PC & TECH AUTHORITY

TECH ADVICE YOU CAN TRUST

OUTLOOK EXPERT

18 PRO TIPS FOR BETTER EMAIL & ORGANISING

WIRELESS DEMYSTIFIED

WI-FI, BLUETOOTH MIRACAST AND MORE

80 COMPONENTS TESTED

BUDGET BUILDER

HUGE GROUP TEST

51 CPUs • 15 RAM KITS • 14 MOTHERBOARDS

REVEALED: THE BEST BITS FOR A PERFORMANCE PC THAT WON'T BREAK THE BANK

REVIEWS

OFFICE FOR IPAD, AORUS X7, HTC ONE M8, DELL M3800, ASUS POISEIDON, ASUS 290, GIGABYTE TEGRA NOTE 7 AND MORE!

HOW TO:

WORD WIZ: PERFECT DOCUMENT FORMATTING

AVOID: TOP 5 WINDOWS DOMAIN MISTAKES

BUILD A MEDIA PC FOR YOUR LOUNGE ROOM TV

RETRO GAMES

HOW TO PLAY YOUR FAVOURITE OLDIES ON THE PC – FOR FREE!

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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

BANGS AND BUCKS

In last month's issue of *PC & Tech Authority*, we enjoyed the indulgent luxury of piecing together a PC using the finest components, with no serious consideration for cost. In this issue, we're going in the opposite direction, and all out, at that. We've undertaken an exhaustive examination of almost every budget component available, rating each with an eye to price as much as performance, and drawing your attention to standout products which offer the best of both of these important considerations.

Given the massive breadth of this undertaking, we've chosen to spotlight the most important core PC system components, namely: CPUs, motherboards and memory. We were able to include almost every CPU that's currently available, and each has been tested and rated, with our reviewers offering valuable insight, revealing where the best bargains lie.

A more discerning look at motherboards and memory was in order, given the vast options available in the market. Our selection is interesting in itself, as the chosen products represent, we think, a wonderful case study of the best choices in the budget category. Drilling down even further, we've uncovered some star performers and at very reasonable prices, too.

Taken together, this massive roundup represents the baseline gear you need for any new system. Now, with all of the information in front of you, we hope you enjoy playing mix and match as you configure a system that does what you need it too and all without spending more than is absolutely necessary.

Ben Mansill
E bmansill@nextmedia.com.au

Also, don't forget to check out the iPad version, packed with exclusive interactive content complementing the regular magazine. Here's a sample of what you can expect:

- **Video:** Get video tutorials, game trailers and more
- **Image Galleries:** Get a better look at some of the products reviewed
- **360 View:** Get up close with tech from every angle.
- **Get the app:** *PC & Tech Authority* for iPad http://tinyurl.com/iPADPCTA

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Is it possible to have a laksa coma? This is seriously the most delicious thing I've eaten in ages but it's making me sleepy...

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All the track studying and trash talking couldn't help Ben at go-karting this month... Tim 1 - Ben 0

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INBOX

IF YOU HAVE A STORY OR POINT TO MAKE, SEND IT IN! TELL US YOUR ANECDOTES, OPINIONS & TALES OF WOE

Getting in touch

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pcandtechauthority.com.au

EMAIL
inbox@pcandtechauthority.com.au
Please limit letters to 200 words, where possible. Letters may be edited for style and to a more suitable length.

LETTER OF THE MONTH

After moving to *PC & Tech Authority* from the former *PC User* because it changed to an Apple boy magazine, I feel that you are starting to fall into the Apple trap.

The one thing that really is getting to me is your round up of apps.

Each month they are nearly all Apple with an occasional one that is Android also, never any Windows.

Even though Windows hasn't as many I fail to see that not one can be found and Android is selling most phones and pads only one a month surely more than one can be found.

Please inform your writer that there are three other systems having apps and readers would like a few apps recommended.

Remember Windows, Android and Blackberry.

A. Lobb

Ben Mansill says: Well, won't you be pleased! Just this last issue we've actually broadened our app review section. Jenneth is now covering the full breadth of the app market, from Windows apps and beyond. How's that for great timing!

David Hollingworth says: "Apple boy magazine" - ouch. Harsh. Some of our best friends are Apple users!

DAMN DLL

I love your magazines and have kept them all as there is often a problem that crops up and I can go and find the solution. Thanks for a great magazine as it is a great read.

I have a Toshiba Computer with Windows 7 on it, but can you help advise me on what to do to fix it please. I am an aged pensioner and I live alone. My computer has a drive problem that keeps coming up and I wanted to know the best way to fix it. It is qtCore4.dll. Can you help regarding on what I can do or must purchase to fix the problem or do I have to have everything taken off my computer and renew the whole program.

C. Whyte

David Hollingworth says: It would be handy to know what program the error is relating to, but chances are some over-aggressive anti-virus program has removed it. You should be able to re-install the offending program. Alternately, if the problem is a recent one, using a Restore Point that predates the issue should fix it.

MISSING NEWSLETTERS

I don't seem to have received any of your newsletters for the past three or four days have you stopped sending them or are you experiencing problems?

J. Hegers

David Hollingworth says: That would be because I was overseas at an event, with dodgy internet and in a different timezone! But regular Newsletters are back now.

TOP SITE COMMENTS

COMMENT OF THE MONTH

Lemon Meringue Pie Or because the new design is meant to be "a much cleaner, less cluttered minimalist look" - Lowfat Lemon CheeseCake.

omega sums up Android.
Web ID: 344705

I wish there was a premium android small phone.

simon gray probably has small hands...
Web ID: 344705

Murdoch is Tywin Lannister! The man pulling the strings of Joffrey Abbott. Time the people rose and put paid to these creeps.

kcobley mixes politics and Game of Thrones.
Web ID: 382469

The fact of the matter is that you must change your password as soon as possible, then change it again after the crisis is over.

Peter Philpot talks Heartbleed sense.
Web ID: 382523

Yay, more Wolfenstein. To be honest as ordinary as the last one was this looks to keep the name alive and the premise and alternate tech just looks fantastic.

Arkayn just wants to shoot Nazis - fair enough.
Web ID: 382293

I love XBox more! I love Samsung more! I love nVidia more!I love those kind of discussions.

FourEyedGeek feels like we do when it comes to fans.
Web ID: 382284

Want to read more? Go to **www.pcandtechauthority.com.au** and search for the Web ID. And check out the Atomic forums: http://forums.atomicmpc.com.au

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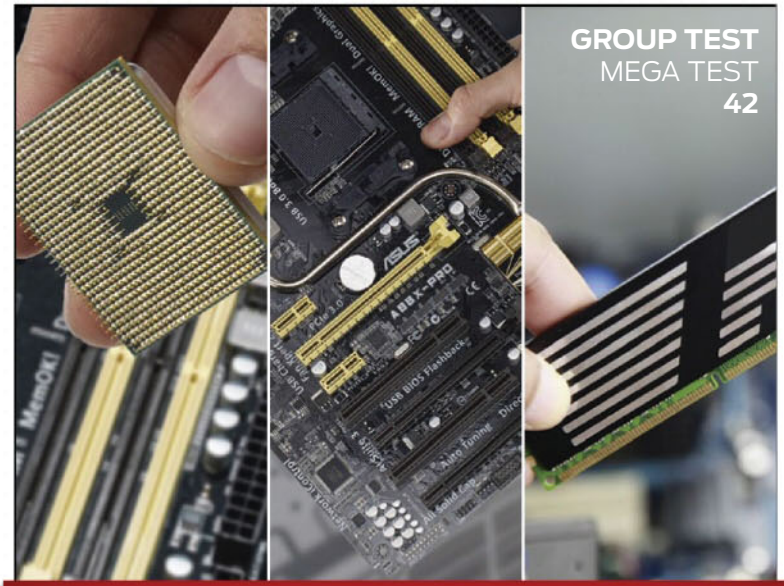

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TECH NEWS

LATEST TRENDS AND PRODUCTS IN THE WORLD OF TECHNOLOGY

SONY WARNS OF FRESH VAIO BATTERY FIRES

SONY SAYS THAT BATTERIES INSIDE THE VAIO FIT 11A MAY CATCH FIRE

Sony is once again warning customers that batteries inside its VAIO laptops may catch fire.

The new warning concerns the Sony VAIO Fit 11A, which has been sold worldwide since its launch in February. The company claimed to have sold in excess of 25,000 of the laptops and is advising customers to stop using the device immediately, according to a report in the Wall Street Journal.

The VAIO Fit 11A is a Windows 8 hybrid device that flips into both traditional laptop and tablet configurations. Its lithium-ion battery was manufactured by Panasonic.

"Sony has identified that the non-removable battery packs provided by a third-party supplier, included in (and limited to) VAIO Fit 11A released in February 2014 could potentially malfunction and cause overheating, resulting in partial burns to the chassis of the PC," Sony said in a statement.

"The safety of our customers is of the utmost importance, so we are advising those with affected models to switch off the unit and discontinue use. We have provided customers with a simple tool to check the serial number to identify whether it is an affected model.

"Customers can then either call our hotline or send us their contact details so we can advise them what to do next. Sony remains committed to the quality and safety of our products and we sincerely apologise to our customers for this issue and the inconvenience this may cause them."

Sony is no stranger to problems with overheating laptop batteries. In 2006, it began a global replacement programme for certain types of lithium-ion laptop batteries, a problem that afflicted most of the world's leading laptop manufacturers at the time.

Then in 2010, US authorities instructed Sony to recall hundreds of thousands of VAIO laptops at the time because of similar overheating concerns.

Sony will probably be relieved that it's the last time it should have to deal with such an issue. In February, the company announced it was pulling out of the PC market, selling the VAIO business to a private equity firm as part of a global cost-cutting drive.

NEW FLASH BATTERY CAN CHARGE YOUR PHONE IN 26 SECONDS

RESEARCHERS UNVEIL FLASH BATTERY SYSTEM AT MICROSOFT SHOW

Tired of waiting for your smartphone to charge? Researchers have created a battery that recharges in half a minute - but unfortunately you'll have to wait three years to get it.

StoreDot, an Israeli development firm, revealed its flash battery system at Microsoft's Think Next Conference.

The small external battery was attached to a Samsung Galaxy S4, and was fully charged from empty in 26 seconds. Most impressive.

StoreDot hopes to shrink the battery down enough to be integrated into devices such as smartphones. However, the company predicts that it will be at least three years before the battery is commercially ready, and it's expected to cost 30% to 40% more than existing mobile device batteries.

The batteries are created using a new material made out of self-assembling nano-crystals, uncovered via research into the use of chains of amino acids called peptides to battle Alzheimer's Disease.

"When the self-assembly process of these molecules can be managed, we can create nano-crystals," founder Dr. Doron Myersdorf told TechCrunch. "We were able to take the same peptides that participate in biological processes in our body and to create nano-crystals — these are stable, robust spheres."

"The diameter of these sphere is 2.1 nanometres. Very, very tiny. And these can be used, because they have special properties and they are robust, in a semi-conductor device or in a battery or in a display," he added. "We are talking about new type of materials that can be introduced into different types of devices."

The new materials are also being eyed for memory chips, image sensors and as a non-toxic way to create displays.

WINDOWS XP CUT-OFF BOOSTS PC MARKET

RUSH TO REPLACE WINDOWS XP MACHINES GIVES THE PC MARKET A MUCH-NEEDED LIFT.

The rush to replace Windows XP PCs has handed the European, Middle East and Africa (EMEA) PC market its first growth quarter in two years.

Shipments in EMEA increased by 0.3% over the same period last year, according to the latest figures from Gartner, even though the global market remains in decline.

The big winners were the traditional corporate PC suppliers. HP saw its year-on-year shipments jump by 15.3% in the first quarter, Dell was up 11%, and Lenovo was up by a staggering 35.6%. The more consumer-focused Acer saw its shipments slide by 2.7%, and is now in danger of ceding third place in the EMEA PC market back to Dell.

"The end of support for Windows XP has boosted commercial desktop sales, driven in part by delayed government buying in major Western European countries," said Isabelle Durand, principal analyst at Gartner.

"The professional PC market looks stronger overall, as business and governments adjust to a more favourable economic environment. We also expect to see the impact of XP migration to continue throughout 2014."

HYBRID DEVICES

Although Gartner didn't break down the figures by device type, it claims that traditional laptop sales are continuing to decline, but it does expect hybrid devices to grow significantly in 2014.

Asus, which currently leads the hybrids market according to Gartner, saw its PC shipments jump by almost 20% year-on-year, suggesting that the Taiwanese manufacturer is well placed to reap the benefits of a shift towards dual-purpose portable devices.

APPLE DOWN

Apple isn't in the top five EMEA PC makers, but holds third place in the US. It saw its year-on-year shipments decline by 3.8% in the US, making it one of only two of America's top five to record a decline in sales, the other being Toshiba (down 7%).

Overall growth in the US market was 2.1% - higher than it was in EMEA - and Gartner predicts more business could be coming the way of the PC makers. "The US PC market has been highly saturated with devices: 99% of households own at least one or more desktops or laptops, and more than half of them own both," said Mikako Kitagawa, from Gartner. "While tablet penetration is expected to reach 50% in 2014, some consumer spending could return to PCs."

HOT... OR NOT

HOT

POWER BRICK USB CHARGERS

It's the little things that often impress the most. Last month we unpacked an HP laptop to review it, and noticed that the AC adaptor had a USB charging port. Gobsmacked, we were. In went our tablet..

NOT

HIGH DPI SUPPORT

It all started with Apple's retina display, and has gone downhill since. Getting an app, or even a browser to display correctly on a high-DP screen is proving to be too difficult for our technology industry. Google's Chrome is the worst offender.

SUBS-ONLY LIGHTROOM HITS THE IPAD

LIGHTROOM MOBILE BRINGS PHOTO EDITING AND ORGANISING TO THE IPAD.

Adobe Lightroom comes to the iPad today, but only for users who've signed up for one of Adobe's Creative Cloud subscription plans.

Lightroom Mobile – a free iOS 7-only download from the App Store – serves as a companion app to the latest version of the desktop application, Lightroom 5.4, which is also released today. New synchronisation features allow images to be transferred to the iPad for viewing, organising and processing on the go; when the collection is synced back to the desktop, any changes are automatically applied to the original files.

It's also possible to view and share - but not edit - your synchronised images via a hosted web portal.

Unfortunately, not everyone can take advantage of Lightroom's new mobile capabilities: synchronisation with the desktop application is handled via Adobe's Creative Cloud service, so at the very least you'll need a subscription to the Photoshop Photography Programme. Non-subscribers using a boxed edition of Lightroom, or looking for a standalone app, are left out in the cold, as the app lacks any native ability to export or print your edited images.

BASIC EDITING WITH SMART PREVIEWS

The first release of Lightroom Mobile supports basic image editing and organising, but it's not as powerful as the desktop application. You can flag an image with a convenient upward swipe, but there's no way to apply or view star ratings. Development tools are restricted to the basics, such as cropping, colour temperature and exposure adjustment; advanced features such as local adjustments aren't currently available.

It's also worth noting that the software works with Smart Previews – limited-resolution proxy images – rather than raw files or full-resolution JPEGs. The intention is to make the most of the limited storage of an iPad, and also to optimise performance.

"Performance-wise, the iPad is not really designed to deal with large files," explained Adobe's digital imaging specialist Richard Curtis, ahead of the launch.

There's also no way to use Lightroom on the iPad to directly control a tethered camera.

GAMING NEWS

ALL THE NEWS THAT'S FIT TO PRINT FROM THE GAMING WORLD

JOHN CARMACK AND CO ARE FEELING POSITIVE ABOUT THEIR NEW, FACEBOOK OVERLORDS

WILL THE OCULUS RIFT MORPH INTO A VIRTUAL SHOPPING MALL, OR WILL IT STAY TRUE TO THE GIBSONESQUE VISION?

VR is very happy. And they want to build cyberspace.

While we're still coming to grips with all the implications of Facebook investing into virtual reality company Oculus VR, the team that is Facebook's latest hire is sounding more than a little bullish.

"At first glance, it might not seem obvious why Oculus is partnering with Facebook, a company focused on connecting people, investing in internet access for the world and pushing an open computing platform," Oculus VR team admit via their announcement of the deal. "But when you consider it more carefully, we're culturally aligned with a focus on innovating and hiring the best and brightest; we believe communication drives new platforms; we want to contribute to a more open, connected world; and we both see virtual reality as the next step."

So this is about far more than virtual reality Farmville - this is about a completely new communication paradigm combining ubiquitous connectivity with a new, graphical way of staying in touch. Gaming's just the start.

"Over the next 10 years, virtual reality will become ubiquitous, affordable, and transformative, and it begins with a truly next-generation gaming experience. This partnership ensures that the Oculus platform is coming, and that it's going to change gaming forever."

And Oculus VR's Chief Technical Officer, ex-id guru John Carmack is sounding even more keen on the whole cyberspace model.

"I have a deep respect for the technical scale that FB operates at. The cyberspace we want for VR will be at this scale."

Cyberspace, huh? Maybe William Gibson was on to something back in Neuromancer:

"Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding..."

EVERYTHING'S COMING UP MILHOUSE FOR AUSTRALIAN DIABLO III FANS

BLIZZARD'S DIABLO III JOINS TITANFALL IN HAVING LOCAL SERVERS.

So not only do Diablo III fans have a whole new expansion to look forward to, not only is the game slowly actually starting to look like the game we all wanted it to be from the outset, but now Blizzard's announced Australian servers for the popular action RPG.

Ding!

"We've listened to community feedback and set a goal of improving the game experience for Diablo players in Australia and New Zealand," said Paul Sams, chief operating officer of Blizzard Entertainment, in last night's announcement. "By deploying local game servers to the region in time for the release of Reaper of Souls, we aim to make slaying demons more fun - for the heroes, at least. Malthael's in for a world of hurt."

GAMES WORKSHOP'S MORDHEIM COMING TO PCS

MORDHEIM: CITY OF THE DAMNED - BECAUSE SOONER OR LATER A WARHAMMER FANTASY GAME IS GOING TO BE GOOD, RIGHT?

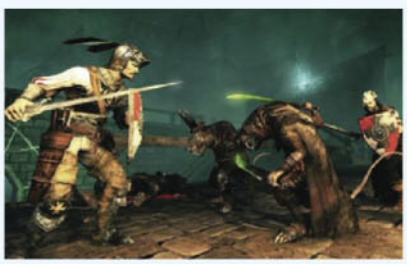
From the 'this time for sure' files, Focus Home Interactive has roped first-time Canadian developer into working on a PC version of the Mordheim, Games Workshop's fantasy skirmish game.

Mordheim: City of the Damned will be a turn-based tactical game, where players form gangs (including gangs of giant, mutant rats), loot bodies, and strive to dominate the ruined city of Mordheim will gathering the arcane substance known as Wyrdstone.

It's an interesting move. Mordheim was a big release at the time, a full-boxed game complete with miniatures and a whole range of add-ons and expansions. However, it's now one of GW's 'Specialist Games' - which is pretty much the term for projects that GW would rather no longer support or put too much effort into selling.

That said, a lot of people still play Mordheim, and based as it is off of the popular Warhammer Fantasy setting, it comes with a complete setting and backstory, not to mention some great art assets as well.

The game's coming late this year.

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CHIP NEWS

INTEL SHOWS OFF REINVIGORATED ENTHUSIAST SECTOR OFFERINGS AT GDC, WHILE NVIDIA AND MICROSOFT HIT BACK AT AMD'S RECENT DOMINANCE AND INNOVATION. **MARK WILLIAMS** EXPLAINS.

CPU

HASWELL-E AND X99

Haswell-E is Intel's first true 8-core desktop-class chip (previous 'E' processors were cut-down Xeon parts).

Along with a total of 16 threads, the CPU will include 15MB L3 cache, 48 lanes of PCI-E 3.0, plus support for quad channel DDR4. A next-gen LGA2011 socket (incompatible with the current LGA2011) will be required, and these will sport a new X99 chipset.

The X99 chipset should finally bring Intel's aging premium X79 platform up to scratch. It's expected to have a full complement of SATA 6Gb/s ports and be all-USB 3.0, with the possibility of 'Flex IO' support and Broadwell-E compatibility down the track. These are targeted for a Q3/Q4 2014 launch.

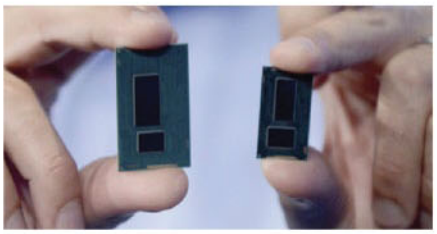
BROADWELL

The successor to Haswell, Broadwell is also targeted at a Q2/Q3 2014 launch, and will essentially be an optical shrink of Haswell (from 22nm to 14nm), with some tweaks to boost clock speeds and power savings. This is its 'tick' of the 'tick-tock' Intel product cadence cycle.

The big news is that Iris Pro (Intel's highest-end integrated graphics solution with on board eDRAM, currently only available with BGA soldered parts like the i7 4570R) will make its debut socketed appearance on these parts, finally giving enthusiasts the best Intel has to offer.

PENTIUM ANNIVERSARY EDITION

To celebrate 20 years of the Pentium brand, Intel will release an Anniversary Edition Pentium, expected in the middle of this year. Sporting Haswell architecture, these dual-core chips will come fully unlocked, have no hyper-threading but will support Quick Sync. They'll be cheap and can be expected to overclock well into the 5 - 6.5GHz range and should provide some fun for overclockers.



▲ Intel's Kirk Skaugen comparing a 4th gen processor to a Broadwell.

DEVIL'S CANYON

This Haswell refresh, due in mid-2014, will rectify something enthusiasts discovered with recent offerings: a poor thermal interface material (TIM) which hampered overclocking efforts. Devil's Canyon will come with a performance oriented TIM under the heat spreader, married with hand-picked and binned chips.

Along with improved high voltage tolerances, these parts should overclock exceptionally well. They'll also work with a new Z97 chipset motherboard. These will be the chips to have for enthusiasts.

GPU

GTX TITAN Z

At Nvidia's GTC event (GPU Technology Conference), the company pulled the wraps off its latest ultra-high-end consumer product; the GeForce GTX Titan Z, being the long-awaited successor to the GTX 690, which was its previous dual GPU card.

While maintaining a similar heat sink/blower cooling solution as used on the GTX 690, the Titan Z has two fully enabled GK110 chips on board (similar to GTX Titan Black). Going on the information released so far, it appears that the clock speeds on this beast could be operating around the 700MHz range, some 20% down on the Titan Black.

Don't take that as much of a downside, though, as everything else has been literally doubled, with 2x 2880 stream processors, 2x 240 texture units, 2x 48 ROPs, 2x 368-bit wide memory buses and 2x 6GB VRAM (yes, 12GB!).

The only thing that hasn't doubled is the price, instead, that has tripled over that of a single card to a massive US$3,000. This card is squarely aimed at compute professionals with workstations or entry level servers, while remaining accessible to some gamers. Expect to see availability late April.

DIRECT3D 12

At this year's Game Developers Conference Microsoft unveiled plans for DirectX 12, which'll debut next year.

Focusing on the graphics portion of the API: Direct3D, DirectX 12 showed how Microsoft will be taking a very similar approach to AMD's Mantle in the next iteration, focusing on removing CPU overheads and giving developers more direct control of graphics cards with "lower levels of abstraction", removing driver and API overheads.

As CPU single-threaded performance isn't growing at the same pace as GPU capabilities, making more efficient use of CPU time with less overheads means faster games with more stuff happening on the display, so expect a good bump in game fidelity and frame rates when DirectX 12 games arrive.

Surprisingly, DX12 compatibility will span multiple platforms and card generations. Many current PC DX11-grade graphics cards, as well as the Xbox One and Windows Phone devices will all see a boost and benefit from this update.

AMD's Mantle API, while similar, is code that works now, works "closer to the metal", and has porting options to Linux.

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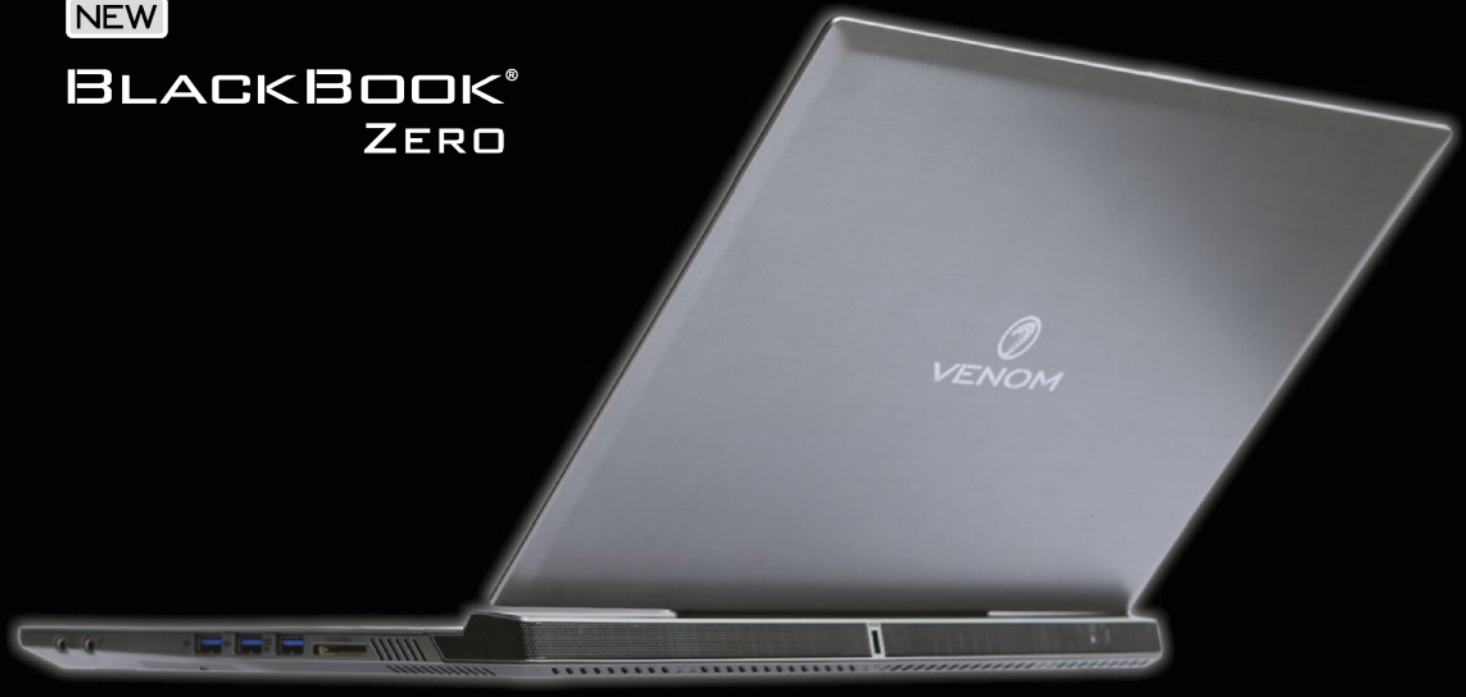

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MOST WANTED

THE THINGS WE CURRENTLY LOVE THE MOST THAT AREN'T NECESSARILY PCS.

CANON POWERSHOT D30

Outdoorsey types may want to record their adventures with this. It's conveniently light and small yet is able to swim with you down to 25m, which is impressive for a rugged compact. We found the Image Stabilisation helpful in our underwater testing, as well as in low light shooting. As a party cam it shoots quickly and the flash doesn't seem to wash out pics like other compacts tend to. There's also a GPS, making this a handy travel camera. But it's around $400, which is a good hundred bucks more than the similarly performing Nikon AW120, though that one only dives to 18m.

www.canon.com.au

CORSAIR K70

The Corsair K70 caught our eye when it was first announced, in a big way. Corsair's K65 is one of the nicest keyboards we've ever used, and the K70 adds the numerical keys to the already gorgeous aluminium chassis. Initially released with Cherry Red switches, Cherry Brown and Blue have just been added. One of these is on its way to us and we're very keen to add the review to the next issue.

www.corsair.com

HYPERX CLOUD

Memory people making headphones? Why, yes. In the Pro and LAN gaming scene, headphones are an excellent product to get your brand exposed, hence these. They arrived just a couple of hours before we sent the magazine to print, so while there wasn't time for a review in this issue, it looks the business so it's a Most Wanted, for now. We can say that they are really very comfortable, far more so than many we've tried lately. HyperX 'partnered' with QPAD to develop these, we're familiar with QPAD's new range and this bears an uncanny resemblance to current QPAD cans. We'll give them a full run for next issue.

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CHERRY

What happened to my Gmail account?

THE STRUGGLE TO RECLAIM WHAT MAY OR MAY NOT BE YOURS.

Love email, but hate spam? In a time not long ago, spam clogged our inboxes. Opening our email, most of us faced a familiar scenario: an inbox full of spam and that sinking feeling. It was a daily chore to sort through and delete, unsubscribe from the spammy shopping deals emails and maybe scoff at the gambling and Viagra daily specials.

Enter the spam filter. A small, but necessary tool in the global fight against the scourge of telemarketers, crooks and scammers. It mightn't be perfect – send a few too many emails and you can end up in the filter inbox – but it was an attempt to hold back the spam flood.

Gmail has been around about a decade and early adopters could find themselves getting an eponymous address rather than the ones available now needing suffixes or prefixes with numbers, extra characters or made up words.

PC & Tech Authority subscriber Leslie was one of those early adopters who signed up and was able to grab an address with his full name. Sounds good, except that this was before spam filters were introduced so any spam that came to the inbox sat there along with the legitimate messages.

"I used my Gmail account for everything and everywhere, and in next to no time my inbox was jammed with more spam than messages. Even with Google's excellent spam filters, my account was overloaded with junk."

Leslie wasn't prepared to sift through the junk which was overloading his inbox so he took what some might call drastic action to deal with the problem. He had a two-stage process to try and escape the spammers. It wasn't without some consideration of the implications and careful checking of the fine print.

"I researched the matter. At that time, Google allowed you to close/delete your account and to reopen your account. I can't recall the exact duration between closing and reopening - I think it was either three or six months. At any rate, after carefully, very carefully, reading and rereading the terms of service and, satisfying myself that I could always reopen my account if I ever wanted to, closed and deleted my account."

▲ Your email address is an important piece of your online identity.

It was a few years later that Leslie decided to try out Gmail again. He figures that the spammers would have moved on and he'd be free to re-open his account.

"So I tried to reopen the account, only to find that it is unavailable. It's not that it is used by someone else – it is just unavailable. I have looked up the current terms of service and I can see that these days if you close an account, you can never reopen it. I understand this, but these were not the conditions that applied to my account at the time I closed it.

Leslie contacted Google in April 2013 and explained the problem and requested that they please review the matter. Nine months later he tried again because he'd had no response from Google.

"I can't reclaim my Gmail account because Google won't respond to me. There is no question of incorrect or improper use of the account. I only ever used it for personal home use. I closed it in good order in accordance with the terms of service of the day."

ROSALYN PAGE has been a journalist for over 10 years specialising in the areas of consumer issues, technology and lifestyle. Rosalyn is the 2008 winner of the Best Consumer Technology Journalist at the IT Journalism awards. Her work is published in a range of newspapers and magazines

"Google gives itself the right to change or stop providing any of its services."

Google gives itself the right to change or stop providing any of its services at its own discretion as part of its terms of service. It also says that if Google disables access to the account, then you may not be able to access the account or anything contained within it.

Investigator contacted a Google rep about Leslie's situation. Google won't reinstate Leslie's account and said that it doesn't recycle email addresses or revive deleted accounts. The rep provided the link page to Google's terms of service, which can be found at www.google.com/intl/en/policies/terms/archive.

Google didn't give an exact date on when it introduced spam filters, but it said that today less then 1% of spam emails make it into the inbox. The was a spike in spam in 2010 and one of the tactics spammers use is account hijacking to steal list of usernames and passwords. Google responded with more checks on sign-in for Google accounts such as comparing the country of sign-in with the country of the last sign-in.

The sophistication of spam filtering came a little too late for Leslie who may not have had to take the drastic – and irreversible – action of closing his account to try and beat the spammers.

HAD AN ISSUE AS A CONSUMER? INVESTIGATOR CAN HELP.

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RETRO GAMES
ON YOUR PHONE, TABLET AND PC

MODERN TECHNOLOGY IS ALL VERY WELL, BUT OLD-SCHOOL ENTERTAINMENT STILLHAS ITS CHARMS. **DAVE STEVENSON** TAKES A STEP BACK IN TIME

Modern computers offer a formidable amount of processing power – and modern computer games push this to the limit. Triple-A blockbusters such as Tomb Raider and Lost Planet 3 will max out your CPU and call for all the horsepower available from a beefy graphics card.

Bigger isn't always better, though. Many older games – ones that would be considered technically limited by today's standards – are remembered with a great deal of affection. And if you want to relive the heady days of Super Mario World, Quake and Bubble Bobble, the tremendous number-crunching capabilities of a current PC make it possible to do so. Virtually every retro gaming console and home computer you can think of can now be emulated at full speed in software, allowing you to run classic games right from Windows, often in glorious Full HD.

Here's how to find and run retro games, and prove that the old days really were the best. For those for whom console gaming will forever be the poor cousin of PC gaming, we'll also explore the various ways you can revisit classics from the days of the DOS prompt.

GETTING CLASSICS THE EASY WAY

Setting up an emulator isn't the only way to play old gaming classics. Jump onto eBay and you can often find the original hardware. Demand has kept prices pretty buoyant, however: you'll pay in the region of $200 for a Commodore 64 with a handful of games, and around the same for a Super Nintendo. The Sega Megadrive has depreciated faster, so if you're after a sniff of Sonic the Hedgehog as it was meant to be played, you might need only $80 for an original 16-bit console.

Buying consoles from eBay isn't terribly convenient, however. If your TV has only HDMI connections, you'll need to get hold of an RF or scart converter, while retro gaming hardware also tends to involve trailing cables across your living room – wireless console controllers

> IF YOU CAN'T PLAY THE GAME IN A PORTED FORM ON YOUR DEVICE, IT'S TIME TO TURN TO AN EMULATOR

became the default option only with the PlayStation 3 and Xbox 360. When it comes to PC games, some publishers have updated their old releases to work on newer hardware. Head to Steam (**www.steampowered.com**), for example, and you'll find the likes of Railroad Tycoon II, The Secret of Monkey Island and Wolfenstein 3D nestled alongside newer titles, often for sub-$10 prices. There's also the DRM-free option of Good Old Games (**www.gog.com**), where almost 700 titles – including SimCity 2000, Theme Hospital and the first three Tomb Raider games – are available, thanks to licensing agreements with around 30 games publishers. Often enough, games are compatible with both Windows PCs and Macs, and best of all, Good Old Games offers truly impulse-buy pricing, with many titles available for less than $10.

There's also a burgeoning business in porting older games to the iPhone and iPad, partly because Apple doesn't allow emulators onto the App Store (since this would allow the execution of unapproved code). Search the store and you'll find plenty of high-quality options, including old-school Sonic titles from Sega, plus Doom and many others.

▶ The remastered version of The Secret of Monkey Island – with optional low-resolution graphics – is available on Steam.

EIGHT PC AND ANDROID EMULATORS TO TRY

SNES9X (PC)
www.snes9x.com
A truly tiny download, Snes9x offers support for the Super Nintendo's greatest hits. Support for DirectX means it's an install-and-go emulator, which can create AVIs of gameplay. Built-in support for proper gamepads means you can recreate the early 1990s straight from Windows.

FUSION 3.64 (PC)
http://segaretro.org/Kega_Fusion
A one-stop shop for anyone with a soft spot for Sonic. Fusion will run ROMs from the Sega Megadrive and its 8-bit forerunner, the Master System, as well as Game Gear, Sega CD and even the niche Sega 32X system. We experienced a bit of video tearing when we tested it, but turning on V-sync in the menu options proved a reliable fix.

PROJECT64 (PC)
www.pj64-emu.com
The Nintendo N64 is a tough one for PCs to emulate due to its tricky controller. However, a quick trawl of eBay reveals a slew of N64-alike controllers as well as USB adapters for original gamepads; those looking to revive an old trove of cartridges should look at Project64, which delivers high frame rates and plenty of configurability for those stuck with a humble keyboard.

VISUALBOYADVANCE (PC)
http://sourceforge.net/projects/vba
Last updated in 2005 but not showing its age, VisualBoyAdvance provides handheld gamers with access to ROMs culled from cartridges for the GameBoy, as well as its later Advance and Color versions. It lends itself brilliantly to modern PC gaming with only two buttons (plus start and select). Make sure you have a few hours free before you find out if the 8-bit version of Tetris can hold its own against modern classics such as Angry Birds.

SNESOID (ANDROID)
SNesoid was unceremoniously dumped from Google Play in 2011 following a complaint from Sega, but you can still find the APK on Google. Two words of warning, though: it's a good idea to install a decent malware scanner before side-loading apps; plus SNes' six-button controller – including two shoulder buttons – doesn't lend itself brilliantly to a touchscreen.

GEAROID (ANDROID)
Another emulator from the creators of SNesoid, this one emulates the handheld Sega Game Gear. The idea of playing 8-bit handheld classics on a tablet feels right, and the two-button control system lends itself well to touchscreens. It works well, and in theory allows you to use a device's accelerometer to control left and right; this wasn't something we could get to work on our HP Slate 10 HD test device, though.

FRODO 64 (ANDROID)
http://frodo.cebix.net
Available on Google Play, Frodo 64 allows you to run Commodore 64 games on Android devices. The controls are a little clunky, though – the keyboard obscures what's happening onscreen, and getting rid of it takes you three levels deep into the menu. Still, it's fast and stable, and you can even connect an old C64 disk drive to a PC and compile your own files.

SUPERN64 (ANDROID)
https://play.google.com
Free, but with the occasional full-screen ad plastered over its menu screens, SuperN64 is an impressive Nintendo 64 emulator. We found the frame rate occasionally lagged, but the biggest problem is controlling it: you'll require some impressive dexterity – and possibly 12 fingers – to properly handle all the N64's buttons and sticks.

EMULATING OLDER HARDWARE

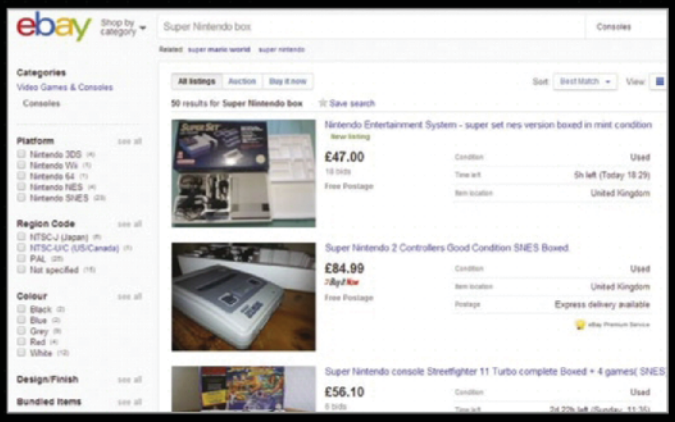
If, for whatever reason, you can't play the game on its original hardware or in a ported form, it's time to turn to an emulator - a program that emulates older hardware, allowing the original game code to run on a modern device.

Emulator software is available for all sorts of devices, but some make better emulation platforms than others. Android users, for example, will find plenty of emulators for old games consoles in Google Play, or distributed as APKs from enthusiast websites (see Eight PC and Android emulators to try, above). Unfortunately, the running-and-jumping mechanics of classic platformers don't translate perfectly to a touchscreen, and the complex combinations of an old-school beat-'em-up present real problems. To make things a bit easier, many emulators allow you to choose where controls are displayed, and let you configure what happens if you mash multiple buttons at once. You can also get dedicated controller accessories for mobile devices, although this obviously compromises the portability of a tablet or smartphone.

If you're going to run an emulator, therefore, we recommend doing so on your PC. There's a wider choice of physical controls on offer, and more power to ensure everything runs smoothly. You're also less likely to run into problems with mismatched screen sizes.

There's more choice, too. The emulator scene on the desktop PC is well established: you name a hardware platform and there will be a developer who claims to have a working emulator for it. The range includes arcade cabinets - see our walkthrough opposite - and modern consoles as well, although we'll focus on older systems here, not least because emulating newer platforms

▲ Demo versions of classics such as Indiana Jones and the Fate of Atlantis allow you a nostalgic dip without spending a penny



▲ABOVE: Secondhand consoles are easy to find, but you'll pay collector prices for one in good condition – more if you want it with the original box
LEFT: Good Old Games has plenty of retro classics on its shelves: this version of Tyrian (1995) was bagged for free during one of their sales

places significant demands on even high-end PC hardware.

There's even an emulator for old MS-DOS systems, called DOSBox (**www.dosbox.com**). You might not think such a thing would be necessary – after all, the basic x86 architecture hasn't changed in decades. However, while the core hardware of a modern PC can trace its lineage back to the 1970s, the same can't be said for the operating system. Windows 8 incorporates all sorts of hardware abstractions and security features that were completely unknown when older games such as Quake ruled the roost.

To run older games, therefore, a DOS emulator is the answer. The multi-platform DOSBox is a supremely lightweight piece of software – the download is less than 2MB – that recreates a DOS 5 environment, complete with built-in support for mouse, CD and SoundBlaster hardware, and allows you to mount a directory on the host PC as a hard disk. From there, you can reacquaint yourself with DOS prompt commands (type "help/all" in DOSBox to see what's available), and install compatible software.

DOSBox isn't the only way to get old PC games running: if you prefer, you can set up a virtual machine in a host such as the free VirtualBox (**www.virtualbox.org**) and install MS-DOS – or a compatible operating system such as FreeDOS (**www.freedos.org**). This is a more complicated approach, but it has the advantage of allowing you to set things up exactly as you want them. DOSBox doesn't offer an easy way to save local configuration, although you can create custom configuration files containing different settings, and specify which you want to load from the command line. There's a comprehensive DOSBox wiki at **www.dosbox.com/wiki**.

One last notable emulator worth mentioning is ScummVM, which doesn't simulate a particular computer at all, but is rather an open-source implementation of the game engine that underpins dozens of 1990s point-and-click adventure games – including Indiana Jones and the Fate of Atlantis, Sam and Max Hit the Road, Full Throttle and the classic Secret of Monkey Island. All you need to run Scumm games is the emulator and the original data files. You can obtain these by buying an old CD-ROM on eBay – expect to pay between $10 and $30 – or download free and demo games from the project website to be found at www.scummvm.org.

FINDING GAMES

Although DOSBox and ScummVM can work with original game discs, most emulators can't use the original media – after all, there's nowhere to plug a game cartridge into a modern PC. To play a game you therefore need to obtain a soft copy of the program data, called a ROM file. ROMs are often surprisingly small – only a few megabytes in many cases, but the question of legality is still a thorny one.

Following a change in the law in 2012, British owners of ebooks, CDs and films are permitted to make digital copies of their content, as long as they don't circumvent DRM technology. This means that if you own a game cartridge, you can legally dump its contents to your PC using a device such as the Retrode (**www.retrode.com**), a USB-based reader for Super Nintendo and Sega Megadrive cartridges.

This isn't terribly convenient, however, or cheap: the Retrode costs €65 (around $90), and has been produced in limited quantities.

CONTROLLING YOUR GAMES

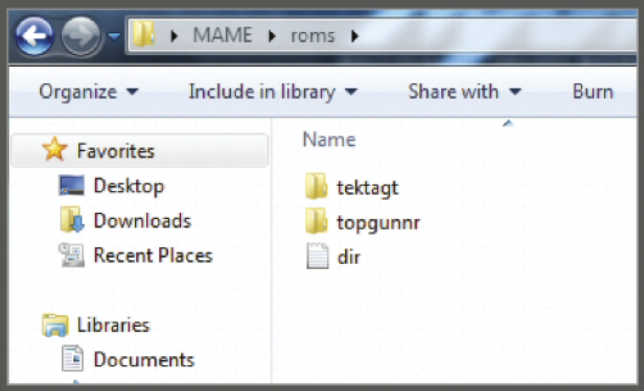
There's one thing the 102-key PC keyboard wasn't built for, and that's games. This hasn't stopped games publishers using it for everything from racing simulations to first-person shooters, but fast-paced platformers lose some of their edge when tackled with anything less than a proper D-pad. Thankfully, OEM pads can be found cheaply: less than $20 will buy you a USB gamepad that apes that of a classic console (plenty of SNES imitators line Amazon's shelves), and there are converter cables that purport to allow classic controllers to connect directly to USB. It's also possible, for $30, to pick up a wireless adapter for an Xbox 360 controller.

For mobile gamers, one striking option is the Ion iCade cabinet ($160), which neatly houses an iPad while providing an arcade-style joystick and eight buttons. The controller connects via Bluetooth, allowing you to have the best of both worlds. Alternatively, for those nostalgic for the rubber keyboards of yore, British company Elite Systems recently raised over $120,000 on Kickstarter to produce a hardware reproduction of the 1982 ZX Spectrum, which connects to a PC, iPad or Android device via Bluetooth and works as a wireless keyboard. The device is due for release this autumn, and Elite's range of iOS and Android apps, including ZX Spectrum: Elite Edition, allows the Bluetooth ZX Spectrum to bring an air of authenticity to modern retro gaming.

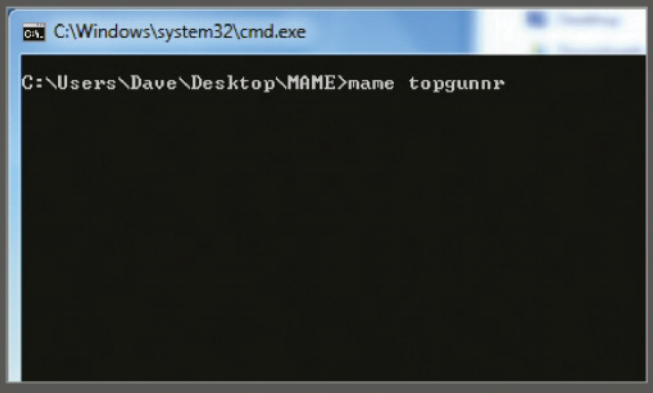
◀Old-school button-bashing comes to the iPad courtesy of the Ion iCade cabinet

INSTALL MAME ON YOUR PC

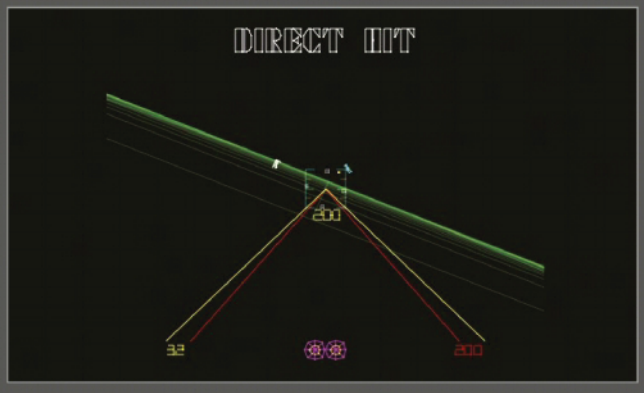
1 The Multiple Arcade Machine Emulator (MAME) lets you run old arcade-game code on your PC. It's a well-supported open-source project, so obtaining the emulator doesn't involve trudging through endless pop-ups: simply head to www.mamedev.org/release.html for the most recent version. Expand the self-extracting EXE into a convenient folder and you're ready to get started.



2 You'll find a selection of free ROMs at www.mamedev.org/roms. These are arcade classics: Rip Cord, for example, came out when James Callaghan was Prime Minister. MAME's selection is a good place to start learning how to use MAME and, crucially, they're all legal. Download the ROM of your choice and extract it into its own folder within the "roms" folder created when you extracted MAME.



3 MAME doesn't have a friendly GUI interface – it's a command-line application. The easiest way to launch your chosen game is to hold down Shift, right-click the folder MAME has been extracted to, and choose "Open Command Window Here". To launch a ROM, simply type "mame" and then the name of the folder into which you extracted your ROM from step two.



4 Once everything is running, the end-user configuration of MAME can be done within the emulator itself. Press Tab to open the configuration menu, from which you can set variables such as screen rotation, brightness and contrast, and also configure the controls for your game.

A much easier approach is to download ROM files from online archives, which you can easily find with Google. Unfortunately, downloading a ROM file from a site such as this is considered copyright infringement.

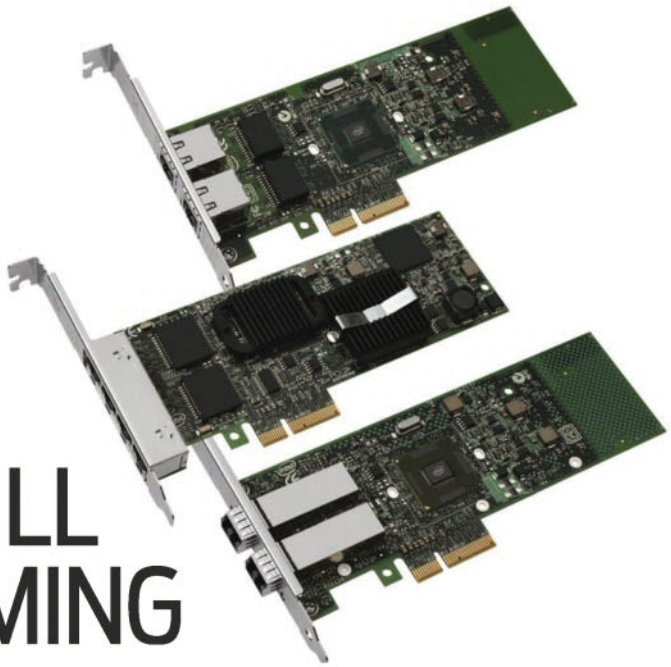
The same is true for abandonware" – software so old that the copyright holder no longer sells or supports it. While you're unlikely to get in trouble for nabbing a long-forgotten game, some titles represent trademarks that are still exploited today, such as the 25-year-old Prince of Persia.

A final word of warning: not only is downloading console ROMs legally problematic, it's also risky. Not every big link marked "Download" on these sites links to the file you're looking for. Some ROM sites use underhand tricks to get you to visit sponsored sites, and one ROM site in particular is notorious for hectoring you into using its bespoke downloader, which then tries to install bogus software on your PC alongside the file you're actually after.

There is a free alternative. The Internet Archive (**www.archive.org**) operates a project called The Old School Emulation Center, which archives classic games for a number of old systems in the name of preserving classic code in an accessible format. For those averse to downloading emulators, there's even in-browser emulation for several platforms, allowing you to play, for example, the 1981 version of Pac-Man as it was on the Atari 2600 without installing any software.

▲ The Retrode offers an intriguing – but untested – way of getting your console cartridges to run on your PC

TRIED AND TESTED: WHY INTEL ETHERNET IS STILL BETTER FOR GAMING



For many years, Intel's Gigabit Ethernet chips have been the backbone of all ROG, and occasionally ASUS and TUF motherboards. The reason being is that it constantly showed better performance in our testing, which reviewers confirmed in their own testing too.

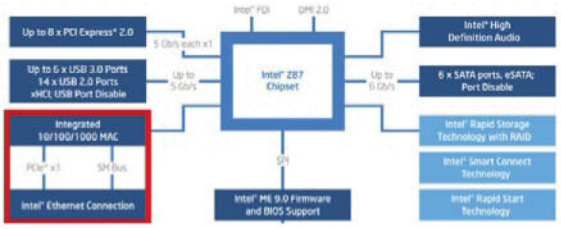
That performance is by no means taken for granted. Each generation the ROG team undertakes extensive benchmarks (that are user repeatable) to understand which chip is better for its audience. After all, you buy a premium brand and expect nothing less. Just because a product throws 'gaming' into the name, are they actually better for it? Not necessarily, which is why things should be tested and benchmarked.

This is the foundation all ROG hardware: only when its worth is proven does it get a space in the gamer's arsenal!

INTEL I217-V GIGABIT ETHERNET

Current ROG Z87 (and some ASUS/TUF) motherboards feature the Intel I217-V Gigabit Ethernet chip, and so the following performance comparatives are based on it.

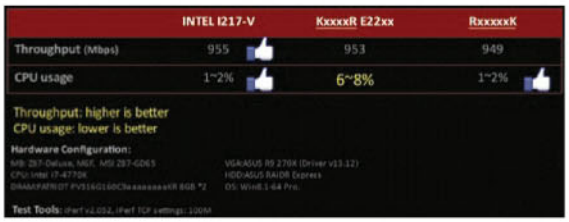
As you'd imagine, having the full triad of Intel hardware on your PCB (CPU, PCH, LAN) also gives better compatibility, energy savings (the I217-V uses just 50mW when the connection is idle, down from a typical 500mW) and the chip itself can offload UDP/TCP checksums from the CPU.



▲ROG Z87 (and some ASUS/TUF) motherboards feature the Intel I217-V Gigabit Ethernet chip

TCP PERFORMANCE TESTING: IPERF

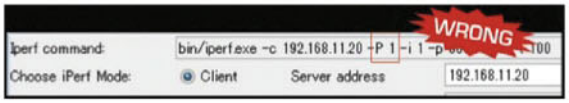
iPerf test results show the differences of TCP throughput performance among Intel and other popular Gigabit Ethernet chips are almost negligible. However, it also shows Intel Ethernet consumes less CPU resource for the same performance level versus typical alternatives.

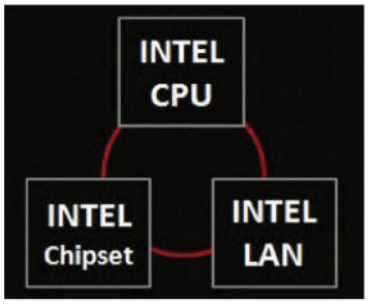


"Only when its worth is proven does it get a space in the gamer's arsenal!"

UDP PERFORMANCE TESTING: IPERF

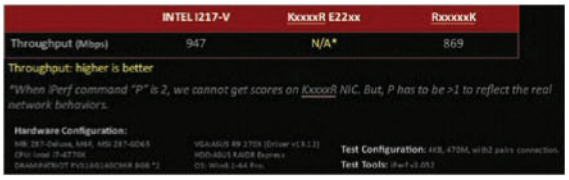
Under UDP, iPerf "P" command should be >1 to reflect real network behavior, as every online task executes at least two connections in the background





Unfortunately, some other Gigabit Ethernet products have capability issues and do not support a UDP setting above.

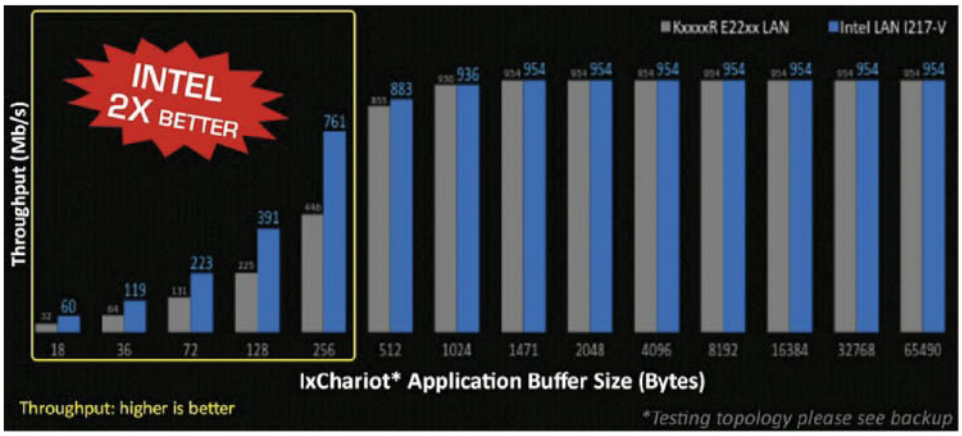
As you can see, Intel's UDP throughput is far ahead of the competition.



UDP PERFORMANCE TESTING: IXCHARIOT

IxChariot is a professional network assessment test tool used by thousands of enterprises and government agencies worldwide to measure the performance and reliability of their networks. We use it here to assess the fine grained performance of Ethernet chipsets in a real-world environment.

Online game packets are usually less than 256 bytes (small). Here, Intel Ethernet shows up to 2x performance advantage over a direct 'gaming' competitor on small packet sizes. This proves that while 'course' testing appears equal, a deeper analysis shows Intel Gigabit Ethernet is clearly better for gaming.



LATENCY PERFORMANCE TESTING: DIABLO III & LEAGUE OF LEGENDS

Network latency is absolutely crucial to online gaming. The lower your ping, the more real-time your game. There are factors outside the control of the PC system that affect it, like the speed of the server you connect to and the inherent performance of your router and internet connection. In the tests conducted by the ROG team, the same physical and internet connection in all cases.

Performance was found to be equal or slightly lower than direct alternatives.

	INTEL I217-V	KxxxxR E22xx	RxxxxxK
Diablo III	159~162	160~168	166~168
League of Legends	11	11	11

Ping time: lower is better

Hardware Configuration:

Network bandwidth: 1Gbit

"Analysis shows Intel Gigabit Ethernet is clearly better for gaming."

▲ The ASUS B85-Pro Gamer motherboard offer the planet's most innovative gaming technologies.

ROG GAMEFIRST II: DON'T FORGET THE BANDWIDTH OPTIMIZATION / TRAFFIC SHAPING SOFTWARE

GameFirst II is a traffic shaping technology that ships with all ROG motherboards. It ensures pings are kept low through constant packet inspection and management, resulting in reduced latency – great for online gaming! Traffic Shaping prioritizes ACK packets, allowing the download to continue at max speed. Whereas previous tests were exclusively done on an isolated connection, ROG also evaluated the effect of having a heavy upload/download run in the background during gaming (World of Warcraft). The performance difference was significant, as you can see right.

LIFE AFTER KICKSTARTER

WHAT HAPPENS TO CROWDFUNDED TECHNOLOGY PROJECTS AFTER THEY'VE ACHIEVED THEIR FUNDRAISING GOALS? **BARRY COLLINS** FINDS OUT

As much as $130,000 pledged to reincarnate the ZX Spectrum as a Bluetooth keyboard; more than $600,000 raised for an alternative rolling news channel co-founded by Grandstand-presenter-turned-"son of God" David Icke; $10,000 to support the parents of a nine-month-old boy from Atlanta who's just undergone his second open-heart operation. The list of projects successfully raising money via crowdfunding – small investments from a large number of people recruited over the internet – is truly eclectic.

Yet, for every large cheque winging its way to the founders of a start-up, there's another – such as the Docking Drawer, which looks like a plywood tray with integrated chargers for your smartphone or tablet – that crash and burn without even hitting 1% of their funding target.

So what's life like for tech entrepreneurs who strike gold on sites such as Kickstarter, or for those find it's a no-go on Indiegogo? We've tracked the progress of several successful crowdfunded projects, and discovered why – for some – the trouble starts the moment the funding target is finally reached.

CASH CONVERTERS

The crowdfunding scene is dominated by two sites: Kickstarter and Indiegogo. Of these, Kickstarter is the alpha male: just shy of 20,000 projects were funded via the site in 2013, with more than $480 million pledged in total. The Pebble smartwatch started life as a Kickstarter project, as did the Oculus Rift virtual-reality headset (now owned by Facebook), and an Oscar-winning film, Inocente.

Indiegogo is perhaps best known for an infamous failure: it was the crowdfunding site that hosted Canonical's failed bid to finance the development of the Ubuntu Edge smartphone. It tempts entrepreneurs away from Kickstarter by offering two funding models. You can opt for the all-or-nothing Fixed scheme, where projects don't get a penny unless they hit their self-determined funding target; but unlike Kickstarter, a Flexible model is also offered, where projects get to keep any money pledged, even if they don't reach their goal. (Canonical chose the Fixed model, which means the company didn't get a cent of the $12.8 million that had been pledged to its canned smartphone.)

▲ With a 3D printer in your living room, the possibilities are endles

▶ The Robox 3D printer was a runaway Kickstarter success

Both sites earn money by taking a commission on successful projects. Kickstarter takes a fixed 5% cut of the pledged funds, while Indiegogo applies a 4% levy on Fixed model projects, and pockets 9% of any Flexible funding project that fails to hit its target. The company claims this stiffer fee is applied to "encourage people to set reasonable goals and promote their campaigns".

What's less certain is what investors get for their money. Although the prizes investors can expect in return for a pledge are listed on the project's page – normally ranging from a mere "thank you" to an early sample of the product being produced – backing a crowdfunded project isn't like buying shares. Backers in Kickstarter projects they have shown good faith in don't receive an actual stake in the company, as they would through direct share ownership, a dividend or a cut of future profits. Indeed, as we'll discover later, there's very little in the way of a guaranteed return at all.

BOTH SITES EARN MONEY BY TAKING A COMMISSION ON SUCCESSFUL PROJECTS

PRINTING MONEY

When crowdfunding works, backers get the almost unique satisfaction of having helped to bring to fruition amazing projects, which may otherwise have progressed no further than a business plan on a bank manager's desk.

The Portishead-based team behind the Robox 3D printer set a funding target of around $200,000 when they launched their Kickstarter project last November. Robox smashed past that target in only a week, and by the time the standard 30-day Kickstarter funding period had ended, the project had amassed a total of almost $600,000 from 435 individual backers – almost 90% of whom had pledged more than $1000, the minimum investment required to get your hands on one of the printers.

On projects such as this, the word "crowdfunding" could almost be replaced with "pre-ordering": the backers were buying a printer, albeit one that would take longer to arrive than one bought from Amazon (backers were promised units by

March 2014). But founder Chris Elsworthy told *PC & Tech Authority* that the company deliberately chose to go down the crowdfunding route not only because of the fast access to finance, but also because of other, equally valuable benefits. That includes the publicity generated from a site that's closely watched by the tech-savvy audience Robox was targeting (not to mention the tech press), and "to gain a crew of people that were excited about what we were doing and would want to help us to drive it forward".

"They've become our beta testers," Elsworthy adds. "They're market-testing our product before we've even produced anything. We've had such good feedback, it's driven us on."

Elsworthy said he was always confident in the appeal of the Robox: a 3D printer that actually looks like a polished consumer product you'd be comfortable letting the kids play with at home, rather than a MacGuyver contraption you'd be wary of using yourself without safety goggles. But that didn't stop him refreshing the campaign page every five minutes, checking on its progress.

"We'd always hoped our product would go way past the $200,000 we asked for," he says. "At the same time, we knew there were a lot of people out there who had already invested a lot of money [in 3D printers], and might want to sit back a bit and not invest in what they considered to be a risk. So it went both ways – some days I'd say 'we'll definitely make millions', and other days I was just like 'I hope we make it over the $200,000 mark'."

Now, with almost three times as much money as he'd hoped for, Elsworthy has the "nice problem of 'where do we spend all this extra money?'".

"We're making sure we can get as much into this first release as we possibly can, because obviously we want our beta-test team – based on Kickstarter – to be able to test everything. When our final user gets it, we should have had a chance to test everything – not only in the office, but live in the real market."

The extra funds have also allowed Elsworthy's team to be more ambitious. "We're looking to employ a lot more people now, to make sure things are produced better and faster. We can dabble into things we felt weren't possible before: we're already looking at upgrades and robots and new heads and the [extra] functionality we hope to bring," he says, somewhat breathlessly.

PR DISASTER

While Robox proactively courted the publicity generated by its Kickstarter campaign, for others it's been a double-edged sword. Take Elite Systems' Bluetooth ZX Spectrum – a wireless keyboard designed to look like the classic 1980s computer, which is complemented by an app including a "catalogue of 100% original, officially licensed, paid-for Bluetooth ZX Spectrum games". The project initially generated plenty of positive coverage on tech sites – so much so that 821 backers pushed it just above its $120,000 funding goal by the end of January.

However, just as that funding period was coming to a close, stories began to emerge that had some backers doubting whether they had made the right decision. Some of the developers of the games being used in Elite's app began posting blogs claiming that they hadn't received any royalties after signing a licensing agreement with Elite for its Spectrum games compendium app, which was originally released in 2010.

On the day the funding closed, 14 of the developers posted a joint statement on the ZX Spectrum keyboard's Kickstarter page, urging people not to purchase any Elite products because the company "has no rights to them", and "has repeatedly failed to honour the terms of the agreements with us and is as a result in breach of copyright".

> STORIES EMERGED THAT HAD SOME BACKERS DOUBTING THEIR DECISION

The post arrived just in time for some backers to cancel their pledge or reduce it to only $1 (backers are allowed to amend pledges only until the funding period closes). Others were left feeling cheated.

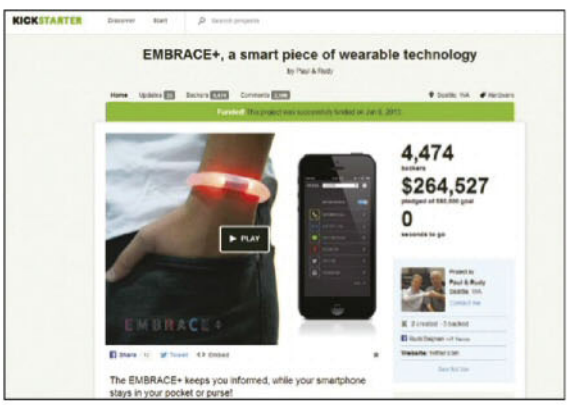
"After supporting this for so long, I now feel dirty. The dark side of Kickstarter stuff I guess," wrote one commenter on the project's page. "If what's being said in these comments is true, it makes me angry but more importantly very, very sad that I not only backed this, but during the course also raised my pledge," wrote another early backer.

Elite Systems didn't respond to our request for comment, but a statement posted on their project page stated: "We wish to assure all of the appeal's backers, including the game developers that have posted, that having been in business for 30 years we take our contractual relationships most seriously."

▲ The Bluetooth ZX Spectrum project was beset by controversy

FUNDING GAP

For many other projects, securing funding at all is the biggest problem. In February 2013, former Microsoft engineer Paul Hornikx and his business partner, Rudi Beijnen, launched a Kickstarter campaign to fund the development of Embrace+, an electronic wristband with different coloured notifications for incoming calls, text messages and other alerts on your mobile phone.



▼ The Embrace+ team's first campaign missed its mark

They set a lofty target of $220,000, but despite attracting almost 1,500 backers, only managed to secure $83,532 – which, of course, meant that under Kickstarter rules the pair didn't receive a penny of funding.

Undeterred, they made a second attempt to get Kickstarter funding for the Embrace+ in May. "Although our first campaign failed, we did receive a lot of positive feedback from all of our backers, and this gave us the motivation to refocus, redesign, and relaunch our campaign," Beijnen told *PC & Tech Authority*.

The pair produced a new video, putting less emphasis on themselves and more on the product, and revamped the product-description page with more photos and technical drawings of the wristband, and its associated smartphone app. "In addition, we lowered the funding goal from $220,000 to $80,000," says Beijnen. "Setting the goal too high is perceived by backers as being greedy. It also makes the chance of succeeding more difficult. Backers want to be part of a success and not a failure, therefore aren't motivated to make a pledge."

It worked. The pair's second campaign saw 4,474 backers pledge a total of $264,527 – $40,000 more than they had asked for at the failed first attempt.

SETTING THE GOAL TOO HIGH IS PERCEIVED BY BACKERS AS BEING GREEDY

YOURS, DISGRUNTLED

Since then, however, things have gone sour. Despite an estimated delivery date of July 2013 for the Embrace+ bracelets, at the time of writing in March 2014 none of the backers appear to have received a wristband.

The project's Kickstarter page is stuffed with thousands of comments from disgruntled backers demanding updates or refunds from the makers. "I don't care about this any more (and I backed it twice, for two of them)," writes one commenter. "The problem with refunds is this: by now [Paul and Rudi] have no doubt peed away most of the quarter-million dollars, and we'll get nothing at all. This has really soured me on Kickstarter forever, if only because [Kickstarter] say they can't do anything on our behalf."

Indeed, Kickstarter practically washes its hands of any responsibility for the outcome of projects. "It's the project creator's responsibility to complete their project," the site states. "Kickstarter is not involved in the development of the projects themselves. Kickstarter does not guarantee projects or investigate a creator's ability to complete their project."

The site insists that it has crafted its terms and conditions so as "to create a legal requirement for creators to follow through on their projects, and to give backers a recourse if they don't"; yet when we asked Kickstarter to clarify the extent of the creator's legal obligation, a spokesperson told us that even though *PC & Tech Authority's* "story sounds thoughtful, we are going to decline to participate in an interview".

For their part, the team behind Embrace+ insist that backers will receive their product. "We can deliver the product and we definitely will," says Beijnen. "Developing a new product that hasn't been done before is very hard, and there are many unforeseen difficulties you need to overcome. A backer making a pledge for a Kickstarter project that entails technology and product development has become a bet [sic], as it comes with an obvious risk following the evidence of many creators failing to deliver what they promised. I can say that our backers made the right bet."

And that appears to be what backing a crowdfunding project is: a gamble. Sometimes that can pay off with groundbreaking products or Oscar nominations; at other times it ends in legal disputes or products that show up later than promised – if at all. Perhaps the real difference between backing a Kickstarter project and sticking your money on a horse is that the punters are left to calculate the odds of success for themselves. ■

CROWDFUNDING: WHAT WORKS, WHAT DOESN'T

WHAT WORKS

PROFESSIONALLY SHOT VIDEO

A glossy short video showing what your product is or what your project aims to achieve is almost a prerequisite for success. Indiegogo claims that campaigns with videos raise 114% more money on average than projects without one.

A WIDE RANGE OF PERKS

Each project offers "perks" or "rewards" for set levels of investment. Product-based projects normally reward backers by getting the goods into their hands before the general public; making sure these are set at sensible prices is key. But setting one or two extravagant, expensive perks – such as allowing the backer to choose the model name of your next product – can pay dividends. Likewise, a $5 perk that gives the backer nothing more than a name-check on your website can tempt people who simply want to reward a great idea.

IN-DEPTH PROJECT PAGES

Most of the successful Kickstarter/Indiegogo projects offer plenty of information about their ideas, including high-resolution photography, technical drawings, business plans and extensive details of rewards. Few people will commit hard cash to a project with a three-paragraph description.

HONESTY AND COMMUNICATION

Come clean about the risks associated with your project, and set realistic delivery dates. Don't over-promise, and communicate regularly with backers on comments – especially if there are delays to the project. Provide links to websites, Facebook or LinkedIn profiles to prove you're not a fly-by-night.

WHAT DOESN'T

GREED

Onlyask for the minimum you need to get the business off the ground. Momentum is crucial: if you don't start climbing towards your funding target in the first few days, it's destined to fail. People are more likely to back a project that's 87% of the way to its target than 2% of the way there, because they want to back a success story and have a chance of getting the product. Remember that both Kickstarter and Indiegogo allow creators to keep any excess funding (minus their cut), and it's not uncommon to see projects get two or three times what they asked for.

ME TOO

Just because the Pebble smartwatch won funding, it doesn't mean you'll get it with the same idea. Many of the projects struggling to pass the 1% mark are copycat ideas – poor imitations of previously successful products. Innovation is what will get you noticed.

POOR RESEARCH

There are plenty of statistics and research to help you set achievable goals and projects. The wonderful Sidekick site (http://sidekick.epfl.ch) not only predicts which projects will succeed or fail (giving you a useful reference point to see which projects are attracting backers), it also has detailed statistics.

IN THE LABS

YOU WON'T FIND BETTER REVIEWS ANYWHERE IN AUSTRALIA!

Hotly recommended

DAVID HOLLINGWORTH HAS GONE PRIZE-MAD – PRIZES FOR EVERYONE! EVERYONE, HE TELLS YOU!

One of the joys of the reviewing gig is being able to find the best of each hardware breed, use that particular dingus personally, and then tell everyone all about it. It's what a lot of folks do for fun anyway, by simply recommending this or that to friends, but we get to add a whole new formal layer to the proceedings.

Namely, prizes.

We don't give out these little badges of honour lightly. Given they are likely to end up on box art or even, in some cases, game trailers, we like to be certain we know what we're doing.

Especially when it comes to awarding something a place in the A-List. This is reserved for pure best-of-breed products; as you might expect, though, working out just what that means when you can have multiple relevant products sitting on Six Star scores... it's a matter of going around the office, talking up each point, ranking flaws, and finally asking ourselves a simple question: would we use this hardware ourself, above all others?

For our Recommended Award it's a bit easier. This belongs to products that we really like; maybe not the best, and may even score less than maximum, but sometimes we just respect a piece of hardware despite any niggling issues. Others are just simply outstanding products we have no issue backing.

Since our old stable-mate *Atomic* was folded into these pages, we've also adopted a couple of its awards. The Hot Award is related to gaming products, from video cards to games themselves. If you see a video card with a Hot Award attached, it's pure, gaming-grade, enthusiast gold. A cut above, basically. On a game it means its' something so slick, polished, and innovative that it really should be played by everyone.

Then there's an award you hopefully won't see too much - our Epic Fail award. This is held in reserve for products that are not simply bad, but that plumb new depths of poorly thought out design or incredibly dodgy build quality.

If you see one of those on something, you know it's something special. In our experience it takes real effort to make a stinker that bad.

But it has happened, and will likely happen again.

DAVID HOLLINGWORTH is our Managing Editor. In between reviewing games and hardware, he looks after *PC & Tech Authority*'s website and social feeds.

HTC ONE M8 **34**

AORUS X7 **32**

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

WHAT OUR A-LIST MEANS

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

PC &TECH AUTHORITY A-LIST

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.

PC &TECH AUTHORITY RECOMMENDED

WHAT OUR RATINGS MEAN

OUTSTANDING
VERY GOOD
GOOD
ORDINARY
POOR
VERY POOR

HOW WE TEST

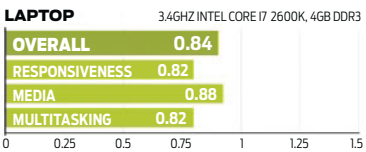
OUR BENCHMARKING TESTS ARE THE BEST IN THE BUSINESS. READ ON TO FIND HOW THEY WORK...

2D TESTS

We test desktop PCs, netbooks and laptops with our own, custom-built, 2011 Real World Benchmarks.

We split the results into three categories: Responsiveness, Media and Multitasking, with the Overall score an average of the three sub-scores.

For instance, responsiveness replicates light browser and productivity workloads. The Media test involves running iTunes for audio conversion, Photoshop CS5 to crunch large images and Sony Vegas 10 to edit home video. This then gets run simultaneously alongside Cinebench 11 in order to get a handle on the multitasking ability of the system.



3D TESTS

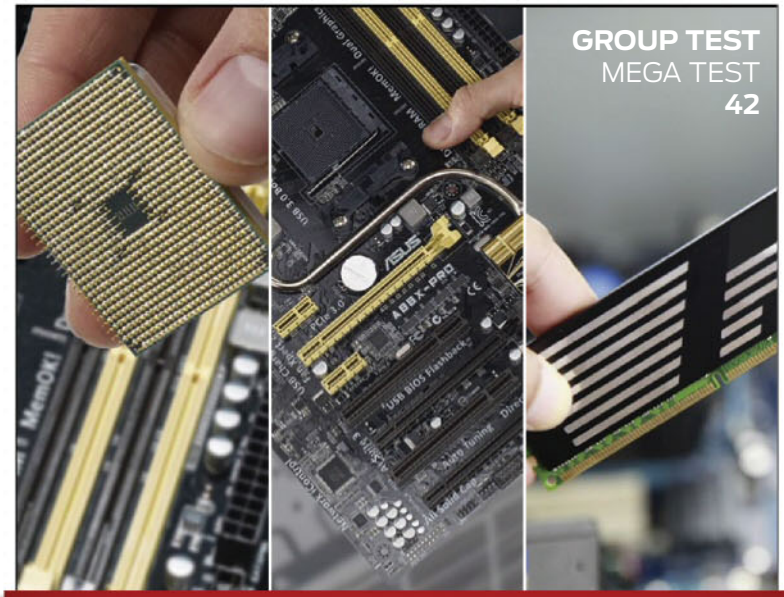
We use pre-recorded demos in Crysis and DIRT 3 to test gaming performance where relevant. We have three standard test settings, depending on the power of the graphics card: Low, Medium and High.

To test gaming performance, we use our own recorded Crysis benchmark. We use the Low, Medium and High quality settings in 1366 x 768, 1600 x 900 and 1920 x 1080 screen modes respectively. Very high-end systems can also be tested using the ultra-intensive Very High settings, with all detail switched on, and varying levels of anti-aliasing enabled.

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.



REVIEWED THIS ISSUE...

WINDOWS 8.1 UPDATE

A FORWARD-LOOKING UPDATE THAT STARTS TO PROPERLY INTEGRATE DESKTOP AND TABLET APPS

PRICE Free for users of Windows 8.1
SUPPLIER Windows Store

Windows 8.1 Update is Microsoft's second major update to Windows 8 in its 18-month life. The last one (Windows 8.1, released in October 2013) brought various enhancements to the Start screen, and restored the Start button to the desktop, but the desktop and tablet interfaces remained disconnected. Now, the free Update sees the two-in-one concept start to properly mature.

The first change you'll notice is that the OS now boots by default to the desktop, rather than to the Start screen. This behaviour has been optional since 8.1, but enabling it by default represents a welcome acknowledgement that the Modern UI isn't (yet) the centre of Windows desktop computing.

That's not to say the full-screen side of Windows has been downplayed. The second thing you'll notice in Update is a new Windows Store icon on your taskbar, signalling a major change in the way Windows Store apps are presented. They can now be pinned to the taskbar, and icons also appear here for full-screen apps that are already open, just as with regular desktop applications. This means you can now jump directly from the desktop into a tablet app without having to take a detour around the Start screen.

It also makes it much easier to switch between running programs. Annoyingly, the Alt+Tab desktop shortcut still doesn't show any full-screen apps that might be running in the background, but that's much less of a problem than before, since you can now see everything that's open in both environments by glancing at the taskbar, and click (or tap) to jump to the desired app. Best of all, you can do this even if you're in a full-screen app at the time: hover your mouse at the bottom of the screen (or drag up) and the taskbar slides into view, over the top of whatever app you're running.

It's now possible to drag down from the top of a full-screen app, too, to make a new title bar appear. This provides some welcome visual affordance for Windows 8's drag-to-split feature, as well as standard Minimise and Close buttons, so mouse users no longer need to simulate Windows 8's swiping gestures with the mouse. A dropdown menu at the left end of the title bar lets you drop an app into split-screen mode without dragging its window.

These changes may not sound revolutionary, but they bring the behaviour of Store apps further into line with traditional desktop apps, which makes Windows 8's two different operating modes start to seem, for the first time, like two sides of the same coin.

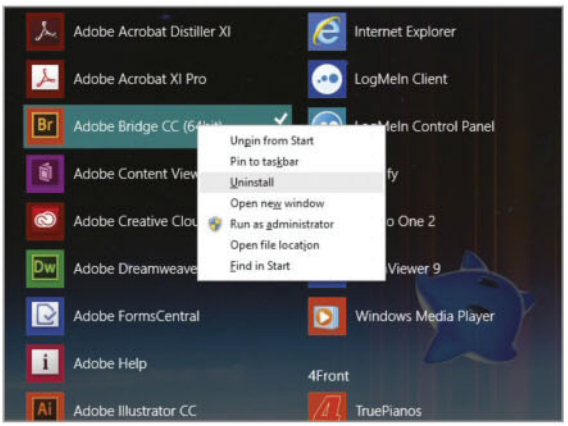
Elsewhere, a few small changes have been made to the Start screen. Right-clicking on Live Tiles now presents a contextual dropdown menu, rather than a button bar at the bottom of the screen, making it quicker to access options such as Resize or Run as Administrator. You can also pin an icon directly to the taskbar from here. Next to your username in the top right of the screen, two new icons offer quick access to power options and the search interface. The latter is functionally unnecessary, since the search pane appears if you begin to type, but it shows that Microsoft is at last thinking about discoverability, which was a serious failing of the original release.

Although it introduces several good ideas, Windows 8.1 Update feels somewhat like a work in progress. Flat, Modern-style icons look incongruous and ugly transplanted onto the taskbar, and while Windows 8's split-screen mode lets you run Store apps next to desktop ones, what's needed is a way to run them in scalable, free-floating windows. This is a change that will presumably come with the next major release of Windows, although you can achieve it now via third-party hacks such as ModernMix (available for US$5 from **www.stardock.com**).

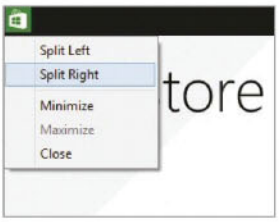
It's also worth reiterating that the Windows 8.1 search interface remains more intrusive and less powerful than the old Windows 7 Start menu. Since Microsoft seems to be addressing the Windows 8 desktop experience, there's faint hope a restored Start menu might appear in some future release, but it certainly isn't in this one.

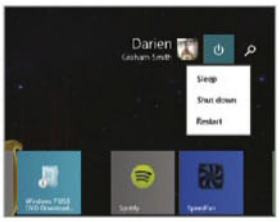
Yet while Windows 8.1 Update doesn't turn Windows 8 into the perfect OS, it's a positive step, not only for what it includes, but also for what it points to. There's work to do, but Microsoft is starting to show how desktop and tablet apps can co-exist. If things continue in this direction, Windows 9 could yet deliver the seamless, no-compromise experience that Windows 8 so optimistically promised.

Darien Graham-Smith



▲ The Start screen gains contextual menus





▲ LEFT:Full-screen apps now have title bars RIGHT: New dropdown controls help beginners

▼ The taskbar can be accessed directly from within a full-screen app

◀ Windows Store apps sit on the taskbar

PERFORMANCE	★★★★★☆
FEATURES&DESIGN	★★★★★☆
VALUE FOR MONEY	★★★★★★
OVERALL	★★★★★☆

PC &TECH AUTHORITY RECOMMENDED

KEY SPECS

1.33GHz Intel Atom Z3740 · 2GB RAM · 32GB storage · 8in 800 x 1,280 HFFS display · dual-band 802.11n Wi-Fi · Bluetooth 4 · microSD · micro-HDMI · 3.5mm headset jack · micro-USB · 8MP rear/2MP front cameras · Microsoft Office Home & Student 2013 · Windows 8.1 · 1yr RTB warranty · 213 x 11 x 136mm (WDH) · 455g

TOSHIBA ENCORE

A GREAT SOFTWARE BUNDLE AND LOW PRICE MAKES THIS THE FIRST COMPACT WINDOWS 8 TABLET WE'D CONSIDER

PRICE $399
SUPPLIER www.mytoshiba.com.au

The Toshiba Encore marks the company's first foray into the Windows 8 compact-tablet market and, on paper at least, it gets off to a strong start. The Encore comes with Windows 8.1, a Bay Trail Atom processor and Microsoft Office Home & Student 2013 thrown in for good measure, too.

Better yet, at only $399 or so, it's significantly cheaper than the two other Windows 8 tablets we've reviewed recently – the $450 Acer Iconia W4 and $450 Asus VivoTab Note 8 .

This lower price is reflected in the build: the Encore isn't the slightest compact tablet we've seen and, at 455g, it's heavier than its rivals. It's also a touch chunky, at 11mm thick. However, as befits its comparative heft, the Encore is robust. Twist it, and there's hardly any creak or bend.

It's easy on the eyes, too: the plastic back panel has a metal-effect finish, and curves softly up at the edges to sit snugly in your hand. The rear panel is slightly textured for a better grip. The bezels surrounding the screen aren't distractingly broad, and the whole thing is set off rather nicely by the silver capacitive Windows button below the screen. We could do without the distracting Toshiba logo on the left-hand side, though.

Scattered around the edges, the Encore's selection of ports are in line with what we'd expect from a compact tablet: there are micro-USB and micro-HDMI ports, and a 3.5mm audio jack on the top edge, plus a microSD slot on the left for adding to the 32GB of internal storage. Wireless connectivity comprises dual-band 802.11n and Bluetooth 4, but there's no NFC, 3G or 4G.

Underneath its attractive exterior is a 1.33GHz Intel Atom Z3740 processor, supported by 2GB of RAM. This setup managed a performance slightly slower than that of the Iconia W4 and the Asus VivoTab Note 8 in our Real World Benchmarks, netting an Overall score of 0.36; its rivals achieved 0.41 and 0.35 respectively. Its browsing speed impressed us, however, recording a SunSpider time of 456ms.

The tablet's two-cell lithium-ion battery didn't disappoint, either. In our light-use battery test, with the screen set to 75cd/m², the Encore managed 9hrs 26mins, not quite up to the VivoTab Note 8's time of 11hrs 29mins and the Iconia W4's 12hrs 5mins, but good enough to keep the Encore powering through the day.

The Encore has an 800 x 1,280 HFFS screen, which is about on par with those of the VivoTab Note 8 and the Iconia W4. Brightness peaks at 314cd/m², which is just enough to ensure the Encore remains readable under harsh overhead light or outside on a bright day. The contrast ratio of 803:1 is a little lower than that of the Iconia W4's 1,030:1 and the VivoTab Note 8's 1,094:1, but it's still enough to lend images a good dose of dynamism. If we had any gripes, they would be that the colours don't fully cover the sRGB gamut, leading to slightly orangey reds and yellowish greens, and that there's a tendency to crush darker greys into blacks.

The touchscreen is perfectly responsive, and swiping through Windows Store apps and navigating Windows 8.1's tile-based Start menu feels natural and fluid. However, using the Encore in desktop mode is tricky, thanks to the comparatively high pixel density and the small screen, meaning that icons and error messages are extremely small. There's no stylus included, either, which goes some way to explain the price difference of around $50 between this model and the VivoTab Note 8, which does come with a stylus.

Stylus or no stylus, however, the Toshiba Encore is still significantly cheaper than both its main rivals, matches both for performance, and packs in connectivity to turn it into a lightweight mobile workhorse. With a full copy of Office Home & Student 2013 onboard as well, it's a bona fide bargain.

Bobby Macpherson

BATTERY: VIDEO PLAYBACK 10HRS 3MINS

BATTERY: LIGHT USE 9HRS 26MINS

PERFORMANCE	★★★★☆☆
FEATURES&DESIGN	★★★★★☆
VALUE FOR MONEY	★★★★★★
OVERALL	★★★★★☆

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PRICE $2,999
SUPPLIER www.aorus.com

If you're considering a gaming laptop, then we assume you have a plan for how it will be used. If part of that plan involves a bit of travel, the X7 is ready to go, weighing in at a very surprising 2.9kg. It's thin – relative to most other gaming laptops – too, with a full height of 22.9mm with the case closed and just 13mm for the base itself. It won't embarrass you in places of seriousness, either, should your plan perhaps also include having it on a desk, or taking it along to do presentations, or the like. That's because its styling is quite nice, and free of the bajingles adorning other gaming machines. It's understated and sleek in classy matte black, and without any bits of it being illuminated for appearances sake.

The 4th-gen i7-4700HQ CPU runs at between 2.4 and 3.4GHz, with RAM options of 4 or 8GB modules filling up the four slots, for a maximum of 32GB.

Things start to get funky with the inclusion of SLI graphics (there's no single-GPU option here), with twin Nvidia GTX 765M GPUs, sporting a total of 4GB of useable graphics memory. This configuration yields a 3D Mark 11 score of 7393, which is on-par with a single desktop GTX 780 GPU.

So, so far the machine is shaping up as a proper desktop-equivalent gaming laptop. That's reinforced when you look at the storage configuration and options. The main drive is an mSATA SSD RAID array, in either 2x 128GB or 2x 256GB configurations. Not bad, not bad at all. On top of that you can also opt for a HDD in capacities of 500GB, 750GB or 1TB. This is exactly the sort of array you'd expect to see in a proper desktop gaming PC, yet, here it all is in a laptop that's also light and quite the good looker.

Still, we expect a decent gaming laptop to essentially be able to operate as a desk-bound computer, because that's how most people use them. These are machines designed to stay put, by and large, with forays out and about only rarely. It's because this Aorus X7 is a relative welterweight and not too bulky either, that we're doubly impressed with it.

Further concessions to its gaming prowess are seen with the inclusion of a Killer LAN chip, which we think is more about branding than actual network benefit; however the inclusion of 802.11ac Wi-Fi is a pleasing and legitimate inclusion – especially if actual online gaming via Wi-Fi is something an owner of this might be planning for.

Also pleasing, is the maximum screen resolution of 1920x1080, on its 17.3inch screen. Laptops – particularly Ultrabooks – are shifting up towards extreme resolutions, with 2560x1600 or so not uncommon, and some heading up towards 4k. For a gaming machine this is a disadvantage, taxing the GPU well past its capabilities. As it is with the Aorus X7, the GPUs included are matched perfectly with the amount of processing most games will require in full detail at Full HD resolution. Having the screen in non-reflective matt is another very nice feature, showing that the boffins at Aorus actually thought about this carefully, and beyond bells and whistles that usually only work best on the shop showroom floor.

It's not quite perfect. The trackpad is a piano gloss material that does a better job of adding friction to your fingertip and impeding its movement, than actually gliding smoothly, as it should. We've never seen such a surface on a trackpad before and it's strange to see that the minds behind all the other decisions that went into the X7's design thought this was a good idea.

Also less than stellar is the audio, which is adequate at best at medium volumes, and poor when cranked up. Still, for media the 2x speakers and 2x subwoofer array is sufficient, and for gaming at top volume just use headphones.

Aorus is a spinoff brand for gaming machines and peripherals made by Gigabyte. We don't think it would have hurt Gigabyte at all to have used its own brand on this laptop, or the other gear sporting the Aorus name, but, as Toyota managed with Lexus, there's no mistaking this as a brand of high quality design and engineering, at least so far.

Ben Mansill

KEY SPECS

2.4-3.4GHz 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 , 1 slot • Backlit Keyboard; USB 3.0 x3, USB 2.0 x2, HDMI, D-sub, RJ45, Surround port, mini-Display port, SD card reader, microphone-in, earphone-out (SPDIF)

PERFORMANCE	★★★★★
FEATURES&DESIGN	★★★★½
VALUE FOR MONEY	★★★★½
OVERALL	★★★★½

DELL PRECISION M3800

POWERFUL COMPONENTS AND A HIGH-DPI DISPLAY JOIN FORCES IN AN UNUSUALLY SVELTE MOBILE WORKSTATION

PRICE $3,999
SUPPLIER www.dell.com.au

Workstation laptops aren't meant to be sexy, but the Dell Precision M3800 turns convention on its head. It packs serious power into a stylish chassis that makes it look more like an Ultrabook than a semi-portable powerhouse such as Dell's own Precision M4800.

Where the M4800's aluminium-panelled chassis measures 40mm thick and weighs in at a substantial 3.2kg, the M3800 is comparatively waif-like, measuring 21mm thick and barely nudging over the 2kg mark. It's no MacBook Air, but for a laptop boasting this much grunt, it's as svelte as they come.

Despite the pared-down chassis, the core specification hasn't suffered. All versions of the Precision M3800 come kitted out with a quad-core 2.2GHz Core i7-4702HQ CPU, and prices start at $2,799. For this, you get a Full HD touchscreen, 8GB of RAM, a hybrid 500GB HDD and Windows 8.1 Pro. Our review unit had a 256GB SSD instead of the hybrid drive, 16GB of RAM and a 3,200 x 1,800 display, bumping up the price to $3,999.

Power isn't at a premium here. The M3800 smashed through our benchmarks with an Overall score of 0.93, but that's a little behind its stablemate, the Precision M4800, which scored 1.01. This comes as no surprise, however. The M4800 is equipped with a significantly quicker 2.8GHz Core i7-4900MQ CPU and a powerful Nvidia Quadro K2100M GPU. The Precision M3800's Quadro K1100M GPU is no slouch, but it doesn't match the raw compute power of the M4800's GPU, and took 2mins 15secs to render our Sony Vegas Pro 12 project, 19 seconds longer than the Precision M4800.

The M3800's 15.6in, 3,200 x 1,800 touchscreen is superb. We recorded a maximum brightness of 402cd/m^2, and while contrast isn't the highest we've seen – our measurements put it at 717:1 – it's no worse than the other high-DPI displays we've seen so far. More importantly, the panel covers the entire sRGB gamut. Colour accuracy is good, too, with an average Delta E of 3.4 and a maximum deviation of 6.2.

As ever, our only qualms concern the screen's ultra-high resolution – something we've moaned about in our previous encounters with high-DPI displays. While Windows 8.1's scaling renders some applications at a sensible size, others end up with text, icons and menus so tiny as to be borderline unusable, so before taking the plunge, check whether the applications you use have high-DPI support.

Look around the Dell's slender edges, and there's a full-sized SD card reader, one USB 2 port, three USB 3 ports, HDMI and a mini-DisplayPort output. The presence of Bluetooth 4 and 802.11ac Wi-Fi is welcome, too. The only disappointing absences are an Ethernet socket and, in particular, Thunderbolt, which would have made a perfect addition to a slim laptop with limited internal expandability.

The M3800's compact chassis has other downsides. Upgradability inevitably suffers, and while it is possible to unscrew the ten Torx screws on the underside and access some parts – the battery, empty 2.5in HDD bay, mSATA SSD and two RAM slots – it's a fiddly process.

Some users will also miss the keyboard and touchpoint from chunkier Precision models. There's little wrong with the M3800's backlit Scrabble-tile keyboard, but it doesn't have the desktop-like key travel of the other Precisions we've tested, and there's no numeric keypad. The loss of the touchpoint is another minor niggle, but it's the M3800's buttonless touchpad that's least endearing. We had to spend some time getting the sensitivity just right, and the integrated buttons can prove fiddly.

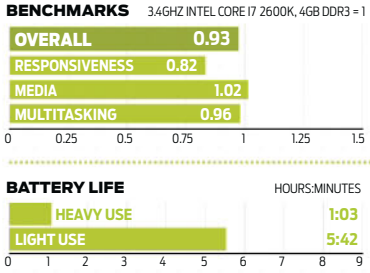
Dell has managed to pack workstation power into an attractive lightweight package, but our biggest worry concerns future-proofing: the slim chassis rules out easy upgradability, and the lack of Thunderbolt limits external expansion. If you can live with those compromises, the Precision M3800 is as stylish and speedy as Windows mobile workstations come.

Sasha Muller

KEY SPECS

2.4GHz Intel Core i7-4702HQ CPU · 16GB DDR3 RAM · 256GB SSD · 2GB Nvidia Quadro K1100M · 15.6in 3,200 x 1,800 IPS touchscreen · dual-band 802.11ac · Bluetooth 4 · HDMI · 3 x USB 3 · USB 2 · SD slot · mini-DisplayPort · Windows 8.1 Pro 64-bit · 1yr NBD warranty · 372 x 254 x 21mm · 2kg (2.5kg with charger)

The M3800's high-DPI display is stunningly bright and crisp



PERFORMANCE	★★★★★☆
FEATURES&DESIGN	★★★★★☆
VALUE FOR MONEY	★★★★☆☆
OVERALL	★★★★★☆

Photography, Henry Carter, repro, Jan Chak

HTC ONE (M8)

A BEAUTIFUL, HIGHLY COMPETENT SMARTPHONE THAT'S PACKED WITH CLEVER FEATURES, BUT THE IMPROVEMENTS ARE TOO SUBTLE TO JUSTIFY THE SIGNIFICANT PRICE PREMIUM

PRICE $820
SUPPLIER www.htc.com/au

The HTC One (M8) is a smartphone with a lot to live up to. Its predecessor, the HTC One, was our favourite smartphone for six months, until the Nexus 5 rolled up. There's more competition coming, too, in the form of the Samsung Galaxy S5 and the Sony Xperia Z2.

With such a daunting task on its hands, you might expect a radical overhaul. In fact, the One (M8) takes a subtle approach; it's more a refinement than a redesign.

Instead of matte silver, the M8 features a polished, dark gunmetal-grey finish with an attractive brushed effect. It still has the smoothly rounded rear of the old unit, but the sharp, chiselled edges have been rounded off.

It has a larger 5in, 1080p display, making the phone slightly bigger than the original, but the difference isn't major; the M8 is only half a fingernail taller. In all, it's a good effort from HTC: the M8 is better looking than the One – and its major rivals.

From a practical point of view, we're disappointed to see that the M8 lacks dust- and water-resistance, unlike the Samsung Galaxy S5 and the recently released Sony Xperia Z1 Compact. However, it's good to see that HTC has added a microSD slot to the new model; with the original HTC One – now renamed the One (M7) – you were stuck with the storage you opted for at purchase.

DYNAMIC DUO

Aside from the design, the most significant update concerns the Duo camera. Flip the M8 over and you'll see two lenses – one that captures the main image and a smaller one that records only spatial information.

This enables the M8 to add dramatic depth-of-field effects to your photos after they've been taken. The UFocus tool allows you to blur foreground or background detail, while the Foregrounder effect isolates the main subject by desaturating the background and adding a sketch filter to it. Dimension Plus adds an interactive parallax effect to pictures; tilt the phone around and the background changes position relative to the foreground subject, in a similar fashion to Apple's parallax wallpapers.

Alas, in most of our test shots, these effects weren't completely clean: we saw plenty of areas where background effects encroached on the foreground subject, and vice versa. It's also too easy to inadvertently leave a finger covering the depth sensor, meaning

KEY SPECS

Quad-core 2.3GHz Qualcomm Snapdragon 801 CPU · Adreno 330 GPU · 2GB RAM · 16GB storage · 5in 1,080 x 1,920 display · 4G · Bluetooth 4 · NFC · dual-band 802.11ac Wi-Fi · 4.1MP/5MP rear/front stills · 1080p video · 2,600mAh battery · Android 4.4 · 1yr RTB warranty · 70 x 9.8 x 146mm (WDH) · 156g

DOT VIEW

HTC has released an ingenious snap-on case, dubbed the Dot View to go with its new phone. It costs $50, and allows light from the display to shine through a grid of perforations in the front cover, to display the time, weather and notifications. It's also possible to answer calls through the perforated flap while it's still closed.

these effects won't work at all.

Still, for general snaps, the camera is more than satisfactory. It uses a 1/3in, 4.1-megapixel sensor with the same 2µm "UltraPixels" as before, and an f/2 aperture. Unlike the original One, there's no optical image stabilisation, but photos look sharper and cleaner: in low light, there's more detail and better control over noise; in good light, there's better judgement of exposure. The dual-colour, twin LED flash means taking snaps in a darkened pub lounge doesn't result in ghost-white skin.

The lack of stabilisation leads to slightly shakier video footage, but more natural colours and crisper details make up for that. Overall, we'd say the M8's rear camera is better than the Nexus 5's, but it still can't match the snappers of the iPhone 5s or the Nokia Lumia 1020.

The front-facing camera has been upgraded to a 5-megapixel unit, which produces surprisingly detailed self-portraits. HTC has added an onscreen countdown timer to make capturing these shots easier, too. We're not keen on the new facial Touch Up filters, however: the eye resizer, skin smoother and face narrower are crude.

SOFTWARE

The One (M8) runs the latest version of HTC's proprietary UI, Sense 6, on top of Android 4.4 KitKat. Naturally, this includes a number of customisations. First up is a feature called Motion Launch, which lets you wake up the phone with various gestures. A double-tap takes you to the lockscreen, while swiping up from the bottom takes you directly to your chosen homescreen. A swipe from the right opens the Android desktop, complete with shortcuts and widgets, and swipes from the top and left access voice-dialling mode and the HTC BlinkFeed interface respectively.

BlinkFeed itself has been updated to scroll continuously, rather than a page at a time. Blocks of colour now space out the items and give it a more airy feel, and it's possible to search through items in your feed by keyword.

There are now two power-saving modes: a standard one and an "extreme" one, the latter of which shuts down all but the essential apps and limits CPU speed, brightness and non-essential features. In this mode, you can access only one screen, which displays the time, as well as shortcuts to the phone, SMS, email, calendar and calculator apps.

CORE HARDWARE AND SPECIFICATION

The M8 sports the very latest in mobile-processing grunt: a quad-core Qualcomm Snapdragon 801 SoC, clocked at 2.3GHz, backed by 2GB of RAM. It's blazingly fast, scoring 2,849 in the multicore Geekbench 3 CPU test, and 29fps in the GFXBench T-Rex HD gaming test. These scores are slightly quicker than those of the Sony Xperia Z1 Compact, and a good distance ahead of the Nexus 5.

HTC has also significantly boosted performance in the audio department. It has redesigned the forward-facing speaker chambers to produce even more volume than before – and it's still distortion-free. Call quality is equally good, and wireless communications are suitably comprehensive, including 4G, NFC and 802.11ac.

▼ The One (M8) is the most attractive smartphone around

DISPLAY AND BATTERY LIFE

The M8's 5in display isn't only bigger than the screen in the original One, it's also punchier, with a contrast ratio of 1,687:1, compared to 1,202:1. It's just as bright as before, making it a fantastic display that's perfectly readable outside and inside.

The One (M8) also has a bigger battery, rising from 2,300mAh to 2,600mAh. HTC claims this, combined with improved component efficiency and the new battery-saver mode, can deliver a "40% increase" in overall battery performance.

That's a little optimistic, but the M8 did perform well in our tests. While playing a 720p video with the screen set to 120cd/m2 (slightly below mid-brightness), capacity fell at a rate of 6.5% per hour. Streaming audio over 3G used up 3.8% per hour. Leaving the phone overnight in standby – but still syncing several accounts – consumed a miserly 0.3% per hour.

These results place it only fractionally behind the Sony Xperia Z1 Compact – but you'll need to watch your gaming habit. In the gaming portion of our battery test, at mid-brightness, the M8 chomped through a frightening 42.3% per hour.

VERDICT

The One (M8) is a better smartphone than last year's One. It has superior cameras and software; the display is superb; and the design is the best we've seen from a smartphone this year. At the moment, it's the best Android smartphone money can buy.

There are two key sticking points, however. The first is that its biggest rival, the Samsung Galaxy S5, brings even more significant changes, including a new camera autofocus system, water- and dust-resistance and a bigger battery, plus fingerprint and heart-rate sensors. The second is that the Nexus 5, although not as impressive, costs $500 less.

The HTC One (M8) is a cracking smartphone, and is packed with useful and clever features, but if you're on a budget, it isn't revolutionary enough to justify the premium over a Nexus 5.

Jonathan Bray

▼ The M8's rear is more smoothly rounded than the original One

PERFORMANCE	★★★★★★
FEATURES&DESIGN	★★★★★★
VALUE FOR MONEY	★★★☆☆☆
OVERALL	★★★★★☆

ASUS RADEON R9 290 + 290X DIRECTCU II OC 4GB

PRICE $760 (290x); $580 (290)
SUPPLIER www.asus.com/au

The excellent AMD Hawaii GPU is finally getting the treatment it deserves with custom cards hitting the market in force, now. With this surge comes better cooling, defeating the main argument against the 290 series, and quite reasonably too. Stock cooling does a poor job of keeping these hot chips cool, and even at 50% fan speed reference 290's are almost intolerably loud.

The ASUS DirectCU II cooler has been seen several times before. It is a well tested design and is able to tame the heat output of the Hawaii GPU. We've been looking at the two new Direct CUII cards from ASUS – the regular 290, and the higher spec 290x – which sports 2,816 shader units vs 2,560 for the 290. Both feature a small factory overclock, lifting the core frequency above the AMD default of 947MHz to 1,000MHz for the 290, and 1050MHz for the 290x. Memory is boosted from the default 1250MHz to a barely-worthwhile 1260MHz for the 290 but a more useful 1350MHz for the 290x.

As well as the custom cooling and the factory overclocks, both the 290 and 290x versions feature the same additional enhancements. There's a fan speed mode switch that selects either a faster fan speed profile or a slower one. There's no benefit to clock speeds here – it's simply a choice of a cool but louder card, or a hotter but quieter card.

Both also boast a full-length metal back plate. This is to add structural strength and won't benefit cooling in any way as it's positioned 3mm or so above the card's PCB. High quality voltage regulators are another ASUS addition to the reference design. These help improve power efficiency and should help extend the life of the card.

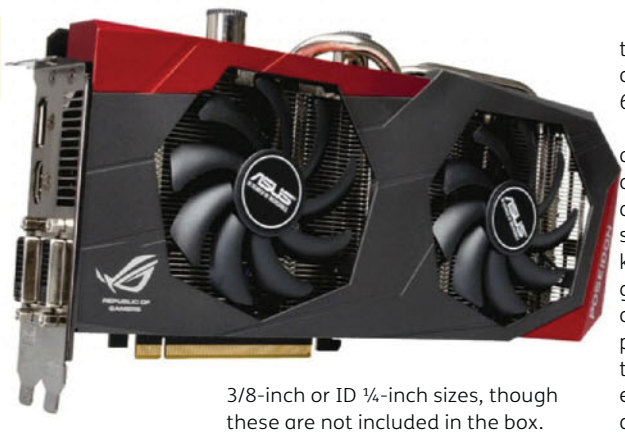
Reference 290 cards can be had for around $540 now, and we think the $40 premium for the ASUS DireectCU II OC 290 is worth it for the superior cooling and engineering, as well as potential for further overclocking. The same goes for the 290x, with the DirectCU II version carrying about the same premium. Remember, too that you can pair any 290/x with one of any other brand for Crossfire, and that a connecting cable is no longer required.

Ben Mansill

PERFORMANCE	★★★★½
FEATURES&DESIGN	★★★★½
VALUE FOR MONEY	★★★★½
OVERALL	**★★★★½**

ASUS POSEIDON PLATINUM GTX 780

PRICE $750
SUPPLIER www.asus.com/au



It's exciting to see some innovative engineering being used for graphics card cooling. For far too long the higher end of the market (Nvidia 780 and AMD 290/x) has been largely based on reference designs. Now, in a rush, all that's changing. Asus seem to have been particularly busy, with its stock DirectCU II cooler being used across a few cards. It also has the Matrix edition for allegedly better overclocking, and now the Poseidon GTX 780.

Its claim to fame is hybrid cooling, which allows the use of either water or air cooling, or in fact both. A vapour chamber and water channel layer is sandwiched just behind a stock DirectCU air cooling part. It adds approximately 4mm of depth to the card, which is impressively little. The water pipe fittings are a standard G1/4-inch size, and if that doesn't match your cooling pipes then you're free to use adaptors for ID ½-inch, ID 3/8-inch or ID ¼-inch sizes, though these are not included in the box.

Compared to a reference GTX 780 card, Asus claims that the Poseidon reduces temperatures by around 7c degrees when using air cooling alone, and up to 24 degrees when on water.

Playing around with overclock settings can be done with Asus' GPU Tweak software, which is operationally similar to MSI Afterburner, and others. Given that these cards are clearly intended to be pushed beyond spec, indeed a small 12% factory overclock is applied to the Poseidon, with the core running at 1006MHz, and the memory at 6008GHz.

The Asus Poseidon is suitable for quiet systems as much as it will appeal to serious overclockers. Having a factory hybrid solution may well sway many potential owners not too keen on performing surgery on stock graphics cards. It's a unique solution and will probably see a limited production run, however it's great to see such options in the market, especially with the surge in popularity of AIO water cooling systems, which makes this easier still.

Given the price premium you would want to take full advantage of the water cooling. A 780 GTX with decent bespoke cooling can be had for around $100 cheaper.

Ben Mansill

KEY SPECS
Nvidia 780 GTX · 3GB GDDR5 · 2x DVI · HDMI · DisplayPort

PERFORMANCE	★★★★★
FEATURES&DESIGN	★★★★★
VALUE FOR MONEY	★★★★½
OVERALL	**★★★★½**

GIGABYTE TEGRA NOTE 7

HERE'S A QUALITY TABLET FROM GIGABYTE, SHOWING THAT THE COMPANY IS QUICKLY GOING FROM STRENGTH TO STRENGTH WITH CONSUMER DEVICES.

PRICE $249
SUPPLIER www.gigabyte.com.au

Tablets are tablets, we're beginning to think. The scope a manufacturer has to differentiate is becoming increasingly limited. Especially so, when one tries to identify genuinely useful adornments. We like the Gigabyte Tegra 7 because there's very little other than impressive performance and good engineering to appreciate. It's not unlike the Nexus, in this respect, although the Gigabyte feels more solid and well built, and with premium materials used.

At its heart is the Nvidia Tegra-4 processor, which currently stands as the quickest available for any tablet. Flicking through apps is as speedy and smooth as we've ever experienced on a tablet, and the grunty processor really helps along apps which use the stylus.

When drawing, it simulates brushes very well, and it's easy to create varying line width. There's no perceptible lag, with the on-screen ink flowing the instant the stylus touches the screen, and the fastest strokes cause no jitter in the lines. This performance is far superior to any of the Samsung Galaxy Note tablets which have a noticeable delay when you start drawing and a low tolerance for quick movements.

The stylus is a double ended type, with a thin and curved nib at one end and a thicker one at the other. It's possible to create quite beautiful calligraphy using the thicker nib.

The screen touch mode switches to one optimised for the stylus when it's slipped from its slot, and in that mode using fingertips is well nigh impossible, however, the excellent stylus action makes this a sensible compromise. If you really are serious about a tablet with a stylus, this is the best going at the moment.

On the downside, the screen is extremely glossy and mirrors everything around it far too well, often making it tricky to focus on the display itself. When lighting conditions are good, though, the IPS screen is vibrant and evenly lit.

At around $250 it's a premium 7-incher with outstanding stylus capabilities, built well and with quality materials and attractively styled.

Ben Mansill

PC & TECH AUTHORITY RECOMMENDED

KEY SPECS

Nvidia Tegra 1.8GHz quad core + Cortex A15 72-core GPU · Android 4.2.2.· 1GB RAM · 16GB memory .· SD expansion to 32GB.· 7-inch HD IPS screen.· stylus

PERFORMANCE	★★★★★
FEATURES&DESIGN	★★★★★
VALUE FOR MONEY	★★★★½
OVERALL	★★★★★

APPS ROUND-UP

JENNETH ORANTIA WITH THE WISE WORD ON THE ESSENTIAL APPS, TOOLS AND UTILITIES WE THINK YOU NEED.

MARVEL

PRICE FREE **DEVELOPER** MOZAKA LTD
PLATFORM IPHONE

Marvel brings app prototyping to the mainstream. You don't have to learn how to program to come up with a working app concept – you simply sketch the screens of your app onto a piece of paper or a whiteboard, take a photo of each one, then add 'hotspots' to each screen to link them together. Since it's built on top of Dropbox, your prototype is also saved in real-time to the cloud.

Is it really that simple to use in practice? You better believe it. We dummied up a set of five screens on lined notepaper, and despite the poorly drawn buttons and barely legible text, linking the screens up was straightforward. You specify the type of device it's designed for (iPhone 4, iPhone 5 or iPad), and after snapping a photo of each screen, you can move and crop the screen around to fit inside the on-screen rectangle display area.

The final step is drawing a box around the hotspot that links it to another screen, specifying the screen that it links to, then generating the prototype and sharing it via email, SMS, Twitter or Facebook. The final working app prototype is then hosted on the Marvel web service. This is also an excellent place to see other people's apps and get inspired.

The screens don't have to be roughly drawn sketches, though. Marvel can also use photos in your iPhone's gallery or images that are stored in your Dropbox, including Photoshop PSD files. If you'd prefer to work on your prototype from your desktop computer, Marvel is also available as a web app, although you lose the advantage of being able to use sketches that you've snapped directly from your iPhone's camera. Once you sign into Dropbox on your desktop, any projects you were working on from your iPhone are available in the web app or its browser version.

As easy as Marvel is to use, it does have a few limitations. Hotspots can only be created using squares or rectangles – circles or other shapes aren't supported. Nor does Marvel support scrolling screens – you're limited to the one viewable area per screen, although, if Marvel really takes off functionality could be increased. At a minimum it's a lot of fun to toy with.

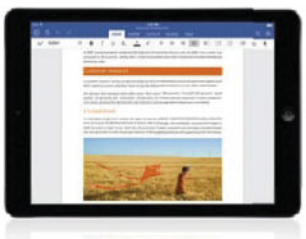
EASE OF USE	★★★★★
FEATURES	★★★★☆
VALUE FOR MONEY	★★★★★
OVERALL	★★★★★

MICROSOFT OFFICE FOR IPAD

PRICE FREE **DEVELOPER** MICROSOFT
PLATFORM IPAD

It's only taken Microsoft four years, but it has finally come up with the goods in the form of Office for the iPad. Unlike the suites for iPhone and Android, this is split up into three discrete apps: Microsoft Word for iPad, Microsoft Excel for iPad, and Microsoft PowerPoint for iPad. Each app is ostensibly free, but you're limited to viewing Office files only. To edit or create files, you'll need to spring for an Office 365 subscription, which costs $119 per year or $12 a month. This subscription lets you access Office on up to five computers and five tablets, which can be a worthy investment if you're sharing the subscription with a family or small work team.

Microsoft Word makes every third party word processor – including Apple's own iWork app – look like amateur hour. All the tools a mobile worker needs to be productive are on board, including tables, charts, track changes and footnotes. Excel, too, is surprisingly full-featured, with plenty of charting options, an extensive selection of formulas organised by category, and a custom keyboard. PowerPoint is the weakest app of the three, as it's more geared toward delivering presentations on the iPad than it is creating them.



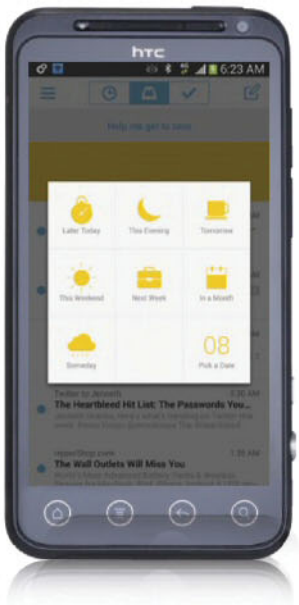
All of the files you create on Microsoft Office for iPad are saved to Microsoft's OneDrive cloud storage service. The idea is that you can get it started on your iPad and do any complicated formatting on your desktop or laptop. Conversely, any files you create through your Office 365 description from your desktop are available on your iPad, and the beauty of Microsoft's solution is that files maintain their fidelity when you view them on a mobile device.

The irony is that Microsoft Office is easier to use on an iPad than it is on Microsoft's own Surface tablets. While the latter uses essentially the same desktop-based interface with some token tweaks for touch use, the version of Office for the iPad has been redesigned from the ground up for easy use on a touchscreen.

EASE OF USE	★★★★★
FEATURES	★★★★★
VALUE FOR MONEY	★★★☆☆
OVERALL	★★★★☆

MAILBOX

PRICE: FREE
DEVELOPER DROPBOX
PLATFORM ANDROID

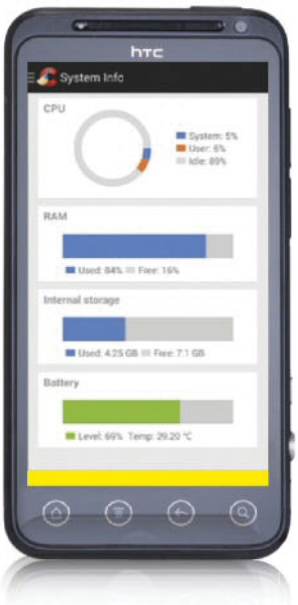


One of the best email clients for iOS has crossed the pond to Android, bringing along its gorgeously uncluttered interface and unique inbox sorting features. The goal with Mailbox is to make it as easy as possible to get you to 'inbox zero', using simple gestures. You can swipe right on a message to archive it, long swipe right to delete it, swipe left to 'snooze' it, and long swipe left to add it to a list. The snooze function is unique to Mailbox, letting you remove a message from your inbox until you're ready to deal with it. The Android version of Mailbox also introduces a new 'Auto Swipe' feature, which claims to remember how you process your email and automatically perform those actions in the future.

OVERALL ★★★★½

CCLEANER

PRICE: FREE
DEVELOPER PIRIFORM
PLATFORM ANDROID

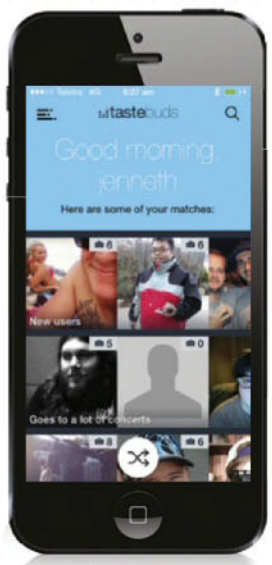


Based on the popular Windows utility that swiftly cleans out all the junk on a PC, CCleaner for Android does the same thing for smartphones and tablets. Once you join the Beta program, there are various one-click actions you can perform to clean up, maintain and optimise your mobile device, such as clearing out the application cache and browser history, reclaiming storage space by removing unwanted apps, and monitoring your CPU and RAM usage. Future releases will add features like process management, custom folder cleaning and functions designed specifically for rooted devices. For now, you can sign up for the beta by joining Piriform's Google+ community, signing up to become a tester, then downloading it from the Play Store.

OVERALL ★★★★½

TASTEBUDS

PRICE FREE
DEVELOPER TASTEBUDS MEDIA
PLATFORM IPHONE

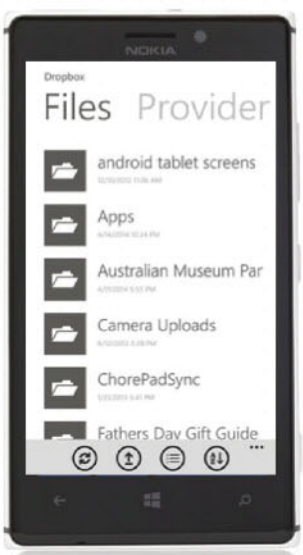


For some people, having different taste in music is the kiss of death for budding relationships. This is the demographic that Tastebuds is aiming for, using the tunes in your music library to match you up with other people near you that share your interests. Matches are grouped into categories such as 'Ed Sheeran fans' and 'Vinyl Collectors', but you also get additional, non-music-related categories like 'Popular users' and 'Chatting today'. Unlike popular dating app Tinder, you don't need to make a match with other people before you can message them. Nor is there a way to narrow matches down to specific age groups or distances – in our testing we managed to get a lot of matches that were based in Melbourne and under the age of 30, but services like these always need time to gain critical mass..

OVERALL ★★★½☆

BOXCRYPTOR

PRICE FREE
DEVELOPER SECOMBA
PLATFORM IPHONE



Boxcryptor adds an extra layer of protection to the files you store in cloud storage services by encrypting them beforehand. Clients are available for all of the major desktop and mobile platforms, with Windows Phone being the newest version available. It works by doing the encryption and decryption (using AES-256 Standard) directly from your device, ensuring your master password is never transmitted and only the encrypted versions of your files are stored in the cloud. The free service supports the major cloud services like Dropbox, Google Drive and Microsoft OneDrive (although you can only use one at a time) – plumping for paid subscription adds features like file name encryption and support for unlimited devices and cloud providers. Annoyingly, you can only encrypt and upload photos from the Windows Phone app.

OVERALL ★★★★½

LABS BRIEFS

INTEL 730 SERIES SSD

PRICE $600 (480GB); $300 (240GB)
WEBSITE www.intel.com.au

Intel played a big role in kicking off the SSD phenomenon with its X25M series, launched back in 2009. Since then Intel has been relatively quite, but now, the giant is fighting back. The SSD 730 series is a consumer SSD with enterprise-class features. The most important of these is power-loss data protection, a rarity is these types of SSDs. On the flipside, enterprise drives are intended for 24/7 operation, so there's no low-power state, and as a result this drive runs hot and consumes up to 5W of power under load. It doesn't help temperatures, either, that Intel has overclocked the NAND chips to 100MHz (up from a stock speed of 83GHz), and the controller – which is Intel's own Tisdale unit – runs at 600MHz (stock is 400MHz).

The 730 is intended for heavy workload tasks, and is optimised for fast i/o performance. It's also one of the pricier SSDs, with a $-per-GB of $1.25 – which would place it as the equal-third most expensive drive in our SSD roundup last issue (alas it just missed that boat).

Ben Mansill

OVERALL ★★★★☆☆

CRUCIAL M550 512GB SSD

PRICE $ 460
WEBSITE www.crucial.com

Another new SSD that didn't quite make it here in time to be included in our SSD roundup (*PC&TA* 198) is Crucial's new M550. It's not a successor to the M500, which will remain available as the company's mainstream SSD, with the M550 slotting in as a slightly higher performance drive for enthusiasts.

Qualifying the M550 as truly an enthusiast SSD is the switch to a better controller, which we see in the Marvell 88SS9189. It also benefits from running custom firmware. The M500 has another jump over the M500 with what Crucial term RAIN ('Redundant Array of Independent NAND'), which operates the drives memory chips in a form of RAID. The performance boost from these tweaks comes in at a claimed maximum 550MB/s read speed (compared to around 500MB/s for the M500), and write speeds of 500MB/s (400MB/s for the M500).

The higher speeds come at a small premium in cost-per-GB terms. Where the M500 came in at .81c per GB for the 480GB M500, the 512GB M550 is a tad pricier at .89c per GB.

Ben Mansill

OVERALL ★★★★☆☆

LEXAR HIGH-PERFORMANCE MIOCROSDHC UHS-1 64GB

PRICE $189 (64GB); $89 (32GB)
WEBSITEwww.au.lexar.com

For most tablets and smartphones this is excessive overkill, but many of us want the best possible performance from our memory cards, even if it means forking over almost $200 to get it. Nothing but the best ingredients have gone into this. Its speed class is UHS-1, which enables transfer speeds of up to 95MB/s. Why would you need such extreme performance? In a word: buffering. Like any digital camera, the smartphone or tablet needs to process its file before being ready to shoot again, and most of this (assuming the CPU is reasonably quick) is down to how quickly the memory can shove the data through the pipeline. It matters little in most scenarios, but for rapid-fire shooting in burst mode, or being ready to shoot another HD video immediately after recording, the UHS-1 rating comes into play.

Rapidly shifting your content to a PC also gets a premium solution, with an included USB 3 adaptor. Capacities available are only 32 or 64GB, the thinking being that anyone who demands such excessive performance will also want high capacity.

Ben Mansill

OVERALL ★★★★★★

GIGABYTE P34G V2

PRICE $1999
WEBSITE www.gigabyte.com.au

It must be challenging being a laptop maker these days, especially when it comes to the gaming space. We're seeing whole ranges of gaming models coming from a number of brands, and with them all sporting more less identical hardware, sticking out from the pack comes down to design, extras, and overall build quality.

Gigabyte's managed to certainly deliver a very price concious machine, that still delivers a staggering amount of gaming power. The combination of a Core i7 4700HQ processor with a brand new GTX 860M graphics chip gives you performance that can handle almost any game currently available, and all in a refreshingly restrained chassis. It's not lit, not aggressively-styled to match a jet fighter or Humvee, and boasts a pretty comfortable keyboard.

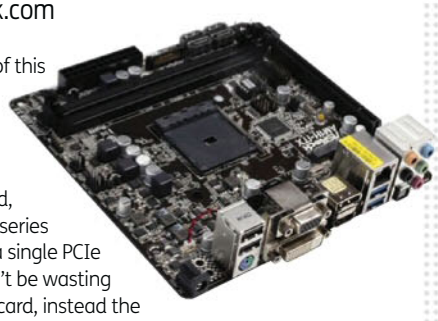
However, a couple of important tricks were missed. The P34G V2's trackboard is imprecise, especially with multi-touch gestures, and its positioning prone to getting in the way during typing. It's also very uncomfortable to use on your lap, generating quite a lot of heat on the lower back edge. As a desktop machine it works well, but on the road, it's a bit too much of a chore.

David Hollingworth

OVERALL ★★★★☆☆

ASROCK AM1H-ITX

PRICE $TBA
WEBSITE www.asrock.com



We liked the look of this when ASRock announced it, so we asked the company for a closer inspection. It's a Mini AM1 motherboard, supporting AMD's Socket-A series and E-series APUs. There's a single PCIe 2.0 x16 slot, but we wouldn't be wasting that on a discrete graphics card, instead the AMD APU graphics would better suit the true secret sauce behind this wee mobo.

You see, it will run on standard PSU cables to give it juice – or, and here's the magic – use a 19v AC adaptor. That opens up all sorts of modding possibilities, allowing creative approaches using a case that need be no larger than the size of the motherboard itself (assuming you run a relatively small heat sink).

As a media PC it could be quite perfect. There's a total of four video outputs (1x D-Sub, 1 x DVI-D, 1 x HDMI and 1 x DisplayPort 1.2), as well as 7.1 channel HD audio (Realtek ALC892). There's even four USB 3.0 ports (along with six USB 2 ports). Four SATA 3 ports will be plenty for any media uses. Potentially, too, this could serve as the basis for a DIY Steam Box, once that platform takes off.

Ben Mansill

OVERALL ★★★★☆☆

MSI GT70 DOMINATOR PRO

PRICE $3,699
WEBSITE www.au.msi.com

Sporting the latest GPU is a hallmark of MSI's gaming laptop range, and its newest model is no exception, with the Nvidia GTX 880M at its core. Not only that, but MSI has equipped it with 8GB of GDDR5 graphics memory. In every other respect this beast generally exceeds even the most extreme desktop gaming PCs, and all in a somewhat portable package. The CPU is an i7-4810MQ and our review model came with 3x128GB SSDs, as well as a 1TB hard drive. MSI didn't skimp with memory, including 32GB. All of this explains the rather high asking price, but remember it can be customised with lesser but still capable innards. We've got the most outrageously specced model, and boy is it impressive. No shortcuts have been taken, there's an optical drive, Killer LAN controller, and a pair of semi-decent speakers built-in, along with a subwoofer of the rather small variety. The audio is great for mid-volume media and gaming, but if you want to crank it right up headphones are the go. The GT70 Dominator Pro is encased in the same chassis as the last model (GX70), and its styling is a bit extreme, some will love it, others may think it a bit excessive.

Ben Mansill

OVERALL ★★★★★☆

ASUS ESSENCE STX II/7.1

PRICE $349
WEBSITE www.asus.com/au

Asus has a new version of the wonderful Essence STX audio card out. It's essentially the same card, with only minor updates to some of the secondary components. That, we don't mind at all, because unchanged is Hi-Fi that's, technically at least, audiophile-grade. Numbers like 124dB signal to noise ratio and 120dB for the headphones come to life with music. When paired with quality headphones (there's a headphone amp on the card, but we still recommend running this via a proper external amp) or speakers there's no other sound card that can touch this. All things considered, it's the most economical path to a true audiophile experience. I've personally been using the original for years and it's magical. The new card offers no noticeable improvements, so shouldn't be considered as an upgrade from the first Essence STX, but if you're running onboard audio this is a revelation. The new card comes in stereo and 7.1 versions, with each including a set up extra op-amps (pliers included too!) to tweak the sound, though I thought the default setup was just fine.

Ben Mansill

OVERALL ★★★★★☆

MIONIX AVIOR 7000 MOUSE

PRICE $79
WEBSITE www.mionix.com

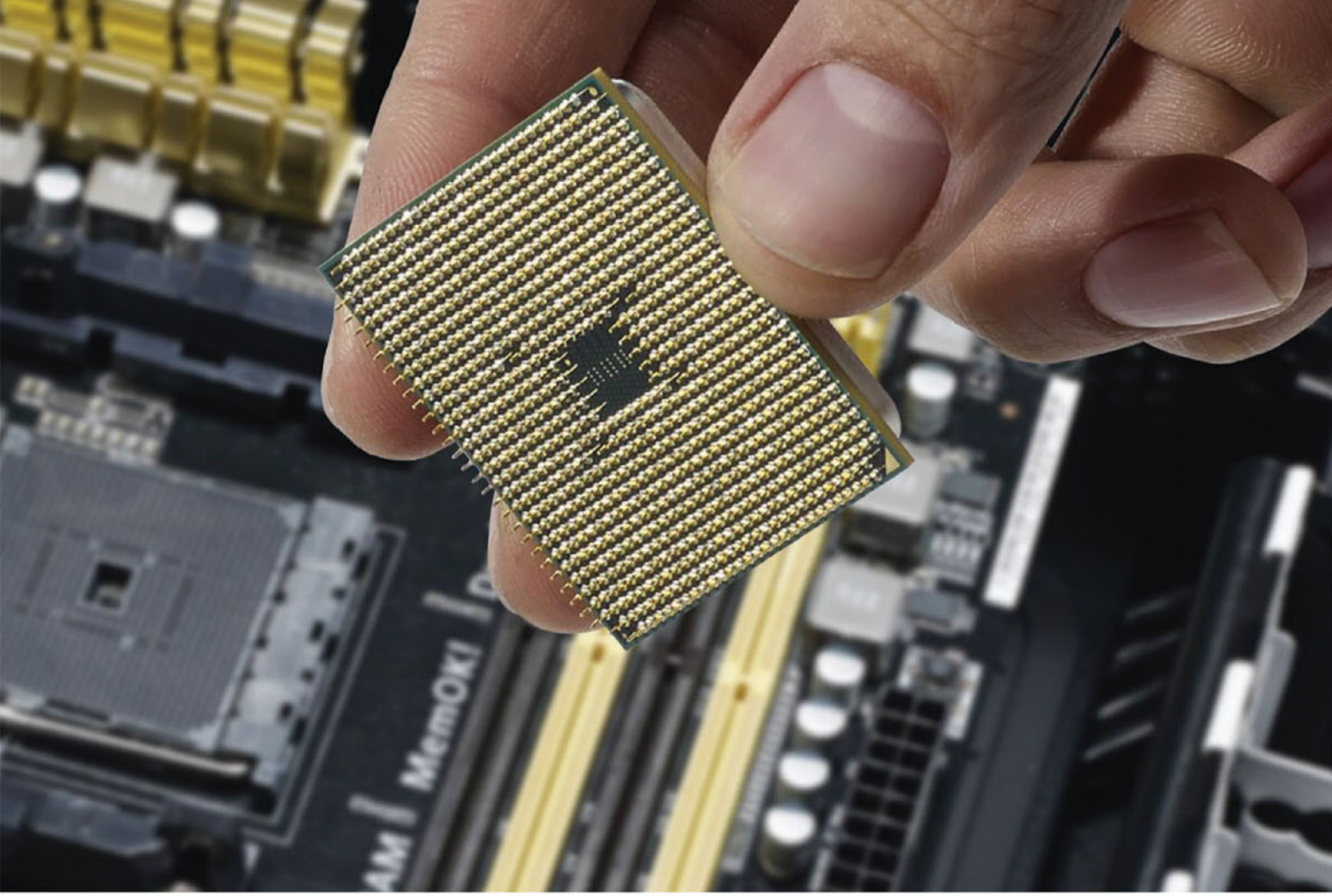
One of the current mice of choice in the *PC&TA* office is the Mionix NAOS. After last month's glowing review, it's remained our main work device - it's smooth, comfortable, and very precise, and we certainly appreciate the elegant styling.

Sadly, the same cannot be said for its lesser cousin, the Avior.

It may well appeal to seem, especially the left-handed. Its symmetrical design, complete with two 'thumb' buttons on either side is handy, but their positioning makes them prone to accidental acitivation, especially if you use certain mouse-grips. And the mouse feet are very grippy, making for a constant rasping feel under your hand, and even excess noise. It's not too much that the Naos is better - and it is! - but that this is that much worse. Given that the Naos is exactly the same price it gets our recommendation over this. It's a shame because more choice with good ambidextrous mice is something the world needs.

David Hollingworth

OVERALL ★★★☆☆☆



PROCESSORS
Chip advisor

CONTENTS REVIEWS

IT TAKES MORE THAN A HIGH CLOCK SPEED TO MAKE A GREAT PROCESSOR. WE'LL HELP YOU PICK THE RIGHT ONE WITH OUR IN-DEPTH GUIDE TO EVERY MODEL

Building a PC rather than buying one that someone else has built means you get to choose exactly which components go into it. Over the next four group tests we'll review all the major components you'll need to create the perfect PC, starting with processors.

The processor is perhaps the most important component, as it dictates how fast a PC will be and the types of applications it will run. Processors vary enormously in price, too, so it's crucial that you pick the right one.

We've tested every AMD and Intel processor that's worth buying to help make your decision a little easier. Older processors, such as Intel's LGA775 chips, are no longer available, so we've decided to omit them – they aren't worth bothering with for a new PC and upgraders should think about buying a new motherboard and processor instead. With prices ranging from $49 to $389, there's a processor here to suit every budget, whatever your speed requirements might be.

The processor is the first component you should choose for your new PC. Deciding between Intel and AMD chips

will determine which motherboard you buy, as you'll need one that has the right socket type and chipset (see our motherboard roundup in this issue starting on page 52 for a more detailed explanation, as well as our individual motherboard reviews).

Processor prices fluctuate constantly, so you may be able to buy the chips we recommend – or even the next model up – for less than we've shown here. Check the prices of other models in the range before you buy to see if you can get a better deal.

CORES FOR CONCERN

Although they have vastly different designs, all processors share common features. Understanding them will help you choose the best one for your own personal needs.

A processor's clock speed gives an indication of its performance but it's not the defining factor. In fact, clock speed is only a useful gauge when comparing processors from the same range, such as the Core i5-4670 and Core i5-4570. Far more important is the number of cores a processor has.

Each core is an individual processor. The more cores you have, the faster your computer will run. There are limitations, though. A PC will only use all its cores if you run multiple applications – in which case it spreads them across every available core – or if your applications are multithreaded. Multithreaded applications run faster when they have access to more cores, although we've found that most applications can only use four cores effectively. Even so, having more cores means, for example, that you can encode a video at speed and still have enough resources left to run several other applications.

All the processors we've reviewed have at least two cores, but quad-core models are very popular, while six- and eight-core models are available, too – mainly from AMD.

Some Intel processors use Hyper-Threading technology, which creates a virtual processor core for each physical one. Virtual cores help speed up applications but they're not as efficient or as fast as extra physical cores. Our benchmarks on page 48 and 49 show you the real differences in relative processor performance.

CACHE IN HAND

All computers use system memory to store data and applications. System memory is relatively slow, though, so processors have their own caches for faster access. The amount and type of cache directly affects performance. L1 cache is the fastest and smallest, and each core has its own. It's used to cache instructions (the actions a processor performs) and data.

If the processor can't find the data it needs in the L1 cache, it looks in the L2 cache, which is also distributed per-core. This can hold a lot more data, typically 256KB or more.

The fastest chips also have L3 cache, which is shared between cores. This is the largest type of cache and is important because processor cores often end up working on the same data from the same bit of memory at the same time. Sharing the L3 cache reduces the number of times a core has to talk to system memory, which is significantly slower.

SIGNS OF INTEL-INGENCE

We haven't reviewed any Intel Core processors that use the LGA1156 socket, as no new models have been released for a while and compatible motherboards are hard to find. For LGA1155 motherboards, there's a choice of Sandy Bridge and Ivy Bridge models. Ivy Bridge chips are faster and better value overall, so we've included these and dropped the older Sandy Bridge chips.

LGA1150 is Intel's current mainstream processor socket, and there's a good choice of chips available for it, all of which use the latest Haswell architecture. This is the latest and fastest generation of chips, but they're not compatible with all older motherboards.

Ivy Bridge and Haswell processors are similar in structure. The Pentium chips are dual-core, the Core i3 chips are dual-core with Hyper-Threading, the Core i5 models are quad-core without Hyper-Threading but with Turbo Boost for automatic overclocking, and the Core i7 chips are quad-core with Hyper-Threading and Turbo Boost. Every chip we've reviewed has integrated graphics, but most of these units aren't good enough for playing games, although they can all handle HD video. To use an Intel processor's integrated graphics, you'll need a board that has the necessary video outputs for your screen. Some boards have no video outputs, so check before you buy. There is no SLI advantage to running integrated graphics along with a discrete card.

> "The processor is the first component you should choose for a new PC. Deciding between Intel and AMD chips will determine which motherboard you need"

AMD THAT'S ALL FOLKS

AMD's processors fall into two camps: those with built-in graphics and those without. The processors with integrated graphics, which AMD calls Accelerated Processing Units (APUs), have an A prefix. Confusingly, there are three generations of A-series APU on the market. Trinity and the more recent Richland processors can both be used in Socket FM2 and FM2+ motherboards, but the latest Kaveri processors can only be used in the newer FM2+ boards.

Don't write off the older generations of APU, as they still provide plenty of punch at a lower price than the latest chips. A-series processors, although impressive for the price, can't match Intel's for processing power but they have superior 3D graphics performance. All but the cheapest A-series processors can play modern games, such as our test game Dirt Showdown, smoothly at 720p resolution with high detail levels. You'll need a dedicated graphics card to play the very latest games at 1080p, but AMD's APUs will at least let you play some decent games.

AMD's high-performance FX processors don't have graphics built in, as they are intended to compete with Intel's top-end CPUs. They require a Socket AM3+ motherboard with a 970 or 990FX chipset. Some AM3+ motherboards with other chipsets also support FX processors, but check the specifications to make absolutely sure before you buy.

Cheaper FX chips have four cores, while more powerful versions have six or eight. The current FX generation is known as Piledriver and uses Vishera cores. Look out for these, as they're superior to the earlier Bulldozer chips with their Zambezi cores, which we haven't reviewed. FX chips can't match the fastest Intel processors for raw power but they're a lot cheaper and certainly on a par dollar for dollar. The six- and eight-core models are also fantastic for serious multitasking, even if most applications can't use so many cores simultaneously.

All FX processors have unlocked multipliers, so if you're feeling adventurous you can overclock them easily to squeeze out some extra free processing power.

INTEL IVY BRIDGE

Intel's Ivy Bridge architecture is almost two years old, but though it's been surpassed by Haswell and a new processor socket, these chips are still very quick and will cope with any modern task. It's still worth buying one if you can find a cheap LGA1155 motherboard

Choosing a motherboard should be easy, as all 7-series boards support Ivy Bridge processors. They may also work on older H61, H67, P67 and Z68 motherboards, but these chipsets need to be updated to support Intel's new ME8 Management Engine. This is apparently more complicated than a simple BIOS update and needs to be done by the manufacturer. Intel recommends that you ask the manufacturer whether a motherboard supports Ivy Bridge before you buy, or you could just buy a board with a 7-series chipset.

The 22nm fabrication process means Ivy Bridge processors run cool and have low Thermal Design Power (TDP) ratings. TDP states the maximum amount of power a cooling system is required to dissipate, so the lower this number is, the better.

SPECIFIC RANGES

There are four ranges of Ivy Bridge processor: the budget Pentium series, the low-end Core i3, the mid-range Core i5 and the high-end Core i7. They have the same core architecture, with 64KB of L1 cache and 256KB of L2 cache per core. The amount of shared L3 cache varies between 3MB and 8MB, depending on the number of cores and the processor type.

In general, more cache means less time accessing slow system memory, which speeds up processing. As multiple cores often have to access the same parts of memory, shared cache is a great way to speed up the PC.

The main differences between the ranges is the number of cores and features. The Pentium range has two cores. The Core i3 range is dual-core with Hyper-Threading, which adds two more virtual cores. The Core i5 range is quad-core, while the Core i7 range is quad-core with Hyper-Threading. The Core i5 and i7 ranges also have Turbo Boost technology, which lets the processor overclock itself by increasing the multiplier automatically. Ivy Bridge processors can Turbo Boost a lot, as they run cool.

Look out for processors with a K in the name, as these have unlocked multipliers, so you can overclock them easily. Changing the multiplier is the only safe way to overclock these chips, as the other usual option – increasing the external bus speed – can break the memory controller and graphics chip.

> "In general, more cache means less time accessing slow system memory, which speeds up processing"

ONBOARD GRAPHICS

The Core i7 range, Core i5-3570K and Core i3-3245 have Intel HD Graphics 4000. This supports Intel's Quick Sync technology, which can speed up media encoding in applications written to use it. We also found that by reducing the graphics settings, older, less demanding games would run smoothly, although you'll need a graphics card if you're serious about games (see table opposite).

The remaining Core i5 and Core i3 processors have Intel HD Graphics 2500 chips, which aren't very fast and can't cope with games. The Pentium range has Intel HG Graphics units that are even slower. However, all the graphics chips can decode HD video and support HDMI 1.4a, so they're useful for a media centre PC.

SPECIFIC PRODUCTS

The newer Haswell processors outclass Ivy Bridge chips, so you're better off buying one of those where you can. If you want to reuse an older motherboard, the Core i5-3570K with its unlocked multiplier is a good choice. For a budget PC, the Pentium G2020 is great value and still quick. It wins a Budget Buy award.

IVY BRIDGE

MODEL	SPEED	CORES	RATING	PRICE INC	SCORE
Pentium G2010	2.8GHz	Two	★★★★☆☆	$125	41
Pentium G2020	2.9GHz	Two	★★★★★☆	$166	43
Pentium G2120	3.1GHz	Two	★★★☆☆☆	$208	46
Pentium G2130	3.2GHz	Two	★★★★☆☆	$210	47
Core i3-3210	3.2GHz	Two	★★★★☆☆	$275	58
Core i3-3220	3.3GHz	Two	★★★★☆☆	$317	60
Core i3-3240	3.4GHz	Two	★★★★★☆	$290	62
Core i3-3245	3.4GHz	Two	★★★★☆☆	$280	62
Core i5-3330	3GHz	Four	★★★★★☆	$337	88
Core i5-3450	3.1GHz	Four	★★★★☆☆	$260	91
Core i5-3470	3.2GHz	Four	★★★★☆☆	$230	94
Core i5-3550	3.3GHz	Four	★★★★☆☆	$335	97
Core i5-3570	3.4GHz	Four	★★★★★☆	$270	100
Core i5-3570K	3.4GHz	Four	★★★★★☆	$285	100
Core i7-3770	3.4GHz	Four	★★★★☆☆	$380	101
Core i7-3770K	3.5GHz	Four	★★★★☆☆	£238	101

INTEL HASWELL

Haswell is Intel's latest processor architecture and the company's fastest range of chips. It uses a brand-new processor socket (LGA1150), so you'll need a new motherboard to go with it.

For the laptop versions of its chips, Intel focused on efficiency, helping to increase battery life dramatically by reducing power requirements. With the desktop PC version, Intel has opted purely for performance.

This fits in with Intel's so-called Tick-Tock strategy, where a Tick architecture is a smaller, more efficient version of a previous design, while a Tock is an architectural redesign that increases performance. With Haswell, Intel has provided the Tock and the chips use the same 22nm fabrication process as the previous-generation, Ivy Bridge chips.

Surprisingly, Haswell chips run hotter than their Ivy Bridge counterparts. While the Ivy Bridge Core i7 chips had a TDP of 77W, the Haswell variants have a TDP of 84W. The new Core i5 chips also have a TDP of 84W. Only the Core i3 models are more efficient, with a 54W TDP compared with last year's 55W. This means the Core i5 and i7 chips require better coolers than the Ivy Bridge range, so factor this into the cost of your purchase.

SPECIFIC RANGES

There are four ranges of Haswell processor: the budget Pentium series, low-end Core i3, mid-range Core i5 and high-end Core i7. All have the same core architecture, with 64KB of L1 cache and 256KB of L2 cache per core. The amount of L3 cache, which all the cores share, varies between 3MB and 8MB, depending on the number of cores and processor type.

With more cache, a chip spends less time accessing slow memory, which should speed up processing. As multiple cores often have to access the same parts of memory, sharing L3 cache is a great way to speed up the PC.

As with Ivy Bridge, the main differences between the ranges is the number of cores and features. The Pentium range has two cores. The Core i3 range is dual-core with Hyper-Threading, which adds two more virtual cores. The Core i5 range is quad-core, and the Core i7 range is quad-core with Hyper-Threading adding four more virtual cores.

Like Ivy Bridge, Haswell's Core i5 and i7 ranges also have Turbo Boost, which lets the processor overclock itself by increasing the multiplier. With a decent cooler the chips can Turbo Boost a lot for increased performance. Haswell processors are generally 10 to 15 per cent faster than their Ivy Bridge equivalents.

Processors with a K in the model name have unlocked multipliers for easy overclocking. As with Ivy Bridge chips, this is the only safe way to overclock, because the other option – increasing the external bus speed – can disrupt the memory controller and graphics chip.

ONBOARD GRAPHICS

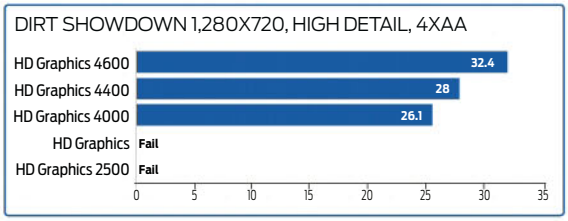
Intel has improved graphics performance again for its Haswell chips. Most have Intel HD Graphics 4600 built in, which can handle some games at 720p resolution. The Core i3-4130 has HD Graphics 4400, which is a little slower, but the Pentium range has HD Graphics units, which are no good for gaming.

SPECIFIC PRODUCTS

Although they run hotter, the faster Haswell processors are better value than the chips in the old Ivy Bridge range. For most people, though, a Core i7 processor is overkill. These only come into their own when you're running a lot of applications or highly multithreaded programs. With that in mind, the Core i5-4670K wins a Recommended award. It's incredibly quick and its unlocked multiplier means you can overclock it for even better performance. The Core i3-4130 also wins a Recommended award because it's inexpensive but fast. Finally, if you're looking for a budget CPU, the Pentium G3220 is a great choice.

HASWELL

MODEL	SPEED	CORES	RATING	PRICE	SCORE
Pentium G3220	3GHz	Two	★★★★★☆	$157	48
Pentium G3420	3.2GHz	Two	★★★★★☆	$151	52
Pentium G3430	3.3GHz	Two	★★★★☆☆	$230	53
Core i3-4130	3.4GHz	Two	★★★★★★	$135	69
Core i3-4330	3.5GHz	Two	★★★★★☆	$171	71
Core i3-4340	3.6GHz	Two	★★★★☆☆	$179	73
Core i5-4430	3GHz	Four	★★★★★☆	$215	99
Core i5-4440	3.1GHz	Four	★★★★★☆	$209	103
Core i5-4570	3.2GHz	Four	★★★★★☆	$229	106
Core i5-4670	3.4GHz	Four	★★★★★☆	$249	112
Core i5-4670K	3.4GHz	Four	★★★★★★	$269	112
Core i7-4770	3.4GHz	Four	★★★★☆☆	$349	112
Core i7-4770K	3.5GHz	Four	★★★★☆☆	$389	115
Core i7-4771	3.5GHz	Four	★★★★☆☆	$365	115



AMD Socket AM3+

SOCKET AM3+				
MODEL	SPEED	RATING	PRICE INC VAT	SCORE
FX-4300	3.8GHz	★★★★☆☆	$125	69
FX-4350	4.2GHz	★★★★★★	$138	76
FX-6300	3.5GHz	★★★★★★	$139	74
FX-6350	3.9GHz	★★★★☆☆	$183	82
FX-8320	3.5GHz	★★★★★★	$189	87
FX-8350	4GHz	★★★★★☆	$239	89

So much attention is lavished on AMD's A-series, with its potent integrated graphics, that the FX range of performance chips gets overlooked. This is a pity, as some FX processors are powerful and good value. FX processors are unusual today in that they lack integrated graphics, so you'll need to budget for a graphics card. If you don't want to play the latest games, you can buy a basic passively cooled AMD Radeon HD 5450 graphics card.

The processors consist of one or more modules, each of which has two cores and 2MB of level 2 cache. Every FX processor on test has 8MB of level 3 cache (which all the modules share), except the FX-4300 which has 4MB. This modular approach is meant to share cache more efficiently, as the two cores in each module can access a larger pool of level 2 cache.

NEW MODULES

The original Socket AM3+ FX processors used Bulldozer modules made of two Zambezi cores, but those have all but vanished. We've reviewed newer chips with Piledriver modules, which consist of two Vishera cores. All AMD FX processors have unlocked multipliers, so if you're feeling adventurous you can boost them beyond their stock speeds.

The main problem with testing AMD's FX processors is that few Windows applications are optimised to take advantage of more than four cores. This means the cheaper four-core FX processors can outperform the pricier six-core chips in tests. Our video encoding benchmark, for example, doesn't push all six cores to their maximum, which means a four-core chip with a higher clock speed can complete the task faster.

This is why the six-core 3.5GHz FX-6300 scored only 64 for video encoding while the four-core 3.8GHz FX-4350 scored 74. However, in the multitasking benchmark, which converts images, encodes a video and plays a Full HD movie at the same time, the FX-6300 leapt ahead with 82 points compared to 73.

At the cheaper end of the range, the competition comes down to the FX-6300 and the FX-4350. The FX-4350 managed a slightly better score of 76 overall in our benchmarks compared with the FX-6300's 74, so it's a better choice if you tend to run only one intensive application at a time. This is what most people do, so the FX-4350 wins a Recommended award.

At the top of the range, the FX-8350 is something of a performance bargain. Few tasks can use its eight cores to their full, which is why the 4GHz chip scored the same 74 in our video encoding test as the four-core FX-4350. However, the FX-8350 surged ahead in the multitasking benchmark with a very strong 97, scoring an impressive 89 overall.

AMD Socket FM2/FM2+

AMD's A-series processors may lack the outright processing power of the FX range, but their integrated graphics chipsets give them a big advantage. This means you can not only do without a graphics card, but can also reduce clutter in your case to improve airflow, or use a smaller case altogether. AMD's integrated graphics processors, which AMD calls Accelerated Processing Units (APUs), have a lot more 3D power than Intel's chips. Intel's graphics have improved, but an AMD APU is still the only real choice if you want to play modern games without a graphics card.

There are three generations of A-series APU available, and even older models are worth buying if you're on a tight budget. The oldest APUs, codenamed Trinity, will work in a socket FM2 or FM2+ motherboard. The next generation is codenamed Richland and also works in both FM2 and FM2+ boards. The latest Kaveri models require an FM2+ board.

The 2D processing functions in Trinity and Richland chips are handled by Piledriver processor modules, as found in the current range of AMD FX processors (see opposite). Richland processors supposedly use an enhanced version of Piledriver, but this makes little difference in our benchmarks. Kaveri chips use new Steamroller modules, which are based on a smaller 28nm process.

Unlike the FX processor range, where the first letter of the model number denotes the number of cores, the A-series APUs follow no such logic. Instead, the A4, A6, A8 and A10 designations refer to number of graphics cores the chip has, but two processors with the same designation may have graphics cores running at different speeds. You're better off looking at the specifications. Most A-series processors have four cores, but the lower-end models (under £60 or so) have two.

Most AMD A-series processors have locked multipliers, look for the K suffix if you'd like an APU with an unlocked multiplier for easier overclocking.

PERFORMANCE

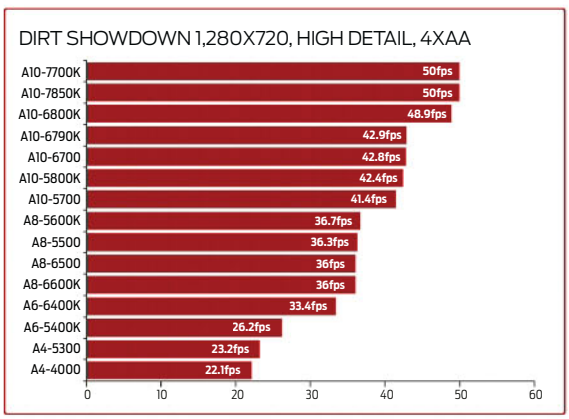
At the time of writing there are 13 Socket FM2 processors available and two Kaveri chips. At the lower end of the scale, there are a couple of potential bargains. The A4-4000 looks a steal at less than $49, but its overall score of 25 in our benchmarks shows that it would start to struggle with anything more than the most basic applications. You're better off finding another $5 or so for the A4-5300, which will give you a useful 16 per cent increase in application performance.

However, both processors are at the edge of what we'd consider acceptable for performance, so we'd seriously recommend upping the budget to around $110 and buying the A8-5600K. This managed a perfectly acceptable score of 62 overall in our benchmarks, so will cope with even intensive tasks. It also ran our Dirt Showdown benchmark at 1,280x720 with 4x anti-aliasing and High detail at a smooth 36.7fps, so it's able to cope with some light gaming. It's a Recommended as a result.

> "An AMD APU is still the only real choice if you want to play modern games without a graphics card."

If you want more gaming performance than the A8-5600K can offer but can't stretch to $110, the A10-6790K is a good buy. With an overall score of 67 it gives you a useful boost in desktop applications compared with our Recommended winner, and 42.9fps in our Dirt Showdown benchmark shows that it's a good basis for a budget gaming PC.

Our favourite A-series processor, however, is the A10-6800K. It's almost as quick as the top-of-the range Kaveri A10-7850K chip in our application benchmarks, as its score of 71 shows, and it's highly impressive in games - 48.9fps in Dirt Showdown is a recipe for smooth gaming in moderately challenging titles even at high detail. It's a Recommended.

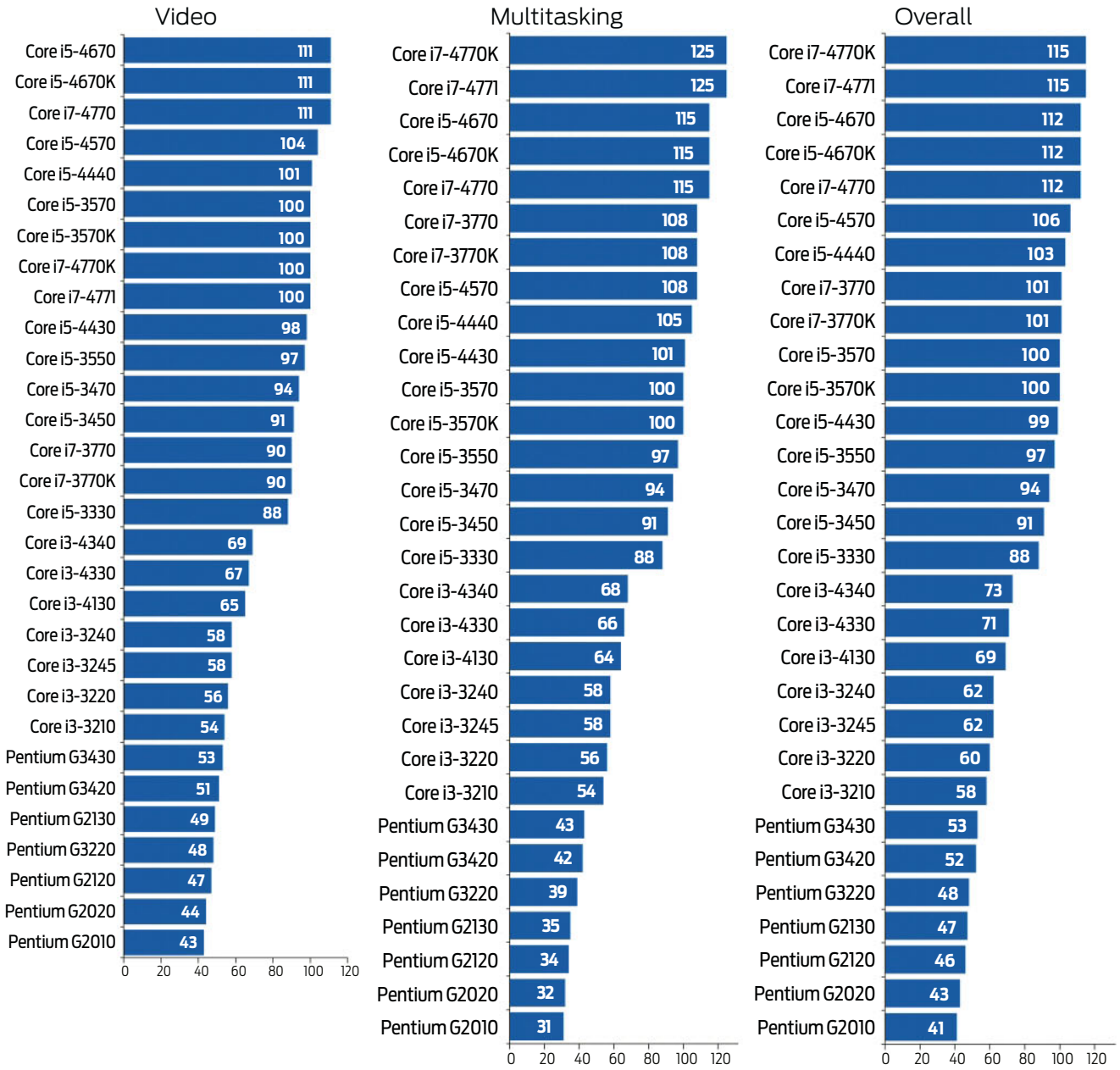


SOCKET FM2/FM2+

MODEL	SPEED	GRAPHICS SPEED	GRAPHICS CORES	RATING	PRICE INC VAT	SCORE
A4-4000	3GHz	720MHz	128	★★★½☆	$49	25
A4-5300	3.4GHz	724MHz	128	★★★★½	$55	29
A6-5400K	3.6GHz	760MHz	192	★★★½☆	$59	30
A8-5500	3.2GHz	760MHz	256	★★★★½	$100	60
A8-5600K	3.6GHz	760MHz	256	★★★★★	$109	62
A10-5700	3.4GHz	760MHz	384	★★★½☆	$150	59
A10-5800K	3.8GHz	800MHz	384	★★★★½	$155	64
A6-6400K	3.9GHz	800MHz	192	★★★★½	$75	31
A8-6500	3.5GHz	800MHz	256	★★★½☆	$183	58
A8-6600K	3.9GHz	844MHz	256	★★★★½	$125	64
A10-6700	3.7GHz	844MHz	384	★★★½☆	$216	67
A10-6790K	4GHz	844MHz	384	★★★★★	$159	67
A10-6800K	4.1GHz	844MHz	384	★★★★★	$175	71
A10-7700K	3.4GHz	720MHz	384	★★★½☆	$195	69
A10-7850K	3.7GHz	720MHz	512	★★★½☆	$220	73

INTEL benchmarks

2D PERFORMANCE



INTERNAL VERDICT

Intel's processors are still the fastest you can buy, outperforming AMD's chips for pure processing power. The new Haswell processors offer the best performance, but Ivy Bridge chips are still good, particularly for those who want to reuse an older motherboard or build a budget PC. The Pentium G2020 wins a Recommended award.

The Haswell processor to buy for the best price and performance is the Core i5-4670K. This quick chip has an unlocked multiplier, so you can increase its speed even further. It wins a Recommended award. If you're building a mid-range PC, buy the Core i3-4130. This chip is fast and great value, winning a Recommended award. For those with less to spend, the Pentium G3220 is a great choice and wins a Recommended award.

INTEL Pentium G2020 ★★★★★☆

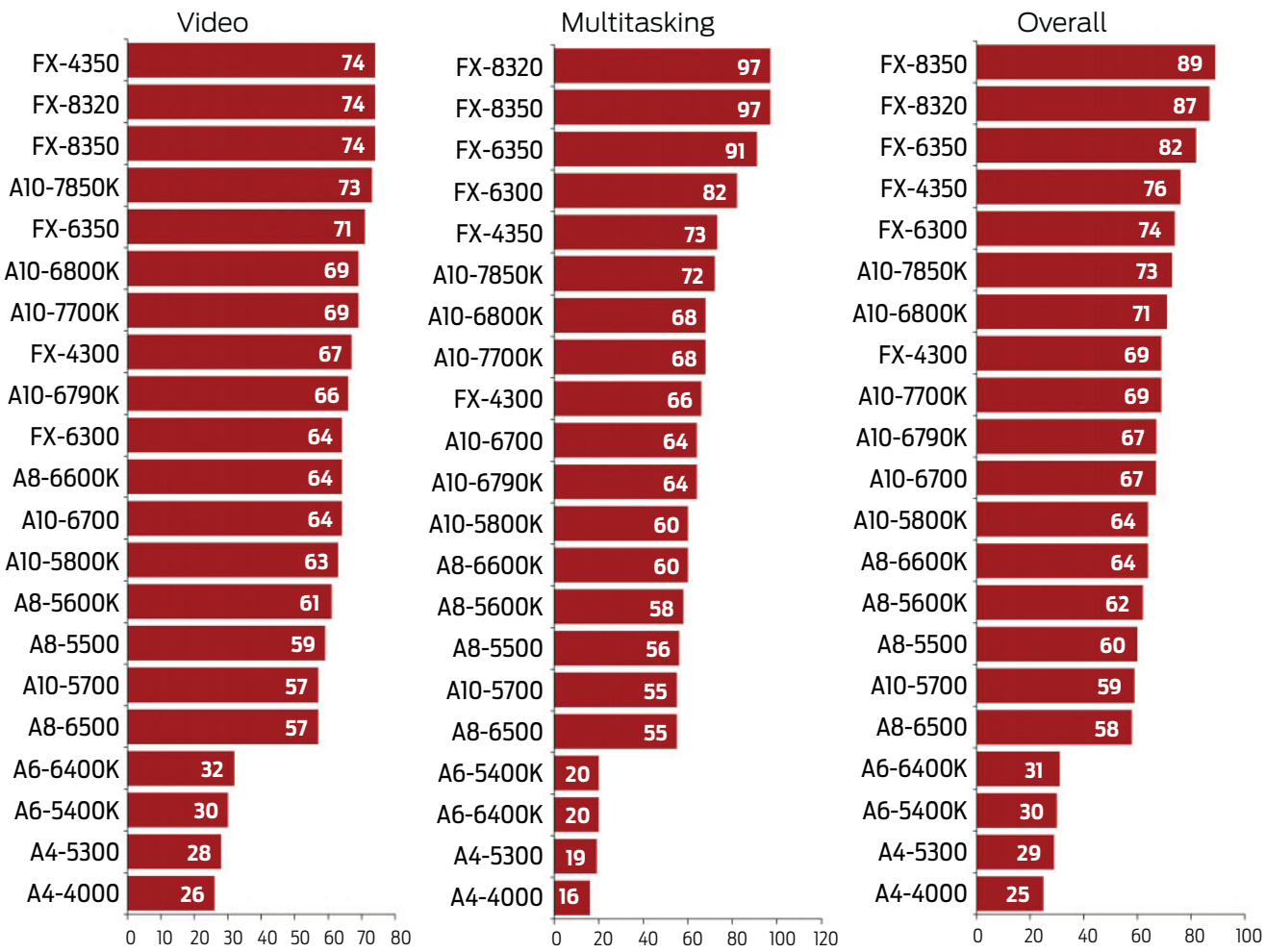
INTEL Pentium G3220 ★★★★★☆

INTEL Core i3-4130 ★★★★★★

INTEL Core i5-4670K ★★★★★★

AMD benchmarks

2D PERFORMANCE



INTERNAL VERDICT

AMD's FX processors may not be able to match Intel's Haswell chips for outright performance, but when you look at the amount of performance they provide per pound they start to make a lot of sense. At the cheaper end of the spectrum, the FX-4350 is a great buy. It will give you strong application performance at a very reasonable price, and for that it wins a Recommended award.

If you plan to use your PC for particularly intensive tasks, the FX-8320 is the processor to buy. For $189 you get a powerful eight-core chip that's amazing for multitasking. It's a Recommended

There are several impressive chips among AMD's A-series integrated graphics processors, or APUs, but two in particular stand out. If you don't have much to spend, the A8-5600K is the best choice. It provides reasonable 2D performance and can play less demanding games smoothly without the need for a dedicated graphics card. It's a Recommended.

Our favourite AMD APU, though, is the A10-6800K. For just over $170 this gives you enough speed even for intensive desktop applications, as well as a surprising amount of on-chip gaming power. It wins a Recommended award.

AMD FX-4350 ★★★★★★

AMD FX-8320 ★★★★★★

AMD A8-5600K ★★★★★★

AMD A10-6800K ★★★★★★

IVY BRIDGE

		BUDGET BUY								
	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL
	Pentium G2010	Pentium G2020	Pentium G2120	Pentium G2130	Core i3-3210	Core i3-3220	Core i3-3240	Core i3-3245	Core i5-3330	Core i5-3450
Processor architecture	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge
Score	★★★★☆☆	★★★★★☆	★★★☆☆☆	★★★★☆☆	★★★★☆☆	★★★★☆☆	★★★★★☆	★★★★☆☆	★★★★★☆	★★★★☆☆
Clock speed	2.8GHz	2.9GHz	3.1GHz	3.2GHz	3.2GHz	3.3GHz	3.4GHz	3.4GHz	3.0GHz	3.1GHz
Socket	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155
Fabrication thickness	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm
Number of cores	Two	Two	Two	Two	Two	Two	Two	Two	Four	Four
Multiplier	x28	x29	x31	x32	x32	x33	x34	x34	x30	x31
FSB clock	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz
L1 cache	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	4x 64KB	4x 64KB
L2 cache	2x 256KB	2x 256KB	2x 256KB	2x 256KB	2x 256KB	2x 256KB	2x 256KB	2x 256KB	4x 256KB	4x 256KB
L3 cache	3MB	3MB	3MB	3MB	3MB	3MB	3MB	3MB	6MB	6MB
Graphics	HD Graphics	HD Graphics	HD Graphics 2500	HD Graphics 2500	HD Graphics 2500	HD Graphics 2500	HD Graphics 2500	HD Graphics 4000	HD Graphics 2500	HD Graphics 2500
TDP	55W	55W	55W	55W	55W	55W	55W	55W	55W	55W
Price inc VAT	£45	£38	£61	£47	£87	£79	£80	£105	£125	£188
Details	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com
Product code	BX80637G2010	BX80637G2020	BX80637G2120	BX80637G2130	BX80637I33210	BX80637I33220	BX80637I33240	BX80637I33245	BX80637I53330	BX80637I53450

IVY BRIDGE

	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL
	Core i5-3470	Core i5-3550	Core i5-3570	Core i5-3570K	Core i7-3770	Core i7-3770K
Processor architecture	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge	Ivy Bridge
Score	★★★★☆☆	★★★★☆☆	★★★★★☆	★★★★★☆	★★★★☆☆	★★★★☆☆
Clock speed	3.2GHz	3.3GHz	3.4GHz	3.4GHz	3.4GHz	3.5GHz
Socket	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155	LGA1155
Fabrication thickness	22nm	22nm	22nm	22nm	22nm	22nm
Number of cores	Four	Four	Four	Four	Four	Four
Multiplier	x32	x33	x34	x34	x34	x35
FSB clock	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz
L1 cache	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 32KB	4x 32KB
L2 cache	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB
L3 cache	6MB	6MB	6MB	6MB	8MB	8MB
Graphics	HD Graphics 2500	HD Graphics 2500	HD Graphics 2500	HD Graphics 4000	HD Graphics 4000	HD Graphics 4000
TDP	55W	55W	55W	55W	77W	77W
Price including VAT	£142	£157	£171	£171	£215	£238
Details	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com
Product code	BX80637I53470	BX80637I53550	BX80637I53570	BX80637I53570K	BX80637I73770	BX80637I73770K

HASWELL

	BUDGET BUY			BEST BUY
	INTEL	INTEL	INTEL	INTEL
	Pentium G3220	Pentium G3420	Pentium G3430	Core i3-4130
Processor architecture	Haswell	Haswell	Haswell	Haswell
Score	★★★★★☆	★★★★★☆	★★★★☆☆	★★★★★★
Clock speed	3GHz	3.2GHz	3.3GHz	3.4GHz
Socket	LGA1150	LGA1150	LGA1150	LGA1150
Fabrication thickness	22nm	22nm	22nm	22nm
Number of cores	Two	Two	Two	Two
Multiplier	x30	x32	x33	x34
FSB clock	100MHz	100MHz	100MHz	100MHz
L1 cache	2x 64KB	2x 64KB	2x 64KB	2x 64KB
L2 cache	2x 256KB	2x 256KB	2x 256KB	2x 256KB
L3 cache	3MB	3MB	3MB	3MB
Graphics	HD Graphics	HD Graphics	HD Graphics	HD Graphics 4400
TDP	53W	53W	53W	54W
Price including VAT	£41	£47	£68	£85
Details	www.intel.com	www.intel.com	www.intel.com	www.intel.com
Product code	BX80646G3220	BX80646G3420	BX80646G3430	BX80646I34130

HASWELL

							BEST BUY			
	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL	INTEL
	Core i3-4330	Core i3-4340	Core i5-4430	Core i5-4440	Core i5-4570	Core i5-4670	Core i5-4670K	Core i7-4770	Core i7-4770K	Core i7-4771
Core	Haswell	Haswell	Haswell	Haswell	Haswell	Haswell	Haswell	Haswell	Haswell	Haswell
Rating	★★★★★☆	★★★★☆☆	★★★★★☆	★★★★★☆	★★★★★☆	★★★★★☆	★★★★★★	★★★★☆☆	★★★★☆☆	★★★★☆☆
Frequency	3.5GHz	3.6GHz	3.0GHz	3.1GHz	3.2GHz	3.4GHz	3.4GHz	3.4GHz	3.5GHz	3.5GHz
Socket	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150	LGA1150
Fabrication thickness	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm	22nm
Number of cores	Two	Two	Four	Four	Four	Four	Four	Four	Four	Four
Multiplier	x35	x36	x30	x31	x32	x34	x34	x34	x35	x35
External bus	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz
Level 1 cache	2x 64KB	2x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB	4x 64KB
Level 2 cache	2x 256KB	2x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB	4x 256KB
Level 3 cache	3MB	3MB	6MB	6MB	6MB	6MB	6MB	8MB	8MB	8MB
Graphics	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600	HD Graphics 4600
Power rating (TDP)	54W	54W	84W	84W	84W	84W	84W	84W	84W	84W
Price including VAT	£95	£115	£137	£129	£145	£160	£173	£218	£251	£227
Details	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com	www.intel.com
Part code	BX80646I34330	BX80646I34340	BX80646I54430	BX80646I54440	BX80646I54570	BX80646I54670	BX80646I54670K	BX80646I74770	BX80646I74770K	BX80646I74771

SOCKET AM3+

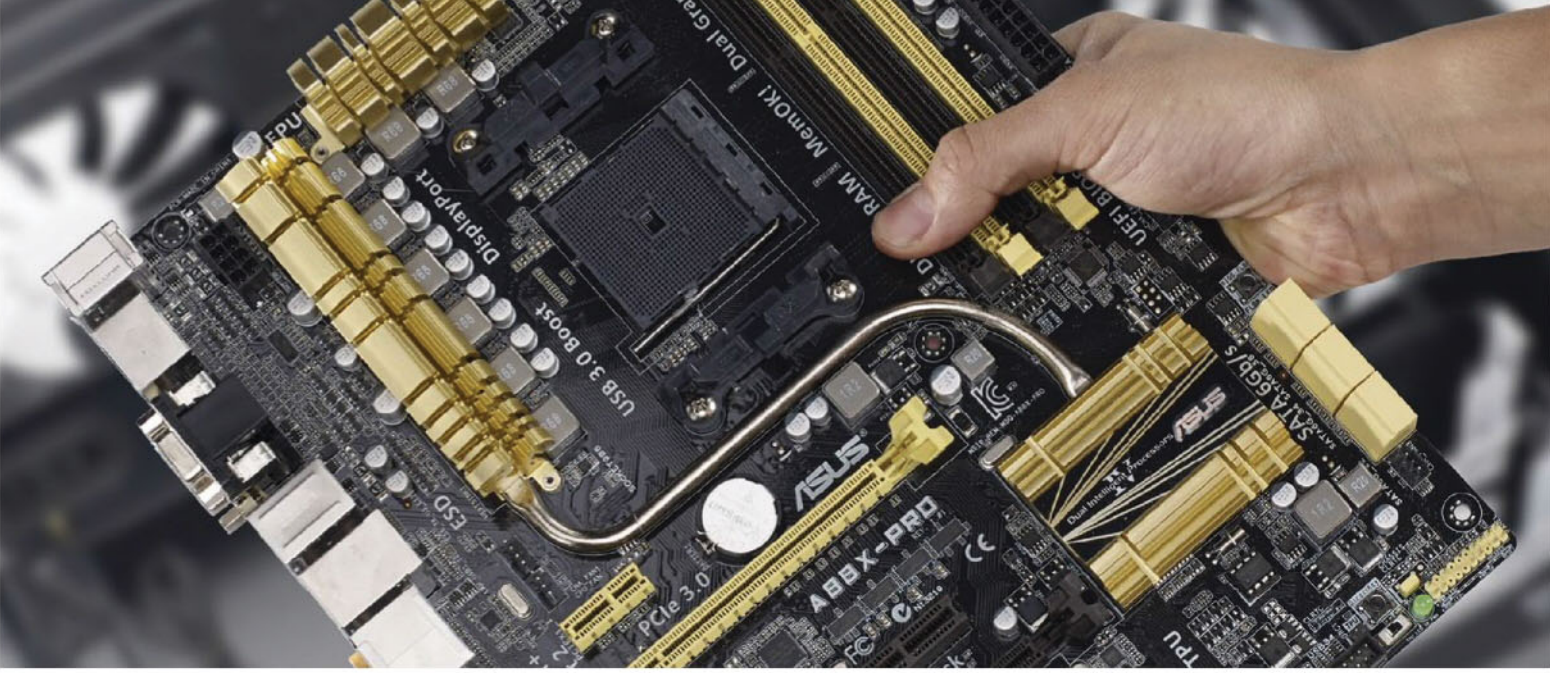
		BEST BUY			BEST BUY	
	AMD	AMD	AMD	AMD	AMD	AMD
	FX-4300	FX-4350	FX-6300	FX-6350	FX-8320	FX-8350
Core	Vishera	Vishera	Vishera	Vishera	Vishera	Vishera
Rating	★★★★☆☆	★★★★★★	★★★★★★	★★★★☆☆	★★★★★★	★★★★★☆
Frequency	3.8GHz	4.2GHz	3.5GHz	3.9GHz	3.5GHz	4GHz
Socket	AM3+	AM3+	AM3+	AM3+	AM3+	AM3+
Process	32nm	32nm	32nm	32nm	32nm	32nm
Cores	Four	Four	Six	Six	Eight	Eight
Multiplier	x19	x21	x17.5	x19.5	X17.5	X20
External bus	200MHz	200MHz	200MHz	200MHz	200MHz	200MHz
Level 1 cache	2x 64KB	2x 64KB	3x 64KB	3x 64KB	4x 64KB	4x 64KB
Level 2 cache	2x 2MB	2x 2MB	3x 2MB	3x 2MB	4x 2MB	4x 2MB
Level 3 cache	4MB	8MB	8MB	8MB	8MB	8MB
Graphics chipset	None	None	None	None	None	None
Power rating (TDP)	95W	125W	95W	125W	125W	125W
Price including VAT	£77	£86	£83	£100	£108	£142
Details	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com
Part code	FD4300WMHKBOX	FD4350FRHKBOX	FD6300WMHKBOX	FD6350FRHKBOX	FD8320FRHKBOX	FD8350FRHKBOX

SOCKET FM2

					BUDGET BUY			
	AMD	AMD	AMD	AMD	AMD	AMD	AMD	AMD
	A4-4000	A4-5300	A6-5400K	A8-5500	A8-5600K	A10-5700	A10-5800K	A6-6400K
Core	Richland	Trinity	Trinity	Trinity	Trinity	Trinity	Trinity	Richland
Rating	★★★★☆☆	★★★★★☆	★★★★☆☆	★★★★★☆	★★★★★★	★★★★☆☆	★★★★★☆	★★★★★☆
Frequency	3GHz	3.4GHz	3.6GHz	3.2GHz	3.6GHz	3.4GHz	3.8GHz	3.9GHz
Socket	FM2	FM2	FM2	FM2	FM2	FM2	FM2	FM2
Process	32nm	32nm	32nm	32nm	32nm	32nm	32nm	32nm
Cores	Two	Two	Two	Four	Four	Four	Four	Two
Multiplier	x30	x34	x36	x32	x36	x34	x38	x39
External bus	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz
Level 1 cache	64KB	64KB	64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	64KB
Level 2 cache	1MB	1MB	1MB	2x 2MB	2x 2MB	2x 2MB	2x 2MB	1MB
Level 3 cache	None	None	None	None	None	None	None	None
Graphics chipset	Radeon HD 7480D	Radeon HD 7480D	Radeon HD 7540D	Radeon HD 7560D	Radeon HD 7560D	Radeon HD 7660D	Radeon HD 7660D	Radeon HD 8470D
Power rating (TDP)	65W	65W	65W	65W	100W	65W	100W	65W
Price including VAT	£28	£33	£41	£67	£65	£89	£82	£44
Details	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com
Part code	AD4000OKHLBOX	AD5300OKHJBOX	AD540KOKHJBOX	AD5500OKHJBOX	AD560KWOHJBOX	AD5700OKHJBOX	AD580KWOHJBOX	AD640KOKHLBOX

SOCKET FM2 / SOCKET FM2+

					BEST BUY		
	AMD	AMD	AMD	AMD	AMD	AMD	AMD
	A8-6500	A8-6600K	A10-6700	A10-6790K	A10-6800K	A10-7700K	A10-7850K
Core	Richland	Richland	Richland	Richland	Richland	Kaveri	Kaveri
Rating	★★★★☆☆	★★★★★☆	★★★★☆☆	★★★★★★	★★★★★★	★★★★☆☆	★★★★☆☆
Frequency	3.5GHz	3.9GHz	3.7GHz	4GHz	4.1GHz	3.4GHz	3.7GHz
Socket	FM2	FM2	FM2	FM2	FM2	FM2	FM2
Process	32nm	32nm	32nm	32nm	32nm	28nm	28nm
Cores	Four	Four	Four	Four	Four	Four	Four
Multiplier	x35	x39	x37	x40	x41	x34	x37
External bus	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz	100MHz
Level 1 cache	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 64KB	2x 96KB	2x 96KB
Level 2 cache	2x 2MB	2x 2MB	2x 2MB	2x 2MB	2x 2MB	2x 2MB	2x 2MB
Level 3 cache	None	None	None	None	None	None	None
Graphics chipset	Radeon HD 8570D	Radeon HD 8570D	Radeon HD 8670D	Radeon HD 8670D	Radeon HD 8670D	Radeon R7	Radeon R7
Power rating (TDP)	65W	100W	65W	100W	100W	95W	95W
Price including VAT	£70	£73	£113	£89	£104	£110	£130
Details	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com	www.amd.com
Part code	AD6500OKHLBOX	AD660KWOHLBOX	AD670TYHHLBOX	AD679KWOHLBOX	AD680KWOHLBOX	AD770KXBJABOX	AD785KXBJABOX



MOTHERBOARDS
Board games

THE MOTHERBOARD DICTATES WHAT COMPONENTS AND EXPANSION OPTIONS YOUR PC HAS, SO GETTING THE RIGHT MODEL IS CRUCIAL. WE EXPLAIN ALL

Your motherboard is the central part of the computer, to which all other components and devices connect. It's vitally important, therefore, to choose the right model, so that you can fit the expansion cards, processor, memory and storage you need. There's a lot to look out for, but we'll take you through the options to help you find your perfect board.

SOCKET TO 'EM

The first thing to consider is the processor socket. This defines exactly which processors can be plugged into your motherboard, although that's not the only limiting factor, as the motherboard's chipset also defines which processors can be used. Some motherboards can have a BIOS update to support newer processors, but that's not always easy to do.

For a BIOS upgrade, you have to have a working system, so that would mean buying a motherboard and an older supported processor, updating the BIOS and then installing the new processor. Given the difficulty involved, check that your chosen CPU is supported by your motherboard out of the box. Our reviews will warn you if the latest AMD or Intel processors aren't supported.

For Intel processors, you need an LGA1155 or an LGA1150 motherboard. The former is the standard used by both the older Sandy Bridge and more modern Ivy Bridge chips, while LGA1150 motherboards are used by newer Haswell chips. However, you need to get the right chipset to use Ivy Bridge and Haswell processors. For the best compatibility you should use 7-series motherboards for Ivy Bridge and 8-series motherboards for Haswell, which we've reviewed here.

Ivy Bridge processors also work on H61, H67, P67 and Z68 motherboards, with one caveat. The older chipsets will need to be updated to support Intel's new ME8 Management Engine, which is apparently more complicated than a simple BIOS update and will need to be done by the manufacturer. Haswell processors will also work with H87, H81, Q97, Q85 and B85 motherboards.

AMD currently uses two processor sockets: AM3+ and FM2+. You can't use old AM2+ processors in an AM3+ motherboard, but AM3 processors will work in AM3+ motherboards. For the best compatibility get a 9-series chipset. The older 7-series chipsets support most processors, although you may need to get a BIOS update for some models.

FM2 processors will also work in FM2+ motherboards but aren't backwards compatible with the older FM1 standard. FM2+ processors are so new that all chipsets support all existing processors. Our reviews will help you find the best one.

Most of the motherboards we've tested this month can be overclocked, assuming you have a capable processor,

> "Motherboard RAID controllers have one big problem: if your board fails, you'll need to replace it with an identical model to read your data"

and we've taken a brief look at how easy the BIOS or UEFI interface is to navigate in each review.

MEMORY MAN

All modern motherboards use DDR3 memory. The maximum supported memory speeds vary from board to board, but all the boards we've tested here support PC3-10600 DDR3 memory. Most also support higher speeds.

It's worth noting that motherboards default to running faster-rated RAM at 1,333MHz until you enable the correct settings, which can usually be done fairly simply by enabling the relevant XMP (eXtreme Memory Profile) or AMP (AMD Memory Profile) profile, which will be auto-detected and displayed within the motherboard's memory settings.

There's little point buying more than 4GB of memory if you're planning to use a 32-bit version of Windows, because it can only use around 3.5GB. If you install a 64-bit version of Windows, you can take advantage of more memory. For memory-intensive tasks such as editing HD video, you'll want as much RAM as you can afford, so check your motherboard's maximum capacity. Four memory slots are better than two, as you can buy two 4GB sticks now and add more memory later, should you need to.

SIZED TO FIT

Motherboards are most popularly available in two sizes: the regular ATX and the smaller microATX. Both types will fit in traditional ATX PC cases, but small microATX cases, such as those used for media centre PCs, can only take the smaller standard of motherboard.

The size makes one more difference: expansion. With less space, microATX motherboards have fewer expansion slots than their big brothers. They can also occasionally have awkwardly placed SATA ports, which are hard to reach when there's an expansion card in the way.

As a typical PC has few expansion cards, there's not the practical advantage to buying an ATX motherboard as their once was. Our reviews will tell you how good each motherboard is and any restrictions it has.

SLOT CARD RACERS

Make sure your motherboard has the right ports and connectors for all your devices, including any legacy kit you might have. Many modern boards don't have IDE connectors, for instance, which could be a problem if you want to use older optical drives or hard disks; you can buy IDE-to-SATA adaptors quite cheaply if you really need to use an old drive.

Modern storage devices use SATA. SATA3 is the latest version, and you can usually find at least two ports on a modern motherboard. On paper, it's at least twice as fast as the existing SATA2 standard, but in our tests SATA3 mechanical hard disks barely show any improvements. If you plan on using a solid state disk (SSD), however, a SATA3 port can make a big difference to file transfer speeds.

Many motherboards also come with RAID controllers for creating arrays using multiple hard disks. These can improve disk access speeds, protect data against a disk failure or do both, depending on the mode you select. Motherboard RAID controllers have one big problem: if your board fails, you'll need to replace it with an identical model to read your data. You're better off using RAID built into Windows or, for better performance, buying a dedicated hardware RAID card.

GRAPHICAL REPRESENTATION

All Intel CPUs have onboard graphics. These aren't great for games, but for decoding video and standard Windows tasks, they do a good job, which means you can save the cost of external graphics card. Make sure that the motherboard you choose has the graphics outputs you need.

With AMD motherboards it's a little trickier. Socket AM3+ processors don't have onboard graphics, though it's possible to buy a motherboard with built-in graphics instead. With FM2+ and FM2 processors, most, but not all, have onboard graphics that are better than low-end cards. If you're not bothered about gaming, you should look for a CPU with built-in graphics and a motherboard with the display outputs you need.

If you want to fit a discrete graphics card, you'll need a PCI-E x16 slot, with the PCI Express 3.0 slot the preferred home. A lot of motherboards have two or more PCI-E x16 slots, which you can use to run dual graphics cards using AMD CrossFireX or Nvidia SLI technology.

RAPIDLY EXPANDING

Additional PCI-E x16 slots can also be used to house a PCI-E expansion card, such as a USB3 card. If you want to expand your computer even further, look for PCI-E x4 and PCI-E x1 slots. Remember, you can fit any lower-rated card in a higher-rated slot; for example, an x1 card will go in an x4 slot.

Older PCI slots have been around for years, but many of today's expansion cards still use this format. They are most often used for wireless networking or adding extra ports.

SOUNDING BOARD

Every motherboard here has integrated audio and analogue mini-jack connectors that support surround sound and also provide line-in and microphone jacks. Watch out for boards with only three connectors, because they can't provide 5.1 surround sound at the same time as inputting audio from the line-in and microphone jacks. They switch inputs for outputs depending on the configuration of the speakers and can be configured using the supplied driver software. Boards with six outputs are preferable if you plan to connect surround-sound speakers to your PC.

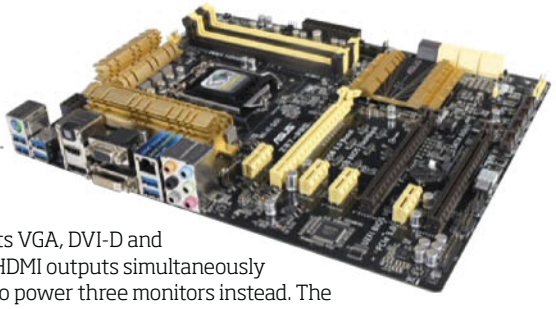
Many boards also have digital coaxial or optical S/PDIF outputs for surround-sound speakers and amplifiers. A motherboard with an HDMI port can output audio as well as video through the same socket.

PORTAL GUN

Almost all motherboards have at least four USB ports, but you're likely to need more than this. The latest boards have USB3 ports, which are worth having if you need fast data transfer to external storage. USB3 hard disks can be significantly faster than standard USB hard disks, especially solid-state disks. Headers on the motherboard connect to the front ports on your PC's case and can also provide more rear ports using a backplate. These backplates may be found in the box, but they can be bought separately for just a few dollars each. Some motherboards also have a FireWire port. Finally, PS/2 ports are handy for plugging in an old keyboard or mouse that you really like, but are of little use otherwise.

CONTENTS REVIEWS

ASUS Z87-PRO



If you're considering jumping to Intel's fourth-generation Core processors (Haswell), the Asus Z87-Pro is a fantastic ATX board.

There are three PCI-E x expansion slots. The first two support the PCI-E 3.0 standard, so should be your choice for a single graphics card. The second slot shares bandwidth with the first, giving you two slots running at x8 speed for dual graphics cards (Quad-GPU Nvidia SLI and Quad-GPU AMD CrossFireX are supported). The third slot runs at x4 speed, so is best used for expansion cards alongside the four PCI-E x1 slots.

There's a great range of ports on the back, including six USB3 ports (with another two available through the board's USB3 header), eight USB2 ports via headers, Gigabit Ethernet, a legacy PS/2 port, an optical S/PDIF output and six 3.5mm audio jacks for 7.1 surround sound audio.

The Z87-Pro's four display outputs give you plenty of flexibility in arranging your displays, as you can either daisy-chain three Full HD screens from its DisplayPort or use its VGA, DVI-D and HDMI outputs simultaneously to power three monitors instead. The HDMI and DisplayPort outputs support resolutions of 4,096x2,160 so you can use 4K monitors.

The four DDR3 memory slots can hold a total of 32GB of RAM at a maximum speed of 2,800MHz when overclocked. This gives you plenty of flexibility if you want to try to get more out of your system, and its six SATA3 ports ensure that all your drives will be able to perform to their highest potential as well. On top of that there are two additional SATA 2 ports.

We tested the Z87-Pro with a Core i5-4670K and 4GB of DDR3 RAM running at 1,600MHz. It scored 115 overall in our multimedia benchmarks, which is a few points higher than we'd expect to see from this setup. This puts it just ahead of the similarly priced Gigabyte GA-Z87-D3HP, so you can be sure the Z87-Pro will give you great performance. Even better, the Z87-Pro comes with several extra features to make it more user-friendly than many of its rivals. We particularly liked its onboard DirectKey, which lets you access its easy-to-use BIOS straight from standby and the MemOK! button and LED light that helps with troubleshooting. What's more, Asus's bundled Wi-Fo GO kit allows this board to be configured as a Wi-Fi hotspot or be controlled as a remote desktop wirelessly. Streaming media is also easy to configure with the Z87-Pro.

The Asus Z87-Pro is a bit more expensive than the other LGA1150 boards on test, but its brilliant performance and range of ports mean it still wins a Recommended award.

SPECIFICATIONS

PROCESSOR SOCKET LGA1150
CHIPSET Intel Z87/Intel Z87
MEMORY SLOTS 4x DDR3
EXPANSION 3x PCI Express x16 slots, 4x PCI Express x1 slots, 6x SATA3 ports, 2x SATA 2 ports
WARRANTY One-year RTB warranty
PART CODE 90MB0DT0-M0MAYO
DETAILS www.asus.com /au
COST $279

VERDICT ★★★★★★

Excellent performance and a wide range of ports and expansion slots make this a great Intel board for Haswell processors

GIGABYTE GA-H81M-S2PV

Measuring just 244x180mm, the Gigabyte GA-H81M-S2PV is a tiny microATX LGA1150 motherboard that uses Intel's H81 chipset. It supports Intel's fourth-generation Haswell Core processors, making it best suited to life as a small home PC.

With its sensible layout, building on it is simple. With space at a premium there's not much room for expansion, but the GA-H81M-S2PV still provides a good range. There's one PCI-E x16 slot running at the full bandwidth, one PCI-E x1 slot for extra cards and two legacy PCI slots. This means there's no dual-graphics support, so this board will be able to support only a single graphics card.

This shouldn't be a problem if you're building a PC on a tight budget or aren't interested in games. There are two SATA2 and two SATA3 ports, so you can use the faster ports for SSDs, using the slower ports for regular hard disks and optical drives. This is a limitation of the H81 chipset, but isn't likely to be a serious limitation for most people.

The chipset also restricts how much RAM you can install, as its two DDR3 memory slots only support a maximum of 16GB at speeds of up to 1,600MHz. This means you can't install the fastest RAM, but with memory making the smallest amount of difference to system performance, it's not too bad a restriction for a budget PC.

Other ports are limited, too, but you still get two USB3 and two further USB ports, with another four USB ports available through internal headers; VGA and DVI-D display outputs; a serial port; two PS/2 ports for a mouse and keyboard; a Gigabit Ethernet port and three 3.5mm audio jacks. It's a shame there's no HDMI port, but at least you can use both video outputs simultaneously if you're planning to have two monitors.

We tested the GA-H81M-S2PV with a Core i5-4670K and 4GB of DDR3 RAM running at 1,600MHz. It didn't perform quite as well as we expected, scoring 108 overall, which is four points behind our reference Haswell system.

The Gigabyte GA-H81M-S2PV isn't as sophisticated as other small LGA1150 boards, but at this price it's hard to begrudge its limitations. Its lack of expansion slots and SATA3 ports won't suit everyone, but if you're looking to build a simple PC with a single graphics card and one main SSD or hard drive, the GA-H81M-S2PV is decent choice.

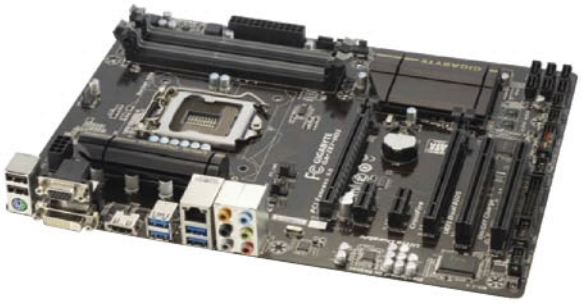
VERDICT ★★★★★☆

This microATX's H81 chipset is fairly limited, but its budget price makes it a good choice for a very simple entry-level PC

SPECIFICATIONS

PROCESSOR SOCKET LGA1150
CHIPSET Intel H81 Express/Intel H81 Express
MEMORY SLOTS 2x DDR3
EXPANSION 1x PCI Express x16 slot, 1x PCI Express x1 slot, 2x PCI slots, 2x SATA2 ports, 2x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE GA-H81M-S2PV
DETAILS www.giga-byte.com .au
COST $69

GIGABYTE GA-Z87-HD3



At just under $150, the Gigabyte GA-Z87-HD3 is much cheaper than other ATX LGA1150 motherboards we've tested recently. That doesn't mean it's short on features, though, as its Z87 chipset makes it an attractive budget option if you're looking to upgrade your processor to one of Intel's fourth-generation (Haswell) Core models.

With its six SATA3 ports, every drive can run at the fastest speed possible. You don't have to worry about new drives not performing as well as existing ones, as they can reach their full potential when you plug them in.

Its four memory DDR3 memory slots can hold a maximum capacity of 32GB of RAM at speeds of up to 3,000MHz when overclocked, giving you plenty of opportunity to install the fastest memory than you can buy.

For expansion, there are two PCI-E x16 slots, but only one runs at the full bandwidth and conforms to the PCI Express 3.0 standard. The other runs at x4 and conforms to the PCI Express 2.0 standard, so you'll want to install your primary graphics card in the first slot. You can run dual graphics cards in AMD's CrossFireX configuration, but using the second PCI-E x16 slot means you can't use either of the two PCI-E x1 slots.

The rear panel's range of ports isn't quite as wide-ranging as more expensive boards, but the GA-Z87-HD3's selection will still suit most users' needs. You'll find four USB3 ports with another two available through the USB3 header, two further USB ports with another six available through the three USB headers, VGA, DVI-D and HDMI display outputs, a Gigabit Ethernet port, a PS/2 port and six 3.5mm audio jacks. Its HDMI output can support a maximum resolution of 4,096x2,160 as well.

SPECIFICATIONS

PROCESSOR SOCKET LGA1150
CHIPSET Intel Z87/Intel Z87
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 2x PCI Express x1 slots, 2x PCI slots, 6x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE GA-Z87-HD3
DETAILS www.giga-byte.com.au
COST $149

The GA-Z87-HD3 began to show its budget roots when it came to performance, as it struggled to match the speeds of its more expensive rivals. When we tested it with a Core i5-4670K and 4GB of DDR3 RAM running at 1,600MHz, it scored just 109 overall, which is a few points slower than we'd normally expect to see. Fortunately, its user-friendly BIOS makes the board easy to overclock with an unlocked CPU.

With its wide range of ports and expansion slots, the GA-Z87-HD3 is a good alternative to more expensive LGA1150 boards if your budget doesn't stretch to more than $150. At this price its performance just isn't as good as the similarly priced MSI Z87-G43.

VERDICT ★★★★★☆

This budget ATX LGA1150 board is a little lacking in performance, but it has a good range of ports

MSI Z87-G43

The MSI Z87-G43 is an ATX LGA1150 motherboard for Intel's fourth-generation (Haswell) Core, Pentium and Celeron processors. It uses the Z87 chipset and comes with plenty of features to form a superb foundation for a new Haswell-based PC.

Its sensible layout makes it easy to build on, and there's a good selection of expansion slots for installing additional cards. There are two PCI-E x16 slots, with the first running at the full bandwidth and conforming to the faster PCI Express 3.0 standard. This should be the slot you use to install a single graphics card. If you'd like to run dual graphics cards, the motherboard supports AMD's CrossFireX standard, but the second PCI-E x16 slot only runs at x4 speed. For further expansion there are two PCI-E x1 slots and three PCI slots.

We were particularly pleased with the Z87-G43's performance. When we ran our multimedia benchmarks with an Intel Core i5-4670K and 4GB of DDR3 RAM running at 1,600MHz, it scored a fantastic 116 overall, which is four points ahead of our reference score. This is superb for an sub-$150 board, making it one of the most powerful motherboards we've tested in recent months. If you do want to overclock your processor, though, doing so is easy thanks to the user-friendly UEFI BIOS.

Its four DDR3 memory slots also let you get the best out of your system, as they can support 32GB of RAM at maximum default speeds of 1,600MHz, or 3,000MHz when overclocked. Likewise, its six SATA3 ports will ensure all your drives will be able to perform at the fastest speeds available.

On the backplate, you'll find a good range of ports. It's a shame there are only two USB3 ports, but two more are available through the board's internal USB3 header. There are also six more USB ports, with another four available through internal headers, a Gigabit Ethernet port, a PS/2 combo port and six 3.5mm audio jacks for 7.1 surround sound. Even better, the board's support for dual- and triple-monitor setups means you can use all three of its video outputs, while the HDMI output can support a maximum resolution of 4,096x2,160.

SPECIFICATIONS

PROCESSOR SOCKET LGA1150
CHIPSET Intel Z87/Intel Z87
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 2x PCI Express x1 slots, 3x PCI slots, 6x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE Z87-G43
DETAILS www.au.msi.com
COST $144

The MSI Z87-G43 is a superb LGA1150 motherboard at an excellent price. At just under $150, it's a great choice if you want to build a powerful system on a budget, and it wins a Recommended award. If you can stretch a bit further, though, the Asus Z87-Pro has even more ports and expansion slots.

VERDICT ★★★★★☆

A superb LGA1150 motherboard for under $150 with great performance and plenty of ports

ASROCK B75 PRO3-M

Intel's B75 chipset is the budget-friendly alternative to the more feature-packed Z77. Both support LGA1155 processors but B75 lacks Z77's overclocking features. However, there's little to choose between the chipsets in terms of ordinary performance, as shown by this motherboard's overall score of 101 in our benchmark tests, which is one point higher than our reference Ivy Bridge system.

The B75 Pro3-M is a budget motherboard, so it has just a couple of rear USB3 ports and four USB ports. There are also two USB headers and one USB3 header on the board itself, so you can add other ports, either on your case or via expansion cards.

Other rear ports include the usual DVI, HDMI and VGA connectors for on-chip graphics, Gigabit Ethernet, an optical S/PDIF output for digital surround sound and five 3.5mm analogue audio connectors that can be configured for up to 7.1 surround sound audio.

The motherboard has four memory slots, so you can install up to 32GB of DDR3 memory. That's plenty even for a really high-end system. There are also two PCI and two PCI-E x16 slots, although the second of these actually runs at x4. However, you can still use it for a second graphics card connected via CrossFireX. Note that the coolers on most graphics cards will block one of the PCI slots when fitted in the top PCI-E x16 slot.

There are two SATA controllers. The Intel chipset controller provides one SATA3 and five SATA2 ports. A sticker on the board advises using one of these six ports for your main system disk, so the SATA3 connector is the logical choice here, particularly if you're booting from an SSD. A second controller gives you an extra two SATA3 ports.

The UEFI BIOS doesn't have an automatic overclocking feature. Its interface is clear, and you can select memory profiles for high-speed RAM, but the B75 chipset doesn't support overclocking of processors with unlocked multipliers, although it does provide very limited adjustment of multiplier and voltage settings. We were able to fix the multiplier of our 3.4GHz Intel Core i5-3570K to 38, for example, but that's the most you can achieve on this board.

SPECIFICATIONS

PROCESSOR SOCKET LGA1155
CHIPSET Intel B75/Intel B75
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 2x PCI slots, 5x SATA2 ports, 3x SATA3 ports
WARRANTY Three-year RTB warranty
PART CODE B75 Pro3-M
DETAILS www.asrock.com
COST $82

VERDICT ★★★★★☆

If you're building a budget Intel system and have no interest in overclocking, this motherboard is ideal

GIGABYTE GA-Z77-D3H

Gigabyte's GA-Z77-D3H is a good-value motherboard for Intel's previous-generation processors – it has few fancy features but still acquits itself well on the specification front.

There's plenty of room for expansion. You get two SATA3 and four SATA2 ports, and you can create a RAID array across the four SATA2 or two SATA3 connectors. There are two full-length PCI Express slots, but one of them runs at x4 speed. This won't be a problem with most cards, but could slow down a CrossFireX configuration. There are three PCI-E x1 slots, one of which will be blocked by a dual-slot graphics card, and two PCI slots.

The rear panel has four USB and four USB3 ports, providing plenty of onboard expansion for peripherals and super-fast external storage. You get HDMI, DVI-D and VGA display outputs for Ivy Bridge's internal graphics, and you can run up to two monitors from the motherboard's graphics outputs.

We had no problems with performance, and the GA-Z77-D3H was quick, managing an overall score of 103, which is three points higher than our reference Ivy Bridge system. There is some scope for overclocking in the motherboard's mouse-driven UEFI BIOS, which, despite its cheesy looks, is well laid out and easy to use. The overclocking options aren't as comprehensive as on some other boards, though, and we couldn't find a way to increase the RAM's voltage.

The motherboard's Z77 Express chipset supports Intel's Smart Response Technology, which uses a small-capacity SSD to cache frequently accessed information to help speed up your system. The motherboard supports miniature mSATA SSDs, which slot into a dedicated space on the motherboard between the processor socket and PCI slots. This saves you having to use a 3½in drive bay for an SSD in your case.

To use Smart Response you have to set your motherboard's SATA controller to RAID mode, but doing so wipes your hard disk so you'll have to reinstall Windows. The manual mentions this, but only in the small print, which we missed to our cost. We would have preferred the option to add an SSD cache later without having to back up and start a Windows installation from scratch. Once we'd installed the cache our PC's boot time went from 47s to 14s, so it's certainly effective.

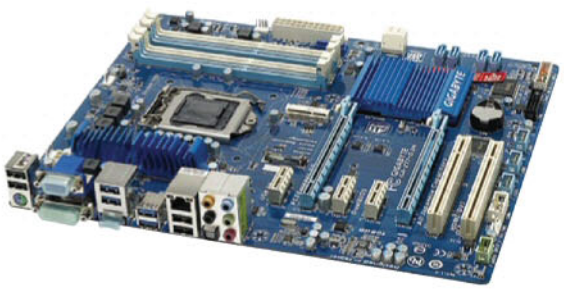
It's a shame about the SSD cache setup, as otherwise this has a lot to offer. If you're after an inexpensive Ivy Bridge system, it's a good buy.

SPECIFICATIONS

PROCESSOR SOCKET LGA1155
CHIPSET Intel Z77 Express/Intel Z77 Express
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slot, 3x PCI Express x1 slots, 2x PCI slots, 4x SATA2 ports, 2x SATA3 ports
WARRANTY Three-year RTB warranty
PART CODE GA-Z77-D3H
DETAILS www.giga-byte.com .au
COST $209

VERDICT ★★★★★★

A good-value Ivy Bridge motherboard, but back up before you set up an SSD cache



GIGABYTE GA-970A-DS3P

If you're looking to build an AM3+ system, Gigabyte's GA-970A-DS3 could be the ATX motherboard for you. It's compatible with AMD's AM3+ FX processors as well as AM3 Phenom II and Athlon II models, and uses the AMD 970 Northbridge chipset and AMD SB950 Southbridge chipset.

At 225x305mm, there's plenty of room for expansion, as the 970A-DS3 comes with two PCI-E x16 slots. The first slot runs at the full x16 speed, so it should be the first choice for a single graphics card installation; the second slot runs at x4 speed. This is only likely to cause a bottleneck if you run dual high-end graphics cards in CrossFireX mode. There are also three PCI-E x1 slots and two PCI slots.

You'll need to install at least one graphics card, as the GA-970A-DS3 has no display outputs. Many do this anyway, as most processors' on-chip graphics aren't good enough to run games or watch 4K video footage, but you'll have to factor in the extra cost of a graphics card if you don't have one.

Instead, all you get on the rear panel are six USB and two USB3 ports, two PS/2 ports for older mice and keyboards, a Gigabit Ethernet port and three 3.5mm audio jacks. Bear in mind that the 970A-DS3 doesn't have any USB3 headers for adding more USB3 ports at the front of your PC, so you'll have to make do with its three USB headers if you need more ports, or install a USB3 card.

The rest of the board was more promising. Its four DDR3 memory slots can hold up to 32GB of RAM and can take modules with default speeds of up to 1,866MHz, but it will also support a maximum speed of 2,000MHz when overclocked. With six SATA3 ports at its disposal, all your drives will be able to perform at the best speeds possible as well, so you won't have to worry about switching them round for performance.

We tested the Gigabyte GA-970A-DS3 with an AMD FX-8350 processor and 4GB of DDR3 RAM running at 1,600MHz. It scored 86 overall, which is three points slower than we'd normally expect to see from this processor, but at least the board's BIOS is easy to use if you do want to overclock.

The Gigabyte GA-970A-DS3P isn't perfect, but it's still a decent AM3+ board. It doesn't have many ports or any display outputs, but its greater number of SATA3 ports and expansion slots make it a great choice.

SPECIFICATIONS

PROCESSOR SOCKET AM3+
CHIPSET AMD 970/AMD SB950
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 3x PCI Express x1 slots, 2x PCI slots, 6x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE GA-970A-DS3P
DETAILS www.giga-byte.com.au
COST $169

VERDICT ★★★★★☆

It doesn't have many ports, but this ATX AM3+ board is a good foundation for an AMD FX processor

MSI 760GMA-P34

The MSI 760GMA-P34 is an AM3+ microATX board that measures 243x228mm. It supports AMD's FX, Phenom II, Athlon II and Sempron processors and uses the AMD 760G Northbridge and SB710 Southbridge chipset.

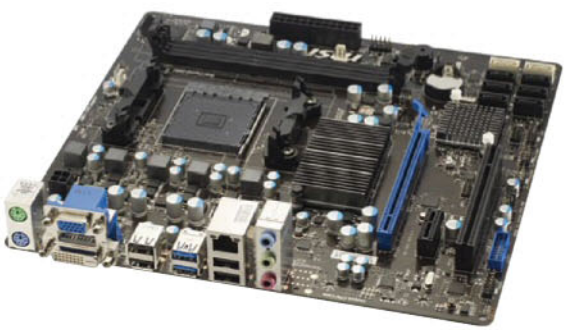
This budget chipset is less sophisticated than other AM3+ models. In particular, it supports a limited number of SATA3 and USB3 ports. On the 760GMA-P34, there are only two SATA3 ports available, compared to its six SATA2 ports. Given that only SSDs can really use full SATA3 speeds, this limitation shouldn't prove too much for most users.

There are also only two USB3 ports on the back panel, but thankfully a further two are available through the board's internal header. You'll also find four more USB ports, two PS/2 ports for a mouse and keyboard, VGA and DVI-D display ports, a Gigabit Ethernet port and three 3.5mm audio jacks. This is a good range for a microATX board.

The 760GMA-P34's main disadvantage is that there's not a lot of room for expansion because of its small size. The 760GMA-P34 has a PCI-E x16 slot that conforms to the PCI Express 2.0 standard, a single PCI-E x1 slot and a legacy PCI slot, but that's your lot. The x1 slot will also be obscured if you install a graphics card, leaving you with just the PCI slot if you want to install another card, such as a USB3 card.

You don't have to install a graphics card, though, as the AMD 690G chipset has built-in Radeon HD 3000 graphics, with both VGA and DVI outputs. The graphics chip's not well suited to games, but it's fine for general Windows tasks and playing videos.

The 760GMA-P34's pair of DDR3 memory slots has a maximum capacity of just 16GB. This will be plenty for most users, but bear in mind that it will only support modules with default speeds up to 1,333MHz.



We were pleased with the 760GMA-P34's performance, as it scored 88 overall when we ran our multimedia benchmarks using an AMD FX-8350 processor and 4GB of RAM. This is exactly what we'd expect.

The MSI 760GMA-P34 is a decent AM3+ board with good performance, but if you want more SATA3 ports and expansion slots, the Gigabyte GA-970A-DS3P is better, although you'll need a graphics card, too.

SPECIFICATIONS

PROCESSOR SOCKET AM3+
CHIPSET AMD 760G/AMD SB710
MEMORY SLOTS 2x DDR3
EXPANSION 1x PCI Express x16 slot, 1x PCI Express x1 slot, 1x PCI slot, 6x SATA2 ports, 2x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE 760GMA-P34 (FX)
DETAILS www.au.msi.com
COST $123

VERDICT ★★★★☆☆

This compact microATX AM3+ board has great performance and a good layout, but its limited expansion slots and SATA3 ports won't be for everyone

ASUS A88X-PRO

The Asus A88X-PRO is an ATX FM2+ board that supports AMD's latest Kaveri APUs. It uses AMD's latest A88X chipset, but it's also compatible with older Trinity- and Richland-based processors, so you don't necessarily need to buy a new processor straight away if you're upgrading your motherboard.

There's plenty of room for expansion, as the A88X-Pro has three PCI-E x16 slots. The first runs at full bandwidth and conforms to the faster PCI Express 3.0 standard, and should be the slot of choice for a graphics card. The second also runs at full bandwidth, conforming to the PCI Express 2.0 standard, but both slots will decrease to x8 if you use CrossFireX for two graphics cards. The other PCI-E x16 runs at x4. There are also two legacy PCI slots and two PCI-E x1 slots, one of which will be obscured if you install a graphics card.

It's unlikely you'll need to install any USB3 cards, as there's a full array of ports on the rear panel. With four USB3 ports and two more USB ports on the backplate and one USB3 and four USB2 headers on the front, you could have a total of 16 USB ports, depending on the layout of your PC case. There are also four graphics outputs, including HDMI and DisplayPort outputs that can support a huge resolution of 4,096x2,160, as well as a PS/2 port, two eSATA connections, Gigabit Ethernet and an optical S/PDIF output with 5x analogue audio jacks for 7.1 surround sound audio.

We were also pleased to see six SATA3 ports for hard disks and SSDs, as well as four DDR3 DIMM memory slots that can support a maximum of 32GB of RAM at a speed of 2,400MHz when overclocked.

The A88X-Pro comes with several useful extras. Our favourite is the Q-Connector kit. Plug your case's cables into the Q-Connector, and this into your board's front-panel header. There's also DirectKey to access the BIOS when your PC is in standby and a small LED number display to help with troubleshooting.

The A88X-Pro's performance didn't disappoint. Our A10-7850K processor and 4GB of 1,600MHz DDR3 RAM scored 72 overall in our tests, which is what we'd expect from this setup. Its UEFI BIOS is very easy to use if you want to overclock, too.

The Asus A88X-Pro is a great FM2+ motherboard with all the features that you could possibly need. However, this board is expensive and in short supply in the UK at the time of writing. If your budget's tight, the Gigabyte G1.Sniper A88X is a better option.

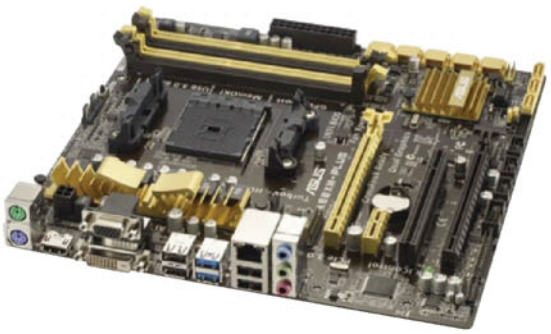
SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A88X/AMD A88X
MEMORY SLOTS 4x DDR3
EXPANSION 3x PCI Express x16 slots, 2x PCI Express x1 slot, 2x PCI slots, 6x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE 90MB0H80-M0MAY0
DETAILS www.asus.com /au
COST $162

VERDICT ★★★★★★

A fantastic FM2+ motherboard that's highly adaptable and easy to use, but it's relatively expensive

ASUS A88XM-PLUS



If you're looking to build a budget FM2 or FM2+ system, the Asus A88XM-Plus looks an enticing prospect with its low price. It's a microATX board, which means that you don't get the same range of expansion slots as on an ATX board.

Even so, there are two PCI-E x16 slots. The main slot runs at the full speed using the PCI Express 3.0 standard, so this should be the natural home for a single graphics card. The second x16 slot runs at x4 and conforms to the PCI Express 2.0 standard. You can use both slots together for dual-GPU graphics using CrossFireX, or you can just use the second PCI-E x16 for an expansion card. There's also a PCI-E x1 slot and a single PCI slot, but the former will be obscured if you install a graphics card.

There's no need to install a graphics card, as AM2+ CPUs have decent onboard graphics that will cope with light gaming. With the VGA, DVI and HDMI outputs you can connect multiple monitors, too. This is great news, as you may be able to save money by not having to buy a graphics card.

You won't run out of RAM, as the A88XM-Plus has four DDR3 memory slots that can support up to 32GB of RAM at maximum speeds of 2,133MHz or 2,400MHz when overclocked. This is more than most users will ever need, but it's handy to have the headroom.

The board's A88X chipset board has eight SATA3 ports. This takes the hassle out of installing new drives, as you can be sure that each one will be performing at the best speeds.

Ports are well catered for on the backplate. Alongside the four USB ports there are two USB3 ports, although a header means you can add two additional USB3 ports. There are also two PS/2 ports, a Gigabit Ethernet port and three 3.5mm analogue jacks.

With an AMD A10-7850K processor and 4GB of 1,600MHz DDR3 RAM, the A88XM-Plus scored 72 overall, which is great for the CPU and shows that this motherboard is quick. We found its UEFI BIOS very easy to use, and also like the physical MemOK! button to help with troubleshooting.

The Asus A88XM-Plus is a great FM2+ board. It doesn't have as many USB3 ports or expansion slots as a full-size ATX board, but it has more than enough for most people's typical needs. With excellent performance and a low price, the A88XM-Plus wins a Recommended Award.

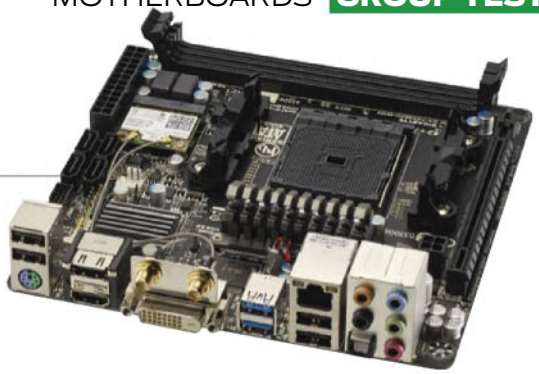
SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A88X/AMD A88X
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 1x PCI Express x1 slot, 1x PCI slot, 8x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE 90MB0H50-M0EAY0
DETAILS www.asus.com
COST $109

VERDICT ★★★★★★

With excellent performance and a great price, this is a great budget FM2+ board with a user-friendly UEFI BIOS

GIGABYTE GA-F2A88XN-WIFI



If you want to build a tiny PC but don't want to compromise on performance, the Mini-ITX Gigabyte GA-F2A88XN-Wifi could be for you. It's designed for a tiny computer, with a built-in 802.11ac wireless card meaning you don't need to hook up wired Ethernet or buy a USB wireless adaptor to get online.

It's certainly convenient, but it has its downsides as well. With the Wi-Fi card already taking up the single mini-PCI Express slot, the only other expansion slot available is one PCI-E x16 3.0 slot. This runs at full bandwidth, making it ideal for a graphics card. AMD's Dual Graphics technology lets you add a low-cost discrete card and run it in combination with the CPU's onboard graphics, giving you a speed boost.

The downside of having only one expansion slot is that it's restrictive if you plan to install anything else, such as a USB3 card or TV tuner. This is one of the disadvantages of Mini-ITX boards in general, as the meagre 170x170mm dimensions means space is at a premium.

There's not much room for building once it's in your case, either. The 4-pin ATX power cable is tricky to reach, and our two sticks of DDR3 memory were right up against our CPU's heatsink when we'd put everything in place. This will severely limit your choice of heatsink, so don't expect to be able to fit a large third-party one.

The two memory slots support 32GB of RAM at maximum speeds of 2,400MHz when overclocked. Its four SATA3 ports also mean all your drives will be performing at the best speeds available as soon as you plug them in.

The range of ports on the rear include two USB3 and four more USB ports, plus a DVI-D output and two HDMI ports for the CPU's onboard graphics, an optical S/PDIF output, five 3.5mm audio jacks for 7.1 surround sound, a Gigabit Ethernet port and two antenna connectors for amplifying your Wi-Fi signal.

The GA-F2A88XN-Wifi performed well in our benchmarks. Using an AMD A10-7850K processor and 4GB of DDR3 RAM running at 1,600MHz, it scored 71 overall, which is what we'd expect, and puts it on par with larger ATX motherboards.

If size is the most important thing for you it's a good choice.

SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A88X/AMD A88X
MEMORY SLOTS 2x DDR3
EXPANSION 1x PCI Express x16 slot, 4x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE GA-F2A88XN-WIFI
DETAILS www.giga-byte.com.au
COST $135

VERDICT ★★★★☆☆

This Mini-ITX motherboard is great for a small PC, but if you use a regular PC case, save money and get more expansion space with a Micro-ATX model

GIGABYTE GA-F2A88XM-D3H

If you're looking for a low-cost motherboard to use with AMD's brand-new Kaveri processors, the Gigabyte F2A88XM-D3H could be ideal. It's a microATX FM2+ board compatible with not just the latest Kaveri processors but older FM2 processors too. This means you can upgrade to this board now if you already have an FM2-compatible processor and then upgrade the processor to a Kaveri chip later.

Although it's a microATX motherboard, the F2A88XM-D3H has all the features most users will need. There are four memory slots, which support a maximum 32GB of RAM, with speeds up to 2,400MHz. There are also a whopping eight SATA3 ports, which is more than enough for even the most dedicated disk hoarder, so you can be sure that all your drives will be working to the highest potential.

The F2A88XM-D3H is a compact motherboard, measuring just 244x244mm, so there's predictably little room for expansion. The board does have two PCI Express x16 slots that support CrossFireX, so you can run two graphics cards together. The first slot runs at full speed using the PCI Express 3.0 standard, but the second slots runs at x4 speed and uses PCI Express 2.0. This is likely to be a bottleneck only if you want to run two high-end graphics cards.

There's also a single x1 slot, which is ideal for adding USB3 Wi-Fi cards, for example, and a single legacy PCI slot for installing older expansion cards such as TV tuners. Unfortunately, you won't be able to access the x1 slot if you use a dual-slot graphics card.

At the rear there are two USB3 ports, alongside four more USB ports, a single PS/2 port, three 3.5mm analogue ports, an optical S/PDIF port and a Gigabit Ethernet port. You can also add two additional USB3 ports thanks to the motherboard's header. Finally, the F2A88XM-D3H has DVI, VGA and HDMI outputs if you want to use the processor's onboard graphics. It's good to see that the HDMI output supports 4K resolutions.

We tested the GA-F2A88XM-D3H with an A10-7850K, and it scored 71 in our multimedia benchmarks, which is expected. If you're using an unlocked processor, you can alter clock and voltage settings in the GA-F2A88XM-D3H's BIOS.

We like the Gigabyte GA-F2A88XM-D3H, with its four memory slots, support for fast RAM and a generous eight SATA3 ports.

VERDICT ★★★★☆☆

A bargain FM2+ board, but it has few USB3 ports and expansion slots

SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A88X/AMD A88X
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 1x PCI Express x1 slot, 1x PCI slot, 8x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE GA-F2A88XM-D3H
DETAILS www.giga-byte.com.au
COST $109

GIGABYTE G1.SNIPER A88X

The Gigabyte G1.Sniper A88X is an ATX FM2+ motherboard that's been designed with gaming in mind. The A88X chipset supports AMD's brand new Kaveri processors, plus older FM2 models.

There's plenty of space to build, so it's easy to get started. With four DDR3 memory slots available, the G1.Sniper is able to support up to 32GB of RAM at a maximum speed of 2,400MHz when overclocked. This will be plenty for most users, but it's nice to have the headroom for future upgrades.

As it's a full-size ATX board, there's a good number of expansion slots. There are two PCI-E x16 slots, but only one runs at the full bandwidth of the faster PCI Express 3.0 standard. The other runs at x4 and uses the PCI Express 2.0 standard. However, this is only likely to be an issue for those wanting to install two high-end graphics cards.

Not that you have to install a dedicated graphics card, as you can use an FM2+ CPU's onboard graphics. You can also use the DVI, HDMI and VGA outputs simultaneously, with the HDMI output supporting 4K resolutions. There are also three PCI-E x1 slots and two legacy PCI slots for other expansion cards. Your hard disks and SSDs won't have to compromise on performance, as the G1.Sniper comes with eight SATA3 ports. That's enough for more storage than most people will need.

On the rear panel, the G1 Sniper has plenty of ports, and Gigabyte has placed a special emphasis on improving its sound support. On top of its optical S/PDIF optical output and five 3.5mm audio jacks for 7.1 surround sound, there's also a gold-plated USB port that's been specially designed to connect to a DAC, cutting down on noise to deliver enhanced audio.

Well, that's if you believe that the connector on a purely digital interconnect can make any difference to sound quality. There's also a PS/2 port and a Gigabit Ethernet port.

We were disappointed there were only two USB3 ports to be found with its five other USB ports, but there's a USB3 header on the front of the board for another two USB3 ports if your case layout allows for it.

With an AMD A10-7850K processor and 4GB of DDR3 RAM running at 1,600MHz, the G1.Sniper scored 71.

The G1.Sniper A88X is well-priced, but unless you need the extra space an ATX board provides, go for the A88XM-Plus instead, which offers more for a similar price.

SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A88X/AMD A88X
MEMORY SLOTS 4x DDR3
EXPANSION 2x PCI Express x16 slots, 3x PCI Express x1 slots, 2x PCI slots, 8x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE G1.Sniper A88X
DETAILS www.giga-byte.com
COST $145

VERDICT ★★★★★☆

A decent FM2+ ATX board with good performance, but you can get pretty much all of the same features on cheaper boards

MSI A78M-E35

The MSI A87M-E35 is a microATX FM2+ motherboard that supports AMD's A-Series processors, including AMD's brand new Kaveri processors, and older FM2 models. As its name suggests, it uses the A78 chipset, which is one step down from the slightly more advanced A88X chipset.

The A78M-E35 has six SATA3 ports, which is great for such a keenly priced board as it means all your drives will be able to run at the best speeds available. Its two DDR3 memory slots can also support a maximum capacity of 16GB of RAM with modules up to 1,866MHz or 2,133MHz when overclocked. This is more than most users will ever need, but it's nice to have the room for expansion.

The A78M-E35's main disadvantage is its lack of expansion slots. This is only to be expected given that it measures just 226x216mm, but all you get is a single PCI-E 3.0 x16 slot, one PCI-E 2.0 x1 slot and one PCI slot. The x1 slot might be obscured if you install a graphics card, too. This shouldn't be too much of a problem if you're building a very simple PC using onboard graphics, but it's still quite restrictive.

The rear panel doesn't have many ports either, but all the basics are there, including two USB3 and four more USB ports, VGA, DVI-D and HDMI display outputs, two PS/2 ports for older mice and keyboards, a Gigabit Ethernet port and three 3.5mm audio jacks. More USB ports are available through the board's three internal headers, if your PC case allows for it. You can also use all three video outputs simultaneously thanks to its triple-monitor support, and the HDMI output can support a resolution of 4,096x2,160 if you have an FM2+ processor and a high-res display.

SPECIFICATIONS

PROCESSOR SOCKET FM2+
CHIPSET AMD A78/AMD A78
MEMORY SLOTS 2x DDR3
EXPANSION 1x PCI Express x16 slot, 1x PCI Express x1 slot, 1x PCI slot, 6x SATA3 ports
WARRANTY One-year RTB warranty
PART CODE A78M-E35
DETAILS www.au.msi.com
COST $75

The A87M-E35 performed well in our mul timedia benchmarks. With an AMD A10-7850K processor and 4GB of 1,600MHz DDR3 RAM installed, it scored 71 overall, which is what we'd expect to see from this setup. The user-friendly BIOS is easy to use if you want to overclock the board as well, as you can use both a mouse and keyboard to browse through its menus.

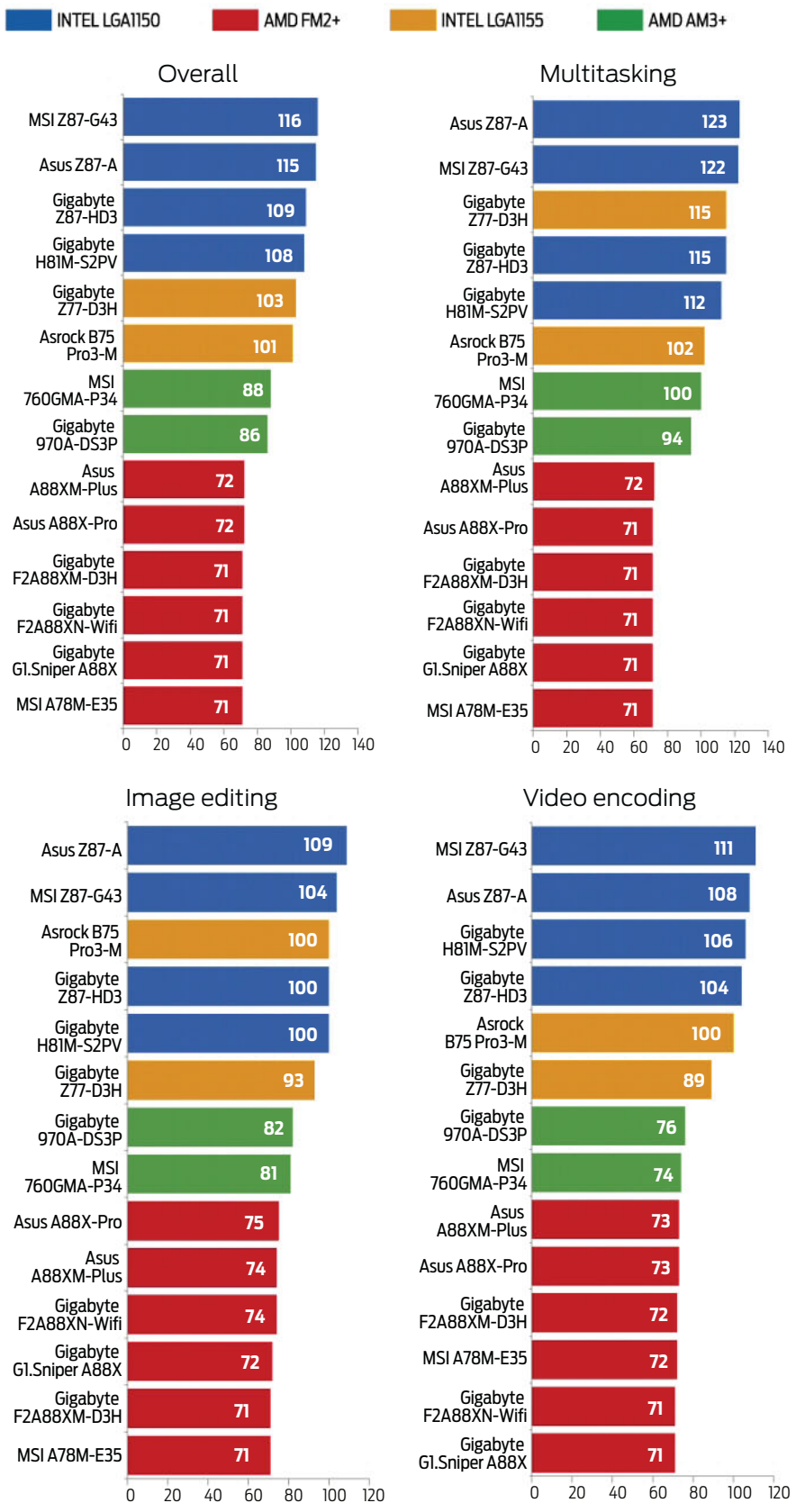
The MSI A78M-E35 is a good microATX FM2+ board. It's not perfect, as its small size doesn't leave much room for expansion, but at just $75, it's undoubtedly great value. However, the slightly more expensive Asus A88XM-Plus is a better buy overall, as it has more expansion slots and SATA3 ports.

VERDICT ★★★★★☆

A cheap FM2+ board with good performance, but it doesn't leave much room for expansion

MOTHERBOARD benchmarks

2D PERFORMANCE



INTERNAL VERDICT

INTEL

There are a number of great Intel motherboards around, including the Recommended-winning Asus Z87-Pro. With lots of ports and expansion slots, this is an excellent board for a new Haswell PC. It wins a Recommended award. MSI's Z87-G43 is another good choice if you don't want to spend more than $150. It wins a Recommended award. Alternatively, the ASRock B75 Pro3-M is even cheaper, but can't be overclocked and is only suited to Ivy Bridge processors. It also wins a Recommended award.

AMD FM2+

All the FM2+ motherboards were virtually identical when it came to performance, but the Asus A88X-Pro stood out. However, it's hard to buy and expensive, so misses out on an award. Overall, the Asus A88XM-Plus is the best choice. This microATX motherboard has all the expansion ports most people will need and it's keenly priced. It wins a Recommended award.

AMD AM3+

This type of motherboard is now looking a bit long in the tooth, but if you have an old AM3+ CPU, the Gigabyte GA-970A-DS3P is the best choice. However, it narrowly misses out on an award because of its relative lack of expansion ports.

ASUS Z87-Pro ★★★★★★

MSI Z87-G43 ★★★★★☆

ASROCK B75 Pro3-M ★★★★★☆

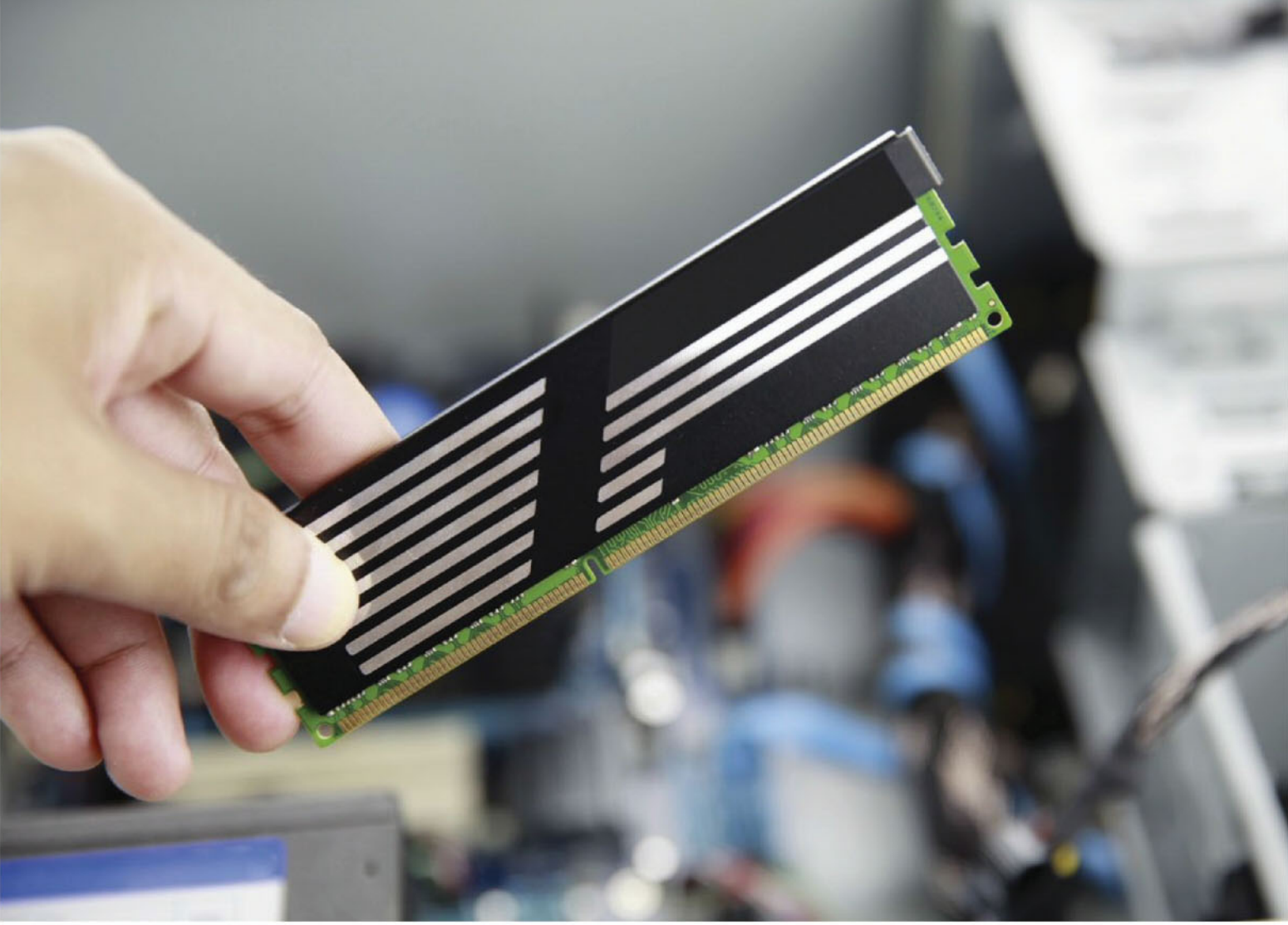
ASUS A88XM-Plus ★★★★★★

Our reference AMD AM3+ processor is an FX-8350, and our reference FM2 processor is an A10-7850K. Our Intel reference processor is a Core i5-4670K.

All the motherboards are tested with 4GB of DDR3 RAM running at 1,600MHz and a 1GB AMD Radeon HD 5870 graphics card.

	INTEL LGA1150				INTEL LGA1155		AMD AM3+
	BEST BUY			BUDGET BUY	BUDGET BUY		
	ASUS	GIGABYTE	GIGABYTE	MSI	ASROCK	GIGABYTE	GIGABYTE
	Z87-Pro	GA-H81M-S2PV	GA-Z87-HD3	Z87-G43	B75 PRO3-M	GA-Z77-D3H	GA-970A-DS3P
Rating	★★★★★★	★★★★★☆	★★★★★☆	★★★★★★	★★★★★★	★★★★★★	★★★★★☆
Socket	LGA1150	LGA1150	LGA1150	LGA1150	LGA1155	LGA1155	AM3+
Form factor	ATX	MicroATX	ATX	ATX	MicroATX	ATX	ATX
Dimensions	220x305mm	244x180mm	220x305mm	244x305mm	244x244mm	305x244mm	220x305mm
Processor support	4th generation Intel Celeron, Pentium, Core i3/i5/i7	4th generation Intel Celeron, Pentium, Core i3/i5/i7	4th generation Intel Celeron, Pentium, Core i3/i5/i7	4th generation Intel Celeron, Pentium, Core i3/i5/i7	2nd/3rd Generation Intel Celeron, Pentium, Core i3/i5/i7	2nd/3rd Generation Intel Celeron, Pentium, Core i3/i5/i7	FX, Phenom II, Athlon II, Sempron
Northbridge chipset	Intel Z87	Intel H81 Express	Intel Z87	Intel Z87	Intel B75	Intel Z77 Express	AMD 970
Southbridge chipset	Intel Z87	Intel H81 Express	Intel Z87	Intel Z87	Intel B75	Intel Z77 Express	AMD SB950
Integrated graphics	None	None	None	None	None	None	None
Memory type supported	DDR3	DDR3	DDR3	DDR3	DDR3	DDR3	DDR3
Maximum memory speed	PC3-24000	PC3-12800	PC3-24000	PC3-24000	PC3-12800	PC3-22400	PC3-16000
Memory slots	4	2	4	4	4	4	4
Maximum memory	32GB	16GB	32GB	32GB	32GB	32GB	32GB
Dual channel support	Yes	Yes	Yes	Yes	Yes	Yes	Yes
INTERNAL PORTS							
Power connectors	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 4-pin ATX
PCI Express x16	3	1	2	2	2	2	2
Dual graphics architecture	Quad-GPU SLI, quad and three--GPU CrossFireX	None	CrossFireX	CrossFireX	CrossFireX	CrossFireX	CrossFireX
PCI Express x4	0	0	0	0	0	0	0
PCI Express x1	4	1	2	2	0	3	3
PCI slots	0	2	2	3	2	2	2
Fan headers	6	2	4	5	3	4	4
SATA2	2	2	0	0	5	4	0
SATA3	6	2	6	6	3	2	6
RAID chipset (maximum disks)	Intel Z87 (RAID 0, 1, 5, 10)	None	Intel Z87 (RAID 0, 1, 5, 10)	Intel Z87 (RAID 0, 1, 5, 10)	None	Intel Z77 Express (RAID 0, 1, 5, 10)	AMD SB950 (RAID 0, 1, 5, 10)
FEATURES							
Network	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000
Sound (ports)	Realtek ALC-1150 (6x analogue out, optical S/PDIF out)	Realtek ALC887 (3x analogue out)	Realtek ALC892 (6x analogue out)	Realtek ALC892 (6x analogue out)	Realtek ALC892 (5x analogue out, optical S/PDIF)	Via VT2021 (5x analogue, optical S/PDIF)	Realtek ALC887 (3x analogue)
USB ports/headers	6/10	4/4	6/8	8/6	6/3	8/3	8/6
Legacy ports	1x PS/2	2x PS/2, serial	1x PS/2, parallel header, serial header	1x PS/2, parallel header, serial header	1x PS/2	1x PS/2	1x PS/2
Other ports	VGA, DVI, DisplayPort, HDMI	VGA, DVI	VGA, DVI, HDMI	VGA, DVI, HDMI	2x USB3	HDMI, DVI, VGA	None
BUYING INFORMATION							
Warranty	One-year RTB	One-year RTB	One-year RTB	One-year RTB	Three-year RTB	Three-year RTB	One-year RTB
Price including VAT	$279	$69	$149	$144	$82	$209	$169
Details	www.asus.com/au	www.giga-byte.com	www.giga-byte.com	www.au.msi.com	www.asrock.com	www.giga-byte.com	www.giga-byte.com
Part code	90MB0DZ0-M0EAY5	GA-H81M-S2PV	GA-Z87-HD3	Z87-G43	B75 PRO3-M	GA-Z77-D3H	GA-970A-DS3P

	AMD FM2+					
		BEST BUY				
MSI	ASUS	ASUS	GIGABYTE	GIGABYTE	GIGABYTE	MSI
760GMA-P34	A88X-Pro	A88XM-Plus	GA-F2A88XN-WIFI	GA-F2A88XM-D3H	G1.Sniper A88X	A78M-E35
★★★★☆☆	★★★★★★	★★★★★★	★★★★☆☆	★★★★★☆	★★★★★☆	★★★★★☆
AM3+	FM2+	FM2+	FM2+	FM2+	FM2+	FM2+
MicroATX	ATX	MicroATX	Mini-ITX	MicroATX	ATX	MicroATX
243x228mm	244x305mm	244x234mm	170x170mm	244x244mm	220x305mm	226x216mm
FX, Phenom II, Athlon II, Sempron	AMD A-Series, Athlon	AMD A-Series, Athlon	AMD A-Series, Athlon	AMD A-Series, Athlon	AMD A-Series, Athlon	AMD A-Series, Athlon
AMD 760G	AMD A88X	AMD A88X	AMD A88X	AMD A88X	AMD A88X	AMD A78
AMD SB710	AMD A88X	AMD A88X	AMD A88X	AMD A88X	AMD A88X	AMD A78
AMD Radeon HD 3000	None	None	None	None	None	None
DDR3	DDR3	DDR3	DDR3	DDR3	DDR3	DDR3
PC3-14928	PC3-19200	PC3-19200	PC3-19200	PC3-19200	PC3-19200	PC3-17064
2	4	4	2	4	4	2
16GB	32GB	32GB	16GB	32GB	32GB	16GB
Yes	Yes	Yes	Yes	Yes	Yes	Yes
1x 24-pin ATX, 1x 4-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 4-pin ATX	1x 24-pin ATX, 1x 4-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 8-pin ATX	1x 24-pin ATX, 1x 4-pin ATX
1	3	2	1	2	2	1
Hybrid CrossFireX	3-way CrossFireX	CrossFireX	AMD Dual Graphics	CrossFireX, AMD Dual Graphics	CrossFireX, AMD Dual Graphics	AMD Dual Graphics
0	0	0	0	0	0	0
1	2	1	0	1	3	1
1	2	1	0	1	2	1
2	5	3	2	2	4	3
6	0	0	0	0	0	0
2	6	8	4	8	8	6
AMD SB710 (RAID 0, 1, 10, JBOD)	AMD A88X (RAID 0, 1, 5, 10, JBOD)	AMD A88X (RAID 0, 1, 5, 10, JBOD)	AMD A88X (RAID 0, 1, 5, 10, JBOD)	AMD A88X (RAID 0, 1, 5, 10, JBOD)	AMD A88X (RAID 0, 1, 5, 10, JBOD)	AMD A78 (RAID 0, 1, 10)
1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000
Realtek ALC887 (3x analogue out)	Realtek ALC1150 (optical S/PDIF, 5x analogue)	Realtek ALC887 (3x analogue out)	Realtek ALC892 (5x analogue out, optical S/PDIF)	Realtek ALC887 (3x analogue out, 1x S/PDIF out header)	Realtek ALC898 (5x analogue, optical S/PDIF out)	Realtek ALC887 (3x analogue out)
6/6	6/5	6/8	6/4	6/3	7/6	6/6
2x PS/2	1x PS/2	2x PS/2	1x PS/2	1x PS/2, parallel header, serial header	1x PS/2, serial header	2x PS/2
VGA, DVI-D	2x eSATA, VGA, DVI, HDMI, DisplayPort	VGA, DVI, HDMI	2x HDMI, DVI, 2x antenna connectors	VGA, DVI, HDMI	VGA, DVI, HDMI	VGA, DVI, HDMI
One-year RTB	One-year RTB	One-year RTB	One-year RTB	One-year RTB	One-year RTB	One-year RTB
$123	$162	$109	$135	$109	$145	$75
www.giga-byte.com	www.asus.com/au	www.asus.com/au	www.giga-byte.com	www.giga-byte.com	www.giga-byte.com	www.au.msi.com
760GMA-P34 (FX)	90MB0H80-M0MAY0	90MB0H50-M0EAY0	GA-F2A88XN-WIFI	GA-F2A88XM-D3H	G1.SNIPER A88X	A78M-E35



RAM TESTED

Thanks for the memory

THE MORE MEMORY YOU HAVE, THE MORE APPLICATIONS YOU CAN HAVE OPEN AT ANY ONE TIME, AND THE LARGER THE FILES THAT YOU CAN WORK ON. WE'LL HELP YOU FIND YOUR PERFECT MATCH

Memory is used by your computer to hold all the data the system is currently using, whether it's system files, applications or open documents. Having enough RAM is vital, as when your PC runs out of physical memory it must use the hard disk instead, which will make your PC slow to a crawl as hard drives are many times slower than RAM.

RAM prices fluctuate, and do so often, so check the prices we've listed carefully, as you may find that some of the kit we've penalised for being expensive has come down in price since the time of writing, and warrants a second chance consideration if the memory itself has taken your fancy thanks to our guide, but the price wasn't to your liking on these pages

PAST MEMORIES

We've only reviewed DDR3 memory because this is the type used by all modern Intel and AMD processors and motherboards. If you're upgrading, you must buy the correct type of module because DDR2 and DDR3 RAM are not compatible. Your motherboard's manual will tell you which type of slots you have. If you don't have a manual, use the CPU-Z tool from **www.cpuid.com/cpuz.php**. This will tell you the name of your motherboard, as well as the type of memory installed, its size, and which modules are in which slots, as well as basic speed information and its operating frequency.

KITTED UP

Most motherboards have a dual-channel memory bus, so using pairs

of modules can theoretically provide better performance than single sticks of the same capacity. For the best possible performance, you should install matched pairs of RAM to take advantage of the motherboard's multiple channels. More often than not, this is just how most memory is sold, so you'll have no trouble achieving dual-channel performance as long as your motherboard supports it, which most do.

We've reviewed 8GB and 16GB matched pair kits. Although 16GB of RAM may seem excessive now, it will help futureproof your PC and keep it running smoothly over the next couple of years. In all cases, 8GB of RAM should be seen as the minimum, especially so if you intend to do more than just casual gaming, as it's all too easy to eat up a system's memory with demanding games.

It's worth noting that if you're using a 32-bit operating system you'll only have access to around 3.5GB of memory, no matter how much RAM you install. To use more, you'll need a 64-bit operating system. Once again, gaming comes into play, with an increasing number of more sophisticated titles supporting 64-bit mode, and hence, more memory.

SPEED RUN

CPU-Z's memory tab reports your memory's speed. However, this figure is half that of the RAM's effective clock speed, as DDR memory transfers data twice per clock cycle, in effect doubling bandwidth. This is why they're called double data rate (DDR) modules. To confuse things further, memory speed can be described in two ways. The simplest is the speed in megahertz, accounting for the double data rate, such as 1,333MHz.

> For the best possible performance, you should install matched pairs of RAM to take advantage of the motherboard's multiple channels

Manufacturers also list the maximum transfer rate in megabytes per second, which is approximately eight times higher than the megahertz figure, so you'll see names such as PC3-10600, which equates to 1,333MHz running speed.

DDR3 memory is available in a wide variety of speeds. The quoted MHz figure is the modules' maximum rated speed, and the memory will run fine at any speed up to the maximum. We've reviewed modules with speeds from 1,333MHz to 2,666MHz.

Different RAM kits with the same speed rating can also have different latency timings. Latency is the delay between the processor requesting information from the memory and the memory providing it. Lower latencies theoretically make for better performance, but modern PCs and RAM are both so fast that this won't make much difference in most applications.

By default, current motherboards set the speed of RAM to 1,333MHz. To set higher speeds, you'll have to enter your computer's UEFI, or BIOS, and enable Intel Extreme Memory Profile (XMP) to make your memory run at its maximum rated speed. Even though some motherboards and memory kits support AMD's memory profiles (AMP), AMD motherboards also support Intel's XMP standard.

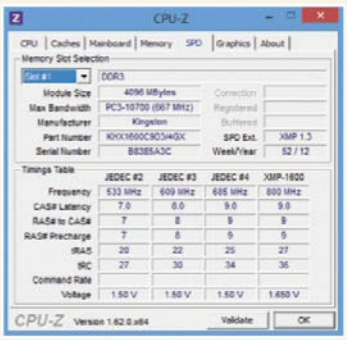
If you plan on manually adjusting your settings to achieve a specific speed rather than relying on memory profiles, you should ensure that all your RAM matches. Settings that work for one kit won't necessarily work for another, even if they're rated at the same speed.

HOW WE TEST

We test all our RAM on an MSI Z77A-G45 motherboard fitted with an Intel Core i5-3570K processor and an AMD Radeon HD 5770 graphics card installed.

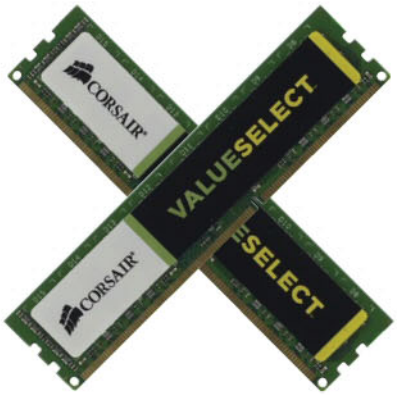
By default, all the RAM modules we tested ran at 1,333MHz when plugged into this motherboard, and therefore we ran our application benchmarks at these speeds to see how the memory performed at its default settings.

However, much of the RAM is designed and rated to run at much faster clock speeds. To activate these faster speeds, we went into the motherboard's BIOS and activated the Intel Extreme Memory Profile (XMP) built into the RAM to automatically adjust the motherboard's memory speed, voltage and latency timing settings to run the modules at their maximum rate. We then ran our benchmarks again to see if this made any difference.



▲ You can get a speed boost from your PC by setting your RAM to the faster XMP timings

CONTENTS REVIEWS



CORSAIR ValueSelect 8GB

The memory chips in the Corsair ValueSelect 8GB kit (CMV8GX3M2A1600C11) may not have massive heat spreaders, but they aren't laid bare thanks to a long sticker that stretches across them. This keeps the memory modules covered and gives a more finished look compared to other value RAM.

The modules are rated at 1,600MHz with latencies of 11-11-11-30, but there are no XMP profiles. Happily, our motherboard recognised the modules' speed and let us select their full 1,600MHz frequency in the UEFI.

The Corsair kit's performance in our PC benchmarks was nothing remarkable, but we didn't expect it be lightning fast. However, the kit did at least produce the same results as our reference memory, scoring 100 overall at a frequency of 1,333MHz and 101 overall when running at 1,600MHz. This shows that you'll be able to rely on this memory.

Even though this memory is part of Corsair's ValueSelect line, it still comes with the same lifetime warranty as the company's other, more expensive, memory. This provides tremendous piece of mind.

While the Corsair ValueSelect 8GB is a decent kit, the G.Skill Ripjaws X 8GB costs around the same, but performed slightly better in our benchmarks, making it the better budget choice. If you've got more money to spend and want to push your system further, the Crucial Ballistix Sport XT 8GB kit, which has heat spreaders, is the kit to buy.

VERDICT ★★★★☆☆

The low price makes this kit attractive, but you can get better performance elsewhere

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-12800 (1,600MHz)
WARRANTY Lifetime
PART CODE CMV8GX3M2A1x600C11
DETAILS www.corsair.com
COST $89

CORSAIR Vengeance LP 8GB

It often seems as if you can either have a high-speed memory kit with overclocking potential or a memory kit that will actually fit under your processor's giant third-party cooler, but not both.

However, the Corsair Vengeance LP kit proves this isn't the case. The kit comprises two 4GB modules rated at a high 2,133MHz with latencies of 11-11-11-27. Even better, each module is just 3cm high, the same as most modules without heat spreaders, so you'll have no trouble at all slotting them into your PC.

Our motherboard detected the kit's XMP profile, letting us up the default speed of 1,333MHz to 2,133MHz. At the default speed, our test computer scored 99 overall in our PC benchmarks, which is one point less than the score achieved with our reference memory running at the same frequency.

With the XMP profile applied and the RAM operating at its rated frequency of 2,133MHz, our system scored 102 overall. Other memory kits scored the same, but remember that the Vengeance LP kit is shorter than most so will suit a wider range of PCs.

At this price, the Vengeance LP 8GB is a great buy if you need high-speed memory that will fit where other high-speed kits can't. If module height isn't an issue and you don't mind paying more, we recommend the Kingston HyperX Predator 8GB. However, there's no doubt that this is an attractive kit if your processor's topped by a large air cooler.

VERDICT ★★★★★★

A great buy for those who need high-speed, low-profile memory

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-17000 (2,133MHz)
WARRANTY Lifetime
PART CODE CML8GX3M2A2133C11B
DETAILS www.corsair.com
COST $132

CRUCIAL Ballistix Sport XT 8GB

The bright and colourful Crucial Ballistix Sport XT (BLS2C4G3D18ADS3CEU) kit looks the part, with its smooth, blue metal heat spreader tapering towards its extremities. The heat spreader makes the two 4GB modules 4.5cm high. This isn't excessively high, but check it will fit in your motherboard if you have a large processor heatsink.

The Ballistix Sport XT's specification hints at great performance, too, as it's rated to run at 1,866MHz with latencies of 10-10-10-30. Our motherboard detected the kit's 1,866MHz frequency even before we'd enabled its XMP profile, although it's possible that some boards will detect it at 1,333MHz, leaving you to manually select the correct profile. Running at 1,333MHz we were disappointed with the overall score in our benchmarks of 98. This is two points slower than our 1,600MHz reference RAM in the same motherboard, so you'll need to configure the speed of this RAM manually.

Still, running the Ballistix Sport XT at its full rated speed of 1,866MHz gave us an incredible result of 104 overall. This makes it some of the fastest memory that we've ever tested. What's even more pleasing is the price, as this kit is only £8 more expensive than Corsair's Value Select 8GB kit.

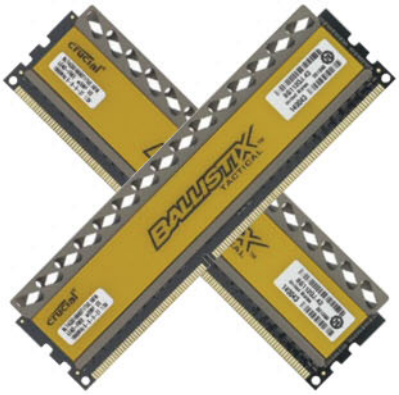
With its excellent performance and a brilliant price, there's little reason to look elsewhere if you want a high-quality 8GB kit of DDR3 RAM.

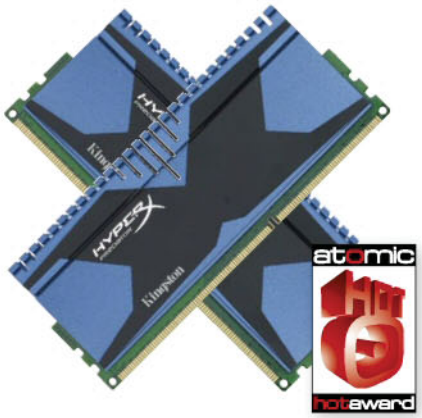
VERDICT ★★★★★★

An excellent performer and a bargain RAM kit to boot

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-14900 (1,866MHz)
WARRANTY Limited lifetime
PART CODE BLS2C4G3D18ADS3CEU
DETAILS www.crucial.com
COST $109





CRUCIAL Ballistix Tactical 8GB

On paper this Crucial Ballistix Tactical kit looks a promising and great-value proposition. The kit comprises two 4GB modules rated at 1,866MHz with latencies of 9-9-9-27. This means the kit should be capable of providing a tangible boost in performance over our reference memory, even though its operating frequency is only a little higher.

In practice, we didn't see any increase in performance. With the Ballistix Tactical kit running at its default frequency of 1,333MHz, our test system produced an overall score of 99 in our tests. This isn't too bad, although it's one point slower than our reference RAM.

The disappointment came when we enabled the Ballistix Tactical kit's XMP profile to raise its frequency to 1,866MHz. At this speed the RAM helped our test computer score a rather banal 100 overall. This is the same performance we'd expect from our reference RAM, whereas we were expecting a slight speed boost.

Thanks to its lacklustre performance this kit isn't such good value when you can get better-performing RAM for less. It isn't particularly good-looking, either, but it does have a relatively small heat spreader and is just 3.5cm tall. This means the kit is more likely to fit under a large CPU heatsink.

There's nothing wrong with the Ballistix Tactical, but we expected better performance. For less money, you can get the higher-performing Crucial Ballistix Sport XT 8GB.

VERDICT ★★★★☆☆

Pedestrian performance and a relatively high price make this is an average kit

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-14900 (1,866MHz)
WARRANTY limited lifetime
PART CODE BLT2CP4G3D1869DT1TX0CEU
DETAILS www.crucial.com
v**COST** $145

G.SKILL Ripjaws X 8GB

The G.Skill Ripjaws X 8GB kit is certainly colourful, but it isn't particularly pretty and, judging from its specification, performance should be nothing to get excited about either. The kit (F3-12800CL9D-8GBXL) comprises two 4GB modules rated at a frequency of 1,600MHz with latencies of 9-9-9-24, which is nothing exceptional. However, as is often the case with PC components, you can't rely on entirely on paper specifications.

Happily, our motherboard detected the kit's XMP profile, and automatically set its frequency to 1,600MHz. With the XMP profile enabled, the kit helped our test computer score 102 overall in our PC benchmarks. This really is impressive for low-cost RAM, showing a definite improvement in system performance. Even when running at a frequency of 1,333MHz, the G.Skill Ripjaws X 8GB helped our PC score 100 overall in the same benchmarks, which is the same as our reference RAM.

Although both modules are covered with a heat spreader, they're only 4cm high. You might, therefore, be able to use this kit even if you have a large processor heatsink installed on your motherboard, although you'll obviously need to check the clearance between the motherboard and your heatsink before you buy the memory.

This kit is great value, too. It doesn't hurt either that it's among the more stylised memory modules. Given its high performance and low cost, the G.Skill Ripjaws X 8GB wins a Recommended award.

VERDICT ★★★★★★

Great performance from a low-cost kit

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-12800 (1,600MHz)
WARRANTY Lifetime
PART CODE F3-12800CL9D-8GBXL
DETAILS http://gskill.com
COST $93

KINGSTON HyperX Predator 8GB

The Kingston HyperX Predator 8GB kit (KHX26C11T2K2/8X) proves you don't have to spend lots of money to boost your PC's performance. It consists of two 4GB memory modules rated at a very fast 2,666MHz. At its rated speed the kit's latencies are 11-13-13-32.

Both modules are wrapped in large heat spreaders that make them a vertiginous 5.4cm high. This means you're almost certain to have trouble using these modules if you have a large, third-party CPU cooler.

Our motherboard detected two XMP profiles. The first is the rated speed of 2,666MHz with latencies of 11-13-13-32, and the second runs the HyperX Predator kit at 2,400MHz with latencies of 11-13-13-30.

When tested at its 1,333MHz default speed, the HyperX Predator helped our test PC score 100 overall in our benchmarks, the same as our reference memory running at 1,600MHz. When tested at its rated speed of 2,666MHz, it scored a mightily impressive 104 overall.

Given the impact memory can have on a PC's performance, this is a decent increase. With the large heat spreaders, it should mean this memory can be pushed even further in the hands of experienced overclockers.

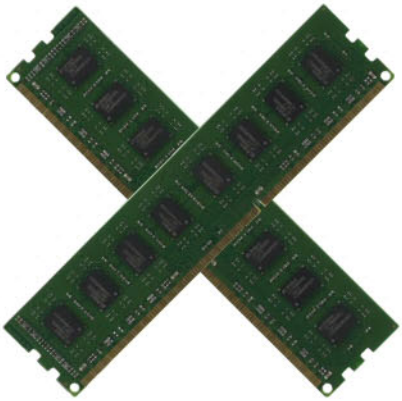
If you don't want to spend much on an 8GB kit you should buy the much cheaper G.Skill Ripjaws X 8GB kit, but the Kingston HyperX Predator kit is worth the extra money and should be particulatly appreciated by gamers and it wins a Hot award.

VERDICT ★★★★★★

Very fast, good looking and decent value, this is the ultimate 8GB memory kit

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-21328 (2,666MHz)
WARRANTY Lifetime
PART CODE KHX26C11T2K2/8X
DETAILS www.kingston.com
COST $132



TRANSCEND JM1600KLN-8GK 8GB

This is the first time we've reviewed Transcend memory, so we were interested to find out how well it performed compared to the bigger brands that we usually review.

It's immediately obvious when you take it out of the box that this is a no-frills kit. Its two 4GB modules will provide your computer with 8GB of RAM. There are no heat spreaders on the memory chips. The one advantage of this is that the memory is just 3cm high, so it will fit in any PC, including those with large CPU heatsinks and fans.

As with most modern budget kits, the memory is rated at 1,600MHz. The latencies at this frequency are 11-11-11-28, which are fairly high. Even so, the JM1600KLN put in a decent performance in our benchmarks. With the modules running at 1,333MHz, our test computer produced a score of 100 overall, which is the same score our test PC achieved with our reference memory. With the JM1600KLN kit running at a frequency of 1,600MHz, our test PC scored 101 overall in our benchmark tests, which again matches the results from our test PC with our reference memory running at the same speed. While this performance is acceptable, the big problem is the price. For a little more you can buy the excellent Crucial Ballistix Sport XT 8GB. Worse still, for less you can buy the G.Skill Ripjaws X 8GB, which also scored higher in our benchmark tests. Either kit is a better buy than the JM1600KLN.

VERDICT ★★★★☆☆

Good performance, but you can get more speed for the same price elsewhere

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 8,192MB (2x 4,096MB modules)
RAM SPEED PC3-12800 (1,600MHz)
WARRANTY Lifetime
PART CODE JM1600KLN-8GK
DETAILS http://www.transcend-info.com
COST $74

CORSAIR Vengeance Pro 16GB

The Vengeance Pro 16GB kit is rated at a high-speed 2,400MHz and comprises two 8GB modules. At its rated frequency of 2,400MHz the kit operates with latencies of 11-13-13-31.

The Vengeance Pro 16GB kit has a black and red colour scheme and is encased in exciting-looking heat spreaders. These have a grip-like depression in the middle of them, which makes pulling the modules out of their slots a lot easier. This will benefit overclockers who regularly swap out memory to test different configurations, rather than those who simply want to install fast RAM in their system and forget about it. As the heat spreaders are 4.5cm high, the modules may not fit under a large processor heatsink.

Our motherboard detected the XMP profile, letting us select its full speed manually. By, default the RAM runs at 1,333MHz when first installed. With the memory operating at this frequency our test PC scored 99 overall in our benchmark tests, which is one point lower than our test PC achieved with our reference RAM running at the same frequency.

With the XMP profile enabled and the kit running at 2,400MHz, our test PC scored a good 102 overall. However, while a decent speed increase for memory, at this price we were expecting a little more.

The Vengeance Pro 16GB kit is well made, but in our tests we found the Kingston HyperX Beast 16GB kit was just as capable. Since it costs less, too, it's a better buy.

VERDICT ★★★★★☆

This expensive RAM is quick, but you can get the same performance for less

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 16,392MB (2x 8,196MB modules)
RAM SPEED PC3-19200 (2,400MHz)
WARRANTY Lifetime
PART CODE CMY16GX3M2A2400C11R
DETAILS www.corsair.com
COST $210

CRUCIAL Ballistix Elite 16GB

This Ballistix Elite kit (part code BLE2CP8G3D1869DE1TX0CEU) is certainly handsome, but you'll need plenty of space to fit it: its jagged black heat spreader is large, standing 5.2cm high. In short, this kit looks and feels like a high-end RAM kit.

The kit is composed of two 8GB modules rated to operate at 1,866MHz with latencies of 9-9-9-27. Our motherboard detected the kit's XMP profile automatically, so we were able to increase the speed from the default 1,333MHz to the full speed. With the Ballistix Elite 16GB kit running at 1,333MHz, our test PC scored 100 overall in our PC benchmarks, the same score as our reference memory running at the same speed.

When we enabled the Ballistix Elite 16GB kit's XMP profile so that it would be able to run at its rated speed of 1,866MHz, the test computer system completed our PC benchmark tests with a score of 102. While this is a decent enough speed boost for RAM, we were hoping for a little more from memory this expensive.

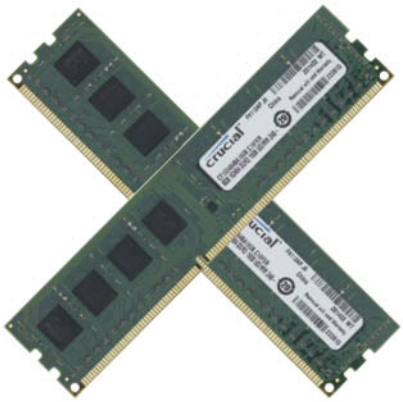
Although the Ballistix Elite 16GB kit is a decent enough RAM kit, it won't be that practical for a lot of people given the size of the heat spreaders. In our tests, the cheaper Kingston HyperX Beast 16GB kit performed just as well, making it the better choice for most people. What's more, the Kingston kit has smaller heat spreaders, making it easier to fit in a wider range of PCs.

VERDICT ★★★★★☆

A handsome RAM kit with pretty good performance, but it isn't cheap

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 16,384MB (2x 8,192MB modules)
RAM SPEED PC3-14900 (1,866MHz)
WARRANTY Limited lifetime
PART CODE BLE2CP8G3D1869DE1TX0CEU
DETAILS www.crucial.com
COST $213



CRUCIAL CT2KIT102464BA160B 16GB

This 16GB dual-channel kit is an unashamedly no-frills product. There are no fancy heat spreaders or ultra-high speed XMP profiles here; just two 8GB modules rated at 1,600MHz with latencies of 11-11-11-28.

These are high latencies for a 1,600MHz kit, but this can be overlooked given its price of $175. That figure makes this set one of the cheapest 16GB kits you can buy.

One benefit of the lack of heat spreaders is that the kit should sit under a large processor heatsink, if you have one installed, as each module is only 3cm high. In fact, if you have an enormous heatsink installed on your motherboard but you're not interested in overclocking RAM to ludicrous speeds, then this kit is a good option.

There's no XMP profile for the modules, but our motherboard had no trouble detecting the kit's 1,600MHz speed. With the memory running at a speed of 1,600MHz, our test PC scored 100 overall in our PC benchmarks. This is the same as our reference RAM.

The memory scored the same in our benchmarks when running at a default speed of 1,333MHz. In our tests, then, increasing the speed of the RAM showed no improvement in system speed, which is a little disappointing.

Although Crucial's CT2KIT RAM is cheap, the Kingston ValueRAM 16GB kit is a little cheaper, stands only 2cm high and performed better in our tests. Given all that, the Kingston kit is the better buy for most people.

VERDICT ★★★★☆☆

Performed roughly as expected, but cheaper 16GB kits are available

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 16,384MB (2x 8,192MB modules)
RAM SPEED PC3-12800 (1,600MHz)
WARRANTY Limited lifetime
PART CODE CT2KIT102464BA160B
DETAILS www.crucial.com
COST $175

KINGSTON HyperX Beast 16GB

The Kingston HyperX Beast 16GB kit (KHX24C11T3K2/16X) consists of two 8GB modules rated at a high speed of 2,400MHz, which means that, on paper at least, this kit is no slouch. The Kingston HyperX Beast's memory modules are draped with high heat spreaders, although the 4.5cm height of the HyperX Beast's modules seem small in comparison. Of course, this extra height means you'll probably have trouble using this kit with particularly large, third-party CPU coolers.

Our motherboard detected both of the HyperX Beast's XMP profiles. The first profile runs the kit at its rated speed of 2,400MHz, while the second runs the kit a slower speed of 2,133MHz. When tested at its default 1,333MHz, our test PC scored 99 overall, a little slower than the 100 scored by our test PC running our reference memory at 1,600MHz.

With the HyperX Beast kit running at its rated speed of 2,400MHz, our test PC scored 102 overall in our PC benchmarks, which is a fairly decent boost in performance given the minor effect that fast memory has on the result of our PC benchmarks. However, when tested at 2,133MHz our test PC produced the same result in our benchmarks, so the extra MHz doesn't make that much difference.

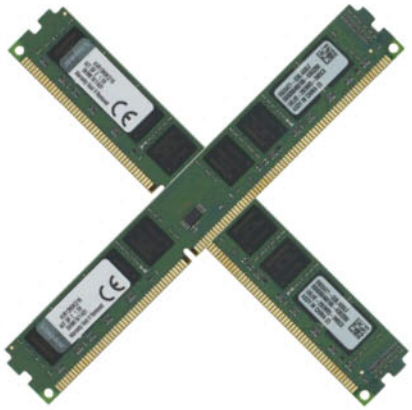
Nevertheless, the HyperX Beast kit is pretty well priced and, if you're looking for a high-speed 16GB kit, this is the one to get. It wins a Recommended award.

VERDICT ★★★★★★

A large-capacity kit that provides a decent boost in performance

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 16,384MB (2x 8,192MB modules)
RAM SPEED PC3-19200 (2,400MHz)
WARRANTY Lifetime
PART CODE KHX24C11T3K2/16X
DETAILS www.kingston.com
COST $240



KINGSTON ValueRAM 16GB

The Kingston ValueRAM 16GB kit comprises two 8GB modules rated at 1,333MHz with latencies of 9-9-9-24. This kit provides your PC with 16GB of memory at an attractive price, but the highlight of this memory is the minute size of its modules.

Each stick of memory is less than 2cm high. This means that not only will you have no trouble fitting these modules in a computer with a large processor heatsink and fan, you'll also have no trouble fitting it in the tiniest PC case. Indeed, the memory is shorter than the arms of most DIMM slots holding the kit in place.

Our motherboard didn't detect any XMP profiles for this kit and ran it at a default frequency of 1,333MHz. At this speed the kit helped our test system score 100 in our PC benchmarks, the same as our reference memory at 1,600MHz. Although not rated for use at a frequency of 1,600MHz, we increased the ValueRAM 16GB kit's frequency to 1,600MHz anyway and re-ran our benchmark tests. This time our test system produced a score of 101 overall, which again matches our reference memory at that speed. Given the price, capacity and size of the ValueRAM kit, we're entirely happy with that score.

If you're looking for a lot of memory on a tight budget, the ValueRAM 16GB kit is a good choice, and will be perfectly sufficient for most uses, including media and gaming, but spend a little more and you can get Kingston's HyperX Beast 16GB, which is rated at higher speeds.

VERDICT ★★★★★☆

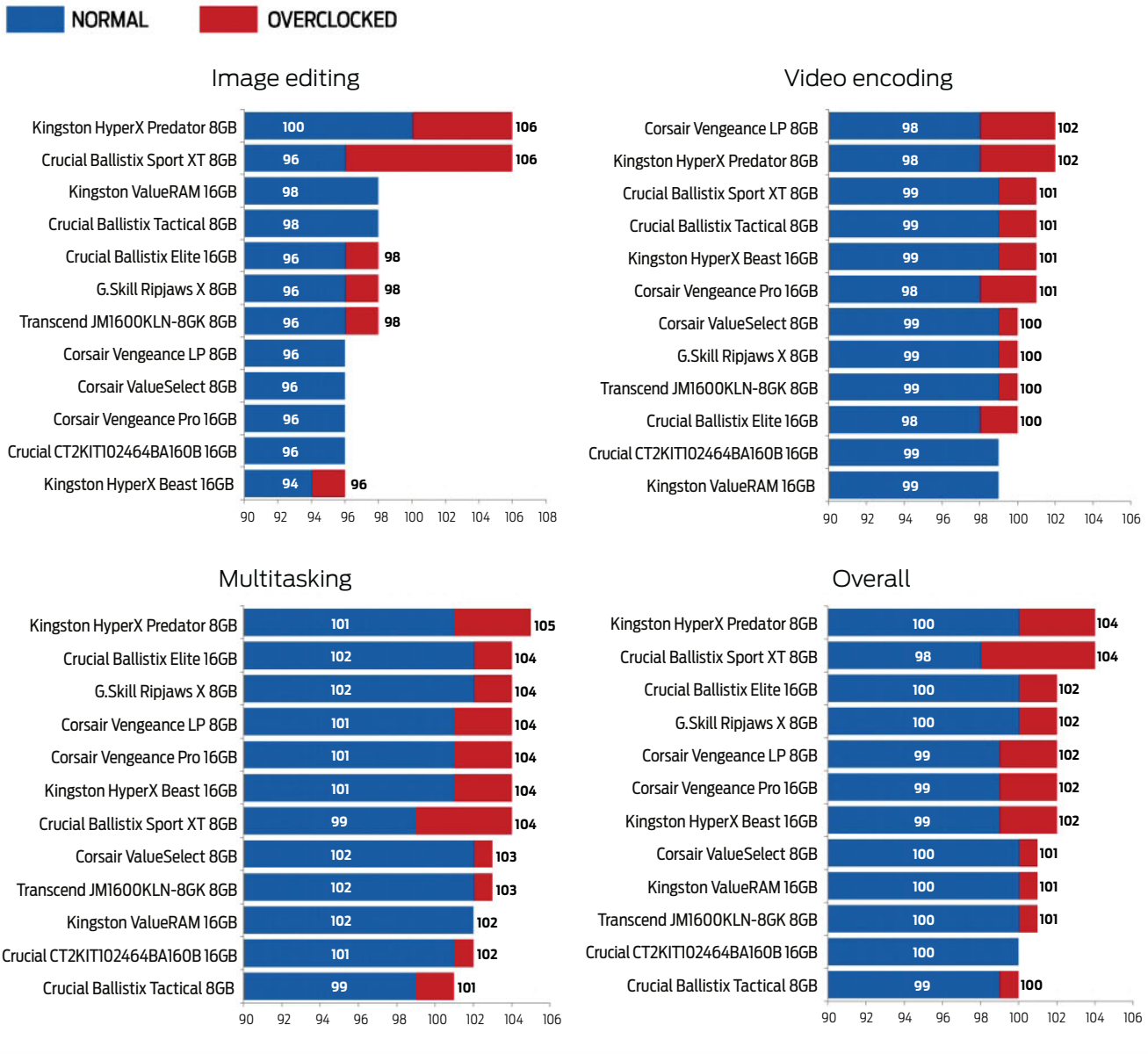
Extremely low profile memory with a high capacity at a great price

SPECIFICATIONS

RAM TYPE DDR3
RAM SIZE 16,384MB (2x 8,192MB modules)
RAM SPEED PC3-10600 (1,333MHz)
WARRANTY Lifetime
PART CODE KVR13N9K2/16
DETAILS www.kingston.com
COST $210

RAM benchmarks

2D PERFORMANCE



INTERNAL VERDICT

Memory doesn't make a huge difference to performance, but some kits are faster than others, and value is also important. With that in mind, we've picked out our winners.

If you're looking for good-value RAM, the G.Skill Ripjaws X is an 8GB kit that performs brilliantly. It wins a Recommended award. If you want a bit more performance the Crucial Ballistix Sport XT 8GB punches well above its weight, delivering the same 104 overall score as our Hot award-winning kit. It's not too expensive, either.

The Kingston HyperX Predator 8GB kit provides blistering performance that matches its high-end looks. If you're an overclocker looking for hyper-fast memory, you need this kit. It wins a Hot award.

Finally, if you want 16GB of RAM, it's hard to argue with the well-priced, fast Kingston HyperX Beast 16GB kit. It wins a Recommended award.

CRUCIAL Ballistix Sport XT 8GB ★★★★★★

G.SKILL Ripjaws X 8GB ★★★★★★

KINGSTON HyperX Predator 8GB ★★★★★★

KINGSTON HyperX Beast 16GB ★★★★★★

8GB KITS

	CORSAIR ValueSelect 8GB	CORSAIR Vengeance LP 8GB	BEST BUY CRUCIAL Ballistix Sport XT 8GB	CRUCIAL Ballistix Tactical 8GB
Rating	★★★★☆☆	★★★★★★	★★★★★★	★★★★☆☆
FEATURES				
Module size	4,096MB	4,096MB	4,096MB	4,096MB
Number of modules	2	2	2	2
Total amount of memory	8,192MB	8,192MB	8,192MB	8,192MB
Rated speed	1,600MHz	2,133MHz	1,866MHz	1,866MHz
Rated bandwidth	PC3 12800	PC3 17000	PC3 14900	PC3 14900
Latencies at this speed	11 11 11 30	11 11 11 27	10 10 10 30	9 9 9 27
Heat spreader	No	Yes	Yes	Yes
Height	3cm	3cm	4.5cm	3.5cm
OVERCLOCKING RESULTS				
Maximum tested module speed	1,600MHz	2,133MHz	1,866MHz	1,866MHz
BUYING INFORMATION				
Price including VAT	$89	$132	$109	$145
Details	www.corsair.com	www.corsair.com	www.crucial.com	www.crucial.com
Part code	CMV8GX3M2A1600C11	CML8GX3M2A2133C11B	BLS2C4G3D18ADS3CEU	BLT2CP4G3D1869DT1TX0CEU

8GB KITS / 16GB KIT

	BUDGET BUY G.SKILL Ripjaws X 8GB	ULTIMATE KINGSTON HyperX Predator 8GB	TRANSCEND JM1600KLN-8GK 8GB	16GB KIT CORSAIR Vengeance Pro 16GB
Rating	★★★★★★	★★★★★★	★★★★☆☆	★★★★★☆
FEATURES				
Module size	4,096MB	4,096MB	4,096MB	8,192MB
Number of modules	2	2	2	2
Total amount of memory	8,192MB	8,192MB	8,192MB	16,384MB
Rated speed	1,600MHz	2,666MHz	1,600MHz	2,400MHz
Rated bandwidth	PC3 12800	PC3 21328	PC3 12800	PC3 19200
Latencies at this speed	9 9 9 24	11 13 13 32	11 11 11 28	11 13 13 31
Heat spreader	Yes	Yes	No	Yes
Height	4cm	5.4cm	3cm	4.5cm
OVERCLOCKING RESULTS				
Maximum tested module speed	1,600MHz	2,666MHz	1,600MHz	2,400MHz
BUYING INFORMATION				
Price including VAT	$93	$132	$74	$210
Details	http://gskill.com	www.kingston.com	http://www.transcend info.com	www.corsair.com
Part code	F3 12800CL9D 8GBXL	KHX26C11T2K2/8X	JM1600KLN 8GK	CMY16GX3M2A2400C11R

16GB KITS

	CRUCIAL Ballistix Elite 16GB	CRUCIAL CT2KIT102464BA160B 16GB	BEST BUY KINGSTON HyperX Beast 16GB	KINGSTON ValueRAM 16GB
Rating	★★★★★☆	★★★★☆☆	★★★★★★	★★★★★☆
FEATURES				
Module size	8,192MB	8,192MB	8,192MB	8,192MB
Number of modules	2	2	2	2
Total amount of memory	16,384MB	16,384MB	16,384MB	16,384MB
Rated speed	1,866MHz	1,600MHz	2,400MHz	1,333MHz
Rated bandwidth	PC3-14900	PC3-12800	PC3-19200	PC3-10600
Latencies at this speed	9-9-9-27	11-11-11-28	11-13-13-32	9-9-9-24
Heat spreader	Yes	No	Yes	No
Height	5.2cm	3cm	4.5cm	1.8cm
OVERCLOCKING RESULTS				
Maximum tested module speed	1,866MHz	1,600MHz	2,400MHz	1,600MHz
BUYING INFORMATION				
Price including VAT	$213	$175	$240	$210
Details	www.crucial.com	www.crucial.com	www.kingston.com	www.kingston.com
Part code	BLE2CP8G3D1869DE1TX0CEU	CT2KIT102464BA160B	KHX24C11T3K2/16X	KVR13N9K2/16

HEARTHSTONE: HEROES OF WARCRAFT

BLIZZARD'S ONLINE CARD GAME IS EASY TO LEARN, HARD TO MASTER AND FIENDISHLY ADDICTIVE.

DEVELOPER Blizzard
PUBLISHER Blizzard
WEBSITE www.battle.net

Blizzard has never been a company known for flooding the market with games, instead it traditionally focused down one of its three major franchises at a time. In recent years it has picked up the pace, juggling new Diablo and Starcraft titles while relentlessly delivering new content for its mega hit World of Warcraft.

This year, however, we are seeing some serious branching out in terms of genre. The company recently began Alpha testing Heroes of the Storm, a 'Hero Brawler' in the vein of the at times baffling games League of Legends and Dota 2, and after an extensive beta period it has now officially released Hearthstone, a computerised card game that has its roots in the actual card game it released for World of Warcraft.

Don't just expect Solitaire or Freecell with a different colour scheme, however. Hearthstone is a trading card game in the vein of the iconic Magic: The Gathering, with its own rules and behaviours, and an underlying undercurrent of the loot hunt for which the company is so famous. However, games like Magic can be tough to get into thanks to years of increasingly complex rules and expansion sets. Whereas one of the most impressive things about Hearthstone is that it adheres closely to Blizzard's easy to learn, hard to master philosophy.

CARDS, JIM, BUT NOT AS WE KNOW IT

The premise is simple, build up a deck of 30 cards from a much wider pool, and aim to use them to whittle your opponent's health down from 30 to zero. Whoever is left standing at the end wins, but the journey is enjoyably complex, sometimes frustrating and always intriguing.

To begin with you can choose one of the nine original classes from World of Warcraft, such as Shaman, Druid, Warrior or Mage. Each class has its own unique subset of cards, unavailable to others, and a special ability. You then build up your 30 card deck by mixing these cards with ones from a wider pool, and face off against another human player to see who wins.

Within your deck you will be packing a mix of Minions, which pack special abilities as well as varying amounts of damage potential and health. You also have a variety of class specific spells which can be played to affect the game. Minion abilities range from healing minions to taunting (which forces the other player to attack that minion rather than your hero, to all sorts of weird, wonderful and at times seemingly counterintuitive abilities.

Each card costs mana to summon, which slows down your ability to play cards, and lets the game begin in a slow and steady way. With each turn the mana pool grows by one, which means that you will start out with incredibly fragile characters holding the line, but eventually have some formidable ones taking it to your opponent as the game moves on.

A MINUTE TO LEARN...

This general mechanic is nothing new, but Hearthstone sticks out from the crowd of cardboard and computer based competitors. Partially this

PLATFORMS
PC • IOS

is because there are none of the inherited years of complexity that have made games like Magic somewhat baffling to understand, but it is also because the game looks, feels and sounds familiar to anyone who has dipped their toe into the biggest MMO of all time. Not only are the minions based on a variety of characters and character types encountered in WoW, but great lengths have been gone to in order to ensure the characters capture the essence of the archetype, as defined by the MMO.

One of the most impressive aspects of Hearthstone is just how smoothly the game transitions between the single player practice mode and the two major gametypes, both of which are purely multiplayer (there is promise of a second single player 'adventure mode' down the track). When playing against random opponents the game only lets you communicate via basic emotes, which is both simple enough for those using touch devices like iPads or Windows 8 hybrids, and restrictive enough to avoid the potential for uncouth or abusive language that can sometimes drive people away from online multiplayer titles.

LADDERQUEST

Even better, the way the game is structured means that even losing relentlessly doesn't suck, there are plenty of incentives to keep playing beyond climbing the rankings in monthly tournaments. Quests are given that reward gold, which can be spent on new card packs, each of which contain five random cards, or to enter 'The Arena'.

In the Arena you have to build a deck from a random assortment of cards and then compete against others. Three losses and you are out, while each win means you will receive a bigger prize at the end of your run (these take the form of cards, card packs or gold). It is a much more freeform game, firstly because of the inherently randomised nature of decks, and secondly because players are often forced to choose a class other than their favourite one.

One of the potential pitfalls of the game is that it uses the all too abused Free to Play model, where there is no cost to access or play the game, but rather it is driven by microtransactions of various kinds. Thankfully the model isn't as bad as some such titles, which actively push players to constantly spend through time limits or experience boosts, but you'll likely want to drop at least a little cash on cards initially, which are sold in packs of various prices.

HEARTHSMACK

The other place to drop money is in the arena, which costs $2 or 150 gold a round after the first free go. If you are good enough you'll likely pull in enough gold to ensure you rarely have to spend to enter, while you can always just focus on play mode if this doesn't appeal.

Suffice to say, Hearthstone is Blizzard at its best. It takes the somewhat obscure trading card game and turns it into something that appeals to the masses, making something endearing and very enjoyable to boot. The fact that it is currently on both Windows and iOS, with seamless cross platform play makes it even more appealing, and the relatively short nature of matches make it a great game to dip in and out of.

John Gillooly

atomic

Blizzard at its best, fun, charming and highly addictive that works equally well with touch and mouse interfaces.

RATING ★★★★★

ELDER SCROLLS ONLINE

THE CLASSIC SINGLE PLAYER RPG INVITES YOUR FRIENDS ALONG FOR A FEW NEW ADVENTURES.

DEVELOPER ZeniMax Online Studios
PUBLISHER Bethesda Softworks
WEBSITE www.elderscrollsonline.com

PLATFORMS
PC · Xbox One · PS4

More than any other game in the Elder Scrolls series, Skyrim was a game that seemed like it wanted to be shared. Not just because of the scale of the game, or its attempts to create stand-in, NPC friends, but because it was just so much fun to explore. With superb graphics and a real sense of a living, breathing world, you just wanted to be able to turn to a friend, admire the view, and then climb the next ridge.

With that in mind, The Elder Scrolls Online should be just what the gaming doctor ordered. It's very pretty, too, and it does a fine job of bringing classic Elder Scrolls mechanics into the MMO milieu – so why then does it feel ever so under-cooked, despite eight long years of development?

PRETTY ELF

There's a lot to like about TESO. The character creation has deep customisation options in terms of appearance, and lets you view your character either without clothes (well, with strategic rags), in starter gear, or in high-end apparel. You can tweak everything from make-up and nose height to bottom size (kind of mesmerising) and shoulder width. There are three factions to pick from, with three races for each – none are totally evil, but not are totally good, either, so there's some nice backgrounds to pick from. And, finally, you can pick a class; there are only four, roughly equating to defensive fighter, damage-dealing fighter, wizard, and rogue, but that's doing a real injustice to the game's sophisticated levelling system.

Once in-game, you level like in any other MMO, but that's pretty much where the similarity ends. In TESO, there are really no limits to how you develop your character – you can wear any armour, fight with any weapon. Want to roll up a two-handed sword wielding Sorcerer? Done. Create a range Dragonknight? Doable. Focus on healing with your rogue-like Nightblade? Odd, but you can certainly give it a go.

Each class has a range of three skill trees, plus there are skills for armour, weapon groups, crafts, and even racial skills, and all are open and useful. Impressively, once you open a skill, with a skill point (earned each level or through exploration), it levels as you earn experience, along with weapon skills. This borrows heavily from the normal run of Elder Scrolls games, and it means an unprecedented amount of customisation for an MMO. You never really feel locked into using certain weapons or playing a certain way, and it's a real pleasure to discover new combinations of class ability and weapon skills.

UGLY ELF

However, for all of that seeming innovation, the game does begin a really disjointed manner. You start as a lost soul, essentially in hell, and complete a few quests to help your mystical saviour escape before waking up on a boat – and then you're told to go to another spot and quest there.

It wouldn't be a problem if the world felt more whole, but there are so many phased areas, and discrete loading screens, that it's hard to get a sense of where it all sits. As opposed to World of Warcraft's opening levels, or the large, wide world of Lord of the Rings Online, it feels kind of archaic.

The quests are all narrative-based, too, and while that seems a good thing at first, it does lead to trains of PCs following the same paths from quest-giver, to quest NPC, and back again, which actually breaks immersion even more than any number of "Kill X boars" quests. That said, it's refreshing seeing such a strong narrative in the game, backed by consistent if not solid voice-acting, and some wonderful NPC characters. Sadly, they're also very talky characters, and the faux conversations do stretch on.

Of course, it has to be said that it's very early days. The launch has been pretty smooth, despite the odd random disconnect, but we're yet to get so far into the game that we've a real idea of end-game quality, for instance. But that's also the rub; while many MMOs have made the – very successful – move to free-to-play, TESO is launching with a paid subscription model, so you need to ask yourself if the game, and $15 a month is worth it.

We're still on our free opening sub. Only time will tell if we're willing to drop cash in a month's time...

David Hollingworth

atomic Fun so far, with great levelling, but a little too narrow in scope

RATING ★★★★☆☆

MARVEL PUZZLE QUEST: DARK REIGN

JOHN GILLOOLY IS SADDNED BY A DECENT GAME WHICH MANAGES TO SHOOT ITSELF IN THE FOOT BY BEING TOO GREEDY.

DEVELOPER Demiurge
PUBLISHER D3 Publisher
WEBSITE www.marvelpuzzlequest.com

When game developers craft a 'Free to Play' game, they walk a fine line between making a reasonable income and strapping an IV line straight into the player's wallet. Without getting too deeply into the underlying economics, most of these titles are designed around only a fraction of the player base actually putting money into the game, which means that the developers are tasked with making that cash flow count.

So it well, like Blizzard with Hearthstone, and you end up with a game that you will spend cash on, but not significantly more than you would spend on a full priced game (or at least, with spending spread out over a long enough period of time that it doesn't feel like a poker machine with no possibility of payout).

However there are a growing number of games that attempt to monetise frustration, to constantly put roadblocks in place in order to make gamers say 'screw it' and start spending in order to keep on playing the game.

Unfortunately Marvel Puzzle Quest is one of those games. It is a spinoff of the hugely popular Puzzle Quest titles, which were developed here in Australia. This particular flavour shares the same publisher but has been developed by Demiurge studios, a developer that has largely handled porting of console games over the years. It takes the strangely addictive gameplay of its predecessors, slaps on the Marvel license, and torpedoes the time/reward curve in order to make more cash.

At heart the puzzle quest formula can be seen as a weaponised version of Bejewelled's 'Match 3' gameplay. For each match two teams (usually of three characters) line up against each other. As you make matches on the game board you deal damage to an enemy of your choice (This is based on a combination of your character's level and the colour chosen). You generate action points for each colour affected. These action points can be used by your team of heroes to drive special abilities, which vary from stunning members of the opposite team, through manipulating the game board itself to dealing massive damage to your foes.

It all makes for a strangely addictive experience, especially when combined with the iconic characters of the Marvel universe. These are unlocked through a variety of means – the basic ones come slowly as you work your way through the various matchups that form the game's 'story', while more powerful heroes with the potential to reach high levels come along much more rarely as rewards. Or you can plonk down hard cash to buy cards, which give one of a selection of random heroes.

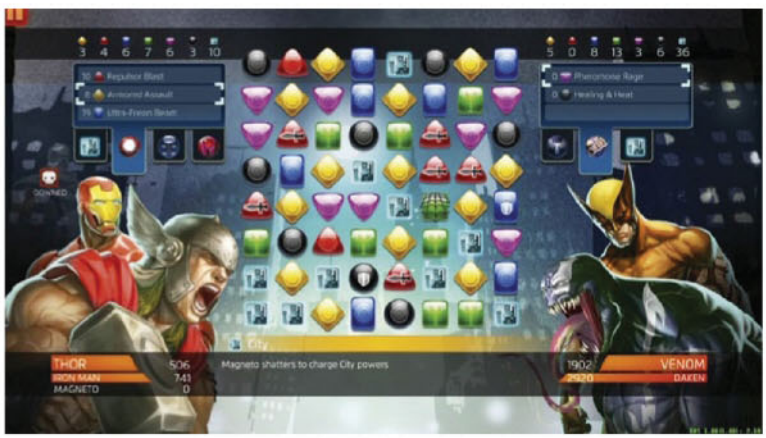
This is annoying enough as it is, but to make matters worse each of these cards only unlocks a single ability point on a character. You need to get the cards for each specific character multiple times in order to unlock all the abilities at their maximum potency, and then level the characters independently using the more common iso-8 currency that is given out as a reward for most activities (or purchased directly from the store).

As a third source of frustration, Demiurge also cycles through different game modes every few days in the game, most of which require one of a very small subset of characters to play. This means that, rather than just focus on a few simple heroes, you'll end up needing to nurture a wide range if you play regularly..

With addicting gameplay and fun, familiar characters Marvel Puzzle Quest: Dark Reign should score well, but the fact that cash-shaped roadblocks are thrown up at every turn just destroys the fun. We wouldn't mind if these were cheap, but they are far from it, and you could very quickly blow more money than you would have done if you had purchased it at full price from a retail shop.

Much as Blizzard's Hearthstone is free to play done right, Marvel Puzzle Quest is free to play done to abusive, insulting levels. It is certainly worth the free pricetag slapped on it, but once you realise that the pacing and enjoyment level delivered by the game is intrinsically tied to your wallet then it sours. We wanted to love this, and part of us does, but we just can't recommend it.

John Gillooly



PLATFORMS
PC · iOS · Android

atomic A fun game ruined by cash grabs at every turn.

RATING ★★☆☆☆☆

THE A-LIST

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

There are two exciting additions to the A-List this issue. Finally, the Nexus 5 is knocked off its perch, replaced with the new HTC One M8. This was cause for debate, as while the HTC One M8 is undeniably the better smartphone, it commands a substantial price premium over the Nexus 5. Still, the mission here is to let you know what the best of the best is, so in goes the HTC One M8.

Also new is the Aorus X7 Performance portable. We were stunned by its speed and features, and delighted to see restrained and classy styling.

Lastly, we've added the Editor's Choice Media Box, and you can read the full story starting on page 84.

NEW

AORUS X7

What we said:
It's understated and sleek in classy matte black, and without any bits of it being illuminated for appearances sake.

There's no mistaking this as a brand of high quality design and engineering, at least so far.

NEW

HTC ONE M8

What we said:
The M8 sports the very latest in mobile-processing grunt: a quad-core Qualcomm Snapdragon 801 SoC, clocked at 2.3GHz, backed by 2GB of RAM. It's blazingly fast, scoring 2,849 in the multicore Geekbench 3 CPU test, and 29fps in the GFXBench T-Rex HD.

PCS DESKTOPS

HIGH-END PC&TA EDITOR'S CHOICE

★★★★★★

PRICE $3414

An extreme PC able to deliver perfect gaming performance, but also be equipped to handle the most demanding desktop apps. See page 18!

SPECIFICATIONS i7 4770K CPU; ASUS Radeon R9 290x DirectCU II OC 4GB graphics; Corsair Dominator Platinum DDR3 16GB; ASUS Maximum VI Extreme motherboard; ASUS ROG Front Panel; Coolermaster Cosmos SE case; Coolermaster V1000 PSU; Sandisk Extreme 2 240GB SSD; 2 x SanDisk Ultra Plus 256GB SSD; WD Black 2 SSD + 1TB HDD

MEDIA PC&TA EDITOR'S CHOICE

★★★★★★

PRICE $1159

This versatile media box is also perfectly capable of doing double-duty as a lightweight TV game box. Built to a budget with performance in mind.

SPECIFICATIONS: Bitfenix Prodigy; Kaveri A10-7850K APU; – Gigabyte GA-F2A88XN-WIFI; Corsair Dominator 8GB; Thermaltake Water 3.0 Pro; Seagate 4TB SSHD; Corsair RM 650 PSU; Logitech Wireless Touch K400

ALL-IN-ONE APPLE IMAC 27IN

★★★★★½

PRICE $1949 **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 2.7GHz Core i5-2500s; 4GB DDR3 RAM; 1TB Western Digital Caviar Black HDD; DVD writer; AMD Radeon HD 6770M graphics; 27in 2560 x 1440 LCD.

HANDHELDS

SMARTPHONE HTC ONE M8

★★★★★★

PRICE From $820 **SUPPLIER** www.htc.com.au

A beautiful, highly competent smartphone that's packed with clever features. Right now it's the best Android smartphone you can buy.

SPECIFICATIONS Quad-core 2.3GHz Qualcomm Snapdragon 801 CPU • Adreno 330 GPU • 2GB RAM • 16GB storage • 5in 1,080 x 1,920 display

TABLET APPLE IPAD AIR

★★★★★½

PRICE $539 **SUPPLIER** store.apple.com/au

The new iPad is pretty much the king of the hill when it comes to tablets, smaller and more powerful than ever before.

SPECIFICATIONS 9.7in 1536x2560 widescreen Multi-Touch display; 1GHz A5X processor, 16, 32 or 64 GB available; 3G and/or Wi-Fi connectivity; max 652g weight.

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

PCS LAPTOPS

VALUE ASUS T100

★★★★½

PRICE $550 **SUPPLIER** www.asus.com.au

Thanks to Intel's new Atom CPU, the Transformer Book T100 delivers full Windows 8.1 in a tiny, affordable package – the netbook is back. The T100 delivers everything you could ask for, and it's ludicrously affordable.

SPECIFICATIONS Quad-core 1.33GHz Intel Atom; 2GB DDR3; 64GB eMMC; 10.1in 1366x768 Touch LCD; Wi-Fi; Ethernet; HDMI.

PROFESSIONAL APPLE MAC BOOK RETINA

★★★★½

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

PERFORMANCE AORUS X7

★★★★½

PRICE $2999 **SUPPLIER** aorus.com

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

SPECIFICATIONS Q.4-3.4GHz 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

ULTRA PORTABLE LENOVO CARBON X1

★★★★½

PRICE $2499 **SUPPLIER** www.lenovo.com/au

Lenovo inherited – and built upon – IBM's legendary ThinkPad build quality, and added a much-needed dose of style to this highly capable machine.

SPECIFICATIONS 2.1GHz Intel Core i7-4600U; 14in touchscreen (2560 x 1440); 8GB RAM; 256GB SSD; 802.11ac/abgn; Bluetooth 4

PERIPHERALS

WIRELESS ROUTER ASUS DSL-N55U

★★★★½

SUPPLIER www.asus.com.au

A high-speed router that looks striking and delivers everything you could want for home connectivity.

SPECIFICATIONS 802.11abgn wireless router; 4 x Gigabit Ethernet ports; 2 x USB; PPOE; PPTP; L2TP; 145x63x174mm.

DESKTOP STORAGE SEAGATE 2TB BACKUP PLUS DESKTOP

★★★★★★

SUPPLIER www.seagate.com

This 2TB external drive still offers good value despite the rise of higher-capacity drives. The USB 3.0 adaptor makes for excellent transfer speeds.

SPECIFICATIONS 2TB external hard disk with NTFS; USB 3.0, with other docks available as optional; 44 x 124 x 158mm 894g.

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 MG5460

★★★★½

SUPPLIER www.canon.com.au

The winner of our most recent printer grouptest, this combines excellent print quality with decent costs and is just as good at printing photos as it is documents.

SPECIFICATIONS 9600 x 2400dpi print; 2400 x 4800ppi scan; USB; 802.11n WLAN; 125-sheet tray; 455 x 369 x 148mm

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

SOFTWARE

SECURITY KASPERSKY INTERNET SECURITY 2014

★★★★★★

SUPPLIER www.kaspersky.com/au

The winner of this year's security software grouptest, a big improvement over recent years, and a good solution for beginners and more advanced users. Kaspersky AV software runs well on even low-end machines, and operates relatively seamlessly and with a small memory and OS footprint.

BACK UP ACRONIS TRUE IMAGE 2013

★★★★½

SUPPLIER www.acronis.com.au

A clear and well-organised front end makes this easier to use than ever. Not much has changed from previous years, but it remains our go-to backup solution.

OFFICE SUITE MICROSOFT OFFICE 365 HOME PREMIUM

★★★★½

SUPPLIER www.microsoft.com.au

The easiest to use Office to date.

WEB DEV ADOBE DREAMWEAVER CS5

★★★★½

SUPPLIER www.adobe.com.au

This edition makes PHP and CMS its core focus, which gives it the new lease of life it so desperately needed.

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.

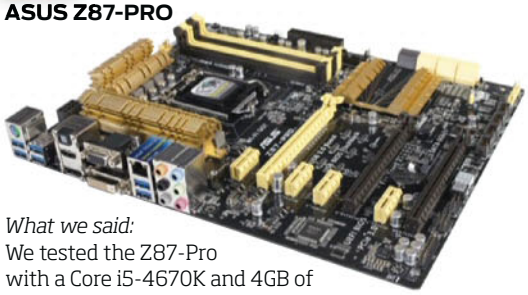
KITLOG

In this month's epic megatest a total of 80 components went through the labs wringer, giving us a terrific opportunity to review our Kilog systems, and so soon after last month's near complete overhaul, too. The numbers speak, and with solid data plus an appreciation for quality features, we're able to update the Game Box with a new motherboard and new memory.

Being driven by budget components, nothing came from the roundup which warranted a place in our Perfect PC box – though being cheap will never proclude something from inclusion here, it's simply that the bits we have specified for the Perfect PC are better than those which picked up awards in this issue's big test.

NEW

ASUS Z87-PRO



What we said:

We tested the Z87-Pro with a Core i5-4670K and 4GB of DDR3 RAM running at 1,600MHz. It scored 115 overall in our multimedia benchmarks, which is a few points higher than we'd expect to see from this setup. This puts it just ahead of the similarly priced Gigabyte GA-Z87-D3HP, so you can be sure the Z87-Pro will give you great performance.

The Asus Z87-Pro is a bit more expensive than the other LGA1150 boards on test, but its brilliant performance and range of ports mean it still wins a Recommended award.

NEW

KINGSTON HYPERX BEAST 16GB

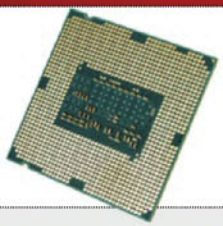
What we said:

With the HyperX Beast kit running at its rated speed of 2,400MHz, our test PC scored 102 overall in our PC benchmarks, which is a fairly decent boost in performance given the minor effect that fast memory has on the result of our PC benchmarks.

The HyperX Beast kit is pretty well priced and, if you're looking for a high-speed 16GB kit, this is the one to get. It wins a Recommended award.

THE GAME BOX

CPU



INTEL CORE I5 4670K

PRICE $275

Gamers can do without Hyperthreading and save $100 or more, compared to an i7. The K version is unlocked for easier overclocking.

MOTHERBOARD

ASUS Z87-PRO

PRICE $279

The most impressive budget board in our roundup, it has all you need for a solid gaming system.

NEW

MEMORY

NEW

KINGSTON HYPERX BEAST 16GB

PRICE $240

Our roundup award winner, it's well-priced, fast and overclocks very well.

VIDEOCARD

GIGABYTE GTX 760 OC 4GB

PRICE $360

An excellent price/performance balance, and with 4GB of memory to handle high resolutions or games with large textures.

THE PERFECT PC

CPU

INTEL CORE I7 4770K

PRICE $400

Intel's top-of-the-line quad-core i7 delivers huge performance and can overclock easily to around 4.4GHz with the K version.

MOTHERBOARD

GIGABYTE G1 SNIPER M5

PRICE $275

We've upgraded this from the Sniper 3 to the newest model, which happens to also be $100 cheaper! Fully featured and fast!

MEMORY

CORSAIR DOMINATOR PLATINUM CMD32GX3M4A2133C9 32GB

PRICE $619

These memory chips are hand selected and tested, and 32GB of fast RAM will keep things smooth and fast in intensive tasks.

VIDEOCARD

MSI GTX 780TI

PRICE $800

This single-GPU powerhouse is cool and quiet yet has the power to push though anything effortlessly. Mature drivers and good cooling help.

SUBTOTAL: $2762 RIG ONLY: $2143

COOLER

COOLERMASTER NEPTON 140XL
PRICE $140
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 840 EVO 250GB
PRICE $190
Super-fast, cheap and space for the OS and your games.

WD BLACK 2
PRICE $340
An extra 128GB of SSD storage plus another 1TB of HDD space, all in a tiny 2.5in size.

KEYBOARD

RAZER ARCTOSA
PRICE $50
A cool-looking keyboard that'll serve you very well if you can't afford the jump to mechanical.

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 $89
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

CORSAIR CS650M
PRICE $140
It's quiet, reliable, and at 650W is more than we need for this build, but has the headroom for additional graphics.

SUBTOTAL: $5192 RIG ONLY: $4198

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 840 EVO 1TB SSD
PRICE $680
Samsung has conquered the market with its 840 EVO, so fill up with 1TB of incredible speed and storage.

WD BLACK 2
PRICE $340
Supplement the EVO with this hybrid drive and 128GB of SSD + 1TB of HDD space.

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 PB278Q
PRICE $690
One of the best 27in monitors on the market, with a pricetag that makes us forget the competition even exists.

MOUSE

RAZER OUROBORUS
PRICE $125
An excellent performer and highly configurable mouse that suits both left- and right-handers.

AUDIO

ASUS XONAR ESSENCE ST/X
PRICE $175
The go-to card for perfect music quality, though the motherboard's onboard sound is fine if this isn't so important to you.

POWER SUPPLY

CORSAIR AX1200
PRICE $349
Reasonable value for this mighty power unit, delivering stable power and able to handle quad-graphics.

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HOW TO

Each month our experts get under the hood to provide you with detailed How To guides on hardware, software and everything in-between.

SYSTEM BUILDER:
Building the perfect loungeroom PC

DAVID HOLLINGWORTH PONDERS BUILDING A SYSTEM THAT CAN HANDLE EVERYTHING YOU COULD WANT TO DO IN FRONT OF A TELEVISION.

Last issue the editor Ben Mansill took us through upgrading his main home desktop system, with an eye not only to updating his PC, but also to creating a benchmark system for our A-List. And, as gaming systems go, it's a pretty solid build, and will not need serious updating for a while.

However, there are other ways to build a machine, with other uses in mind. So, this month, as planned we're going to look at building a more versatile system, with an eye to creating the perfect lounge room system – part home theatre PC, part NAS, and able to handle the occasional bit of gaming, too.

WHERE TO START?

Picking the right case is always bit of challenge when building a new PC, made doubly complex by the combination of build quality and simple aesthetics. But, no matter how shiny a desktop system may be, they often – ironically – end up hidden under desks, or out of the way in studies or gaming dens. A PC designed for the lounge room, on the other hand, is often more on show.

Another consideration is how it fits in with the rest of your lounge room's AV gear. If you're bit of an audiophile, you'll likely have a sizeable amp and/or receiver, a DVD or Blu-ray player, possibly even cable boxes and so on. Thankfully you can find a number of cases that are designed with just that hi-fi stack look in mind. Silverstone – a case manufacturer we just don't see enough of these days – has some spectacular designs in this area. The ML02 would be our first choice for this kind of build; it's a pure multimedia chassis, even including a built LCD display and remote, in an 82mm high body.

> "Whirring case fans, video-cards with tiny, whiny, cooling fans, can all get in the way"

But that does limit you in terms of components – if you want a more versatile system, or one with, say, a video card so you can handle some gaming, it's not ideal. You'll probably need a Mini-ITX case.

Again, there are a lot of choices. You can save some hassle by opting for barebones systems from the likes of Shuttle, for instance. These trim little cases could easily fit unobtrusively into the lounge room; the XPC Z787R6 (catchy name) already has a motherboard and power supply, and is aimed at multi-monitor set-ups and even commercial displays. But with all that power and connectivity, it makes a great option for a powerful yet compact HTPC.

Shuttle's cases can be a little cramped, though, so if you want a touch more room, then the our top two case picks would be Corsair's Obsidian 250D and Bitfenix's Prodigy. The 250D is one of our favourite cases, and wonderfully designed case.

However, given our own personal aims for a system that's versatile, the Prodigy wins out. It comes in black and white, and the white model's stark design has a certain appeal, while the carry handles mean we can have a second system in the home that can be moved about, or even be taken on the road if ever a LAN party opportunity pops up. It also has excellent floor clearance and removable dust filters – which could be handy for cat owners.

It's also roomy enough to build pretty much anything into.

▼ Other case options we considered for the build were the Shuttle XPC and Corsair Obsidian 250D.

HARDWARE

One of the things you need to keep in mind when it comes to any machine that's going to be used for media consumption is sound. Whirring case fans, video-cards with tiny, whiny, cooling fans, and even hard drives can all get in the way of enjoying a few tunes or watching your favourite movies. At the same time it's also nice to keep machines like this relatively inexpensive, especially if they're the second (or, in this specific case, fourth) PC in the house. Nonetheless, you want a system that's going to be able to handle multimedia and the odd game, which isn't difficult to achieve given the powerof the APU we have selected for this build.

So, for our money, AMD's new Kaveri A10-7850K APU is the best

choice for this kind of system. For an all in one APU, it combines CPU and GPU in one chip; it's not going to be playing something like Crysis 3 all that well, but for more modest games it will be fine, and it's perfect for media playback. It runs pretty cool, too. AMD's goal for gaming with the Kaveri was to enable playable

"...for more modest games it will be fine, and it's perfect for media playback..."

frame rates at Full HD resolution, which is, of course, exactly what the TV screen is running which this box will end up being connected to. On the flipside, the new socket design is so new that it hasn't had time to spawn a particularly large range of motherboards, at least at this stage.

That in turn limits our motherboard choices, but thankfully there's standout product that's perfect for our lounge room PC – GIGABYTE's GA-F2A88XN-WIFI. With built-in HDMI, USB3, and Dual Band Wi-Fi, it ticks all our boxes. And there's room to add in a video card later.

For RAM, we're going with an 8GB kit of Corsair Dominators, which is a bit of overkill, but will be handy if we do add in a video card for higher-end gaming, and to keep the chip cool we're going with a relatively quiet Thermaltake Water 3.0 Pro. It's rated for 20 dBA, so shouldn't ruin music or anything else.

Storage is a bit tricker. Again, you want something relatively quiet, but you also want enough room for lossless audio files and HD video, if you're that way inclined. Once upon a time you'd need an array of drives for this kind of thing, but we're going with one – Seagate's rather excellent 4TB SSHD, a real best of both worlds product. We're rather leery of single drive systems for backup redundancy, so we'll definitely be making use of a separate networked device, in this specific case a WD My Cloud 3TB that's already serving as the backup repository for all the PCs in the house.

Finally, to keep things in the Corsair family, and quiet, Corsair RM 650. Again, it's overkill for the system as it stands, but leaves some power headroom for any further additions as it's perfectly possible that this box will make lounge room gaming so popular in the house that an upgrade to a discrete graphics card becomes a logical option. More importantly though, it's so quiet that Corsair have had to sticker the product to remind people that it doesn't actually sound like it's even on – perfect for our lounge room machine.

And that's our system! It's roomy, expandable for uses outside of the lounge, quiet, and with more than enough power and storage for any avowed AV addict. ■

UNDER CONTROL

One of the essential parts of a great AV setup is being able to handily control it all from the convenience of your lounge, comfy-chair, or bean-bag (we don't judge).

There are a lot of remote-based options for HTPCs, but for our build we something that properly leverages the PC part of that equation. After all, a remote is only so good at helping you search for that latest funny cat video you saw on YouTube the other day.

Logitech's a trusted name in keyboards, and while we think it's getting eclipsed in some areas, its Wireless Touch K400 offers everything we could want. It's light and thin, has a range of ten meters (more than enough, but still handy), and has a multi-touch touchpad for making full use of Windows 8.

THE SPECS

- Bitfenix Prodigy $99
- AMD Kaveri A10-7850K APU $225
- GIGABYTE GA-F2A88XN-WIFI $135
- Corsair Dominator 8GB $125
- Thermaltake Water 3.0 Pro $125
- Seagate 4TB SSHD $245
- Corsair RM 650 PSU $160
- Logitech Wireless Touch K400 $45

TOTAL COST: $1159

PSU status monitor

Cable management

What the critics say:

The Thermaltake Toughpower XT 875W offers a great combination of features, aesthetics, quality, versatility, and performance. If you'rea person that appreciates quality design and construction, then the Toughpower XT 875W will not disappoint you. – Pure Overclock

HOW TO:

18 expert tips to get more from Outlook

SAVE YOURSELF TIME, WORK MORE EFFICIENTLY AND SYNCHRONISE HOME AND WORK LIFE WITH THESE BRILLIANT FEATURES. **DARIEN GRAHAM-SMITH** REVEALS ALL

WHICH VERSION

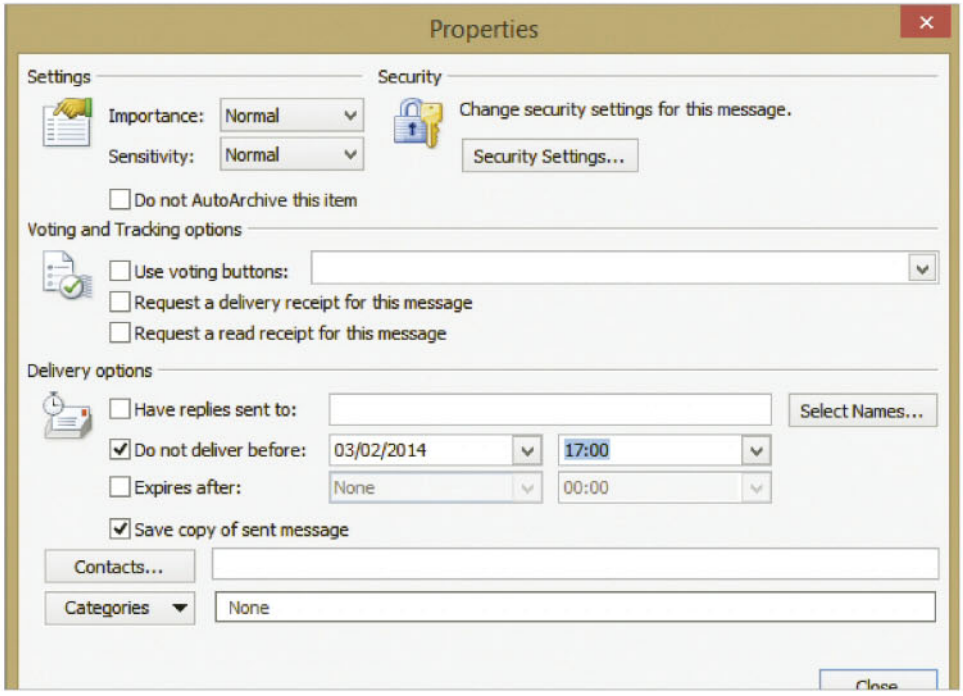
These tips are geared towards Outlook 2007, 2010 and 2013, but many also apply to Outlook 2003 and earlier.

1 SPARE YOURSELF REPEATED TYPING WITH QUICK PARTS

If you regularly need to trot out a standard passage of text, you can save it as a Quick Part for easy insertion into your emails. Simply highlight the text in the composer window, then switch to the Insert tab, click the Quick Parts dropdown and select "Save selection to Quick Parts gallery". In future, when you start typing the phrase, you'll see it pop up as a suggestion – hit return to insert it in full. You can also select your text with the mouse from the Quick Parts dropdown. Right-click on it for placement options, or to edit and manage Quick Parts and other "building blocks".

2 WRITE A MESSAGE TO BE DELIVERED AT A FUTURE TIME

If you have some news that you don't want to share immediately, Outlook lets you defer delivery until a specified time. Write your email, then switch to the Options tab and click Delay Delivery. This opens a requester with a "Do not deliver before:" field; enter a date and time, then click Close. The Delay Delivery box remains ticked, indicating that after you hit Send, the message will be held until the specified time for sending. If you're using an Exchange server, you can now close Outlook; if you're using POP or IMAP you'll have to leave the application open until the specified time for delivery has passed.



▼ The option to delay delivery can be useful if you want to time messages to send later

3 GROUP MESSAGES BY...

If you receive a high volume of email, tracking down relevant messages can be a chore. Outlook can group emails into conversations, so that a single click shows all related messages together. You can set this on a global or per-mailbox basis by going to the View tab and ticking "Show as Conversations". Click the "Arrange By:" bar at the top of the message list and select "View Settings..." from the dropdown menu to configure additional grouping options.

4 CREATE A FOLDER FOR COMMON SEARCHES

You can always search the current folder by typing into the search field above the message list. If there's a particular search you frequently carry out, you can simplify the job with a Search Folder. Go to the Folder tab and click New Search Folder to create one: you can choose from a variety of templates (such as finding mail from specific people, or mail marked as important) or set up your own criteria using the "Create a custom Search Folder" option. Your new search folder appears in the folders pane at the left-hand side of the Outlook window; click on it to see messages meeting your selected conditions. Right-click and select Rename Folder to give it a convenient name.

5 FILTER EMAILS TO FIND RELEVANT MESSAGES

Another quick way to find specific emails is to use the Filter Email dropdown at the far right of the Home tab. Choosing a menu option instantly filters your mailbox display to show only certain types of emails, such as those with attachments, those dated within a specific time period and so forth. Within your filtered view, you can type into the regular search box to drill down further. For more search options, select "More Filters..." from the dropdown to make the Search Tools tab visible: here you'll find additional settings, as well as the Recent Searches dropdown that lets you repeat recent searches with a single click.

6 JUNK OR IGNORE UNWANTED EMAIL

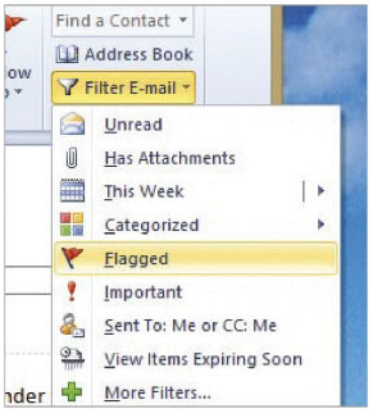
If someone keeps clogging up your inbox, you can block all future email from that sender by clicking the Junk dropdown on the Home tab. Select "Junk E-mail Options" to open a configuration dialog that lets you specify what you count as junk and what you don't – here you can blacklist entire domains and even entire countries. If the sender is legitimate but the conversation isn't relevant, click Ignore: this doesn't permanently block anyone, but new emails in that particular conversation thread will be binned as soon as they arrive.

7 Instantly create new emails and appointments

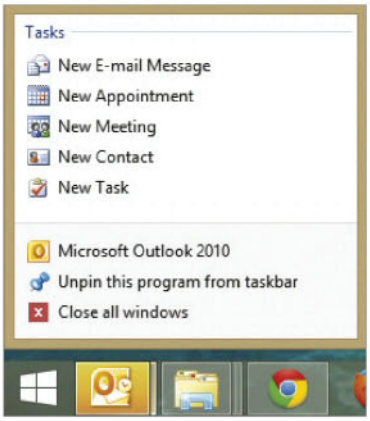
If you make full use of Outlook's features, you may find yourself frequently switching back and forth between email and calendar modes. Regardless of whether you're looking at your inbox or your calendar, you can create new emails, appointments, contacts and so forth using the New Items dropdown on the Home tab. If you don't want to delve into the Outlook interface, right-click on Outlook's icon in the Windows 7 or 8 taskbar to open a jumplist offering direct shortcuts to create any sort of new item.

8 AUTOMATE RECURRENT TASKS WITH QUICK STEPS

If you find yourself regularly performing a particular task – such as forwarding an incoming email to a colleague, or inviting a group of recipients to a meeting – then Quick Steps can save you time. You'll find a set of predefined Quick Steps in the middle of the Home tab, but the real power of the feature comes in defining your own. Click the dropdown arrow and select New Quick Step to create a custom sequence of actions that can categorise, move, flag and delete messages with a single tap of your mouse. Clicking on "Manage Quick Steps..." opens a dialog from which you can duplicate and edit shortcuts, so you can create a range of variations on a theme.



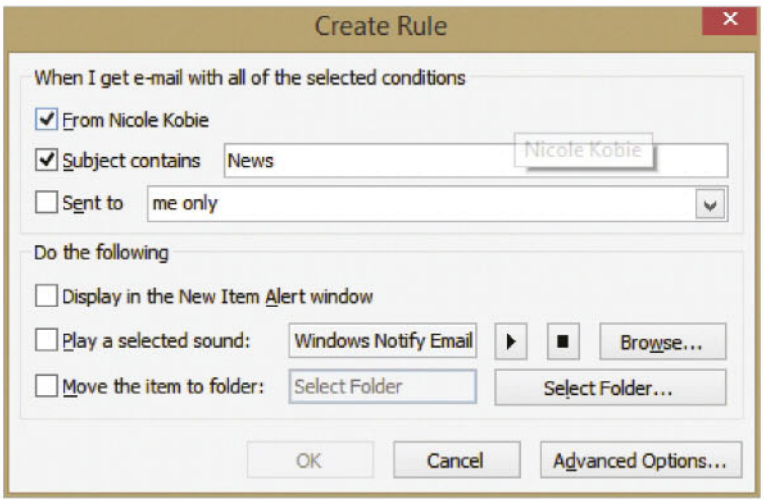
The Filter Email menu can help locate important messages within seconds



Outlook allows you to easily switch between email and calendar modes

9 SORT YOUR MAIL WITH RULES AND CONDITIONAL FORMATTING

If Quick Steps are too much effort, consider setting up a Rule to automatically process messages as they arrive. The Rules dropdown in the Move section of the Home tab provides the options to create and manage rules; if you select a message before clicking, it will offer to create a rule affecting similar messages. Select Create Rule and you'll be given the option to set all sorts of criteria to check for – sender, recipient, size, date and more – and choose what should happen to matching emails. A similar feature is Conditional Formatting, which you'll find under View Settings on the View tab. This doesn't move or process messages, but it displays emails matching certain criteria in a specified font and colour, so you can instantly spot them in your inbox.



Restrict the email you receive by setting up Rules

10 SEND TEXT MESSAGES FROM WITHIN OUTLOOK

When email won't cut it, Outlook supports sending SMS text messages directly to your contacts. You'll need to register with a third-party messaging service to use this feature, however, and if you want to send more than a handful of text messages you'll inevitably have to pay. To set up SMS, click the New Items dropdown under the Home tab, select Text Message (SMS) and, in the dialog that opens, click "Find a text messaging service for your mobile operator".

11 AUTOMATICALLY CLEAR OUT UNNEEDED MESSAGES

If you want to save space or tidy up an unwieldy email trail, the Clean Up tool in Outlook 2010 and 2013 can help. It analyses a complete email conversation and deletes any messages that have been quoted in their entirety inside a subsequent message – the logic being that you can still see what's been said by checking subsequent messages. To use Clean Up, click its dropdown on the Home tab and choose whether you want to tidy up a single conversation or a whole folder. Click the Settings button in the alert that opens to choose what sort of messages should be culled and what should be left alone.

12 DELEGATE ACCESS TO YOUR MAIL AND CALENDAR

If you're going away, you can temporarily let someone else manage your inbox and appointments. To set this up, open the File tab (or the Orb in Outlook 2007), then click the Account Settings dropdown and select Delegate Access. Click Add and enter the name

of the person (or people) to whom you want to grant access. You'll see a set of dropdowns for permissions: by default, your delegate can access and update your calendar and task list, while email and contacts remain private. Note that your delegate must be using the same version of Outlook as you, and the items you want them to access must be stored on an Exchange server: they won't be able to get at a mailbox that lives on your hard drive.

13 MANAGE READ RECEIPTS

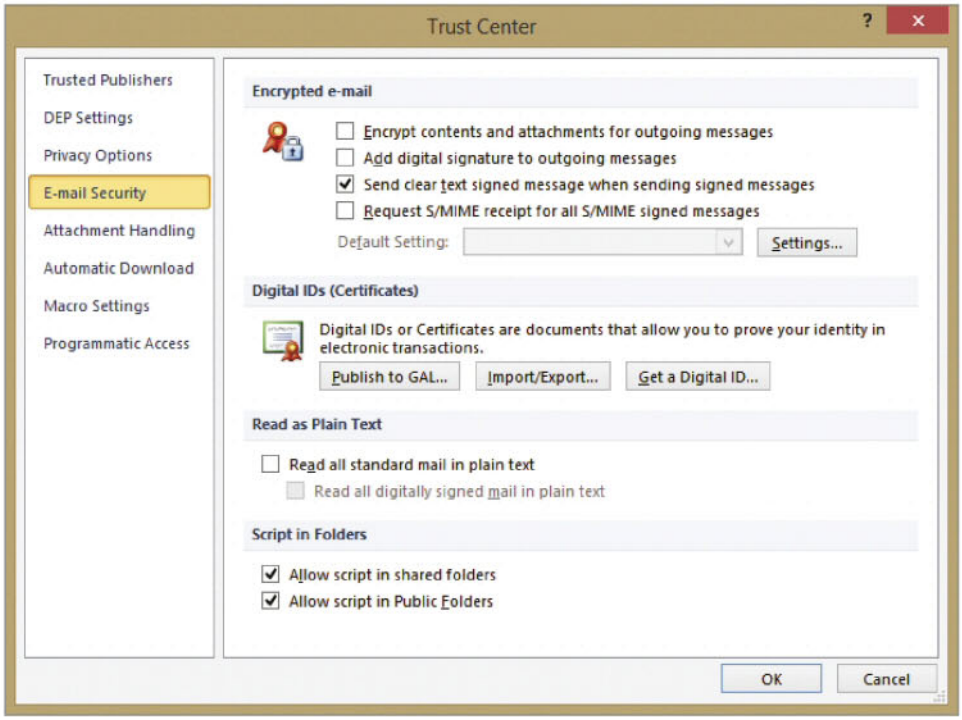
Happily, Outlook is well-behaved enough to ask permission before sending a read receipt; you can customise its behaviour further by clicking on the File tab, opening Options, selecting the Mail view and scrolling down to the Tracking section. Here you can choose whether receipts should be sent always, or never, and you can also configure your own receipt request settings. One useful option is the ability to request a delivery receipt, which confirms your email has reached the recipient's mail server, without insisting on a notification when it's actually already opened.

14 TIME ZONES

If you travel for work, you'll know the frustration of finding meetings and appointments in Outlook show up at the wrong local time. Under File | Options | Calendar you'll find the option for setting your local time zone: once you've done this, email timestamps and calendar entries will be shown with the appropriate offset. You can configure a second time zone to be shown so that (for example) you can keep track of what time it is back home, or see what time it is for your colleagues overseas, to ensure you catch them during office hours and don't contact them at an inconvenient time of day. You can also click Swap Time Zones to easily switch from one location to the other.

15 "POST-IT" NOTES

Outlook includes a built-in sticky notes feature. Press Ctrl+Shift+N from anywhere in the Outlook interface to create a new note, which can be dragged and positioned anywhere on screen. By default, notes appear in pale yellow, but you can assign them to categories, which causes them to switch to the associated colour. To manage your notes, click on the Note icon at the bottom of the View pane: From here you can copy, organise and print notes, and also search, via the field at the top-right of the window, for notes containing specific text.



16 ENCRYPTED EMAIL

If you want to prove your messages are really from you, Outlook can cryptographically sign your emails. You can even go a step further and encrypt the text and attachments, so that only recipients with whom you've shared the key can read them. To set this up, open the Trust Center Settings (you'll find the button under File | Options | Trust Center) and click on E-mail Security. Enabling digital signing and encryption is as easy as ticking the relevant boxes, but you'll need to create and import a digital ID if you don't already have one. Click "Get a Digital ID..." to see links to a range of providers, including Comodo, which offers free email certificates.

▲ Encrypting your emails can ensure that they're only read by the intended recipient

> **"If you travel for work, you'll know the frustration of finding meetings..."**

17 ACCESS YOUR PERSONAL EMAIL WITHIN OUTLOOK

To add a personal mailbox to Outlook, go to the File tab and click Add Account to open the wizard: if you're using a web service such as Gmail or Yahoo Mail, check the provider's instructions for setting up access via POP or IMAP. If you're using Outlook.com with Outlook 2013, simply enter your email address and Outlook will handle the rest. To access Outlook.com mail from earlier versions of Outlook, click "Manually configure server settings or additional server types", then select the Microsoft Outlook Hotmail Connector from the window that opens. This lets you access not only your webmail but also your personal calendar from within Outlook.

18 SYNC GOOGLE CALENDAR WITH OUTLOOK

In Google Calendar, move your mouse over your calendar in the left-hand pane, click on the dropdown that appears and select Calendar Settings. Click Private Address | ICAL to obtain the URL of your calendar's iCal feed. Now, in Outlook, go to File | Account Settings | Account Settings..., click on the Internet Calendars tab and paste the URL into the dialog that opens. After a few minutes the calendar will start to update and your events will appear in Outlook. If you want to make Outlook events appear in Google Calendar, which is something you may want to do if the idea of a truly centralised organiser appeals, then you'll need a third-party tool to allow that to happen: One option is gSyncit by Fieldston Software (**www.fieldston software.com**), which offers a free trial version that lets you sync one Google calendar with one Outlook calendar. ■

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HOW TO:

Rulers and tab stops

SIMON JONES EXPLAINS HOW SOME OF THE TRADITIONAL FUNCTIONS OF A TYPEWRITER CAN BE USED IN WORD TO FORMAT DOCUMENTS MORE EFFECTIVELY

When I was 16, I learned how to type by going to night school once a week at the local technical college. Over the course of a year, we were drilled by a very nice, firm and matronly instructor. (Yes, you guessed it, I was the only male in a class of 20-odd.) We were taught not only to type with all ten fingers while not looking at the keyboard, but also how to lay out a document, how to produce carbon copies, and other useful typists' skills. We learned on big old-fashioned manual typewriters, building up sufficient strength in our little fingers to bash out an "a" or semicolon with the same force as an "f" or "j". By the end of that course I'd passed two exams – Pitman Elementary and RSA I – and could type at 90 words per minute. I wanted to go on to study computer science at university, and had decided that being able to type quickly and accurately would be useful in life.

The typing skills I learned have stood me in good stead. A couple of issues ago, I wrote a column about the paragraph-formatting options in Microsoft Word. I mentioned in passing how understanding the functions of the ruler and tab stops was crucial when properly formatting documents; this month, I'll follow up on that by examining them in some detail. The "tab" in tab stops is short for "tabulation", which means the act of laying data out in tabular form – that is, in rows and columns. On a traditional typewriter, the printing position moves by one character space whenever you press the key to type a character or press the spacebar. It always moves by the same distance, since old typewriters used a monospaced font, in which the letter "i" takes up the same space as the letter "m".

There were two or three special keys that were exceptions and did something different. The Backspace key moved the print position back by one character space, and the Tab key moved the print position to the next tab stop. On an electric typewriter, the Return key took you down one line and back to the beginning of the next line; on a manual typewriter, this job was done by the Return lever attached to the platen (the roller that the paper was wound around), which you pushed with your left hand. The Tab bar on a typewriter was a metal bar running parallel to the platen, and it had several movable levers that could be slid to any desired position and then fixed into place: these metal prongs were the tab stops, and pressing the Tab key made the printing position slide across to the next one and stop. These tab stops would usually be arranged regularly across the page – every five, eight or ten character spaces, for instance – but you could freely move them to any positions you wanted.

> "The screeching noise emitted by the typewriter would make the instructor gasp in horror"

Regularly spaced tabs are useful for indenting lists, or subsection headings to various levels, whereas custom tab spacing is used for laying out tables of data with variable-width columns. To set the tabs on a manual typewriter, you had to write out your data in rough using pencil and paper first, then calculate the longest word or phrase in each column, add two extra spaces to stop the words in the columns bumping into each other, and then add up these lengths across the page, not forgetting your margin, to find out which character positions all your tabs needed to be set to before you could start typing. This was a tedious business, and you had to get it right. If you made a mistake your table contents would go horribly wrong and you'd have to start all over again. Woe betide anyone who pulled the paper out of the typewriter in a rage without loosening the platen first. The horrible screeching noise emitted by the typewriter would make the instructor gasp in horror, and earn you the privilege of typing a whole page of "asdf ;lkj" as punishment.

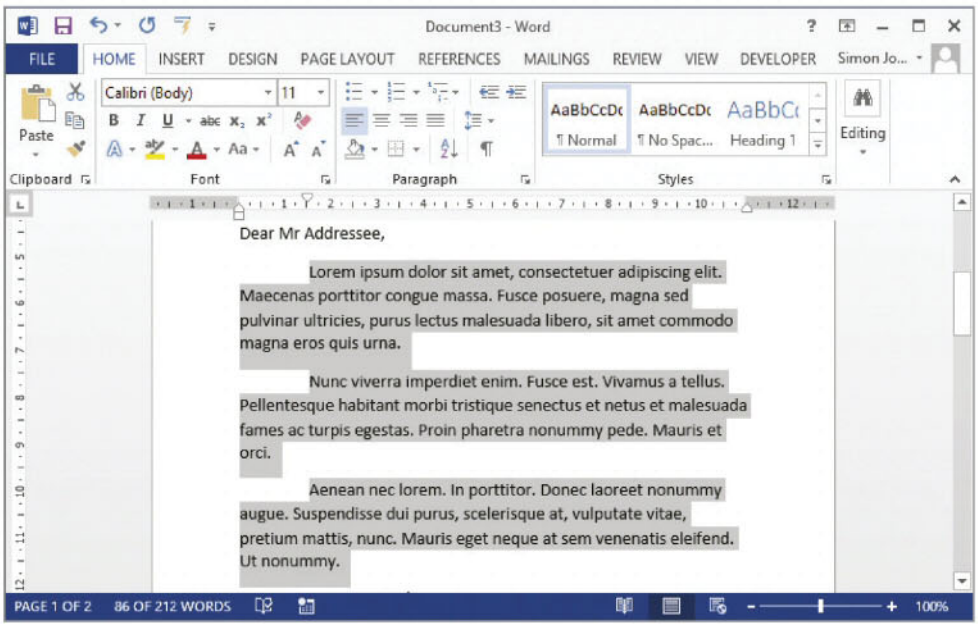
THE RULER

This concept of tab stops survives in modern word-processing programs such as Word, and forms the basis of a lot of simple document formatting. That mechanical Tab bar has now become the ruler, and because we now use proportionally spaced fonts it measures in inches or centimetres rather than character spaces. Word may not show the ruler by default but it's easy enough to turn it on using View | Show | Ruler. You can't see them, but if you don't define any custom tab stops there are default stops set at every half-inch (1.27cm). This half-inch measurement has been baked into Word's program code since its inception more than 30 years ago: it's not something that you can change, even if you'd prefer to use a more metric measurement. You can, however, have the ruler show inches or centimetres by going to File | Options | Advanced | Display | Show Measurements In Units Of; you can also choose millimetres, points or picas.

"This half-inch measurement has been baked into Word's code since its inception..."

The ruler shows the current margins as grey areas at its left and right ends, and the zero point of the ruler starts at the left margin. White arrows on the ruler show the current left and right indents, and you can drag these to set them to different positions. Indents aren't the same as margins: margins apply to a whole document or sections of a document, whereas indents are temporary overrides of these margins that apply only to one or more paragraphs. (You can also apply indents to styles, so you can reuse them more easily, as we'll see later.)

The right indent marker is quite simple – just a white arrow that points upwards. Drag this right indent arrow leftwards to increase the space between the text and the right-hand edge of the page, or drag right to decrease it (it's easier to see the effect if you have some text in your document). The left indent marker is more complicated, since it not only sets the margin, but also a first-line indent or hanging indent. The marker has three parts: a block at the bottom, an up arrow in the middle and a down arrow at the top. The block at the bottom is the left indent and works in much the same way as the right indent. The down arrow is a first-line indent: drag this and only the first line of the paragraph is indented, while the rest of that paragraph stays aligned to the left indent. This was a popular formatting choice in the days of manual typewriters, and is still widely used – it's recommended by many style guides for academic writing, and is used in books and publications including *PC & Tech Authority*. It's intended to make it easier to find the starts of paragraphs, particularly when you don't put any additional vertical space between your paragraphs, enabling you to fit more words on a page. However, even when I was learning to type in the early 1980s, many businesses preferred the clean "fully blocked" format with a consistent left margin.



▲ The ruler shows the first-line indent on the selected paragraphs

A hanging indent is almost the reverse of a first-line indent, whereby the first line of a paragraph starts further left than all the following lines. It's rarely used with paragraphs that are all text, but is quite common alongside bullet points or numbered paragraphs: the bullet or paragraph number appears separated from the first word of the following text, and subsequent lines start at the same point as the first word, thus making the bullet or number stand out.

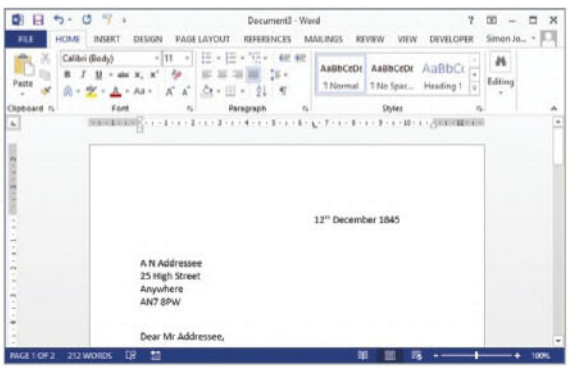
Try dragging the left-hand indent markers on the ruler to see what they do, but remember that they only affect the currently selected paragraph – if you want to set indents for multiple paragraphs, select all those paragraphs first before you start dragging the indent markers. Alternatively, you can set the indents as you want on one paragraph and then use the Format Painter to copy that format elsewhere. (Of course, the Format Painter is a rather blunt instrument in that it will copy all the formatting of a paragraph, including colour, font, bullets and other paraphernalia, which may not be what you want.)

TAB STOPS

I've mentioned that, by default, Word gives you a tab stop every half-inch (or 1.27cm). Press the Tab key and the insertion point will jump to the next tab stop from wherever it was. If you reveal formatting characters with Ctrl+* you'll see that Word marks tabs on the page with a small right arrow.

If you don't want the default tab stops, you can define your own. Just click in the ruler where you want a tab stop and a small L symbol will appear – if it isn't in the right place just drag it to the left or right to reposition it

▼ The semi-blocked format has a custom left tab on the line for the date to the right of centre



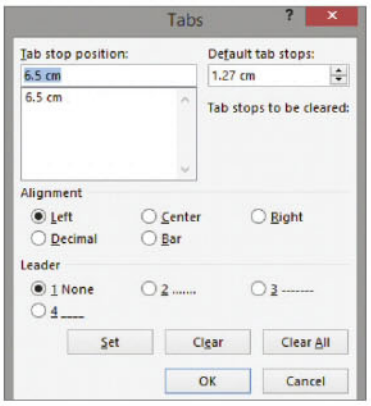
(drag it downwards off the ruler to delete it). Placing a custom tab stop will remove all the default tab stops that came before it, but leave all the ones that come after.

By default, all tab stops are left tabs, which means that the text coming after them will be aligned with the tab stop to its immediate left. On a manual typewriter, left tabs were all you had, and any other behaviour required a DIY approach. If you wanted text to be aligned right at a tab stop, you had to press Tab to go to that tab stop, then Backspace by the exact number of characters in your text and then start typing. Nowadays a word processor will do all of that for you. On the far left of the ruler is a small square showing the type of tab stop you'll create on the ruler: if you click on this square the tab stop type will cycle through all of its possible values, which are left tab, centre tab, right tab, decimal tab, bar tab, first-line indent and hanging indent, all indicated by small symbols.

Right tabs align text with the tab stop to their right, which is useful when you want to have both left-aligned and right-aligned text on the same line. It's also often used for headers or footers, where you might have the document name to the left and the page number to the right. Centre tabs centre the text on the next tab stop, which is again useful for putting a mixture of alignments into one line, such as a header or a footer. Of course, both these effects could be achieved by using tables, where each cell can have a different alignment, but tables introduce their own quirks, such as cell padding, which might get in the way in certain circumstances.

Decimal tabs are used for numbers, and they cause a list of numbers to align at their decimal points. It doesn't matter how many digits there are to the left or right of the decimal point, so this is perfect for scientific or academic texts where you don't want to artificially reduce or inflate the precision of all your numbers by giving them all the same number of decimal places to fit.

The bar tab is unusual, as it actually puts a vertical bar through the selected paragraphs at the position of the tab stop: it can be used together with hanging indents to separate the hanging heading, bullet, or number from the text to which it applies. It also gives a visual indication of the range of text that belongs to a particular heading. Again, you could achieve something similar by using



The Tabs dialog gives you precise control over the tab stops in your text

tables and table borders, but bar tab is a more lightweight effect from the old school.

If you want more precise control over tab stops, then double-click on the ruler to bring up the Tabs dialog, where you can set tab stops by typing in a measurement, selecting the type of alignment you want and then clicking the Set button. You can also add extra effects such as dot leaders, which fill the space up to the next tab stop with dots or dashes. This device helps your eye to connect the words on the left with the page number on the right. A table of contents in Word is formatted with a right tab with a dot leader at the right margin to get just this effect. The Tabs dialog also allows you to delete some or all of the custom tab stops in your selected paragraphs or change the default tab stops for those paragraphs from their usual 1.27cm.

Remember that these settings apply only to the paragraphs you've selected in your text, but they'll be copied into each new paragraph you create after this one until you change the style.

TABS IN STYLES

If you want your custom tab stops to apply to many paragraphs, you should set them into a style. The easiest way to do this is to set up the tab stops as you want them, then update the style of that paragraph to include the tab stops, or create a new style from that particular paragraph.

For instance, if you wanted all your Normal-style text to have a first-line indent, you would put the insertion point in a paragraph that was already in Normal, then drag the first-line indent marker on the left of the ruler towards the right to indent the first line of the paragraph. Next, right-click on the Normal style in the Style Gallery on the Home tab of the ribbon, or on the Normal style in the Styles task pane, and select Update <stylename> to Match Selection. The first-line indent then becomes part of the Normal style, and all the paragraphs of that style have their first line indented by the same amount.

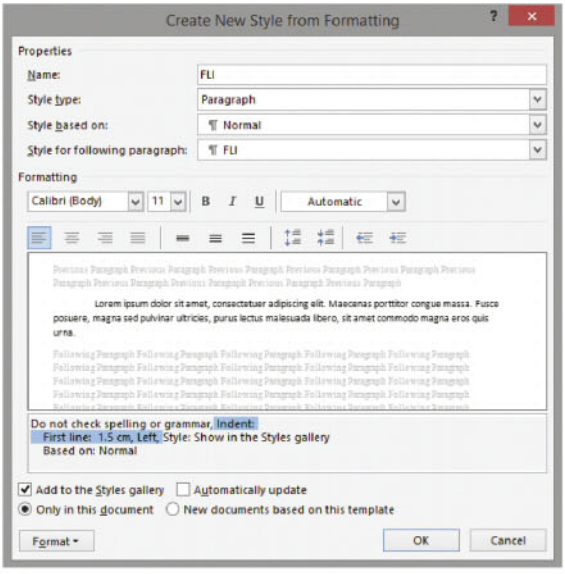
If you want some but not all of your text to have an indent, indent one paragraph and then create a new style from that paragraph. Show the Styles task pane (using Alt+Ctrl+Shift+S) and click the New Style button at the bottom left of the task pane. Name your new style and click OK. Now whenever you want that particular indentation, you can choose that style from the Styles gallery or task pane.

You can do exactly the same with tab stops by laying them out in one paragraph, then creating a style so that you can reuse them. By default, any new style you create will be based on the style it was created from, so a style for hanging indent based on the Normal style will inherit all the other attributes of Normal. This means that if you decide you want to change the font or size of your Normal text, your hanging indent style will change automatically to match, without you having to specifically find that text and change its font as well. ■

TEMPLATES

If you want your custom indents or tab stops to be applied to many future documents, or even to become the default for all your documents, you can save your new or modified styles as a style set or a template. I'll cover this in more detail in a future column.

You can create a new style to include a first-line indent



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Wireless connections: what you need to know

WI-FI, BLUETOOTH, 2.4GHZ, MIRACAST AND MORE: **DARIEN GRAHAM-SMITH** EXPLAINS EACH OF TODAY'S NUMEROUS WIRELESS STANDARDS

The word "wireless" has meant many things through the years, from radios to infrared to Bluetooth to the alphabet soup of 802.11a, b, c and beyond. Now many people use it as a shorthand for Wi-Fi, but that's far too simplistic. Wireless protocols are complicated, cryptic and misleading, so it makes sense to arm yourself with some knowledge. Here, we explain all the different "wireless" imposters; if your connection isn't as reliable as you'd like, read on to discover why.

> The most up-to-date Wi-Fi standard is 802.11ac, which was approved in January

SIMPLE BROADCAST TECHNOLOGIES

The simplest sort of wireless communication is where a device transmits an open signal into the ether, which can be received and understood by any listening device. It's the way traditional broadcast radio works, and the same radio frequency (RF) technology can be used in hobbyist computing projects where there isn't a need for secure communications.

The big downside of RF is its susceptibility to interference. If two devices positioned close to one another are broadcasting simultaneously at the same frequency, a listening device probably won't understand either.

Another simple broadcast technology is IrDA, named after the Infrared Data Association, which developed the standard. IrDA encodes data in patterns of infrared light, in much the same way as a television remote control, so although the transmitted data can be received by any device in range, the receiver still has to be within around 5m of the transmitter. For data transfer, infrared has largely been supplanted by Bluetooth, which doesn't require line of sight and has much greater bandwidth (offering transmission speeds of 25Mbits/sec versus IrDA's maximum of 4Mbits/sec).

DARIEN GRAHAM-SMITH
A technical journalist who regularly contributes to magazines like *PC & TA*.

WIRELESS INTERCONNECTS

If you buy a wireless keyboard or mouse, it may use Bluetooth, or communicate using radio transmissions in the unregulated 2.4-2.5GHz frequency range. Technically, this is the same type of RF communication as described above, but operating at a much higher frequency. This means that the signal has a shorter range (around 10m is common), especially since the peripherals themselves typically have tiny internal aerials.

That shorter range makes it hard for a would-be spy to get near enough to eavesdrop on your keystrokes. On top of this, modern 2.4GHz-input devices typically use a pairing system, whereby a unique encryption key is shared when you press a physical button on both the keyboard, say, and the receiver. Even if other devices nearby can "hear" your keystrokes, they won't be able to decode them, and the bidirectional link also means errors can be detected and re-sent. Support for "channel-hopping" – automatically switching between different transmission frequencies – ensures that the keyboard and receiver can communicate even when interference is present.

Attempts to create more general-purpose wireless interconnects have had a chequered history. There is an official Wireless USB (WUSB) standard, but it was last updated in 2010, and is held back by its speed: theoretically, it should be able to match USB 2's maximum 480Mbits/sec bandwidth, but in practice you're unlikely to get anywhere close to that.

A similar concept is the 802.11ad protocol, branded "WiGig" after the Wireless Gigabit Alliance that developed it (now incorporated into the Wi-Fi Alliance). WiGig can use low-frequency communications to talk to a device that's 10m away on the other side of a wall, or automatically switch up to 60GHz to communicate with a device sitting right next to the transceiver at up to 7Gbits/sec. The technology hasn't caught on in the mainstream, but the USB Implementers Forum is working on a new approach to wireless USB that will function over WiGig as well as Wi-Fi networks, so the technology

could yet have its day.

A more advanced wireless interconnect is Wi-Fi Direct, a standard that lets any number of Wi-Fi-equipped devices exchange files and information directly, rather than having to go through a router. Only one device needs to support Wi-Fi Direct – the others will simply see it as a regular access point – but range and bandwidth will depend on the hardware, and on which Wi-Fi standard is being used (we'll get into these issues later). Many smartphones and tablets can act as hosts, as can the Xbox One; you can already buy mice, loudspeakers and printers that support Wi-Fi Direct connections.

WIRELESS DISPLAY

The Miracast standard lets you transmit video wirelessly to a TV or monitor by sending an H.264-compressed stream over an 802.11n Wi-Fi Direct link. Support is already built into a number of Android devices, and recent Ultrabooks that support Intel's own WiDi wireless-display technology can talk directly to Miracast-compatible displays. OS support is built into Windows 8.1.

Few TVs are directly compatible with Miracast, but you can buy a receiver that plugs into your TV via an HDMI cable. The catch is latency: it takes time for the transmitting device to encode the video stream, and more time for the receiver to decode it again. Officially, Intel's latest drivers cut this down to 60ms, but we've seen external displays lag behind the built-in one by up to a second. That's fine for presentations and movies, but a disaster for games.

Apple devices don't currently support Miracast, but the proprietary AirPlay system does a similar job, letting you use a television to mirror the screen of a Mac or iOS device.

AD HOC CONNECTIONS

Some wireless technologies aren't intended for persistent connections, but for ad hoc data sharing. The most extreme example of this is the radio-frequency identification (RFID) tag – a tiny transmitter that shares a single piece of programmed information with any receiver that comes near to it. RFID technology is commonly used for access management, so an automated door might open only when it detects an RFID tag with a valid identity, or a reader on a London bus might use the RFID chip embedded in your Oyster card to log your journey. Contactless payment systems work in the same way, and modern Australian passports include an embedded RFID tag detailing the holder's personal information, since this is quicker to read electronically and harder to falsify than a printed page.

▲ Bluetooth's support for profiles means that many different types of hardware can interoperate seamlessly

RFID transmitters don't necessarily need a power source. The chip has such modest power demands that it can run off the current induced by a nearby electromagnet, and this can be built into the reader. Conversely, it's possible to use powered RFID tags that can also communicate with passive readers.

RFID supports an extremely wide range of frequencies, from 120kHz up to 10GHz, with different transmission speeds and different ranges; the most powerful active tags can be read at a range of up to 200m. RFID isn't something you'd necessarily build into a personal computer or smartphone, but it does have consumer applications: for example, you could conceal an RFID tag inside the frame of a bike, and use it as evidence of ownership if the bike is stolen.

A related technology is near-field communication (NFC). This builds on RFID principles by adding two-way communications capabilities: when two NFC devices are close enough to "see" each other (conventionally established by tapping them together, although physical contact isn't needed), they can take it in turns to send and receive.

NFC is built into an increasing number of smartphones and tablets. In principle, it could be used to exchange files and information between such devices. In practice, NFC's useful range of around 4cm (coupled with a slow maximum data rate of 424Kbits/sec) makes this impractical. Implementations such as Android's "Beam" feature typically use NFC simply to exchange basic device information, which is then used to initiate a faster and more robust link, such as Bluetooth. Similarly, Windows 8.1's "NFC printing" feature doesn't actually transmit pages via NFC; the tag embedded in the printer merely broadcasts its network path and driver details to a receiver. This information can then be used to automatically configure the client so that print jobs can be sent to the printer via conventional infrastructure.

Passive NFC tags are also used in retail, enabling customers pay for goods from a digital wallet by tapping their smartphone against an

MESH NETWORKING WITH ZIGBEE

ZigBee is a low-power 2.4GHz wireless network system based on a "mesh" topology. There's no central gateway; each ZigBee device connects directly to other devices within radio range, from around 10m to 100m depending on the transmitter and ambient conditions.

What's clever about this type of network is that devices that aren't in range of each other can still communicate by relaying their (encrypted) traffic through intermediary devices. By agglomerating clients in this way, a ZigBee network can in theory extend for miles, across up to 65,536 nodes.

In practice, such a network might be very slow: ZigBee's maximum data rate is 250Kbits/sec, so routing traffic back and forth across thousands of nodes could induce considerable latency.

The system makes more sense for domestic devices, such as home-automation appliances, which only need to transmit occasional and intermittent small amounts of data.

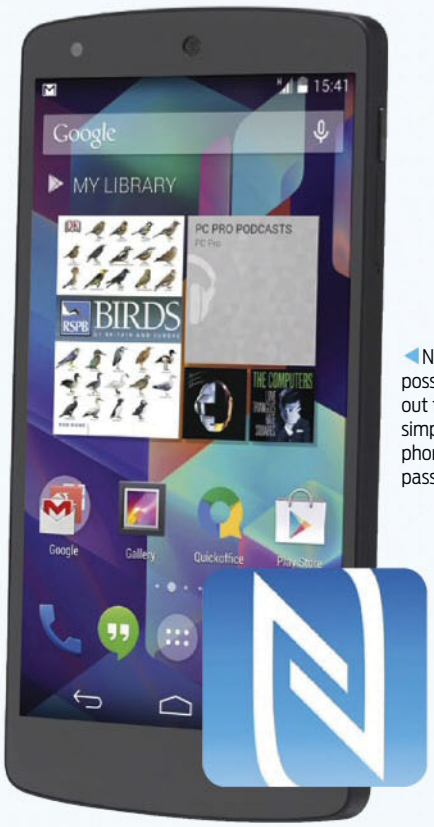
ZigBee was introduced in 2003, and there are now more than 600 certified products available worldwide, including USB adapters for PCs and Raspberry Pi-type systems. It's fair to say it isn't a mainstream standard yet, but the industry alliance behind it – which includes ARM, Cisco, LG, Motorola, Philips and Toshiba – hasn't lost faith. Last year ZigBee was incorporated into the GreenPeak Open Smart Home Framework, a set of standards for connected domestic devices, and with Internet of Things projects and wearable technology also in the ascendant, ZigBee may yet see success.

embedded tag. It's basically the same idea as the RFID-based payment systems mentioned above, but with the roles reversed so that the active reader is provided by the customer. This makes it much cheaper and easier for service providers to implement – all they have to do is program a cheap, robust NFC tag with the appropriate charging details.

BLUETOOTH

Bluetooth is the world's most popular ad hoc wireless connection: today it's built into most laptops, smartphones and tablets. It works in the 2.4GHz band, like the keyboards and mice mentioned above, but the standard is more sophisticated, including more than 30 "profiles" that allow Bluetooth-enabled devices to work together in different ways.

A Bluetooth keyboard, for example, would support the Human Interface Device (HID) profile, so a compatible operating system would know it could receive input from it. A pair of wireless loudspeakers would use the Advanced Audio Distribution Profile (A2DP), meaning the OS would recognise them as an audio output device. Other defined Bluetooth profiles cover remote control for TVs and hi-fi systems, file transfer, printing, speech transmission and network gateway services – so you can, for example, tether a mobile phone to a laptop via Bluetooth and share its 3G connection.



NFC makes it possible to carry out transactions by simply tapping your phone against a passive chip

A Bluetooth link is established by instructing two compatible devices to scan for and connect to one another (sometimes a passkey is required to confirm the link, so you can't simply connect your phone to someone else's without their assistance). The connection range depends on the class – that is, the power rating – of the devices involved: low-power Class 3 devices have an effective range of around 1m; Class 2 works over around 10m; and Class 1 should support a connection distance of 100m.

There have been four major revisions of Bluetooth. They're all backwards-compatible, and it's rare these days to see a device using anything older than Bluetooth 2.1, which was released in 2007. This supports all the major profiles and can beam data between devices at up to 2.1Mbits/sec – fast enough to stream high-quality audio to a headset or a car stereo. (This is referred to as Extended Data Rate, or EDR, since it's around three times faster than the original Bluetooth specification.)

Bluetooth 3, released in 2009, adds support for high-speed transport, which increases the maximum transfer speed between devices to 24Mbits/sec. This works by co-opting 802.11 hardware, rather than relying wholly on the Bluetooth chipset, so not all Bluetooth 3 devices support it. Other upgrades in Bluetooth 3 offer more reliable connections and automatic power management, so the chipset can scale back its consumption when it isn't transferring data.

The current version of Bluetooth is 4.1 – a minor update to Bluetooth 4, which was released in 2010. Both are branded as "Bluetooth Smart", and the big change is the inclusion of a new operating mode called Bluetooth Low Energy. That name is no joke: it's been calculated that a Bluetooth Smart device in LE mode can stay connected to a nearby host for almost a year on a single watch battery. The trade-off is a very slow effective data-transfer rate, of around 0.27Mbits/sec, so headsets, speakers and so forth continue to use the standard or high-speed modes; LE is really intended for simple devices, such as fitness trackers.

802.11 WIRELESS NETWORKING

802.11 wireless – branded as Wi-Fi – is the universal standard for wireless local area networks. Established in 1997, it's a standard that's been through numerous revisions, and although backwards-compatibility isn't built directly into the protocol, it's normal for hardware to support older and newer Wi-Fi revisions simultaneously.

Although most commonly used in "infrastructure" mode (whereby all clients connect to a wireless access point or router), the 802.11 standards also support an ad hoc mode, which can be used to connect devices together directly. In practice, it's easier to connect devices together over a LAN managed by a router, or to use a complementary technology such as Bluetooth.

The revision of the Wi-Fi standard

WIRELESS POWER

We've focused on wireless data transfer, but it's perfectly possible to convey electrical power from one device to another without cables. The technology doesn't yet work over a long range, but it's already possible to charge a smartphone wirelessly by laying it onto a charging pad, or placing it onto a stand.

That's thanks to an open standard called Qi, developed by the Wireless Power Consortium (**www.wirelesspowerconsortium.com**), which uses electromagnets to induce a charge in nearby devices – "nearby" in this case meaning less than 4cm away. Numerous phones from HTC, LG, Motorola, Nokia and Samsung either include built-in Qi charging or support an optional Qi battery.

A rival technology called Rezence is also being worked on by an industry group called the Alliance for Wireless Power (www.a4wp.org), whose members include Broadcom, Dell, HTC, Intel, LG and Samsung. This project aims to push the development of wireless charging for devices drawing 20W and more – but we haven't yet seen any hardware, and it remains to be seen whether its range will be any more extensive than that of Qi.

▲ MIMO technology can double or triple the data throughput of a wireless network

that first came to prominence was 802.11b (ratified in 1999). This wireless system is based, like most of its peers, on the unlicensed 2.4GHz frequency band. To be precise, it uses 13 "channels" ranging from 2.412GHz to 2.472GHz, so if there's interference on one, you can (manually) switch to another. Each channel is actually 20MHz wide, which means the channels overlap; if you have two routers in close proximity, avoid using adjacent channels as they'll interfere with one another. Note that in the US only channels 1-11 are licensed for public use, so imported devices may not support the full spread of channels.

802.11b supports a maximum data rate of 11Mbits/sec. In practice, though, much of this is eaten up by the overhead of the protocol, and by the vagaries of wireless transmission: in real-world use it's unusual to see a data-transfer rate of more than 5Mbits/sec. If the connection can't be maintained at full speed, the system can automatically drop down to slower modes (5.5Mbits/sec, 2Mbits/sec and 1Mbit/sec). The theoretical maximum range of 802.11b is 35m indoors and 140m outdoors.

Devices that support 802.11b networking should in theory work with modern routers, but if they're that old they may not support the WPA2 (Wi-Fi Protected Access) encryption standard, introduced in 2004. Many 802.11b devices were designed to use the older WEP (Wired Equivalent Privacy) security standard; this is now strongly discouraged, after a flaw in the system was discovered in 2001 allowing the encryption to be easily broken by someone eavesdropping on the encrypted signal.

Following 802.11b, 802.11g was introduced in 2003, based on almost identical technology but raising the maximum data rate to 54Mbits/sec. Owing to technical limitations, an 802.11g network will run more slowly when an 802.11b client is connected. This is due to the need to manage traffic so as not to swamp the older client. The overall speed isn't dragged down to 11Mbits/sec, but the throughput drop for 802.11g devices can be 30% or greater.

802.11n was released in 2009, although "draft-n" hardware based on unfinished drafts of the standard had been on sale for some years beforehand. The first big change in 802.11n is optional support for 5GHz bands as well as 2.4GHz ones, enabling devices to escape the interference from other wireless networks and communications devices (as well as microwave ovens - notoriously "noisy" in the 2.4GHz band).

Another improvement introduced in 802.11n is support for MIMO (multiple-in, multiple-out) designs, allowing routers to combine the transmission strength and bandwidth of multiple antennae. This improves range to approximately double that of previous 802.11 standards, and allows much faster data throughput: across a single Wi-Fi channel, a maximum bandwidth of 300Mbits/sec is theoretically achievable over four antennae. If you're shopping for an 802.11n-compatible router, look for one with as many aerials as possible. Note that smartphones generally have only a single antenna, so they can't take full advantage of MIMO speeds: tablets and laptops are more likely to have two or more antennae.

The most up-to-date Wi-Fi standard is 802.11ac, which was finally approved in January. This standard uses the 5GHz band only, although ac-compatible routers invariably support a fallback 2.4GHz connection for devices using older standards.

802.11ac supports yet higher transmission speeds than 802.11n, with a theoretical maximum of 88Mbits/sec per antenna on a single channel. It's possible to bond up to eight channels together into an ultra-fat 160MHz band, and to use up to eight antennae for MIMO transmission, yielding a theoretical maximum data rate of 7Gbits/sec.

The latest generation of 802.11ac hardware (called Wave 2) also adds support for multi-user MIMO, which allows the router to communicate at high speed with several clients at once, increasing the throughput of the network as a whole. ■

WHAT HAPPENED TO 802.11A, C, D...?

802.11a was created at the same time as 802.11b, and was in fact a more advanced system: it operated in the less crowded 5GHz frequency band and supported a higher data throughput of 54Mbits/sec. However, it was more expensive to implement, and, owing to its shorter wavelength, didn't penetrate so well through walls and indoor obstacles, leading early adopters to prefer 802.11b. Later developments such as 802.11c and 802.11d mostly cover "behind-the-scenes" protocols; 802.11z, ratified in 2011, defines a tunnelling system for allowing wireless clients to transfer data directly to each other, bypassing the access point. Having used up the entire alphabet, the standards body labelled the next standard 802.11aa, and carried on from there.

DVD CONTENTS

GAMES, ESSENTIALS, FULL SOFTWARE, DRIVERS & MORE!

This month we've loaded the DVD up with the latest versions of the tools and utilities you'll need. Keep it on hand to save yourself the trouble of downloading, and it might also be a good time to see if your own installed versions of these are all up to date.

For a bit of fun there are two terrific games on the DVD. First there's Prime World, a clever role playing strategy game from the Heroes of Might and Magic V people, as well as Moebius Empire Rising, a paranormal mystery adventure.

Enjoy!

What is Clonezilla?

Clonezilla is a partition and disk imaging/cloning program similar to True Image® or Norton Ghost®. It helps you to do system deployment, bare metal backup and recovery. Two types of Clonezilla are available, Clonezilla live and Clonezilla SE (server edition). Clonezilla live is suitable for single machine backup and restore. Clonezilla SE is for massive deployment, and can clone many (40 plus!) computers simultaneously. Clonezilla saves and restores only used blocks in the harddisk, which increases the clone efficiency. At the NCHC's Classroom C, Clonezilla SE was used to clone 41 computers simultaneously. It took only about 10 minutes to clone a 5.6 GBytes system image to all 41 computers via multicasting!

Features

- Free (GPL) Software.
- Filesystem supported: (1) ext2, ext3, ext4, reiserfs, reiser4, xfs, jfs, btrfs of GNU/Linux, (2) FAT12, FAT16, FAT32, NTFS of MS Windows, (3) HFS+ of Mac OS, (4) UFS of FreeBSD, NetBSD, and OpenBSD, (5) minix of Minix, and (6) VMFS3 and VMFS5 of VMWare ESX. Therefore you can clone GNU/Linux, MS windows, Intel-based Mac OS, FreeBSD, NetBSD, OpenBSD, Minix and VMWare ESX, no matter it's 32-bit (x86) or 64-bit (x86-64) OS. For these file systems, only used blocks in partition are saved and restored. For unsupported file systems, sector-to-sector copy is done by dd in Clonezilla.
- LVM2 (LVM version 1 is not) under GNU/Linux is supported.
- Boot loader, including grub (version 1 and version 2) and syslinux, could be reinstalled.
- Unattended mode is supported. Almost all steps can be done via commands and options. You can also use a lot of boot parameters to customize your own imaging and cloning.
- One image restoring to multiple local devices is supported.
- Multicast is supported in Clonezilla SE, which is suitable for massively clone. You can also remotely use it to save or restore a bunch of computers if PXE and Wake-on-LAN are supported in your clients.
- The image file can be on local disk, ssh server, samba server, or NFS server.
- Based on Partclone (default), Partimage (optional), ntfsclone (optional), or dd to image or clone a partition. However, Clonezilla, containing some other programs, can save and restore not only partitions, but also a whole disk.
- By using another free software drbl-winroll, which is also developed by us, the hostname, group, and SID of cloned MS windows machine can be automatically changed.

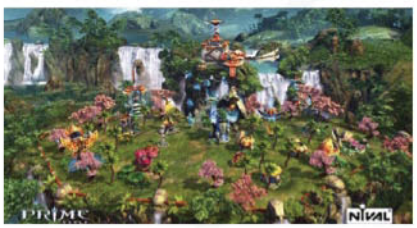
Prime World

Join the war between technology and magic in Prime World, the new role-playing strategy from the creators of Heroes of Might & Magic V, Blitzkrieg, and Etherlords. Choose from dozens of characters and fight your friends in a battle for victory, glory, and precious Prime!

Prime World merges persistent RPG hero development, PvP and story-driven battles and castle building. You can hire, equip and train your heroes between battles using collectible and upgradable talents, build a thriving economy in your city, and play together with your friends. You can even start your own clan and fight other clans!

Prime World offers various battlegrounds to challenge your friends – there are currently eight game modes, with more to come: from fast and fierce 3v3 Outpost to dark and moody 4v4 Dragonwald. And you will be able to play single-player episodic missions as well.

Each Prime World player is the lord of his or her own castle, the main base of operations and home to the player's heroes. In the castle, players can build various buildings (from mining facilities to decorative structures), create new talents, and select sets of talents to equip their heroes with for upcoming battles. The construction and infrastructure of this town is an important gameplay element in Prime World. A good town results in a combat advantage!



Moebius Empire Rising

The first in an all-new series of paranormal mystery adventures from award-winning game designer Jane Jensen, creator of the bestselling Gabriel Knight® series and Gray Matter.TM Step into the shoes of Malachi Rector, a brilliant antiques dealer and historian whose photographic memory and eye for deduction transforms locations and clues into interactive puzzle pieces and historical patterns. Players will criss-cross the globe's most exotic locales as they solve challenging riddles, search for hidden clues, and connect evidence and events to uncover a global conspiracy that threatens to bring worldwide ruin. When a young woman is brutally slain and a secret government agency decides to investigate, only Malachi Rector holds the key to unlocking this puzzle—a man whose destiny may not be his own to define.

* Use your photographic memory and deductive powers to analyze locations and clues to fit historical patterns
* Blends 2D and 3D graphics to provide sophisticated storytelling, atmosphere and puzzles
* Travel to Venice, Cairo, Zurich, and more, unraveling the mysteries of space and time
* Unlock hero Malachi Rector's destiny, and uncover his mysterious connection to ex-Special Forces soldier David Walker
* Unearth a global conspiracy that threatens to bring worldwide disaster

PC & TECH AUTHORITY

DVD CONTENTS

No 199 / JUNE 2014

FEATURE : PRIME WORLD + MOEBIUS EMPIRE RISING **DRIVERS:** ATI CATALYST + NVIDIA FORCEWARE **EDITORIAL:** BURNING AN ISO IMAGE + PC&TA EDITORIALS **TROUBLESHOOTING** + SERIAL CODES + BLANK REGISTRATION WEBSITE + **WINDOWS:** 7ZIP + CCLEANER + CUTEPDF + DEFRAGGLER + DEEPBURNER + FOXIT READER + APPLE ITUNES + MALWAREBYTES' A/M + SANDBOXIE + SPYBOT S&D + VLC MEDIA PLAYER + WINRAR + WINZIP **INTERNET** + AOL INSTANT MESSENGER + VUZE + DROPBOX + GOOGLE CHROME + FILEZILLA + M/S SECURITY ESSENTIALS + MOZILLA FIREFOX + MOZILLA THUNDERBIRD + SKYPE + STEAM + ZONEALARM **LINUX:** CLONEZILLA

INSTRUCTIONS: Open Windows Explorer, navigate to your DVD drive and double-click Index.html in the root directory. **DISC PROBLEMS:** To replace faulty DVDs, please send the discs to: *PC&Tech Authority* DVD Replacements, Level 5, Building A, 207 Pacific Highway, St Leonards NSW 2065

Make sure to include your name and postal address on the back of the package so that we know where to send the replacements. For all other DVD related issues email **cd@pcauthority.com.au**. As the delivery platform only, *PC&TA* and Haymarket Media cannot and will not provide support for any of the software or data contained on these discs. Although all discs are virus scanned, Haymarket Media cannot accept any responsibility for any loss, damage or disruption to your data or computer system that may occur while using the discs, the programs or the data on them. There are no explicit or implied warranties for any of the software products on the discs. Use of these discs is strictly at your own risk.

Input Output

DAN RUTTER BRINGS THE ANSWERS TO YOUR QUESTIONS LIKE NO-ONE ELSE CAN

THUMB-DRIVE SURGERY

I trod on my flash drive - it had to be the 128GB one not the 4GB one, didn't it? - and snapped the connector off. The little circuit board's delaminated where the connector was soldered on, but the traces that went to the connector are clearly visible past the destroyed part of the board, and I reckon I could solder something onto them.

Is there a way to put a new connector on this thing, or will that be an express train to data corruption?

Christian Wong

Now pull out the little piece of paper with your fortune on it!

O Yes, you can fix it, and yes, it'll probably be fine, if ugly. As long as the mechanical damage really is only to the USB connector portion of the board, and no cracks have gone further into the land of microscopic surface-mount components, then it really does just need a new connector. USB connectors only have four contacts, too (bit.ly/usbpinout), so a novice can solder them quite successfully. (As compared with, say, a DVI connector, which uses 24 contacts, plus another five for the optional cross-shaped analogue contacts.)

The easiest way to do this, especially with a drive with damage to the USB-plug traces, is to sacrifice a USB cable with an A plug on it (the same gender the drive had before). Chop the non-A-plug end off, strip the wires, figure out which one goes to which contact with your $10 yellow plastic multimeter in continuity mode, and then solder the wires onto whatever broken device has lost its plug.

If you don't care about keeping the busted drive, then you can improvise something without having to solder - little alligator clips, syringe-type circuit test clip leads, paper clips, whatever's necessary to temporarily connect the circuit-board terminals to the USB socket of a computer for long enough to recover your data.

If you solder a cable onto the circuit board, though, you can keep using the thumb drive. Once you know it's working, just drown the board in hot-melt glue or some similar substance to protect the connection. (Although it is a great Half-Arsed Electrical Repairer tradition to use half a mile of vinyl electrical tape in this situation, please don't.)

The management, as usual, disclaims all responsibility if this advice results in you shorting a USB connector and blowing up your USB controller.

CONFIG, SCHMONFIG

I've got a new PC (but with Windows 7 x64, cos like all right thinking people I will not have Win8 in the house) and now I can install stuff in Program Files (x86), but some of the stuff I install gets error messages if it tries to make any files of its own, like config files, in the same folder.

Windows pops up a do-you-really-want-to-do-this thing when I install the programs, but there's no similar notification when the programs try to do stuff, it just fails every time.

I thought it was a permissions problem, but digging through account permissions and folder permissions only shows me that there are indeed some things my administrator account can't do, but they're all greyed out and I can't change them!

Don't make me smash this thing. It has an SSD and a GeForce 750. It's really nice. It's just allergic to boringprogram.cfg files.

Keith Centeno

O You've got User Account Control turned on, and your old programs weren't installed in a way that UAC could track. (Did you just copy a folder or two into Program Files, by any chance?) UAC thinks those programs may be doing something underhanded. But even then, as you say, it should tell you, not just deny those programs entry to the nightclub and swear it never even saw them.

UAC is a good idea, and by and large works, though it can also be a good idea to turn UAC off when you're setting up a new scratchbuilt computer, to avoid endless "yes, mother, I meant to install that one TOO" experiences. If UAC totally blocks some software that matters to you, though, just turn it off for good. You can still restrict the account permissions of your everyday login and get reasonable security, provided you actually read the requesters when things install.

(This is the big problem with many security systems that pop up "do you really want to..." requesters. The less experienced the user, and thus the more they actually need that security system, the more likely it is they'll just be trained to always click OK without reading.)

AN IMPENETRABLE CAT5 JUNGLE

I At my work the server room has a huge network patch panel, the backside of which is a horrorshow. Multiple cable colours, multiple cable lengths, all just plugged in all over the place.

The front of the patch panel looks fine, though, neatly and correctly labelled, and everything works. I presume whoever wired the back just used every cable that came to hand before buying a reel of one colour, or something. But is this likely to be a problem in the future?

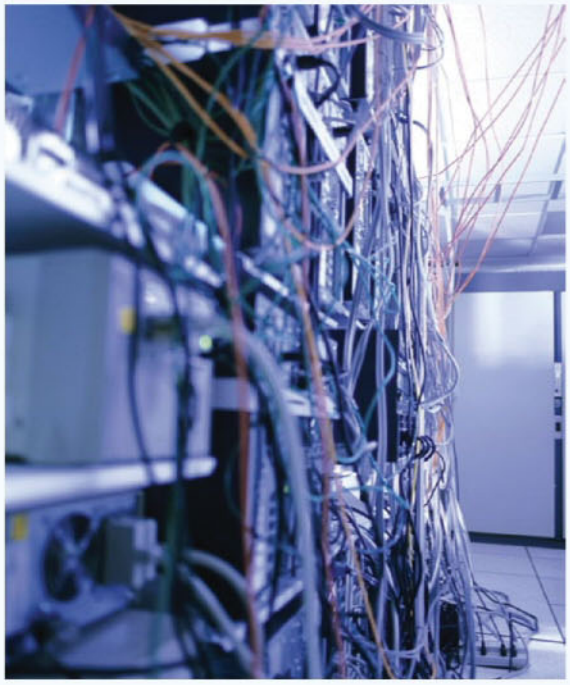
We've had about the same number of network problems in this office that I've seen in every other job I've had (not very many), and none were traceable to the patch panel, but is it a ticking bomb situation?

T. C.

It's probably fine.

The idea of the standard patch panel is that the back of it is wired up precisely once, when it's installed. Every single socket is supposed to be connected to the appropriate other socket, even if nowhere near all of them are yet needed. Then, the panel's pushed into its rack or into the corner or into an Ikea bookshelf (depending on your business's scale...) and the back of it is never touched again. The wiring behind the panel should be neat and tidy, but provided it doesn't break network rules (wrong cable grade, kinked conductors, outrageously long, that sort of thing) it can be as much of a spaghetti-explosion as you like, and still work.

So this is another of those things that's only a worry insofar as it indicates that the person responsible for the ugly rack wiring might have done something just as ugly, but more likely to cause problems, somewhere else.



This kind of crap is acceptable, but only on the BACK of the patch panel.

THE H4XX0R-F0N3

I was sitting in a cafe the other day, and as I always do I tried to connect my phone to any local free WiFi, of which there wasn't any. The phone connected to an unencrypted network, but the browser just showed one of those "give us money for a magic code" pages, I think from the small hotel next door. OK, no problem, no surfing for me, get on with lunch.

Except after I *finished* lunch, I noticed that I now had new email downloaded to the phone. I definitely didn't get it via 3G or any other phone network, but there it was. But the Internet was still clearly blocked, because I hadn't gone next door with however much money they wanted.

How did this happen? Do I have a magic telephone?

Harry Toft

The network you connected to did not block your Internet access as well as it was actually meant to.

The "gateway" device that was supposed to block you until you had a paid code correctly redirected port-80 HTTP requests to the pay-to-login page, but it passed port-110 POP e-mail traffic without complaint. It might also pass port-25 SMTP e-mail upload traffic, though any such activities on an unencrypted public network are not a great idea security-wise.

Holes like this can be exploited in a number of ways. You could, for instance, tunnel an encrypted SSH connection through some port that turns out to be un-blocked and connect to the Internet quite securely via the server - like perhaps your home PC - at the other end of the tunnel. Or, for a clumsy but more straightforward solution, you could connect to a remote machine via VNC or Remote Desktop or something and just use a browser on that machine.

A properly configured pay-gateway should block all ports for non-paying users, but dumb ones that only block port 80, or let through any port higher than 999, are not hard to find.

Note that doing any of this stuff is now quite spectacularly illegal in many jurisdictions, so do please be very careful and not too greedy. Just accidentally checking your mail isn't likely to get you indefinitely detained as a cyber-terrorist, but deliberately exploiting such loopholes can, in the unlikely event that you're caught, get you in big trouble even if you haven't been downloading movies and sending death threats to world leaders.

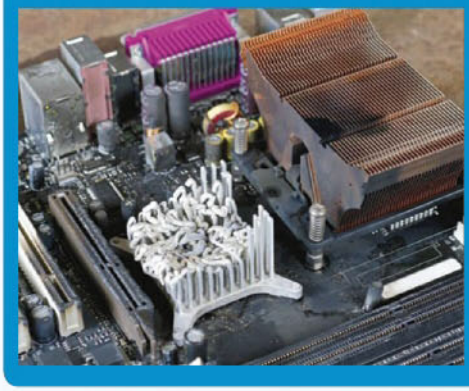
I/O OF THE MONTH

THE SILENT DEATH

I Do modern PCs still have beep error codes? There was a small power cut last night and my PC hasn't worked since (so this is yet another of your "I'm typing this on my phone, because..." letters). I've taken every component out of the motherboard except for the CPU and the power connections, and when I turn the machine on now the fans still spin, but there's no error beep for no-RAM, no-video-card, et cetera.

Any ideas on what's dead, besides "everything"?

J. Bignold



O Yes, you should get BIOS error beeps if you power up a motherboard without some essential component(s) connected to it. If there are no beeps then either you don't have a PC speaker plugged into (or built into) the motherboard, or something major is probably fried.

It might be something wrong with the power supply, which is the component most likely to get barbecued by mains power problems. This is by design; a PSU is meant to sacrifice itself to save the rest of the PC - passing through mains weirdness to the other components is one of the things that crappy off-brand maybe-not-even-legal PSUs can be expected to do. If the fans are spinning though, the PSU is probably OK.

So, most probably, you've got a dead CPU, a dead motherboard, or possibly even both. If nothing else in the computer is old and flaky (no five-year-old drives, either spinning or SSD...), so you can't justify a whole new machine, then I'd just get a new CPU and mobo and turn the old ones into wall decorations.

◀I'm not convinced. It could still be the power supply

Top five Windows domain mistakes

CREATING YOUR DOMAIN IN MICROSOFT WINDOWS CAN BE A MINEFIELD, SAYS **STEVE CASSIDY**. HERE ARE FIVE AREAS WHERE EXTRA CARE IS NEEDED

If you want to use most of the nicer, smarter parts of Microsoft's network software portfolio, you'll have do so with a domain. I realise that many will be thinking that this topic ought to be done and dusted by now, since almost all long-lived, mid-sized businesses are already doing so. Even so, we're living through the dog days of Windows XP, and there are still many smaller operations that, rightly or wrongly, are treating the end of XP support as the occasion to reappraise everything they're doing. These stuck-on-XP types tend to have a slightly eccentric outlook on how to receive and deploy the very latest Microsoft products.

I'm frequently amazed by the myriad explanations and convictions that some clients put forwards as to why their disastrously dysfunctional domain is actually set up just the way that Microsoft intended – if only Redmond would admit it. Rather than explain their wrongheadedness over and over again, let's look instead at a few of the scenarios that crop up, the impact they have, and the fix that's required to get back on track:

1 THERE'S A REGISTRY KEY FOR THAT

There's a widespread belief that all those layers of utilities, wizards, advanced scripts and GUI are merely glittery, cosmetic fluff, meant to obfuscate the real Registry in its capacity as an essential storage and configuration tool. The thinking is that whenever you come across some peculiarity of behaviour you disapprove of – let's say, for example, the way that workstations create THUMBS.DB files – then you must immediately dive into your machine's Registry and start editing it.

To be fair, much of the documentation for both current and earlier releases of Windows makes this sound like a legitimate and straightforward way to go, but I have to remind you that once you've decided to implement a Windows domain (or to use any systems that rely on domain features), then your Registry needs to be boldly labelled "do not disturb", and treated with a good deal of care. This is because Microsoft regards the Registry as its own rightful property, not yours. Many parts of the Registry are used by the security and user-control sections of the domain setup, and if you start playing with remote desktop platforms such as Citrix and Microsoft RDP, then you're dealing with segmented Registries – that is, user-dependent hives that will change as different user sessions log in and out.

> Once you've implemented a domain, your Registry needs to be labelled 'do not disturb

It's not easy to wean yourself off such precarious Registry fiddling, but the best solution is the one that Microsoft recommends: learning how to use Group Policy Objects and their associated editor. There's a particular stick-in-the-mud type of Registry jockey who will loudly argue that the obfuscatory style of the Group Policy environment is even worse than using Regedit. What's more, they'll argue, there are vast areas of performance tuning that an unadorned GPO environment can't touch. However, you can fix such cases by inserting script into the relevant part of the overall domain Group Policy, so that they'll be picked up by the relevant users.

STEVE CASSIDY
Steve mixes network technologies with human resources consultancy work

2 DNS SERVERS

DNS is possibly the least understood and most vital part of any Windows network, with or without a domain controller (DC). DNS actually has a vast and globe-spanning body of documentation; the trouble is that it's been written by engineers, and therefore takes the broadest possible view. This means that it encompasses every conceivable configuration in an attempt to build up a definitive body of knowledge. As such, it doesn't even consider the existence of casual readers who need only a quick overview, and who will end up swamped with information they don't need to worry about.

Anyone struggling to get by with a basic DNS configuration will uncover a daunting mental labyrinth the minute they dip into the documentation. Unlike the security and container-versus-group topic I'll come onto in item four – which is regularly abused by consultants in pursuit of fat fees – this DNS problem is one that foxes consultants and amateurs alike. I've often despaired at DNS setups in networks built by people who have been on all the courses but still don't understand how important a Reverse Lookup Zone is for effective Windows operation. I've heard of people who are charging good money to clients, yet have no idea how to read the responses from the ubiquitous, simple and very easily understood NSlookup utility.

I'd love to be able to say that I can show you a clear, step-by-step guide to making Windows DNS function well, and balance requests for names for the inside and outside of your business network. However, even the TechNet article that heads the Google searches I tried merely babbles about performance issues that are of no concern to modern machines, then quickly degenerates into a series of pointers to RFC documents, written back when the steam-powered PDP-11 was then considered a general-purpose workhorse.

Essentially, if you're reading this because you're a first-time domain implementer, then I'd suggest you hold fire until you've searched online for some simple instructions and, ideally, read at least half-a-dozen permutations on the phrase "Windows DNS setup best practice". It's all too easy to fall into common traps and pitfalls which can be avoided.

THE INTERNET OF THINGS

If you use Google Maps to zero in on the junction of Poydras and Loyola in New Orleans, you'll just about be able to see an imposing glass tower. Now imagine yourself on that spot at 4am in late February. The Hyatt Regency hotel is dark because, even though it's full, everyone's in bed. The roads are empty because it's the middle of a storm. Rain squalls swoosh across the car parks that surround the Superdome next door, forcing you to turn so that you happen to look up at just the right moment. On the dot of 4am, each window lights up simultaneously with a ghostly blue glow. Every TV in the building has turned itself on in perfect synchronisation.

That smooth pattern of blue spilling out of all the rooms is from the hotel's Home menu page, at which all these TVs start up. In your role as hypothetical observer, you'd then have witnessed a random sequence of darkenings as each separate convention attendee (me included) is woken up by the chintzy Muzak emanating from their TV, and tries various ways to turn the damn thing off. My telly (in room 2305, around the other side of the tower from you, since you ask) responded to its remote control and shut down, but other guests – all qualified nerds, I might add – had a harder time. Most quickly found yanking the power cord out was the quickest way back to sleep. Several reported that pressing the power button didn't work, as the TV would just come back on. These poor souls joined the unplugging club pretty soon.

This last effect occurred because these ostensibly modern TVs were actually only monitors, connected by HDMI to a battered computer on the wall, hooked up to an Ethernet hotel network. When faced with an active wall-mount box, these "TVs" were obeying an in-line hardware signal, included as part of the HDMI specification, that tells device B to power up whenever device A is turned on and vice versa.

But we're not interested in that, for we are network people. That box on the wall is our focus, as it was for the hundreds of geeks jolted from their slumber, and for the squad of irritated techies who

turned up the next day with master room keys and backpacks full of reload and system-wipe tools. I believe from what I saw of their efforts that the box on the wall was running XP Embedded in a heavily customised config to provide on-demand TV, with a pass-through Wi-Fi implementation based on a USB dongle.

I never did discover what had triggered the 4am startup, but from the demeanour of the support team, I'd be prepared to bet that either an infected laptop acting as a relay pass-through for malicious traffic, or else a black-hat show attendee, lay at the root of their difficulties.

Many people believe that the rapid pace of change in computer security, and the imminent demise of Windows XP, are phenomena they can observe from afar. I'm tempted to say this TV affair was the kind of thing you expect when nerds come to town. But what the nerds are exposed to today is coming after you tomorrow. Having neglected its tech investment for too long, I expect the Hyatt is now looking at a sizeable bill to guarantee those TVs can't come on spontaneously again. It's a fun party trick that must have made less-clued-up observers jump, but it's also a sobering reminder of the perverse effects we can expect as technology pervades every corner of modern life.

3 FOREIGN (NON-WINDOWS) DHCP SOURCES ARE FOR GROWN-UPS

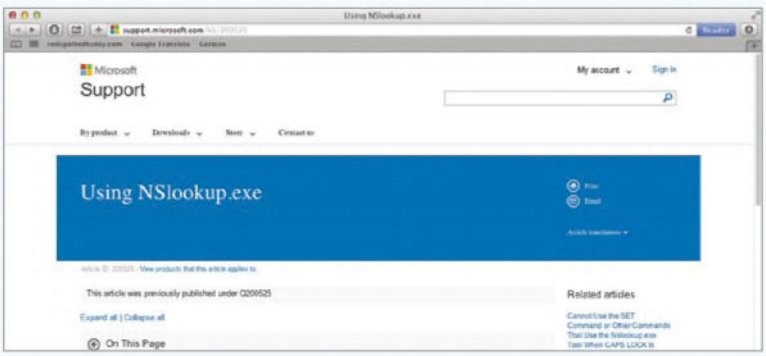
This is a problem for both the very bottom and the very top end of the network market. Middle-market users will tend to follow the right way of proceeding because training courses have been taken – a fact that's been pretty clear for some time. Bottom-end users generally encounter their first domain setup – probably thanks to the purchase of a complicated business application that has a database and security – long after they've connected their PCs to that funny internet thing, which necessitated a router. And routers like to hand out IP addresses.

At the very top end of the market, things are very different. Here, it's likely that the network contains many more devices than only Windows PCs, and that it's been provided with paranoid levels of protection as a centralised architecture. The top priority is to keep all the VoIP phones running after someone has broken the Windows server, especially if the company is striving to meet some of the painful regulations that govern the taking of payments by phone, which have ended up intruding a very long way into the network.

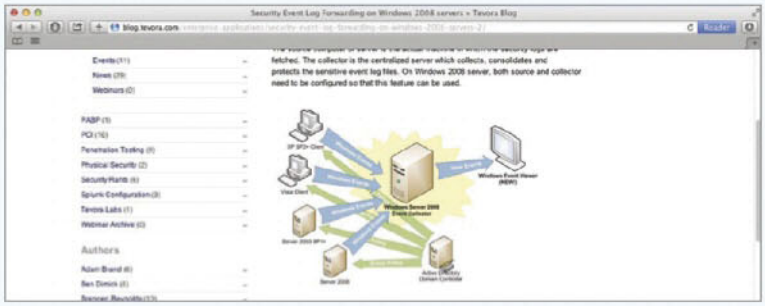
The bottom line is that a Windows domain prefers to hear about its devices and PCs from a DHCP service running on a DC, which immeasurably improves things such as device-name lookups and security conversations. The DC is widely understood to be a resource for workstations to look stuff up on. However, not many people realise that the DC also polices your LAN by chatting to any machine that makes a request of it, and checking whether that machine should be given what it's asking for.

A refusal doesn't actually terminate the connection, and this fact raises the false impression among sceptics that such policing is an optional extra, and that other external name-resolution and security-exchange mechanisms will kick in at a later stage in the "wake up; get address; pass login details; grab mapped drives" sequence. Not so. The trouble is that if you don't get DHCP right, odd things will keep happening to your PCs. If you tighten up your security (see item four for how that can bite back), or you're obliged to maintain several different Windows versions and bring them all into one friendly domain, later security conversations may introduce all manner of difficulty.

Don't get me wrong, I'm not advocating a "DHCP right or wrong" state of mind. In particular, I don't



The rule is clear: the uglier the layout, the more valuable the information. Here you'll find everything you wanted to know about NSlookup, which is a crucial tool for debugging domains



Not all Windows domains are quite this complicated – but it's amazing how many parts you can miss out and still think it's working

like the way that lots of technical documentation, stretching right back to the dawn of IP as a protocol, will insist that you employ reservations to ring-fence machines with static IP addresses. I'm still puzzled about how you can keep two DHCP servers active at the same time against the unexpected. However, ignoring such doubts, my simple advice to you is to not to work around setting up a DHCP server in your domain. There's more to come on this subject, because Windows Server 2012 R2 is starting to place heavy emphasis on the far more complex and powerful IPAM machine-configuration service.

4 LITERALLY SECURE

This isn't really about security. I know, people often find that in a growing company they need to hide stuff away to protect it from accidental deletion: I take that as a given, since it's often the reason for a business to adopt the domain model in the first place. The problem I'm alluding to here isn't about folder or share permissions: it's about people who read the domain cookbook for the first time and become completely mesmerised by those various illustrative, example-driven explanations of what Active Directory (AD) and domain login can be made to do when you're implementing a complicated security environment.

I'll introduce a quick case study from outside the world of Windows domains. AD is at least as complex and configurable as the security structures within Lotus Notes, which – Lotus and then IBM were proud to announce – had been used to supply an email and groupware environment for the Northern Ireland Assembly, a legislative body with ready access to a wide range of weapons and ammunition. "Only one container" was the Lotus mantra for how they had erected a secure, testable "Chinese Wall" between the recently warring factions in the assembly and made it work in the long run. The truth is that almost all such waffle about advanced separations between entire business divisions and user groups (including all the stuff about forests and partitions and the like) is simply a vast collection of temptations to divert you into nonsense. It works, of course – indeed, it all functions nicely once you've understood and implemented every last ramification, and it most certainly boosts the obfuscating and fee-maximising efforts of unscrupulous IT consultants the world over. Yet almost all of it is entirely useless.

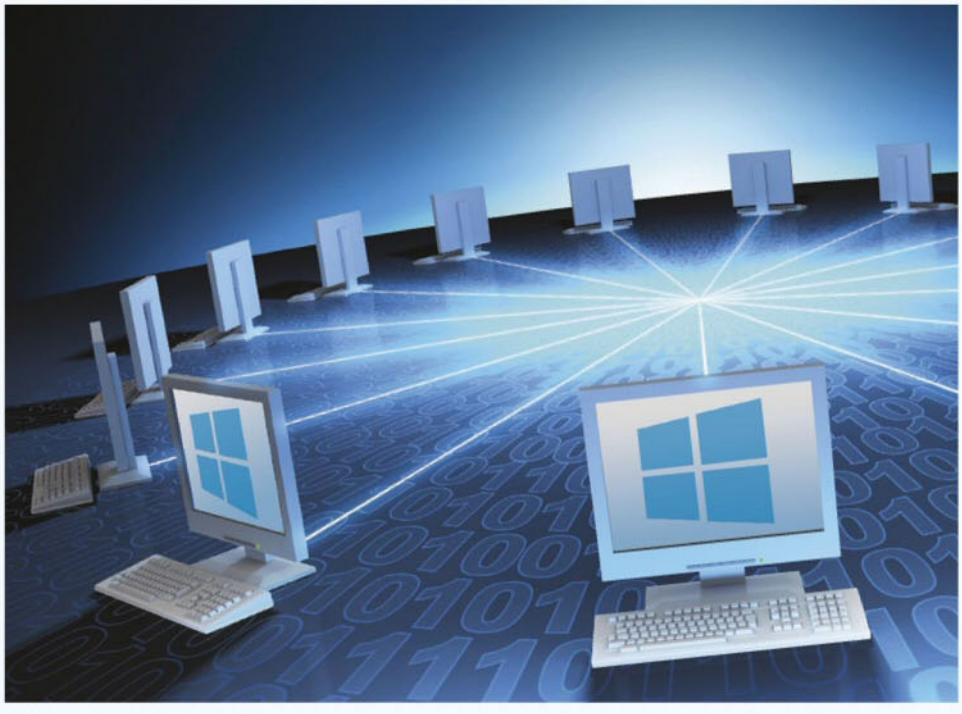
For a business with only five divisions, and a thousand people in each division, a modern PC acting as a DC can run pretty well by collecting these users together into simple, clearly organised and helpfully named groups. However, I came across one network recently that had a top-level domain called "fredone" and a top-level DC called "fred-one", with other levels called, for example, "fred-six", each with a matching server. Quite apart from any software consequences of such poor choices, it was a terrifying mental tongue-twister every time a network administrator arrived and tried to figure out where and how to log in.

5 THE CAVALIER DELETION

Short but sweet, this one. Hardly anyone understands that if you have a DC that dies, it won't automatically disappear from AD. Microsoft expects you to restore the dead machine from a backup, then remove it from AD (which is apparently best accomplished by demoting it), wait while that removal propagates to all the other DCs, and only then to finally and confidantly consider it dead and buried. I've lost count of the number of domains I've seen that won't run the scripts that come alongside the Server 2012 upgrades because, at some point in the past 15 years, some visiting expert decided to build themselves a temporary, experimental DC, and then just wiped the disks of the machine they hosted it on. AD remembers incidents like that, so all manner of propagations and conversations will start to fail because they expect to find a participant whose ghost has long since faded away. ■

NTDSUTIL TO THE RESCUE

The fix for problems created by an incorrectly deleted domain controller is a very slow and careful walk through the well-identified and well-documented Ntdsutil command-line tool, which you'll find at **http://tinyurl.com/7rkybkq**



The post-Ballmer era

JON HONEYBALL HOPES THAT NEW MICROSOFT CEO SATYA NADELLA WILL BE MORE PRAGMATIC, AND STOP TRYING TO PROP UP THE OLD GUARD OF WINDOWS

The news that emerged from Mobile World Congress in Barcelona couldn't have been more confusing. Nokia, which is about to become part of Microsoft, has launched a range of Android phones aimed at the lower end of the market; ironically, the excessive licensing cost of Windows Phone must have played a part in the decision to jump ship. As for Microsoft, having new Android-based devices on its books – even at arm's length – must be causing the collective Redmond nose to wrinkle.

What will this do to the developer story from Microsoft? Developer support is one of the areas where Microsoft has always retained a strong reputation: the company is able to point to all sorts of programmes and resources aimed at supporting developers large and small. But this scenario has been falling apart in recent years. Just look at the array of new technologies that have come and gone, to the fury of those who invested time and money in learning them. Add to that the entire programmes that have been chewed up and spat out recently, culminating in the summary execution of TechNet.

Now I'm hearing that developers are having problems with the 2013 build of Visual Studio. Apparently, it's prone to spitting out its dummy if it's taken away from the internet for too long: it simply shuts down, which can be rather bothersome if you're in a hotel with a poor internet connection, or sitting on a plane.

Let's be clear about this. I have no problem with software subscriptions. Office 365 is one of the best things to come out of Microsoft in a long time – although I still bear the scars from the dreadful way Microsoft handled the 2013 upgrade process – and I like the way Adobe is handling its online subscription offering, even if I'd prefer an option to add a third or fourth device at a discount, rather than multiples of the original price. I like the way I can move licences around to suit my needs.

I don't even mind software that phones home to check it has a valid licence, although some companies take it too far. I'm looking at you, Wolfram, and the way your client software shuts itself down within about 12 minutes of a network outage, causing your network licensing server to disappear. No software vendor has the right to stop a legitimate purchaser from doing real work. I don't mind if the software starts whinging that it hasn't talked to a licensing server for a while, or even if it threatens to go beyond whinging when ignored for a long time, perhaps a month. But going straight into shutdown mode is unacceptable. Bad form, both Wolfram and Microsoft.

> To be a services business, Microsoft needs to get its software onto every device

Back to the Android thing. If Microsoft is going to inherit new Android devices from Nokia, what on earth will its developer story be? Will it revive its J# tools for Visual Studio and release a cross-compiler? Or would it be better to go with Xamarin, the cross-platform solution that lets you develop in Visual Studio and then target out runtimes for a range of devices? Maybe the post-Ballmer era will be a more pragmatic one, one that recognises Windows Phone is going nowhere fast and that the monsters that are iOS and Android have already eaten its breakfast, lunch and dinner.

Indeed, we're already seeing the signs of pragmatism with the release of Office for iPad (*see p30*). More on this from me next issue, but it's already clear this is far more than a port of the desktop apps to a smaller screen. And it needs to be. If Microsoft truly is turning into a services business, it needs to get its software out onto every capable device, and trying to prop up the old guard of Windows simply has to stop.

SHARED SCREENS

My first month with the new Mac Pro has been fascinating. As I predicted, this device is an astonishing waste of money if you're only going to be browsing the web, fillling in spreadsheets and doodling in a paint program. To get value from this behemoth, you need targeted and heavily optimised applications designed to exploit its extraordinary capabilities to the full.

I set up a bunch of 5K video-editing tasks from our Red Epic-X camera, then performed multiple overlays, distortions and transparencies on

them. Final Cut Pro X ate this problem with one large munch, and the CPU meters barely flickered. Most of the time, however, it's difficult to see any performance benefit compared to an i7-equipped iMac.

I'm still waiting for the arrival of proper 4K monitors before moving ahead on the video front, so my current desktop is a case of "plus ça change, plus c'est la meme chose". For the past couple of years, I've been using a 27in iMac with a 27in Thunderbolt display beside it, ramped up by an empty Apple keyboard box. (How Apple managed to get two 27in screens to be different heights is beyond me; Cupertino's screw-ups are rarely this bad.) Now that I have the Mac Pro on my desk, the Thunderbolt display is connected to this, and the iMac has reverted to a single screen.

Old habits die hard, though, and despite the arrival of a second keyboard and mouse on my desk, I still find myself trying to move the cursor from one screen to the other. This doesn't work, since it's now two separate computers. Surely there has to be a solution to this? Well, there is. In fact, there are several.

The one I ended up using is a free package called Teleport (**http://tinyurl.com/7yzvk**). To use it, download the tiny package, run its control panel extension and turn it on; do this for both machines. Each computer will find the other, and you can arrange their desktops just as you would arrange multiple monitors connected to the same computer.

In operation, it's simplicity itself. Start with the keyboard and mouse on the main computer and slide the mouse pointer to the edge of the screen; it will hop to the monitor on the second computer exactly as it would if you were using two screens on one computer. Move the mouse pointer back to the first screen and you'll assume control of the first computer again. Better still, the contents of the clipboard are transferred between your computers as you move the mouse around.

If you want a solution that can handle more than only OS X, take a look at SynergyKM, which has clients for many platforms. Line up a Windows machine, a Linux box and a Mac and you can move the mouse pointer and keyboard between the three in a nicely seamless fashion.

Finally, a trick for Mac users worth remembering: a recent iMac can be used as a monitor as well as a computer. In fact, you can switch between the two modes. All I need to do is connect a Thunderbolt cable between my Mac Pro and my iMac, then use a key combination to switch the iMac between Target Display Mode and normal operation. The iMac continues to operate as normal in Target Display Mode; you just can't see what it's doing.

I like the speedy, cheap Asustor AS-608T NAS box so much that I might buy a second one

All these capabilities have caused me to rethink my plans for the Mac Pro. I briefly considered using it as my daily computer and throwing all sorts of beta software onto it, but now I'm tempted to keep the iMac as my hack computer and reserve the Mac Pro for optimised, high-end workstation software. But to which should I attach the storage? Should I keep the 48TB on Thunderbolt attached to the iMac, or should I move the fibre-optic Thunderbolt cables to the Mac Pro? Where should the system's centre of gravity be?

This difficult decision isn't made any easier by the arrival of the Asustor AS-608T 24TB NAS box, which was recently recommended by *PC &Tech Authority*. Just over a grand for 24TB of fast storage? Don't mind if I do. In fact, I like it so much that I might buy a second one and mirror them across the network. However, to put my faith in an Ethernet-switched storage NAS, I need to be sure that I'm getting the best performance out of my Gigabit switches.

That's why I've delegated to Rob, our new lab rat, the task of looking at the status pages on all the switches and working out where all the traffic is coming from and going to. This will help us decide which devices really need Power-over-Ethernet. Some are obvious, such as the security cameras and desktop VoIP phones, but others aren't so simple. Once we've conducted a full analysis of the traffic-flow patterns around the lab network, we can perform a wholesale replugging and re-routing exercise.

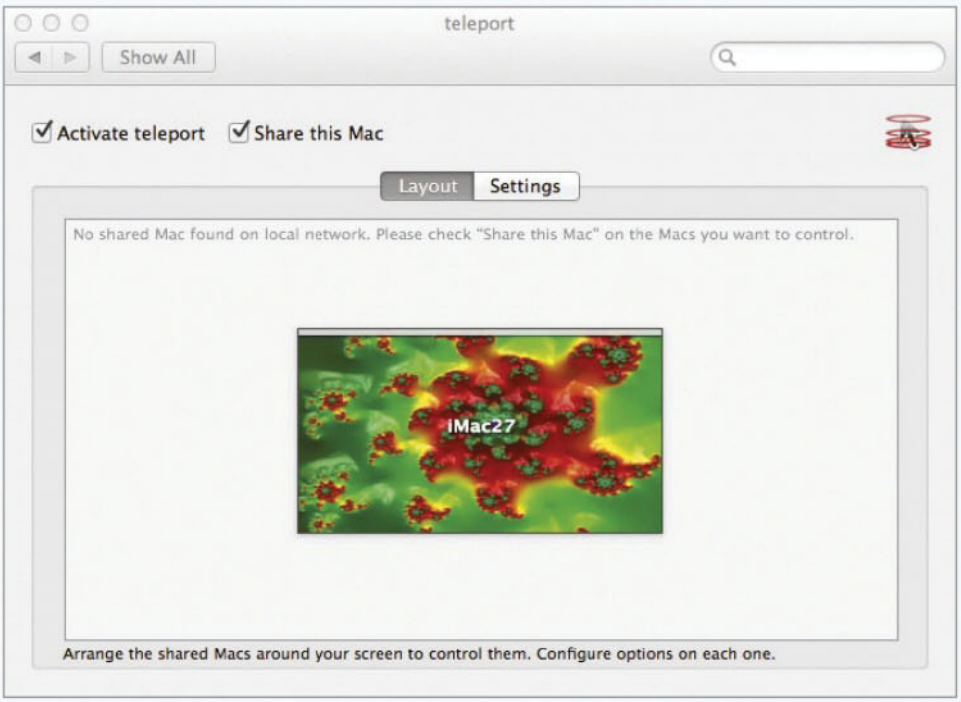
I might even be brave and drop in some VLANs to segregate the networking further. With around 7km of 10Gbits/sec Ethernet wire running around the edge of our lab, the network architecture ought to resemble a plan of some sort, rather than a plateful of spaghetti. Perhaps I should get RWC's Networks editor Steve Cassidy to drop by and take a look, but I fear he'd try to put IPv6 on my coffee machine and wire up my chair as an input device.

THE EVER-DECREASING PRICE OF WINDOWS

I recently uttered a prediction that caused some to gasp: namely, that the cost of Windows for the home desktop is inexorably moving towards zero, and that it's only a matter of time before Microsoft stops pretending anyone's prepared to spend money on it.

Without a doubt, some of the woes in the laptop and Ultrabook

JON HONEYBALL
Computer journalist and consultant specialising in both client/server and office automation applications.



You can easily use a recent iMac as a secondary monitor

market have been exacerbated by the relatively high cost of a Windows licence: when a market is collapsing towards free, an OS licence that costs tens of dollars is no help to manufacturers that are struggling to compete with Android. They come to resent it as a Microsoft tax.

So it's interesting to hear that the next big release of Windows – which will no doubt be named something snappy such as Windows 8.1 Service Release 1 Upgrade Pack For Intel Windows Desktops Without Active Directory SP1, or WSRUPFIWDWADS for short – is going to come at a significant price reduction for OEMs. Some have even suggested it may drop to $15. If this turns out to be true, I might be right that the new CEO of Microsoft, Satya Nadella, could be tempted to make a bold gesture in the direction of customers still running Windows XP.

How about a 60-day window in which you can get 8.1 Update 1 Home Edition for free? Yes, a full licence. These home users aren't prepared to cough up any money, so give it to them for free. This wouldn't be plain sailing, though, since there's no direct upgrade route from XP to 8.1. They might have to run a full backup, wipe their machine, install and recover data. Perhaps Microsoft could even offer this service as part of a whole upgrade package. Or maybe not – I can see sound arguments both ways. Making the offer to the customer base would be a significant gesture itself, worthy of the incoming CEO of an important company. Of course, it won't happen, since the bean counters would hate it. Hey, it was a nice thought.

> I utilise a mere fraction of Excel's power, probably less than 5% on a hard day

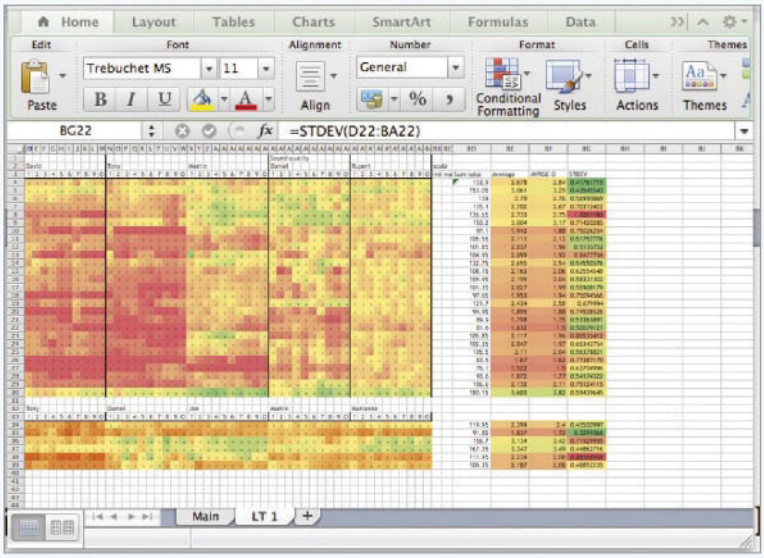
CONDITIONAL FORMATTING IN EXCEL

Like most of us, I utilise a mere fraction of Excel's power, probably less than 5% on a hard day – and that's being generous. The problem is, alternatives to Excel don't have the exact 5% I need (or, more precisely, need at this moment).

I really like the idea of Numbers for the Mac, for example, but today I ran into a bizarre roadblock. You can't select a range and print only that range; you can choose only whole pages. At least, I believe that to be the case – perhaps you know better? I wanted to print a small part of a sheet and found that it wasn't possible. I could make the sheet look beautiful in ways that would make Excel weep with sadness and jealousy, but print only part of a page? No.

As I get older, I marvel more and more at the way other people think about the software-development process (and the hardware one, too, for that matter). I became bored with Windows Update more years ago than I care to remember, but today it isn't only drivers and app patches that I need to hunt out; I need to look for firmware updates for almost every new computing device. I'm even more bored of products that ship with buggy firmware that eats the battery in a fraction of the time it should, or have a propensity to slump into power-saving mode and remain there seemingly forever.

Anyway, back to Excel. It's worth taking some time to look at its conditional formatting capabilities, which have been beefed up considerably in recent versions. My favourite is to use a colour scale to "hotspot" interesting high or low numbers. Go to Conditional Formatting and choose Color Scales, then enter the ranges you want your colour scale to work across. Here in the lab, we use a lot of 1-to-5 scales, where 1 means poor and 5 means good. Put red at the 1 end and green at the 5 end of the scale, and make sure it passes through yellow at 3. Apply this scale to a range of data and you'll be amazed at how much easier it is to interpret the information now. ■



Excel's colour scale makes it much easier to interpret information

Dark clouds

FIONA TEAKLE WONDERS IF THE CLOUD HAS BROUGHT INCREASED RISKS, AND IF SO, HOW CAN THEY BE MITIGATED?

As the world becomes increasingly connected we are becoming more open in a public sense. Are people starting to lose sight of what it means to have privacy and even ownership over their ideas, data and photos? We post things online without second thought, but what are we actually losing out on?

In an article released by IFIP (International Federation for Information Processing) in November, they highlight the fact that they believe there are major practical pillars of trust in the internet which are being internationally weakened in a systematic way at the behest of government organisations and other major actors in the field. Even more recent, the world has become increasingly aware of the word "Heartbleed". Brought to us by a Google security engineer and some other researchers; they published some information indicating they had discovered a serious flaw in some versions of OpenSSL cryptographic software library. Essentially if you knew how to get through the flaws, you could have access to everyone's most personal information, such as passwords, bank details etc. So while most people have since gone away and changed passwords this does open up a lot of other questions.

Cloud. Still a buzz word everyone is talking about, if this security flaw exists in the simplest places how does this affect corporate data sitting on a public cloud? While the companies will have gone and patched the environments, there is nothing stopping another flaw in the future. Once you put the data in the cloud, be it corporate or personal data, the issue of ownership appears. This was brought to light in recent times by Microsoft; who were in some hot water over looking at emails stored in a Hotmail account on their cloud, which lead to the arrest of a man for stealing trade secrets. Essentially Microsoft did nothing legally wrong; they complied too their terms and conditions. However for companies looking to move corporate data and email to the cloud they need to remember once it's there, it's owned by whoever is the cloud provider.

> "...it's important to take a step back and look at your security habits and fix what you can before it's too late"

Steve Wozniak put it best "With the cloud, you don't own anything. You already signed it away. The more we transfer everything onto the web, onto the cloud, the less we're going to have control over it."

Security is something to be taken seriously whether in cloud or on premise. While in the cloud you should consider what you may be losing in terms of network security. If you are going to a public cloud you no longer have control over what security is in place around the cloud. While most cloud providers would have complex security measures, you are ultimately losing control. The positive aspect of this is that the vendor is then also responsible for ensuring your data is safe and secure.

On the other side when you are on premise you have other options to consider such as supporting the additional infrastructure you are putting in to enable your business. There are also the basics of ensuring you are up to date with patches etc. to minimise vulnerability.

At the end of the day it's about risk and a business decision around what you are willing to risk and what you are not. Understanding where you company lies in each of the different aspects, assessing what part you may be willing to compromise and what you may not be is critical. Understanding this will ensure you are making the correct decisions for your business from a critical ICT point of view.

While there are important aspects that we can take into our everyday life, there are simple things that we can all do to ensure our online presence is secure:

- When looking at online accounts, ensure you have two-step verification in place.
- Passwords should be unique, long, hard to guess and different for different sites
- Use caution on unfamiliar Wi-Fi networks

While some of these are common sense, sometimes it's important to take a step back and look at your security habits and fix what you can before it's too late.

In order to ensure you stay on top of the latest security threats and vulnerabilities why not look at joining one of the ACS ICT Security SIG. The SIGs are run out of the states and have events running throughout the year to ensure you are able to keep up to date.

While the security risks are real and of concern, I do not want to suggest that you should all move away from cloud and using of the internet. Like always it's about being prepared and understanding the risks associated with doing what you are doing. Don't always immediately trust the company you are using to ensure that you data is safe, take your own measures to secure your data. While banks and other providers will always do their very best, you need to take some personal ownership. After all it is your information or data! ■

FIONA TEAKLE is Director of the ACS Young IT Board. You can contact her at fionateakle@acsmail.net.au

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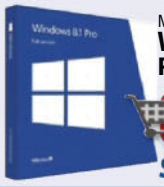

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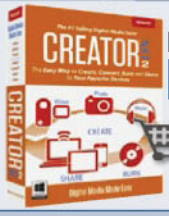

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Jon Honeyball sheds a high-resolution tear as he predicts free-to-air's demise

I am quite cross. No, scratch that, I am somewhat furious. And it's all because of Netflix.

I discovered this service a year ago and instantly fell in love. I was a little annoyed that the UK service didn't have quite the same depth and breadth as the USA version, but a quick hunt for an IP-obfuscating service soon put that to bed.

For a fixed fee of about a fiver a month, I could watch all sorts of interesting stuff from both sides of the Atlantic. I could watch it when I wanted to, and I could pause and rewind. I could watch several episodes at once if I had the time, and the inclination, and the material was engaging enough to pull me in deeper.

Then came *House of Cards*. Like quite a few brave American productions, this borrowed the underlying premise from an original UK product and took it to whole new levels. It follows on from numerous groundbreaking TV from the US: think *The West Wing* (still watchable for the umpteenth time), *Lost* and *24*. *Breaking Bad* was superb, according to my friends, but I confess I couldn't really get my head into it.

So why, you might ask, am I angry? First, because the baton has shifted away from the UK to USA for TV creation. To me – someone brought up watching dire American TV such as Kojak and Cannon – this is an appalling thought. Who can forget Dallas and Dynasty? Both were simply awful, in acting and technical quality.

Back then, the BBC was a beacon of quality in terms of both content and presentation. It set standards; it showed what was possible. And no-one would deny the BBC its licence fee for the quality it delivered, time after time.

Today, things have changed. I have a Sky subscription at home, and BBC programming is lost in a huge collection of alternative sludge. Back in 1979, Pink Floyd sang, "Got 13 channels of sh*t on the TV to choose from". Today, on my Sky HD box, it's hundreds.

Then comes my second gripe: the delivery. Even if the BBC were offering me something compelling to watch, I'd have to do so at a picture quality of 1080i on my rather lovely 55in television. Sky can't do 1080p, let alone anything higher. All this means I haven't bothered to take my 4K Samsung TV home from the lab; what would I watch on it? The Redray player lives at the lab, and there's no other source of 4K to look at.

So compare and contrast the best we British can do with Netflix. If I've read the reports correctly, *House of Cards* was shot in 4K using Red cameras. It might even have been 5K or 6K, depending on the choice of Red camera. And the picture quality, delivered over a standard 18Mbits/sec ADSL line in my village, is astonishing. That's despite the fact it's being delivered at 1080p rather than 4K; this isn't surprising because Netflix is using a high bit-rate stream, at around 5.8MB/sec.

Netflix isn't stopping there. In January, the company announced its imminent move to 4K streaming. This will require H.265 hardware codec support in the TV for processing, and a 15.6MB/sec stream rate to support full 4K. Of course, this is an adaptive system, so it will drop down to HD if the data rate slows. The transition to HD will happen at around 11.7MB/sec.

Then it struck me – I'm not watching the BBC any more. Not even via iPlayer, although I'll pick up a missed programme occasionally. Despite its highly regarded nature documentaries, the stark reality is that the BBC has fallen significantly behind the curve. Netflix commissioned *House of Cards* and shot the entire thing in one go, then released the entire second series at the same time. None of this nonsense about staggering it one episode per week. As soon as you think of internet streaming as your primary delivery vehicle, then the BBC's solutions appear terribly last century. One episode per week. Streaming for only a week or so per episode. A lack of support for the highest-quality emerging standards. Plus programming that has been largely bought in from outside production companies anyway.

> **"It struck me – I'm not watching the BBC. Not even via iPlayer. The stark reality is that it has fallen behind the curve"**

If I'm not watching the BBC, and it isn't leading the way in technical or artistic standards, what am I getting for my licence fee? And that, dear reader, is a question that has no answer, and is one that will sink the licence fee faster than you can say "the horse has bolted from the stable". The BBC will implode, and good riddance to much of it. I just hope those niche corners of quality, such as Radio 3, the orchestras, and the last bastions of its Reithian heritage, aren't wiped out in the final collapse.

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