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ISSUE 296/OCTOBER 2014

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PROTECT YOURSELF

Manufacturers need to think beyond hardware

Say what you want about Apple, but there's one thing it understands better than any PC manufacturer, and that's the ecosystem. Regardless of what happens to the iPad, iPhone and iPod, it now has a massive market of loyal customers thanks to iTunes, and that ecosystem will still be going strong long after the last iPhone 5S has given up the ghost and gone to the great recycling bin in the sky. Its customers' buying power means that Apple has buying power, which makes it a force to be reckoned with in a way that most PC manufacturers can only dream of.

Apple has managed to manoeuvre itself into this position because it's a software company, and an innovative one at that. Mere hardware manufacturers can't compete on that level, and if you consider what most driver installation routines are like, it's a hill few are capable of climbing. There are some that stand a chance though, and the ecosystem is core to what Nvidia needs to do with its SHIELD Tablet, which you can find reviewed in this issue on page 18.

The SHIELD's game streaming is made possible by a combination of hardware and software working seamlessly together. Being able to stream PC games from your beefy desktop rig to the SHIELD's screen (or to your TV via its HDMI port) makes it a console-beater for us. It's so flexible and works so well, we can't help but be impressed. But for Nvidia to really stand a chance with SHIELD, it needs to own the ecosystem so it can become a specific target device for apps and games that will run natively on it. And for that to happen, it needs to sell the SHIELD in serious amounts and/or get its Tegra K1 chip in as many devices as possible – something that may just be happening.

Nvidia's SHIELD is quite possibly the most exciting device we've looked at in the last year, and it isn't really down to that much of a hardware difference. It's about the software. It's about the ecosystem. ■

Alan Dexter
Editor
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FUTURE

IS NOW A GOOD TIME TO UPGRADE? WE REVEAL THE HARDWARE AROUND THE CORNER THAT'S WORTH HOLDING OUT FOR

There's a school of thought that says there's never a good time to upgrade. There is always something better just around the corner. To be fair, there is some truth in these words – the development cycles of the major hardware players is fast enough that you'll never be too far away from the next great processor or graphics card. Even so, you've got to know when to take the punt on new hardware. That's where we come in, guiding you to the best kit at any given time, taking into account what's just around the corner and where the latest releases stand in respect to their peers.

Having said that, there are times when the weight of what's coming throws out this delicate balancing act. And that's exactly where we find ourselves at the moment – not in every sector, but in enough areas to make it tricky to recommend certain builds purely because we know what will soon be hitting the shops. High-end PCs, for instance, are about to get a major shot in the arm thanks to the next release from Intel, while Nvidia's next graphics card isn't too far away either.

Over the next few pages, we are going to be taking a look at the major upcoming releases that should be on your tech calendar. We'll investigate Intel and AMD's processor plans, then take a peek at what's lined up next in the graphics card market. We then look at storage, memory, peripherals and the major software updates. Being armed with all this information will ensure that you make the right decisions about when you upgrade, and what to keep in mind when you do.

PC TECH

INTEL PROCESSORS

AFFORDABLE SIX-CORE CPUS AND 14NM MARVELS

INTEL HASWELL-E
Q3 2014

Intel's 'E' processors have always been something of an oddity because they are essentially server processors that have filtered down to the desktop market. The next iteration of these chips, codenamed Haswell-E, is due for release shortly – we'll have the full breakdown in the next issue of *PC Format*. But what sets this particular series apart from its predecessors is the fact that it will be available in more than just the very highest SKUs.

While we will still see a benchmark breaking eight-core, 16-thread i7 5960X clocked at 3GHz (Turbo-ing to 3.3GHz) that will set you back a cool $1,000. There will also be a couple of six-core, 12-thread versions that will be available at slightly more reasonable price points. These prices haven't been confirmed yet, but they are rumoured to be as low as $350 for the 3.3GHz i7 5820K. If true, this could really muddy the usually-clear water between the relatively more value-conscious desktop parts and these enthusiast chips.

Haswell-E will also be the first time that DDR4 gets an outing on desktops, which may help explain why Intel feels the need to make some more affordable members of the family. This is because DDR4, much like its predecessors, will be incredibly expensive at launch and isn't set to offer significant advantages over DDR3 for a little while into its lifecycle. You'll need a motherboard packing Intel's X99 chipset for Haswell-E, so when you start adding up all of the platform costs, it certainly won't be a budget option. It will, however, pack some serious multi-threading performance into its chunky LGA 2011 packaging.

INTEL BROADWELL
Q4 2014

The next Core architecture for desktops from Intel is codenamed Broadwell, and it is set to make an appearance at the end of the year. This is essentially a 14nm die shrink of Haswell, with the possibility of a few nips and tucks here and there, but it does nothing to fundamentally change what Haswell offers.

Die shrinks have traditionally enabled Intel to up the clockspeeds of their predecessor chips, but as we've just had the Haswell refresh – codenamed Devil's Canyon – the pressure is on for Intel to really make these chips stand out from what it's done before.

Broadwell was originally pencilled in to make an appearance much earlier than this, but the transition to the new production process hasn't been without issue. These problems have been sorted now, and the Broadwell processors are expected to make an appearance at the end of 2014, ramping into full production at the start of 2015.

The good news about Broadwell is the motherboards that support it are already with us – Intel's Z97-powered motherboards were launched with the release of the Devil's Canyon chips a few months ago. This means that by the time Broadwell actually lands, these motherboards will be mature and performing well. You may need to get jiggy with a little BIOS flashing, but that isn't beyond the scope of you clever lot.

The next completely new architecture from Intel, codenamed Skylake, will use the 14nm production process and is expected to appear in the second half of 2015. Not a lot is known about the chip just yet, but the architecture is expected to support both DDR3 and DDR4.

AMD PROCESSORS

MORE HEAVY PLANT AND AN AMBIDEXTROUS FUTURE

AMD EXCAVATOR
2015

The current Steamroller architecture, which can be found inside AMD's range of Kaveri APUs, is set to be replaced by the Excavator architecture some time in 2015. Yet the actual specifics aren't as clear as Intel's regimented tick-tock timetable. What is known is that the first chips to use this fourth-generation Bulldozer core will be the Carrizo APUs, which will use the Socket FM2+ packaging and be produced with a 28nm production process.

The core itself is expected to boast support for a number of new instructions, as well as introducing support for DDR4 alongside the current DDR3 memory controllers. Chips that use the Excavator core probably won't support both memory types at the same time, but will make the transition over to the new memory standard when it's more financially viable. The first Carrizo APUs will undoubtedly ship with just DDR3 support, but with the option of a refresh to support DDR4 when it makes financial sense to do so, possibly with a new socket too. As Carrizo is an APU, the graphics subsystem is obviously very important, but it hasn't been confirmed at this stage what form this graphics core will take. Currently, it's expected to be another outing for the Graphics Core Next tech that can be found in the current range of APUs and graphics cards. But still, we can't help hoping that these APUs are more powerful in order to keep Intel honest and lower power graphics cards competitive. Just giving more of the APU's silicon over to the graphics core may be enough here, although this may be a bit of an issue without the drop in production process.

AMD PROJECT SKYBRIDGE
2015

AMD isn't just tying its future into the x86 ecosystem. Having already committed to designing an ARM-based, eight-core server system-on-a-chip (SoC), it is going one step further and introducing a fully ambidextrous silicon future.

Project Skybridge is a design framework that's specifically set up to allow for either an ARM-based SoC or an x86-based chip to run effectively in the same platform. The ARM variant will be a 20nm Cortex A57 chip with an integrated Graphics Core Next GPU component, and will be pin compatible with an x86 SoC based on a next-gen core codenamed Puma+.

When we say "pin-compatible", don't expect to be able to pick up a desktop board before dropping in either an ARM or x86 processor yourself. It's more likely that, at a manufacturing level, a platform will be able to have either one of the chips soldered down onto the same BGA motherboard. This will allow manufacturers to have a single design for a device and be able to offer both Windows- and Android-based versions of the same product without having to change anything apart from the chip itself.

Project Skybridge's ARM component will be AMD's first official Android platform and as such both SoCs will be aimed primarily at the low-power mobile market.

AMD K12 AND BEYOND
2016-2017

AMD has stated that this will be the last revision of its Bulldozer architecture before it is retired. One of the architectures following it is codenamed K12 and is expected to hit the shelves sometime in 2016. This follows on from the ambidextrous roadmap AMD laid out for Project Skybridge and shows it is treating its ARM development with the same respect it has for its x86 parts.

The new K12 chip will be based on the ARM64 instruction set and will use a 14/16nm production process. It could potentially get AMD in a wide range of custom and embedded designs. But K12 is being designed as a higher-performance part compared with the low-end Project Skybridge SoCs. K12 isn't just being lined up for servers and tablets, but is also being touted for consumer laptops and Chromebooks too.

Alongside the K12 ARMv8 chip will be a corresponding new x86-based 64-bit design. As yet, there are no concrete details surfacing about what AMD is going to do with its x86 license post-Bulldozer, but we can only hope a focus on improving the instructions per clock/single-threaded performance is made a priority.

We have heard some rumours of a 14/16nm x86 design with the top model rocking some 20 cores. And those whisperings are quite specific about such cores not being AMD's compute cores either. It is also rumoured to be AMD's first LGA processor too, sticking the pins into the socket rather than on the chip itself. A high-performance FX CPU sounds like a pipedream right now, but it might happen…

"WHILE WE WILL STILL SEE A BENCHMARK BREAKING EIGHT-CORE, 16-THREAD i7 5960X CLOCKED AT 3GHz (TURBOING TO 3.3GHz)"

NVIDIA GRAPHICS

MORE CUDA CORES THAN YOU'VE HAD HOT GPUS

NVIDIA GEFORCE GTX 880
AUTUMN 2014

We've been waiting on the new Maxwell GPU architecture to replace the Kepler graphics cards for a while now. Nvidia has stuck with the (admittedly very impressive) Kepler silicon for years, rolling out newer, high-priced spins of its professional graphics GPU, the GK110, to keep upping the ante. We had our very first taste of the Maxwell GPU at the start of this year with the GTX 750 Ti and it was the first time Nvidia had launched brand new chip architecture on a low-end card.

Have no fear, though. Nvidia is all set to drop a high-end Maxwell-based card – probably called the GTX 880 if previous naming convention is anything to go by – in September. We had expected the new architecture to be accompanied by a fresh production process too, giving us the hefty power saving and performance that the GTX 750 Ti has demonstrated in the Maxwell GPU architecture, as well as the extra boost that dropping from a 28nm production process to 20nm should deliver.

TSMC, the actual physical manufacturers of Nvidia GPUs, have unfortunately run into problems with the 20nm node. Currently, we're unsure whether that's in terms of yield, cost or performance – it's possible there could be issues with all three. Whatever the real reason, the GTX 880 will still be based on a 28nm process, which will allow us to see clearly what benefits the new Maxwell silicon can offer over the existing Kepler chips on the market.

We will probably see at least two new cards based on the GM204 GPU coming in the autumn, but as yet we don't have any final specifications on what that chip will entail. The rumours say that the top GPU could be housing anywhere between 1,536 and 3,200 CUDA cores. But if it wants to beat the existing GK110-based cards it's going to have to be something quite special.

NVIDIA PASCAL
2016

Nvidia's GPU roadmaps always have to be taken with a pinch of salt. Years and architectures come and go without a word on what's happened, but this March we were told about the 'next big thing' from its GPU skunkworks. The Pascal GPU is the architecture that will come after Maxwell and is set to pack in some serious next-generation technology.

The biggest change will likely be the introduction of NVLink. This is an Nvidia-designed interconnect that offers significantly higher bandwidth than even the next iteration of PCIe has been designed to deliver – between five and twelve times the bandwidth of PCIe 3.0. NVLink is probably only going to be used on server-based pro cards and seriously high-end consumer GPUs as it will demand a radical change in motherboard design. Essentially, we're looking at a socketed GPU daughterboard laid parallel to the motherboard rather than standing vertically in a PCIe slot. NVLink is also set to deliver more than the 75W currently offered from PCIe, which could rid us of the sprawl of power cables we have today. We still think lower-end Pascal GPUs will be using existing PCIe layout because there is still support in the GPU design for the standard interconnect.

As well as NVLink, Pascal is going to launch with 3D memory, which is similar to that which Samsung has been using for its newest SSD designs. These will be on-package memory chips, stacked on top of the GPU with connections drilling through the layers providing huge amounts of bandwidth between memory and chip. We don't know what process Nvidia is looking to use for Pascal, but there have been rumours it will be skipping the awkward 20nm node and will move straight on to 16nm later in Maxwell's lifetime. It stands to reason that Pascal's transistors will be as small as 16nm.

AMD GRAPHICS

REFRESHING VOLCANOES AND SWASHBUCKLING GPUS

AMD VOLCANIC ISLANDS 2.0
AUTUMN 2014

You simply cannot have one graphics card manufacturer releasing a slew of new cards without the other wanting to get involved. And while AMD is not likely to be offering a brand new graphics architecture, it will be refreshing its existing Volcanic Islands range of cards. These will essentially just be slightly tweaked versions – probably in order to reduce the manufacturing costs and power draw rather than boost actual gaming performance.

It looks as if the first will be a GPU codenamed Tonga, which is likely to be a direct replacement for the existing R9 280. We've heard whispers from some AMD card manufacturers that AMD is looking to simply use the same name for the new card, although it's more likely to be some sort of R9 285. That sounds mighty confusing because if the expected specifications are realised, then the Tonga GPU will come with a 256-bit memory bus instead of the existing card's 384-bit bus. It is expected to have the same 2,048 cores as the R9 280X, along with a higher clockspeed, so it should have some pretty decent performance to make up for it.

There is also meant to be a new lower-end part, possibly designed to take on the GM107 Nvidia GPUs. That is important because AMD doesn't currently have an answer to the combined low-power and high-performance of the GTX 750 Ti. The rumoured lower-end GPU is expected to be codenamed Iceland and should be a direct replacement for the Cape Verde GPUs that are available today. In terms of a higher-end refresh, there is a possibility of a higher-clocked version of the Hawaii XT GPU that is currently in the R9 290X, so we could get a Hawaii XT2 in the same way we had a higher-clocked Tahiti XT2 for the HD 7970 GHz edition a couple of years ago.

AMD PIRATE ISLANDS
2015

The real new AMD graphics cards are all set for a launch next year. If any of the rumours or leaks we've seen so far are to be believed, the R9 390X could need its own fusion reactor to keep it running. The R9 390X is going to be based on the Bermuda GPU, which is a GCN chip built on the new 20nm production process. Despite the smaller GPU lithography, it could end up being an absolutely enormous processor if the touted 4,224 GCN core figures are in any way accurate. If you thought the GK110 GPU in the GTX Titan was hefty, it looks like the Bermuda XTX could be even bigger.

With the 512-bit memory bus on which the Bermuda GPU is expected to run, it looks unlikely that the new partnership between AMD and SK Hynix to produce stacked high bandwidth video memory is going to produce 3D VRAM for the first round of Pirate Islands GPUs. Like Nvidia, AMD is relying on TSMC to nail down whatever issues it has been having with the 20nm production process before we start to see actual volume manufacturing of AMD's new graphics cards. If AMD wants to pursue the 20nm lithography, it may have to start pushing the launch deep into 2015.

There have also been some leaked documents about the Treasure Island and Fiji GPUs. Treasure Island will be the basis for the R9 370X; with some 1,536 GCN cores it should provide a good deal of extra performance over the R9 270X it will effectively be replacing. The R9 380X will be the Fiji-based card and could be the serious sweetspot for AMD as it is rumoured to have a full 3,072 GCN cores and a 384-bit bus. This could indicate a similar strategy to the one Nvidia used for this last generation, with the R9 380X being the top card with the R9 390X being some crazy, ultra-enthusiast, $1,000 option.

"NVLINK IS PROBABLY ONLY GOING TO BE USED ON THE SERVER-BASED PRO CARDS AND SERIOUSLY HIGH-END CONSUMER GPUS"

STORAGE

ALL SET FOR A HIGH-BANDWIDTH FUTURE

NVM EXPRESS
Q4 2014

NVM Express, or to give it its full title, Non-Volatile Memory Host Controller Interface (NVMHCI), is a specification for accessing solid-state drives over the PCI Express bus in a much more efficient way than the current AHCI (Advanced Host Controller Interface) allows for.

The specification is going to be a key ingredient for getting the most from the newer SATA Express and M.2 SSDs that are starting to appear on the market.

AHCI has been with us for a long time, and is important for legacy compatibility, but it is holding SSDs back. NVMe, however, exploits the low latency and multiple lanes available from PCI Express to really drive performance. This is helped by the fact that NVMe has been built from the ground up to make the most of how SSDs work. Multiple command queues, being able to handle multiple threads at the same time and specific optimisations for 4KB commands all work together to improve SSDs. SSDs may be speedy already, but once NVMe takes off, there should be a serious shift in their performance.

There's an operating system element to NVMe as well, but the good news is that the NVMe Windows Working Group has been beavering away in the background and has managed to squeeze native support for NVMe into Windows 8.1. This means that if you're rocking Microsoft's latest OS then you just need the drive and a compatible motherboard when they do get released.

SANDFORCE SF3700
Q1 2015

LSI's second-generation SandForce controllers redefined the SSD industry at launch. At one point, it felt like every SSD out there had a SandForce controller chugging away at its heart – even Intel jumped on the bandwagon. It is testament to LSI that it has managed to get its controller in so many drives, and testament to the performance on offer.

Yes, the compressed data performance hasn't stood the test of time particularly well, and newer controllers from other manufacturers have left SandForce behind, but this is still a company worth watching and capable of some serious performance.

The LSI SandForce third-generation controller, the SF3700, is shipping out to OEMs between now and the end of the year and we should start seeing new SSDs based on this controller by the start of 2015. LSI is focusing on combined read and write performance for this new controller – it will be optimised for reading and writing in smaller chunks as opposed to one massive read or write (as commonly tested in benchmarks). Reportedly, LSI is looking to allow manufacturers to disable compression algorithms to produce more consistent performance, regardless of the data.

We expect the new SF3700 to stir up the market when it's released, leading to a flurry of launches from all the major players. Given the move over to SATA Express interfaces, this could make for some interesting times, and some seriously high performance.

"NVME EXPLOITS THE LOW LATENCY AND MULTIPLE LANES AVAILABLE FROM PCI EXPRESS TO REALLY DRIVE PERFORMANCE"

MISCELLANY

NEXT-GEN RAM AND BETTER-THAN-LIFE

DDR 4
Q3 2014

The next iteration of RAM, namely DDR4 SDRAM, is already out in the wild, although so far it has only been employed in servers. Even there, it's hardly widespread. Just as night follows day, so DDR4 will gently nudge DDR3 off the specification sheets and into the footnotes of IT history. The big push for desktops comes with the release of Intel's Haswell-E processors, which will support quad-channel DDR4 configurations. Intel Broadwell and AMD Excavator will also support the new standard eventually.

DDR4 boasts the potential to increase memory bandwidth by a cool 50 per cent over DDR3, while at the same time slashing power consumption by 30 per cent. This latter point is a key reason why server administrators have been so keen to snap up the technology – it's going to save them money regardless of the initial premium that accompanies any new technology. Just to put some hard figures on this: the operating voltage of DDR4 ranges from 1.05V to 1.2V, while DDR3 starts at 1.2V and then tops out at 1.65V.

At launch, you can expect to see the initial slew of memory operating at 2,133MT/s (million transfers per second), which is on a par with the top-end DDR3 memory sticks. However, the specification is rated up to 4,266MT/s, which is where the real performance boost comes in. The 284-pin DIMM modules look similar to the 240-pin modules used for DDR3 and are indeed the same width, but the connectors are smaller to cram them into the same space. The modules are slightly taller and thicker than DDR3 modules in order to make signal routing easier. Of course, there will be a price premium to start with, but with the likes of the Crucial Ballistix Elite 16GB PC4-21300C15 kit starting at £240, the transition to DDR4 may not be quite as painful as the last generation.

OCULUS RIFT
2015

When Facebook wanders in and drops a cool $2bn on a headset, you know that there's something more to this whole second coming of virtual reality than just a neat peripheral for a few specific games. And sure enough, even before Facebook appeared on the scenes, plenty of games developers were lining up to get their games in on the action. With the likes of *Elite: Dangerous*, *Star Citizen* and *Project CARS* all jostling for a piece of the Rift, this might be the coolest tech you ever buy.

In case you've managed to avoid being sucked into the whole excitement surrounding the device, Oculus Rift is a head-mounted 3D display that tracks the movement of your bonce to give the impression that you're actually in the virtual world, not just viewing it through a window. The final models will boast a 7-inch display with native resolution greater than 1080p, have a responsive head tracking system and be comfortable for long play sessions.

We tried the first iteration of the developer kit, and have to say that some of the demos are very impressive, although not without their issues. The screen resolution of the first-generation development kits wasn't great, there was some tracking lag, and we found being unable to see our keyboard and mouse frustrating. The second-gen development units are shipping now, and the head-tracking and screen resolution are improved, but controlling yourself in-game is still an issue. Expect to pay about £250 for the finished model, but price and release date are not confirmed.

THE SOFTER SIDE

HARDWARE'S NOTHING WITHOUT GOOD SOFTWARE

MICROSOFT WINDOWS 9
Q3 2015

There's no official word on the release date for Windows 9, but several analysts suggest that it should be out before autumn 2015. Microsoft blogger Paul Thurrott has gone one step further, suggesting that it could be with us in April 2015. This is somewhat due to the bad name with which Windows 8 has managed to tarnish itself.

It's fair to say that Windows 8 hasn't had it easy, but that's partly because Windows 7 nailed what most of us wanted from an OS. Windows 9 could be the next logical update for many though, so it does make sense that it'll be an earlier release.

Windows 9 is expected to keep building on the ethos set out by Windows 8 – that is, unifying the operating system across a wide range of devices. Key to this concept is the idea of creating Universal Windows Apps that function the same across a wide range of hardware. Given the guff that currently fills the Windows Store, this may not be particularly exciting, but we can see that it is essential for realigning Microsoft's ecosystem to its new cross-platform ethos.

As for the ill-fated Start Menu, a preview of Windows 9 was shown at Build 2014 that showed a return of Start Menu, albeit one that contained Modern UI elements. Either way, we're seeing that as a win for users. Properly functioning Windows Modern UI apps are expected to be included at release, along with improved power management code, better integration with the cloud and enhanced support for gestures and other methods of interacting with our devices.

We will probably see another interim update for Windows 8 – Windows 8.2, no doubt – before we hit the next big release. This could even be a chance to try out some of the things that Microsoft wants to squeeze into the Windows 9 OS.

DIRECTX 12
Q4 2015

Microsoft first gave concrete evidence of DX12 at this year's annual Games Developer Conference. The demonstration featured Xbox One racing title, *Forza*, running on a Titan Black-powered PC.

It was a remarkable feat on many levels. Not only is *Forza* very much an Xbox exclusive IP, but the demo aptly showed just how capable the alpha build of DirectX 12 was. And while you could say that the Xbox One is essentially a PC anyway, that's only from a hardware level – there is a whole mess of operating system to consider.

In keeping with the multi-platform plans of Windows 9, the next version of DirectX is being designed to run on a wide variety of platforms. As well as PCs, it will work on the Xbox One, tablets and even phones. Platform-agnostic, if you will.

The other major focus of its development is to be a more efficient and thinner API. It's impossible to talk about this side of things without mentioning Mantle, which is AMD's rethinking of graphics APIs to cut down on some of the overheads and make better use of the hardware in our machines. DirectX 12 is going to do for every graphics subsystem (from Nvidia, Intel and AMD) what Mantle can only hope to do for AMD's cards. ■

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PC GAMER EDITOR'S CHOICE ★★★★★

expert REVIEWS ★★★★★

Hardware

#296/October

Performance gear, uncompromising verdicts

WHAT ARE YOU DOING, DAVE?

"Show me any game on any console that can claim the 130m subs of the League of Legends"

Dave James is quite prepared to be called a fanboy. After all, he's been very taken by Nvidia's latest SHIELD and that's only a few letters away from SHILL... But Dave's adamant he's not a fanboy of any particular manufacturer, just of PCs in general. And he's been getting very excited that suddenly people are agreeing with his upbeat prognosis on the gaming PC.

How long are Sony and Microsoft going to carry on with this whole console charade? They must be seriously hanging out for a shedload of platform-exclusive titles filtering out of Gamescom, because there sure as hell isn't anything coming out on either Xbox One or PlayStation 4 that would make any self-respecting PC gamer sit up and take notice.

Sure, there are a handful of exclusive titles to which we might raise our heads and grunt some vague interest towards, but we're sitting on the most platform-exclusive titles around. And the most popular ones too. Show me any game on any console that can claim the 130 million subscribers of the *League of Legends* phenomenon. Is there anything out there whose community would willingly contribute millions to either the prize fund of a single tournament or a game's development? *DOTA 2*'s The International tournament had a prize pool of nearly $11 million and *Star Citizen*'s Chris Roberts is still frantically scratching his head trying to figure out new stretch goals for its funding campaign. We're pushing towards $50 million now and things are just getting a bit silly – Cloud Imperium is currently working with actual linguists to create 'real' alien languages for all of the different races featured in the game.

Do we even need to remind you about the ever-expanding *Elite: Dangerous* universe or the slowly evolving world of *DayZ*? Not forgetting the host of fantastically varied and innovative indie titles that are exclusive to the PC for the simple reason that it's the cheapest and easiest platform to code for and publish to. Sony and Microsoft may well be trying hard to court the indie devs at the moment, but they're going to be spending a long time playing second fiddle to the PC.

Software is vital to any ecosystem and the PC has a catalogue of games that is larger, older, deeper and more varied than any other platform. But it's also the hardware that makes the PC so exciting. This month we finally got our hands on Nvidia's new SHIELD Tablet. Sure, it's an Android-based tablet, but it's so closely tied into the PC that it has quickly become my favourite streaming machine for my living room. Freeing my PC games from the rickety desktop in my home office has been a very liberating experience.

The PC is where the innovative folk play. The second coming of VR first made itself known here, and other revolutions in display tech, such as the 21:9 LG panel and Asus' G-Sync RoG we're checking out this month, are only worth a look on the PC. And the innovation doesn't just stop when we get our computers into our homes either – the rise of Twitch and other high-quality homebrew video projects have brought a new generation of people to the platform. It's a seriously exciting time to be a PC owner.

P26
ASUS ROG SWIFT PG278Q

DayZ may be evolving slowly, but it's built on a passionate PC following

Marvell's NVMe controller is ready...

Sadly, devices using the new PCIe-based controller won't be around until next year. This is still quite exciting news for us SSD nerds, though, as the new memory controller is specifically designed for solid-state drives running across the PCIe interface. Current M.2 PCIe-based drives are still using AHCI protocols, which were originally designed for ye olde spinning platter hard drives. As such, there's a hefty performance overhead in there when you're running speedy Flash NAND over a nippy interface because of the HDD legacy. Marvell's NVMe (non-volatile memory express) 88SS1093 controller is capable of up to x4 PCIe 3.0 connections and should therefore provide the fastest SSDs we've ever seen. Stay tuned.

Gold Award

This is the ultimate badge of hardware excellence. Only truly outstanding gear gets this coveted award. Oh, and there are no prizes for runners-up here.

Our Hardware Manifesto

Would we buy it and should you buy it? That's all you want to know and it's all we care about. Performance and value for money are the two key pillars supporting the mighty *PC Format* Gold Award on its lofty pinnacle.

THERMALTAKE'S LATEST PC WETWARE IS SUPER-WIDE

This summer I've been all too tempted to start strapping liquid CPU chillers to my forehead in an attempt to alleviate the fetid heat that's settled over our office like a stinking, damp, overly affectionate sheepdog. Thermaltake's Water 3.0 Ultimate cooler is only making my desire to bolt a water pump to my skull that much more tempting.

The cooler has a massive 360mm liquid-filled radiator tasked with dragging excess heat out of your processor. And you can strap on up to six 120mm fans to maximise the airflow.

There is one elephant in the PC chassis, and that's the fact that such a wide radiator isn't going to fit inside many cases. I've been struggling to squeeze a 240mm cooler into a standard ATX chassis… the Water 3.0 Ultimate could cause much frustration.

EDITOR'S ONE TO WATCH

Could GTA V and Elite: Dangerous be Mantle's killer apps?

AMD has been almost desperately pushing its Mantle graphics API as a serious competitor to Microsoft's DirectX, but proper support has been thin on the ground. Things look set to change soon if game support falls as has been rumoured. If both *Grand Theft Auto V* and *Elite: Dangerous* tip up using Mantle to its fullest, it could be quite a feather in AMD's gaming cap.

VideoCardz.com has posted a list of games in three categories: released games with Mantle support, unreleased games with Mantle support and games that have experimented with Mantle support. Currently, *Elite: Dangerous* and *GTA V* are in the list of games with pending support, which means that both Frontier Developments and Rockstar have signed up for the Mantle private beta program.

AMD's Mantle is a low-level graphics API that closely mirrors the way developers have been coding to the hardware in consoles. With Rockstar working on both the PS4 and Xbox One versions of *GTA V* it will have a good understanding of AMD's PC hardware, and with Mantle working in a similar way it could help the PC version of the game work better on AMD graphics cards. That will aid PC gamers with multi-core, multi-threaded CPUs because part of the problem with the current DirectX API is that it demands a lot of cycles from your processor, introducing a performance overhead that Mantle doesn't have. It also means a Mantle-supported game engine can take advantage of all the threads available to it, making those eight-threaded Core i7s and FX-8350s worthwhile gaming CPUs.

While Mantle has a lot of potential, we're still yet to see it really translate into a proper, tangible benefit for the end-user. But if these two PC titles are able to demonstrate a performance boost for AMD graphics cards we could see the balance of power begin to tilt away from the dominant Nvidia install base.

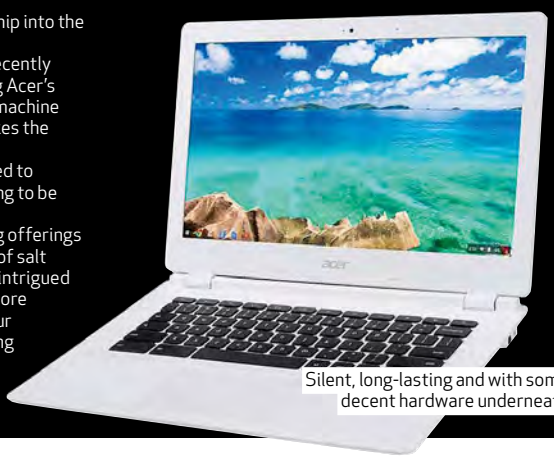
If *GTA V* can play best on AMD graphics cards it will be a major feather in Mantle's cap

HIGHLIGHTS THIS MONTH

Green-tinged Chromebooks

Fresh from dropping its fancy Tegra K1 chip into the new SHIELD Tablet, and with rumoured involvement in the Nexus 8, Nvidia has recently announced that it is going to be powering Acer's next Chromebook. The £270-ish 1080p machine could well be the cheapo laptop that makes the Chromebook option worth our time.

The new machine is still going to be tied to Chrome OS, which means there's not going to be any SHIELD-y streaming fun, but Acer is promising that there will be some gaming offerings via WebGL. We'll take that with a couple of salt shakers though. Nonetheless, I am quite intrigued to check out how well the TK1 does in a more familiar laptop form factor. With a 13-hour battery life and an entirely passive cooling design, it could turn out to be a really impressive little productivity laptop.



Silent, long-lasting and with some decent hardware underneath

£240 TABLET

NVIDIA SHIELD TABLET 16GB

The only tablet a PC gamer should buy?

VITAL STATISTICS

Price £240 (+£50 wireless controller)
Manufacturer Nvidia
Web www.nvidia.co.uk
Processor Nvidia Tegra K1, 2.2GHz ARM Cortex A15
Memory 2GB RAM
Screen size 8-inch
Native resolution 1,920 x 1,200
Storage capacity 16GB (32GB available)
Expansion MicroSD, USB OTG

Our Jeremy put it quite succinctly while playing with Nvidia's original clamshell SHIELD device. "There's something utterly brilliant about this," he said, streaming *GRID 2* from the *PC Format* test rig. "But at the same time there's also something quite awful about it."

The flip-top lid, the serious weight and the tiny screen made the SHIELD Portable rather an unwieldy beast, but the fact that you could play PC games on a wee handheld device – and play them well – was incredibly exciting. The biggest failing of Nvidia's first handheld was the fact it was such a tightly focused device – it was a games machine and that was it. Versatile it wasn't.

But this second bite at the Android gaming cherry sees Nvidia taking a more balanced approach. It's created an incredibly versatile and more desirable device. It's seriously powerful and probably the best value PC game-streaming machine you can plug into your HD telly. This new SHIELD Tablet is a pretty traditional 8-inch slimline slab, with a pair of stereo speakers set into the bezel surrounding the screen. Inside is the impressive new Tegra K1 (TK1) processor, which is one of most powerful mobile chipsets around. It's an ARM-based processor – the quad-core Cortex A15 – clocked at a speedy 2.2GHz, and the K in its name is down to the Kepler-based GPU at its heart. That's the current top graphics architecture Nvidia has in its very fastest discrete graphics cards and makes the TK1 capable of some really impressive visuals.

There are a total of 192 CUDA cores inside, which is one full Kepler SMX module – the same as some low-end discrete Nvidia graphics cards. Backing up the impressive TK1 processor is 2GB DDR3 memory and, in this version, 16GB of NAND flash-based storage. There's also a 32GB version, which has a micro SIM slot for 4G/LTE connections. Nvidia has included a microSD slot so you can expand the storage capacity. This edition also supports on-the-go storage, like Corsair's Voyager Pro, via a micro USB port.

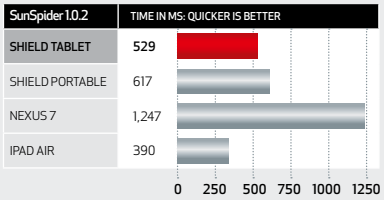
The screen itself is a 16:10 aspect ratio with a native resolution of 1,920 x 1,200. It's an IPS panel so the colour reproduction and viewing angles are impressive. It's not the best screen around and is certainly not as good as Apple's Retina displays, but it won't be chewing through the battery as hungrily. Subjectively, you're not going be suffering – the image quality on this 8-inch panel is still really very good. Nvidia has even created an Xbox-aping controller which connects to the SHIELD wirelessly over Wi-Fi Direct.

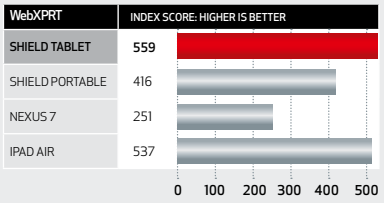
"THE BEST VALUE GAME-STREAMING MACHINE YOU CAN PLUG INTO YOUR TV"

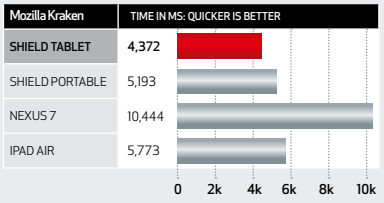
Technical analysis

The improvement over the Tegra 4 processor in the original SHIELD is evident, as is the performance gap between the Tegra K1 and the Apple and Qualcomm processors in the iPad Air and Nexus 7. The only tablet that can get close to the power of the latest SHIELD is Microsoft's latest Surface Pro, and that's kitted out with a proper Intel Core CPU.

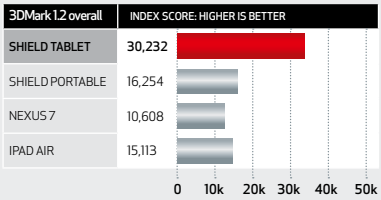
CPU performance

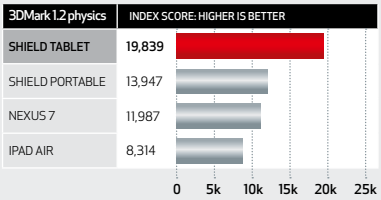


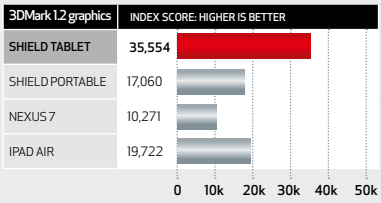


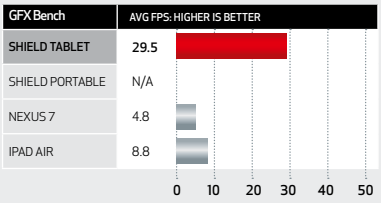


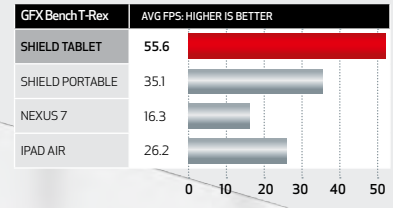
GPU performance

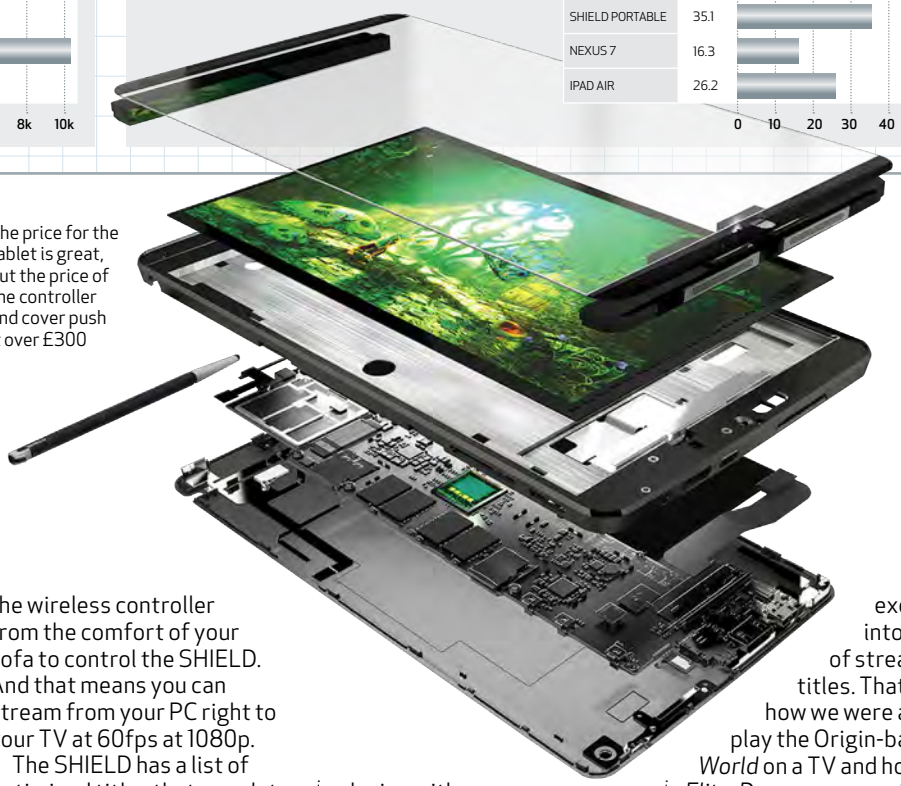












The price for the tablet is great, but the price of the controller and cover push it over £300

Hardware-wise, the new SHIELD Tablet packs a punch and is capable of gaming performance no other Android device can achieve. You'll get optimised versions of a selection of games via Nvidia's Tegra Zone, including *Trine 2* which is being bundled with the SHIELD Tablet at retail. There are also Android-native versions of *Half Life 2* and *Portal*, with more titles to come. It looks like we're finally getting some proper games on our tablets that aren't just ropey tower defence clones or low-polygon shooters… cough… *Bioshock*… cough.

Impressive innards

But it's the not-so-secret sauce of GameStream that makes the new SHIELD of such interest to us PC folk. Linked in with a GeForce graphics card with a Kepler-based GPU, and connected via the GeForce Experience app, you can stream practically any game from your desktop rig onto the tablet in your hand. That's pretty impressive, as is the robust nature of the streaming service. By attaching an HDMI cable to the tablet, connected to a HD television, you can use the wireless controller from the comfort of your sofa to control the SHIELD. And that means you can stream from your PC right to your TV at 60fps at 1080p.

The SHIELD has a list of optimised titles that populate the PC tab in the tablet's GameStream app. These are meant to offer the best PC streaming experience on your device, but will also give direct access to Steam's Big Picture Mode. Activate Steam on your remote desktop PC and you'll see the Big Picture Mode splash on either the tablet or on your TV if you're HDMI-ing it up in Console Mode.

Even if the games in your Steam library aren't optimised for Nvidia's streaming or for playing with a controller, the SHIELD will still have a damn good go at getting it streamed onto your telly. It's that plucky, I-might-as-well-have-a-go nature of the SHIELD's streaming capabilities that really impresses us. If the game you want to play isn't running through Steam, or hasn't been picked up by GFE, then you can add it to the list manually. All you have to do is pull up GFE on your desktop machine and add the executable into the list of streaming titles. That was how we were able to play the Origin-based *FIFA World* on a TV and how we got *Elite: Dangerous* running smoothly on a tablet.

GeForce Experience

Sadly, just because you can get a game running, that doesn't mean it will necessarily be a great experience. *FIFA World* had some serious lag when playing online; it didn't make the game impossible to play, but it wasn't an experience we were rushing to try again. *Elite* wouldn't recognise the wireless controller unless the desktop machine had a

We're finally getting some proper games on our tablets

controller attached to it when the stream was launched, but aside from that it was smooth and reliable.

Your experience with the SHIELD depends on your wireless network too. Connect to a 5GHz-capable router in the same room and you'll get the full 1080p experience, but roam away from your router and you'll see the SHIELD knock back the visuals in order to maintain a smooth, lag-free connection. Technically, you can go completely mobile with the SHIELD. If you've got a connection with a 5Mbps upload speed and the download connection to the device is at least the same then you should be able to stream your PC games on to the SHIELD from wherever you are. The network infrastructure isn't there right now, but given a few years that could be a viable way of serious mobile gaming.

All this makes the SHIELD Tablet an incredibly versatile device. We've always said that as long as the device is a good tablet first and foremost then you could almost see the GameStream tech as a freebie. And it is most definitely a good tablet. We've tested it against the iPad Air and Nexus 7, and it outperforms both in terms of our mobile benchmarks. The battery life is pretty competitive too, but using the TK1 to its fullest in-game will quickly chew through the power. Using the tablet in Console Mode increases the battery life. By shutting off the panel and switching displays to a connected TV you're only showing an interactive video and not really taxing the processing power of the SHIELD at all. That way you can get around 12 to 14 hours out of a charge.

Our only struggle with the SHIELD Tablet as a gaming device is when you're playing on the 8-inch display. The size of the screen isn't a problem, but because the controller is now separate from the screen it's harder to use while sat on the sofa or in bed – you need to find somewhere to rest the screen while your hands are filled with gamepad. For any Nvidia-owning PC gamer this is realistically the only tablet you'd consider buying. It's a great device on its own merits, but its versatility sets it aside from the rest of the digital slab crowd. ■ **Dave James**

"THERE ARE A TOTAL OF 192 CUDA CORES INSIDE – THE SAME AS SOME LOW-END DISCRETE NVIDIA GRAPHICS CARDS"

PCFormat Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★★½

Nvidia has priced the SHIELD Tablet perfectly, making a great Android slate with gaming benefits.

★★★★½

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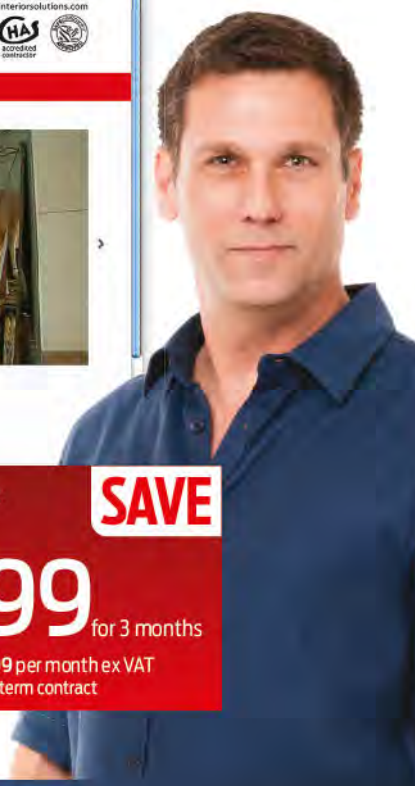

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VITAL STATISTICS

Price £770
Manufacturer LG
Web www.lg.com
Panel size 34-inch
Panel type IPS
Native resolution 3,440 x 1,440
Max refresh 60Hz
Response 5ms
Inputs DisplayPort, HDMI, Thunderbolt

In the interests of full transparency, let's start with a confession. Your author for this review of LG's latest 34-inch mega monitor thinks the 21:9 aspect ratio is a dumb idea.

At least, he thought it was. What's about to unfold here is the most embarrassing volte-face since the government U-turned on the hyper-critical issue of taxing pasties. Yup, this is earth-shattering stuff, people.

Anyway, the context here is provided by the 21:9 monitors we've seen previously. They've all been 29-inch models with 2,560 x 1,080 pixel grids. And they're basically a bit silly. They do have some benefit for games and movies. But when you're dealing with a fairly large and expensive screen, those 1,080 vertical pixels are simply too restrictive for general usage. Enter, therefore, the new LG 34UM95. For starters, it ups the ante to 34 inches. Immediately, this helps to mitigate the old 29-inch form factor's visual shallowness. The LG is so big your initial thought is no longer "crikey, this thing is like looking through a letterbox".

Then there's the resolution. We're now talking 3,440 x 1,440 pixels. Yep, the same vertical pixel count as the popular 27-inch segment and its 2,560 x 1,440 grid. Instantly, our previous objection – not enough vertical pixels for simple stuff like web browsing – melts away. Okay, we'd prefer it was even better. 1,600 vertical pixels would be nice, but the vertical resolution is certainly no longer an instant turn off. Instead, we reckon you'll be massively turned on by the sheer visual spectacle.

In games, you don't actually look directly at the edges of the screen much, which makes it sound like they're redundant. But they do serve a purpose, as proved by this widescreen LG as it gives you a much more life-like filling of your peripheral vision than a normal monitor. Suddenly, every other screen you've used looks like a miserable little window into your gaming world whereas this one truly immerses you in the action. It's one of those things that's almost impossible to appreciate until you've tried it. But in this larger format, count us in. We're sold. In fact, if anything, it makes us wonder how fabulous a 40-inch 21:9 panel might be. Let's not get ahead of ourselves though – at 34 inches, it's pretty bloody wonderful.

Back to black

Of course, there are issues with the 21:9 aspect ratio. Standard HDTV content is 16:9, which means you end up with black bars on either side. In practice, watching 16:9 content turns the LG into something akin to a 27-inch monitor. To make matters worse, a lot of streaming web content that contains 21:9 aspect video is actually hard coded in 16:9 with black bars inserted into the video stream. Play that kind of video on the LG and you get black bars left and right, above and below. Completely crappy, in other words. This isn't LG's fault and it's not universal. YouTube, for instance, supports true 21:9 video. It's just hardly anything is actually uploaded in this format. You won't have that

Technical analysis

Eight million pixels versus five million. That's the rough difference in pixel count between a 4K computer screen and this superwide 21:9 effort from LG. That is a hell of a lot fewer pixels for your graphics card to push. And another reason why this new superwide form factor makes for a much better gaming experience than 4K.

problem with Blu-ray content or, cough, most downloaded and locally stored movies. But the 21:9 aspect is going to cause you frequent frustration when viewing content online. You have been warned.

Then there are games. We've already spoken about how life-alteringly amazing they look. But only when they work properly. Which isn't always the case. The majority of recent titles we tried support 21:9 just fine. But some don't. A good example is *Skyrim*. Even with tweaks to config files, you may struggle to achieve the right result. It's not an absolute deal-breaker, but is something to bear in mind.

> "EVERY OTHER SCREEN LOOKS LIKE A MISERABLE LITTLE WINDOW"

Beyond that, all that's left to discuss are the particulars of this LG model. We're expecting to see quite a few monitors based on the same 21:9 IPS screen. First up, you have to accept this is a 60Hz panel with no frame-syncing technology. If that's what you want – and we can fully understand why you might – simply look elsewhere. For now, no monitor combines all of the latest and most desirable technology. There's no getting away from that.

As for the LG 34UM95's raw image quality, we're not absolutely blown away. The specs say it is a native 8-bit panel with dithering to mimic 10-bit in terms of colour depth. But subjectively, its look is somewhat redolent of the cheaper 6-bit IPS panels on the market. It's tricky to put your finger on exactly why. Is it a tiny bit less vibrant? Is the contrast not quite as satisfying? Perhaps. Anyway, at default settings the objective metrics show good details in the white scales and perhaps a hint of detail loss in the black scales, but nothing too ugly. The viewing angles, meanwhile, are absolutely fantastic and colour gradients basically look great.

We are also keen on the joystick-controlled OSD. At first it is baffling. But eventually you get the hang of it and this single knob that controls everything works surprisingly well. Whatever, it gives you access to a large and clear on-screen menu with all of the usual image quality options, including three levels of pixel overdrive.

Feeling fruity

Less pleasing is the cheapo tilt-only stand. Yes, you can dismantle it and rebuild choosing one of two heights. But it essentially offers very little adjustment, which is disappointing at this price point. As it happens, we suspect the price is partly down to the inclusion of a Thunderbolt interface, allowing for compatibility with the latest Mac Pros. And that in turn might explain the Apple-esque tilt-only stand.

It's also worth noting that the external power brick is huge. Think gaming desktop replacement laptop power brick and you'll get the right idea. Another minor issue involves display interface compatibility. This is a fast-evolving subject, what with various iterations of DisplayPort and HDMI appearing soon or mooted for the future. But as things stand with HDMI 1.3, you can't drive this display at 60Hz. The bandwidth available only allows for 50Hz. In practice this isn't too awful, although we did notice some slightly odd judders. It would be tolerable as a temporary solution, put it that way. Instead, it's DisplayPort that offers the full 60Hz experience (or Thunderbolt for Mac Pro users). It's not as nice as 120Hz-plus, but you simply can't have everything you want in a monitor right now.

So far, we have painted a picture of a spectacular new display form factor in a monitor that has a few minor flaws. But if there is a major catch, it could be input lag. We say "could be" because precisely how much input lag bothers you is a very personal issue. The LG is clearly slower than our reference Dell 3007WFP, which in turn is slower than the super-fast Asus ROG Swift. Some of us here on *PC Format* could immediately feel a little lag. Others didn't notice or thought it was just fine. Our advice? If you can, try before you buy. Actually, we'd also say wait before you buy. Hang fire for the much cheaper monitors using this same 34-inch panel that are due for release later this year. ■ **Jeremy Laird**

PCFormat Verdict

Features	★★★★☆
Performance	★★★★☆
Value	★★★☆☆

Ultra widescreen is intoxicating and super-cool. But wait a few months for the price to hit £500 later this year.

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3XS Graphite LG156

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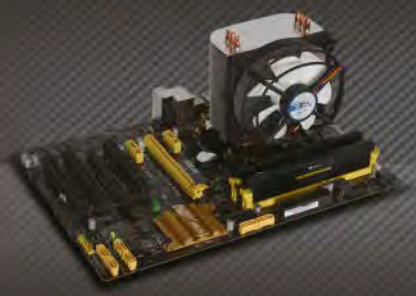

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VITAL STATISTICS

Price £695
Manufacturer Asus
Web www.asus.com
Panel size 27-inch
Panel type TN
Native resolution 2,560 x 1,440
Max refresh 144Hz with Nvidia G-Sync
Response rate 1ms
Inputs 1x DisplayPort

On paper, the new Asus RoG Swift doesn't just tick all our boxes for the ultimate gaming monitor. It mashes them into oblivion. It's the screen we've been waiting for. And before anyone pipes up about TN versus IPS panel technology, the latest 28-inch 4K monitors have proven that TN can be pretty. End of debate.

In that context, and assuming it delivers, we can just about cope with the Asus' £700-ish price tag. But beyond the headline specs, what exactly are you getting? As an RoG item, it's premium through and through. The chassis and stand are fully adjustable, while the overall look and feel is expensive. The best bit is the super-slim and near-flush screen bezel. But the power and status light that forms a full ring around the swivel point on the stand is pretty darned snazzy, too.

Input-wise, you're limited to a single DisplayPort socket. Problematic? Penny pinching? Not in our view. This is a panel with a very particular purpose. And due to the bandwidth requirements of driving a 1440p pixel grid beyond 60Hz, that purpose can only be achieved with DisplayPort.

Likewise, we're not bothered by the lack of pointless image-processing frills like dynamic contrast. There's a triple-level option for pixel overdrive, with the middle setting being the best compromise between speed and inverse ghosting. And that's your lot.

Moving on to the critical question of image quality. First, the bad news. Immediate impressions make it clear that this 1440p TN panel can't match those new 28-inch 4K TNers for raw image quality.

We're not talking about sharpness, resolution or pixel pitch. Instead, the issues are things like contrast, vibrancy, perceived depth and viewing angles. Before the 28-inch 4K generation appeared, the Swift would probably have had a shot at being rated as the very best TN screen we'd seen.

Almost famous

But as good as it is – and it is very good by broader TN standards – things have moved on dramatically, and that makes the Swift slightly disappointing. Elsewhere, it's much better news. As ever, 144Hz is just glorious – on the desktop, in-game, everywhere. Once you've gone high refresh, you won't ever want to go back.

As for Nvidia's G-Sync tech, it's a little more hit and miss. When it works, it's lovely. No rips, no tears, no judder, no stutter. And most of the time it does work. But the effects are relatively subtle and it can be hard to verify correct operation. Like multi-GPU scaling, the benefits are obvious, but it will occasionally drive you mad wondering whether it's working.

All of which means the RoG Swift somehow manages to be easily the best purist gaming panel we've ever seen, and still disappointing. The problem is the breakneck speed of monitor development of late. 4K, high refresh, synced refresh, super-wide aspect ratio, improved panel tech. As things stand, no single monitor has managed to bring it all together. Despite the Swift's messianic promise, the wait continues... ■ **Jeremy Laird**

Technical analysis

We all agree that high refresh is great. But do you really need 144Hz? In practice, you get most of the benefits of high refresh at 90Hz to 100Hz. From there, it is diminishing returns. Notching it up to 120Hz makes a little difference, ditto 120Hz to 144Hz. For our money, however, 120Hz is probably plenty. But 144Hz – as seen on this monitor – hardly hurts.

PCFormat Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★☆☆

The Swift is not quite the messiah of monitors, but we think it's still pretty bloody good for purist gaming.

★★★★☆

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ASUS G550JK

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VITAL STATISTICS

Price £899
Manufacturer Asus
Web www.asus.com
CPU Intel Core i7-4700HQ
GPU Nvidia GeForce GTX 850M
Memory 12GB DDR3L @ 1,600MHz
Weight 2.6kg
Screen 15.6-inch IPS, 1,366 x 768

If it weren't for the ubiquitous red trim and Republic of Gamers regalia emblazoned on the chassis of Asus' new G550JK, you'd hardly be able to tell it was a gaming laptop. Its cooling fans are subtle, as is the brushed metal exterior and restrained keyboard aesthetic. The user-controlled red LED backlighting is a bit of giveaway at this point, but where so many manufacturers fall the wrong side of tacky in a bid to look 'aggressive' Asus manages to maintain an air of decorum with the G550JK.

The machine's build quality is excellent. Squeeze the mounting around the screen and you don't feel layers of flimsy plastic buckling under your fingers – it feels steadfast. The keys are intelligently spaced and give good feedback, and of course the backlighting is a boon. The quality extends to the trackpad as well, which is responsive and doesn't get sticky under sweaty fingers (hey, it's summer). Bundled with this 15.6-inch gaming lappie is a subwoofer unit, which plugs in via a proprietary connection near the charger. But the pièce de résistance is its IPS screen. It's absolutely dripping with deep colour, gives a great viewing angle and is neither too glossy nor fuzzy in direct sunlight. Everything on the outside of this laptop is absolutely tip-top.

However, this isn't some money-no-object Alienware machine. It comes with a tag of £900, and compromises must be made to hit that price point while looking as pretty as this. Intel's Core i7-4700HQ holds its end of the bargain in CPU-intensive tasks, outperforming pricier laptops we've tested in the past.

However, the GTX 850M isn't your one-way ticket to hassle-free, silky smooth high performance mobile gaming, even on the G550JK's native 1,366 x 768. For day-to-day use Asus' latest can't be faulted and it's actually quite luxurious. But ironically, given its RoG regalia, gaming is its chief weakness.

Turn it down

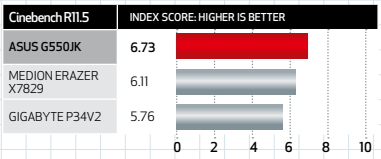
You should only really consider the GTX 850M's performance level a drawback if you're chasing that 1080p 60fps dream on a mobile device, though. By swallowing a little pride and turning a few in-game sliders from 'ultra' to 'high', the components under the hood can throw out a steady 30 frames per second, and do so impressively quietly. Even under the load of the Heaven 4.0 benchmark the laptop is quiet as a mouse. This is a multi-talented device – but sadly, sheer gaming power just isn't one of its strengths. Crucially, it's actually small and light enough to take with you.

The 15.6-inch screen might not trick your eyes into believing you're at an IMAX, but the sharpness and portability more than make up for it. The appearance, size and weight of the G550JK make it a realistic device for use on public transport, on a wobbly table in a café, or simply on your lap. This is a multi-talented device but it runs the risk of confusing potential buyers. Yes, it is a gaming laptop, but not an uncompromising thoroughbred like Medion's Erazer X7829 on p30. Outright gaming grunt isn't a feather in its cap, but in almost every other regard it's a great package. ■ **Phil Iwaniuk**

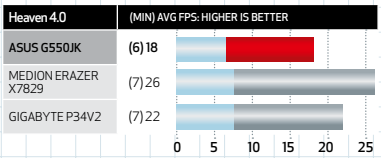
Technical analysis

The Maxwell-powered GPU at the heart of the G550JK makes it a cool, quiet and efficient gaming machine. It doesn't have the power of the beefy Medion, but it's far lighter and has a better shot at giving you some gaming performance on the go. The GPU is a compromise, but not a bad one.

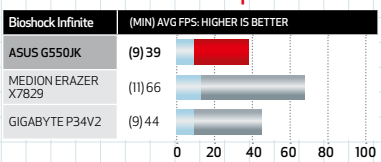
CPU performance



DirectX 11 synthetic performance



DirectX 11 native resolution performance



PCFormat Verdict

Features ★★★★½
Performance ★★★½☆
Value ★★★★½

Has an enticing price without sacrificing quality or usability. The primary tradeoff is in the GTX 850M, but it's still a capable PC.

★★★★☆

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VITAL STATISTICS

Price £1,179
Manufacturer Medion
Web www.medion.com
CPU Intel Core i7-4710MQ
GPU Nvidia GeForce GTX 870M
Memory 16GB DDR3 @ 1,600MHz
Weight 3.8kg
Screen 17.3-inch, 1,920 x 1,080

Squatting on your lap with all the elegance and portability of a broken Ford Transit, the Medion Erazer takes the term 'mobile' with a pinch of salt. It weighs nearly four kilos, has a full 17-inch display panel, and would very likely break your spine if you tried to walk it from your house down to... anywhere at all.

And it isn't worried about this in the slightest. Because this machine is tremendously well-endowed down below. Actually, we've steered into some really weird territory here so let's be explicit: the CPU and integrated GPU powering this monstrosity can handle just about any game you care to throw their way, in full HD and ultra graphics settings, and still produce a genuinely playable frame rate. Not in a "It's 2007, I've managed to get *Crysis* running at 14fps and that'll have to do" sort of way. We're talking about a rock-solid 60 frames per second in all but the most GPU-intensive games. Thanks to the snazzy i7-4710MQ CPU and integrated GTX 870M GPU, this computer has sprinted the *PC Format* gauntlet at impressive speeds, posting the second-best frame rate in *Metro: Last Light*'s ultra-gruelling benchmark test. Above it? Asus' £1,800 G750. There are just five frames per second between the two, which works out at £124 per frame. The Erazer X7829 offers great value performance – that's what we're trying to say.

There is little else to shout about on this hulking mass of a laptop, though. The keyboard is functional and without fancy flourishes. While the laptop's screen does have a native 1080p resolution and a matt display, its colours are still pretty dull in comparison to Asus' lively G550JK, which we have reviewed on p28.

At the sides and rear of the chassis are some ugly and ungainly cooling vents, which are very much required given the meaty GPU within. Nevertheless, we reckon they could have been designed to be far more visually discreet. The Erazer X7829 is extremely quiet, even while you're playing a game and thrashing its components, but inevitably it also gets very hot. This machine comes from the old school of gaming laptop design, where function reigns on high and finesse is for all those namby-pamby iPad-swiping sissies.

Fat stuff

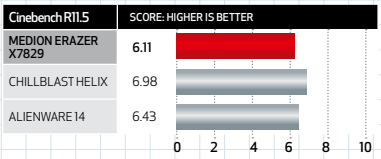
Just how portable you find the X7829 machine depends entirely on how closely your body resembles Dwayne "The Rock" Johnson's, but if you're looking to save some space in your home this will actually make a highly capable desktop PC replacement. There are HDMI and DisplayPort outputs if you need a bigger screen, and five USB ports (three USB 3.0 and two USB 2.0) for various gamepads, keyboards and mice. The machine also comes equipped with a Blu-ray/DVD drive so you can enjoy all your favourite films while you're out and about.

With all these whistles and bells its weaknesses are nullified – but if you are really keen to game on the move, we'd highly recommend picking one up and walking around with it for a bit before you decide to commit to the purchase. ■ **Phil Iwaniuk**

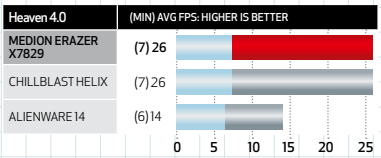
Technical analysis

The X7829 posted some of the best GPU benchmark results we've seen, and outstrips the pricier Alienware 14 across the board... apart from CPU tasks, in which it oddly lags behind. When you consider the expense of Chillblast's Helix, the Erazer's value is clear.

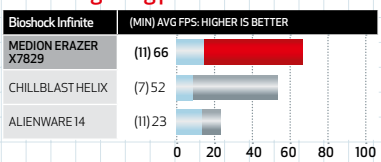
CPU performance



DirectX 11 synthetic performance



DirectX 11 gaming performance



PCFormat Verdict

Features	★★★★☆
Performance	★★★★★
Value	★★★★☆

Considering its performance capabilities, this ungainly machine's price tag is bargainous. But it isn't terribly mobile.

★★★★½

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team-dignitas

William "Scarra" Li - Team Dignitas
"League of Legends LCS Mid-Lane All Star"

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£1,250 GAMING LAPTOP

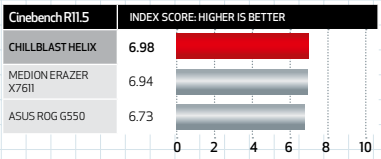
CHILLBLAST HELIX

A svelte laptop design packing some impressively powerful internals

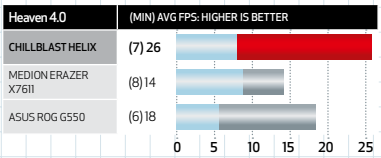
Technical analysis

Thin and light gaming notebooks really don't get much quicker than Chillblast's Helix. The Medion Erazer X7611 we checked out a few months back has the same chassis but a slower GPU, and the Asus G550 is equipped with a lower-end, Maxwell-based GPU. The Helix is the most expensive of the three, but you have to pay for performance.

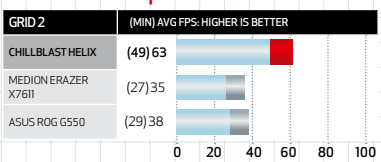
CPU encoding performance



DirectX 11 synthetic performance



DirectX 11 native performance



VITAL STATISTICS

Price £1,250
Manufacturer Chillblast
Web www.chillblast.com
CPU Intel Core i7 4710MQ @ 2.5GHz
Memory 8GB DDR3 @ 1,600MHz
Graphics Nvidia GTX 870M 3GB
Storage 120GB Samsung 840 EVO mSATA, 1TB Seagate SSHD
Screen size 17in
Native resolution 1,920 x 1,080

There must be a certain frustration floating around MSI's notebook department. It spends time and resources designing funky new laptop chassis and creating winning machines, then its OEM department flogs them off to companies that effectively undercut MSI's own devices. But that's all to the benefit of Chillblast here and, by extension, us rabid PC consumers too.

The Helix is rocking effectively the same chassis as the MSI GS70 Stealth series of laptops, just as the Medion Erazer X7611 did a few months back. This time though, Chillblast has gone for a much higher-end specification to make that £1,250 price tag seem more reasonable.

At the heart of this machine is the HyperThreaded Core i7 4710MQ processor. That's an eight-threaded mobile Haswell with a nominal clockspeed of 2.5GHz, but given a certain level of cooling support it can turbo up to a heady 3.5GHz. The thermal constraints of this thin MSI chassis meant that we only saw the i7 hit a maximum of 3.3GHz. Still, that's pretty quick for a mobile CPU.

And it's a very thin mobile PC indeed. We were impressed when Medion tipped up with the same design, and none of the shine has worn off in the intervening months. Despite the 17-inch screen and beefy components, the Helix is still just shy of 22mm thick; that's thinner than a 15-inch MacBook Pro. Obviously it doesn't have the Apple's Retina screen resolution, but since it's a gaming laptop, that's most definitely a good thing. Ideally you want to be gaming at your LCD panel's native resolution, and you're not going to be doing that on a super high-res screen.

Gaming grunt

The gaming performance in this svelte design is very impressive. An Nvidia GTX 870M provides the graphical grunt, and it's a mighty capable GPU at the Helix's 1080p native res. Basically what we have here is the mobile version of the GTX 760 Ti desktop card – it has the same 1,344 CUDA cores at its heart, running at a +900MHz clockspeed. That means we can play plenty of games at their highest setting and don't have to sacrifice the pretties to the gods of frame rates.

More demanding games will require a little finessing of the settings to get a smooth frame rate, but that's where Nvidia's GeForce Experience really comes into its own. In a laptop, GFE's one-touch optimisation makes gaming at good frame rates a doddle.

The only downside of having this much high-end hardware in a thin notebook chassis is that your speedy silicon is still going to generate plenty of wasted energy in the form of heat. The Helix gets pretty loud when you're taxing either the CPU or GPU, and can get rather hot underneath. There's a reason Chillblast offers external notebook coolers in its configuration pages.

The flipside is that the speakers on the Helix give an impressively rich audio experience, so pushing up the volume is a trade-off we're quite happy with. The performance and form factor trump a little extra fan noise for game geeks. ■ **Dave James**

PCFormat Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★★☆

A top quality thin and light desktop replacement machine, thanks to the efforts of both Chillblast and MSI.

★★★★½

£600 GAMING PC

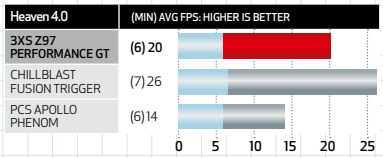
SCAN 3XS PERFORMANCE GT

Budget gaming from Scan's skunkworks

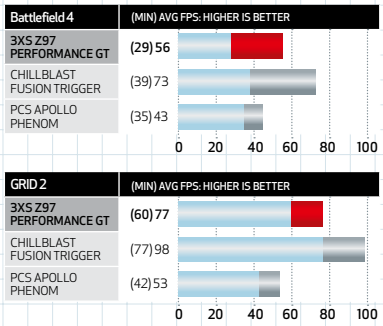
Technical analysis

The £600 Scan machine is only £50 more than the PC Specialist Apollo Phenom, but because of that GTX 760 it runs considerably faster in-game. The Chillblast machine is some £250 more and packs a quad-core i5 and GTX 770 to give it a lead over the Performance GT.

DirectX 11 synthetic performance



DirectX 11 1080p gaming performance



VITAL STATISTICS

Price £600
Manufacturer Scan
Web www.scan.co.uk
CPU Intel Pentium G3258 Anniversary Edition @ 4.5GHz
Motherboard Gigabyte GA-Z79M-DS3H
Memory 8GB Corsair DDR3 @ 2,133MHz
Graphics MSI GTX 760
Storage 1TB HDD
Warranty Three years (one year on-site, two years parts and labour)

The current state of the PC market means you don't need to spend an absolute fortune on a PC to get a decent gaming experience. That's partly down to the lengthening of hardware generations, especially in the graphics card arena, but also because there's masses of gaming power at the lower end of the hardware spectrum. Exhibit A, m'lud: Intel's Pentium Anniversary processor.

We checked out Intel's cheapo Haswell overclocking processor last month, and were mighty impressed with it, too. Now, Scan has used it as the basis of its well-priced Z97 Performance GT machine. This is a £600 rig with a great specs list, making sensible cuts in the correct areas and delivering in the right places. You've got MSI's GTX 760 Twin Frozr taking care of the graphical grunt work, a quality motherboard chipset, and one of the best system warranties money can buy.

To keep the price down, Scan has made concessions in the storage, chassis and cooling. In any machine under £1,000, there really isn't a lot of point splashing out on an SSD; you'll either be taking cash away from places it's better spent in performance terms, or you'll end up with a drive so small it will be no use to man nor machine. The choice to stick with a 1TB HDD is a wise one – we'd rather the machine took a little longer to get into a game but ran well, than launched quickly but had the frame rate of a zoetrope. And that 1TB of storage space will still be immensely useful when you can afford to upgrade to an SSD later down the line.

The Fractal Design Core 1000 chassis is rather basic, but you're not going to suffer by having your components housed inside it. The cooling might be a different matter. Scan has opted for the Arctic Cooling Freezer i11, which is an active air cooler with an almost silent, chunky fan. While it's more than a match for the Pentium Anniversary chip in general usage, it does seem to struggle a little at the hefty 4.5GHz overclock.

Silicon stability

Our test machine developed some stability problems at that level and we had to replace the CPU after a day's testing. That's likely down to a failure in the CPU silicon itself rather than the Scan build, but any issue will soon present itself when the processor is running at 87°C in *Battlefield 4*. To us, that 4.5GHz overclock seems a little too ambitious given the temperature the chip achieves at such speeds. That does highlight how important it is to get a good warranty with your overclocked rig, and Scan offers one of the best. Problems with overclocked systems tend to happen within the first year, and so 12 months of on-site support is fantastic – you shouldn't be without a working system for long if anything does go wrong.

Scan has put together a really impressive package with this well-priced, smartly-specced system. Our only concern is the ambition of the 4.5GHz overclock. Aside from that, the GTX 760 is going to deliver a great 1080p gaming experience. ■ **Dave James**

PCFormat Verdict

Features ★★★☆☆
Performance ★★★★☆
Value ★★★★★

For £600 you get a great spec, a decent upgrade path, an excellent warranty and a quality little 1080p gaming machine.

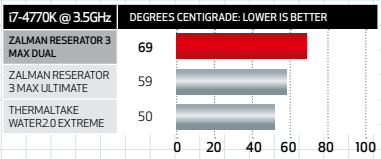
★★★★☆

£99 CPU COOLER

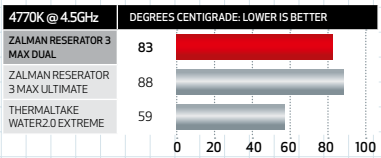
Technical analysis

Fitting the Zalman Reserator 3 MAX Dual is an absolute doddle thanks to its well-illustrated manual. In fact, it took almost as long to tighten the eight screws holding the mounting bracket for the water block as it did to fit the water block onto the motherboard.

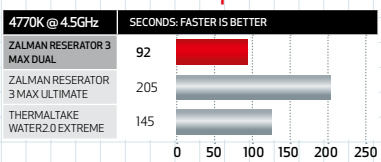
CPU 100% performance



CPU 100% overclocked performance



Peak-to-idle overclocked performance



ZALMAN RESERATOR 3 MAX DUAL

Zalman's Reserator 3 MAX Ultimate has a new big brother...

VITAL STATISTICS

Price £99
Manufacturer Zalman
Web www.zalman.com
Intel socket compatibility 775, 1150, 1155, 1156, 1366, 2011
AMD socket compatibility AM2, AM2+, AM3, AM3+, FM1, FM2
Water block Copper
Cooling fans 2x 120mm
Dimensions 276 x 122 x 73mm

Late in 2013, we took a look at Zalman's Reserator 3 MAX Ultimate. Like most of Zalman's chillers, it looked like nothing else on the market, and was the first AIO (all-in-one) liquid CPU cooler to use nanofluid tech. Now the company has upped the ante with the launch of that cooler's bigger sibling, the Reserator 3 MAX Dual, which features two radiator units.

If you thought the original's radiator was impressive, just imagine two of them bolted together. The radiator unit measures some 276 x 122 x 73mm (LxWxD). That's a bit longer than a normal twin-fanned radiator associated with water cooling, which shouldn't present any real problems when you're fitting it in your case. The same may not be true of that 73mm depth, which may be incompatible with smaller chassis designs.

Pretty cool

As with most things Zalman, the cooler is beautifully and cleverly engineered. The designers have taken two of the original dual-core radiators and joined them together so the fluid makes four complete passes around the cooler while being chilled by the fans. The radiator units are joined at the point where the two pipes from the water block enter and exit the cooler. The cooler radiators are made from copper with a black nickel-plated finish, and the fan unit is created from clear plastic with an aluminium trim. The fans and the water block are illuminated with blue LEDs.

The water block is made from copper with an embedded pump, and the whole unit measures a mere 37mm tall. The water block uses a micro-finned base, which helps to move the heat quickly away from the CPU – Zalman claims it can pump up to 90 litres of fluid an hour.

So what about that nanofluid stuff, then? Well, Zalman has added nanoparticles to the cooling fluid to help improve the performance.

Keeping everything chilly are two nine-bladed 120mm fans, which spin between 1,000 and 2,280rpm and produce noise levels from 23.2dBA to 46.6dBA – or, to put it another way, from barely audible to very noticeable, especially when you're pushing the CPU.

To Zalman's credit, the Reserator 3 MAX Dual is pretty straightforward to put together and install on the motherboard. We have to stress that our scoring was carried out on a lab bench testing rig and not in a case. Nevertheless, it was still quicker to install than some other air coolers we have tested in the past.

The Reserator 3 MAX Dual performs perfectly well, but there is a nagging feeling in the back of your mind that it should be doing a good deal better. At its best, it's only cooling the CPU by 10 degrees more than its single-radiator-equipped sibling, and it's not as effective as some much cheaper liquid coolers we've tested. Those twin fans come into play when the CPU is returned to its idle state from running at full chat, and the time it takes to get back down to the idle temp is really quite amazing. If only its performance the other way was a bit better. ■ **Simon Crisp**

PCFormat Verdict

Features	★★★★☆
Performance	★★★½☆
Value	★★★½☆

We're a bit disappointed with the Reserator 3 MAX Dual. With twice its predecessor's cooling power, we expected better.

★★★★☆

£250 STEREO SPEAKERS

HARMAN KARDON NOVA

Clear globes of aural delight or form over function?

VITAL STATISTICS

Price £250
Manufacturer Harman Kardon
Web www.harmankardon.co.uk
Format 2.0 stereo
Frequency response 55Hz - 20KHz
Input Bluetooth, optical, analogue 3.5mm
Transducers 63mm woofer, 35mm tweeter
Power 20W woofer, 20W tweeter

These speakers are not designed for our desks. The gorgeously globular Novas aren't meant to reside in a mess of bills, geeky toys and discarded (but still hoarded) hardware. Harman Kardon's Novas are aching for a minimalist glass desktop with just a faux-industrial anglepoise lamp and a MacBook for company, all sat in the middle of a white room with wooden flooring and a single bookcase nonchalantly leaning up against one wall.

But dammit if they don't still look rather sexeh sat either side of our big screen monitors amidst our clutter. The clear, spherical casing surrounding the ridged black sound trumpets inside is accented by the bass-rumbling rear membrane and an expanse of material covering the speaker on the front.

There are no dials or buttons to spoil the clean lines of the Nova speakers, just sleek touch-sensitive lights that serve as controls. To alter the volume, you simply slide your finger across the gradually dimming or intensifying points of light on the top curve of the right-hand speaker. To select your input, only a feather touch is required on the relevant control LED to the side. In fact, you don't even have to do that if you're going down the NFC Bluetooth route with a compatible phone – tap your device against the side to pair it and away you go.

But we're looking at the Nova set as a 2.0 stereo kit for PCs, and the vast majority of us are still rocking the 3.5mm analogue connection. That's something that doesn't seem to sit well with these little Harman Kardon noise-makers – the electrical interference from unshielded motherboard audio utterly destroys any enjoyment you might have of the Novas' aural quality. And that's the sort of audio most of us have.

Blueteeth

With a Bluetooth PC connection though the sound is pretty darned good. There is no discernible hissing and the clarity is genuinely impressive. The low-end may not have the really punchy bass that some gamers desire, but the crystal high-end is exactly what we're after. The Novas' proprietary DSP seems to emphasise the mid-range. That's great for movies or game dialogue, but in musical terms it can make some of your favourite tunes strangely unbalanced.

They're not the loudest speakers, but they manage to retain impressive aural clarity right through the volume range; you'll still pick out individual sounds even with the volume pushed way down – that's a very desirable trait from a speaker set. The Novas retain a pleasingly precise spatial sound too, despite the shortish connection between the left and right speakers – you can't put much distance between them.

We're impressed with the audio of the Nova speakers, but not £250-impressed. The slight lack of punch at the low-end is to be expected without a separate sub. But with the failing of the analogue connection it is somewhat difficult to really recommend them if you don't have a dedicated soundcard or a modern motherboard complete with electrical shielding. ■ **Dave James**

PCFormat Verdict

Features	★★★★½
Performance	★★★★☆
Value	★★½☆☆

Good sound reproduction for the most part, but the analogue failings make them tough to recommend to the PC faithful.

★★★½☆

£113 PROCESSOR

AMD A10-7800

A low power APU for the small form factor, non-gaming crowd

VITAL STATISTICS

Price £113
Manufacturer AMD
Web www.amd.com
Socket AMD FM2+
Clockspeed 3.5GHz
Turbo 3.9GHz
Cores 4
Threads 4
TDP 65W

Every time AMD releases a new processor there's a microsecond rush of excitement, a thrilling jolt that runs up our collective spines at the thought that maybe, just maybe, AMD has at last released a genuinely cool and competitive straight CPU. That rush of excitement quickly recedes, fading in the miserable realisation that there's still no revival of the desktop FX line. All we're left with is just another APU. Sigh.

So, here is the new AMD A10-7800. It's a slight refresh of the original desktop Kaveri APU line, sitting between the top-end A10-7850K and the middling A10-7700K in terms of both pricing and specs. It's operating with a dual-module Steamroller CPU component, giving it a total of four cores, four threads and the full complement of Graphics Core Next shaders for its GPU part. In current AMD parlance that translates to 12 compute cores comprised of four GPU cores and eight GPU clusters.

That's the same basic configuration as the top-end desktop Kaveri chip. As the A10-7800 is only some 100MHz shy of the peak Turbo mark of the A10-7850K, it doesn't actually deliver much lower CPU performance than the best Kaveri can offer. Importantly for an APU, it's also running the exact same GPU configuration as the top A10 part – there are the full 512 GCN cores and they're all running at the same 720MHz as the A10-7850K.

There's not a lot to get too excited about there then – for a tenner less than the top APU you get one that's only slightly slower. But with the weak CPU power of the Kaveri lineup compared with a similarly-priced Intel chip, you might as well pay the extra if you really have to have an APU. Bear in mind that because the A10-7800 is lacking the all-important K-series tag, there's no overclocking allowed. This is a locked-down CPU that simply cannot do anything about the weak single-threaded performance of its Steamroller cores.

Power friendly

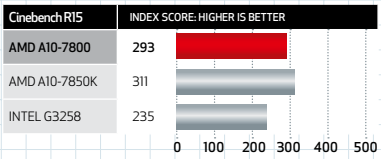
It's not all bad news. This APU is a 65W chip, compared with the 95W TDP of both the A10-7850K and A10-7700K. You can even go a little further and knock the TDP down to an impressively low 45W. That will impact the chip's general performance because the lower TDP reduces the base clock of the CPU part, yet it still retains the same top Turbo speed – impressive.

If you're going to be dropping a hefty GPU into your system that doesn't make a lot of difference, but the performance drag that the A10's weak single-threaded power places on the graphics card means you probably wouldn't do that anyway. However, if you're looking for a PC to run purely on the processor graphics of your APU then the A10-7800 is the most efficient, cost-effective option. It's still got the same level of graphical grunt as the top Kaveri and, even though it's got a lower clockspeed, the combined compute power of the GPU/CPU combo will deliver almost as well in accelerated applications. Knock the TDP to 45W, drop in some high-speed memory, and you've got a decent small form factor base. ■ **Dave James**

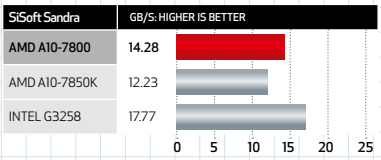
Technical analysis

The new APU is at least competitive with the top Kaveri APU at stock speeds, but the A10-7850K squeezes ahead with some light overclocking. Up against the Intel Pentium Anniversary chip (G3258) – which has half the thread count and is half the price – the A10-7800 looks to have a bit of a lead, but once the Intel chip is overclocked that soon disappears.

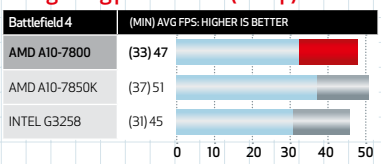
CPU rendering performance



Memory bandwidth performance



DX11 gaming performance (1080p)



PCFormat Verdict

Features	★★★★☆
Performance	★★★☆☆
Value	★★★★☆

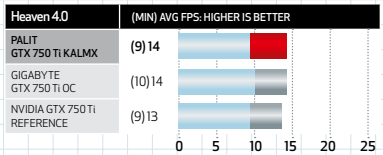
Your best bet for an APU if you're only interested in processor graphics. There's nothing here for gamers though…

£120 GRAPHICS CARD

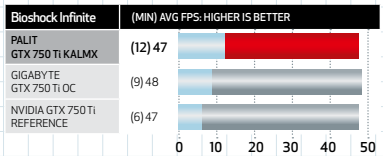
Technical analysis

We've compared this Palit GTX 750 Ti to the slightly overclocked Gigabyte offering and Nvidia's reference design (all three cards cost roughly the same). Even though the Gigabyte card boasts higher clocks, it doesn't translate into a real performance lead. Gigabyte's card also needs a PCIe power connector.

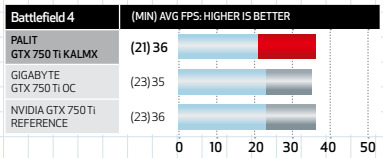
DirectX 11 synthetic performance



DirectX 11 gaming performance (1080p)



DirectX 11 gaming performance (1080p)



PALIT GTX 750 TI KALMX

Shhh, it's oh so quiet…

VITAL STATISTICS

Price £120
Manufacturer Palit
Web www.palit.biz
GPU Nvidia GM107
Base clock 1,020MHz
Boost clock 1,085MHz
Memory clock 2,700MHz
Memory capacity 2GB
Memory interface 128-bit

Since we've spent a lot of time crystal-ballin' this issue, let's take a second to think about what our perfect graphics card would be. Ours would be a powerful, energy-efficient, cool and quiet GPU; one that isn't going to melt our sexeh small form factor chassis into a puddle of exotic slag, but is still capable of delivering the frame rates we desire.

Nvidia's latest GPU, based on the updated Maxwell graphics architecture, has at least three ticks against the four wishes on that list. The fact that the GTX 750 Ti is just missing the top-notch gaming performance we're always desperate for makes the wait for bona fide high-end Maxwell-powered graphics cards even more irksome.

Still, the GTX 750 Ti impressed the Hades out of us, even though it arrived at a time when everybody seemed to be making $1,000 graphics cards. Those ultra-expensive cards were designed for some ephemeral group of 'ultra-enthusiast gamers', whereas the GTX 750 Ti was an unassuming mid- to low-end card capable of competitive 1080p gaming performance with a fraction of the power-draw or heat generation.

That made Nvidia's latest GPU a prime candidate for a little living room box, or something to chuck into a £300 beige box, turning it into a potent budget gaming rig. The fact it could run powered only by the juice from the PCIe slot itself made it a peerless bargain upgrade card.

The only thing we missed in the first set of cards we checked out was a passively-cooled version. The low-power GM107 reference GPU cooler ran to a positively chilled 54°C, making a chunky heatsink-only cooler a genuine possibility; in fact we jury-rigged an old AMD heatsink onto the reference chip and it worked perfectly. Palit then followed suit and produced an impressive, bus-powered, dual-slot version that's completely silent.

Game in silence

The GTX 750 Ti KalmX doesn't really make any compromises to get to that noiseless state, running at the same base clock as the reference card we had direct from Nvidia. That means it posts almost identical benchmark numbers, with only expected testing variance separating the results. The only slight issue is the lack of an extra fan blowing over the top of those myriad aluminium fins. This means the KalmX ends up hitting 83°C under full gaming load, so you're less likely to see that boost clockspeed over an extended gaming session. However, as we've seen from overclocked GTX 750 Ti cards, a slight difference in clockspeed means you're only really losing out on a few FPS at most.

If you want a little box for your living room that doesn't force you to turn the volume all the way up to drown out the noise of its fans, Palit's KalmX is a great choice. If you're streaming from a fat desktop rig in another room, the job's a goodun, but if you want to play some 1080p games locally then Nvidia's GM107 is pretty darned capable in those terms too. Palit's KalmX is one of the most versatile budget-oriented graphics cards we've ever tested, and we're quite taken by it. ■ **Dave James**

PCFormat Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

Quite the quiet little GPU this one. A great starting point for a small form factor living room PC, or a budget gaming rig.

★★★★½

£50 GAMING MOUSE

AORUS THUNDER M7

Can Aorus' first gaming mouse stand out from the established players?

VITAL STATISTICS

Price £50
Manufacturer Aorus
Web www.aorus.com
Sensor Avago ADNS-9800
Sensor type Laser
Sensitivity 50-8,200dpi
Polling rate 125-1,000Hz
Programmable buttons 16

There's something pleasingly chunky about Aorus' first gaming mouse, the Thunder M7. This MMO-centric, multi-buttoned mouse rides high off the desk, has a pair of hieroglyphic-looking eyes shining out of the front of its grill and fits more comfortably in your hand than you might expect.

When we first ripped it from its packaging, the tightly-packed side-buttons and elevated chassis weren't really selling it as a rodent we'd want to use for any extended period of time. But having spent a good while living – and gaming – with the Thunder M7 we've definitely developed a soft spot for it. Where that soft spot gets decidedly rocky, however, is with the main thrust of its overall design – those MMO-lovin' buttons.

You don't need to be a rodent-loving aficionado to guess which sensor the Thunder M7 is relying on for its accuracy – that maximum 8,200dpi is a good indication that we're once more dealing with another laser mouse based on the Avago ADNS-9800 sensor. That's no bad thing; familiarity often breeds contempt, but we're pretty happy campers when it comes to the accuracy of this sensor.

You wouldn't generally be using it at the top sensitivity, but you could argue that today's high-res desktops benefit from a little speedier mouse movement. That said, on a 4K desktop you're dealing with some tiny icons and the slightest twitch can throw you right off target. It's a good shout, then, that Aorus hasn't tried making the top dpi setting a main selling point. In fact, like the super-speedy Logitech Proteus, it doesn't offer dpi speeds that high unless you dip into the mouse's Macro Engine to set it up.

Trial and error

Aorus' Macro Engine software is designed for use across its currently limited peripheral range and offers all the tweaks you'd expect. There are five profiles to fill with your choice of macros and whatever bizarre button configurations you want, but you can also disable some to avoid cycling through unused profiles. The macro recorder is simple to use and pretty effective, and the key mapping is quick to operate, with visual indicators as to which of the nine buttons you're messing with.

As we've already hinted, those buttons are very tightly-packed, which means that figuring out which one you're slapping your thumb against can be a bit of trial and error. Thankfully, they're not as cramped as they are on the strangely popular Razer Naga. There's somewhere for us claw-grip gamers to rest our thumbs too, with a little Braille-like nodule on one of the central buttons to help. Even so, in a frenzied raid, the buttons didn't feel natural or particularly accurate.

So, while the rest of the Thunder M7's design sits quite comfortably with our gaming sensibilities, those extra buttons simply don't do anything for us.

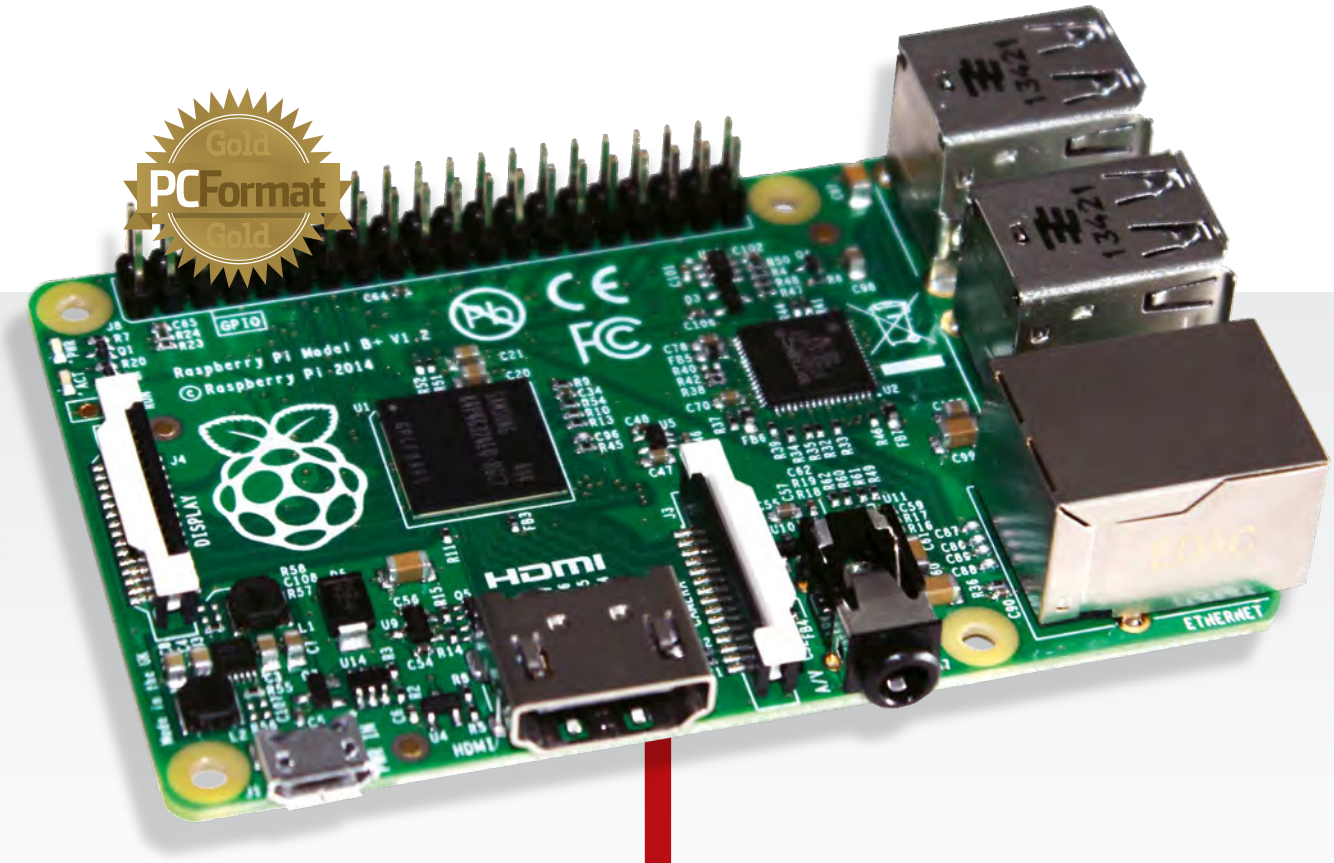
We hope Aorus isn't limiting the scope of its designs though, as we'd love to see this chunky little rodent with just two programmable buttons next to the left mouse button, instead of the current mostly-useless clump. ■ **Dave James**

PCFormat Verdict

Features	★★★★½
Performance	★★★½☆
Value	★★★★☆

A decent, chunky and accurate gaming mouse, but those MMO-centric buttons are just a little too tightly packed for us.

★★★★☆



£29 PROJECTS COMPUTER

RASPBERRY PI MODEL B+

How does the latest addition to the family compare with its predecessors?

VITAL STATISTICS

Price £29
Manufacturer RPi Foundation
Web www.raspberrypi.org
CPU ARM1176JZF-S 700MHz
Chipset Broadcom BCM2835 SoC
Memory 512MB
Storage MicroSD
Ports 4x USB 2.0
Connection 40-pin GPIO
LAN 100Mbit Ethernet
Outputs HDMI, RCA, 3.5mm jack

Hot on the heels of the Compute Module, the Raspberry Pi Foundation has snuck out another single board computer. The Raspberry Pi Model B+ is the final version in the Model B series. A similar revision to the Model A is expected later this year.

Like previous models, the B+ uses the Broadcom System on a Chip (SoC), the BCM2835 and accompanying ARM11 700MHz CPU, and 512MB of RAM. But based on community feedback, it now has an improved port layout. Ports are no longer dotted around all the sides but concentrated on two, and there are now a couple of extra USB 2.0 ports, taking the total to four. Next to the USB ports is an Ethernet port, and moving further around there's a single headphone jack, now with analogue audio and video output in a four-pole design. This removes the need for a separate composite video output and saves space. The analogue audio output has also been improved. Skipping over the standard HDMI port, the last port is a micro USB, connected to a more efficient power circuit that reduces the power consumption to just one Watt – therefore extending the lifespan of any battery-powered projects. On the underside, the SD card slot has been replaced with a tactile microSD slot.

The Foundation has added an extra 14 pins to the GPIO connector, taking the total number up to 40. Of these 40, the first 26 pins are fully compatible with the original Raspberry Pi GPIO, which means the majority of add-on boards will work with the B+. We successfully tested it with Pimoroni's Pibrella and PiGlow. We did, however, encounter an issue with the Wolfson Audio add-on as the B+ lacks the P5 header pins needed for a connection, while the popular PiFace is designed to fit the Model B layout.

More pins

The extra pins access more of the SoC, giving you more pins for bigger projects. There are two new GPIO pins – pins 27 and 28 – which enable future add-on boards to use an EEPROM chip, and will automatically configure the add-on board on boot.

Previous Pi projects, such as ScratchGPIO and Python, are fully compatible with the model B+ too – it's as simple as copying the files across.

The model B+ obviously offers quite a lot to Raspberry Pi users, but that doesn't mean the Model B will be phased out anytime soon. James Adams, director of hardware for the Raspberry Pi Foundation, confirmed to us that as long as the demand is there the Foundation will keep making them. Both models will also continue to benefit from software upgrades.

With a guaranteed future for both models, the Model B+ refines the original design. It doesn't really offer any substantial new features, but does deliver greater potential thanks to the enhanced GPIO and extra USB ports, all for less money and lower power consumption. While we'd like built-in wireless, Bluetooth, USB 3.0, a faster CPU/GPU and more memory, these would break the platform continuity. ■ **Les Pounder**

PCFormat Verdict

Features	★★★★☆
Performance	★★★☆☆
Value	★★★★★

With more ports and pins, the Model B+ is a welcome refinement and delivers changes the community has asked for.

★★★★½

Lend us your ears...

Whether you've a fortune to spend, a budget to stick to or a terrifying phobia of cables, we've got the headset for you

Audio-Technica ATH-AG1

£232 www.audio-technica.com

Were it all about the sound quality, then pro-audio outfit Audio-Technica would be on to a winner with its fancy ATH-AG1 headset. It is the audiophile brand's first foray into gaming audio and the impressive cans boast some of the best in-game sound that we've ever heard from our PC. The AG1's concession to gaming means it has the exaggerated bass that we've come to expect from such headsets, but doesn't come at a cost to the rest of the aural experience. The high notes are as crisp as Kettle Chips and the frequency response range offers an impressive depth to the sound. It's worth noting that the mic is utterly fantastic too.

But it's not all about sound, because if the damn things won't rest on your head as comfortably as a noisy cloud then they are simply no good for an extended gaming session. The Audio-Technica cans use a Wing Support Mechanism to rest this lightweight headset on your bonce, which is great if the size of your head fits in with the AG1's design. Those with a slender skull, like our Phil, may struggle to find a comfortable fit. So, while the sound quality matches the high price tag, the overall design might not. ■

VITAL STATISTICS

Manufacturer Audio-Technica
Frequency response 20Hz-20KHz
Weight 310g
Connection USB and 3.5mm wired

★★★☆☆

CM Storm Sirus-C

£69 http://gaming.coolermaster.com

Some top-bod at Cooler Master had been heard to shout "moar noiz!" during the design phase for the Sirus-C headset, and so its engineers threw another pair of drivers into these CM Storm cans. That means each pillow-soft ear cup has two separate drivers in it – a 44mm one for the mid-range and treble, then another 40mm woofer to hound your ears with throbbing bass notes. Because of the extra sound processing and amp tech, these hefty cans waddle off the scales at a rather weighty 425g. It's lucky the build quality is so good and the padding so ample.

What do those separate drivers mean then? Well, let's be clear, the audio from the Sirus-C is very good, but it's not really noticeably better than a decent single driver setup. The standard frequency response range means that while the sound is clear both at the top and bottom, it doesn't produce the depth offered by single-driver sets with a wider range.

The microphone is a little underwhelming; it's relatively clear but just a bit flat. And that's kind of how we feel about the Sirus-C as a whole – it's a very competent headset, but despite the impressive audio specs it doesn't reach the extra heights you might expect. ■

VITAL STATISTICS

Manufacturer Cooler Master
Frequency response 20Hz-20KHz
Weight 425g
Connection USB and 3.5mm wired

★★★★☆

Gamdias Eros

£46 www.gamdias.com

This bargain-priced headset from peripheral newcomer, Gamdias, is a bit of a surprise. On first sight it looks every bit the £46 gaming headset – all glossy red and black styling with a fat, pivoting boom mic. It doesn't scream quality, it just mumbles something about certain plastics being cheaper to manufacture. But throw the Eros over your ears and you'll be as stunned as we were about the level of audio loveliness that flows into your lugholes.

The Eros combines bold, pounding bass notes with pin-sharp treble, making it a great gaming headset. It only rocks a modest 20Hz-20KHz frequency response range, but sounds almost as good as sets costing twice as much. Despite the questionable appearance, the cans are comfortable and cushion your head in gently-padded luxury – ideal for that lengthy *Battlefield 4* frag-fest.

The mic is nothing to get excited about, but it doesn't let the Eros down when you're screaming at your squad for a little fire support. The audio quality isn't quite so astounding musically, with treble feeling just a little too harsh for some vocals. Yet for a well-priced gaming headset, you can't really ask for more than what Gamdias has delivered. ■

VITAL STATISTICS

Manufacturer Gamdias
Frequency response 20Hz-20KHz
Weight 310g
Connection USB wired

★★★★½

Gamdias Hebe

£35 www.gamdias.com

With Gamdias offering the Eros for a bargain £46, what can we say about the even-cheaper Hebe? For a start, I guess we can say that Gamdias hasn't really got the hang of styling PC peripherals for anyone over the age of 17, with glossy red colour utterly dominating these budget-priced cans. We can also say that this isn't a headset for any Twitchers out there who want their words to soothe the eardrums and not perforate them – that microphone is only just functional enough for the odd gruff team command or a bit of trash-talk mid-game.

Aurally, the Hebe is as much of a surprise as its big brother Eros. The sound quality is similarly excellent, with a virtual soundscape that's crisp and effective enough to allow you to place audio sources with impressive accuracy. We don't know what Gamdias' magic formula is – and it certainly wasn't present in its ropey Hephaestus headset we checked out months ago – but it has managed to create a pair of budget-priced headsets that do away with unnecessary gimmicks and just deliver genuinely impressive audio. This 3.5mm jack connected set is slightly cheaper than the USB-cabled Eros, but the sound is almost as good. ■

VITAL STATISTICS

Manufacturer Gamdias
Frequency response 20Hz-20KHz
Weight 372g
Connection 3.5mm wired

★★★★☆

Kingston HyperX Cloud

£86 www.kingston.com

When we first saw Kingston's HyperX-branded headset there was a twang of recognition in our collective hivemind tech lobes. It is effectively QPad's excellent QH-90 headset but with a little bit of a paint job. Then there was an immediate shudder as we heard that Kingston had taken one of our favourite headsets and decided that it needed bigger 'splodes. Yup, Kingston has turned up the dial on the bass. To our surprise, it hasn't taken anything away from the original headset's aural quality. Our one concern with the QH-90 was that the bass response was a little light because of the delightfully balanced EQ that QPad had used. Kingston has augmented the low-end of this HyperX version to give the sub-20Hz frequencies a punch that is more felt than heard. It's not punching your ear like the Mad Catz cans, but adds depth to the bass notes without muddying other sounds.

And because it's practically identical to the QH-90 set, it's got an elegant, robust and lightweight design that feels comfy after long periods of use, and the detachable mic is as clear as you could want. Incredibly, Kingston has improved on an already impressive headset. ■

VITAL STATISTICS

Manufacturer Kingston
Frequency response 15Hz-25KHz
Weight 350g
Connection 3.5mm jack

★★★★★

Mad Catz FREQ 4D

£94 http://madcatz.com

Hands up all you gamers who have been after a total immersion helmet. Y'know, so you can *feel* what it's like to have a round enter your skull or a grenade explode next to your ear. Thanks to Mad Catz, you can now get mighty close with its ViviTouch tech. The idea is that when you get low-end sounds passing through the ear cups, you get a palpable vibration through some fancy harmonic distortion.

We must admit none of that sounds particularly pleasant on the page, but with ViviTouch turned on (via a switch on the headset itself) you do get a fairly satisfying bass thud. Unfortunately, the FREQ 4D is tuned towards bass-heavy sound, which means even with ViviTouch shut off it is practically impossible to flatten out the EQ enough to make music or films sound anything other than utterly synthetic. Sadly, that makes the FREQ 4D's gimmick rather aurally destructive – it is suited for gaming to the detriment of anything else.

We have to tip our hat to the *Titanfall*-branded aesthetics, though, if only for the fact that the set looks like it was ripped straight off Porkins' charred corpse after crashing into the doomed Death Star. ■

VITAL STATISTICS

Manufacturer Mad Catz
Frequency response 20Hz-20KHz
Weight 306g
Connection USB and 3.5mm wired

★★★☆☆

SteelSeries H Wireless

£205 www.steelseries.com

Well, SteelSeries just misses the award for the most expensive headset in the test. Unlike the Audio-Technica cans, that price premium isn't tied into its audiophile roots but in the underlying tech. The H Wireless is, obviously, a wireless headset and pulling wires out of peripherals always ends up adding to the price tag. Still, £205 is a huge amount to spend on a wireless headset, so you would expect something rather special for the money.

By and large, the SteelSeries headset pretty much delivers. The aural quality is impressive, with solid, controlled bass notes, clear mid-range and crisp treble. But it's not exactly class-leading – the Kingston HyperX cans still stand out as the best-sounding in this test.

But you're not really paying for audio; you're paying for wireless connectivity. And this is where the SteelSeries set excels. The transmitter box is part amp and part charging station, with an OLED display and physical dial and push button that is simple to use. With a pair of Li-ion batteries – one for play, one for charging – you'll barely miss a beat and the 12m range is excellent. It's a seriously impressive kit, but hugely expensive. ■

VITAL STATISTICS

Manufacturer SteelSeries
Frequency response 20Hz-20kHz
Weight 324g
Connection Wireless

★★★★☆

Turtle Beach EF Z300

£156 www.turtlebeach.com

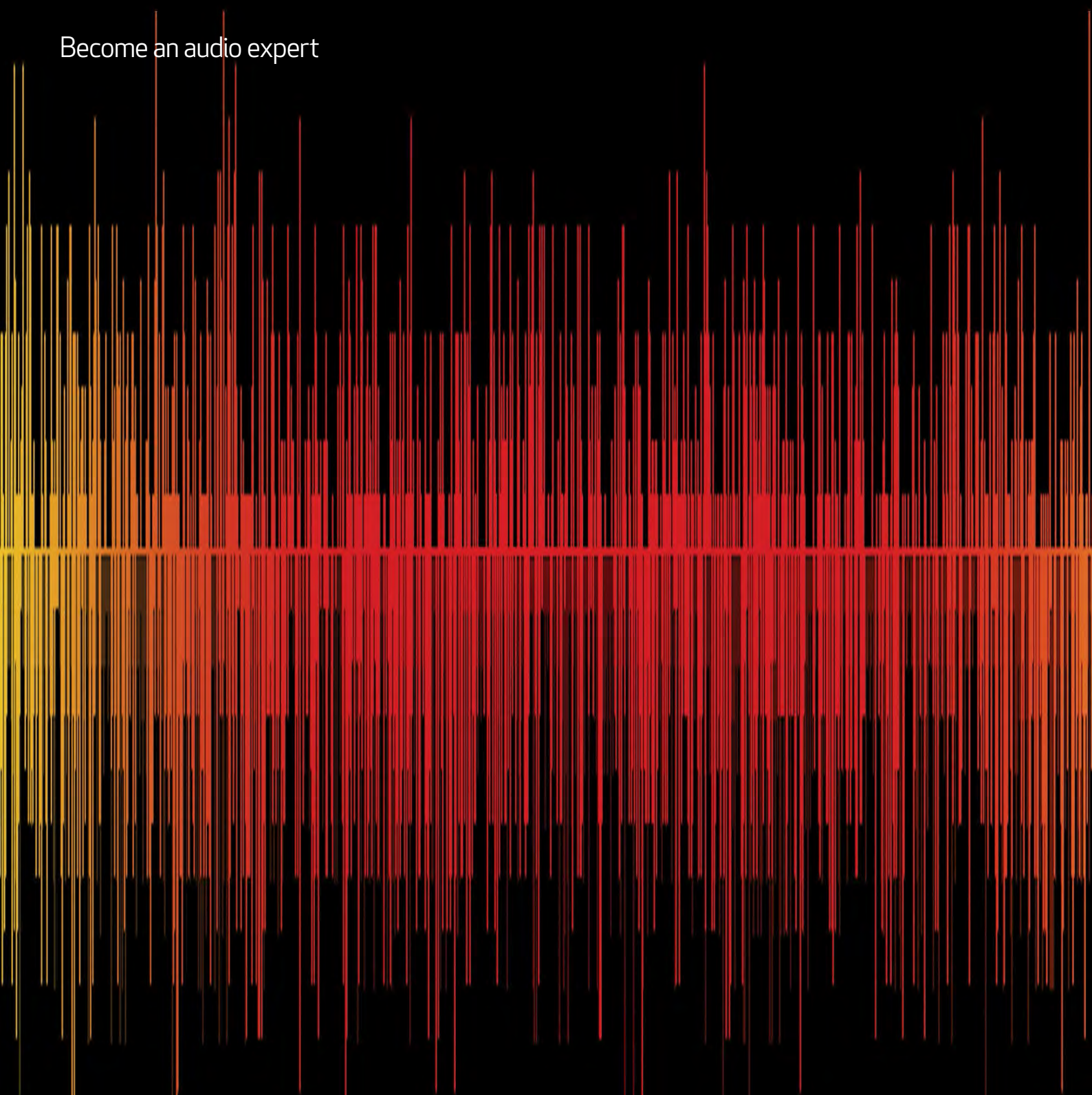
Craving a life without leads, but the SteelSeries cans just too rich for your blood? Well, the Z300 from Turtle Beach is both cheaper and lighter, but is sadly not quite capable of delivering the sort of aural experience you'd want – and might rightfully expect – from a £156 set of cans. The wireless setup itself isn't the problem. With dual-band Wi-Fi you get almost the same range as the pricier SteelSeries headset, and there is Bluetooth pairing if you are keen to link up to a separate laptop or mobile device. The Turtle Beach headset only comes with a single battery, so you'll have to rely on that hoary ol' USB chestnut for all your charging purposes.

But yes. The audio. It's not necessarily bad, but it really doesn't stand out from the likes of the bargain-priced Gamdias cans we've also reviewed here. The virtual 7.1 surround sound does an okay job of offering a more expansive soundscape than plain old stereo, but only really to the extent of giving you a bit of a separation between the front and rear noises. That underwhelming feeling extends to the general sound quality – big explosions sound fine, but then they do on the Hebe headset too… for a quarter of the price. ■

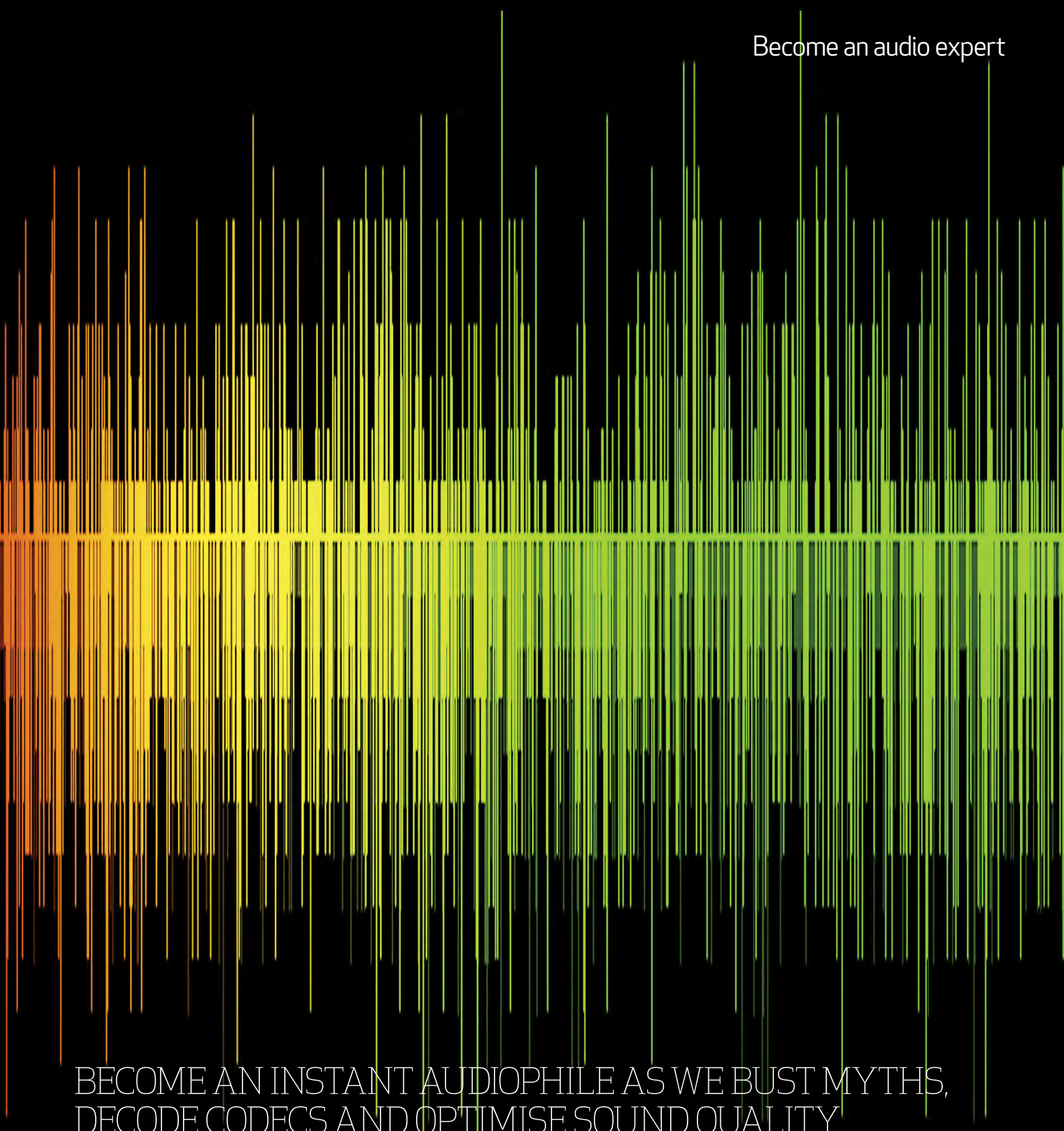
VITAL STATISTICS

Manufacturer Turtle Beach
Frequency response 20Hz-20KHz
Weight 319g
Connection Wireless

★★★½☆



BECOME AN AUDIO EXPERT



BECOME AN INSTANT AUDIOPHILE AS WE BUST MYTHS, DECODE CODECS AND OPTIMISE SOUND QUALITY

Digitised music has made it possible to access your favourite tunes in an instant. Whatever you're into, it's out there in some form or another. Sound is also an integral part of gaming – melodies, soundscapes and effects all bring you deeper into the experience.

The thing is, audio is intangible, making it very hard to rate in terms of quality; many people have higher opinions of early game tunes built on primitive architecture than cinematic orchestral scores, for example. It's a subjective thing to deal with, but if you've ever want to push past the sonic boundaries and become an audio guru, your PC is a good place to start.

We'll give you a run-through of the basics of what you need to know. You'll learn best practice, rules of thumb, and by the end you'll be able to separate fact from fiction. Always remember that it's a highly personal field that's influenced by opinion.

Audio isn't a complex task for your PC to handle though. In terms of CPU scheduling, audio tasks are generally relegated to background processes, and setting your processor scheduling up to handle these tasks as a priority is actually a good idea if you want to run audio while using your PC for other tasks.

Whether you're looking for a deeper understanding of audio for music, for games, films or anything else, it's possible to beef up your system and get better results, whether its done from inside the computer or outside. Choosing the right hardware and knowing about digital delivery of sound will fill a lot of gaps, but usually the biggest changes can be made at the final point of the chain – your speakers.

Speakers

Speakers come in all shapes and sizes, for all types of use – from tiny, portable ones to huge wall-shaking boxes. There are lots to choose from, but how do you cut through the crowd and find the best sound quality?

LIFE IN STEREO

Everyone knows what stereo means, right? It means two channels – one for each speaker. That's very true, and everyone is correct to say it, but the significant thing about stereo is the effect it produces through speakers. By turning a sound up in one speaker and down in another, the sound actually appears to move; by having two speakers, instruments in music can be placed in the stereo panorama from right to left at points between the two speakers. Sit between them and close your eyes, and you may be able to point to the position where a vocal or guitar is coming from.

Playing a 'stereo' file through a phone's speaker(s) can't give a real stereo effect. The panorama would be tiny, with both signals coming from basically the same point in space. Portable single speakers are much the same, however good the sound 'quality'. A soundbar looks great under a TV, and has some width, but in terms of a stereo panorama, two speakers further from the TV perform better, giving more defined stereo separation and width to the sonic 'stage'.

SHOWROOM SOUND

Portable single speakers may be all the rage, and are good to sling into a bag for a holiday or a picnic, but their small size limits their ability to represent music as it was intended to be heard. The stylish designs of these mini Bluetooth machines cast them in all colours and shapes – including spheres, obelisks and cylinders – but the housing of the traditional, rectangular speaker is actually beneficial. Sound coming out from the front of a speaker cone issues backwards too, and the tried-and-tested 'shoe box' design will be perfectly tuned to reinforce this. That's what the hole on the side is for, in case you were wondering.

Single speakers won't give a clear stereo effect

BASS INSTINCTS

Anyone who has ever compared the output from a sound system with a subwoofer to one without will know the incredible difference in power these booming boxes can bring. Higher parts of sound need a smaller speaker that can move very quickly, whereas lower tones need a bigger, heavier one with more power behind it. The bass we feel from a dedicated low-frequency woofer brings music and sound a real feeling of weight that's undeniably better.

But it's possible to fake this rich sound, at least for a few minutes. Smaller speaker units can create artificial bass power and even push it too far. After five minutes, this overcompensated bass can start to drone on, clouding the rest of the music and actually fatiguing the listener's ears. Nevertheless, that five-minute fake is usually long enough to convince someone in an electronics showroom that a sound system has more power than it really does. Get it home and it can easily start to grate.

SPEAKER NETWORKS

A separate subwoofer is the real deal, especially if you want to take revenge on your neighbours. The woofer is where the '1' comes from in 2.1, 5.1 or 7.1 setups. It can also be known as the LFE or 'Low

The quality of...

HOW DOES AUDIO QUALITY STACK UP WHEN COMPARING DIFFERENT WAYS TO ACCESS IT?

If you don't understand bit rate, it's easy to be impressed by a high number. It's time to shed some light on the matter.

The best frame of reference is CD-quality audio. The CD specification was created in the '80s with quality in mind. Its 16-bit resolution is arguably impossible to tell from anything higher, and at 44,100Hz, it can replicate anything we can hear. In terms of bits per second, the benchmark figure is 706kbps.

Ripping a CD at its highest quality will replicate it like-for like, but how do today's music playing methods stack up? The most popular music streaming service online is Spotify. Standard (free) users get 160kbps, and mobile users get even less. Pay for a subscription, though, and the quality rises to 320kbps. The sound quality is good even at 160kbps, as the encoding used on Spotify's files is suited for music.

YouTube's audio quality has varied over the years, but the video service now gives audio the attention it deserves, mostly via a 192kbps AAC file if your connection is sufficient to keep up. The quality of the audio is independent of the video quality you select, but this hasn't always been the case. In fact, any material that was uploaded before 2011 won't exceed 128kbps. YouTube's algorithms are more suited to speech than music if anything, and the stereo information can come out a little mangled if the volume of a piece of music drops suddenly.

Amazon's MP3s have a target rate of 256kbps; digital TV allows a variety of formats and qualities; SoundCloud streaming is good quality (but the files will be processed sonically after uploading) and DAB digital radio allows for a range of sound quality, putting you at the mercy of individual broadcasters.

Surround sound is essential for movie buffs

> "A separate subwoofer is the real deal if you want to take revenge on your neighbours"

Frequency Effects' channel in terms of audio for video, and is often dedicated to 'impact sounds' such as explosions and rumbles in films rather than playing a part in the rest of the soundscape.

You've probably heard of active and passive speakers. The latter require the signal to be amplified before input, whereas active ones have an amplifier inside. In a single system 'as sold', the amplification will be taken care of at some point in the chain, whether the system is advertised as active or passive. If you're building a custom setup, active speakers may give you greater versatility – though they will need a power source.

Similarly, separate 'mid-range' and 'tweeter' loudspeakers will be more efficient and deliver a better sound quality, even if it's not as obvious as the presence of a hard bass element. As an ideal setup, your individual speaker units should contain multiple speakers (drivers) and be supplemented by a subwoofer if the units are too small to house a large-diameter speaker cone.

Tiny, stylish speakers won't cut it for audiophiles

Files and formats

There's plenty of audio jargon about, and a lot of confusion can come from file formats. The root of the problem is the many ways that things are rated and measured, and this usually depends on how it's delivered. Streamed audio is often quoted in kilobits per second – to match internet speeds – whereas some files are simply downloaded with a note as to the file type. 'This is an AAC file' doesn't tell you most of what you need to know about its quality, so let's set things straight.

CD-quality audio takes 44,100 16-bit 'snapshots' of an audio waveform every second. That's 705.6kbps, doubled for stereo signals to make 1.4Mbps. Compare this to a 'standard' MP3 of 128kpbs. One's bigger, and the other has to find some data to remove.

Today's highest quality audio could use data up to 17mbps, and anything starting to push above the CD-quality boundary may be marketed as 'HD audio'. However, even true audiophiles are unlikely to be able to tell the difference. The high bit rate exists for the production stage, where dozens of studio processes will be applied to audio, which must remain crystal clear throughout.

What about 3D audio? This usually implies that some processing is added to your signal before reaching the speakers. These flashy effects could be said to create depth or to add extra width further out from where your speakers are placed. They may be

Four alternative media players

THE GOOD, THE BAD AND THE OGGLY BATTLE FOR YOUR AURAL ATTENTION

MediaMonkey

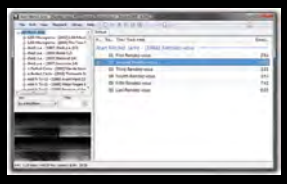
www.mediamonkey.com

MediaMonkey's philosophy is to get your music library organised. If your collection includes badly named files, unknown files, duplicate files or anything else, this could be the one for you.

Foobar2000

www.foobar2000.org

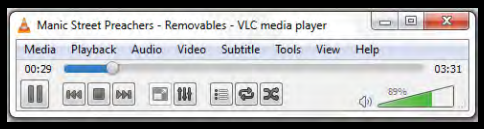
An open source player that claims to be both lightweight and easily customisable. Anyone looking to code their way into the player of their dreams or to search a stash of user-created mods will be happy. A cult player.



VLC

www.videolan.org

Chances are you've already downloaded VLC for playing videos. The appeal of VLC for audio – just as for video – is its simplicity, fast load times and pan-format capability. Good for when you've absolutely got to play something immediately, not for all-round organisation.



Winamp

www.winamp.com

Reports of Winamp's death were premature, and the veteran player is still trucking after being acquired by Radionomy, It may have become a little bloated, but it's still a strong choice for those wishing to do "things that Windows Media Player can't". Streaming and a good list of plugins make it a great alternative.

fun processes to experiment and play around with, but always keep in mind that any professionally produced music you buy has been treated with far more complex algorithms already, to the taste of a golden-eared engineer.

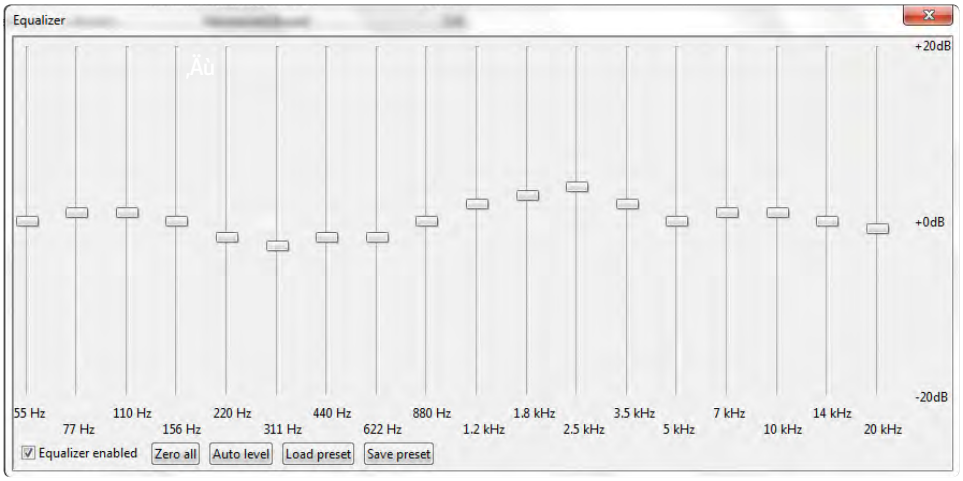
MP3 EXPLAINED

Back in the days of dial-up 56k internet, there wasn't much joy in downloading an 11MB per minute high-quality file of music. As with most media, the huge size of a 'complete' WAV file needed to be reduced, and it couldn't just be squeezed down – that would be audible in the music.

Instead of reducing files' bit rates, scientists developed an algorithm that would identify and remove the parts of music files that couldn't be heard – bits that were hidden or masked by other parts of the sound. This left something that, in theory, sounded the same but used less data. A 'standard' 128kbps MP3 file brings the size down to just under 1MB per minute.

As people got over the joy of simply being able to send and receive audio over the internet, the flaws in the MP3 format started to become apparent. The most noticeable problems are a loss of the highest frequency sounds, taking some of the 'crispness' away from cymbals and other bright elements in the sound. Anyone who has ever tried listening to very low-quality internet radio may have heard weird, electronic gargling glitches in between parts of speech. This is a likely symptom, and may still be apparent (to a lesser extent) in higher-quality non-speech material. Another deficit could be a poor quality at the left and right edges of the stereo panorama, which may only become noticeable when things suddenly become quiet. The quality of a 'lossy' format audio file can only ever be as good as the algorithm used to encode it, and the sorts of sounds that particular algorithm will work best at encoding.

Of course, if a low-quality format is then rendered back out as a high-quality one, it'll still sound the same, even if the file size suddenly skyrockets – a bit like re-saving a JPEG as a BMP.



Equalisers are to compensate for your listening environment

FORMAT WARS

The quality of audio encoding is becoming more sophisticated as problems arise, and bit rates up to 320kbps are built into the MP3 format's specification. As well as different ways to encode MP3s, other formats have risen in popularity. The open-source Ogg Vorbis (OGG) format is generally considered better-sounding than an MP3 of the same file size, and is supported by most media players.

With today's high speed internet connections and storage capacity, a full-quality, 35-odd-megabyte WAV or AIFF file download may not be the imposition it once was, but compressed, lossy formats such as MP3 and AAC are still used for streaming audio. To See how different file formats stack up, look at 'The quality of…' on p46.

Sound cards and connections

The soundcard isn't an item that goes through yearly renaissances, but there are various options designed for different use cases.

As the bridge between your OS and your speakers, a soundcard only needs to live up the quality of those two components. In terms of capability, any would-be connoisseurs of 'HD audio' will probably be satisfied with something relatively cheap and cheerful. The considerations to make when buying a soundcard should actually be determined by the hardware you're hoping to match it to.

CARD CONNECTIONS

A 2.0 or 2.1 sound system will only really need one stereo output jack.

Slim speakers can't compensate for lack of bass

Multiple drivers in one speaker handle tasks more efficiently

A 5.1 surround-sound setup requires a card with three output jacks (one for the front sides, one for the back sides and one for the centre speaker) and a 7.1 system will be supported by a card with four outputs.

It's possible for an external unit (usually your subwoofer) to take a single signal and split it to produce the necessary '.1' information. It's even feasible for a stereo signal to secretly contain more than the standard two channels, which are then decoded from the two-channel signal into more. This is one way to use a soundcard with a single stereo output for surround-sound purposes, but the original stereo file would have had to be encoded in this way in the first place – very unlikely, especially if it's a track you've ripped from a CD.

Digital audio connections could include S/PDIF (using phono or coax connections), ADAT Lightpipe (using optical cabling) or otherwise. S/PDIF is most often used in surround-sound applications, and ADAT is an eight-channel more professional standard connection.

QUALITY CARDS

While the soundcard market has all but stabilised, there are marks of quality that could be applied if you're looking for a 'better' one. The key component for outputting the best quality signal is the card's digital-to-analog converter (DAC). These don't have an obvious measurement of quality in numbers, but as usual, the more expensive the better (though how much difference you'll be able to hear is up for debate). The card's latency (the time is takes to receive audio from Windows and then output it) may be relevant for recording applications, but straightforward listening shouldn't affect your choice. Either way, a lower time is better.

Music appreciation

Some media players, plugins and even speaker systems give you the ability to change your sound. Evolved from the bass/treble controls of consumer gear, these make it possible to play around with the signal and boost its best bits. This can be a good way to play with a sound, but keep in mind that a lot of work has already gone into getting it 'just right'.

However, sound effects such as these do have a noticeable benefit in compensating for the sound of your listening environment. It's difficult to escape the effect the dimensions of your room have on the sound coming out of your speakers, but a graphic equaliser (EQ) can help in this.

Spending some time treating the actual room and surrounding space can also have a big impact on the quality of your sound. You can forget the myth of sticking egg boxes on the walls, but adding more absorptive materials (such as upholstery, carpets and curtains) can make a big difference. ■

"Remember that any music you buy has been treated with complex algorithms"

Busting sound boosting myths

THE SALESMEN'S AUDIO SNAKE OIL SEPARATED FROM PURE WATER

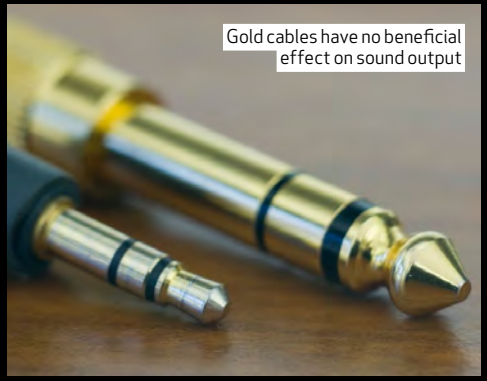
Gold-plated cables are often peddled for audio applications. The theory (so the manufacturers would have you believe) is that gold conducts electricity better than the copper used in standard, less expensive cables, and will therefore give you sparkling audio. Really, this is just a cop-out, and if anything, mismatched impedance between circuits could actually make a signal worse.

Sticking with precious substances, it's more and more common to hear claims of 'MP3-crystallising' technology. In theory, this sort of promise could be implemented to reduce some *artefacts* associated with MP3's lossy compression, but it wouldn't be able to put back any of the information that was removed in the creation of the file. The type of material removed from an MP3 is hugely variable depending on its content, and it should theoretically be inaudible anyway.

Common advice back in the days of portable CD players was to stash your Discman in the freezer. The reason? A good chilling would result in a larger dynamic range and less background noise. As well as a PC being far harder (but still possible) to get below zero, it's not going to improve an audio signal – especially a digital one. And there'll be less space in there for fish fingers.

How about surround-sound headphones? These virtual-reality cans have a lot to answer for. There are no genuine tricks that can fool the ear into thinking there are more directions at play when one speaker is right next to each of their ears, although surround-sound could be theoretically possible using multiple, small loudspeakers placed within one headphone.

As for new technology on the horizon, commentators recently speculated that Apple may be planning to replace headphone jacks with dedicated digital ports, presumably to allow more sophisticated mic/headphone/speaker combinations to be plugged in. If this comes true, there's no doubt people will start moaning about 'that old copper wire connection the 3.5mm jack plug' and how bad it used to be. The jury is out on this myth, but it won't be for long.


Gold cables have no beneficial effect on sound output

Tech Porn

Performance kit laid bare

GIGABYTE BRIX GAMING

You've got to love it when a PC manufacturer starts thinking seriously *inside* the box. Gigabyte's engineers have been pondering the question of what could be the big barrier to getting mini PC boxes to run games at decent frame rates. Obviously the limiting factor is the choice of graphics processor inside. We've had to put up with AMD and Intel pretending their respective processor graphics solutions are in any way capable of really delivering a proper PC gaming experience, and now Gigabyte has decided enough is enough and has jammed a proper desktop GPU into its tiny BRIX Gaming machine.

When we first got our hands on this little box, courtesy of Cyberpower, we inevitably pulled it apart to get a look at what was inside making it tick. "This has to be a mobile GPU," we thought. Oh no, this dedicated graphics card Gigabyte is calling a GTX 760 seems to be some weird homebrew variant with the full 1,344 CUDA cores and a massive 6GB of GDDR5 video memory.

The only difficulty with that is the tiny BRIX doesn't have a lot of space for the serious cooling such a GPU needs. With the copper cooling block having to cope with both the 47W CPU and the discrete GPU, the two tiny fans can't really do enough to allow either component to maintain full speeds for long. Still, this is the fastest little gaming box around, so long as you're willing to stump up the £850 to kit it out with OS, storage and memory too... ■ **Dave James**

1 Be discrete
Fitting a GTX 760 into such a small form factor is either a stroke of genius or the result of some engineer having a stroke mid-blueprint. Still, even thermally throttled, the BRIX Gaming is capable of some pretty impressive gaming feats.

2 Memory matters

The basic barebones unit cost might seem pretty pricey, but you need to fit memory, storage and an OS into the bargain too. The full system from Cyberpower comes in at a rather hefty £850. Considering the Scan machine we've reviewed this issue costs just £600 all-in, that's a lot of cash.

3 Full speed ahead

The two tiny fans on the side of the BRIX Gaming simply can't get enough air across the wee copper heatsink to allow the GTX 760 to run at its 900MHz+ peak for very long. There's going to be some serious throttling going on in-game.

RIG BUILDER

Whether you're upgrading your PC or starting anew, this is the best kit

One of the joys of owning a PC is that you can upgrade it as you go. Need higher frame rates in games? Drop in a newer graphics card. More power elsewhere? Grab a new processor or go for that old favourite: a memory boost. There's a wealth of upgrades that can transform your machine, and you can change slowly over time to suit your budget, so you rarely have to suffer a sluggish rig for long. Every now and then, the best possible upgrade is to dump your current rig and start afresh by building a whole new machine from scratch.

What sort of machine should you build, though? Which items are important? Which work well together? How much should you be budgeting for? That's a lot of questions, and to get the right answers means having to go and research all the current trends in order to make the best decision. Before you do that, though, take a look to the right. You'll discover that we've taken the hard work out of the equation and presented you with three machines that fit three different budgets.

On these pages are our usual recommendations for putting together a budget, mainstream and silly high-end machine. These rigs all include a screen and peripherals in the ticket price, so if you're keeping your existing goodies then you can spend more elsewhere. And what's our choice? Either get a larger SSD or a more powerful GPU. Happy building you lovely people! ■ **Dave James**

HOW TO... BUY A MOTHERBOARD

Your choice of motherboard almost entirely dictates what sort of PC you end up with. It will determine whose CPU you go for, and what range you can pick it from. It also decides what storage you can use, how many graphics cards you're able to fill out your PC with and, almost more importantly, it dictates how big your final build can be.

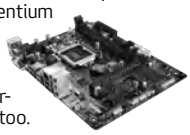
The key thing to remember is that you don't *have* to go for a full ATX spec board if you want high performance. A micro-ATX or Mini ITX board can be just as capable of offering serious PC grunt as their larger brethren. You don't have to be restricted on the overclocking front either. Since Intel relaxed the draconian restrictions on overclocking with the Haswell range, you're not limited to the Z-series. In the new line-up both H97 and Z97 allow overclocking, and in the previous generation the lowly B85 chipset could also be tweaked. These days, it's a much more flexible motherboard market.

BUDGET £486

When every pound counts, spend them wisely

MOTHERBOARD £38
Gigabyte B85M-D2V

This micro-ATX board is the perfect foil for Intel's Pentium Anniversary CPU, with good connectivity and decent over-clocking chops too.



CPU £52
Intel Pentium G3258

Poor AMD, it's a clean sweep for Intel on all our recommended rigs. The new Pentium is simply the best budget chip around, offering Haswell for peanuts.

MEMORY £36
Crucial 4GB 1600 DDR3

Memory pricing continues to be incredibly volatile, but it's still a great time to squeeze more sticks into your rig. You really should see 4GB as the minimum these days.

GRAPHICS CARD £102
MSI GTX 750 Ti OC

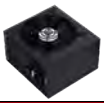
Nvidia's latest GPU is quite a feat of engineering because of that brand new Maxwell architecture. The MSI card is a bargain at this price too.

SOLID STATE DRIVE £75
Crucial MX100 256GB

The 256GB version may lag behind the 512GB drive, but it's got enough space to be going on with and is much quicker than any HDD you can put it up against.

POWER SUPPLY £40
SilverStone Strider E 500W

We may be talking about a budget rig here, but it's still a rather hefty chunk of cash to risk on a no-name power supply. This 500W SilverStone PSU will give you peace of mind and all the PCIe leads you need.



CHASSIS £47
Corsair Carbide 200R

Much more impressive than its price tag may lead you to believe, the clean lines and added extras of this chassis make it the budget case to beat. An understated bargain.

SCREEN £79
AOC E2250SWDNK

This 21.5-inch panel has a native resolution of 1,920 x 1080 and looks pretty good despite that price tag. You'll need a minimum of £150 for IPS, but this TN ain't bad.

OPTICAL £17
LG GH22LS50 DVD-RW

It's hardly the sexiest component, but until games and OSes come on USB sticks, this is your best option to get your rig up and running.

CPU COOLER N/A
Intel Stock Cooler

The Pentium Anniversary chip is a very cool-running CPU, even when overclocked. We managed a stable 4.2GHz on this stock Intel cooler.

MAINSTREAM £1,000

You don't have to spend a fortune to get a stunning rig

MOTHERBOARD £114
Asus Z97-A

We're still in the early stages of the new 9-series motherboard releases, but this well-priced and impressively-specced Asus board is the best we've seen so far. Good start!

CPU £180
Intel Core i5-4690K

For almost the same price as the ol' 4670K you can pick up one of the newer Devil's Canyon CPUs. It's only got a 100MHz clock boost, but the new TIM should help overclocking.

MEMORY £58
Corsair Vengeance LP 8GB

This pair of 4GB sticks will give you all the performance you could ever want, and they're in stormtrooper white. They'll only take up two slots in the board for upgrading, too.

GRAPHICS CARD £170
Nvidia GTX 760

Unfortunately, the ol' HD 7870 XT is hard to get hold of and rather pricey now. Thankfully, the GTX 760 has arrived for less than £200 and offers some serious gaming performance, too.

SOLID STATE DRIVE £150
Crucial MX100 512GB

Crucial has made a big splash in the SSD market with this chunky drive. The 512GB version is quicker, larger and cheaper that the 480GB M550.

POWER SUPPLY £52
OCZ ModXStream Pro

If you want to build a performance machine, you're going to need a powerful PSU. This 500W baby will power the rig, with extra to spare. It's quiet as well.

CHASSIS £60
Cooler Master CM690

The CM690 eschews silly gimmicks in favour of producing a no-nonsense chassis that has plenty of cooling options for your mainstream rig. There's space aplenty inside, and all at a reasonable price.

SCREEN £123
Viewsonic VX2370Smh-LED

For years, we've been lamenting the constant use of TN panels in our gaming monitors, always preferring the delights of the IPS screen. Now they can be yours for just £123.

KEYBOARD £65
Corsair Vengeance K65

We love a good mechanical switch keyboard here on *PC Format*, and Corsair is making some of the best. The K65 is a great compact option, with a compact price to boot.

CPU COOLER £28
Enermax ETS-T40

Enermax has simply amazed us with this, its first CPU cooler. The performance is excellent, the price is astonishing, it's easy to fit and it isn't so big that it limits your case or mobo choices.

HIGH-END £3,967

If you really want to treat yourself, this is how to do it

MOTHERBOARD £236
Asus P9X79 Pro

Asus has really gone to town on the X79 platform, spamming the market with a host of boards (and most of them are pretty darned good, too). This here P9X79 Pro is a great little performer.

CPU £850
Intel Core i7-4960X

With the same six-core setup as the previous gen, there's not a lot of extra stock performance, but if you're after the fastest CPU, this is it right now.

MEMORY £97
Kingston HyperX 16GB

The quad-channel memory config of the X79 makes for a great opportunity for RAM makers to ship new kits. This XMP 1.3-compatible kit is a tasty 16GB package.

GRAPHICS CARD £791
Nvidia GTX Titan Black

The GTX Titan Black Edition has the full-fat GK110 core of the GTX 780 Ti, but with 6GB VRAM and the double precision maths turned back on. Perfect for serious work.

SOLID STATE DRIVE £389
Samsung 840 EVO 1TB

It's been a while coming, but we're finally seeing terabyte-class SSDs, and for a decent price. The 840 EVO uses some impressive algorithms to offer high speed, too.

POWER SUPPLY £171
CM Silent Pro Gold 1000W

Cooler Master continues to impress with its power supply units, and this wonderful box of tricks managed to scoop the gold award in our exacting test way back in *PCF*246.

CHASSIS £286
CM Cosmos 2 Ultra

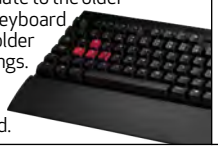
Cooler Master was always an impressive maker of cases, but it has truly stunned us with this chassis. Yes, it's expensive, but if you can afford it, go for it.

SCREEN £922
HP ZR30W 30-inch

HP's 30-incher is exactly what high-end gaming means to us and if money is no object, this is the screen to buy. You'll need the GTX Titan to really show it off.

KEYBOARD £120
Corsair Vengeance K70

Corsair's update to the older Vengeance keyboard rights all its older sibling's wrongs. It's also a truly stylish gaming board.



CPU COOLER £105
Thermaltake Water 2.0 Ext.

Why settle for a reasonable overclock when you can hit 5GHz? This kit is speedy, boasts incredible performance and is quiet in operation.

Back issues available

SAVE UP TO 30%

Never miss an issue again!

Gaming &

Because gaming is a way of life

"The *Yogventures* debacle has shed uncomfortable light on the perils of investing in a Kickstarter project"

This month, resident gaming savant Dom Reseigh-Lincoln has been channelling his inner warrior in the beta of Bungie's truly ambitious MMO FPS, *Destiny*. If the relatively short taster is anything to go by, the game that follows in the hallowed footsteps of the *Halo* franchise is set to be one 2014's most exciting releases. Also, instant hoverbikes are radder than rad.

Ahh, we love the smell of a failed Kickstarter in the morning. Mmm, breathe it in – that heady scent of swallowed cash and the increasingly distant responses of a once enthused organiser. The corpse in question is YogsCast's crowd-funded MMO *Yogventures*, and its odorous cadaver has kicked up quite a stink across the internets.

YogsCast – if you're not clued up on your dairy-based monikers – is a Bristol-based team of YouTubers who rose to web fame via a bunch of *Minecraft* videos. YogsCast is one of the online video community's biggest success stories, so when the team approached its community with the idea for a new, fan-driven online adventure game, many a loyalist penny was pledged at its feet.

The team had drafted in US developer Winterkewl Games to take point on the game, and with the Kickstarter project raising around $570k in 2012, everything seemed rosy. We even had a series of developer diaries showing character models and the incredibly basic looking, *Minecraft*-aping gameplay that would form the heart of *Yogventures*' user-driven experience.

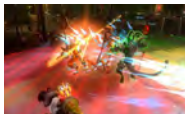
And then an email popped up in the inboxes of those backers. Turns out YogsCast and the devs had used up every cent trying to make a game that far exceeded their abilities. In fact, YogsCast was quick to distance itself, making it clear it has no responsibility for the project and all the bucks stop with the now-dissolved Winterkewl Games. With both the devs and YogsCast having released catty statements blaming one another for the absence of $570k and a playable game, the debacle shed an uncomfortable light on the perils of badly organised Kickstarters. Questions about protection for backers and liability of organisers are being asked more loudly than ever.

P66
THE FUTURE OF ESCAPISM

In brighter news (can we really call *Doom* bright?), the latest incarnation of Id Software's *Doom* (technically *Doom 4*, but this is a reboot; just like *Doom 3* in fact, but this one doesn't have a number because *reboot*) was showcased at the annual QuakeCon event. Bethesda Softworks (which took over publishing duties with *Doom 3*'s *BFG Edition*) hasn't released any footage and it has stressed the fact it probably won't release any more before 2015. Those that did see the reveal in person have reported the gameplay footage shown harks back to the ultraviolence of the original *Doom*, rather than the horror edge of the third entry. Let's just hope there's no Kickstarter.

Here's hoping the new *Doom* fares a little better than the ill-fated YogsCast project

RECOMMENDED



Wildstar
NCSoft
PCF294 p64
Clever questing and a stand-out combat system make for an entertaining MMO that is as large as it is full of character.
★★★★½

Smite
Hi-Rez Studios
PCF293 p66
An addictive game makes the lane-pushing genre more approachable with smart tweaks to the old formula.
★★★★★

Trials Fusion
Ubisoft
PCF293 p70
Fusion's thrill is not found in leaping a yawning chasm, but in the simple clearing of an overhanging ledge with efficient grace.
★★★★½

Diablo III: Reaper of Souls
Blizzard
PCF292 p64
This awesome expansion has made *Diablo III* even better, and includes some fun little goodies. We like.
★★★★½

Titanfall
EA
PCF291 p64
The most exciting multiplayer shooter in recent years, but one that is held back by its questionable staying power.
★★★★½

South Park: The Stick of Truth
Ubisoft
PCF291 p66
A fun, polished RPG attached to a genuinely funny 15-hour-long *South Park* episode.
★★★★☆

HotWired

IN THE NEWS

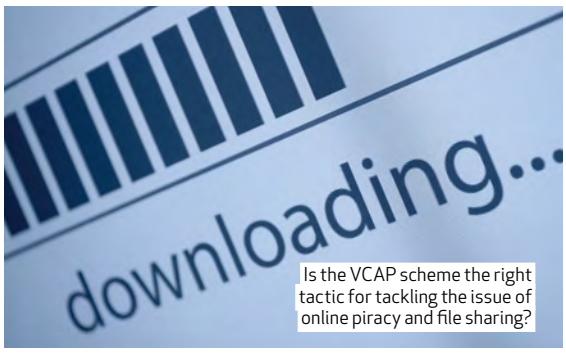
UK pirates to have wrists slapped

Are you an avid plunderer of the digital waves? Do you regularly call port in the bountiful sway of the Pirate Bay? Well, if you're a keyboard buccaneer in the UK, you can breathe a sigh of relief – turns out the government is looking to move away from its approach of prosecuting purveyors of illegal downloads in favour of a simple email warning.

From 2015 onwards, the new Voluntary Copyright Alert Programme (VCAP) will use email notifications to urge prolific pirates to cease or face legal retribution. The new scheme, which is also endorsed by a number of major ISPs and organisations representing content creators, aims to passively educate web users in the impact the illegality of their actions. So far the VCAP scheme has attracted the direct support of Sky, Virgin, TalkTalk and BT, with more UK-operating ISPs expected to sign up in the near future.

"It's about persuading the persuadable, such as parents who do not know what is going on with their net connection," says Geoff Taylor, president of the British Phonographic Industry. "VCAP is not about denying access to the internet. It's about changing attitudes and raising awareness so people can make the right choice."

While tackling illegal downloads with such a softly-softly approach might be a new tactic, it remains to be seen whether such a passive approach will be the solution needed to protect content creators and drastically reduce online piracy.



Is the VCAP scheme the right tactic for tackling the issue of online piracy and file sharing?

ON THE DOWN LOW

We all have a list of *cool* shows and movies in our Netflix viewing history. *Breaking Bad*? Right on. *House of Cards?* Now you're talking. *Power Rangers Super Samurai*? Grow up, you big man-baby! Well fret no longer – Netflix is testing a 'private viewing mode' that will keep your umpteenth watch of *Ella Enchanted* a secret.

This new mode will allow you to enjoy even the guiltiest of pleasures without them appearing on your viewing history. It also ensures the TV show or film doesn't affect the suggestions Netflix generates based on your viewing habits. It's being tested across all regions, but it's not guaranteed to get a full rollout. Netflix is likely to gauge its popularity with its test audience before approving it for 'Flix proper.

HIGHLIGHTS THIS MONTH

Enjoy the view – it might be the best part of the mission

RELEASE OUT NOW

Firefall

Players wanted. Must like long walks with little reward

Enemies sometimes need a bit of encouragement to start shooting back

***Firefall* is a free-to-play MMO shooter with an emphasis on dynamic events, skill-based combat and desperate defences against overwhelming enemy forces. All of which sounds promising, but there's also a lack of variety, constant busywork and a set of interconnected systems that sit awkwardly against the moment-to-moment drudgery of the game. It has potential, but in almost every instance, it fails to meet the ideal it's trying to sell.**

The single greatest example of this – at least during the 30 hours that I've played – is found in Sunken Harbor. It's a hub containing a PvP arena, designed for players to let off steam between missions and activities. Only, where the in-game displays and banners advertise a fully featured team competition, the reality is an unstructured free-for-all, where the few who show up take potshots at each other before growing bored and wandering off. Mostly it sits empty – a symbolic beacon of *Firefall*'s lengthy and troubled development.

That's a shame, because in the right place, with the right class and in the right event, you get a hint of what the game should have been. There's frantic fun to be had dodging and weaving with your jetpack, avoiding fire and clearing out hordes. *Firefall* contains the suggestion of a solid shooter, and occasionally it rises to the surface.

Set primarily in Brazil, *Firefall* depicts a world that's witnessed more than its share of cataclysm. First there was the Firefall itself: an asteroid shower that devastated much of the planet. More relevant to the main plot is the Arclight, an interstellar spaceship that crashed into Earth on its maiden voyage. Its flaring engines pulled through a strange purple death cloud from an alternate dimension. This is the Melding, from which emerged the Chosen – the rather self-defeating name given to the humanoid beings now trying to wipe out humanity.

VITAL STATISTICS

- **Price** Free
- **Developer** Red 5 Studios
- **Publisher** In-house
- **Web** www.firefallthegame.com
- **Multiplayer** Massively
- **DRM** Account log-in
- **Recommended spec** Dual-core CPU, 4GB RAM, 1GB VRAM GPU

Aero dynamics

This is the backdrop against which you, the gun-for-hire Ares 35, operate. As a mercenary, the invasion of the Chosen is, at first, only tangentially related to your operations. The war provides plenty of opportunities to pick up work, so most of your time is spent taking on missions from each hub's job board. These offer a variety of scenarios in which you go to a place to kill things. Sometimes you kill things while defending a person, sometimes you kill things while collecting items, and sometimes you kill things because those things need killing.

Each job is accompanied by dialogue between your handler, Aero, and your temporary employer. Some of them form multi-part


Squad Thumps have a chance to spawn a mass wave of Chosen. Followed by death


An in-game banner for a PvP mode that doesn't exist in the game


Some weapons are much more satisfying than others

quest chains that span multiple hubs. At each new area, I made sure to pick up any missions involving a rogue named Wiley, who'd had dealings with my callsign's last owner. It was a fun little mystery sprinkled throughout the game. But aside from this, and a few other exceptions, conversations waver between incidental and annoying. Aero, in particular, has a jarringly moralistic edge. She'll repeatedly tell NPCs you're not a contract killer, which rings somewhat false.

From its opening to its sparse endgame (currently a dedicated PvP zone and couple of raid bosses), *Firefall* is an awkward mix of shooter and MMO. It lacks the breadth of systems needed to keep levelling fun, and so devolves into repetition. Too often, I would take down the requisite number of bandits, only to see the counter increase as a new wave spawned.

The few times a mission does try something different, it can go badly wrong. For one job, I was required to disguise as a bandit. This happened without warning after completing a combat objective, leaving me close to death and without my abilities, jetpack or health regeneration. After I inevitably died, I respawned at the quest hub with the disguise still intact – forced to sprint back to the objective without access to my deployable vehicle.

When not on a job, you'll stop at a dynamic event. These range from small solo missions to more difficult group activities. There's little to distinguish these from the regular quests – you're still travelling to an area of the map to fend off bugs, bandits or Chosen. But many require you to hold out against waves of enemies, and it's this structure that provides the best showcase for *Firefall*'s combat.

At the start, each player has access to five battleframes. These lightweight mech suits function as your class, and can be swapped at any Battleframe Station. XP goes towards levelling your equipped frame, so while experimentation is possible, it's more effective to stick with a single type. The battleframe defines your weapons and abilities, and – while all are useful in combat – some have the edge in terms of how enjoyable they are to play.

The minigun of the Dreadnaught and the scoped automatic rifle of the Recon are particularly dull to wield. I grew more attached to the plasma grenades of Assault class's cannon, which required me to be consistently accurate on the move. It doesn't match the satisfying skill level required by *Tribes: Ascend*'s Thumper DX or Spinfusor, but it offered a challenge that dragged me through the game's repetition.

Each frame can equip abilities to the first four slots of the hotbar. Engineers place turrets, Biotechs deploy healing area-of-effect spells, and Assaults slam to the ground, doing huge damage to the collected enemies below. The best example of this is squad 'Thumps'. These are resource collection events, and can be called down by players to any location. Personal thumpers offer a challenge, but it's the craftable squad versions that provide some of the game's most tense and engrossing battles.

Where to?

If that sounds like unqualified praise, know that the event system is completely unsupported by the way players travel across the map. Melding Tornadoes are interesting – group battles against a swirling, purple, Chosen-spawning twister. It's a call to arms for the playerbase, with coordinates shared over zone chat when one appears. Except, even knowing where it is, it can be difficult to reach. You can teleport to mission hubs, but doing so costs Credits – a currency I was never comfortable wasting. You must therefore either walk or drive, the latter only an option if you've bought a vehicle with real money or crafted one following a level 25 mission. Most tornadoes had disappeared by the time I'd arrived, or were empty, leaving me with no hope of finishing the encounter.

This is *Firefall*'s other major failing: it doesn't respect your time. It looks nice, but those views don't justify how long you'll spend sprinting from location to location. In one early mission, I was asked to trek north to meet a character. When I arrived, they asked me to turn around and head back. It's so absurd it's actually funny, but it highlights a persistent flaw.

The real money store is largely stocked with cosmetics and XP boosts. It's not 'pay to win', but it's skewed so that the non-paying options take more time than they're worth. Crystite, the basic in-game currency, is earned slowly, and is largely swallowed up by researching new crafting options. This in itself is a slow process – all crafting actions are performed on a timer that can take anything from seconds to days. That timer, of course, can be bypassed by paying real money.

These small inconveniences add up. Free-to-play games must strike a balance between time and money, but here it feels off. Not because of the contents of the store, or the value of each currency, but because *Firefall* is rarely engaging enough to make that commitment seem worthwhile. ■ **Phil Savage**

PCFormat Verdict

Makes you work a lot for very little. The churn of missions further spoils an only occasionally entertaining shooter.

Nothing a little antacid won't fix

RELEASE OUT NOW

Risen 3: Titan Lords

Its hero might be dead, but this third instalment brings the series back to life

Piranha Bytes knows you probably didn't like *Risen 2*, and so the studio symbolically kills it off a mere 30 minutes into the sequel. There's our hero from 2012's pirate-themed adventure, still nameless after all these years and looking as though he just wandered off the set of *Assassin's Creed IV*. But piracy apparently isn't what you want, and so he dies in front of a glowing portal in a ruin without so much as a last "Arr."

Fortunately, he is risen. His corpse spends three weeks fermenting in the tropical sun before he's brought back to life by a loopy shaman. Piranha revives the series with him, and fittingly sends him off in search of his soul. It's a generally fun romp that takes him into deep caves hiding menacing shadow lords, and into bleached dreams where he waxes philosophical with villains from *Risen*'s past, but happily it's not the kind of game that demands encyclopedic knowledge of its forebears. *Titan Lords*' tale of securing the help of powerful mages stands quite well on its own.

You can thank the three new factions you can align with for a lot of that. The voodoo of *Risen 2* makes a return in the camps of the 'natives', but they never steal the show quite like their neighbours. The Guardians serve the Mages on their rocky isle, but their melee prowess (and gear) adds a welcome edge to the spellslinger faction by leaving them with a degree of melee prowess. Scowling on stage left, we have my fellow Demon Hunters, who bring a bit of Conan-style grit to the proceedings.

VITAL STATISTICS

- **Price** £40
- **Developer** Piranha Bytes
- **Publisher** Deep Silver
- **Web** www.risen3.deepsilver.com
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** 2.GHz CPU, 2GB RAM, GeForce 9600GT / Radeon HD 3850

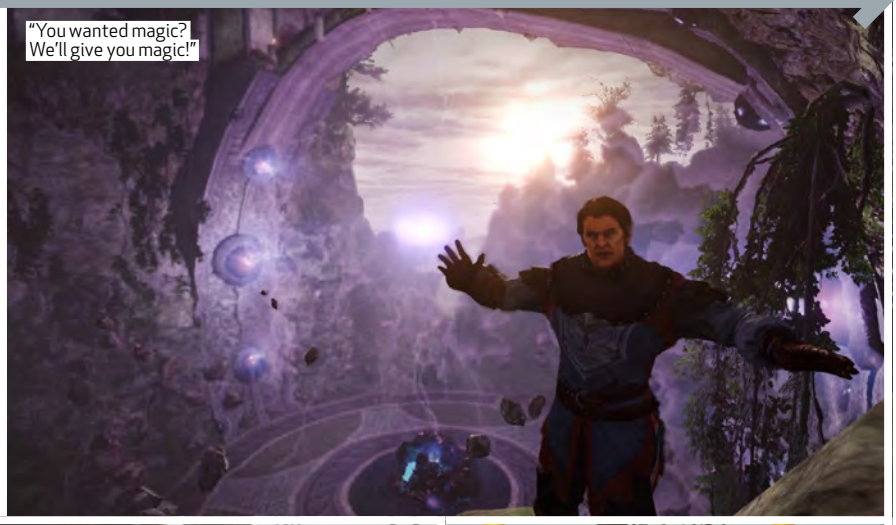
It's three kinds of magic

Yet more importantly, the three factions bring magic. This enhances the experience of *Risen 3* so thoroughly that it's appalling to think that its predecessor shipped without it. A chief criticism of *Risen 2* was that the tendency of enemies to gang up on you kept you from attacking, but here I send them flying back with a spell like the Demon Hunter's Shockwave. While they're wiggling from shock, I whip out a crossbow and – *thoonk thoonk thoonk* – they collapse like dominoes. It's stupid fun.

But let's be candid: it takes a while to reach this state of combat nirvana. *Risen 3* wisely isn't so stingy with gold and gear as its predecessor – nor does it leave the locations of quest objectives open to guesswork – but its core combat does rely on the same dubious dance of parrying, heavy attacks and slashes, despite fancy new animations. *Risen 3* is strikingly bug-free considering the series' reputation, but sometimes obvious hits seem to miss and relentless enemy attacks can still break seemingly well-timed blocks.

But then this is a world where Glory is earned by killing chickens, to say nothing of chopping down liches from other dimensions. Glory is everywhere, and it's used to boost stats that affect our hero's prowess in skills such as Melee or Influence. It's a versatile system, and one that enabled me to turn my Demon Hunter into a


I love how my companion is just content to watch this happen


"You wanted magic? We'll give you magic!"


Here there be monsters. And you blow them away


Good thing Edward Kenway taught me how to do this

battle mage of sorts who wreaked havoc with his battleaxe while summoning demon dogs. Not powerful enough? Buy some lessons from folks around towns. Toss in consumable spells of the crystal and runic varieties and companions from various factions, and you'll find few situations where hope is in short supply.

And situations abound. There's a pleasing balance of combat and story, seasoned with minigames for lockpicking or arm wrestling for extra gold. And bless my beard, the ship battles! Somebody's been playing *Assassin's Creed IV*, and it's paid off. Once our hero nabs a ship, clashes with sea monsters and enemy ships begin – just when the rest of the game starts to slip into a predictable rhythm. The versatile mix of broadside cannon bursts and races to keep powder kegs from exploding ensure the concept never outstays its welcome.

Any concerns? Well, it's not exceptionally pretty. Frankly, *Risen* looks old. But I still didn't want to stop playing. ■ **Leif Johnson**

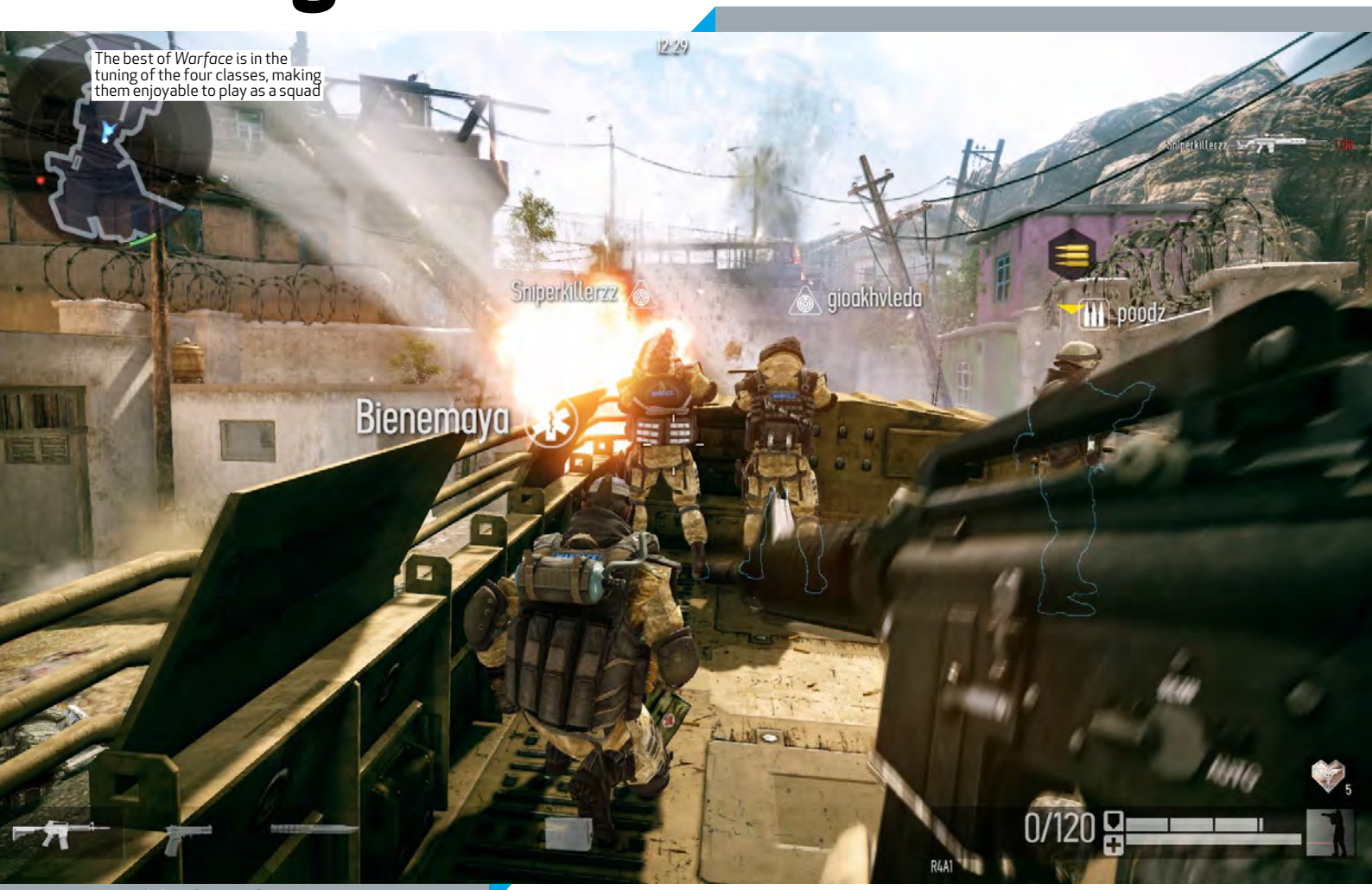
Alien V. This time they have wings

With some creative spell use, you can bring along several helpers

PCFormat Verdict

Combat quibbles and muddy graphics do little to spoil the fun of this enjoyable RPG. Now with ship-to-ship combat.

★★★★☆



The best of *Warface* is in the tuning of the four classes, making them enjoyable to play as a squad

RELEASE OUT NOW

Warface

Crytek's free-to-play shooter sets its sights a little too low

Do you remember that bit in *Call of Duty*? You know the one I mean. You were a guy – a war guy – and you ran around a corner to find another war guy running in the opposite direction. Yes! This was your moment to shine. You raised your RDS and sprayed hot 5.56mm NATO into his exposed back, earning you 100 points, a kill and a little shot of dopamine. Then, disaster struck! Another war guy ran around the corner behind you, the screen turned red and you died. Do you remember that bit? You must do, because it happened to everybody, everywhere, every day, for years and years.

Warface is Crytek's free-to-play stab at *Call of Duty*'s deathmatch formula, which it spreads across multiple modes, bundles with a thin handful of new ideas, and shackles to an ever-present storefront. *Warface* is the game you play if you fancy running in a circle shooting people in the back but don't want to pay full price for the privilege – which is a reasonable notion – and is also the game you play if you are 10 years old and your parents won't buy you something better. I know that because the voices I've heard in-game have, universally, been children; on one occasion I heard someone being told off for not doing their homework. That brief moment of kitchen sink drama was the most fun I've had with *Warface* – a game that is otherwise as oppressively all-right-I-suppose as you'd expect the lovechild of two business models to be.

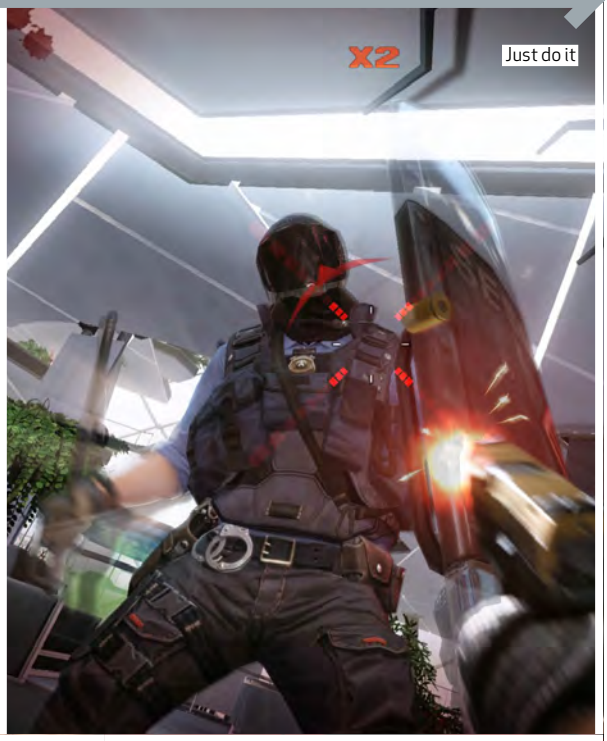
VITAL STATISTICS

- **Price** Free-to-play
- **Developer** Crytek
- **Publisher** In-house
- **Web** www.warface.com
- **Multiplayer** Online, co-op and competitive
- **DRM** Online only
- **Recommended spec** Dual-core CPU, 512MB GPU, 2GB RAM

Paleface

Warface feels like something you played once in a sticky-floored arcade during a half-remembered summer holiday. It should smell of cigarettes and old carpet. It's low-rent in the way that lightgun shooters traditionally were, and it's this, rather than the *Call of Duty*-shaped hole it aspires to fill, that gives it a personality. It's not a substantially realised thing – it never reaches *House of the Dead* or *Area 51*'s shit-but-kitsch territory – but it's something, and when *Warface*'s angry red LED damage indicators are bursting from the body of a stricken foe there's a little of *Time Crisis* to the experience.

You can press a button to slide along the ground on your butt and earn bonus points for killing someone while doing so. One of the better modes is like *Counter-Strike* with bad maps. There's a capable co-op mode where you fight your way through a series of themed alleyways blasting pigeon-brained AI and sometimes tangling with helicopters or mechs or tanks, an experience that scales up through a series of difficulty levels and that, in its final stages, requires some



coordination. It's very repetitive, but it looks okay and it's free.

Warface isn't terrible – I found myself sinking hours into it – but its successes are those of other, better games. If you want a modern military shooter, you should play *Counter-Strike: GO*. Or *Titanfall*. Or one of the earlier *Battlefields*. Or *Call of Duty*. If a free competitive game on PC is what you're looking for, look further; there are lots. This is a game with tame ambitions that manages to achieve a few of them. There's merit there, I suppose, but not enough to warrant a recommendation. ■ **Chris Thursten**

PCFormat Verdict

***Warface* is a middling contender in the most oversubscribed genre around, and it trades too hard on being free-to-play.**

★★★☆☆

Den of confusion

Warface has a safe house that you can visit from the menu. You can't bring your friends. It is pointless

Three basketball hoops
There is a ball here, but you can't pick it up. Why do you have three of these?

Football net and so on
Weights, a football net, a camera and sofas A graveyard for various useless items.

Pinball table
You'll find a *Warface* pinball table, but instead of actual pinball it just has a big screenshot of the game on it.

Sci-fi holo-table
Why is there a glowing holo-map of a featureless hill in this run-down warehouse?

Gods have yet to get YouTube

Taking hostages is hard. I'm not robbing that bank any more

Also, the dog!


The script can be a bit wonky, but serviceable


I dread to think what you'd consider managing badly

RELEASE OUT NOW

Gods Will be Watching

Gods will be watching, but it's your job to judge

This is a game about the fact that you're probably not a psychopath, but that hey, sometimes shit happens.

First scenario: you're not a terrorist. Your hostages may disagree, but, as you tell them, you're not looking to hurt anyone. They're just there for protection while your team hacks a government server.

Then the timer starts. All you have to do is keep things quiet for your hackers, and keep the guards outside the door out of flashbang range – an instant game over. And everything would be fine, if everyone would just sit and be quiet for a few minutes. But will they? No! Shouting at them doesn't calm them down. Damn it! The computer feed's been hacked again. Have the hackers fix that, then – what now? All this pussyfooting around has made the hostages lose respect and openly rebel. There's an easy way to fix that. Let's hope their leader learns to love hopping.

And so, slowly but surely, in a hundred tiny little steps down that road paved with good intentions, does *Gods Will Be Watching* make you the bad guy. Or the mad scientist. Or the pragmatic military leader, slowed by a wounded soldier.

VITAL STATISTICS

- **Price** £7
- **Developer** Deconstructeam
- **Publisher** Devolver Digital
- **Web** www.godswillbewatching.com
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** Core 2 Duo, 2GB RAM, 512MB 3D card

Cold-hearted

This is a very unpleasant, very uncomfortable game to play. It demands cold decisions in nightmare situations and then depicts the results with the heartless edge of a rusty scalpel. In a particularly beautiful little twist of that knife, the game itself stands back from moralising, encouraging you to do it to yourself at the end of each stage, with a *The Walking Dead* style breakdown of how everyone else who played did – a reminder that you could almost certainly have done better.

For the most part, it's extremely effective, squeezes every drop of life out of its pixels, and backs it all with a great atmospheric soundtrack. Where it struggles is that in order to stretch out the handful of stories into a commercial game, each vignette is designed to be challenging, even if you do opt to take the easier – often morally repugnant – shortcuts like thumping hostages. The resulting repetition after things go wrong saps the emotional core of each story, rapidly turning characters into simple puzzle pieces.

The scenarios are long and can't be saved, which can be a real pain if you screw up on something minor, That aside, *Gods Will Be Watching* is a clever idea that is well-executed. It avoids the overt morality of similar games in favour of simply asking you to judge yourself as you see fit. This is a very different kind of adventure that will make you feel bad, but hopefully for most of the right reasons. ■ **Richard Cobbett**

PCFormat Verdict

An inspired and different take on the concept of 'survival' in games, where you get to bring your own horror.

Expect to part with your hard-earned cash to get cards

RELEASE OUT NOW

Magic 2015

Less jaw-dropping feats of illusion and more financial sleight of hand

For years, the *Duels of the Planeswalker* series produced limited but satisfactory versions of the classic card game *Magic: The Gathering*. The ballooning success of *Hearthstone* makes this a great time to introduce new players to the complex, highly competitive king of the genre. Instead we get a clunky, under-featured sequel hobbled by microtransactions.

The underlying ruleset is still brilliant, and *Magic: The Gathering* is far more challenging than anything you'll experience in *Hearthstone*. Unfortunately *Magic 2015* locks this potential behind a huge grind, which you can pay money to circumvent.

Formerly, you'd beat bosses to unlock themed decks, which you could then tweak with additional cards. In *Magic 2015* you are locked into playing with a hybrid starter deck after the tutorial. As you progress through the campaign – linear strings of AI battles divided into five 'planes' – you receive booster packs that slowly grow your card collection. Eventually, you'll have enough to enter the deck creator and build something new.

The deck builder allows for good customisation, but amassing enough cards to make interesting use of it takes far too long. Each section of the campaign has an 'explore' option that lets you play AI battles to win booster packs. Expect to use this a lot, and expect to unwrap boosters full of duplicates and weak cards.

The format seems designed to push players into picking up card collections, for £3 per plane, or £14 for the whole bunch. If you want full access to the variety of *Magic 2015*'s cards, you'll need to cough up far more than the initial £7.

And then there's the state of the game itself. Menu screens hiccup during long transitions between pages. In matches, button-clicks sometimes go unregistered and the 'continue' button has frozen up in multiplayer, mid-match. At best it's a frustrating experience with fewer features than its predecessors. At worst, *Magic 2015* is a cynical redesign created to suck money out of players. As such, I'm unable to recommend *Magic 2015* to anyone at all. If you want to play *Magic*, any edition prior to this one is more fun. If you're looking for competitive card-duelling, you'll get oodles more out of *Hearthstone* without paying a penny. ■ **Tom Senior**

VITAL STATISTICS

- **Price** £7
- **Developer** Stainless Games
- **Publisher** Wizards of the Coast
- **Web** www.bit.ly/1yILkOU
- **Multiplayer** 2-4
- **DRM** Steam
- **Recommended spec** 2GHz CPU, 1GB RAM, 512MB GPU

PCFormat Verdict

***Magic 2015* seems designed to extract money from players with little reward. Don't bother – stick to *Hearthstone* instead.**

★★☆☆☆

Elite's David Braben is giving us our own public or private universes to escape into

THE FUTURE OF ESCAPISM

TECHNOLOGY AND PSYCHOLOGY ARE COMBINING TO INCREASE IMMERSION LIKE NEVER BEFORE. HOW ARE THEY DOING IT, AND IS IT ALWAYS A GOOD THING?

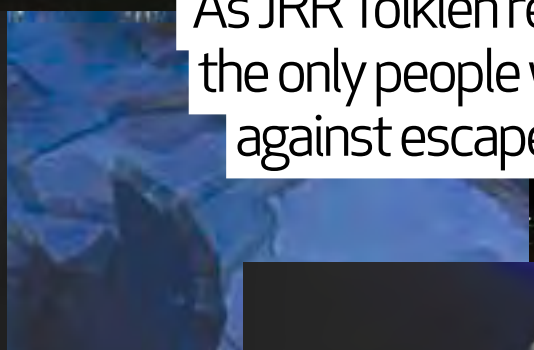
What is escapism? It's a step away from the pressures of the world that diverts you from the tedium and unpleasantness of everyday life. It also has a negative side when taken to an extreme. In this sense, the escapist is escaping too much. Whether they're unable or unwilling to cope with the pressures they're facing, ignoring them actually makes them worse.

Whether positive or negative, escapism can take many forms. A hot bath. A meditative retreat. A country walk. Watching the sunset over Machu Picchu. A holiday to a country where everything is cheap. Increasingly, though, it's technological. I live in London, but I've been to packed cities all around the world. On those few occasions that I'm forced onto a tube or metro, I see a fascinating social experiment. The train at rush hour is a high-pressure environment; it's often too hot, crowded, smelly, bumpy and rapidly-changing to be comfortable. In this high-stress situation, people around the world react in different ways. In Japan, for example, many people fall asleep (or pretend to). They'll do this standing up, alone among strangers, for two or three stops. In Paris, rudeness ramps up to such a degree that the Metro company has issued a special book of tongue-in-cheek etiquette (http://onforb.es/1uJEq0W). In almost all major cities, people plug into their smartphones and play apps or music, or read on Kindles, and pretend the rest of the passengers don't exist.

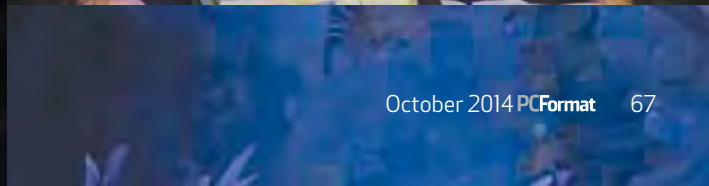
So how is technology aiding escapism? How do psychologists think that escapism is going to change? Are the simulations we currently call games the perfect escapist tools, or do they add to the problem?

Sony shows off its VR tech with shark attack sim *The Deep*

"As JRR Tolkien reminded us, the only people who inveigh against escape are jailers"



Sony's Project Morpheus headset will bring virtual reality to console owners



So we're talking escapism, and how technology and gaming can augment people's ability to get away from the troubles of the world in a healthy manner. Many mature technologies are already contributing to this immersion – high-resolution screens, surround-sound systems, well-designed user interfaces, touchscreens, motion sensors, haptic feedback and so on. We can now touch, see, hear and feel a photorealistic world.

Yet the core technology that's most useful for escapism now is virtual reality (VR). We've talked about this extensively in the past, but it's worth emphasising that modern forms work even better than the best 3D cinema. As psychologist Jamie Madigan told me, "Having a setup that allows you to forget about the technology between you and the game world is what spatial presence is all about, and from what I understand VR setups do that very easily. In many ways, they trick our brain at the same level that reality does."

In previous issues we've talked about the Oculus Rift VR headset, which Facebook bought for $2 billion in March this year. The Rift hasn't reached a consumer-ready stage (though Mark Zuckerberg has said that he wants to sell it as cheaply as possible), but the latest development kit (DK2) is much higher resolution than the previous iteration, and is being delivered to developers now.

I attended the Develop Conference in Brighton to ask questions about virtual escapism and to get my hands (and eyes) on the Rift's first real competitor, Sony's Project Morpheus.

It's a convincing challenger, and one of its strongest features is its ergonomic design. Though the Oculus Rift has improved substantially since the first time I used it, it's still an awkward piece of kit. It has straps and weights in strange places, making it a real workout for your neck. By contrast, Sony has used its experience in product design and outsourced all the Morpheus's non-screen hardware to a small desktop box. This has resulted in a lighter headset with the same power and resolution as the Rift.

Sony has also focused on making the kit work natively with the PlayStation 4, its motion-sensitive Move controllers and its camera. By targeting the PS4 instead of the PC, Sony has sacrificed raw power for standardised hardware and a living room experience. The only flaw is that Morpheus currently uses LCD screens instead of the Rift's superior OLED. Yet both headsets are prototypes, and the ultimate goal for Oculus and Sony is a wireless, lightweight headset no larger than a set of ski goggles. Whatever the hardware, given its established audience and the competition in the console market, the Morpheus is looking more plausible as an early VR success than the Rift – the VHS to Oculus's Betamax, perhaps.

But what do you experience on these devices? As gaming has expanded, it's becoming increasingly hard to speculate about where it's going. The simple answer would be 'everywhere'.

"The combination of evolving technology and ubiquitous experimentation might well lead to games being pervasive throughout the whole of society," explains Liquid Flower Games' music composer Joost Kraaijenbrink. "Of course, physically speaking, we're already gaming pretty much everywhere. We all have handhelds, or at least games on our phones, so for most of us, wherever we go, we can play games." But it's not just hardware – it's about software in everything we experience, and all software having game-like elements.

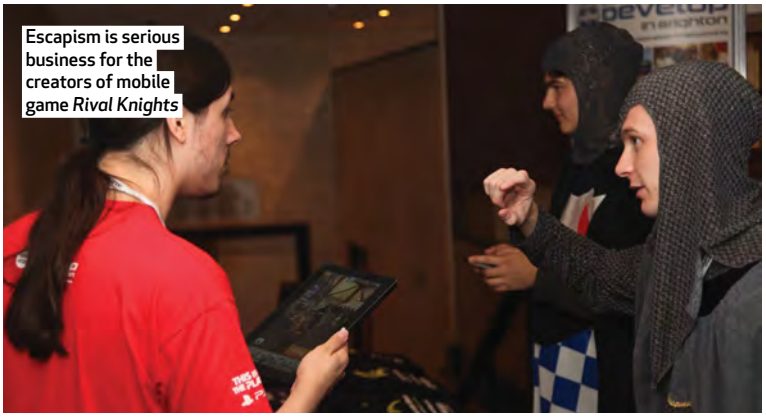
The conference's Indie Dev Day opened the floor to smaller game developers

Sony's street luge VR demo uses realistic motion to create an immersive experience

USING IMMERSION

Technology isn't the only thing that leads to immersion; it's also how developers use it. Away from the Project Morpheus demos at the Develop conference, Patrick O'Luanaigh of game developer nDreams offered practical tips to developers wanting to maintain immersion. He explained that players want to stay immersed, so the developer's aim is to maintain the illusion – by keeping movements smooth, avoiding the uncanny valley and keeping everything's speed realistic, for example. Controls are equally important. Players can't see a controller, so developers might forgo the [W][A][S][D] keys for the easier-to-find arrow keys. For example, in *Call of Duty* your characters walk and sprint faster than the average human, and turn faster too, so it feels unnatural in VR.

Dr Richard Bartle says social elements in games are essential



Escapism is serious business for the creators of mobile game *Rival Knights*

Kerry Turner, developer of *Heartwood*, aims to sustain immersion by keeping the game's world consistent

Psychology and game design

Other ways for game designers to address psychological problems

Even in games whose settings are seemingly otherworldly or alien, the same rules apply. Freelance game developer and designer Kerry Turner is just finishing work on *Heartwood* (http://heartwoodgame.com), a VR simulation of a strange woodland. Despite its whimsical premise, she focused on keeping it realistic. "I want, as much as possible, for the player to feel like themselves in a strange place," she explained. "With that in mind, I think that tropes that suggest everyday reality – gravity feeling 'right', head movement when walking, that sort of thing – have an important part to play in the effect I'm trying to achieve. Having said that, I don't think they're important in all fantastical games. I think that the real key to immersion is consistency – not necessarily consistency with reality, but just an internal consistency that lets you experience that sense of presence."

Berni Good is the is the founder of Cyberpsychologist Limited, and consults on the intersection of psychology and gaming. She says that although developers have worked out some guidelines themselves, there are psychological tricks and problems they have yet to discover. After all, current VR technology is analogous to the black and white era of movies.

The first simple trick she points to is maintaining the player's sense of competence, whatever they're doing. "(This) is a key psychological intrinsic need as discussed and researched within a psychological theory called Self Determination, first postulated by Deci & Ryan (1985)," she says. Given the clumsiness of players in a game relative to their expectation of their own capability, ensuring competence is harder than it sounds. The Morpheus shark attack demo I played failed to maintain competence, as the player was given a flare gun that fired flares that did absolutely nothing. Patrick O'Luanaigh's talk even suggested dispensing with the perception of your own body completely, because to make a believable body that matched every player's expectations – colour, size, reactivity, texture, shape, detail – is nearly impossible.

This ties in with a sense of maintaining 'flow', which Dr Linda Kaye of Edge Hill University addressed at the conference. It's described as a state of energised focus, full involvement and enjoyment. In games, flow is all about keeping a player absorbed and keeping them coming back. By balancing a game effectively against a player's skill so that they don't find it too hard or too easy, you can keep them in a flow state, even as part of a group of online players. As Berni Good puts it, "Developers can enhance flow by focusing more on the cognitive features in gameplay such as challenge, concentration, goals and feedback."

Similarly, interactions with uncanny characters can bounce players straight out of their sense of immersion. The concept of the

Jamie Madigan has a PhD in psychology and writes a blog about the psychology of gaming at www.psychologyofgames.com. He's impressed by the way designers use psychological studies. "You've got the guys at Riot using psychology to reduce toxic behaviour in *League of Legends*, for example, by controlling how social situations are constructed within the game and providing players with different kinds of feedback about their behaviour," he says. "It's basic social psychology stuff, and it seems to be working. Other companies employ psychologists in their user interface design groups, and in playtesting. Anything that requires measurement of human behaviours and attitudes could benefit from the involvement of a psychologist."

However, he's also cautious about the degree to which the research itself is biased towards politically popular topics rather than practical learning. A lot of the psychological research now focuses on violence in games, games addiction and using games in education. "Those are fine research topics," says Madigan, "but I would love to see more psychologists addressing more nuts-and-bolts features of game design. What is the best way to provide players with feedback about their progression through a game? What kinds of interactions do they want (and have) with other players? How can you best present comparisons with other players to best motivate players to keep playing and improving? And, of course, how do you curb antisocial behaviour?"

Still, he believes the future for psychology and games is bright. "I want to see classes in media psychology and video game psychology taught as part of psychology programs and game design programs," he says.

uncanny valley was first created by the robotics professor Masahiro Mori in 1970, and it's swiftly reached the same state in games as it has in robotics – if a character isn't utterly convincing, it's oddly off-putting and jarring. In terms of game design, it's often better to create something deliberately inhuman than something that only *just* fails to be human as the eye is more critical of the latter and tars it with the brush of psychopathy. This can be a real problem if the developer intended that character to be sympathetic.

It's also worth keeping social elements alongside the challenges in your games. Dr Richard Bartle (co-creator of the first MUD) split gamers into the four categories of explorer, socialiser, killer and achiever. These categories were fairly arbitrary, but have held up well as a sociology of gamers and those socialisers need some social elements to play with – even if they're only NPCs who make a little quip every time they sell the player a health potion.

And, of course, the experts at the conference warned against using the cynical compulsion loops employed by free-to-play game developers everywhere – despite the way they can increase 'flow' – because the player is bounced right out when the game asks for payment at a critical moment. "Some of the consumer psychology around this area sadly is being used by some developers to 'trick' the gamer into paying more out," says Berni Good. "They know who they are, and frankly it's not ethical. Enough said."

She suggests that in order to achieve deeper immersion, VR needs to advance from its current state as a purely visual medium. "Enhancing presence will be key to the future success of psychology and video games. I would suggest that games will have built into them ways to dynamically feedback and change the direction of the game for each specific player by using tools such as advanced brain monitoring or other psycho-physiological and psychological tools," she explains. "I see a focus on presence to get to the point whereby the presence in 3D worlds will feel the same in a virtual world as in the real world."

Again, this may be a few years down the line, but who knows where we'll all be when the wearable technology revolution really takes off? It's not inconceivable that VR games will be able to interact with the wearables you own, and any residual RFID tags in the area.

Ian Livingstone holds forth on the importance of escapism in education

ESCAPISM AS ADDICTION

Escapist games take all forms. Much escapism is helpful – giving you time to think about problems or allow wounds to heal – but it's not always positive. The Norwegian psychologist Frode Stenseng has argued that the flow state praised by Dr Kaye and Berni Good resembles the focused condition seen in obsessions and addictions. He says flow can develop either harmoniously or obsessively, and all of the above techniques could be negative for someone who's coming to their gaming in a poor mental state. The jury, after all, is still out on whether problematic gaming is actually gaming addiction.

> "I realised that I only felt better while playing, and once I logged out that feeling evaporated"

Philippa Warr is a journalist and writer, working for publications including the *Guardian* and *Wired*. She's quite candid about the fact that she has had a problem with gaming – specifically with Valve's *Dota*, a multiplayer arena combat game. As the psychologists indicated above, she uses the games as a method of relaxing and stepping away from her problems. The problem isn't the gaming, which is reassuring; it's that it's not helping with her problems.

Warr's Steam profile reveals that she has spent nearly 1,500 hours playing the game. "Sometimes you need to be able to occupy your mind with something other than what's bothering you," she says. "Games can do that, especially ones like *Dota* where there is so much to learn but you do so through a rhythmic match setup. It's comforting because of the repetition of the map and the basic phases of the game but stimulating because of the variety within that."

However, at some point her *Dota* gaming turned from a positive comfort into a place to avoid her problems. "I realised that I was only feeling better while playing and as soon as I logged out that feeling


Berni Good is an expert on the connection between psychology and gaming

Riot uses psychological techniques to encourage teamwork in *League of Legends*

Develop offers gamers, developers and industry leaders to share their insight

Linda Kaye says 'flow' is key to immersion in games

would evaporate. It wasn't having a knock-on positive effect on the other situation, even just in terms of offering a bit of respite and letting you come back a bit refreshed. That was the point at which I felt like I was hiding and that it was a negative thing. I wasn't even enjoying the game, exactly. I was just enjoying not having to deal with depression for an hour at a time, or feeling like I was socialising without having to actually talk about anything."

Professor Jeffrey Snodgrass of Colorado State University explored this contradiction in a 2014 paper called *Motivated MMO Play and the Pleasures and Perils of Online Experience*. He found some interesting distinctions in how players reacted depending on how they played a sample game – the ubiquitous MMO *World of Warcraft*: "The authors find that playing to achieve is strongly associated with distressful play; results that support findings from other studies. By contrast, social and immersion play lead more typically to positive gaming experiences, conclusions diverging from those frequently reported in the literature."

Berni Good explains that the study also seems to show that less stressed individuals benefit more easily from the relaxation offered by games, while individuals bringing stress into the game don't get the relief they seek.

That tallies with Warr's *Dota* experience, where she felt the social side of the game had become token, secondary to a very strongly-achievement oriented competitive culture, which failed to dissipate the stress and depression she was feeling during her actual day-to-day life. In my opinion, the contrast between the simple drive to achievement and regularity of success in the game, compared to the difficulty and complexity of achieving anything noteworthy in real life feels like a reason for depression – and another reason for seeking escapism.

Technology is mediating our contact with the outside world, and allowing us to contact each other's private worlds more and more easily. Imagine everyone you might see on the London Underground today, locked away in their heads, sleeping while standing or playing games on their phones. Now imagine stepping into the same scene, but everyone is wearing VR sunglasses and playing games entirely by themselves, heads bobbing and mouths moving in a hundred cross-cutting fantastical dialogues. It's an alien world, but it may be coming. And it won't be good for everyone. ■

Ian Livingstone wants to see gaming used in education to make useful knowledge stick

An escapist's education

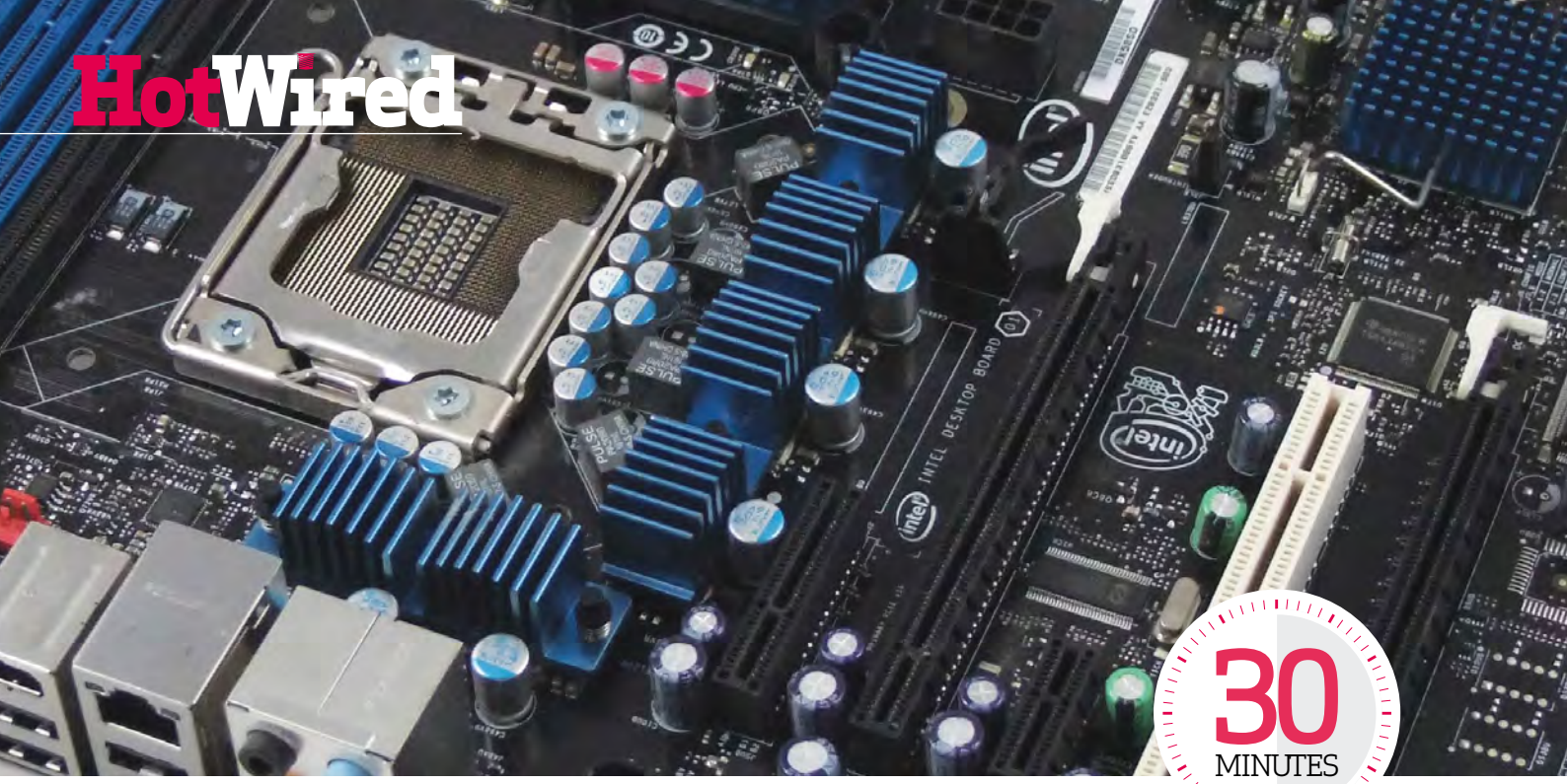
Can escapist games be used to improve learning in schools?

Education, you might think, is exactly the opposite of escapism. After all, the traditional English school, as depicted by Dickens in *Nicholas Nickleby* and Thomas Hughes in *Tom Brown's Schooldays*, was a fairly brutal institution - precisely the thing a child would want to escape from. Yet, as Liquid Flower's composer Joost Kraaijenbrink points out, it has the potential to benefit greatly from gamifying and immersion. "One learns best by doing, and the interactivity in games allow for a much more 'doing' approach than any other medium, without actually needing the resources (or risks) to do whatever you want to teach for real. Think simulators, not just for things like airplanes or cars, but also perhaps surgeons, architects, management, etc."

Beyond the egalitarian benefits of letting anyone experience any job through simulators, which is still some way off, education could still benefit from the enthusiasm and reduction in stress that come with 'non-achiever' gameplay. After all, immersed, engaged and relaxed children are receptive children.

At the Develop Conference, Ian Livingstone (former life president of Eidos, founder of Games Workshop, co-creator of *Fighting Fantasy* and the new UK Creative Industries champion) explained how he thought education should change. "In schools today, we focus too much on the computational nature rather than the how, when and the why," he said.

As well as pushing immersive education, he wants to teach coding as a tool for creativity, and to gamify education, so that pupils learn the important life skills that are inherent in many games rather than plain academic facts which are of minimal use after school life. He also claimed that peer-to-peer learning improves pupil performance by 30 per cent. When it comes to escapism and immersion in education, there's definitely some room for further studies.



30 MINUTES

Diagnose POST issues

Don't panic if your system appears dead, says Chris Lloyd, it's probably just resting

PROJECT GOAL

A stable PC
Fix a system that won't pass its POST, or at least find out why.

REQUIRES

Mobo manual
You'll need this to establish that your motherboard, RAM and chip are compatible, and see where everything plugs in.

Pozidriv screwdriver
For any disassembly necessary.

Thinking cap
Some problems might need a little brainwork to resolve.

Damn, it's dead. You've just pressed the power button and there's little sign of life, let alone an operating system. You may see text from the BIOS, a blue screen or nothing at all. There may be silence, or a flurry of beeping and frantic fans. Never mind driver problems; this is more fundamental than that. Your box has failed at the first fence and the POST has bombed.

The POST (power-on self-test) is the very first software your rig runs, and it lives within the BIOS. It runs basic diagnostic tests on your hardware, checking that it's present and working. Only after this is confirmed will the bootstrap loader be accessed and your operating system cranked into gear. The POST's main jobs are to check the processor registers, verify the size and integrity of your RAM, check that the graphics card is ready, check the system clock, interrupts and such, pass control to other hardware system BIOSes (notably the graphics card), and finally shake hands with your drives and select a booting one.

Should things go wobbly during the POST, you know something fundamental is going wrong. At this point your BIOS will tell you with a series of beeps, rather like Morse code, possibly accompanied by little LEDs. It'll then shut down, freeze or start booting again. No beep codes doesn't mean the end of the line though; there are plenty of situations that the POST can't catch, or which cause it to fail before it even gets going.

Stay frosty

Time to remember Occam's Razor: "Entities must not be multiplied

Getting naked

If you suspect a short on the case, then it's a good idea to get systematic by pulling everything out and starting afresh. It can also pay to run a system outside the case before you build it, especially if you are recycling parts you are unsure about.

Sit the motherboard on a firm, clean and non-conductive surface, then plug in your power supply, processor and cooler and fire it up by shorting the power pins with something metallic. It might not get far, but you should get some beeps that refer to memory (expected and good), or your processor (bad). Alternatively, there may be silence (possibly worse).

Add your hardware until you find your problem – or not. It may be indeed have been your case. Just don't touch anything when its powered up. Not because you'll get a shock (there's nothing nastier than 12V outside the PSU) but because you're likely to cause a short circuit yourself.


Take the case out of the equation to see if it's at fault

beyond necessity." Or, put another way, the simplest solution is most likely the correct one. It was good enough for Einstein, Planck and Heisenberg. If the problem could be either a power spike causing a power line on your PCB to short or you forgetting to turn it on at the plug, you should probably check the plug first.

Start with the basics and try not to make assumptions. Listen to your system. Read what the POST flashes up on the screen. Are all the fans firing up? Is the BIOS beeping at you? Modern PC components are very reliable and thoroughly tested, so spontaneous failures are rare. No matter how experienced you are, it is all too easy to skip a simple, but obvious step. Remember, the most fallible component in your system is probably you.

The POST dates back to the original IBM PCs, when memory was less reliable and things failed more often. Much of it is concerned with checking memory integrity. It's not exactly an in-depth process – more a set of simple call and response signals and checksums to see what's on the end of the wires, and whether it responds properly.

There are two basic sources of POST errors. Either the tested component is a burnt wreck that will never work again, or (much more likely), you've plugged it in crooked, in the wrong place, or forgotten something simple and fixable. This is a little glib perhaps, but there really isn't much middle ground with modern kit; boards and chips generally work as advertised, or not at all. This is good news really, as these days memory errors are more likely to happen because you've got the wrong sort, or it's in the wrong slots, rather because it's a pile of dead chips.

Jargon buster

POST
Power-on self-test– a series of simple checks your BIOS makes to ensure things are plugged in and working properly. It runs once when you boot.

BIOS
Basic input/output system – a small machine code program stored on a chip on your motherboard. It contains just enough code to get your PC to use hardware and run an OS. It's generally unused once your OS is up and running.

CMOS
An area of non-volatile memory within the BIOS that stores basic hardware configuration. This is what you can configure when you boot into the BIOS to change things.

First, read the manual. Yes, we know, how tedious. If this is the first time the combination of motherboard, processor and RAM have come together, then check here to see if they are supported. Just because you can plug the chip in, it doesn't follow that the board can handle it. The manual will also detail what gets plugged in where. Yes, this is basic stuff, but remember the Razor. Have you been fiddling with BIOS settings? It's easy enough to set RAM timings that fail. If you've just made some changes, undo them. If you've just added some hardware, remove it.

TOP TIPS

STATIC KILLS

Or so we're told. It's good practice to earth yourself on the case or other metal object before delving in. It's not quite the danger many quote though (wearing an earth strap is a bit excessive).

Beep or no beep

At this stage, a lot depends on whether you get a POST error code (consisting of one or more beeps). These give you a pretty good idea what's at fault (see 'Beeping beeps', below). If you get silence then you probably have a power issue – a missing connection, blown fuse or worse. If the problem is a fan failure then your BIOS may have stepped in to stop proceedings.

If there are no error codes, you'll have to do a bit more detective work yourself. If you're quite certain everything is plugged in firmly, then start by removing things until you see a change. Remove any external hard drives and USB drives, then the internal drives. Still nothing? Try removing any expansion cards.

Next to go is the memory. Remove it all. You should now get a error code complaining that there's no memory – if not, you have motherboard or power problems. Fit one stick and try every suitable slot (the board may only respond to the slots in order, or it may not care). Try each stick on its own in turn. A faulty stick or slot will soon identify itself.

If the RAM checks out then we're down to the bare bones. Pull the graphics card and your BIOS should produce an error code. Same story with the processor. If you still get no error codes, then all you're left with is the PSU or the motherboard.

One tricky customer is the random short circuit or broken PCB line (although nothing is actually random – ask any mathematician or physicist). Flexing a mobo can cause a crack in a PCB line, which may close and open as you fiddle with things. Alternatively, there may be a little bit of something conductive floating about the case (it doesn't have to be big). These can be awkward to fully diagnose. If you suspect a short then full disassembly may be called for (see 'Getting naked', opposite). Ideally. any suspected dead component should be tested in another system before being binned – a luxury perhaps, but it's nice to be sure.

We've built dozens and dozens of systems here in our secret lair, and we've had our fair share of DOAs. Each time there's the initial panic, fearing some expensive component (often on loan) has crashed and burned. Then we look again, and wouldn't you know it? We forgot to plug in all the power cables, or some such. So don't panic, the chances are it is recoverable. If not, its not too hard to track down the culprit.

Beeping beeps

If your box is beeping, it's trying to tell you something important, so listen. You used to need a system speaker to hear these tones, but modern boards have their own little built-in beep-maker. A system speaker isn't your regular sound system, either – it's separate and specifically for error codes, and we haven't seen one for years.

IBM created the original set of beep codes. One long beep and two short, for example, means it can't find a working graphics card. The BIOS makers have added to the error codes over the years. Unfortunately there is no standard for what beeps signal which problem, and although there are some consistencies, (small numbers of short beeps are mostly memory errors), there are enough variations for it to be really annoying and require specific documentation.

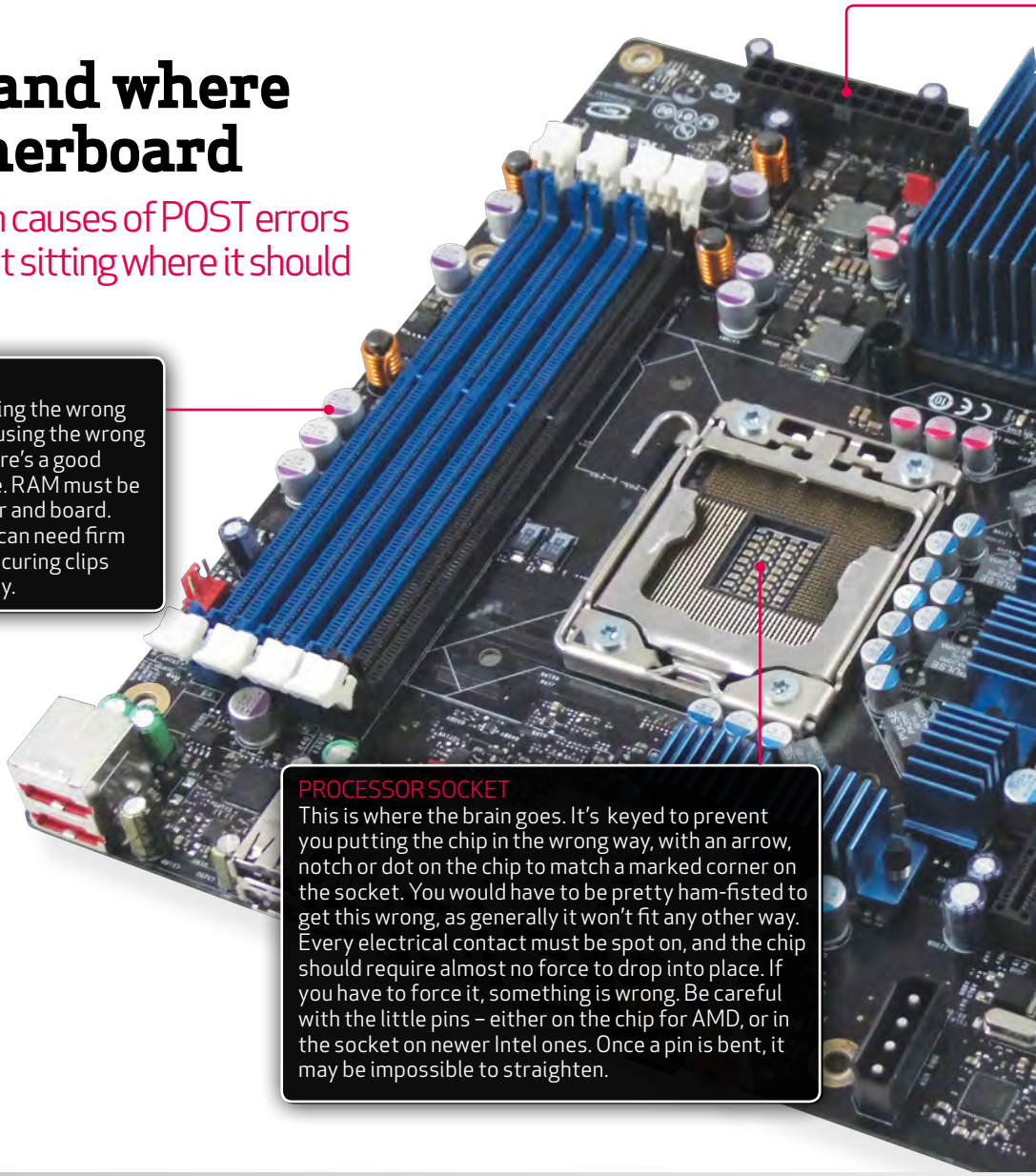
If your system beeps, you can use the manual or a device with a working internet connection to decipher them. Try searching for POST error codes – the top articles are all pretty good, especially the TechNick one. More beeps don't necessarily mean a more serious problem. Once you've located the source of the issue, remove and re-seat the offending hardware, then try again. It it's a powered component, check that the power is plugged in, and try a different power cable if you have a spare. Try swapping things around as described above if it's a memory error.

The error codes are a decent starting point, but they don't tell you the exact problem, or how severe it is. It may be a simple seating issue, or a component may be trashed. Still, they're a huge help.

BIOS makers have added their own error codes, but there's no standard

What's what and where on your motherboard

One of the most common causes of POST errors is a component simply not sitting where it should



DIMM SLOTS
Some very common problems are fitting the wrong RAM, putting it in the wrong slots, or using the wrong capacity. If this is a new build then there's a good chance your problems stem from here. RAM must be properly matched with your processor and board. Your manual will detail all this. Sticks can need firm coaxing to get into place, too. If the securing clips don't engage cleanly, its not in properly.

PROCESSOR SOCKET
This is where the brain goes. It's keyed to prevent you putting the chip in the wrong way, with an arrow, notch or dot on the chip to match a marked corner on the socket. You would have to be pretty ham-fisted to get this wrong, as generally it won't fit any other way. Every electrical contact must be spot on, and the chip should require almost no force to drop into place. If you have to force it, something is wrong. Be careful with the little pins – either on the chip for AMD, or in the socket on newer Intel ones. Once a pin is bent, it may be impossible to straighten.

Are we all plugged in?

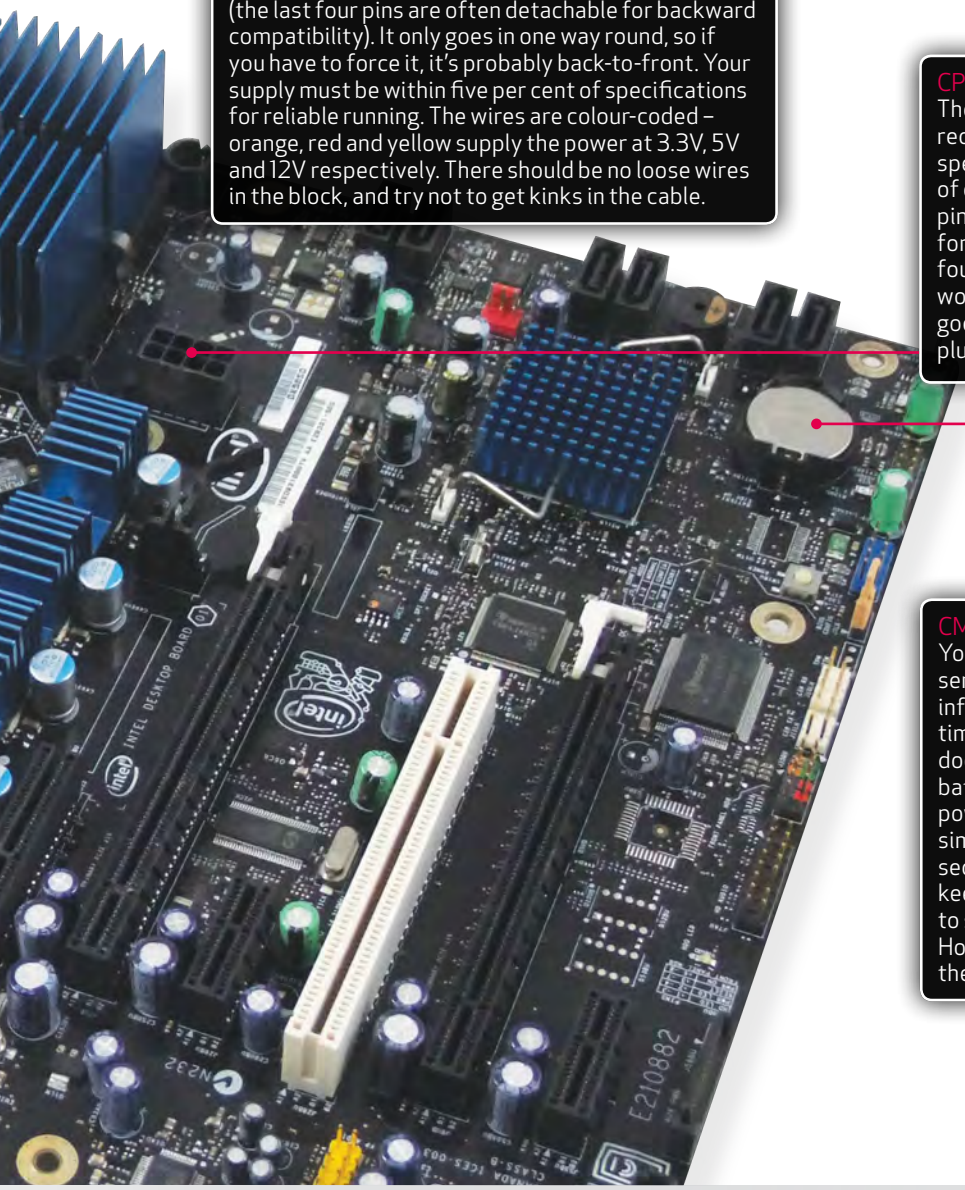
Never underestimate how easy it is to make a fundamental error

1 Is it really on?

On the back of your PSU there is probably an innocuous-looking black power switch, which is rarely touched in everyday use. It's easy to forget about it and start worrying about dead components when all the time you haven't switched on the juice. If this fails, try replacing the kettle lead; you may have a faulty one, or a blown fuse.

2 Processor power

Chips get their own power supply, and it's easy to forget to plug this in. It'll use either an eight-pin block or a four-pin block. Often the power supply leads splits the eight-pin into two four-pins to make it compatible with both. It's the socket next to your processor, often called '12v ATX'. Another easy miss is the power for your CPU cooler.



MAIN POWER CONNECTOR
The ATX standard dates from 1995. It was originally a 20-pin block, but now usually appears as a 24-pin one (the last four pins are often detachable for backward compatibility). It only goes in one way round, so if you have to force it, it's probably back-to-front. Your supply must be within five per cent of specifications for reliable running. The wires are colour-coded – orange, red and yellow supply the power at 3.3V, 5V and 12V respectively. There should be no loose wires in the block, and try not to get kinks in the cable.

CPU POWER BLOCK
The CPU socket supplies power, but processor requirements soon outgrew it. This power block is specifically for the processor. Depending on the type of chip fitted, it'll be a block with either eight or four pins. Often the cable comes with two four-pin blocks for cross compatibility. If your chip only needs a four-pin block and the board has an eight-pin, don't worry, just plug in the full eight-pin connector. It only goes in one way around, so don't force it. Without this plugged in, your system is dead in the water.

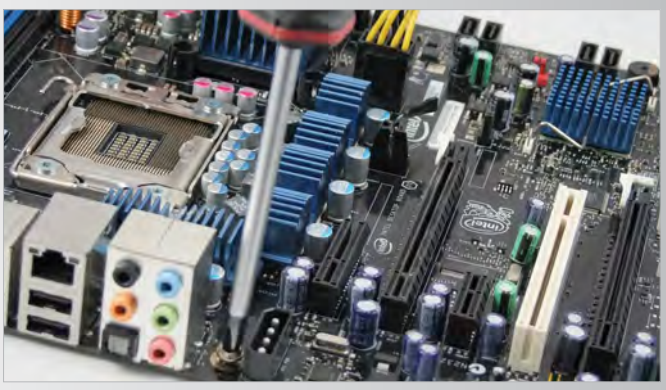
CMOS BATTERY
Your CMOS (complementary metal oxide semiconductor) is the part of the BIOS that stores information such as what hardware you have, memory timings and so forth. It draws very little power, but does need some, which is why it has a little coin battery. If your system loses the date and time after powering down, this battery is on its way out. It's a simple replacement – just be careful not to bend any securing clips. These days the battery is just used to keep the clock going, because flash memory is used to store hardware settings and requires no power. However, the term CMOS is still used for the part of the BIOS holding variable data.

3 Video power
Another easily overlooked connection is the graphics card's power supply. They can be hungry things, and only mediocre cards can run off the socket power alone. There are one or two six-pin blocks and/or an eight-pin block. Just make sure they are all filled. It's best to use cables directly from the PSU rather than adapters.

4 Front panel
The polarity of the reset and power switches isn't important. If your activity lights fail to light, try reversing the connection. Try disconnecting the reset switch if you suspect a short. You can fire a system manually by shorting the power pins if you suspect your case switch, but make sure you've properly identified them first.

More than cables

Okay, so it's all plugged in. What's next to consider?



1 Get in there

Video cards can take considerable force to get properly seated, which can be worrying, as flexing your board is really not a good idea. Make sure the mobo is fully supported with stand-off posts before applying pressure. Many boards have securing clips for the card. If you can't get these to click in neatly, the card needs pushing down further. Try removing and re-seating if the angle is at all crooked.

2 Unwanted shorts

If an electrical conductor touches your board then it can cause a short circuit on the fine network of tracks, which is guaranteed to cause trouble. Check the posts that the board sits on. Did you install them all in the correct places? There is no standard pattern and its easy to get one in the wrong place. You won't see it from the top, and a misplaced one can easily cause a short-circuit on exposed soldering.

3 Loose screw

A short anywhere will call a halt to operations. Did you drop a screw in there? It's easily done. Are there any wires touching the board that may have worn insulation? It's good practice to have all wires routed well away from the board, especially underneath, where there are sharp soldered connections that can cut into wires. Many cases have a tray under the board to keep wires out of such trouble.

4 Memory slots

Are your memory modules all fully seated, with the securing clips in place? Are they in the right slots? Check the manual to make sure. Wrongly configured RAM is a common cause of dead boxes. It must match the board and processor. Try booting with a single stick of RAM, or one pair for coupled systems. You may have a faulty RAM socket or a faulty stick, so mix and match to pin it down.

5 Memory speed

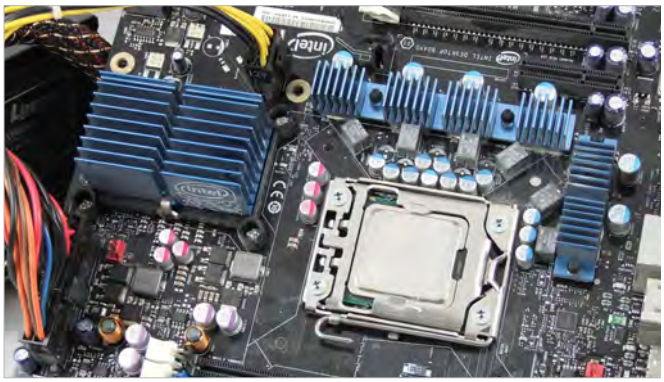
If you can boot with at least one stick of RAM, then enable the XMP profile (basically factory-approved overclocking) in the BIOS if the board support it, or set the memory speeds in the BIOS manually to match your stick's specs. If your sticks are rated at a higher voltage than the default settings allow, it can cause stability problems.

6 Processor all square?

Is your processor seated cleanly, flat and the right way around? There is a visual indicator on the chip (often an arrow) and the socket has a similar indicator, or is obviously asymmetrical. Never force the chip into place – we don't want a bent pin. They can be coaxed back to vertical very, very carefully, but if one breaks you're stuffed.

Getting tricky

So you've covered all the basics. Now what?

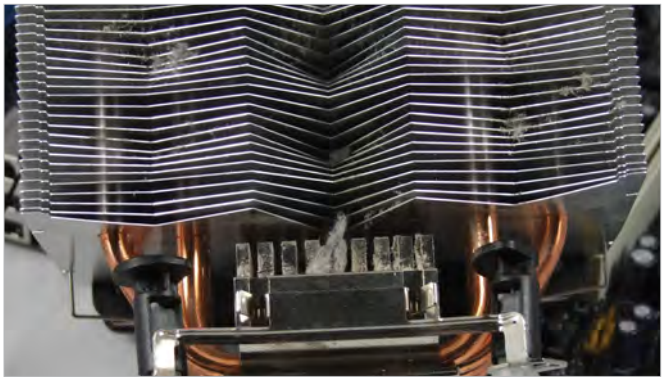


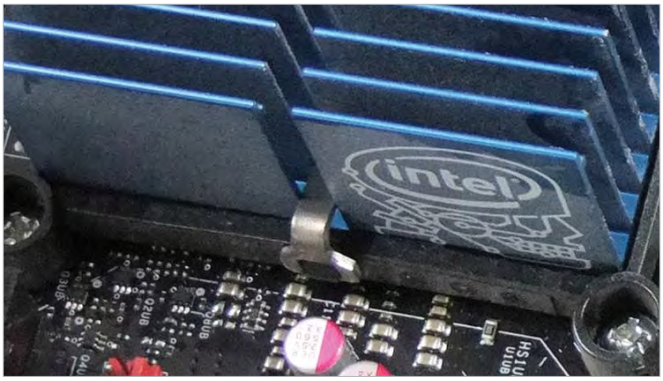
1 Re-seat your cooler

Your processor cooler needs to be seated firmly in place and completely flush, or the chip will overheat. Are all the connectors snug and is the cooler level? Did you put a (tiny) bit of thermal paste on? The contact between the top of the chip and your cooler needs to be good and true. The motherboard's thermal cut-out will trigger if it detects the temperature going too high, which may only take seconds.

2 Clear the BIOS

It will wipe some useful information, but resetting the CMOS can fix some setting woes. The simple way it to go into the BIOS and restore the factory settings, but this isn't much help if you can't get into the BIOS setup. Most boards have a jumper or DIP switch that will reset the CMOS. Once cleared, your BIOS will re-detect all your hardware on booting, which may clear an overlooked incompatibility.





3 Dust the fan

Does the chip fan go mental before the whole system locks up? If your cooler is fitted properly, the problem could be restricted airflow. Often there's an accumulation of dust deep inside the cooler, sitting between the fan and lodged in the cooling fins, or hair wrapped around the fan. A fine pair of tweezers or more thorough disassembly will put things right. If your rig sits on the floor, this is a common woe.

4 Clean the board

A grubby board may have collected dielectric material, or the grot may be acting as a blanket of insulation. Blow dust away and use a soft brush on more stubborn bits. If it's really grubby, you have the death or glory option of washing it (yes, really). Remove the CMOS battery, and use clean water. It must be completely dry before running any power. If it works, glory. If not, tough, it's properly dead now.

Power failure

Power supplies are tricky to diagnose unless they start to smoke, or there are loose wires in the power blocks. PSUs are sealed and have fans, so they attract dust that insulates components and clogs fans. If your motherboard appears dead and you've checked that everything is plugged in, your PSU deserves suspicion, it may be that it just can't reach operating voltages anymore.

Symptoms vary, and affect almost every other component. They are also easily confused with other failures. If it's good enough to fire the box, but not for sustained use, a PSU failure can get nasty – unreliable supply during writes can leave unreadable junk smeared across your storage drive.

This tendency to affect all components does at least give you a decent clue that power is the problem.Thankfully they have a tendency to all fail together, but not always. A more obvious sign is a hard-working PSU fan. It may fail only under heavy load, such as right in the middle of an intense bit of 3D gaming. If you're upgrading a system, particularly the graphics card, are you sure the PSU can cope? Capacity should exceed requirements by at least 20 per cent. Trying to recycle old PSUs can also cause issues with inadequate 12V supply, older ATX supplies only have one 12V rail.

You can beg, borrow or steal a PSU tester, or do a basic check of the power lines directly with a multimeter (every geek should have one). If you suspect the power supply, your best bet if is to try another working PSU. Don't give up on a motherboard until you've tried it with another PSU first, or checked your PSU on another board. ■

Think carefully before using an old PSU with a new graphics card. Can it cope?

Fix problems with your PC

Is your OS acting up? Let the Windows Repair tool find and fix the problem, says Nick Peers

PROJECT GOAL

Identify and solve Windows problems

Sometimes your computer is misbehaving and it's hard to work out what's wrong using only Windows' built-in tools.

REQUIRES

Windows Repair (All in One)

Download this essential repair kit from www.tweaking.com.

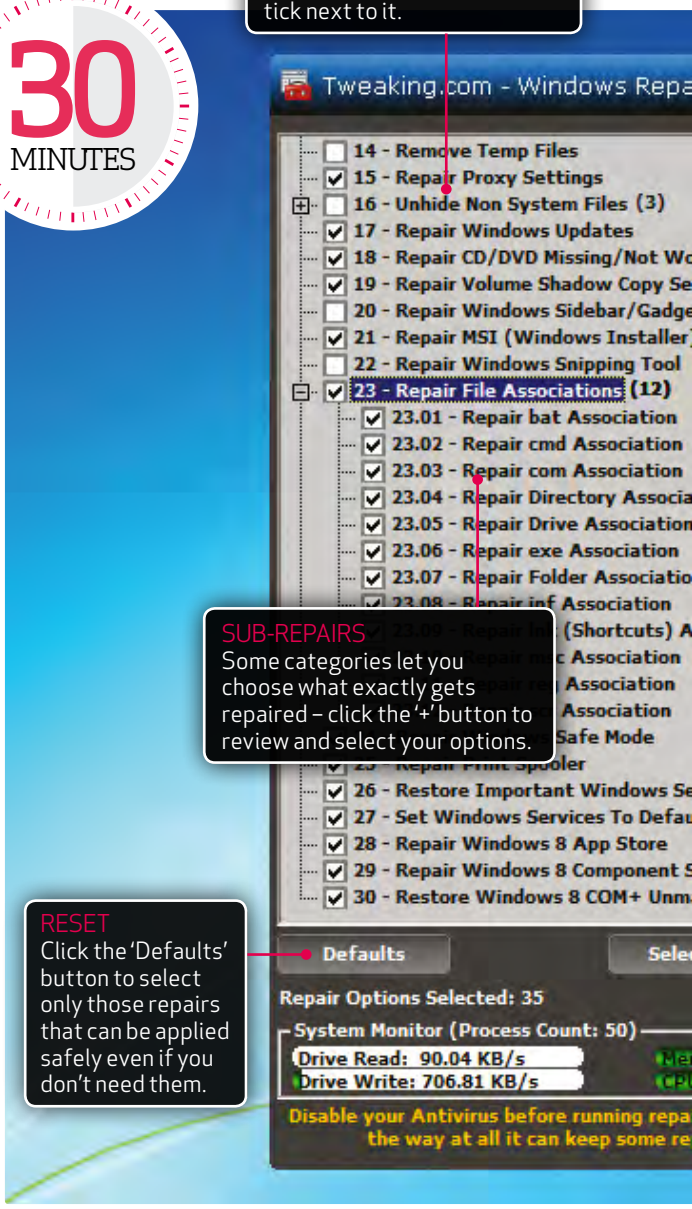
Malwarebytes Anti-Malware

Solve problems caused by malicious programs with the tool from www.malwarebytes.org.

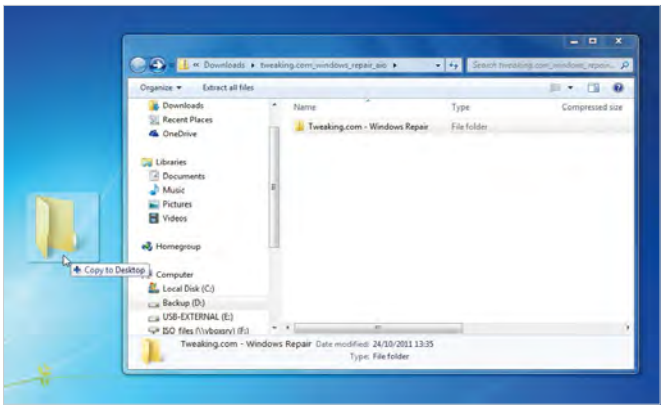
Troubleshooting PC problems can be a real pain, particularly if you need to resolve the issue quickly and can't easily pinpoint a cause – and therefore solution – to your woes. Windows' built-in tools can go some way towards solving common issues, but if you're currently struggling to fix a problem that seems deeply embedded, then Tweaking.com's Windows Repair (All in One) utility could be a lifesaver. It performs a series of basic checks, takes key backups and then presents you with a list of repair tools that can fix all manner of issues.

It's worth running many of the tools in this package even if they don't appear to be linked to your problem, as sometimes your symptoms may point to a series of underlying glitches that aren't obviously linked. In this tutorial we'll take you through the program one step at a time, hopefully guiding you towards that elusive solution to your problem and saving you the effort of performing a full Windows reinstall.

30 MINUTES



Step-by-step: Fix your PC

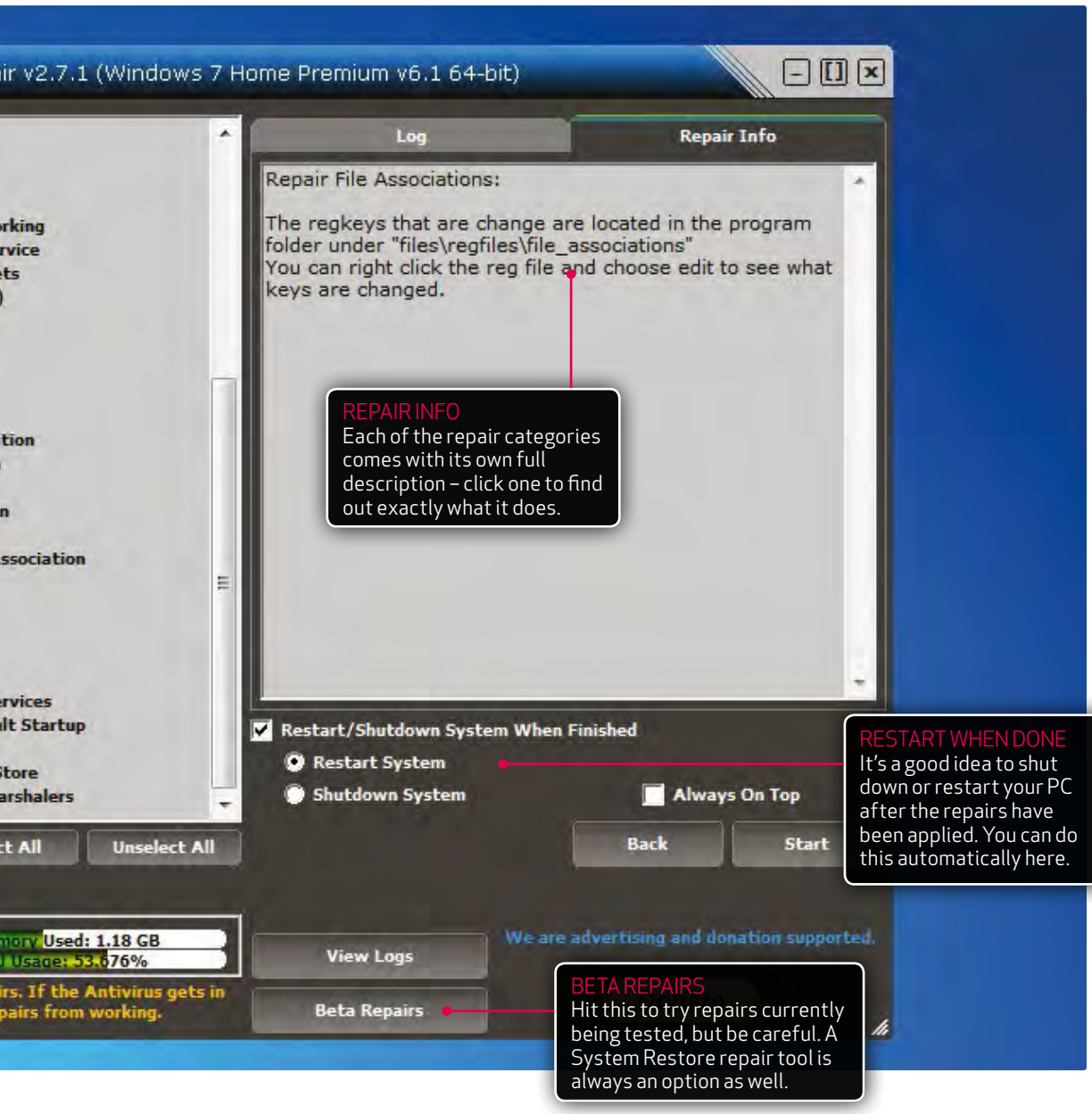


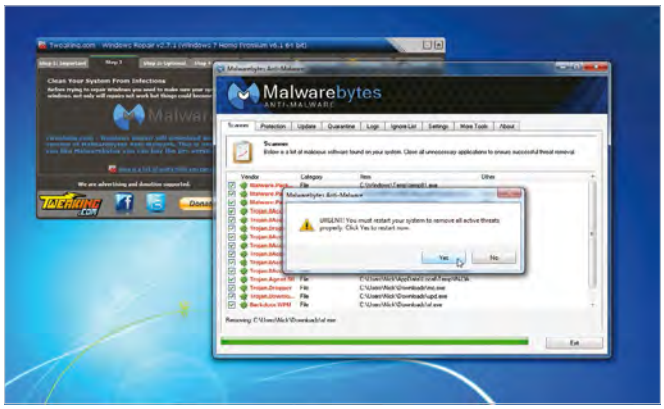
1 Download and launch

Visit www.tweaking.com and click 'Programs' then 'Windows Repair (All in One)'. Some problems may prevent you from installing new programs, so click the 'Direct download' link under Portable and save the zip file to your Downloads folder. Double-click this zip file and copy the folder on to your desktop. Open it and double-click the 'Repair_Windows' shortcut to begin.

2 Power reset

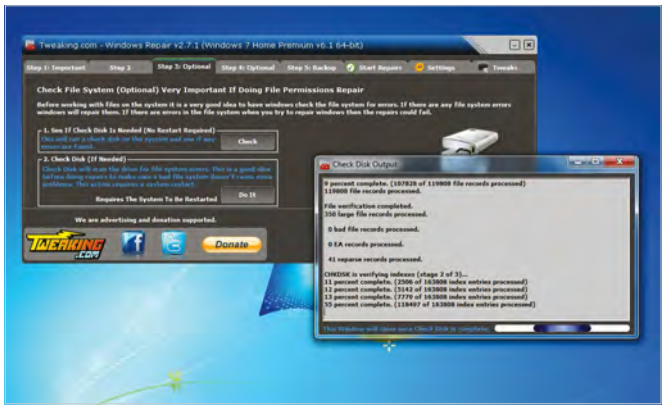
Click 'Yes' when prompted. Windows Repair will check it has the files it needs – if any are missing, you'll need to re-download the zip file and start again. You'll now be prompted to do a 'power reset' – as instructed, power down your PC, remove all power cords and batteries, then hit the power button a few times to clear all power. Then reboot and restart Windows Repair.





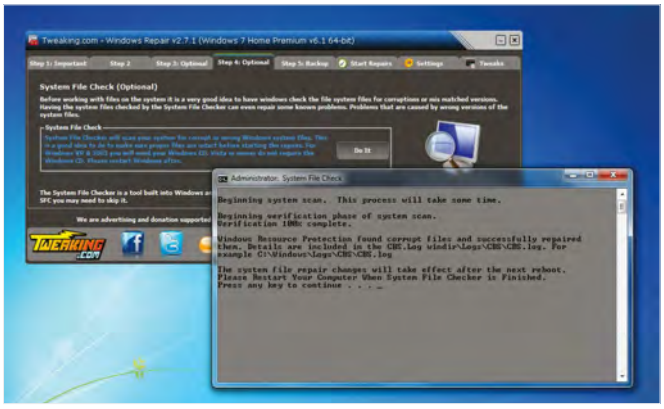
3 Scan for infections

Switch to the 'Step 2' tab. Run a full scan with your security software, then – if it's installed – run a full scan with Malwarebytes Anti-Malware. If you don't already have it, click 'Download & scan system'. Windows Repair will download, install and update a copy of the program, then run a scan automatically. If threats are found, follow the instructions to remove them, rebooting if prompted.



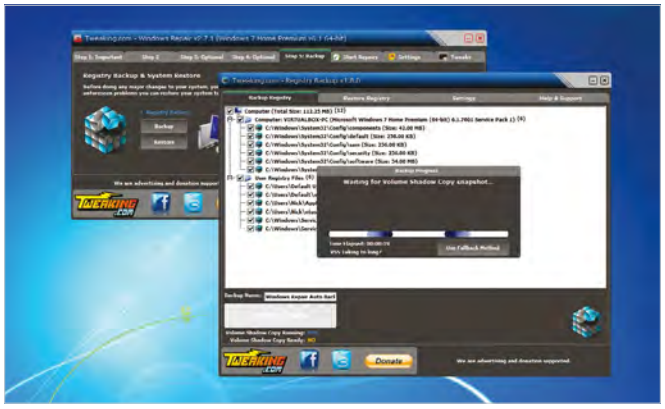
4 Check drive for errors

Once Malwarebytes has run and corrected any problems, close it and click 'Next'. The following step is worth following even if you think your hard drive is fine. First, click the 'Check' button to scan for errors. If any are found, click 'Do it' and let your PC reboot. The drive will be scanned again and fixes applied. Now restart Windows Repair, jump to step 3 and repeat the check. Repeat repairs if necessary.



5 Run System File Check

When your drive has been given a clean bill of health, click 'Next'. Read the instructions – XP users will need their installation CD at this point – then click 'Do it'. A command prompt window will open and the System File Check tool will perform its scan. If errors are found, press any key to exit, then restart your PC before running the check again to verify that all is now well.

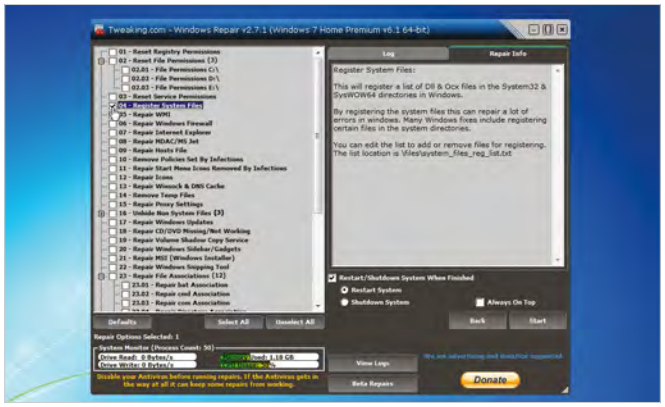


6 Take fail-safe backups

Click 'Next' to move on to the 'Step 5: Backup' tab. Start by backing up the Registry files – click 'Backup' under Registry Backup, then click 'Run' twice if prompted. Wait a minute or two – if nothing happens, click 'Use fallback method'. Once complete, click 'Create' under System Restore to add another level of backup. The cloud backup option isn't required, so click 'Next' when done.

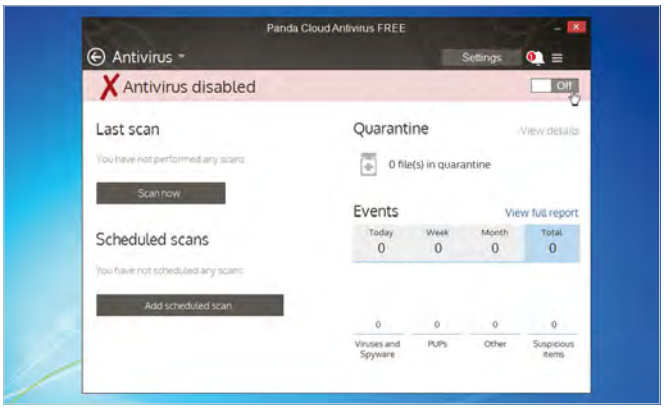
7 Review fixes

Read the disclaimer about the fixes offered, then click 'Start'. A window will open that listing all the repair options available – 30 are in place at the time of writing, and more are being developed all the time. Some repairs are ticked by default – these can be safely applied even if they don't directly refer to your problem. To find out more about an individual repair, click its name in the list.



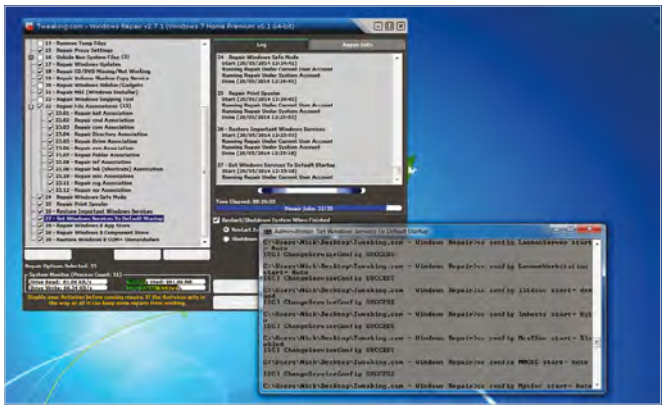
8 Select fixes

Some fixes can take a while to process, so if you have an older PC and can see which fix or fixes should resolve your problem, click 'Unselect all' and then simply select each fix by clicking the box next to it. If you're unsure what could be causing your problem, start by clicking 'Defaults' to select those repairs you can safely try without worrying about any side effects.



9 Disable antivirus

Your security program may interfere with any repairs you attempt to perform. Before disabling it as recommended, physically disconnect your PC from the internet; the simplest way is to switch off your modem or router, or unplug your PC's Ethernet cable. Once done, open your security software's configuration tool and choose to disable its auto-protect feature.



10 Apply fixes

Once you've selected which fixes to apply, tick 'Restart/shut down system when finished'. Hit 'Restart system' and finally click 'Start'. Depending on the repairs you've selected, the process may take a while. Once complete, your PC will reboot and hopefully the issues you've been having will be fixed. Don't forget to switch on your security software before reconnecting to the internet. ■

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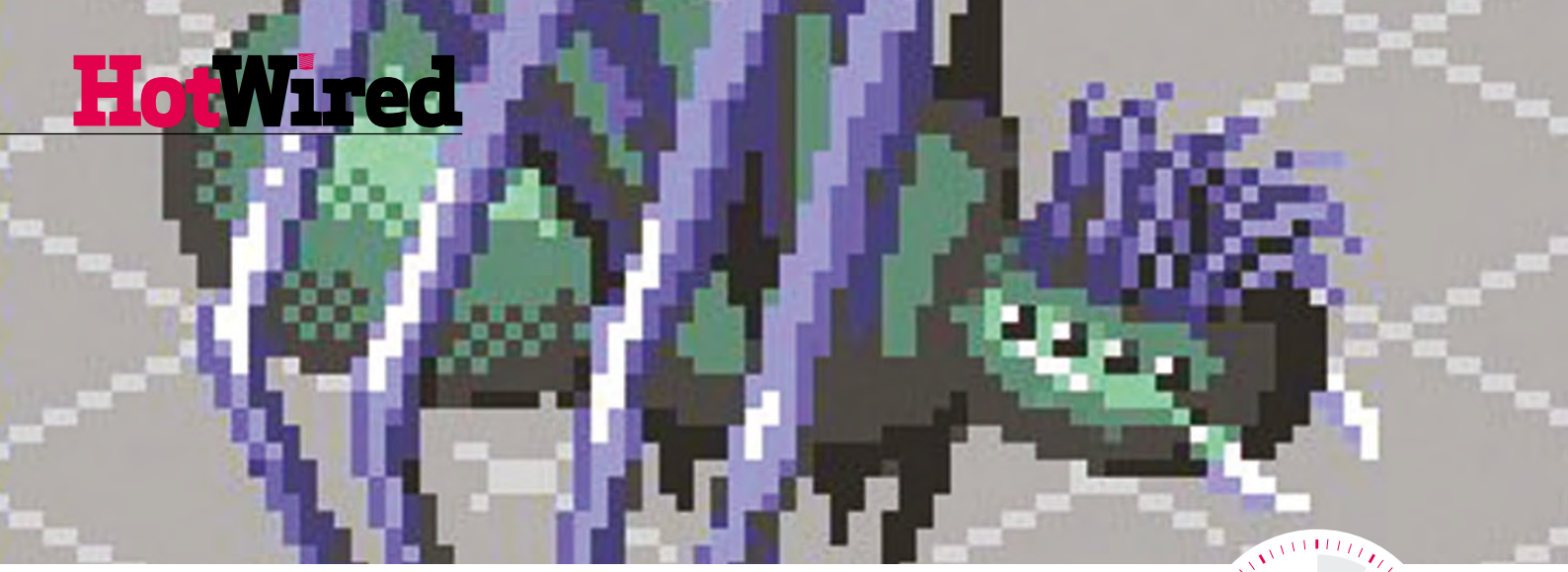


Make retro pixel art

1 HOUR

Catherine Emma Ellis helps you create your own 1980s-style videogame character

PROJECT GOAL

Pixel art

Make your own '80s-style sprite, one pixel at a time.

REQUIRES

GIMP

Get it from www.gimp.org.

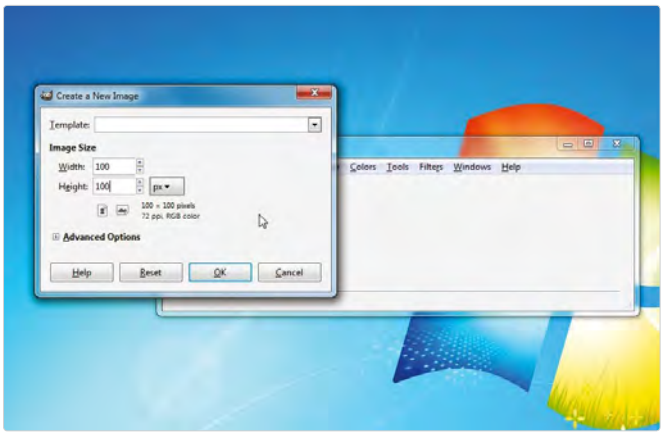
Think of retro games and you'll probably think of the pixellated look of titles on consoles like the NES. Games such as *Bomberman* and *Kid Icarus* worked within the limitations of '80s technology, yet offered hours of fun and iconic designs.

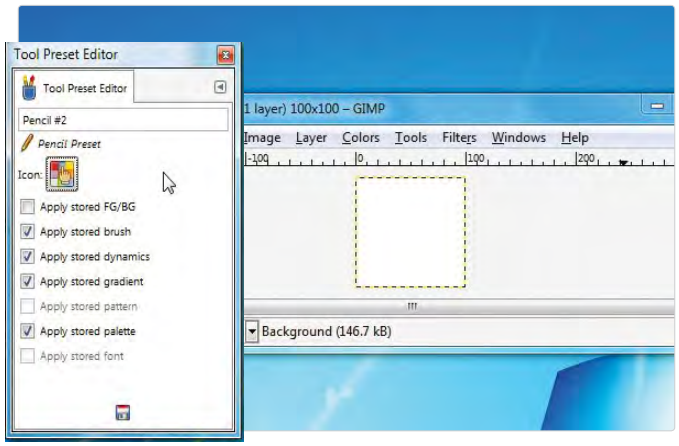
The style faded into obscurity with the development of more powerful consoles and 3D graphics, but has seen a recent renaissance in indie games like *Savant: Ascent* (www.savantgame.com). The art is still drawn pixel-by-pixel using a limited palette, but is smoother thanks to careful shading and more muted hues not available to 1980s game developers.

One of the most popular uses of pixel art is in role-playing games based on an isometric grid. We're going to create a character (or sprite) for use in such a game.

Step-by-step: Create an isometric character

Use free image-editing tool GIMP to take a trip back in time to game consoles past





1 Prepare your canvas

Start by downloading and installing GIMP from www.gimp.org, then create a new image. A canvas size of 100x100 is plenty – larger pieces of pixel art are impressive, but take weeks to complete. Now select the Pencil tool. This, Fill and Zoom are the only tools required, but we need to alter some settings so we can draw individual pixels.

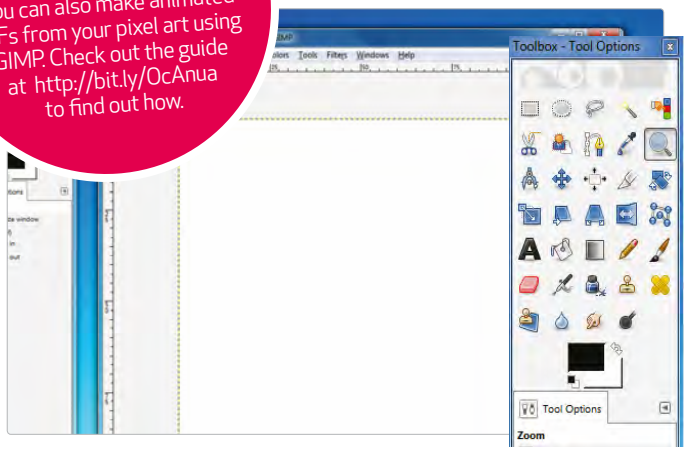
2 Sharpen your pencil

With the Pencil selected, click 'Brush Type' and select '1 pixel'. Change the size to 1 and turn dynamics off. Deselect Apply Jitter and Smooth Stroke. You can save it as a preset by clicking the blue floppy disk icon at the bottom let of the toolbox. Click on 'New Tool Preset', give it a handy name like 'Pixel art' then the floppy disk icon to save it.

TOP TIPS

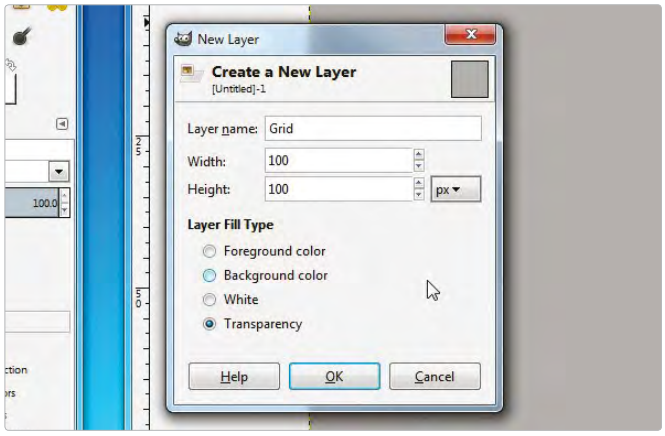
MAKE YOUR OWN ANIMATED SPRITES

You can also make animated GIFs from your pixel art using GIMP. Check out the guide at http://bit.ly/OcAnua to find out how.



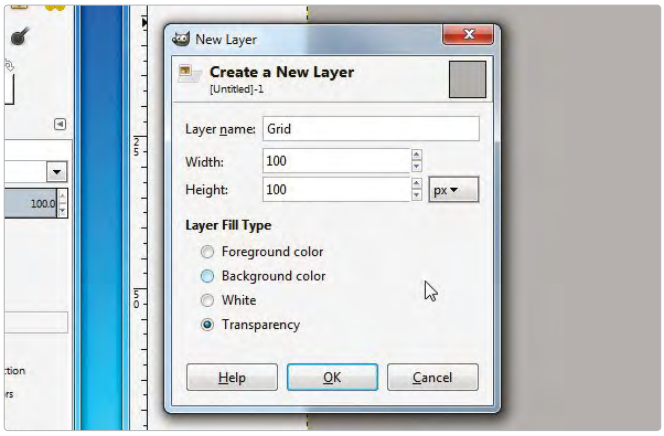
3 Zoom in

Use the Zoom tool to take a closer look at your image (about 550 per cent should be fine, although it will depend on your monitor's resolution). You want to be able to see and manipulate each pixel easily. Make sure you zoom out periodically while you're working to check that your art looks okay when viewed at actual size.



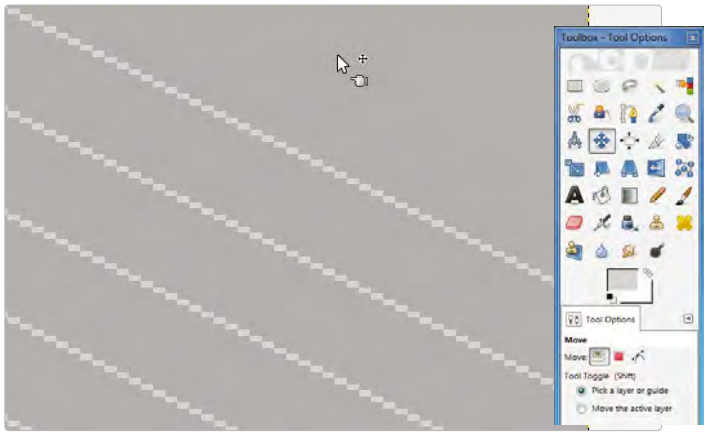
4 Paint it grey

We need to make careful use of shadows and highlights to ensure our pixel art character looks three-dimensional. Select the Bucket Fill tool and make the whole image a medium grey colour. This neutral background shade will make it easier to judge how bright to make highlights, and how dark to make shadows.



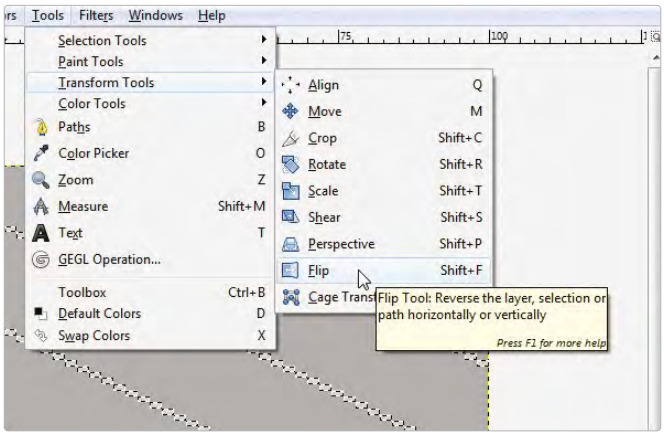
5 Create a guide

Now we're going to create an isometric grid as a guide. Create a new layer and call it 'Grid'. Select the pencil tool and choose a different shade of grey. Now click the top left pixel of your image, then hold [Shift] and move your mouse pointer to the right-hand side. When the co-ordinates at the bottom left read '99 49', click to draw a line.



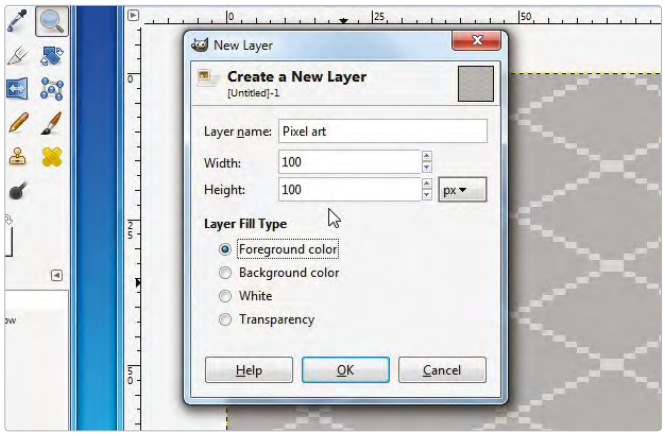
6 Line it up

Click [Ctrl]+[C] to copy the line and [Ctrl]+[V] to paste it, then select the Move tool and move the pasted line a little below the original. Click on the background to deselect the line, then copy and paste both lines. Repeat the process until the image is filled with evenly spaced diagonal lines.



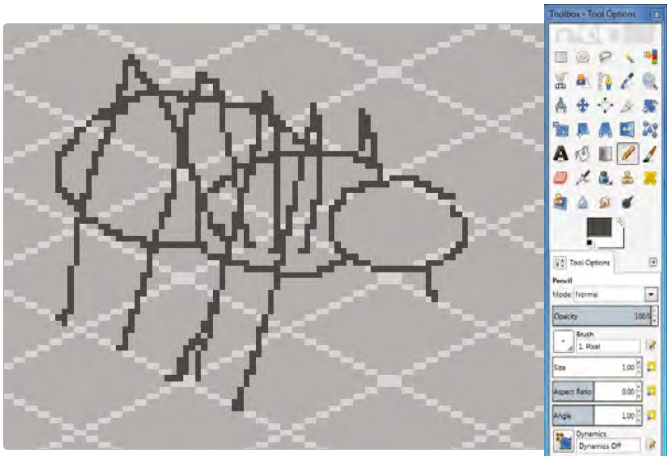
7 Build a grid

Now copy and paste all the diagonal lines, but don't deselect them. Instead, click 'Tools > Transform tools > Flip'. Click once anywhere on your image to flip the copied lines. This will give you an isometric grid. Because it's on its own layer, you'll be able to delete it easily when you've finished.



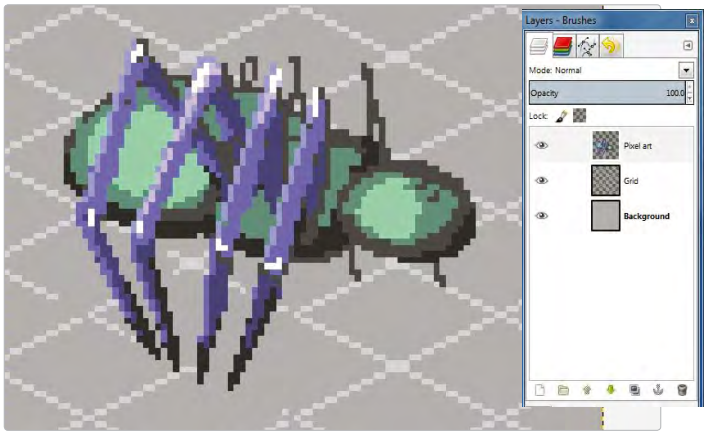
8 Pick a subject

Create a new layer and call it 'Pixel art'. The next step is largely up to you, but we're going to draw a spider-like creature, which could be an enemy in a game. Make sure you use the grid as a guide to help you get the right perspective, and don't use any tools other than your customised Pencil and Bucket Fill.



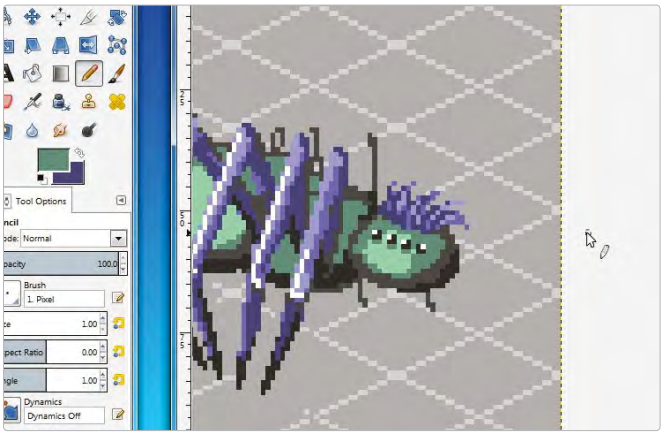
9 Sketch it out

Take a leaf out of the classic artist's textbook and start simple. Rather than trying to get every pixel perfect first time, make a rough sketch of your idea. It's very easy to edit and refine as you go along. Just make sure you use the isometric grid as a guide, and always bear in mind that your character is a three-dimensional object.



10 Refine it

Once you've got a rough sketch, try filling each section with a different colour to make them easier to identify. You can then decide where your light source is and begin adding shades and highlights accordingly. Feel free to tweak; here we've decided to make our spider's legs tilt inward to make it look more alien.

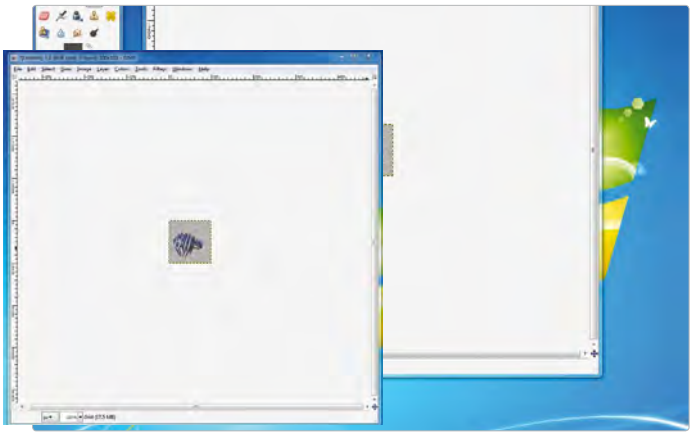


11 Add texture

Try to create the impression of different textures rather than making your character uniformly smooth. Here, we've decided to give our spider some fur on its head, using 'strokes' of differing shades to represent sections of hair. Zoom out regularly to check that your texture effects work when viewed at 100 per cent.

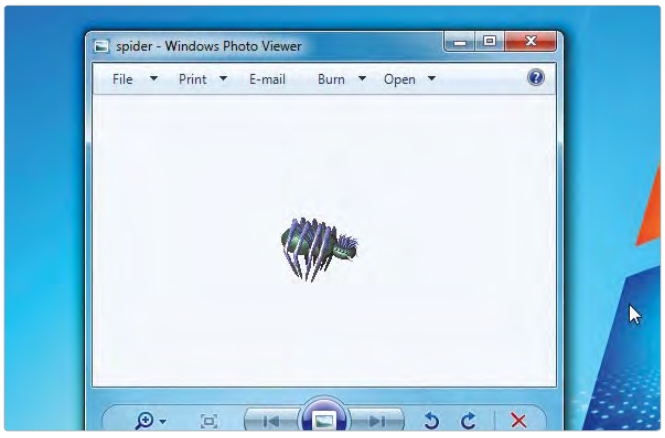
12 Try dithering

Early videogames required graphics that used as few colours as possible. One way to get around this limitation was to use dithering, a chequerboard of lighter and darker pixels that blends together to look like a single, mid-toned colour. Give it a try! You can create an interesting texture if the two colours are quite different.



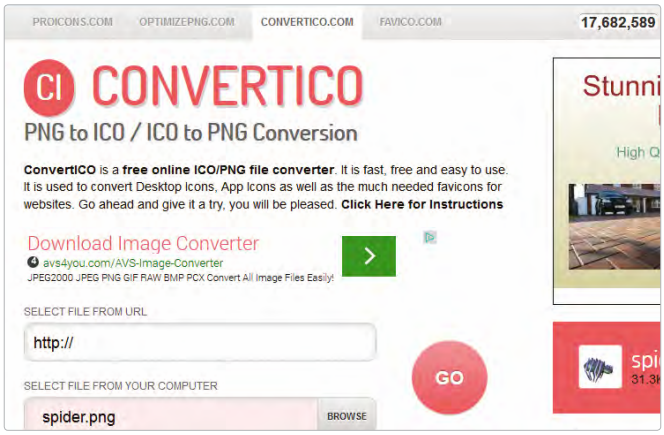
13 Prepare to export

Once you're happy, click on the Grid and Background layers in the right-hand palette and delete them. Now click 'File > Export As'. We want to keep our transparent background, which means saving it in PNG or GIF format. Don't choose JPG; this format doesn't support transparency and the compression will make everything blurry.



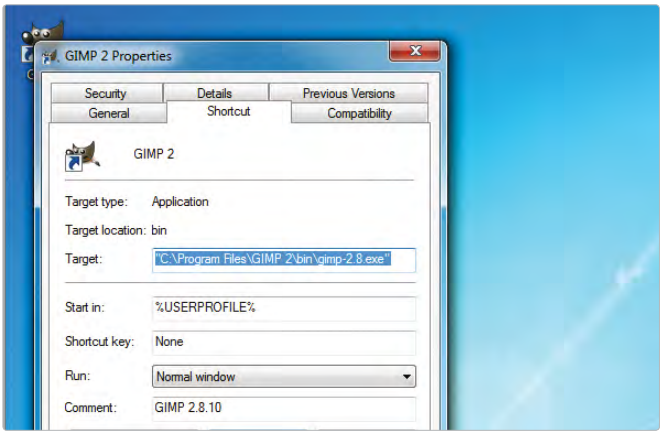
14 Keep it transparent

Select a file type from the drop-down list and give it a name. At the next dialog box, uncheck 'Save Background Colour' and 'Save colour values from transparent pixels', then click 'Export'. Your finished pixel art will now be saved with a transparent background, ready for use in a game, as an icon on your desktop, or on a web page.



15 Convert to ICO format

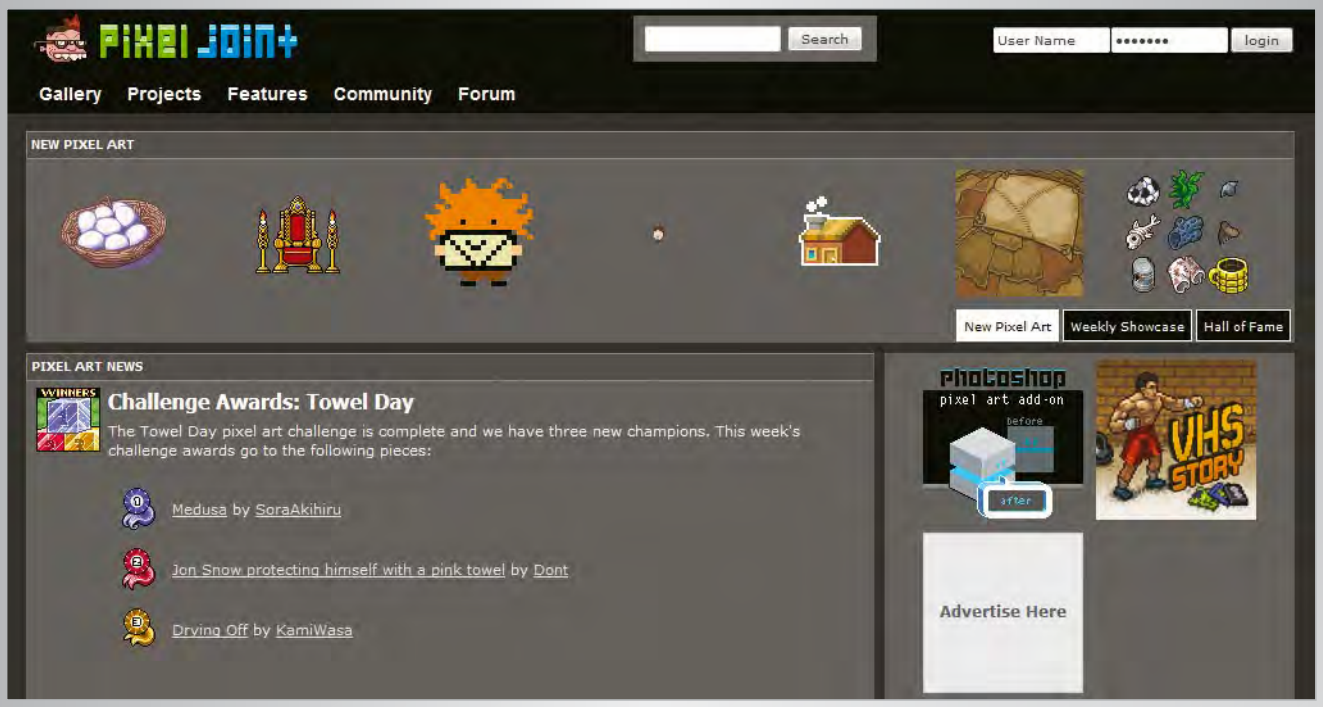
One of the easiest ways to use your pixel art is to convert it into an ICO file and use it to replace one of the program icons on your desktop. You can do this using a website called ConvertICO (www.convertico.com). Simply browse for the PNG or GIF file on your computer, then click the 'Go' button and it will be converted instantly.



16 Use on the desktop

You'll see a preview of your icon on the right-hand side of the page. Click the large arrow and download the icon to a convenient place on your computer. Now go to your Windows desktop, right-click an icon and select 'Properties'. Click 'Change Icon', browse to your newly made ICO file and click 'OK'. Click 'Apply' and enjoy!

Take your pixel art further with the right advice and inspiration



Pixel Joint (www.pixeljoint.com) is a great place to share your pixel art, get inspiration and ask for feedback to help you improve your own work

Creating good pixel art takes time and practice, but there are lots of online communities where you can ask for advice on works in progress, and display your finished creations for constructive feedback. One of the most well respected is Pixel Joint (www.pixeljoint.com). In addition to providing a place for you to display your creations, the site's owners post weekly challenges to inspire artists. The site's users vote for their favourite entries each week, and the top three receive an award for their efforts. There are also interviews with pixel artists that offer an insight into their work process (http://bit.ly/111kZPH) and a range of handy tutorials (http://bit.ly/1s5T6tD).

Another great place to look for advice and inspiration is DeviantArt – a huge art site that's part gallery, part social network, and great for getting your work seen. To browse the site's pixel art gallery, visit www.deviantart.com/digitalart/pixelart. Use the menu on the left to select different categories, including characters, objects and scenes. You'll also come across various groups dedicated to the style, including http://pixel-artists.deviantart.com, where members can share their work and exchange advice. Anyone can register for a free account with DeviantArt, and additional features are available for a subscription fee.

Whichever community you join, remember never to share illustrations created using tools such as Blur, Airbush and Gradient, and always save your work in PNG or GIF format. If you want to share your pixel art on a forum, upload it to an image hosting site like Imgur (www.imgur.com), and paste the section of code under the heading 'BBCode' into your post. ■

Manage your files quickly and easily

30 MINUTES

Use DropIt to take the tedium out of file management, says Nick Peers

PROJECT GOAL

File management

Use DropIt to easily carry out file and folder operations.

REQUIRES

DropIt

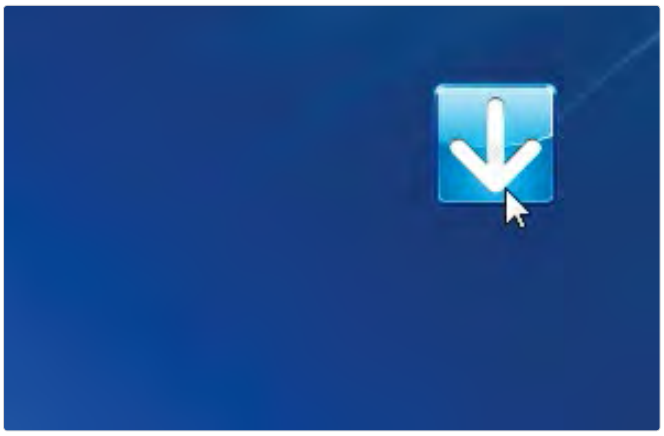
The software is open source.

DropIt is a tiny free tool that's designed to speed up common file and folder operations such as copying, moving, renaming and encrypting. You can set it up to monitor selected folders automatically, or manually drag files and folders on to the DropIt icon, which floats above all other windows on the desktop.

DropIt uses a series of 'associations' to select files, filtering them by name, type or even properties. It then performs a specific action on the selected files, which you can customise to suit your personal needs. You can set up multiple associations covering a wide range of files and types, and even organise your associations into profiles for specific tasks. If you regularly perform the same file-based tasks, you're going to love DropIt.

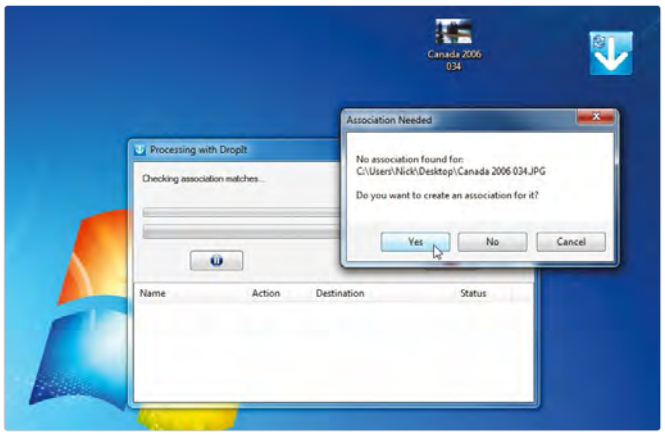
Step-by-step: Get down with DropIt

How to supercharge monotonous operations



1 Set up DropIt

Download and run DropIt from www.dropitproject.com. When installing, tick 'Launch DropIt' at the end of the setup before clicking 'Finish'. You'll see an arrow appear on-screen – this is the DropIt tool, which floats on-screen above other windows. Click on it and drag it somewhere less distracting – a right-hand corner, for example.



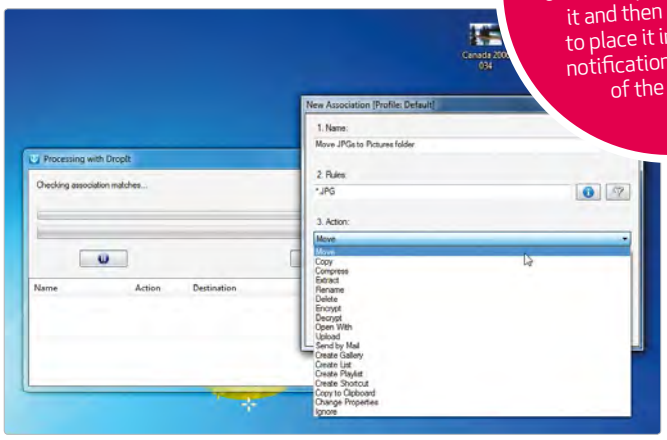
2 Your first association

DropIt creates 'associations' that process files based on a set of rules. For our first example we're going to create a simple association that moves any JPG file dragged on to the DropIt icon to your Pictures folder. Locate a JPG file and drag it on to the DropIt icon. Click 'Yes' when prompted, then give it a descriptive name to help you identify it.

TOP TIPS

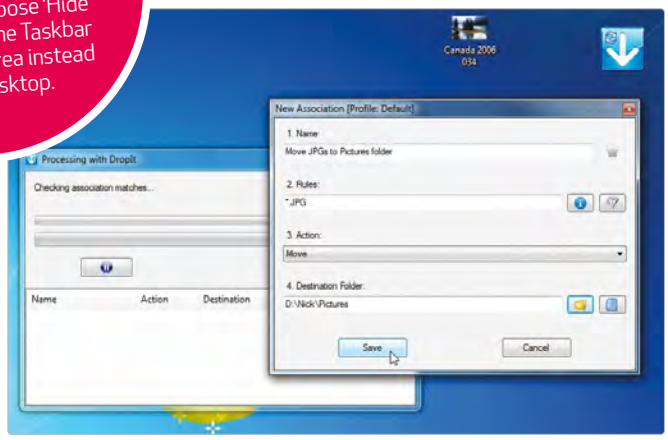
HIDE IT

If you don't like the location of the DropIt icon, right-click it and then choose 'Hide' to place it in the Taskbar notification area instead of the desktop.



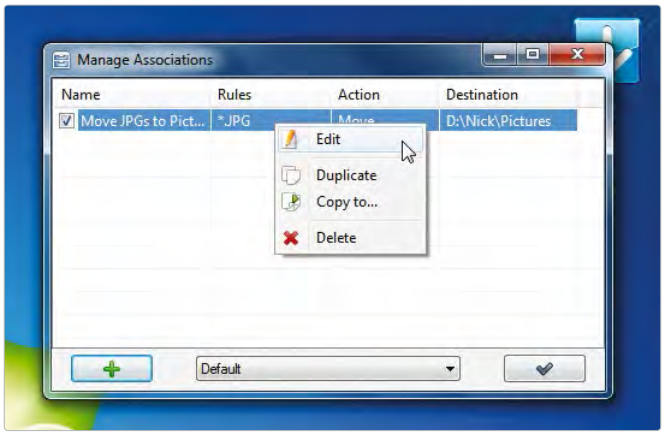
3 Verify rules and action

The Rules box is already pre-filled with *.JPG, indicating that the association will only apply to files ending in .JPG. Click the 'Action' drop-down menu to see a list of actions you can perform using DropIt. As this rule is designed to simply move all JPG files that are dragged on to the DropIt icon to your Pictures folder, leave 'Move' selected.



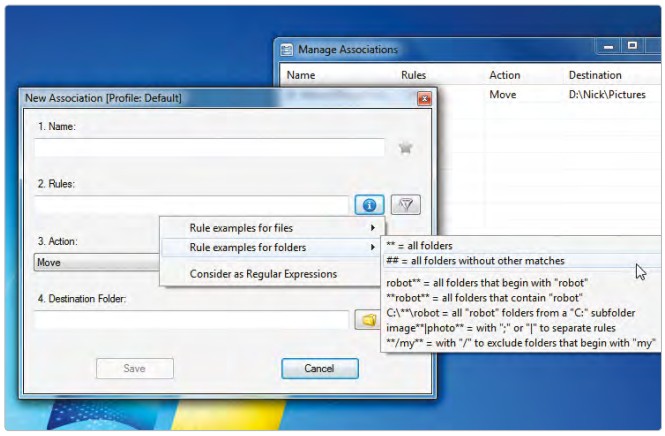
4 Complete action

Click the folder button next to Destination Folder to select your Pictures folder (if you try to select your Pictures library, DropIt will simply create a Pictures folder on the desktop for your files), then hit 'Save'. The association isn't performed immediately – click the 'Play' button and the file will be magically moved. Test with another JPG file.



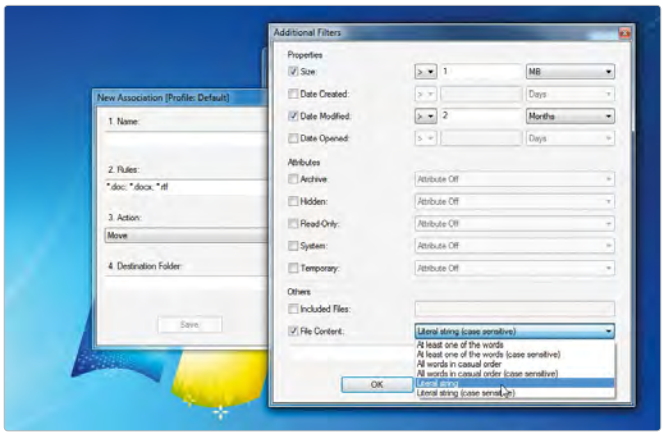
5 Create second association

Right-click the DropIt icon and select 'Associations' to manage existing associations and create new ones. You'll also see a Default drop-down menu. Clicking this reveals that DropIt supports profiles, allowing you to organise available associations depending on specific circumstances. For now, click '+' to create another association.



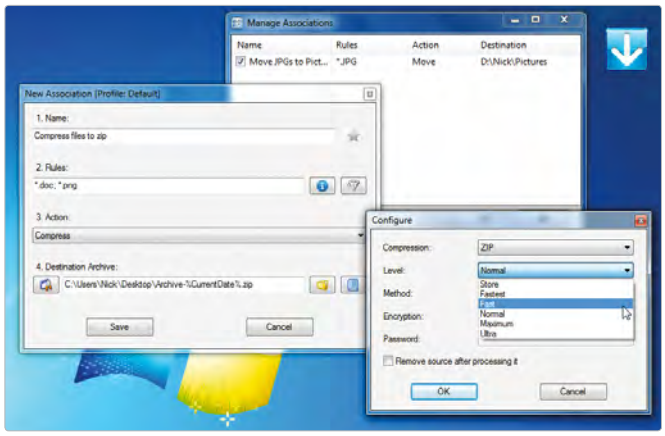
6 Apply more complex rules

Each rule uses a set of filters to determine which files or folders to process. Click 'i' to see examples of filters you can create based on the file or folder name. Use the * character as a wildcard for files, and ** for folders. Use / to exclude items. To apply multiple filters, separate each one with either a semi-colon or | character.



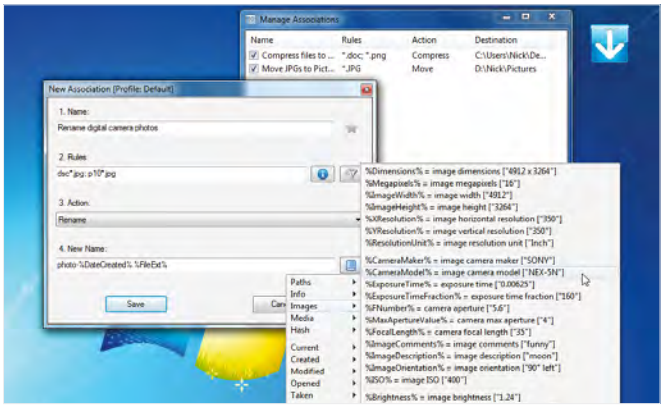
7 More filter options

You can apply filters based on file properties, attributes and content. Hit the funnel button next to the 'i' to choose. Tick a filter to enable it, then click the '>' drop-down menu to make the filter apply when the file is greater than (>), equal to (=) or less than (<) the given attribute. File content lets you match based on words or text strings.



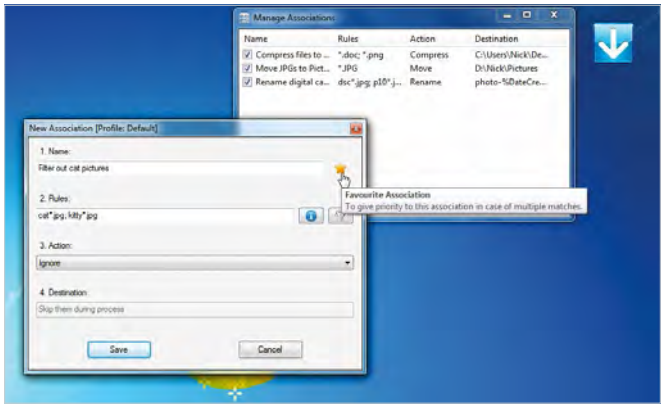
8 Actions: compress

Click the 'Action' box to reveal actions you can perform on a file – one action can be performed per association. 'Compress' packs together all the files selected by the filter into one archive file, for example. See how the final box changes depending on what option you select – for compressed files, click 'Configure' to choose an archive type, for example.



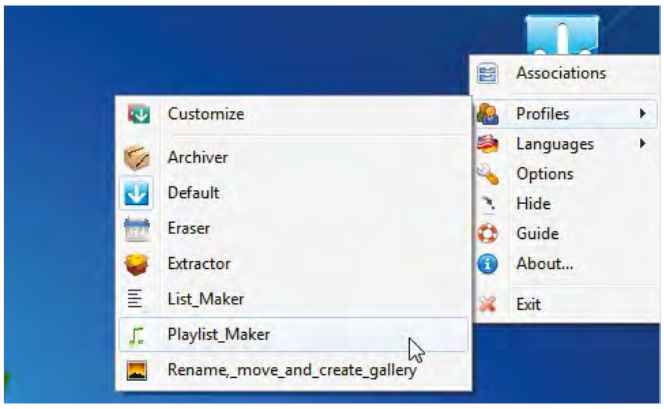
9 Actions: rename

The Rename option is good for quickly renaming digital camera photos that have unhelpful filenames, such as GEDC0500.jpg. After selecting 'Rename', click the book icon next to the file name to reveal a list of options that can be inserted into the renamed filename. Click 'Images' to see a list of naming options, including file dimensions and the date when the photo was taken.



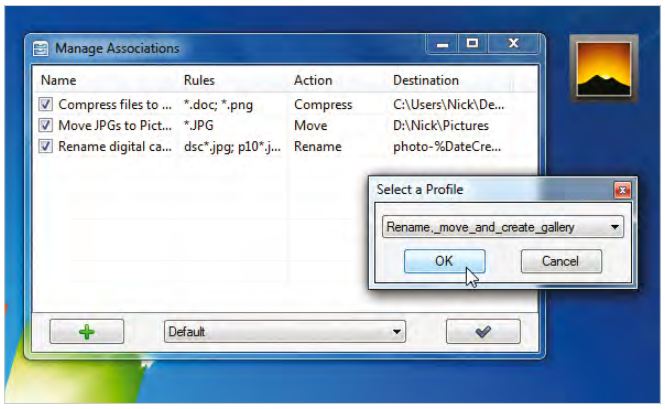
10 More actions

Other handy actions include creating image galleries, music playlists and shortcuts, changing a file's properties, or even ignoring it altogether. The latter option is best used for creating exclusion filters, so files matching the rule are immune to any other associations you've set up. To make this work, click the star button next to its name to prioritise it over other associations.



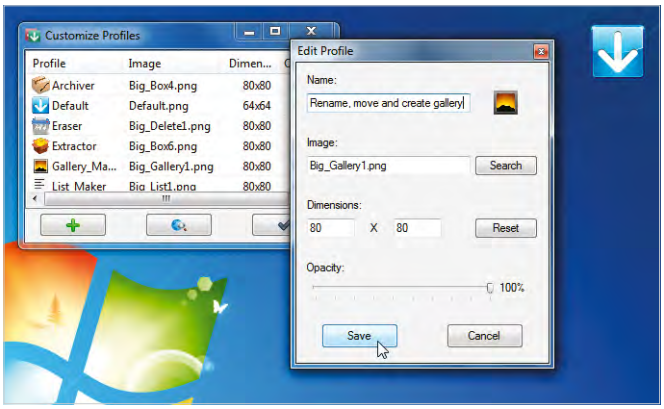
11 Use profiles

DropIt supports profiles – collections of related associations that can be applied for specific purposes. The program includes a number of profiles with pre-built associations for a variety of uses, including creating music playlists and compiling text lists of files. To switch profiles, right-click on the DropIt icon and select your profile from the Profiles drop-down menu.



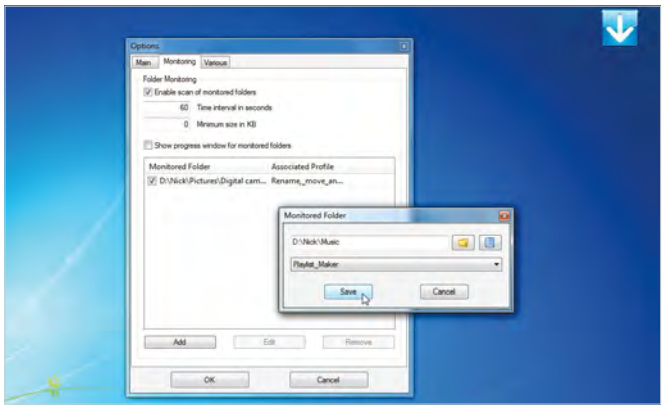
12 View profile associations

You'll see the DropIt icon change to the profile icon that's been selected to help identify which one you're using. To see what associations this profile performs, right-click the icon and choose 'Associations'. You can transfer any of these to another profile: right-click one and select 'Copy to' to do so. Select another profile from the drop-down menu to view its associations.



13 Manage profiles

To set up and manage profiles, right-click the DropIt icon and choose 'Profiles > Customize'. Click '+' to create a new one. Give it a suitable name, then click the 'Search' button to pick the icon that DropIt will use when the profile is selected. Alter its dimensions to change its size and use the Opacity slider to adjust transparency, if required. Click 'Save' when you're done.



14 Monitor folders

To enable DropIt to monitor folders automatically, right-click the DropIt icon and choose 'Options > Monitoring'. Tick 'Enable scan of monitored folders', then click 'Add' to choose a folder using the folder button. Select the profile whose associations you want to process on any files in the selected folder and click 'Save'. Repeat for any additional folders you wish to monitor. ■

Speed up your PC in five minutes

5 MINUTES

ReadyBoost lets you speed up your PC with a USB stick. Dan Grabham shows you how

PROJECT GOAL
A speedier PC
Use Windows Readyboost to pep up your PC's performance.

REQUIRES
Flash storage
An SD card or thumb drive.

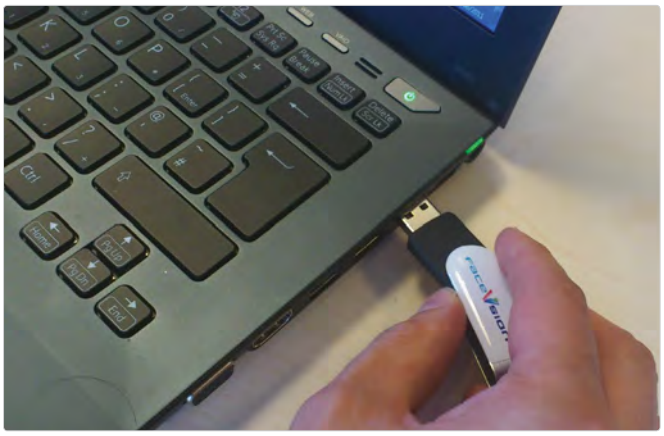
There's little more frustrating than realising your once speedy computer, which served you well just a few months ago, is starting to feel slow and unresponsive. Don't worry though – you don't need to fork out for an upgrade yet. Windows offers a quick and easy solution.

ReadyBoost is an extremely useful built-in tool that uses removable flash memory, such as USB sticks and SD cards, to cache some files to speed up your system.

In Windows 7 and 8, the amount of memory that can be used for ReadyBoost has been greatly increased, and you can now use more than one form of removable memory, giving you extra scope to speed up your machine. It's particularly useful for systems running with less than 2GB of RAM, such as netbooks.

Step-by-step: Give your PC a speed boost

If you have a USB stick or SD card handy, faster performance is only a few clicks away



1 Insert your USB stick

First, make sure that you have your choice of removable flash memory to hand. To start the ReadyBoost process, you need to insert your USB stick into your computer and wait for the AutoPlay menu to appear. If you're opting to use an SD card instead, just place it into the slot on your laptop or desktop PC, or use an external card reader.

2 Choose ReadyBoost

Once the AutoPlay window pops up, you can start using ReadyBoost. The relevant option is at the bottom of the list, where you'd normally choose to browse the device or load images from an SD card into Windows Live Photo Gallery. When you click 'Readyboost', you'll be taken straight to a configuration screen.

3 Create a dedicated device

If you only intend to use this USB flash drive for ReadyBoost and don't plan to store any data on it as well, you should turn it into a dedicated device. To do this, simply check the second option in the list, 'Dedicate this device to ReadyBoost'. This option makes all of the USB drive's storage space available to be used by Windows.

4 Prepare it for use

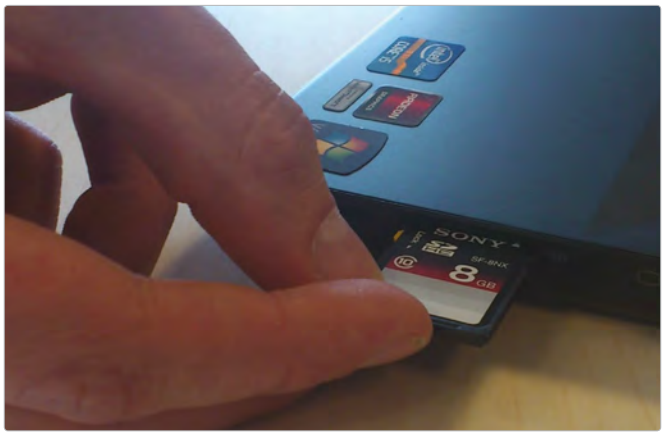
Now that your USB stick is a dedicated device, it's ready to give your computer the performance boost it so badly needs. Click 'OK' and your device is prepared for use by the system. From now on, whenever you insert that drive into your PC, Windows recognises it as a ReadyBoost device and speeds up your system.

5 Partition a USB device

If you still want to be able to use your USB stick for storage, but you also need to speed up your computer, a different option is required. This will have a less dramatic effect than making it a dedicated device, but can still be helpful. Insert your USB stick or SD card and click the 'Speed up your system' option as before.

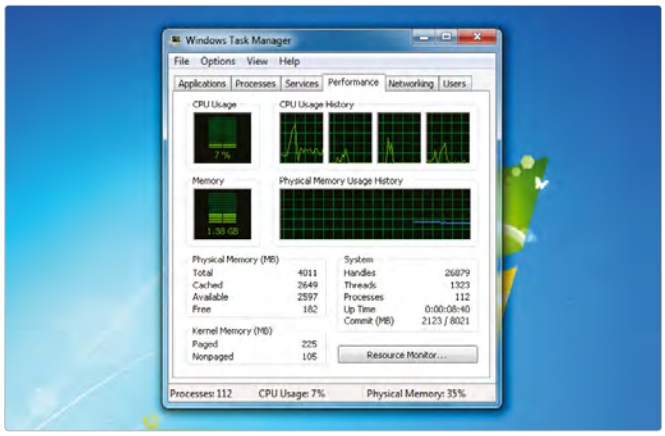
6 Slide to increase

You can use the slider to allocate a portion of the disk's space to ReadyBoost, while still leaving room for your files. Move the slider left or right until you're happy with the amount of space. We wouldn't recommend dedicating less than 256MB to ReadyBoost, otherwise you won't see much difference in the speed of your system.



7 Double up

In Windows Vista, ReadyBoost only supported one device with a capacity up to 4GB, but with Windows 7 or 8 you can use multiple fast devices, with nearly unlimited memory. If your PC has an SD card slot that's unused for the majority of the time, why not consider making this a semi-permanent ReadyBoost slot?



8 Enjoy!

You should now have a noticeably more responsive PC. Although ReadyBoost won't help you transform a basic machine into a gaming behemoth, you should feel a real change in your system's performance, and it might even help you stave off the need for a new computer for a little while to come. ■

Ask Luis

All the stuff **you** didn't know

Like the Eye of Sauron, Luis Villazon's gaze sweeps balefully across the landscape of your technical problems

ICDNT

CAN YOU HAVE TOO MUCH LINUX?

I have an ageing – some might say aged – laptop that has grown too old to run any meaningful version of Windows. However, I am very fond of it and have given it Linux Mint, dual booting in XCFE and KDE flavours. Unfortunately my knowledge of dual booting is only sufficient to be dangerous. Since I installed KDE, it has become the default boot option, but both I and my laptop would prefer XCFE to be the default. I can only think of something stupid like reinstalling in the reverse order, but I feel certain that you would know of a more elegant solution.

You may ask why I am writing to you in a predominately Windows magazine. The answer -
Julian Cameron

Let me stop you there. I didn't ask. I won't ask. This *isn't* a Windows magazine, it's a PC magazine. I don't care if you are running Windows, Linux, DOS or VMS. If you can get it to boot on your PC, you are welcome to ask me about it. And if you can't get it to boot, you can ask me anyway.

Now, the default OS is defined by the grub.cfg file in /etc/default/grub. Each OS gets a section in the file that begins with something like 'menuentry "Linux Mint yadda yadda"...' and then some configuration parameters enclosed by curly brackets. The default OS is defined by the line that says 'set default = "0"'.

If you change the 0 to a 1, you'll change the default to the other OS. If you aren't comfortable with hacking grub.cfg, or you intend to change it often, you should probably install the Grub Customizer utility. This is available as a Personal Package Archive and you can install it with the following terminal commands:

```
sudo add-apt-repository ppa:danielrichter2007 grub-customizer
sudo apt-get update
sudo apt-get install grub-customizer
```

RATH

WILDLY FLUCTUATING RAM

I have a CAD workstation built by myself, and I have an intermittent problem. When I bought the motherboard, I got three sticks of DDR3 RAM and it only showed 4GB in Windows. I swapped the RAM around with no change, so I assumed one of the sockets was faulty. I persevered for a few days, then Windows started to show 6GB. I needed more RAM due to my CAD requirements. I inserted three new sticks and it only showed 8GB instead of 12GB. After a few days Windows showed 12GB. It has been like that for almost five years, until I updated my graphics card to the Quadro FX 1800 and now it's back to showing 8GB of RAM. A week went by and guess what? It's saying 12GB again, so I am at a loss to what the hell is going on.
Stephen Nisbet

This issue is the 250th Ask Luis I have written for *PC Format*. Over the last 18 years, I have answered over 5,000 questions and read a lot more. And after boiling down the bones of so many broken PCs, the rich puddle of technical gravy left at the bottom of the pan is this: the more complicated and impossible a problem seems, the simpler the solution actually is.

Truly intermittent faults are only caused by one of two things: thermodynamics or kinetics. Either something got too hot or something got jolted. In your case, it's the latter. Your motherboard has a dodgy contact somewhere – probably near the RAM sockets, but that's not important. What is important is that opening the case and installing cards makes the board flex a bit and this is evidently enough to disturb the connection. You can always hope that it beds back in by itself and gives you another few years of relatively consistent performance, but there's no silver bullet.

Well, there is, but it costs as much as a new motherboard. It's also the same shape as a new motherboard. Because it's a new motherboard.

IMRTIUTB

PERSUADE ME TO UPGRADE

I have an HP G62 laptop with Windows 7 Home Premium and the laptop has a Core

This is a PC magazine first and foremost, we won't discriminate because of your choice of OS

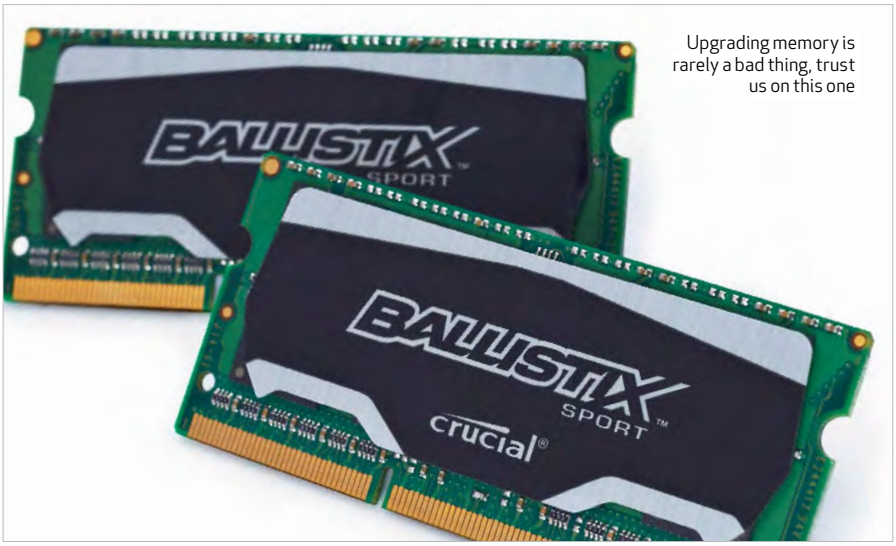
Free technical support

Email Luis for guaranteed insults and possibly even some technical help as well.

pcfhelpline@futurenet.com
PCF Helpline, 30 Monmouth Street
Bath, BA1 2BW

The six categories of all human misery

IUTWANID:	It Used To Work And Now It Doesn't.
IGAEM:	I Get An Error Message.
IMRTIUTB:	It's More Rubbish Than It Used To Be.
RATH:	Randomly, A Thing Happens.
ICDNT:	I Can't Do the New Thing.
IKBTL:	I Know Better Than Luis.



Upgrading memory is rarely a bad thing, trust us on this one

1.3 CPU and 4GB of memory. I would like to upgrade the memory to 8GB, but I would like to know if the CPU will work with the upgrade and will it improve the performance of the PC?
Edmond January

More memory will *always* improve performance. Sometimes it will only improve performance a tiny bit, or not enough to justify the upgrade cost, but no PC ever got slower after a RAM upgrade.

There's no such thing as a Core 1.3 CPU, so I can't tell if you mean a 1.3GHz Core 2 Duo or a Core i5. There's no such thing as an HP G62 laptop either – there are well over 300 models in the G62 family, and most will take 8GB. Instead of making me check through every single model, you can go to www.crucial.com and use its configuration tool to find out for yourself.

If your hardware supports 8GB, the next question is: does your OS? Windows 7 Home Premium, like most versions of Windows, comes in 32-bit and 64-bit versions. Click 'Start', right-click 'Computer' and choose 'Properties'. It will say which version you have next to System Type. If it's 64-bit then Windows will make use of all 8GB. If it's 32-bit then the benefits of more than 4GB become much more situational. Upgrading to Win8 64-bit *and* 8GB RAM is what you should do in this case, because, you know, *it's 2014 already* andwhoarethesepeoplestillusing 32bitoperatingsystemsIdon'tevenknow.

IUTWANID

WAR ON TERROR OR WAR ON ALIENS?

Now that America is banning us from flying with uncharged laptops I find myself with a problem. I have a trusty three-year-old laptop that I use purely as a games machine (mostly *XCOM: Enemy Unknown*) and DVD player for long boring evenings in hotel rooms when I'm away on business. The trouble is that its battery long ago gave up the ghost. This isn't a problem normally, because I always play with the mains adapter, but now it seems that the TSA is going to deny me my innocent fun. What's up with that?
Matt Clarke

Count your blessings. In a few years we won't be able to fly with any possessions at all. We'll just be shepherded naked through the X-ray machine and arrive in the US like time-travelling Terminators. Airports will be surrounded by a sprawl of seedy biker bars so that we can all pop in and demand "I need your clothes, your boots and your laptop." Terrorism isn't a military tactic; it's a psychological one and there isn't a good counter to it, besides shrugging and getting on with your life. If Al-Qaeda is stopping you from taking your old laptop on a plane, you'll just have to buy a new one. Or you could get out of your hotel room and go and checkout the local nightlife, I suppose. (But realistically, get a new laptop – *XCOM* is awesome.)

ICDNT

EASY REINSTALLING FOR MUMS

I recently had to reinstall Windows on my mum's laptop for what feels like the millionth time and obviously as well as the hassle of the install itself, I had to spend a couple of hours downloading and updating the drivers. While I was waiting for one of these steps to complete I was idly browsing the net and I came across

"IN A FEW YEARS WE'LL JUST BE SHEPHERDED NAKED THROUGH THE X-RAY MACHINE"

YOU ASKED!

FAQ

Wireless contraception

Standing under power lines to make yourself sterile?
Don't be silly. This is chip that is implanted under a woman's skin and releases 30 micrograms of hormones every day for 16 years.

Don't implanted contraceptives already exist?
Yes, but you have to see your doctor to have it removed if you want to get pregnant and it's an outpatient procedure. A wireless contraceptive can be turned on and off remotely.

How remotely?
Not very. The chip is very short range, so you need to put the remote control device against the skin. No one can hack your contraceptive from across the room or via population-control satellites.

But could the government still control my fertility?
Not really. Although it could theoretically restrict the remote-control devices to the population-control secret police, there's still nothing stopping you physically removing the chip. This device is just a way to combine the flexibility of the contraceptive pill with the reliability of an implant.

Could it be used for other things?
In principle the technology could be used to deliver other drugs. Imagine an anti-malaria implant that you can activate whenever you visit tropical countries. Soldiers could have anti-nerve agent drugs implanted so they could instantly activate them during a gas attack.

Like a power up!
Exactly. Combining drug-on-a-chip with a non-invasive way to control delivery is also good for drugs that don't work in pill form because they don't survive the digestive process.

Who's behind this?
A startup company called MicroCHIPS. Trials begin next year.

Read more at:
www.mchips.com

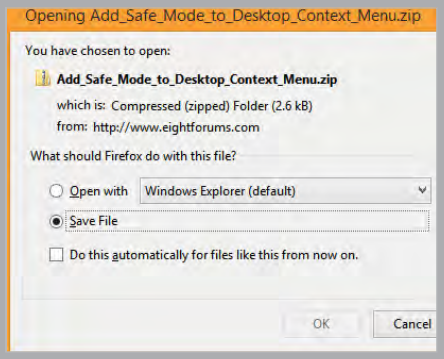
a program called SlimDrivers, which looks like it would take a lot of the grind out of this job. Have you heard of it and would you recommend it?
Mark Hellebore

No, I wouldn't. I'm naturally suspicious of utilities that do things that the OS ought to do already. SlimDrivers is the free version of DriverUpdate (www.slimcomputer.com). It checks your installed drivers against an online database of version numbers and offers to update any that are old. Just like Windows Update does, in other words. So what shortfall does this utility attempt to address? Is it that it knows about even newer, more up-to-date drivers than Windows does? Is it that it checks the drivers for every chip and controller on your motherboard? Well, contrary to popular assumption, having the very latest drivers for all your hardware is not necessarily a good thing. Updating drivers is a (fairly lazy) troubleshooting tactic. It's not a vaccine. In fact, if your system already works, then installing a newer driver can only make things worse.

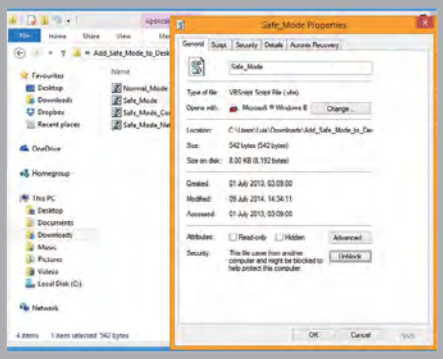
So running SlimDrivers preventatively isn't necessary or desirable. "But what about after a fresh install?" you ask. And I answer, "What in the name of Jesus, Mary and Joseph are you doing reinstalling Windows so often on your Mum's laptop?" Does she have a failing hard disk? Is she prone to randomly deleting things from the Windows folder? Is she continually bathed in hard gamma radiation from your faulty television as she browses Facebook on the sofa? Or do you just dutifully reinstall every time she complains that Windows is slow? If she has a genuine problem so serious that your only recourse is to reinstall Windows, write to me with the details of that and I'll fix it for you. Otherwise, just stop reinstalling! And if you absolutely do have to reinstall so often, why not make a clone of the hard disk with a fresh install and updated drivers and then restore from that, instead of downloading all the driver updates again each time from scratch. Much quicker, much more sensible.

> "UNLESS YOUR PC CONTROLLED THE DAMPING RODS IN A NUCLEAR POWER PLANT, YOU'LL BE FINE"

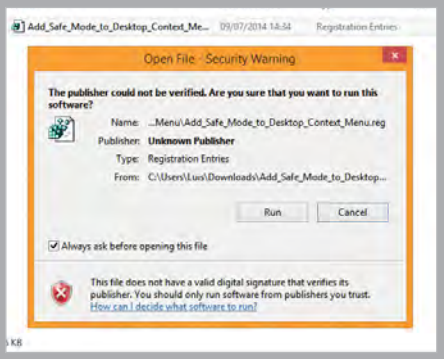
Safe Mode in two clicks
Restart in Safe Mode from the context menu



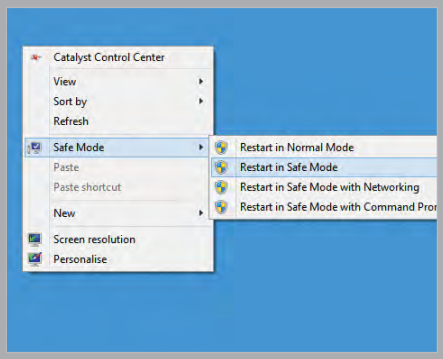
1 Download
This trick uses a Registry hack from www.eightforums.com to add an extra item to the desktop right-click menu. When you click an item on the submenu, it runs a Visual Basic script to reboot the PC in your chosen safe mode. You can download the files from www.bit.ly/1mfEPGr.



2 Unblock
Save the zip file to your Downloads folder and open the Safe_Mode folder within it. Right-click each of the script files there and choose 'Properties > Unblock'. This bypasses the UAC warnings that would otherwise display each time you run them. Move the Safe_Mode folder to C:\Windows.



3 Hack
Once that's done, you need to double-click the Add_Safe_Mode_to_Desktop_Context_Menu.reg file. Doing his will will add the new keys to your Windows Registry. You'll need to have administrator privileges to do this (and indeed for the unblocking described in step 2).



4 Safe Mode
You can now right-click anywhere on the Windows desktop and choose Safe Mode to see a cascading submenu. Click any of those choices to restart in that mode. From Safe Mode with Command Prompt, you can type explorer to launch the desktop so you can switch back to Normal Mode.

RATH

IS SOMEONE HACKING MY WATCH DOGS?

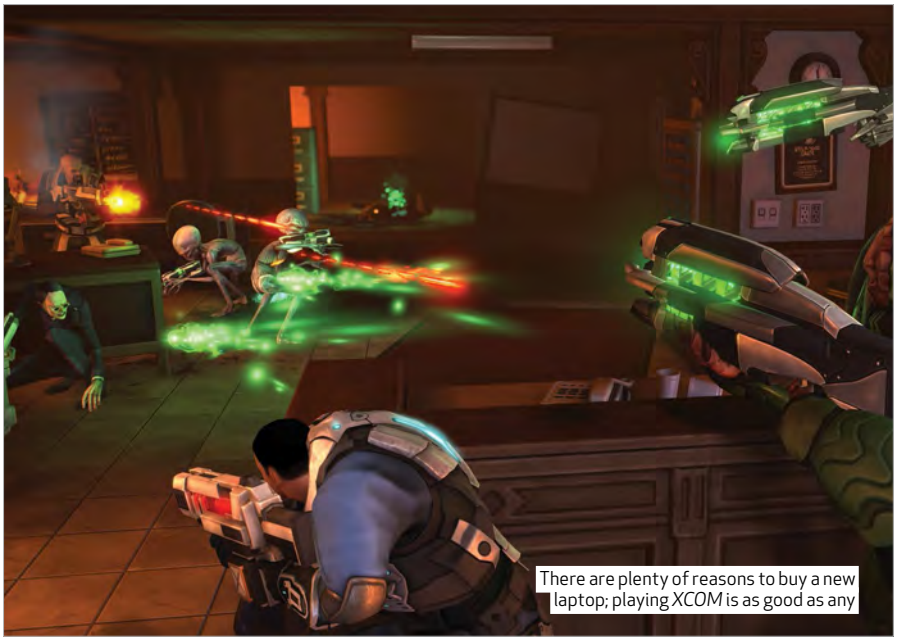
I have always exclusively played flight sims on my PC (which is about as pimped out as you can get) but recently I was tempted to try *Watch_Dogs* after seeing my son play it on the Xbox. Randomly while I am playing though, the mouse stops working to control my view and switches to a regular cursor that floats over the top of the game screen. Clicking back on the playing area usually works, but not always. Is my simulator cockpit just too awesome for this console game?
Andrew Dewey

In a way, it might be. Your use of the word 'cockpit' makes me think that perhaps you are running multiple monitors. (Frankly, if you aren't, I don't see how you have any business calling your PC fully pimped.) On games that don't have multi-monitor support, the cursor isn't always locked to the main screen. If you get carried away and drag the pointer beyond the confines of the screen, you can click out of the game, just as if you were in windowed mode. Alt-tabbing back to the game is generally a more reliable way to get back in this case than simply clicking in the game area. There are utilities to force the mouse to lock to the main monitor. Primary Lock (www.theisozone.com/downloads/misc/freeware/primary-lock) is one such, though I haven't tried it myself.

ICDNT

WHAT'S THE SHORTCUT FOR SMILEYFACE?

I've been experimenting with a Surface Pro 3 and so far I quite like it. The onscreen keyboard is great for typing emoji for emails or Facebook etc. But



There are plenty of reasons to buy a new laptop; playing *XCOM* is as good as any

oftentimes I'm using the keyboard (that's one of the main selling points of the Surface Pro, surely?) and there doesn't seem to be any easy way to access the emoji from the keyboard. I don't want to have to reach up and tap the screen every time I want a smiley. I'm sure I could figure out a keyboard shortcut or something but dammit, I don't want to have to!
Jordan deHaas

Leaving aside the fact that the whole *point* of emoji is that they are constructed from ordinary ASCII characters and graphical emoji are an abomination against man and God, you can bring up the onscreen keyboard from the physical keyboard. Hit [Win]+[R], then type **tabtip**. I'm not sure it's easier than tapping the screen though.

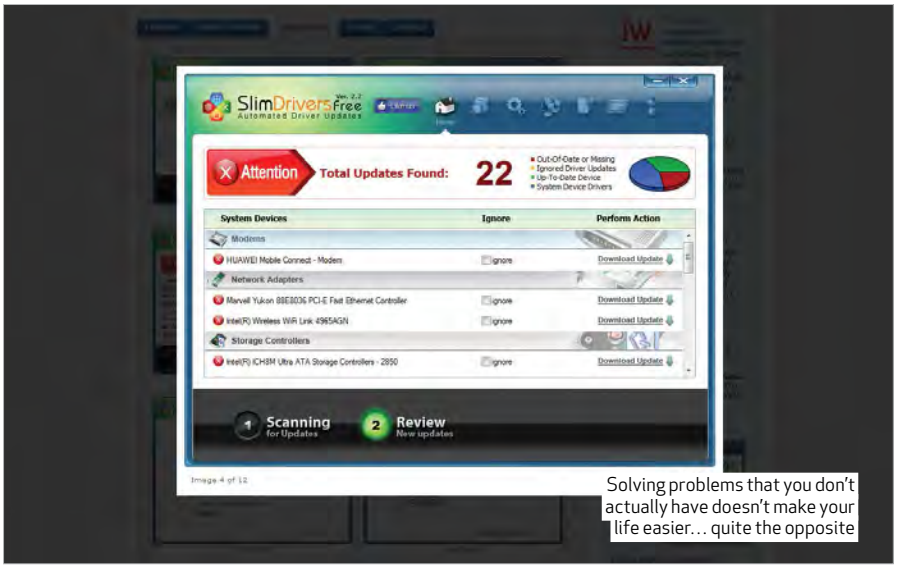
IGAEM

COUNTDOWN TO DISASTER

My desktop has a blue screen with a white font and digital percentages ascending at great speed until 100 per cent then it instantly and automatically shuts down while I'm operating. What could be the possible problem and how can it be rectified?
Wellington Mwale

That'll be the Blue Screen of Death. Most previous versions of Windows stop there to give you a chance to read all the vague and cryptic text before you reboot. But in Win8 there is a percentage counter while it collects 'error info' and then it reboots automatically. If your PC is running from an SSD, that counter will fly by pretty fast.

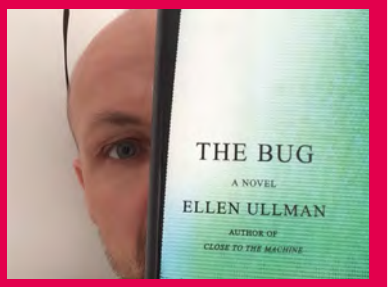
So now we've established what your error screen is called, what is to be done about it? Well first of all, you need to get past the whole 'of Death' part. This is an exaggeration (absolutely every person on the planet does this). You won't die. No one will die. Your PC has just crashed. Unless it was controlling your dialysis machine or the damping rods in your home nuclear power plant, you'll be fine. These errors should really be called the Blue Screen of



Solving problems that you don't actually have doesn't make your life easier… quite the opposite

NO NEED TO READ

The Bug by Ellen Ullman



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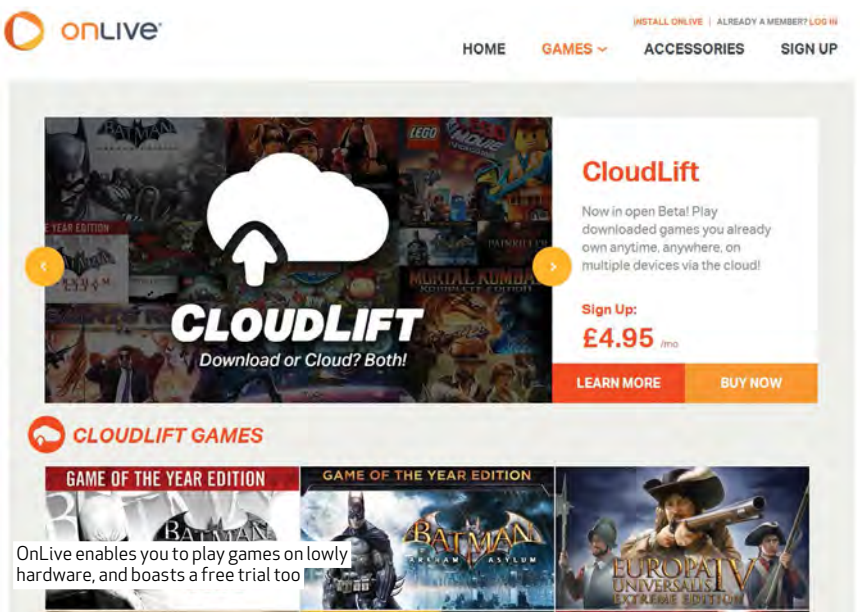
This novel is to programming what Michael Crichton's Airframe is to the airline industry. It is the story of a tiny bug in the user interface of a database. A bug that can't be reliably reproduced, can't be explained and can't be fixed. It takes over lives, changing some and destroying others with a reach far beyond its own subroutine. But, like *Airframe*, this story is also an anticlimax. The hunt for the bug is so intense, its ramifications so big, that when it is finally found at the end of the book, you can't help thinking 'Was that it?'

If you look this book up on Amazon today you will notice that it has a different cover. It will also tell you that the first edition was published in March 2013, but that's just the first edition from its current publisher. *The Bug* is actually much older than that. My copy was published in 2003 back when Windows XP was still fairly shiny and we all programmed in Java, but the story is *set* in 1984 when we didn't have Windows *anything*. *The Bug* is about a hand-rolled graphical user interface for a database, written in C and running on UNIX.

Ullman is at least as interested in describing the specifics of the code in this fictional program, as she is in the lives of corporate code-warrior Ethan Levin, who created the bug, and Roberta Walton who becomes a programmer in order to fix it. If you are over 45 and programmed in the 1980s and 1990s, the warm rush of nostalgia is hard to resist. But for everyone else, this is a historical novel. It's not just the technical stuff, either – the entire corporate culture of software development has simply changed too much in the last 30 years for any of the characters' motivations to remain genuinely relatable.



OnLive enables you to play games on lowly hardware, and boasts a free trial too

Stopping Suddenly. Although stopping suddenly is a major cause of death among skydivers, in your case it just means that you need to check that your RAM isn't faulty and then roll back any recent hardware or software changes you have made. And yes, I know this is really vague, but that's because you really haven't provided me with any more information than 'Help! Error!'

ICDNT

INTERROGATING MY RAM

I bought a PC through the small ads in my local paper, and I'm benchmarking it to see how much of a bargain or lemon it was. I can right-click 'This PC' in Explorer and view properties to see how much RAM I have, but it doesn't tell me what kind or how fast it runs. Is there another Windows tool that will tell me more, or do I need to Google the serial numbers on the chips themselves?
Brian Heaton

Googling the RAM serial numbers seems like the long way around. A better option would be to use the tool at www.crucial.com to see what RAM the motherboard supports. Even if it's a home-built golem PC and you can't find a make or model identifier on the motherboard itself, the Crucial tool will scan your system for you.

But you don't even need to do that. Windows uses the Windows Management Instrumentation thingy ('service', I guess you'd call it) to provide information about the hardware and drivers to software applications that ask nicely. This is what the online tool and other utilities like CPU-Z do , but you can do it for yourself with the WMIC command. Enter **wmic** at the command prompt and hit [Enter]. Type **MemoryChip get BankLabel, Capacity, MemoryType, TypeDetail, Speed** and hit [Enter] again. The MemoryType field will be 20 for DDR, and 21 for DDR-2. DDR-3 memory should return a MemoryType of 22 or higher, but I've noticed that it often returns 0. This is technically 'Unknown' but you can nearly always take it as meaning DDR-3. You can read a full list of the possible values at http://bit.ly/1kVAggd.

IMRTIUTB

WHAT DOES THE (X86) MEAN?

Why are there two Program Files folders on my hard disk? Program Files (x86) is 110GB on my system whereas Program Files is only 508MB. They seem to have several duplicated folders inside them. Do I really need both? Is there some way to merge them?
Taj Suleiman

The short answer is the Program Files (x86) is for 32-bit applications and Program Files is for 64-bit apps. The short version of the really, really long answer is that 32-bit apps can't load 64-bit DLLs and will crash if they try, so they need to be kept separate. There are lots of 32-bit apps around that predate 64-bit operating systems, so they don't know that 64-bit DLLs are even out there and will trustingly try and load the first file they find with the right name. There are several ways this problem could have been solved but the one that Microsoft chose was to create two top-level folders and when a program installer calls the SHGetKnownFolderPath function, Windows checks whether the installer is 32-bit or 64-bit and returns the path to the correct Program Files folder for that application. Program Files (x86) is much larger on your PC because there are still an awful lot of 32-bit apps out there.

IMRTIUTB

GAMING AT UNIVERSITY

I will be starting uni this autumn, and I'll have to leave my awesome gaming rig behind. Even if I had space for it in my tiny room, it is also the shared family PC, so they aren't going to part with it. But I do have a 15" Toshiba Satellite C50 that I'll be taking with me. I don't kid myself that this will be good enough for gaming, but is there some way I can log in remotely to the home PC and play games that way? I have free Wi-Fi at uni.
Dan Maslin

It depends on the game. Turn-based games like *Civ5* or *XCOM* might be okay over something like TightVNC, but real-time shooters will just be too laggy. What you are describing is essentially what OnLive (www.onlive.co.uk) offers, except that it hosts the games on its own servers with encoding hardware that compresses each frame update in a millisecond. However awesome your home PC is, it isn't good enough to do that. But it doesn't need to be, because as I say, OnLive already does this for you. You can use its CloudLift service to upload games that you own to its servers and access them remotely via any hardware capable of playing a video stream. It costs £4.95 a month and I have no idea how satisfactory the experience is, but it has a seven-day trial, so that's probably the easiest way to find out. ■

STATS KNOW-IT-ALL?

Quiz

1. What is IBM's annual revenue?
a) $550 million
b) $1.2 billion
c) $100 billion
d) $600 billion

2. How much will IBM spend on R&D in the next five years?
a) $100 million
b) $300 million
c) $3 billion
d) $30 billion

3. How much of that will be spent on developing new chips?
a) None
b) 10%
c) 70%
d) 95%

4. What percentage of IBM's revenue currently comes from microelectronics?
a) 2%
b) 22%
c) 62%
d) 98%

5. What does it make from manufacturing chips?
a) $1.5 billion a year
b) $250 million a year
c) Nothing
d) $1.5 billion *loss* per year

Answers: 1c 2d 3b 4a 5d

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THE MONTH IN NUMBERS

$85 million

The amount that Kim Kardashian stands to make from her mobile game. According to gossip site TMZ, *Kim Kardashian: Hollywood* has brought in $200 million in revenue, and Kardashian will take a 45 per cent cut of net profits. She's got a big bum, y'know.

200

The maximum number of people Yahoo Japan's 'Ending' service will email if you pass away. The service delivers a password protected email to your loved ones, who then activate the message on receipt. We would be tempted to write: "I can see what you're doing", in ours.

480

The number of cameras in Carnegie Mellon University's prototype motion capture suite. The Panoptic Studio analyses data from cameras to interpret movement. It can even capture non-human movement such as a shower of confetti.

25 PER CENT

The increase in computer sales in Western Europe in the second quarter of 2014, according to the International Data Corporation. The end of Windows XP, more competitive computer pricing and the rise of Chromebooks are all claimed to have contributed to the upsurge. And *Goat Simulator*.

$5 million

The prize awarded to a Chinese gaming team for winning Valve's recent *Dota 2* tournament. NewBee scooped the prize – the biggest ever given away in a gaming contest – at The International tournament in Seattle.

PC Format has a mole. A man wedged inside the games industry's nether regions. A man rendered so hideously paranoid by a life spent playing sub-standard PS2 ports that he won't even let us edit his copy. These are his troubled thoughts…

THE VOICE OF REASON

Doomed from the start

Y'know, I consider myself to be a pretty lucky chap. As well as being the first person to win the Euromillions jackpot without actually buying a ticket, I wangled my way into the *Doom* presentation at this year's QuakeCon event. While you may have read reports of the momentous preview I and a handful of others were privy to, most of these are out-and-out lies. This is what really happened.

It is an incredibly hot day at the Hilton Anatole hotel in Dallas, Texas. Men who wear stetsons and spend an obscene amount of time and money making their shoes as shiny as possible are outnumbered by gamers who possess more interesting facial hair than a sasquatch Charles Darwin. Everyone sweats atrociously.

Doom, the upcoming fourth entry in the legendary FPS franchise, is the subject on everyone's trembling lips. The E3 trailer, which features an enormous cyberdemon with more polygons than the entirety of *Doom 3*, is still imprinted on people's minds. This year's *Wolfenstein: The New Order* is concrete proof that Bethesda knows how to keep franchises alive with just enough call-backs to keep the fans happy and smiling.

The doors open and we're led in, quivering with anticipation. Pete Hines, Bethesda's resident motormouth, takes to the stage. "DOOOM!" he yells. Then he runs about on the stage, pretending to hold a machine gun while going, "Dudududududu!". He aims upwards. "Imagine here's a big demon here!" he yells. "Blam! I just shot his head to bits! Imagine that!" The crowd goes wild. "PETE!" they scream. "PETE! PETE! PETE!"

We're all at fever pitch now. Pete fires up PowerPoint – '97, no less, the finest vintage of PowerPoint. He shows us some pictures he's made of how the demons will look. In crayon. He explains how he felt the demons needed "more horns" and to "be much more redder". The demons are very red, and they now have horns instead of eyes. One demon, a boss, is just a big red horn.

The crowd has now spontaneously ejaculated in unison, but they're thirsty for more. Pete moves onto the new weapons in *Doom*, explaining that the BFG is still considered one of the greatest guns in the world of first person shooters. *Doom* improves on this by making it bigger – it now takes up a whopping 85 per cent of the screen space. The man standing next to me has died of excitement.

Pete Hines ends the presentation by victoriously imitating the famous door sound from *Doom*. "Eeeer-weee!" he goes, while moving his hands down in front of his face. The vast majority of people here have regressed into a child-like state of blankly staring at the lights, gently humming "Doom" over and over again. And, just before heading back outside into the blazing Texan sun, Peter hands out $10 to each and every attendee, with the message "Say nice things about what you just saw." ■

Illustrator Kevin February

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