PC & TECH AUTHORITY

TECH ADVICE YOU CAN TRUST

GROUP TEST
DESKTOP STORAGE
FOR PROFESSIONALS

IS YOUR JOB SAFE?
WHERE THE ROBOTS ARE TAKING OVER

BLAZING BITS THAT WON'T BUST THE BANK

SPEED DEMONS

- **SSD FACE-OFF**
  High-end and budget

- **MICRO ATX**
  Motherboard roundup

FREE DVD

FREE FULL APPS

- DRIVER BOOSTER 2 PRO
- WEBSITE X5 HOME 11
- KEYDEPOT 2015
- **EXTENDED TRIAL:** *ESET SMART SECURITY*

HOW TO:

- MAKE A FORTUNE WITH YOUTUBE
- DATABASE VS SPREADSHEET

- JOBS: DATA ANALYST

STONE AGE TECHNOLOGY

Why are we still using these?

NEXUS 6 REVIEWED

GOOGLE'S PHABLET + SONY XPERIA Z3

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RE-EVOLUTION

All of the good things

Evolution, as it is want to do, continues in *PC & Tech Authority*. The pace of change has slowed, and the dust is settling quite nicely.

Thanks to reader Calum's suggestion we are now including Mac software on our DVD. Mac's are PCs too, at least in terms of being a desktop or laptop computer – and that's as far into that religious argument I'm getting :) All together, now, I say, as we computing people use whatever tools we like best, without fear or favour.

Incidentally, I occasionally receive letters pointing out that our DVD is a redundant thing, and that everyone just downloads what they need online. But that's not why we have a DVD. No, the DVD is a container for the free full versions of software that we provide each month. Our team works hard each issue to secure free apps that are exclusively available to you on our DVD at no extra cost. We always endeavour to include apps that have a wide appeal, so as many of you as possible derive benefit from them.

If you tally up the cost of purchasing them directly and traditionally it's in the triple figures. *That's* why we have the *PC&TA* DVD.

Of course we also use the space to include many things you certainly can download free, but isn't it nice to have important drivers and internet tools on a handy disc in case of emergency?

Several letters I receive have another common theme, and that's sparked another tweak here. More PC. Put simply. More relevant PC – more specifically. We've long covered super high-end performance PCs and parts – and always will, but we don't all game on mega systems, or game at all. Not everyone is a professional video editor, and only a few of us bother to overclock beyond the increasingly irrelevant world of competitive overclocking.

So moving ahead there will be an increased focus on every day PCs and components.

That's part of the reason we brought Bennett onboard as our Senior Labs Editor. His discerning analysis and writing style communicates well the real-world advantages of certain PC parts.

A casualty in the shake up is our regular apps round up. I think that short app reviews – particularly for mobile devices – are best served by magazines and websites dedicated to this. Serving up a couple of pages of piecemeal app service uses space we'd rather use for more PC content. Important apps, like professional tools, will always receive the full Labs treatment, so it's a net gain there, I believe. And of course, our Real World Computing writers ('the 'back section') will continue to do an incredible job of detailing the very wide world of software and experiences.

We're done, now, with overhauling. The magazine looks nicer, has better content within and is set to charge into another year, driven hard by the incredible and non-stop evolution that really matters – being in tech itself.

So much stuff keeps happening, new products rain upon us with increasing intensity, innovation continues to startle and surprise, and all the way we're eating it up, dissecting, understanding and sharing our discoveries and insights.

Ben Mansill
Editor
bmansill@nextmedia.com.au

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- *Our tests are performed by experienced reviewers in our Labs in accordance with strict benchtesting procedures*
- *Our brand new benchmarks have been tailor-made to reflect real-world computing needs*
- *We put tech through its paces – seriously. From processing power to battery life, from usability to screen brightness, our tests are exhaustive*
- *We will always offer an honest and unbiased opinion for every review*

THE TEAM...

Digital Editor
David Hollingworth
E dhollingworth@nextmedia.com.au
T @atomicmpc

Senior Labs Editor
Bennett Ring

Advertising Manager
Jo Ross
E jross@nextmedia.com.au

Account Manager
Kimberly Bloom
E kbloom@nextmedia.com.au

Art Director
Tim Frawley
E tfrawley@nextmedia.com.au

CONTACT US...

Call us (02) 9901 6100
E-mail us
inbox@pcandtechauthority.com.au

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INBOX

Readers write

LETTER OF THE MONTH

HONEYBALL, CONT.

I feel compelled to respond to Super Mick's letter attacking Jon Honeyball's "fair & balanced" reviews of Microsoft. I have been a subscriber to this magazine from Day 1 and have always appreciated Jon's columns. In fact his articles are one of the reasons I still subscribe.

Like Super Mick, I am in the IT industry, also like Mick I do not work for Microsoft (MS), Apple or any OS vendor. Having said that I do believe, from a business perspective, that MS products are the better solution.

If your reader had taken the time to read Jon's reviews of MS Server products over the last few years he might have been surprised to see how favourable they were. Personally, I have tried alternatives to MS business products and found them of little value.

So, I am a huge fan of MS business products and, after much continuous testing, would consider no other server OS, PC OS or Smartphone OS.

If I do fault Jon it is that neither he, or PC & Tech Authority for that matter, has shown how Windows Phone OS works and syncs so well with Exchange Server.

Jon's primary complaints about MS have been mainly based on the Windows PC OS's and the initial Surface products. They are completely valid and correct which is evidenced by MS's turnaround with Windows 10. This is how large corporations operate, they make mistakes and then correct them.

Again, as Jon pointed out at length, Windows XP is still incredibly stable as a basic OS, he still praises it. Vista was a compromise that was always doomed. Windows 7 got MS back on track and is still my favourite OS.

Windows 8 was a "back to the future" event, a total disaster probably promoted by MS Sales & Marketing Division.

In conclusion, whilst I have always been an MS user and proponent, I value Jon's comments and found them helpful in many situations.

I also think your reader, Mick, has not taken the time to read Jon's commentaries on other business products outside the OS environment.

Thanks for your great magazine.

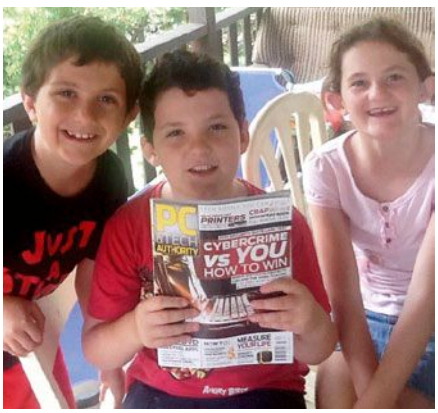
Roland

CALUM, CONT.

After reading the section on wireless connections I asked my Godfather to buy me some iBeacons. I use them to show the wifi networks and passwords.

My desktop background has an Apple logo with Steve Job's silhouette in the apple. This was a tribute I found online. I was amazed with the work that Steve Jobs accomplished.

Calum



Editor's note: *Calum was our Letter of the Month winner last issue, and is our new favourite reader. He lives on a station literally at the 'Back of Bourke', and among the many cool photos he sent us, and stories he shared – including a photo of the family helicopter being prepared for goat mustering (!) – comes this nice summary of his aspirations from his Mum*: He has just finished year 5 at Bourke Walgett School of Distance Education where he does most of his lessons in a 2-way satellite classroom. He loves all things tech especially solving problems and making things work. He has said since Kindergarten that he wants to be on a help desk.

Now he is learning coding and whatever he can online. We live 160kms from town and he drives his Suzuki with his twin sister and younger brother. He is a great help to his Granny both on the property and on her PC. He helps her friends with Skype and other software.

Calum had a wonderful birthday this year, his Godmother gave him a Mac. He has set it up to talk to the school network, print with AirPrint and he operates two desktops on the Mac. He is so enthralled!

Stay gold, champ! Ed.

KEEPING IT REAL

The recent letter by Jason Robards (Inbox, Jan 2015) struck a chord with me in the a desire to see some more middle of the road 'components' discussed and reviewed within your magazine. Not all of us want or need to conduct extreme overclocking, install a liquid nitrox cooling system and have heat dissipation fins glowing cherry red. I suspect I am one of the silent many who do not do high end video editing or on line gaming. I am not asking you to go Volvo and bowling hat here, just a little less of the WRX and a bit more Toyota with roof racks. :-)

Marc Watson

LOTM WINNER

This month's comment of the month will receive a Cooler Master SF-17 gaming laptop cooler (our review is on page 46).

www.coolermaster.com.au

Want to get in touch?

MAIL: Inbox, Level 6, Building A, 207 Pacific Highway, St Leonards NSW 2065

WEB: pcandtechauthority.com.au

EMAIL: inbox@pcand techauthority.com.au

Please limit letters to 200 words, where possible. Letters may be edited for style and to a more suitable length.

WANT TO READ MORE?

Go to ***www.pcandtechauthority.com.au*** and join in the conversation. Also check out the Atomic forums: ***http://forums.atomicmpc.com.au***

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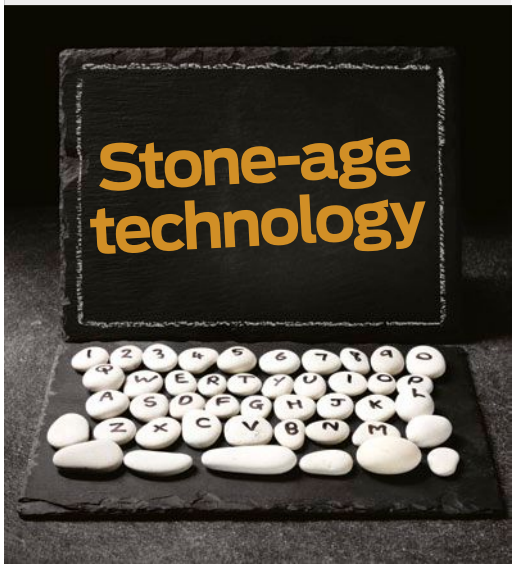

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TECH NEWS

The latest trends and products in the world of technology

SONY ATTACK "IMPOSSIBLE TO AVOID"

Celebrity gossip and leaked scripts may seem trivial, but all companies must accept that attacks will happen and plan for them, say experts

The recent Sony Pictures hack that leaked emails about upcoming movies – and gossip about actors – could cause "severe" damage to the firm. Security experts have warned that it's impossible to protect perfectly against such targeted attacks.

The hack came to light in November when anonymous hackers contacted Sony Pictures CEO Michael Lynton, threatening "great damage" if Sony didn't meet their demands. The following month, the hackers started to leak unreleased films, as well as salaries, passwords, gossip and executives' emails.

Fingers were pointed at North Korea, since the information-stealing malware had previously been used by criminals there – and the country was the subject of the Sony film, *The Interview*, which was pulled from cinemas amid escalating threats.

However, F-Secure analyst Sean Sullivan suggested the attacks weren't state-sponsored, but were simply the work of criminals. "It appears to be an extortion scheme", he said.

SERIOUS DAMAGE

The attack has attracted considerable attention: since the leaked information relates to upcoming films and famous actors, it has made headlines around the world. And while gossip about the next James Bond film may not seem serious, the leaks could be seriously damaging to Sony, Sullivan said.

"Sony Pictures' business is Hollywood, and that business is driven by personal relationships," he told us. "It seems impossible that this won't damage [Sony's] ability to do business. There must be significant loss of trust in [its] executives."

Sony has threatened to take legal action against anyone reporting details of the leaked data, but Kaspersky Lab security expert David Emm believes this is unlikely to limit the damage of the attack. "As well as any financial damage incurred to the company from the breach, it's also likely that the company will ultimately suffer severe damage to its reputation.

"Building a strong business reputation demands tenacity and consistency," Emm added. "Unfortunately, losing a hard-earned reputation can take just a few moments, particularly if an attack has happened more than once."

This isn't the first time a part of the Sony conglomerate has been compromised. In 2011, Sony's PlayStation Network was hacked; the company didn't immediately warn users, and said the attack had cultimately cost it hundreds of millions of dollars.

POLICE AND PATROL

Sullivan pointed out that many major firms have been hacked in recent years, but that Sony had seemed particularly slow to notice the attackers and shut down their access. Firms should not only focus on strengthening their "perimeters", he advised, but must "patrol and police" inside it, to enable a rapid response when hackers do get through. "Defending your company requires a 100% success rate for all time. That's not doable, so you need to plan for a breach to happen at some point."

Emm warned other companies to learn from Sony's mistakes, as trends such as Bring Your Own Device make it harder to lock down infrastructure – especially at large companies with employees and systems spread around the world.

"There's a temptation to focus on the latest threats and the techniques they implement to penetrate targeted companies," he added.

"But it's important not to neglect the basics: this includes secure password management, applying security patches, judicious network management (such as network segmentation), the use of encryption to protect intellectual property and education of staff."

SONY PICTURES

APPLE MAY DITCH IPHONE 5C

Reports suggest Apple is planning to stop making the iPhone 5c after sales failed to impress. The colourful smartphone was launched in 2013 as a cheaper iPhone option. Apple, at this stage, hasn't revealed sales figures or confirmed the rumours.

SKYPE TRANSLATION APP ARRIVES

Microsoft has released an early preview of Skype Translator, which can translate speech in near real-time. The first version works with Windows 8.1 and 10 and can translate between English and Spanish. Sign up for it at http://www.skype.com/en/translator-preview/ and read more about the future of translation tech in last month's *PC&TA* (see issue 207 p92) .

ADOBE BUYS FOTOLIA

Stock image library Fotolia has been bought for US$800 million by Adobe, which plans to integrate it into its online Creative Cloud service. This will give Adobe subscribers easier access to the image library – although images won't be free. Fotolia will also remain a standalone service.

WINDOWS 10 TAKES SHAPE: WILL YOU NEED A SUBSCRIPTION?

Rumours suggest that Microsoft will move to a subscription model for Windows 10, as details on its next operating system continue to gradually emerge.

It's known that Windows 10 will arrive around the middle of the year, with a technical preview available currently to download and install. Until now, however, the company has revealed few commercial details about the release.

That's starting to change, with Microsoft naming 21 January 2015 as the date when it will reveal the "next chapter" of the Windows OS.

Hints coming out of Microsoft's headquarters in Redmond, Seattle suggest we can expect the final code to include a fully integrated version of voice assistant Cortana, as well as a new settings menu, but the big news is that Microsoft may be considering switching to a subscription model or a "freemium" system: speaking at a Credit Suisse event, Microsoft COO Kevin Turner said that Microsoft would be looking to "monetise" Windows 10 "differently".

This could include charging for a subscription for professional features while offering a consumer version for free – which seems plausible, since other Microsoft staff have suggested that users of the Technical Preview will eventually be able to upgrade to the finished release free of charge.

What we think: "Microsoft needs to produce a winner with Windows 10, and win back users," said *PC&TA* Futures editor Nicole Kobie. "Missteps with Windows 8 hurt Microsoft's reputation among power users, businesses and average consumers alike, and while Windows 8.1 addressed some complaints, Windows 10 needs to be perfect."

What you said: A move to subscriptions for Windows wasn't popular among readers. Kevin Cozens felt that Microsoft has been "charging over the top for years", adding that "if there's going to be a subscription fee, then I'll be closing the Windows and biting the Apple." Instead, he called for Microsoft to make Windows 10 completely free.

Others suggested a two-tier approach might be possible: offering a consumer version free of charge, but asking enterprise and professional users to cough up for more advanced features – not much different from the subscription-like Software Assurance model that's already offered to corporations, noted Wright_is.

◀ Microsoft COO Kevin Turner said the firm will look to monetise its new OS "differently"

HOT... OR NOT

HOT

4K

It's time. Time for razor-sharp fonts, pixels you can't see anymore and screens that fit more in! We have tested enough 4k screens, now, to be sold on the standard.

Sure, they're expensive, and yes, you need a pair (or more) of the fastest graphics cards for gaming, but one look and there's no going back.

NOT

BLUETOOTH SPEAKERS

We don't have anything actually against these little wireless audio bricks. No, we wish for a day when our email inbox isn't polluted by a press release announcing yet another. Truly. Every day. Well, it feels that way. Certainly if you include the Chinese factory-mails we get offering them in lots of 10,000.

INTERNET SURVEILLANCE PROPONENTS UNWITTINGLY SURVEILLED

Swedish Pirate Party turns the tables on metadata champions

The president of the youth wing of the Swedish Pirate Party has duped attendees of a major security conference into connecting to an unencrypted Wi-Fi network in protest of internet surveillance.

Gustav Nipe set-up a Wi-Fi network labelled 'Open Guest' and tracked the internet searches, emails, and text messages of around 100 conference attendees including politicians, journalists, and security experts – amongst them strong proponents of internet surveillance.

Nipe said he used NSA-style techniques on a smaller scale to narrow down and plausibly identify those responsible for individual searches, emails and messages.

"That we can identify government officials, journalists and politicians with the help of a wireless network and their less thoughtful use of online services demonstrates the tremendous power available in controlling the Internet," he said.

"On several occasions, we logged connections to mail servers of governmental agencies. Using an open, unencrypted network to read governmental correspondence is not good."

GAMING NEWS

The hot game news and opinion with **Angus Baillie**

Elite: Dangerous Beta COMING TO MAC in around 3 months

Frontier Developments has confirmed that the Mac version of its successful space exploration and combat simulation game Elite: Dangerous will be going into Beta in about 3 month's time. This announcement was made in the Elite: Dangerous online newsletter amidst a slew of information regarding the new content, tweaks and fixes that will be coming in updates to the popular game over 2015.

To date the Windows version of the game has sold over 300,000 units, exceeding Frontier's base estimations for units sold at this stage of release.

CITIES XXL

Focus Home Interactive will be bringing Cities XXL to PC on the 12th of February. Cities XXL will be building on all the promising elements of its 2009 predecessor with the intention of releasing the most realistic city builder ever made. The game will come boasting a host of features, such as a complex and self-sufficient global economy, deep pollution management options, and giant 3D maps of up to 100 km2 that will offer a range of different natural resources to sustain your population and boost the exports of your city, amongst many others.

STEAM MACHINES TO BE 'FRONT AND CENTRE' AT GDC

On the back of an assertion that the term 'Steam Machine' is dead – stemming from a comment made earlier by Origin PC CEO Kevin Wasielewski – Valve have come forward to put this suggestion to rest and confirm that the Steam Machines will be placed 'front and centre' of their large presence at this year's Game Developers Conference in March.

Steam Machines are living room, console-style PCs that will feature a unique controller and a new Linux-based Steam Operating System, able to be manufactured by any company as long as they meet a minimum specification.

GAMERGATER SENDS SWAT TEAMS TO HOMES OF CRITICS

Strengthening the argument that the online movement known as Gamergate is fundamentally incapable of rational and reasoned discussion, a number of hoax calls by members of the movement have been made to police resulting in SWAT teams turning up to the homes of prominent critics of Gamergate. This kind of attack is known as 'swatting' and in a single week the Gamergate movement has been linked to two such instances, in one of which police had been falsely informed that a former-Gamergater-turned-critic had taken "multiple hostages and was threatening violence".

SWAT teams are known to respond to distress calls with overwhelming force and hoax calls such as these are made to intimidate targets, and can be placed from anywhere in the world with little risk of being identified as the one who placed to call. The risk to the individual caller is only slight when compared to the substantial risk the target is put under when they are unknowingly set upon by an armed and unwitting police force. As the Gamergate movement sinks to new lows we can only ask ourselves how and when this madness will end?

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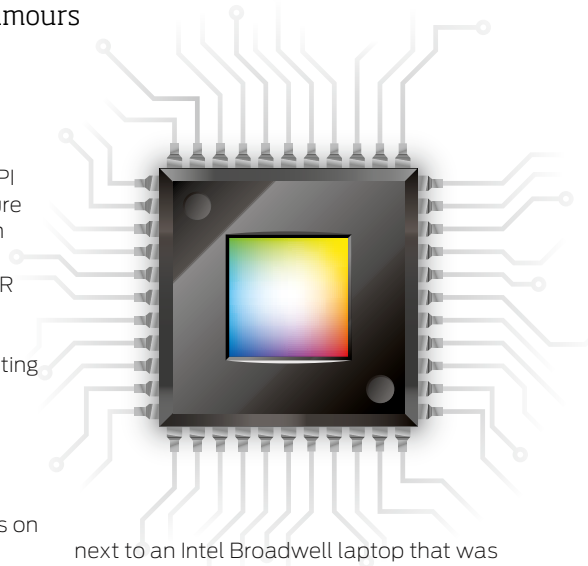
CHIP NEWS

CES sees two sneaky reveals, a Lake in the Sky leaks and AMD using Oculus Rift to build chips? **Mark Williams** checks out the latest in chip news and rumours

CPU



NEW SKYLAKE DETAILS

Information has turned up about what new technology will be aboard Intel's future Skylake platform.

Intel's venerable Enhanced Intel Speedstep Technology (EIST), the technology that down clocks and 'turbos' most of Intel's current CPU line up depending on load, will be getting a new feature, the ability to control the speed of the memory banks attached to it. Meaning your RAM in the future will scale in speed up and down based on load too, making for further power savings. This is currently only aimed at laptops on release.

Next, the PCH aka Southbridge currently with 8x PCIE 2.0 lanes will be bumped up to a sizable 20x PCIE 3.0 lanes with inbuilt support for up to 3x M.2 or SATA Express devices.

Skylake will also see the full implementation of eSPI (enhanced Serial Peripheral Interface) which will replace LPC (Low Pin Count), basically Intel's standard that handles legacy and ROM based chips on your motherboard. eSPI will provide a more efficient architecture for flash, bus and power controllers on motherboards.

Finally Intel will be removing the FIVR (Fully Integrated Voltage Regulator) system which was introduced with Haswell and is responsible for distributing voltages to individual blocks and controllers on the package. Skylake will see IMVP8 (Intel Mobile Voltage Positioning) used instead, as it is with current mobile Intel platforms. Good news for overclockers, as it means less on package heat to deal with.

CARRIZO CES PROTOTYPE

CES saw AMD showing off its upcoming Broadwell-U adversary, Carrizo, in a prototype laptop on show. No benchmarking was done or allowed, but one thing that was shown was that Carrizo was able to handle full 4k H.265 video decoding on the fly rather well (thanks to the inbuilt UVD decode block) sitting next to an Intel Broadwell laptop that was barely managing single digit frame rates. Quite a feature as we head into the 4K era.

Other details revealed by AMD show that Carrizo (at 3.1B transistors) will sport AMD's new Excavator cores which are allegedly 23% smaller and 40% more power efficient than Kaveri (at 2.41B transistors). The smaller CPU cores and higher transistor counts mean there should be quite a beefy GPU on-board!

GPU

GTX 960 IMMINENT

The first of Nvidia's truly mid-range Maxwell parts should have launched by the time you read this, January 22nd.

Sporting the new GM206 core, the card from initial leaks looks well placed to take AMD's R9 280X to task, handily beating it in a few 3DMark benchmarks, and that's with early drivers too.

The specs appear to give it 1024 CUDA cores running at 1.2GHz, 64 TMU's, 32 ROPs and supported by 2GB of GDDR5 memory over a 128-bit memory bus. Bar the frequency, that's all half of what the GTX 980 packs.

The card is powered by a single 6-pin power connector and requires just 120W to operate. Launch pricing is expected to be around $400 for reference versions, and we'll have a full Labs group test in the next issue of *PC&TA*.

NVIDIA'S SECRET CES SURPRISE

Slipping under the radar, the GTX 965M made its launch debut at CES. In many respects its specifications are actually very similar to the upcoming desktop GTX 960, though there are some key differences. While CUDA core count, TMU's, ROPs, memory and bus width are all the same as the leaked GTX 960 specs (see above), the GTX 965M is actually a GM204 core that has been further cut down to match its mission parameters, much like the GTX 970M.

The core clocks in at 944MHz and the memory has been tuned down from 7GHz to 5GHz to save power giving it just 80GB/s of memory bandwidth, half that of the GTX 980M.

390X TO FEATURE 3D CHIPS

LinkedIn profiles of two AMD employees have given away some details about AMD's upcoming flagship card the R9 390X, aka Fiji XT, and the existence of a 380X GPU.

The juicy part comes from the following in one of the profiles: "Developed the world's first 300W 2.5D discrete GPU SOC using stacked die High Bandwidth Memory and silicon interposer".

The 300W consumption figure is a little concerning, showing that AMD haven't been able to make much in the way of power efficiency gains. The rest of the description tells us that AMD will be using 3D stacked memory sitting on an interface which the GPU also will sit on. Not true 3D stacking (stacked memory on top of the GPU) but this 2.5D solution has cooling, price and manufacturing fault recovery benefits. All attractive things for first steps into the 3rd dimension.

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	Austin Computers	(08) 9202 0100	http://austin.net.au
SA	IT Warehouse	(08) 8296 3211	http://www.itwarehouse.com.au
New Zealand	Just Laptops	0800 58 78 52	http://www.justlaptops.co.nz/
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NO.1 IN GAMING

MOST WANTED

Left-field tech of CES

Quitbit lighter

The Quitbit lighter is designed for tech-minded smokers looking to cut down or quit. This smart-lighter automatically tracks every cigarette, then syncs with an iOS or Android device to let you know how naughty you've been. Users can track trends on the app, and can set when Quitbit will be operational if you're looking to cut down on peak smoking time.

When Quitbit is synced with your smartphone, you can track the smart-lighter's location.

Quitbit has an inbuilt display for referencing essential predetermined information, while a full recharge is rated for a week of firing up. There's no need for refills or replacements, either, as it ignites ciggies via a heating coil.

www.quitbitlighter.com

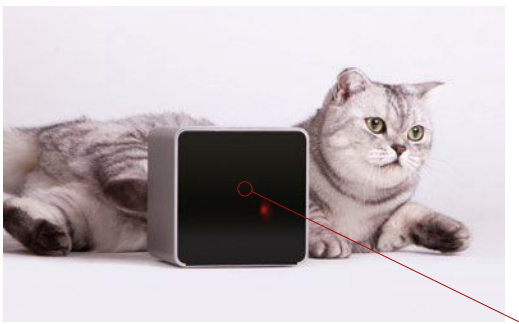
Tao chair

Science tells us that office jobs can adversely affect health, as evolution dictates that our bodies are designed for movement and not sitting in chairs for hours on end. Not anymore. The TAO Chair is purpose built to answer the contemporary question: "How do I sit on my butt and stay fit?"

Thanks to the mysterious v'Variobics system', this chair works out different muscle groups. Sensors embedded inside the armrests track the force of bodily movements and display a running tally of calories burnt on an inbuilt display. Basically, whenever you push, the TAO Chair pushes back.

The good news is that TAO Chair owners won't need to leave the couch to exercise when binge-watching streaming services Stan and Netflix launch in Australia later this year.

www.taochair.comv



Petcube

Crazy cat folks and pooch-loving people now have the option to never need to miss a moment with their beloved pet when they're away from home. The Petcube connects to your home Wi-Fi and streams 720p video from 138-degree wide-angle cameras. But it's not just about keeping an eye on your pet.

Users can communicate with their animals by way of a two-way audio stream, so Lassie can keep her owners abreast of what's happening at home. There's even an option to play with your pets via an inbuilt laser to drive your cats wild even when you're not around. It's all controlled by way of iOS or Android app, so checking up on your animals at work can be as discrete as faking a phone call.

https://petcube.com

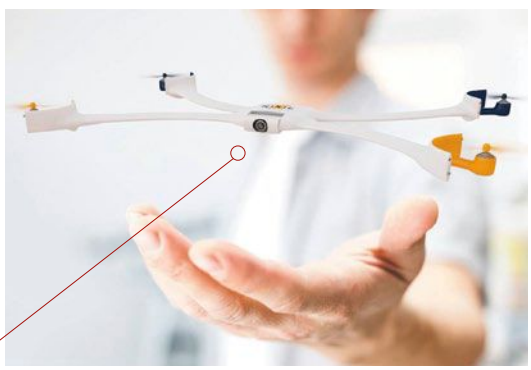
Nixie wearable camera drone

Selfie potentiality hits all-new heights with this three-in-one product. Part camera, part drone, part wearable, the Nixie is an early adopter's wet dream. The pitch is this wearable will unwrap itself from your wrist with a gesture and take flight.

From there, it takes a Michael Bay-inspired spin around the subject matter (that's you), then comes back to wrap around your wrist again. That's the thrust of the main 'boomerang mode', with other modes on the drawing board.

The autonomous soaring camera captures video at 1080p. While selfie-sticks are all the current rage of vanity photography, the Nixie just elevated the potential for new possibilities of awkward-angle Facebook display pictures.

www.flynixie.com



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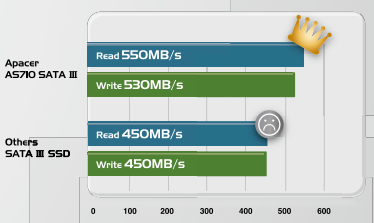
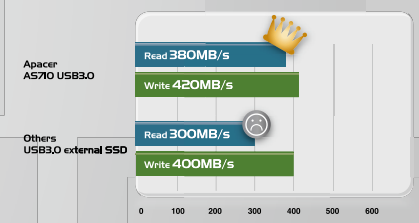
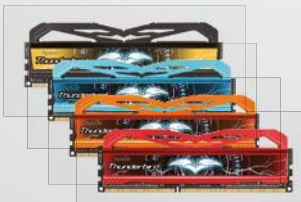
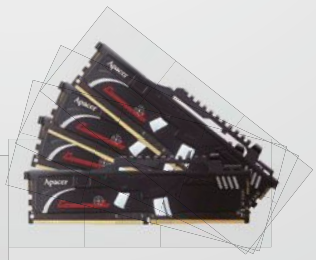




Over clocking Series



Thunderbird DDR3



Commando DDR4

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AH332

AH350

AH353

AH175 mobile drive

Portable Hard Drive Series

AC231

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B510

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WHAT IS AN OMBUDSMAN?

Anthony Caruana knows who to talk to, and how to talk to them, when thing don't go your way

A few years ago, we had a billing dispute with a telco we were using. Essentially, they had overbilled us for mobile data services resulting in an excess usage charge that quadrupled the usual monthly bill.

We called the telco, taking note of the time we called and the name of the operator. After over 45 minutes, it was clear that the dispute was not going to be resolved. At that point, after escalating the matter to a "manager" in the call centre, we decided enough was enough and invoked a higher power; the Telecommunications Industry Ombudsman.

An ombudsman is an independent party, appointed by a government, to represent the rights of consumers against companies. In Australia, there are several different types of ombudsmen.

Parliamentary ombudsmen investigate complaints made by citizens and constituents about the administrative actions of government agencies. There are also industry-based ombudsmen who investigate complaints from customers of companies providing services such as telecommunications, banking, insurance, investments, energy, water and public transport. These can be state or federal appointed. There are also other statutory ombudsmen or commissioners.

Obviously, the role of the ombudsman needs to be funded in some way. The good news is that it's the companies that are complained against that wear the cost of ombudsman inquiries. Often, consumers can feel powerless when facing off in a dispute with a large company. But in a business world where margins are often very tight, large companies are loathe to have complaints raised to an ombudsman.

So, how do you make a complaint through the ombudsman?

It's important to understand that the ombudsman won't advocate for you until you've made a reasonable attempt to resolve the dispute with your service provider. For example, if you're disputing charges on a bill, you'll need to have called the provider and ascertained how the over-charges might have occurred. There's no point contacting an ombudsman until you've made a reasonable attempt to solve the problem yourself directly with the service provider.

Make sure you take detailed notes throughout this call. Note the time of the call, who you spoke to, what, if any, offers to rectify the issue were made and any evidence you might have to support your cause. In our dispute with the telco, we were able to prove that some of our data use was simply not possible as we were on a planeat the time!

If the service provider has an internal escalation process then you should go through that, even if you think it will be futile, in order to demonstrate to the ombudsman that you've attempted to resolve the dispute before eventually upping the ante.

Make sure you stick to the facts and avoid getting angry on the phone. Most call centre calls are recorded and it won't help your cause if you've been rude or difficult with call centre operators.

Once you've tried everything you can with the service provider and still not received a satisfactory offer of a resolution it's time to call the ombudsman.

There are both federally-appointed and state-based ombudsmen. Finding the right one is reasonably easy with some simple web searching. You may also find that the service provider lists the appropriate ombudsman on their website or customer charter information.

Be ready with the notes you took during your attempts to resolve the dispute. Avoid using emotive language and stick to the facts. The more information you have on hand the better.

Our experience with ombudsmen is that presenting a clear story can go a long way to helping your case. If English is not your preferred language you can request an interpreter or you can lodge complaints online.

> "It won't help your cause if you've been rude or difficult with call centre operators"

Assuming your complaint is reasonable, the ombudsman will provide you with a reference number and an alternate contact within the service provider organisation who is specifically designated as the person for dealing with ombudsman inquiries.

Once a complaint reaches this level, the operator will be able to deal with your complaint with greater authority than call centre staff.

That doesn't mean you'll necessarily "win" in the dispute but the likelihood of a reasonable resolution is much higher. But, as the service provider's costs increase as they deal with the complaint, they are more likely to want to resolve the issue.

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.*

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***

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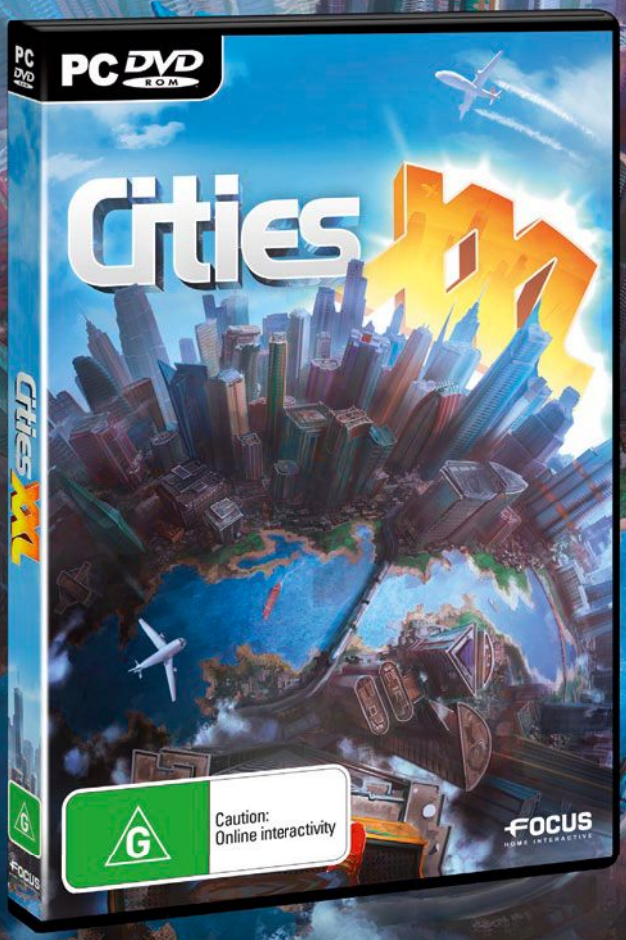

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FOCUS HOME INTERACTIVE

Intel's 5th generation hits laptops

Y HAS IT TAKEN SO LONG FOR INTEL TO GET ITS U BOAT OUT THE DOOR? **MARK WILLIAMS** DEEP DIVES INTO THE LATEST CPU RELEASE FROM INTEL.

> The two CPU packages that make Broadwell-U. The PCH sits above the CPU die on each. The right one sports the larger GT3 IGP hence its extra length.

Fifth generation Broadwell CPUs from Intel are already out in the form on its Core M line up (aka Broadwell-Y) which are at the lower performance end of Intel's product stack (any lower and you're into Intel's Atom range), Broadwell-Y is aimed at low power solutions like tablets, 2-in-1 tablet convertibles and fanless Ultrabook designs.

Broadwell-U however, which Intel launched at the recent Consumer Electronics Show, is the first of Intel's 5th generation Core CPUs that the average consumer will likely get their hands on and sits in the middle of its intended BGA packaged line up.

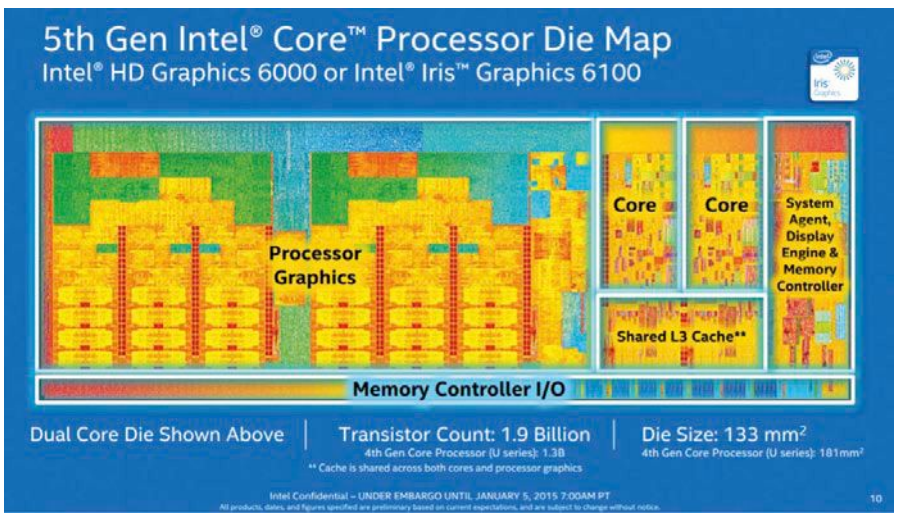
The next step up in power from Broadwell-Y (4.5W max) and still only dual core, Broadwell-U (15-28W max) is aimed at mid to high end Ultrabooks and other thin-and-light or low end laptops, even into small integrated desktop solutions like Intel's NUC or Gigabyte Brix-type products.

HONEY, I SHRUNK THE CHIPS!

Intel is having a tougher time producing these CPUs as it initially struggled to refine its new 14nm (nanometre) manufacturing process to achieve acceptable yields. Broadwell's launch was pushed back early on and in what would normally happen in around 6-8 months, the launch of this new generation of mainstream CPUs is going to take around 10 months. Broadwell-Y launched back in September of last year, Broadwell-U is just launching now, and the highest tier quad core BGA Broadwell-H (47W max) CPUs and 1150 socketed desktop Broadwell-K parts are currently projected for a mid-2015 release. The extended launch window shows how hard it's starting to become with each new node shrink.

Node shrinks, the "tick" in Intel's "tick-tock" release cadence ("tock" being new architecture releases), as with Intel's new world leading 14nm process do however afford benefits all of its own despite no under the hood architectural changes having to take place. Node shrinks mean less voltage is required for the silicon to operate, providing power and heat savings and thus cooler and longer lasting devices.

As the die size physically shrinks down too it also allows manufactures to utilise the saved die space to add in even more transistors thus allowing them to add more grunt for free. Which is the case with Broadwell-U.



NUTS AND BOLTS

Broadwell-U is being manufactured as just two chips from which all the variants will be derived from. One is larger in size due to having more dedicated graphics transistors on board for its "GT3" IGPs, see the image above while the smaller one powers the rest of the line-up with "GT2" and "GT1" IGPs, but more on that later.

Thanks to the 14nm node, compared to the previous generation Haswell-U (22nm process) GT3 equipped CPUs, Broadwell-U has shrunk down 26% to 133mm2 despite packing in over a massive 46% more transistors, 1.9 billion total! The figures for the leaner GT2 and GT1 IGPed versions are equally impressive too, down a huge 37% in die size (82mm2) and includes an increase of 35% more transistors for 1.3 billion total.

Despite all these new transistors, the idle power consumption of these 5th gen chips has dropped all the same. Where the 4th generation was around 9.5W to 11.5W, Broadwell-U has dropped down to 7.5W to 9.5W at idle and it has Intel claiming that it'll extend battery life by around 60 to 90 minutes overall.

Interestingly Broadwell-U will be maintaining pin compatibility with Haswell-U, meaning manufacturers, should they decide, could drop these new processors into existing product designs for a cheap and easy product line refresh, all that's needed is a simple firmware update.

THE BRAINS

Despite the new manufacturing node giving Intel thermal headroom aplenty to play with

< A look at how the internals of the GT3 "Iris" powered version is laid out

Model	Cores/ Threads	Base/ Peak Freq (GHz)	EUs	GPU Base /Max Freq (GHz)	LPDDR3/ DDR3 Support (MHz)	L3 Cache	cTDP Down
28W + Iris 6100 Graphics (GT3)							
i7-5557U	2/4	3.1/3.4	48	300/1100	1866/1600	4MB	23W
i5-52 87U	2/4	2.9/3.3	48	300/1100	1866/1600	3MB	23W
i5-5257U	2/4	2.7/3.1	48	300/1050	1866/1600	3MB	23W
i3-5157U	2/4	2.5/2.5	48	300/1000	1866/1600	3MB	23W
15W + HD 6000 Graphics (GT3)							
i7-5650U	2/4	2.2/3.2	48	300/1000	1866/1600	4MB	9.5W
i7-5550U	2/4	2/3	48	300/1000	1866/1600	4MB	9.5W
i5-5350U	2/4	1.8/2.9	48	300/1000	1866/1600	3MB	9.5W
i5-5250U	2/4	1.6/2.7	48	300/950	1866/1600	3MB	9.5W
15W + HD 5500 Graphics (GT2)							
i7-5600U	2/4	2.6/3.2	24	300/950	1600/1600	4MB	7.5W
i7-5500U	2/4	2.4/3	24	300/950	1600/1600	4MB	7.5W
i5-5300U	2/4	2.3/2.9	24	300/900	1600/1600	3MB	7.5W
i5-5200U	2/4	2.2/2.7	24	300/900	1600/1600	3MB	7.5W
i3-5010U	2/4	2.1/2.1	23	300/900	1600/1600	3MB	10W
i3-5005U	2/4	2/2	23	300/850	1600/1600	3MB	10W
15W + HD Graphics (GT1)							
Pentium 3805U	2/2	1.9/1.9	12	100/800	1600/1600	2MB	10W
Celeron 3755U	2/2	1.7/1.7	12	100/800	1600/1600	2MB	10W
Celeron 3205U	2/2	1.5/1.5	12	100/800	1600/1600	2MB	10W

they haven't upped the peak frequencies these CPUs will be running at. Haswell-U topped out at 3.5GHz with the i7 4578U. Broadwell-U on the other hand, at least with what's currently been launched, only tops out at 3.4GHz on the i7 5557U which is partly why Intel is claiming the extra battery life statistics. However where Broadwell-U is improving is with the base clocks, the i7 5557U has a base clock of 3.1GHz compared to 3.0GHz on the i7 4578U. This trend continues across the whole line up, basically matching peak clock speeds of the 4th generation processors while getting a 100-300MHz speed bump on the base clocks, even up to an extra 600MHz in the case of the i7 5500U versus the i7 4500U.

The move to 14nm doesn't appear to be just a 'dumb' die shrink either, Intel is claiming a 5% Instructions Per Clock (IPC) improvement thanks to a few tweaks, mostly to do with scheduler and buffer optimisations amongst other things, giving these 5th-gen parts an edge despite similar or 3% lower peak clocks.

THE BRAWN

5% IPC boost for the CPU is nothing to scoff at, but when you're claiming 22% improvement to graphics, that's much more impressive indeed.

All those extra transistors mentioned earlier have been mostly spent beefing up the graphics processor's execution units (EUs). The larger GT3 powered chip now sports 48 EUs compared to Haswell-U's 40 EUs and takes up a massive two thirds of the die space, while the smaller GT2/GT1 powered chip with 24 EU's total compared to the previous generations 20EUs, a solid 20% uptick in GPU resources, take up half the die space.

"you will be able to say "Hello HAL" (or whatever you like) to bring your laptop out of sleep without touching it!"

Any model you see in the table above with a '5' or '8' as the second last digit means it has 1866MHz memory support. This is mainly to benefit the inbuilt higher end GT3 Iris 6100 or HD 6000 GPUs giving the necessary bandwidth to sufficiently feed them, which was shown to be very effective with the 4th generation parts too.

The lowest, GT1 HD Graphics found on the Pentium and Celeron versions are actually the same die as the GT2 HD 5500 parts but have half of the EUs disabled, to recover yields from manufacturing defects in the GPU areas.

4K AND WIRELESS

Feature wise, Broadwell's GT3 and GT2 powered products now support 4K resolutions at 60Hz compared to the previous 30Hz and also support 4K H.265 decoding (though not purely hardware accelerated) at 30fps. Broadwell GT1 powered products now also sport two features previously reserved for the GT3/2 products, Quick Sync (which is now also up to 2x faster) and Wireless Display support. Improved API support with DirectX 11.2 (DX12 too when it comes) and OpenCL 2.0 round out the improvements.

DOWN SOUTH

The smaller chip on the CPU package (the top die in the top-left image), the Platform Controller Hub (PCH) or Southbridge to those that have been around a while has had two improvements made to it. The first more minor one is some improved I/O throttling, power and thermal management for better battery life and allows for the 'wake on voice' ability.

That's right, with Broadwell-U you will be able to say "Hello HAL" (or whatever you like) to bring your laptop out of sleep without touching it!

AUDIO TRICKS

The second and larger improvement on the PCH, Intel are integrating their DSP (Digital Signal Processor) right into the PCH removing some extra, typically Realtek, components from the system and allowing for better and quicker power gating for even more power savings. The beefier DSP now also allows for Waves and DTS post processing and enables hardware accelerated real time voice recognition, likely making that feature a big selling point on systems this year, a certainty with Cortana (think Siri) coming with Microsoft's upcoming Windows 10. Dictating emails and commanding your PC to play a specific song or to Google something without touching your PC could be about to happen.

THE FUTURE

Broadwell won't be coming to replace budget socketed desktop Haswell parts, though performance and HEDT parts should get the Broadwell treatment by mid-2015 as well. When it does come though it will see for the first time Iris graphics coming to socketed systems, which could give reason for AMD to worry, IGP graphics is its strongest and only niche it can compete well in at the moment.

Due to the initial 14nm production ramp up issues Broadwell is being rolled out quite late. By the time the new high end laptop Broadwell-H and desktop Broadwell-K parts come, Skylake (the next architectural refresh) will be just about ready to launch in the second half of 2015, giving mere months for some Broadwell parts before they potentially become outdated.

The 14nm process should be a lot more mature by then though and should see Skylake's release not be quite as lengthy as Broadwell's has been. ●

10 inventions nobody wants

THINK BACK 30 YEARS: NO MOBILE PHONES, NO INTERNET, ZERO LOLCATS. BUT ALSO NO SPAM, VIRUSES OR WINDOWS ME. WITHOUT A DOUBT, EVEN GREATER INNOVATIONS LIE AHEAD IN THE NEXT 30 YEARS, BUT HOW DO WE AVOID THE MISTAKES? HERE, STUART TURTON SENDS A WARNING TO OUR FUTURE SELVES. IT'S NOT TOO LATE... IS IT?

1 Generation perfect

"We're on the cusp of having much more information, and the appearance of having much greater discretion, in choosing the traits of our children," wrote bioethicist Thomas H Murray in a recent article on designer babies in the journal *Science*. "What use will we make of it, and should there be limits?"

It's a conversation we'll be having soon, because the genetically perfect genie's already out of the test tube. In February 2014, the US Food and Drug Administration started discussing clinical trials of genetic-manipulation techniques aimed at preventing diseases in newborns. The problem is that all our genetic levers are kept behind the same locked door. Kick it down and everything from eye colour to height becomes a choice on a checklist.

But what happens when babies are customisable like cars? Rich and poor won't only be a matter of who can afford the best lawyers, but who has the smartest, most beautiful children. It won't even be a two-tier society; it will be them and everybody else, divided by an ever-widening genetic gap. Basically, do you want to live in a world where Kim Kardashian can bling her own baby?

2 AI up, lad

It's only a matter of time before Siri and Cortana swallow their respective OSes whole. Eventually, they won't just be clever algorithms reminding us about birthdays and heavy traffic, but AIs that we can verbally interact with to get things done. When that happens, we'll discover that Windows and OS X are know-it-all brickies who stop working every few hours for no reason.

Pleading with my PC not to crash is embarrassing enough without the computer telling me to "man up" in a non-human accent. In fact, we should probably agree to ban all AI research outright. At the end of the day, AI will either mirror the mind of its creator, or surpass it so completely we'll have no idea how to control it. I call this the girlfriend protocol, and it's terrifying.

3 Ad and subtract

If *Mad Men* has taught us anything it's that we were once brilliant at advertising. Ad executives would smoke 50 cigarettes straight and drink whisky by the tumbler-full, with inspiration materialising in the miasma of terrible living. Unfortunately, the moment they cleaned up their act, they lost their advertising mojo – allowing companies such as Google to swoop in.

Page's prodigies aren't interested in wooing us with products we haven't seen before. They prefer to bludgeon us with ads for things we searched for two minutes ago. It's the digital equivalent of having a used-car salesman follow you around all day because you glanced at a Volvo in his showroom.

As a result, it's a bit difficult to be excited by the concept of video screens that know our names and pester us with products as we walk down the street. In *Minority Report*, Tom Cruise was catcalled by biometric billboards wanting him to buy an expensive car. In real life, most of us would find ourselves besieged by ads for flat-pack furniture and cheap holidays ion the Gold Coast.

4 Voyeur of the damned

Remember when we all thought *The Truman Show* was a comedy? Turns out Jim Carrey had a beady eye on the future all along, except the real version of *The Truman Show* isn't remotely amusing.

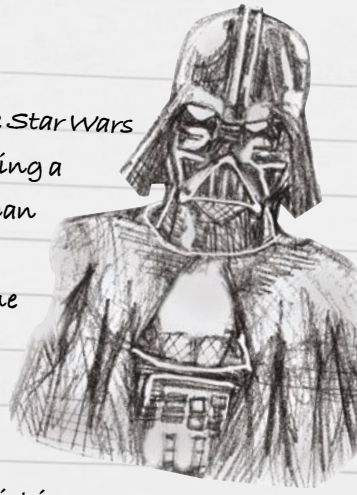
Drones are already watching our streets 24/7. Cameras are being built into glasses and gizmos, while the internet's learning how to link up every bit of data collected on us.

Forget voluntarily uploading stuff to Facebook and YouTube; it's getting to the point where we can't help but be caught on camera, our entire lives captured from every angle. Toss in some automatic facial-recognition tech, and it isn't ha rd to conceive of a future in which every video of us is collated into an easily accessible folder, available to whichever authority decides it needs to see it.

5 Hollow words

Dear JJ Abrams,

Congratulations on landing the Star Wars director's gig – I'm sure you're doing a great job. Quick favour, though, can you please ditch the holograms? I know George loved a bit of "help me Obi-Wan", but have you noticed that holograms are rubbish? Have you, JJ?



Imagine a world where pulling a sickie doesn't involve only a few half-hearted coughs down the phone, but a full physical performance in your boss' office. Imagine having some telesales worker appear in your living room while you're eating dinner. That's the reality of holograms, JJ, and it's a future in which all telephonic communication dies because it's too much effort.

Case in point: I love my parents, but the crux of that love is the whopping lie I tell them when I need to hang up at the end of a particularly taxing telephone conversation. "Sorry mum, can't talk about grandchildren right now, the house is on fire." That sort of thing.

Popularise holograms and you're effectively ending millions of loving relationships. Is that what you want, JJ?

Yours sincerely,

The little people

10 inventions nobody wants

6 Speccy all eyes

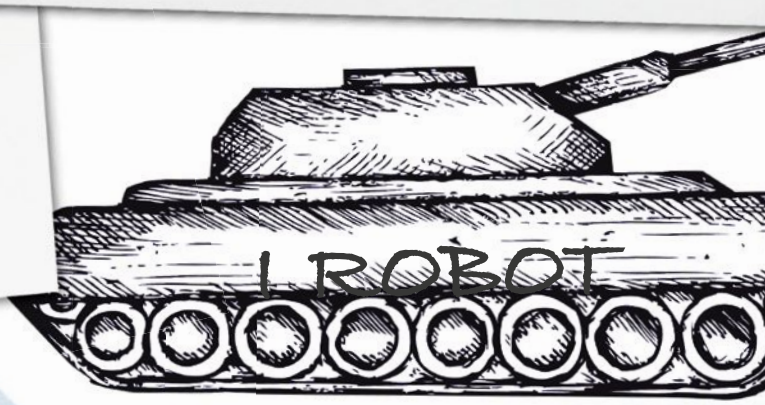
Google Glass could be the end of civilisation as we know it – a shame, since it's a great idea in theory. Don't know this person who seems to know you? No problem, Google Glass can perform facial recognition and deliver that information as elegantly as a butler delivering a crisp morning paper. Faux pas averted.

Except, anybody who's ever used Glass knows this isn't how it works. Google Glass switches people off whenever they try to use it. Their face goes blank, their eyes empty out, and the person they were is momentarily shunted to one side at Google's request. It's terrifying.

Think about it. You bump into an old friend you haven't seen for a while. They see you and their face shuts down. A second later it reboots, a vapid smile leaping onto their face because Google has informed them it's your birthday. Except that it isn't your birthday. Or worse still, it's your birthday and they don't bother mentioning it, even though you know they know because they're wearing Google Glass. Really, how can any friendship survive this sort of honesty?

7 The forever war

Forgive me for turning serious all of a sudden, but war is heartbreaking; a dreadful, extravagant waste of life. It takes special thinking to solve this tragedy not by eradicating war, but by sending machines to fight our battles instead. While we're used to drones scouring distant battlefields, their pilots hundreds of miles away, the next stop is to promote those pilots to managers, leaving the robots to pick their own targets and fire on them with impunity. Organisations such as the Campaign to Stop Killer Robots are lobbying for an international ban on autonomous war machines, but with half of the world on fire, and the US quietly recommitting itself to campaigns in the Middle East, Eastern Europe and Asia, there's a suggestion that automated warfare may arrive sooner rather than later.



8 Metal hearts

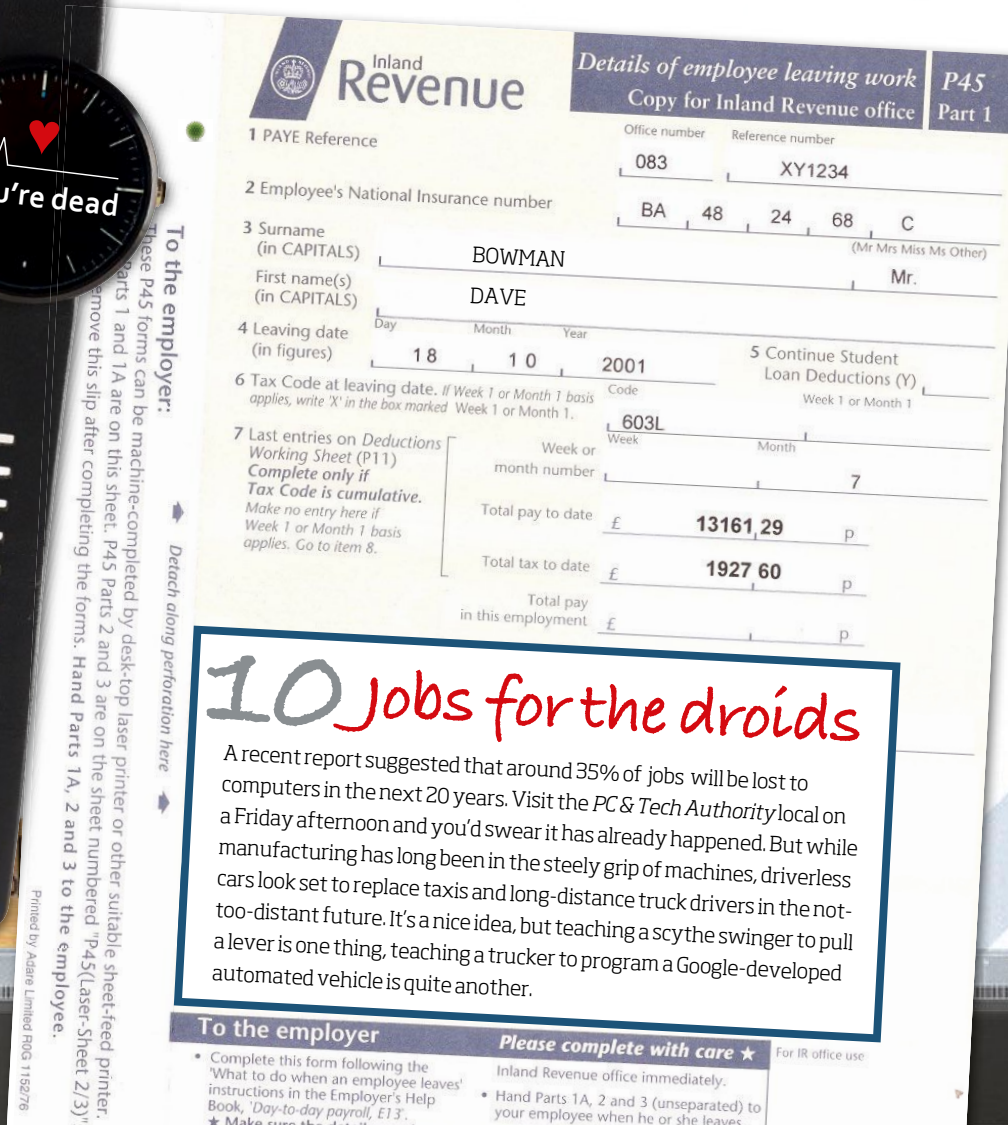
Tech companies have a perverse fascination with my health. Smartwatches seem determined to monitor every aspect of my well-being, from the number of footsteps I take in a day to my heart rate and who knows what else. Google, Microsoft and Apple all want to stash this information, along with my medical records, on their servers, while EA's digital gaming service, Origin, tells me to get a life when I've played FIFA for too long.

But here's what they're all missing. I know I'm lazy. I didn't wake up one day to discover I'd become Benny Hill overnight, and the situation isn't going to be resolved by a wrist-mounted guilt box telling me to take a run in the rain because my blood pressure is so high it could launch a rocket into orbit. This is data-mining disguised as corporate concern, and it isn't going to end with gadgets. Soon we'll have pacemakers and brain bits with web interfaces logging everything we do. It's terrifying, incredibly open to abuse, and a far better idea on paper than in reality.

9 A little problem

Nanotechnology is the science of small things, allowing us to build billions of robots capable of squeezing themselves onto a pinhead. They'd float in the air and in our bloodstream, repairing us, building things, being generally small and helpful – an army of nans, if you will.

This would be a corking idea if we, a civilisation that can't find its own car keys ten seconds after we put them down, weren't inventing them. A civilisation of lost pens and puzzles missing pieces. We're rubbish at small. The first time we spotted the atom, we cracked it in half and blew a hole in the world. With this in mind, does anybody really think it's a good idea to let billions of self-assembling, infinitely powerful, invisible robots loose in the world? Do we really want to spend the next thousand years searching down the back of the sofa for them?



Inland Revenue

Details of employee leaving work
Copy for Inland Revenue office

P45 Part 1

1 PAYE Reference — Office number: 083 — Reference number: XY1234

2 Employee's National Insurance number: BA 48 24 68 C

3 Surname (in CAPITALS): BOWMAN — (Mr Mrs Miss Ms Other): Mr.

First name(s) (in CAPITALS): DAVE

4 Leaving date (in figures): Day 18 Month 10 Year 2001

5 Continue Student Loan Deductions (Y)

6 Tax Code at leaving date. *If Week 1 or Month 1 basis applies, write 'X' in the box marked Week 1 or Month 1.* Code: 603L — Week 1 or Month 1

7 Last entries on *Deductions Working Sheet* (P11) ***Complete only if Tax Code is cumulative.*** *Make no entry here if Week 1 or Month 1 basis applies. Go to item 8.*

Week or month number: Week — Month: 7

Total pay to date: £ 13161 29 p

Total tax to date: £ 1927 60 p

Total pay in this employment: £ p

To the employer: These P45 forms can be machine-completed by desk-top laser printer or other suitable sheet-feed printer. Parts 1 and 1A are on this sheet. P45 Parts 2 and 3 are on the sheet numbered "P45(Laser-Sheet 2/3)". Remove this slip after completing the forms. Hand Parts 1A, 2 and 3 to the employee.

Detach along perforation here

Printed by Adare Limited ROG 115276

10 Jobs for the droids

A recent report suggested that around 35% of jobs will be lost to computers in the next 20 years. Visit the *PC & Tech Authority* local on a Friday afternoon and you'd swear it has already happened. But while manufacturing has long been in the steely grip of machines, driverless cars look set to replace taxis and long-distance truck drivers in the not-too-distant future. It's a nice idea, but teaching a scythe swinger to pull a lever is one thing, teaching a trucker to program a Google-developed automated vehicle is quite another.

To the employer — Please complete with care ★ — For IR office use

- Complete this form following the 'What to do when an employee leaves' instructions in the Employer's Help Book, 'Day-to-day payroll, E13'.
- ★ Make sure the details
- Inland Revenue office immediately.
- Hand Parts 1A, 2 and 3 (unseparated) to your employee when he or she leaves

Stone-age technology

PHONES, TABLETS AND PROCESSORS ALWAYS SEEM TO BE IMPROVING, YET SOME TECH HAS BARELY ADVANCED IN DECADES. WE LOOK AT THE STONE-AGE TECHNOLOGIES THAT ARE IN NEED OF A BIT OF EVOLUTION

CONTRIBUTORS: Tim Danton, Darien Graham-Smith, Nicole Kobie

1 Voicemail

Does anyone actually like voicemail? Born from the dying embers of answering machines, it once seemed useful - but not any more. Often you're forced to wade through menus, pressing random digits on your handset to hear a rambling message with no actionable points, which would have been far better expressed in an email - despite the limitations of that medium, as we'll discuss below.

Voicemail has evolved somewhat over time. Voice messages can now be attached to emails, or automatically transcribed by services such as VoiceCloud. Google also offers its own Google Voice transcription service, if you happen to be one of the three people worldwide who use Google Chat.

But none of this is enough to give us hope. The best we can wish for is that in the future our various personal systems become so interconnected and clever that they're aware if we're available to take a call or not; and if we're not, they can invite people to call back later, leave a brief message to be automatically transcribed, or just leave us in peace.

2 Printers

We've lost count of the false dawns surrounding the paperless office, the most recent being when the iPad came along. "I'll carry all my documents with me on this

marvellous A4-sized device," executive after executive said as they justified their expensed purchase, "and in doing so I'll save the environment!"

While that certainly hasn't happened, we have seen a falling demand for personal printing – much of it due to the growth in smartphone use rather than tablets. Phones, in tandem with Facebook and Flickr, are now the go-tos for sharing photos, and the need to print out directions has evaporated thanks to the phone in our pockets and the GPS device mounted on the dashboard of our cars.

Work-related printing isn't showing any sign of disappearing, but that may yet come, as millennials gradually become the largest demographic group in the office: a MetaFacts study in 2012 found that 18- to 24-year-olds were far less likely to use physical print-outs than those over 54.

3 Email

The email standard we use today was created in 1982, but it builds on mainframe messaging systems dating back to the 1960s. And it shows: it's a barebones service, suitable for a small community using basic terminal hardware. It wasn't intended to grow into a global medium for professional and personal communications – and frankly, it's a poor fit for the job.

For starters, there's no confirmation when a message reaches its destination; no support for text formatting or embedded images; no privacy (unless encrypted by the sender, messages pass from server to server in plain text, which can be read by anybody in between); and no distinction between different types of message. There's also little user authentication, which means any spammer can create a fake identity, fire off a million messages and vanish into the ether.

Over the years, there have been attempts to address these shortcomings: read-receipt systems, such as HTML email, and endless anti-spam measures. The problem is, since these efforts are all grafted onto the standard, rather than being part of it, they can't be relied upon to work predictably across the numerous clients and services in use. Hands up who's ever received an email with messed-up formatting?

Email is now so deeply entrenched that it may be impossible to upgrade – but that doesn't stop people from trying. Most recently, Google launched its Inbox app, which natively supports rich content and tries to help the user manage their mail by drawing on the sender's broader online identity. It isn't clear whether the world at large is eager to centralise yet more of its communications on Google's servers, but frankly it's likely to be a better experience than carrying on with the decrepit email standard.

4 Desktop PCs

It's always the CRT monitors you notice first when watching a 1990s film. Hairstyles may have shifted, clothing fashions come and gone, but it's the flickering CRT monitor that really nails a film to its era with carbon-dating-like accuracy – more so, at least, than how old Tom Cruise looks in it.

Yet switch your attention to the PC attached to the monitor and it's surprising just how much has remained the same. Tower desktop PCs have been using the same, unchanged basic design for nigh-on 20 years, and even inside the case this remains true: the motherboard may be blue or black rather than green these days, but fundamentally we're still plugging

"Google offers its own transcription service if you happen to be one of the three people worldwide who use Google Chat"

cards into slots and attaching hard disks via cables.

Why hasn't the world moved on? The answer likely boils down to power and convenience. If you need maximum processing power, a tower case allows space for a meaty desktop chip, along with the hardware needed to deal with its heat generation and power consumption. It's a similar story with graphics cards, with multiple GPUs now the norm in enthusiasts' desktops.

And if you've ever needed to maintain a fleet of PCs, you'll immediately recognise the convenience of being able to remove the side from a device and add more memory, replace a hard disk (or add a second one), and upgrade core components such as the processor and graphics card. In contrast, a laptop needs replacement, with all the delays that can cause. The end result: we still think desktop PCs will be kicking around, fast and strong, for decades to come.

5 Cables

In the 1890s, Guglielmo Marconi perfected his first radio transmitter. Yet today our PCs still rely heavily on physical cabling, not only for power but also for communicating with peripherals and other devices.

There are many reasons to get shot of cables. They're messy, as anyone who's ever rummaged around the back of a computer desk will attest. They're liable to become damaged or lost, serving as an unnecessary point of disconnection between otherwise compatible hardware. And the business of producing them is wasteful: it's estimated there are two billion PCs in use worldwide, and a similar number of smartphones, so just think of the energy that's expended producing USB cables.

Things are improving: Bluetooth is increasingly the norm for keyboards, mice, loudspeakers and other low-bandwidth accessories, and wireless printers are typical. But compared to USB 3 and Thunderbolt, even "fast" wireless technologies such as Wi-Fi Direct are slow to transfer large files, and lack the bandwidth needed to drive a Full HD or 4K screen. Similarly, wireless charging systems such as Qi can deliver enough juice to charge a phone or smartwatch placed directly onto a pad, but we're some distance from powering a laptop from afar as you sit with it on the comfy sofa.

Initiatives are underway to overcome these hurdles, however, to get rid of cables once and for all. As we reported last month, chip giant Intel is working on a reference design for a fully wireless laptop, including technology that's capable of communicating with peripherals and displays at gigabit speeds. We're talking five years at the very least for wireless computing to become the standard, but after 120 years of being tied down by cables, that isn't such a long wait.

6 Keyboards

The Qwerty keyboard was invented in the 1870s, and while it's gained a few keys since – see "Alt Gr" and the mysterious "Scroll Lock" – its basic mode of operation hasn't changed one jot. That's shocking, because having to manually push a dedicated button for each character in your sentence is a horribly inefficient way to communicate. Project the keyboard onto a flat, cramped touchscreen, as on today's smartphones and tablets, and it makes even less sense.

Yet the keyboard continues to chug along,

Guess the year - yes, the CRT monitor is a dead giveaway...

principally because the obvious alternatives are far worse. Handwriting recognition can't deliver either the accuracy or speed we demand, and while voice recognition is getting better, nobody wants to live in a world where we're jabbering away at our smart devices all the time.

We've recently seen a few fresh approaches. On the mobile front, gestural typing systems such as Swype make typing more fluid, while in the physical realm one occasionally comes across innovative projects such as the FrogPad - a 20-key keyboard that sadly never reached commercial production. A shame, since its one-handed design would have meant an end to perpetually switching between keyboard and mouse.

What we're really waiting for, though, is a move beyond the model of mapping single letters onto keys. One promising idea is the Microsoft Research Type-Hover-Swipe project, which detects gestures in the air above the keyboard as well as key presses. Such an approach could see us using a form of sign language to "type" in units of words and phrases rather than individual characters - allowing us to get down hundreds of words per minute by simply twiddling our fingers.

7 Batteries

If you're using a gadget away from the mains, we can almost guarantee it's thanks to lithium-ion (Li-ion) technology. The idea of Li-ion batteries was first proposed by Exxon engineer M Stanley Whittingham in the 1970s - but it took decades of research by academics at the University of Oxford, Bell Labs and the University of Texas before the idea took off. That's because lithium isn't exactly safe to keep around: leave it sitting out on the counter and it will burn down your house. Modern batteries therefore use certain compounds of lithium - this is where the "ion" comes in - that make them less dangerous.

The first commercial Li-ion batteries were released by Sony in 1991, and within two decades they dominated the market. They remain popular because they simply work: they don't have a memory, so you don't need to run them down before recharging, and they discharge more slowly than nickel-cadmium variations.

However, lithium-ion batteries age poorly; capacity begins to deteriorate after only a year - whether or not the battery is in use - and the battery can become effectively useless after as little as three years. Improvements have been made over the years, as researchers tweak designs by using different metals and chemicals, with IHS iSuppli analyst Thomas McAlpine reporting a 7% annual improvement rate. But this isn't enough to make a significant impact on our gadgets' battery life - especially since larger screens add to power demands.

"Hairstyles may have shifted, clothing fashions come and gone, but it's the flickering CRT that nails a film to its era"

Happily, innovation is happening, both in lithium-ion technology and in other formats. A team of researchers at Stanford University is working on silicon nanotube Li-ion batteries; by using silicon in the anode - the negative electrode - researchers have managed to create cells offering ten times the power capacity, alongside longer usable life. Meanwhile, the California Lithium Battery company is looking to use silicon and graphene instead of lithium, saying it could offer triple the capacity of Li-ion models.

8 Phone umbers

The idea of needing to memorise a ten-digit sequence merely to communicate with someone seems almost like a step back from the earliest days of telephone, when an efficient corps of ladies would patch you through to your requested caller - and probably listen in on the juicier calls, a pleasure these days allegedly reserved for the NSA and GCHQ.

The days of phone numbers appear to be, well, numbered, with most people now opting to press on an avatar than dial the actual number. In fact, we're heading towards a time when pressing "Tom" on your phone (or whatever we call our personal communications device) will engage location-awareness technology to opt for the cheapest or most convenient method by which to connect to him.

Within a couple of decades, we wouldn't be at all surprised if phone numbers will be seen as a relic of early technological development, in much the same way we now look at CRT monitors.

The FrogPad was a step forward in keyboard tech, but it never reached

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THE UNCOMFORTABLE TRUTH ABOUT SEXISM IN TECH

OUR LOW-LEVEL ACCEPTANCE OF SEXISM, FROM SCHOOLS TO BLUE-CHIP COMPANIES, IS PUSHING WOMEN AWAY FROM POTENTIALLY GREAT CAREERS IN TECH. **STEWART MITCHELL** INVESTIGATES

Yahoo's Marissa Mayer, HP's Meg Whitman and lastminute.com co-founder Martha Lane Fox – they're the high-flyers whose rise to the top of the technology industry suggests that we've finally broken free of gender discrimination. But have we?

Behind those headline successes, many women in technology still find themselves isolated in an unwelcoming environment. Those who take steps to confront sexism can meet with resentment or disdain, and they may even find themselves sidelined professionally.

Certainly there are women who enjoy rewarding, well-paid work in the technology field. But some sectors remain a boys' club, which appears to resist female involvement. The Gamergate saga proved that: what started as a debate over game-review ethics splintered into a character assassination of female developers.

Game creator Brianna Wu, for example, came under fire after mocking Gamergate for "fighting an apocalyptic future where women are 8% of programmers and not 3%". She received a deluge of online threats, including one stating: "I'm going to rape your filthy ass until you bleed then choke you to death on your husband's tiny Asian penis." The message included details of Wu's home address, which forced her to move out of her home in fear.

It's a shameful situation in an industry that owes so much to pioneering women such as Ada Lovelace and Grace Hopper, and the many female software engineers who drove coding during the 1960s. Such attacks create an environment in which technically capable women are fearful to confront sexism where it still exists.

EVERYDAY SEXISM

Although efforts are underway to address some inequalities – including pay, to an extent – the IT industry remains male-dominated. It's an imbalance that's reflected in company diversity reports. Microsoft, for example, boasts 29% female workers across its staff, but in technical positions only 17% are women. Of Google's senior management and executive officer team, 17 are male while only three are women. Men make up 83% of Google's engineering staff; Apple's technical team is 80% male.

> **"Casual sexism in tech can go unchallenged, exemplified by ill-advised comments from certain chief executives"**

The high percentage of men in the sector doesn't necessarily make it sexist; if fewer women go through education to get on the first rung of the ladder, an imbalance is inevitable. But the masculine skew allows casual sexism to go unchecked, exemplified by ill-advised comments from certain chief executives.

In October 2014, Microsoft CEO Satya Nadella made a patronising statement (which he later retracted) that suggested women shouldn't ask for pay rises. "It's not about asking for the raise, but knowing and having faith that the system will actually give you the right raises as you go along," he said. "And that, I think, might be one of the additional superpowers that quite frankly women who don't ask for a raise have. Because that's good karma." Not that karma pays the rent – even for women with "additional superpowers".

The laddishness that thrives in testosterone-heavy climes leads to sexist attitudes going unchallenged among otherwise professional workers. Take the presentation by a principal developer at Atlassian, which compared Apache Maven software to his girlfriend. Jonathan Doklovic fleshed out the comparison by saying that the software "looks beautiful, complains a lot, demands attention, interrupts me when I'm working and doesn't play well with my other friends." It's fair to say the presenter's joke wasn't universally appreciated.

"Women continue to leave the industry because it's so toxic," said Randi Harper, a developer and engineer. "Trying to get more women to go to school for STEM [science, technology, engineering, maths] is the wrong approach; we need to attack the problem of fixing the environment to make it a place where they can stay.

"It's so subtle that you're often left

2014 WHITNEY WOLFE

Originally a co-founder of Tinder, Wolfe was allegedly stripped of the title because the association was considered "slutty". She launched a sexual harassment case against the company, citing sexist abuse and claiming she had been forced out after a relationship with a company founder turned sour. Tinder settled out of court.

2014 JULIE ANN HOWARTH

Coding network GitHub's first female engineer, Howarth left under a cloud after decrying a culture of sexism and bullying within the company. "What I endured as an employee of GitHub was unacceptable and went unnoticed by most," she tweeted of the ordeal. GitHub issued a partial apology.

2010 MARK HURD

Once credited with saving HP, Mark Hurd was forced to step down as CEO after a sexual harassment inquiry. It was found that he had abused his position to try to pressure a female employee to enter into a relationship with him – despite her insistence that she didn't want to date a married man.

wondering if it really happened, and when you try to talk about it, you sound like a crazy person because it's so small – but it's death by a thousand paper cuts. While there are definitely valid stories of women being belittled directly to their faces, even in front of co-workers, at least that's something that you know is wrong. In my experience, it's worse when it isn't quite so direct."

Of course, not all offices are the same, and there are workplaces where men and women are on a par both numerically and socially. Indeed, many of the women we spoke to said they had rarely come across gender-related problems at work.

"When you're in the workplace, you don't run into discrimination very much," said programmer Pam-Marie Guzzo. "It's more… in a broader cultural context that you see it. And that can influence young girls."

"Every now and again, you run into those who think you're not as intelligent as them, but I don't think that's a gender thing – I think it's people being arrogant," she added.

Much depends on the culture in the workplace, company maturity, and the ratio of men to women. Anecdotally, academic campuses with a more equal gender split and a liberal culture appear less likely to be fuelled by testosterone than "brogrammer" start-ups. Large companies with mentoring programmes and more structured human resources teams are also less likely to tolerate sexism at work, and to have procedures in place to deal with complaints.

^ Martha Lane Fox co-founded lastminute.com in 1998 and now chairs the board of the digital skills charity, Go ON UK. Her success in the tech industry remains a rarity, however

Even within larger companies, however, stories of management bullying are rife, and the attacks are often directed at women.

"It's a bullying culture," a former Microsoft senior director told a recent Center for Talent Innovation (CTI) study. "I think it's because those guys were bullied in school. They don't know any other way to act." She highlights a meeting where a product manager was "screaming at the top of his lungs" at a woman's feature-set ideas, yelling: "Why would you think I'd be interested in this garbage? How stupid are you?"

It was enough to make that particular woman leave the industry, although it should be noted that many men might have felt the same in similar circumstances. The long hours, high pressure and on-call nature of many tech companies is also cited as a reason for women leaving the industry.

"Of the small numbers of women who are going into the industry, more than half are leaving because of those issues," said Lynn Anderson of The Metis Movement, which promotes women in tech. "People don't want the strain – you get a guy that works through the night and it makes it look like other people don't have the passion. There's

< Female role models for young girls could encourage interest in technology, leading to a greater take-up of the subject at schools and universities

animosity if you're not committed to being there 24/7; sometimes women can't be."

The workplace environment is something that contributes to worrying CTI figures that show 52% of women leave technology as an industry because they're made to feel unwelcome and undervalued, and see their careers stagnating.

"A woman's ideas will be shot down without even being considered, and the men who are doing this don't even realise they're doing so because she's a woman," said Harper. "If you don't have rock-solid self-esteem, it's going to wear you down over time. Women start to think that their ideas aren't great, and this is going to keep them from going after promotions, from thinking that they should ask for the same amount of money as their male co-workers. Eventually, given enough time, women will just drop out entirely."

CAREER SPEED BUMPS

The industry makes the right noises about wanting to hire more women - in fact, big companies are actively competing for the best female candidates from a small pool - but behind the scenes, the major players' old worries persist.

Bosses still fear costs and disruption caused by maternity leave and childcare if they choose to hire younger women, leading some employers to come up with fairly controversial solutions that they say are designed to empower female staff.

Facebook and Apple both offer "female-friendly perks" that include covering the costs of egg freezing in a bid to delay

"If sexism in the workplace is subtle, the misogynistic trolling of women on Twitter is altogether more shameless"

workers having children, and Apple also covers the legal costs of adoption. The plan is to avoid disruption during their staffers' most productive years, but what impact it will have down the line remains unknown.

In smaller companies and start-ups such perks are unimaginable and will probably be unaffordable; instead they may simply bin applications from women they expect might be planning a family. This is the kind of discrimination that's easy to mask.

"I was senior management and therefore involved in the recruiting process, but HR would often ask, 'Wouldn't it be better to put a man in?'" said Sadie Sherran, an SEO expert involved in the hiring process at one company. "Or if people say they're getting married or engaged, then people were thinking 'They'll be having children after that - better to get a man'."

SEXUAL HARASSMENT

According to that 2013 CTI report, based on a global survey of almost 6,000 STEM workers, more overt sexism at work in the form of harassment is also all too common, with half of the respondents having experienced some sort of sexual harassment and a fifth "subjected to comments and catcalls when they wear a skirt or use lipstick".

Some men in senior positions, especially in out-of-office environments such as conferences or social functions, cross the line between being friendly and sexual predation.

"I worked as management, but when I came into contact with the directors I found them very sexually aggressive towards me and another colleague," said one of our interviewees. "There was one occasion at a conference, where one of the directors tried it on with me and another director tried it on with her. They plied us with drinks - it got to the point where a male colleague and myself had to get involved to protect her. They were pushing drugs onto her and touching her inappropriately. I had to drag her away."

IGNORING THE ISSUE

Given the serious nature of the harassment, you'd think HR would investigate, but you'd be wrong. Our interviewee believed the firm involved was more concerned with protecting its reputation and directors than resolving the claims. Being vocal about the incident achieved little, and instead she later found herself singled out and criticised for wearing provocative clothing at work in a bid to discredit her.

"I found that I was being victimised," she said. "The company would pull me into HR on a day when I was wearing a suit and they'd say, 'We've had complaints that you're dressing inappropriately for work'. I'd look at myself and say 'What's inappropriate

REPROGRAMMING PRECONCEPTIONS

According to women in the industry – and many bodies trying to address the gender gap – one of the root causes of gender imbalance is the low number of girls choosing to study computing and science subjects at school and university.

Stereotyping still sees girls pushed towards subjects relevant to the nurturing and creative industries, and away from science and maths. Female students make up a minority of computer-science intakes in universities.

Keeping more girls interested in computing at schools and colleges could lead to more balanced working environments – but achieving that will require overturning the idea that coding and technical tasks are intended for boys only.

"It's common in the media," said programmer Pam-Marie Guzzo. "When we were growing up and films had computer scientists or nerds in school, it was always guys. There were never any female characters portrayed. As you grow up, if that's all you see, then you assume it's normal. You get into this mindset that it's a boys' club, and that's what it's always going to be, and what it always has been – which isn't true at all."

A case in point is a Barbie book that recently hit the headlines. I Can Be A Computer Engineer was pulled by publisher Mattel after it was pointed out that, contrary to the title, the book portrays women as unable to work with computers. The pink-heavy book portrayed Barbie as a clueless game designer who relied on boys to help her with coding, and to fix the computers that had become infected with a virus. Is it any wonder that girls get the impression that technical roles are for men?

"There are fewer women in STEM jobs because they are at various points given the impression that these spaces aren't for girls," said Casey Fiesler at the Georgia Institute of Technology. "Unfortunately, that was the message of the Barbie book."

"To me, the most problematic line in the book was: "'I'm only creating the design ideas," Barbie says, laughing. "I'll need Steven's and Brian's help to turn it into a

real game".' It reads like the idea that Barbie could be the one coding is funny – because programming is for boys and art (design) is for girls."

In response, Fiesler has created her own "remix" of the book with a more positive message: see http://tinyurl.com/pu4tlev to read her updated version.

It often seems that men do the speeches at technology launches, while women are used purely for decoration

about this?' and they'd say 'No, it's not today, it was another day.' But they couldn't tell me exactly what I was wearing that was inappropriate.

"They were pointing a finger at me and saying, 'Yeah, you had a problem - it's on your record - now we're going to put things on your record that show you to be a slut.' It was like they were doctoring my file to put them in a better light if it ever came out."

DARING TO STAND UP

If sexism in the workplace can be subtle, the misogynist trolling of women in the tech industry on Twitter is altogether more shameless, as trolls are willing to put a bewildering level of effort and bile into their attacks.

The anti-feminist campaigns have a modus operandi. They use Twitter to threaten their victims, then dig up the individual's past and post it online, including highly personal information, any criminal record and private photos. They fabricate stories with doctored images and bombard the target's employer with complaints and criticism in a bid to get them fired. This isn't "name-calling", it's a concentrated campaign to ruin someone's reputation.

Randi Harper attracted the hate mob's wrath by helping to create a block list that stopped harassers' tweets from reaching their targets. What she believed was a service to protect women was instead seen as a censorship tool by opponents, who then went on to drag up all the dirt from her past in an attempt to discredit her.

Even in researching this article, a campaigner tried to warn us off speaking to Harper after we'd contacted her via Twitter. Using a disposable Twitter account, he slurred Harper by branding her a neo-Nazi and posted a link to a photo of her in front of a Nazi flag. That the doctored photo included her dead sister only made the tactics more contemptible. Sadly, similar threats appear to be having an effect on women who refrain from speaking out on industry issues for fear of the fallout.

"We can't talk about the problems without being called professional victims, martyrs – or being told that we're just too sensitive," said Harper. "We're told that it's our fault, or that we're just imagining things. Women are afraid to tell their stories, so men think that there isn't really a problem except with the few of us who are able to stand up and be vocal. We need to make the industry a safer place for women to speak up. The public backlash can be soul-crushing."

A WAKE UP CALL

Despite the career opportunities and the addressing of the pay gap that make the industry look a picture of equality, it remains a patchy work in progress. If women can't confront the sexism that still exists in technology without fear of reprisal then the industry can't call itself female-friendly. ●

GENDER GAP BY NUMBERS

83% of Google's engineering staff are male

17% of Microsoft's tech team are female

25% of Amazon management staff are women

IN THE LABS

Where product testing is very serious business

TESTING TIMES

BEN MANSILL BRINGS GOOD NEWS FROM THE *PC&TA* LABS

It's now time to overhaul the *PC & Tech Authority* benchmarks. We've got over 20 years of benchmarking experience under our belt, so know exactly which pieces of software are best for putting each component of a PC under stress. We've relied on a mixture of real world software tests and synthetic benchmarks created by companies that solely exist to build relevant and reliable benchmarking software, for our testing.

Over on the facing page we have detailed what we are using, and many of those can be downloaded free online, or for a reasonable sum grab the full pro versions. That way you can run your own tests on the systems or devices you use yourself, if you are so inclined, so you can see how your gear compares to the latest products reviewed in the magazine.

On occasion we will use different benchmarking software if our Labs team feels that certain products are better tested with different processes and software. Rest assured we will always spell out what we use, why, and how in these instances. Put simply we just don't have space on the facing page to list everything that we use!

TRICKY GEAR

There were a couple of pleasant surprises as we compiled this month's Labs section. Everyone was impressed by Alienware's Graphics Amplifier. Having an external unit housing a discreet graphics card opens the door for a smoother and more economical upgrade cycle during your time of ownership – especially as you can install a 'hand me down' card that may have come from your desktop as you upgrade that. The form factor also allows you to keep the laptop itself in service for much longer, and the Alienware 13 is such a lovely looking thing that motivation is high to do just that.

It's such an obvious innovation, and we certainly hope it sees widespread use through more of Alienware's products. Several years ago Sony did something similar with one of its high-end Vaio laptops, but it was a fixed GPU in the external housing. Not nearly the same thing as Alienware's tremendous flexibility.

We were also blown away by the record-shattering battery life of Sony's Xperia Z3 tablet. Nearly 18 hours of media playback? Just amazing. And all in a tablet that's delightfully slim. It really is nice to see Sony rack up some wins. It's a company we've all had great affection for over the years and it's well overdue for a winning streak, again.

SSDs continue to evolve, as you'll see in our face-off starting on page 49. Yet again, Samsung is leading the way with new storage technology. I think we can all agree that performance – even for budget SSDs (and we have included a few of those, too) – is rather incredible, and the next step is improving reliability. SSDs haven't been around long enough to properly gauge fail rates, but anything that can improve the lifespan of these components is most welcome!

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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

The science behind the numbers

While all manner of products come through our labs, as much as possible we run standardised tests for specific product categories. This allows you to compare products we may have reviewed in an earlier issue with something newer. However, at times we'll deviate if we feel a certain test is more appropriate to a certain type of product or group test.

GRAPHICS CARDS

To put today's GPUs under the most pressure, we use two real-world games with excellent built-in benchmark routines, in the form of Grid Autosport and Thief. These were selected as they don't favour Nvidia or AMD, instead taxing both equally, and their scores are in frames per second, where higher is better. Finally we run the synthetic 3DMark benchmark to get a holistic view of each GPU's performance. 3DMark's Fire Strike Ultra benchmark is used to push high-end GPUs to the limit, while the Sky Diver benchmark is used to test gaming laptops and mid to low-end GPUs. Both of these tests give an overall score, and once again higher is better.

LAPTOPS, CPUS AND MOTHERBOARDS

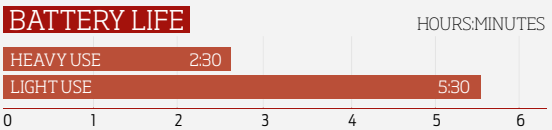
Futuremark's brilliant PCMark 8 Home benchmark is designed to see what today's Windows 8.1 PCs can do. We run the Home sub-benchmark as this most accurately replicates the average home user's workload, testing across five different synthetic benchmarks: Web Browsing, Writing, Casual Gaming, Photo Editing and Video Chat. Readers can download this benchmark for free to see how their system compares.

MEMORY

In the rare instance we're reviewing a new type of memory, or an exceptionally different memory kit, we use the SiSoft Sandra memory benchmark, which has been used by memory makers for over two decades.

STORAGE

We use Anvil's Storage Utilities to storage, as this synthetic benchmark was built specifically to test the performance of today's hard drives under a wide range of conditions. When necessary, we'll also use the PCMark 8 Home benchmark to provide extra information.



LAPTOP BATTERY LIFE

We subject laptops to two battery tests. In the light-use test, we optimise the system settings for the greatest power efficiency. We then disconnect the mains and run a script scrolling a selection of web pages until the system shuts down, giving you a realistic idea of the surfing time each laptop offers.

For the heavy-use test, we engage Windows' High Performance power profile, set the display brightness to maximum, and allow the taxing Cinebench 3D renderer to push the processor load to the limit. This gives a worst-case figure, revealing how long you can expect the battery to last under the most demanding conditions.

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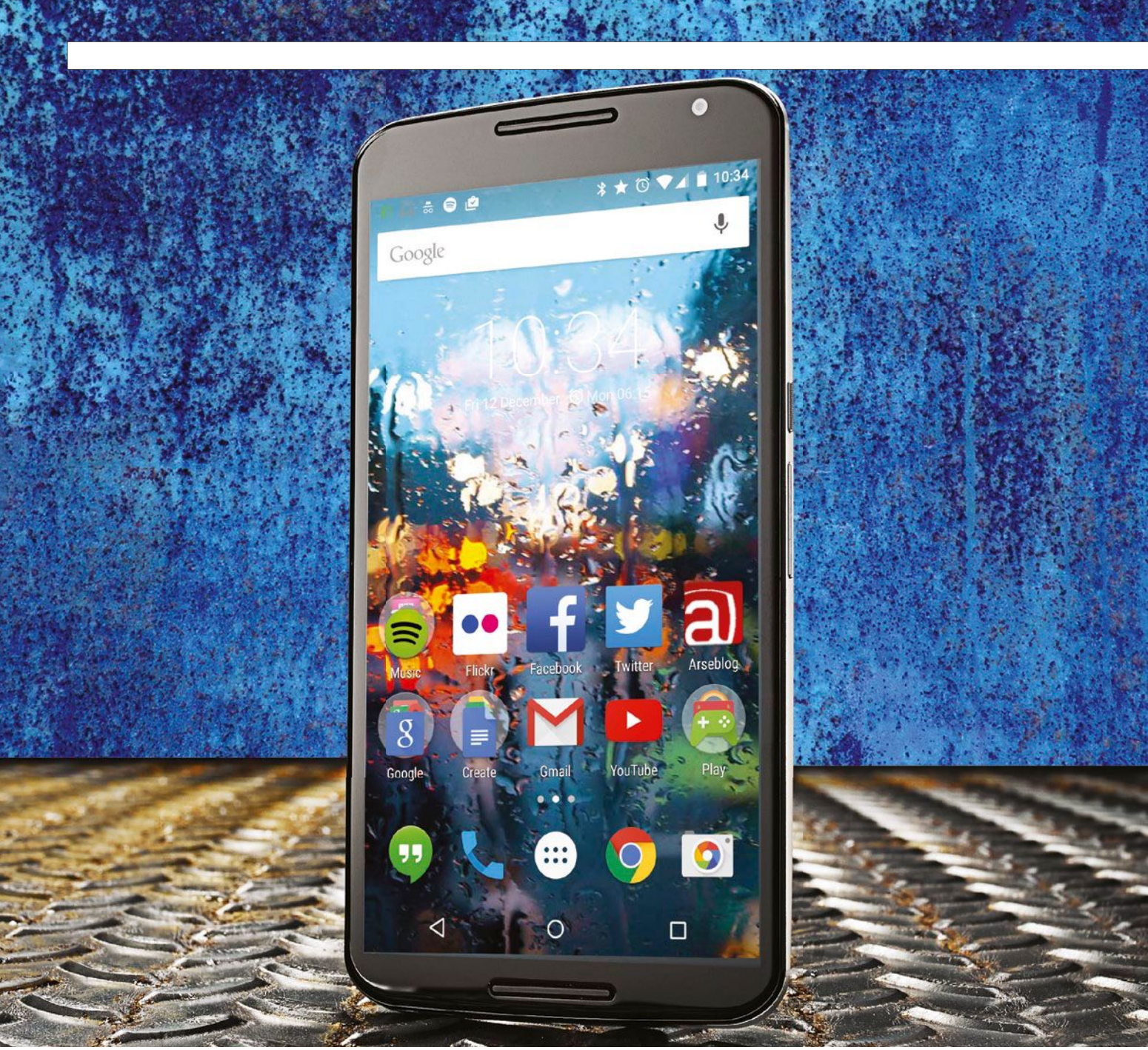


Nexus 6

A BEAST OF A SMARTPHONE - AND AN EXCEPTIONAL ALL-ROUNDER - AT A VERY REASONABLE PRICE

Google seems to be entering a new phase with its latest round of Nexus devices – the Nexus 9 tablet last month and now the Nexus 6 smartphone. In the company of HTC and Motorola, Google is pushing its mobile devices upmarket – a brave move in light of the incredible success of last year's low-cost Nexus products.

PRICE, DESIGN AND KEY FEATURES

Google's flagship smartphone certainly isn't the bargain last year's Nexus 5 was. SIM-free, the Nexus 6 will set you back $860-900 (street price) for the 32GB version, and around $50 more for the 64GB model, while the 16GB Nexus 6 isn't available locally.

Is it worth it? Physically, the Motorola-made Nexus 6 makes a good start in justifying the extra outlay – it's a much more luxurious handset than the Nexus 5 was, and the build quality is far better than that of the disappointingly cheap-feeling Nexus 9.

The first thing you notice about the Nexus 6 isn't the design, however, but the sheer size of the thing. The screen measures an enormous 5.96in across the diagonal: it's almost 0.5in larger than the Apple iPhone 6 Plus, 0.26in bigger than the Samsung Galaxy Note 4 and gains almost an inch on its cousin, the Moto X (2nd Gen.).

It's a real handful of a phone, measuring 83mm across, a huge 159mm tall and 10.1mm thick. It's larger than all those devices we just mentioned, and it weighs a not-inconsiderable 184g – making it the heaviest phone we've laid our hands on in quite a while.

The Nexus 6 is most definitely a phone for those who favour cargo pants over skinny jeans, and who don't mind texting with both hands. Unlike some recent larger-screened smartphones, if offers no software function to shrink down apps or move them within reach of a single thumb.

For us, the Nexus 6 is a step too far, but the size of one's smartphone is a very personal thing. Others may find that it's the ideal size for them – the perfect compromise between compact tablet and smartphone.

Leaving aside its size, there's plenty to love about the Nexus 6's design. There are no fancy customisation options – it's only available in "midnight blue" or white – but elsewhere the design language is all Moto X (2nd Gen.), which is very much a good thing.

It's surrounded with a softly curved silver-aluminium frame, which feels great in the hand. The smooth, matte-plastic rear isn't soft to the touch like the Moto X's, but it doesn't give an inch and feels pleasant under the finger. The Nexus logo is emblazoned in silver lettering across the back, lending the phone a touch of class. The screen, which is topped with Corning's Gorilla Glass 3, is slightly curved at the edges, so thumbs and fingers slide on and off without catching.

Above and below the screen sit a pair of stereo speakers that must be among the loudest we've come across on a phone – they really pound out the volume. It's a great phone for listening to podcasts and radio in the kitchen, although music still sounds rather tinny.

Google continues to disappoint when it comes to storage. Just like the Nexus 9, and the Nexus 5 before it, the Nexus 6 has no microSD slot. There's also no way to easily remove and replace the battery.

However, we're big fans of Android 5 (Lollipop), which shows its face on a smartphone for the first time here. It's a revamp that represents the biggest leap forward for Google's mobile OS we've seen, and its colourful flat icons, revamped core apps, notifications and lockscreen all hang together just as well as they did with the Nexus 9. The whole shebang feels superbly responsive, too.

"Even by eye, colours on the screen look slightly off, and in many cases a little overenthusiastic, even lurid"

DISPLAY

The screen is what the Nexus 6 is all about. Why else would anyone put up with such a giant smartphone if not for all that extra space?

It's important to nail such a critical element, and the Nexus 6 gets off on the right foot. Motorola has employed an AMOLED panel behind the Gorilla Glass frontage, so the black level is deep and contrast is superb.

Using AMOLED technology should allow the phone to keep power demands to a minimum when using Lollipop's "ambient display" mode – where notifications appear when the phone is in standby. This is a clever feature, but you may want to think about switching it off. Google quotes up to 250 hours of battery life with it on, a figure that leaps to 330 hours with it off – a significant 32% longer.

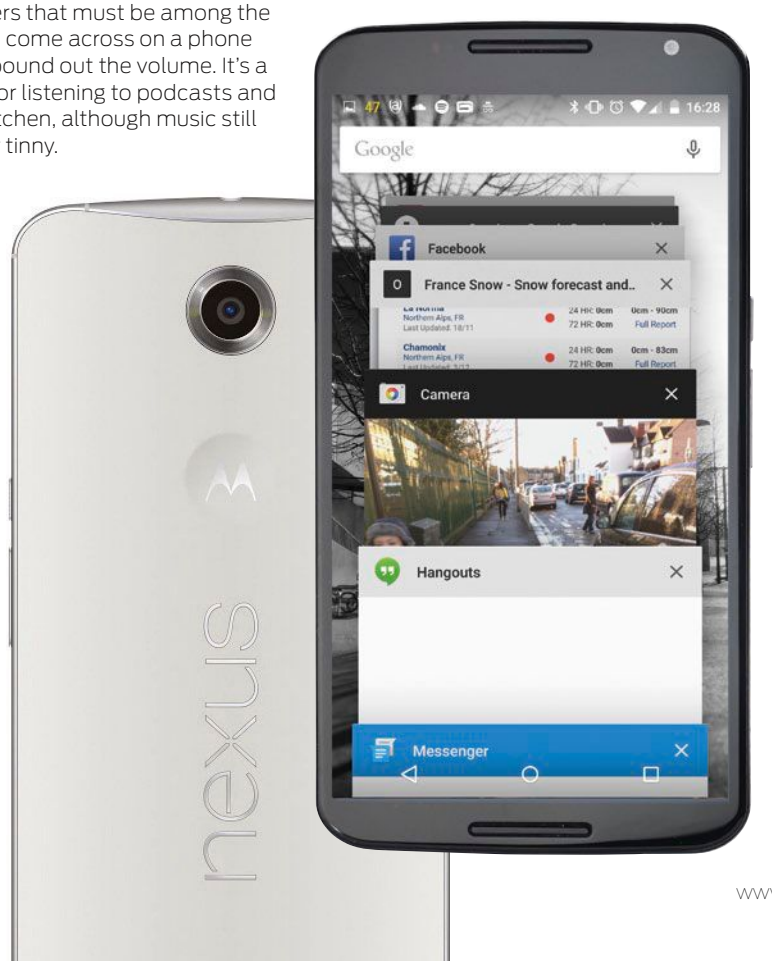
As has become the norm for larger flagship smartphones (the Galaxy Note 4 and LG G3 come to mind), the resolution of this enormous screen is Quad HD – that's 1,440 pixels across and 2,560 down.

This gives a faintly ridiculous pixel density of 493ppi, and although we remain unconvinced that even a 6in display needs that many pixels, there's no denying the screen is sharp, with crisp text and sharp images all round.

In terms of colour and brightness performance, though, we're less impressed. The main problem is that the Nexus 6 employs content-based dynamic contrast that can't be disabled. Even with "adaptive brightness" switched off in the settings (this adjusts brightness depending on the ambient lighting conditions), the Nexus 6 constantly adjusts the brightness according to what's displayed onscreen.

As such, white text on a dark background will look gleamingly brilliant, while the white background of a web page will look slightly dim. In fact, brightness can swing by as much as 70cd/m2, an adjustment that's particularly noticeable when you open the settings menu (which has a white background) from a homescreen with a dark background.

This makes any definitive judgement of colour accuracy impossible, since it's effectively in constant flux. Even by eye, colours on the screen look slightly off, and in many cases a little overenthusiastic, even lurid. One thing is clear: this screen isn't a patch on those on the Galaxy Note 4 or the iPhone 6 Plus.



> Good battery life, great design and Android 5 but far too big for one-handed use – unless you're a giant

CORE HARDWARE AND PERFORMANCE

Nexus products are normally cutting-edge when it comes to core performance, and the Nexus 6 is no different. Inside is the fastest SoC that Qualcomm produces – a quad-core Snapdragon 805, running at 2.7GHz with 3GB of RAM and an Adreno 420 GPU – the same get-up as found in the Galaxy Note 4.

As expected, the Nexus 6 swatted aside all the benchmarks we threw at it, matching the Galaxy Note 4 blow for blow in all the big tests. It's also reasonably

USING THE NEXUS 6 ONE-HANDED

The Nexus 6 is big – too big to make one-handed use practical, in our opinion. Much of the time, this isn't an issue, but on occasion you'll need to answer calls, reply to texts, search the web or find something nearby with Google Maps when one of your hands is occupied – holding a shopping bag, for instance – and the size makes this almost impossible.

However, the handset has an ace up its sleeve: Google Now. Since this is a Nexus device, Google's voice-control and dictation system can be activated using the key phrase "OK, Google", which means all you have to do to activate it is unlock the phone – just about achievable one-handed on the Nexus 6.

At this point, as long as you have a data connection, you can do all the above without having to touch the screen at all. And the efficacy of Google Now's voice-recognition system and the quality of the Nexus 6's microphones mean it works with a remarkable degree of accuracy, even in the noisiest environments.

In fact, it's so good – and the Nexus 6 so big – that we've increasingly found ourselves turning to Google Now even when we're not forced to do so. As long as you don't mind talking to your phone, it's surprising how much you can do one-handed.

competitive with the iPhone 6 Plus, until you get to the GFXBench tests – that's because, with a 1080p screen, the iPhone has far fewer pixels to shunt around. Still, 27fps is perfectly respectable, and in everyday use and gaming the Nexus 6 put in a decent showing: it's slick and responsive in most situations, whether browsing heavy web pages or Google Maps, and multitasking doesn't faze it.

The phone does, however, become rather hot when used intensively. The top portion of the screen hit 41˚C at times and the rear 39˚C, which starts to get uncomfortable after a while.

BATTERY LIFE

Battery life is a mixed picture. For light- and moderate-use scenarios, it's excellent. In our 720p video-playback test, where we put the phone into flight mode and set the screen as close to 120cd/m2 as possible, the capacity of the Nexus 6's 3,220mAh battery fell at a rate of 6.8% per hour.

It's in good company here, almost matching the Galaxy Note 4's result of 6.2%, although it falls some way behind the iPhone 6 Plus' impressive score of 4.9%.

The audio-streaming test, which gives an indication of a phone's standby performance, resulted in a depletion rate of 2.3% per hour, slightly better than the Galaxy Note 4 and on a par with the 6 Plus.

In other good news, the Nexus 6 has wireless charging built in, and comes with a "Turbo" AC charger, which we found was capable of ramping up the charge very quickly indeed: 17% in 15 minutes is enough of an emergency boost to be genuinely useful.

Push the CPU, however, and stamina takes a dramatic turn for the worse. In the GFXBench battery test, with the frame rate capped at 22.4fps (lower than the maximum of which the phone is capable), a result of 2hrs 24mins is pretty poor, and well short of the iPhone 6 Plus' time of 3hrs 26mins, which is rendering more than twice the number of frames.

All in all, though, it's a thumbs-up for the Nexus 6's battery life – just don't expect it to last long when you're gaming hard.

> The Google device is a monster, measuring 83mm wide, 159mm tall and 10.1mm thick

CAMERA

On paper, the cameras look decent. The rear snapper has a top resolution of 13 megapixels, an f/2 lens, 4K video recording, optical image stabilisation (OIS) and a dual-LED ring flash; the front-facing camera can capture 2-megapixel stills and 1080p video. It can't match the Galaxy Note 4's 16-megapixel camera, but it beats the 8 megapixels of the iPhone 6 Plus.

In testing, it performed much better than expected – given how disappointing the camera on the Moto X (2nd Gen.) was – capturing largely clean images and video in good light, and well-exposed and well-focused photographs and video in low light, without our needing to use the dual-LED flash.

If there's a weakness, it's the speed of the autofocus system. This isn't anywhere near as fast as that of the Galaxy Note 4 or the iPhone 6 Plus, both of which employ phase-detect autofocus like a DSLR or compact system camera. The Nexus 6 doesn't have that, instead relying on contrast detection, and this takes quite a while to lock focus. In video, it's more of a problem: the focus jumps backwards and forwards distractingly as you pan the camera around.

In general, though, we're pleased with the results from the Nexus 6's camera, and it's nice to see that Google has refrained from messing about too much with the camera software. It's simple, effective and not overladen with features, putting most of what you need a tap and a swipe or two away. The only major thing it lacks is full control over ISO and shutter speed, but as compensation it's possible to tweak the exposure up and down.

CONNECTIVITY, STORAGE, PRICE AND CALL QUALITY

As you'd expect of a high-end handset, connectivity is cutting-edge. The Nexus 6 has Cat 6 4G support, for download speeds of up to 300Mbits/sec and uploads of 50Mbits/sec.

There's 2x2 MIMO 802.11ac Wi-Fi, which we saw hit speeds between 8MB/sec and 9MB/sec when reading a large movie file at close range from a network share. NFC is covered, too, as is Bluetooth 4.1, and you also get SlimPort for HDMI output from the phone's USB port.

As far as storage is concerned, there are only two configurations of the Nexus 6 to choose from: a 32GB model and a 64GB model. Call quality is perfectly respectable. The Nexus 6 goes loud enough that you can hear your caller in even the noisiest environments – just be careful not to put the phone to your ear in speakerphone mode or you'll come away with your ears ringing.

VERDICT

The Nexus 6 has taken us by surprise in the short time we've had it. Once you get past its gargantuan size,there's an awful lot it does right. Battery life is good, the camera is excellent, and the build and design quality are second to none. And although its rivals hold an edge over it in many areas, the differences aren't huge.

For us, Samsung's Galaxy Note 4 remains top dog in the phablet stakes, thanks to its slightly more manageable size and its stylus input, but if you're in the market for a big phone you'd be doing yourself a disfavour by not putting the Nexus 6 on your shortlist.

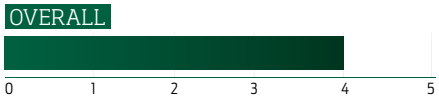
Jonathan Bray

KEY SPECS

$860 (32GB) $920 (64GB) · www.google.com.au

Quad-core 2.7GHz Qualcomm Snapdragon 805 SoC · 3GB RAM · 32/64GB storage · 5.96in 1,440 x 2,560 AMOLED display · 802.11ac Wi-Fi · 4G (Cat 6 up to 300Mbits/sec download) l 3,220mAh battery · Android 5 (Lollipop) · 1yr RTB warranty · 83 x 10.1 x 159mm (WDH) · 184g

OVERALL



Alienware 13 Laptop and Graphics Amplifier

GORGEOUS MOBILE COMPUTING TAKES ON THE DESKTOP GAMING BEHEMOTHS

Deciding on whether to spend your money on a high-end gaming laptop or a good desktop has always been something that requires serious pondering. Having the funds for both is out of the reach of many people, so effort needs to be made weighing up all the different considerations.

Alienware has set out to make that decision much easier with the Alienware 13 Laptop and Graphics Extender.

Take a beautiful 13 inch core i5 gaming laptop, add a peripheral that is smaller than a mini-ATX case, install a nice high-end graphics card of your choice and you have a device that gives a gaming desktop a run for its money.

The Alienware 13 Laptop has all the features you would expect from a gaming rig. Capable on-board graphics in the form of Intel GTX 860M with 2GB GDDR5 provides a pretty good mobile visual experience. An Intel core i5 4210U 2.7GHz with 3MB cache at the base level, which can be upgraded to an i7-5500U for an extra $300, gives enough CPU grunt to handle almost any game. RAM is 8GB 1600MHz Dual Channel DDR3L and the base price point allows for a 500GB Hybrid SATA disk drive, however there are plenty of SSD options, up to a 512GB M.2 for only $300 more.

Since one of the reasons for opting for a laptop is easy portability, Alienware have realised that weight is a serious concern and the 13 slips in at only a tiny bit over 2kgs (4.537lbs) making it an easy task to sling into a bag and over your shoulder. They have also managed to keep the dimensions small (27.9mm x 235mm x 328mm), while giving an excellent amount of space to both the touch-panel and the keyboard which has a lovely soft touch and just the tiniest amount of "clickiness".

As always with Alienware devices, you can customize all the pretty lights to an array of colors and morphic/flickering styles. You can even make different sections of the keyboard a different colour, for easy differentiation in a gloomy LAN hall. The display is 1366x768 native at the base with a beautiful clarity and colour range. A 13-inch display might seem to be too small to really become immersed; however on testing we found that gaming on the smaller screen is far more enjoyable than we had guessed it would be. It's possible to add up to two additional monitors to the on-board graphics when the laptop is desktop bound.

THE GRAPHICS AMPLIFIER

But it is this change from a laptop to a desktop that the power of the Alienware Graphics Amplifier comes into play.

The box itself is 173.5mm x 409.55mm x 185.5mm which is enough room for a single full-length, dual-wide, PCI-Express x16 graphics card; a 460 Watt Power Supply and generous airflow to cool the card under load. The PSU and airflow are included in the box; the graphics card is not.

The Amplifier will support both Nvidia GeForce (GTX 600 series and newer) and AMD (Radeon HD 5000 series and newer) with up to 375W of power draw. It plugs into the laptop using a proprietary connection (some sort of PCIe/USB combo) which seems to allow transfer speeds equivalent to about four to six lanes of PCIe. Installation of the card is a complete no-brainer. Pop open the top, drop the card into the slot, plug in the power cables and close.

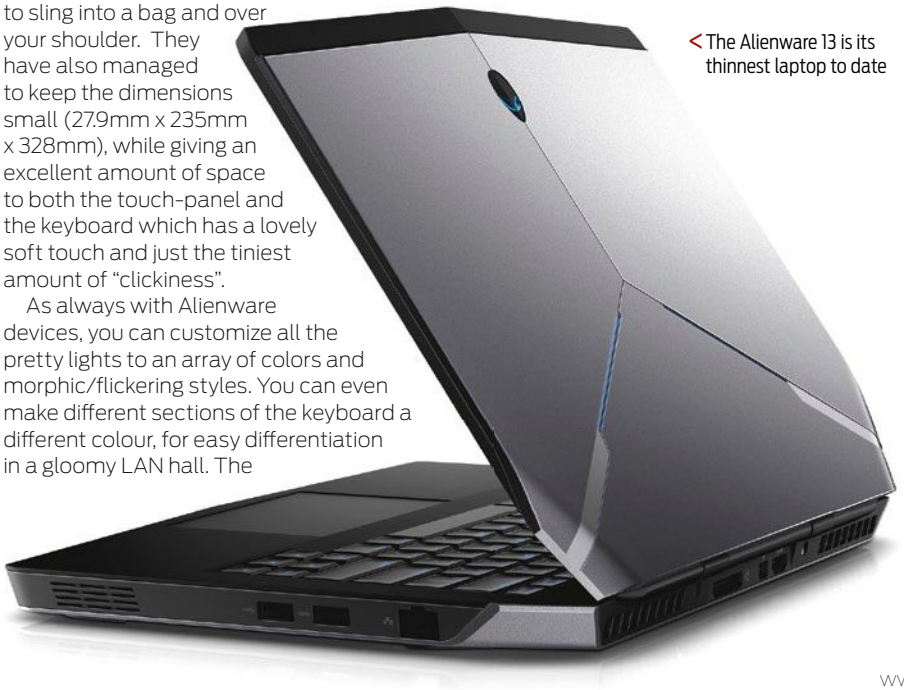
The laptop will need to be rebooted if it is already running, as the amplifier shuts off the internal GTX860M GPU (leaving the integrated graphics on the CPU running) and then the magic begins. The Amplifier has four USB slots in addition to whatever ports the graphics card has for monitor connections, so adding your keyboard and mouse here means that the Amplifier becomes a docking station as well.

A 3DMark run both with and without the Amplifier plugged in shows some impressive results on the test machine (base model with an Nvidia GeForce GTX 780 installed in the Amplifier). Before booting with the cable in, the result was a quite respectable FireStrike score of 3244. Once the cable was in and the laptop fired up with the Amplifier sparking however, this jumped to a whopping 5676 with similar scale improvements across all tests.

Given the quality of the Alienware 13 laptop (15 and 17-inch models have also just been announced), being the only device that can use the Graphics Amplifier is a minor niggle and it can be expected that other Alienware laptops will support the connection. At less than $2000 for the whole kit (laptop, high-end graphics card and graphics amplifier), a rig that can be both a gaming laptop and an upgradable gaming desktop is a great price and well worth the investment.

Nichole Tillotson

< The Alienware 13 is its thinnest laptop to date



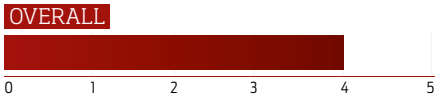
KEY SPECS

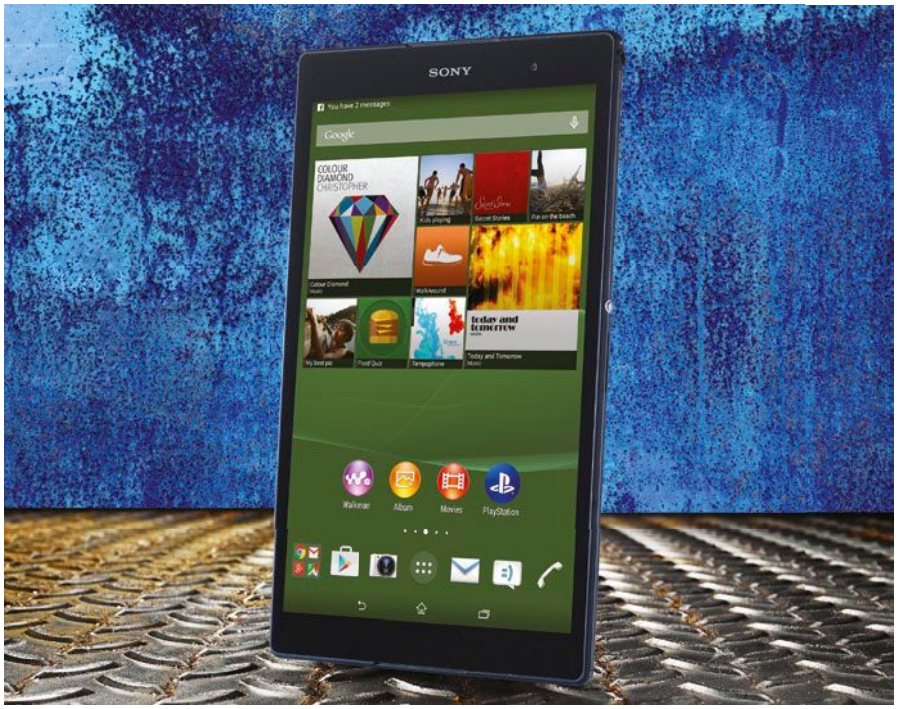
$1000 (Alienware 13 laptop), $300 (Graphics Amplifier) · www.dell.com

Alienware 13 Laptop - Intel® Core™ i5-4210U Processor · 13 inch HD (1366 x 768) TN-Panel Display · NVIDIA GeForce GTX 860M with 2GB GDDR5 · 8GB Dual Channel DDR3L 1600MHz · 500GB Hybrid (8GB Cache) SATA 6Gb/s · Killer 1525 802.11ac 2x2 WiFi and Bluetooth 4.0

Alienware Graphics Amplifier - 460 Watt Power Supply · (4x) USB 3.0 · (1x) PCI-Express x16 Slot

OVERALL





Sony Xperia Z3 Tablet Compact

SLENDER, STURDY AND PERFECTLY FORMED, BUT THE SONY'S RECORD-BREAKING STAMINA COMES AT A PRICE

At first glance, it's difficult to see how the Z3 justifies its price, especially in terms of the bald specifications.

On the display front, it comes with an 8in IPS display with a resolution of 1,200 x 1,920. Inside, it's powered by a Qualcomm Snapdragon 801 SoC, with 3GB of RAM and an Adreno 330 GPU. None of this is groundbreaking stuff, and for $499 (RRP) we'd also expect a little more than 16GB storage (although there's a microSD slot for expansion).

However, a closer look reveals a handful of things that elevate this tablet above the humdrum. It has the same water and dust resistance as the firm's smartphones – its IP68 rating means it's impervious to the ingress of dust and capable of being submerged in up to 1.5 metres of water.

The cameras are also a cut above the tablet norm – at least when it comes to the numbers. You get an 8.1-megapixel camera on the rear and a 2.2-megapixel shooter up front, although there's no LED flash to help out in low light.

In terms of connectivity, there's a full roster of top-end technology, too, with 802.11ac Wi-Fi, Bluetooth 4.1 and NFC for quick pairing with wireless peripherals.

The design furnishes more points in the Z3's favour. For starters, it's the lightest, slimmest tablet of its size, outdoing both the iPad mini 3 and the Galaxy Tab S 8.4 in this regard. It's 124mm wide, 213mm tall and only a fraction thicker than the iPad Air 2, at just 6.4mm. It's the merest slip of a thing, weighing little more than an ebook reader, at 266g.

Despite this, there's barely any flex or give to be found – which is no mean feat for such a dainty tablet. It's an engineering achievement of which Sony should be proud.

SCREEN AND PERFORMANCE

It's just as well there's plenty else to like about Sony's compact tablet. The Full HD display, stretched across 8in, delivers a pixel density of 283ppi, which is as sharp as you need.

It's searingly bright, reaching 477cd/m2 with the brightness turned up, and contrast is a respectable 1,078:1. We recorded an average Delta E of 6.37, which would normally indicate colours that are way off. However, although hues look a little more intense than we'd expect from a colour-accurate display. sRGB coverage is excellent (98%), and colours across the rest of the spectrum don't look particularly unnatural to the eye.

The Z3 has a quad-core, 2.5GHz Qualcomm Snapdragon 801 processor and 3GB of RAM, and this delivers a solid set of benchmark figures. In the single- and multi-core Geekbench tests, its scores of 977 and 2,654 compare well with the Galaxy Tab S 8.4's 936 and 2,768, and its GFXBench T-Rex HD (onscreen) frame rate is twice as good, at 28fps. It feels extremely responsive, too, whether you're browsing hefty web pages or panning and zooming around in Google Maps. But the really impressive side to the Z3's performance is battery life. In our 720p looping video-playback test, where we set the screen to a brightness of 120cd/m2, the 4,500mAh battery lasted for an astonishing 17hrs 45mins, smashing the *PC&TA* record for tablet battery life – previously held by the Amazon Kindle Fire HDX 8.9in (2014) – by 50 minutes, and outrunning the Galaxy Tab S 8.4 by a full 5hrs 23mins.

CAMERAS

Alas, the Z3's 8-megapixel rear camera struggles to produce consistently good results. The main problem here is lens flare, which means that most of our shots in less-than-favourable conditions came out lacking in contrast and looking washed out. We weren't too keen on Sony's processing of pictures, either, with heavy-handed compression artefacts smearing the finer details.

VERDICT

Although it has its weaknesses, the Sony Xperia Z3 Tablet Compact is a fabulous piece of hardware. The battery life is incredible, the display is super-bright and performance is excellent. Couple these attributes with a slim, lightweight, water-resistant chassis and you have a high-calibre compact tablet – one that holds an edge over all its rivals.

Jonathan Bray

BATTERY LIFE

Looping video 17hrs 45min

KEY SPECS

$499 · www.sony.com.au

Quad-core 2.5GHz Qualcomm Snapdragon 801 SoC · 3GB RAM · 16GB storage · microSD slot · 8in 1,200 x 1,920 IPS display · 2.2MP/8MP front/rear cameras · 802.11ac Wi-Fi · optional 4G (with phone-call capability) · 4,500mAh Li-ion battery · Android 4.4.2 (KitKat) · 1yr RTB warranty · 124 x 6.4 x 213mm (WDH) · 266g

OVERALL

Asus ProArt 328Q

A STUNNING PANEL WITH PREMIUM SPECS AND FEATURES

Asus has loaded its new ProArt 328Q screen with an impressive set of features and specifications. It's a screen that goes beyond merely conforming to 4k resolution, hefting in forward-looking connectivity options as well as well considered design.

The ProArt 328Q was debuted at Computex last year as a preview, and now it's available in Australia. 32 inches of screen real estate, an unusually trim bezel certainly plonks it into the premium category, which is held up, too, with premium extras. There's a 4-port USB 3.0 hub, very nice, plus support for mobile device connectivity through MHL 3.0 and there's also a picture in picture function.

Connectivity is also forward-looking, a little too much so for our liking. You get DisplayPort 1.2 and HDMI 1.4 as well as HDMI 2.0. The latter allows a screen refresh of 60Hz via a single cable, while HDMI 1.2 will only provide a 30Hz refresh. In testing, we were unable to achieve 60Hz via DisplayPort, using the included cable. At only 30Hz the screen (like any) is almost unusable thanks to the mouse lag that comes with the slower refresh. It turns out that the video card we were using was only DisplayPort 1.1-compatible, after checking with Asus. DVI is not an option at all, which is a disappointment. If you're considering this (or any 4k screen) you will want to be sure your video card has the right connectivity.

The panel offers full sRGB coverage, and is factory calibrated, hence the ProArt classification. The 10-bit panel uses a 14-bit lookup table so overall colour reproduction is excellent, which was confirmed in our testing. It's not intended as a screen for gamers, although that mostly falls to your graphics card being up to the 3840 x 2160 task (assuming your connectivity allows the full 60Hz refresh rate, which might be difficult with DVI still the main option for gaming cards). Nvidia Gsync is not supported.

The pedestal is particularly good, accommodating good height adjustment, as well as portrait orientation.

Using it was a delight, with its crispness doing wonders for fonts and images, and we would rank this as one of the best 4k screens available today.

Ben Mansill

KEY SPECS

$1839 · www.asus.com.au

32" (16:9 aspect ratio), IPS with 178/178-degree viewing angles · 3840 x 2160 pixels · 100% sRGB, 14-bit colour lookup table hooked to a 10-bit panel · 1 x DisplayPort 1.2 (4K at 60Hz), Mini DisplayPort 1.2 (4K at 60Hz), 1 x HDMI 2.0 (4K at 60Hz) / MHL 3.0 (4K at 30Hz), 1 x HDMI 1.4 (4K at 30Hz) and 4 x USB 3.0 ports

OVERALL

LG 31MU97 Digital Cinema 4K Monitor

A GLORIOUS SCREEN THAT'S PRICED TO REFLECT ITS PREMIUM PERFORMANCE

4K is an odd beast. There's no disputing that the resolution and clarity of images is absolutely beautiful and that once you get used to the sharpness it's hard to look at a 1080p monitor again but when it comes to everyday practicalities it's sometimes difficult to justify the high price tag.

From a basic work standpoint, the LG 31MU97 makes for an imposing window into spreadsheets and word documents as there is more than enough screen real-estate to have multiple full windows open at once. That is, it makes an imposing window after you spend a while fiddling with the size of fonts and icons to make them visible to the naked eye, as the 4K resolution automatically shrinks everything down to Lilliputian size. The IPS panel is bright and clear with excellent viewing angles and a matte screen to eliminate glare.

Thanks to the odd aspect ratio and the fact that the refresh rate is limited to 60Hz when connected via DisplayPort or MiniDP and 24Hz when connected via HDMI, it's not the greatest when it comes to games. Without DisplayPort you can expect quite a bit of mouse lag thanks to the lacklustre refresh rates. The 17:9 aspect ratio also means that a number of games appear letterboxed.

When used for graphics work, video, design or anything else that requires excellent colour reproduction the monitor truly shines, however, thanks to the fact that it can display over 99.5% of Adobe RGB colours.

The very high resolution (compared to the '4k' Asus, above and its 3840 x 2160 resolution, both are exceptional for desktop use and gaming, but for fine image and video editing the LG stretches ahead) of 4096 x 2160 signals its intent as a pro monitor, and video editors or photographers in particular will value the excepional pixels per inch rating.

LG has made a great true 4K monitor with super crisp image quality but for the price you'd probably be better off waiting a few months until 4K storms the market and prices drop significantly and for the technology to become desirable for more than just professional graphics needs, but for that use it is an exceptional screen.

Daniel Wilks

KEY SPECS

$2499 · www.lg.com/au

31-inch 4096 x 2160 (17:9 aspect ratio) · LED backlit IPS screen · 99.5% RGB · 5ms response time · 10-bit colour depth · 178/178-degree viewing angles · 2 x HDMI · 4 x USB 3.0 · 1 x DisplayPort · 1 x Mini DisplayPort

OVERALL

For an over the top build with a complex water cooling rig and many fans it's great

Thermaltake Core X9

BIGGER IS NOT ALWAYS BETTER

There's big, really big, and Only-in-Texas big. The Thermaltake Core X9 falls into the latter category. This ridiculously large case is larger than many Sydney apartments, providing a wealth of space for all of your components and then some. Yet how has Thermaltake kept the price so low on such a large case? The answer is an unfortunate one.

Before we delve into the problems with this case, let's get a grip on just how large it is. Measuring a ridiculous 502mm x 380mm x 640mm, it's easily one of the largest cases to ever bend the desks in the PC and Tech Authority labs. Yet it only tips the scales at a relatively light 17kg – we say relatively, as it's still quite the behemoth. It's definitely not the kind of case you want to move more than once every few years, if that, and lugging it upstairs in a three story townhouse is about as much fun as moving a small fridge.

With such large dimensions it's easy to see how it can accommodate an extra-large E-ATX motherboard inside. The huge chasm that is the case's interior is divided into two main cavities; the top is built for the motherboard and add-on cards, while the bottom is for drives and a power supply... or two. The concept is that each has its own airflow, ensuring the ultimate in cooling prowess. Yet we can't recall the last time a PSU or SSD pumped out more heat than a light bulb – it's not like anybody uses those little heat bricks called high speed mechanical drives any more. The entire chassis is designed to be stackable, just in case you want to have two or three of these monstrous cases taking up all of your living space.

The first issue presents itself in the case's overall construction. Each side, apart from the giant window, is made from SPCC metal. However, it's a grill-type construction, which means it's very flexible. As far as audio isolation goes, it might as well not be there, as all the fan noise will come straight through the grill. We believe it's possible to have excellent cooling and a quiet case here at PCTA, but the Core X9 indulges in the former while totally disregarding the latter. That's fine if you don't mind the annoying hum of fans while you work all day, but we'd rather not, thank you very much.

Then there are the drive cages. Twin cages are included within, with room for three drives each, but they're barely attached to the chassis. Just two screws affix each cage to the case, so they bounce and flop around at the slightest touch. It just doesn't feel very well built, which is a complaint that extends to the rest of the case. When you're building a case this large, we'd rather a few more kilograms were spent on sturdier materials than those found here, but it's a compromise that obviously had to be made to keep the price down.

The other issue is that the case feels like it was built big, simply for the sake of being big. Even with a large radiator and more spinning blades than a heliport within, there's a huge amount of wasted space inside. Compared to the likes of the CoolerMaster Cosmos II, which is a huge case yet feels incredibly well built, while managing to deliver whisper-quiet performance and excellent cooling, the Core X9 feels like an odd exercise in space disposal.

There will be those with certain size deficiencies who feel the monstrous dimensions of the Core X9 make up for their inadequacies, but for most of us this is simply too big, yet built too fragile. Lacking any of the aesthetic grace of Thermaltake's better cases, it's simply a big square steel box, and that's just not good enough in today's highly competitive case market.

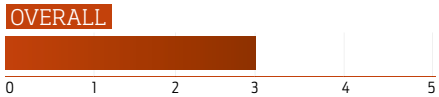
Bennett Ring

KEY SPECS

$225 · www.thermaltake.com.au

502 x 380 x 640 mm, 17kg · 8 expansion slots · USB 3.0 x 4 · HD Audio x 1 ports.

OVERALL



Cooler Master Nepton 120XL All-in-One cooler

SUMMER IS THE TIME FOR WATER SPORTS

Cooler Master has been making All-in-One cooling units since AIO's first hit the market, and over the years has continued to improve and refine upon these entry-level water cooling units. In the past, pre-built water coolers were a long way behind the efficiency of a custom-built water loop, but they've slowly narrowed the gap with better pumps, wider pipes and smarter water blocks. The Nepton 120XL proves that you needn't have a plumber's ticket to introduce your PC to the delights of water cooling, but it's still not quite up there with a custom-rolled water cooling rig.

Like most All-in-One kits, the Netpon 120XL comes with an array of different mounting options. Name an AMD or Intel socket, and this cooler works with it. Regardless of the socket type that the kit will call home, the installation process is quick and painless thanks to the intuitive mounting design employed here.

There have been a laundry list of improvements to the new Nepton 120XL compared to prior All-in-One water coolers, but they follow the same trends we've been seeing for the last couple of years. First and foremost is an improved pump, which now churns through 120 litres per hour. It's not quite enough to fill your pool, but is more than adequate for CPU cooling. It's also rated to last for a total of 70,000 hours, which is far longer than the average cooler will ever be used. More importantly it's now extremely quiet, and we couldn't hear it over the whoosh of the fan even while under load. Speaking of which, the 120 in the product's name denotes the fan diameter, twin 120mm unit that operates at extremely low volume. One is mounted to each side of the radiator in a standard push/pull configuration. Strangely Cooler Master doesn't indicate what speed the fans rotate at, but it's definitely on the quieter end of the spectrum.

Both fans are attached to a rather standard looking radiator unit, which doesn't appear to have undergone many, if any, changes from Cooler Master's preceding range. It still uses aluminium fins instead of the copper fins found in more extravagant systems. Thankfully the water block, which is the piece that makes contact with the CPU, has been improved. According to the tech specs, the copper base has a total surface area of 3500 square millimetres, but the impressive improvement is in the surface area of the fins attached to the rear of this. This has increased to a whopping 32,000 square millimetres, a sizable increase over prior water blocks from Cooler Master.

^ Two fans, one radiator, very efficient

Rounding out the list of improvements is an upgrade to the pipes used to convey water between the water block and radiator. It uses FEP tubing, which is less prone to kinks and blockages than the older rubber style found. Still, it's not that big a deal, as similar material has been commonplace in other All-in-One units for at least a couple of years. Unlike home-grown water cooling kits, the Nepton 120XL comes with a five year warranty, ensuring you won't wake up to find a puddle in your PC case in the near future. This warranty includes topping up of the coolant – there's simply no need thanks to the enclosed design employed here. In fact, if you do tamper with the coolant levels, you can kiss the healthy warranty goodbye, as the water top-up port is covered by a Warranty sticker.

To put the Nepton 120XL to the test, we fired up our I7-4790K processor overclocked to 4.4GHz, with a 1.25V core voltage. The synthetic benchmark Prime 95 was used to get the CPU up to maximum load temperature after 30 minutes, before the temperature was measured. Under load, the Nepton 120XL measured 79C, which is a huge improvement over the stock Intel cooler, and good enough for 24/7 running. However, we also measured it against the fantastic Noctua NH-D15 air cooler, one of the most powerful yet quiet air coolers on the market.

To our surprise, the NH-D15 beat the Nepton 120XL by a couple of degrees, although it was just a tiny bit louder.

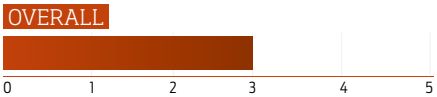
Recommending the Nepton 120XL isn't a clear cut situation. It's slightly worse than our favourite air cooler, the Noctua NH-D15, while costing $20 more. Yet it's also a tiny bit quieter, and might also fit more easily within certain cases. Whether or not it's the one for you will depend on how these circumstances apply to your specific rig.

Bennett Ring

KEY SPECS

$119 · www.coolermaster.com.au

OVERALL



BlackBerry Passport

YOU'LL LOVE IT OR HATE IT, BUT THERE'S NO DENYING BLACKBERRY'S LATEST SMARTPHONE IS DIFFERENT

BlackBerry has tried everything to get out of its sales slump: sticking with what it knows (the classic Q10), ditching the keyboard for a touchscreen (Z10), and even targeting emerging markets (Z3).

With the BlackBerry Passport, it has returned to the physical keyboard that first made it famous – and also ditched the touchscreen rectangle common to pretty much every other smartphone, and gone square instead.

That odd shape is the Passport's main selling point – although the OS has had a welcome update too – but it's also the reason many will find it hard to hold and use: this isn't a smartphone for the masses, but for a specific selection of users. If you're one of them, you may find the Passport a revelation that makes working on the move easy; if you're not, you may wonder what mind-altering substances BlackBerry's engineers have been indulging in.

SIZE AND DESIGN

Although the screen is a square, measuring 4.5in across the diagonal, the device itself is more of a stubby rectangle. It's 128mm tall and 90mm across, with the "chin" of the device taken up by the physical keyboard at the bottom and a thick black bezel at the top giving room for the 2-megapixel, 720p front-facing camera and a rather large BlackBerry logo. As if anyone will have to ask who manufactured this oddity.

The keyboard isn't a full five-row affair, as in times past. Instead, there are just three rows of physical keys in the Qwerty layout, plus Backspace, Enter and spacebar keys. A one-line virtual keyboard for numbers and symbols pops up when you type, or you can open a larger version by swiping up on the physical keyboard.

That's right: the keyboard itself is touch-sensitive, a feature that opens up a selection of intriguing gesture controls. You can use it to scroll through web pages by sliding your finger down across the keys, or pan left or right on a page with a swipe. While you type, words are suggested along the top of the keyboard, and you can swipe up underneath one to select it. It's a clever system and it's a wonder no-one else has thought of it.

^ Great keyboard for typing longer emails, a fantastic screen and impressive battery life. Although the support for the Amazon Appstore is an improvement, but the library still has major holes

Those who have never got on with virtual keyboards will love the Passport's keyboard. Its keys feel sturdy and have a slight angle to make it easy to grab the right key with the tip of your thumb. However, as you're holding the device to type, it can be difficult to get your finger into the bottom corners. If you're used to a virtual keyboard, it will take time to get up to full speed, and it feels odd to push the keys rather than just graze them with a fingertip. We were never able to type quite as fast with this keypad as we have with the Swype app installed.

Keyboard aside, the Passport is a chunkier, thicker design than most flagship handsets, at 9.3mm and 196g, and it feels rock-solid; we don't expect to hear reports of Passports bending in pockets any time soon. The rear is black plastic and there's a metal rim around the edge, which has a slight curve to make it more comfortable to hold; most of the time, though, you'll be grasping it in both mitts. On the bottom edge, there's a pair of speakers and a micro-USB port for charging; on the right

OS AND SOFTWARE

The Passport is the first phone to run BlackBerry OS 10.3, the highlight of which is an updated messaging hub and PC companion software, BlackBerry Blend. The hub places all notifications in one place for at-a-glance updates, and now allows you to transfer conversations from one type of communication to another – say, from SMS to email.

Via BlackBerry Blend, you can now access your phone's hub on other devices: Windows laptops, desktops and tablets are supported, as are Android tablets and iPads, but not Android smartphones or iPhones. Install the appropriate app to get your notifications, and you can tuck your phone away for the rest of the day. If you feel you're drowning in notifications, Blend is a life-saver.

Unlike other mobile OSes, BlackBerry's doesn't have an editable homescreen. Swiping up and to the right when in an app brings you to the messaging screen, and swiping straight up brings you to the multitasking view, which displays what's currently running as well as recently used apps. Swipe right to see your full app listings. The gesture system is more complicated than on other systems – you'll want to work through the tutorial – but once you get the hang of it, it's easy to navigate.

Another timesaving feature is the search tool. Start typing from the app screen, and it finds everything related to the term. Search for "settings", and it brings up the settings adjustment screen, a quick settings tool, and even emails that mention the word. Speaking of settings, they're easy to use and powerful: setting up email accounts is a moment's work, and you can easily see how much battery, CPU and memory a specific app uses.

Apps are a still a major issue. The inclusion of the Amazon Appstore and its repository of Android apps means the Passport has much more choice available to it than previous BlackBerry handsets, there are still problems: many apps we installed failed to run, and there are still plenty of holes – neither Kindle nor Google Maps were available.

side is a pair of metallic volume buttons, and at the top is the headphone jack and power button.

The microSD slot and the SIM slot are accessible via a small clip-off panel at the back of the device.

DISPLAY, PERFORMANCE AND CAMERA

BlackBerry says it went with a square display to make reading easier, and the 1,440 x 1,440-resolution screen (453ppi) is a joy for viewing documents and websites on. It's especially good outside, even in the sunshine: our tests show it has an impressive maximum brightness of 707cd/m2, and a solid contrast ratio of 790:1, with a good spread of colours and decent accuracy. It covers 90% of the sRGB colour gamut with an average Delta E of 1.65.

> *"The Passport has genuine innovations: the touch keyboard, the intriguing shape and the messaging hub are all clever ideas"*

Navigating through the OS, launching apps and scrolling through web pages are all smooth and judder-free, which perhaps isn't a surprise given the 2.5GHz Qualcomm Snapdragon 801 chip. Because the Passport won't run all Android apps successfully, we were only able to run the single-threaded SunSpider JavaScript benchmark, but here it pulled in a respectable time of 876ms. In terms of other specifications, it has a solid 3GB of RAM with 32GB of built-in storage that's expandable via a microSD card, and supports 4G.

The camera is unremarkable and can't compare with the quality of the Apple iPhone 6 or the Samsung Galaxy S5. Detail in images looks smudged thanks to over-compression, and poor auto white balance spoils some images with a pinkish tone, although flipping on the HDR setting improves the situation. The autofocus can be slow. In short, the camera is perfectly fine for a quick snapshot or nabbing a business card's details before you lose it, but if you're a smartphone photography devotee, you'll want a different handset.

The Passport does come with a nice selection of photo apps, however. There are built-in editing and filter tools – handy, since Instagram isn't available – and the camera app is reasonably intelligent. It recognises when a scene has extremes of light and dark, and suggests you capture using HDR.

When it recognises a face, it will nudge you in the direction of its Time Shift tool, which takes a burst of photos, so you can avoid the one where your subject's eyes are shut tight. If you're looking to set a background photo on your square Passport display, you can also capture at a 1:1 ratio.

BATTERY

One area where the Passport shines is battery life. The large chassis gives BlackBerry room to cram in a massive 3,450mAh battery, and it lasts well. In our tests, it drained at a rate of 7.3% per hour while playing a 720p video.

That's pretty good considering the size and resolution of the display, but more impressively, it consumed only 2% per hour while streaming audio over 3G with the display switched off. That puts it on a par with the iPhone 6.

One caveat: when we first set up our social networking and email accounts, the initial synchronisation drained the battery flat in no time. Once it settled in the Passport easily lasted a weekend of light use without a trip to the power outlet, although that was without playing any video or graphics-intensive games.

VERDICT

The BlackBerry Passport has genuine innovations: the touch keyboard, the intriguing shape and the messaging hub are all clever ideas, showing that the Canadian smartphone maker shouldn't be counted out completely.

However, what makes the Passport special also makes it a niche device. While phones are getting bigger, most people still want a smartphone that fits in a pocket, and for all but a few users a virtual keyboard is sufficient and a square display an unnecessary oddity.

That said, if you're irritated by reading on rectangular displays, long for the days of physical keyboards, and are more likely to email than Instagram, the Passport may well be ideal for you.

It is most let down by the lack of supported apps; BlackBerry must find a way to get key apps on to its platform. Still, this creative take on mobile working must be applauded, even if we don't expect the Passport to sell in the millions. At the $849 price, it's competing with flagship phones, making this truly a case of try-before-you-buy. Use it for a week: some will send it back frustrated, but others might just fall in love.

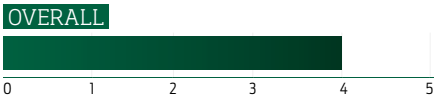
Nicole Kobie

KEY SPECS

$849 · au.blackberry.com

2.5GHz Qualcomm Snapdragon 801 · Adreno 330 GPU · 3GB RAM · 32GB storage · 4.5in 1,440 x 1,440 IPS display · 13MP/2MP rear/front cameras with optical image stabilisation · 4G · microSD slot · 3,450mAh Li-ion battery · 90 x 9.3 x 128mm (WDH) · 196g

OVERALL



LG G Watch R

THE ROUND-FACED SUCCESSOR TO THE G WATCH BRINGS STRONG BATTERY LIFE AND A SENSE OF STYLE TO ANDROID WEAR

The G Watch R's key selling point isn't difficult to spot. Where most Android Wear smartwatches offer a conventional rectangular screen, the G Watch R's display is a perfect circle. We've seen this type of design before, in the shape of Motorola's Moto 360, but where the lower part of the Motorola's screen is cut off by a small black bar, LG's latest smartwatch displays a fully circular face.

It's a design that instantly lends the G Watch R a certain cachet. To our eyes, a square-faced smartwatch, no matter how luxurious, inevitably calls to mind the low-cost digital watches of yore. The G Watch R's classic shape suggests a more grown-up accessory, an effect that's supported by the faux winding knob (which in fact turns the screen on and off), and is completed by a dive-watch-style bezel. The chunky body won't suit slender wrists, but at 62g it's lighter than most dumb chronometers, and the comfortable leather strap is easily replaceable via a standard 22mm fitting.

Wake up the watch and you're greeted by a 1.3in screen, with a 320-pixel diameter that translates to a pixel density of 246ppi. That's not quite Retina-sharp at typical watch-reading distances, but it delivers crisp and clear text and images. LG has also chosen to use P-OLED (polymer OLED) technology, which delivers sumptuous colours that really leap off your wrist; at maximum brightness of around 310cd/m2 it's a sight to behold, and it's easily readable even in bright sunlight.

So far so good – but there's a catch. The G Watch R's high-brightness settings can be a bit too dazzling for discreet indoor use; there's no ambient light sensor to automatically dial it down when you need to. Happily, the latest Android Wear update introduces a new "sunlight mode", which temporarily pushes the brightness up to maximum, automatically returning to normal the next the screen wakes up. You can quickly activate this mode by triple-clicking the side-knob, so it's a decent functional workaround.

It's also worth mentioning that OLED screens are susceptible to screen burn, which isn't covered by the warranty. It remains to be seen whether this early generation of Android Wear watches will be in use long enough for that to be a problem. Android Wear tries to minimise burn by subtly shifting the position of your watch face each minute, and you can help matters further by choosing mostly black faces and switching between them periodically.

The outer ring surrounding the screen is, in our view, a design misstep. It doesn't actually rotate – not that you could really take the G Watch R diving anyway, since its IP67 rating means it's only water-resistant to a depth of 1m. And the raised surround interferes with the swipe gestures used to navigate Android Wear, creating a sense that the software and hardware don't quite gel. Those who prefer a minimalist face may find the physical markings a needless visual distraction as well.

And then there's the charger. Similar to the regular G Watch, the G Watch R charges via a USB dock that attaches magnetically to the back. But it's a disconcertingly loose fit, feeling more like a pedestal than a clip. It takes only an inadvertent shove to knock the watch off its charger, which doesn't inspire confidence.

As all Android Wear smartwatches run the same base software, the G Watch R can't really be faulted in terms of function. The vibrator is a bit weedy, but you do get a heart-rate monitor for one-shot pulse readouts, which several models (including the original G Watch) lack. Continuous heart-rate monitoring isn't supported.

What's more, LG has packed in the biggest battery we've yet seen on an Android Wear device, rated at 410mAh. In our tests, this gave the watch a projected battery life of two days and 21 hours per charge (at default settings), helped along by the efficiencies of the OLED display. This isn't the transformative leap in smartwatch longevity that we've been waiting for, but it's 19 hours longer than the original G Watch.

^ LG's use of P-OLED technology translates to a bright screen with superb colours

That, perhaps, is the G Watch R's saving grace. If you're looking for an upmarket smartwatch, the Moto 360's wireless charger, built-in light sensor and edge-to-edge screen make it a much slicker and more polished device. It's a touch cheaper, too, but the battery life of barely more than 24 hours means the G Watch R is a better compromise. It doesn't come close to the elegance of a real high-end timepiece, and it's significantly more expensive than its rectangular rivals. But if you're looking for an Android Wear watch that won't let you down at the end of the day, it's your best bet – so far.

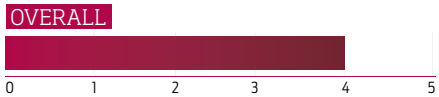
Darien Graham-Smith

KEY SPECS

$359 · www.lg.com.au

Single-core 1.2GHz Qualcomm Snapdragon 400 processor · 512MB RAM · 4GB storage · 1.3in circular 320 x 320 P-OLED touchscreen · optical heart-rate monitor · Bluetooth 4 LE · 410mAh battery l Android Wear · 1yr RTB warranty · 46.4 x 53.6 x 11.1mm (WDH) · 62g

OVERALL



Steinberg Cubase Pro 8

A HOST OF IMPROVEMENTS MEAN CUBASE REMAINS THE MOST ACCOMPLISHED MUSIC-PRODUCTION SYSTEM AROUND

Cubase has long been our music-production system of choice, and this latest release brings some notable updates – including a name change. The flagship is now Cubase Pro, for a distinction from the Artist and Elements editions.

More significantly, Cubase 8 also promises a significant boost to performance thanks to a "massive engine rebuild". Low latency is now used only on tracks that demand it, such as those being recorded, and there's also better disk buffering for virtual instruments.

To test the effectiveness of these improvements, we created a sample project in version 7.5 using lots of virtual instruments and demanding effects, then piling on plugins until we saw constant playback glitches.

On loading this project into Cubase Pro 8, the glitches disappeared. Using the built-in performance monitor, we saw the average load meter hover at around 50% during playback in both version 7.5 and 8. However, the real-time peak meter fell from a highly volatile reading in version 7.5, with regular overloads, to a steady reading of around 15% in version 8.

To push the experiment further, we then duplicated every track in the project. This caused some dropouts in version 8, but only to a similar extent to the original file in version 7.5.

These improvements go a long way to reduce the headache associated with managing system resources. While effects plugins place a steady load on resources, the demands of virtual instruments vary depending on the number of notes played. In the past, this has often meant grappling with the Freeze commands to ensure the engine isn't pushed too hard at any point. In Cubase 8, playback is not only more efficient but also more predictable, so you're less likely to encounter the occasional dropout.

Another key improvement affects Linked Channels, a feature originally introduced in Cubase 7 for synchronising mix settings across multiple channels. These covered everything from channel volume to EQ, effects and routing settings, but they didn't work well alongside automation, as automation data overrode other settings.

The new VCA Faders feature in Cubase 8 overcomes this issue, adding a virtual channel with a fader that offsets the volumes of linked channels. Automation data is handled appropriately, with the VCA Fader value simply superimposed onto the automation envelope. The VCA Fader can itself be automated too, and it's even possible to nest VCA Faders to create complex automation layers, should the need arise.

Alongside these low-level changes, you'll also find some welcome cosmetic and workflow improvements. A new Workspaces menu makes it easy to save and recall interface layouts, while a docked Racks panel neatly houses virtual instruments and media assets. EQ frequencies are now shown as note values, helping to tune resonant frequencies more musically.

There's a redesigned plugin manager, too, allowing multiple custom lists of plugins – perfect for picking out chains for specific tasks. A new Direct Routing module allows mixer channels to be sent to up to eight destinations and switched quickly between them. It's a niche feature, but it could be useful for flipping between processing chains.

Finally, there are the new sonic toys – not quite as impressive as those in version 7.5, but still very welcome. VST Bass Amp does what the name suggests, and is a useful companion to VST Amp Rack. Quadrafuzz v2 is a four-band distortion effect with five distortion algorithms and gate and delay effects on each band; it's capable of anything from a gentle scuff to total annihilation, and it's tremendous fun to experiment with. A Multiband Envelope Shaper and Expander make it possible to sculpt frequencies and timing with incredible precision. And the DeEsser for reducing vocal sibilance has been overhauled, with finer control and a cleaner results.

Those who want a streamlined, jargon-free interface should look elsewhere. But if you seek meticulous control over the music-production process, this is another superb update – and at only $139 for users of version 7.5, it's attractively priced too.

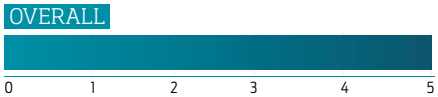
Ben Pitt

LEFT: Choose from 19 stomp boxes, six amps, four cabinets, eight microphones and six mic positions with the virtual Bass Amp
RIGHT: Quadrafuzz splits audio into four frequency bands, roughs it up and then puts it back together

KEY SPECS

$139 with scaling increases for earlier version upgrades · www.steinberg.net

OVERALL



Labs Briefs

Toshiba Encore 2

$459 (64GB); $399 (32GB) · www.toshiba.com.au

At 560g (quite light) and 8.98mm thickness (not thick at all), the 10.1in Windows 8.1 Toshiba Encore 2 passes the front gate test for a tablet. The tricky folding magnetic stand (creates a half-pyramid shape) is very nice indeed. The bezel is large by today's standards, and the screen annoyingly glossy if it's used with bright ceiling lights in an office. Not so good, but still, it's more than an average tablet and certainly one worth looking closely at.

There's a full version of Office 365 Personal (1 year subscription), and that's almost the trump card. It's not often you see this. Two months of Norton Internet Security comes with it too, less cool, but still more than many, and there's no annoying bloatware on the Encore 2.

Overall it's a nice tablet to hold, even nicer to prop up on its clever stand, and only the glossy screen to hold it back from the full 5 stars.

Ben Mansill

BlueEye ThunderDisk Pro

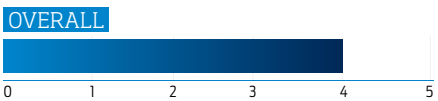
$249 · www.anyware.com.au

When high capacity and high speed storage is needed, an emerging product category designed to fit that need is what we'll call the 'portable SSD'. In actuality it's a 'mini portable external mSSD drive'. Last year we reviewed the Corsair Flash Voyager GTX, and now we have a one from BlueEye, a company we're not familiar with, but it comes into Australia via Anyware, long time disty's of PC gear.

It connects via USB 3.0, and its internal interface is M-SATA at SATA III standard. You should see speeds of up to 400MB/s, depending on the PC port you're using, which will yield best results if it's one of the USB 3 ports that connect directly to the motherboard.

Besides data storage and transfer, its support of Windows To Go adds another layer of versatility, especially in corporate environments, allowing a full Win 7/8 bootable OS image with WTG's protections and redundancies onboard.

Ben Mansill



Cougar 600M

$59 · www.cougar-world.com

In terms of visual design, the new 600M mouse from Cougar looks more than a little quirky. It's deeply asymmetrical, with a comfortable extension to rest your thumb on one side, and dramatic, seemingly over-exaggerated cut into the body on the other. It looks like it would feel uncomfortable, and probably is for those with large hands, but in practice it's surprisingly useable.

It's very responsive, too, with great click feedback, and a very stiff mousewheel. The side-buttons are well-placed, and even the 'sniper' button doesn't get in the way, but is still very useable. It's smooth on just about any surface, and the multi-coloured lighting system makes it easy to match with any other coloured peripherals. With 512kb of memory on board, it can also store all your gaming settings.

For the cost, it's a very competitive little mouse. Not for everyone, but very much a contender.

David Hollingworth

Kogan Atlas X1510

$329 · www.kogan.com.au

On spec, this remarkably cheap machine seems like great value. A large 15.6in 1366 x 768 screen with a Pentium N3540 2.16GHz quad-core CPU, 500GB 5400 rpm HDD and 4GB of 1333MHz RAM is enough to power any student through the year. It's about the same price as the cheapest Chromebook, and about $100 cheaper than the cheapest Windows 8.1 laptop of similar spec via the major retailers.

But to use it is a fairly dismal experience. The screen is the worst LCD we've ever seen, muddying fonts and bleeding at the edges of images. It's blurry with lacklustre colours. The case feels shockingly cheap, rattling and sounding hollow and weak as you tap it. The track pad gives jerky imprecise movement. It's completely vanilla with no apps whatsoever, not even a trial version of Office, so you'll need to factor in the cost of that suite, or use a free office suite of your choice. Better to hunt around for clearance sales of similarly equipped machines from brands that place greater importance on quality, we think.

Ben Mansill

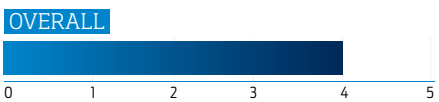
Coolermaster Storm SF-17 Gaming Laptop Cooler

$79 · Gaming.coolermaster.com

This was released mostly-globally about a year ago, sans Australian and New Zealand. Now you can buy this particularly good notebook cooler. We wouldn't say it's solely for gaming, as any laptop up to 19in can sit atop its grippy rubber chucks and benefit from the huge 180mm fan. The fan blades have an unusual shape, with a varying width across their length and a twisting contour – exactly like you see on a jet engine. A rotary speed dial is included, allowing speed to be tuned between 700 – 1200rpm.

There are 4 levels of angle as the laptop support area is elevated up from the base. A metal mesh sits between the fan and your laptop. Four USB 2 ports are on one side and the unit is juiced via a 5V DC brick. Moulded channels along each side are intended to offer a degree of cable tidying.

Ben Mansill



Seagate Backup Plus Slim

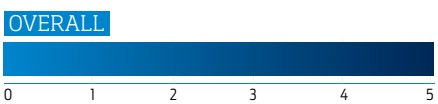
$155 · www.seagate.com.au

While high capacity and high speed USB stick drives are quickly becoming an option for carrying around large volumes of data, the good old spinning hard drive still has some fight left.

Lately we've been using the Seagate Backup Plus Slim 2TB. It's a particularly compact (113.5mm x 76mm, 150g) unit and is certainly jeans-pocketable (front pocket included!). The case is aluminium, and that definitely adds to its ruggedness. A short USB 3 cable rounds out the package.

Backup software is included on the drive, although there's no app or function to provide secure encryption or password protection. While we also have the RAID 0 Seagate Backup Fast here in the office, and there's no reason at all to consider that a data risk, the Backup Plus Slim does all the heavy lifting around here. It's speedy, small and hassle-free. The 2TB model can be found for as litle as $112 online, and comes in 500GB, 1TB and 2TB flavours.

Ben Mansill



Audio-technica ATH-PDG1

$189 · www.audio-technica.com.au

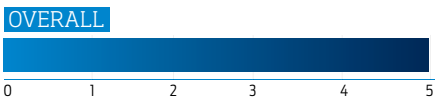
These cans are a revelation. After all my bitching and moaning in the last issue about how not one set of decent gaming headphones have come my way for a year, or more, these wonders arrive, and do it all.

Comfort - check! You can wear them for hours and not for a second experience anything less than warm soft ear hugging bliss.

Sound quality - big yes! Music is delicate and superbly balanced and defined, with tight bass doing what it should do and never making a mess of things. Everything from gentle classical to rocking guitar noise sounds delectable. Gaming is sublime. They create a precise soundscape with any gaming genre.

The tricky cable runs from a single detachable connection on the cans, has the mic built-in and there's an in-line volume and mute. An extension cable is included. You can also run a simple 3.5mm audio cable for music only. Good job, audio-technica, for showing how it's done right!

Ben Mansill



Worx SD Slidedriver

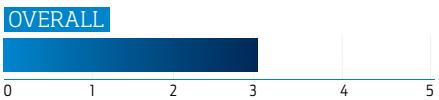
$69 · www.worx.com

We got this thing in for a review after receiving a press release, unusually for us, because something like this should be a mostly unnecessary but lustfully desirable part of every PC owner's kit. Also because it looks very neat, and it seemed to tick all the PC-fiddling boxes.

Here's what we found. It's nicely sized and can reach deep into a fiddly PC easily. There is a LED headlight – this we found to be especially fantastic. Being cordless is nice, though a necessity, of course for this sort of thing, we imagine, being as unfamiliar as we are with power tools. It has a 6-shooter magazine, holding, obviously, six heads. They are selected by pulling back the top back bit exactly like you would with a gun. Makes the same Hollywood sound, too. This is cool beyond words. It's the greatest thing in the world. Makes you feel like a big man. Really does.

But the rotational speed is not variable. Killer score blow! If only... Still, for anything but little things that can break, like motherboard screws, it's just fine. Chik-chik boom!

Ben Mansill



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SSD shootout

SOLID-STATE DRIVES ARE GETTING FASTER, LARGER AND CHEAPER. WE TEST THE BEST DRIVES ON THE MARKET TODAY

Solid-state storage used to be prohibitively expensive and hampered by tight capacities, but the market has recently matured. SSDs are now viable alternatives to hard disks, thanks to lower prices, higher capacities and faster speeds.

It's a fast-moving part of the tech world, which means rapid innovation is the norm. The number of new techniques and technologies present in SSDs means there's a lot to look out for when buying a drive – it's certainly a trickier task than picking a hard disk.

MAKING MEMORIES

Flash memory chips form the bulk of an SSD, and advances in this space have the biggest influence on the performance and longevity of the drives you buy.

The most recent technological development was introduced by Samsung in May, in the shape of 3D V-NAND. This marks a big change in how SSD memory is constructed: instead of installing transistors in traditional horizontal layers, this drive stacks them vertically too.

This change means Samsung can pack in many more transistors without shrinking the manufacturing process, so the NAND doesn't suffer from the performance inefficiencies, current leaks and higher costs associated with smaller process nodes. The 850 Pro employs a 40nm process – an archaic-sounding choice compared to the sub-20nm chips used in other commercial drives – but that's moot when the Pro's vertical arrangement means Samsung has the luxury of extra space to utilise.

This innovation means Samsung is finally free from the shackles of chasing smaller processes. That's been the path of SSD development for several years, despite the obvious cons: smaller nodes mean better performance, but they put more demands on the components and reduce endurance. For those reasons, other firms including Intel are already moving down the same path to improve storage deficiencies.

CELL DIVISION

The flash memory in modern SSDs comes in three types: SLC, MLC and TLC. These acronyms describe the number of bits stored in the cells that make up NAND memory, with single-, multi- and triple-level used in different drives.

Each type of NAND has pros and cons. Single-level cells have the best endurance and raw speed, but they're more expensive to produce, since each NAND cell stores only one bit, and thus storage density is lower. SLC SSDs are typically used for mission-critical PCs that read and write huge amounts of data.

The next step up, MLC, stores two bits per cell. This makes it cheaper to produce drives with the same capacity as an SLC equivalent, but longevity is hampered. The increased number of bits in each cell means it's more difficult to distinguish between the states, which reduces endurance: on an atomic level, higher voltages and more frequent changes in the charge level cause the silicon-oxide insulation inside the cells to erode at a faster rate.

Triple-level cells increase the capacity and reduce the cost even more, but performance and endurance decline further. These disadvantages mean MLC and TLC drives aren't suitable for intense workloads, but they have ample endurance and performance for home and gaming systems and generally, they're cheaper as a pleasant bonus.

Flash memory controllers manage the interactions between the NAND cells and the rest of the PC. They don't handle only file reads and writes – they also manage drive maintenance and cleaning procedures.

"The number of new techniques and technologies present on SSDs means there's a lot to look out for when buying a drive"

Many SSD manufacturers source controllers from third-party firms. Marvell is consistently popular, and controllers are often bolstered by custom firmware that allow for different areas of a drive's performance to be emphasised.

Other firms develop their own silicon. Samsung produces its own triple-core MEX parts, and Intel also produces homegrown controllers.

GET CONNECTED

Every modern SSD uses the current SATA III standard to connect to your PC or laptop, and its maximum transfer rate of 6Gbits/sec is enough for consumer applications. But this is also on the road to change, and newer connectors could soon supersede SATA.

The most prominent currently is mSATA, which is already found inside many laptops and on most high-end motherboards. It's a SATA III interface but, crucially, squeezed into a tiny space – the connector is slimmer than a SATA plug, and the drives themselves are several times smaller than normal SSDs.

V The SATA III is fast enough – for now

Drives compatible with the mSATA standard are plentiful, but they're still limited by SATA III's maximum bandwidth – an issue that will become more significant as NAND chips become faster and cheaper.

A new form factor, M.2, solves this by cramming the SATA Express interface – which supports both SATA III and PCI Express 3 – into an even smaller connector. Its maximum transfer rate of 16Gbits/sec outstrips SATA III, and M.2 drives can come in several different lengths and widths. If anything will replace SATA, it's this.

HOW BIG?

That's for the future, though. Assuming you're buying today, the most important consideration may also be the most banal one: physical size. Most 2.5in SSDs sold these days are 7mm thick, but a handful are still the chunkier 9.5mm. These thicker drives may not fit inside laptops that only accept the slimmer parts.

Take a peek inside the box, too. Some drives come with spacers to bulk out 7mm drives to fit into 9.5mm bays, and others come with adapters so they can be installed in a PC's 3.5in hard disk bay.

Also check the warranty. Some SSDs, such as Samsung's 850 Pro, come with generous ten-year deals, but more affordable SSDs often make do with two or three years of coverage.

The final thing we'd check before buying an SSD is its endurance rating. Endurance is measured in gigabytes or terabytes, and these measurements represent how much data can be written to the drive before it's liable to fail. Endurance ratings in gigabytes generally indicate the amount of data that can be written to the drive daily, while a terabyte rating represents how much data can be written over the drive's lifespan – its warranty period.

These figures vary wildly. The cheap Crucial MX100 is rated for a modest 72TB workload, while the pricier Samsung 850 Pro is rated for 150TB.

SAMSUNG 850 PRO 256GB

Samsung's current flagship is a testament to the benefits of controlling an entire supply chain, from research to production. That tight grip means Samsung's 850 Pro was the first commercial drive to deploy 3D V-NAND, and it helps this drive maintain a lead over the market.

The 850 doesn't just gain an advantage from its innovative NAND flash. Its triple-core MEX controller also has a part to play: it's the same as the one found in its predecessor, the 840 Pro, but clocked 100MHz faster. There's also a 512MB cache of low-power DDR2 memory.

It's a potent specification. The 850 Pro's AS SSD sequential read and write results of 527MB/sec and 502MB/sec are the best we've seen, and it topped the table in the 4K 64 read and write tests as well. Anvil's benchmarks run similar tests, and here the 850 Pro also proved dominant.

The Samsung followed its stunning start with great results in the ATTO benchmark. It was the fastest SSD on test in 12 of the 15 read tests, which evaluate performance with a wide range of different file sizes. When writing files in ATTO it led the way in 11 of those 15 tests.

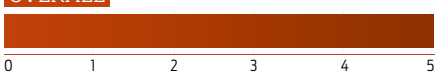
The Iometer and PCMark8 storage tests evaluate longer-term performance. Here, unsurprisingly, the 850 Pro continued to impress. Its total I/O result of 6,997 is the best here, and its total figure in Iometer sat at 267MB/sec – again the quickest result we've seen. In PCMark8's extensive storage test, the 850 Pro scored 4,984 points – not the best, but not far behind it.

The Samsung 850 Pro is a drive with very few weaknesses. Its Iometer average and maximum response times weren't top of our results table but, even then, the difference between the 850 Pro and faster rivals can be measured in mere milliseconds. It's a similar story with AS SSD's access times – the 850 Pro doesn't lead the way, but it isn't far behind.

The 850 Pro costs around $210, which, for this 256GB model, works out at 82c per gigabyte. It's expensive, but it justifies its price through its rapid and consistent pace. It's the SSD to buy for market-leading performance.

$210 · www.samsung.com.au

OVERALL



	PCMark8		Anvil read			Anvil write		
	Score (PC Marks)	Band width	Seq 4MB	4K	4K QD16	Seq 4MB	4K	4K QD16
AMD	4,937	220	489	26	249	489	86	338
Crucial	4,966	261	516	30	298	328	97	302
Fujifilm	4,991	288	518	22	287	482	74	245
Samsung 850 Evo	4,984	275	512	37	346	497	99	337
Samsung 850 Pro	4,984	275	527	35	370	497	92	335
SanDisk	4,925	207	522	30	296	475	71	310

	AS SSD read				AS SSD write				ATTO read		ATTO write		Iometer			
	Seq	4K	4K 64	Access (ms)	Seq	4K	4K 64	Access (ms)	4K	2048K	4K	2048K	Total IOPS	Total MB/sec	Av I/O resp (ms)	Max I/O resp (ms)
AMD	493	26	364	0.04	497	77	315	0.05	231	532	264	532	1,892	72	0.5	728
Crucial	519	30	330	0.04	332	96	287	0.05	126	554	289	339	1,754	67	3.4	133
Fujifilm	518	21	363	0.08	489	74	228	0.05	275	554	217	525	5,475	210	0.2	22
Samsung 850 Evo	510	43	375	0.04	499	96	287	0.04	314	549	279	529	5,270	202	0.2	5
Samsung 850 Pro	527	35	384	0.05	502	93	320	0.04	295	563	273	536	6,997	267	0.9	15
SanDisk	505	31	330	0.05	473	72	291	0.05	256	550	294	502	1,843	70	0.5	53

SANDISK ULTRA II 240GB

The SanDisk's name makes it sound like a high-end drive, but that's deceptive – its $140 price and 240GB capacity mean it costs only 58c per gigabyte, making it one of the cheapest big-name SSDs.

It's the first SanDisk drive to use TLC NAND, and the first consumer drive to use this type of memory aside from Samsung. The chips used here are 19nm parts – a process less than half the size of Samsung's 40nm silicon. Elsewhere, SanDisk uses a Marvell-made controller.

The choice of TLC NAND has clearly been made on grounds of price rather than performance, but the Ultra punched above its weight in several of our benchmarks. In AS SSD's sequential read and write tests, the SanDisk achieved scores of 505MB/sec and 473MB/sec – not enough pace to trouble the Samsung 850 Pro, but within touching distance of more expensive rivals.

Compared to other budget SSDs, the SanDisk did rather well indeed. In some of ATTO's smaller read tests, the Ultra II was twice as quick as affordable rivals, and hit 550MB/sec for 2MB reads. The Ultra proved even better when writing files; it gained 502MB/sec for 2MB files, while the Crucial MX100 languished at 339MB/sec.

Meanwhile, in the Anvil test suite, the Ultra II's 4MB sequential read pace of 522MB/sec is among the best we've seen and its 475MB/sec write speed is decent.

Other tests, however, expose the gap between the SanDisk and a real premium drive. In Iometer, the Ultra II's total I/O score of 1,843 was one of the poorest we've recorded, and its maximum I/O response time of 53ms is a long way behind the 5ms and 15ms scores achieved by Samsung's Evo and Pro drives.

For the money, though, the SanDisk Ultra II 240GB is very impressive. It stays in touch with top SSDs in some benchmarks, and in almost every test it's quicker and more consistent than its similarly priced rivals. Crucial's MX100 was once the budget king, but now SanDisk's Ultra II has that crown.

Mike Jennings

$140 · www.sandisk.com.au

BEST OF THE REST

SAMSUNG 850 EVO 250GB

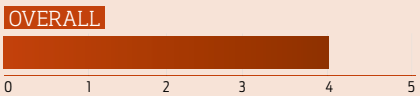
Samsung's newest drive – the 850 Evo – is cheaper than the 850 Pro, but still uses 3D V-NAND flash chips. The 850 Evo is produced with TLC rather than MLC memory, so cells store three bits of data rather than two – a move that increases storage density and reduces cost at the expense of performance.

That's not to say the Evo is sluggish. It impressed in AS SSD, occasionally besting even the 850 Pro. Its Iometer result of 5,270 is third best, and in PCMark8 it scored 4,984 – second to the Fujifilm and equal to the 850 Pro.

The Evo only faltered in ATTO. Its larger-file read speeds proved slow, and most of its write speeds were average.

The $179 Evo is the best mid-range drive we've seen: faster than AMD's drive, and more consistent than the Fujifilm SSD. However, with better all-round performance available for only $31 more, we'd suggest you save a few more dollars and opt for the 850 Pro.

$179 · www.samsung.com.au

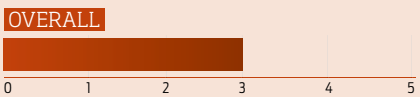


FUJIFILM HQ-PC 256GB

Photography firm Fujifilm's first foray into SSDs isn't a homegrown part. It's a rebadged Toshiba drive that employs 19nm MLC NAND.

The HQ-PC was mid-table in most of the AS SSD tests, and its good performance in individual ATTO tests was undermined by mid-table speeds elsewhere. The HQ-PC's best performances came in the longer-term tests: its Iometer result of 5,475 IOPS was second only to the Samsung 850 Pro. Its $220 price (via Amazon) is a lot to pay, though, for such inconsistent performance. A better mid-range bet is the Samsung 850 Evo.

$220 · www.fujifilm.com.au



CRUCIAL MX100 256GB

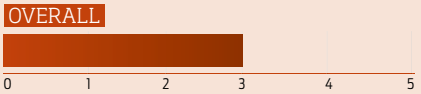
Crucial's $145 drive works out at 56c per GB and, using that measure, it's the cheapest SSD here.

That low price hasn't precluded innovation. It's the first mainstream consumer SSD to use 16nm NAND – no surprise given the drive is manufactured by Crucial's parent company, Micron. This is a double-edged sword, however, since the smaller process can improve performance in some areas, but hamper it in others.

The MX100 is adept when reading files, but it falters when writing them. For instance, in AS SSD's read test its top 519MB/sec pace was the group's second best, but its 332MB/sec writes let it down. This pattern was repeated in ATTO, where the MX100 almost caught Samsung when reading, but fell behind when writing larger files. In Iometer, its total I/O score of 1,754 was the group's poorest.

The MX100 is cheap, then, but the SanDisk is almost as affordable and a much more consistent performer. If you want to save cash, choose that instead.

$145 · www.crucial.com



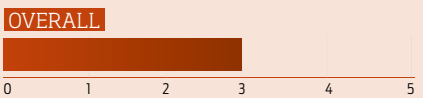
AMD RADEON R7 SSD 240GB

This drive bears the AMD logo, but it's made by Toshiba-owned OCZ. It uses a Barefoot 3 M00 controller similar to the chips inside OCZ's SSDs, and Toshiba's 19nm MLC NAND flash.

Its AS SSD sequential read pace is the worst here, and that poor form continues in ATTO – its read tests are among this group's slowest. The R7 picks up in write tests, but even here it's hampered by inconsistency.

Worst of all is the price: at $189, it's poor value for money based on the performance on offer.

$189 · www.amd.com.au



Little Rippers

MICRO ATX MOTHERBOARDS CAN DELIVER STAR PERFORMANCE IN A DIMINUTIVE PACKAGE. **BENNETT RING** ROUNDS UP FIVE OF THE BEST

It might seem hard to believe, but the microATX motherboard standard has been around for almost twenty years. Originally launched way back in 1997, these petite motherboards must officially measure just 244mm x 244mm, but they can be even smaller if the manufacturer so desires. Despite existing for almost two decades, it's only in recent years that the microATX format has become popular amongst the general computing community. Earlier models were as costly as they were limited in features, limiting their use to very specific industrial or commercial uses. How times have changed. Today's microATX boards now feature most of their full-sized ATX cousin's characteristics, while prices have plummeted.

WHY USE MICRO ATX?

The obvious benefit to using a microATX motherboard is its tiny dimensions. With the PC now a permanent fixture in many living rooms, owners want a PC that can fit nicely inside a standard AV unit. While it's possible to buy HTPC cases that can squeeze a full-sized ATX board into the same space as an amplifier, microATX cases are the preferred choice for keeping living-room PCs trim, taught and tiny.

Gamers looking for a mobile gaming box are also an obvious target for the microATX format. While early models were extremely limited in their functionality, today's gaming microATX boards deliver full multi-GPU support, along with quality onboard audio solutions, all in a package that will easily fit into a tiny case that can be carried with a shoulder strap.

Finally there are users who simply don't want a hulking PC tower taking up precious space in today's increasingly cosy abodes. With living spaces getting smaller as more Aussies move into apartment blocks and townhouses, being able to tuck your PC away behind the monitor frees up precious floorspace.

If there's one audience that probably isn't too interested in the microATX format, it's the tweaking and overclocking crowd. It's not that these pocket powerhouses can't overclock, it's just that the smaller cases they tend to be housed in don't have the best thermal properties.

WHICH BOARD IS FOR YOU?

For those with money to burn, Asus's Maximus VII Gene is hard to resist with its potent mix of ear-tickling audio, powerful graphics potential and excellent overclocking features. Those who just want the basics will find the ASRock Z97M Pro4 a capable solution for simple mini-PCs, while gamers and entertainers on a budget can't go past the value-packed Gigabyte Z97MX GAMING 5.

PCMARK 8 HOME BENCHMARK SCORES	
ASUS TUF GRYPHON Z97 ARMOUR EDITION	4087
ASUS MAXIMUS VII GENE	4213
ASROCK Z97M PRO4	4012
GIGABYTE Z97MX-GAMING 5	4123
MSI Z97M GAMING	4154

HOW WE TEST

This roundup sees PC and Tech Authority switch to our new suite of motherboard benchmarks. Rather than reinvent the wheel, we're now using the formidable PCMark 8 suite, developed by the benchmark professionals at Futuremark. For this roundup we used the "Home" mode of the benchmark, which runs five different tests that aim to replicate normal household use. These include Web browsing, Word processing, Casual gaming, Photo Editing and Video Chat.

Our test components were comprised of an Intel Devil's Canyon i7-4790K processor, cooled by CoolerMaster's new Nepton 120XL water cooler. An NVIDIA GTX 760 provided the graphics processing power, while 2 x 4GB sticks of Kingston's HyperX memory was run at the Z97 standard speed of DDR3 1600, despite most of these boards being able to run much higher, overclocked memory speeds. A Corsair Force LX SATA 3.0 128GB SSD rounded out the components, and a clean, cloned install of Windows 8.1 was installed for each motherboard.

To ensure a fair fight, we updated the BIOS on every motherboard, but this isn't something we'd normally do for brand new motherboards. However, some of the boards in our test have been out for several months or more, and had their BIOSes updated by the supplier, forcing us to update all of them to deliver a clean race. This explains why the gap between the boards is so close; they're all running the same Z97 chipset, and any launch quirks have since been ironed out by BIOS updates.

The following five boards cover a wide gamut of possible uses, from budget media box to high-end portable game machine. We asked each supplier to send a board in the $200 to $250 price range, which is why several of them feature entertainment and gaming-oriented features. Read on to see which microATX motherboard is the one for you.

	STREET PRICE	PCI-E SLOTS	PCI SLOTS	SLI/ CROSSFIRE?	SATA PORTS	USB 2.0	USB 3.0	ETHERNET	WI-FI	AUDIO	WARRANTY
ASUS TUF GRYPHON Z97 ARMOUR EDITION	$253	2 X PCI-E 3.0/2.0 X16 (DUAL AT 8/8), 1 X PCI-E 2.0 X16 (VX4), 1 X PCI-E 2.0 X1	0	YES/YES	6 X SATA 3.0	4	4	INTEL I218V GBIT	NO	REALTEK ALC892	5 YEARS
ASUS MAXIMUS VII GENE	$249	2 X PCI-E 3.0/2.0 X16 (DUAL AT 8/8), 1 X PCI-E 2.0 X4, 1 X MINI-PCI-E 2.0 X1	0	YES/YES	8 X SATA 3.0	7	6	INTEL I218V GBIT	NO	REALTEK ALC1150	3 YEARS
ASROCK Z97M PRO4	$139	1 X PCI-E 3.0 X16, 1 X PCI-E 2.0 X16	2	NO/YES	6 X SATA 3.0	6	6	INTEL I218V GBIT	NO	REALTEK ALC892	3 YEARS
GIGABYTE Z97MX-GAMING 5	$178	1 X PCI-E 3.0 X16, 1 X PCI-E 3.0 X8, 1 X PCI-E 2.0 X 4, 1 X PCI-E 2.0 X1	0	YES/YES	6 X SATA 3.0	8	6	KILLER E2200	NO	REALTEK ALC1150	3 YEARS
MSI Z97M GAMING	$219	2 X PCI-E 3.0/2.0 X16 (DUAL AT 8/8), 2 X PCI-E 2.0 X1	0	YES/YES	6 X SATA 3.0 + 2 X ESATA	6	8	KILLER E2200	NO	REALTEK ALC1150	3 YEARS

Asus TUF Gryphon Z97 Armour Edition

READY FOR A ROUGH AND TUMBLE

Asus's "The Ultimate Force", aka TUF, series of motherboards have been around for several years now, and they all share one very unique feature. As you can see from the images, a special "armour" covering is available for the board that covers most of the front of the PCB. This is an optional extra that adds around $45 to the price of the board – the price we've used here includes the special covering. The aim of this is to deliver better airflow over the steamier components of the motherboard, but to be honest we're a little sceptical. An absolutely tiny fan is responsible for pushing air throw the very confined armouring, and we just can't see how this would be more effective at cooling than leaving the covering off and allowing a couple of 80mm case fans to do the job instead. There's also the fact that the armour covering is bound to become a dust trap over time, leaving us with the feeling that this expensive armour is nothing more than a gimmick.

However, the TUF moniker means more than just a plastic shroud on the board, as Asus claims that it equips these boards with a range of life-saving features. Asus claims the high quality power components ensure a smooth, reliable energy supply to the board, but they're not the only ones to make this claim; it seems every motherboard manufacturer has the best capacitors if their motherboard packaging is to be believed. However, what isn't deniable is the inclusion of special Electro Static Discharge protection around the USB, Audio and LAN connectors. While we can't really test these claims in the lab, the inclusion of a healthy five year warranty suggests that Asus is ready to put its money where its mouth is.

Along with the front armour, the Gryphon includes a back plate, which will stop the motherboard flexing under pressure. Given the small size of the board, we can't see this being an issue, as it tends to only plague much larger motherboards. One thing that we can't deny about the additional armouring is how striking it will look through a Perspex window – this is definitely the kind of motherboard that deserves a view to the outside world.

Asus has stocked this board with the most full-length PCI-E slots we've seen on a microATX board. Two of these are of the fastest PCI-E 3.0 x16 speed, but if both are in use they drop to x8 speeds. This makes the board fully compatible with Nvidia's SLI dual-GPU solution, a feature many of the microATX boards lack. Obviously

CrossFire support is also included, which doesn't require twin x8 lanes.

Six SATA 3.0 connections is par for the course on Z97 motherboards, though it's not the leader in this regard despite the high price tag. There's also no sign of SATA Express or M.2 connections, a surprising omission given how popular the latter is with small form factor builders, as it allows the installation of tiny OS drives around half the size of a stick of DDR 3. Speaking of which, four DDR3 slots are included, but the maximum supported speed of only 1866MHz is well below that of other boards. Audio support isn't quite as flashy as some of the more entertainment-oriented boards, using Realtek's older ALC892 chipset without any extra frills.

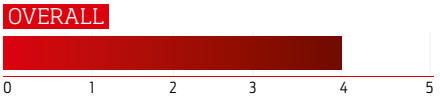
A quick glance at the PC Mark 8 Home result shows that this board came second last, which might seem unacceptable given the high price tag. Yet closer examination reveals that the performance difference was marginal, within a percentage point or two of the fastest boards, which is impossible to notice in day to day use.

As one of the most expensive boards in the roundup, the ASUS TUF Gryphon Z97 Armour Edition lacks some of the additional extras found on similarly priced boards, such as high quality audio or additional SATA and USB ports. We're also not convinced that the thermal armour is little more than a gimmick, though case modders will love the way it looks. However, the focus here is on longevity, and the five year warranty will go a long way to winning long-term users over.

KEY SPECS

$253 · www.asus.com.au

OVERALL



Asus Maximus VII Gene

ONE FOR THE GAMERS

Compared to some of the other microATX motherboards in the roundup, the front face of the PCB on this product looks surprisingly clutter free. Don't let the looks fool you though, as this little pocket rocket packs the necessary punch that serious gamers are looking for.

It's obviously intended for gamers thanks to the "Republic of Gamers" (aka ROG) branding splashed all over the box. A special group within Asus that designs products specifically for gamers, the ROG brand has become synonymous with premium products that deliver the extra features gamers need. In the case of the Maximus VII Gene, the most obvious feature is the audio riser card included in the box. Called the "SupremeFX Impact II" sound card, it's actually based around the Realtek ALC1150 codec found in a couple of other products. However, the fact that it's isolated from the motherboard on its own riser helps to keep EMF noise to a minimum, while the use of quality ELNA capacitors help bring out the best of the Realtek chip. We tested it with a set of Audio Technica headphones, and were pleasantly surprised when it automatically detected the correct impedance to use with our cans. The sound quality was excellent, easily matching the standalone Asus Xonar DG we've used in the past with headphones, without taking out a PCI-E or PCI slot.

That's a good thing, as there aren't too many expansion slots on this board, with just twin PCI-E x16 slots, a single PCI-E x4 slot, along with an aging mini-PCI-E 2.0 x1 slot. Thankfully there's also an M.2 connection for speedy OS drives, tucked away between the two main PCI-E slots. Given the board's gaming focus, the inclusion of both SLI and CrossFire support is a given. As expected, when using the PCIe 2.0 x4 slot, both the mPCIe 2.0 x1 and M.2 slots are disabled, but this is an issue across nearly all Z97 boards.

Overclockers will find a raft of features that make tweaking CPU and memory speed a breeze on this board. For starters, the inclusion of a Start and Reset button on the board makes test bench work very convenient, as users won't need to fiddle with a screwdriver and pins to figure out how to reboot a CPU pushed too hard. ASUS's MemOK button also runs a quick diagnostic test on the memory, helping to push the board to the maximum supported memory speed of 3300MHz, one of the fastest in the roundup.

A whopping eight SATA 3.0 ports are included, though we wish you luck finding a small form factor case that can accommodate so many storage devices. Still, it's nice to have the option. There's also plenty of ports for USB devices, with seven USB 2.0 and six USB 3.0. Asus has stuck with Intel's I218V Gbit Ethernet connector, but has included its own GameFirst III proprietary software solution for packet control. This can be set to prioritise certain types of traffic, but most gamers will simply set it to gaming mode and forget it.

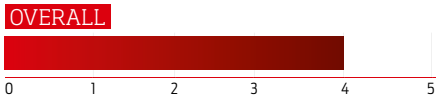
Given Asus's high price tag and super slick overclocking features, we weren't surprised to see this motherboard take out the top spot in the benchmarks. It's a bit of a hollow victory though, as all of the boards performed within a whisker of each other.

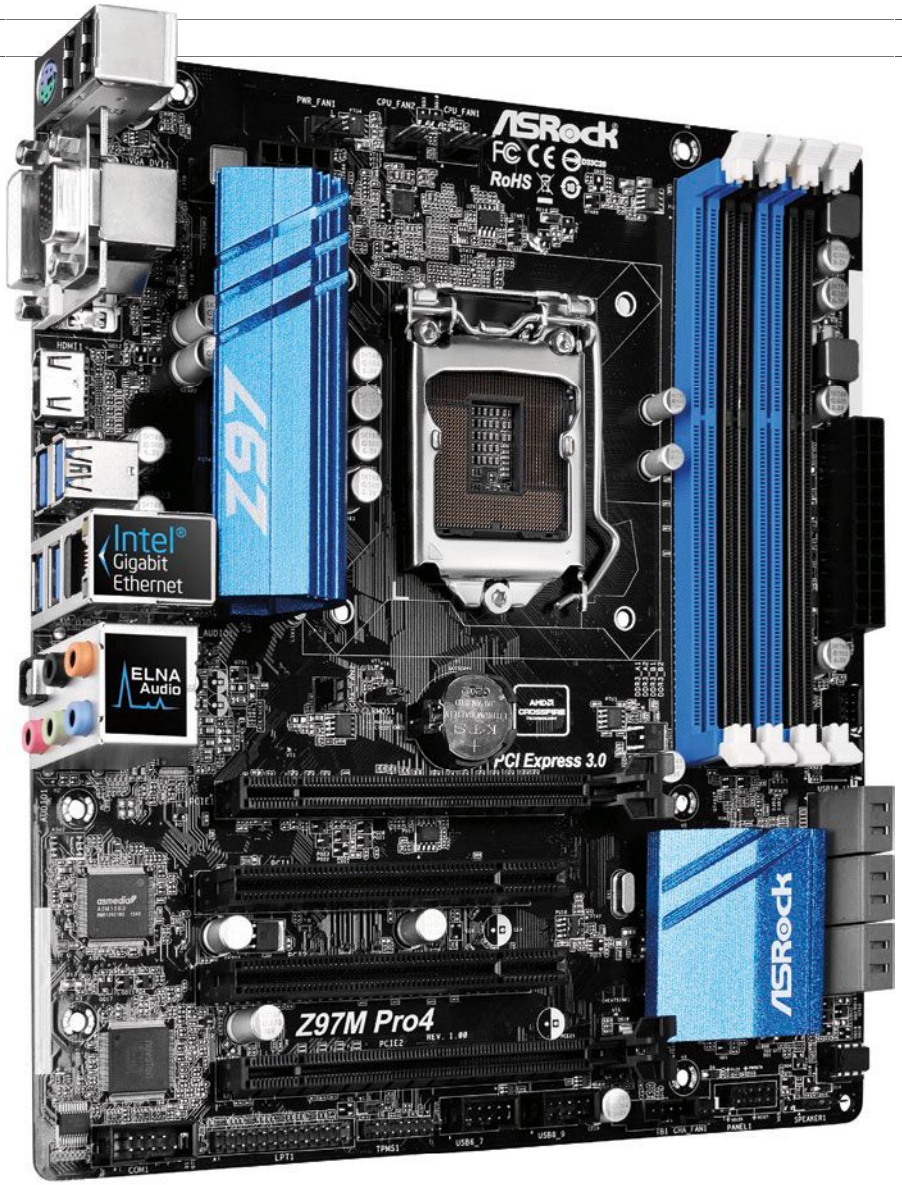
It might be one of the most expensive boards in the roundup, but for gamers looking for a no-compromise backbone to their ultra-portable gaming rig, the Asus Maximus VII Gene has a lot to offer. Most important of all is the premium audio solution and dual-GPU support, while the overclocking features are a nice extra. If you've got the cash to spare, there is nothing better for gaming, but Gigabyte's offering delivers most of the features with less of a blow to your bank balance.

KEY SPECS

$249 · www.asus.com.au

OVERALL





ASRock Z97M Pro4

READY FOR YOUR BUDGET BUILD

Priced at just $139, the ASRock Z97M Pro4 is roughly half the cost of the more expensive boards in this roundup. As such, it'd be unfair to expect the wealth of features found on the premium boards, but ASRock has a reputation for delivering surprising value in its affordable products. Can the Z97M Pro4 live up to this tradition?

Opening the box reveals a distinct lack of extras – there's a manual, backplate and a couple of SATA cables. Compared to the overflowing boxes of goodies delivered with higher price tags, it's a rather stark presentation. The same can't be said of the front of the motherboard though, as ASRock appears to have put every square centimetre to use. Most obvious are the expansion slots, with a single PCIe 3.0 x16 , another PCIe 2.0 x16, and twin PCI slots sitting between these. This presents a couple of issues; firstly, the lack of twin PCI-E 3.0 slots means no SLI support, though CrossFire is. The biggest issue though is the placement of the first PCI slot, which will be impossible to use if a GPU resides in the first PCI-E slot. Despite this, the Z97M Pro4 is the only board in our roundup to still include legacy PCI slots, which could be reason enough to choose this product for those with old PC products that they don't want to shelve.

The onboard chipset cooling is extremely simple compared to other boards, with a couple of very basic aluminium heatsinks, but this isn't likely to be an issue unless you're into extreme overclocking. It should be possible to do a spot of simple overclocking though, and the maximum supported memory frequency of 3100MHz is very surprising for such a cheap contender.

As expected for this price point, the range of features isn't going to set the world on fire, but it's also not a long way off boards twice the price. Six SATA 3.0 ports are plenty for most users, but you can forget about any M.2 or SATA Express connections. Six USB 3.0 ports sit alongside another six USB 2.0 ports, though you'll obviously need to use USB headers for several of these, the same as every other microATX motherboard.

The onboard audio is based around Realtek's older ALC892 codec, the same component found in the ASUS TUF Gryphon Z97 Armour Edition. ASRock claims that it has been improved with the use of ELNA capacitors, but we did notice a level of hiss that wasn't present on more entertainment focused boards. A surprising inclusion, which is found on many of ASRock's boards, is the Thunderbolt 2 header. This dedicated set of pins allows the installation of a Thunderbolt 2 add-on card, and there's no mention of it knocking out any of the PCI-E/PCI slots if used. Note that this add-on card costs extra though, and we couldn't seem to find any Australian retailers selling it yet, which makes it a bit of a non-feature. Intel's zippy I218V Gigabit LAN connection is included and, like Asus, we see ASRock offering its own packet-prioritisation software, ensuring the lowest possible ping for gamers.

Despite this board's low price, the performance result from the PCMark 8 Home benchmark shows that cost doesn't necessarily have to impact speed. It might have posted the lowest score of the bunch, but it was still within a percent or two of the fastest boards.

The ASRock Z97M Pro4 is a simple, no-frills kind of product. Built to the lowest possible cost, it lacks many of the features that high-end, performance users need. But that's the point, as this motherboard is aimed at those who want a simple desktop or HTPC machine on the tightest possible budget. Considering it's around half the price of the more expensive microATX boards, ASRock has managed to retain a decent amount of features, making this an excellent proposition for those who don't have money to spare.

KEY SPECS

$139 · www.asrock.com

OVERALL

MSI Z97M Gaming

HERE COMES ANOTHER ONE...

Sitting squarely in the middle of the price range between the Gigabyte and Asus gaming boards is MSI's answer to gaming in a small form factor. The MSI Z97M GAMING board wears its intended use proudly on its sleeve, but has one ace up its sleeve that could see it the preferred board of choice for many keyboard warriors.

To put it bluntly, this is a very attractive motherboard. There's something about the masculine heatsinks and black PCB that makes this board stand out from the pack, which could make it the perfect partner for the Perspex-inclined.

There's also a healthy range of PCI-E slots for gamers and HTPC owners, who tend to use more add-in cards than the norm. Twin PCI-E 3.0 x16 slots are included, which fall back to 8/8 speeds if both are in use, which is normal for the Z97 chipset. This makes it fully compatible with both AMD and Nvidia's multiple GPU solutions, a must for serious gamers. Tucked away next to each of these full-length PCI-E slots are two PCI-E 2.0 x1, perfect for sound cards or video capture cards. An M.2 connection rounds out the peripheral options, and it's hidden away between the two main PCI-E slots, as per the expected way for these.

As with the other gaming-focused boards, audio takes special precedence on this motherboard. MSI's solution is called Audio Boost 2, and once again uses SoundBlaster branding to impress. Yet once again closer examination reveals that the sound chip is provided by Realtek in the form of the ALC1150, the exact same chip found on the other boards. It's got very similar EMF shielding to Gigabyte's solution, but lacks the dedicated add-in card of ASUS. High quality audio capacitors help to bring out the best of Realtek's solution, and our listening tests proved this solution to be on par with Gigabyte's OP-AMP sound system.

Also following in Gigabyte's footsteps is MSI's decision to use the Killer E2200 networking chip, and once again we lean towards Intel's solution when it comes to dependability and reliability. Having said that, the ability to prioritise different types of traffic is a boon with the Killer software, especially for gamers who choose to game while downloading or streaming media, a big no-no in our books, even with QoS software in action – ping is king!

MSI makes much ado of its Military Class 4 components, which it claims deliver much lengthier lifespans than competing products. While we don't have a time machine, and thus can't test these claims, the inclusion of a standard three year warranty is identical to the other gaming boards.

Basic overclocking features are included in the easy to use BIOS, while the maximum supported memory speed of 3300MHz is the highest of the bunch. Be prepared to pay through the nose for memory that can run at this speed though, for very little performance increase in games or entertainment applications. Only video editors and those working with large sample sizes of data will truly appreciate such high speed memory.

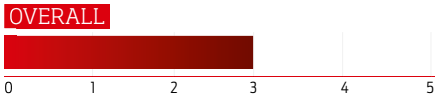
Once again the performance numbers prove how close the performance of motherboards made by different manufacturers but using the same Intel chipset turns out to be once the BIOS revisions have been made. With the second highest score in the roundup the MSI board flexes its slightly larger biceps than the competition.

At $40 more than the Gigabyte board, we're not really sure why gamers would pay the extra premium, as both seem extremely similar. If the MSI has one edge, it's in the aesthetics department, likely making this the preferred option for many case modders.

KEY SPECS

$219 · www.msi.com

OVERALL



Gigabyte Z97MX-Gaming 5

GAMING PROWESS THAT COMES CHEAP

Proving that you don't need to pay an arm and a leg for a fully featured gaming microATX motherboard, the Gigabyte Z97MX-Gaming 5 aims to deliver everything gamers need at a price point that is slightly more affordable than the likes of Asus's ROG product. At around two thirds of the price of the Asus Maximus VII Gene, how many corners has Gigabyte had to cut to keep the budget in check?

Not many, it appears. First and foremost are the PCI-E 3.0 x16 and PCI-E 3.0 x8 slots, which give this board full compatibility with both Nvidia's SLI and AMD's CrossFire multi-GPU solutions. There's a third full length PCI-E 2.0 x4 slot for add-on cards, along with a final PCI-E 2.0 x1 slot. As expected, PCI users are out of luck, but that's true of most Z97 microATX boards.

Along with this focus on GPU power comes enhanced audio, in the form of Gigabyte's upgradeable OP-AMP solution. This debuted a few years ago, and allows the user to upgrade the onboard amplifier to one of the many third party solutions found online. While the software interface suggests the hardware solution is powered by SoundBlaster, it turns out that this brand is only responsible for the software. The audio hardware is based around the same Realtek ALC1150 audio chipset found in the better gaming boards, but has been improved with EMF isolation and user-configurable headphone impedance. Our listening tests proved it to be a capable solution, if not quite as crystal clear as the add-in card found in the more expensive ROG audio solution. HTPC owners can ignore the audio feature completely though, using the HDMI port to bitstream a pure digital signal to their decoder. Having to manually adjust the dip switches on the motherboard to suit the impedance of your headphones might sound like a hassle, but unless you're continually testing new headphones it's likely you'll only need to set this once and then never touch it until you upgrade your listening equipment.

Unlike Asus, Gigabyte has gone for Killer's E2200 gaming network solution. While this is promoted as a plus for gamers, we have to point out the few issues we've had with it in the past, with the software sometimes not detecting certain games, causing them to not work at all online. The fix is as simple as editing a text file, but unless you know about it, it can be a baffling problem. The software has improved greatly over the last year or so though, so it's not quite the issue it once was. We still lean towards Intel LAN controllers for overall performance and reliability though.

Six SATA 3.0 connectors provide plenty of storage options, which are expanded by the inclusion of both M.2 and SATA Express connections, giving it a theoretical leg up on the Asus board in this regard, which only includes M.2. We say theoretical though, as M.2 seems to be winning the high-speed connection war, with SATA Express drives harder to find than hen's teeth.

Overclockers will miss the onboard features that make the Asus Maximus VII Gene so easy to overclock, yet Gigabyte's strong overclocking heritage makes itself known in the excellent BIOS design. Hitting the maximum potential of your Devil's Canyon shouldn't be an issue on this motherboard, while the maximum supported memory frequency of 3100MHz is close to the best of them.

As expected, performance on this motherboard was top-notch. Posting a score of 4123 in PC Mark 8's Home benchmark sees it within a percentage point of two, repeating the theme that most motherboards based on the same chipset will eventually end up performing almost equally once their BIOS bugs have been ironed out.

Gigabyte has delivered a fantastic gaming board in this product, one that is equal to the Asus in many ways. It mightn't have some of the overclocking features of the Asus product, but most gamers won't need these anyway. If you're looking for a gaming board that has excellent audio and multiple-GPU support at a great price, you can't go wrong with the Z97MX-Gaming 5.

KEY SPECS

$178 · www.gigabyte.com.au

OVERALL

GROUP TEST

HIGH-SPEED STORAGE

TODAY'S DEMANDING PROFESSIONALS NEED MORE THAN SIMPLE, SINGLE-DRIVE STORAGE, BUT WHICH SUPER-SPEED DRIVE SHOULD YOU BUY?

If there's one thing you can be sure about with storage, it's that just when you think you have enough of it, new applications will come along to prove you wrong. Photography, video, audio and design professionals know this better than anyone: as they transition from editing 1080p, Full HD video to the new 2K and 4K formats, or shift up to shooting with the data hogs like the latest 36-megapixel full-frame cameras, additional space and bandwidth become essential.

Let's look at the numbers. Raw, uncompressed 4K video requires a staggering 9GB/sec of bandwidth to edit a single stream; even when compressed to Apple's HQ 4K format, you're looking at 106MB/sec, or 212MB/sec if you want to composite two clips.

Meanwhile, raw files from a full-frame Nikon D810 can now push above 50MB per shot. Suddenly, that consumer-grade USB 3 or old FireWire 800 drive no longer appears to be up to the task.

Enthusiast users are also facing new requirements. More PCs, workstations and high-end laptops are launching with smaller, faster SSDs, and while these are great for performance and responsiveness, they're not as good for working on multiple projects or spinning up virtual machines. Even those who simply want to store and stream media around the house face challenges. As high-resolution audio formats and 4K codecs and content enter the mainstream, existing storage solutions will struggle to keep up.

Luckily, a new generation of storage device is emerging. Combining speedy SSDs, RAID and faster USB 3 and Thunderbolt 2 interfaces, they're poised to handle the explosion of 4K media and high-resolution photos, giving professionals and enthusiasts what they need to get things done.

FORM FACTORS

High-speed storage devices fall into three classes. First, there are the basic portable and desktop drives. The former are often powered over USB; the latter are usually powered by a separate power supply and designed to sit on a desk. Professional and enthusiast drives are more robust than consumer models, provide better cooling and are faster – the norm is either a 7,200rpm magnetic hard disk with a generous cache, or alternatively a high-performance SSD.

Beyond this, we have RAID devices, packing between two and six hard disks or SSDs into an enclosure with a USB 3, Thunderbolt or Thunderbolt 2 interface. With the RAID configured to a RAID0 striped configuration, you get a huge boost in performance and all the available capacity, although there's an associated risk: should one drive fail, you could lose all your data. Configure it to RAID1 or RAID5 and you take a hit on performance and capacity, but gain the benefits of redundancy; your data is safe should one drive fail. In applications such as video editing, where performance is all

important, RAID0 is usually the preferred option, but you might want a second drive providing backup.

RAID is ideal for professionals and high-end enthusiasts, but it's pricey. There's also a learning curve in setting up and managing arrays and logical drives, even if the hard work has been done for you, as is usually the case.

Finally, we have direct-attached storage (DAS) and network-attached storage (NAS) devices with larger RAID configurations, more exotic interface technologies and/or more complex storage pools. You'll find these in professional environments, but they fall outside the remit of this Labs.

USB 3 OR THUNDERBOLT?

USB 3 has a maximum bandwidth of 625MB/sec, with the forthcoming USB 3.1 revision doubling that to 1,250MB/sec. That's a lot of bandwidth – enough to cover several 4K streams. The original Thunderbolt specification, however, goes one better, handling two 1.25GB/sec channels, while Thunderbolt 2 combines them for 2.5GB/sec of bandwidth.

But while Thunderbolt 2 wins on theoretical performance, the situation is more complex. First, with most single-drive devices, the bottleneck isn't the interface but the drive. With a given SSD or hard disk, Thunderbolt and USB 3 tend to run neck and neck; it's only once you go to the faster RAID0 configurations that Thunderbolt 2 comes into its own.

Second, only a few – mostly Apple – PCs and laptops support Thunderbolt 2, and they cost more. Add the fact that both Thunderbolt and Thunderbolt 2 drives carry a premium and it's clear there are savings to be made by opting for USB 3, which is now supported across a wider range of systems.

HOW WE TEST

To put these high-performance drives through their paces, we connected them to an Apple Mac Pro (2013) with OS X 10.9 and a Windows 8.1 Boot Camp partition installed. Drives were connected via USB 3 and Thunderbolt as appropriate. On OS X, we ran a series of file-transfer tests, with one handling 4.4GB of RAW photos and another more than 10.2GB of raw 4K footage from a Red 4K video camera.

We also tested the drive's performance with small files and larger files using the QuickBench synthetic benchmark. Switching to Windows, we then ran additional tests using the ATTO disk benchmarking utility and CrystalDiskMark to obtain sequential and random read/write results across a range of scenarios.

All the drives in this Labs were tested using an Apple Mac Pro

		LABS WINNER
	Buffalo MiniStation DDR HD-PGDU3	CalDigit T3 with Thunderbolt 2
OVERALL	★★★☆☆	★★★★★
Price	$225	US$899
Manufacturer	buffalo-technology.com	caldigit.com
Warranty	2yr RTB	5yr RTB
CORE SPECIFICATIONS		
Form factor	Portable	Desktop RAID
Number of bays	1	3
Supplied capacity	1TB	9TB
HDDs supplied (unformatted capacities)	w RAM cache	3 x 4TB
SSDs supplied (unformatted capacities)	N/A	N/A
Replaceable drives	✗	✓
Maximum capacity	N/A	15TB
USB 3	✓	✗
USB 3 (type)	✓ (micro-USB)	✗
Thunderbolt	✗	✓
Thunderbolt 2	✗	✓
Power supply	Bus-powered	External power brick
Software supplied	Buffalo Tools	✗
Accessories supplied	USB 3 cable	✗
Quoted write speed	300MB/sec	580MB/sec
Quoted read speed	400MB/sec	580MB/sec
Supported RAID levels	N/A	0, 1, JBODs
Default configuration	N/A	RAID0
RAID type	N/A	System level
Supplied file system	FAT32	HFS+
OS support	Windows 8.1, 8, 7; OS X 10.7+	Windows 8.1, 8, 7; OS X 10.6.8+
PHYSICAL ATTRIBUTES		
Indicators	1 x activity, 4 x cache	1 x power, 3 x status
Locked bays	N/A	✓
Kensington lock	✗	✓
Dimensions (WDH)	81 x 132 x 18mm	135 x 241 x 116mm
Weight	199g	4.5kg

< Mechanical hard disks still rule the roost when it comes to cost per gigabyte

SSDS VS HARD DISKS

There are also trade-offs to be made with the type of drive employed by your storage unit. For single-drive desktop and portable storage, SSDs will deliver maximum performance, but you'll lose out on price and capacity over hard disks.

An SSD will probably give you enough space to work on one or two projects, but it isn't as good for archiving and accessing huge quantities of material or working on a larger project. This is where the additional capacity of a hard disk comes in.

An SSD RAID unit can give you the best of both worlds, combining multiple SSDs into one high-performance storage pool. However, the costs rise dramatically to match this level of peformance.

OTHER CONSIDERATIONS

Other things to look at include expansion potential – are there drive upgrades available, should you need them further down the track? – and native formatting. For obvious reasons, most Thunderbolt 2 drives ship with an OS X-friendly HFS+ file system preinstalled. Windows will happily read from this, but it won't normally write to it, which means you'll have to re-prep the drive for Windows before deployment. Although this isn't a difficult task, the process doesn't always run smoothly.

				RECOMMENDED	
G-Technology G-Drive with Thunderbolt	LaCie d2 Thunderbolt 2	Lexar Professional Workflow DD512	OWC Mercury Elite Pro Dual	OWC ThunderBay 4	Promise Pegasus2 M4
★★★☆☆	★★★★☆	★★★☆☆	★★★★☆	★★★★☆	★★★☆☆
$469	$699	$219	$389	$724	$1495
g-technology.com	lacie.com.au	au.lexar.com	macfixit.com.au	macfixit.com.au	promise.com
3yr RTB	3yr RTB	2yr RTB	3yr RTB	3yr RTB	2yr RTB
Desktop	Desktop	Portable	Desktop RAID	Desktop RAID	Desktop RAID
1	1 (+1 for optional SSD)	1	2	4	4
4TB	6TB	512GB	Supplied empty	Supplied empty	4TB
1 x 4TB	1 x 6TB, 64MB cache	N/A	N/A	N/A	4 x 1TB
N/A	Optional 128GB	1 x 512GB	N/A	N/A	N/A
✗	✗	✗	✓	✓	✓
6TB	6TB	N/A	6TB	6TB	4TB
✗	✓	✓	✓	✗	✗
✗	✓ (micro-USB)	✓ (micro-USB)	✓ (Type B)	✗	✗
✓	✓	✗	✓	✓	✓
✗	✓	✗	✗	✓	✓
External power brick	External power brick	Bus-powered	External power brick	Internal	Internal
✗	Intego Backup Assistant (OS X), LaCie Genie Timeline (Windows), LaCie Private-Public	✗	Various utilities and shareware	SoftRAID 5, various utilities and shareware	Promise Utility
Thunderbolt cable, USB 3 cable	Thunderbolt cable, USB 3 cable	USB 3 cable	Thunderbolt cable, USB 3 cable	Thunderbolt cable, USB 3 cable	Thunderbolt cable
Not stated	Not stated	245MB/sec	442MB/sec	1,342MB/sec	Not stated
226MB/sec	220MB/sec	450MB/sec	421MB/sec	1,342MB/sec	Not stated
N/A	N/A	N/A	0, 1	0, 1, 5	0, 1, 5, 6, 10
N/A	N/A	N/A	RAID0	RAID5	RAID1
N/A	N/A	N/A	Hardware	SoftRAID 5	System level
HFS+	HFS+	ExFAT	HFS+	HFS+	HFS+
Windows 8.1, 8, 7, Vista; OS X 10.7+	Windows 8.1, 8, 7; OS X 10.6+	Windows 8.1, 8, 7; OS X 10.6+	Windows XP+; OS X 10.8+	Windows 7 SP1+; OS X 10.6+	Windows 8.1, 8, 7; OS X 10.8+
1 x status	1 x status	5 x capacity, 1 x status	N/A	1 x power, 4 x status	1 x power, 8 x status
N/A	N/A	N/A	✗	✓	✗
✓	✓	✗	✓	✓	✓
235 x 130 x 48mm	60 x 217 x 130mm	74 x 60 x 23mm	71 x 229 x 133mm	245 x 135 x 177mm	127 x 167 x 107mm
1.4kg	1.5kg	164g	2.5kg	3.9kg	2.9kg

In depth: the future of storage media

A LOOK AT THE TECHNOLOGY BEHIND THE SCENES THAT WILL ENSURE WE CONTINUE TO SEE HIGHER-CAPACITY STORAGE MEDIA IN SMALLER PACKAGES - INCLUDING THE USE OF DNA

^ Samsung is the first manufacturer to offer commercial V-NAND drives

While developments in magnetic and solid-state storage tech continue to see performance improve, capacity grow and prices fall, current technologies won't last forever. Even the perpendicular magnetic recording (PMR) technology that boosted capacity and speeds in the middle of the last decade is beginning to run out of steam, as platters reach the superparamagnetic limit – the point at which the magnetic bits that hold the data become so small they can no longer sustain their charge.

Meanwhile, NAND flash memory – used in current SSDs – has its own limitations. While wear-levelling techniques have increased the lifespan of SSDs, each block of memory is only good for 10,000 to 30,000 writes.

What's more, NAND faces its own challenges in terms of improving capacity, while current NAND SSDs only hint at the performance of potential SSDs to come.

THE HEAT IS ON

So far, PMR has been enough to keep areal density (the density of bits of data stored in a given space), drive capacity and transfer speeds heading upwards. More recently, shingled magnetic recording (SMR), a new parallel arrangement of tracks on the platter, has helped single-platter mechanical drives reach 8TB, with the chance to go further. Even this, however, won't be enough to keep magnetic media moving onwards and upwards indefinitely.

Two key technologies might help, the first being heat-assisted magnetic recording (HAMR). HAMR gets past that dastardly superparamagnetic effect by using a tiny laser to heat the equally tiny portion of the magnetic disk onto which the data is being written. On a conventional hard disk drive, if the areal density is much beyond 1TB per square inch, the data site becomes so tiny that the magnetic medium needs a very high coercivity – resistance to the effects of magnetic fields – in order to avoid changing with minor thermal fluctuations. The only problem is that as the coercivity rises, it becomes difficult – if not impossible – to write to the medium.

> *"As long as magnetic hard disk technology is the best way to get higher capacities at lower prices, it's here to stay"*

However, coercivity can be temperature-dependent. Heat up the data site and coercivity drops, enabling you to write to it. The spot then cools quickly, coercivity rises and the data is locked in place. The result? Areal density can be pushed up, increasing the amount of data that can be stored on a platter, without making the drive unreliable. In fact, it should eventually be possible to fit up to 50TB of data in a single square inch.

For a long time, HAMR looked like one of those promising technologies that might never happen, but in March 2012, Seagate demonstrated a prototype HAMR drive with an areal density of 1TB per square inch. Commercial drives could hit the shelves by the end of 2016, with 2TB 2.5in drives and 6TB 3.5in drives among the first to benefit from the technology.

After that, we could see HAMR drives with an areal density of up to 10TB per square inch, a figure that should rise even higher in the future.

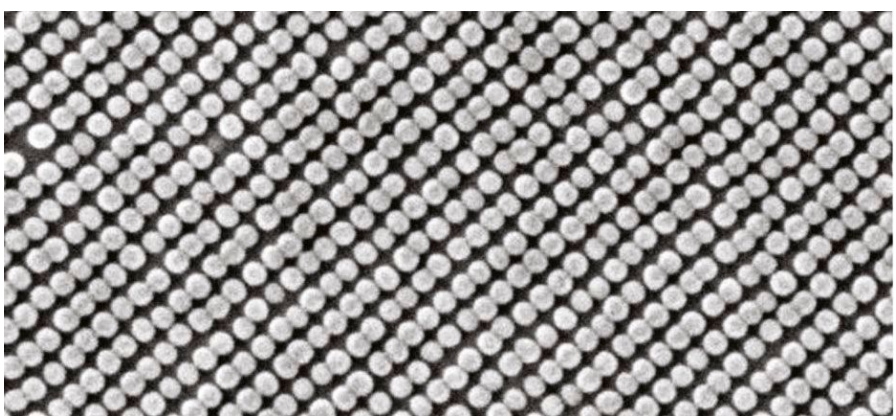
PATTERNED MEDIA

HAMR isn't the only technology that might help push magnetic media further. Bit-patterned media (BPM) also shows plenty of potential.

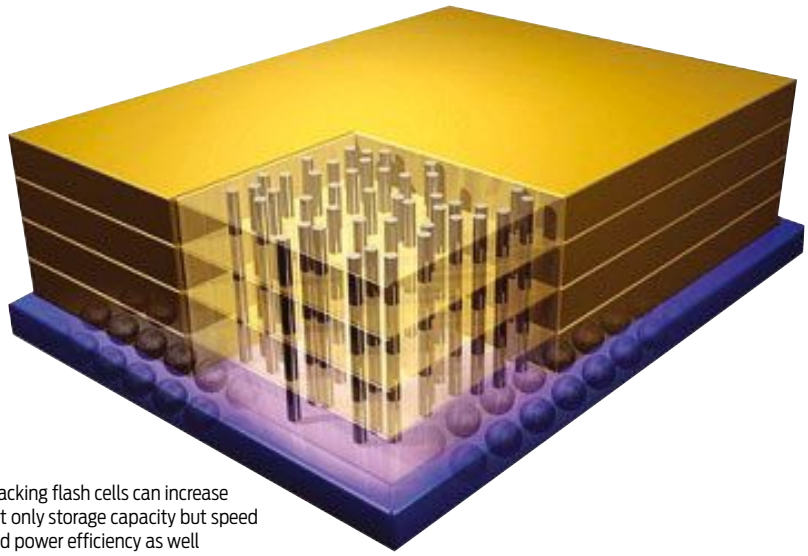
In a conventional hard disk, the magnetic media is one featureless, continuous film, and data is written to the grains within that film. BPM, however, transforms it, using nanolithography to form patterns in the media, giving each bit of data its own magnetic island on the surface. The advantage here is that there's a stronger energy barrier between the islands than between the grains on a conventional platter, decreasing the impact of the superparamagnetic effect. With islands 10nm wide, it should be possible to reach areal densities of 20TB to 300TB per square inch. Researchers in Singapore have already successfully demonstrated media with an areal density of 3.3TB per square inch,which is a significant improvement on current technology.

SOLID-STATE OF THE ART

As long as magnetic hard disk technology is the best way to get higher capacities at lower prices, it's here to stay. All the same,



V Dividing magnetic media into "islands" makes it possible to achieve higher densities



^ Stacking flash cells can increase not only storage capacity but speed and power efficiency as well

we can expect SSD technology to develop further in the next few years, with positive effects on capacity, performance and cost.

We're already seeing a transition from the NAND flash technology used in the majority of current SSDs to 3D NAND technologies – or, in Samsung's terminology, V-NAND. Regular NAND flash memory has cells that contain the data arranged side by side, horizontally. This has worked fine up until now, but as cells are packed in more densely, there's a risk that charge can flow from one to the next, resulting in corruption, while the cells themselves become more difficult to pattern using photolithography. V-NAND, however, stacks the cells vertically to make multi-bit cells 24 to 32 layers deep. Combine this with a different structure and insulation and it's possible to gain more from the same area of wafer, increasing capacity and speed, while improving write cycles and boosting power efficiency.

V-NAND drives are already on the market in the shape of Samsung's 850 Pro SSD and a second-generation line-up of 128GB, 256GB and 512GB SSDs. Intel has also announced plans to ship its own 3D NAND drives in the second half of 2015.

One potential alternative to V-NAND is phase-change memory, a new form of solid-state storage in which a chalcogenide glass is rapidly heated, converting it from a crystalline to an amorphous phase. In fact, it's possible to switch the glass to a number of distinct, intermediary states, resulting in a storage medium that can hold multiple bits of information.

In theory, phase-change memory could be used to produce SSDs that come closer to the performance of system RAM, with lower latency than NAND, faster read and write times, and write cycles that go into the millions. For the moment, however, it's seeing more use in hybrid devices, such as IBM's Project Theseus; this combines phase-change memory, NAND and DRAM in a prototype storage device that can outperform equivalent NAND SSDs by between 12- and 27-fold.

EXOTIC OPTIONS

This is all very exciting, but the real future of storage might be something else altogether. Molecular memory, for example, would see data stored as individual molecules, using the magnetic state of each molecule to represent a one or a zero.

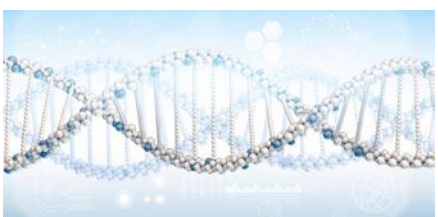
This concept has always had problems, not least the fact that prototype molecular memory systems have relied on cooling materials to near absolute zero. In 2013, however, chemists from the Indian Institute of Science Education and Research in Kolkata showcased a new molecule that could be arranged at temperatures nearer to room temperature. It's possible that molecular memory could reach areal densities of an incredible 1,000TB per inch.

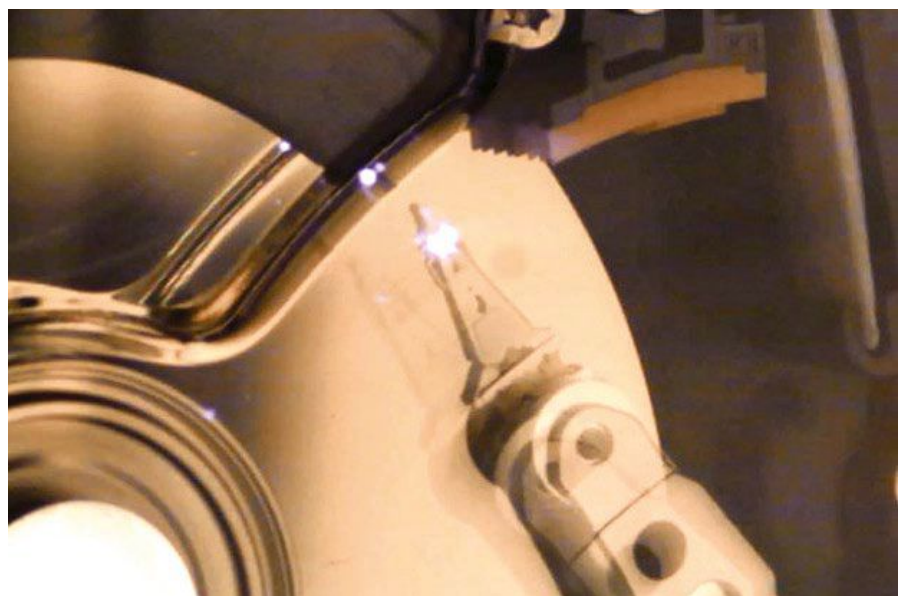
REALLY EXOTIC OPTIONS

Yet the answer could be even closer to home. DNA, for example, is an incredibly efficient storage medium; one gram of a single-stranded genome could be used to store 700TB of data.

In 2012, a team at Harvard University digitised an entire book on genome engineering, using chemical processes to store it as vDNA then make 70 billion copies, effectively storing 44 petabytes of data in a few grams of biological material. That's an awful lot of data in a really tiny space – who knows what applications it might power?

v Solid-state technology could give way to data stored in DNA





CalDigit T3 with Thunderbolt 2

WELL DESIGNED AND QUIETLY CAPABLE, THIS IS A BRILLIANT THUNDERBOLT 2 STORAGE DEVICE FOR DEMANDING USERS

While you can't exactly describe it as compact or stylish, the CalDigit T3 with Thunderbolt 2 is about as unobtrusive as a three-bay 3.5in RAID is going to get. At only 135mm wide and 116mm tall, it's noticeably smaller than the OWC ThunderBay 4, and from the front it doesn't appear to be much larger than the pint-sized Promise Pegasus2 M4, although it's a good 60mm deeper than its sibling.

The aluminium enclosure is both tough and good-looking, with chunky rubber feet on the underside to minimise vibrations being transmitted to your desk. Discreet status indicators sit at the bottom of the front panel, right next to the circular power button.

Maybe it's the ribbed-aluminium casing, or the ambient-temperature-controlled smart fan, but the T3 with Thunderbolt 2 is relatively quiet by desktop RAID standards. You can hear it humming away above the near-silence of the Mac Pro, but it's a restrained noise in comparison to the racket produced by the OWC and Promise units reviewed elsewhere in this group test.

This is one drive you won't mind sitting on your desk while you work, although do bear in mind that you'll need to find extra space for the hefty external power brick.

OPTIONS AND SETUP

The T3 is available in a variety of configurations, covering all sorts of budgets and requirements. The Thunderbolt 2 version we tested ships with a choice of 6TB, 9TB, 12TB and 15TB HDD arrays, and you can get one with a 4TB SSD array inside as well. The only disappointment is the lack of USB 3; to run this RAID unit, your desktop machine or laptop will need support for either Thunderbolt or Thunderbolt 2.

The drives are replaceable, fitting into slide-in caddies that lock in place with a security hex key, releasing only when the tiny hole next door is prodded with the special thick pin provided in the box. This may not be hugely secure, but it should prevent drives being accidentally ejected in the middle of a job. In practice, we found the mechanism slightly awkward, and it's clear that CalDigit doesn't want you removing the drives anyway: note the placement of a "warranty void if removed" sticker over one screw in each caddy.

The T3 came optimised for maximum performance, preconfigured as a RAID0

> rom the front, the T3 is as unobtrusive as desktop RAID units get

< The only disappointment is the lack of USB 3; the T3 is Thunderbolt-only

striped array. If you prioritise resilience over raw performance, though, it's easy enough to change that configuration using OS X's standard Disk Utility or the Windows Disk Management tool.

In general, we prefer this approach to proprietary software. What's more, where the Promise Pegasus2 M4 had us messing around with drivers, and the OWC drives forced us to fiddle with system files to get them working under Boot Camp, the T3 worked without a hitch. Windows users will still need to reformat the array from HFS+ to NTFS, but the T3 is a little more Windows-friendly.

PERFORMANCE

With the included Toshiba drives doing the heavy-lifting and Thunderbolt 2 handling the connection, the CalDigit T3 is impressively speedy.

Where some drives took more than a minute to copy 10.2GB of 4K video files, the CalDigit took less than 22 seconds; only the OWC ThunderBay 4 has faster read speeds.

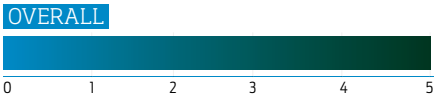
On write speeds it trades punches with the OWC, losing out on sequential writes but performing better when it comes to random writes. While the ThunderBay has a slight edge on performance in some scenarios, the CalDigit has more than enough speed to handle demanding virtualisation and 4K video-editing applications. It's smaller than the ThunderBay 4, but still very powerful.

VERDICT

The T3 is an expensive RAID device, but when you factor in the drives and the capacity included, it's good value. The 9TB of storage should be enough for the most demanding professional applications, and we found the T3 easier to use and work with than the other units here, particularly under Windows. Capacities up to 15TB are available, or up to 3TB in an SSD array.

Given this, a generous five-year RTB warranty, storming performance and excellent design, we're happy to crown the T3 with Thunderbolt 2 as our Labs winner, and with a perfect score it also earns a Recommended award.

OVERALL



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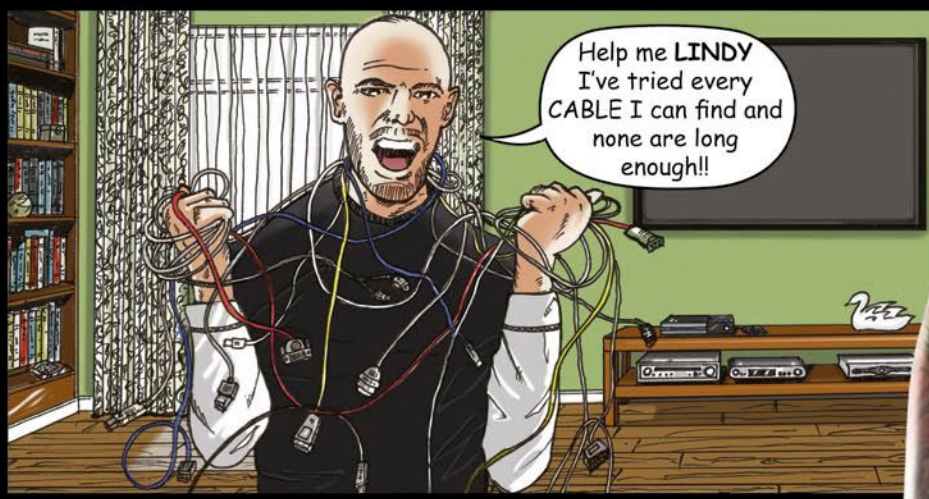

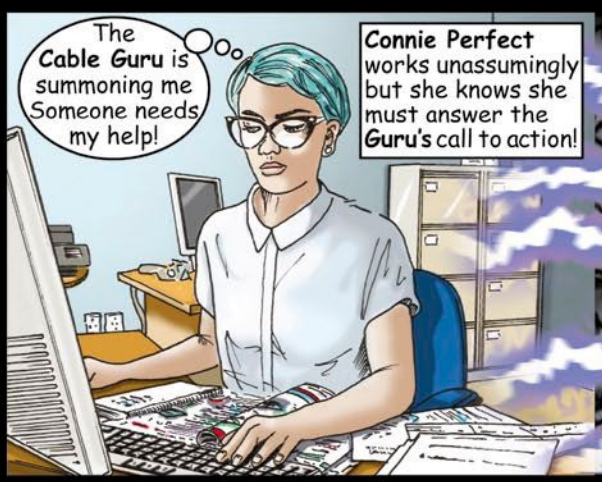

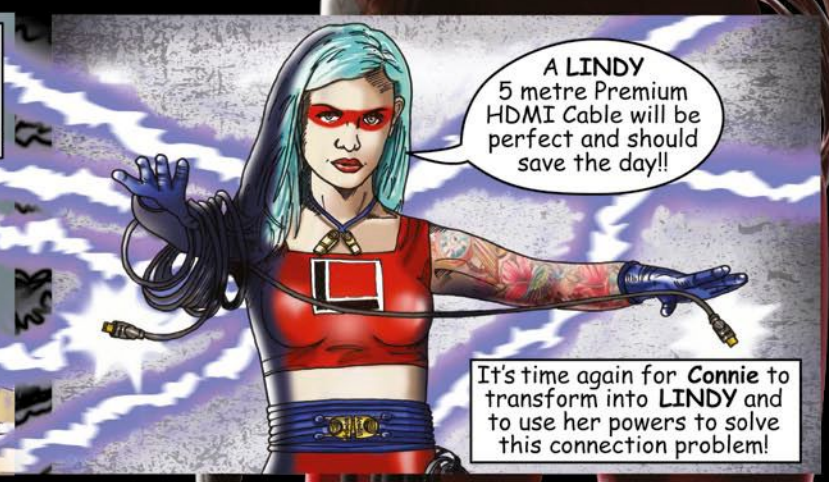

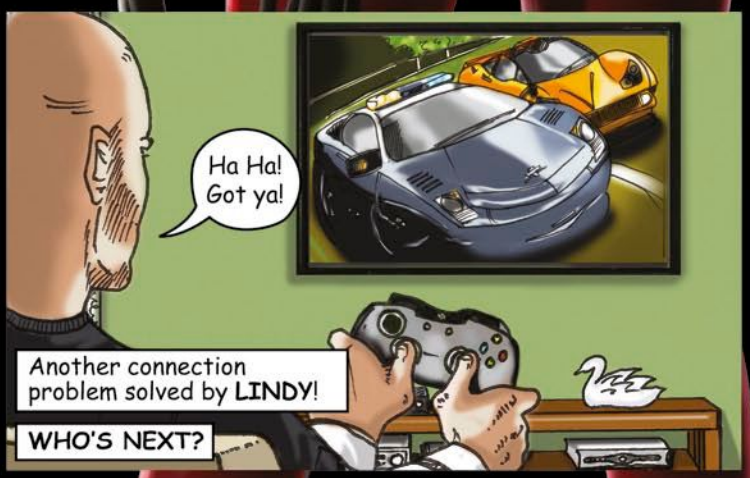

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The OWC Mercury Elite Pro Dual emits noticeable hum in operation

OWC Mercury Elite Pro Dual

EFFECTIVE, HIGH-SPEED STORAGE THAT WORKS WITHOUT FUSS - AND THE PRICE IS IMPRESSIVE TOO

Resembling its ThunderBay 4 stablemate after a crash diet, the OWC Mercury Elite Pro Dual is a two-bay desktop RAID unit with both Thunderbolt and USB 3 interfaces. Our review sample was supplied with two 2GB, 7,200rpm Toshiba hard disks – a configuration OWC sells in the US through its parent company MacSales; in Australia, it's through Macfixit as well as other retailers.

Still, bought separately, the drives will set you back only $89 each, or $178 for the pair, and if you can prefer you can choose your own drives based on your budget and requirements.

Inserting the drives is a palaver, requiring you to remove the inner chassis from the outer enclosure, then insert both units at a slightly awkward angle. Like the ThunderBay 4, this is an extremely solid, well-constructed drive. Unfortunately, again like its larger sibling, it's noisy, emitting a noticeable hum from the fan when the drives are in operation.

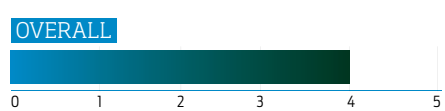
Unusually, the Elite Pro Dual uses a hardware RAID controller, which provides a choice between RAID0, RAID1, a single-volume Span mode and two independent drives, via the adjustment of a screwdriver dial at the rear. It's possible to change the RAID configuration at any time, although OWC warns that this will destroy all data on the disks. Perhaps as a result of this, changes must be confirmed by pressing the small Confirm button with a paperclip.

The benefit of this approach is that there's no faffing with the Elite Pro Dual. It presents itself both to OS X and Windows 8.1 as a single volume, preformatted to HFS+ but easily reformatted to NTFS without the need for proprietary utilities. Where other RAID devices caused problems while running under Boot Camp on the Mac Pro, the Elite Pro Dual behaved impeccably. On the software front, OWC provides a selection of disk utilities, backup utilities and shareware.

With the two Toshiba drives in RAID0 configuration, the Elite Pro Dual performs well over Thunderbolt, reaching write speeds of more than 300MB/sec and read speeds in excess of 350MB/sec in OS X, with similar results in Windows. That performance doesn't degrade when connected over USB 3, either.

Overall, the Elite Pro Dual is a great halfway house between single-drive desktop enclosures and larger, high-performance RAID devices. It provides plenty of space and bandwidth, plus impressive transfer speeds, but in a slightly smaller, less obtrusive box.

For some potential customers of this product, fitting the drives yourself may be off-putting, however it makes the whole package comparatively inexpensive, with the drives and enclosure costing a shade over $567. At this price, it isn't merely a cheaper option than the larger RAID units, but also a viable alternative to the non-RAID desktop hard drives.



The d2 can be fitted with an SSD upgrade, but this removes the option for USB 3 connection

LaCie d2 Thunderbolt 2

GOOD LOOKS, DECENT SPEEDS AND POWERFUL UPGRADE OPTIONS MAKE THIS DRIVE A CONTENDER

Long favoured by design pros who prefer to work on Macs, LaCie knows how to put a good-looking drive together, and the d2 Thunderbolt 2 is no exception. Its aluminium, unibody enclosure is both stylish and tough, and while it isn't always clear what the huge blue LED on the front is indicating, it does look impressive when it's flashing rapidly.

It isn't a case of style over substance, however. With a 6TB 7,200rpm drive with a 64MB cache, the d2 Thunderbolt 2 promises a good balance of performance and capacity. It's also possible to upgrade this slimline drive by inserting an internal SSD, giving you 128GB of high-speed flash storage in addition to the supplied 6TB HDD capacity.

Even the aluminium chassis has its practical side, helping to cool the drive without the obtrusive fan noise exhibited by other external drives. You can hear the d2 Thunderbolt 2 over the ultra-quiet Mac Pro, but it soon fades into the background.

As standard, the d2 Thunderbolt 2 provides two Thunderbolt 2 ports for daisy-chaining purposes and a single USB 3, making it a useful drive both for Mac and Windows users. However, fitting the SSD upgrade takes up the USB 3 port, so it's only usable if you're happy working with Thunderbolt 2.

Performance is good for a single-drive enclosure, with read and write speeds of 206MB/sec and 186MB/sec respectively while transferring 4.4GB of photos. This rises to 216MB/sec and 214MB/sec with larger 4K video files. It's also speedy when it comes to handling smaller file sizes; worth bearing in mind if you're more interested in virtualisation and backup than editing video.

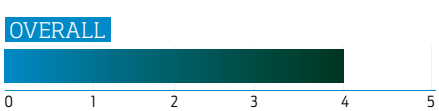
Across the board, the LaCie is significantly faster than the G-Drive with Thunderbolt, but not quite up there with the OWC Mercury Elite Pro Dual.

However, the SSD upgrade is a serious ace up its sleeve. With read speeds in excess of 700MB/sec and write speeds of more than 443MB/sec in our simple transfer tests, it can handle any application you throw at it.

The QuickMark OS X benchmark puts it at around 379MB/sec read and 329MB/sec write with smaller, sequential transfers, but that rises to 673MB/sec and more than 1GB/sec for larger files. Arguably, this makes the d2 Thunderbolt 2 a superb storage option for audio, video, photography and design professionals. You can keep your current project on the SSD for speed, then archive assets and completed projects to the 6TB HDD.

Without the SSD, the LaCie d2 is a strong option for enthusiasts and professionals who don't need the extreme performance of the big RAID desktop drives, although the price shows that you do pay a slight premium for the design and build quality.

With the SSD, however, it's a serious contender for cost-conscious buyers, providing the associated speed when you need it most, and plenty of capacity when you don't. If you want high performance and capacity within one logical drive, then RAID is still the way to go, but if you can find a place for the d2 Thunderbolt 2 in your workflow, it certainly has much to recommend it.



^ The DD512 can work as a USB 3 SSD or slot neatly into the HR1 or HR2 storage drive hubs

Lexar Professional Workflow DD512

A FAST, LIGHTWEIGHT DRIVE DESIGNED TO WORK AS ON-THE-GO STORAGE FOR CREATIVE PROFESSIONALS

Lexar's tiny portable SSD provides 512GB of storage in a unit a little smaller and thicker than a pack of playing cards. Part of Lexar's Professional Workflow system, it can either work independently as a USB 3 SSD or slot neatly into the HR1 or HR2 storage drive hubs (see right). The former connects to a computer via USB 3, the latter uses Thunderbolt 2 for additional bandwidth.

The four-bay hubs don't only support the 512GB DD512 and 256GB DD256 SSDs, but also a range of media readers, including SDXC/SDHC, microSDXC/SDHC, CompactFlash and CFast options. The idea is to provide a flexible workflow setup for professional photographers and videographers, providing all their storage needs in one device and preventing them from having to find and connect a mass of cables when they'd rather be getting on with work.

Drives can be slotted in and out at any time, although they do need to be ejected from the OS first to avoid data corruption.

You can, of course, pack in four DD512 units to give a total capacity of 2TB, but it's important to remember that the HR1 and HR2 don't provide any RAID capabilities. You're not getting the performance of a striped array or the fail-safe redundancy of RAID1 or RAID5: the system simply delivers a collection of fast solid-state external drives.

The drives themselves are simple but solidly made, with a row of blue LED indicators to indicate capacity and status on the front panel, plus a rubberised pad at the bottom to stop them slipping around on your desk. Each LED represents one-sixth of the total capacity, so it's easy to see how far along you are.

The drives are also extremely light; at an almost-unnoticeable 164g each, you could easily cram one in a camera bag or pocket without really noticing.

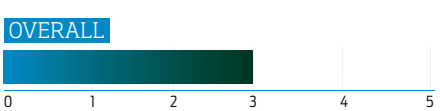
Drives are recognised instantaneously once connected by both OS X and Windows – and it helps that the DD512 can use the same exFAT format on both.

We expect SSDs to be fast, and the DD512 doesn't disappoint. It will happily reach sustained read speeds in excess of 320MB/sec and write speeds greater than 220MB/sec, beating the single-HDD USB 3 and Thunderbolt drives here. Understandably, however, it falls behind faster RAID devices.

Of course, the price you pay is capacity. High-capacity solid-state storage might be coming down in price, but it's still a very long way behind conventional magnetic storage on the gigabytes-per-dollar front.

If you want space to archive photos or videos, you're barking up the wrong tree, then, but that won't matter if all you desire is additional storage while you're on the move that can be quickly and easily reconnected to your main computer when you're back at base.

It isn't for everyone, but for the photographers and videographers that Lexar has in its sights, the Professional Workflow DD512 could well hit the button. We can see it working well as a supplement to a main high-speed storage solution, and is still very well suited as an exclusive storage arrangement.



OWC ThunderBay 4

WITH POWER, PRICE AND PERFORMANCE ON ITS SIDE, THE THUNDERBAY 4 STANDS TOE TO TOE WITH THE BEST

From its huge, powder-coated black outer chassis to the fearsome roar from its fans when you turn it on, the OWC ThunderBay 4 exudes power. It's a four-bay, 3.5in-drive RAID enclosure with dual Thunderbolt 2 interfaces. Unlike most of the other drives on test this month, it also has a built-in power supply.

It's an extremely solid unit, and although substantially louder than the CalDigit T3 and Promise Pegasus2 M4, it's not uncomfortably noisy. Drives need to be fitted within a tough metal caddy, which slides into place inside the enclosure. The caddies are then screwed in, before the enclosure is locked behind the steel-mesh front panel with a key. Combine all that with the Kensington lock slot on the rear and the OWC has a strong sense of security surrounding it.

In the US, OWC's parent company, MacSales, offers the ThunderBay 4 in a variety of ready-made configurations. Our review sample came with four 2TB, 7,200rpm Toshiba drives in a RAID5 configuration. Locally the drive is available diskless. To buy the four drives separately would normally set you back an additional $356, although, at less than $1100 for the whole shebang, that's still excellent value.

Unlike its OWC stablemate, the Mercury Elite Pro Dual (opposite), the ThunderBay 4 doesn't have a hardware RAID controller. It uses SoftRAID 5 to create and manage RAID configurations in OS X.

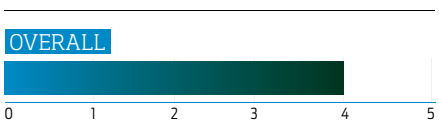
This is easy to use and has a simple, wizard-based approach, so it's not difficult to create a RAID0 or new RAID5 array if you need to do so. In Windows, you can use the standard utilities, although we had to rename two Apple system files on our Boot Camp partition to prevent the Mac Pro crashing after startup.

When it comes to performance, the ThunderBay 4 is a beast. It produced the fastest read speeds in our test – bar the SSD built into the LaCie d2 Thunderbolt 2 – hitting peaks of 510MB/sec and 518MB/sec with our raw photo files and 4K video files. It recorded sequential read speeds in excess of 760MB/sec in CrystalDiskMark on Windows. Write speeds aren't quite as impressive, although the ThunderBay still outperforms the CalDigit and Promise RAID devices in some of our tests. With such stellar sequential read and write speeds, the ThunderBay 4 would be a valuable asset in any 4K video-editing workflow.

Its size and noise mean the OWC ThunderBay 4 won't be a natural fit for every studio, but it's a great option if these aren't huge concerns.

The balanced performance, plug-and-play operation and lower profile of the CalDigit T3 make it our high-speed storage system of choice, but if you want to save a little cash and don't mind choosing and fitting your own drives then the OWC ThunderBay 4 is a cost-effective alternative to the CalDigit T3, and slightly more flexible, too.

A lockable front panel and Kensington lock slot at the rear make the ThunderBay ideal for security-conscious users



^ For such a small package, the Pegasus2 delivers high performance

Promise Pegasus2 M4

A COMPACT DESKTOP RAID DRIVE THAT WORKS BETTER WITH OS X THAN WINDOWS

Desktop RAID units don't get much more compact than the Pegasus2 M4: it's a chipper little block only 107mm high and 127mm wide, all dressed in black. It owes its diminutive size partly to its use of 2.5in hard drives instead of the 3.5in drives found in many RAID devices. These pop smoothly out of the chassis at a press of the button to the right of each drive and are mounted on sliding rails, making it easy to get them in and out to replace or upgrade.

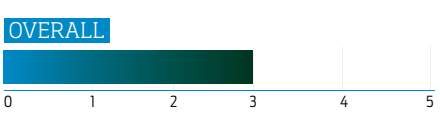
The four drives supplied with our review model were 1TB, 5,400rpm Toshiba HDDs, but the drive screws are standard, so any four matched 2.5in drives should be fine. The only downside is that 2.5in drives don't offer as much potential for future upgrades as 3.5in units, because 2.5in drives don't reach the higher capacities.

In OS X, it's easy to set the Pegasus2 to work. Simply plug in the mains lead – there's no external power brick – then hook up one of the two Thunderbolt 2 ports and it connects. It's supplied preformatted as a RAID5 configuration with HFS+, and you can rebuild the array using the supplied Promise Utility software. With multiple screens and tabs to navigate and options spread throughout them, it could be easier to use, but it has some useful wizards to help you set up your RAID array for specific tasks.

In Windows, the news isn't so good. For one thing, you need to install a driver before the M4 can be recognised; on our test Boot Camp partition, the driver crashed the system immediately after install or upon rebooting. The Windows version of the Utility software didn't always behave as expected, either. Eventually, we got the drive up and running by removing the drivers and physically removing two disks, before setting up a simple two-disk RAID with the remaining disks. After this, we were able to rebuild the array with four drives and resume testing.

Once set up, the Promise Utility software works well, with plenty of real-time monitoring and management features, plus some simple tools that let you make necessary repairs and see which drives are operating within the array.

Performance is beyond what you'll get from any single-drive USB 3 or Thunderbolt 2 product but, with 5,400rpm disks, the Pegasus2 can't match the speeds of the drives from OWC and CalDigit. It will hit sequential read speeds of 400MB/sec while reading or writing large files, but its rivals are consistently faster, particularly under Windows. For some users, the M4's compact size might make all the difference, especially since it offers an easy upgrade path to 2.5in SSDs. If performance is of greater importance than a small form factor, though, you would do better to look elsewhere.



Buffalo MiniStation DDR HD-PGDU3

A COMPACT, WELL-BUILT MOBILE DRIVE AT AN AFFORDABLE PRICE - ITS QUICK IN BURSTS, LESS SO FOR SUSTAINED TRANSFERS

It may look like a standard portable USB 3 drive, but the Buffalo MiniStation DDR HD-PGDU3 promises to combine the high speeds of an SSD with the affordability and capacity of an HDD through the addition of a dedicated 1GB DDR3 RAM cache.

The drive itself is fairly understated, measuring a jacket-pocket-sized 81 x 132 x 18mm (WDH) and weighing only 199g. It draws both power and data through its single USB 3 connection, so there's no power supply to lug around, and, while the matte-black plastics don't lend it the high-end feel of some other drives, the casing feels robust.

Ease of use is a strong point. The drive comes preformatted for Windows, but it's easy to reformat for Mac use; once you plug in the cable, it springs to life on the desktop immediately.

Speed is supposed to be the MiniStation DDR's key attraction, and up to a point it is. Although we didn't quite match Buffalo's claimed read and write speeds of 300MB/sec and 400MB/sec in our tests, the results weren't a million miles short of the mark. In QuickBench, for example, it gave us average read and write speeds of 296MB/sec and 369MB/sec with large files.

However, the drive struggles to maintain these speeds over longer periods or when transferring a greater number of smaller files. The results in our timed transfer tests were among the worst, both when copying our group of DNG raw files and when copying larger 4K video files.

It appears, then, that while the MiniStation DDR HD-PGDU3 can be as fast as an SSD, it can't produce that speed consistently. It is, however, a well built, compact and easy-to-use mobile drive that undercuts SSD models by a substantial margin. If all you need is some cheap, reasonably speedy additional storage, it's worth a second look.

> This ordinary-looking drive hides an ingenious hybrid design

G-Technology G-Drive with Thunderbolt

A VERSATILE DESKTOP DRIVE THAT BOASTS BOTH USB 3 AND THUNDERBOLT CONNECTIONS

With its aluminium casing and glowing-blue Thunderbolt logo, the G-Drive with Thunderbolt 4TB seems to be taking design cues from LaCie in its keenness to appeal to the pro designer market.

It's a heavy enclosure, weighing nearly 1.35kg, but the low-profile design, large vents and cooling fins beneath the body help it remain cool and keep noise to a minimum. We could hear the G-Drive over the near-silent Mac Pro, but only just.

The drive supports the original 1.25GB/sec Thunderbolt standard rather than the new 2.5GB/sec Thunderbolt 2. This isn't such an issue on a single-disk device, where you're unlikely to swamp a 1.25GB/sec connection, and there's compensation in the drive's provision of a USB 3 port.

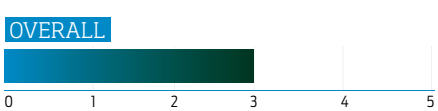
With both interfaces, the G-Drive plays well with OS X and Windows systems, and we had no problems using it with its default HFS+ configuration then reformatting to NTFS for use in Windows. It helps if you already know how to do this, however, since the instructions merely suggest you use OS X's Disk Utility to repartition and format the G-Drive as a FAT32 device – which is hardly the most efficient way of doing things.

We tested the G-Drive with both Thunderbolt and USB 3 connections, and generally there wasn't much to separate the two: in some cases, we saw higher read speeds through Thunderbolt, but in other tests, the results were so close as to make no practical difference.

In either case, the G-Drive with Thunderbolt is a competent performer rather than a great one, delivering a range of read and write speeds between 100MB/sec and 170MB/sec. This doesn't trouble the LaCie and OWC desktop drives, nor the RAID systems at the top of our leaderboard.

The G-Drive is a decent option for the money, then, but if you're after flexibility, resilience and raw speed, we'd advise looking elsewhere.

< The G-Drive is quiet, looks great and has both USB 3 and Thunderbolt connections



View from the Labs

THE PC INDUSTRY WILL HAVE TO DO MORE TO WELCOME THUNDERBOLT IF WE'RE TO GAIN FROM THE BEST TECHNOLOGY, SAYS STUART ANDREWS

If this Labs proves anything, it's that there's never been so much choice when it comes to high-performance storage. Whether you have $200 or $1500 to spend, whether you're looking for a portable or a desktop solution, whether you want the raw performance of RAID0, the resilience of RAID1 or a simple, single-drive solution, there's something for you. And while high-end applications grow more demanding, particularly in the realm of 4K video, the technology is keeping up.

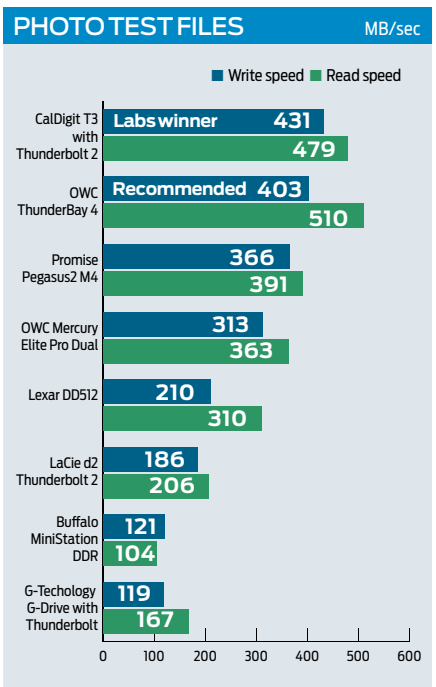
We've tested drives here that can transfer data at speeds of 500MB/sec, 700MB/sec and even 1GB/sec, albeit in specific circumstances. Mechanical hard drives are still getting larger and cheaper, while even high-capacity SSDs are slowly becoming more affordable. Should 4K video hit the mainstream, the technology will be available, at the right price, to meet the demand.

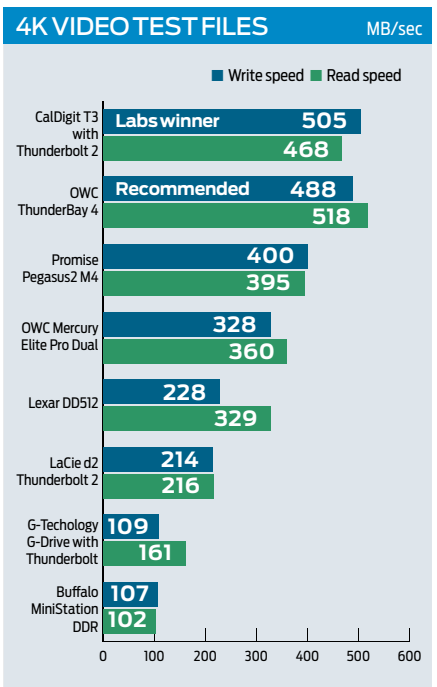
Manufacturers aren't all taking the same approach, however. The CalDigit T3 with Thunderbolt 2 and OWC ThunderBay 4 both deliver extreme performance at a high-end price, but if you don't have the budget for either, you can still get that level of capacity with the option of SSD performance by purchasing the LaCie d2 with Thunderbolt 2. Lexar's DD512 and H1 hub don't make the ideal mainstream storage solution, but they could be perfect for photographers and videographers who spend much of their time shooting, not sitting at a desk. Instead of seeing SSD and hard disk as competing technologies, manufacturers are finding ways to integrate them.

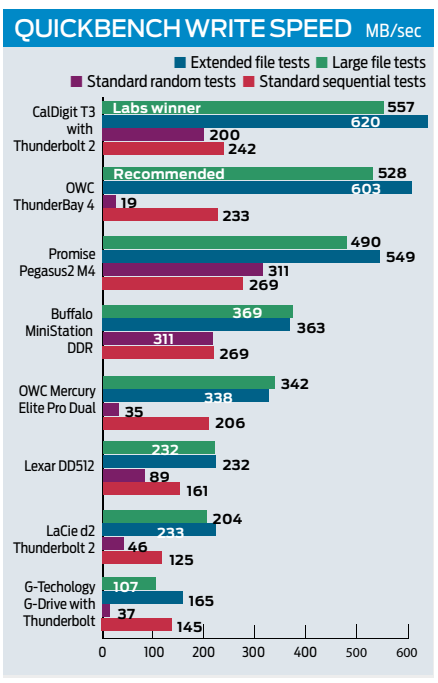
The only sour note? Some of the best technology is tied to an interface that the majority of PCs and Windows workstations don't support. Why? Because Thunderbolt and Thunderbolt 2 are seen as an unnecessary expense in the PC world, rather than a standard feature as they are on Macs. A few PC and motherboard manufacturers are bucking the trend, but, unless Thunderbolt 2 trickles further down into the PC market, many PC users will be denied the best-of-breed storage devices.

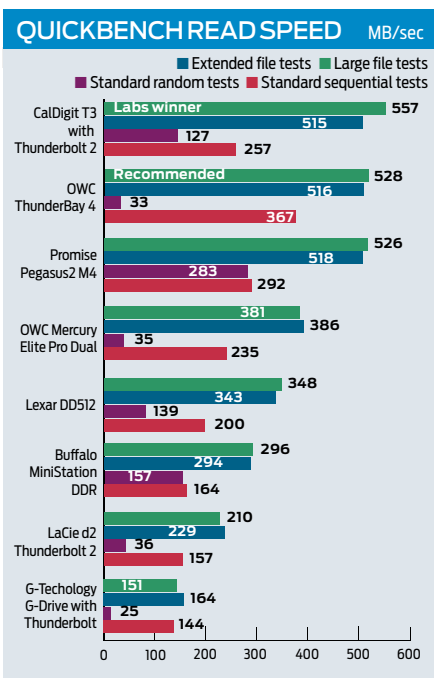
It isn't that USB 3 is lacking the bandwidth, or that many drives are maxing out the bandwidth of Thunderbolt and Thunderbolt 2. The problem is the focus on Thunderbolt and Thunderbolt 2 to the detriment of USB 3 – and PC manufacturers don't seem bothered. The result of this? Many Windows-based photographers, video-editors and enthusiasts will be making do with second-class solutions while their Mac-based competitors get the best.

Mac users will say this has always been so, citing OS X's dominance of the professional video, design and photography markets as evidence. All the same, Windows professionals deserve more choice. Until the PC industry does more to adopt Thunderbolt 2, they won't get it.









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THE MISSION

Upgrade Australia is six months of hardware advice and recommendations from our most trusted partners, in our print publications and online, and it all culminates in a very special technology event taking place later this year, where it will all come together, and where you get to interact directly with the best PC technology brands and products anywhere in the industry.

So, without further ado...

BACK TO UNI WITH A DESKTOP THAT DELIVERS

A uni students' guide to nabbing the right parts for a desktop that's the perfect study buddy and procrastination pal.

You're a student and you well know that good tools mean a better job done and less stress while you're at it. Student life also means a good mix of work and play, so in this month's Upgrade Australia we'll show you how you can sort yourself with a powerful PC that does double-duty as a machine that is as much fun to play on as it is to get the work done.

After all, with limited breathing space in an intensive study schedule, your play time is just as important as your time spent hitting the books.

BUILDING YOUR OWN RIG

Intel's newest range of core components can match your specific needs, and your budget. If you like the idea of optimal performance and future-proof computing, go with a Core i7 Extreme 5960X CPU. With this high-performing eight-core, 16-thread beast at the heart of your desktop build, your CPU will keep up with whatever you throw at it, like hardware-intensive HD video editing, RAW photo editing or music composition.

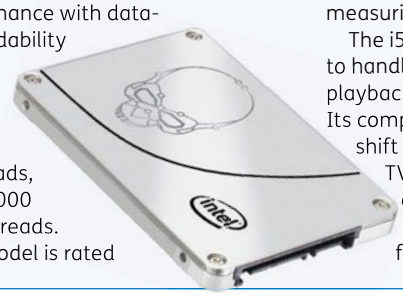
If an 'extreme' level CPU is overkill for your needs, you can still score impressive performance on a lower budget. Intel's Core i7-4790K and i5-4690K have the power on tap to rip through demanding tasks and deliver mighty gaming speed.

At a base frequency of 4.0GHz, the Core i7-4790K CPU is zippy for everyday processing, but can automatically jump to 4.4GHz via Turbo Mode when extreme performance is required, or, if a study session shifts to a resource-intensive gaming marathon. Hyper-Threading Technology also automatically unlocks additional processing efficiencies as 4 cores operate on 8 threads. The 4790K has been built with overclocking in mind, which means hardware tweakers can get even more out of this CPU that's built to handle overclocked loads at reasonable temperatures.

The i5-4690K CPU starts with a clock speed of 3.4GHz and can Turbo Mode to 3.9GHz. It's also overclocking friendly, unlocking the option to push it even further to pull even faster performance out of your desktop.

NO MORE BOTTLENECKS

When you've got your motherboard, CPU and memory sorted, there's no point bottlenecking your desktop's speed potentiality with an old-school hard drive or entry-level SSD. You can own enthusiast-grade performance with data-centre dependability with an Intel 730 SSD that sports 550MB/s sequential reads, and up to 89,000 IOPS random reads. The 480GB model is rated for 70GB of reads per day, which means you can rely on a 730 SSD surviving well into the future, even with heavy use throughout the assessment period. Your desktop will thank you for it, too, with impressive boot-up speeds, fast loading of applications and, most importantly, less time staring at a loading screen when you're gaming.



SMALL SIZE, BIG PERFORMANCE

If either desktop space or budget (or both) are the biggest factors in your desktop purchase, it's worth considering an Intel NUC Mini PC. A NUC ('Next Unit of Computing') can be bought as a customisable kit. Personalise the on-board memory, hard drive and operating system, just as you would with a regular desktop purchase. The biggest difference is the size, though, with an NUC measuring in at just four inches square.

The i5 CPU and HD Graphics 5000 unite to handle daily operation, multimedia playback and most gaming admirably. Its compact design makes it a cinch to shift from study desk to lounge-room TV, for gaming on the big screen, either directly from the NUC or by streaming from a faster PC.

Evolve

HANDS-ON WITH THE EAGERLY ANTICIPATED 4V1 SHOOTER

Multiplayer games are predicated, on the whole, on having two equal sides duking it out – teams of equal number and ability on a level playing field striving to kill more enemies, capture more strategic points, score more goals or otherwise achieve their opposing objectives. Evolve is one of a select group of games that does something very different by adhering to the concept of asymmetry. It's a game of four players versus one, but thanks to some extremely clever design and balance neither side feels as though it has a distinct advantage.

The premise of the game is a great science fiction staple – a team of specialists hunting a monster. Four players take the role of the Hunters. These hardened warriors each fill a special niche – Assault, Trapper, Medic and Support – while the other takes the role of the monster, one of three (or four if you pre-order) terrifying creatures capable of evolving into deadlier forms if they gorge themselves with enough protein. Each of the Hunter archetypes features three characters that fill the same role but in a different way. The three Assault characters all share the ability to project a short duration shield to protect themselves from damage but their weapon load-outs and secondary abilities make them play very differently. Markov, a heavily armoured, partially cyborged hulk of a man wields a lightning gun that does constant damage at medium range and an assault rifle for long range and can also lay mines. Hyde, an eye-patch wearing thug wields a mini-gun for medium range combat and falls back to an extremely short range but equally extremely dangerous flamethrower for close up work.

Parnell, the final Assault character has a shotgun for close range combat and a multi-fire rocket launcher for long range. He can also sacrifice some of his health to vastly increase his move and fire rate for a short time. Each of the characters fills the same role but plays very differently and requires different approaches. Each Hunter is also equipped with a jump pack.

THE MONSTER

Much like the Hunters, each of the Monsters fills the same role in a very different way. Each of the creatures shares the ability to eat creatures they kill the replenish health and shields as well as store up evolution energy. When enough energy is gathered the creature evolves, first to a second, more powerful form and finally to its ultimate, extremely dangerous form. At each evolution the Monster player can choose which of their abilities to power up, making them a far more formidable foe.

Each of the beasts, the Goliath, Kraken and Wraith play extremely differently. The Goliath is all about brute force. It can leap up and slam back into the ground, throw massive boulders and breathe fire. It's tough and resistant to damage, making it a close up fighter. The Kraken on the other hand is a ranged fighter, capable of flying and using a number of ranged electrical attacks. The Wraith is based around speed, stealth and hit and run attacks, making it something of a rogue archetype

"the action transforms from a cat and mouse chase to something more akin to Predator"

as opposed to the warrior and magic user of the Goliath and Kraken respectively. Each monster requires different tactics both to play and to defeat.

PLAY BALANCE

The resulting gameplay balance is fantastic. At the start of a game the four Hunters have to find the monster and try and kill it before it can evolve to become deadlier, and the complimentary skills of the four Hunter classes ensure that all roles are vital and that teamwork is paramount. The Trappers can most easily track the monsters for the most part and are the only class that has the ability to erect a forcefield to keep the Monster confined to a small arena for a limited time. The Assault character is vital for doing damage and the Medic and Support are essential to make sure that the other players are kept alive and are capable of using their skills to their utmost.

The Monster starts around by trying to kill and eat as many computer controlled creatures as it can to build up evolution energy, all the while trying to avoid being spotted by the Hunters. As the game goes on the action transforms from a cat and mouse chase to something more akin to Predator, with both sides hunting each other with equal aggression.

GAME MODES

The two game modes we've had a chance to play so far, Hunt and Evacuation, both revolve around this hunter/hunted theme but both play out remarkably differently. Hunt is a basic single match, with the Hunters and Monster trying to destroy each other over a variety of beautiful alien maps. Evacuation, on the other hand is played over a series of maps, five in all, with each round seeing the Hunters both trying to destroy the Monster and rescue as many civilians as possible.

Each round also has a specific mission for the Monster, such as the destruction of a generator or the hatching of an egg. If the monster achieves their goal it can radically change the way the next round plays out. Destroy a power plant, for example and the next round will see the map saturated in a toxic cloud that damages the Hunters. If the Hunters manage to save the power plant, automatic turrets are activated and will fire on the Monster in the next round.

These perks lend a real sense of urgency and weight to each round in Evacuation. Evolve will also feature an offline mode enabling players to control a single hunter or the Monster with the other roles filled by the AI.

Daniel Wilks

KEY SPECS

www.evolvegame.com

Genre - Multiplayer FPS • Developer - Turtle Rock Studios • Publisher - 2K • Platform - PC, PS4, Xbox One

Total War: Attila

VANDALS AND OSTROGOTHS AND SAXONS, OH MY!

When Total War: Rome II launched it was something of a dog, plagued with bugs and glitches that all but brought the once legendary strategy series to its knees. A year and a half on from the initial release of Rome II, many of the bugs have been ironed out and the game is much improved as a result but surprisingly Creative Assembly are releasing a standalone expansion for Rome II that drastically changes up the way the franchise, from its inception, is played.

Set several hundred years after the period of Rome II, Attila takes place around 400AD and the fall of the Roman Empire, Attila is not a game about expansion and conquest. Previous Total War titles have always had a core gameplay model based around city building and the expansion of territory by defeating and ultimately conquering rival states but Attila turns this model on its head. Players either take the role of one of the surviving Roman empires dotted around the world or as one of the migratory civilisations that live on the move and exist seemingly to sack and plunder other civilisations. As the Romans it's a game of defence. The core mechanics are still there, with city building, unit recruiting and epic real time strategic battles still making up the bulk of play, but the might of the Roman Empire is broken so the format has become one of a game of survival rather than expansionism. The defence of Rome is paramount and the decisions you have to make to achieve this end are very different from what has come before.

The remains of the empire are besieged on all sides. The German nomadic tribes, the Vandals, Goths and Saxons harry outlying settlements. These nomadic cultures resupply by sacking settlements so they are a constant threat, but is it worth sending an army to defend a remote province of little value when the army may well be defeated on the field and leave Rome ill equipped to defend from a greater threat. Or is it worth the potential weakening of Roman defences to deny an invading army supplies they can then use to press further into Roman territory? Rather than being on the defensive, for the Romans the game is all about defence, shoring up your support base, maintaining cities as best as possible and recruiting heavily to defend what territory is left.

The opposite is true for the migratory groups. The hordes don't start the game with a capital city but instead have the ability to order their armies to set up a semi-permanent camp that can be upgraded in a similar manner to a city, allowing for the recruitment of more troops and using and the building of other structures that can boost the economy and morale of the troops. Armies can't remain sedentary for too long, however. As nomadic warriors, the hordes require the sacking of Roman cities to replenish vital supplies not available on the road or in camp. They must also remain on good diplomatic terms with the other migratory tribes that inhabit Europe, as a nomadic group with no true fortifications provides a far easier target for another band of nomads than a walled city.

The code we have doesn't allow access to the Hun campaign as yet, so we don't have any experience playing as Attila, but from a historical perspective it will most probably see the player working their way through Germania and Italia before finally laying siege to Rome. Although in real life the Huns never successfully took Rome, the control of the city will probably be a win scenario.

Some fans of previous Total War games may have become leery of the franchise after the buggy launched of Empire: Total War and Total War: Rome II, but from what we've seen of Attila so far, it looks as though they are back on track and set to deliver another great strategy experience when it hits shelves in February.

Daniel Wilks

KEY SPECS

www.totalwar.com/attila

Genre - Strategy • Developer - Creative Assembly • Publisher - SEGA , Majesco • PC

Pillars of Eternity

MODERN DEVELOPERS ARE LOOKING TO THE PAST, AND KICKSTARTER FOR INSPIRATION

The Infinity Engine has a special place in the hearts of many gamers. The venerable engine formed the core and aesthetic of some of the most revered isometric RPGs of all time, including Baldur's Gate, Icewind Dale and Planescape: Torment. The lush painted backgrounds and combination of voice acting and scrolling text became the benchmark for how RPGs looked and operated in the late 90s and early 2000s. Since that time things have progressed in leaps and bounds, with new and improved graphics engines allowing for more detail, full 3D environments, full voice acting and a fully controllable camera, but even to this day, where games such as Skyrim and Dragon Age: Origin dominate the RPG market, the yearning for more traditional RPG systems remains strong in a portion of the market.

Enter Obsidian Entertainment, the developer behind such beloved RPGs as Star Wars: Knights of the Old Republic 2, Neverwinter Nights 2 and Fallout: New Vegas. Obsidian Entertainment, a company originally formed by former members of Black Isle Studios, the developers and publishers of many of the iconic Infinity Engine games, headed to Kickstarter to see if there was a market for a new isometric RPG. The results were far more positive than they initially expected. The original goal was to raise $1.1 million to deliver a party based RPG with a handfuls of races, five character classes with a story written by some of the luminaries of the Infinity Engine days. By the time the Kickstarter (and attached Paypal account) around 77,000 people had pledged nearly US$4.2 million to the project, giving the developers ample cash to broaden the scope of the game.

As it stands now, Pillars of Eternity features six races, eleven classes, multiple background and a massive world to explore. Built using a heavily modified version of the Unity engine, Pillars of Eternity captures both the look and feel of the old Infinity Engine games from the moment it is booted up. Although it is based on an entirely new set of rules and set in a bespoke world, there is a definite Dungeons and Dragons familiarity to the game. This is a deliberate move by the developers, with the interface and character shoots highly reminiscent of those from the Infinity Engine games. This sense of nostalgia serves as a neat entry point for fans of the original games but also serves as a fairly easy inroad for anyone even remotely familiar with RPGs.

Basic control feels resolutely old fashioned in a good way, from dragging a square around the party to group them and clicking on the ground to make them move, but there is also a definite sense of modern game design sophistication at work. Character creation choices look as though they will have a definite impact on the way the game plays out, with race, sex and background choices sometimes influencing the way NPCs react to the player's character. In the Beta we've played, a blacksmith went from being cagey to being distinctly friendly when he noticed the calloused hands of a fellow tradesman (thanks to the chosen background of Labourer), while other reacted with caution due to the fact that our character's chosen race was 'Godlike', humanoids with distinctly disfigured heads that many believe are the spawn of either gods or demons.

There is a good deal more freedom in character creation than the traditional Infinity Engine games as well thanks to the fact that all of the character's statistics effect all of their skills in some way – strength effects the damage of all abilities, so it's entirely possible to make a musclebound magic user, or, as Intelligence effects the duration of skills, a brainy Barbarian. Statistics can also effect conversations by opening up new conversational gambits.

Much like the general control scheme, combat feels both nostalgic and sophisticated, utilising a real-time engine with what is commonly referred to as an active pause – the ability to instantly pause the action at any time to give commands to each of the members of the party. At the current stage of development combat is challenging over all available difficulty levels, with even the most basic of monsters such as wolves or spiders potentially offering a deadly threat. There is still no firm release date for Pillars of Eternity, but considering it is currently in Beta and looks highly polished we should be able to expect a final release within the next few months.

Daniel Wilks

KEY SPECS

www.eternity.obsidian.net

Genre - RPG • Developer - Obsidian Entertainment • Publisher - Obsidian Entertainment/Paradox Interactive , Majesco • PC

The A-List

ONLY THE BEST OF THE BEST MAKE IT TO *PC & TECH AUTHORITY*'S A-LIST

A desktop storage roundup this issue see the replacement of the long-standing Seagate Backup Plus, with the Labs winner from our roundup. The CalDigit T3 with Thunderbolt 2's story is on page 64 .

WHAT WE SAID:

The T3 is an expensive RAID device, but when you factor in the drives and the capacity included, it's good value. The 12TB of storage should be enough for the most demanding professional applications, and we found the T3 easier to use and work with than the other units here, particularly under Windows.

Given this, a generous five-year RTB warranty, storming performance and excellent design, we're happy to crown the T3 with Thunderbolt 2 as our new Labs winner.

It's a little unusual in that – currently, at least – it's only available for purchase via Amazon. Perhaps demand will see an upswing thanks to the 'A-List Bump' and a local disty can take this gem on.

PC DESKTOP

ALL-IN-ONE Apple iMac 27in

★★★★★

PRICE $2199

SUPPLIER www.apple.com/au

If you can afford it, the 27in iMac is the finest piece of all-in-one engineering on the market. A truly powerful beast with performance to match its looks..

SPECIFICATIONS 3.2GHz quad-core Intel Core i5; 8GB DDR3 RAM; 1TB Western Digital Caviar Black HDD; NVIDIA GeForce GT 755M 1GB; 27in 2560 x 1440 LCD.

PERIPHERALS

WIRELESS ROUTER Netgear Nighthawk X6 AC3200

★★★★½

SUPPLIER www.netgear.com.au

Designed to keep pace with high-bandwidth content consumption, it is the router King.

SPECIFICATIONS 1GHz dual core processor with 3 offload processors, 6 High performance antennas, one 2.4GHz band and two 5GHz Wi-Fi bands

DESKTOP STORAGE CalDigit T3 with Thunderbolt 2 NEW

★★★★★

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 DS214play

★★★★★

SUPPLIER www.synology.com

The fastest NAS in our grouptest (*PC&TA 197*), with excellent media streaming capabilities.

SPECIFICATIONS 2.1GHz Intel Atom; 2GB RAM; 2 x USB 3 + 1 x USB 2; iOS and Androidmobile apps; RAID 0, 1, 5, 10; JBOD .

ALL-IN-ONE PRINTER Canon Pixma IP 8760

★★★★½

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 grouptest, 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 TF103C
★★★★★

PRICE $429

SUPPLIER www.asus.com.au

While ostensibly a tablet with a removable keyboard, it also fits tidily into the value portable category thanks to it's immense usability and remarkably low price.

SPECIFICATIONS Quad-core 1.86GHz Intel Atom Z3745 · 1GB RAM · 8GB/16GB eMMC storage · 10.1in 1,280 x 800 IPS display · dual-band 802.11n Wi-Fi

PERFORMANCE
Aorus X7
★★★★½

PRICE $2999

SUPPLIER www.aorus.com

Super-sleek, light, outrageously powerful and with a spec-list that outclasses many high end desktop systems.

SPECIFICATIONS Q4-3.4GHz i7-4700HQ · 4GB/8GB DDR3L 1600, 4 slots (Max 32GB) · 17.3" Full HD 1920x1080 · NVIDIA® GTX 765M SLI GDDR5 4GB · mSATA 128GB/256GB, 2slot 2.5"HDD 500GB/750GB/1TB 5400rpm

PROFESSIONAL
Apple Macbook Retina
★★★★★

PRICE $3199

SUPPLIER www.apple.com/au

The machine that does everything right, and looks the part, too. We've chosen the top-end 2.3GHz i7 model with 16GB of RAM and a 512GB SSD plus GT 750M graphics.

SPECIFICATIONS 2.3GHz Intel Core i7; 16GB RAM; 512GB SSD; 15in 2880 x 1800 LCD; 1 x USB 3; 2 x USB 3; 2 x Thunderbolt 2; dual-band 802.11abgn Wi-Fi; Bluetooth 4; 3G

ULTRA PORTABLE
Microsoft Surface Pro 3
★★★★½

PRICE $1549

SUPPLIER www.microsoft.com.au

Attach the Type Cover 2 and it's as good, if not better, than any 'proper' ultra portable laptop. It took three versions, but Microsoft has nailed this format. At least an i5 is recommended.

SPECIFICATIONS 1.9GHz Intel Core i5-4300U; 12in touchscreen (2160 x 1440); 8GB RAM; 256GB SSD; 802.11ac/abgn; Bluetooth 4

HANDHELDS

SMARTPHONE
Sony Xperia Z3 Compact
★★★★★

PRICE $699

SUPPLIER www.sony.com.au

In short, no other smartphone offers the same level of performance and features at this price.

SPECIFICATIONS 2.5GHz Qualcomm Snapdragon 801 SoC · 2GB RAM · 16GB storage · Adreno 330 graphics · 4.6in 720 x 1,280 IPS display

TABLET
Apple iPad Air 2
★★★★★

PRICE $539

SUPPLIER
www.apple.com/au

The iPad Air 2 is definitively the best tablet on the market right now, and rightfully replaces its predecessor on our A-List.

SPECIFICATIONS 1.5GHz Apple A8X SoC · 2GB RAM · 16/64/128GB storage · 9.7in 1,536 x 2,048 IPS display · 7,340mAh battery

EBOOK READER
Kindle
★★★★★

PRICE $109

SUPPLIER
www.amazon.com

The new model is quicker, slimmer, lighter and cheaper than before. If all you want to do is read books, its simple design and performance are perfect.

SPECIFICATIONS 6in e-Ink screen, 170g weight, 114 × 8.7 × 166 mm, 2GB memory, 10-day battery life . WEB ID 279534

SOFTWARE

SECURITY Norton Security 2015
★★★★★

SUPPLIER www.kaspersky.com/au

Great malware protection and equally good legitimate software recognition

BACK UP Acronis true image 2015
★★★★½

SUPPLIER www.acronis.com.au

The 2015 version adds full-system backup and dual backup and unlimited cloud storage.

OFFICE SUITE Microsoft Office 365 Home Premium
★★★★½

SUPPLIER www.microsoft.com.au

The easiest to use Office to date.

WEB DEV Adobe Dreamweaver CS6
★★★★½

SUPPLIER www.adobe.com.au

This edition makes PHP and CMS its core focus.

AUDIO Cubase 7.5
★★★★½

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
★★★★½

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 5
★★★★½

SUPPLIER www.adobe.com.au

An excellent tool for photo management and light editing, as used by the pros and now available at a very reasonable price.

The Kitlog

MANY SIGNIFICANT CHANGES HIT THE DECK IN THIS MONTH'S *PC&TA* DREAM SYSTEM BUILDS.

There's a lot of new in this month's Kitlog. We've updated the CPUs for both builds to newer models of the same family, partly because availability of the previous CPUs was falling, but mostly to factor in the improved performance.

Storage sees a switch from the Samsung 840 Evo which was used in both builds (but of different capacity) to Samsung's new 850 PRO, which won our Labs test in this issue. We've also ditched the WD Black hybrid drive, swapping in a bargain basement Seagate Barracuda drive for the Perfect PC, and we'll leave it up to you to decide what you need for expanded storage beyond the SSD in the Game Box.

The Perfect PC's mouse (previously the Razer Ouroborus) has been swapped for the CM Storm Reaper. This is the mouse I have settled on as my personal favourite, and all throughout 2014, as almost every new mouse released was tested by me, I always went back to the Reaper. It feels fantastic, glides more smoothly on a mouse pad than any other, and the cursor movement on-screen is smoother and more natural than any other we have tested. As further testament, *PC&TA* Art Director Tim Frawley also uses the Reaper, and he's as particular as I am. It's a bit too heavy to use as a gaming mouse, however, so the excellent TT Sports Volos stays for the Game Box.

Happily, all of these changes have resulted in a considerable reduction in cost (not our goal, just a happy consequence). The Game Box is now $286 cheaper than last month's rig, while the new Perfect PC shaves a hefty $537 off the previous build.

Despite several new and impressive 4k screens hitting the market lately, including one each from Asus and LG in this issue, we're sticking with the Asus PB287Q for now as the Perfect PC screen, thanks entirely to it's remarkably low price.

THE GAME BOX

CPU

INTEL CORE I5 4690K
PRICE $289
Ripping along at a stock speed of 3.5GHz, this 'K' model allows easy overclocking for even more performance.

MOTHERBOARD

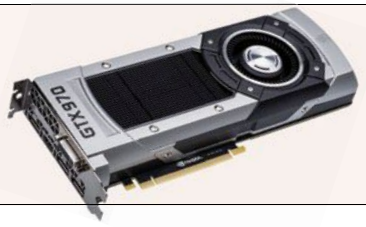
ASUS ROG RANGER
PRICE $219
Fully featured, extremely well engineered. Alternatively, the MSI Gaming 7 or Gigabyte Z97X-UD5H are equally as good at the same price.

MEMORY

KINGSTON HYPERX BEAST 16GB
PRICE $240
Our roundup award winner, it's well-priced, fast and overclocks very well.

VIDEOCARD

NVIDIA GTX 970
PRICE $500
Quiet, sips power, but when the performance is needed this blazer eats up the frames.



THE PERFECT PC

CPU

INTEL CORE I7 4790K
PRICE $419
Out of the box at 4GHz and with a 4.4GHz Turbo speed, this CPU will eat anything thrown at it.

MOTHERBOARD

ASUS Z97 DELUXE
PRICE $339
Plenty of cutting-edge technology crammed into this package. It's for those who want it all in a LGA1150 system.

MEMORY

CORSAIR DOMINATOR PLATINUM CMD32GX3M4A2133C9 32GB
PRICE $615
These memory chips are hand selected and tested, and 32GB of fast RAM will keep things smooth and fast in intensive tasks.

VIDEOCARD

NVIDIA GTX 980
PRICE $700
It's a pure powerhouse, with the fastest single-GPU performance available today, and with support for advanced lighting and VR.

TOTAL: $2691 RIG ONLY: $1793

COOLER

COOLERMASTER NEPTON 140XL
PRICE $120
Easy to install AIO CPU cooling, relative quiet and performance to rival twin-radiator units.

CASE

BITFENIX RONIN
PRICE $99
Bitfenix continues to deliver great budget cases that look terrific and are easy to build in.

SYSTEMDRIVES

SAMSUNG 850 PRO 500GB
PRICE $300
Samsung's newest SSD offers greatly improved durability. Supplement it with a hard drive of your choice if needed.

KEYBOARD

CORSAIR K70
PRICE $160
The glorious perfection of mechanical keys with well thought-out gamer design.

DISPLAY

LG IPS277L
PRICE $400
27 inches of IPS glory. The resolution isn't perfect, but the price is. The thin bezel makes this a very attractive screen.

MOUSE

TT SPORTS VOLOS
PRICE $79
The easy first choice at *PC&TA* HQ where we play hard and test every mouse. Also superb value.

AUDIO

TT ESPORTS CRONOS
PRICE $80
Fantastic set of headphones that delivers great 2.1 audio for gaming and music without swamping you with bass.

SOUND BLASTER X-FI XTREME
PRICE $80
The best positional game audio and pretty good music quality, too.

POWER SUPPLY

COOLER MASTER G750M
PRICE $125
Outstanding value for money, it's powerful enough for even performance PCs packing twin GPUs.

TOTAL: $4998 RIG ONLY: $3700

COOLER

CORSAIR H105 WATER COOLER
PRICE $160
Best-of-breed cooling plus nice and quiet equals a happy CPU.

CASE

COOLER MASTER COSMOS II
PRICE $400
The only case you'll ever need. Premium luxurious bliss.

SYSTEMDRIVES

SAMSUNG 850 PRO 1TB SSD
PRICE $749
Our Labs winner is fast and durable with a wide choice in capacities.

SEAGATE BARRACUDA 2TB
PRICE $100
Supplement the PRO with cheap HDD storage.

KEYBOARD

CORSAIR VENGEANCE K95
PRICE $179
The perfect keyboard. Lovely Cherry Red mechanical switches, a slick and attractive aluminium body and customisable backlighting make this The One.

DISPLAY

ASUS PB287Q
PRICE $719
A fully-featured 4K monitor with near-perfect colour accuracy for under $800.

MOUSE

CM STORM REAPER
PRICE $85
Very solid and feels fantastic under the hand with sweet on-screen movement.

AUDIO

CREATIVE SOUND BLASTER ZXR
PRICE $269
Superb music and general audio, with the versatility of a comprehensive set of connectivity options.

POWER SUPPLY

CORSAIR HX1000I
PRICE $349
Corsair's mighty HX1000i pumps out extremely reliable power, even when under full loads.

SUBSCRIBE
FOR YOUR CHANCE TO
WIN ONE OF FIVE COOLER MASTER KEYBOARD AND MOUSE SETS!

SUBSCRIBE TO *PC & TECH AUTHORITY* THIS ISSUE AND YOU'LL GO INTO THE DRAW TO **WIN ONE OF FIVE CM STORM QUICKFIRE XT AND CM STORM RECON COMBOS VALUED AT $188 EACH!**

When you're gaming and you're aiming for the win, every click and every keystroke matters. Cooler Master understands this. Developed by pro-gamers, the CM Storm Quickfire XT and CM Storm Recon provide you with a pure gaming experience with no added gimmicks.

The Quickfire XT built with the Cherry MX Red switch has proven itself to be the standard in gaming mechanical switches for gaming keyboards. The Recon Gaming Mouse is designed specifically for gamers that demand the utmost in durability, functionality and accuracy. The ambidextrous form factor and rubberized coating making it a versatile for all types of grip gestures, equipped with a pair of Omron Micro switches and Avago 3090 high precision optical sensor to ensure your movements are true and your click will register accurately first time.

Together they will provide the ultimate pure gaming experience.

CM STORM
GAMING.COOLERMASTER.COM

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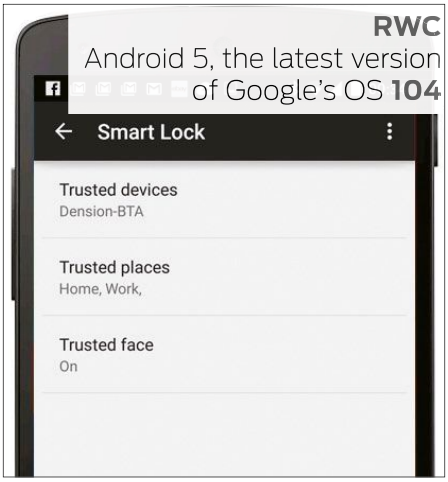

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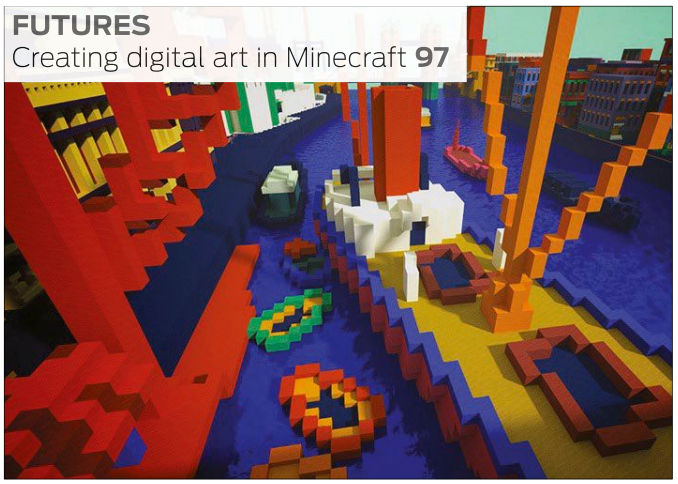


RWC
The wider vision on cloud and infrastructure **110**

7 SPREADSHEET PROBLEMS... AND HOW TO SOLVE THEM

There are hundreds of reasons why spreadsheets are brilliant - but sometimes, as **Simon Jones** explains, a database can do the job better

If you need to make a list of anything, it's tempting to see Excel as the default repository: after all, it's only a small list of items for yourself or a few of your closest colleagues.

Perhaps you need something more sophisticated – formulae for some calculations, or macro programming to automate the collection and processing of data. No problem: just type "=" to start writing a formula and from there Excel will be your guide.

Unfortunately, the ease with which you can start work in Excel or a rival spreadsheet program is also one of its problems. What starts as a small project in Excel grows and grows, until you're left with a behemoth – at which point you could also be facing speed and stability issues, or even a development problem you just can't solve.

Here, we examine the issues you can often come up against with spreadsheets, how you could possibly tackle them in Excel, and when you'd be better off taking the plunge and switching to a database as a solution instead.

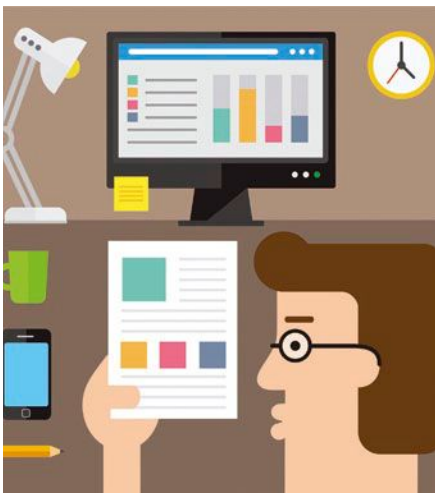
1 MULTI-USER EDITING

When Excel systems grow organically, you quickly run into the problem that only one user can open a workbook at any one time. The second person to try to open the file is told it's already open and that they can cancel, wait or view a read-only version. Excel's promise to let you know when the other person closes the workbook is rather hollow, since it doesn't check the status very often, and indeed it might never enlighten you. Even if it does, someone else might nip in and open the file before you.

There are three ways around this: you can use Excel Online, the cut-down, web-based version of Excel; you can turn on the Shared Workbooks feature; or you can split the data into several workbooks so that a different person can use each workbook without you all treading on each other's toes.

2 SHARED WORKBOOKS

Excel Online allows multiple editors by default, but it's missing so much functionality that it isn't really a contender for anything but the simplest tasks.



"When Excel systems grow organically, you run into the problem that only one user can open a workbook at any one time"

Although its Shared Workbooks feature looks like it should do the job, it's loaded with restrictions. You can't create a table or delete a block of cells if the workbook is shared, for example.

There are workarounds for some restrictions – for others it's a matter of changing the structure of the workbook, rather than using a workbook that's already been set up – but they can get in the way. As a result, it can be impossible to use a shared workbook in the same way you might use an ordinary, single user workbook.

Changes in shared workbooks are synchronised between users each time the workbook is saved; this can be on a timed schedule, forcing a save every five minutes, for example. However, the overhead of regular saving and tracking every user's changes is quite large: workbooks can easily balloon in size and put a strain on your network, slowing down other systems.

Shared workbooks are also fragile and prone to corruption. Microsoft is aware of the problem, but doesn't seem to be doing much about the issue. It looks like it's hoping Excel Online's multi-authoring method will take over from the older shared workbook technology, but this won't be a realistic proposition until the company removes all the restrictions and extends the multi-authoring technology to the full Excel desktop application, as it has with Word, PowerPoint and OneNote.

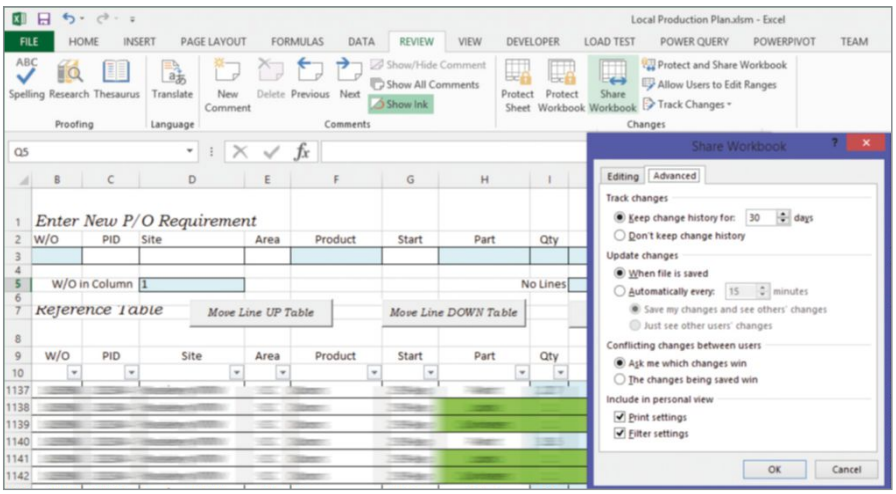
3 LINKED WORKBOOKS

Splitting your data across multiple workbooks can provide a workaround to the problem of multi-user editing. But it's likely these workbooks will need to have links between them so that values entered in one can be used in another. Links between workbooks are also useful for keeping logically separate data in separate files, rather than just separate sheets in one workbook.

Annoyingly, these links are another source of frustration and instability. They can be absolute, including the full path to the source workbook, or relative, including only the difference between the source and destination paths. Although this sounds sensible, Excel employs arcane rules to decide when to use each type of link and when to change them.

The rules are governed by a variety of options, some of which aren't at all obvious, and by whether the workbooks were saved, and where they were saved before the links were inserted. The links can also change when you save the workbook or open and use Save As to make a copy, rather than copying the file using the File Explorer. The upshot of all this confusion and uncertainty is that the links between workbooks can break easily, and recovering from broken links can be a time-consuming process, during which no-one can actually use the files affected.

Linked data is only updated when the files are opened, unless you specifically click Data | Connections | Edit Links | Update Values. Because of this, if your links aren't between two workbooks, but cover three or more, you have to open all the workbooks in the correct order to ensure the updated data flows in order, from the first to the second to the third. If you changed a value in the first workbook and then opened the third, it wouldn't



∧ You can set an Excel workbook to be multi-user, but it makes the file larger and more fragile, and imposes many restrictions

see any changes because the second workbook hadn't updated its values.

This chaining of data is logical, but it increases the likelihood that data is either incorrect or that you'll try to open a workbook that someone else may already be editing.

Of course, you can try to avoid linked workbooks altogether, but there's a chance you'll end up entering the same data into more than one workbook – and with that comes the danger of typing it in slightly differently each time.

4 DATA VALIDATION

Errors can creep into data in any computer system: people mistype words or transpose digits in numbers with monotonous regularity. If your data isn't checked as it's entered, you're going to have a problem.

By default, Excel accepts whatever the user types. It is possible to set up validation on look-up lists, but these can be difficult to maintain, particularly if the same field is used in more than one place. If users have to enter document ID numbers or customer reference numbers without any checks, it's easy to tie the wrong records together without realising it. The data integrity of the system is then fatally compromised, and any analysis of the data is suspect.

You may already be suffering the effect of this problem without realising the root cause. Consider a situation where you have a list of invoices in Excel where the user has typed the name of the customer slightly differently on each invoice. You've got invoices to "Jones Ltd", "Jones Limited", "Jonse Ltd" and "joness". You may be aware that these are all referring to the same company, but Excel doesn't. Any analysis of the invoice data, such as a pivot table by customer by month, will give multiple results where there should only be one.

5 NAVIGATION ISSUES

Large workbooks are difficult to navigate. The row of sheet tabs across the bottom of the window is a terrible mechanism for finding your way around if there are more than a handful of tabs; when there are more tabs than can be displayed across the screen, it becomes even more difficult to find what you're looking for. You can right-click on the arrows to the left of the sheet names to bring up the Activate Sheet dialog, but even that only lists the first 20 sheets before you have to scroll the list – and there's no way to sort, group or search for the sheet you want.

6 SECURITY ISSUES

You can add security to Excel workbooks, but it's rife with problems. Protection is geared much more towards protecting the structure of the workbook, rather than the data. You can try to lock some sheets and cells to stop users changing the structure and formulae, but if they can see the data then they can usually change any or all of it (unless you do some clever macro programming).

7 SPEED ISSUES

Excel isn't the fastest application in the world, and its programming language, VBA, is sluggish compared to more professional programming languages such as C#. This all stems from the intended use and flexible nature of Excel. It is, after all, a spreadsheet engine. Yes, it can be pressed into service to manage lists of data, but that doesn't mean that it's the best choice for this kind of work. Indeed, there are other applications better suited to such tasks – because they were designed to do them.

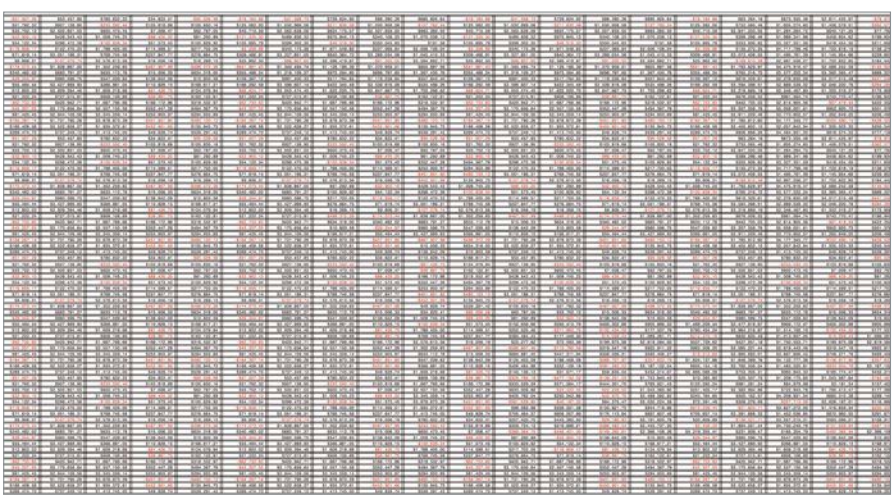
ENTER THE DATABASE

If you're hitting any of the problems outlined above, don't ignore them: there's a professional answer to storing "structured data", and it's our old friend the database. It doesn't have to be scary or expensive, and it should give you the opportunity to think logically about your data, how it links together and how you interact with it.

Take heed, though: if you're moving from a spreadsheet solution to a database, don't slavishly duplicate the spreadsheet design: you should take the opportunity to make it better.

There are general-purpose database applications available, with which you can construct a bespoke solution. Alternatively, you may find that a specialist database application – one that has already been designed for the purpose you require – is cheaper, faster to implement and a better fit.

∨ An Excel workbook can easily grow to become slow, flaky and cumbersome to usemany restrictions



For instance, if you have a list of customers and details of all your interactions with these customers, that could be considered to be a customer relationship management (CRM) system. Despite its fancy name, a CRM system is simply a specialised database. Similarly, accounts packages such as QuickBooks and Sage are specialist databases. If you can't find a prebuilt application that suits your particular needs, you can probably build one yourself or get one built for you by your IT department or a consultant.

The most common database type is a relational database. This stores its data in tables, which consist of rows and columns of data. Each row holds the data for a separate item – for example, a particular customer – and each column describes a different attribute of the item, such as the customer's name or credit limit.

> *"You only need to enter a customer's data once to create a record, then you can use it on as many invoices as you need"*

The tables have relationships defined between them so that, say, an invoice carries the customer ID. This means you can easily find all the invoices for a particular customer or, from a particular invoice, retrieve the customer's phone number. You only need to enter the customer's data once to create the customer record, and you can then use it on as many invoices as you need without having to type it in again. To create a database, you have to define these tables and relationships and then define the layout of the screens you want to use to list and edit this data.

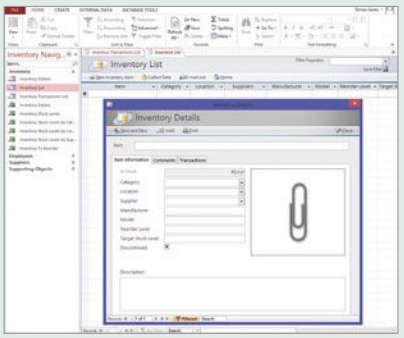
There are dozens of database applications out there. Some are easy to use and do the whole job, allowing you to define the tables, data-entry screens and reports; others are more fully featured in specific areas but require other tools to do the complete job. A program may be very powerful when it comes to defining the tables and relationships, but completely lack any tools for defining data-entry screens. Microsoft SQL Server is the obvious example here. As with other large database systems, SQL Server takes care of the back-end and expects you to use another tool, such as Visual Studio, to develop the front-end.

> If analysing your spreadsheet reveals it contains many different types of data, you probably need a database

WHICH DATABASE IS RIGHT FOR YOU?

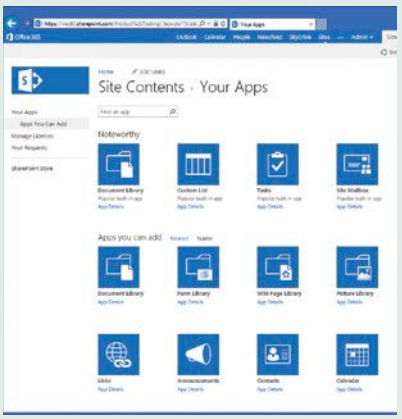
ACCESS

Access is one of the granddaddies of desktop databases. It's easy to use – and easy to abuse. You can design tables, screens and reports from scratch, or start from a template. Some of the templates are overtly American and don't always teach good practice, but they get you started quickly. Screens and programming features can be quite sophisticated, and you can deploy your finished application to your intranet rather than relying on file shares to get the application to the users.



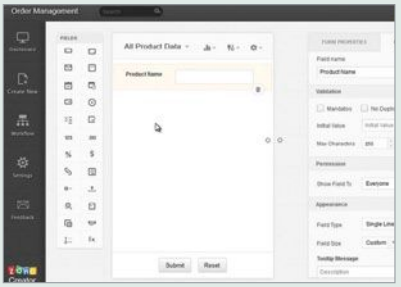
SHAREPOINT

SharePoint is a database as well as a document-storage mechanism. You can use it to compile simple lists and link them together. The Form Designer isn't terribly sophisticated, but customisation is possible. SharePoint's ability to suck a list of data amassed in Excel into a custom list is useful. It makes the list available to everyone on your network, but also enables you to add security to restrict who can do what with that data. You can ask SharePoint to alert you by email whenever someone adds, edits or deletes records and, if you're storing data concerning people, calendar items or tasks, you can synchronise that data with Outlook.



ZOHO CREATOR

The web service Zoho Office includes a database application that uses drag and drop to lay out its forms in an easy, intuitive manner. You can also use drag and drop to program the interactions and workflows. Being a web service, your data and applications are available from anywhere, with simple security to keep your data private. Zoho charges per user per month, but limits the number of records you can store for that price. It charges extra for storing more data or for other features such as email integration.



HOW TO MAKE YOUR FORTUNE ON YOUTUBE

Some people are earning millions from YouTube clips. What's their secret, and how can you jump aboard the gravy train? **Ian Betteridge** shares his expertise

With more than a billion visitors every month, YouTube is the third most-used website on the planet after Google search and Facebook. And it's home to hundreds of YouTube "stars" making six-figure sums from their channels, including plenty of amateurs who started out creating videos for themselves.

We don't have space here to tell you how to turn an idea you may have into a storming success on YouTube – I've created a dedicated book for that, called How to be a hit on YouTube (http://tinyurl.com/nb4sjsl) – but we can explain exactly how YouTube channels make their money.

RIGHTS AND WRONG

In order to understand how to make money from your channel, you first need be aware of how to set up advertising, the different ad formats available to you, and how to determine which of your videos are actually making money.

Before you turn ads on, however, you need to ensure you have the full rights to what you create. That means all music, footage and artwork.

The kinds of things you'll need to clear include logos, thumbnails, intro/outro/background music, and even software interfaces and games. Often, this clearance takes the form of explicit written permission from the rights-holders, but sometimes you'll find that copyright holders have given blanket permission for their content to be used. It's important to always check, no exceptions.

People often talk about "fair use" with regard to copyright material. In the US, this gives specific rights to the use of another person's material under limited circumstances – for example, for the purposes of education or as part of a parody.

> *"Before you turn ads on you need to ensure you have the full rights to what you create"*

You definitely don't have the right to use a clip from someone else's content, even if the clip is short. YouTube's Content ID feature enables major partners such as studios and record companies to automatically scan for their content. If found, you'll be issued with a takedown notice; three takedown notices could lead to you being banned from YouTube, so it simply isn't worth the risk.

LET'S TALK MONEY

The first step on the road to YouTube fortune is to enable monetisation on your channel. Head to the Monetisation tab in your account settings and, assuming your account is in good standing, click "Enable my account". (If your account isn't in good standing – typically because you've uploaded copyright-infringing material at some point in the past – this option won't be available.)

Congratulations – you're now a YouTube Partner, eligible to earn money from your work! The next step is to verify your channel, by visiting youtube.com/verify. This gives you access to series playlists and YouTube Live, features that YouTube regards as "advanced".

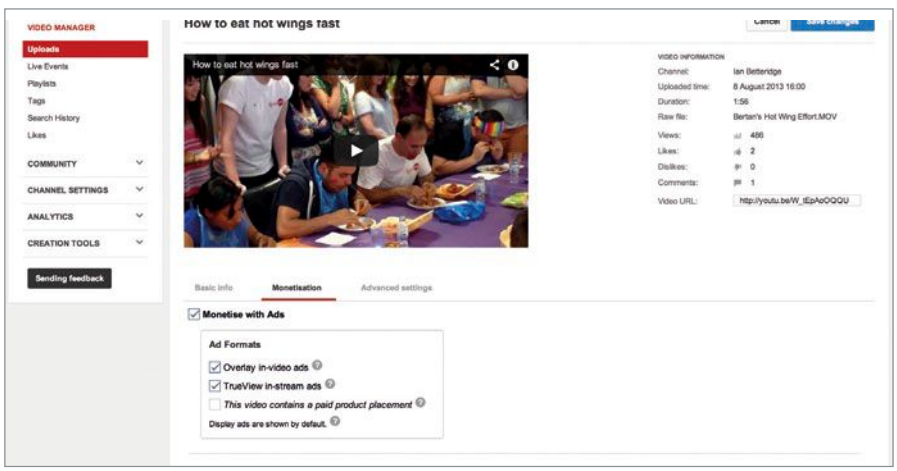
Payment and some aspects of monetisation are achieved through Google's AdSense programme, which is the same system used to pay websites that use Google Ads. Although you can begin monetising without linking to an AdSense account, you'll need to associate your YouTube account with an approved AdSense account to see your earnings in YouTube Analytics and to be paid the money owed to you automatically. If you've already created an AdSense account in the past, just visit the Monetisation tab in your YouTube account settings, and follow the instructions to link the two.

If you don't already have an account, go to the Monetisation page in your channel settings and click on the section marked "How will I be paid?" From the AdSense Association page, follow the "next" step to be directed to AdSense. Select the option at the bottom of the page to choose the Google account you wish to use, enter the password for your Google account and accept the AdSense association.

Once you provide contact information and submit your AdSense application, you'll be redirected back to YouTube, where you'll see a message informing you that your AdSense application has been received. Approval should take no more than 48 hours, after which you'll start to receive payment via AdSense when the amount of money you've earned reaches a given threshold.

With advertising enabled, you'll see new monetisation options appear against every video you've created, and every new one you upload. The number of options available to you will vary depending on the length of your content.

The key thing to remember is to enable everything that YouTube makes available to you. There's a temptation, particularly for new channels, to minimise the ad formats you select, because you don't



Once you enable monetisation, each video will present options depending on the length of content

"Before you turn on ads, ensure you have the full rights to what you create – all music, footage and artwork"

want to put people off by serving up too many. But the good news is that YouTube determines when to show ads algorithmically, based on how the person who's viewing has reacted to ads in the past. For example, those who click "Skip ad" as soon as possible will see far fewer pre-roll skippable ads. Viewers who always drop out when they see a non-skippable ad will see fewer of those. Basically, you can leave it to YouTube to determine how many and what type of ads to show.

Having said that, it's worth having an idea about the different formats available to you. There are a number of options, some of which are worth more than others are.

STANDARD IN-STREAM

Standard in-stream is a non-skippable format, which means the viewer must watch the advert in full before the video will play. According to research, 70% of in-stream ads play all the way through. Users are significantly more likely to click on in-stream ads versus ordinary web banner ads, which, due to their "unstoppable" nature, makes them particularly valuable. If you start to see lots of Standard in-stream ads on your channel, you know that you're likely to make more money.

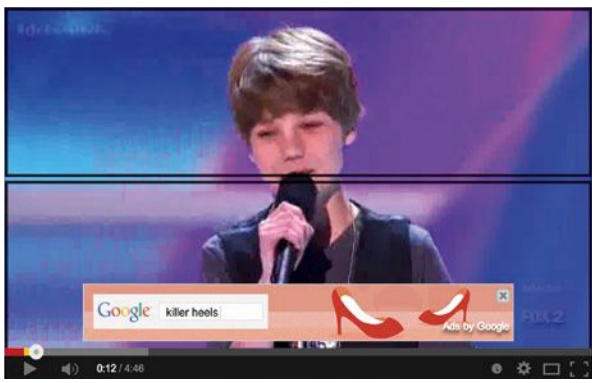
TRUEVIEW IN-STREAM

Like Standard in-stream, TrueView in-stream ads appear in your video, either as pre-roll or mid-roll (those that appear during your video) ads. The difference is that they're skippable after five seconds, which means viewers watch them only if they're interested. Your channel is paid if someone watches either the whole ad, or 30 seconds of a longer ad, and they form the bread and butter of ads on YouTube. According to YouTube, anywhere from 20 to 50% of viewers watch the whole ad.

INVIDEO OVERLAY

InVideo overlays usually appear at the bottom of a video, at any point while it's playing, but usually around 8-10 seconds in from the start. They can be closed by the viewer at any time. These ads earn you money on a cost-per-click basis, so are often the least valuable of all the ad formats. However, advertisers interested in response (having people visit their site) will pay good money on a per-click basis for some topics.

^ Viewers are more likely to click on Standard in-stream ads, which can't be skipped over



< InVideo overlays that sit at the bottom of videos earn you money on a cost-per-click basis

DISPLAY UNITS

Display ads show on the YouTube holding page rather than in the video itself. They are, effectively, standard clickable banner ads. Since this type of ad doesn't require any specific new creative work from advertising agencies (as it's a standard format), it's one of the easiest units for YouTube to sell. However, the amount of money you'll make from these is relatively low, as they don't receive huge rates of response from users.

TRUEVIEW IN-DISPLAY

With an increasing number of companies opting to make their own video content on YouTube, TrueView in-display ads are becoming more common. They're effectively ads that link to other video content on YouTube, and can generate good revenue if companies are willing to pay to get plays on their own content.

PRODUCT PLACEMENT

Although this isn't strictly an ad format, product placement can be a good earner for established channels. As the name suggests, this is simply ensuring a prominent placement for a product in your videos, and needs to be prearranged directly with the company wanting to place the product. You'll probably find that as your channel becomes larger, you'll receive offers for product placement. For example, Jenna Marbles (who has more than 13 million subscribers) included prominent placement for Bella Beachwear's swimwear in a video – mainly by wearing the range in the recording.

TRACKING YOUR EARNINGS

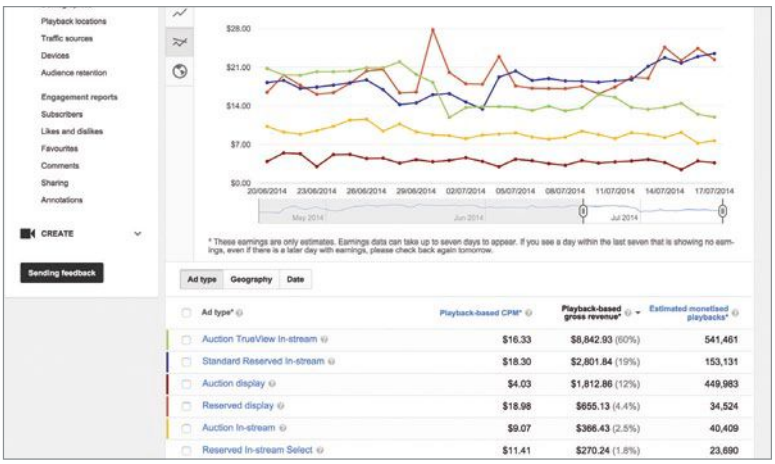
The primary place to work out how much your YouTube videos are earning is YouTube Analytics (youtube.com/analytics). Click on the Estimated Earnings tab, and you can actually drill down to how individual videos are performing. The all-important Estimated Earnings report provides earnings-related details for all your content, as well as the channel and video levels.

CHANNEL PERFORMANCE

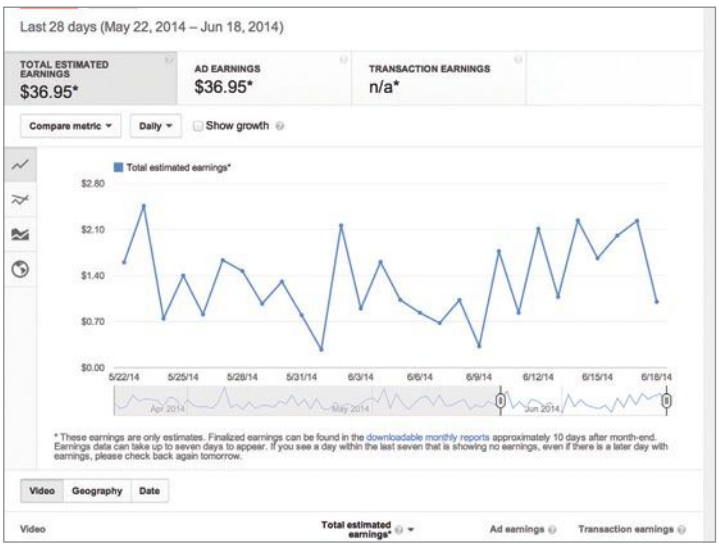
First, take a look at the overall performance of your channel. You'll see three blocks: total estimated earnings; ad earnings; and transaction earnings. Unless you're supplying rental content, only the first two will be applicable.

ESTIMATED EARNINGS

Beneath this is a graph for total estimated earnings, which is initially set to daily



^ Head to the Ad Performance section of your channel to determine which ads are earning you the most money



> YouTube Analytics will give you a breakdown of estimated earnings for the whole channel or each individual video

totals. If the totals are small, you probably want to change this to show either weekly or monthly figures. Under the graph is a timeline that gives you a big-picture view over time, with handles you can use to stretch out the time period you're looking at. You can also change this in the time period dropdown menu which is at the top of the page.

BIG EARNERS

Finally, you'll see a top-ten list of the best-performing videos on your channel. You can click on these to drill down to view an individual video's performance, or use the search box to find more. You can look at the performance of whole playlists too.

The "Estimated monetised playbacks" tab should help you spot this straight away. However, as the name suggests, the estimated earnings shown in YouTube Analytics are just that.

Although they should be close to what your final earnings will be, they aren't the canonical truth about what will finally end up in your bank account.

For this information you need to go to the downloadable earnings reports, in the Reports tab of YouTube Analytics. In particular, the Performance Reports section will give you a view of the actual amount payable on a month-by-month basis, although – as you'd expect – the amount is in arrears, so you'll see reports only for the previous month rather than the current one.

ANALYTICS

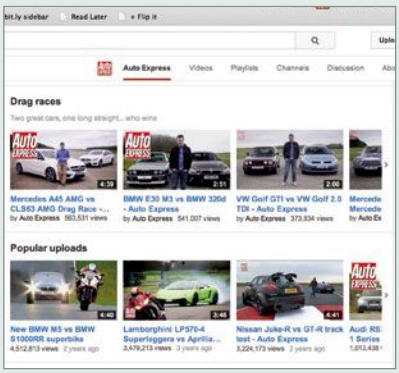
For a full set of analytics, you need to download the report. This gives you the performance of everything on your channel, and breaks it down according to the performance of the individual kinds of ad available to you. You can also filter your earnings to help you better understand whether your revenue is coming from viewers on YouTube or on embedded content found elsewhere on the web.

These reports are a goldmine of information for larger channels – but at the start, you can probably just consider the estimated earnings as the best place to go. ●

4 WAYS TO KEEP YOUR AUDIENCE WATCHING

1 USE PLAYLISTS

This is a great way to keep someone watching beyond the end of a single video, but make sure you put some thought into your playlists – it's not enough to simply shovel lots of very different content into a playlist and hope people will keep watching: they won't. Instead, imagine you're curating a set of videos. When you put one video in the playlist, imagine yourself in the place of the viewer and ask what they would be interested in next.



2 KEEP VIEWERS IN SUSPENSE

This isn't only about creating compelling content: you need to borrow a few tricks from TV too. Think about the last time you watched TV with ads. Did anyone say something such as "find out what happens after the break" or "later in the programme, we'll tell you how..."? These kinds of verbal prompts are designed to keep you watching – and, crucially, give nothing important away at the same time.

3 PROGRAMME YOUR CONTENT

Programming essentially involves creating a regular schedule, letting people know in advance that you'll be doing certain things at certain times. It works because it builds expectation among viewers: if they like your content, they'll come back every month, week or day to see what you're doing. Start to think of your content as episodes rather than one-offs and you could benefit from "the box-set effect", where viewers keep going from one video to the next.

4 LINK WITH ANNOTATIONS

If you don't use annotations then you're missing a trick. Annotations are added to videos after you've uploaded them, and can be used to link to any point inthe video, back to your website or – most importantly – to any other video or playlist on YouTube.

SELINA JONES
DATA ANALYST

In a new occassional page in *PC & Tech Authority,* we look at jobs in IT and talk to someone in the field.

WHAT DOES YOUR JOB INVOLVE?

At the moment I work for a higher-education establishment, and we have a big customer-relationship-management (CRM) system full of details about alumni and donors. Part of my job is to delve into that data, to analyse where gifts are coming from and work out who's most likely to make gifts in the future.

I run a lot of other queries, too: I might need to find people that meet a particular criteria, for a mailing or perhaps a telethon, or I might need to create a report on something we've done lately. So I pull the data out and ask: what did the picture look like before? What is it now? What's changed as a result of our actions?

There's an element of predictive modelling too: I'll use statistical software to identify people with particular characteristics that we're interested in, then model other people who look similar.

WHAT TECHNICAL TOOLS DO YOU USE?

Our database has an built-in query tool, which I can use to pull the data off and put it into Excel, or for statistical modelling I'll use IBM's SPSS software. In previous jobs I did more SQL coding, using plugins such as Oracle and Crystal Reports to extract data – that was when I worked for a local authority, looking at health- and social-care data.

I also have a background in Access – I used it to pull out data from various databases, and sometimes people would come to me and say "my database doesn't work any more", so I'd have to go into the Visual Basic code and work out why. I wasn't trained in that, but I was able to pick it up, stepping through and debugging bits and working out why things weren't working.

I'm now in a big organisation with more hierarchy, so I don't get to go into the back-end these days. There's no more writing SQL, which can be frustrating because you're limited to what's in that custom CRM. But I expect that will change at some point, because what people want is becoming more complex.

DID YOU NEED A TECHNICAL BACKGROUND TO GET INTO THIS LINE OF WORK?

Actually, I originally studied classics at university. It was interesting, but not particularly useful. However, I did do a postgraduate certificate in social-science research methods, in which there was a statistical element.

Really, though, my career started with a basic data-entry assistant job, which was my first introduction to databases. It was here that I completely fell in love with data, and all my jobs since then have revolved around data analysis – becoming more in depth as my technical knowledge has increased. The move from a local authority into the fundraising profession might seem a big change, but I'm still using the skills I had before. People are recognising that these skills are transferable, so it's perfectly possible to move between fields.

HOW MIGHT SOMEONE GET STARTED IN THIS CAREER?

There are plenty of opportunities out there: every organisation seems to want someone who can get to grips with data. You can actually get started with basic Excel skills. It sounds silly, but many people don't understand things such as pivot tables and conditional formulae, so at the lower end of the salary spectrum, you'll definitely find jobs where companies may need someone who can use Excel.

When you want to move onto statistical analysis, you may be able to get training in a package such as SPSS. Otherwise, you can download R for free, and work your way through the online documentation and support.

The thing about this career is that you have to be someone who enjoys playing with things. You have to put your own time into exploring datasets, looking for patterns and seeing what kind of things you can do. Often at work you'll be given a specific task, and you won't necessarily have time to do much exploration, so you need to know how to look at the big picture and find what you're looking for.

"many people don't understand things such as pivot tables and conditional formulae"

WHAT'S THE WORST PART OF THE JOB?

Perhaps the most frustrating part is when you've spent hours and hours pulling together a report, and then somebody's first reaction is "wouldn't it be great if we could see such and such as well?" People don't always recognise the time and effort that goes into this type of work, or they may not immediately grasp why you've focused on one thing rather than another. But as long as you're clear about exactly what you're giving people, they're normally very satisfied.

WHAT'S THE PAY LIKE?

The average Australian wage for a data analyst is $62,582, but data (and especially "big data") is becoming enormous, and as more organisations see the value in data, salaries are only going to improve. In the job I'm in now I'm actually treated as the senior person in my team – that was a real surprise at first, because normally in other teams I've been quite junior. But that's the way things are going.

WHERE TO START

- Moneyball: The Art of Winning an Unfair Game by Michael Lewis (or watch the film with Brad Pitt)
- CoolData (cooldata.wordpress.com)
- Stats With Cats (statswithcats.wordpress.com)

ARE ROBOTS REALLY GOING TO TAKE YOUR JOB?

Oxford researchers have warned that a third of jobs could be lost to robots. **Nicole Kobie** separates the fact from the fiction

Robots and automation will take over more than a third of jobs over the next two decades, researchers have predicted – and if that sounds familiar, we're not surprised. It's hardly the first caution sounded over smart machines.

The experts are in agreement. "There's no sector of the economy that's going to get a pass", software entrepreneur and author Martin Ford has declared. MIT scientist Andrew McAfee warns that "the jobs that are going away aren't coming back." Economists Jeffery Sachs and Laurence Kotlikoff see a worrying potential "for smart machines to engender long-term misery".

These dire warnings appear to be backed up by the latest research from the University of Oxford, with Carl Frey and Michael Osborne warning in a Deloitte-commissioned report that 35% of jobs are at high risk of being lost to automation in the next two decades.

Angus Knowles-Cutler, a senior partner at Deloitte, has argued that "technological advances are likely to cause a major shift in the labour market in the coming decades", with many people facing unemployment. "A widening gap between haves and have-nots is also a risk as lower-skill jobs continue to disappear," he added. To avoid that outcome, Deloitte suggested, employees need to improve skills and companies must help with retraining.

But are jobs really at risk? Any research is speculative, but the idea splits even AI and robotics experts; a recent Pew Research survey (www.pewinternet.org/2014/08/06/future-of-jobs/) suggested that 48% believe "robots and digital agents" will displace blue- and white-collar workers, with the prospect of mass unemployment, while 52% said such technologies won't displace more jobs than they create.

WHICH JOBS COULD GO?

Some jobs are clearly at risk: self-driving cars are already to be found on US roads, and Daimler has shown off its Mercedes-Benz Future Truck 2025 – so named because that's when the self-driving truck is expected to hit the roads.

Meanwhile, US general Robert Cone said in January 2014 that drones and robots may let the army cut the size of a combat team by a quarter; California-based Knightscope has created the 5ft-tall K5 Autonomous Data Machine that can roll around a building as a security guard; and Amazon is running a competition to create automated shelf-pickers.

IPsoft's Amelia AI is already used to take customer-service calls and even burger-flippers may be replaced: San Francisco's Momentum Machines has built a machine that cooks 360 burgers an hour to order, even slicing vegetables.

^ Rethink Robotics' Baxter could bring robots within reach for small businesses

v Robots have long been used in industrial settings such as car factories

The Oxford research suggests that low-skill, highly repetitive jobs are most at risk, such as sales staff, drivers, construction workers and office administration staff. "These trends are already well underway," the report ominously noted.

Not all jobs are at risk: the report concluded that 40% of jobs are safe from automation. Those in "skilled" management, financial services, engineering and science, education, media, the arts and healthcare are all secure from robot usurping – as are those in computing.

Before readers breathe a sigh of relief, note that there's disagreement over the jobs that will be affected. The Oxford research suggests those most at risk are lower-skilled, but in 2014 then science minister David Willetts pointed out computers are better at cognitive functions than simpler tasks. "Giving a cup of tea to a little old lady is a bigger robotics challenge than chess against Kasparov," he said in a speech at Policy Exchange.

Much of what we see as intelligent work isn't hard to replace, such as accountancy, or "significant areas of" journalism,

WORKPLACE ACCIDENTS

Robots are hardly a new arrival in many workplaces – car factories being one obvious example – but as they make more inroads into industry, and become more advanced, there's a greater safety risk. So far, there have been few accidents: a New York Times report revealed a total of 33 deaths or injuries in the US due to robots at work in the past three decades. Even then, details of some accidents suggest human error may have been the cause.

However, at the moment, most robots are specialised machines doing repetitive work, often inside "cages" to keep human limbs out of the way; as that shifts to smarter machines that move around, there's more of a risk of accidents occuring with people.

On the other hand, robots may improve safety: the majority of car crashes are human error; self-driving cars can't get distracted, tired or drunk.

^ A recent Pew Research survey revealed a lack of consensus over whether jobs are at risk from robots

Willetts said, pointing out that Bloomberg has long used computers to automate reporting of corporate results, and that USA Today runs a computer-generated weather article on its front page. "Some of these things that we think of as quite high-level cognitive may be more likely to be computerised ahead of giving that little old lady a cup of tea."

JOB CREATION

Even if jobs do disappear, it's nothing to be alarmed about, since such job churn is always happening, according to think tank the Adam Smith Institute. "The economy destroys 10% [of] jobs each year," noted senior fellow Tim Worstall in an essay on the think tank's website. "Unemployment doesn't rocket by that amount because the economy also, roughly you understand, creates three million jobs each year."

We can't even imagine many of those new jobs yet. "As has happened before, as has been happening for centuries, as the machines take over the muck spreading, then the muck spreaders go off to do something else. Usually, something a little less smelly and more enjoyable," Worstall said.

However, while there may be the same number of jobs, they may be in different places or be less meaningful work – the number of "middle-class" jobs such as secretaries has already slumped thanks to technology.

Asked about structural unemployment, Willetts recalled when offices were filled with "typing pools" of young women – a role that no longer exists, but where workers could find alternative employment easily – but admitted coal-mining areas were less flexible and hadn't rebounded as well.

"Advances in technology dramatically change the type of work we do, but they won't mean there's less work as a whole to go around," he said. "We've had two centuries of dramatic technological change, and there are more people in work than ever before."

Indeed, Rodney Brooks, the inventor of Baxter (see Meet Baxter, below), suggested to Wired that the rise of robots could bring manufacturing back to Britain. "We think of manufacturing as happening in China," he said. "But as costs sink because of robots, the costs of transportation become a far greater factor than the cost of production. Nearby will be cheap. So we'll get this network of locally franchised factories, where most things will be made within five miles of where they are needed."

Even if we do lose jobs to robots, there's an upside: we can work less. However, we need to find a way to ensure people make enough to afford to buy the products of robot labour, noted Noah Smith, an assistant professor of finance at Stony Brook University – and to make sure all the world's labour doesn't end up in the hands of a few US tech firms.

In the same paper for Nesta, he added: "A society with cheap robot labour would be an incredibly prosperous one, but we will need to find some way for the vast majority of human beings to share in that prosperity, or we risk the kinds of dystopian outcomes that now exist only in science fiction."

MEET BAXTER

Baxter is the Raspberry Pi of industrial robotics: it's flexible, easy to use, and relatively cheap – at US$25,000 for the base model, it's potentially affordable for smaller businesses.

Made by Rethink Robotics, Baxter is described as an "interactive production robot". Rather than taking over one repetitive job from humans, Baxter can learn a variety of tasks. And you don't need a degree in programming to teach it. Baxter can be trained simply by showing it what to do; hold its hands and run them through the process you need it to complete, and the OS will save the pattern.

Unlike other robots, Baxter doesn't need to be caged off for the safety of co-workers. It's been designed to be safe to work alongside humans, with no parts that can grab or pinch people, sensors that can tell what it's touching, and a large Off switch.

Rethink Robotics was founded by Rodney Brooks, who also set up iRobot – the company that makes Roombas. Not surprisingly, Rethink Robotics doesn't think robots will steal jobs. Jim Lawton, chief marketing officer, said in a blog post: "The simple fact that technology makes human life better has been proven over and over and over again."

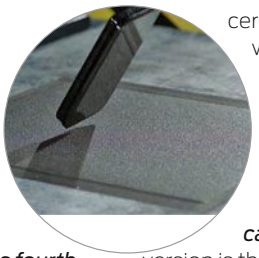
WHAT IS...GORILLA GLASS 4?

Ever dropped and smashed your phone? The clever folks at Corning are trying to prevent shattered displays with the latest version of Gorilla Glass

Smartphones are like toast: drop them and they always seem to land on the unfortunate side. But rather than smearing jam on your floor and ruining your breakfast, you're left with a shattered display. Corning, the creator of the toughened glass that's used to cover displays on more than three billion (and growing) devices around the world, has decided enough is enough.

Gorilla Glass? Is that for monkey exhibits at zoos? Don't be silly – gorillas aren't monkeys. Gorilla Glass is a specially strengthened glass – technically, it's an alkali-aluminosilicate glass – used on top of LCD or OLED panels. Corning strengthens its glass by dipping it into molten potassium salt at 400ºC, which leads to an ion switcheroo: smaller sodium ions are drawn out and replaced by larger potassium ions. When it cools, the larger ions press together, increasing the tension and the strength of the glass.

And this is used on all phones? On some models. Corning claims Gorilla Glass is used across 40 brands on more than 1,300 models – including the iPhone and iPad – but other phones and tablets use a different type of toughened glass, with the tasty name "soda lime". Apple also uses sapphire glass to cover the fingerprint reader on newer iPhones.



So exactly how drop-proof is this fourth version? The company realised that most smartphone displays are broken after being dropped, so it has focused its attention on making its glass stand up to fumbling fingers and gravity. It designed a test that simulates a smartphone falling one metre and hitting a rough surface, such as asphalt or concrete. According to Corning, devices fronted with soda-lime glass shattered almost all of the time, while gadgets boasting Gorilla Glass 4 survived 80% of the time – and twice as often as "similar" alkali-aluminosilicate glasses, which we're assuming means Gorilla Glass 3. You can watch the test video here: www.youtube.com/watch?v=8ObyPq-OmO0.

Sounds like dark magic. Well, we're certainly being kept in the dark when it comes to details. The glassmaker is saying simply that scientists "formulated" Gorilla Glass 4 with "drop performance" in mind.

There must be something you can tell me? Okay, okay. The new version is thinner: a 0.4mm sheet of Gorilla Glass 4 can handle twice the pressure of a 0.55mm sheet of Gorilla Glass 3, which means smartphone makers have another way to shave thickness from their devices.

When can I expect my phone to toughen up? Gorilla Glass 4 samples are already with Corning's customers, so expect it to start fronting phones and tablets from early 2015. It may well end up in other places, too, as the company is pushing its toughened glass as a stronger material for car windscreens and smart appliances in the home – it's one thing to have to put up with a shattered smartphone, while it's another thing entirely if it's your fridge that's cracked.

CROWDFUND THIS!
SINCLAIR ZX SPECTRUM VEGA

Our pick of tech projects on Kickstarter and Indiegogo

Is the ZX Spectrum really back? First released in 1982, the Sinclair ZX Spectrum is a British computing icon – and now it has been reworked as an '80s-style games console.

It's being made by Luton-based Retro Computers, a start-up backed by Sir Clive Sinclair's Sinclair Research. If you're wondering about the use of the official Spectrum name, it's under licence from Sky In-Home Service, which obtained the IP rights from Spectrum via Amstrad.

How does it work? There's little technical detail available, but the creators say it combines a low-cost ARM microcontroller with "a clever piece of software". The device itself is a small Spectrum-style box, with a joypad and four keys on the top. It plugs into your TV, so you don't need a monitor.

What games can it play? The Vega comes preloaded with 1,000 Spectrum games, but it supports all 14,000 games that were developed for the original device, some of which Retro Computers will make available as free downloads (it's working with "original Spectrum game developers" to secure their permission to run old games, and will give a software royalty donation to the Great Ormond Street Hospital). If you have any old Spectrum games – and we're impressed at your nostalgia if you do – you can run them via an SD card.

What does it cost? Here's the bad news: the initial batch of 1,000 were snapped up within days. Retro Computers has already committed to a second manufacturing run, though, with prices likely to remain at £100 per unit – £25 cheaper than the original machine. You can also show support by shelling out for artwork and books autographed by Sir Clive himself, and £75 buys an invite to the launch party. We're hoping booze is included.

Likely to get funded? Already there – the £100,000 funding goal was surpassed within three days. Funding closed on 30 January 2015, with the first units due for delivery in April.

Link: pcpro.link/245spectrum

WELCOME TO THE FUTURE OF DIGITAL ART: MINECRAFT

The Tate has teamed up with the developers of Minecraft to bring artwork to life inside the insanely popular block-building game. We spoke to creator and artist, **Adam Clarke**, to find out why he thinks the future of art is digital

Players of minecraft are used to building their own works of art, but now they can explore André Derain's The Pool of London and Christopher Nevinson's futurist look at New York, Soul of the Soulless City, while immersed in the popular game. And there's plenty more to come. We blocked out some of creator Adam Clarke's time to ask him a few key questions.

You first came up with the idea of art in Minecraft for a competition run by Tate, but you didn't win. How did the project still happen?
After I didn't win, Tate got in touch with me and proposed a collaboration. They commissioned me to design eight Minecraft maps that explore different paintings – to create Minecraft maps so we could literally walk into those paintings and explore them and have a little adventure. We brought together some of the best makers of Minecraft maps in the world, and also some game designers in order to do Redstone [the name of Minecraft's in-game programming tool] and some command-log stuff, and we built it all from scratch.

It's been suggested that Minecraft is a good way to get children into coding. How do you think your project fits into that?
We're in a YouTube culture, where young people will tend to use YouTube rather than television or traditional forms of media to get the information on stuff they're interested in. With this project, we're going to be using YouTube to inform them about how we built the maps. If you're interested in the coding part of it, you can look up how we coded these games, and even attempt to do it yourself. If you're interested in the artwork side of it – making and building – you can follow that kind of pursuit. So it's a whole range of different kinds of ideas.

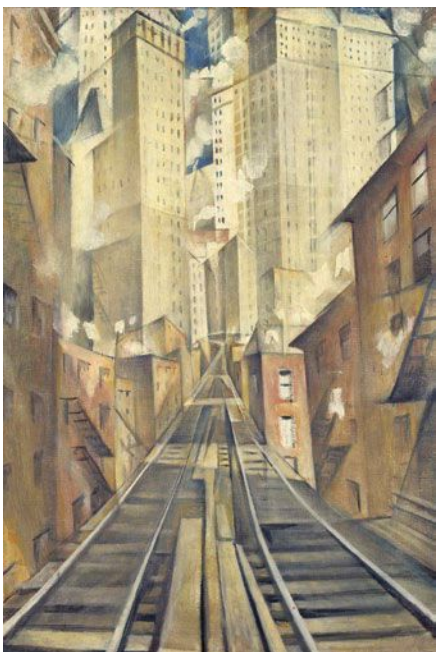
Why is Minecraft so appealing to children?
Minecraft has amazing appeal because it's one of the few places children are allowed to be creative and spontaneous. They have more freedom in the game than they have probably ever had in a classroom. Also, the Minecraft experience isn't intimidating.

Are there any more pieces of art on the list?
We have six more maps to produce. The two we're working on next are a painting called The Toy Shop by Peter Blake and Carnation, Lily, Lily, Rose, by John Singer Sargent.

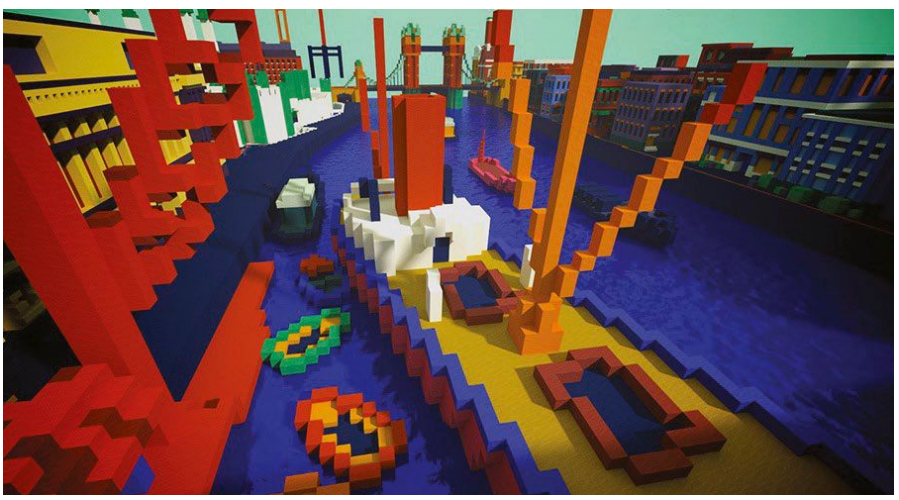
Do you think the future of art is digital?
I have a six-year-old boy and he doesn't see a distinction between digital [and not]. For him, digital things and paintings, they hold the same value. So something that's created by me in clay, for example, has a similar value to something that's coded or made up of pixels.

I think the next generation of young people will take on board the talent behind a pixel and the talent behind a piece of clay as being of equal value to one another. I think this is already being talked about, especially in computer games and within the entertainment industry, which will lead to meaningful art and authentic digital experiences too.

If you have Minecraft, you can download Clarke's artwork-themed maps at http://tinyurl.com/nxm7fob.



> Christopher Nevinson's Soul of the Soulless City in paint and in Minecraft



> André Derain's The Pool of London reimagined

DVD CONTENTS

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Advanced Memory Scanner: Enables improved detection of persistent malware that employs multiple layers of encryption to conceal its activity.

Cloud-Powered Scanning: Speeds up scans by whitelisting safe files based on the ESET Live Grid file reputation database.

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Idle-State Scanning: Aids system performance by performing in-depth scans when your computer is not in use.

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Stop hackers from misusing your passwords and bank account details. Enjoy safer connections, stay invisible in public Wi-Fi networks, and prevent your private data being copied to unauthorized flash drives.

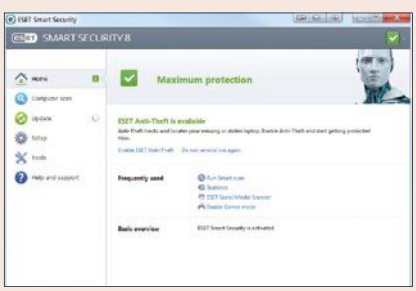
REGISTRATION & INSTALLATION:

- Download and run ess_nt32_enu.msi (32 Bit) or ess_nt64_enu.msi (64 Bit)
- Proceed with the installation process.
- While you wait for the install to finish, point your browser to http://www.antivirusfreetrials.com.au/.
- Fill in your details in the form presented, a special set of keys will be sent to your email.
- Once the installation has finished, launch ESET Smart Security
- Once launched, a prompt will appear asking you to activate your product (We're going to use log in details in this instance). Check your email for a set of log in details, use these details to activate and log into ESET.

Congratulations! You now have a 6 month trial version for ESET Smart Security!

For support of this software, please direct your queries to: http://www.eset.com/au/support/

Note: Please be advise that it is recommended that you remove other antivirus solutions, in fact, this installation will prompt you to!



ASHAMPOO SNAP 7
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Ashampoo Snap 7 is ideal for beginners and professionals alike.

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IOBIT DRIVER BOOSTER PRO 2
Registered version
Updating drivers is usually an initial step to avoid hardware failure, system instability and hidden security vulnerabilities.
To update drivers regularly is also an effective way to enhance your overall PC performance, and maximize your gaming experience. While this process could be risky and frustrating if done manually,

Driver Booster PRO is introduced to download and update drivers for you automatically with just one click. Based on cloud library, Driver Booster PRO can always be the first to identify outdated drivers, and download and update driver at an unrivalled speed.

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KEYDEPOT 2015
Registered version
Always stay on top
In the summary view of KeyDepot, you can get an overview of your saved passwords or you can let them display, sorted by self-defined categories.

SAFETY FIRST
KeyDepot uses the highly secure AES-256 algorithm, which is approved in the U.S. for state documents classified top secret.

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When using KeyDepot on several computers, we recommend the use of a Cloud account. Your password data is thus always synchronized on all devices.

1-CLICK LOGIN
You can call straight from within the program a desired web page and then let complete the login data for each respective text box for username and password with just one click. It really is that quick and easy!

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JON HONEYBALL

"IT SEEMS MY FRIEND HAS AN INSATIABLE DESIRE TO SAY 'YES' TO ANY OFFER THAT POPS UP ON HER COMPUTER"

Users are unwittingly installing tools and widgets that are playing havoc with their systems. It's time to nuke them

It was a plaintive message on Facebook: "My computer has gone very slow, is there anything you can do about it?" I couldn't refuse to help a friend, so I agreed to take her laptop in for investigation. It was clear from the start that something was slowing down her machine harder than a bottle of sleeping tablets. Everything took a long time, it was turgid and lethargic in operation and even logging on took an age. Clearly something was amiss.

A quick check of the system with a few downloadable antivirus tools showed nothing of significance, so this wasn't a pure malware issue, nor were there any of those nasty ransomware screens popping up asking for $100-plus to fix it. After a quick dig around Chrome (actually it was a pretty slow dig, but you get the idea), her default browser, the root of the problem became apparent.

It seems my friend has an insatiable desire to say "yes" to any offer that pops up on her computer. As a result, a good dozen browser extensions were in play, mostly for unnecessary shopping optimisers, searchbots and the like. It took only a few seconds to nuke everything in there, which certainly helped a little. Then I turned my attention to the "Uninstall a program" section in the control panel; it's useful to sort this list into descending order as it's better to see which programs have hit the machine most recently at the top. As expected, there were several clusters of installations spread over several days during the previous few months. Each of these clusters showed that around half a dozen installations had taken place on that particular date, and each looked very suspicious indeed, with odd names and some curious misspellings. A good giveaway to their lack of respectability was that most didn't contain Publisher information, which suggests they weren't digitally signed, either. I know that many honest manufacturers and software authors can be careless about filling in their Publisher name field – I'm looking at you, Epson – but having nothing there is usually a sign that something isn't right. To be quite clear, while its absence isn't instantly damning, most reputable software has a Publisher name field.

The dates were a giveaway, because on each of these occasions she'd said yes to some sort of download: a shopping speed-up tool; a better search bar; something that would solve world hunger. Each of them appeared to have dragged down a pile of other things, too, and this is why I was seeing a cluster of installs on each date. Fixing it was simple enough – just dump anything I didn't recognise. I'd already ascertained that there was nothing of great importance on her machine in terms of user data, but I still prefer to clean up whatever is there (rather than nuke everything from orbit and start again) when dealing with a friend's computer. That's because I'm not sure what will happen as a result. Will their recovery solution actually work? At least on my own hardware I know I can do this and it will work every time.

About an hour or so later, I'd pulled all dubious-looking items off the machine, and then rerun some antivirus and anti-spyware scanning tools and found it to be clean. A quick run through Windows Update ensured the latest patches were in place, including the Adobe files that would inevitably be out of date. This machine was back to a good working configuration and its performance was exactly what you'd expect from a PC of its vintage and specification. If the machine had been full of malware then my friend would have been horrified, but clearly there's a disconnect in the minds of many users about what appears to be "useful tools" or "add-on widgets" and what is genuinely useful.

I'm really not sure how to fix this problem. If someone is absolutely determined to install something then they will, and this is especially true on older versions of operating systems. It's less likely to be an issue with current and future OSes, because they tend to be locked down so that only products from known publishers on known app stores will install. If ever there was a case for installing the latest version of your OS, then this would be it. But clearly we need a far higher level of suspicion among the userbase to stop such malware getting onto computers in the first place.

My rules still apply: browser extensions are usually a bad thing; unknown apps with weird names and a lack of Publisher information are a bad thing, too.

Nuke them all – and in future, tick "No" to anything that you're not 100% certain about or familar with.

Tying the Watch firmly to the iPhone isn't likely to hurt Apple's phone sales

WINDOWS 10 BETA

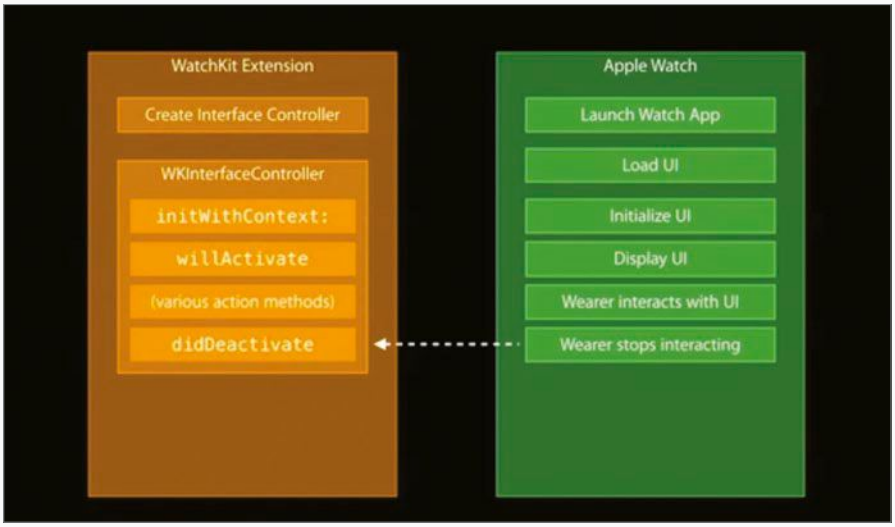
The Windows 10 beta release rolls forward, and I continue to be impressed. However, there's one item in the recent beta that has caused some users plenty of grief: it appears that Microsoft has removed the Placeholders facility by which you could choose what files would sync between OneDrive and your local machine. Placeholders enabled you to browse files on OneDrive without actually having them stored on your local machine – a clever facility, especially if you have generous OneDrive storage but limited local space.

I can't help but feel that this is a somewhat stupid move on Redmond's part, which causes old-timers such as me to become hot and bothered and start reminiscing about all the other innovative storage technologies that Microsoft has half-baked then walked away from over the years: Cairo OFS; Structured Storage; the structured storage deconstruction to NTFS Streams (cancelled in NT 3.51 beta); Drive M: in Exchange Server (which was prone to self-immolation if you dared to run CHKDSK against it); SharePoint storage; SQL Server storage and the whole WinFS debacle.

And can anyone, anywhere point to an actual user of the ReFS file system who has been supported in recent Microsoft server products? It's supposed to be very clever and a big step forward from NTFS, but it lacks significant features and simply isn't ready for primetime. I've yet to come across anyone who's using it, but maybe you know different. We already have the ongoing "OneDrive for Business for Mac" debacle, and now it seems that OneDrive in Windows 10 will be neutered as well.

> *"Can anyone, anywhere point to a user of the ReFS file system who has been supported in recent Microsoft server products?"*

Not that the competition is without fault. I run Dropbox on a PC at home to act as a home archive of my important work data. It decided to get stuck with 27 files that simply wouldn't sync, and no matter how I poked and cajoled Dropbox, it wouldn't play ball on that PC. Worse still, there aren't any good enough debugging windows to tell me what's going on, so that I could dig around and find the offending files. Sometimes I simply have to conclude that computers simply hate me.



^ Apple has released a limited number of tools for its Watch device

APPLE WATCH

Apple has released its SDK environment for the Watch. From viewing the videos, it's clear that it's taking a conservative approach to how this will work, and is initially releasing only a subset of the tools. I'm impressed by the thinking. An app on a watch is essentially a visualisation of an app that runs on the phone – there's a transport layer between the two that enables both pieces of the application to talk to one another, but the idea of getting the phone to do all the heavy-lifting is clever. After all, it has the more powerful processor, the bigger battery and the most sensor capabilities – GPS, for example. Putting such functions into the watch itself would inevitably have created space and power restrictions. And of course, tying the watch so firmly to the iPhone platform isn't likely to hurt Apple's phone sales either, which must be part of its intention.

For the past few weeks, I've been living with the Motorola Moto 360 watch, which uses the Android Wear platform running on an Android smartphone. Checking out Android 4.4.4 and Lollipop 5, it's clear that Android OS is now reaching maturity, and I could quite happily give up my iPhone and move over to an Android 4.4.4 or 5 device for my day-to-day work. Okay, I'd miss quite a few apps that I've come to rely upon, but these tend to be niche apps that I use only infrequently. The Moto 360 is interesting and has a beautiful screen – I love some of the third-party watch-face apps that have become available for it, but I'm not wholly convinced that I'm in tune with the way it performs notifications.

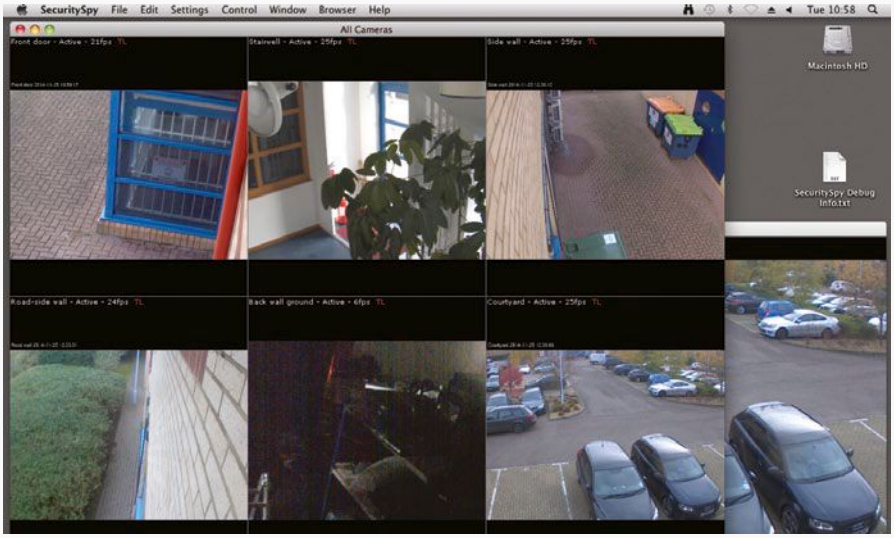
It's much better than the Pebble, another device to which I've just recently returned. This whole issue of notifications is key to the wrist-computing experience. Wrist-worn devices need to be lightweight, offering only sufficient information to make comprehension simple, fast and reliable, but never becoming a constant source of distraction and interference. I'm not convinced that either the Pebble or the Moto 360 has this quite right just yet, and I'd certainly prefer to have finer control over how demanding the notifications are from each information source.

I'd like this control to be time-sensitive, too; although the "out of hours" facilities found on recent Android and iOS devices are useful, I feel that this is still only scratching at the surface. For example, I want fewer updates when I'm driving, so why not tie in the accelerometers to the process? Maybe this is already happening, but I can't find myself quite at ease with the notifications processes yet. The same is true of notifications that land on my desktop: once again, too much information, provided too frequently, becomes an annoyance. This fine-tuning is something that will take much learning by the vendors.

ROUTER SECURITY

Your network router is a key element in your home or office network – it's the bit that connects your internal network

JON HONEYBALL
Jon is the MD of an IT consultancy that specialises in testing and deploying hardware
@jonhoneyball



< SecuritySpy enables you to keep an eye on multiple cameras from multiple vendors

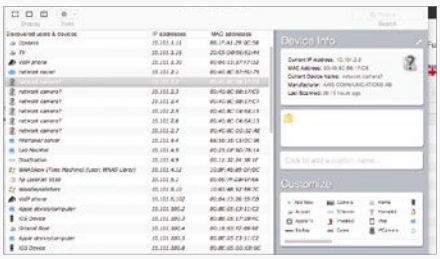
to the outside world. Almost all routers do network address translation (NAT), which hides everything connected to your internal network behind a single, external-facing IP address, and there's also a firewall in there to control how it responds to incoming and outgoing requests through the router. Most routers are set up by default to allow any outgoing requests to do so via any port, and to block every kind of incoming request. That should be the end of the matter, except there are some wrinkles.

For example, your router will almost certainly have a bunch of interfaces enabled to allow for remote configuration and management: this is usually done via an HTTP or HTTPS web page, but it could involve SNMP, or other protocols such as Telnet or SSH. There's clearly a decision to be made over where you want these interfaces to be visible – obviously to your internal network, but what about the outside one? Do you ever need to remote-manage your router from outside your own network, and if so, is this from any IP address – including a hotel in the Caribbean – or just the fixed IP address you have at your home?

This being so, I was interested to see that Avast's new antivirus includes a network security-testing tool. How it works isn't particularly well explained, but I think it calls a cloud service that then peeks back down your internet connection into your router and has a good look around. Using it on a friend's network, I discovered they had their network-management interfaces bound to the external-facing network as well as the internal one. Fortunately, a strong password was in place, but it's certainly an enhanced risk to leave ports and interfaces open when you don't need them. A quick root around the web configuration from inside the network and I'd disconnected all those external-facing remote-management interfaces. My friend sighed a deep sigh of relief.

As a rule of thumb, don't expose any interface that you don't need. There may be some allowances for remote management, but if this is the case then ensure that you lock it down to accept only incoming connections from known IP addresses: from your home network, for example, or from an outfit that you know might in future need to remotely connect. Better still, set up a simple VPN tunnel to allow your remote computer to tunnel over the internet and appear back inside your network, just as if it were a local computer. Some people like using remote-control tools, but I prefer to keep things simple and involve only the necessary amount of technology.

V Keeping tabs on your network is easy with IP Scanner Pro for OS X



IP SCANNER

If you want to keep an eye on your network, it's useful to have a tool that can scan your system and present the results in graphical form. There are many ways this can be achieved using freeware or command-line utilities, but sometimes it's nice to have a tool that displays a little more tinsel.

I couldn't locate the security cameras on my home network, since for some reason I'd allowed them to grab their IP addresses from DHCP but hadn't set up any reservations for them. The particular DHCP server in question doesn't display its reservations list in an attractive form, so I went hunting for such a tool, and found it in IP Scanner Pro for OS X. This quickly ran around my network, identified a bunch of devices and presented me with a good list that I could slice and dice as I wished. The free version can handle only a small number of IP addresses, but the Pro version will go the whole hog.

IP scanning is always useful, but when you're playing "hunt the device" it can be invaluable, although I'm not sure its value actually extends to the $38 cost of the Pro version. This seems a little steep – $20 would be pushing it, and I can't help thinking that sales are being lost because of the price.

However, given that it can root around subnets and take a good look around a business network, the pricing is perhaps to be understood in that context. The low IP count of the free version is probably a little too tight for home users who would happily pay a few pounds for a more home-orientated version.

SECURITY CAMERA SOFTWARE

Another piece of software I've come to rely on is SecuritySpy. This OS X app is excellent at keeping an eye on all of your security cameras. I use models from a number of vendors at the office and at home, and SecuritySpy has no problems consolidating them into a single, unified control surface. You can set up motion detection, recording, and numerous features such as alarms, out-of-hours support and so forth. It's a solid piece of code that just works. It isn't cheap, but there's a full free trial that you can play with for a month.

Be warned, though: you'll need quite a healthy computer to handle all the high-resolution streams from multiple cameras.

OS X 10.10.2 UPDATING

Oh dear me, it seems that Apple has put out a beta update of OS X 10.10.2 that's caused Google Chrome to explode. Chrome was using a particular API call that Apple has now deprecated, and it's something to do with trackpad sensing. I'm sure that Google will get onto the case quickly enough and resolve this, but it's a timely reminder that even the biggest players manage to overlook API changes now and then... ●

PAUL OCKENDEN

"I JUST WISH GOOGLE HAD LEFT THE OLD APP IN PLACE – EMAIL SUPPORT IN LOLLIPOP IS A MESS"

There are some rather odd goings-on in Android 5, the latest version of Google's OS – but it's not all bad news

By now, many Android users will have upgraded to Android 5, or Lollipop. If you have, you'll have discovered that it's a bit of a mixed bag.

There's much to like, but there are also a few annoying changes. My main bugbear is the fact that Google has ditched the standard Email app, and forced everything through Gmail.

Thankfully, the Gmail app does now support Exchange Server, but there are some huge annoyances, particularly when used in a multiple-mailbox scenario. For starters, everything is red. Yes, I know red is the "official" colour of Gmail, but surely it should be possible to colour-code mailboxes so you can determine at a glance which one you're viewing?

An even bigger hole – one that has received many complaints – is that there's no combined inbox view.

MESSYMAIL

This was a wonderful facility in the old Email app, which you could use either in the app or via the homescreen widget to view all of your email in one place. It's dead and buried now, though. If you have half a dozen mailboxes on your phone, you'll need a widget for each one. Even that's currently broken: I'm finding widgets often don't update until you click through to that mailbox. Sorry Google, but email support in Lollipop is a mess.

I know there are various third-party email clients available, and I've tried many of them, but they all seem to have limitations. Some don't support Exchange Server, others don't offer Gmail account support. Some have trouble rendering HTML emails, others have less-than-flexible alerting options.

just wish Google had left the old Email app in place, or at least made it a downloadable option.

PAUL OCKENDEN
Paul owns an agency that helps businesses exploit the web, from sales to marketing and everything in between @PaulOckenden

LOLLIPOP SECURITY

It's not all bad news for Lollipop, however. I particularly like the fact that you can set up device security so that when you're at a particular trusted location (say, at home or in the office), you can unlock your handset without typing in a code or password.

You can also add trusted Bluetooth devices, so if you're in your car, for example, there's again no need to bother with fiddly unlock codes. It's a shame this only seems to work with full-fat Bluetooth devices; there doesn't currently appear to be any support for Bluetooth LE devices such as iBeacons.

The new notification system in Lollipop has divided opinion: whether you like it or not seems to depend on the method you previously used to switch your phone into silent mode. If you pressed the volume control all the way down, you'll probably love the new setup, but if you preferred to hold down the power button and choose the silent option, you'll be disappointed, because the option is no longer there. The power button is now just for, well, power!

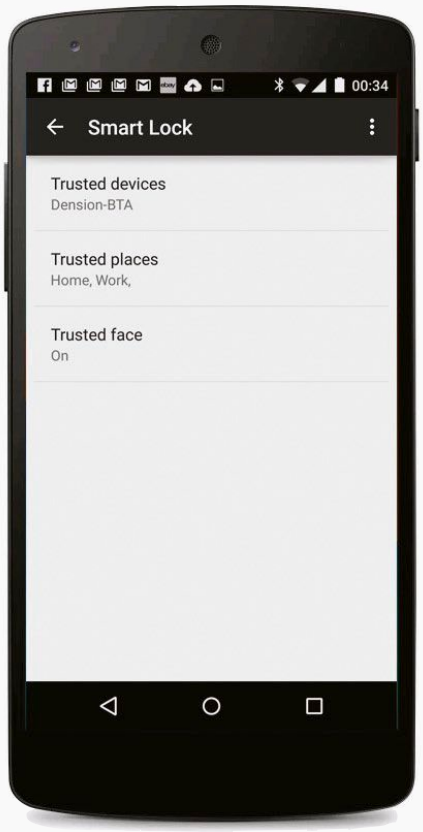
On Lollipop, the volume button gives you the option to disable notifications,

> *"can you think of a situation where you might set an alarm and then not want to be alerted when it goes off?"*

either completely or for a set number of hours. You can also prioritise notifications; perhaps you'd like phone calls to be muted but still want to see calendar notifications. You can set any app to be a priority, and certain contacts too, so that even when the phone is muted their calls will still get through. It's all incredibly flexible, although I suspect some users will find it just a little bit confusing.

What's really odd is that even alarms are disabled in full silent mode – can you think of a situation where you might set an alarm and then not want to be alerted when it goes off? No, me neither.

Lollipop's new Smart Lock is actually more of a smart unlock feature



KID MODE

Parents who let their kids play with their phones will appreciate a couple of the new options. The first is a Guest mode, which essentially starts a new user session that doesn't have access to your personal data. This prevents kids from trashing your calendar, or sending naughty emails to your boss. Even more restrictive is the ability to pin a particular screen.

This means you can hand over your phone safe in the knowledge that it's locked to a single app – perhaps a game or a streaming video service such as Netflix. To unlock it, the guest would need to key in the phone's normal unlock code. ●

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PROFESSOR IAIN E BUCHAN

"THIS IS A MAJOR STEP FORWARD THAT IS LIKELY TO ENGAGE A NEW GENERATION OF PATIENTS"

A bright future of digital health(care) is closer than you might think - if we can lift the cultural and organisational barriers

What horizon of digital healthcare have you been sold? Genetic profiling and an app for every ailment? If so, you'd be forgiven for thinking there's a long way to go from the current experience of booking an appointment with your GP. Here, from my vantage point as director of the Health e-Research Centre, I'll explore how information technology could transform the way we interact with health services.

Before I look at what's wrong, let's not lose sight of what's right: the English NHS is the envy of policymakers the world over, and in this article we will see that the lessons it has learned, and those which remain to be learned, apply to Australian services, too.

Since the first NHS patient was registered in 1948, there's been a commitment to universal healthcare free at the point of need. Every day, 1.5 million patients are treated by a workforce of 1.7 million. The UK experiences better health, and spends less on healthcare, than nations of equivalent or even greater wealth.

Yet the current route of entry to this wonderful ecosystem of services is a telephonic gauntlet, with busy receptionists acting as gatekeepers. Designed to triage GP access according to need, the system isn't without fault: patients must endure long waits in electronic holding pens; key symptoms remain unrevealed despite probing questions; fantastic ailments are proffered in Oscar-worthy attempts to work the system; and – my late mum's favourite backup plan – patients resort to sitting in the waiting room to door-step the doctor.

PROFESSOR IAIN E BUCHAN is a professor in public health informatics at the University of Manchester and director of the Health e-Research Centre at the national Farr Institute of Health Informatics Research
@profbuchan

Herein lies the conundrum: on one hand, we have controlled access to the NHS, which delivers world-leading efficiency; on the other, the public have come to expect the online, on-demand services of a digital economy. But here also lies an opportunity to use digital resources to support self-care, freeing up the time of health professionals for those who most need their help.

Can self-care be underpinned with helplines, algorithms and a web of self-help recipes? Well, the NHS Direct experiment led to the 111 phone line and online symptom-checkers. These meet part of the need, but they don't empower patients with personalised, persistent information about their health and care. What's required is an easy-to-use combination of medical records and medical "textbooks", which are open to both the patient and their care team at the same time.

> *"A typical hospital IT department can have tens or hundreds of databases from a variety of vendors"*

Is the NHS ready for this culture shift? Allow me to share with you a story of how one GP surgery in Manchester created a sea change in opinion, gluing the digital tomorrow to the reality of today. In 2000, a GP and colleague of mine, Dr Amir Hannan, had a special need to re-evaluate the way his practice interacted with its patients. Following the trial of infamous GP and serial killer Harold Shipman, Dr Hannan was appointed to help rebuild the practice's patient-doctor relationships.

To do this, he and his colleagues set about creating a "partnership of trust", involving transparency in the way they interacted with their patients. Central to this was patient access to records online – a controversial innovation at the time.

Explaining to his patients how and why they should use this facility, Dr Hannan gradually saw the project snowball: patients not only accepted the partnership, they loved it. From the ashes of a real-life horror story sprang a community of engaged evangelists taking ownership of their local healthcare services.

One of the most passionate advocates of patient access to records was Margaret Rickson. Sadly, Margaret passed away this year, but she wanted her story to be told. Since she suffered from a long-term lung complaint, Margaret struggled to pick up repeat prescriptions without getting out of breath. So, when she heard about Dr Hannan's initiative, she took up IT lessons – at the age of 77 – acquired her first PC and became the first person in her community to order a repeat prescription online, making the most of the home-delivery service.

BARRIERS TO CHANGE

The technologies used then, and now, to enable online access to NHS records were commonplace: web-based authentication (using credentials collected from the practice) and read-only rendering of records in a browser. Indeed, the innovation wasn't technical but social, empowering patients to become more engaged in their healthcare and to influence the way local health services are thus delivered.

Today, there are technical barriers to further innovation in access to health information and care. First, in terms of systems' requirements: to envision holistic digital healthcare, we must create a new understanding of what a patient is – less a passive recipient and more a coproducer of care. Second, in terms of legacy systems: to plug the blind spot of what is happening to a patient's health in between contacts with the NHS, we must join existing clinical information systems with the developing consumer health technologies that are centred on patients and citizens.

Although Google and Microsoft have tried to establish personal health record systems that interoperate with clinical information systems such as GP records, the results have been underwhelming.

< Health-promoting smartwatches that sense heart rate, skin temperature, position and motion aren't licensed as medical devices, but they could empower patients with an "early warning system"

Google Health was canned, and Microsoft's HealthVault is making slower progress than expected. This shouldn't be surprising: a typical hospital IT department can have tens or hundreds of databases from a variety of vendors, with only a handful of staff who know how to integrate them. Even the integrated offerings from large vendors are effectively delivered as a "kit car".

Considering that the NHS is one of the world's largest stores of computable clinical information, you might expect industry/NHS partnerships to be forming a crucible of personal health record innovation. However, this isn't the case.

SENSITIVE SYSTEMS

Why? Well, in addition to the blizzard of legacy systems, harnessing the raw data as actionable information isn't as easy as it might seem.

Let's take a look at a typical GP record system. There are two main databases: the "demographic file" record, containing facts about you such as your name, your address, your date of birth, your NHS number and the GP with whom you are registered; and a "journal file" of healthcare transactions, such as a diagnosis code with the date it was made, who made it, and a text-based "rubric" describing the code, which the GP can edit.

Diagnostic observations such as "COPD r/o" (shorthand for "chronic obstructive pulmonary disease has been ruled out") can be found – so the information isn't as computable as it first looks.

Furthermore, the traditional record-keeping culture is one of "note to self about my patient, and messages to colleagues" rather than "information that my patient, I and other care-givers have recorded to support (self) care", so you can understand why some doctors may not want to open up the record if they've been using shorthand that might misinform or offend. But things are about to change.

The notion of access for consuming information about oneself is then likely to give way to what health informaticians refer to as "coproduction".

PATIENT POWER

Coproduction is the crossroads where actively engaged patients meet with technological advancement and capability. The result? An empowered community involved in the generation of its own health information – and the point where the dawn of personalised medicine breaks through.

Patient-driven notes could be used to assist conversations with health professionals, tapping into a new source of valuable information. No longer will the blunt instrument of "how did you get on with your tablets?" be necessary at a follow-up visit to a GP, who too late discovers the patient stopped their course of antibiotics early because they were feeling better. Instead, an online story – via an NHS app or SMS loop – showing a drop-off in tablets being taken as quality-of-life scores pick up could prompt an alert to be sent to the primary care team, which could respond with supportive messages encouraging the patient to finish their course of tablets, thereby reducing the risk of breeding drug-resistant bacteria.

At the same time, new healthcare signals will emerge from the booming market in wearables. Most of the major consumer IT companies are introducing smartwatches that can record changes in heart rate, movement and skin temperature. Although not intended for clinical use, the data could help alert patients running into problems.

For example, a patient with chronic lung disease who's developing a serious chest infection might have an increase in temperature and heart rate that signal the need for treatment. Early treatment in the community can prevent deterioration and keep patients out of hospital – lowering their risk of premature death or catching other infections, alleviating suffering and saving money that can be used to help other patients.

There are regulatory obstacles to overcome, including the legal classification of clinical predictive algorithms as "medical devices". As such, the health applications of smartwatch data may be restricted to the fitness market, which is less regulated than healthcare. This could deprive patients with long-term conditions of necessary innovation.

"Smartwatches can record changes in heart rate, movement and temperature... this could help alert patients who seem to be running into problems"

Let's look further into the future and imagine the ideal GP record. Simple: there isn't one. Instead, personal health information is synthesised from multiple sources, ranging from wearables to multiple healthcare settings such as hospitals, general practices, community nurse visits, pharmacies and opticians.

VISION FOR THE FUTURE

This information may start to look more like a digital avatar than a filing cabinet. Indeed, it needs to have different "personalities" to maximise the engagement of individuals in reporting changes in their symptoms and other personal health information that can guide care, while presenting the same information in different ways to health professionals.

Embryonic developments of this kind of interaction can be seen at clintouch.com, where apps empower people to monitor their own symptoms and medication. Critically, the personality of the app is co-designed by the main users – the patients.

There's a long way to go from today's apps to tomorrow's health avatar, but substantial benefits can be realised incrementally. Crucially, the ideas and the will to utilise technology in this way are already in place.

Of course, demand alone may not provide the environment needed to incubate complex innovations such as the healthcare avatar. A social contract between public-sector service providers and the general public, similar to that underpinning the NHS, may be required to help protect and govern the advancement of holistic digital healthcare.

In addition, multiple nations and companies will need to work together if the algorithms supporting care are to learn in efficient and transparent ways. Yes, this is a big vision. ●

DAVEY WINDER

"I'M FAR MORE CONCERNED WITH SITES USING ENCRYPTED CONNECTIONS THAN THE COLOUR OF MY ADDRESS BAR"

Some large corporations will turn up their noses at free website security, but an easy-to-implement HTTPS system should be welcomed by everyone

Google recently went "on message" regarding security by announcing that it will start giving a higher ranking to sites that use encrypted HTTPS connections, rather than unencrypted, plain-vanilla HTTP ones that are open to far more abuse. Given that, while content remains king, SEO has become queen of the online commercial landscape, anything that encourages site owners to tighten security has to be a good thing. Indeed, there's now a move towards "encryption by default" within Google, as can be seen by the way it treats its own services.

Unfortunately – and especially lower down the business-size-versus-profitability graph – many people find the cost and complexity of migrating their sites to HTTPS a huge stumbling block. Unless you have sufficient cash to pay your web developer (assuming you had the cash to use one in the first place) to apply for and handle the implementation of the necessary certification, chances are you won't bother. Attempting to do it yourself could prove worse still: misconfiguring your certificate is all too easy, given the bureaucratic nature of the application process, and that leads to error messages and authentication warnings that nobody wants. This is where a new initiative, due to go live by the summer of 2015, comes in.

Let's Encrypt (letsencrypt.org) is being touted as a new certificate authority that could make HTTPS application and implementation almost a one-click process – or at least turn a three-hour ordeal into a 20-second breeze. Backed by the Electronic Frontier Foundation (EFF), Cisco and Mozilla, with help from researchers at the University of Michigan, Let's Encrypt will issue and manage certificates automatically for anyone who wants one. It promises that migrating from HTTP to HTTPS will become a one-command process, made possible by a new protocol, the Automated Certificate Management Environment (ACME), which supports stronger domain-validation methods than we have at the moment.

The plan also includes the employment of "internet-wide datasets of certificates", such as the EFF's own Decentralized SSL Observatory and Google's Certificate Transparency logs, which aim to make better decisions about when certificates are safe to issue than we're used to. At the helm will be a new non-profit outfit called the Internet Security Research Group (ISRG). If it delivers on its claims to enable any domain owner to get a trusted certificate at absolutely no cost, and to make secure configuration of that certificate painless and simple, then I'm behind it all the way.

I like the fact this will be a fully transparent service – all the issued and revoked certificates will be publicly recorded and available to inspect – and I also like the open standard nature of the automatic issuance and renewal protocol.

I'm less sure that everyone reading the technical "how it works" blurb at the Let's Encrypt website will enjoy its constant use of the word "nonce", though. Please relax, child molesters are not knowingly being employed to check certificate authenticity: "nonce" in this context refers to an arbitrary number used once in a cryptographic communication.

More seriously, does Let's Encrypt mean that the commercial certificate bandwagon is about to shed all four wheels? I'd like to think "yes" with regard to certificate charges and all the hoop-jumping associated with registration (an internet scandal worthy of Anne Robinson's attention for far too long), but I somehow doubt it. Certificate authorities, despite their costs, complexities and security concerns over the years, will remain viable for many reasons, not least because of the business-size scale graph I mentioned earlier. Once you shift up from the middle regions to the top echelons, you'll find plenty of organisations for whom trust, not cost, is the issue.

Traditionally, the corporate mindset is wary of conceptual "free lunches", which is sometimes, but not always, a good stance. In any case, I'm afraid these firms will continue to maintain the status quo for no better reason than that it's always been this way – they believe a free service can't possibly be as good as people being paid a king's ransom.

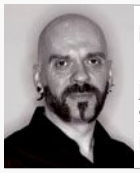
If Let's Encrypt can achieve some degree of commoditisation in the certificate-issuing business, this attitude may change, but I doubt it: this new initiative will offer only the simplest of certificates, of the Domain-Validated (DV) variety.

There's a reason for this – it's the only kind that will be easy to automate, since it requires only proof of domain ownership to acquire. However, many larger organisations want the perceived greater degree of user trust that comes from an Extended-Validation (EV) certificate. These require much more in terms of documentation than domain ownership (and will turn your browser's address bar green, if your browser supports such frills).

These EV versions are business/organisational certificates only, so we may soon see a split between business and personal users when it comes to certificate-authority use. I predict smaller businesses will inevitably be attracted towards the no-cost option, though. I repeat: I'm happy with that, since I'm far more concerned with sites using encrypted connections than the colour of my browser address bar.

HOTEL WI-FI IS DEAD

Like many readers, I do a fair amount of business travel and stay in plenty of hotels and motels, which means I use a lot of hotel Wi-Fi. Actually, let me rephrase that:



DAVEY WINDER
Davey is an award-winning journalist and consultant specialising in privacy and security issues @happygeek

I used to use a lot of hotel Wi-Fi. This is no longer the case, because hotel Wi-Fi is for the most part dead, as far as I'm concerned, for reasons of speed, greed and insecurity.

The first two failings – high costs and low speeds – fit naturally together: as broadband speeds have risen in the past few years (on paper, at least), so have the exorbitant rates being charged for what has essentially become a commoditised service. In Google's definition of "exorbitant", it offers the example "some hotels charge exorbitant rates for phone calls", which is accurate but rather dated, since everyone with any sense makes calls on their mobile nowadays. Similarly, anyone in their right mind should be using mobile data for hotel internet access – after all, you or your employer are already paying for a contract that includes data.

The savvy user will have an unlimited data account and access to 4G networks, which are the final nails in the coffin of hotel Wi-Fi. Most places I've visited in the past six months have had 4G coverage, and a little in-room speed testing has shown download speeds as high as 38Mbits/sec and uploads at an impressive 17Mbits/sec. To compare and contrast with the Wi-Fi available in the same rooms, I coughed up for one exorbitant hour everywhere I stayed, which proved my point – the best it bought me was 18Mbits/sec downstream and 6Mbits/sec up. Both tests were completed on the same tablet (attached to a keyboard case).

Even when I've stayed in backwaters where 4G has yet to arrive, I've found that 3G remains preferable: contention on hotel Wi-Fi systems tends to be so severe that there's far less lag over a 3G connection, which means I get more work done for less cost. Wi-Fi leases are often kept up for far too long – eight hours in some cases – which just clogs up the network.

The budgeting becomes more complicated overseas, depending on which network plan you have and whether you can procure a local SIM with data included at a reasonable price. It's far from impossible, though, and almost always a better deal than the hotel offering.

The experiences of my fellow Real World columnists seem to confirm this: when Jon Honeyball is in the US, he simply tops up his SIM card, sticks it into an Android handset and turns on its Wi-Fi hotspot feature.

If you work for someone else, you may not care about the costs, but I've been running my own business for 20 years and such expenses remain important to my bottom line.

Then there are security issues to consider – or, more to the point, insecurity issues, which arise when you use "guest" Wi-Fi in public areas such as the lounge, or when in-room internet access is free. Packet-sniffing applications, network analysers – whatever you call them – are out there by the score, and some of this software is very sophisticated indeed. It's simple enough to be used by anyone with a little technical know-how – and the captured data will be easily understood by those with a little more – so such apps make it easy to pull passwords out of thin air.

Readily available software even offers the chance to piggyback an open session while someone else is still using it, gaining access to their account and data. Yes, we all know about using secure connections through VPNs, HTTPS and so on – assuming the server side supports them, of course. However, not all service providers support encrypted email connectivity from an external IP address if you venture outside your corporate-inbox comfort zone, for example by indulging in a little personal surfing in your downtime.

Oh, and just because the email connection is encrypted to the server doesn't necessarily mean the pre-connection password handshaking is always secure.

"You can mitigate the risk of using any unsecured Wi-Fi network, but the most secure option is to avoid using them at all"

You can mitigate the risk of using any unsecured Wi-Fi network, but the most secure option is to avoid using them at all, since it only takes one error of judgement, one slip of the finger, to let in the bad guys. Ever heard of the Evil Twin attack, for example, in which a bad guy sets up a hotspot in a hotel with a plausible-sounding name, then sits back and reaps the stolen data rewards as client after client connects to it, thinking they're hopping on the official hotel network?

HEARTBREAK HOTEL

As I was writing this column, an even more sophisticated hotel Wi-Fi threat came to light, known as Darkhotel. This one's interesting, since it appears to target not merely the business traveller, but specifically the high-value, executive-level business traveller.

It's part of a pretty sophisticated advanced persistent threat (APT) attack, whereby the bad guys identify their victim in advance – presumably by social engineering and spear phishing – to determine his or her travel plans, including hotel locations. Researchers at Kaspersky Lab, working in conjunction with a luxury hotel Wi-Fi management company in Asia, have determined that the Darkhotel group – a name that's being applied both to the gang and the method of attack – has been active for at least seven years.

Once the target connects to the hotel Wi-Fi network, they're redirected, via a pop-up, to a software update that installs a malicious executable that already resides on the hotel's server. Okay, so this is at the extreme end of the hotel Wi-Fi risk spectrum, considering how targeted these victims are, and it would appear zero-days, kernel-mode keyloggers and reverse-engineered security certificates are all involved in pulling it off. Given that all the targets to date seem to have been drawn from the defence or nuclear-power industries, there's more than a whiff of state-sponsored shenanigans in this ploy.

This scam goes way beyond the arguments I've made above about insecure hotel Wi-Fi, but I felt it interesting enough to merit inclusion anyway, if only to highlight the danger that hotel environments can present to the unwary.

My main problems with secure, in-room hotel Wi-Fi concern price and throughput rather than security. I'd expect any decent hotel, or more likely its third-party network provider, to keep the in-room network separate from the guest network, using VLAN/switch-port/wireless isolation to prevent rogue users from accessing other network user resources.

Similarly, employing a combination of Internet Control Messaging Protocol (ICMP) snooping, to stop the Evil Twin attacks, and firewalling of the access points – to drop private-network-routed IP traffic – helps keep the commercial network system as secure as possible.

Unsecured, free access is a different matter. Let's face it: when I've finished a hard day of work and get back to my hotel, I tend to kick back and relax, which often means frequenting the bar or lounge area rather than my room. That's when I'm at my most vulnerable, and it's precisely when the attacker wants to strike, since I'm more likely to make a silly mistake.

To help keep bad guys from your data, remove hotel "guest" Wi-Fi from the equation; use VPNs and encrypted connections; don't allow any software updates away from your own network; and keep your guard up at all times.

Bear this in mind and treat all hotel networks as potentially dangerous – and as ridiculously poor value – and you can't go too far wrong. ●

STEVE CASSIDY

"OUR CONVERSATION ABOUT COLLABORATIVE TECHNOLOGIES SERVED TO SHED LIGHT INTO THE DARKER CORNERS OF HIS JOB..."

Highlighting an organisation's true way of working could have resulted in one employee's decision to head for the door

I think I may have just made someone walk out of his job in a fit of pique. It's difficult to tell, because once they've gone, there's no well-developed business etiquette for ringing them up to ask, "I say old chap, was that me?" However, since the departure followed soon after a meeting with me on the subject of "collaboration", there are grounds for suspecting that I was the reason.

Collaboration is something of a dirty word at the moment: it's perfectly clear that a lot of market-making dealers in the big banks have been "collaborating" all right, in ways they weren't meant to, and using tools they shouldn't have been using. The most incriminating evidence in the latest market-rigging scandal was, after all, a series of log files that somebody had kept of chats in ordinary consumer-style chatrooms. I should declare an interest here, since I've been paid to work for at least one of the banking giants involved in the scandal, one that was indeed mentioned in Channel 4 economics editor Paul Mason's superbly informal rant.

A video of Mason's words went viral (see tinyurl.com/nhbnj2r), and it was the kind of media spotlighting, so I suspect, which drove that guy to storm out after my meeting in a huff, because just before news of that banking scandal broke, he was an unashamed proponent of both social communication as well as collaborative working.

My interest in the idea of collaboration goes back to the days of dealing-room technology, when the mode of communication for official records was the Telex machine. Giant lumps of cast metal, featuring columnar Bakelite keys, which drove a bucketful of powerful solenoids to whack out messages onto a multipart roll of paper, character by character with finger-tingling thuds. Sometimes, I'd look at these rolls that recorded a week's worth of trades – at the leisurely pace of the Telex, "collaboration" was limited to "OK CU", or perhaps at the end of the day "OK BIBI" between dealers who knew one another well. But even back in the mid-1980s (and starting far earlier), banks knew of the importance of recording the communication that flowed through their dealing rooms, because the rate of accusations of bad behaviour was fairly constant, even if the rate of bad intentions was a whole lot lower than today. Read chatroom transcripts from the current scandal, featuring words such as "numpty" and "mug" scattered throughout, and the evidence of malice is overwhelming.

Back then, no matter what the means of conversation, the rules were firmly in place: the banks could reasonably request their staff to only communicate with customers and fellow traders using methods that presented an audit trail. No audit trail meant no commitment, and this applied equally to the traditional dealer's method of working, which was over voice circuits: point-to-point spider webs of direct copper lines ensured that not even a dial-tone delay intruded into the completion of fast-moving market trades. They may sound like an ideal opportunity to scam the market, were it not for the presence of large, ponderously turning tape recorders in a rack in the corner of the room...

Fast-forward to the 21st century and collaboration seems to be offered under two almost diametrically opposed headings. On the one hand there's corporate collaboration, in which we employ Track Changes in Microsoft Word, forwarding trails of emails and attachments, group calendars, shared folders; pretty well the entire IT armoury when it comes to the ways in which teams can work together. On the other, there's the intrusion of consumer-targeted services in the workplace, which is a complete nightmare since these consumer apps – starting from basic text

Back in the day, official information was recorded using the Telex machine

STEVE CASSIDY
Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart @stardotpro

messaging and working up to WhatsApp and Facebook Messenger – are delivered over the air, not via the corporate network.

My esteemed colleague, Mr Winder, this month writes about the death of hotel Wi-Fi thanks to the rise of 4G networks, but my point is about another, unannounced, death – namely, the death of any chance of having your staff concentrate on their jobs, on the security and liabilities of your business, or even on the truck they're driving. Whenever a message comes in, the implied assumption of all these mobile services is that your adult self should drop everything and encourage your inner child to grab the shiny, buzzing, flashing thing and read it.

There are very few classical network-traffic style fixes for this problem. Even if shallow collaboration via bits of chitchat data is passing through your firewalls, most chat-platform makers retreat to standards whenever the question of logging and monitoring is raised. Yes, I do understand that Facebook Messenger uses an evolution of Jabber, and that Jabber is covered in the extensible messaging and presence protocol (XMPP) standards documents, but that doesn't go anywhere towards helping me add a syslog or firewall rule to pull that traffic out of the stream in a coherent manner. Incidentally, while checking to make sure I wasn't walking a plank with that assertion, I happened across tinyurl.com/ngn7pqe, which should keep those hardcore techies who seek a low-level solution occupied for hours.

> *"I foresee a future in which corporations at risk of unguarded collaboration tools will invest in mobile-phone signal detectors and jammers"*

Once you add mobile (over the masts, not via Wi-Fi) into the mix, the problem of tracking chatroom collaboration becomes worse still. The solution is likely to arise through mobile device management (MDM) – permitting only company-approved apps onto company-supplied phones – but fine-grained control of collaborative chat-type traffic isn't on the cards in Bring Your Own Device scenarios.

The fact is that the banking disaster wouldn't have been held back for very long by any such implementation, since the Bad Guys would have just brought in their own phones anyway, and taken the risk of being caught using them. I foresee a near future in which corporations at risk from unguarded, unthinking collaboration tools will invest in mobile-phone signal detectors and jammers. This could be the only rational response to the curiously permissive world of the mobile networks. Or perhaps in this future where companies can insist on a "messaging disclosure clause" as part of their employment contract, so they can approach a network operator or application-platform provider with a personal freedom-of-information request (a form of collaboration members of staff, both good and bad, may find rather uncomfortable when used).

Conversations via collaboration tools within the financial sector need to be trackable

The other type of collaboration – the sort that caused my man to resign – isn't so much about informal back channels, juvenile chitchat and cliquish plotting. It's of the kind that's likely to become far more apparent following Microsoft's recent announcement that it's integrating Microsoft Office with Dropbox. This has all the hallmarks of giving in to the inevitable, since Microsoft's cloud file-storage/sharing service isn't quite as well regarded by customers as Dropbox. There's already a whole generation of business people for whom the file server or NAS box is a strange, foreign object. I claim to be able to spot these folk from miles away – they're the ones whose lights are still on in the wee small hours as they wait for absurdly large Dropbox syncs to complete (often between two machines in the same room). I'm aware that there are probably workarounds, but this sort of user doesn't do workarounds – to them it's all about brand names and free stuff. What they're pursuing is a number of ambitious ideas floated during Dropbox's expansive phase of the past few years, which aim to speed up publication through collaboration – but in reality the "collaboration" is simply the Word document being republished in a tablet-friendly format that can only be read and not edited.

It appears that what made my not-quite-a-colleague resign so abruptly was that he'd suddenly realised that the business he'd recently joined wasn't being wilfully backward and curmudgeonly by failing to use document collaboration. Rather, the whole way his business was structured was not about people working in open, ad hoc, equal-status teams, but instead a ruthless, top-down hierarchy in which individuals were given clear briefs that they were expected to work on in isolation, with the boss making the final decision about published content. Our conversation about collaborative technologies merely served to shed light into the darker corners of his job description, and revealed the true reason why his office was low on banter, paper-aeroplane competitions and had no pool table. So he left.

IDENTITY CRISIS

The modern-day identity crisis is best illustrated by another little anecdote from friends down at the local Community Centre. On my last visit, they discovered that to accomplish their next task in server-side work, they had to investigate whether their basic Business router could support PPPoE, as a way of deferring to their firewall as the landing device for their external IP address. As is usual in such situations, they were obliged to call a helpline to obtain the router

Hunting down the password and authentication username of a router wasn't a pain-free process

device password and also the DSL authentication username and password. Now, normally, if I'm with a client when this sort of issue crops up, I go shopping – partly because, as I get older, I find it increasingly agonising to listen to the whole telephone-support process, but also because I want to make very plain that I don't want to be seen hanging around and charging money for waiting on some other business' voodoo ritual.

On this occasion there was no shopping I could do, so I waited around and got to be a fly on the wall as the helpdesk tried to validate a technical enquiry call about a Business DSL account by asking for the mother's maiden name.

There was much tittering and everybody offered up their own mother's maiden name to see whether there was a positive hit, but of course this only made things worse because the identity-validation script in the call centre at the other end raises a red flag if the security questions are answered wrongly. Eventually, the gatekeeper at the other end saw the stupidity of the situation, sidestepped security and we received our answers, but the whole silly process took about 20 minutes, and it wasn't the only case they'd been through like this.

Quite a lot of the attendees at the regular computer clinics arrive there to try to figure out what's gone wrong with their password for one service or another, and this is, I think, going to turn into a whole new type of user support. We've been used to the idea that getting someone's PC or tablet to run cleanly, securely and with a well-chosen spread of apps marks the end of responsibility for the classic support nerd. Fiddling about with email accounts and passwords is the province of the end users themselves, and they don't expect to have to pay anybody to help them sort it all out.

However, that attitude was only sustainable as long as your identity remained separate from that email address. Now, the opposite is true: many utilities, social services, government departments, mega-corporations and charities all treat your email address as your first and best identity, even if you're fronting an enormous organisation yourself. Identity validation and, more importantly, recovery is based on a fairly simple list of things about you, and when it goes wrong the recovery processes make use of a long time lag as the primary means to shake off the fakers. So we now have a situation in which Google Maps resorts to sending you a postcard, after a random delay of anything up to a month.

The other story was about a family whose Yahoo address had been compromised, but who couldn't reach the security-validation emails that were being sent to their original, cable-TV-provider-supplied email ID following a house move away from the coverage patch of that supplier. They too were kept in a month-long limbo since paper validation has a built-in, deliberate delay. These types of folderols don't feel technical in the slightest, but they stand in the way of any technical progress being made. Perhaps most perniciously, they also stand in the way of a techie being paid for a piece of work he's agreed to do. I can't think of any way of charging a home user a reasonable sum that will cover "oh yes, I'll just stay on call to dash back and continue any time next month once your postcard from Google finally turns up".

> *"Eventually the gatekeeper at the other end saw the stupidity of the situation... but the whole process took about 20 minutes"*

I expect that in the future an entirely new kind of job will emerge, growing out of the IT support business more at an individual than a company level, and it will exhibit much of the look and feel of the old notary public – someone who knows how to approach these big cloud providers, and the weird government departments, and the insurance companies; someone who tracks the way their procedures and their responses change, and how that might affect their customer's ability to use their service portals. This new job would be deployed on a subscription basis, so you'd treat it a bit like professional-indemnity insurance, paying a peppercorn annual fee for the right to get in contact and request help with some pointlessly stupid bureaucratic trap that only looks technical because it's suddenly been enshrined in a web page or a mobile app.

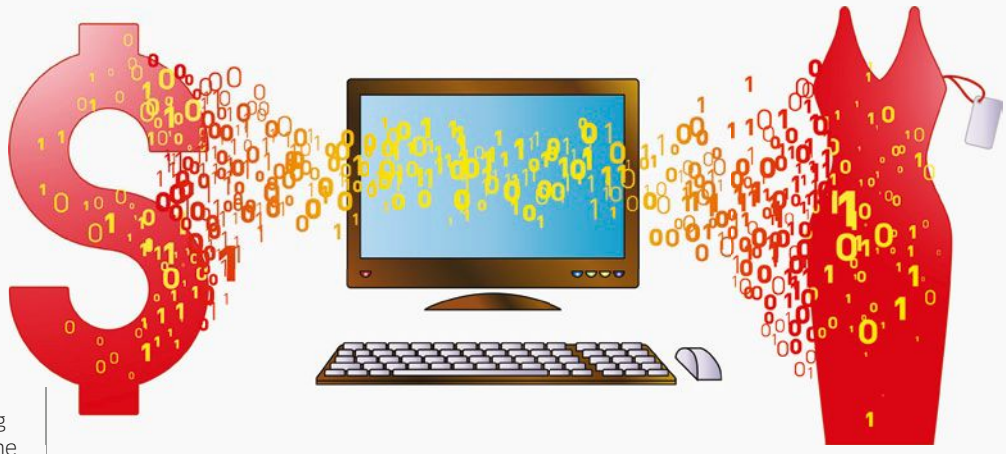
Also in my dream future there will be a strong difference between consumer, fun and friendly trivial identities, and the far more serious and lifelong variety. Perhaps a life-insurance business, whose customer-retention periods stretch into the multiple decades, would be the one to issue that kind of address, with some flashy, physical identity management included so that it didn't fall into the trap of bizarre and actively harmful identity validation.

I have to relegate all this to dream status for now, first because the existing businesses and institutions best placed to take up such a role have manifestly failed to do so, and second, the whole tech-support business has passively allowed this to become a massive problem, by standing idly by while operations types dream up authentication procedures that look good as part of a slick sign-up process, but collapse later in the lifecycle of the relationship (or the user!).

What's needed is a nice label, a phrase that a techie can use to describe something that's purely a validation problem; a matter of dancing the right dance at the right time when engaged with some indifferent, poorly regulated, gargantuan monolith, with no revenue stream attached to your request and no likelihood that under-servicing you will have any comeback to the individual or the business. I'd like to propose "Kafkaism" or "Kafka's Paradox" as a suitable label, although I suspect that quite a few of the individuals whose indolence creates the problems aren't actually educated to a sufficient standard to have come across Franz K's work. Since most people's reactions to these situations are to cover their phone mouthpiece and vent a string of expletives, perhaps a better label would be "four-letter problems". ●

ANALYSE THIS

Fiona Teakle appreciates it when analytics are used for good, not evil



In 2012 an article was released that spoke about how retailer Target was able to use the data they were getting from customers and analyse to determine if a lady was pregnant and when they may be due. This was back when people were first becoming aware of analytics and the way in which we are now being tracked as consumers. More recently I've started receiving personalised emails from Woolworths through the Everyday Rewards program which provides an outline of specials for the week tailored to my past spending habits and that I may be interested in, and this is only the tip of the iceberg as to what the stores really know about you.

While some of the insights can become personal, is it a good or bad thing that companies are starting to know more about us? Business intelligence is not just about retail companies learning about spending habits, it can be beneficial for all companies.

- Eliminates guesswork: rather than making a decision based on gut feel or based on previous experience you are making informed decision with facts. Business intelligence can offer historical data as well as real time updates in order to provide various statistical analyses.

- Real feedback: through the benefit of social analytics you are able to see what people are saying about your product or service. Whether we like it or not, social media is now part of people's daily tasks, and most of the time they are honest (more honest than they would be to your face). Having access to this information allows you to make changes before it hurts your business.

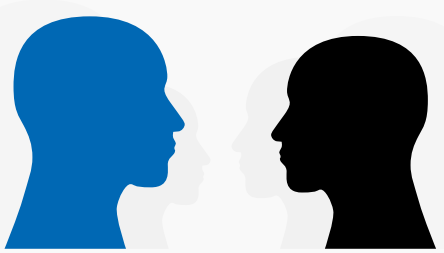
- Eliminates waste: with the right analytics in place companies can analyse cross department processes and ensure that the whole company is acting in an efficient manner overall.

- Identifies opportunities: using everything at hand you are able to ascertain any potential opportunities; through market trends, comparison to competitors and ultimately respond better to consumer consumption. If you are able to analyse historic data and determine you may require an additional amount of product at a certain time, you are then able to capitalise on something that in the past you may of missed.

While there are many advantages of utilising business intelligence there are some negatives with it as well.

- Cost: as with all new technology the cost can be quite high in terms of licensing and set-up, which may rule it out as valuable for small to medium businesses. The time to implement the solution can be significant depending on the type of technology and what you are trying to understand. I would expect that as with any technology as it continues to gain popularity the cost and implementation time will continue to decrease which will enable the smaller businesses to gain access to the benefits.

- Business engagement: as business intelligence sits in the IT department it is critical that the business is engaged as every step, as at the end of the day you are measuring your business. Too often the business is not engaged at the right level, which leads the information provided to contain what IT (or the vendor) think is relevant, but may not actually be relevant to the business.



"The critical part of any business intelligence is to integrate it well into an existing process."

- Exposure of business information: there is a risk that you may expose some company information through the use of BI. For example storing on a third party platform may enable them to view the information and data and potentially on sell to competitors. Whether you end up hosting in house or externally you need to ensure the security policy that you or your vendor has is solid and you are covered.

The critical part of any business intelligence is to integrate it well into an existing process. Integrating into existing practices ensures you will gain the right level of information relevant to your company, however in order to do this successfully you need to be clear on how your business works.

The ACS has some Special Interest Groups (SIGs) around Business Intelligence. If you are interested in hearing more on the topic and understanding it better, I encourage you to check them out. Or if you feel you have something to add why not reach out to your local branch to potentially lead a discussion or event around the area?

Whether you are a fan of the user profiling, analytics being used or not, the reality of the situation is that you can't stop it. The stores and companies are using the data to provide better customer satisfaction and it will only increase.

FIONA TEAKLE
Fiona is Director of the ACS Young IT Board. You can contact her at fionateakle@acsmail.net.au

THE MOST IMPORTANT UPGRADE OF 2015 COULD BE TO YOUR EARS, ACCORDING TO JON HONEYBALL

High-definition audio is a curious beast. The CD standard, known as Red Book, uses 44.1kHz sampling at a 16-bit data depth. That gives up to around 20/21kHz of audio, and about a 96dB signal-to-noise ratio. At the time when Sony and Philips released this format in 1980, it was thought to be more than enough, and it has served us well over the years. Studios needing extra headroom for mixing purposes, however, quite quickly moved on to 24 bits and a 192kHz sampling rate.

In the meantime, the quality of our music libraries has decreased as we have moved into the era of the computer-based audio player. The need to save space has resulted in some quite unpleasant compression systems such as MP3. Based on a model of what the average user could hear, it has the same effect on music as a mincer on a prime piece of steak. Unfortunately, it was until recently a necessary downgrade if you wanted choice on your portable player.

Today, we don't really have an issue with storage on the computer, transfer speeds to a player, or even storage within the player itself. It hit a high spot of 160GB on the iPod classic that's just gone out of production, but my new iPhone 6 Plus has 128GB of storage, which is certainly enough for plenty of music. With that much space, I can afford to forego compression to get the best sound quality.

Unfortunately, at the same time we've moved on from on-device music to a world of music streaming. With services such as Spotify, we demand to have music on tap, running over trivial amounts of bandwidth. The issue has moved from storage to pipe capacity.

Meanwhile, there's been a growing awareness that HD audio is worthwhile. My Pono hi-def player, backed by an impressive number of musicians, arrived yesterday. It plays 192kHz/24-bit audio, and output is truly immersive. It sounds like a master tape of my own recordings, made on my professional recording equipment at 192kHz/24-bit.

So how can we get this HD quality working down a narrow streaming pipe? And do we need to anyway? Well, Bob Stuart at hi-fi manufacturer Meridian Audio appears to have the answer. The company has spent years working on neurological mapping of the brain and understanding how the ears work. It seems that material above the Nyquist frequency (around 21kHz on CD format) does matter. Not in terms of what we hear directly, but in the way the ear/brain interface processes timing information. The research is quite compelling.

At an Audio Engineering Society lecture in October, Bob Stuart unveiled the new MQA format. This takes 192kHz/24-bit audio and encodes it above 21kHz into a pair of subsignals that can be placed way down into the noise pattern of the baseband audio signal.

The result is that it's backwards-compatible, something that raw 192kHz/24-bit doesn't allow for. You can play an MQA-encoded file on an ordinary player and it will work. If your player is MQA-compatible, it will decode these extra signals and regenerate the original studio-quality signal.

Does it work? Yes. Careful listening to studio-quality audio shows that this encode/decode system delivers. It does so at a data rate of only 1Mbit/sec, and without the nastiness you get from MP3 and other lossy compression systems. MQA is, in effect, a lossless solution in the time domain, and this is critically important to how we actually hear things.

Given that so much music today is consumed via smartphones and a set of headphones, it's important that we rescue folk from what I would call "MP3 hell" – a set of mediocre encoders well out of date and relevance, which munges up the sound in a quite horrible way. And we must do so in a way that's both backwards-compatible and low data rate streaming friendly, which rules out lossless formats such as raw 192kHz/24-bit and encoders such as FLAC.

Meridian has said that there are major announcements to come in the first half of 2015, and a senior representative from Warner was present at the MQA launch. He made very strong noises about the industry's desire to go down this route.

> "The need to save space has resulted in some quite unpleasant compression systems such as MP3"

I can only wish Bob Stuart, Meridian Audio and MQA success.

Meridian has been doing leading-edge DSP work in audio for decades, and everything about this new format looks considered, thoughtful and properly researched. If you care about music, then keep an ear open for more information about MQA. It could just be the musical nirvana your ears and your devices have been waiting for.

PC & TECH AUTHORITY

Level 6, Building A, 207 Pacific Highway, St Leonards NSW 2065
Locked Bag 5555 St Leonards NSW 1590
Chief Executive Officer David Gardiner
Commercial Director Bruce Duncan

EDITORIAL
Editor: Ben Mansill: bmansill@nextmedia.com.au
Art Director: Tim Frawley
Digital Editor, Tech and Gaming: David Hollingworth: dhollingworth@nextmedia.com.au

REGULAR CONTRIBUTORS
Jon Honeyball, Paul Ockenden, Davey Winder, Steve Cassidy, Sasha Muller, Darien Graham-Smith, Nicole Kobie, Tim Danton, Jonathan Bray, Fiona Teakle, Bennett Ring, Anthony Caruana, Daniel Wilks, Mark Williams

EDITORIAL INTERNS
Angus Baillie, Robert North

PRODUCTION
Advertising Coordinator: Melanie Ballard
Production Manager: Alison Begg
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ADVERTISING
Phone: (02) 8399 7603 Fax: (02) 8399 3622
Group Advertising Manager:
Joanne Ross: jross@nextmedia.com.au
Account Manager:
Kimberly Bloom: kbloom@nextmedia.com.au

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- Intel® i350 Dual port Gigabit Ethernet Controller
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