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ISSUE 298/DECEMBER 2014

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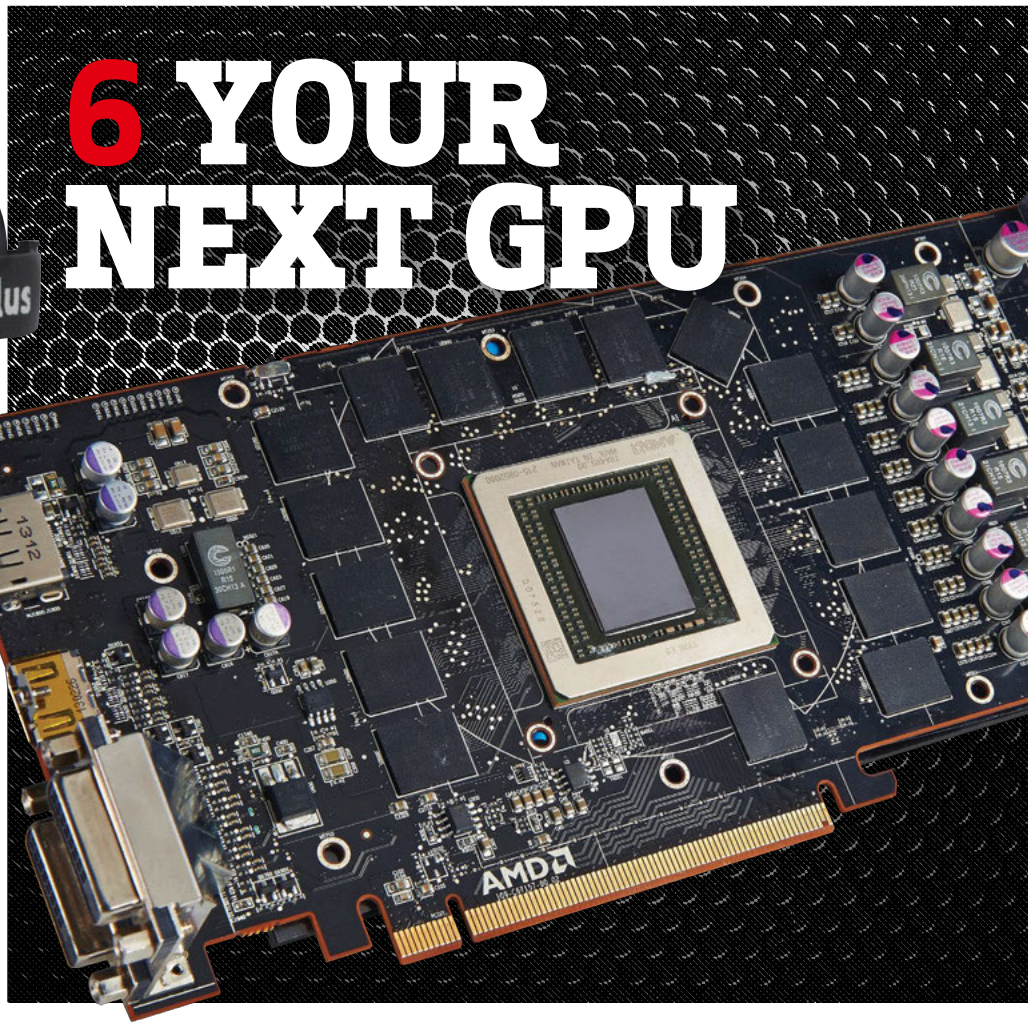

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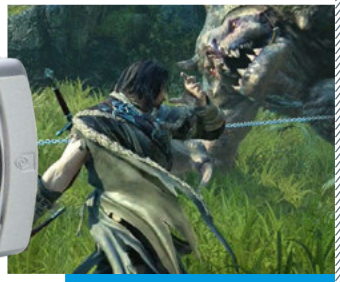


Hotwired...

Game reviews...

GRAPHICAL JOY FOR ALL!

GPU performance, but now all in the name of efficiency

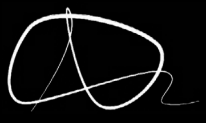
The best thing about the inexorable march of PC progress is that more and more power becomes available further down towards the budget end of the market. That's a given, but in these times where even the games developed for the next-gen console platforms are more than happy with even averagely-specced machines, it means high-performance PC gaming is becoming freely available to more and more people.

But if we've already got the necessary gaming performance, where do the hardware manufacturers go now? New technologies, such as the advances in real-time lighting Nvidia is touting with its VXGI pseudo ray-tracing, will demand more GPU performance, but it's driving down the actual energy requirements that's getting the most attention these days.

And that's the focus of Nvidia's new Maxwell architecture. As well as having the full architectural breakdown of both the GTX 980 and GTX 970, we've also pulled together the twelve finest GPUs currently available to see which would be a fit for your next graphics card upgrade.

We've also got the cheapest, and one of the most effective X99 motherboards available in MSI's X99S SLI Plus, and AMD's attempt at low power processing, too. And as we roll on towards the Winter we're seeing the first flush of new games hitting the shelves, including the awesome *Alien: Isolation* and the surprise hit, *Shadow of Mordor*. All in all, there's never been a better time to be a PC enthusiast!

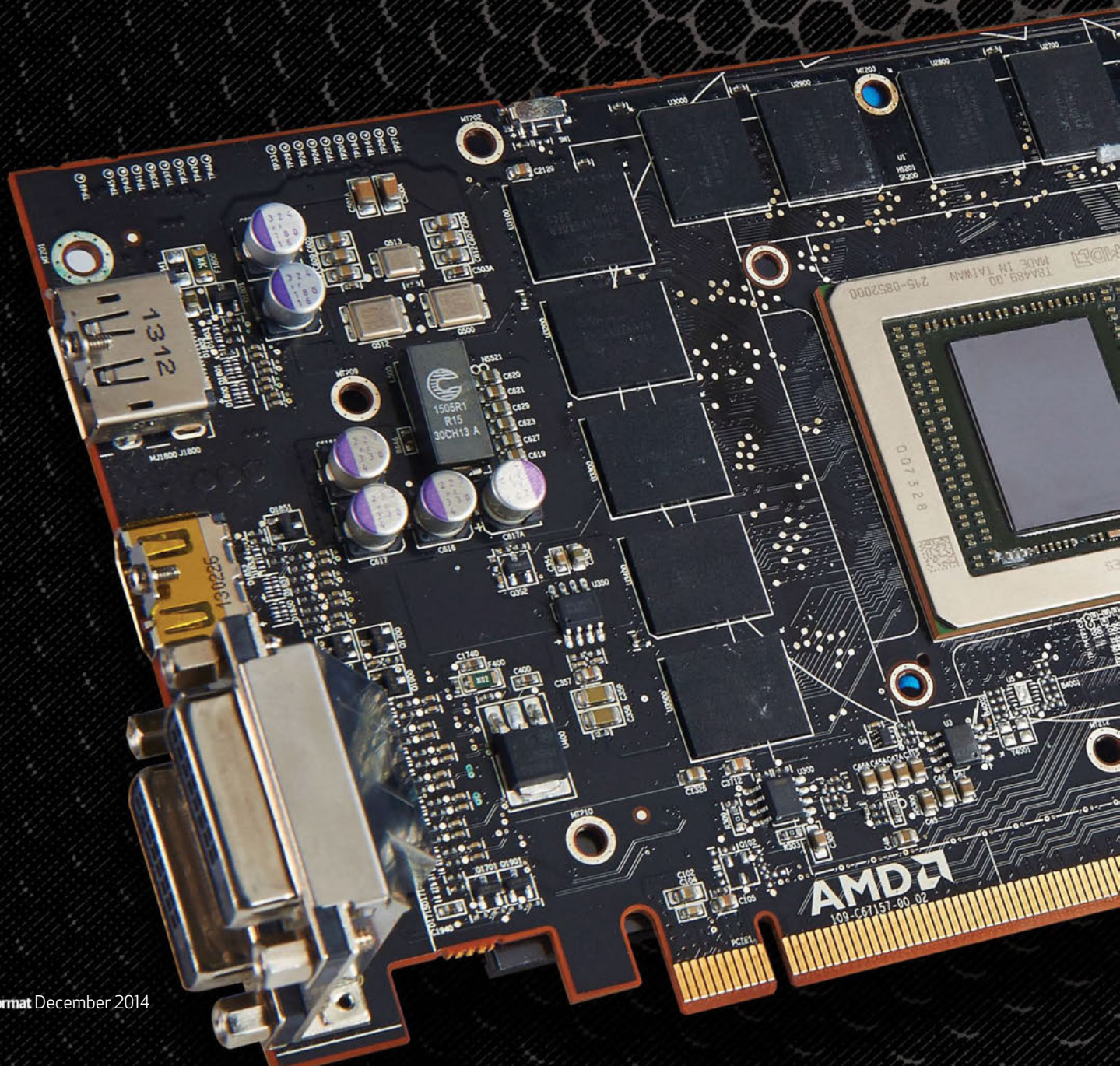
And don't miss our special digital edition offer. Get a free Apple Newsstand or Google Play Store version of this month's mag at no extra charge and start enjoying all the interactive features of our digital edition on your iOS or Android device. Turn to page 35 for more details. ■



Alan Dexter
Editor
alan.dexter@futurenet.com

IMAGE IS EVERYTHING

WITH A NEW SET OF GRAPHICS CARDS HITTING THE SHELVES, THE TOP-END OF THE GPU MARKET IS ALL SHOOK UP. SO WHERE DOES THE SMART MONEY GO NOW?



Nvidia has dropped its Maxwell bomb on the graphics card industry, and we're now all a bit excited about Titan Black-style performance filtering down into more affordable, cooler and quieter cards. But the green team isn't your only option, no matter how much Jen-Hsun Huang might want it to be. There is also the Texan side of the graphics divide.

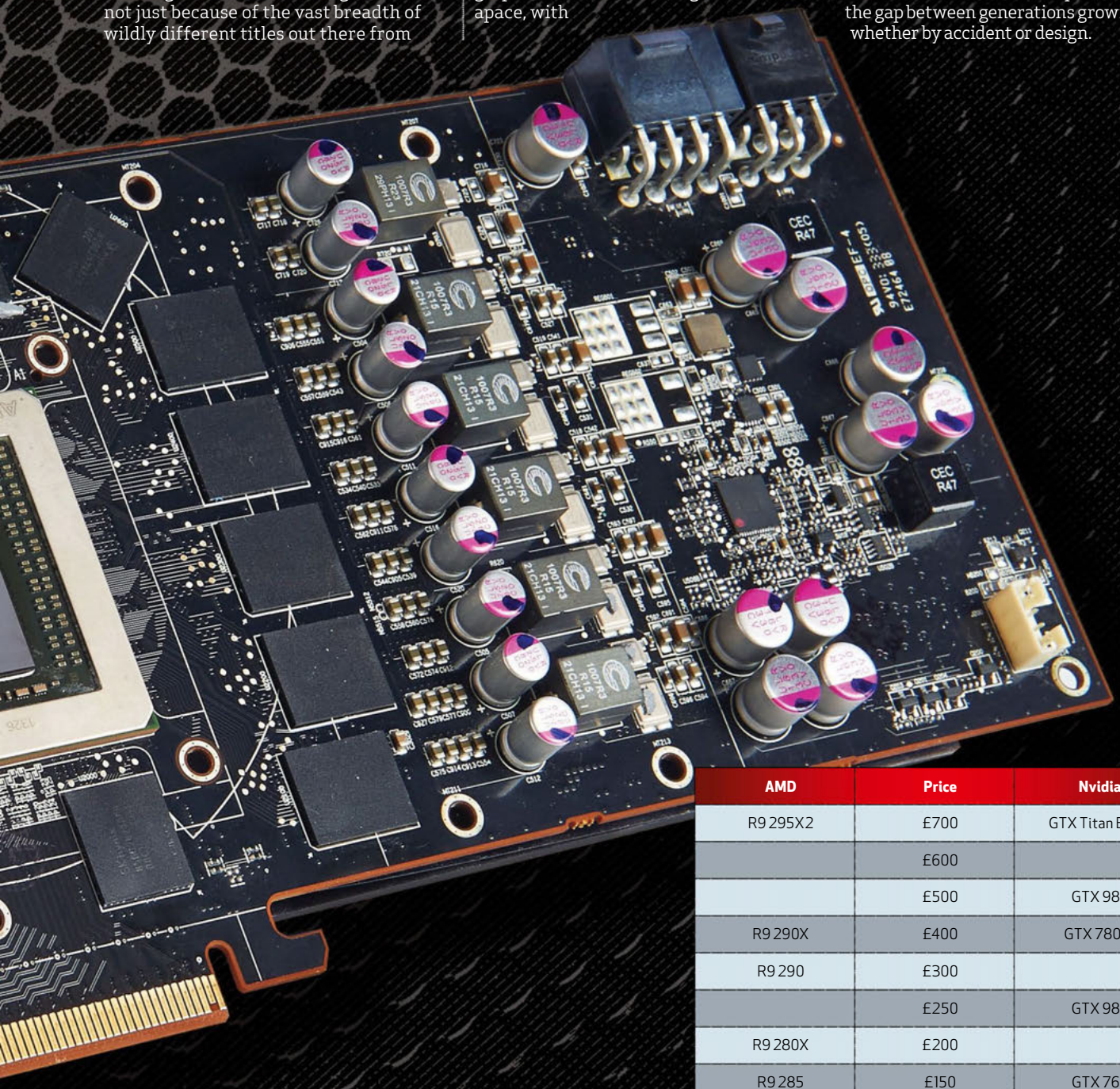
AMD's offerings may not have the single GPU power of the latest Nvidia silicon, but the current healthy competition in the PC graphics market means we consumer types can pick up affordable cards with unprecedented levels of gaming performance.

It's a great time to be a PC gamer, and not just because of the vast breadth of wildly different titles out there from both established AAA-farms and the indie/crowdfunded bods. The vast majority of PC people are still using 1080p screens – around a third according to Valve's Steam Hardware Survey – and even right down at the £100 level you can find graphics cards capable of delivering an excellent gaming experience at that now-standard resolution. And, because they're purely bus-powered, cards like the GTX 750 Ti represent an excellent drop-in upgrade for practically any basic PC out there with a spare PCIe slot, regardless of PSU.

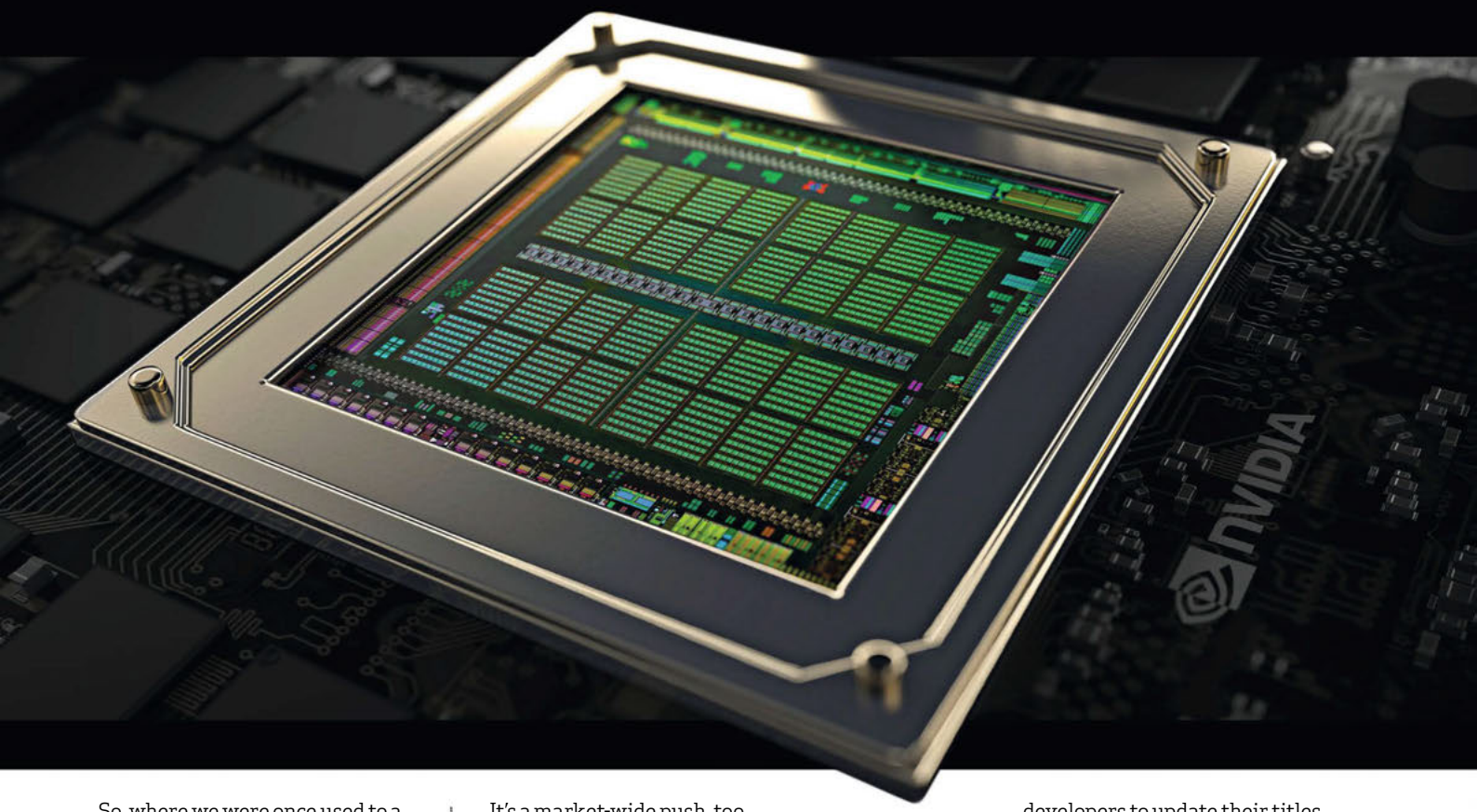
But incremental performance upgrades and price drops are only one part of the story. The evolution of the graphics card is continuing apace, with both the discrete GPU manufacturers, and Intel as purveyor of integrated graphics, moving towards new APIs and introducing new open and proprietary technologies to push things forward.

And there are new spaces future GPUs need to exploit too, with the rise of the 4K resolution and, of course, the increasing resolutions of virtual reality devices such as the Rift. So what do the graphics cards of today offer, and what do we need to prepare for in the future?

The lifetime of your current graphics card is probably longer than your previous one and, if the product cycles of GPUs continue to lengthen as they have been, your next one will be even longer lived. It's a common trend across components, with the gap between generations growing whether by accident or design.



AMD	Price	Nvidia
R9 295X2	£700	GTX Titan Black
	£600	
	£500	GTX 980
R9 290X	£400	GTX 780 Ti
R9 290	£300	
	£250	GTX 980
R9 280X	£200	
R9 285	£150	GTX 760
R9 270X	£100	GTX 750 Ti



The new Maxwell GPU is one of the most efficient graphics chips we've ever seen

So, where we were once used to a yearly product cycle we're starting to get close to a three-year gap.

While that might not do such great things for the rabid tech-mongers desperate for the next new thing to get super-excited about, it's actually a positive boon for the PC platform as a whole. Once upon a time, you had to work damned hard to keep pace with the changes in what made a gaming-capable rig, and spend a pretty penny doing so too. Now a decent graphics card won't suddenly be rendered obsolete every time a new AAA title is released.

Power efficiency

But that doesn't mean innovation has become a casualty of the GPU war. While the iterative release of new GPU architecture has slowed we are seeing refreshes of existing chips at lower price points and with lower power demands filtering through between generations.

Efficiency in particular has become almost as much of a target as increased performance now, with so much effort being given over to driving up the performance per Watt of new GPUs or mid-generation refreshes.

The new Maxwell cards from Nvidia – stretching back to the excellent low-end GTX 750 Ti – have focused specifically on driving down power requirements, and their operating temperatures have dropped in sync with this increased efficiency.

It's a market-wide push, too. AMD's latest mid-range card, the R9 285, is essentially a refresh of the existing Tahiti-powered R9 280, but its main focus is on driving down both the cost and the power demands. AMD has admitted though that the new GPU sitting inside the R9 285 isn't the full implementation of the Tonga silicon, so we can also expect a higher-spec R9 285X at some point raising the stream processor count from 1,792 to 2,048.

We're also seeing new features being designed by both AMD and Nvidia to improve the performance or image quality of their respective graphics cards. AMD's Mantle API is still in its beta phase at the moment, with worryingly few titles really taking advantage of its close-to-the-metal nature. And the ones that do make the most if it display some troubling characteristics with the latest version of AMD's GCN architecture.

Performance with the Tonga-based cards actually drops when you switch from Direct3D to Mantle. It's a bug that can be fixed with software updates, but it sounds like it might require developers to update their titles accordingly. Moving forward, an API is only going to succeed if it can be forwards-compatible and still function with new hardware releases without requiring devs to back-patch older games.

> "Efficiency has become almost as much of a target as performance"

DirectX 12

That's something Microsoft seems very confident about with its upcoming DirectX 12 release. It's a superset of DirectX 11, so there should be enough common ground for existing software to work with hardware built to the DirectX 12 standard. As a necessarily slightly higher-level API than Mantle, that should be something Microsoft can manage more easily.

The two main benefits of DX12 are a reduced CPU overhead and increased scalability across multiple CPU cores. This again ties into the efficiency trend we're seeing on the hardware side. The new API will enable more effective management of the CPU as a whole. In an example at the Intel Developer Forum this year Intel and Microsoft demonstrated a Gigabyte BRIX machine running the asteroid demo previously shown at SIGGRAPH. It renders thousands of unique asteroids and can switch from a DirectX 11 rendering path to a DirectX 12 one to demonstrate the benefits brought by the new API.

One option is to boost the graphics performance, and it does this by apportioning more of the

Whither the wanderer?

The future of the powerful desktop GPU looks rosy, but what about the wandering stars of the mobile graphics world?

The plight of mobile PC gaming was at the forefront of Nvidia's launch of the GTX 980M and GTX 970M. The new mobile Maxwells were introduced alongside their desktop counterparts, but this time they have far more in common than just the names.

As power demands of desktop GPUs steadily increased, the performance gap between desktop graphics cards and the mobile iterations bearing the same name also increased. From the excesses of its power-hungry Fermi architecture Nvidia's Kepler GPUs have been trying to shorten that gap.

In the days of Fermi, the GTX 480M offered 40 per cent of the performance of a straight GTX 480. With the GTX 980M, Nvidia is estimating the performance at about 80 per cent of the GTX 980's.

Thanks in part, to the improved power efficiency of the Maxwell architecture, Nvidia is also making a push for proper mobile gaming. BatteryBoost is Nvidia's latest attempt to cut the power cord. With the 980M, switching to battery no longer kills the performance – the 100W available from the battery is enough to power the Maxwell GPU so you can keep gaming.

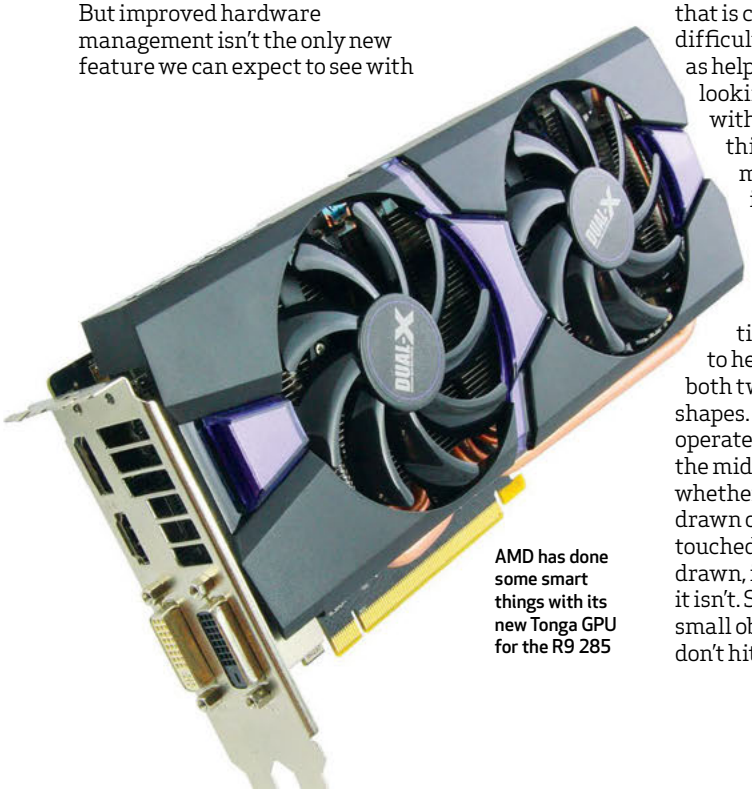
Then there's the problem of battery life. Taking the latest MSI GT72 980M-powered laptop as an example, Nvidia had the machine's gaming life at just 49 minutes on a full charge. Using BatteryBoost pushes that up by 55 per cent to 76 minutes. That's still not brilliant, but exceeds the one hour mark. On less intensive games though you could push over 100 minutes.

It's enabled by GeForce Experience, and drops the graphics settings on a game-by-game basis to leverage a little more playing time away from the plug socket, prioritising frame rate over top visual fidelity. Because it's in GFE though BatteryBoost too can be tweaked depending on your preference.

available power to the GPU while dropping the CPU demands. Boosting the graphics while dropping unnecessary processor performance means higher frame rates are available within the same power envelope. Alternatively you can opt to cap the frame rate at an acceptable level and DX 12 will manage both CPU and GPU loads to prioritise graphics performance while significantly dropping overall power demands. This has the added benefit of soothing CPU cooling fans, too.

Smoke and mirrors

But improved hardware management isn't the only new feature we can expect to see with the arrival of DirectX 12. Microsoft is also working on some interesting new rendering features for its next-gen API. Max McMullen, development lead for Direct3D 12, introduced a set of new techniques when Nvidia introduced its latest Maxwell GPU.



AMD has done some smart things with its new Tonga GPU for the R9 285

The first of these was rasteriser order views – something that sounds similar in design to the PixelSync DX 11 extension that Intel created last year. The idea is to aid the creation of transparent objects to allow for real time rendering that keeps the ordering of objects consistent – something that is currently incredibly difficult and costly to do. As well as helping to create realistic-looking transparent objects with multiple visible surfaces, this technology should make creating effective, interactive smoke effects possible too.

The next two rendering techniques, conservative rasterisation and volume tiled resources, are designed to help more accurately render both two- and three-dimensional shapes. Standard rasterisation operates on a small test point set in the middle of a pixel, determining whether a given pixel should be drawn or not. If the test point is touched by an object then it is drawn, if it misses the sample point it isn't. Sometimes this means that small objects, or parts of objects, don't hit any test points in one frame, but do in another. This leads to these objects flicking in and out of existence in a scene. Conservative rasterisation solves this problem by using the whole pixel as a test point. This is now feasible thanks to the smaller pixels in modern displays, and means we get more consistent images without the blockiness you would experience with larger/fewer pixels in a scene.

Lifelike lighting

Both that and volume tiled resources – a method of reducing the data size of a textured 3D scene – feed into Nvidia's latest attempt at bringing pseudo ray-tracing into real-time gaming. Voxel Global Illumination (VXGI) is its proprietary tech, soon to be introduced into Unreal Engine 4 and Crytek's CryEngine, is a method of calculating one-bounce lighting paths using voxels for more realistically lit scenes rendered in real time. We go into a bit more detail on p24, but it's accelerated on Maxwell GPUs reducing the computational complexity of such expensive ray-tracing techniques.

But what about right now? There are graphics cards filling out pretty much every point on the price scale, but which ones make financial sense and which are just asking too much without giving anything in return? We've collected 12 of the best gaming GPUs around to answer that very question...

ANATOMY OF A GRAPHICS CARD

WE'VE DECODED THE GRAPHICS CARD TO FIND OUT WHAT MAKES TOP GAMES TICK

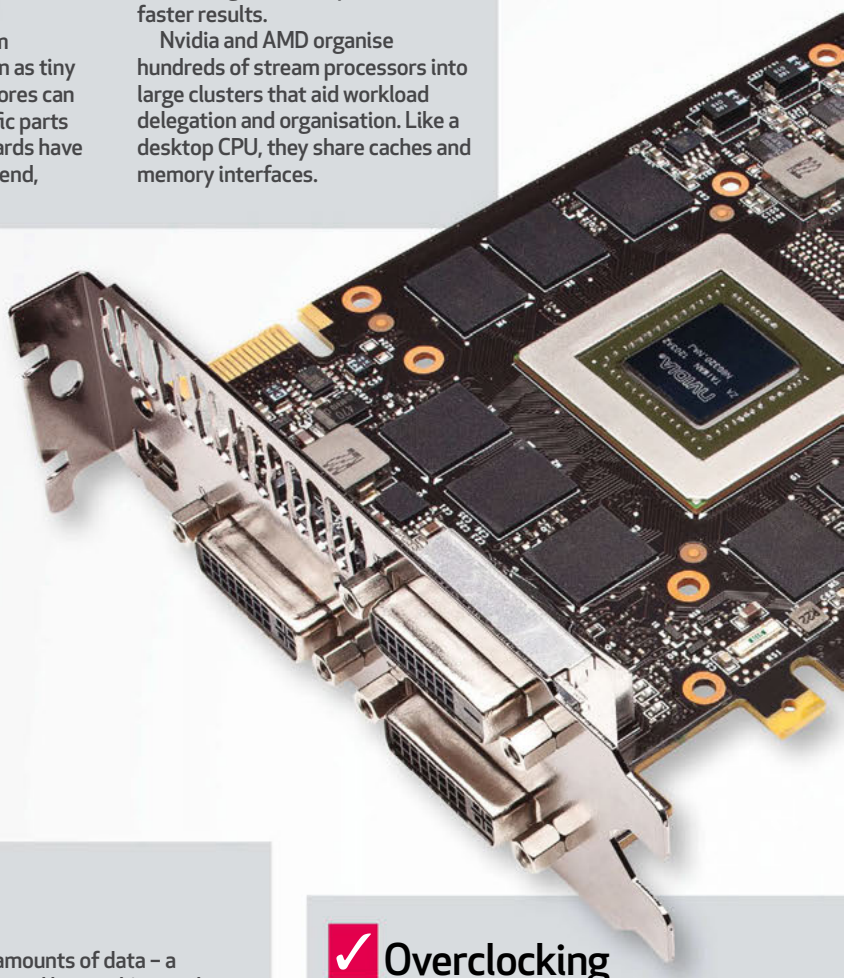
The core

The processing core functions in a similar manner to a PC's processor – it uses clock cycles and cores, and speed is measured in hertz. The specialised demands of this hardware means a graphics processing unit, or GPU, is built in a different way.

The mathematical demands of a GPU mean that high-end graphics cards have more transistors than high-end processors; an Nvidia GeForce GTX 780, for instance, has seven billion, which is more than four times the number included in Intel's Core i7-4770K.

Transistors form stream processors, which function as tiny processing cores. These cores can be used to produce specific parts of images, and graphics cards have hundreds – or, at the high end, thousands. The huge numbers help with the intensely parallelised workloads handled by GPUs and, as ever, higher clock speeds mean faster results.

Nvidia and AMD organise hundreds of stream processors into large clusters that aid workload delegation and organisation. Like a desktop CPU, they share caches and memory interfaces.



The fabrication process

This refers to the method by wich wafers – and, therefore, the dies that create graphics cores – are produced. AMD and Nvidia contract external firms such as TSMC and GlobalFoundries to build these, and they're always pushing to build wafers with smaller transistors.

Transistor size is measured in nanometres, and reducing this number has several advantages. If transistors are smaller, more can be packed into a graphics card's die – which means more raw processing horsepower. Smaller transistors have improved thermal efficiency, which means higher clock speeds – and, again, more power.

It's a constant challenge to produce smaller transistors consistently. Current GPUs use 28nm dies, and there's no firm date for a jump to 20nm.

Memory

Graphics cards are powerful enough that they need dedicated memory – and, as usual, the more and the faster the better. It's used to temporarily store the data that's been generated by the graphics card before it's used to render frames on-screen.

Current graphics cards use GDDR5 memory, which is based on the DDR3 memory used in desktop PCs and laptops. Graphics memory is configured differently to DDR3, with higher bandwidth at the expense of latency in order to handle consistent, large amounts of data – a challenge encountered by graphics cards.

Even the cheapest GPU will be accompanied by 2GB of GDDR5, but that's the bare minimum for playing top-tier games. Mid-range cards are now often sold with 3GB or 4GB, and top-end cards sometimes have more.

Make sure a new graphics card has enough memory and at a high enough speed to last the course, because it can't be upgraded, unlike RAM inside a desktop PC.

Overclocking

Graphics cards use the same basic components as processors, and they're even easier to overclock than their socketed stablemates.

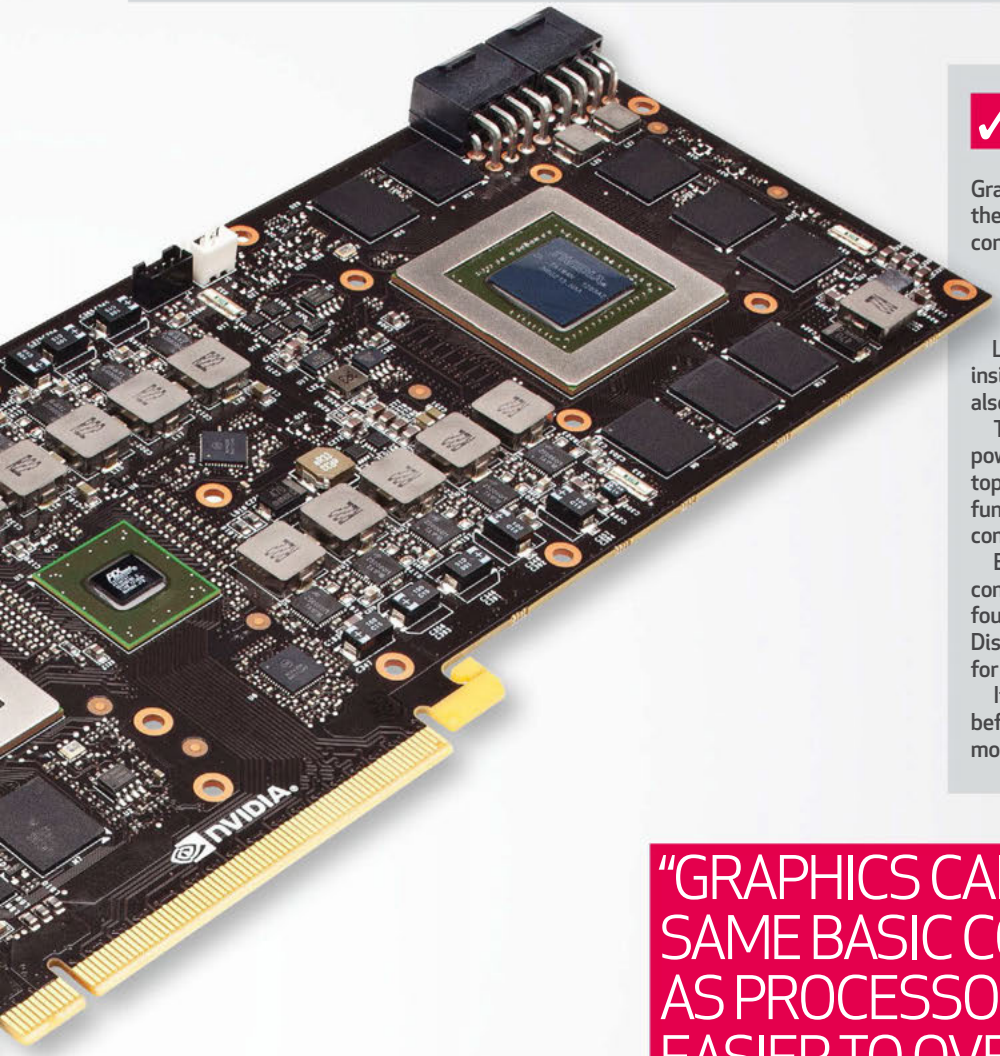
For starters, GPU overclocking doesn't require fiddling in the BIOS. It can be done in software, with some options available in AMD and Nvidia's drivers, and other third-party tools that can improve speeds by clicking a button.

Graphics overclocking involves tweaking the core and memory clocks, and sometimes the

Slots and display connections

A graphics card interfaces with the rest of a PC via a PCI Express slot, which can cope with the kind of demanding data transfers required by graphics cards. Motherboards have PCI Express sockets in a variety of sizes, and most graphics cards use x16 slots – the largest. These fall into two standards: PCI Express 2.0 and 3.0. The latter is newer and has ample bandwidth for even the most powerful cards, where 2.0 might struggle.

Also check whether a PCI Express slot is able to use its full bandwidth. Most motherboards have one PCI Express x16 slot that runs in x16 mode, but secondary slots are often restricted to just x8 or x4 modes (which means they're only able to use a half or a quarter of their potential bandwidth) due to chipset restrictions.



Physical challenges

Graphics card installation isn't as simple as pushing the card into a slot – the card needs to have the right connections, and the case needs to be large enough.

Powerful cards generate more heat, which means larger and more sophisticated cooling systems are required to keep the core chilled. Larger heatsinks are sometimes too long to fit inside smaller cases, and double-width coolers can also block motherboard slots below the card.

That's not the only physical consideration. More powerful cards require more electricity, with some top chips needing two eight-pin power plugs to function. Most power supplies come with these connections, but it's worth checking in advance.

Every graphics card has a variety of outputs that connect to monitors. The most common connections found on modern cards are HDMI, DVI and DisplayPort – the latter is the newest, and is useful for connecting extremely high-resolution displays.

It's worth checking which outputs a card has before purchase to make sure they match your monitor – or so you can order an adaptor.

"GRAPHICS CARDS USE THE SAME BASIC COMPONENTS AS PROCESSORS, BUT ARE EASIER TO OVERCLOCK"

boost limits – so cards can dynamically overclock to even higher speeds.

The GPU equivalent of upping the voltage involves raising the card's power limit, which is usually as simple as raising a slider.

It's easy to overclock a graphics card but, as with desktop processors, it is a risky business. If damage is caused to the card because of overclocking, it can void its warranty – as well as break the card.

AMD and Nvidia

AMD and Nvidia are the big players in graphics, with both firms battling for GPU supremacy. Both companies use different naming schemes. Nvidia's cards are all prefixed with 'GeForce', and top-end cards also use 'GTX'; low-end products only use 'GT'. Beyond that, the bigger the number the better – cards such as the GTX 750 and 760 are mid-range products, with the GTX 970 and 980 at the high end. Cards with the 'Ti' suffix are slightly more powerful versions of their origin card.

AMD's Radeon naming scheme has recently changed. Now its cards are divided into three groups: R5 cards are entry-level products; R7-branded parts sit in the mid-range; and high-end chips are denoted by the R9 prefix. Beyond that, it's a similar story to Nvidia – the bigger the number, the better the card, and the higher the price. Cards with an X attached to their names are more powerful.

The companies tend to follow each other closely when it comes to price and performance – it's handy to look for overclocked cards and game bundles to help differentiate between the two when buying a new card. ■

£700 HIGH-END

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Cores 2x 2,816
Clockspeed 1,018MHz
Memory capacity 2x 4GB GDDR5
Memory bus 2x 512-bit
ROPs 64

AMD didn't mess around when it was putting together its latest dual-GPU graphics card and that's what has made the R9 295X2 the very fastest card around. While Nvidia was getting all excited about its ridiculous $3K Titan Z, AMD had liquid-chilled its top graphics processors and put the 295X2 out for around a third of the price. And smashed it for gaming performance too.

The manufacturer of every other dual-GPU card we've tested has had to down-clock the component graphics processors to get them onto the same PCB, sharing the same cooling array. Opting for a closed-loop liquid-cooler has allowed AMD to offer higher clockspeeds on the twin Hawaii XT GPUs than in its R9 290X. It's only by 18MHz, but it's still impressive.

As is the overall gaming performance. With a CrossFire total of 5,632 Radeon cores across the twin GPUs and a super-fast, high-capacity memory system, the R9 295X2 is without doubt your best bet for a single-card 4K rig. The fact that you can hit 60fps in *Battlefield 4* at 4K Ultra settings should tell you all you need to know about the power of this thing.

But it's not all about straight gaming performance with dual-GPU cards; there's also the trust issue. Really, if you have the space in your machine you're much better off going for a dual-card CrossFire/SLI array. Buying a dual-GPU card is like opting for RAID 0 rather than RAID 5; there's no redundancy if a chip packs up.

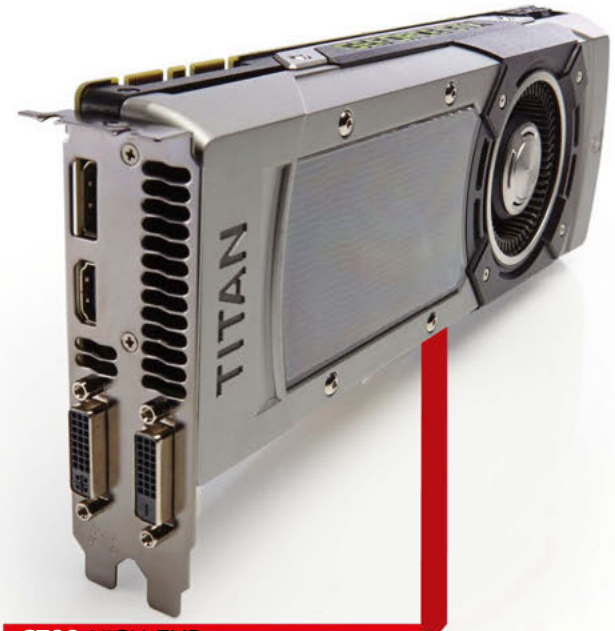
Not all games are coded to run with multi-GPU support from the off, either. If you're running at a standard 4K resolution though, that's not a huge issue; just one of its Hawaii XT GPUs, with its huge memory bandwidth, can pretty much keep pace with the best of Nvidia's single-GPU cards. ■

PCFormat Verdict

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

Certainly not a great-value card, but definitely an incredibly powerful one thanks to that liquid cooler.

★★★★☆



£700 HIGH-END

NVIDIA GTX TITAN BLACK

VITAL STATISTICS

Price £700
Manufacturer Nvidia
Web www.nvidia.com
GPU GK110
Cores 2,880
Clockspeed 889MHz
Memory capacity 6GB GDDR5
Memory bus 384-bit
ROPs 48

When the first GTX Titan arrived, its only competition was the dual-GPU GTX 690. It didn't quite hit the same performance heights, but was barely shy in gaming terms – and all with a single graphics processor. Nothing else could match the meaty GK110's top-end performance.

And then Nvidia rumbled on, releasing more and more cards based on the stonking GK110 GPU. The GTX 780 followed with a cut-down version, then the GTX 780 Ti upped Nvidia's game with the full might of a 2,880-cored GK110. With the Ti now outshining the GTX Titan, it released this Black version with full double precision performance and double the frame buffer.

But with the performance of the GTX 780 Ti now available for half the price, the latest Titan feels rather unnecessary for us normal consumers. The first Titan had double precision power for the pros and the gaming performance consumers loved. The Titan Black only has some small relevance to the professional user, desperate for double precision processing without the price of the Quadro cards. Gamers picking up a Titan Black will be disappointed, and much poorer as a result.

At this price you might hope it could at least keep the R9 295X2 honest, but even though it's got a high-capacity, high-performance frame buffer the GK110 can't hope to pin back a pair of Hawaii XT GPUs. The expensive ol' Titan Black now lags behind the new GTX 980 too, so things aren't looking great unless you *must* have double precision. And we'll bet that doesn't include many of you reading this.

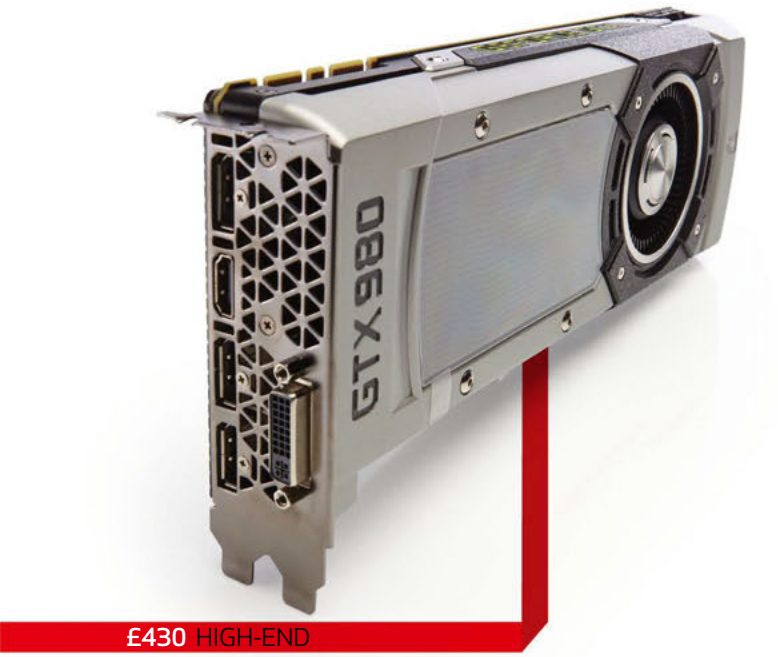
In its first flush the GTX Titan could make a case for itself. But now the GPU gang has caught up, and in some cases pulled out in front, this high-powered card is suddenly looking a little anachronistic. ■

PCFormat Verdict

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

The Titan Black looked a little out of touch coming after the GTX 780 Ti, and is now looking positively geriatric.

★★★☆☆



£430 HIGH-END

NVIDIA GTX 980

VITAL STATISTICS

Price £430
Manufacturer Nvidia
Web www.nvidia.com
GPU GM204
Cores 2,048
Clockspeed 1,126MHz
Memory capacity 4GB GDDR5
Memory bus 256-bit
ROPs 64

We've anticipated Nvidia's Maxwell architecture finding its way into the high end of its graphics card range since we first clapped eyes on the GTX 750 Ti in all its energy-efficient glory. Finally it's here and the new GM204 GPU is definitely worth the wait.

We have a full architectural run-down and in-depth review of the new 900 series cards starting on p26, but suffice to say the new SMM layout can squeeze masses of cores into a small space and get more out of them than the previous Kepler designs. Nvidia has also done impressive things with the memory architecture, allowing it to use a relatively low-end 256-bit memory bus without affecting high-res performance. Its compression algorithms make the 7Gbps frame buffer perform far better than we expected.

The GM204's performance per watt is unprecedented in gaming graphics cards. Normally that would have us worried about compromised performance at the top end, but the GTX 980 outclases the GTX Titan Black in our gaming benchmarks. That all makes the GTX 980 a very powerful graphics card, and one that doesn't demand its own power plant to keep you gaming.

The GM204 is also highly overclockable and we were able to hit a stable 1.5GHz high – we're getting on for CPU frequency numbers these days. That boosted clockspeed makes a difference to your gaming performance too; push the clocks up and you will get a tangibly higher frame rate.

But it is a pricey beast. Anything over £300 for a graphics card still seems crazy to us, especially as this 28nm chip is going to be enjoying healthy yields and is unlikely to be costing Nvidia a fortune to manufacture. If it wasn't for its little brother though, this card would be getting the win. ■

PCFormat Verdict

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

Maxwell is impressive, and the GTX 980 has some killer features to back up its efficiency and performance.

★★★★½

£383 HIGH-END

NVIDIA GTX 780 TI

VITAL STATISTICS

Price £383
Manufacturer Nvidia
Web www.nvidia.com
GPU GK110
Cores 2,880
Clockspeed 875MHz
Memory capacity 3GB GDDR5
Memory bus 384-bit
ROPs 48

The GTX 780 Ti was effectively the card that killed the Titan. With the full fat GK110 GPU and the complete 15 SMX unit package, the new top-end consumer card took the crown from the ultra-enthusiast GTX Titan in one fell swoop.

With another 192 CUDA cores in that extra streaming microprocessor, 16 more texture units and a healthier clockspeed the GTX 780 Ti didn't need the full 6GB frame buffer the Titan was packing to give it the edge in gaming terms. Nvidia did bring in the Titan Black after the 780 Ti, but even that couldn't offer much more than the already impressive consumer spin of the fully featured GK110.

The GTX 780 Ti can still hold its head high in the face of stiff competition from the R9 290X and its direct replacement, the GTX 980. The new Maxwell-based card can push past the 780 Ti with fewer transistors, a smaller chip, lower power requirements and lower temperatures. But the last-gen GPU hasn't been utterly blown away in performance terms, so there's no need to start crying into your keyboard if you've got one in your rig right now.

Still, even with the price cuts accompanying the GTX 780 Ti's slow march to the silicon graveyard, it's not a card we'd recommend you buy right now. Shopping around, at the time of writing, you might be able to find one for as little as £330. But considering the GTX 970 in overclocked trim is at least its performance equal and costs less, those price cuts aren't enough. Well, not unless you have an SLI-capable motherboard and a 780 Ti that is looking for a friend anyway.

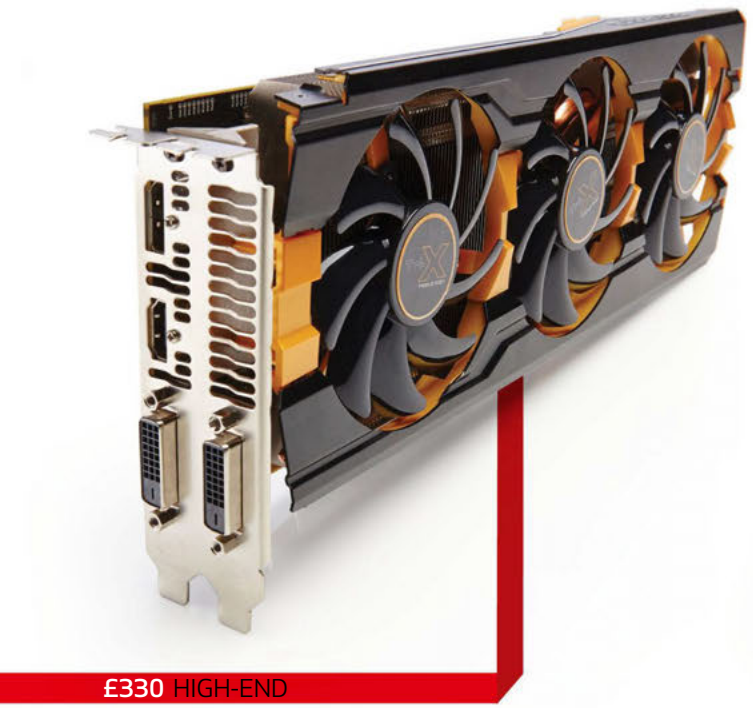
The GTX 780 Ti is still a capable graphics card, but now really only highlights how impressive the new GM204 GPU really is – going toe-to-toe with last generation's top-end, high-complexity GPU and beating it all counts. ■

PCFormat Verdict

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

Still a capable graphics card, but the one-two punch of the new 900-series cards has knocked it clean out.

★★★½☆



£330 HIGH-END

SAPPHIRE
R9 290X TRI-X

VITAL STATISTICS

Price £330
Manufacturer Sapphire
Web www.sapphiretech.com
GPU Hawaii XT
Cores 2,816
Clockspeed 1,010MHz
Memory capacity 4GB GDDR5
Memory bus 512-bit
ROPs 64

The R9 290X was an incredibly advanced card when it first arrived in our labs, but keeping 2,816 streaming processors running at a full 1GHz clockspeed came at a cost. There's a reason the R9 295X2 has to be water-cooled: these chips generate a their own personal Hades.

The reference design ran at a ridiculous 93°C at full pelt. AMD claimed it was rated to run at that temperature for its entire life, but we had a feeling that life might be pretty short with heavy use. Thankfully AMD partner Sapphire came to the rescue with this Tri-X design, a relatively inexpensive third-party cooling solution attached to a modestly overclocked GPU.

Suddenly Sapphire's R9 290X was running at a more sensible 71°C maximum and now we've got a thoroughly impressive high-end graphics card. Now the GTX 980 has arrived it's looking like last-gen tech when you're talking about 1080p and 1600p gaming, but the R9 290X was one of the first cards to actually make 4K gaming a realistic goal.

Even now, thanks to that 4GB frame buffer and 512-bit memory bus, it's able to stand toe-to-toe with the GTX 980 at 3,840 x 2,160.

We'd still put our money on the Maxwell boards, but it must be reassuring for any AMD fanfolk out there to know they're top GPU hasn't been totally outclassed in terms of gaming performance.

With the bottom also falling out of the GPU mining market, there are likely to be some AMD bargains floating around too. The R9 290X is still a power-hungry GPU, but if you can find it for a good price it's still got some legs. ■

PCFormat Verdict

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

A quality high-res card, and Sapphire's cooling keeps the Hawaii GPU in check. Keep a look out for bargains.

★★★★☆

£299 HIGH-END

GIGABYTE
GTX 970 G1 GAMING

VITAL STATISTICS

Price £299
Manufacturer Gigabyte
Web www.gigabyte.com
GPU GM204
Cores 1,664
Clockspeed 1,050MHz
Memory capacity 4GB GDDR5
Memory bus 256-bit
ROPs 64

We haven't been this impressed with a new graphics card and GPU since the mini marvel that was the GTX 460. The top-end GTX 980 was impressive with its 2,048 CUDA cores and healthy video memory, but the GTX 970 is arguably better still.

Even cutting out 384 CUDA cores, in three full SMM units, barely touches the gaming performance of the GM204 GPU in the GTX 970. The fact Nvidia has kept the same memory configuration for this second tier Maxwell card is to its credit and, with something like this factory-overclocked GTX 970 G1 Gaming, the performance delta between it and the GTX 980 is minuscule.

We've got an in-depth review of what makes this card so good on p30, but basically the combination of the super-efficient GM204 GPU and the Windforce cooling array makes it one of the coolest, most powerful £300 cards ever.

At this level you could easily ignore every graphics card above it up to AMD's twin-GPU monster, the R9 295X2. The GTX 970 is cutting a swath through the high-end market.

Because it's still got that hefty frame buffer, and the same compression algorithm magic as its big brother, it's every bit as capable a 4K gaming card as the R9 290X and GTX 980. The fact it can pretty much best a Titan Black is quite something too.

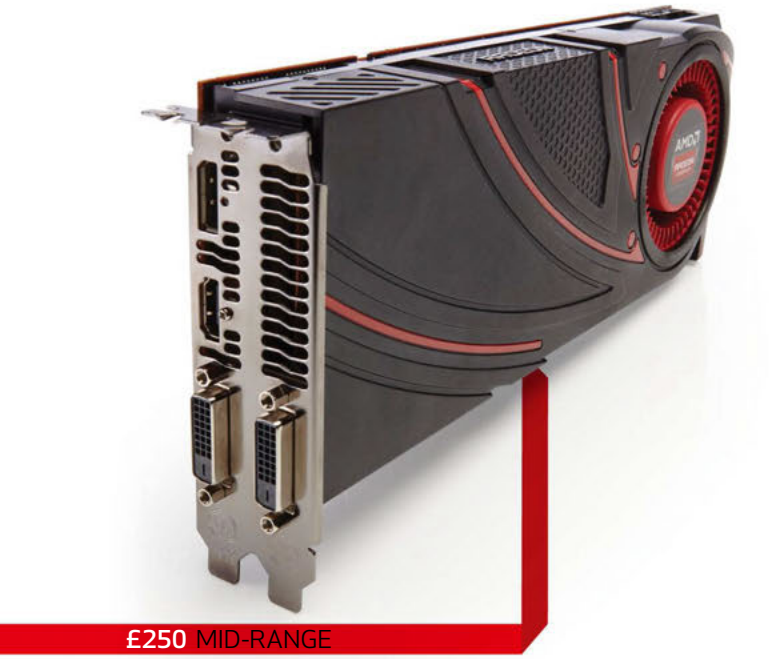
We've long held that top-end GPUs shouldn't exceed the £300 mark, and thanks to its efficiency and performance, there's almost no need to look higher up the stack. We're still looking for a chink in its armour, but for now this is getting on for being the ideal graphics card. ■

PCFormat Verdict

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

A fantastic factory-overclocked card that justifies its price with serious gaming and thermal performance.

★★★★½



£250 MID-RANGE

AMD R9 290

VITAL STATISTICS

Price £250
Manufacturer AMD
Web www.amd.com
GPU Hawaii Pro
Cores 2,560
Clockspeed 947MHz
Memory capacity 4GB GDDR5
Memory bus 512-bit
ROPs 64

The tale of AMD's R9 290 and 290X late last year was almost directly analogous to the GTX 970 / GTX 980 situation we find ourselves in today. Back in the autumn of 2013, AMD released its Hawaii GPU based cards, The 290X dropped with the largest, most complex GPU AMD had ever made. This was followed by the suffix-less 290, which offered almost equal performance for far less cash.

Both these cards need some serious cooling to get the best out of them. The stock cooler, like the one on this reference-design R9 290, will end up with GPU running at a painfully hot 93°C when under 100 per cent load in-game. AMD though reckons that shouldn't be a problem for the life of your graphics processor. While we haven't seen any hard evidence to point to the contrary, having the fans spinning up as loudly as they do, and having that much excess heat floating around your expensive gaming rig, surely isn't going to make for the most pleasant gaming experience for you.

Performance-wise though, the R9 290 is still a relatively happy high-end card, now dropping perilously close to mid-range money. As we've already said, it's not far off the performance of the R9 290X, and will deliver decent high-res gaming frame rates for your cash. It's a little way behind an overclocked GTX 970, and is likely to trade blows with a reference clocked version. Therein lies the rub for this last of the high-end GPUs – the GTX 970 in any guise is causing problems with its heady mix of high performance, low power and chilled temperatures.

If you can find an R9 290 with a third party cooler for this price it might be worth a punt for the AMD faithful though, but we couldn't recommend anyone pick up either 290 or 290X with the struggling reference cooler. ■

PCFormat Verdict

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

The reference cooler might be a dog, but the second-tier Hawaii GPU is still a capable gaming graphics processor.

★★★★☆

£216 MID-RANGE

HIS R9 280X ICEQ X2

VITAL STATISTICS

Price £216
Manufacturer AMD
Web www.hisdigital.com
GPU Tahiti XTL
Cores 2,048
Clockspeed 850MHz
Memory capacity 3GB GDDR5
Memory bus 384-bit
ROPs 32

The AMD GPU powering this mid-ranger from HIS is over two years old; we got our first taste of its graphics architecture way back at the end of 2011. That's indicative of the slowing pace of GPU progress over the last few years, but also testament to the power of AMD's Graphics Core Next (GCN) design.

In its first flush of youth the R9 280X was called the Radeon HD 7970, rocking the very first Tahiti XT GPU. Really though, the 280X is more like the higher-clocked GHz Edition of that card as its boost clock sits around 1,000MHz.

It was the daddy of the GPU world and its high-end heritage is still evident in the 2,048 streaming processors, the hefty 384-bit memory bus and the 3GB frame buffer. The chunky HIS cooler might have a fair bit to do with that as well, and means this iteration of the 280X runs nicely cool and impressively quiet too.

The fact this ageing GPU is still capable of pumping out decent 1600p gaming frame rates at the top settings makes this well-priced card a tantalising prospect. But the age of the silicon at its heart means you are missing out on some of the AMD advances that came after the first GCN 1.0 design. The 280X needs a physical bridge for CrossFireX support, and lacks both True Audio and the advanced GPU boost tech that came with the Hawaii and Bonaire chips and full support for FreeSync when DisplayPort 1.2a arrives.

AMD has already replaced the R9 280 with the R9 285 over the page and, given the fully-featured Tonga GPU is able to hold the same 2,048 cores as the 280X, we wouldn't be surprised to see a top-spec R9 285X very soon. That, combined with the proximity of the R9 290 price crash and the reference-clocked GTX 970, would have us holding off on the ol' 280X. ■

PCFormat Verdict

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

The R9 280X is showing its age, falling behind cheaper, slower AMD models with far more modern feature sets.

★★★☆☆

£170 MID-RANGE

SAPPHIRE R9 285

VITAL STATISTICS

Price £170
Manufacturer Sapphire
Web wwwsapphiretech.com
GPU Tonga Pro
Cores 1,792
Clockspeed 965MHz
Memory capacity 2GB GDDR5
Memory bus 256-bit
ROPs 32

When we first heard about the Tonga Pro-powered R9 285 from AMD, we were sceptical about whether it was really a new GPU, or another exercise in AMD rebadging. But no, the Tonga GPU is a fresh slice of GCN silicon, commonly known outside of AMD as GCN 1.2.

Our concern with the new R9 285 was that it seemed to be replacing a more advanced card. The old R9 280 had the same GPU configuration (1,792 cores, 112 texture units and 32 ROPs) as this new R9 285, with a seemingly superior memory setup. Because it shared a similar high-end heritage to the 280X, being built from the ruins of the HD 7950, it again had a 384-bit memory bus and a full 3GB of VRAM.

That should mean the R9 285 will have a much lower memory bandwidth than the card it's replacing, so the high-res future will look a lot less rosy with the Tonga GPU. But AMD has, unsurprisingly, outsmarted us. Like Nvidia's latest Maxwell GPU, the Tonga architecture contains some funky lossless memory compression techniques that allow the effective memory bandwidth to belie that seemingly low 256-bit bus.

With a higher clockspeed and the GCN 1.1 improved boost tech, the R9 285 is close to the performance of the 280X despite lacking the cores and memory configuration. And because it represents the latest implementation of the GCN architecture you get support for its full feature set, including the one that interests us most: FreeSync.

We are though still sceptical as to whether 2GB is enough video memory these days. With the consoles being more memory-heavy these days future cross-platform games could suffer. But right now the R9 285 has got the gaming performance and is the top sub-£200 card around. ■

PCFormat Verdict

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

A great-value mid-range graphics card, nailing the sub-£200 GPU market with aplomb.

★★★★½

£150 LOW-END

NVIDIA GTX 760

VITAL STATISTICS

Price £150
Manufacturer Nvidia
Web www.nvidia.com
GPU GK104
Cores 1,152
Clockspeed 980MHz
Memory capacity 2GB GDDR5
Memory bus 256-bit
ROPs 32

There is a pitched battle going on between the new R9 285 from AMD and Nvidia's old GTX 760. The 285 has youth on its side, plus performance and memory compression techniques to put the lie to its 256-bit memory bus, leaving Nvidia to fight on price alone.

Is that enough? It's not a sustainable model, but it can't be long until the mighty Maxwell architecture seeps into the sub-£200 market. The GTX 760 then is left twisting in the wind, hoping that a slight saving and support for the likes of GeForce Experience might give it a helping hand.

The GTX 760 doesn't really have an analogous part from the last generation, lacking the CUDA core count of the second-tier GTX 670 before it. It's a long way behind the next Nvidia GPU still being made, too. After the launch of the GTX 980 and 970, everything from the GTX 780 Ti to the GTX 770 were discontinued. You can still find stock around, but that's the last of it.

The 760 is a capable enough Kepler card at 1080p settings, but given the price proximity of the R9 285 it's impossible to recommend anyone purchase new. It's not a million miles behind the competition, but the main thing the R9 285 has going for it is that it often has much higher minimum frame rates. At this level of the market, a smoother gaming experience is most definitely worth the extra £20 for the superior card.

The GTX 760 really suffers by comparison, and seems to be Nvidia's sacrificial soldier, left to slow the enemy advance while it gathers some Maxwell-powered reinforcements to try and turn the tide against AMD's lower mid-range dominance. This Kepler card feels like it's had its day and should soon shuffle off to the GPU memorial home to spend the rest of its days in comfort, maybe playing *Minecraft*. ■

PCFormat Verdict

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

An aging graphics card, struggling to justify itself against more vital competition from AMD's R9 285.

★★½☆☆

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£138 LOW-END

AMD R9 270X

VITAL STATISTICS

Price £138
Manufacturer AMD
Web www.amd.com
GPU Curacao XT
Cores 1,280
Clockspeed 1,000MHz
Memory capacity 2GB GDDR5
Memory bus 256-bit
ROPs 32

As soon as you drop below the £200 mark things get mighty tight. That's because gaming performance seems to scale in a pretty linear way, meaning the four cards crowded into this £200-£100 gap each fit into fairly tight, price-sensitive niche.

With a card like the R9 270X then we end up having to say, if you've literally only got a hard and fast budget of £138 to spend on a new graphics card, then this is the one to go for. That doesn't make for a very constructive review or a particularly helpful one.

The issue here is that the release of new higher-end cards has compressed the lower echelons of the graphics card market, meaning that there's barely £20 difference between one card and its empirically superior competition. With the R9 270X that's the GTX 760 just above it, but then you're looking ever upwards where another £32 will get you into the world where the R9 285 is king.

The Curacao XT GPU in the 270X was already on a hiding to nothing compared with the latest AMD card given that its got much fewer cores, but then you're also in the same boat as the old R9 280, missing interesting new features that make the latest iteration of GCN much more tempting.

Things are just too tight then for the R9 270X to be able to justify itself to consumers. Sure, it's cheaper than the competition, but not by enough to make you forget the weaker gaming performance or the lack of the latest features.

So, if you've literally only got a hard and fast budget of £138 to spend on a new graphics card, then this is the one to go for. But in real terms saving that £30 on a far superior GPU becomes a false economy, forcing you into a position where you'll want to upgrade again all the sooner. ■

PCFormat Verdict

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

The market is too tight to justify paying for weaker cards in the face of better ones with serious feature sets.

★★½☆☆

£103 LOW-END

NVIDIA GTX 750 TI

VITAL STATISTICS

Price £103
Manufacturer Nvidia
Web www.nvidia.com
GPU GM107
Cores 640
Clockspeed 1,020MHz
Memory capacity 2GB GDDR5
Memory bus 128-bit
ROPs 16

As the cheapest GPU in the test, you might expect the ~£100 GTX 750 Ti to get a bit of a kicking from us PC gaming elitists. But we still have a soft spot for this quality little card. There are many reasons why this vanguard of the Maxwell GPU architecture pleases us so much and the price isn't even the main one.

It was a change of pace for Nvidia to release its new GPU architecture on a low-end card first. Things were different this time around, possibly because Nvidia was hoping for the 20nm production process to have its issues ironed out to allow for the subsequent GM 204 to be manufactured on the small lithography.

The GTX 750 Ti introduced us to the tech that has made the GTX 970 our favourite graphics card right now. The extra logic dropped into the new SMM units and extra parallel performance that squeezes more performance from the same number of CUDA cores, means that even though the GM107 comes with a paltry 640 cores, it can still give a decent account of itself.

It's a resolutely 1080p card, but you can get decent frame rates at the highest settings. Drop your demands a little and you'll get smooth gaming on the latest titles with this power-sipping card. And this efficiency makes us love the GTX 750 Ti even more. The reference model needs no extra PCIe power connectors, taking all its juice from the bus. And the GPU runs so cool it's a doddle to run it completely passively cooled – perfect for a silent living room PC plugged into your 1080p HD TV.

The lack of power connectors means that even £300 PCs picked up for college work can accommodate a GTX 750 Ti and get PC gaming immediately. It really is the great leveller, making PC gaming practically possible for almost everyone. ■

PCFormat Verdict

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

A fantastic low-end GPU. Cool, quiet and easily installed into any basic PC with a spare PCIe slot.

★★★★☆

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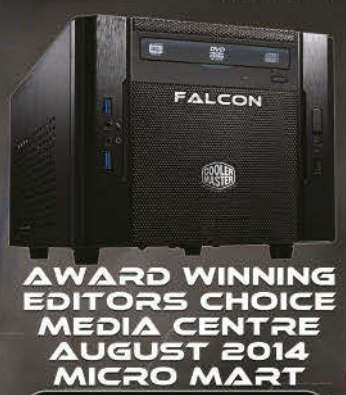

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Cooler Master 350K Case
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2Gb AMD Radeon R9 270X
500W Aerocool 80+ PSU
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3Gb ASUS AMD Radeon R9 280
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REVIEWED OCTOBER 2014 CUSTOM PC

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How we tested

Testing graphics cards can be a long-winded process, but it's not all just about a single average frames per second number any more. There are many things to take into consideration when you're picking through the vast array of graphics cards available these days.

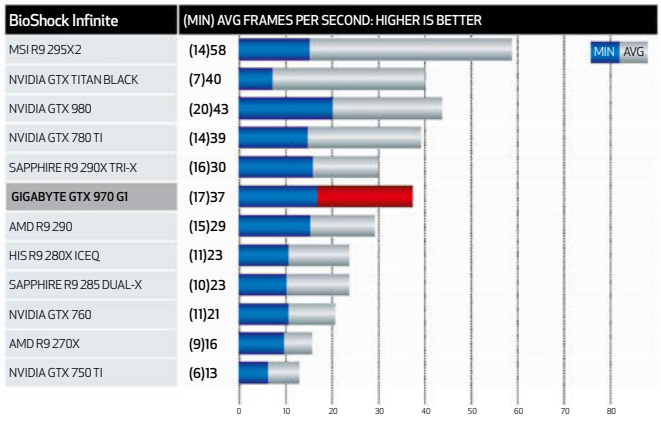
Of course gaming performance is the still the key metric, not to mention how the different cards can scale across different resolutions too. We've covered three levels of resolutions, all tested at the relevant game's highest graphics settings, with 4x MSAA attached. The first is the big 4K daddy. Running at the super-detailed 3840 x 2160 your GPU needs a lot of horsepower, and we're seeing cards with the necessary performance start to arrive.

We also test at our standard 2560 x 1600 and the prevalent 1920 x 1080 resolution. We've offered more testing at the last res as it's the most popular. In terms of the actual figures it's just as important to show the minimum frame rates achieved as it is indicative of either a smooth or choppy experience in-game.

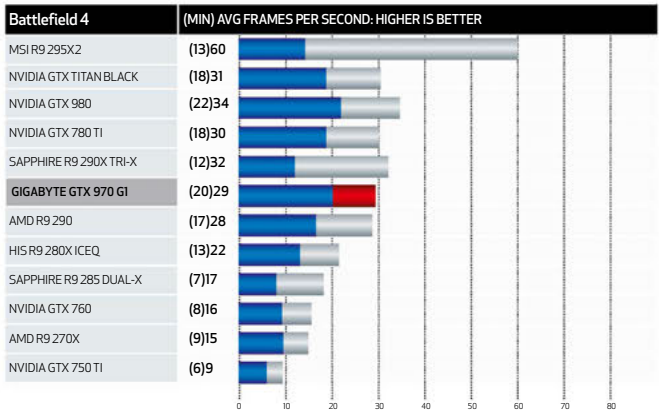
Finally we've also tested the thermal performance of the different cards and how efficient they are in terms of both cash and power. Our performance per Watt index is simply the 1080p average FPS score divided by the peak platform power draw in BF4 and times by 1,000 to deliver a more pleasing comparative index score. The pounds per FPS metric is simply BF4 at 1080p again, using the card's price divided by the average FPS score to give a relativistic value measurement in terms of how much each frame costs the user.

3840 x 2160 Ultra

DirectX 11 gaming performance

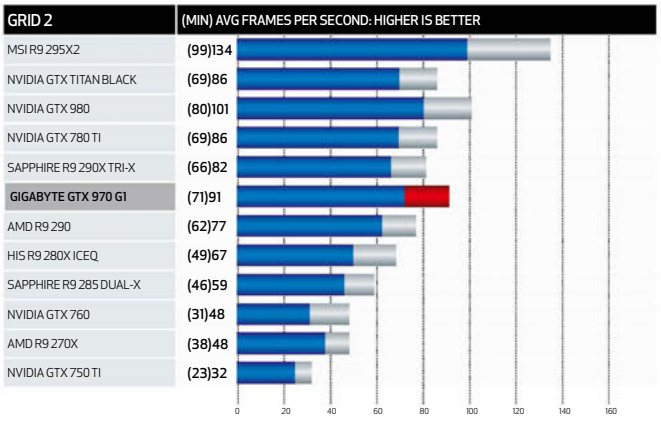


DirectX 11 gaming performance

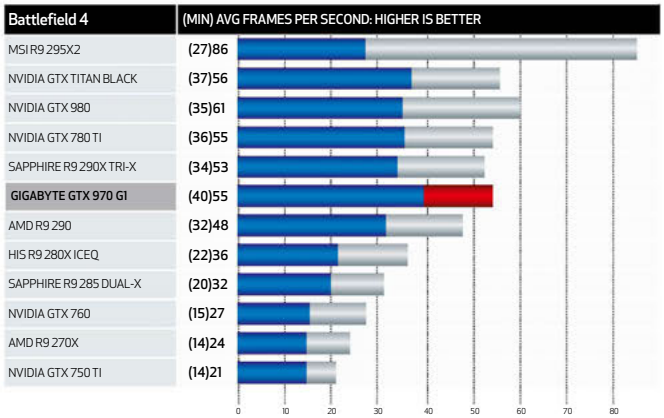


2560 x 1600 Ultra

DirectX 11 gaming performance



DirectX 11 gaming performance

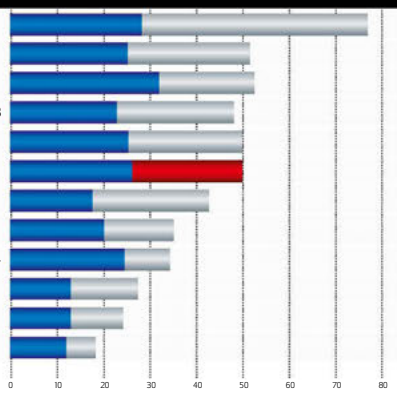


	Price	Manufacturer	Web address	GPU	Shaders	Texture Units	ROPs
MSI Radeon R9 295X2	£700	MSI	uk.msi.com	2x AMD Hawaii XT	2x 2,816	2x 176	2x 64
Nvidia GeForce GTX Titan Black	£700	Nvidia	www.nvidia.com	Nvidia GK110	2,880	240	48
Nvidia GeForce GTX 980	£430	Nvidia	www.nvidia.com	Nvidia GM204	2,048	128	64
Nvidia GeForce GTX 780 Ti	£383	Nvidia	www.nvidia.com	Nvidia GK110	2,880	240	48
Sapphire Radeon R9 290X Tri-X	£330	Sapphire	www.sapphiretech.com	AMD Hawaii XT	2,816	176	64
Gigabyte GTX 970 G1 Gaming	**£299**	**Gigabyte**	**uk.gigabyte.com**	**Nvidia GM204**	**1,664**	**104**	**64**
AMD Radeon R9 290	£250	AMD	www.amd.com	AMD Hawaii Pro	2,560	160	64
HIS Radeon R9 280X IceQ	£216	HIS	www.hisdigital.com	AMD Tahiti XTL	2,048	128	32
Sapphire Radeon R9 285 Dual-X	£170	Sapphire	www.sapphiretech.com	AMD Tonga Pro	1,792	112	32
Nvidia GeForce GTX 760	£150	Nvidia	www.nvidia.com	Nvidia GK104	1,152	96	32
AMD Radeon R9 270X	£138	AMD	www.amd.com	AMD Curacao XT	1,280	80	32
Nvidia Geforce GTX 750 Ti	£103	Nvidia	www.nvidia.com	Nvidia GM107	640	40	16

1920 x 1080 Ultra

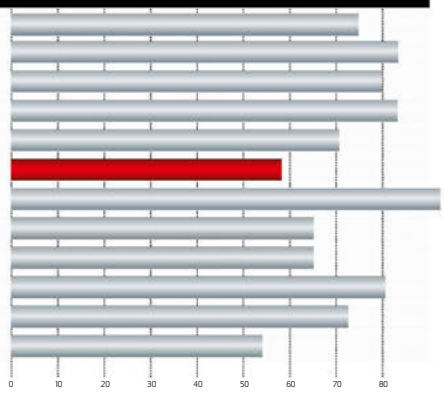
DirectX 11 gaming performance

Metro: Last Light	(MIN) AVG FRAMES PER SECOND: HIGHER IS BETTER
MSI R9 295X2	(28)77
NVIDIA GTX TITAN BLACK	(25)52
NVIDIA GTX 980	(32)53
NVIDIA GTX 780 TI	(23)48
SAPPHIRE R9 290X TRI-X	(25)50
GIGABYTE GTX 970 G1	(26)50
AMD R9 290	(17)43
HIS R9 280X ICEQ	(20)35
SAPPHIRE R9 285 DUAL-X	(24)34
NVIDIA GTX 760	(13)27
AMD R9 270X	(13)24
NVIDIA GTX 750 TI	(12)18



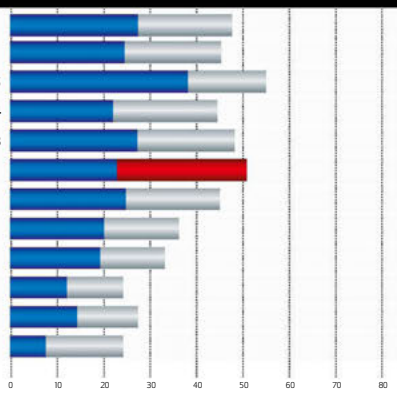
Thermal performance

100% GPU load	DEGREES CENTIGRADE: COOLER IS BETTER
MSI R9 295X2	75°
NVIDIA GTX TITAN BLACK	83°
NVIDIA GTX 980	80°
NVIDIA GTX 780 TI	83°
SAPPHIRE R9 290X TRI-X	71°
GIGABYTE GTX 970 G1	58°
AMD R9 290	93°
HIS R9 280X ICEQ	65°
SAPPHIRE R9 285 DUAL-X	65°
NVIDIA GTX 760	81°
AMD R9 270X	73°
NVIDIA GTX 750 TI	54°



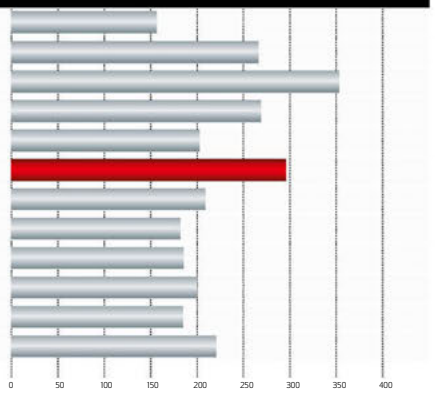
DirectX 11 gaming performance

Company of Heroes 2	(MIN) AVG FRAMES PER SECOND: HIGHER IS BETTER
MSI R9 295X2	(27)47
NVIDIA GTX TITAN BLACK	(24)45
NVIDIA GTX 980	(38)55
NVIDIA GTX 780 TI	(22)44
SAPPHIRE R9 290X TRI-X	(27)48
GIGABYTE GTX 970 G1	(23)51
AMD R9 290	(24)45
HIS R9 280X ICEQ	(20)36
SAPPHIRE R9 285 DUAL-X	(19)33
NVIDIA GTX 760	(12)24
AMD R9 270X	(14)27
NVIDIA GTX 750 TI	(7)24



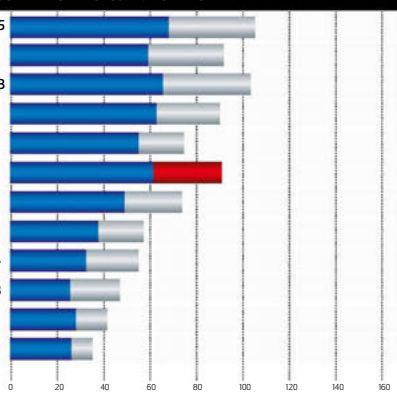
Gaming performance per Watt

Battlefield 4 @ 1080p	PCF INDEX SCORE: HIGHER IS BETTER
MSI R9 295X2	154
NVIDIA GTX TITAN BLACK	261
NVIDIA GTX 980	353
NVIDIA GTX 780 TI	265
SAPPHIRE R9 290X TRI-X	201
GIGABYTE GTX 970 G1	297
AMD R9 290	210
HIS R9 280X ICEQ	181
SAPPHIRE R9 285 DUAL-X	186
NVIDIA GTX 760	200
AMD R9 270X	186
NVIDIA GTX 750 TI	220



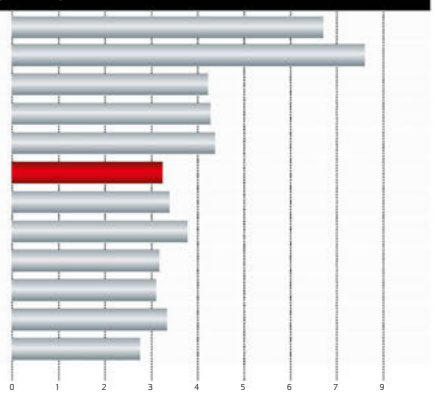
DirectX 11 gaming performance

Battlefield 4	(MIN) AVG FRAMES PER SECOND: HIGHER IS BETTER
MSI R9 295X2	(68)105
NVIDIA GTX TITAN BLACK	(59)92
NVIDIA GTX 980	(65)103
NVIDIA GTX 780 TI	(62)90
SAPPHIRE R9 290X TRI-X	(55)74
GIGABYTE GTX 970 G1	(61)92
AMD R9 290	(49)73
HIS R9 280X ICEQ	(37)57
SAPPHIRE R9 285 DUAL-X	(34)54
NVIDIA GTX 760	(26)48
AMD R9 270X	(29)41
NVIDIA GTX 750 TI	(26)36



Gaming performance per Pound

Battlefield 4 @ 1080p	£/FPS: CHEAPER IS BETTER
MSI R9 295X2	£6.67
NVIDIA GTX TITAN BLACK	£7.61
NVIDIA GTX 980	£4.17
NVIDIA GTX 780 TI	£4.26
SAPPHIRE R9 290X TRI-X	£4.46
GIGABYTE GTX 970 G1	£3.25
AMD R9 290	£3.42
HIS R9 280X ICEQ	£3.79
SAPPHIRE R9 285 DUAL-X	£3.15
NVIDIA GTX 760	£3.13
AMD R9 270X	£3.37
NVIDIA GTX 750 TI	£2.86



	Memory	Memory bus	Core Clock	TDP	Score
	2x 4GB GDDR5	2x 512-bit	1,018MHz	500W	★★★★☆
	6GB GDDR5	384-bit	889MHz	250W	★★★
	4GB GDDR5	256-bit	1,126MHz	165W	★★★★½
	3GB GDDR5	384-bit	875MHz	250W	★★★½
	4GB GDDR5	512-bit	1,010MHz	290W	★★★★☆
	4GB GDDR5	**256-bit**	**1,178MHz**	**145W**	★★★★½
	4GB GDDR5	512-bit	947MHz	275W	★★★★☆
	3GB GDDR5	384-bit	850MHz	250W	★★★
	2GB GDDR5	256-bit	965MHz	190W	★★★★☆
	2GB GDDR5	256-bit	980MHz	170W	★★½
	2GB GDDR5	256-bit	1,000MHz	180W	★★½☆☆
	2GB GDDR5	128-bit	1,020MHz	60W	★★★★

MSI Radeon R9 295X2
Nvidia GeForce GTX Titan Black
Nvidia GeForce GTX 980
Nvidia GeForce GTX 780 Ti
Sapphire Radeon R9 290X Tri-X
Gigabyte GTX 970 G1 Gaming
AMD Radeon R9 290
HIS Radeon R9 280X IceQ
Sapphire Radeon R9 285 Dual-X
Nvidia GeForce GTX 760
AMD Radeon R9 270X
Nvidia Geforce GTX 750 Ti

And the winner is…

Gigabyte GTX 970 G1 Gaming

When we get down to it there was only ever really going to be one winner in this latest graphics card group test. The second-tier Nvidia Maxwell card is simply stunning. So stunning in fact that we're not sure exactly how relevant even the GTX 980 is. At £300 the overclocked, super-cooled Gigabyte card is great value and can outperform cards more than twice its price – and even keep a dual-GPU monster like the R9 295X2 honest.

The value and performance are one thing, but the long term cost to you is almost as important. The fact that it only just about scrapes above 60°C when you clock it as high as 1.5GHz means that most of the time it's barely going to be breaking a sweat inside your machine. And then there's the platform power draw – in terms of performance per Watt, the latest Maxwell cards are excellent, leaving the competing hot and heavy AMD cards wheezing in their wake.

There's also the fact that you can get GTX 970 cards for closer to £260 too if you don't fancy the pre-overclocked sort. They'll still deliver excellent performance numbers for even less cash, although they will most likely get a little warmer. Essentially this new card means that only the real money-no-object crowd should think about spending more than £300 on a graphics card these days.

For that money-no-object crowd though, AMD's R9 295X2 is a mighty tempting prospect. Pairing up GPUs is really the best way to get proper gaming performance at the mighty 4K resolution, and the R9 295X2 certainly delivers on that score. There is though a certain lack of trust between us and dual-GPU cards; we've had too many problems with them in the past, even with this latest Radeon. But if you want to hit 60FPS at 4K in *Battlefield 4* with a single card there really is only one option.

Between the R9 295X2 and the GTX 970 then it's a bit of dead space. The prices are simply too high for the performance you can get at the cheaper levels. It all ends up leaving the Titan Black looking just a little out of place in this gaming-centric test – and even the GTX 780 Ti now too.

It all gets pleasingly linear as you drop below the GTX 970, though it's all pretty moot up to the new R9 285. Either an overclocked or reference GTX 970 will clear up between £300 and £250, and the R9 285 is the go-to card below it. You don't want to spend cash on an ageing R9 280X given the 285's performance and feature set, and the cheaper GTX 760 and R9 270X can't justify themselves either.

Bringing up the rear though – owning the £100 GPU market – is the glorious GTX 750 Ti. We love this plucky inaugural Maxwell card, mostly for making it possible to turn any off the peg PC World PC into a bona fide 1080p gaming rig with a simple PCIe drop in. No PSU upgrade or anything. Plug and play of the most pleasing sort.

In the end then we're left with a set of well-performing and generally good-value graphics cards that can deliver quality gaming performance at a variety of price points. PC gaming win. ■

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WHAT ARE YOU DOING, DAVE?

For practically everyone, both Nvidia and AMD have nailed down gaming performance

Dave James has been travelling up and down the coast of California this month on the hunt for CPU advances, new GPUs and sea lions. He's come back with two out of the three, which ain't a bad return for his toils. Unfortunately his kittehs are still struggling to get used to sharing the litter box with 700lb aquatic mammal. But at least his pond's free of newts…

Having spent much of the last month either being talked at about graphics cards or testing them to hell and back, it's interesting to see how little time is given over by the manufacturers to actual gaming performance these days. That shouldn't come as a surprise when the vast majority of gamers are still rocking a 1080p screen. High resolutions are the future of PC gaming, but only just over one per cent of those in the Steam Hardware Survey use a higher resolution as a primary display.

Which means, for practically everyone, both Nvidia and AMD have already nailed down gaming performance. Everything but the most laggardly GPUs of the current generation of graphics cards are capable of hitting decent frame rates, at even the highest 1080p settings.

Launching the new Maxwell cards Nvidia spent most of the time showing off new features rather than the performance of the new cards. One of the most intriguing of these is something you wont see for a while, though – possibly until DirectX 12 makes an appearance. The Voxel Global Illumination (aka Voxel Cone Tracing) technology is designed as a waypoint on the road to full, real-time ray-tracing. Nvidia is now referring to that as path tracing, possibly to get away from the fact that it's been promising real-time ray-tracing with every GPU launch of the last few years. Created in 2011, the combined power of hardware acceleration inside the Maxwell architecture and new rendering features in DirectX 12 (volume tiled resources and conservative rasterisation) should make it a workable method of accurately lighting a game scene realistically in real-time.

It works by first transforming the geometry in a given scene into voxels – effectively 3D pixels – and then determining whether any opaque material exists inside each voxel. It then calculates the amount of direct light reflected by those opaque voxels, and the final pass covers a single bounce of indirect light moving around the scene. Those voxels themselves are never actually rendered; they are simply used as a shortcut for calculating how the light reacts and moves around the geometry in a scene. VXGI will allow for more realistic reflections, diffuse and specular effects, effectively offering a global illumination engine that can be used in real-time for the next generation of games.

Nvidia used a scene from the Apollo 11 moon landings, rendered in real-time, to demo the advanced one-bounce cone-tracing lighting effects. While it was an impressive display on a static environment I'll be more impressed when we see something in UE4 or CryEngine running in an animated game environment. If VXGI does make it into games though it could make for a massive visual difference in-game on GeForce over Radeon.

P30
GIGABYTE'S GTX 970

The moon landings rendered in *Minecraft*…

Why Windows 10?

So why did Microsoft choose to skip forward a numerical version and go straight from Windows 8 to Windows 10? It does seem like something of a strange and unexpected leap. There are a number of reasons and theories being put forth around the interwebs, from the fact that it could perhaps be seen as a bit of a negative statement in Germany (Windows, No!) to the idea that the number nine is seen as being traditionally unlucky in Japan.

One Redditor, claiming to be a Microsoft Dev, said the internal rumour mill had it that many third-party programs contained OS compatibility code covering Windows 95 as Windows 9* that generally it seems like the easiest thing to do for all concerned was to just avoid the name. Another win for Occam's Razor?

Gold Award

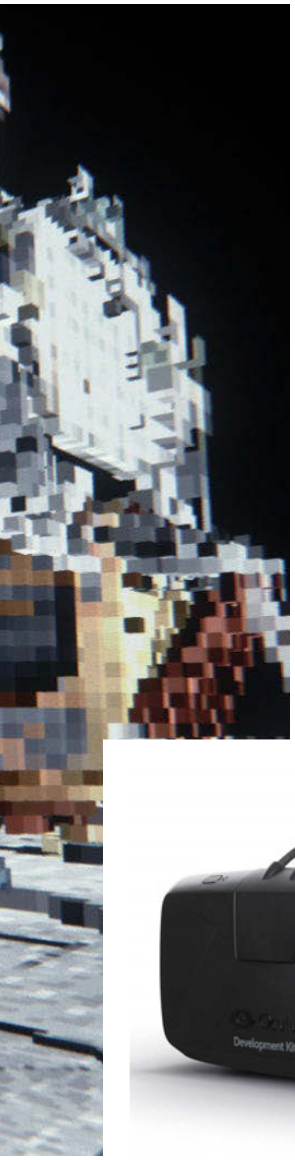
This is the ultimate badge of hardware excellence. Only truly outstanding gear gets this coveted award. Oh, and there are no prizes for runners-up here.

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.

THE EXTERNAL GPU FOR LAPTOPS IS BACK…

Since my first trip out to Taiwan's Computex show I've seen laptop makers trying to come up with a way to attach desktop GPUs to portables. But now MSI thinks it's cracked it with the GS30 laptop and gaming dock it was showing off at this year's IDF. The laptop itself is a svelte design with an Iris Pro Haswell CPU inside and a 2,560 x 1,440 IPS screen. But the real key is the full x16 PCIe 3.0 connector hidden in the rear of the machine around the hinge of the base and screen. That's where you plug it into the chunky dock to access whatever desktop graphics card you want to throw into the enclosure. Inside dock is a 450W desktop PSU, in what looks like an SFX standard, and SATA connectors to allow for extra connected storage. On the outside you get a built in speaker and extra USB ports too. This niche device is set to launch at CES 2015.



EDITOR'S ONE TO WATCH

Nvidia wants to own VR

Maybe we're going a bit overboard on all the Nvidia stuff this month, but given AMD has been offering very little graphically recently – even the bargain-priced R9 285 hasn't gone down perfectly with its Mantle woes – the feature-gasm that has accompanied the Maxwell launch is well worth a look.

As well as dropping the voxel bomb, it's also shown off a new low-overhead anti-aliasing technique and a method of down-sampling to get improved visuals. For the rabid Rift faithful though it's the VR Direct announcement that's most interesting. It's essentially a collection of VR features gathered under an umbrella title.

The focus of pretty much all of them is getting that latency down. At the moment you're looking at a latency of around 50ms – which isn't bad – but that can break immersion at best or make you vomit at worst. With VR Direct, Nvidia is talking about getting latency down to just 25ms.

The biggest step down in latency comes with auto asynchronous warp. This builds on something John Carmack has spoken about, and is focused mostly on getting the head-tracking information dropped into the pipeline as late as possible. Making this the last thing calculated means head-tracking and motion should become as fluid as possible.

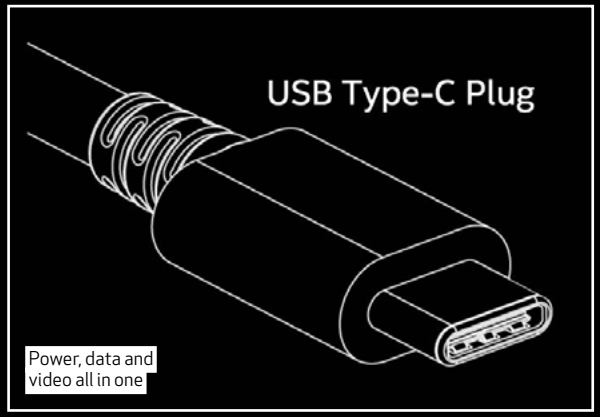
Nvidia is also implementing VR SLI when a virtual reality device is detected. This switches from traditional alternate frame rendering (AFR), with each GPU in an SLI array rendering every other frame to a situation where, in a dual-GPU setup, one card is dedicated to each eye. This helps cut down latency too, which AFR might increase.

And thanks to Nvidia's work on the old 3D Vision and the back catalogue of supported games it's hoping to convert those titles into functional Rift/VR games automatically. Like VXGI, all this is still just marketing talk. We won't know for sure how much any of Nvidia's work actually affects the quality of VR gaming on its GPUs compared to running an AMD-based rig for your Rift until the consumer version drops and we can finally test all these promises.

Slicing up the latency demands should stop all the vomiting

Once cable to rule them all

If you thought the USB-C was just about being able to plug something in whichever way up you wanted then you're missing some exciting cable news. Yes, my life is complete, I'm writing about exciting cable news. The upcoming USB-C connector looks mighty impressive, especially given that its Alternative Mode includes support for DisplayPort 1.2/1.3. Genuinely, that's hugely impressive as it will make for a single cable to dock your laptop, allowing for up to 10Gbps of bi-directional data, 100W of power supplied to your machine and support for a full 4K video stream – all at the same time down one cable. I think I need a lie down…



Power, data and video all in one

HIGHLIGHTS THIS MONTH

£430 GRAPHICS CARD

NVIDIA GEFORCE GTX 980

The green team's Maxwell GPU architecture is all grown up

VITAL STATISTICS

Price £430
Manufacturer Nvidia
Web www.nvidia.com
GPU Nvidia GM 204
SMMs 16
CUDA cores 2,048
Base clock 1,126MHz
Boost clock 1,216MHz
Memory capacity 4GB GDDR5
Memory speed 7Gbps
Memory bus 256-bit
ROPs 64

We've waited a long time for Nvidia to get the latest Maxwell GPU architecture into its high-end graphics cards, but finally the GTX 980 is here and it looks like it's been worth the wait.

The GTX 980 is the top Maxwell card running with the brand new, super-efficient GM 204 GPU, with the second-tier GTX 970 coming close behind.

On the surface, the GTX 980 is a bona fide high-end graphics card, topping the performance of even an overclocked GTX 780 Ti from last generation while creating less sound and fury than the outgoing Kepler cards.

This isn't the first time we've come across Nvidia's latest architecture though; the inaugural Maxwell GPUs appeared back in February with the twin goodness of the GTX 750 and GTX 750 Ti. They marked a change in strategy for Nvidia. It was the first time the green graphics giant had debuted a brand new GPU microarchitecture without launching it in a new high-end ~£500 graphics card first.

Those initial Maxwell cards are unashamedly lower-end parts, designed to offer decent 1080p performance with the added benefit of seriously impressive thermal and energy efficiency.

In fact, so good is the power efficiency of the GTX 750 Ti that you can easily run it with completely passive GPU cooling. Building a silent HTPC or living room gaming rig is suddenly a genuine possibility.

The first Maxwell cards also don't need any extra power above what can be supplied directly via the motherboard connection, which means they can be a quick drop-in upgrade for any PC with a free PCIe slot. Any £300 office PC can now immediately become a good 1080p gaming rig without any other upgrades.

Architectural

The GTX 980 uses the same GPU architecture that made the inaugural Maxwell cards such a success at the low end, and is using all the efficient silicon engineering to jam a vast number of CUDA cores into a relatively small GPU die.

The big change from Kepler to the latest Maxwell architecture is a fundamental difference in the way the cores are distributed across the GPU and how they're accessed. The streaming microprocessor (SM) was first introduced with the old Fermi GPU tech and evolved through the Kepler architecture and its SMX update.

The SMX units of the Kepler generation have subsequently been replaced by SMM units for Maxwell, allowing for greater parallelism by apportioning more control logic inside each of the new streaming microprocessors.

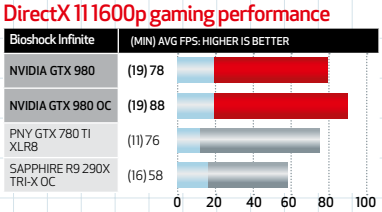
The first two iterations of the SM – in Fermi then Kepler design – held a total of 192 CUDA cores looked after by a single set of control logic spread out across the lot. The new SMMs though divide themselves up into four sections of 32 CUDA cores, with discrete instruction buffers, warp schedulers and dispatch units for each block.

That separation within the SMM allows for greater efficiency and boosts overall processing speed. They're a

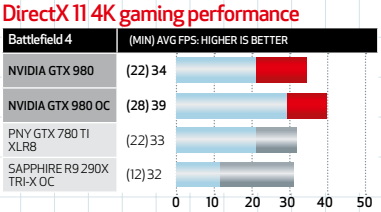
Technical analysis

This is essentially a mid-range class GPU – generationally equivalent to the GTX 770 – but it's able to best the very top of the Kepler workstation GPU, albeit by a relatively small amount. In overclocking terms that quickly changes – we managed an impressive 1,480MHz boost over the standard 1,126MHz base clock. That gives it a serious frame rate hike.

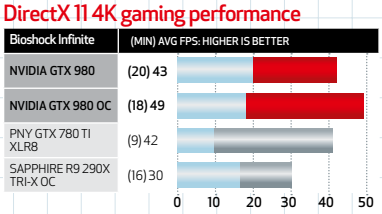
DirectX 11 1600p gaming performance



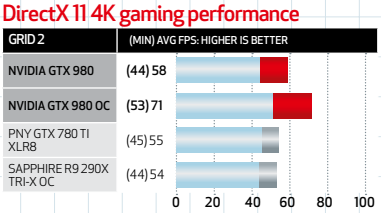
DirectX 11 4K gaming performance



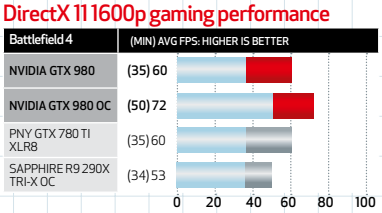
DirectX 11 4K gaming performance



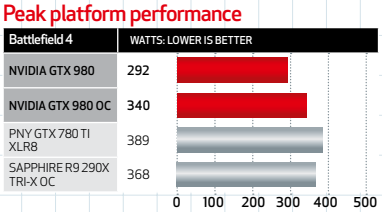
DirectX 11 4K gaming performance



DirectX 11 1600p gaming performance



Peak platform performance



bit smaller too, which allows Nvidia to squeeze more units into smaller GPUs. The GM 204 GPU of the GTX 980 is 398mm^2 whereas the GK110 of the GTX 780 Ti is a chunkier 561mm^2, yet Nvidia has squeezed 16 SMM units into the GTX 980 while it could only manage 15 in the GTX 780 Ti.

In each SMM though there are fewer actual CUDA cores - 128 vs. Kepler's 192 - but because of the more efficient layout, Nvidia estimates it can get around 35 per cent extra performance from each of the CUDA cores in its new Maxwell GPU architecture.

So, with those 16 SMM units the new GTX 980 has a healthy 2,048 CUDA cores, and because of their improved efficiency, those cores can compete in performance terms with the full 2,880 cores of the Kepler generation GK 110 GPU of the GTX 780 Ti.

The number of cores isn't everything though. The new Maxwell GM 204 GPU also has a ROP count of 64 – 16 more than the very top of the Kepler architecture. That helps when it comes to boosting the slightly slower memory interface of Maxwell too.

That overall memory architecture has changed and you'll see that, while the GTX 980 might have an extra 1GB in the frame buffer compared with the GTX 780 Ti, it's running on a slower 256-bit memory bus. Normally that would have us rather concerned about the high-resolution performance of the new card, especially given that Nvidia is talking up the 4K power of its new GPU at every opportunity, but Nvidia has done some clever things with the setup of Maxwell's memory. For a start, the GM 204 has 2MB of L2 cache inside – a boost of 500KB over the 1.5MB of the full-fat GK 110 GPU. That gives the GPU a bit more memory performance inside the GPU itself before spitting data out into the frame buffer.

Nvidia has also done some interesting things regarding memory compression algorithms – along the lines of what AMD has done with its latest R9 285 graphics card. It has used a selection of lossless compression techniques to offset the need for more expensive, higher-bandwidth memory controllers.

The results of this mean the Maxwell GPU can reduce the number of bytes that need to be fetched per frame from the memory. Nvidia's calculations have it at 25 per cent fewer bytes needed per frame compared with Kepler. In terms of bandwidth then, Nvidia claims its memory is effectively running at a speedy 9.3Gbps as opposed to the stated 7Gbps DRAM it's using.

> "THIS IS THE HIGH-END GRAPHICS CARD TO BUY IF YOU CAN AFFORD IT"

Apples and oranges

There's something else worth mentioning when we're comparing this new Maxwell implementation with the outgoing Kepler chips. If we're being entirely fair to the new GTX 980, we really shouldn't be comparing it to the GTX 780 Ti. The GM 204 sits in the Maxwell GPU generation in the same position as the GK 104 GPU did in the Kepler.

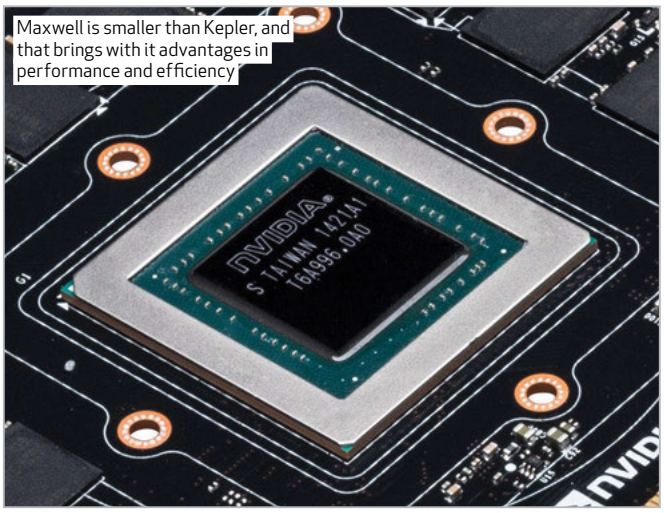
The GK 110 GPU of the GTX Titans and the GTX 780 and GTX 780 Ti cards was a full-fat, professional-class GPU, used primarily in the Quadro workstation cards that came after the first flush of the Kepler architecture. And you can bet there'll be a GM 210 GPU waiting in the wings when Nvidia wants another performance boost…

In those terms, the generational jump from GK 104 to GM 204 is huge. The 1,536 CUDA cores of that GPU's top spin – lately used in the GTX 770 – make it a much slower graphics card than either the GTX 980 or the lower-caste GTX 970. And that's despite the GTX 980 and GTX 770 running at the same temperature and maximum platform power draw.

But we're going to keep referencing the GTX 780 Ti in comparison with the new Nvidia GTX 980 because they

represent the top consumer SKU of their respective graphics card generations.

Actually, we'll mostly to be referencing those two cards for the simple fact that, despite being essentially a lower class of GPU silicon, the GTX 980 can outperform the GTX 780 Ti across our benchmarking suite.



Maxwell is smaller than Kepler, and that brings with it advantages in performance and efficiency

Gaming performance

As we said earlier, the most impressive thing is that this new card can outperform the workstation-class GK 110 GPU inside the GTX 780 Ti. And that means – double precision performance aside – it can also outdo the GTX Titan Black.

In our platform-agnostic Heaven 4.0 benchmark there isn't much to choose between an overclocked GTX 780 Ti and a reference GTX 980, but as soon as you start throwing gaming workloads through the cards things change quite a bit.

At the highest resolutions a standard GTX 980 can only claim a few frames per second boost on average, but it's the overclocking performance that really impresses. The efficiency of the Maxwell architecture allows the GTX 980 to boost well over its base clock, and with some tweaking you can push well past an overclocked GTX 780 Ti.

What of the competition? Well, that would have to be AMD's Radeon R9 290X. The GTX 980 is consistently faster than AMD's fastest single-GPU card, but costs some £100 more. Then there's the fact that the 290X is liable to run at 93°C without a decent third-party GPU cooling array, and will draw more system power than even a seriously overclocked GTX 980.

Considering the GTX 780 Ti is currently retailing at around £460 (stock-clearing Zotac cards aside), the price of the new GTX 980 isn't bad. The reference card is suggested to retail at £430, which is a little less than the top Kepler card.

That makes sense for Nvidia, because the smaller, simpler GM 204 must be cheaper to produce than the huge GK 110 GPU. And it means Nvidia will be making a lot more money on each GTX 980 it sells than the GTX 780 Ti.

It makes sense for us too, because the cooler, quieter, less power-hungry Maxwell card still outperforms the GTX 780 Ti. This is the high-end graphics card you'd buy right now if you can afford it.

That's got to make tough reading for AMD though. It doesn't have a single-GPU card that can cope with the might of this top Maxwell GPU, and Nvidia's current Maxwell line has a lot of room to grow.

If you were hoping for a huge performance lead over the top cards of the last Kepler generation then you might be a touch disappointed. Even so, the combination of energy efficiency and the extra features – plus the promise of DirectX 12 improvements really taking Maxwell's best parts even further – makes this an impressive overall package. ■ **Dave James**

PCFormat Verdict

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

The Maxwell architecture is impressive, and the GTX 980 implementation has killer features to back up its performance.

★★★★½

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VITAL STATISTICS

Price £299
Manufacturer Gigabyte
Web www.gigabyte.com
GPU Nvidia GM 204
SMMs 13
CUDA cores 1,644
Base clock 1,178MHz
Boost clock 1,329MHz
Memory capacity 4GB GDDR5
Memory speed 7Gbps
Memory bus 256-bit
ROPs 64

Gigabyte has taken the new second tier Maxwell-based card and gone to town on it, taking advantage of both its efficiency and its impressive performance potential. The G1 Gaming version of the GTX 970 is one of the most impressive new cards we've seen for a while, and starts to make the GTX 980 seem rather irrelevant for a good percentage of PC gamers.

Nvidia's GTX 980 is its new darling graphics card, and as such the poster-child for the new Maxwell-based GPU generation. The first flush of GTX 980s are therefore mostly pure Nvidia reference design boards. This is a pretty standard thing with new high-end cards, but it does mean that, despite their serious overclocking potential, we aren't seeing many factory-boosted options with third-party coolers.

Titan falls

That's not the case with the GTX 970 though. The manufacturers are really going to town on the second-tier GM 204 card, and this Gigabyte G1 Gaming is a fantastic introduction. If you decide you want to take it further than its factory-overclocked settings, you can even get mighty close to the performance of a reference-clocked GTX 980. And that means you'll be getting superior gaming performance to a £700 GTX Titan Black. For £300. Colour us impressed, Gigabyte.

Inside the GTX 970 you'll find the same Nvidia GM 204 GPU that made the GTX 980 such an impressive graphics card, with just a few little nips and tucks here and there to fit it into the lower price point. Crucially though, the important parts remain to give you bona fide high-end graphics performance.

The big change is on the traditional streaming microprocessor units front. The SMM count for the GTX 970's GM 204 GPU is down from 16 to 13. That still gives you a very healthy 1,644 CUDA cores for your money, though it does seem like a pretty severe slicing from the 2,048 cores in the GTX 980. In actual performance terms, however, it's kept honest by the rest of the hardware surrounding it.

The GTX 970 still has the same 2MB of L2 cache, the same 64 ROPs, the same 256-bit memory bus, the same speed and algorithmic advances in the actual memory itself and, crucially, the same 4GB frame buffer. It's the common memory capacity between the two latest Maxwell-powered cards that allows them to be such key players at the highest resolutions. We kind of expected Nvidia to have sliced a great deal more of the good stuff out of the GTX 970's version of the GM 204 GPU, but we're incredibly pleased to see what remains.

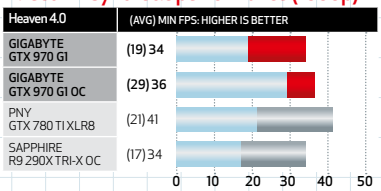
Sibling rivalry

Right from the outset, it's clear that Gigabyte's G1 Gaming GTX 970 is aiming squarely at its big brother. The base clock is some 128MHz higher than the standard GTX 970 base (essentially taking the reference boost clock as its starting point), which immediately means that this new card is running faster than

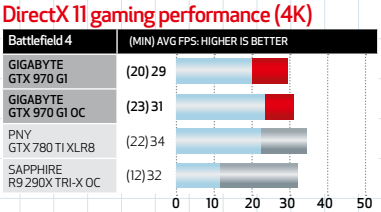
Technical analysis

Compared with a reference GTX 980, the G1 Gaming isn't far off in performance terms. That is until you really start pushing the clockspeeds. At 1,501MHz the GTX 970 is able to perform at similar levels to the standard GTX 980, even at the very highest resolutions. And the Windforce cooler has the beating off the other two cards, even overclocked.

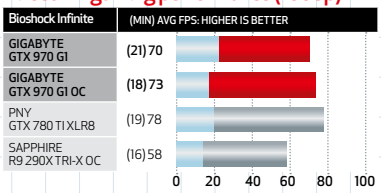
DirectX 11 synthetic performance (1600p)



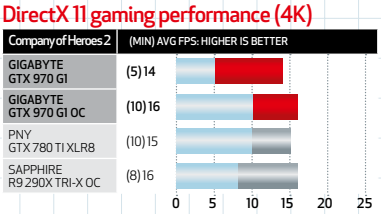
DirectX 11 gaming performance (4K)



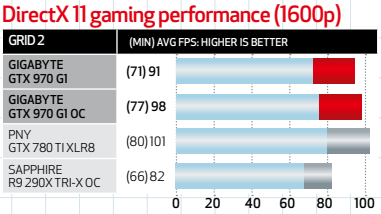
DirectX 11 gaming performance (1600p)



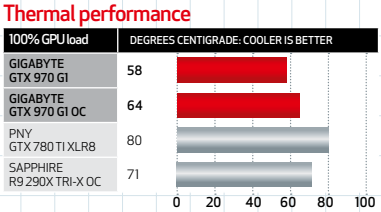
DirectX 11 gaming performance (4K)



DirectX 11 gaming performance (1600p)



Thermal performance



the GTX 980 out of the box in GPU terms.

But that's just the story of the base clock. The G1 Gaming's boost clock goes even further than the GTX 980's, hitting 1,329MHz as a standard turbo setting compared to the 1,216MHz of the top reference card.

Wind of change

The reason it's able to hit such high boost clocks is down to Gigabyte's powerful Windforce cooling array. The large triple-fan/triple-heatsink setup means it's a longer card than the standard GTX 980 design, despite having a shorter PCB, but also makes it one hell of an effective cooling solution. With the factory-overclocked GPU working its silicon socks off, it was still only just about hitting a maximum temperature of 58°C. That's incredibly cool running for a proper high-end GPU, especially one that's capable of hitting 30FPS at top 4K settings in *Battlefield 4*.

And even when we worked our own overclocking magic on the G1 Gaming, it was still only very occasionally hitting a maximum 64°C. With the GM 204 running at an incredible 1.5GHz, that's one hell of a technical achievement.

And that would also encourage us to spend our money on this iteration of the GTX 970 in favour of a reference clocked and cooled GTX 980. Yup, we'd rather have this card than a reference design from the top of Nvidia's GPU stack. With both cards running out of the box, the GTX 980 has a visible performance lead, but if you push up this card's clocks – and it was impressively stable clocked at 1.5GHz – then you're getting almost identical performance figures.

If that were the end of the story though, you might still put your money on the reference GTX 980. After all, its GPU isn't being pushed as hard in order to achieve to those speeds. But the overclocked Tri-X version from Sapphire can't cool to the same extent, or provide performance to beat this cheaper card. Well, we say 'cheaper', but we've got a feeling that, with a lack of new GPUs to call its own, AMD is going to be embarking on a price war out of necessity.

Windforce cooling array really does make a tremendous difference; even operating at 1.5GHz, the G1 Gaming was running over 15°C cooler than the reference card.

Money matters

And then there's the price. The stock GTX 970 starts at £260 and this factory-overclocked version is another £40 on top of that, but is still at least some £140 cheaper than a basic GTX 980.

Inevitably, then, the beleaguered AMD R9 290X is in some trouble. Even the Currently a standard R9 290X retails for approximately £330, but at the time of writing a reference-clocked/cooled 290X from XFX can be yours for £270. If the rest of the manufacturers swallow that same £60 cut, things could get more interesting.

For our money though, we'd rather stick with the cool, quiet and quick GTX 970 from Gigabyte. The Nvidia ecosystem feels a little more vibrant right now, with some funky new technology (such as MFAA and DSR) making the green team seem like more of a value proposition.

In real terms however, it's the additional straight-line gaming performance that gives the new Gigabyte card the win for us. ■ **Dave James**

> "SUPERIOR GAMING PROWESS TO A £700 GTX TITAN BLACK. FOR £300"

PCFormat Verdict

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

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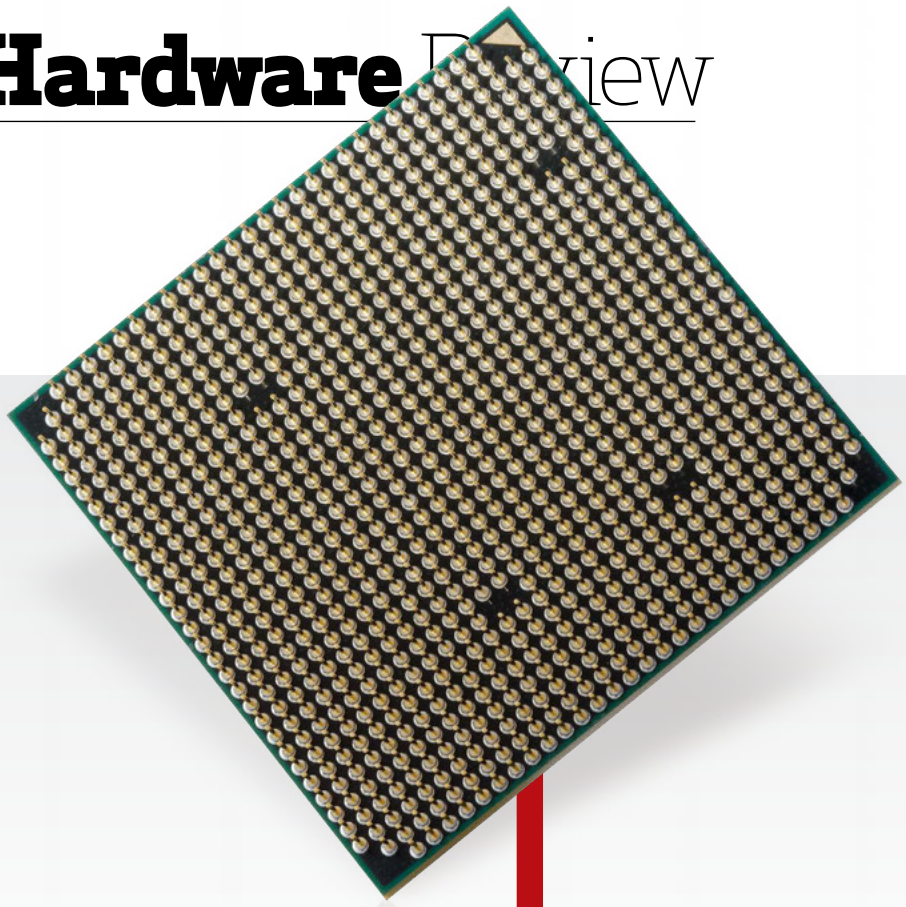


£144 PROCESSOR

AMD FX-8370E

AMD rejigs old hardware in an attempt to compete with Intel

VITAL STATISTICS

Price £144
Manufacturer AMD
Web www.amd.com
Socket AMD AM3+
Core technology AMD Piledriver
Clock speed 3.3GHz (4.3GHz Turbo)
Cores 4
Threads 8
Lithography 32nm
Cache 4x 2MB L2, 8MB L3
TDP 95W

AMD has ceded the CPU high ground to Intel's all-conquering i7 chips, but the firm still reckons it can fight in the mid-range – and that's exactly where the new FX-8370E hunkers down.

This chip is different from the rest of AMD's FX parts thanks to its 'E' suffix. It stands for 'energy efficient', and means it has a TDP of 95W. That's a reduction from the 125W and 220W TDPs used by other AMD FX chips, but it's still 11W more than Intel's Core i5 parts require. That's because the FX-8370E still relies on the toasty 32nm Piledriver architecture, rather than the 28nm Steamroller cores found in the firm's APUs.

The power reduction means that this chip's specification has taken a hit. Its stock clock of 3.3GHz can't compare with full-fat FX, most of which start at 4GHz. The low-power FX closes the gap in Turbo mode, where its top figure of 4.3GHz matches the full-fat FX-8370. That's a decent figure, given that the standard FX-8370 has 30 extra watts at its disposal.

This chip still uses the AM3+ socket, and relies on the same old chipsets. That's a problem, as the top-end 990FX part doesn't support USB 3 or PCI-Express 3.0, with third-party controllers needed to facilitate both of those now-common technologies.

AMD's introduction of a low-power eight-thread chip still makes sense, though. It's the first time AMD has released a 95W, eight-thread Piledriver part. Its £144 price puts it directly alongside the Core i5-4570, and is £30 cheaper than the Core i5-4690K. Both of those parts are Hyper-threaded quad-core CPUs with 22nm silicon, and the latter is unlocked.

An Intel-beater?

AMD reckons that this chip can take on the best Core i5 parts, but our benchmarks indicate that it can't keep up. Its single-thread Cinebench score isn't as good as the latest Pentium, let alone a Core i5, and despite closing the gap in the multi-threaded test, it still couldn't quite topple its rival.

It didn't impress in gaming tests, either. A *Battlefield 4* average of 54fps is some distance behind a Core i5, and in *Rome 2* the FX chip averaged 61fps – close, but still a couple of frames behind. In *Metro: Last Light*, however, the AMD part averaged 60fps, which was good enough to best every Core i5 part.

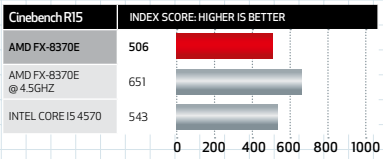
This low-power chip is still unlocked for overclocking, despite its low-power branding and specification, so we took the 200MHz base clock, multiplied it by 22.5 and upped the core voltage to 1.4V. The 4.5GHz core helped the FX chip catch up with the Core i5 in the Cinebench multi-threaded test and the X264 video encoding benchmark, but its single-threaded performance still faltered.

AMD's latest chip set out to prove a point on performance and power consumption, but this part merely demonstrates that AMD's Piledriver architecture is too old to compete. It's barely able to catch up to a Core i5, and its underwhelming pace is paired with still relatively high power consumption. And then there's price, the Core i5 4570 easily has it beat. ■ **Mike Jennings**

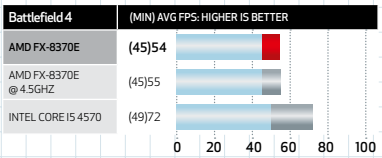
Technical analysis

This chip promises lower power consumption, but AMD's ageing architecture hampers its ambitions. The FX-8370E's idle power consumption of 73W is more than Core i5, and it peaked at 164W – more than most Core i7 silicon. When overclocked, those figures jumped to 79W and 241W, and still at 4.5GHz it can't compete with a standard Intel i5.

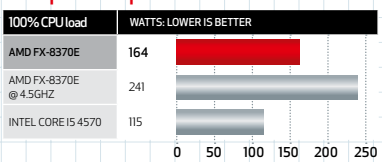
CPU rendering performance



CPU gaming performance



Peak platform power



PCFormat Verdict

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

Better performance than previous AMD parts, but this ageing architecture still can't match Intel in performance or efficiency.

★★★☆☆

£158 INTEL X99 MOTHERBOARD

MSI X99S SLI PLUS

Is this the budget X99 board we've been waiting for?

VITAL STATISTICS

Price £158
Manufacturer MSI
Web http://uk.msi.com
Form factor ATX
Chipset Intel X99
Socket LGA2011-v3
Memory Quad-channel DDR4
Storage M.2, SATA Express, 8x SATA 6Gbps
Extras SLI, Crossfire

This is it – pretty much the cheapest X99 motherboard you can currently buy. Of course, normally giving the nod to the absolute cheapest option in any price category would be asking for trouble.

This time, however, things could be a bit different. For starters, maximising value is critical when making the move to Intel's new high-end X99 platform, the new LGA2011-v3 socket and the Haswell-E PC processors that go with it.

For the first time in living memory, you can actually make a value argument in terms of upgrading from the best quad-core CPUs for the LGA1150 socket – for instance, from the Core i7-4970K to the cheapest of the new Haswell-E processors, the six-core Core i7-5820K. Price-wise, you're looking at just over £250 for the 4970K or just under £300 for the 5820K. Tempting, eh?

Possibly not if you have to add a £100 premium for an X99 motherboard for the 5820K over an equivalent Z97 LGA1150 board. Then there's the extra outlay for DDR4. Put it all together and it's obvious that Haswell-E makes most sense if you can minimise costs. Enter this MSI X99S SLI PLUS effort, therefore.

At a little under £160, it's no bargain basement offering, but it's not very much more costly than a low-end Z97 mobo. What's more, the X99 chipset is a quality item with loads of features regardless of what board it's plugged into.

Game on

First impressions of the X99S are reassuring. There's proper heft and thickness to the PCB. It's a bona fide high-end motherboard in that regard. The core feature set is hardly cut-down, either. You get a full set of eight memory DIMM slots, for example, ensuring maximum flexibility.

Ditto the presence of a full-length M.2 slot and a SATA Express connector. Okay, we doubt many of us will make much use of the latter, but it's there and if SATA Express turns out to be more popular than it currently seems, you're covered. Similarly, there's support for both Nvidia's SLI and AMD's Crossfire multi-GPU platform. Again, only a very small minority of gamers use these technologies, but it's nice know they're there.

Elsewhere, there's an octet of USB 3.0 ports on the back panel, and hardware buttons for power, reset, clear CMOS and MSI's OC Genie function. Finally, the PCB itself is all black with a nice matte finish.

If you're looking for negatives, it is admittedly a little off the pace in terms of the benchmark numbers, but absolutely not to the extent you'd ever notice in the real world. And, critically, it does fine in the most important metric of all: overclocking.

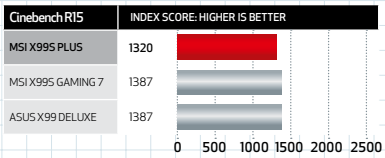
Audiophiles should also note that the sound circuitry is not isolated. In an ideal world, we'd have a LED debug screen to help us troubleshoot during the build process too, and the BIOS menu is a little confusing.

But these are pretty minor concerns. Overall, the X99S is pretty much exactly what we'd hoped for from an entry-level X99 board, and it instantly becomes our weapon of choice for pairing with our new favourite CPU, the 5820K. Nice job, MSI. ■ **Jeremy Laird**

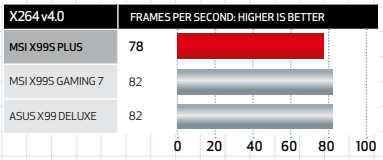
Technical analysis

A superficial perusal of the MSI X99S SLI PLUS's benchmark results is a recipe for disappointment. It's not exactly an across-the-board world beater. Look a little closer and you'll find it does actually lead the way on occasion and where it is behind the pack, the performance delta is throughly inconsequential.

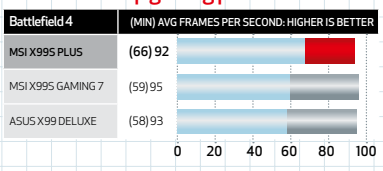
CPU rendering performance



CPU encoding performance



DirectX 11 1080p gaming performance



PCFormat Verdict

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

Exactly what we wanted from an affordable X99 board and perfect for pairing with the six-core 5820K.

★★★★½

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Computer Shopper - 5 Stars
Expert Reviews - 5 Stars
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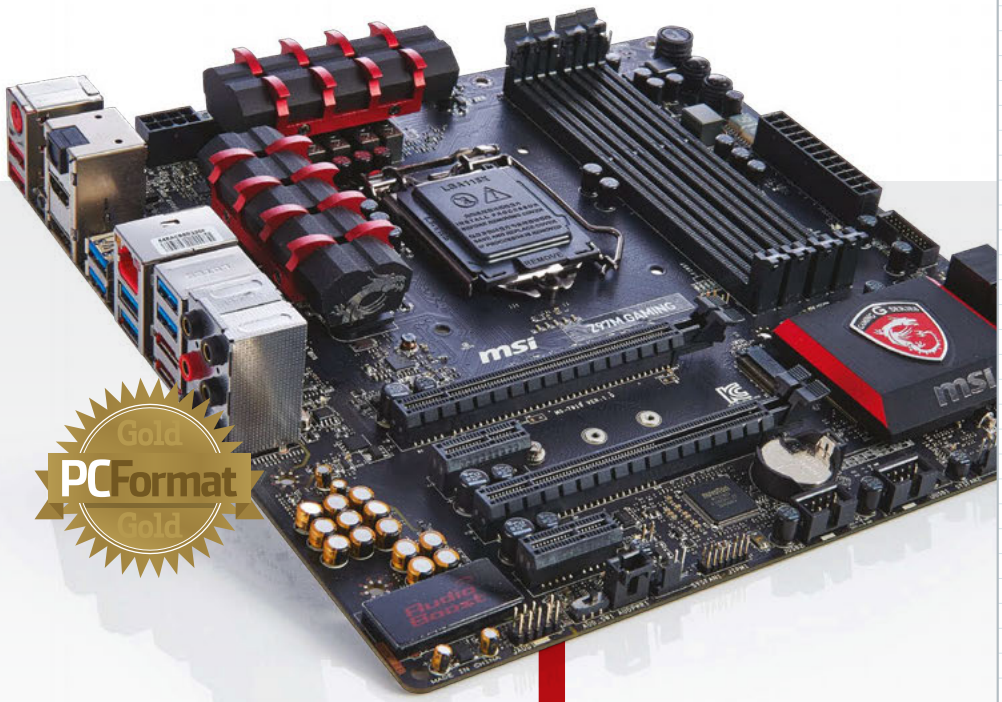


£107 INTEL Z97 MOTHERBOARD

MSI Z97M GAMING

All other things being equal, smaller is better. That's the theory, anyway…

VITAL STATISTICS

Price £107
Manufacturer MSI
Web http://uk.msi.com
Form factor Micro ATX
Chipset Intel Z97
Socket LGA1150
Memory Dual-channel DDR3
Storage M.2, 6x SATA 6Gbps
Extras SLI, Crossfire, HDMI, Displayport

There's something very pleasing about small form factor PCs. It's to do with packing serious power in a compact package to form a dense box of gaming goodness. By comparison, full tower PCs now feel a bit cobbled together. A bit inefficient – even agricultural.

On the other hand, there are limits to the appeal of small PCs. You don't want to make significant compromises in terms of functionality or especially performance. We don't want to pay a massive premium for the privilege of diminutive proportions, either. All of which tends to push us towards the compact micro ATX form factor as opposed to the positively Lilliputian Mini ITX option.

In that context, the new MSI Z97M Gaming should be right up our alley. It's a micro ATX board that seems purpose built to push all our buttons. What's more, we like the price. The direct comparison here involves full-ATX Z97s with SLI and Crossfire support, since that's what the Z97M Gaming provides. They start at around £80, so you *are* paying a premium for the micro ATX thing, but it's not debilitating.

Small and solid

Out of the box, the vibe is good. The PCB is thick, which the small board size only accentuates. This thing is nice and solid. We immediately spot the isolated audio circuitry, too. It's a feature that barely existed a few years ago, but we now find ourselves sniffing it out on every board. If you've got decent speakers hooked up to your PC, it's well worth picking a board with reduced noise and interference.

Next up is the full-length M.2 port that mounts the SSD parallel to the board surface rather than sticking up. Given the small PCB, you might expect a compromise in this area, so it's nice to have full flexibility to choose any M.2 drive you fancy. There's no SATA Express port, but that's fine by us. SATA Express as a standard is looking increasingly dead on arrival.

Elsewhere, you get a pukka LED debug display, physical power and reset switches and a clear CMOS button on the back panel. As we're talking back panels, you'll also find six USB 3.0 ports, HDMI, DisplayPort and optical S/PDIF, among others.

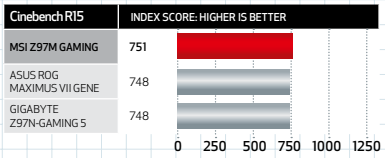
Add in the aforementioned support for both Nvidia's SLI and AMD's Crossfire multi-GPU platforms (albeit limited to two-card configs) and the result is very little by way of compromise in return for a pretty reasonable price premium over a standard ATX board. The only unambiguous negative is the location of the sysfan headers over the far side of the PCB from the CPU fan headers. That's not ideal for a closed-loop water cooler.

As for performance, there's not much to report. The Z97M Gaming kicks out numbers that are very much in the same ballpark as a wide range of Z97 boards of all shapes and sizes. If we were being hyper critical, the 4.6GHz overclocking result is just a smidge disappointing. But the best of the rest only manage 4.7GHz, so it's hardly a disaster. If you're looking for a board for a compact gaming rig, the Z97M Gaming should be towards the top of your shortlist. ■ **Jeremy Laird**

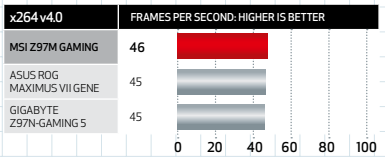
Technical analysis

That there's no real news in our benchmark results is actually good news. The only way that a Z97 motherboard really sets itself out from the rest, in terms of stock-clocked benchmarks, is by being a bit borked. All healthy Z97 motherboards kick out very similar numbers. And even in overclocking terms the Z97M is competitive.

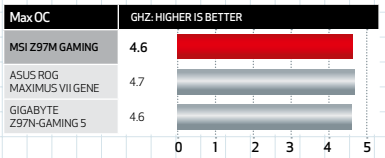
CPU rendering performance



CPU encoding performance



Overclocking performance



PCFormat Verdict

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

An almost compromise-free way to squeeze all the the power of your gaming rig into a smaller form factor.

★★★★½

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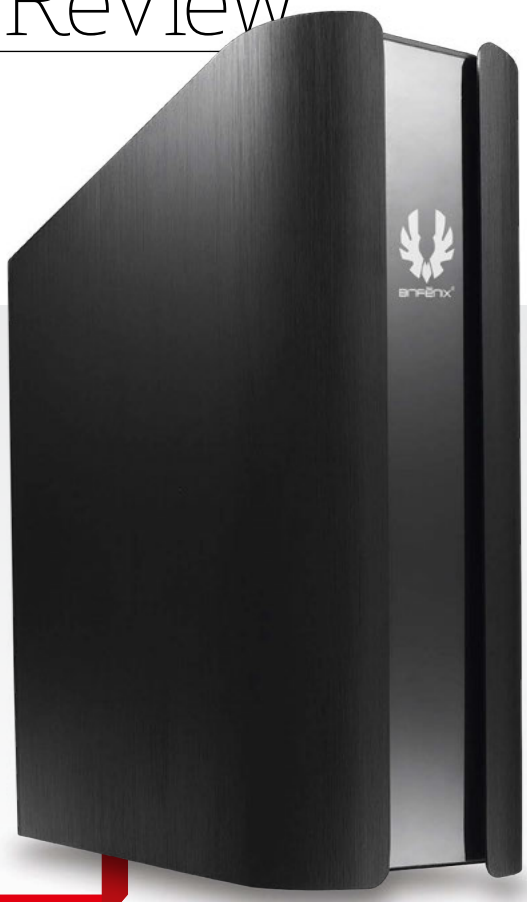

£94 MICRO ATX CHASSIS

BITFENIX PANDORA

A small form factor chassis with a little of the Cylon about it

VITAL STATISTICS

Price £94
Manufacturer BitFenix
Web www.bitfenix.com
Form factor Micro ATX, mini ITX
Drive bays 2x 3.5in, 3x 2.5in
Expansion slots 5
Front panel 2x USB 3.0, Audio I/O
Cooling 2x 120mm fans
Dimensions 160 x 420 x 465mm

Small form factor chassis are getting a lot bigger these days. This new micro ATX chassis from BitFenix, the Pandora, isn't much smaller than a normal ATX mid-tower case. But considering the power available in small form factor hardware right now, that extra size is needed.

The sweeping, curved front of the Pandora helps make it seem smaller than it is, though it really is a relatively slimline chassis at only 160mm wide.

The styling of the Pandora is its real strength. The use of thick, metal plates for the side panels is a good choice and gives our version a certain Mac aesthetic. The windowed version enables you to make sure everybody knows that its a PC though, letting you blast out eye-burning LED lights from your motherboard or graphics card.

You can get a whole host of funky new tech inside the Pandora too. BitFenix has made sure there is a healthy amount of space in there to house even the chunkiest of components. There's space in the roof for a 240mm radiator, which is good seeing as you could drop a beefy Haswell E setup inside thanks to micro ATX X99 boards like the EVGA one we've featured as a centre-fold this issue. The Pandora will house seriously chunky graphics cards too; if you eschew CPU water cooling, you could happily fit an R9 295X2 in there.

BitFenix is a big supporter of the modding crowd too – just check out the different Prodigy builds that have been put together in the wild. And the Pandora is making it easier than ever to personalise your PC by including a 2.4in (240 x 320) TFT screen in the front, the BitFenix ICON. You can drag and drop images onto the display via the software interface to give it that personal touch.

Building

But the Pandora isn't without a few problems. We're not particularly sold on the 'pop-off' side panels. We'd prefer to have screws securing the sides of our PC rather than hoping the push clips remain secure. We're the sort of folk to be opening up our PCs on a semi-regular basis, and we can't help feeling that the fit is going to get looser over time, ending up with loose-fitting, rattly panels. The push-to-release top vent is also a bit of an issue on our review sample. The first time we tried removing the grating, one of the two connections failed, meansing it no longer fits securely on top.

That's a real shame as the sweeping, sleek aesthetic is darned attractive and the internal design is rather impressive too. Despite not having a lot of space inside for such luxuries as cable management, it still manages to provide routing for the fattest of wires to make sure they're not obstructing either airflow or the view from the optional Perspex side-panel.

The Pandora has something of the Cylon about its curvy, armoured finish, but we'd struggle to really recommend it as an effective chassis for your DIY small form factor build. A more secure fit to the side panels and a more robust top vent though might go a long way towards changing our minds. ■ **Dave James**

PCFormat Verdict

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

A lovely-looking small form factor chassis, just let down by a few questionable design choices on the otherwise sexy side-panels.

★★★½☆

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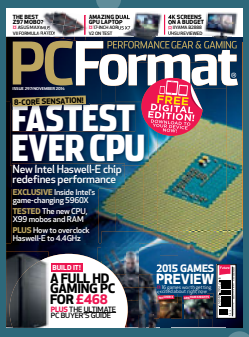

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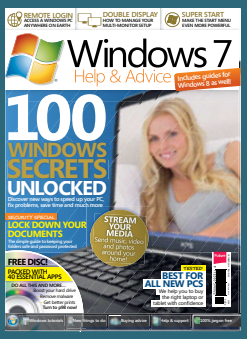

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£70 GAMING HEADSET

PLANTRONICS RIG

Sensibly-priced surround cans throw themselves into the mix

VITAL STATISTICS

Price £70
Manufacturer Plantronics
Web www.plantronics.com
Driver size 40mm
Frequency response range 20Hz – 20KHz
Connection USB, 3.5mm stereo jack (auxiliary out)
Impedance 32
Mic sensitivity -58dB

Plantronics isn't just a gaming headset manufacturer – it also produces audio and comms equipment for the world of business, which means there's a good chance of finding its wares in any given call centre. Not an incendiary nugget of information on its own, but it is pertinent to the RIG. This mid-priced gaming setup is designed to be equally at home pumping out game audio or being used for Skype calls.

That functionality is facilitated by the mixer – a wired soundcard/amp supplied with the headset that allows you to adjust your mic and PC audio output levels and flick between connected devices. Yep, it can be hooked up to both your PC and a mobile device simultaneously. Around the edge of its plastic body is an overall volume control, which contains faders for adjusting mic and in-game levels. In the centre lies a switch that changes whether you hear the feed from the 3.5mm cable, or via USB. In theory you can connect your smartphone or tablet, then your PC, and never take off the RIG ever, *ever* again.

The sound of progress

The real-world problem-solving potential doesn't strike us as particularly high with this one (is it much of a chore to just answer your phone?), but nonetheless it's a new and interesting proposition that allows some handy, if specific, lifehacks. For example, you might want to listen to podcasts from your phone while playing something on your PC. The RIG can make it so. Or perhaps your buddy doesn't have a gaming headset, so you want to talk on the phone while you play. Okay, we're stretching now.

Perhaps we're feeling uncharitable because of the morass of cabling it produces. The 3.5mm cable doesn't detach, so even if you never intend to hook up a mobile device, you're stuck with its useless, dangling length.

Trying to figure out the merit of the RIG's multi-connectivity makes us feel like pensioners scanning the categories on Netflix, so let's stick to the basics: the headset itself is one of the best we've come across at this price range in looks, build quality and overall sound. Its visual design is understated enough to be used on the go, and as the boom mic can be swapped out for an inline remote, that's well within the RIG's capabilities.

Surround sound is pretty impressive too, pricing considered. Whizzing bullets and other Dolby clichés don't sound quite as immersive as with top-end cans, but there is a noticeable difference to run-of-the-mill headsets in the same price range. We have a few minor reservations regarding overall sound quality: the closed cup design doesn't isolate external noise completely, meaning some low-end oomph is lost, and although three EQ settings are offered by a button on the mixer, we found they all run a little hot and sound on the verge of distortion at higher volume levels.

As an overall package, the RIG can mix it with the best. It's just odd to see it bound to that largely extraneous mixer – we'd much prefer a model without. ■ **Phil Iwaniuk**

PCFormat Verdict

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

You can't fault a thing for having *too much* functionality, so the RIG's baffling mixer doesn't nullify its build and sound quality.

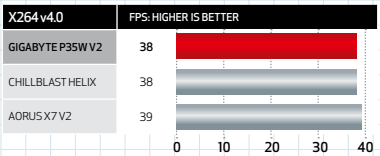
★★★★☆

£1,399 GAMING LAPTOP

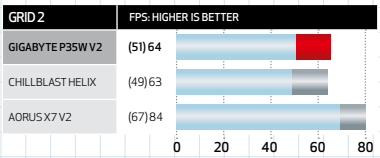
Technical analysis

The base specifications of this machine are remarkably close to the slightly cheaper Chillblast Helix we reviewed a couple of issues ago, and the performance isn't that different either. We've also compared it to the pricier Aorus X7 V2 that we saw last issue (£1,750), which boasts a pair of GTX 860M GPUs, but otherwise has a fairly similar spec.

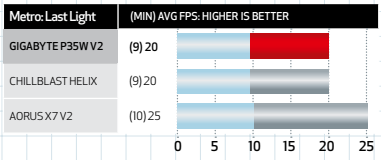
CPU rendering performance



DirectX 11 gaming performance



DirectX 11 gaming performance



GIGABYTE P35W V2

With power where it counts there's a lot to love here, but it isn't quite perfect

VITAL STATISTICS

Price £1,399
Manufacturer Gigabyte
Web www.gigabyte.com
CPU Intel Core i7-4710HQ
Memory 16GB DDR3
Graphics GTX 870M GDDR 6GB
Display 15.6in, 1,920 x 1,080
Storage 2x 128GB mSATA SSD + 1TB 5,400rpm HDD
Dimensions 385 x 270 x 21mm
Weight 2.3kg

Here we are once again, having that most delicious carrot waved in front of us – the promise of the gaming Ultrabook. With each new laptop that offers this dream-like prize we seem to be getting closer and closer to that particular gaming nirvana – but can Gigabyte actually deliver on the goods this time? Well it certainly puts in a darn good show.

The big sell for this machine, as far as gaming is concerned, is the graphics subsystem. The P35W v2 boasts Nvidia's GeForce GTX870M – at least until the mobile Maxwell GPUs roll out. This GK104 Kepler GPU has 1,344 CUDA cores and lays claim to 6GB of GDDR5 memory, big by anyone's standards, and clearly enough to handle this laptop's 1,920 x 1,080 display.

This is joined by an Intel Core i7-4710HQ, which is a quad-core processor with hyperthreading. This Core i7 boasts 6MB of cache and has a default clock speed of 2.5GHz, which can turbo up to 3.5GHz. It's paired with 16GB of DDR3 RAM to offer up a base configuration that handles gaming and more serious day-to-day tasks with ease.

At high settings and at the screen's native 1080p resolution you're looking at smooth frame rates (above 30fps at any rate). This power isn't limited to making the most out of your games either, with that beefy core helping you to do more productive things with the 15.6in screen.

Speed and sound

While the processor and graphics subsystems are obvious hits with the P35W v2, there is surprising power on the storage front too. The main boot drive is made up from a pair of 128GB mSATA drives in a RAID array to produce a speedy home for Windows 8 – a sequential read and write performance of 923MB/s and 595MB/s respectively. Impressive. This tails off a tad when it comes to 4k performance – 25.8MB/s and 51.8MB/s for reads and writes respectively – but you're still looking at a great home for your OS. This is backed up by a healthy 1TB data drive, so there's plenty of room for games and data too. The inclusion of the Blu-ray drive is impressive given the thin chassis, especially as Gigabyte has included a bracket that enables you to add even more storage to the machine.

While this all sounds very promising and would normally have us reaching for the gold award, there are a couple of factors that hold it back from receiving that cherished accolade. The first is the weight. While this is certainly a thin machine, at 2.3kg it can't really be described as light. It's just that tad too heavy to be slung around easily. The price is a little on the high side too. You do get a lot for your pence, but it's still a high initial outlay.

Our main frustration though is something that has annoyed us since the very first gaming Ultrabooks appeared: when you stress the processor or the graphics subsystem, the cooling fans whirr noisily into action. It isn't jet-engine territory, but it's still loud enough to put you off your film watching, pull you out of your immersive game, or just plain annoy you. ■ **Alan Dexter**

PCFormat Verdict

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

A powerful gaming laptop for certain, but a loud and a slightly heavy one as well. The price isn't going to be for everyone either.

★★★★☆

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. Want 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 getting 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 at our guide. 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'll have more cash to spend elsewhere. And what's our recommendation if you find yourself with that pleasant problem? 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 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

MOTHERBOARD	
■ Gigabyte B85M-D2V	£38
CPU	
■ Intel Pentium G3258	£52
MEMORY	
■ Crucial 4GB 1600 DDR3	£36
GRAPHICS CARD	
■ MSI GTX 750 Ti OC	£103
SOLID STATE DRIVE	
■ Crucial MX100 256GB	£79
CPU COOLER	
■ Intel Stock Cooler	NA
POWER SUPPLY	
■ SilverStone Strider E 500W	£40
CHASSIS	
■ Corsair Carbide 200R	£47
OPTICAL DRIVE	
■ LG GH22LS50 DVD-RW	£17
SCREEN	
■ AOC E2250SWDNK	£79
Total	£491

MAINSTREAM

MOTHERBOARD	
■ Asus Z97-A	£114
CPU	
■ Intel Core i5-4690K	£180
MEMORY	
■ Corsair Vengeance LP 8GB	£58
GRAPHICS CARD	
■ Sapphire R9 285	£170
SOLID STATE DRIVE	
■ Crucial MX100 512GB	£150
CPU COOLER	
■ Enermax ETS-T40	£28
POWER SUPPLY	
■ OCZ ModXStream Pro	£52
CHASSIS	
■ Cooler Master CM690	£60
KEYBOARD	
■ Corsair Vengeance K65	£65
SCREEN	
■ Viewsonic VX2370Smh-LED	£123
Total	£1,000

HIGH-END

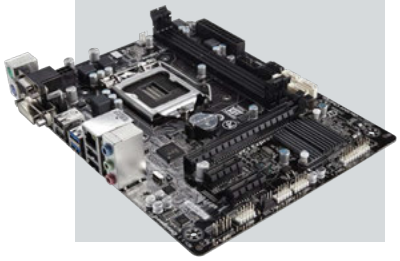
MOTHERBOARD	
■ Asus X99 Deluxe	£236
CPU	
■ Intel Core i7-5960X	£769
MEMORY	
■ Corsair Vengeance LPX 16GB	£283
GRAPHICS CARD	
■ MSI R9 295X2	£700
SOLID STATE DRIVE	
■ Samsung 840 EVO 1TB	£389
CPU COOLER	
■ Thermaltake Water 2.0 Ext.	£105
POWER SUPPLY	
■ CM Silent Pro Gold 1000W	£171
CHASSIS	
■ CM Cosmos 2 Ultra	£286
KEYBOARD	
■ Corsair Vengeance K70	£120
SCREEN	
■ HP ZR30W 30-inch	£922
Total	£3,981

BUDGET

WHEN EVERY POUND COUNTS, SPEND THEM WISELY

MOTHERBOARD
Gigabyte B85M-D2V

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



CPU
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.

CPU COOLER
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.

MEMORY
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
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
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
SilverStone Strider E

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.

OPTICAL DRIVE
LG GH22LS50 DVD-RW

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

CHASSIS
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
AOC E2250SWDNK

This 21.5-inch panel has a native resolution of 1,920 x 1080 and looks pretty good despite that ridiculously-low price tag. It's no IPS-beater, but it'll do for half the cash.

MAINSTREAM

YOU DON'T HAVE TO SPEND A FORTUNE TO GET A STUNNING RIG

MOTHERBOARD
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
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.

CPU COOLER
Enermax ETS-T40

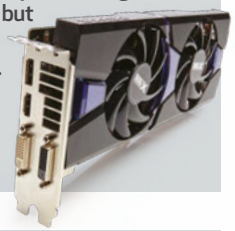
Enermax has simply amazed us with this, its first CPU cooler. The performance is excellent, the price is astonishing, it's easy to fit and it isn't so big that it limits your case or mobo choices.

MEMORY
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
Sapphire R9 285

The brand new Tonga Pro GPU in AMD's R9 285 is an impressive wee thing, making it our favourite sub-£200 card right now. The 2GB frame buffer might be a worry for the high-res future, but it's a beauty.



SOLID STATE DRIVE
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
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.

KEYBOARD
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.

CHASSIS
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
Viewsonic VX2370Smh

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

HIGH-END

IF YOU REALLY WANT TO TREAT YOURSELF, THIS IS HOW TO DO IT

MOTHERBOARD
Asus X99 Deluxe

As usual this Deluxe board from Asus is absolutely stuffed with funky features. It's one of the finest, and best-looking, X99 boards around and not a bad overclocker either.

CPU COOLER
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.

MEMORY
Corsair Vengeance 16GB

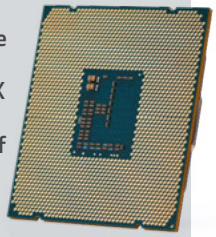
The Haswell E platform is the first to bring DDR4 to the consumer. That does though come at a hefty price, but it's damned quick...

GRAPHICS CARD
MSI R9 295X2

The dual-GPU R9 295X2 is undeniably the quickest card around. We still worry about these sort of cards, but the liquid-chilling helps those concerns, and it's a beast at 4K.

CPU
Intel Core i7-5960X

If you're after the fastest, most advanced CPU around the eight-core/sixteen thread Haswell E is it. There is also the six-core i7 5820K for a more reasonable £300, but the 5960X is the pinnacle of modern CPUs.



SOLID STATE DRIVE
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
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 PCF246.

KEYBOARD
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 with the red backlight glowing against its black brushed metal chassis.

CHASSIS
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 to drop this much on your case, you'll be more than happy.

SCREEN
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.

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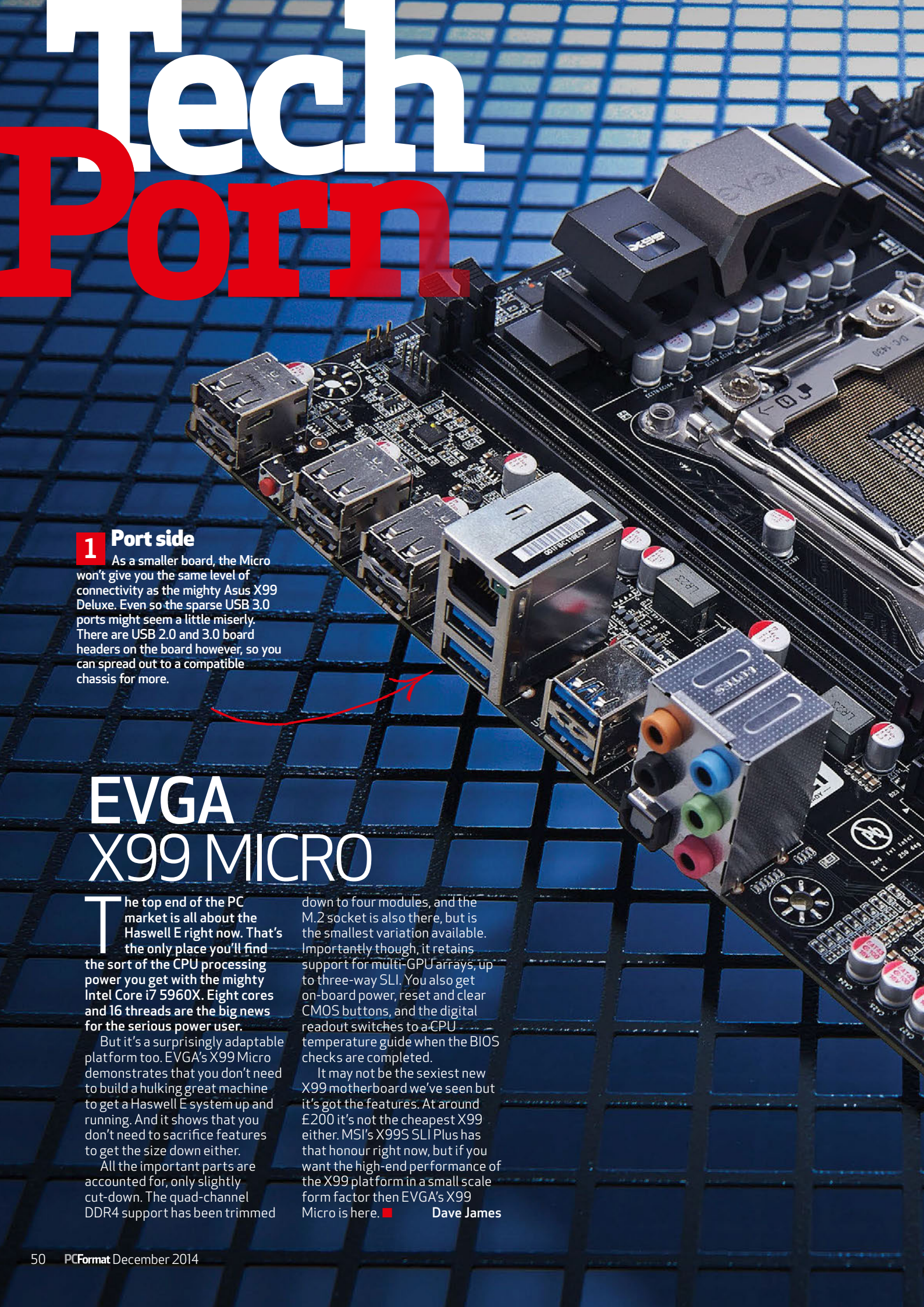
Tech Porn



1 Port side
As a smaller board, the Micro won't give you the same level of connectivity as the mighty Asus X99 Deluxe. Even so the sparse USB 3.0 ports might seem a little miserly. There are USB 2.0 and 3.0 board headers on the board however, so you can spread out to a compatible chassis for more.

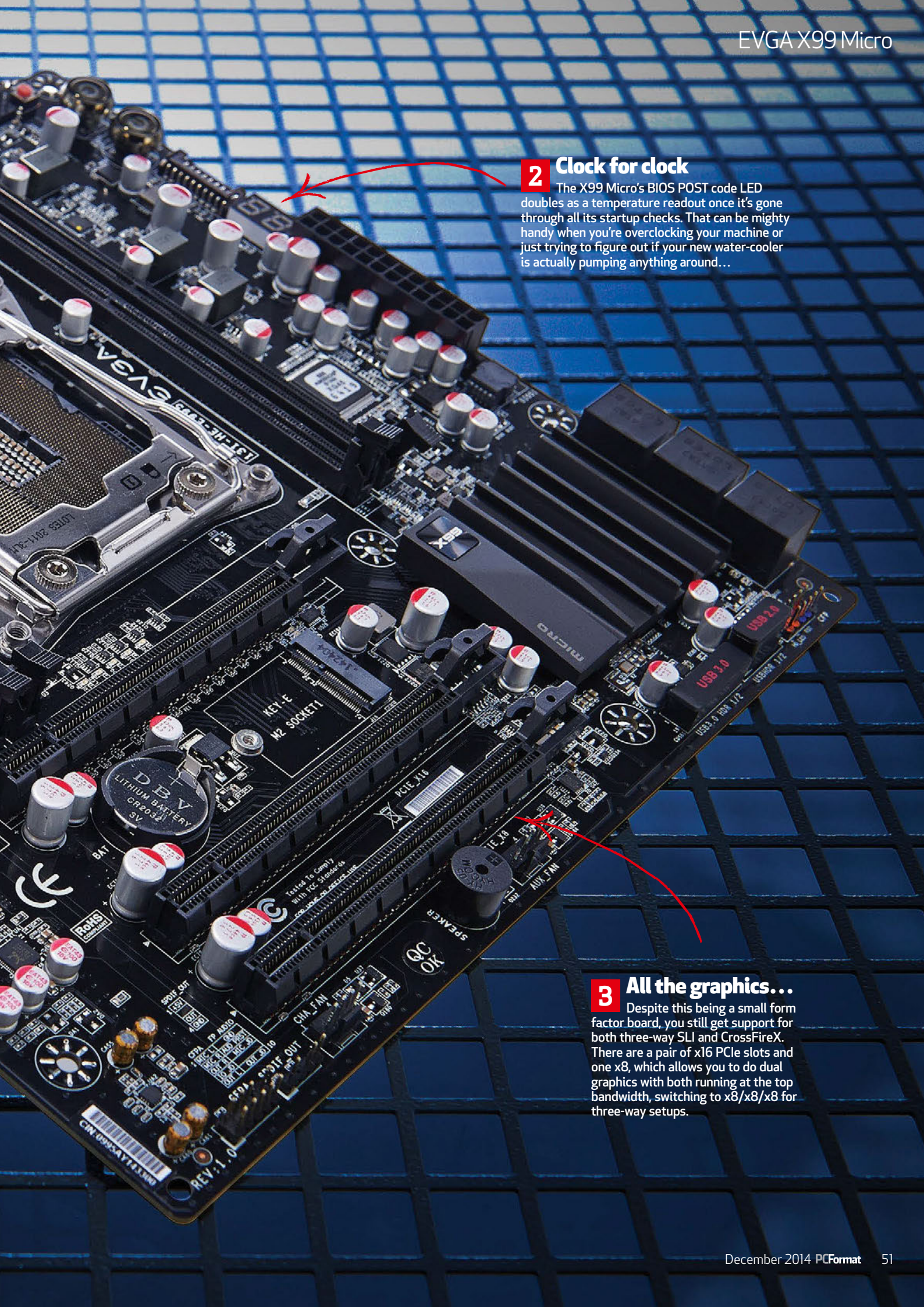
EVGA X99 MICRO

The top end of the PC market is all about the Haswell E right now. That's the only place you'll find the sort of the CPU processing power you get with the mighty Intel Core i7 5960X. Eight cores and 16 threads are the big news for the serious power user.

But it's a surprisingly adaptable platform too. EVGA's X99 Micro demonstrates that you don't need to build a hulking great machine to get a Haswell E system up and running. And it shows that you don't need to sacrifice features to get the size down either.

All the important parts are accounted for, only slightly cut-down. The quad-channel DDR4 support has been trimmed down to four modules, and the M.2 socket is also there, but is the smallest variation available. Importantly though, it retains support for multi-GPU arrays, up to three-way SLI. You also get on-board power, reset and clear CMOS buttons, and the digital readout switches to a CPU temperature guide when the BIOS checks are completed.

It may not be the sexiest new X99 motherboard we've seen but it's got the features. At around £200 it's not the cheapest X99 either. MSI's X99S SLI Plus has that honour right now, but if you want the high-end performance of the X99 platform in a small scale form factor then EVGA's X99 Micro is here. ■ **Dave James**



2 Clock for clock

The X99 Micro's BIOS POST code LED doubles as a temperature readout once it's gone through all its startup checks. That can be mighty handy when you're overclocking your machine or just trying to figure out if your new water-cooler is actually pumping anything around…

3 All the graphics…

Despite this being a small form factor board, you still get support for both three-way SLI and CrossFireX. There are a pair of x16 PCIe slots and one x8, which allows you to do dual graphics with both running at the top bandwidth, switching to x8/x8/x8 for three-way setups.

SHOW REPORT

IDF 2014

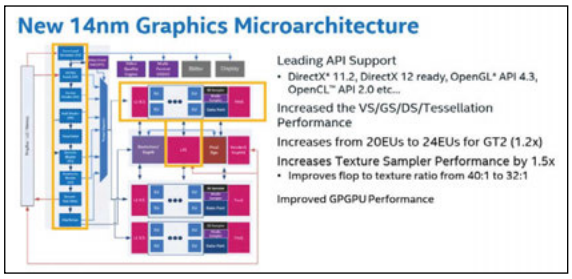
Dave James straps on his geek-hat and delves into an Intel Developer Forum full of Broadwell, Skylake, wearables and 711 million PC gamers

This is the first IDF in recent memory where Intel has spent so much time talking about the desktop PC. There were no claims to being just six months away from having the best phones, and the big data server stuff had been given its own session elsewhere. Intel's Kirk Skaugen, senior VP of its Client Group, even took to the stage in the opening keynote enthusing about how "one in 10 people on the planet" were PC gamers.

"Desktop is alive and well," Skaugen exclaimed. "It's innovating, whether it's small form factors, all-in-ones, portable all-in-ones or extreme gaming."

This all came from an excited Intel talking up its new Broadwell processors, which are definitely, honestly, out early in 2015. Skaugen was happily painting the picture of its advanced new 14nm production process finally at a volume production stage for its new processors. Broadwell is the die-shrink 'tick' to the Haswell CPU architecture's 'tock', and we'll then see new, more efficient Core processors dropping into the same 9-series chipset as the latest Devil's Canyon range.

If that all sounds rather familiar, it's because at the same keynote last year, Intel CEO Brian Krzanich held up 'working' Broadwell silicon, proclaiming: "This is it folks. 14nm is here. It's working and we'll be shipping by the end of the year."



The new spin on the graphics side makes Broadwell more of a tick-plus

But, after problems with yields in the manufacturing process, it really *is* here this time and really *will* be shipping by the end of this year instead. Only we won't be seeing the Devil's Canyon chips being usurped just yet – it will be the new Core M Broadwell that drops just before the end of 2014.

POWER FOR PORTABLES

But, damn, the Core M processor looks impressive. I got to play with the new 4.5W 14nm chip at IDF with Intel's benchmarking team. The Core M is the new marketing name for the old, low-power Y variants of Intel's Core Architecture, and will power a new range of 2-in-1 Ultrabooks and tablets.

The big selling point of the Core M processor is that it's suitable for implementation in a completely fanless design while still retaining all the goodness of a bona fide Core architecture processor. This is no Atom chip, people. In fact, the most interesting comparison for the Core M is putting it up against the Core i5 4300U Microsoft has used in the Surface Pro 3. MS must be cursing the Broadwell delays robbing it of using this powerful, passively-cooled CPU for its flagship productivity tablet.

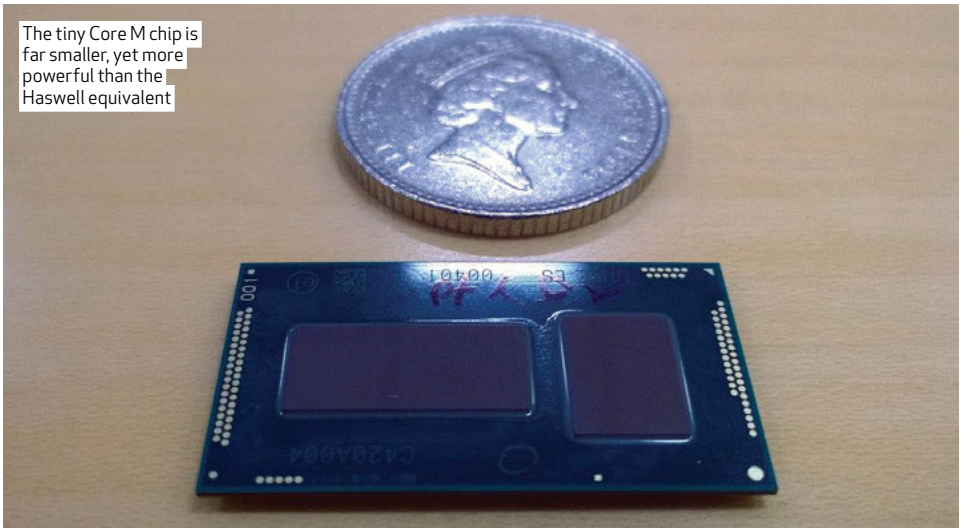
The Llama Mountain reference sample we saw was using the 'up-config' of the Core M. Intel's ingénieur extraordinaire, Francois Piednoel, explained the three OEM-controlled states you can run the Core M in. The 'up-config' is designed for maximum performance and runs at 6W, the 'down-config' is there for extending battery life and is the 3W option, and the 'standard' level is the quoted 4.5W.

In straight Cinebench terms, the Core M 5Y70 was running only around five per cent slower in the multi-threaded CPU rendering test. Considering that's with the chip running at 6W compared with the 15W of the Core i5, that's mighty impressive stuff.

But those TDPs are a little misleading because they're just the average thermal design over time, not the maximum wattage a Core M will hit. Intel's engineers are confident that it's more efficient to drive the silicon to peak performance as quickly as possible in order to power through a processing task quicker than it would be to ramp up slowly.

"One of the strengths of Core M," Piednoel explained, "is that we have found ways to ramp very quickly from 500MHz to 2.6GHz, and that gives us awesome responsiveness.

'If I want to raise my voltage very fast and I want to go from 500MHz to 2.6GHz,' he continued, 'I better crank up the wattage just for a few micro-seconds just to get my voltage up. If you measure very closely you will see a peak, but that's not the TDP."



The tiny Core M chip is far smaller, yet more powerful than the Haswell equivalent

So if you look closely, you'll see that the Core M is capable of spiking up to 15W for a few microseconds in order to raise the clockspeed quicker. That was borne out by the Sunspider test on the Llama tablet (I would *so* buy a tablet called simply 'the Llama'). The Core M completed the test in 115ms, while the Surface Pro 3's i5 took 196ms. That's quite a hefty win for the wee fella.

DESKTOP DEALINGS

On the laptop/2-in-1/pro-tablet side of things then, Broadwell looks like a mighty fine CPU. We're not so sure the desktop chips are going to be so exciting though. Lisa Graff, Intel's VP of the Desktop Client Group, was rather non-committal over whether we would see any K-series i3 chips in the same vein as the excellent Pentium Anniversary chip.

"We'll take a look," she told me. "We're going to see how these [Pentium Anniversary] do and get customer feedback on what they like and what they don't like, then we'll use that feedback and plan whatever the next thing will be."

But on the plus side, we will definitely see socketed Iris Pro CPUs with the 14nm Broadwell chips. For the homebrew mini-PC that's a definite bonus. 'What we haven't had is the ability to have a socketed desktop processor with really high performance integrated graphics.' Graff explained. 'Especially for desktop, this part I'm talking about, that will be the big hitter for us with Iris Pro graphics.'

And the graphics part of Broadwell is looking like getting more than just a die-shrink too. "It's not just a tick," explained Intel's graphics manager, John Webb. "It's a tick plus on the graphics." IDF saw Intel graphics engineers detailing the redevelopment they've enacted on the GPU component. Now we get an extra four execution units (EUs) over Haswell in the standard core. It should then follow that Iris Pro comes with another eight, taking it up to a possible 48 EUs.

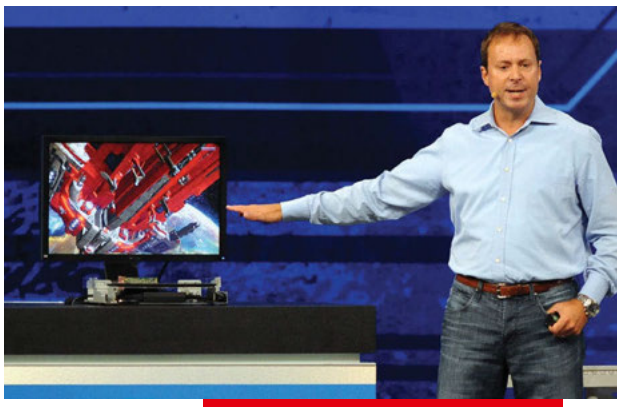
Just looking at the standard HD 5300 GPU in the Core M Broadwell compared with the higher-clocked HD 4400 in the Core i5 4300U (850MHz vs. 1.1GHz), the Broadwell graphics are definitely quicker. I only had 3DMark Ice Storm Unlimited available to use in the benchmarking session, but with a score of 50,439 compared with Haswell's 48,173, Broadwell's processor graphics are looking good. Socketed Broadwell Iris Pro should be a lot better.

FOSSIL FUELLED

The forum wasn't just about the new CPUs, though – Intel was also talking up the rise of wearables. Given Apple was hyping its new Watch a mile or so down the road that wasn't a great surprise, but a partnership with fashion brand Fossil was. Intel's Brian Krzanich wheeled out Fossil's CMO Greg McKelvey on the opening day.

He explained that while Fossil had been in smartwatches for a decade, the technology hadn't really been there – "the battery life was more nuisance than convenience," he explained. But now the combination of functional technology and interest from non-techie types means the wearable is starting to catch on. Krzanich also showed off the BioSport SMS earphones with heart-rate monitoring, which run directly from your phone's battery, and a fashion-conscious smart bracelet called the Mica.

Finally we also saw the launch of Intel's Edison machine. Essentially it's a Raspberry Pi-a-like, but running on an x86 22nm Atom CPU, clocked at 500MHz, with 1GB DDR3 RAM, a 32-bit Quark MCU (multipoint control unit) and 4GB eMMC storage. Intel is hoping to court the makers with Edison, and hopes to possibly drive a wave of homebrew wearables too. ■



Kirk Skaugen showing Skylake running 3DMark comfortably

Wearables got their time in the sun too, like these heartbeat-tracking headphones

Skylake's not far away...

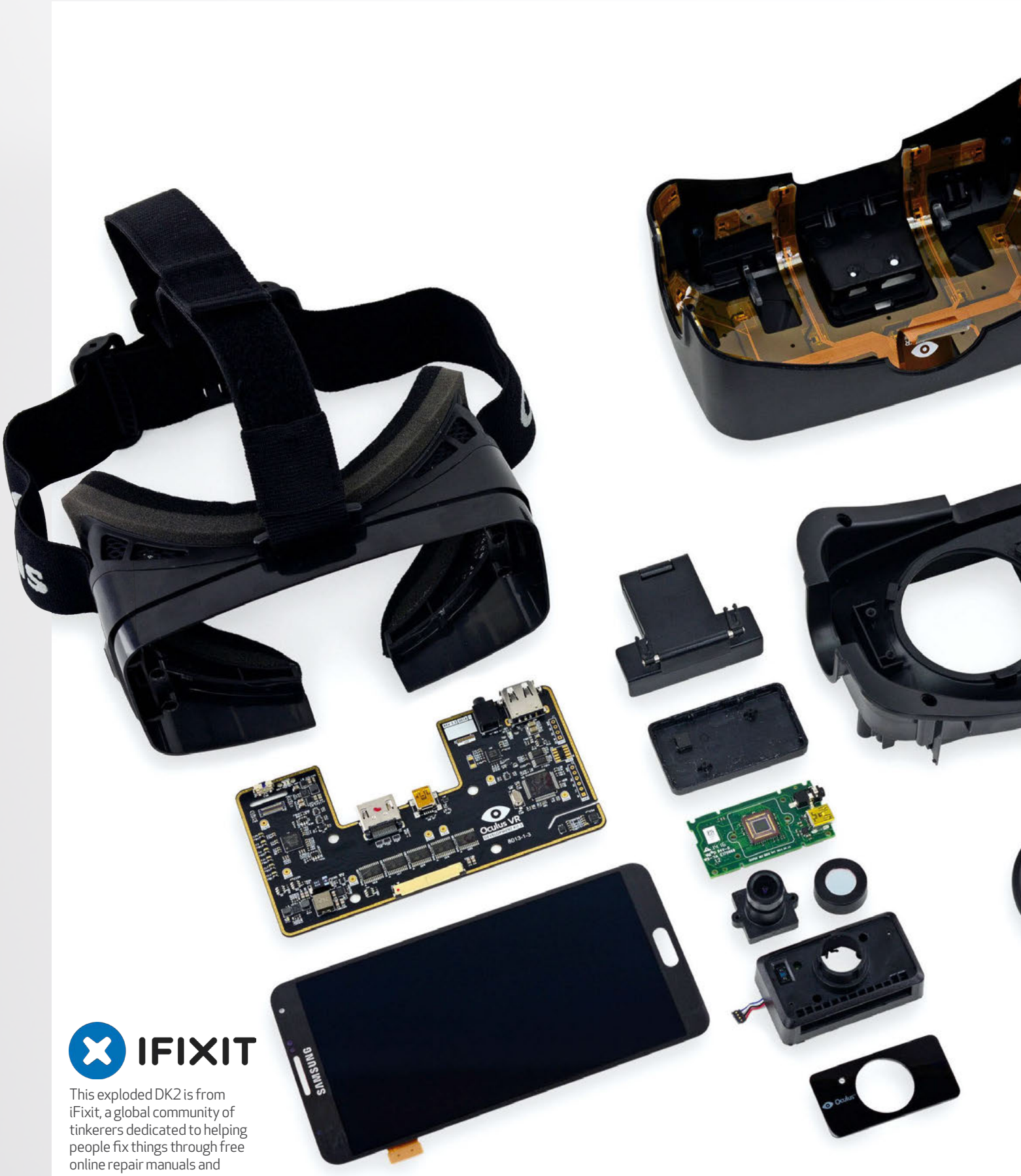
...but that may not be great news for the desktop Broadwell CPUs

It wouldn't be an IDF without some future-gazing, but not normally with a demo of a new CPU a couple of generations past where we are right now. But that's what Kirk Skaugen did in the main keynote this year. He showed off both a 14nm Skylake (6th Gen Core) laptop and a prototype desktop running 3DMark with claims that at the same time as Broadwell chips are making their way into the machines of us consumer folk, the reference Skylake silicon will be in the hands of the manufacturers and developers. Following that, in the second half of next year we'll have a brand new Skylake 14nm microarchitecture to enjoy.

"You should expect a significant increase in performance, in battery life, in power efficiency," said Skaugen. "I'm excited, I'm ecstatic on the health of Skylake. Because Skylake's going to be so amazing – everyone's working on Skylake right now."

So, from a development point of view, it seems that Broadwell has been forgotten by manufacturers before it's even been released. Intel expects the OEMs to simply drop Broadwell into their existing pin-compatible designs, and so will have now shifted focus to Skylake to get their machines finished and ready to roll out the next time there's an IDF for us to attend.

But we can't help wondering just how late Broadwell would have to have been for Intel to have ditched it entirely and moved over to Skylake. With Broadwell desktop chips not expected on the scene until the spring and Skylake arriving in the second half of the year, you could potentially see the 6th Gen Core architecture just six months after the 5th Gen. More likely though, Intel will release Skylake on a few select mobile SKUs in 2015, pushing the desktop release back until possibly early 2016.



IFIXIT

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BUILD AN OCULUS RIFT PC

THE OCULUS RIFT COULD BE THE BIGGEST THING TO HIT GAMING SINCE *DOOM*. MAKE SURE YOU HAVE THE RIGHT EQUIPMENT TO FULLY EXPERIENCE THE REVOLUTION

You might have heard about the Oculus Rift (especially if you're a regular reader of *PC Format*). It started life as a Kickstarter campaign to create a wearable virtual reality head-mounted display that can be connected to your PC.

Its aim was to finally live up to the potential of virtual reality by making us feel as though we are really inside the game – and avoiding the headache-inducing problems of its forebears. Some of us are still dizzy from trying Nintendo's Virtual Boy in the '90s. The Oculus Rift's potential has led to it being incredibly successful – and it hasn't even been officially released yet. When Facebook buys you for $2 billion, you know you're on to something pretty amazing.

What makes the Oculus Rift stand out from the failed virtual reality offerings of the past is that it has successfully achieved presence when running in-game. What this means is that when you're wearing the Oculus Rift, your brain can be fooled into believing that you actually are in the game world. This is achieved through a number of technologies that work together to make the virtual reality of the Rift as convincing as possible. Needless to say, for this level of immersion, you're going to need a very capable PC.

Part of the appeal of the Oculus Rift is that you'll be able to plug it in to almost any PC. At the moment, there aren't any minimum system requirements to use the device – all it needs is an HDMI or DVI video-out port, which almost all recent PCs have. However, just because you *can* plug the Oculus Rift into your Windows Vista laptop with 1GB of RAM and onboard graphics, doesn't mean you *should*. The more powerful your computer, the better the virtual reality experience will be – so if you really want to achieve presence in-game, you might have to be prepared to perform some upgrades. However, the promise offered by the Oculus Rift means that it will be well worth the expense. Here's how to get your rig VR-ready.

If the Oculus Rift hasn't officially launched yet, why would you think about upgrading your PC already? Well, to start with, just because the consumer version isn't available to buy, it doesn't mean you can't use an Oculus Rift right now. The Oculus Rift DK2 (Development Kit 2) is currently being shipped out to people who have pre-ordered it, or supported Oculus Rift on Kickstarter. Although it's primarily designed for developers who want to make, or port, their applications and games to the Oculus Rift, it does contain a number of advancements over the original Development Kit, most of which will make it to the consumer version when it releases. If you simply can't wait to try the Oculus Rift (and who could blame you?) the DK2 is a good choice.

It's also wise to begin planning your upgrade in preparation for the release of the consumer version from a practical perspective. You don't necessarily have to go out and buy all the new components immediately, but it's a good idea to know exactly what you'll need to upgrade so your PC is ready when the consumer version launches. There's very little worse than owning a new toy that has to remain in its packaging because your current PC isn't up to the task.

"The biggest strain the Rift is going to put on your PC is in the graphics department"

The Oculus Rift Development Kit 2 shows noticeable streamlining in size and shape

GRAPHICS

The biggest strain the Oculus Rift is going to put on your PC is in the graphics department. Realistic graphics aren't the be-all and end-all of creating immersive effects in virtual reality. After all, we're seeing some very exciting Oculus Rift projects that make use of stylised graphics, rather than photo-realistic ones. But there will no doubt be some very graphically demanding games that will look phenomenal, and you'll want your PC to be able to handle them.

It's also worth noting that for the best levels of immersion, the DK2 model uses two OLED screens (one for each eye) that display a resolution of 960 x 1,080 each. So not only will your graphics card need to be powerful enough to display impressive graphics, but it will have to be able to do it twice.

There are rumours that the consumer version may ship with even higher resolutions. In the future we may even see an Oculus Rift that can handle 4K – great for immersion, but your GPU will struggle. At a minimum, the Oculus Rift needs to display the graphics at a 60Hz refresh rate. While this is pretty standard for most monitors, for the best effect you'll want to be able to display the graphics at 75Hz. In order to keep the virtual reality world around you from feeling sluggish – or having a sense that things are moving in slightly slow motion – or from causing motion sickness, latency is also an important factor to keep down, with a system latency of 50 milliseconds being the current goal (although ideally it would be under 20).

John Carmack, Oculus VR's CTO and a no doubt familiar name for PC gamers, has been particularly concerned with latency issues in modern GPUs. He was also seen at the launch of Nvidia's G-Sync project, so there is a good chance that there have been ongoing discussions with Nvidia about including virtual reality optimisations in its new GPUs. With the launch of the GeForce GTX 970 and 980 there are newer options avaiable too. We also recommend going with a GPU with at least 3GB of GDDR RAM, though 4GB or more would be preferable, thanks to the high resolutions needed for an optimal virtual reality experience.

A new paradigm in PC gaming or yet another false dawn for virtual reality?

PROCESSOR

While the GPU of your Oculus Rift rig will be doing most of the heavy lifting, it doesn't mean you should neglect your processor. In the past, when deciding what processor to go for, the choice between an AMD or Intel CPU was pretty close, and often boiled down to budget or

The best games for the Oculus Rift

You've got your rig sorted – it's time to get some games fired up to really see what it can do

Because it's still very much in its infancy, the Oculus Rift might have the potential to be compatible with some current games – thanks to the vorpX 3D driver that's designed to port existing games to the Rift – but not every game will be playable. You can find out more and download vorpX from **www.vorpx.com**.

Meanwhile, for some specially designed games that make the best possible use of Oculus Rift thanks to native support, be sure to check out *Euro Truck Simulator*, which offers an excellent, and rather relaxing, virtual reality experience. If that's a little tame, why not try out base jumping without having to leave your chair and fling yourself into a dangerous-looking hole? Check out *Aaaaa! – A Reckless Disregard for Gravity*, which reproduces an impressive feeling of speed (and vertigo) with the Rift.

Perennial favourite *Team Fortress 2* has been given a new lease of life thanks to native support for Oculus Rift being included by producer Valve, which has also highlighted its support for virtual reality by including native support in its classic *Half-Life 2*. There are some incredibly impressive videos floating around that there internet currently, showing people playing *Half-Life 2* with the Oculus Rift and Razer Hydra motion controls.

Quite possibly the closest you can come to being Luke Skywalker

As we mentioned earlier, although first-person shooters can benefit from Oculus Rift support, the best examples at the moment are games where you sit in a cockpit and control a vehicle – preferably one fitted out with huge guns. This is why *Hawken* is such a great fit, because you'll really feel you're inside a huge mech. *Elite: Dangerous* is another fantastic example of this, especially when paired up with a joystick. We've been zooming around the galaxy in our dinky spacecraft as often as we can – it's an amazing experience.

personal preference. These days, the choice is a lot easier – sadly not because of what Intel is doing right, but what AMD is doing wrong. It's also a bit of an open secret that Intel has been taking an interest in virtual reality in general, and Oculus Rift in particular. Intel is keen to have its chips as the de facto choice for VR enthusiasts, and we're inclined to agree, because it has been showing some interesting technological advances coming out of its R&D department regarding improving the virtual reality experience, such as using bicubic texture lookups and barrel distortion to help improve the appearance of graphics when wearing a head-mounted display.

AMD hasn't been neglecting VR either, though what we've heard so far from the company about VR has been mainly to do with its graphics cards. If you have a Sandy Bridge or later Intel CPU, you should be good to go when it comes to getting the most out of the Oculus Rift.

THE REST

You don't want to cram in a load of high-end components only to let them be bottlenecked elsewhere in your PC, so you'll want to make sure that the other areas of your rig are up to the task. We recommend at least 8GB of RAM and, for future-proofing, we suggest going for a motherboard that can hold more than one GPU in SLI or Crossfire. Although multi-GPU setups won't be necessary for the Oculus Rift, it can give you a bit of leeway later on for upgrading your machine, though we recommend going for one powerful GPU, rather than two (or more) less beefy ones, simply because driver updates for multi-GPU setups can be sluggish.

You'll also want a decent PSU to power all of your components. Because you may well be running some pretty power-hungry bits of kit – especially if you're going to be using more than one GPU – you'll want a PSU that provides plenty of juice while remaining efficient. For this we recommend something such as the Corsair RM1000, which offers 1,000 watts of power while remaining 80 PLUS Gold Certified. It has a zero-rpm fan mode, which means the fan won't even start during low and medium loads, thanks to some cunning heat management of the PSU – so there won't be any annoying whirring noises while you're trying immerse yourself in VR. Which is nice.

The Oculus Rift includes an external IR camera as a positional tracking unit

VIRTUAL REALITY PERIPHERALS

BOOST YOUR OCULUS RIFT EXPERIENCE WITH THESE ADD-ONS

✓ VR headset: Oculus Rift DK2

The consumer version of Oculus Rift isn't expected until some time next year, but if you can't wait until then, you can buy the Development Kit 2 version right now (the recently announced Crescent Bay version isn't available to buy yet).

DK2 comes with a number of enhancements from the previous development kit, including positional tracking via a webcam for increased immersion – lean forward in your seat and the same movement will be transferred into your game. There's also a low persistence OLED display with improved resolution to reduce blur and motion sickness, and a built-in latency tester to help you calibrate the device for the best possible experience. It's available to order now from htpp://www.oculusvr.com/order for £350.

✓ Motion controls: Razer Hydra

Originally launched while the Nintendo Wii was at the height of its popularity, the Razer Hydra was pitched at bringing the then-popular motion controls to PC. Back then, this might not have been something many of us were asking for, but with the Oculus Rift, the Razer Hydra has seen something of a renaissance, with the combination of virtual reality and motion controls proving to be an irresistible combo. This new-found popularity has made the Razer Hydra somewhat difficult to track down, but it should be top of the list of potential peripherals to go with the Oculus Rift.

✓ Sound card: Creative Sound Blaster ZxR

While the idea of buying a discrete sound card may seem like a rather archaic practice, it is probably worth considering if you do want to create the most immersive Oculus Rift experience possible, because surround sound can really help place you right inside the game. While many motherboards these days come with onboard sound, they can only offer 7.1 surround through the analogue connections. For most of the time, if you want to use surround sound via an optical cable, which is the most popular method of connecting surround sound speakers and headphones, you'll probably need to invest in a separate sound card. For the ultimate sound quality and immersion, we recommend Creative's Sound Blaster ZxR. It's a little on the pricey side, but well worth the money considering the sound quality.

✓ Steering wheel: Logitech G27

Racing and driving games are genres that really benefit from the Oculus Rift, with the rather sedate-sounding *Euro Truck Simulator 2* becoming a surprise hit thanks to the virtual reality experience. To get fully immersed, you'll want the best steering wheel money can buy – which the Logitech G27 currently is. With pedals, a gear stick and the ability to turn the wheel 2.5 times lock-to-lock, just like a real steering wheel, this is an excellent addition to the Oculus Rift. It also comes with force feedback for even greater immersion. The pedals sit in the nest of cables at your feet, and the wheel and stick clamp to your desk. Just be careful not to wrench them off during a particularly sharp turn.

✓ Headphone and Oculus Rift holder: standard mannequin head

Okay, this one might not be the most obvious, but you're going to want a place to securely hold your Oculus Rift and headphones, so why not use something that will look pretty awesome next to your rig? You can buy standard mannequin heads from a number of online stores (we found this one at www.buyhair.co.uk) and it's a great way to make sure your Oculus Rift and headphones are kept safe and secure. It will certainly give your friends something to talk about when they come to visit. If keeping a head on your desk is a bit too creepy, there's a number of stylish headphone holders you can also use.

✓ Joystick: Thrustmaster HOTAS Warthog

You've probably guessed by now – thanks to our recommendations of getting top-of-the-range graphics cards and sound cards such as the Sound Blaster ZxR – that building the perfect setup for the Oculus Rift isn't going to be cheap. The Thrustmaster HOTAS Warthog might be pretty expensive (around £270 for the joystick and throttle combo) but it is, in our not-so-humble opinion, currently the very best joystick on the market. Oculus Rift works best with games where you're sitting in a cockpit, such as flight simulators and space sims such as *Elite* – and a decent joystick can add even more immersion to your VR experience.

✓ Headphones: Steelseries H Wireless

Most of the time we'd recommend going for a full physical 5.1 speaker setup for the best surround sound experience rather than a headset that can only offer a simulation. However, with the Oculus Rift, where you're going to be moving your head, for the best immersive experience we recommend a wireless headset – and the Steelseries H fits the bill nicely. It offers excellent sound quality and very good virtual 7.1 surround sound – especially when paired with the Creative Sound Blaster ZxR sound card opposite – which makes it possible to spatially pinpoint sounds in-game. It also comes with two swappable Li-ion battery packs and a charger built into the transmitter so you'll never be without juice. ■

Gaming &

#298 / December

Because gaming is a way of life

"Microsoft has continued its policy of using lorry-loads of money to win over gamers"

This month, PC Format's gaming vagabond Dom Reseigh-Lincoln has been playing a *lot* of *Destiny*. Yes, it's technically not on PC (boo hoo), but that doesn't mean the more resourceful ones among us can't fathom a way to actually play it. *cough* consoles *cough* At least it gives him a break from all that time he's wasted playing bloody *Titanfall*. *counts the hours and cries*

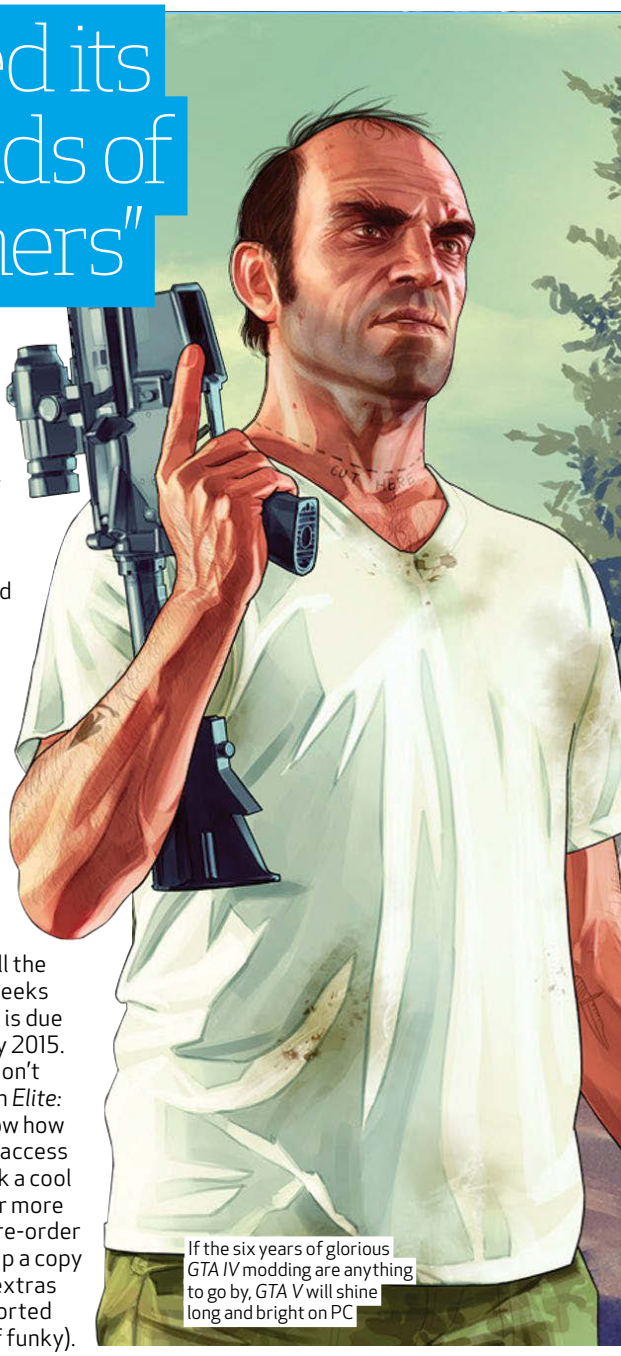
With nary a games convention in sight (well, there was the Tokyo Game Show, but that's about as relevant to us PC users as red rings and yellow lights of death), the past four weeks have been quite the mill for gaming shenanigans.

So there was this thing, you know the one, where a certain software giant spent the equivalent of a small country's defence budget on a Swedish 'indie' studio. Yes, Microsoft has continued its new policy of throwing out lorry-loads of money in order to win over gamers. Remember its 'purchase' of the new *Tomb Raider* sequel? *rubs fingers together* Money! Now it's purchased *Minecraft* publisher and developer Mojang for a cool $2.5 billion. While the deal is essentially a way for the big M to lock out any more PlayStation-based versions of the brick-building phenomenon (if the PS4, PS3 and Vita versions aren't enough), the more significant question is where the franchise will go from here now that the studio's founders have left for pastures new. *Minecraft Karting*? Please, please no.

P64
ALIEN: ISOLATION

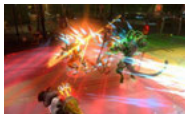
GTA V is coming! Haven't you heard? Sure, it's coming to *other* platforms first (again), but it's still coming to PC. A reason to smile! No? Oh, some of you are annoyed that there's going to be a slight delay to its eventual release on these overclocked shores. Despite all the grumbles, a normally quiet Rockstar was quick to put our minds at rest and assure us that the delay was in the best interests of the PC version. "We are incredibly excited to be bringing *GTA V* to the PC, but the game requires a little more development time in order to ensure that it is as amazing and polished as possible," it explained. "Please do stay tuned as we reveal new features and information about all the new versions in the weeks ahead." The PC version is due for release on 27 January 2015.

And finally, while we still don't know when space-faring wet dream *Elite: Dangerous* is set to arrive, we *do* know how much the full version will cost. While access to the beta will currently set you back a cool £50, the eventual release will be a far more agreeable £40. Those who want to pre-order without access to the beta can pick up a copy for the same price with some funky extras (if a digital concept art book and assorted in-game detritus is your definition of funky).

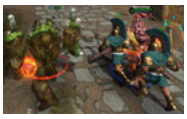


If the six years of glorious *GTA IV* modding are anything to go by, *GTA V* will shine long and bright on PC

RECOMMENDED

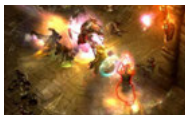


Wildstar
NCSoft
PCF294 p64
Clever questing and a stand-out combat system make for an entertaining MMO that is as large as it is full of character.
★★★★½



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

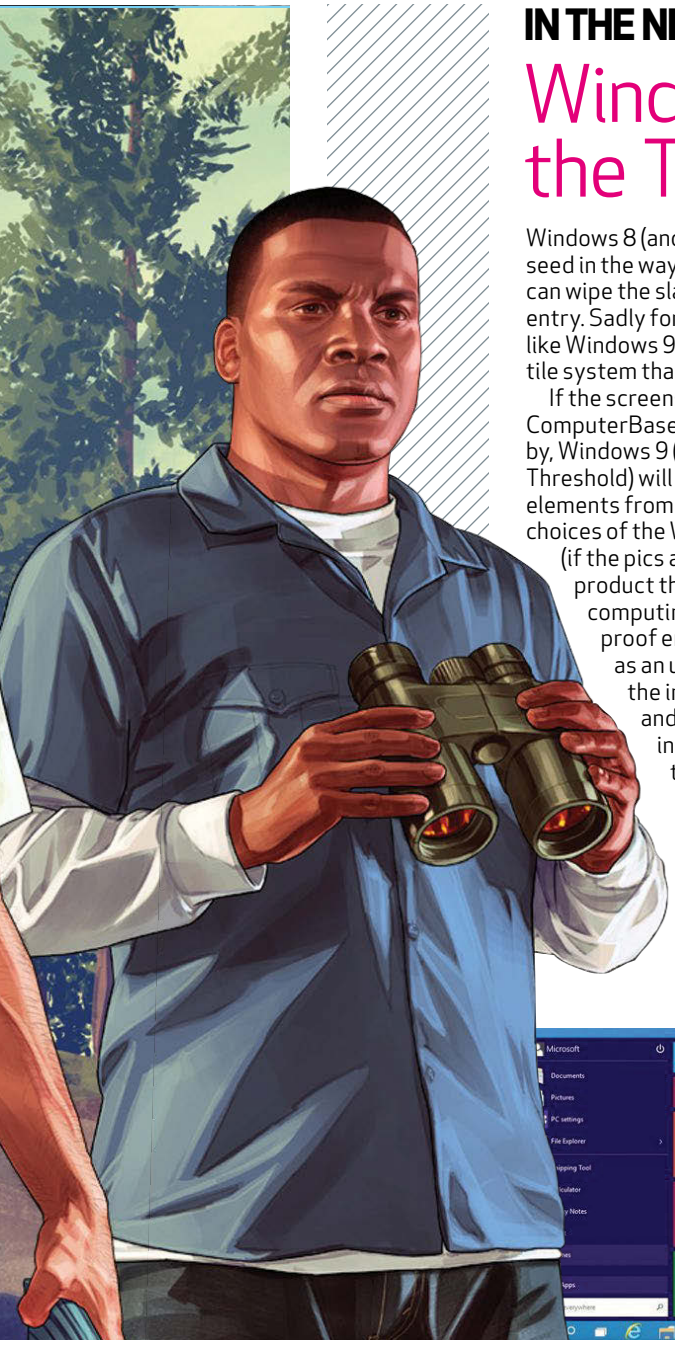


Diablo III: Reaper of Souls
Blizzard
PCF292 p64
This awesome expansion has made *Diablo III* even better, and includes some fun little goodies. We like.
★★★★½

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

Windows eyes the Threshold

Windows 8 (and its update, 8.1) have certainly failed to seed in the way Microsoft had hoped, but it's hoping it can wipe the slate clean with a brand new numbered entry. Sadly for all you Win8 haters out there, it looks like Windows 9 is sticking with the touchscreen-centric tile system that drew so much ire last time.

If the screenshots posted by German tech sites ComputerBase and WinFuture are anything to go by, Windows 9 (supposedly codenamed Windows Threshold) will try to marry a number of greatly missed elements from Win7 with the unwavering design choices of the Windows 8 era. It's clear that this version (if the pics are legitimate) is a long way from the product that will be released to the general computing public; the presence of an IE 11 icon is proof enough of that. However, features such as an updated and streamlined Start Menu, the inclusion of bespoke virtual desktops and the ability to run Windows 8-style apps in a more classic windowed mode show that Windows 9 will still be a significant step forward from its much-maligned predecessor. If rumours are to be believed, Microsoft is set to reveal the new operating system in the coming months, with a suspected release date in early 2015. Personally, we think it could be just the change Windows has been crying out for.

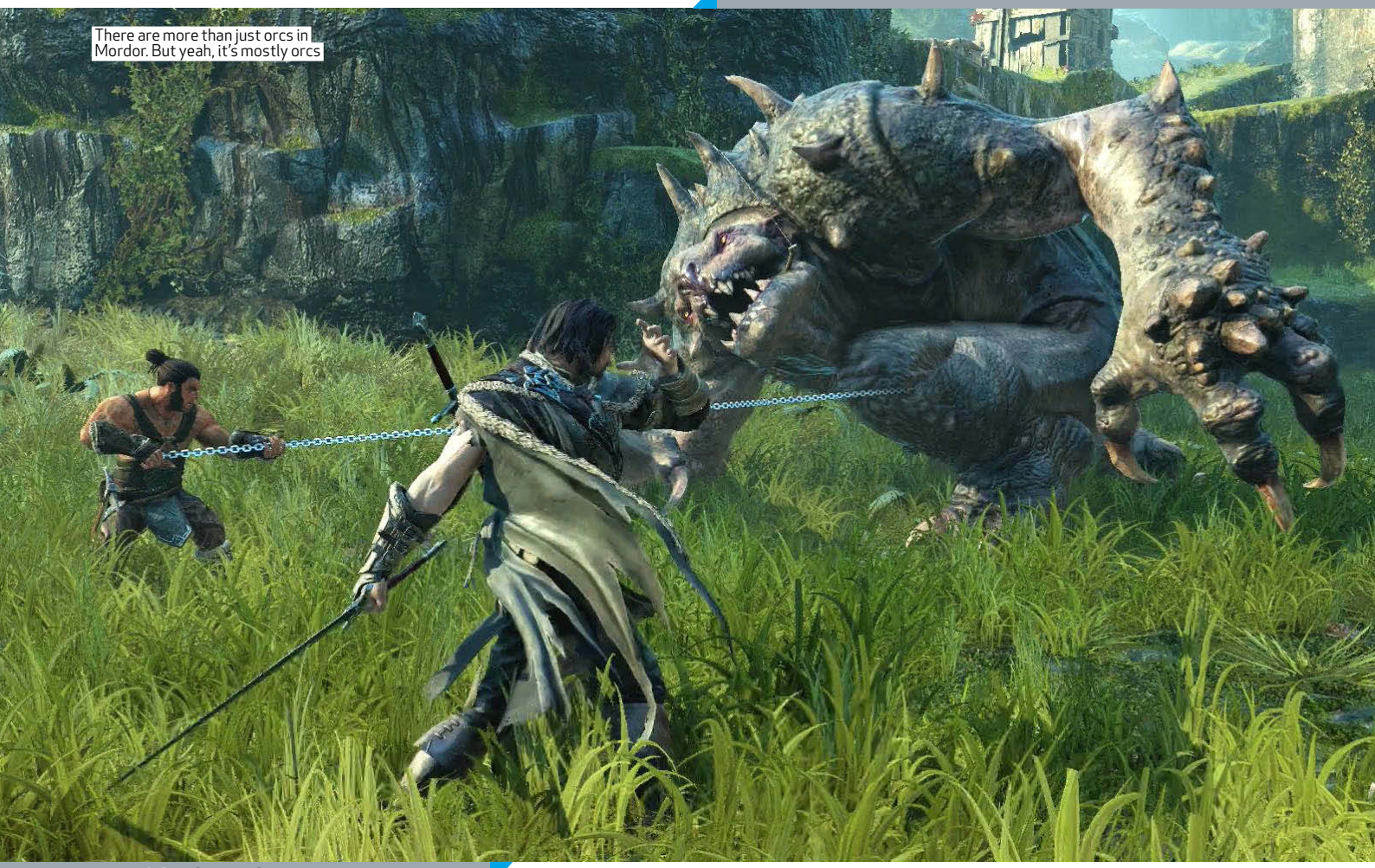
Windows 9 doesn't look radically different, but could be the change the OS needs

STEAM USERS MALIGNED

If you have a Twitch profile linked to your Steam account, we suggest you check your recent expenditures because a certain malware bot has been infecting users across the platform, accessing their personal details and spending their hard-earned cash.

The threat was discovered by Finnish security software maker F-Secure, which was quick to inform its community. "It might be helpful for the users if Steam were to add another security check for those trading several items to a newly added friend and for selling items in the market with a low price," it said. "This will lessen the damages done by this kind of threat." The warning has spread throughout Steam's own online populous, with Valve stressing the need for vigilance among its users.

HIGHLIGHTS THIS MONTH



There are more than just orcs in Mordor. But yeah, it's mostly orcs

RELEASE OUT NOW

Shadow of Mordor

Proving that revenge is the dish that tastes the sweetest

Ghûra the Funny One isn't laughing. I suspect the name's ironic: the hulking orc has never been good at telling jokes from what I can tell. It doesn't help that he's now sporting a nasty gash from where I thunked an arrow at his head somewhere in the barrows of Udûn.

Now he's tracked me down across the muddy Black Road across untold miles to take revenge. Good timing too, as I'm stuck parrying the spear of Lûga Ghûl Lover. One uruk captain is bad enough; in my state, two is a death sentence.

"You're going to pay for smashing my face," he screams. I'm already running, and I suspect he'll mock me for it next time we meet. The great pleasure of playing *Shadow of Mordor* is that this wasn't a mission; it was an encounter based on (poor) choices I'd made in the past.

Shadow of Mordor is an open-world adventure with combat and platforming that owes heavy debts to the best action-adventure games of yore, but blazes a trail for future games with its vendetta system, which weaves endless unscripted narratives across Sauron's home. These are just as strong as the main missions, and the system plays a key role in generating side missions as the balance of power shifts.

This is the story of Talion, a Gondorian ranger who's lost his wife and son (and his own life, at that) to a band of marauding orcs. So far, so formulaic. But above this flimsy foundation stands a tale that should appeal to even the most disgruntled of Tolkien academics. Talion's misadventures start the night Sauron returns to Mordor, which humans have gentrified over the past year. His mysterious resurrection pairs his body with the wraith of an important elf lifted from the pages of Tolkien's *Silmarillion*. The associated cutscenes of the main story look as though Monolith pulled them from a proper Peter Jackson production, but at other times *Shadow* relies too heavily on nods to fandom. They're not even subtle. One second someone will bark at Talion to "Fly, you fool," the next he's told that "Not all those who wander are lost."

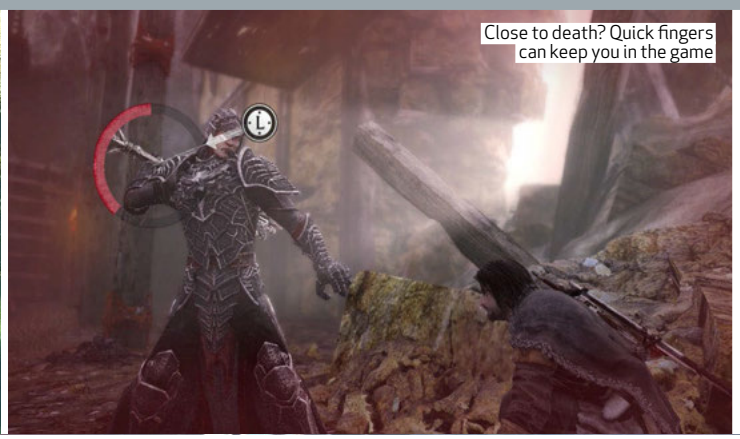
The narrow focus on Mordor is a small drawback of the two massive maps that make up the open world surrounding Talion, where he activates missions scattered around his old patrol grounds. It's a varied world that's fun to explore, filled with ramshackle uruk forts and the spectral remnants of towers from a lost civilisation, which serve as quick-travel points and triggers for nearby missions.

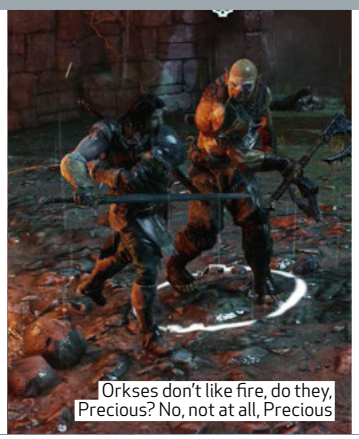
VITAL STATISTICS

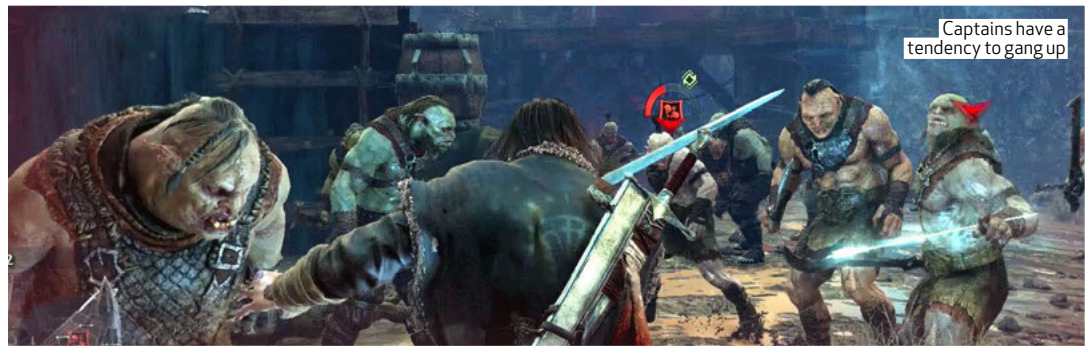
- **Price** £30
- **Developer** Monolith Productions
- **Publisher** Warner Bros.
- **Web** www.shadowofmordor.com
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** 3GHz CPU, DirectX 11 graphics card, 8GB RAM

Bierkiller

It's also the breeding ground for *Shadow of Mordor*'s remarkable 'nemesis' system, which creates a


Close to death? Quick fingers can keep you in the game


Orkses don't like fire, do they, Precious? No, not at all, Precious


Captains have a tendency to gang up

world where life seems to go on regardless of whatever Talion's doing. Take Zunn the Brewer. He was the first orc to kill me, back when he was just another nameless face in the green masses I'd jump into. Me, I just respawned back at the nearest spirit tower. But killing me changed Zunn; it gave him a purpose, a name. More importantly, it promoted him to the rank of captain, giving him spiffy individualised armour, his own abilities, and of course, making it harder to take him down.

Somehow I never got around to killing Zunn. Once we crossed swords again, but he escaped while his buddies and wargs kept me occupied. Later he killed me again – I blame the framerates, more on that later – earning him yet another promotion. In time, the oaf became a Warchief, a rank that requires special challenges such as killing 10 enemies by stealth to even spawn Zunn and his bodyguards. It's a great system that punishes death by empowering the orc who killed you, and it rewards victory through the satisfaction of revenge.

And that's but the surface of the system. Further nuances lie beneath, such as the way some background orcs chatter about the specifics of your past failures or victories or how you can use your wraith buddy's powers to rip information about the weaknesses and abilities of a captain or warchief from another orc's brain. If you've failed so much you're seeing multiple captains travel together, you can hop into side missions that let you interrupt duels or hunts and thus kill up to two nemeses.

A typical fight sees me zipping across towers and walls, stealth-killing archers and poisoning the uruk's grog. Such actions (along with Talion's hunt for lore objects and glowy runes) bear the heavy stamp of *Assassin's Creed*, but the core combat is pure *Batman: Arkham Asylum*, and *Shadow of Mordor* is all the better for it. It appears at its best when its brawls explode into battles, particularly when I'm careless enough to let an orc trigger an alarm.

I'm doing well. I've built up a hit streak that lets me execute an orc in the thick of battle. It's one of the skills I've acquired by unlocking skill tiers from killing so many captains. Still another lets me stun orcs when I vault over them by pressing the spacebar. But that's just half of it. Talion, don't forget, shares his own body with Mr Ancient Elf, and it's the latter who actually lobs arrows while in a state akin to *Batman: Arkham Asylum*'s Detective Vision. It transforms him into a battlemage of sorts. I press [R] after building a hit streak, and Talion slams his fist down, sending orcs around him reeling back from the shockwave. I press [Z] with the bow in action, and he zips toward an enemy as though teleporting. Late in to the game, he even learns the ability to 'brand' orcs into serving him, essentially turning them into mind-slaves. It's a shaky moral shift that even Talion expresses discomfort with after learning the skill, and it's a fitting homage to the theme of corruption that runs through Tolkien's works.

Rune quest

I do regret that Talion never doffs his tatty ranger's cloak. Switching to flashier gear is one of the things I love most about the *Assassin's Creed* series, where, for instance, I can make Edward Kenway look more like a proper pirate. Not so here; not without preorder bonuses or DLC. But *Shadow of Mordor* makes up for some of that loss with a rune system for Talion's sword, bow and dagger that replaces traditional loot. One rune might ignite enemies when you counter with your sword; another might make you immune to poisons. You can even break them down for attribute points, which allow you to unlock more slots for a weapon and pump up Talion's health.

The siege of GeForce

But how does it run? The fact is, my own rig is a good deal more humble than the big rigs in the office. I simply walked into Mordor with an AMD 2.8GHz processor, 16GB of RAM, and an Nvidia GeForce GTX 750 Ti on Windows 7. If GTX 980 machine is Gandalf, I guess my PC is Meriadoc Brandybuck. And yet I managed to play the entire game on Ultra settings, chiefly for the sake of the screenshots around these words. I wouldn't recommend it, and neither would Monolith, which lists 6GB of VRAM as necessary for Ultra-quality textures.

Most of the time my PC fared fine, but framerates would plummet to clip-show rates when Talion found himself in cramped villages, surrounded by dozens of orcs, and bombarded with many explosions. On the bright side, those moments aren't that common.

Shadow of Mordor still looks stunning on lower settings, and even if you can't experience the glory that is Ultra, you shouldn't miss out on what's undeniably the best *Lord of the Rings*-based game to date. Oh, and there's a dwarf (although beardless). As a member of the Fellowship of the Beard, that always counts for something in my book. ■ **Leif Johnson**

PCFormat Verdict

A gritty and unusual adventure. The hardware specs are demanding, but this is the Middle Earth game to rule them all.

A burst of fiery justice can see the alien off – but for how long?

RELEASE OUT NOW

Alien: Isolation

Could this finally be the Alien game that doesn't disappoint?

Set fifteen years after the original film, *Alien: Isolation* sees you playing as Amanda Ripley, daughter of Ellen, an engineer for megacorporation Weyland-Yutani. She's on a journey to the space station Sevastopol when she learns that the flight recorder for her mother's lost ship, the Nostromo, is being held there. But it's clear from the moment she gets to the abandoned space-city that something is horribly wrong.

Sevastopol is a labyrinthine warren of corridors, vents and tunnels – it's being decommissioned and is in a severe state of disrepair. Most of the game is spent in the claustrophobic confines of its twisting metal bowels.

But while we've explored environments like this before in games like *System Shock* and *Dead Space*, it's the art design that sets *Isolation* apart. Resisting the urge to create a slick, contemporary vision of the future, The Creative Assembly have instead looked to the production design of the film for inspiration. They've built their world as Ridley Scott and his team would have in 1979, using only technology from the period.

The chunky keyboards, phone receivers, distorted CRT monitors, and blinking coloured lights should look dated, but it has quite the opposite effect. This is a tactile, practical, and convincing science-fiction world, with machines and environments that are functional and utilitarian, rather than overtly futuristic. You almost feel like you can reach out and touch it.

VITAL STATISTICS

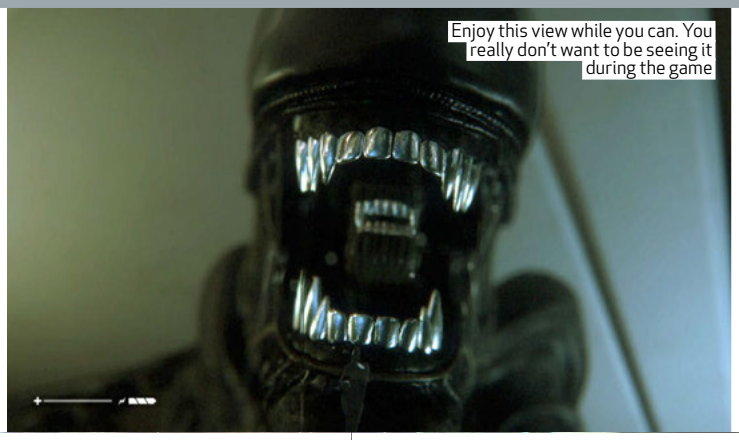
- **Price** £40
- **Developer** The Creative Assembly
- **Publisher** SEGA
- **Web** www.alienisolation.com
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** 3GHz CPU, 2GB DirectX 11 GPU, 8GB RAM

Creature discomforts

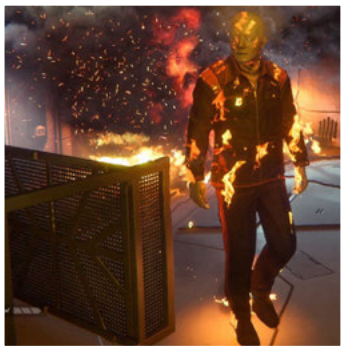
But a sci-fi corridor isn't much without something horrifying to chase you down it. So it's a good thing that *Isolation* is the first game to make HR Giger's alien every bit as formidable and intimidating as it is in the films. In *Alien*, Ripley asks Ash how they can kill the creature that burst from Kane's chest aboard the Nostromo, and he replies, gravely: "You can't." This, unlike the dumb drones you blasted your way through in *Colonial Marines*, is also true of Sevastopol's alien. It's a merciless, unstoppable force.

You can shoot it, but it'll just get angry and pounce at you. You can burn it, but that'll only scare it away for a few seconds. *Isolation*'s magic lies in the fact that you have to outsmart its single alien rather than kill it. This turns what could have easily been yet another FPS with xenomorphs into a thrilling, drawn-out game of cat-and-mouse with the scariest cat imaginable. It's a deft blend of stealth and survival horror that, thanks to dynamic AI and clever, systemic design, is much more than the sum of its parts.

You'll know when the alien is near. As you creep through the station,


Enjoy this view while you can. You really don't want to be seeing it during the game


It might tell you where danger lurks, but its beeps will give you away




The characterisation is great, but the voice acting is a little lifeless

you hear it above and below you, behind the walls, under the floor. You're relatively safe when it's hidden away like this, but you never know what vent, crack or hole in the ceiling it'll suddenly emerge from. It arrives with a beastly hiss – a sound that becomes your cue to hide or run. Then you hear the pounding of its footsteps as it wanders the corridors, hunting for its prey.

The alien is an almost constant threat, but there are other dangers on Sevastopol. Malfunctioning androids called Working Joes wander the station, brutally killing any humans they come across. Their rubbery, emotionless faces and glowing eyes are genuinely unnerving. Get too close and they'll grab you, draining your health until you manage to break free. You can kill them, but they take a lot of resources to bring down, making stealth the best option. They're a lot slower than the alien, but every bit as deadly.

Keep it down

Then there are other survivors. You'll run into them less often, and they're a lot easier to kill, but they usually work in groups. They won't shoot on sight, and will give you a few seconds to back away if you wander into their territory, but it doesn't take much to send them into a frenzy of gunfire. Luckily, if they shoot at you, the noise will attract the alien and it'll kill them all. This is often the best way to get past human enemies: provoke them, then wait for the bloodbath.

Whichever enemy you're up against, sneaking is always the key to survival. You'll pick up a shotgun, a revolver and a few other weapons as you progress through the station, but they're more of a curse than a blessing. For one, they're only really effective against humans. It takes a dozen headshots with the revolver to drop a Working Joe, and the alien is essentially bulletproof.

Any noise, from sprinting to knocking a chair over, will give your position away, so you'll spend much of the game creeping methodically between objectives. This might sound dull on paper, but the presence of the alien makes almost every moment exhilaratingly tense. After getting through one long, difficult section, my palms were sweating and I had to go for a lie down. This is not a game you want to play just before bed.

The audio design is just as accomplished, using many familiar effects from the film, like the metal scrape of vent covers opening and the electronic chatter of the computers. But it's also a vital part of the stealth, and I advise playing with a good pair of headphones or surround sound – you can track the movement of the alien by sound alone, gauging its distance and position by its footsteps.

As Ripley Junior is an engineer it's a good excuse to add a crafting system to the game. Raw materials litter your surroundings and can be taped together to create useful items. As well as the noisemakers and Molotovs, you can make smoke bombs, EMP mines for disabling synthetics, and blinding flashbangs. The effects of these are all temporary, but if you stun an android with a mine, you can whack it over the head with your wrench for an easy kill. Flares can be tossed to lure the alien, and if you toast it with your flamethrower it'll scream and run away – but not for long.

Combining items and weapons in interesting ways, and playing with the enemy AI, gives the game a lot of unexpected depth and kept it interesting for the entirety of the 25 hours it took me to finish it. Yeah, that's right: twenty-five hours. This is a long game, but it never outstays its welcome. This is down to the pacing, which is pretty much perfect.

But now for the weak link. The story is disappointing, retelling a familiar yarn we've already heard countless times in the *Alien* universe. The good thing about this is that it lets you relive classic *Alien* moments and experience them from a more visceral perspective. The bad is that it feels derivative, never taking the chance to make its own mark on the mythology.

They've done an excellent job with the PC version. On ultra settings at 1080p, the game runs at a solid 60 frames on my fairly decent 2GB GPU at work, and loiters somewhere around 30-40 on the relatively ancient 1GB card in my home PC. The geometry of the levels is pretty simple when you look at it closely – especially with all that lo-fi retro tech – but it's the beautiful volumetric lighting and smoke, detailed levels filled with clutter, and bold visual design that give it its fidelity.

It's ridiculous that it took the developers of a historical RTS so long to finally create an authentic *Alien* game, but The Creative Assembly have managed it. They've succeeded where countless others have failed by treating Giger's monster with the reverence it deserves: as something to be feared and respected, not faced head-on with a pulse rifle. *Isolation* is a taut and electrifying horror game that perfectly captures the essence of the legendary film. I just wish they'd been a little braver with the story. ■ **Andy Kelly**

PCFormat Verdict

This is the game the *Alien* series has always deserved. A deep, fun stealth game set in an evocatively realised sci-fi world.

You can now organise specific attacking routines

RELEASE OUT NOW

FIFA 15

Feel the highs and lows of modern day football

How fitting that on the day I review *FIFA 15*, I am retweeted by my eight-year-old self's footballing hero, Gary Lineker. His exploits during the 1990 World Cup (defecating himself on the pitch notwithstanding) kickstarted a life-long love affair with football, and his own game, *Gary Lineker's Hot Shot* on the Amiga, began a search for my own perfect football game – a search that continues nearly a quarter of a century later.

If I'd told that eight-year-old kid that one day he'd be playing *FIFA 15*, with its world-class physics engine, unmatched audio, countless leagues, nets that bulge and even lift off the ground, and its own bloody collectible card game, he'd look at me in amazement. And not just the kind that comes from seeing a bearded version of himself from the future. And if I then told him that I was going to pick holes in this game, he'd be well within his rights to slap me in the face.

Yet that is what I must do, but before I break down where *FIFA 15* breaks down, it's definitely worth mentioning that this, finally, is the version of *FIFA* PC gamers deserve. Unlike the knock-off versions we've been palmed off with over the years, this is the proper, Ignite Engine-fuelled, 'next-gen' iteration of *FIFA 15*, with every bell and referee's whistle you'll find on PS4 or Xbox One. It runs very well on an upper mid-range rig, and despite the relative lack of graphics options, immediately feels like a console game running on the PC, which in this rare case is probably what you want.

EA's mantra this year is 'feel the game', which is a marketer's way of saying that it has captured the emotional and dramatic side of the sport, along with all the kicking and running. This amounts to cutscenes showing players dropping to their knees at a missed chance, shouting at each other when mistakes are made and pushing opponents after a bad tackle, but it does breathe life into a series that has always felt a little robotic.

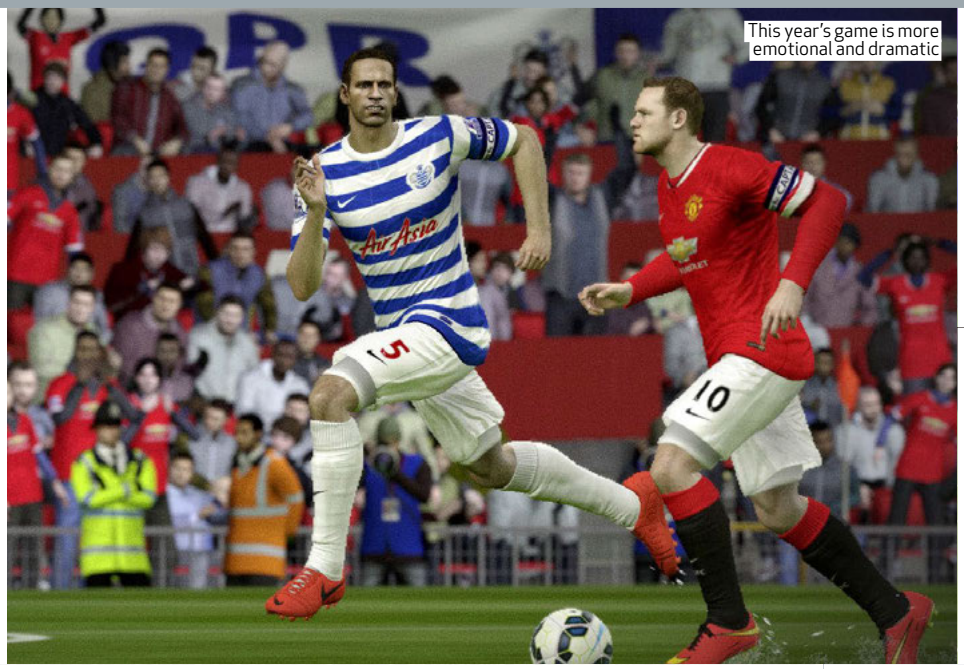
Saving the day

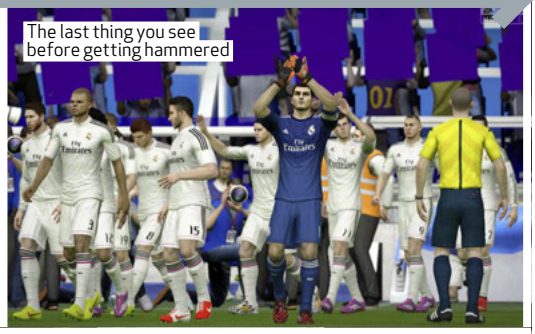
If all this adds character to proceedings, it's the goalkeepers who provide the muscle. EA's calling them 'next-gen keepers', which doesn't really mean anything, but they're noticeably better than they ever have been, That doesn't just mean they're harder to beat either – they also make more believable mistakes. It's infinitely more gratifying to score five one-on-ones that see the goalkeeper react in different ways than it is to score the exact same goal five times, even if the end result is the same.

FIFA 15 is probably EA's most convincing and varied effort, then,

VITAL STATISTICS

- **Price** £40
- **Developer** EA Sports
- **Publisher** EA
- **Web** www.easports.com
- **Multiplayer** Online, co-op and competitive
- **DRM** Origin
- **Recommended spec** Quad-core CPU, 4GB RAM, 1GB GPU


This year's game is more emotional and dramatic


The last thing you see before getting hammered


Rooney doing some Swiss cheese training drills


Keepers now feel more human than robot


Balotelli was delighted he'd found his giant

but it still struggles in some key areas. It might look like football, but it rarely flows like football. Matches – especially online – are almost always played on the counterattack, with quick reverse passes to the strikers far too easy to pull off. Matches, then, take place in constant transition, far more like basketball than the gradual shifts in momentum that 'real' football typically enjoys.

This is less of an issue when playing against the AI, but doing so raises its own problems. Computer-controlled players seem hell bent on proving that *FIFA 15*'s dribbling game is stronger than last year's, and consistently attempt ridiculous runs that more often than not result in them getting tackled.

Do it yourself

You can dive into the menus and adjust almost every aspect of the game, from the speed of play to the amount of control you have in passing, even through to the AI tendencies of other players, and it is possible to strike a better balance than the vanilla game provides. However, while deep customisation should never be sniffed at, do you really want to be responsible for creating the game that you've forked out £40 for? It's like paying for a meal at one of those restaurants where you have to cook your own steak on a hot bit of stone. No, I'm paying you to do that mate. Nice chips though (yes, that is a football pun).

Off the pitch, *FIFA 15* is an incredible package. YouTube favourite, Ultimate Team, returns with the ability to loan star players, and can become as life-consuming as you want it to be. Meanwhile, the online Seasons mode (and its co-op brother) are as captivating as ever.

It should be noted that online *FIFA* is a subtly different game from the offline version – the latency is imperceptible, but in such a physics-driven simulation, even the tiniest of delays in input can affect how you dribble and shoot. As such it tends to focus more on pace and high-through balls in favour of tactical build up.

The strongest *FIFA* yet, then? Yes, especially for PC-only players who are sick of being stuck with an inferior effort, but as much as *FIFA 15* captures the emotional side of the game, it still hasn't quite found its beating heart. And as such, my Lineker-inspired search for perfection continues. ■ **Jon Denton**

PCFormat Verdict

Strong, handsome and, at times, fantastic, this is unquestionably the best *FIFA* for PC so far, but still never quite feels like football.

The gorgeous scenery is reminiscent of *Dear Esther*

RELEASE OUT NOW

The Vanishing of Ethan Carter

The great outdoors has never looked so good, but something dark lurks beneath

Paul Prospero's job description, supernatural detective, isn't just awesome, it carries a double meaning. Yes, he's an investigator of the otherworldly, visiting Red Creek Valley to solve the mystery of a young boy's disappearance and several gruesome murders, but he also has magical powers himself. He's able to see the past as a series of ghostly images, like a spectral highlight reel. By examining clues, reconstructing crime scenes, and replaying events, Paul can piece together the events leading up to Ethan Carter's disappearance... when he's not gawking at one of the prettiest games ever made.

"This game is a narrative experience that does not hold your hand." This is the first thing *The Vanishing of Ethan Carter* tells you. It feels like a bit of a boast, but it's sort of true. There's only a brief introduction: Ethan Carter wrote a letter to Paul, asking for his help. Beyond that, the game trusts you to discover how it works on your own.

VITAL STATISTICS

- **Price** £15
- **Developer** The Astronauts
- **Publisher** The Astronauts
- **Web** www.the astronauts.com
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** 2.8GHz CPU, DX11 GPU, 4GB RAM

It doesn't fabricate reasons for you to sprint or crouch in a tutorial. There are no quest arrows, and if you're not careful you can walk past entire story elements. You can even solve the game's mysteries out of sequence. It's cool with that.

The Vanishing of Ethan Carter doesn't trust you entirely, though. It will draw your attention to the crankshaft on the nose of a stalled train, at which point the word 'Crank?' will appear, duplicating itself, swirling in front of your eyes, flooding across the screen with all the subtlety of a pop-up ad. Crank? Crank? Crank? Crank? Crank? Hold on. I'm getting a psychic message here... I think I need to find... a crank? And then crank it? Glad this game doesn't hold my hand.

If you reach the end without finding everything, there's a handy map painted on a wall with, well, a bunch of quest arrows, directing you to the puzzles you missed. The point is, while *The Vanishing of Ethan Carter* doesn't guide you in the usual sense, it still tries awfully hard to make sure you don't miss anything. Thankfully, doing so is well worth your time.

Spectre inspector

Paul's skills don't end with floating tooltips. After reconstructing a murder scene by finding and replacing a few items, he can conjure up the events that led to the bloody tableau. First, he sees them as a series of images: holograms of ghosts, still and silent, in various phases of the murder. Once you've found them all, you need to put them in chronological order. Did the couple peer into the crypt before the death in the graveyard, or after?

Once you've assigned numbers to the ghosts, you can watch the scene unfold in a spectral replay, provided you've ordered the scene correctly. If not, the scene will play until it reaches your mistake before dissipating, leaving you to make corrections and run the spook-reel again. It's an enjoyable activity, rather like directing a movie without having seen the script.

The flatcap: the hallmark of a hardened criminal

The game eschews jump scares for eerie atmosphere

Number the ghostly figures to replay each grisly crime

Nope, can't see anything out of the ordinary here

Just watch me…

There are a couple of other types of puzzles too. One requires a fair bit of memorisation – something I'm rotten at (I had to resort to taking screenshots and referring to them for comparison). Another involves matching symbols to unlock a gate. And, in true video game tradition, there's a big water valve to turn. The puzzles are familiar, but very well-made and satisfying to solve.

The Vanishing of Ethan Carter isn't really *scary*. It's eerie, certainly. It's spooky and unsettling. Despite there only being one real, genuine, board-certified jump-scare – cheap, sure, silly, yes, but still well done – the general sense of dread and loneliness led to me jumping a number of other times. The tension comes not from trying to scare you, but from making you *think* you might be scared at any moment. That's the best kind of tension, and it's entirely successful.

It's also gorgeous. The lighting, the textures, and the attention paid to the foliage and landscape meant I wound up stopping every couple of minutes just to look around in admiration. Peering over the edge of the massive dam (and peering back up at it, later, from below), gazing at the sunbeams filtering through the trees, admiring the beautiful decay of abandoned buildings, staring across a bridge, crossing it, and then turning to stare across it from the other end.... I don't care if there are bloody corpses all over the place. I'd live in Red Creek Valley in a second, and possibly, for a second. On my PC – Intel i7 2.8 GhZ, 8GB RAM, Nvidia GeForce 660Ti – it ran remarkably smoothly on maximum settings for such a fine looking game.

The world is also extremely large, and while this isn't a complaint, it's not exactly stuffed with activities. There are several long stretches of trail, perfectly enjoyable to walk along, but with absolutely nothing going else on. Some will enjoy it, feeling a bit of a *Dear Esther* vibe; others, I'm sure, will wish there was a bit more to actually do.

Quiet time

When it comes to the story, developer The Astronauts has exercised remarkable restraint. This is the first game in a long time where I didn't want to skip anything being said, mainly because there's not much of it. Paul's long nature walks offer ample opportunity for him to spew his thoughts, but while he does occasionally murmur some vague filler, he's always brief about it. Written clues are generally only a paragraph or two, and even the ghostly movies are quick and concise. *Ethan Carter* makes the most of its few words, and gives you plenty of time to think about them.

With so much going for it, it's a shame *Ethan Carter* shoots itself in the foot by not letting you save your game manually. I was playing late at night for full creepiness, and decided to call it quits and get some sleep. A warning popped up: quitting would lose the progress I'd made since my last autosave. When was my last autosave? No idea. That's the problem with minimal on-screen elements: I never saw the autosave indicator. Fearing I might lose the past half-hour of work, during which I'd found many clues but hadn't solved a puzzle, I trudged on, trying to progress enough to force the game to save again. Twenty minutes later, I solved another puzzle at the other end of the map, though I was annoyed at having to rush through it just because I wanted to go to bed. What's more, when reloading the game the next morning, I'd been returned to the middle of the map, leaving me to wonder if the distant puzzle I'd solved the night before had been saved after all. It had, which I only found out after making another long trek back there.

That annoyance – I won't say it was minor – was about the only thing I didn't enjoy about *The Vanishing of Ethan Carter*. Visually, it's spectacular. It's tense and the mysteries are enjoyable to solve even when they're not that hard. The voice acting is decent, and while I don't think the story paid off in spectacular fashion, I found it intriguing, satisfying, and most importantly, wonderfully restrained. ■ **Chris Livingston**

PCFormat Verdict

A tense stroll through a gorgeous world, some fun supernatural detective work, and an efficient script with sparse dialogue.

★★★★☆

RELEASE OUT NOW

Wasteland 2

Twenty-six years in the making, this hardcore RPG is like a drink of water in the desert

There's a mad monk up ahead. He's dressed in rags and his body hunches over with a great burden. Behind him is a woman carrying a small pack; ahead is a gnarled raider.

My guide through the dusty canyon warns me not to interfere as the raider demands the woman's goods. She begs him to stop, but it's too late. The hunchback monk, a disciple devoted to the nuclear god Titan and The Great Glow, has sworn to protect his charge.

He rushes forward, shouting a prayer, then detonates the small warhead he carries. A mushroom cloud emerges from the blinding light, vaporizing the monk and the raider. The woman lies legless before me. "Kill me," she croaks. I do, but not before I take her pack.

Wasteland 2 pulls few punches. It shouldn't – as a post-apocalyptic RPG and the latest in the new wave of 'hardcore' role-playing games, it should be difficult and dark. It's the sequel to the game that inspired *Fallout*, and the product one of the most high-profile Kickstarter campaigns ever. That's a lot of weight to carry, and inXile founder Brian Fargo has called it the most important game of his career. That a sequel to a 26-year-old game happened at all is pretty amazing. That it's also good is astounding.

VITAL STATISTICS

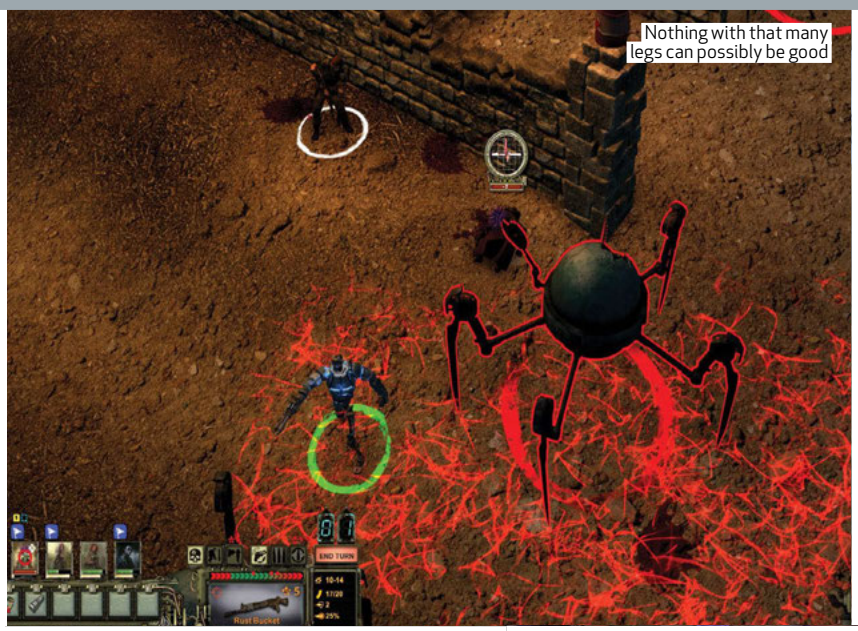
- **Price** $40
- **Developer** inXile
- **Publisher** inXile
- **Web** http://bit.ly/1sKliSk
- **Multiplayer** None
- **DRM** Steam
- **Recommended spec** Core i5, 8GB RAM, Nvidia GTX 750 Ti

Building character

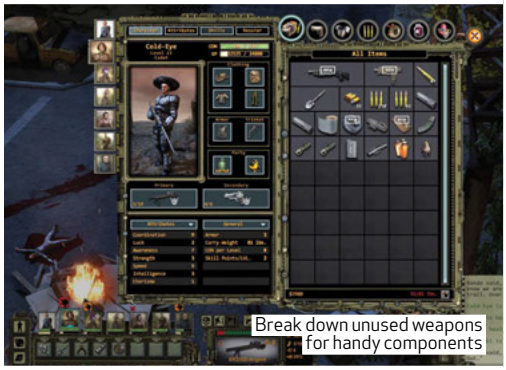
Wasteland 2 begins much as its predecessor did – choose or create four new recruits to the shining beacon of law and order in post-nuke Arizona, the Desert Rangers. One of your own has been murdered while investigating strange radio transmissions, and you must solve the mystery of his demise.

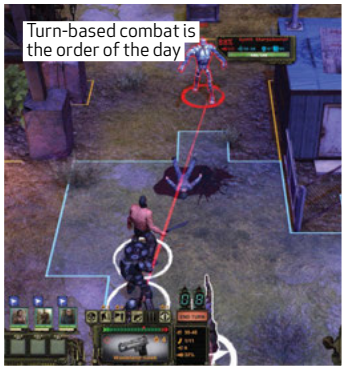
Each character has six basic stats. Coordination, for instance, affects your ability to shoot, as well as how steady your hands are when jimmying a lock or disarming a bomb. These abilities tie into skills. Some are obvious, such as brawling and handguns. Others seem useless at first; who would focus on repairing toasters? I did, and some of my best experiences (and loot) came from bringing life to a discarded appliance.

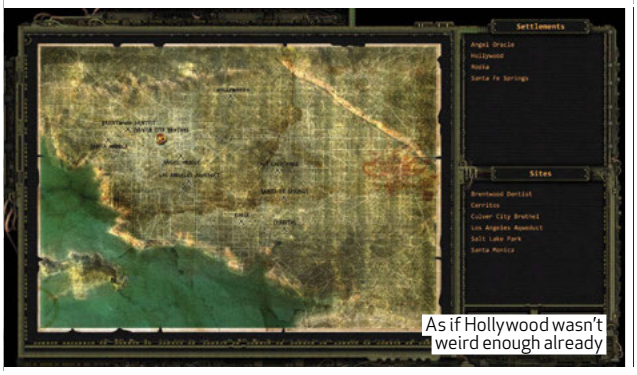
Even with four characters under my control, I struggled to find a balanced mix of skills and abilities. This is by design, and it nicely complements the companion NPCs who join you on your travels. You can add up to three followers for a maximum party size of seven. Each NPC has their own agenda, and if your goals don't align, they can leave in a huff. A brash warrior named Takayuki joined me after I saved his mother from a mining cave-in, bringing with him strong explosive skills, and with that, a surefire way to disable traps on lockers and chests. Another


Nothing with that many legs can possibly be good


Your four custom characters can be joined by up to three NPC companions


Break down unused weapons for handy components


Turn-based combat is the order of the day


As if Hollywood wasn't weird enough already

companion, Pistol Pete, asked me to save his town from an invading gang. If I chose to work with the gang instead, Pete would abandon me, taking his valuable firearms and bartering skills with him.

Take aim

Combat feels like a mix of *XCOM* and *Fallout*: encounter a group of enemies, get a turn order, then spend action points moving and attacking. Cover is useful, adding a defensive and aim bonus, but is often destructible, so maybe those crates aren't as safe as you thought.

The people of the wastes are rarely friendly, but often need your help. There were few easy decisions as I struggled to prioritise one group over another. Early on, for instance, I received distress signals from Hightown and an agricultural centre, both needing urgent assistance. I saved the ag centre first, battling mutated plants and giant, man-eating rabbits, but when I got to Hightown, the attacking raiders had killed everyone. Oops.

Once you leave Arizona, you'll meet even stranger people in LA. God's Militia are standard religious fanatic types, punishing sinners down the barrel of a gun. The Children of the Citadel and their cyborg leader, Matthias, promise immortality by joining flesh with machinery. Angel Oracle is a stadium taken over by Mannerites, who believe the key to restoring society is extreme politeness. On a call-in radio show, their leader, Mr Manners, counsels a woman who must choose to save either her husband or her children from raiders. Manners suggests the husband, since it's not becoming in society to be a widow and she can always have more kids. Polite doesn't always mean nice.

This is where *Wasteland 2*'s writing and voice work really shine. The Mannerites and their rivals, the get-ahead-in-life Robbersons, are inspired by self-help books, and watching the groups tear each other apart over philosophies that seem trite today is amazing.

The world is fascinating, but I encountered a few pathing issues, including one in a late-game fight that required a reload. Other problems are intrinsic to the game. Almost all loot is random, which meant an hour spent de-trapping and unlocking a combination safe would sometimes only reward me with a handful of bullets.

Wasteland 2 isn't the prettiest game, either. Character models look okay from a distance, but can be ugly up close. Models and other assets are reused too often; even the wonderful NPC portraits are repeated for separate characters.

These are issues, but they're surmountable. Weighed against the sheer amount of content in the game – my 50 hours skipped entire subplots and side areas – they're small problems. I'm already planning my second playthrough, wondering if it's time to merge my body with the cybernetics offered by Matthias' cult. I want to know what happens if I save the town of Highpool, or retrieve a warhead from the Servants of the Mushroom Cloud, or if I can help the street kids in Hollywood stay safe. This wasteland is deep and dark and dangerous, and one well worth getting lost in. ■ **Cory Banks**

PCFormat Verdict

An excellent RPG despite its share of glitches, with combat and writing every bit as good as its predecessor's.

★★★★☆


Trousers of +1 driving


Putting takes a while to perfect


Like Spider-Man, sand is your enemy


The perfect game for a relaxing Sunday afternoon


Coastal links courses are among the hardest

RELEASE OUT NOW

The Golf Club

A forgotten sport brought back to life on PC

Amazingly, this is the first golf game released on PC since 2011's *Tiger Woods 12: The Masters* – which, lest we forget, was appalling. Reminiscent of the early *PGA Tour* games, *The Golf Club* focuses squarely on simulation. No player upgrades, no slow-mo *Matrix* replays, no microtransactions, and no minigames; just pure, no bullshit golf, and I love it for that.

But there's a catch. To really enjoy it, you need a gamepad. The swing is clearly designed with an analogue stick in mind, and the keyboard and mouse controls are rubbish.

Instead of a power bar, the accuracy and strength of your shots is governed by the stick. Pull it back to determine how hard you'll hit – halfway will strike with 50 per cent power – then push it forward to swing. If you keep the stick straight as you release it, your shot will be accurate. If not, you'll slice it.

This doesn't offer the same level of precision as an old-style *PGA Tour* power bar, but it does make the process of swinging the club feel more organic. You won't be able to replicate the same perfect shot over and over again, which makes your avatar feel more like a fallible human and less like a golf robot.

There are no licensed courses or players. You won't be able to knock balls around TPC Sawgrass or win the European Tour as Rory McIlroy. Instead, the game comes bundled with a powerful but easy-to-use editor. This means that as well as the large selection of official courses, there's an ever-growing pool of user-made greens to play on too. A community rating system helps keep the good ones visible and the stinkers buried.

But while I do admire the game's innate simplicity, it is missing a few things that would make it feel more complete. The lack of an in-game tutorial is glaring, especially when the developer's YouTube channel is filled with them. There's also no atmosphere. Tournaments feel disappointingly lifeless without a gallery of spectators cheering you.

The announcer is great, though. HB Studios' audio designer, John McCarthy, provides the game's commentary, and his laid-back demeanour and soothing Canadian accent complement the relaxing atmosphere of the game perfectly. Some phrases repeat, but he has an impressive array of reactions. He's also surprisingly encouraging when you go over par, telling you not to worry, and reminding you that it's only a game. What a nice man.

You'll be disappointed if you come into *The Golf Club* looking for a career mode or any kind of character progression. But if all you desire from a golf game is the purity of the golf itself, it's an enjoyable, well-made game with a good variety of courses and enough depth to keep the simulation interesting. ■

Andy Kelly

VITAL STATISTICS

- **Price** £27
- **Developer** HB Studios
- **Publisher** In-house
- **Web** www.thegolfclubgame.com
- **Multiplayer** Local, online
- **DRM** Steam
- **Recommended spec** 3GHz CPU, 4GB RAM, 2GB GPU

PCFormat Verdict

Admirably back-to-basics, eschewing fancypants gimmicks to focus entirely on the ancient art of hitting balls into holes.

T3

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- SAMSUNG GEAR S
- SONY SMARTWEAR

Apple Special

iPhone 6 + Watch

- iPhone 6 and 6 Plus tested
- Hands-on with Apple Watch

Get Yourself

Connected

53 Wireless Upgrades To Change Your Life

Overclock your GPU

Not getting the rock solid FPS you want? Give your GPU a boost says Matt Hanson

PROJECT GOAL

Overclock GPU

We'll show you how to safely push your graphics card to its limit, as well as stress test the overclock to ensure that it 's stable, helping you get the best performance when playing games.

REQUIRES

Dedicated GPU

While it's possible to overclock integrated graphics, it isn't recommended, so you need a dedicated GPU from AMD or Nvidia. The card manufacturer (such as ASUS) isn't important.

Software

You also need overclocking software – see 'Top tip' opposite.

There comes a time when no matter how powerful your graphics card is, running the latest games with all the visual settings cranked up to 'Ultra' will cause it to stutter. But does that mean you should start considering putting down cash for a new GPU? Thankfully not – by overclocking your graphics card, you can push it to work harder and achieve even better results.

When playing games, you'll see the benefit straight away, with more consistent frames per second, and a boost to the overall performance. The best part is that you'll be able to achieve these improvements without having to spend any additional money.

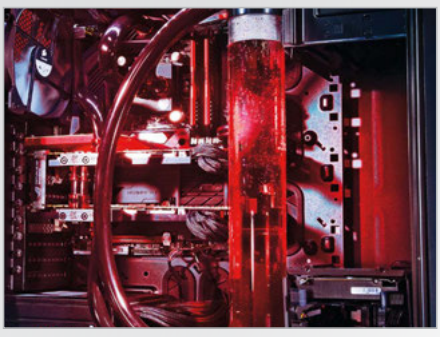
Of course, as with overclocking processors, there are some caveats to overclocking your GPU. The first thing to bear in mind is that there are risks associated with the procedure. You're going to be pushing your graphics cards to its limits, and there is always a slight risk that things can go wrong. You may also want to check the warranty that came with your GPU, because overclocking can invalidate it. We don't want to scare you off, however, because for the most part, overclocking is safe and easy – but you should be aware of the risks. You should also keep your expectations in check. With a good overclock, you will see improvements when playing games straight away, but if there's a game that your graphics card is really struggling with, an overclock won't suddenly make it playable. If that's the case, we're afraid you may have to look at upgrading your GPU.

As with overclocking the processor, the process of

Keep things cool

When overclocking your graphics card, it produces more heat than when running at stock speeds, so you must make sure it doesn't overheat. Keeping the mass of wires and cables under control works wonders for airflow – which is essential for keeping the components cool. Many PC cases enable you to route your cables and wires behind the motherboard, giving your components room to breathe.

Speaking of cases, yours should be a decent size, because small cases can get a bit too hot when overclocking. Graphics cards usually come with their own fans and heatsinks. These are fine for stock speeds and even overclocking, but if you're going to be doing some heavy-duty overclocking, video editing and gaming, you may want to buy some aftermarket coolers for your GPU. Alternatively you can incorporate a liquid cooling system to keep your processor and GPU cool.



Liquid cooling is fiddly and expensive, but it looks great

overclocking a graphics card can be time-consuming, because you're going to want to test your graphics card along the way to make sure your overclock is stable. Thankfully, there's a number of things that make overclocking your graphics card a little easier than overclocking a processor. To begin with, the overclocking procedure is done using tools within Windows, rather than the BIOS. This means you don't have to keep rebooting your machine each time you want to apply a tweak or test the stability of your system, which saves you a fair amount of time. The various tools we're using to overclock the system are also quite a bit more user-friendly than the BIOS, with graphical cues and explanations that keep you updated about what changes you're making to your system.

Getting prepared

There's a few things you can do before you begin overclocking your graphics card to ensure the procedure goes as smoothly and safely as possible. A little maintenance and research now will save you time and frustration later, and will make sure that your overclock is built upon as sturdy a foundation as possible. The first thing you should do is research your graphics card. By typing the model and make of your card – as well as the manufacturer – into a search engine, you'll be able to see whether other people have been overclocking the same card – and what sort of results they are getting. Websites such as www.overclock.net and www.tomshardware.co.uk have active forums populated by enthusiasts. These are good resources to check to see whether anyone else has overclocked the same GPU as you have. However, their results should only be used as a rough guide for what you can expect, and you should not assume that you can just apply the same settings and you're done. Graphics cards can vary from revision to revision, so your GPU might not be exactly the same, even if it appears so on paper. Applying a big leap in clock speeds is not advisable either, because putting in the wrong values could damage your hardware.

While researching your graphics card, it's worth visiting your card manufacturer's website (www.nvidia.co.uk and click on 'Drivers' for Nvidia cards, or http://support.amd.com for AMD cards) to find out whether you need to download and install new drivers, because it's a good idea to make sure your graphics card's drivers are as up to date as possible before you start overclocking.

You should also take this opportunity to download and install the various tools we're using to overclock and test your graphics card. For more information about these tools, see 'Overclocking tools' (below) and 'Stress tests and benchmarks' (on page 77). For stress testing the overclock, we'll be putting your graphics card and its new overclock through a series of tests to make sure it can perform under pressure. These benchmarks are also handy for seeing the benefits of your overclock, so before you start you should run a number of the benchmarks and make note of the results. You can then compare your results to your final overclock for a good indication of just how successful your work has been.

Jargon buster

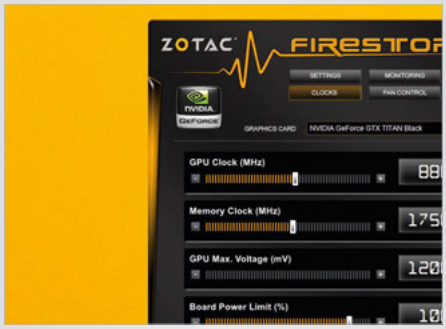
Benchmarks
These are synthetic tests designed to put your PC's components through their paces, and record the results. They are an easy way to see just how well your machine – or certain parts of it – are performing.

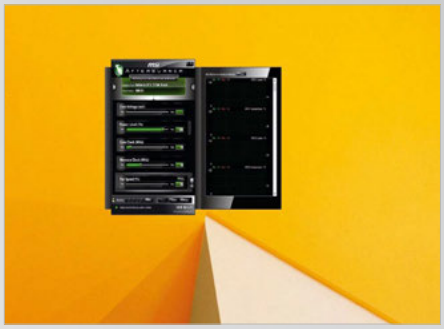
FPS
Frames per second, also referred to as frame rate. The higher the frame rate, the smoother and more responsive the game, and overclocking can help achieve higher frame rates.

TOP TIP
GET THE SOFTWARE
Most graphics card vendors include a disc with the drivers for your card and their own monitoring and overclocking software. If you don't have the software, you can download it

Overclocking tools

There are plenty of tools for overclocking your graphics card





1 ASUS GPU Tweak

Asus GPU Tweak is a handy tool for applying your overclock. If you have an ASUS graphics card, the utility should be included on the CD that comes with the card, along with the drivers and other utilities. If you don't have an ASUS graphics card, you can still use the program, which can be downloaded from http://bit.ly/PCFasustweak. When you run GPU Tweak, you'll see a window that contains a number of sliders to apply to your overclock. On the right-hand side you'll see GPU-Z Incorporated, which is a handy standalone tool for getting information about your graphics card.

2 Zotac Firestorm

Zotac Firestorm comes on a disc that's shipped with Zotac graphics cards, but like ASUS GPU Tweak, you don't need a Zotac card to use the program, and it can be downloaded from www.zotac.com/z-zone/zotac-firestorm.html. Zotac Firestorm has a more understated design than ASUS GPU Tweak. Rather than having a lot of information thrown at you at once, you get a single window with a number of tabs. Clicking 'Clocks' takes you to the overclocking section, which uses sliders to increase values. Clicking 'Monitoring' displays temperature, fan speeds and more info, which is helpful for safe overclocking.

3 MSI Afterburner

MSI Afterburner is perhaps the most popular overclocking tool for graphics cards – and again, you don't necessarily need an MSI graphics card to be able to take advantage of it. It can be downloaded from http://event.msi.com/vga/afterburner. The program offers a similar interface to ASUS GPU Tweak and Zotac Firestorm, so the decision of which overclocking tool you go for will mainly be down to personal preference. For the purposes of this guide, we're using MSI Afterburner, but you can apply the same settings in any of the other overclocking toolsçif you have those instead.

Overclock your GPU

Follow this guide to easily – and safely – overclock your GPU

1 Download and install software

First, make sure you've got the appropriate tools installed. Then check for any new drivers for your graphics card and install them. Next, download and install Heaven Benchmark from http://unigine.com/products/heaven. This is what you'll use to check your overclock is stable. Finally, install an overclocking tool – we're using MSI Afterburner (http://event.msi.com/vga/afterburner).

2 Run MSI Afterburner

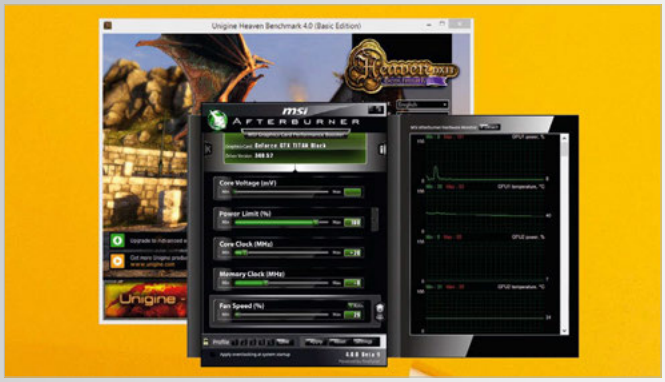
Although MSI Afterburner says it's designed for MSI cards, it works with other manufacturers' cards as well. On the first screen, you'll see an overview of your card, and sliders that can be used to overclock it. On the right you'll see graphs that show you the temperature and power levels of your card. Keep a close eye on these to make sure they remain safe.

3 Start the overclock

The safest way to overclock your card is to increase by small increments, then test the stability of the overclock. To do this, go to the Core Clock (MHz) slider and drag it right to increase it by 10MHz. Once done, click 'Apply'. You can check that the overclock is successful by using GPU-Z (which can be downloaded from www.techpowerup.com/gpuz) and looking at the GPU Clock entry.

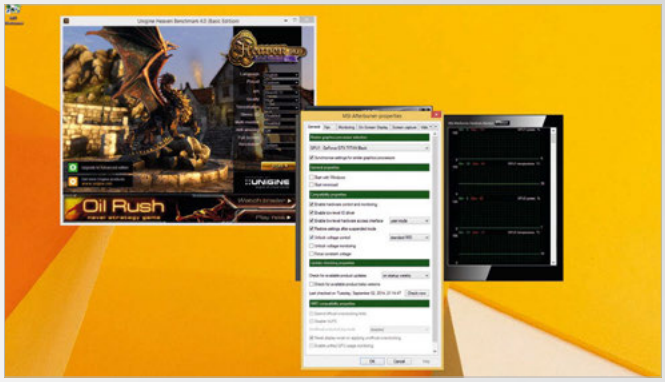
4 Test your overclock

To make sure your overclock is stable, run the Heaven Benchmark. This puts your graphics card through a number of intensive tests. At the main welcome screen, set Tessellation to 'Extreme' and Anti-aliasing to 'x8' and then click 'Run'. Press [F9] to actually start the benchmark. If it completes without any errors or problems, your overclock is stable and you can repeat the process.



5 Repeat the process

If the benchmark is OK, return to Afterburner and raise the core clock speed by another 10MHz, then check GPU-Z. If all is well, run Heaven Benchmark. Keep an eye out for errors, including glitches on the screen. If the benchmark is OK, repeat again until you see an error, then return the core clock to the last stable value, or go to step 6.



6 Increase the voltage (or not)

When your card falters, you can reduce the clock speed to the last stable value, or increase the voltage (though this is riskier). In MSI Afterburner, click 'Settings' and tick 'Unlock voltage control'. Increase the slider by 10mV and run the benchmark. If it's stable, increase again. Ensure the temperature hits no more than 90°C.

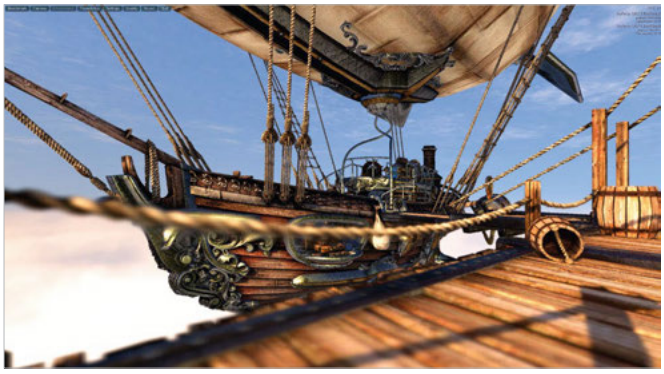
Increase the memory clock

Once you've figured out how high you can push the core clock of your GPU, you can do the same with the memory clock. This can help you eke out some more performance from your graphics card, and the good news is that if you've gone through the process of overclocking the core clock, you know the drill. Move the slider to increase the value by 10MHz and then click 'Apply'. Now, run Heaven Benchmark again and make sure that it runs fine and no errors occur. Don't worry if the benchmark stutters or doesn't play smoothly – the aim of the benchmark is to really put your GPU through its paces, so it just means that it's doing its job. If the benchmark completes OK, go back to MSI Afterburner and increase the memory clock value by 10MHz again. Keep doing this until the overclock is unstable. When it is, dial the memory clock back to the last stable value. You'll now have your maximum overclock, and you can begin really stress testing your machine to make sure this overclock is stable – see 'Stress tests and benchmarks' below. If you're not happy with your overclock, and your PC behaves erratically, don't worry – simply click the 'Reset' button on MSI Afterburner to return all the values to normal. The overclock is only applied when you run MSI Afterburner, so you can start it up before playing games. If you want the overclock to run automatically, place a tick next to 'Apply overclocking at system startup'.

Once your core clock is set, it's time to turn your attention to your card's memory clock

Stress tests and benchmarks

Put your overclock through its paces



1 Run Heaven Benchmark again!

Run Heaven Benchmark once more, but this time you don't need to run the benchmark option, just let continue to run. The longer you leave it, the more certain you can be that your system is stable – we recommend at least four hours. You don't have to sit glued to your monitor, but look out for artefacts and errors. If after four (or more) hours your PC is okay, you can be confident about your overclock.

2 Run MSI Kombuster

While using Afterburner, you may have noticed a greyed-out 'K' on the left. This links to MSI Kombuster, a tool for stress testing your overclocked GPU. Head to http://bit.ly/PCFkombustor to download and install the program; then the 'K' icon in Afterburner is highlighted. This program has a number of heavy-duty benchmarks, which really push your GPU and its overclock. If it survives these, it bodes well.

3 Compare benchmark results

Hopefully, before you began, you ran Heaven Benchmark and saved the results. The next time you run it, save the results (they're saved as an HTML file), then open up both sets. You can see the benefits the overclock has provided, including a higher score and higher FPS. Another good benchmark is 3DMark (www.3dmark.com). Some games come with their own benchmark utilities as well.

4 Play some games

The point of overclocking your graphics card is to get improved performance in games – so now comes the fun part. Fire up your favourite games and have a play. Hopefully, you should notice that frame rates are now a lot smoother. In some cases, you may even be able to increase the graphics settings. If you want to see how your frame rates are performing, download Fraps from www.fraps.com. ■

Customise Windows 8.1

25 MINUTES

Christian Hall explains how you can improve Windows 8.1 with a few carefully applied tweaks

PROJECT GOAL

A better OS
Restore your favourite Windows 7 features and make your PC work the way you want it to.

REQUIRES

Classic Shell
Get a new custom Start menu. From www.classicshell.net.

StartIsBack+
Does exactly what you'd expect. Get it from http://bit.ly/1eDnJ2h.

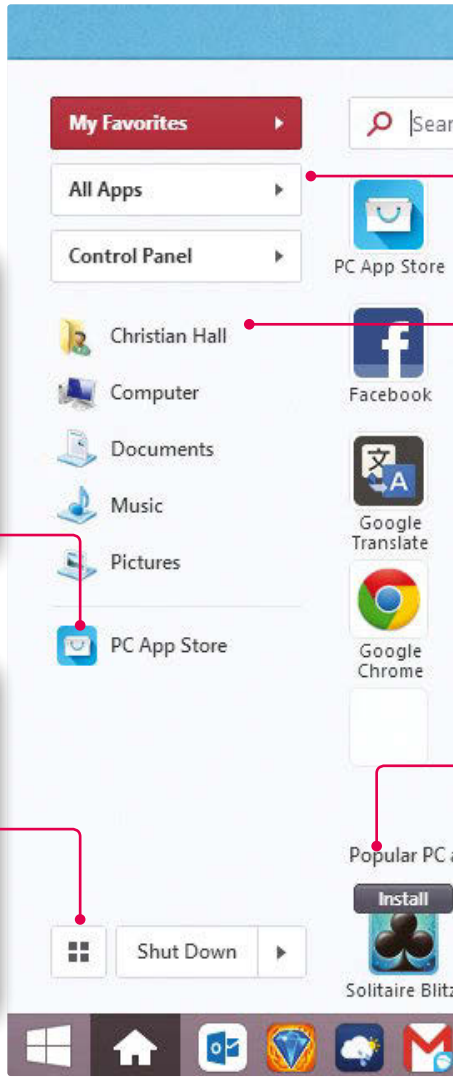
Chocolatey
Necessary to run StartIsBack+. Grab it from http://bit.ly/qbvEmi.

Pokki
Yet another way to restore the Windows Start menu. Available from www.pokki.com/windows-8-start-menu.

The Windows 8.1 interface is the latest iteration of the Windows desktop, but you don't have to stick with the default look if it's not to your taste.

The Modern UI was a radical change, and many people still expect the Windows Start button to bring up a classic Start menu rather than the new Start Screen (and get frustrated when it doesn't). With a few tweaks, that core interface element can be returned, and we'll look at three different versions that you can install for free.

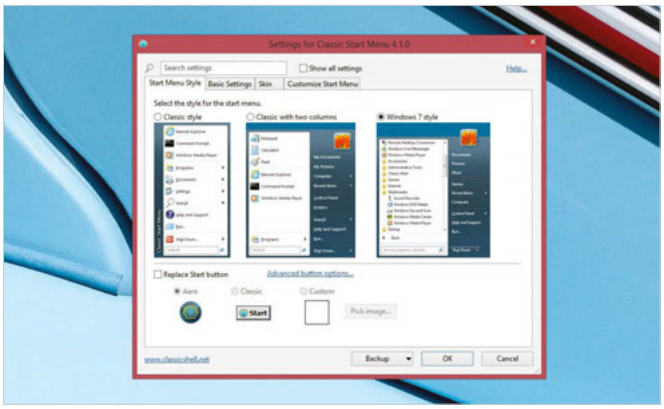
There are lots of ways to improve the OS besides adding a new Start menu. For example, the slimmed-down desktop in Windows 8.1 means it isn't always obvious where to find the options to change the interface, but main ones can be found by right-clicking the Taskbar and clicking 'Properties'. Another thing that might annoy you is Microsoft's decision to disable the Libraries feature by default, but this can be reinstated by opening 'Windows Explorer > View > Options' and ticking 'Show libraries'. Read on for more handy tips…

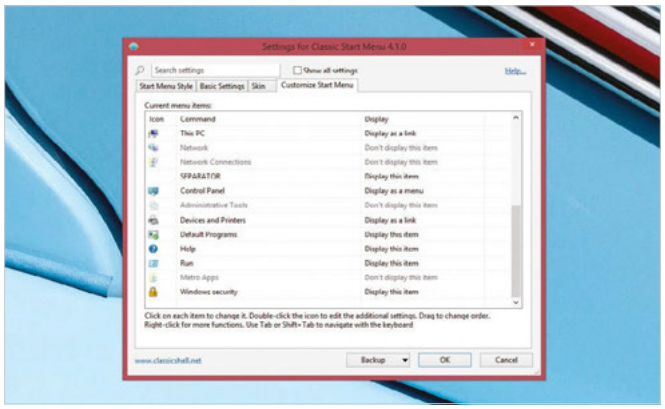


PC APP STORE
Click here to install new Pokki apps through the store. Alternatively, you can use the search bar in the top-right of the Pokki menu.

TOGGLE START MENU
This button toggles between Pokki's Windows 8 Start menu and the Modern UI. Pokki's tool doesn't replace the Modern UI like some programs do.

Step-by-step: Customise your OS





1 Get the Start button back

There are various third-party programs that will bring back the classic Windows Start menu in Windows 8. One of the most popular of these is Classic Shell (available free from www.classicshell.net). This gives you three different styles for the Start menu, options for the Start button, and skin choices to make it fit naturally into Windows 8 (such as reducing transparency and changing icon size).

2 Customise the Start menu

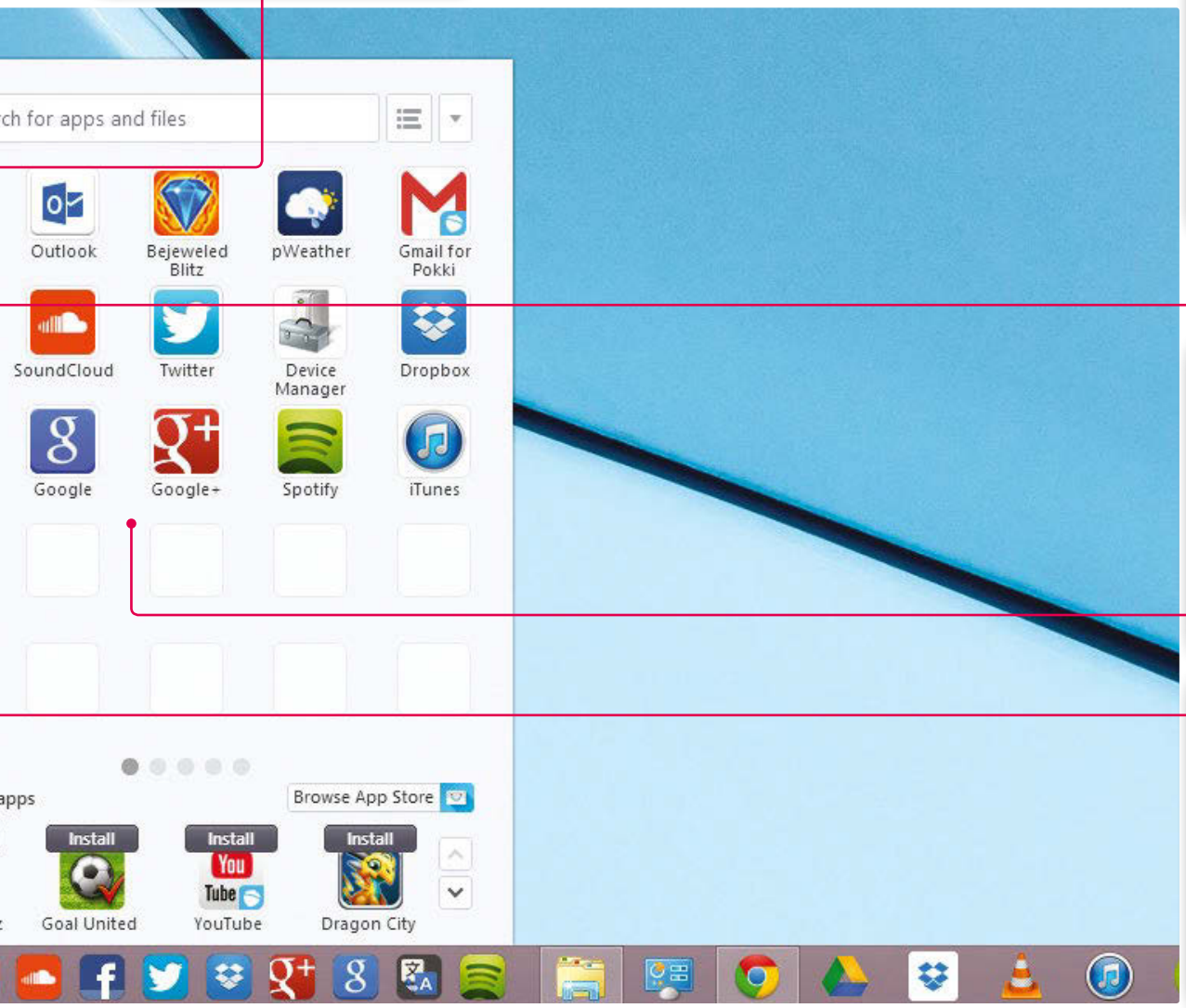
You can right-click on the Start button and select 'Settings' to bring up the Classic Shell options at any point. You've already chosen a style for your new Start menu, so click 'Customize Start Menu' to choose which menu items you want to be included. Beside each program in the list, choose either 'Don't display', 'Display as a link' or 'Display as a menu' to suit the way you work.

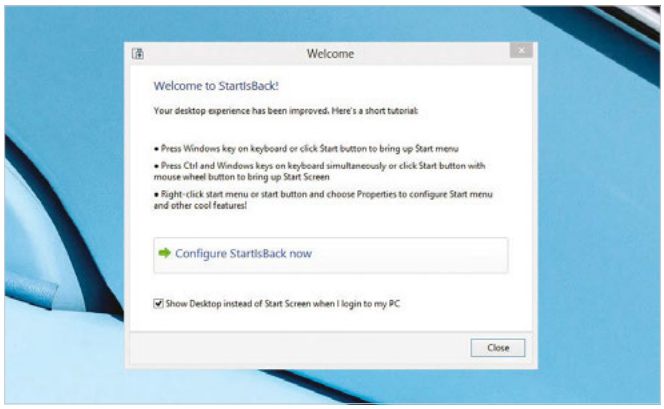
ALL APPS
Gives you a list view of all installed apps. Add them to your Favorites by clicking the star icon on the right.

YOUR FOLDERS
If you liked the way the traditional Start menu worked, with quick links to your folders, this is where they are in Pokki.

MY FAVOURITES
Pokki groups your favourite apps like a smartphone home screen, making it faster to launch programs from the desktop.

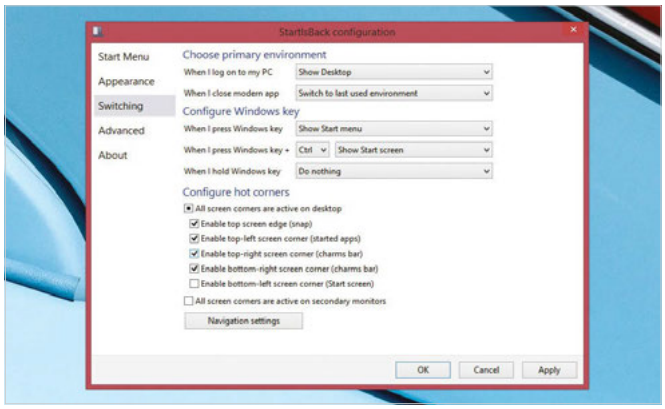
POPULAR PC APPS
Pokki's recommended apps appear here. These won't be personalised recommend-ations, but a selection of popular installs.





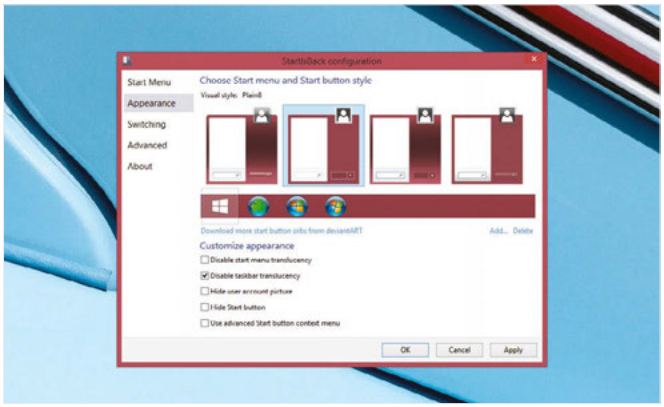
3 Configure StartIsBack+

Another option is StartIsBack+. Before you can begin, you'll need to install the PowerShell execution engine, Chocolatey, from http://bit.ly/qbvEmi. Once that's done, download the StartIsBack+ installer package from http://bit.ly/1eDnJ2h. You can't execute this file – instead, you must go into the Command Prompt and type **cinst startisbackplus**, then hit [Enter].



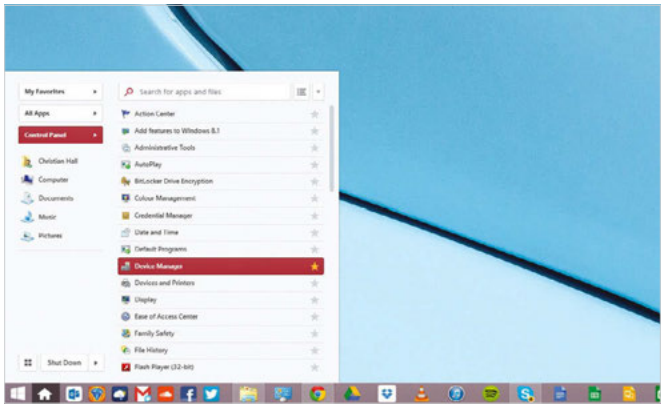
4 Switching options

Now restart Windows. Under the 'Switching' tab you can specify what your PC should do when you boot into Windows 8, and configure the [Windows] key to perform a certain action in the interface. You can also configure hot corners from this menu – a feature that is missing from Windows 8.1 as standard. All of this means you can change the default interface settings to better suit your needs.



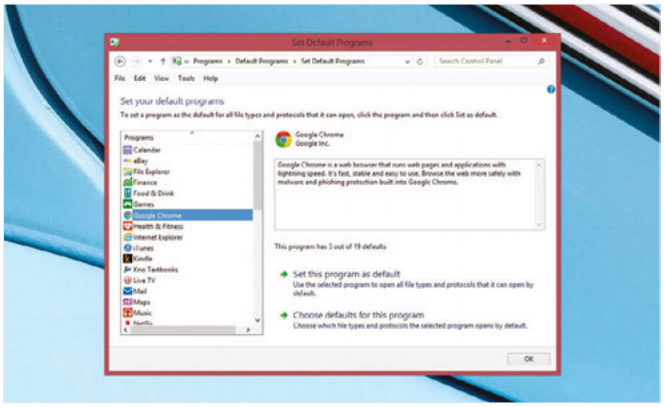
5 Change the Start button

You can make some visual alterations with StartIsBack+ under the 'Appearance' tab. For instance, you can get the old Windows 7 Start orb back instead of the new white Windows logo. There's also a link here to DeviantART, where you'll find custom Start buttons that you can download and install. You can select new visual styles for the whole Start menu, too.



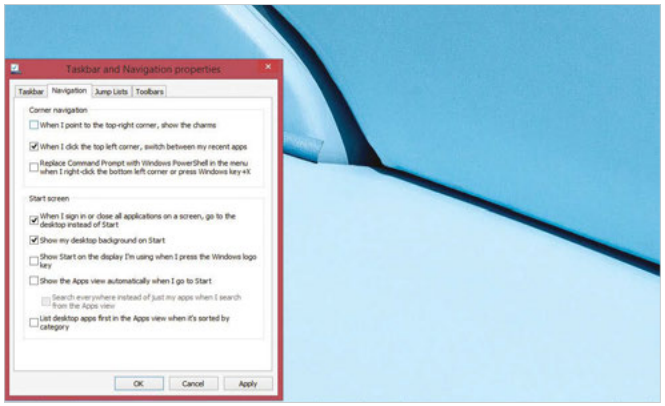
6 The Pokki menu

Windows 8 Start Menu by Pokki (free from www.pokki.com/windows-8-start-menu) is another great tool, but it doesn't actually replace the Start button. With Pokki, you can search and organise your favourite apps and websites on your desktop, just like you would on a smartphone. Take a look at the annotation on the previous page for a description of its features.



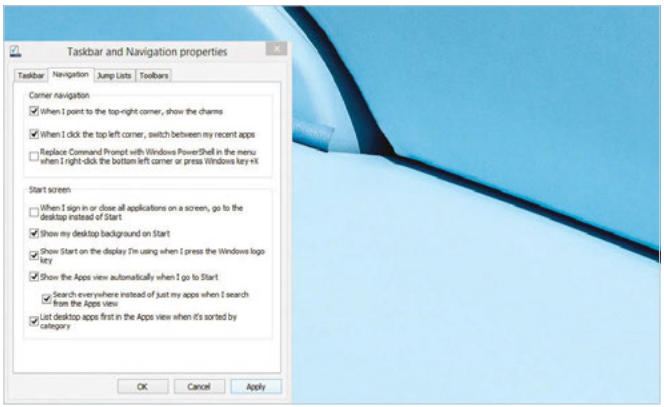
7 Escape the Modern Interface

Music, videos, pictures and PDFs are automatically opened using Modern UI apps by default, but you can change this behaviour so they open within the desktop instead. From the Start screen, type **default programs** and click on the 'Default programs' icon under the results. Click 'Set your default programs' and choose the app you want to set as your default for each file type.



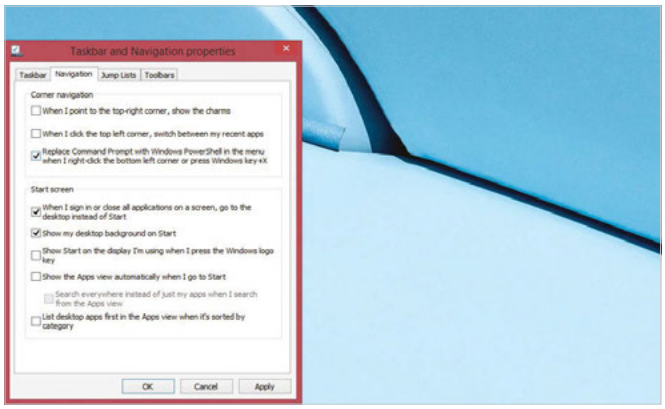
8 Disable Charms

Charms in Windows 8.1 are designed to speed up access to menus, but they are activated by the hot corners, which can be a nuisance. If you find yourself inadvertently activating the menu with your mouse whenever you move the pointer to the top-right, it's possible to disable it. Go to 'Taskbar > Properties > Navigation' and untick 'When I point to the upper-right corner, show the Charms'.



9 Show all apps

If you want to retain the Modern Start Screen but are keen to change the layout, it's possible to display all your installed apps at once. Right-click on the Taskbar and choose 'Properties > Navigation'. Tick the last four boxes in the Taskbar and Navigation Properties dialog box. When you click on the Start button, you will see all your desktop applications first on the list.



10 Replace the Command Prompt

Right-clicking on the [Windows] button brings up a list of power user commands. If you want to perform complex tasks that use DOS-style commands, you can replace Command Prompt with Windows PowerShell. To give this a try, again, right-click on the Taskbar and choose 'Properties > Navigation' and tick 'Replace Command Prompt with Windows PowerShell'.

Make great home videos

Creating a movie masterpiece is easy with Windows Movie Maker, says Henry Winchester

PROJECT GOAL

Better videos
Compile videos from multiple clips, edit footage, add credits and more – all for free.

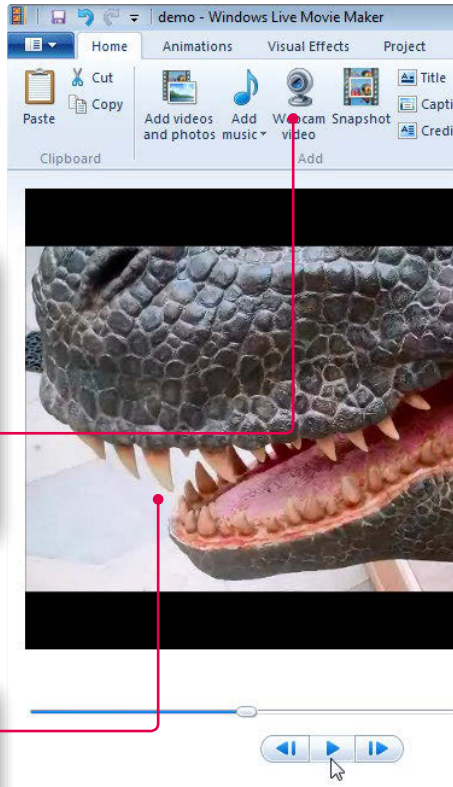
REQUIRES

Video clips
Home movies or recorded game footage – any videos you want to make polished and presentable.

Windows Movie Maker
Download it from http://explore.live.com/windows-live-movie-maker if you don't already have it.

Given that just about every modern phone and digital camera has a video mode, it's not surprising that the internet is deluged with video clips. In fact, it's estimated that 35 hours of footage is uploaded to YouTube every minute. Of course, most of this is low quality material shot on a basic camera and uploaded without any editing, but it's quick and easy to spruce up your own home recorded videos and give them a professional edge using Windows Movie Maker.

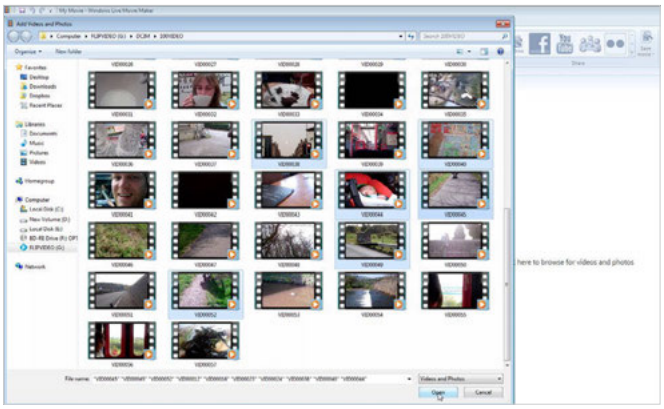
You probably already have Windows Movie Maker on your PC, but if not, visit http://explore.live.com/windows-live-movie-maker and follow the on-screen instructions to download and install it. Once you've got it up and running, you'll find it easy to edit your videos, combining several clips with titles and still images to create a movie. You can then upload your masterpiece to YouTube or send it by email to share it with friends all over the world. Settle down in your director's chair and let's get started!

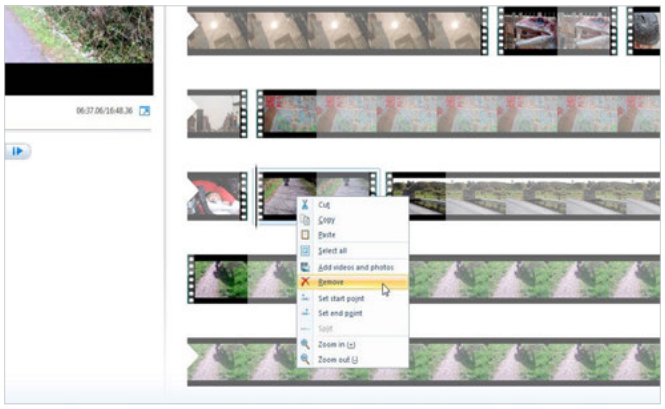


WEBCAM
Windows Live Movie Maker enables you to record from your webcam. Great if you want to add an introduction to your video.

PREVIEW
Here you can see a complete preview of what your movie will look like. Use the bar to navigate, and click the bottom-right box for full-screen.

Step-by-step: Make a movie





1 Import your clips

Fire up Movie Maker, then click 'File > Import media items' and browse to the video clips on your PC. Once you've found the clips you want to include in your movie, select them (you can hold down [Ctrl] to highlight more than one), then click the 'Open' button. It might take a little while for Movie Maker to import the clips, especially if they're particularly long, or were shot in high-definition.

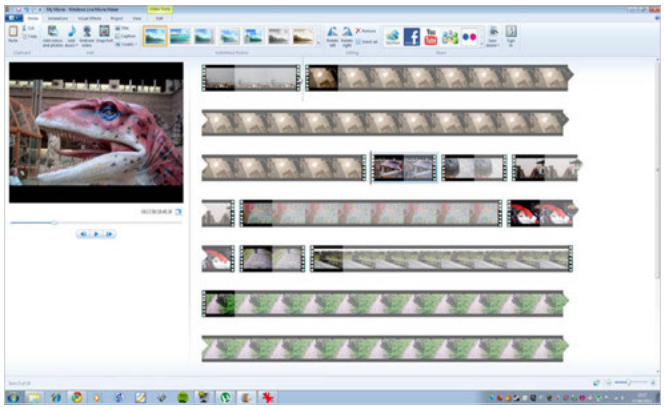
2 Remove material

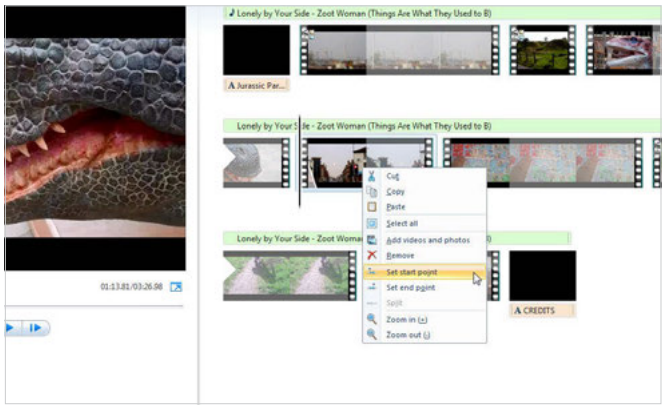
The clips are presented in the order in which they were shot, but don't worry if this isn't what you want – we'll show you how to move them around in a moment. If there are any clips you don't want to appear in your finished movie, right-click them, then select 'Remove'. If you accidentally delete something, you can add it again by clicking 'Add videos and photos' at the top.

AUTOMOVIE
If you've got a series of clips and don't want the hassle of editing them, the AutoMovie buttons add transitions and a theme automatically.

TRANSITIONS
You can see the effects you've added to clips in the first panel. For example, this one swipes in from the previous clip.

PLAYBACK
As you play your movie, this black bar moves across each clip. Click and drag it to see what's happening in each frame.



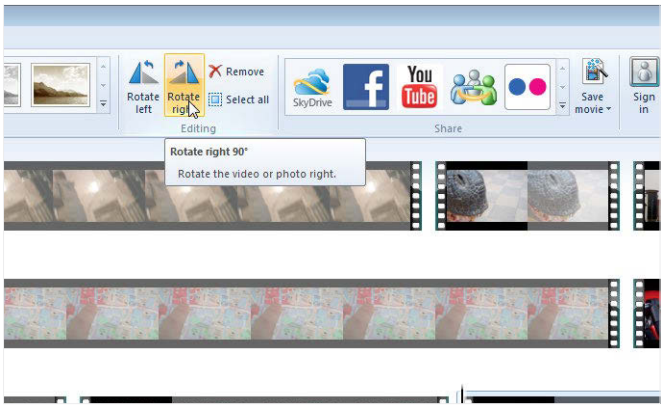


3 Moving movies

To move your imported clips around, simply left-click one and drag it into the space between two other clips. Movie Maker automatically rearranges the clips based on where you leave them. You can preview your whole video in the pane to the left at any time, too – just click the 'Play' button at the bottom if you want to see how your edited movie is coming along.

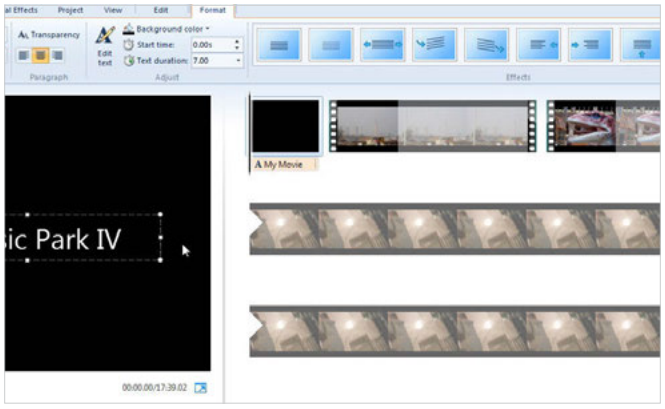
4 Trimming clips

You can trim your clips to remove any unwanted footage. To trim from the start, simply play the clip in the left-hand panel, then pause it where you want to cut. In the right-hand panel, right-click on the black 'Play' line and select 'Set start point' – this removes everything from the clip before this point. Select 'Set end point' to remove everything after this position.



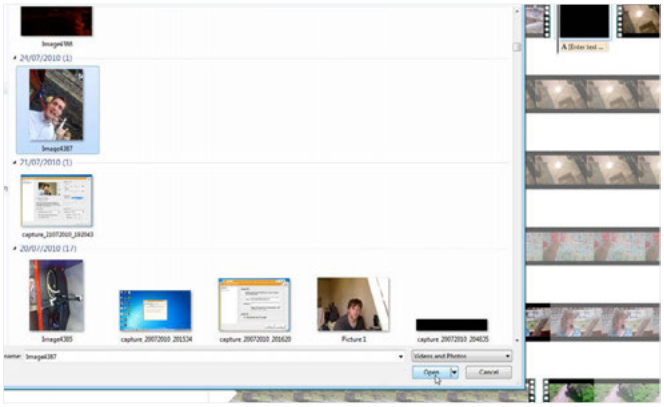
5 Turn it around

Some of our videos were shot in portrait orientation rather than landscape, which means they appear sideways once we've imported them into Movie Maker. To rectify this, it's simply a question of selecting the clip by clicking on it, then choosing 'Rotate right 90°' or 'Rotate left 90°'. Remember that there will be a black bar on either side of the clip, though.



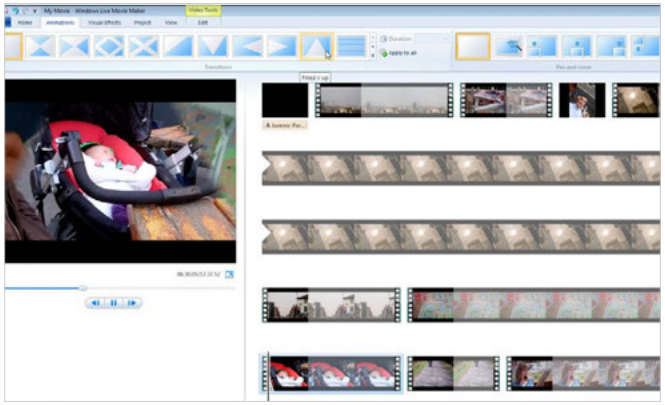
6 Create titles

To add a title to your film, click on the first clip and choose the option 'Add a title'. Here you can type text and choose an animation style for it – the one we've selected slowly expands. You can also add extra titles at any point in the movie by clicking on the relevant clip and choosing 'Add a title'. This can be a handy way to break up long movies into sections.



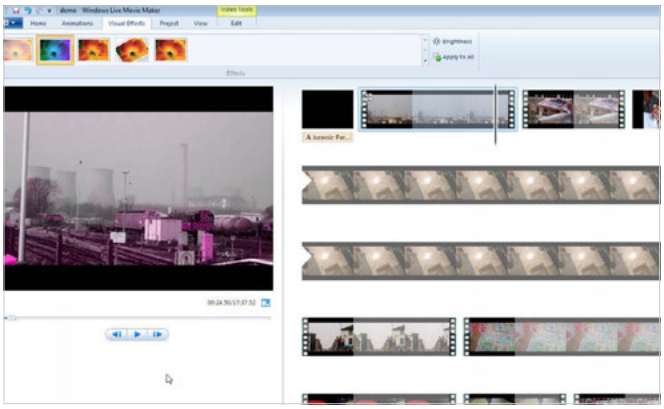
7 Insert photos

Your movie needn't only consist of moving clips – you can also add relevant photos or other still images in between your pieces of video footage. To do this, click 'Add videos and photos', then browse to your photo folder. Choose the picture you want to add, then click 'Open'. Double-click on a picture of add it and use the top ribbon to adjust how long it should appear on screen.



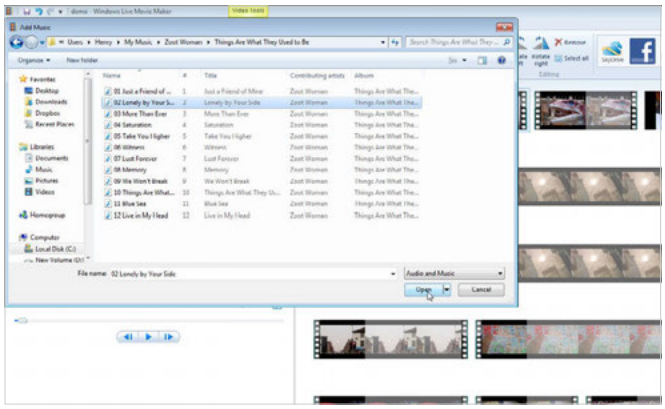
8 Fading away

By default, Movie Maker cuts straight between clips, but you can spice up these transitions using a selection of stylish animations. Click on the clip you want to animate, then select the 'Animations' option at the top of the screen. Here you can choose from various fades and wipes that can be used to link one clip to the next. Try a few to see which one looks best.



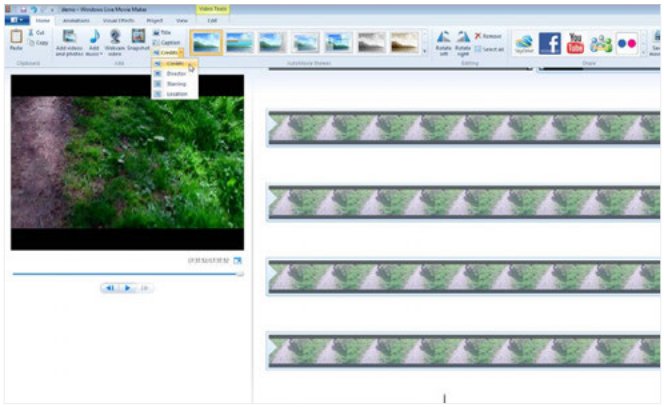
9 Special effects

Adding retro or psychedelic visual effects to video clips instantly makes videos look more interesting (for better or worse). Simply click the clip you want to change, then choose 'Visual effects' and take your pick from the list at the top. You can also change how bright clips are by clicking the 'Brightness' button at the top. It's best not to go overboard with these effects.



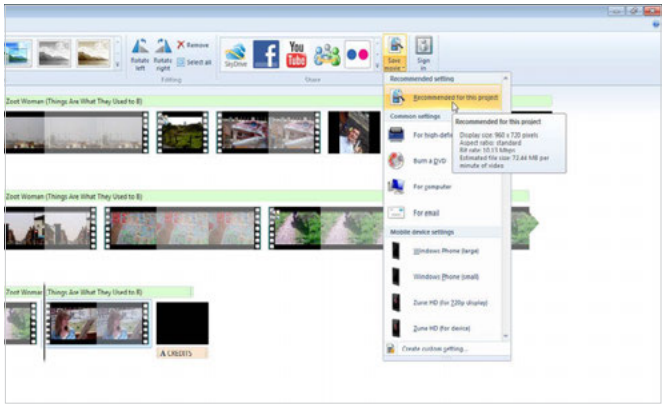
10 Add music

To add a soundtrack to your video, select the 'Add music' option. You can choose whether the music starts at a specific clip, or plays all the way through your whole movie. Browse to the track you want on your PC, then choose 'Open'. You can combine the music with your movie's existing audio by clicking 'Audio mix' and moving the slider to the left or right. Remember, YouTube may mute copyrighted music.



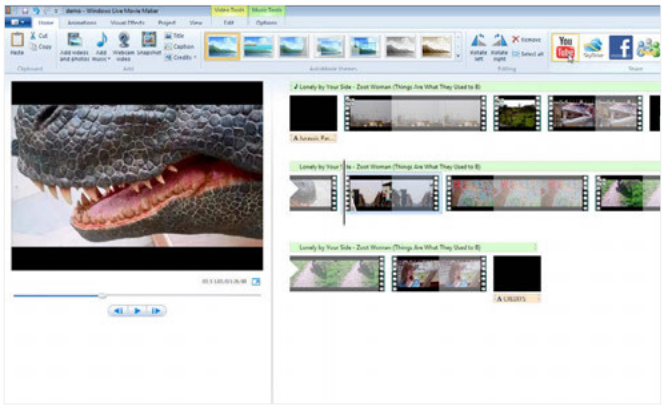
11 Giving credit

Closing credits – which list the film's director and its 'stars' – can be used to add a professional touch to your videos. Click right at the very end of your movie, then select the small arrow to the right of 'Credits'. Movie Maker has a list of preset options to choose from, and once you've typed your credits in, they will scroll up the screen just as they do in the cinema.



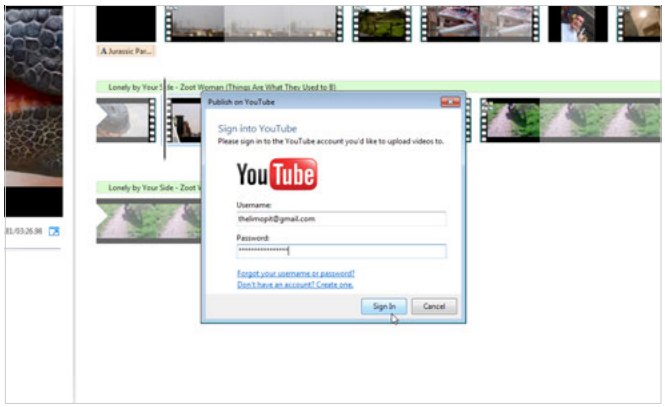
12 Save yourself

When you're happy with your edited video, there are several ways to display it, and share it with family and friends. If you simply want to store the video as a WMV file on your PC, click 'Save movie'. Here you're given some options – you can save it in full-blown high definition, or as a compact file to make it more suitable for emailing or uploading to a service like Google Drive.



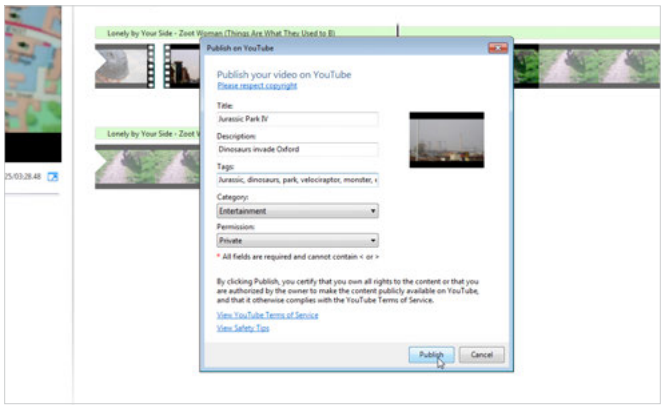
13 Publish online

At the top of the screen you'll see an assortment of publishing platforms, including SkyDrive, Facebook and YouTube. All of these options work in much the same way. To publish a movie to YouTube, click the appropriate icon and you'll be given a number of possible resolutions. Remember that a higher resolution naturally means a bigger file size, which will take longer to upload.



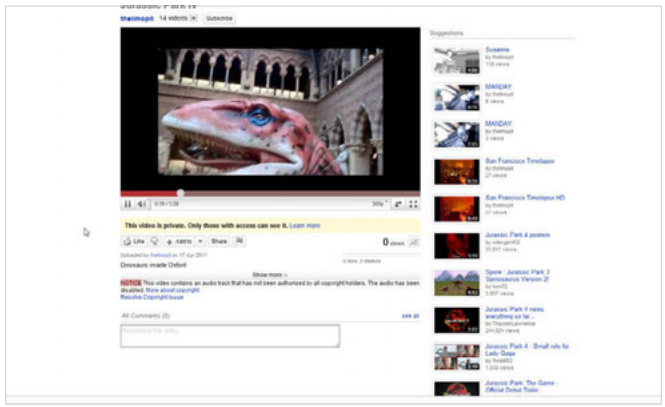
14 Sign in to YouTube

Once you've picked a suitable resolution for your video, you'll be asked to sign into Windows Live. Enter your email address and password, and click 'Sign in'. Next you're asked to enter your YouTube username and password (if you have a Google or Gmail account, you can use that instead). If you need a YouTube login, click 'Don't have an account'. It's quick and easy to get set up.



15 Publishing options

Add a title for your video on YouTube, along with a brief description and some tags to make it easier to search for, then select a category. If you don't want people without a link to be able to see your video, set Permission to 'Private'. Once you're happy with your settings, click 'Publish' to upload the video. It may take a while, depending on your computer and internet connection speed.



16 Share with friends

Once your video has been uploaded to the site, you can share the YouTube address with your friends by simply copying it and pasting it into an email. You can show off your filming and editing skills, and it's a great way to document everything from family days out to live concerts. The more you use Movie Maker's features, the better you'll get at it, so get stuck in and have fun! ■

Secure your wireless network

30 MINUTES

A good password isn't always enough. Christian Hall's tips will keep your data safe

PROJECT GOAL

Secure Wi-Fi
Protect your data from potential criminals.

REQUIRES

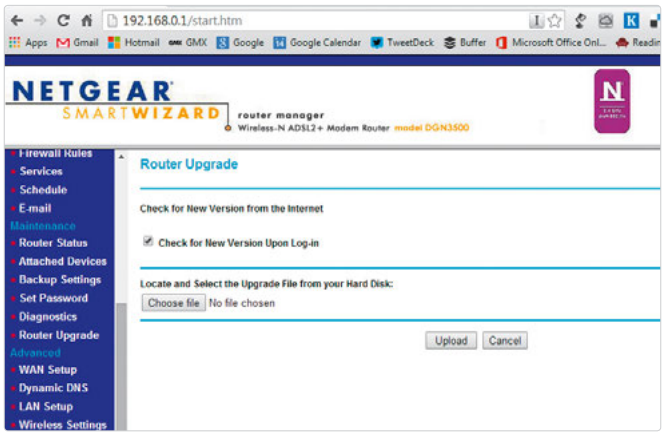
Router firmware
Download from manufacturer.

Securing your network beyond the password level seems like a chore. That's understandable, but with so many wireless devices in the hands of other people just feet from your property, you need to go a little further to ensure your privacy is kept intact. We're going to guide you through the essential steps you should take to improve the security of your home wireless network.

At the core of most home Wi-Fi networks is a router, which sends data between wireless devices and the internet. To set up your router, you must access the admin panel through a web browser. This is where you enter your network address and account information. The admin panel is protected with a username and password, but as you'll see, that's just the first stage in protecting your network.

Step-by-step: Tighten security

Techniques and advice to help lock down your wireless network



1 Wi-Fi protected setup

If you're updating your router, your new device will follow either the 802.11n or 802.11ac specification, and will almost certainly come with WPS (Wi-Fi Protected Setup). This is usually a button that you press to lock the router while you set it up. It will let you bypass any password setup until you're securely logged in to the admin panel.

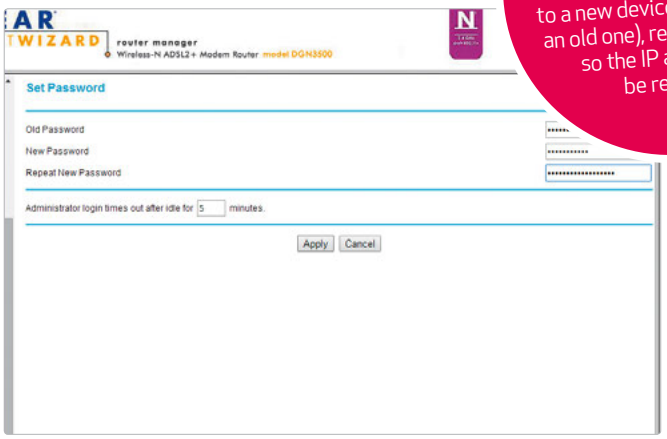
2 Update your router's firmware

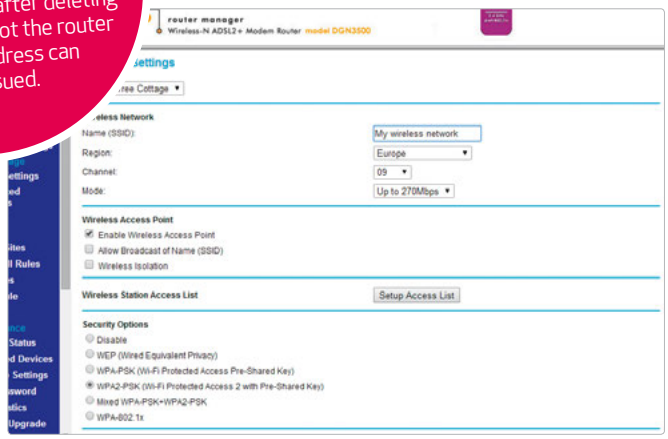
Older routers can develop security issues as you attach new devices to your network. Check your router manufacturer's site for a firmware update. This will ensure compatibility with the latest devices and will refresh your router. It will usually involve downloading a file and uploading it via the firmware section of your router's admin panel.

TOP TIPS

STATIC IP ADDRESSES

To reassign a static IP address to a new device (after deleting an old one), reboot the router so the IP address can be reissued.



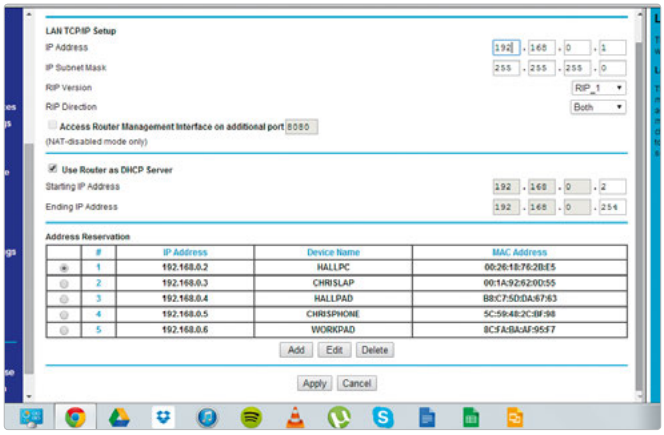


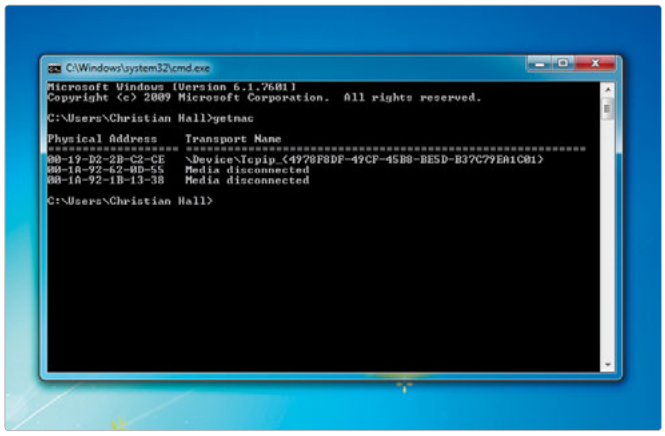
3 Change your password regularly

Firmware updates might be the only way to add better security features, but when you reboot the router afterwards, you'll have to configure its security options again. We recommend using WPA-PSK or WPA2 at the very least, and you should choose a new password that includes both letters and numbers, making it difficult to crack.

4 Switch off SSID

By default, routers broadcast their ID to nearby devices, but it's easy to stop this so snoopers can't see your network. In your router's admin panel you should find an option to stop broadcasting the SSID (service set identifier). To connect, you'll need to enter both the name and password; it won't appear on the list of available networks.



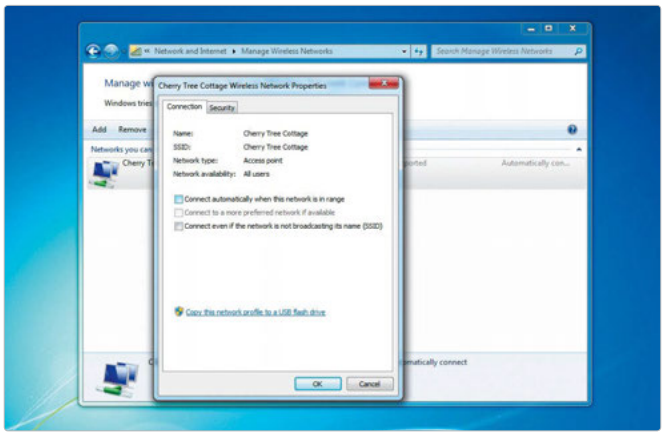


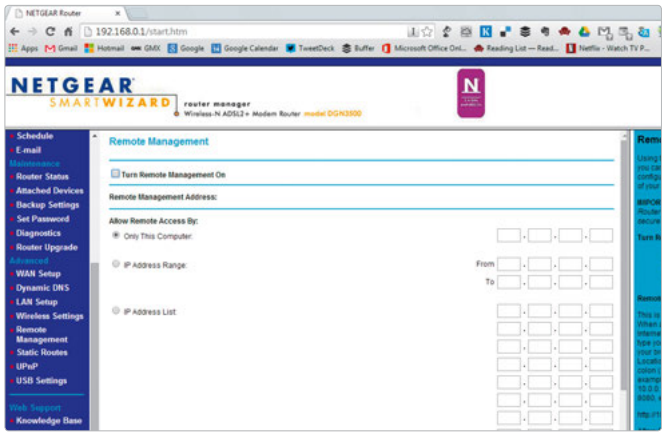
5 Address reservations

If you give each device a static IP address, your network will not only be faster and more reliable, but also more secure because you can easily see which devices are connecting to it. Devices you don't recognise will be given IPs that are not in your list of reserved ones. To do this, follow the simple guide at http://bit.ly/1pQNEa1.

6 MAC filtering

Stop unrecognised devices from gaining access by creating a list of MAC addresses for your devices and only allowing these to connect. Look for an address filtering option in your router admin panel. To find the MAC address for a Windows PC, type **getmac** in the Command Prompt. Check the manufacturer's site for other devices.





7 Don't auto-connect to hotspots

Connecting to open Wi-Fi networks exposes your PC to security risks. To disable automatic connections, click 'Control Panel > Network and Sharing Center > Manage Wireless Networks' and right-click the one you want to change. Click 'Properties > Connection' and uncheck 'Connect automatically when this network is in range'.

8 Disable wireless administration

Change the setting that allows router administration through a wireless connection to 'off'. You now need a wired connection to get to the admin panel, essentially preventing wireless hacking. You have now completed the core tweaks to protect your network, but check the manufacturer's instructions for other ways to stay secure. ■

Roll back changes with System Restore

1 HOUR

Is your PC behaving erratically and you don't know why? Matt Hanson can help…

PROJECT GOAL

Problems solved

Undo troublesome changes.

REQUIRES

Nothing

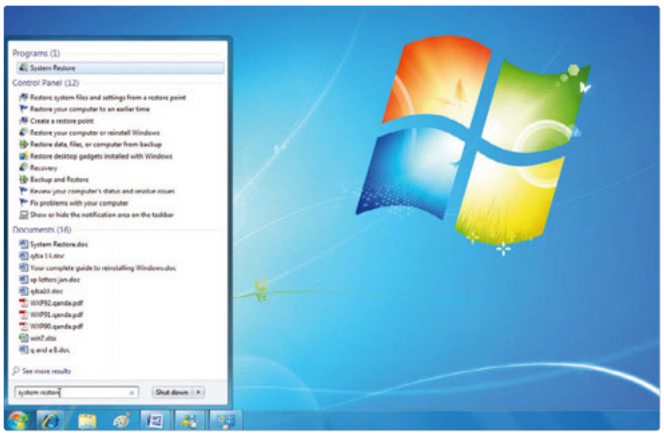
System Restore is built into all recent copies of Windows.

Sometimes your PC can start having problems apparently out of the blue. Even the smallest change can cause them to stop working properly. Thankfully, ever since the launch of Windows XP, Microsoft has included an extremely useful safety net as part of its operating systems – System Restore.

This brilliant program works silently in the background, periodically creating snapshots of your PC's settings, which are known as System Restore Points. If you start to experience problems with your PC, then you can choose a System Restore Point that was created before the issues started. Selecting a previous Restore Point will roll back your computer's settings to before the problem arose, which should let it run normally again.

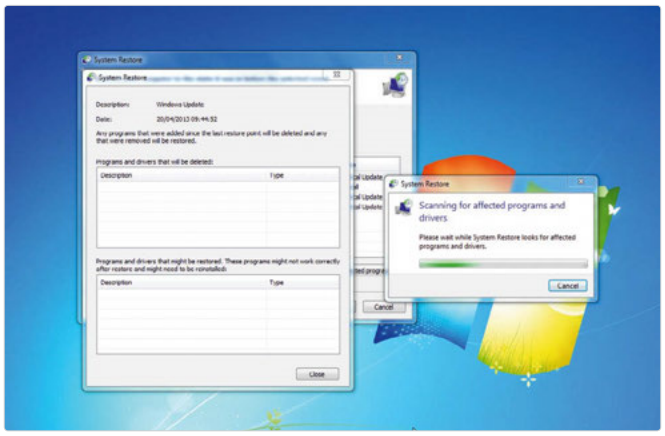
Step-by-step: Roll back system settings

Undo system changes that are causing your PC problems



1 Launch System Restore

Before you can roll back your system, you'll need to launch the System Restore program. If you're using Windows Vista or Windows 7, you can do this by clicking 'Start', then typing **system restore** into the search box and pressing [Enter]. If you're using Windows XP, go to 'Start > All programs > Accessories > System tools > System Restore'.



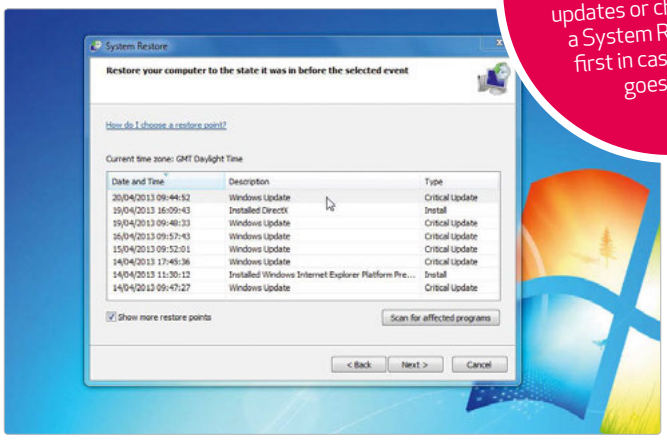
2 Scan for affected programs

Using System Restore doesn't affect documents or files you've created, such as music and photos. Recently installed programs and drivers might be removed though, because they might be what's causing the problem. Click 'Next' then select a Restore Point and click 'Scan for affected programs' to find out what will be removed.

TOP TIPS

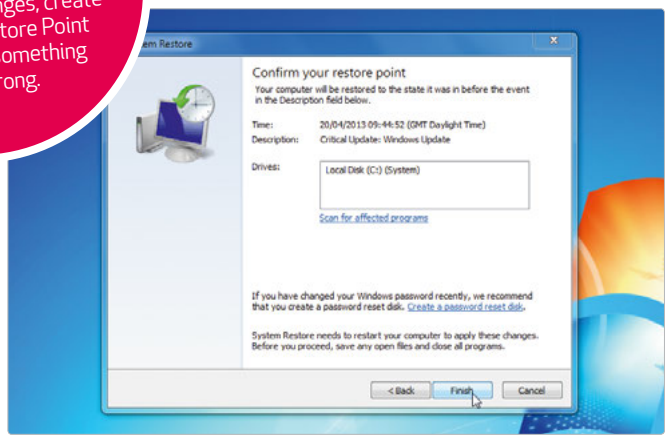
BE PREPARED

When trying complicated updates or changes, create a System Restore Point first in case something goes wrong.



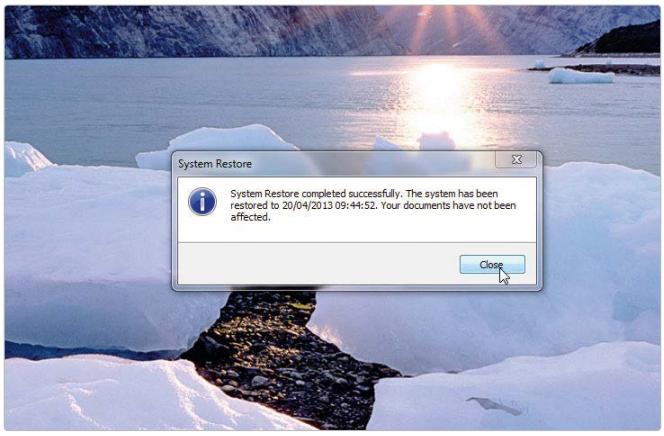
3 Select a Restore Point

Choosing the right Restore Point to roll back to is vitally important. Go too far and you might lose settings and programs that haven't caused any problems. To help you select the correct Restore Point, take a look at when and why each one was created. Click 'Show more Restore Points' to see older ones.



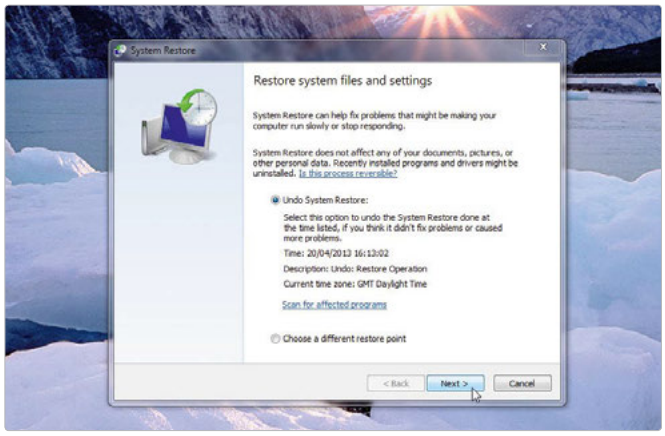
4 Confirm your Restore Point

Select a Restore Point and click 'Next'. Now confirm your selection and create a password reset disc if you regularly change your password – System Restore might roll back to a time when you had a different password. Click 'Create a password reset disc' or click 'Finish' to begin the roll back.



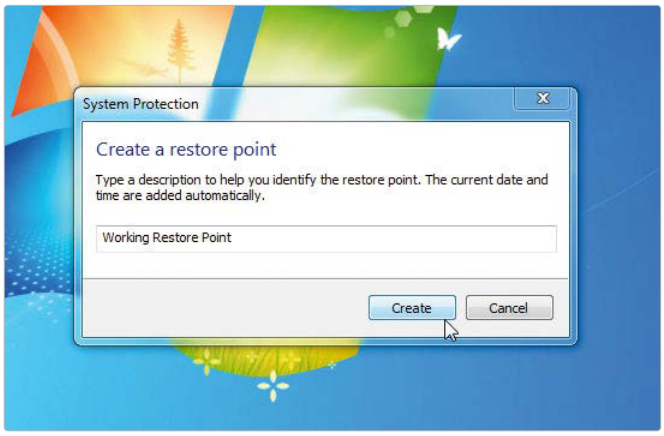
5 Check your system

Once the System Restore process is underway you won't be able to stop it. Windows will apply the changes and then restart your PC. You'll then see a dialog box letting you know that System Restore has completed successfully. Take some time to make sure that the problem you were experiencing has been fixed.



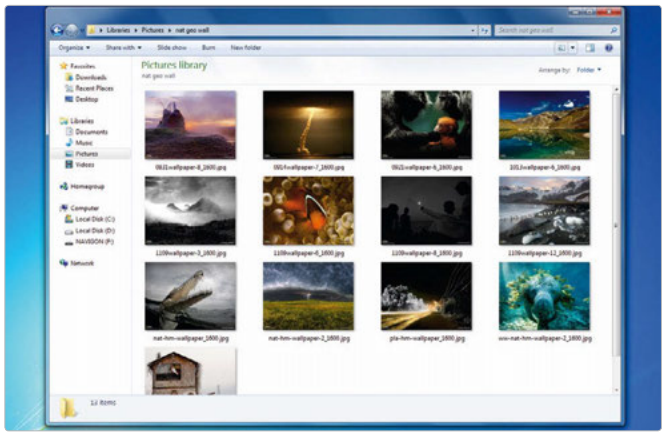
6 Undo any changes

If System Restore doesn't help, or causes more issues, you can reverse it. Open System Restore and select 'Undo System Restore'. If you can't see it, click 'Next' and you should see the last time you used System Restore. The description should be 'Restore Operation', and the Type should be 'Undo'. Select that and click 'Next' and then 'Finish'.



7 Create a System Restore Point

If you're about to attempt something complicated, it's always a good idea to create a System Restore Point that you can roll back to if you encounter any problems. Click 'Start', then right-click 'Computer > Properties'. Click 'System Protection > Create'. Type a description into the text box, then click 'Create' again once you've finished.



8 Enjoy your problem-free PC!

Now your PC should be running properly again and your files and photos will be unaffected. Windows will continue to create System Restore Points in the background whenever you make changes so you don't have to worry if things go wrong and you start experiencing problems – just use System Restore to save the day! ■

Create your own Facebook Group

30 MINUTES

Wanna be in my gang? Graham Barlow helps you connect with like-minded people

PROJECT GOAL

Facebook group
Make a group dedicated to a topic close to your heart.

REQUIRES

Facebook account
Any user can make a group.

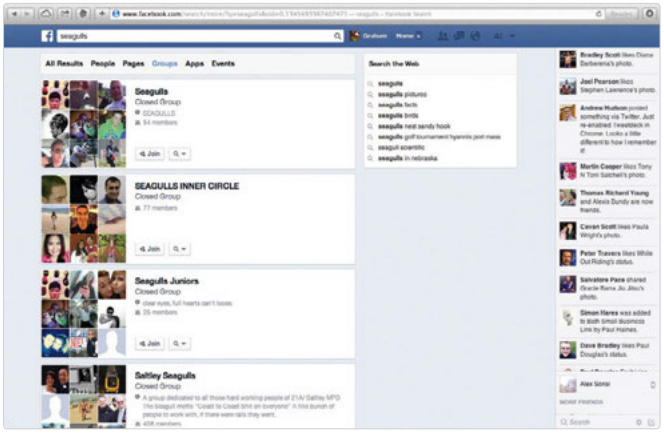
Facebook Groups offer the chance to join a community dedicated to a particular interest or subject. While there are already plenty of Groups that you can join, the most exciting thing you can do with Groups is create and run your own. Facebook makes it easy to do, and it costs nothing to set up.

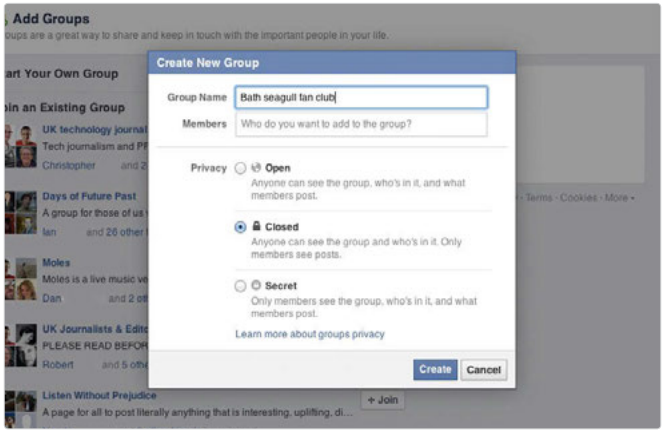
The privacy settings in Facebook Groups can be customised to make them work for different purposes. You can use them for personal communication or as a way to keep in touch with family, for example, but they also provide a way to meet and talk to strangers, and enable you to start a community based around a subject.

Once you've created a Group and become the administrator, it's completely up to you to promote it and get people to join.

Step-by-step: Set up a Group

Invite friends, choose admins, share files and spread the word





1 Start your first Group

There are many reasons why you might want to start a Group on Facebook – maybe it's for a club you belong to, or a sports team. However, if it's for something such as supporting a band, it's best to check that a Group doesn't already exist. Type the band's name into the search bar, then click 'See more results' followed by 'Groups'.

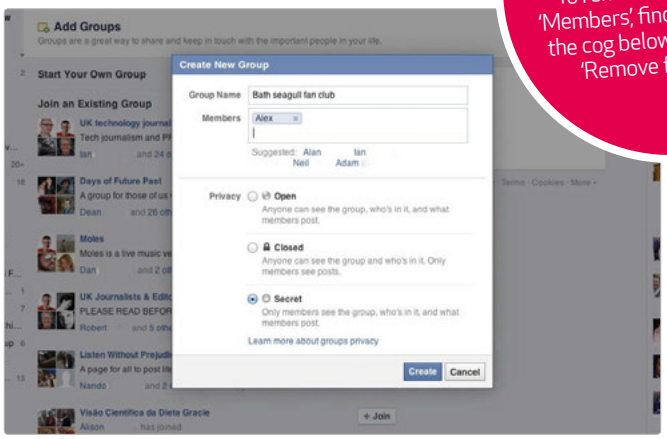
2 Name your Group

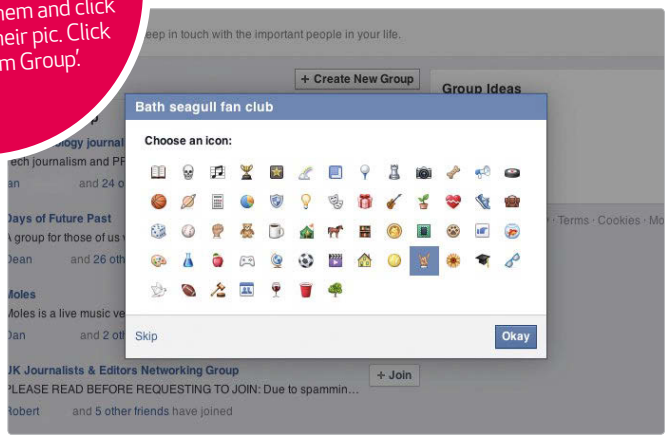
If you're satisfied that you won't be duplicating an existing Group, it's time to make a new one. Groups are listed in your sidebar. At the bottom of the list of ones you've joined, you'll see the option 'Create Group'. Click this, then click 'Create New Group'. Type in a name and enter the names of Facebook friends you'd like to invite to join.

TOP TIPS

MANAGE MEMBERS

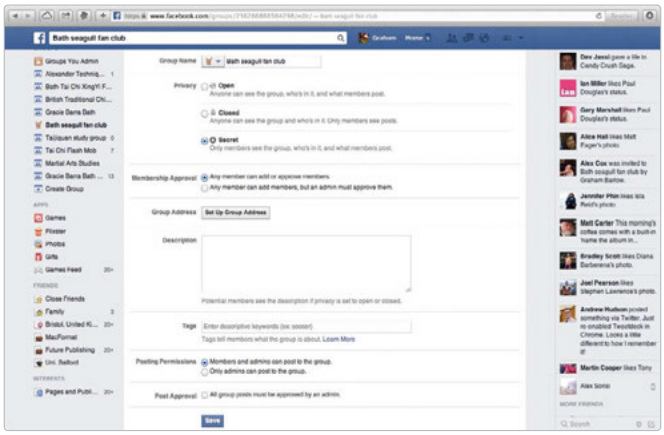
To remove someone, click 'Members', find them and click the cog below their pic. Click 'Remove from Group'.





3 Set Group privacy

Security and privacy are essential considerations whenever you're using a social network. Groups can be open, closed or secret. An open Group has everything on display, while a closed Group's posts are hidden until you have applied to join and been accepted. Secret Groups are invitation-only and don't appear in Facebook searches.

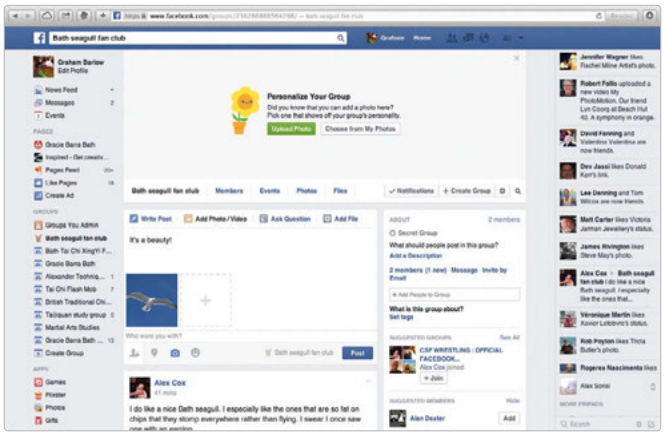


4 Personalise your Group

Once you've created the Group, you'll be prompted to choose a suitable icon that will represent it. Once you've selected one, you'll arrive at the Group page. Here you can upload a Group photo, add a description and set tags. These help the Group appear in Facebook searches if you want to attract members.

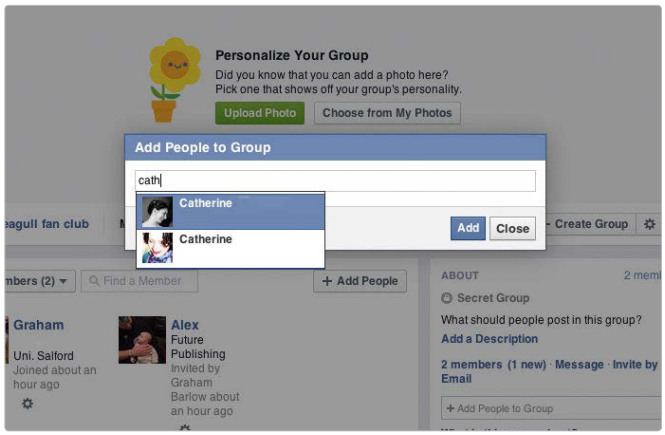
5 Change the Group settings

As the creator, you need to know how to change the Group settings. On the Group menu bar is a small cog – click this, then choose 'Edit Group Settings'. Here you can change how members are approved and how posts are approved. You can even remove or block any members who are causing trouble.



6 Choose your admins

Admins are Group members who have special privileges. They can approve members, approve posts and even remove people from the Group to spread the workload. To make somebody in your Group an admin, click the 'Members' tab, then click the cog icon beneath a member's name and choose the option 'Make admin'.



7 Add files to your Group

Groups aren't just great places to talk with like-minded people – you can also upload photos and other types of files. Select 'Photos' from the Group menu bar, then click on 'Upload Photos' or 'Upload Video'. Once you've selected your file, you can write a comment to explain it, which will accompany it in the Group's news feed.

8 Promote your Group

A group is only as good as its members. To get more people interested, start with your Facebook friends – click 'Members', then 'Add People'. As you start to type the names of your Facebook friends, they are autocompleted for you. Facebook also suggests people you might like to add on the main Group page. ■

Ask Luis

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

Is your PC busted? Luis Villazon is ready to take your call. If you just want some company at night, that's fine too

ICDNT

LIFE IN THE REAL WORLD

My younger sister has just finished her English literature degree and has so far spent the summer entirely failing to find a job. Apart from telling her "I told you so", which I've certainly indulged in, is there anything constructive I can suggest she could do in order to retrain for an actual job? I know you've said in the past that anyone can learn to program, for example, but is that really a realistic goal for an English graduate?
Martin Smethick

Absolutely! When I taught myself to program, 30-something years ago, only massive dweebs did it. By now it has become so mainstream that it actually requires a luddite stubbornness to avoid. Is your sister going to get a job as a software developer with a BA in English? Probably not. But being able to do a little bit of Javascript or Python – or even just write an Excel macro – is always a good thing to be able to put on your CV. I was a software developer for seven years, but I didn't start out trained as one. My first degree was in zoology.

In a lot of ways I think that we are entering a golden age of programming. In the same way that cooking was once something that only mothers and chefs did, and then in the 1980s we were all allowed to have a go with the stove, so programming has been democratised by the fact that virtually every object that uses electricity now has to be programmed. Learning the programming equivalent of cheese on toast or spaghetti bolognese isn't hard. In fact there are so many diverse programming languages these days that it is almost impossible *not* to learn one at some point in your career. Have a look at this month's FAQ, for a fun (but completely useless) one that might appeal to your sister.

ICDNT

COOPERATIVE CREEPERS

Is there a way to run *Minecraft* as a multiplayer game on the same PC without an internet connection? My six-year-old son isn't ready for the internet yet (or at least, I'm not ready for him to be on it) but I'd like to be able to join in with him when we are digging caves and punching trees.
James Caulfield

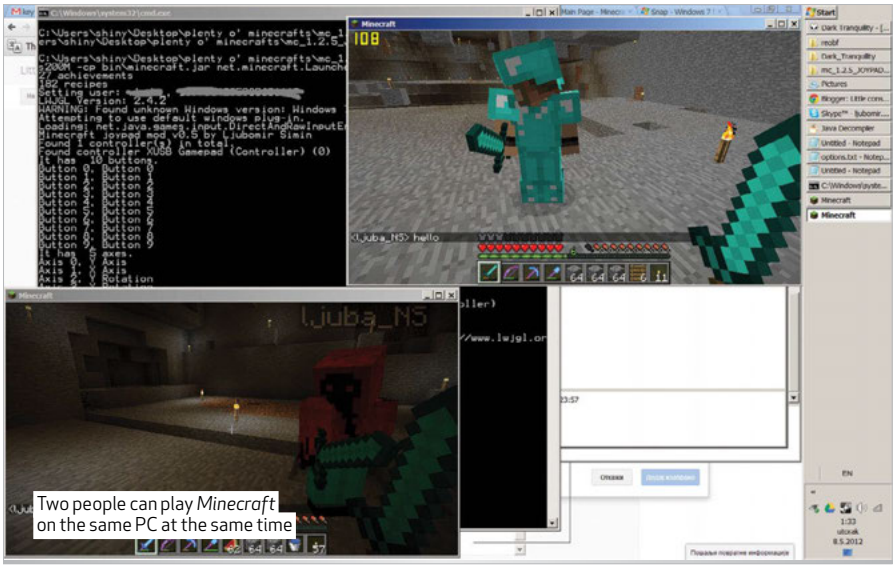
There will never be a time when you feel your child is ready for the internet. The possible trouble that they could get into expands much faster than your willingness to accept it. Even at age six, I'm not sure it is realistic to adopt an isolationist policy. Talk to him, explain in general terms the possible nastiness he could come up against and keep the PC in a public part of the house, in a place where the screen is in view to anyone walking past. If you teach your children the truth about the internet early on, the day will come when you'll feel relaxed enough to put the lock back on the bathroom door, and let them take their iPads in there with them.

But wipe away that cold sweat; this is not that day. For now, all you need to do is play *Minecraft* with your son, which is hardly a chore. It's easy enough to run multiple copies of *Minecraft* on the same PC, provided it has the horsepower to keep the framerate high enough. You can run each in windowed mode and tile them to fit on the screen. For multiplayer, each copy will need to be logged in to a different account. The real problem here is how to control two games at once. You can't just plug two keyboards in – there's no way to direct the input from each keyboard to a different copy of the game. The only way around this that I can think of is to use the joypad mod (http://bit.ly/1qGEL4q) so you can use the keyboard and mouse for one copy and a USB game controller for the other.

IUTWANID

A BETTER MOUSETRAP

I recently finished the single-player campaign of *Watch_Dogs* and yesterday I started playing multiplayer for the first time. I have a dual-monitor setup, which I use for flight sims, but in *Watch_Dogs* it's really annoying. The mouse keeps leaking



Two people can play *Minecraft* on the same PC at the same time

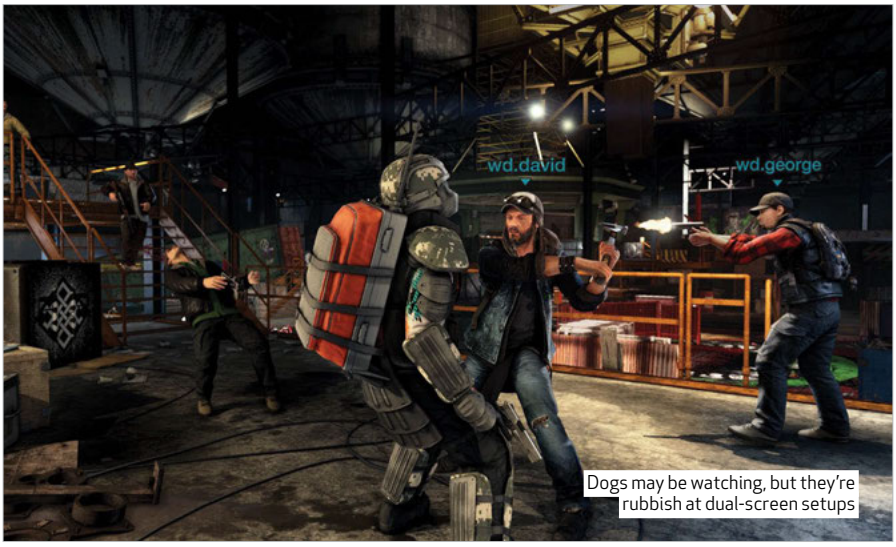
Free technical support

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.



Dogs may be watching, but they're rubbish at dual-screen setups

over on to the second screen if I get too enthusiastic. I don't remember this ever happening in single-player, but maybe things there were just less frantic. I've tried reinstalling all the usual suspects, but it hasn't made any difference to the problem. Is there a reason this might be a glitch in multiplayer?
Adam Dulles

That's not the answer (or droid) you are looking for. This obviously *could* be a glitch in multiplayer and if it were, there would be a reason for it, since we live in a deterministic universe. But unless this mouse lock thing actually is caused by a glitch in multiplayer, then you aren't interested in the reason for this glitch. And even if it is a glitch in multiplayer, you don't actually care about the *reason* for the glitch; you want the solution for it.

"LEARNING THE PROGRAMMING EQUIVALENT OF SPAGHETTI BOLOGNESE ISN'T HARD"

I probably care slightly more about the reason for the (presumed) glitch than you, because finding the reasons for glitches is kind of my whole jam. But even I'm not that bothered. This is a very vague set of circumstances that make reproducing the error extremely difficult. I don't know what kind of mouse you have or which version of Windows you're running or what 'the usual suspects' implies for you, when it comes to reinstalling. So let's both agree to ignore the reasons for the glitch (if glitch it be) and focus on some fixes.

I have two. Fix 1: run *Watch_Dogs* in full screen mode – this should automatically lock the mouse input to the primary monitor. Fix 2: use one of the many multi-monitor utilities that have a 'mouse-trap' function to do the locking for you – MurGeeMon, for instance (www.murgee.com/MurGeeMon)

IMRTIUTB

TERRIBLE TEARING

I'm getting a lot of screen tearing in games, even though I have my fps capped to the monitor refresh rate. I thought the whole point of capping my fps was to prevent tearing? I have reinstalled a couple of games to see if it made any difference (and obviously my graphics drivers are fully up to date) but it's still doing it. Would upgrading to Windows 8 or a faster graphics card help?
Rav Sandhu

No and no. You've misunderstood what screen tearing is. Your graphics card has a frame buffer that holds the current frame as it is rendered and the monitor has a refresh rate that determines how often it copies the contents of that buffer to the screen. But that buffer takes a finite amount of time to fill and if the monitor happens to grab the buffer while it is still being filled, it will take part of the current frame and part of the frame before.

Unless the scene is perfectly still, the two halves won't match up and you'll see the join. This is known as tearing. Capping the game's frame rate doesn't prevent this, because even if both game and monitor are refreshing at 60Hz or 75Hz, there is nothing to say that they are in sync. If the game is updating just a fraction before the monitor, you'll still see a torn frame. Running at the same refresh rate actually makes things worse, because *every* frame will be torn. What you need to do is enable vertical sync, either in the game or in your graphics card driver options. This forces the graphics card to wait for the monitor to grab a frame

YOU ASKED!

FAQ

Shakespeare

It's a programming language designed to make your source code read like a Shakespearean play.

How can that possibly work?
The characters in the play take the place of the variables. Each one must be named after an actual Shakespearean character and you declare them like this:
Macbeth, a Scottish prince
Everything after the comma is a comment, so you can use this to say something about what the variable actually does, if you want:
Hamlet, a loop counter

That's it? The variables have to be Shakespeare characters?
No – variables have to be 'on stage' before you can use them, so they have to enter and exit. And the only way to change the value stored in a variable is for characters to have conversations. For example:
[Enter Romeo and Juliet]
Romeo:
Thou art as lovely and sweet as a golden pony!
[Exeunt]
Every noun counts as 1 (unless it is a 'bad' object, like a pig or a coward, in which case it counts as -1). Each adjective doubles its value, regardless of whether it is good or bad. So here Romeo has written the value 2 x 2 x 2 x 1 = 8, to Juliet.

How do you print a string?
The command 'Open your heart' tells the recipient to print the numerical value stored in that variable, while 'Speak you mind' causes it to print the letter with that ASCII value. So:
Hamlet:
You lying stupid fatherless big smelly half-witted coward! You are as stupid as the difference between a handsome rich brave hero and thyself! Speak your mind!
This prints ASCII(72), which is 'H'. You can use this basic system to do anything you could do in any other programming language. It's like assembly language, but more fun.

Read more at: http://bit.ly/1pgn5HY

before it starts writing to the frame buffer with the next one. The frame rate is still capped to the monitor refresh rate, but it is also synchronised with it.

Vertical sync can be a bad thing in online games because the netcode is often updated at the same time as the frame. Restricting the frame rate means that you send fewer position updates to the server, which makes things a bit more laggy. This is apparently significant enough for 'serious' players to prefer playing with v-sync off, but in single-player games you won't notice or care.

IGAEM

SUSPICIOUS EXE

I know you are pretty down on the risks of viruses and hackers, so I'm hoping you will be able set my mind at ease. I recently downloaded an app called Glasswire to see which programs on my PC are accessing the internet. It lists something called gwinstst.exe but this doesn't show up on Task Manager, which makes me suspicious. It's installed in appdata\local\temp, which seems suspicious as well.
Tim Mumford

This is sort of like owning a gun. Statistically speaking, having a gun makes you more likely to be shot, and yet people buy guns to protect themselves. Similarly, downloading lots of monitoring apps because you are paranoid about being hacked normally just makes you feel even more paranoid. That exe is part of Glasswire itself, so it's probably quite safe. I say 'probably' because there is always the possibility that Glasswire is doing some nefarious scanning or downloading in the background. 'Quis custodiet ipsos custodes?' as they say. (I have no idea who says this.)

> "IT'S A SMEARY WATERCOLOUR SKETCH THAT LOOKS A BIT LIKE A PC IF YOU SQUINT YOUR EYES"

IGAEM

COBBLED TOGETHER JUNK

I am trying to build a working PC from some leftover bits from several older PCs (don't ask me why). I have assembled an Asus M5A78LM LE motherboard, a 500W PSU, 4GB of RAM and a hard disk. I put a new Celeron processor in this and it worked for a short time, but then I started getting 0x101 errors, especially in games. Any ideas?
Mark Cleverdon

Probably the power supply; probably overheating. That would be my guess. A budget PSU might struggle to supply enough power on the 12v rail, so it runs hot and eventually runs beyond tolerance and the voltage starts to fluctuate, which triggers the BSOD.

A guess is all this can be though, because you haven't exactly painted me a detailed picture of this Frankenstein PC of yours. It's just a smeary watercolour sketch that sort of looks a bit like a PC if you squint your eyes and stand back a bit. You're going to have to do some systematic diagnosing of your own, or get hold of a fine marker pen and add some more detail if you want me to pronounce with more confidence.

ICDNT

PACK PROS AND CONS

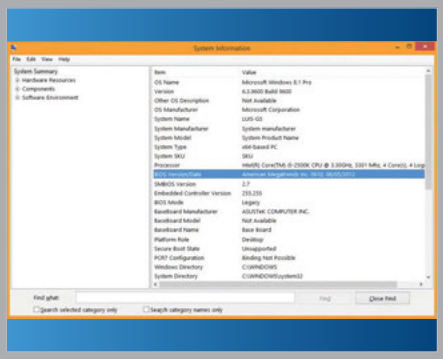
I am in the process of planning my next PC. It's going to be a self-build and I have finally settled on the specifications for most of the hardware [long boring list of components snipped – Luis].

What I'm stuck on is which version of Windows I should get. Which do you recommend out of Windows 8.1 Pro and Windows 8.1 Pro Pack?
Derrick Pugh

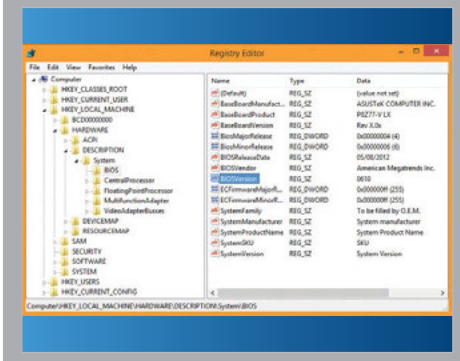
They aren't really different editions. The Pro Pack is just an upgrade option for those running the core version of Win 8.1 to give them the Pro features (with one extra, which I'll get to in a minute). Regular 8.1 has an RRP of £100 and 8.1 Pro is £190, although both are obviously available a bit cheaper on Amazon and the like. That

What's my BIOS?
Four ways to identify your BIOS version

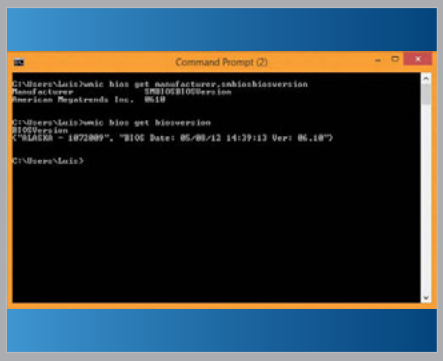
1 Old school
The standard way to view your BIOS or UEFI information is, of course, to boot into the setup program by hitting [Del] or [F2] when your PC first boots. This isn't exactly convenient though because you need to reboot and if you have an SSD, the window for hitting the right key is pretty short.



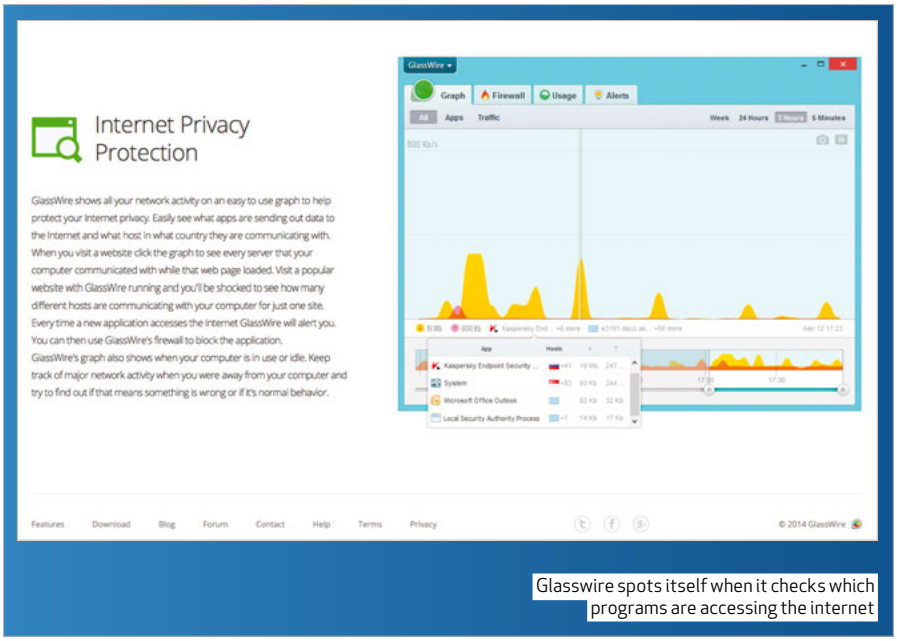
2 New wave
System Information will do the same thing for you. To access it, hit [Win]+[R], type **msinfo32** into the Run box and hit [Enter]. You'll see the BIOS version and date, and if you look down to the BIOS Mode heading, you'll be able to see whether you are using BIOS (Legacy) or UEFI.



3 Alternative
All System Information is doing is reading the appropriate values from the Registry, so if you want to cut out the middle man you can open regedit yourself and have a look at the HKLM/HARDWARE/DESCRIPTION/System/BIOS key. It doesn't tell you anything extra though.



4 Hardcore
If you want to make life unnecessarily complicated for yourself, you can even do this via the command line. You can type **wmic bios get manufacturer**, **smbiosbiosversion** or **wmic bios get biosversion**. They format the information slightly differently, but the results are basically the same.



Glasswire spots itself when it checks which programs are accessing the internet

extra £90 gives you file and disk encryption, remote desktop assistance, group policies and virtual hard disk booting. If you don't know what any of those are, then you don't need them.

The one extra thing in the Pro Pack is Windows Media Centre. This used to be bundled with Win7 but was removed from Win 8 so that Microsoft didn't need to pay the licence fee for the DVD codec that they didn't think anyone cared about anymore. If you have Windows 8.1 and you want Windows Media Center, the only way to get it is to pay £100 for the Pro Pack. But if you already have Win 8.1 Pro, you can add Media Center for just £7. Although that's still overpriced in my view.

Too long, didn't read? Okay, just get regular Win 8.1 and use a free third-party media player like VLC (www.videolan.org)

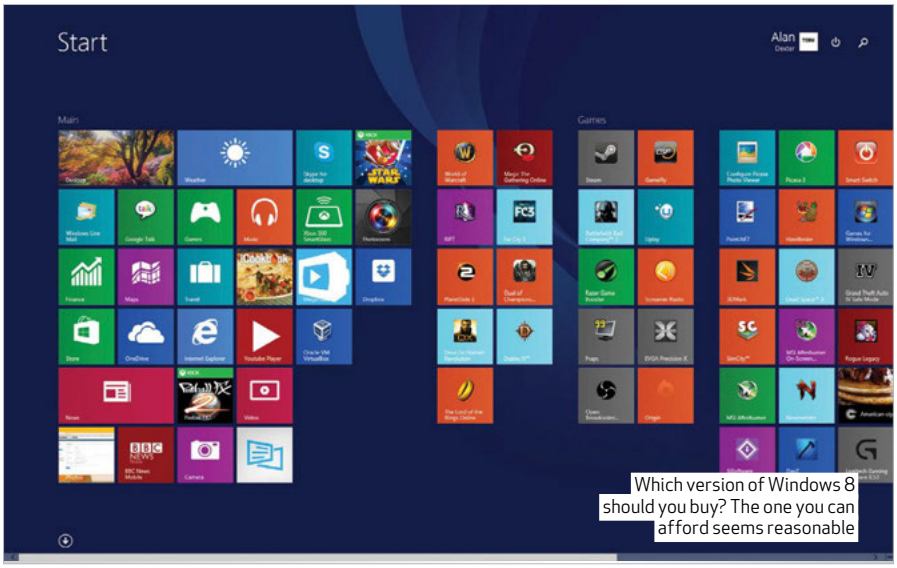
RATH

PUMPKIN O'CLOCK

My desktop PC switches to the desktop at exactly midnight every day. Whatever I am playing at the time makes no difference. Midnight chimes and I drop back to the desktop. The original program is still running, so I can [Alt]+[Tab] to get back, but it's annoying just the same. I have had this PC for many years, upgrading piece-by-piece along the way, and it has always done it. I thought (or at least hoped) that upgrading to Windows 8 would fix it, but no such luck.
Aiden Kieley

Sounds to me as if you have something that is set to launch at midnight every day and this is stealing focus from your full-screen app, which causes you to flip to the desktop.

Try booting into Safe Mode at 11:55pm and see if it stops happening. Or better yet, open Task Manager just before midnight and see what new application or process loads at the hour. If you click the Startup tab in Task Manager, you should be able to locate that app and disable it. If it doesn't appear there, try searching



Which version of Windows 8 should you buy? The one you can afford seems reasonable

FLASHBACK

What Luis said…

5 years ago *(PCF233)*

About basic literacy

Sending email from your mobile is no excuse for ignoring the basic rules of English. You dropped a total of 15 letters from otherwise correctly spelled words in the course of your long ramble and deliberately misspelled 'was' as 'wuz' six times. Fifteen characters is 0.76 per cent of your whole message; you'd have saved 20 times that if you just got to the point.

10 years ago *(PCF167)*

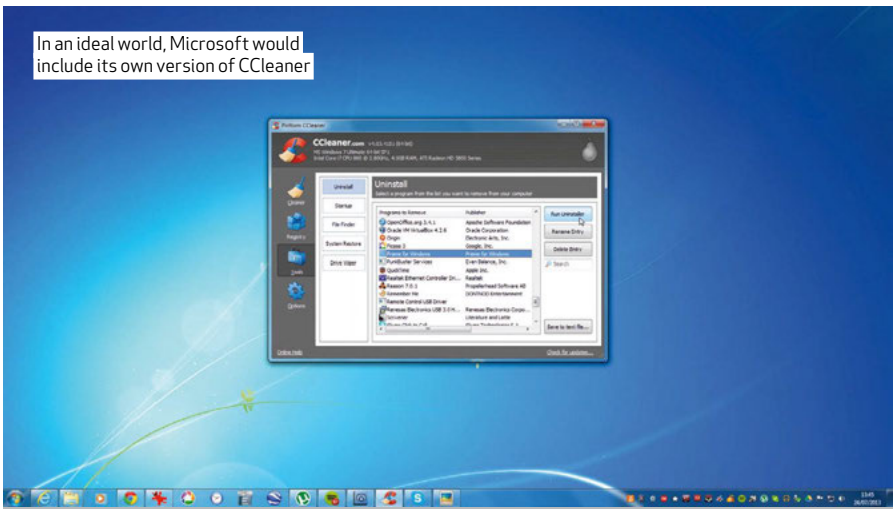
About using two graphics cards

It won't give you faster frame rates, any more than having two cars will let you drive either one any faster. In the last century, 3dFX did briefly dabble with single-line interleave (SLI), which allowed a pair of cards to render alternate raster lines on the display and thus boost performance. But this only worked if both cards were exactly the same and was a pretty expensive way to buy performance. Even if graphics cards did output generic 'graphics power' that could be pooled by your PC, the TNT2 is so antiquated that its contribution to the frame rate would be dismissed as a rounding error. They sell for a fiver on eBay.

15 years ago *(PCF102)*

About laptops

I have a laptop but it's a monochrome 486 thing that I use when I need to write without being distracted by desktop themes and the Cool Website of the Day. It's not a replacement for my desktop and it isn't likely to be, so long as I have to buy my own hardware.


In an ideal world, Microsoft would include its own version of CCleaner

the registry for the name of the app or process. Some applications have update checkers that load at specified times.

IMRTIUTB

DON'T HARSH MY BUZZ

I'm experiencing a very weird glitch and I just know that you aren't going to believe me when I explain the circumstances that cause it, but I promise it's true. I have an external sound card (an Asus Xonar DX) with a gaming headset plugged into it. I recently installed the Shark 007 codec pack along with some other stuff and since then I have had a strange buzzing sound coming through the headphones. I know the problem isn't with the headset because if I disable system sounds in the volume mixer, the buzz goes away. But the only other thing it could logically be is the Shark 007 codec and I have uninstalled that, to no effect. Could the codec have corrupted my sound card settings somehow?
Lee Angel

I'll make you a deal. I promise to take your problem at face value and believe that the things you have said happened really did happen. In return, I want you to believe me when I say that this isn't caused by the Shark 007 codec, it's caused by *Oblivion*.

Yes, *Oblivion*, the *Elder Scrolls* game. That *Oblivion*. This was part of the 'other stuff' that you installed, wasn't it? Don't answer that – I know it was, and anyway, you promised you were going to believe me. There used to be a very obscure bug in *Oblivion* that corrupted the surround sound settings on some soundcards. This must have got written to a configuration file somewhere, because the buzzing sound it created would persist through a reboot but only manifested itself in 7.1 surround sound. If you press the 7.1 button on your Xonar to disable surround sound temporarily, and then press it back again, you'll find the buzz disappears.

And if this *doesn't* work, it's not my fault, it's yours for not believing hard enough. In which case you should email me back with "I don't believe in fairies" as the subject line and I'll have another think.

IMRTIUTB

WHAT ARE THOSE YELLOW THINGS?

I have been repairing and fixing PCs – both mine and my friends' – for many years now, but there's one thing I am still a little puzzled about. When I'm deleting Registry items for programs that have been uninstalled, is it better to just delete the keys on the right hand side, or should I also delete the entire yellow folder on the left. Does it slow Windows down to leave the folders there? Is there any advantage?
Jim Savoy

Those folders are technically the Registry keys. The things on the right hand side are called *values*. The key is a container for one or more values. Strictly speaking, leaving empty keys in the Registry will slow Windows down slightly because it will need to look inside each one when Windows starts, to confirm that there is nothing in them. But the difference is probably measured in milliseconds. The thing is, the performance penalty for leaving the entire key there is only very slightly larger. If it were significant, Microsoft would include its own version of CCleaner. Unneeded Registry keys are like the empty cardboard boxes in your loft. Yes, theoretically they count as clutter and you should sort them out one day, but the benefit isn't worth the risk of you losing your footing and falling through the ceiling into the bathroom below. ■

STATS KNOW-IT-ALL?

Quiz

1. Which instant messaging service was permanently shut down on 31st October?
a) MSN
b) AIM
c) ICQ
d) Skype

2. When was MSN first launched?
a) 1990
b) 1995
c) 1999
d) 2004

3. How many users did the service have at its peak?
a) 440 million
b) 330 million
c) 220 million
d) 110 million

4. How much did eBay pay for Skype in 2005?
a) $1 billion
b) $2.6 billion
c) $5.5 billion
d) $8.5 billion

5. How much did Microsoft pay for it in 2011?
a) $1 billion
b) $2.6 billion
c) $5.5 billion
d) $8.5 billion

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

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THE MONTH IN NUMBERS

$4,588,888

The amount internet tat-seller Amazon paid for the top-level .buy domain name. The purchase basically means Amazon will be able to sell domain names ending in '.buy', which could be hugely lucrative as buying stuff online is apparently a thing people enjoy these days.

100m

The number of takedown notices the British Phonographic Industry (BPI) has sent search engine giant Google since June 2011. It seems that the BPI blames Google when copyrighted material appears in search results, resulting in the mass of angry letters obscuring Google's doormat.

$250,000

The amount Yahoo alleges it was fined, per day, by the US National Security Agency for not releasing user data as part of the PRISM program. Yahoo apparently stuck to its guns and highlighted the unconstitutional nature of leaking data until it was ordered by a court to hand it over.

8.1 Gbps

One of the data transfer speeds supported by the upcoming USB 3.1 standard. It means you can run 4K video from DisplayPort 1.3 compatible devices through the interface, meaning you can potentially ditch those ridiculous overpriced video cables.

5.5m

The number of people who tried out EA Sports' *FIFA 15*, making it the company's most-played demo of all time. That means it's been played even more than *Crocodile Plays Pool 4*, *Flower Rugby*, and *Multi-Storey Car Park Graffiti and Wee Experience* – some of EA Sports' other successful titles.

Illustrator Kevin February

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

An everyday billionaire

Two and a half billion dollars. The amount Microsoft paid for *Minecraft* is the same as the gross domestic produce of the Philippines. It's enough to buy 12 and a half Boeing 787 Dreamliners, or just two and a half billion things that cost a dollar each. Two and a half billion doesn't even fit on most calculators. It's an extremely absurd amount of money, completely overwhelming in its colossal gargantuaness.

Minecraft has become such a sure thing that Microsoft is happy to part with that amount of cash and just reap the ongoing profits like interest. We were worried that it would 'do a Nokia' and make *Minecraft* run solely on Windows Phones, but apparently this won't be the case. *Minecraft* will be left to its own devices, to tick over nicely and continue to generate enough money every year to fund Microsoft's stupid phones and rubbish operating systems.

Where it all gets a little murky is Markus 'Murkus' 'Notch' Persson, *Minecraft*'s creator and Mojang's co-founder. He publicly criticised Facebook's purchase of the Oculus Rift flop-to-be, so it seems odd that he's selling out to Microsoft, the evilest company on Earth before Facebook and Google learned how to make money from the internet. But he's Notch. He's revered as a god by eight-year-olds. He can do whatever the hell he wants.

From my experience Notch is a genuinely nice person who makes time for people. We had an amazing conversation about bottoms. He is perhaps a little misguided, a little too easy to offended, but that's what happens when you have opinions and things you care about. He could just be any other guy with a Twitter account and an opinion and things he cares about, only he now happens to have more than a billion dollars in his regular-guy bank account.

If there's going to be a problem, it's that Notch could easily and naively stumble into the dark side. He could start making *Minecraft* blocks out of children. Many, many people around the world are probably thinking that if they had a billion dollars they'd use it to make blocks out of children, and if just one of these people lets on to Notch that turning children into blocks is a thing people consider on a daily basis, then it could lead to Notch building an evil lair made entirely of childblocks. Much the same thing happened with Richard Branson, only he started by turning puppies into copies of Tubular Bells.

As long as we keep the child-block people away from Notch, everyone's a winner. *Minecraft* will stay much the same. Notch will have more money than the combined population of Yemen. Microsoft will continue to make stupid phones. Okay, so Microsoft customers might not be happy. And two men on the internet will inevitably be a bit angry about it. But that's normal. Everyone else will be happy, and that's what matters here. The children will be exceptionally happy, because they won't be turned into blocks. ■

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