling this show, which saw 8,000 visitors this year, is likely to get rather bigger, rather quickly in the next few years. ●

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THERE'S A NEW WILD WEST AND IT'S FULL OF IOT DEVICES THAT COULD JUST STOP WORKING, SAYS JON HONEYBALL

“The flood of Internet of Things (IoT) devices has made me pause and ask a key question: what, now, is a product? In the past, it was easy. I had hardware with an operating system, or at least firmware. Then I had software. The common connector was the “platform” – the apps ran on the OS, which sat on the hardware. I could buy hardware from one place (Acer, Asus, Dell, HP), my OS from another (usually Microsoft, but more often now Android or iOS), and developers wrote code for that platform.

If the hardware died, or the vendor went out of business, it wasn't a huge disaster. Next time I could choose a different vendor, and the connecting “glue” of the OS meant that my apps would continue unhindered. Similarly, if an app vendor disappeared, I could switch to another app offering similar functionality.

Things are different now. When you buy an IoT-era device, you're normally buying not only the hardware but an accompanying app. This, on the surface, appears little different to the previous model. The crucial change stems from the expectation that I can access the hardware, even when I'm not on the same network – for example, when away from home.

This wouldn't matter if the world had woken up to the capabilities and usefulness of VPN tunnelling, which would allow me to connect back to my home network as if I was really there, and hence connect to the device hardware. Indeed, VPN tunnelling back to home makes a great deal of sense if you take the same view of electronic security as physical security. With

increased bandwidth into and out of the home, via FTTC connections, this isn't as big a problem as in the past.

But since IoT devices become detached when we move away from our home networks, there's been an inevitable race to put much, or even all, of the control infrastructure into a set of cloud services. My app talks to the cloud service, the IoT devices talk to the cloud service (thus avoiding nasty incoming routes firewall issues) and I can connect. This, on paper, is great – it works whether I'm at home or sitting in a hotel in some remote corner of the world. All I need do is connect to a big cloud provider and that's likely to work well.

“With a stroke of the bankruptcy court's pen, my IoT devices fall silent, even if I'm in the same house as them”

There appears to be no downside. Except for one rather large one – what happens if the vendor disappears? With no vendor, there's no money to pay the cloud provider for hosting the cloud service, and so that will disappear too. With a stroke of the bankruptcy court's pen, my IoT devices fall silent, even if I'm in the same house as them.

I'm prepared to accept this risk from big vendors. I think it's unlikely that Cisco will disappear, so my entirely cloud-controlled Cisco Meraki infrastructure is unlikely to stop working tomorrow. I feel the same about my rather nice Philips Hue bulbs. But what about that webcam from the smaller vendor that's rapidly

gobbling up its venture capital cash pile? How do I know it will be around in six months? Anyone want to say “Pebble” at this point? Maybe we need to recast the relationship between the vendor, cloud provider and customer. Maybe we need cloud provisioning to be a joint responsibility between the vendor and the customer, so that there's a legal relationship between the customer and the cloud provider. So even if the vendor disappears, there's a legal expectation of continuation of service to be delivered by the cloud provider for the customer.

Such a change would be hard to put together, and I'm sure lawyers would have a field day. And you might even argue that who really cares for a set of security webcams that you have at home? At worst, you have to buy an entirely new set from someone else, in the case of those devices that have only a cloud control element and no local network access.

But this problem is only going to grow. We need, and quickly, some sort of Kitemark equivalent for devices or services that require and rely on a cloud service, and a binding promise of future delivery of such a service. It isn't acceptable for capability to just disappear and devices become scrap, or for “functionality to be reduced or impaired” in the future because your device has been sidelined or dropped by its new owners.

Handling this issue, and being seen to do so, will soon separate the serious players from the fly-by-nights. I suggest the top tier get their act together as soon as possible, because there is a real differentiation value here. Customers will only accept getting burnt a couple of times before they get wise.



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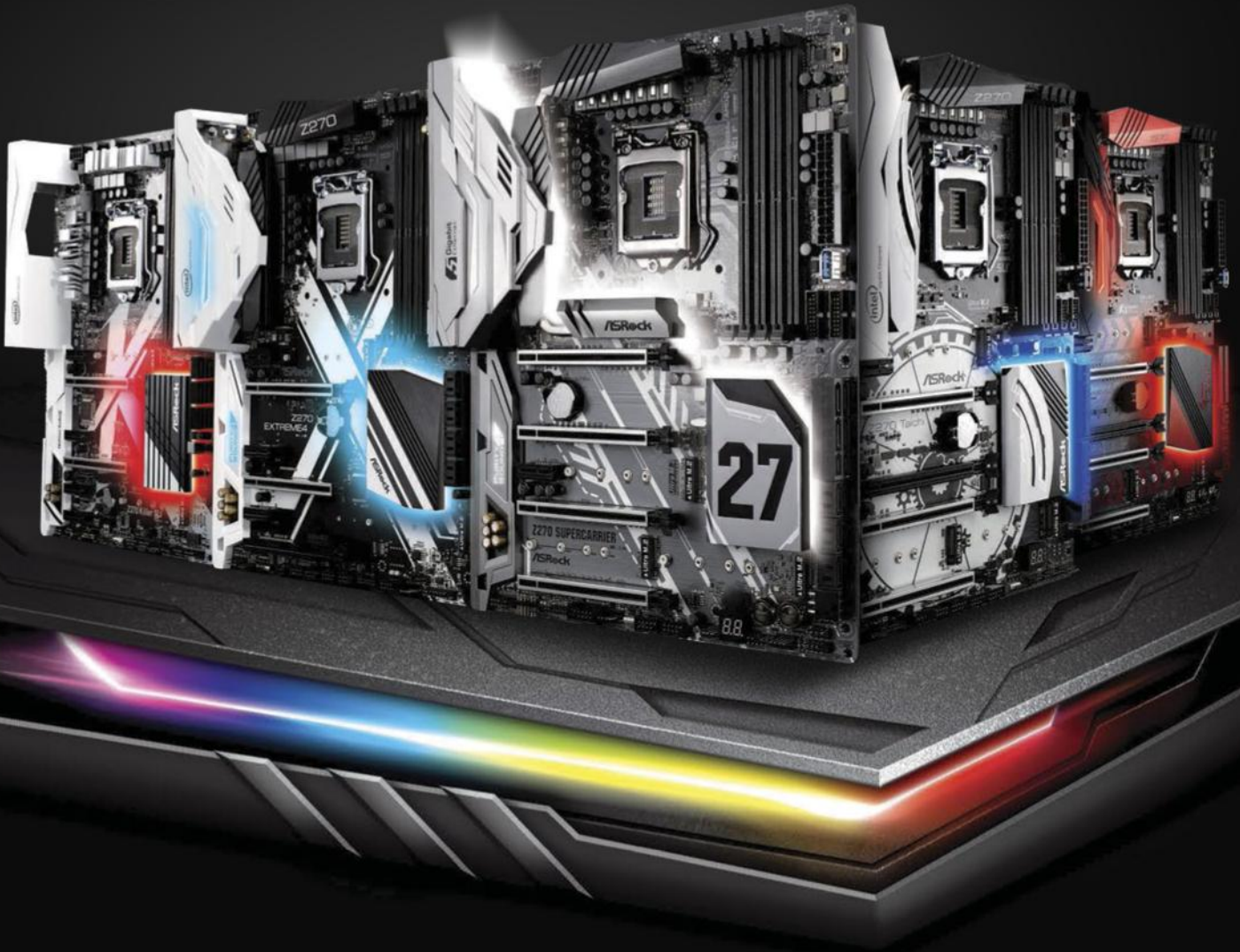
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