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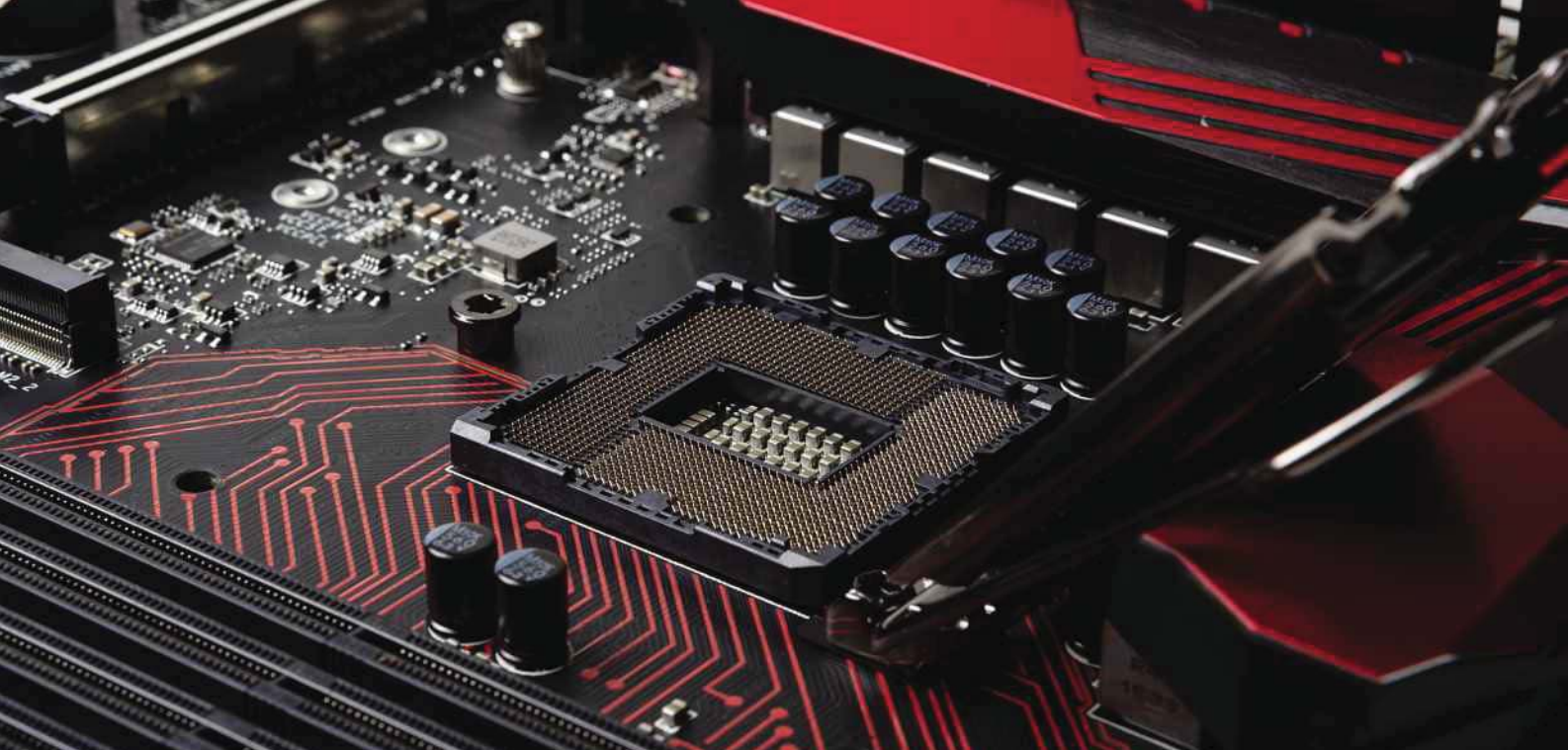


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NEW MOTHERBOARDS: WHAT TO LOOK FOR

How should you go about picking a new board?

Buying a new motherboard means considering a wide range of technologies, and knowing what to look for is important for making sure you end up with a system that's useful and good value – and, for that matter, one that's working at all...

CPU Sockets

If you're buying a new motherboard, you could start by selecting one that's compatible with the CPU generation you're planning to buy from – usually that'll mean the most recent. Whether you're upgrading your chip or not, making sure you've got the correct socket is important. While most old hardware can be convinced to work with any modern motherboard through converters or expansion cards, nothing will let you get a CPU into a motherboard it's not designed for.

There are several sockets you'll find on a motherboard which determine the type of chip it takes.

LGA1151 is Intel's last-generation socket supporting almost all desktop-size Skylake chips, from the lowliest Pentium to the fastest Core i7, as

well as the future Kaby Lake chips due out next year. This means that buying a motherboard with an LGA1151 socket gives you plenty of upgrade opportunities for the future, so it's a good time to buy especially if you're not planning to buy a new CPU right now.

LGA2011-3 is an alternative Intel socket which supports the "enthusiast" version of Haswell and Broadwell, Haswell-E and Broadwell-E. These super-fast chips aren't cross-compatible with standard Intel CPUs. Although physically similar to its predecessor, LGA2011, LGA2011-3 does not support earlier generations of chips, so be wary if you're looking for this type of hardware. The forthcoming Skylake-E will use a new socket, LGA2066, but isn't expected until the second half of 2017

If you want an AMD motherboard, there are different sockets to look for.

AMD's APU chips, which combine a CPU and GPU (like Intel Core chips) require a Socket FM2 or FM2+ depending on their generation. The current generation of chips use Socket FM2+, while its predecessor, Socket FM2, accepts Trinity and

Richland chips, but not the first generation of APUs (Llano) which used Socket FM1.

AMD also releases FX-series CPUs (which have no GPU) and at present, these all use the AM3+ socket, which is not compatible with any generation of Fusion APU. The forthcoming Zen CPUs will use a new AM4 socket, but neither is on sale yet.

It's worth noting that Socket FM2+ motherboards can accept a socket FM2 chip, but Socket FM2+ chips cannot be placed in Socket FM2 motherboards. This makes upgrading slightly easier – if you have an FM2 chip already, you don't have to replace the CPU to upgrade the motherboard. The upshot of this is that if you're buying a new AMD motherboard, it makes sense to buy an FM2+ board.

Other Features

Once you've narrowed your choices down to a motherboard that supports your preferred chip, there are a few other questions that need answering.

The size and capabilities of the board need to be considered, for instance. If you're aiming for a

compact or low-power system (such as an HTPC or media server) then look for micro ATX or mini ITX boards. If you're aiming for a regular desktop PC, a normal ATX board is the standard choice. If you're aiming for power, get a board with robust overclocking features and plenty of support for cooling expansions.

The number of expansion slots is also worth taking into account. Smaller boards may only have a couple of slots, but that's fine if they're going in small systems. If you've got plans for a multi-GPU setup, make sure there are plenty of PCIe slots. Some features, such as onboard Wi-Fi or USB 3.0, might negate the need for one of your expansion cards, so take that into account as well.

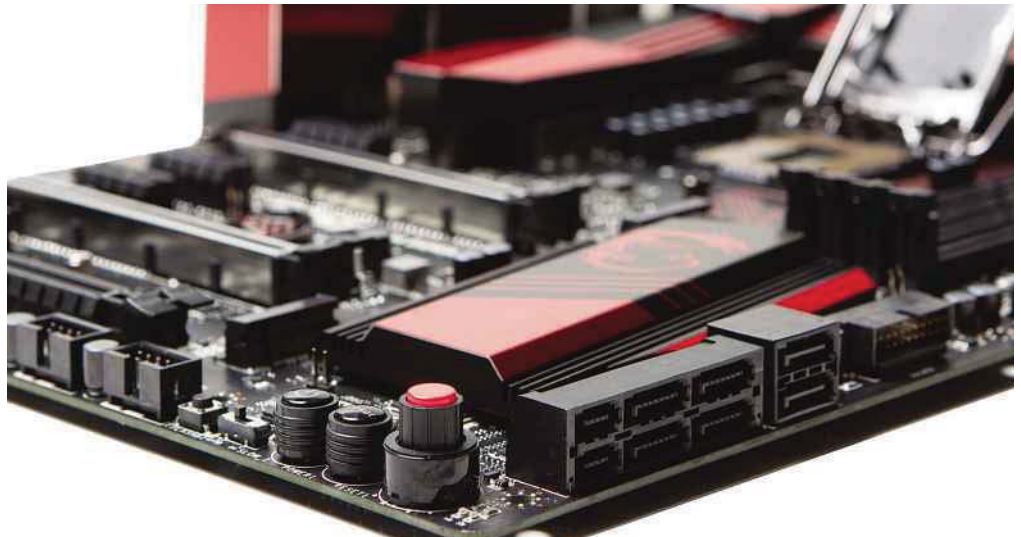
Most motherboard upgrades won't present any problems with RAM, though smaller boards may have fewer slots, so take that into account if you've currently got a full complement. There is one circumstance under which you'll also be required to buy new RAM when you upgrade your motherboard too: if your current system is using DDR3 and you buy a DDR4 board. You could potentially still upgrade from a DDR3 board to another DDR3 board, which might save a little money, but at this point DDR4 seems like the better choice.

It's worth noting that in the same way that the ability to overclock isn't something featured on all CPUs, not every motherboard can do it either. If you're planning to overclock, check that the motherboard's chipset does actually support it. Some can't overclock at all, some will only allow a limited overclock on the RAM, and others – usually the most expensive chipsets – can fully overclock both the RAM and the CPU.

Price & Manufacturer

Motherboard prices run a reasonably wide gamut, from around £40 for the cheapest varieties (typically smaller or older models with fewer capabilities) to more than £300 for the most feature-packed and advanced boards. That leaves a lot of room to manoeuvre when you're looking for the right one.

If you buy an Intel-based board then you're unlikely to find anything using the newest chipsets for



under £70. If you want something more modern, we'd recommend spending somewhere in the region of £80-£120. Above that, you're buying specialist overclocking- and performance-focused hardware that casual users don't need.

AMD motherboards start just as cheap as Intel's, but top out much lower. You'll not find an AMD motherboard more expensive than £200. That makes the sweet spot for current generation purchases come in a little lower, so if you budget between £60-£90 for an AMD board then you're sure to get something worth owning.

Once you've decided on a model and price-range, you'll then have to decide which manufacturer to go for. In the long run, the difference between manufacturers is reasonably small since they all manufacture hardware using the same chipset specifications anyway. If you're a

casual user who doesn't poke around inside your BIOS or case very much, you can probably base your decision on price alone without anything to worry about. In particular, Intel's own-brand motherboards are highly recommended for buyers who want to get a good deal on the price, but aren't interested in flashy design elements or additional features.

Pickier users are advised that Asus boards are often considered to have the best balance between features and reliability, but it's still a slim gap between them and their close competitors, Gigabyte and MSI, so don't worry if one of the latter manufacturers has a feature (or price) you prefer!

Ultimately, upgrading a motherboard isn't a particularly difficult process – it just requires a few extra factors to be considered once you've made your initial decision. Don't be put off! [mm](#)

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MOTHERBOARDS: WHAT'S COMING UP?

We take a look at the latest advancements in this field...

If you're wondering whether to buy a new motherboard or hold off in anticipation of what's coming, you need to know what features are in the pipeline. Both AMD and Intel have released lots of details about the future of their chips and architecture, so coming up with a plan for your future upgrades is relatively easy if you're willing to do the research.

Of course, if you're not willing to do the research you don't have to worry. Whether you want to buy a new motherboard now and need to know whether it's worth hanging on, or just need to figure out what you're buying next year, we've got the details you need to know right here in our look at

what's coming up for AMD and Intel's forthcoming platforms.

Intel: 2017 & Beyond

The follow-up to Intel's Skylake chips are code-named Kaby Lake. With some similarities to the way Broadwell and Haswell were related, Kaby Lake is actually an optimisation of Skylake and will share the architecture of the previous chip. This means that it will be largely compatible with Skylake motherboards and use the same socket (LGA 1151), so there's no particular need for an upgrade if you want to buy one.

Despite this, Kaby Lake does add new features that will impact compatible motherboards, and a new one wouldn't

be an entirely bad idea if you've got the money. Support for USB 3.1 generation 2 is native, meaning Kaby Lake-revised motherboards could conceivably offer USB throughput of up to 10Gbps. It also adds extra support for 3D and 4K performance, and native HDCP 2.2 support, which may not be available on your existing Skylake-compatible boards even if you put a Kaby Lake chip in them.

The real follow-up to Skylake, however, is Cannonlake. This will be a 10nm shrink of the 14nm Kaby Lake chips and is currently projected to arrive on shelves in late 2017. At present there is no confirmed CPU socket for Cannonlake so while it's possible that it may use LGA 1151 (meaning it could be backwards-



“ Improvements in storage interfaces are certain to come, as SATA gives way to PCIe ”

speeds storage, such as Intel Optane, RST PCIe storage and Intel RST 15.

Beyond that, Intel will also be releasing their new enthusiast platform later in 2017, meaning another new socket release. Skylake-X replaces the likes of Haswell-E and Broadwell-E and uses an entirely new chip interface: LGA 2066. It also launches alongside Kaby Lake-X, which is a new strategy for Intel.

Socket LGA 2066 motherboards will support 44 PCIe 3.0 lanes, with no integrated graphics and a new KBL PCH-X chipset. RAM support will be either DDR4-2666 or DDR4-2400, and you'll also get ten USB 3.0 ports. LGA 2066 is expected to last for four years before being replaced by LGA 2076 in 2020, meaning the socket will persist through Cannonlake-X as well – ideal if you're looking for a long-term high-end investment.

AMD: 2017 And Beyond

The release of AMD's new FX Zen chips will be followed next year by Zen-based APUs. The new stand-alone Zen chips, designed to push back against Intel's dominating performance of the desktop CPU market in recent years will use a new AMD socket: AM4

As with the CPU, the chipsets on AM4 motherboards are designed to beat Intel at the desktop game, meaning you can expect them to be compatible with the latest technologies. Code-named Bristol Ridge and Raven Ridge, these motherboards will have three chipsets: the A320 platform will be aimed at entry-level users, with the B350 platform aimed at mid-range users and the X370 aimed at high-end users. All three chipsets will support M.2 storage connectivity, PCIe Gen 3 and DDR4.

So far it seems that all of AMD's boards will feature dual BIOS, to make flashing and updating safer, while ports on a standard B350 board include two USB 2.0, four USB 3.0 and two USB 3.1 Type A ports – in addition to the standard PS/2, display and audio ports, of course.

If you're hoping to hang on for a Zen-based APU, there's no current information as to whether they'll be

compatible with AM4 boards in any specific way. Plans for a new APU socket called FM3 were revised into AM4, so it's probable that both the FX and APU series Zen chips will run on the same socket, at least, but accessing the graphical capabilities on the APU version might require an additional chipset.

Future Features

Some features aren't technically announced as part of AMD or Intel's future plans, but are likely to appear down the line anyway.

One such example is USB 3.1 Type C, which is becoming increasingly popular as a replacement for Micro-USB in phones and on mobile devices like laptops. Although primarily designed for mobile devices, you can expect future motherboards to add the port as a way of ensuring compatibility with mobile hardware and their accessories.

Improvements in storage interfaces are also certain to come, as SATA gives way to PCIe, M.2 and other newer BUS-based connectors like NVMe. SATA might be strong at the moment, but support for newer technologies is creeping in around the edges and eventually SSD sizes will reach the point where the greater bandwidth of better connectors becomes actively beneficial in removing a bottleneck, instead of just providing benchmark bragging rights as they do now.

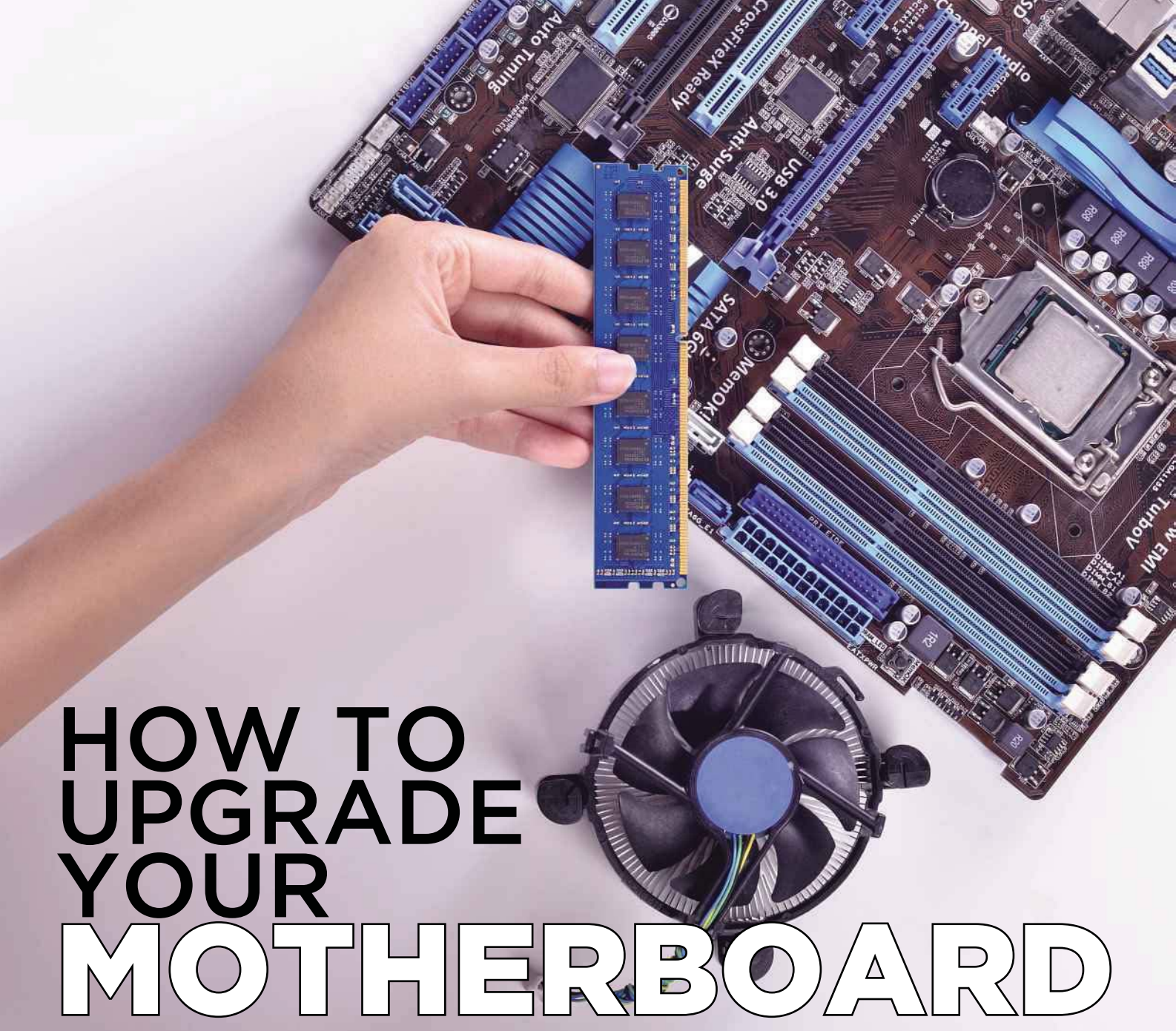
Better enterprise and encryption features are also likely to be added to most boards, while dual BIOS will probably become standard before too long, now that it's making the transition from unexpected extra to high-end necessity – and after all, BIOS flashing does remain a severe weak point for motherboards.

Other than that, we'll simply have to hang on and see where 2017 takes us. One thing is sure, though: whatever motherboard you buy, they'll have a better one out soon, so don't stress too much on the specifics. You'll be able to run your computer whether it has the latest features or not. [mm](#)

compatible with current motherboards) so think you should take that with a pinch of salt – there's no confirmation one way or the other!

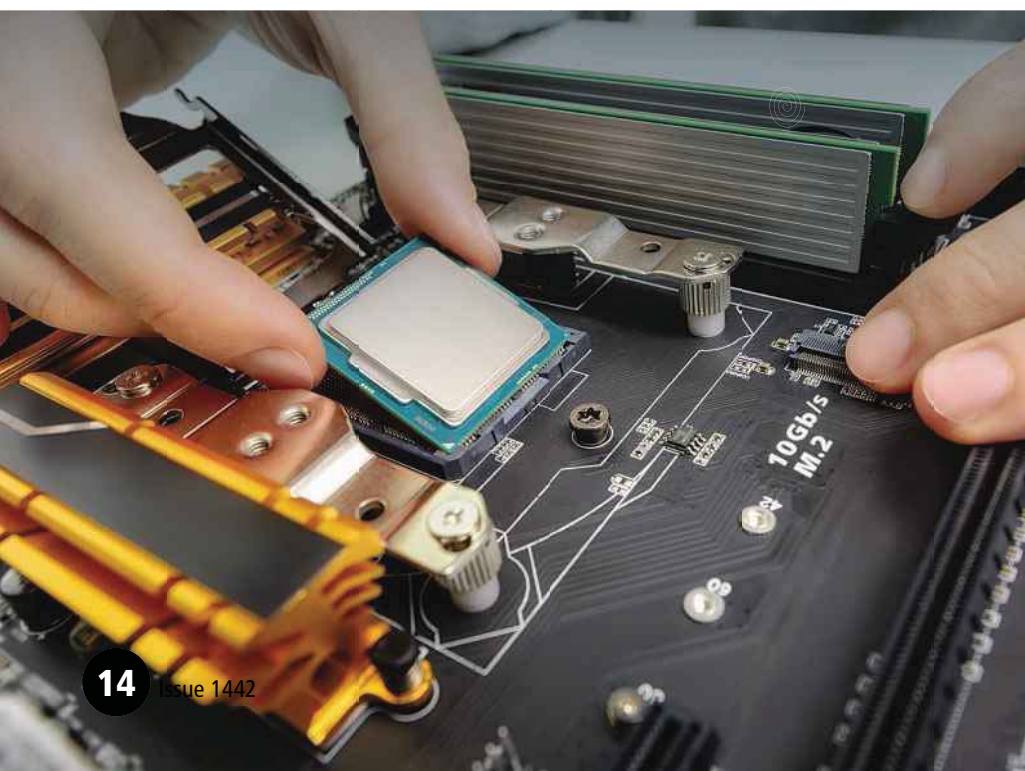
One thing we do know is that the introduction of Kaby Lake chips will coincide with the release of a new Intel platform: Union Point, the Intel 200 series of chipsets, which are expected to be released in early 2017. Kaby Lake will definitely be compatible with both Intel Series 100 and Intel Series 200 chipsets, so motherboard upgrades will be optional – but if you want a new one, you'll get access to all the latest features.

The key new features expected for Union Point include support for up to twenty-four PCIe 3.0 lanes (four more than the Intel 100 series) as well as six SATA 3.0 ports and ten USB 3.0 points. They'll also add support for more high-



HOW TO UPGRADE YOUR MOTHERBOARD

Put your PC back ahead of the pack...



When considering an upgrade, it's easy to get seduced by the simplicity of adding more RAM, a faster processor, or a superior graphics card. What about changing your motherboard, though? In many ways, the motherboard is the hardest part of the PC puzzle to get right. You don't just need to find one that fits the hardware you currently want – you also have to consider those you might want to buy in the future.

Still, a fresh motherboard brings with it a host of benefits. Unlike the incremental improvements that come with RAM or CPU upgrades, a new motherboard will instantly offer extra features and expansion possibilities that weren't there before. It will, quite literally, make your PC into a different machine.

The number of co-dependencies your motherboard is expected to accommodate makes it one of the most difficult pieces of

“ Current operating systems have taken a lot of the strain out of swapping your motherboard around ”

backwards (and sometimes forwards) compatible, but most of the time you'll need to stick to the same socket you've already got if you don't plan to change the CPU chip as well.

The same goes for RAM. Older motherboards will only support DDR3 memory, while modern boards support DDR4. The two aren't compatible, so if you want to retain the RAM you already own, check in advance – although, unlike a CPU, RAM is at least cheap to replace.

You also need to consider the size and capabilities of the board. If you're aiming for a compact or low-power system, look for micro ATX or mini ITX boards. If you're aiming for a regular desktop PC, a normal ATX board is the standard choice. If you're aiming for power, get a board with robust overclocking features and plenty of space for cooling.

If you're planning to scrap your current graphics card (or don't own one) you should also make sure that the motherboard has a graphics chipset. Intel motherboards come in several flavours with different graphics capabilities, but there are variants which assume you don't need on-board graphics.

Once you've decided what features and chipset you're looking for, you will need to decide on a manufacturer. Asus boards are often considered to have the best balance between features and reliability, though it's a slim gap between them and their close competitors Gigabyte and MSI. Intel's own-brand motherboards are also highly recommended for those who want a good deal on price and aren't interested in flashy designs or extra features.

hardware to upgrade – especially if you're not building a fresh PC, just replacing the motherboard on the old one. Current operating systems have taken a lot of the strain out of swapping your motherboard around, but it's still a difficult process that requires a fair amount of understanding.

Choosing A Motherboard

Selecting the best motherboard means you have to consider every other component in your system as a factor in your purchase, not to mention those you might yet buy. A good way to start is to choose a motherboard that's compatible with your existing CPU, then work your way outwards towards the other components – RAM, hard disks, expansion cards, then any optical drives and beyond.

The most immediate concern when choosing a motherboard is that it has the correct socket for the CPU you want to put it in. Some chips and sockets are

bits around. If nothing else, having a backup will be useful if – for some reason – you find yourself unable to reassemble your PC.

Secondly, have a copy of your operating system on standby. There are far more drivers used to power the components on a motherboard than you might initially think, and there's no guarantee they'll be available on your current installation (which, after all, is configured for a different motherboard.) If you need extra drivers, there's a good chance they'll be on your Windows disc, if not the one that comes with your motherboard.

Thirdly, you need to prepare your software licences for transferral to what they will recognise as a new PC. This means de-authorising your accounts on software which has a limited number of simultaneous activations (iTunes, Adobe products and some anti-viruses, for example) and gathering Product Keys for other software packages. Although you shouldn't need to re-install these programs, you may need to re-insert the licence key to confirm that you are legally using it. This includes Windows, which will need to be re-activated.

Finally, before you start doing anything, set yourself up a clear space with plenty of room to work in. It's a good idea to place the case on a table with a lamp nearby to ensure proper lighting, because cases can get shadowy and dark as they fill up, which makes reading important labels and counting pins harder to do. A small tray for screws will ensure you don't let any roll away. If this is your first time taking a PC to bits, you may also want to take some photos of the interior before taking it apart, so you can use the pictures as a guide to reassemble the machine if anything goes wrong.

Oh, and aside from taking the usual precautions regarding static build-up, you should make sure that before you do anything, you read your new motherboard's documentation. Not just the quick-start guide! The whole thing. The bits that are in English, at least. Every motherboard is different, so don't assume you can relate the plugs on one to the plugs on another. Only when you have some idea of what goes where should you pick up your screwdriver and start.

Installing Your New Hardware

Upgrading a motherboard is no simple procedure, and will require you to almost completely dismantle your PC. It's not something that should be attempted by the inexperienced or faint-hearted. With that in mind, the best way to prepare is to make sure you know exactly what you're doing before you start.

First, make backups of anything important on your hard drive, either to a USB key or external hard drive. It's not necessarily likely that anything will break, but if it's going to happen there's a fair chance it'll happen when you're moving

Uh Oh...

There's a lot that can go wrong when you upgrade a motherboard, and not every fault comes with a helpful POST beep to tell you where to look. Here's a quick troubleshooting guide to help you out if things don't work first time.

PROBLEM: I pressed the power button and nothing happened!

PROBABLE FAULT: Something isn't connected/activated between the mains and the power button.

SOLUTIONS:

Check that the mains socket is plugged in and switched on.

Check that the mains kettle lead is plugged into the PSU.

Check that any PSU master switch is set to 'on'.

Check that the PSU mains power is plugged into the motherboard.

Check the power button's front-panel connector is attached to the right motherboard pins.

PROBLEM: I pressed the power button, the fans started and the disk drives powered up, but nothing else happened!

PROBABLE FAULT: The CPU isn't getting enough power to begin the POST.

SOLUTIONS:

Check that the CPU is properly seated.

Check that your graphics card is not drawing too much power. Look up how much power your PSU puts out, and how much power your graphics card needs. You may need to buy a stronger PSU.

Check that the six-pin power supply has been properly attached to the graphics card.

PROBLEM: The POST completed, but the BIOS can't find a boot disk!

PROBABLE FAULT: No communication between the hard drive and BIOS.

SOLUTIONS:

Check that the primary hard drive has power.

Check that the data cables between motherboard and hard drive are properly inserted.

Check that the BIOS isn't trying to boot from a connected USB device.

Check that the BIOS is set to auto-detect and boot from hard drives.

Try another boot device – the hard drive may be corrupt, unformatted or incompatible.

Step-By-Step Guide

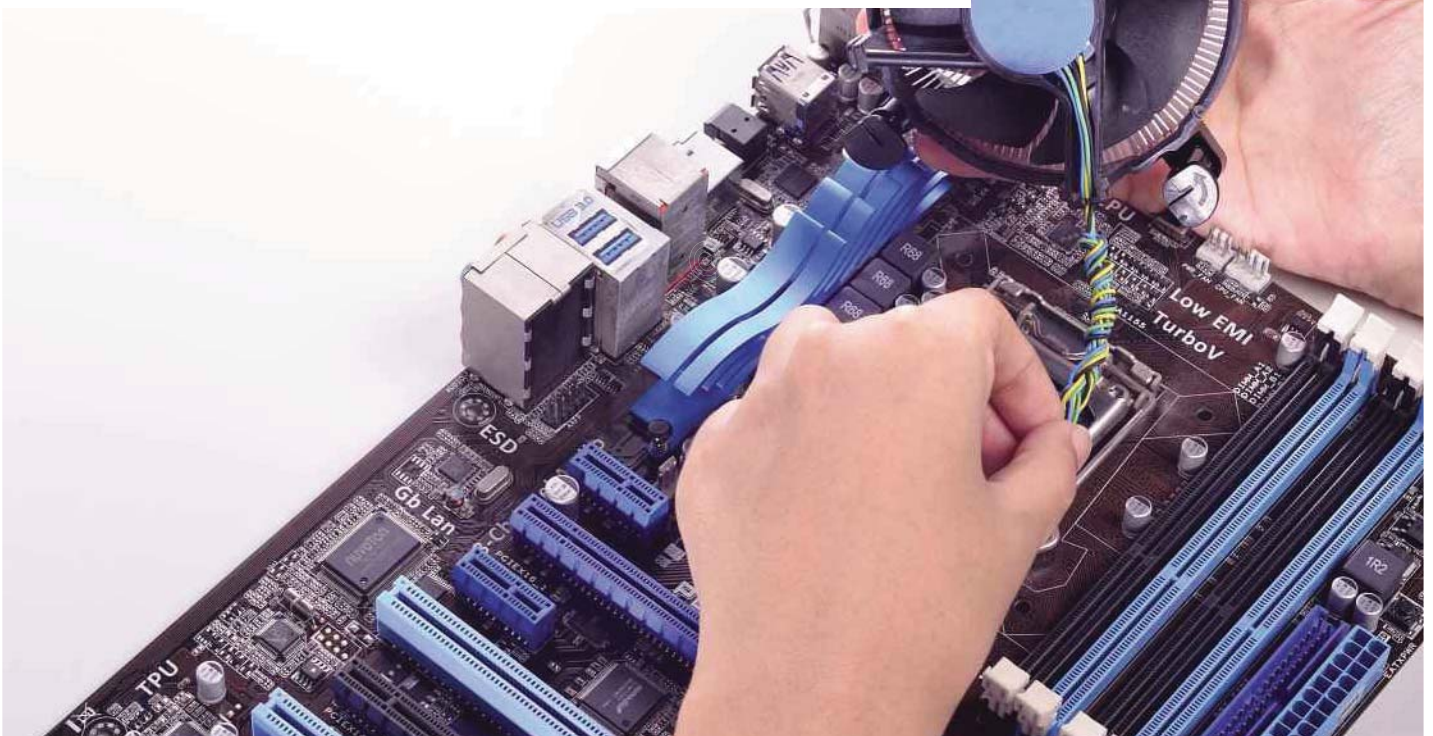
1 Preparation

Make your backups, sort out your software, familiarise yourself with the components and make sure you've discharged both yourself and the PC of all electricity before you touch anything. Take the case to your workspace and lay it flat.

2 Dismantling Your PC

You will have to take out most of your computer's components, so begin by unplugging the power supplies to any disc drives, fans and graphics cards that run off the main PSU. When you are sure the PSU is disconnected, unscrew it from the case and remove it. You don't have to do this first, but because it's the largest and most sprawling component, you will probably find that removing it gives you the most room to work.

Next, disconnect any other cables connected to the motherboard. Most cases will allow you to leave drives in their bays, but if they are in the way, you can remove them now. You can also remove any other connections, such as USB extensions and the reset/power button cables now.



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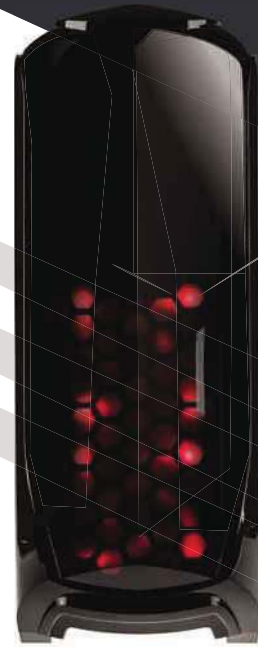
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Remove the expansion cards and place them somewhere safe. Each card will only be held in by one screw, so once that's out don't be afraid to give them a fairly strong pull if they won't dislodge. Although computers might look delicate, they can stand a fair amount of force as long as you're not damaging individual components on the circuit board. If it helps, pull the card with one hand while pushing the backplate at the rear exterior of the case.

If all has gone well, at this point your motherboard should contain nothing more than the RAM and CPU, with nothing else connected to it. Find the screws holding the motherboard in place and remove them. You should find one at each corner and a couple at the edges. Take care, though, there may be one or two in the centre mixed in with the components, which makes them easy to miss if you're not aware of them. When all of the screws are removed, the motherboard should be immediately loose as nothing else holds it in place. If it doesn't move freely, you've missed something.

When you remove the motherboard, you'll also need to take out the I/O backplate. This is the metal protector that surrounds the various interface ports at the rear of your PC, and you should have been given a new one with your new motherboard. Simply push on it from the outside until it pops out of place.

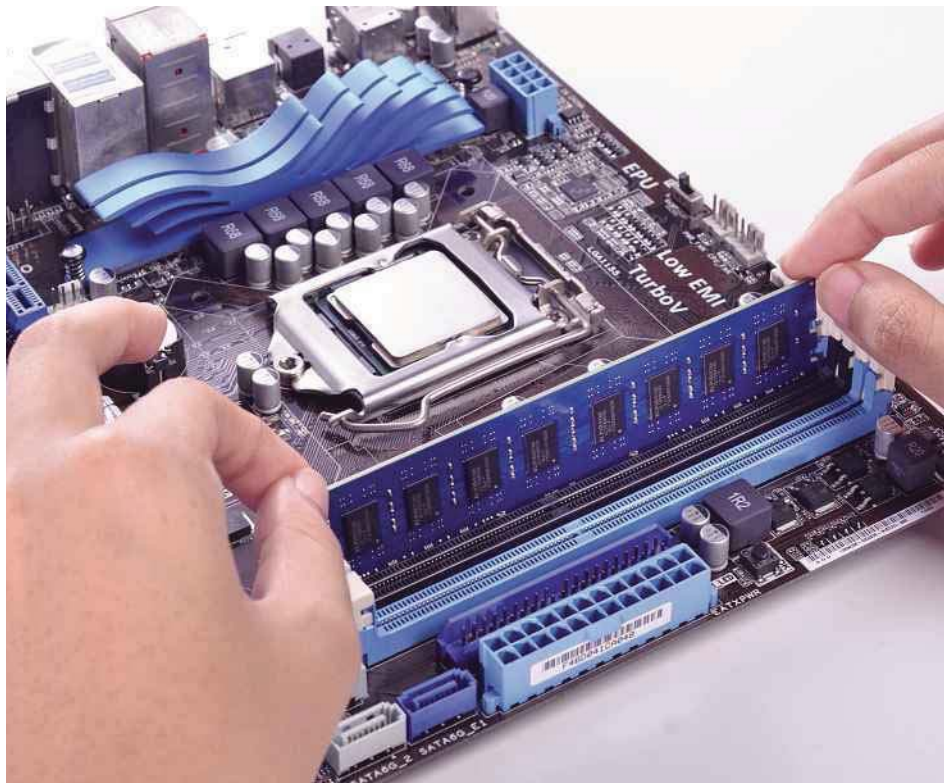
When the motherboard is out, you can now easily remove the RAM, CPU fan and/or the CPU. These are more delicate than expansion cards, so be careful not to bend any pins or force anything that seems stuck. The CPU may have some kind of release lever, and the RAM almost certainly will, so apply force to those rather than the components themselves.

3 Installing Your New Motherboard

First, you should install is the new I/O backplate. Once the motherboard is in, it'll be virtually impossible to get this installed without removing everything and starting again, so don't forget to do it! It should slot firmly into place – push it from the interior outwards.

Next, take your new motherboard and line up the I/O ports with the I/O backplate. This can be a frustrating process, so take your time and don't be afraid to bend the tabs on the backplate a little if they're getting in the way. When the ports are lined up, screw the motherboard into place. Start with opposite corners, and don't overtighten the screws, as this can warp or crack the motherboard. Conversely, don't leave it too loose – you don't want it rattling around!

When the motherboard is seated, you can begin re-inserting components and connecting



Reconnect the mains power, monitor, mouse and keyboard, then prepare for the most terrifying moment

internal cables. The CPU is probably the hardest because it is the most delicate, so do that first, remembering to affix the fan over it at the same time. Apply more thermal paste to the CPU if you need to and remember to attach power to the CPU fan once the PSU is back in – you don't want to cook your processor the first time you switch your PC on!

Next, attach any smaller cables, such as the reset and power switches (the front panel connectors) that require accurate pin placement to work. Re-insert the RAM, remembering to put the largest module in the memory slot numbered zero. If you removed any disk drives, now is a good time to re-seat them and re-attached any SATA cables. Then re-insert expansion cards and screw them in.

At this point, your PC should be entirely reassembled, save for the power supply. Screw the PSU back in, then connect the power cables up. Start by connecting the power supply to the motherboard (it'll be a chunky, 20+4-pin plug), then reconnect power to the disk drives, graphics card (a six-pin PCI-E power supply) and any fans you disconnected. Every drive should have a power supply attached (either four-pin molex, or L-shaped SATA) as well as a data cable.

Reconnect the mains power, monitor, mouse and keyboard, then prepare for the most terrifying moment of the entire process: waiting for the startup screen to appear when you press the power button.

4 Reconfigure Your OS

If all has gone well (and refer to the 'Uh oh...' box out if it hasn't) Windows will reboot and automatically detect your new motherboard and install the necessary drivers. You may have to wait a little while for your keyboard and mouse to work, since the necessary port controller might not be installed straight away. Once Windows has detected everything, it will reboot a final time.

When you have control back, install any software or drivers that are missing from your motherboard's driver CD (or download the latest versions from their website). Once this has been completed, reactivate any applications that you deactivated, and re-enter your Windows product key if required. With that: congratulations! You've successfully installed a new motherboard. Replace the case sides, and you're finished. **mm**

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Intel Motherboards Guide

With such a wide range to choose from, how do you pick the right motherboard?

Having an up-to-date system is important if you want to get the best performance for the best price, but even once you've decided on a chip to get, choosing the right motherboard to go with it can be difficult. There are loads of different manufacturers and chipsets, and countless variations within those sub-groups. What features do you look for and why?

To help you make that decision, we've taken a look at the motherboard market and selected what we think are the best boards depending on which of Intel's CPUs you've bought. Our findings have been divided into two different categories: boards for budget systems, and boards for high-end systems. And if you're looking at buying an AMD system, don't worry – we've got those covered in a separate article!

“ **Intel's motherboard lines over the last few generations have come in six different chipsets** ”

Intel Chipsets

There are loads of chipsets on the market, and extensively explaining the capabilities of each would see us quickly running out of room.

However, we can tell you what the latest generation of boards are, what they're used for, and crucially how they relate to previous-generation hardware so you know how to find your preferred options.

Intel Chipsets

Intel's motherboard lines over the last few generations have come in six different chipsets. The letter prefix indicates the board's purpose and the number following indicates the position in the line. Q and

B-prefixed chipsets are mostly aimed at business use, while H and Z boards are aimed at consumers.

The Intel 100-series chipset is designed for use with Skylake CPUs. They were first released in Q3 2015 and crucially, aren't backwards-compatible with earlier Intel chips thanks to a revised socket type: LGA1151. They have dropped PCI support completely and while they are capable of supporting DDR4 RAM, many boards still use DDR3.

As ever, there are six different chipsets in the series, all of which are grouped together under the 'Sunrise Point' codename:

H110 will be the budget consumer chipset, with fewer PCIe lanes than the others – just six, all of which are PCIe 2.0. It will only have four SATA 6Gbps ports, no SATAe or PCIe M.2 support, up to four USB 3.0 ports and up to ten USB 2.0 support. Previous H-series boards had a limited number of DIMM slots, no overlocking support, no SLI graphics support and no extra features like Intel Smart Response SSD caching, so expect a similar stripped-down approach when the H110 comes to market. Its previous generation equivalents are the Haswell H81 and the Ivy Bridge H71.

B150 motherboards are out now, and break with Intel

“ It’s worth remembering that the Intel 200-series motherboards are due out early next year ”

tradition in being aimed at gamers as well as business users. The B150 has eight PCIe 3.0 slots, six SATA 6Gbps ports, up to six USB 3.0 ports, up to twelve USB 2.0 ports, and no PCIe m.2 support. They’re largely aimed at budget users, and again don’t support overclocking or SLI. The previous equivalents are (loosely) the Haswell B85 and the Ivy Bridge B75.

Q150 motherboards are aimed at business users, and due for release soon. They’ll be similar to B150 boards, but support two more PCIe lanes, two more USB 3.0 ports, and two more USB 2.0 ports. Its Haswell equivalent is the Q85 and the Ivy Bridge equivalent was the Q75.

H170 boards are out now, and aimed at mainstream PCs, replacing the Haswell H87, Devil’s Canyon H97, and Ivy Bridge H77. They support 16 PCIe lanes, allowing for SLI mode graphics, six SATA 6Gbps ports, up to two SATAe ports, eight USB 3.0 ports, 14 USB 2.0 ports, and two PCIe m.2 ports. Anyone building a standard home PC based on Skylake should start by looking at this line. The price is around £70-£100, making it quite reasonable.

Z170 boards are out now, and aimed at gamers and enthusiasts. The business-focused version, the Q170, will follow later this year with similar specs. These boards have 20 PCIe 3.0 lanes, six SATA 6Gbps ports, up to three SATAe ports, up to ten USB 3.0 ports, and up to 14 USB 2.0 ports. They also support up to three PCIe M.2 devices. The Z170 succeeds the Devil’s Canyon Z97, Haswell Z87

and Ivy Bridge Z77 with a complete set of features and full overclocking support. The Q170 doesn’t support overclocking, but has extra enterprise features. If you want a high-end system for business or pleasure, these are the boards to look out for.

It’s worth remembering that the Intel 200-series motherboards are due out early next year, but since they (and the Kaby Lake CPUs they’re designed to work with) will be backwards-compatible with the Intel 100-series, you don’t have a huge incentive to hold off on buying one. As long as you don’t have a pathological need to own the latest technology, you’ll be fine with any of these Intel boards for easily a year or two.

Skylake Budget CPUs

The cheapest Skylake processors around are the Celeron and Pentiums. Priced between £40 and £85, these chips are slow and basic, usually aimed at very light use systems.

Celeron and Pentium chips lack advanced capabilities like multi-threading, and have slower GPUs, so you should look for similarly basic motherboards. They’re best used in slim-form desktop systems and, at the faster end of the spectrum, media PCs, both of which beg smaller motherboard sizes such as mATX and mini-ITX.

If you’re looking for a consumer system (and since you’re reading Micro Mart, we’ll assume you are!) then the H110 chipset is the one to go for. The other low-end chipset, the B150, is only of much interest to those



Biostar H110MHV3



MSI H110M Pro-VD

building gaming systems, and we’re not convinced that it’s worth buying one to go with a Celeron or Pentium CPU, so don’t look too hard at them!

Budget: Biostar H110MHV3 (£46)

One of the cheapest Skylake boards on the market today, it will, like all Intel boards, accept any chip up to a Core i7 if you’re feeling flash. Anything Core i3 or above would probably benefit from a better board, but this one is okay for budget systems, with dual-slot DDR3, four SATA 6Gbps connectors, a pair of PCIe slots and four USB ports (2 x USB 3.0). It does have one x16 PCIe slot, supporting graphics cards, but there’s not a particularly good reason to put one in a system

that uses a board like this. Integrated audio is provided by the RealTek ALC887, and the on-board LAN controller supports gigabit Ethernet.

High-End: MSI H110M Pro-VD (£51.99)

Slightly more expensive, the MSI H110M Pro-VD is one of the more expensive H110 boards, which should give you an indication of how cheap most of them are. The primary difference between this and cheaper boards is that as well as having an additional PCIe slot (one x16, two x1), it contains both a DVI and a D-Sub port, while cheaper versions usually omit one or the other. The audio is again a RealTek ALC887 chip, and on-board LAN supports gigabit Ethernet. SATA connectors are the same configuration as the

“ Intel’s Core i3 chips are primarily aimed at non-mobile, non-gaming systems ”

cheaper version of the board, but the USB controller is better with four USB 3.1 ports and six USB 2.0.

Skylake Core i3

Although they’re part of Intel’s performance line, Intel’s Core i3 chips are primarily aimed at non-mobile, non-gaming systems. They are powerful enough for most general uses including full HD video, but are not necessarily optimal for those purposes.

The best reason to buy a Core i3 over the alternatives is if you’re running a system that is frequently used, but rarely taxed. If you’re doing a lot of word processing, collecting emails or browsing, a Core i3 should fit your needs. Similarly, if you’re hoping to kit out a small office with several systems, Core i3 will ensure they have good, lasting performance at a low cost.

Skylake Core i3 chips start around £100 and top out around £150. None of them can be overclocked and they’re not especially good gaming systems, which means a low-end H170 chipset motherboard would provide all the features you need.

Budget: Biostar Hi-Fi H170S3H (£66)

Again, it’s Biostar that offers one of the cheapest motherboards for the H170 chipset. The Biostar Hi-Fi H170S3H has four DDR3 DIMM slots, two PCIe 3.0 x16 slot (allowing dual graphics cards, if you want!) and one PCIe slot. You can add two SATA-3 devices, but there’s also support for SATA Express and M.2. You get four USB 3.0 ports and two USB 2.0 ports.

Again, it has ALC887 audio and gigabit Ethernet on board, the true incentives over the cheaper motherboards are the dual HDMI ports, which make it perfect for watching high-definition media and multi-screen setups.

Gigabyte GA-H170-HD3 (£94)

The Gigabyte GA-H170-HD3 doesn’t add a ton more features, but that’s not to say it isn’t worth paying extra for. The main draw is that its four DIMM slots are DDR4, though it also has HDMI-out, DVI out and D-Sub, meaning it can support up to three displays simultaneously. PCIe slots include a two PCIe x16 slots, two PCIe x1 slots, and two legacy PCI slots. You get a total of six SATA-3 ports, two SATA Express slots, one M.2 slot, a gigabit LAN controller, RealTek ALC887 audio and up to 14 USB ports in total – eight USB 3.0 and six USB 2.0. That’s enough to run any reasonable system on!

Skylake Core i5

Core i5 CPUs are the all-rounder of Intel’s performance bracket. They do everything well, and are perfect for home systems that do everything, from playing games to watching videos to editing photos. The balance of price and performance is about as good as it gets, but they’re not cheap. The lowest-priced i5 chips start at £180, and the most expensive are almost £240.

In most cases, H170 boards are still sufficient for any system that runs on a Core i5, but there’s an at least one configuration in which this doesn’t apply, and that’s if



Biostar Hi-Fi H170S3H



Gigabyte GA-H170-HD3



Asus H170-PRO

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Gigabyte GA-Z170X-UD3

you're basing a gaming system on a Core i5 (which isn't an unreasonable thing to do). If you're building a gaming system and it's got a K-series CPU and/or you want to double up on graphics cards, you need a Z170 chipset motherboard – though for a Core i5 it doesn't have to be a high-end one.

Budget: Asus H170-PRO (£115)

It's not really a motherboard for gaming systems, but that makes the Asus H170-PRO an ideal board for Core i5 owners who want a fast all-round system rather than a dedicated gaming system. The H170 has four DDR4 DIMM slots, USB Type-C compatibility in addition to six USB 3.0 and six

USB 2.0, three display outputs, two PCIe x16 slots, two PCIe x1 slots, and two PCI slots. SATA support includes six SATA 6Gbps, one SATA Express and one M.2. A great board for any general use system.

High-End: Asus Z170 PRO GAMING (£130)

This gaming board is worth buying despite its price, but only if you have an unlocked Core i5 CPU that can take advantage of the overclocking features the Z170 chipset offers. It has four DDR4 DIMM slots, two PCIe x16 slots, a PCIe x4 slot and three PCIe x1 slots. As well as three display outputs it supports Sata Express, M.2, four SATA 6Gbps devices and has two

USB 3.1 ports (Type A and Type C) alongside six USB 3.0 ports and eight USB 2.0 ports. Combined with a ton of gaming-specific software and hardware features, there's very little not to love.

Skylake Core i7

Intel's Core i7 line is the best of the current generation of chips, and while they're most popular with gamers who want to get the best speeds around, they're also useful for tasks that involve a lot of multi-threaded processing – video encoding in particular.

Either way, if you're building a Skylake Core i7 system, you don't want anything less than a Z150 board so you can take advantage of the best the chips have to offer, whether that's overclocking or something else.

The cheapest Core i7 chips start at £250 and go well north of £300, but if you're buying a system at this end of the market, a low-priced board isn't necessarily what you're after. If you are, remember that even the cheapest LGA1151 boards can technically run a Core i7, but we'll concentrate on the high-end ones.

Budget: Gigabyte GA-Z170X-UD3 (£140)

At this end of the market, the word 'budget' doesn't

hold a lot of meaning, but if you want something that matches your processor's capabilities without costing way too much, this Gigabyte GA-Z170X-UD3 is worth going for. It has four DDR4 DIMM slots, three display ports, three PCIe x16 slots three PCIe x1 slots, six SATA 6Gbps ports including two M.2 slots and three SATA Express connectors, both Type A and Type C USB 3.1 ports, seven USB 3.0 ports, six USB 2.0 ports and a Thunderbolt connector. Fair to say it's pretty packed!

High-End: Asus Maximus VIII Hero (£206)

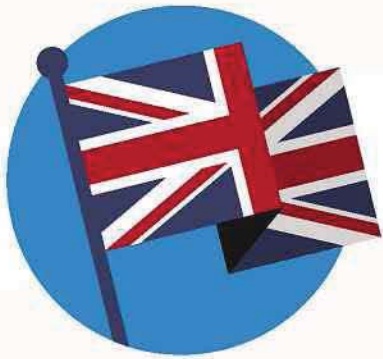
What would you expect a motherboard four times cheaper than the most basic one around to contain? The answer is 'a lot'. And That's true. As well as supporting four DDR4 DIMMs at up to 3733MHz, it has gigabit Ethernet with LANGuard and GameFirst technology, three PCIe x16 ports, three PCIe x1 ports, an M.2 socket, two SATA Express ports and six SATA 6Gbps ports, ROG SupremeFX sound with gold-plated jacks, and a full complement of USB 3.1, 3.0 and 2.0 ports for a total of 16. All that plus a ton of overclocking features. It might cost a bomb, but it's definitely giving you its money's worth. **mm**

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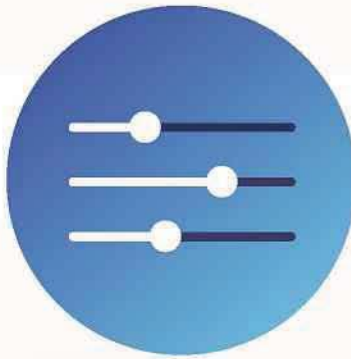


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AMD Motherboards Guide

If you're looking to build a cheap PC, one of these boards could be the answer

AMD's new platform is just around the corner, which makes buying a new motherboard tricky. In all honesty, it's probably not worth buying an AMD motherboard until the release of the Zen chips if you're planning to build a new desktop or gaming system.

But if you're looking for a smaller, cheaper system where performance isn't an issue or upgrading/repairing an existing AMD computer there's still plenty of scope for buying new motherboards. Indeed, with the current platforms at the end of their life, it might even be a good time to upgrade...

AMD Chipsets

AMD's APU chips, which combined a CPU and GPU (like Intel Core chips) require a Socket FM2 or FM2+ depending on their generation. The current generation of Kaveri chips (including the Godavari refresh) use Socket

“ If you're buying a new AMD motherboard, you're probably buying an FM2+ board ”

FM2+, and their successor may also use this hardware. Socket FM2+ also accepts older Trinity and Richland chips, but not the first generation of APUs (Llano) which used Socket FM1.

The upshot of this is that if you're buying a new AMD motherboard, you're probably buying an FM2+ board. They have the most potential for upgrading and can accept at least one generation of older chips, and may yet support the next version (AMD has announced it'll be around until 2016 at least).

There are four main lines for AMD's A-series chipsets, all of which can support Godavari features (though some may require a BIOS update to enable the newest capabilities.)

The A58 motherboards are entry-level FM2+ boards, recommended for use with A4 and A6 APUs. They support dual-graphics (meaning an APU and compatible graphics card). Technically the A58 has been replaced by the A68H, meaning A58 boards are very cheap. They're commonly cut down, with two DIMM slots, one PCIe 3.0 slot, one PCIe 2.0 slot, and USB 2.0/SATA 3Gbps. Solidly last-generation stuff. They may suit budget system builders and those putting together compact systems, but at this point they're largely to be avoided outside of a specialist context.

A68H boards are a safer bet, aimed at home users with moderate needs. They're also

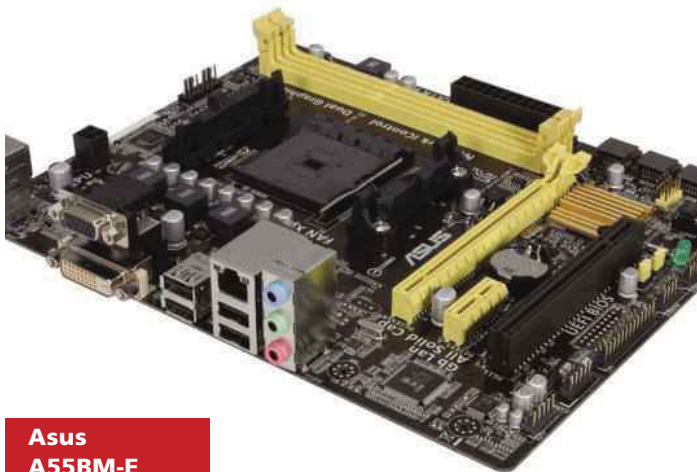
designed to be paired with A4 and A6 APUs, with the same dual-graphics capability as the A58, but they also have native support for four SATA 6Gbps ports and two USB 3.0 ports.

A78 motherboards support PCIe 3.0, have a native six SATA 6Gbps ports and four USB 3.0 ports. They're designed to operate with A8 and A6 APUs, and even support limited levels of overclocking, making them a good choice for casual gamers.

A88X boards are at the top of the heap, though. They support full Crossfire multi-GPU systems and full overclocking of the A10 and A8 chips they're designed to pair with. They also support advanced storage, like RAID,



**Gigabyte
GA-F2A55M-DS2**



**Asus
A55BM-E**

and have four USB 3.0 ports, ten USB 2.0 ports and six SATA 3Gbps ports.

If it looks like AMD's motherboards don't quite match up to Intel's, that's largely because they're older. But keep in mind that they're also cheaper even at the high end.

If you are after an AMD motherboard for a new system, the A88X is the only one we can really recommend, mainly because it's the only one that comes close to Intel's offerings. But it's still quite far out of date by those standards, and when you're buying a new system or upgrading an existing one, it seems like a bad call to buy hardware this near to the end of its life cycle.

Motherboards For Low-Cost FM2 APUs

If you're after a budget processor, AMD's low-end Fusion chips are as cheap as you can get. The lowest-price Fusion chips are the A4 series, and costs run as low as £30 for the A4-4000 chip. At this price, the chips are best used for low-use and basic systems, although they're popular with HTPC-builders because their GPU, which greatly exceeds the capabilities of similarly cheap Intel chips, can run high-def video without the need for a separate graphics card. A budget chip would also be suitable for a dedicated NAS unit or file server.

Whatever type of system you're building, you need a motherboard that can fit

“ FM2 motherboard is likely to come in more expensive than the chip itself ”

the basic Richland chips that you'll be buying at this price. Gaming and even heavy application use is out of the question, so the choice of motherboard should also reflect that. While an FM2+ board would be enough, it clearly makes more sense to go for a slightly older and slightly cheaper FM2 board instead. The ones we've picked would be ideal for pairing with the A4-4000, A4-5300 and A4-6320.

Budget: Gigabyte GA-F2A55M-DS2 (£35)

Even if you're buying a low-end processor, an FM2 motherboard is likely to come in more expensive than the chip itself. That's certainly true of the Gigabyte GA-F2A55M-DS2, which is one of the cheapest (full-size) FM2 motherboards around.

The main disadvantage to buying this board is that its A55 chipset doesn't have support for SATA-3, which might be a problem if you're hoping to build a file server with multiple clients, but it's also not going to matter hugely if you're pairing it with a standard hard drive: SATA-2 is enough to max out most mechanical drives, and even SSDs struggle to reach full data throughput!

If you're building a media PC the lack of an HDMI port could present a problem, but you can get high-resolution images through a DVI-D connector as long as your screen supports dual-link.

Other than that, you get plenty of standard features: On-board gigabit LAN, ALC887 sound, two DIMM slots, three

PCI slots, six SATA-2 ports and eight USB 2.0 ports. It won't be the best system in the world, but it'll be enough.

High-End: Asus A55BM-E (£45)

The Asus A55BM-E might only be a tenner more expensive than the Gigabyte model, but for a budget system that's a fairly noticeable leap. On the surface, the board is relatively similar to cheaper ones: two DIMM slots, six SATA-2 ports, three PCI slots, on-board gigabit LAN, ALC887 integrated sound, and eight USB ports – although in this case, two of those are USB 3.0.

But crucially, this board supports HDMI-out, which makes it a far better candidate if you're building a media PC. HDMI supports HDCP, and therefore can offer full-scale Blu-ray playback, as well as the convenience of transmitting audio on the same cable. Given the price it's not a huge amount of extra performance, but it does have the advantage of offering some kind of future-proofing as well: if you upgrade your APU to a faster chip further down the line, you'll have a video output that supports the best-quality interface for your monitor. Worth investing in.

Motherboards For Mid-Price FM2+ APUs

AMD may have struggled to take on Intel at the higher end of the market, but their latest Fusion chips are ideal mid-range performers. Especially if you don't want to buy a separate graphics card! Kaveri chips feature R7-series GPUs, which makes them very solid



ASRock FM2A75 Pro4+



Gigabyte G1.Sniper

gaming performers. Their price also makes them a viable alternative to buying a Core i3 chip and a graphics card.

That means if you're buying an FM2+ chip (which, at current prices, are just north of £100) what you're really looking for is a motherboard that can support a gaming system but doesn't cost a huge amount. Luckily (or unluckily, depending on your point of view) FM2+ is still new enough that there aren't many boards to choose from. But that does

make our job of recommending one easier.

Budget: ASRock FM2A75 Pro4+ (£50)

If you avoid micro-ATX boards, which aren't much good for gaming, the cheapest FM2+ board on the market is probably the ASRock FM2A75 Pro4+. As well as its Socket FM2+ interface, it has four dual-channel DIMM slots supporting DDR3 at up to 2600MHz, HDMI-out, dual-link DVI, gigabit LAN, seven

PCI slots in total, six USB 2.0 ports, two USB 3.0 ports. Five SATA-3 connectors and one eSATA-3 connector.

As motherboards go, that's as formidably up to date as they come. Some of the features are only accessible with an FM2+ chip, but frankly, when the price is this reasonable it's worth buying even if you're going to put an FM2 chip in there and upgrade later. If there's anything to complain about, it's the A75 chipset, which is really designed for Trinity and Richland chips, and therefore doesn't have full support for Kaveri features (like 4k graphics output). It's a small detail, and not something that'll bother mid-range and budget users, but it is something to be aware of before you buy it.

High-End: Gigabyte G1.Sniper (£100)

It's probably the best FM2+ motherboard on the market right now. It's certainly one of the most expensive. The Gigabyte G1.Sniper is broadly the same as any other FM2+ board, with support for four dual-channel DDR3 DIMMs at overclocked frequencies, support for 4K HDMI output (with an FM2+ chip only), gigabit LAN port and seven PCI slots, but it also takes things a little further. You get eight SATA-3 connectors, four USB 3.0 ports and nine USB 2.0 ports.

The true selling point is its controller chipset, which is the A88X. Based on the FM2 A85X platform, it has improved RAID support, and access to the full range of Kaveri features – something that cheaper boards haven't got. Pair this

board with an A10 7700K or A10 7850K and you'll have a decent, affordable system that doesn't require an additional graphics card for gaming. Intel might have the upper hand in most areas, but at this price, AMD is finally fighting back.

Motherboards For High-End AM3+ CPUs

There's a problem with AMD's fastest CPUs, and it's one that's been well-covered. The fact is, their single-threaded performance is so poor that if you're building a gaming system with a separate graphics card then there's no good reason to buy one over an Intel system, which costs the same (or less!) and offers far better performance. If you're not using the integrated GPU for gaming why would you settle for an AMD chip at all?

There are circumstances under which an AMD chip can successfully outperform an Intel chip, and that's in applications which involve true multithreading. Most of these, such as video processing or commercial 3D rendering aren't going to be of much interest to the casual use buying or building a home system, unfortunately. Luckily, AM3+ boards are AMD's most prolific, and that means if you are wedded to an AM3+ chip you have huge scope for choosing one to go with it.

Budget: ASRock 990FX Extreme3 (£95)

The features on AM3+ boards aren't usually as advanced as the latest Fusion motherboards, but that doesn't mean you're relegated to the middle ground either. The ASRock 990FX Extreme3 compensates for its mid-range features by using high-quality components, such as their proprietary DuraCap capacitors which have 2.5x the life span of average capacitors.

“ There's a problem with AMD's fastest CPUs, and it's one that's been well-covered ”

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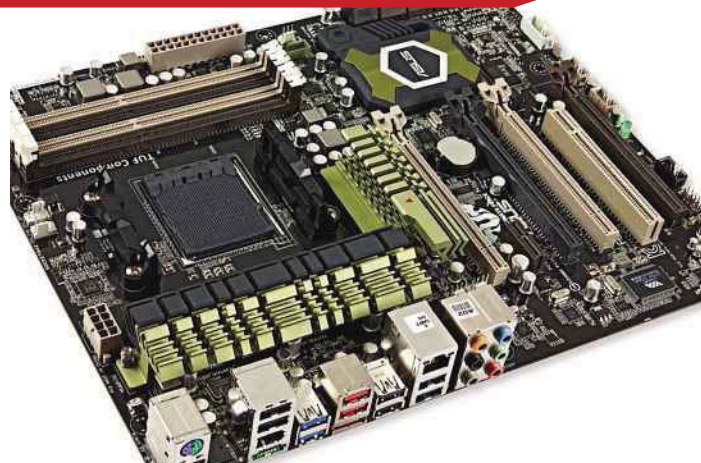
“I’m loving my new ride. I would recommend this service to anyone”



Tatiana, 8 September



**ASRock 990FX
Extreme3**



**Asus Sabertooth
990FX**

AMD Sockets

Like Intel, AMD has a selection of different sockets which stretch over several chip generations. Here are the ones you might encounter, and what chips they're attached to.

AM3/+

Socket AM3+ is a modification of the earlier AM3 socket designed for Bulldozer and Vishera CPUs. It is compatible with AM3 CPUs, but contains a huge number of improvements to chip design that AM3+ chips can take full advantage of. Some AM3 motherboards can be upgraded to support AM3+ chips with a bios update, although there are also power requirements that not every AM3 board can meet.

FM2

Socket FM2 (and before it, Socket FM1) is the previous-generation socket for all of AMD's GPU-integrated APUs. Like Intel's consumer chips, these CPUs integrate a graphics processor, although unlike Intel's chips they're reasonably powerful and often gaming-capable, as opposed to basic, non-gaming GPUs. Socket FM2 is used by both Trinity and Richland chips, as well as the Athlon X2 and X4 chips based on them.

FM2+

Socket FM2+ is AMD's latest. Released in 2014, it supports the Steamroller core Kaveri APUs. The main physical difference is that the FM2+ has a slightly different pin configuration, with two additional pin sockets. This means that while Socket FM2+ APUs are not backwards compatible with Socket FM2 motherboards, it is possible to use Socket FM2 chips, such as Richland APUs, in motherboards that have an FM2+ socket.

AM4

Planned for the forthcoming AMD Zen CPUs and APUs, the AM4 slot will succeed both AM3 and FM2+ for the foreseeable future.

That's in addition to the standard high-end features. Quad-configuration video card support, for example, and four DIMM slots supporting dual-channel RAM at 2100MHz. You get two USB 3.0 ports, six USB 2.0 ports, five SATA-3 ports and one eSATA-3 port, on-board gigabit LAN, ALC892

audio, and six PCI slots total.

Certainly, if you're planning to build as good an AMD system as you can, this board would be the smart choice, if not the best. There's no area in which it's lacking, and it'll easily allow room for further expansion should you want to improve your PC. True, AM3+

is becoming a deprecated socket which doesn't give you man upgrade prospects. But ultimately, that's the only thing wrong with it.

High-End: Asus Sabertooth 990FX (£185)

The most expensive AM3+ motherboard currently available

to buy is the Asus Sabertooth 990FX, which features Asus's Republic of Gamers-approved technology. A somewhat sad state of affairs given the FX-Series' inherent unsuitability for gaming, but if you've got the fastest AMD chip and want the best motherboard to go with it, this is your only real option.

Many of its most advanced features are aimed at heat dissipation and management, such as thermal radar, improved ceramic heatsinks and TUF extra-durable components, but the truth of the matter is that if you're likely to take advantage of these features, you'd prefer to be running an Intel chip anyway.

Even the features aren't really much to be desired. Even at £50 more than the ASRock 990FX, it's running the same basic chipset, so it looks more or less the same, only with more of a few things. Four DIMM slots, quad-GPU support with six PCI slots, eight SATA-3 ports and two eSATA-3 ports, a gigabit LAN controller, ALC892 sound, 12 USB 2.0 ports and six USB 3.0 ports. It's undoubtedly got features gamers would appreciate, and it is the most powerful AMD motherboard, but if you're a gamer, you'd do better with an Intel setup. [mm](#)



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Under Threat

The UK government has confirmed that it's investing £1.9bn in a new cybersecurity strategy, but what exactly are the threats it's looking to stop? Mark Oakley takes a look

During the cold month of October, the Internet of Things (IoT) showed the world a glimpse of its true potential. DNS services provider Dyn was rocked by a DDoS attack so severe, and so persistent, that its servers buckled under the pressure. Multiple web-based services were affected as a result: Netflix, Amazon, PayPal, Ancestry.com, news broadcasters, and media outlets included.

IoT devices, hailed by so many as the future of technology, were just the tool; those behind the attack – Anonymous attempted to take some 'credit' – used botnet malware called Mirai that had distributed itself around various Internet-connected devices such as baby monitors, CCTV and printers, turning them into a weapon that could be used to bombard any target they liked with massive amounts of connection requests. In doing so, this incident became the first large-scale embodiment of the fears some people have been voicing about the IoT for some time. Securing your computers, mobile devices, and servers from cyber-attacks is one thing; you can download and install security software yourself and feel a degree of safety from that. How secure is your web-

connected printer, though? Will that Internet-connected toy robot become under a hacker's control, and what about web-connected vehicles? These worries are the kinds of themes that Charlie Brooker's consistently brilliant *Black Mirror* addresses, but incidents such as the Dyn attack serve as a reminder that, while hacking makes for a good story, the threats are very real.

So who can we look to stop such threats from happening in the first place? While for many, government spending on technology is typically associated with surveillance – another theme common in Brooker's series – our own government has just announced large-scale investment intended to protect all our cyber futures.

Defend, Deter, Develop

Chancellor Philip Hammond announced the government's new five-year strategy at London's Future Decoded conference in November. He committed to handing over £1.9bn to fund the National Cyber Security Strategy, which has at its core three central pillars: defend, deter, and develop.

“ Supporters of hacktivists believe that the work they are carrying out is for the greater good ”

Defend comes from further investment in the government's own cyber defences, “critical national infrastructure sectors like energy and transport”, and the wider economy, working with industry to drive up security standards across both the private and public sectors. In his speech, the chancellor used cited the case of a fake government address that was being used to defraud people, an address that has since been shut down with the government's intervention, as an example of the kind of activity that this encompasses. Under this section of the strategy, the government is also looking at alternative means of security, including investment in emerging technologies such as FIDO (Fast Identity Online) authentication, which uses alternative techniques beyond password protection – for example locally storing biometric and other personal ID data on hardware to protect it.

Deterrence is another big factor, with the government promising to take measures to “raise the cost and reduce the reward” of cybercrime. Clearly, handing down tougher sentences for anyone taking part in cybercrime should have an impact, but as the best method of dealing with attacks is to stop them before they occur in the first place, then investment in detecting, tracing, and retaliating to threats is also on the government's ‘deter’ radar. Developing a “fully functioning and operational cyber counter-attack capability” is seen as vital as should a cyber-attack take down our own systems, giving us no time or means to respond, and the government feels that the country will need to have a plan in place to deal with that that other than military retaliation.

As for the final pillar, development, the government has committed funding to a new cybersecurity research institute, a virtual network of UK universities focused on technological research in hardware, looking to improve smartphone, tablet and laptop security. The government is actively calling on the next generation for help with this, as the old methods just aren't all

that relevant in a world where organisations could potentially be toppled, and reputations ruined, with the click of a button. It's investing in cybersecurity education for young people, also.

As physical proof of its commitment to the strategy, a new National Cyber Security Centre has also been opened in central London to give the whole operation a frontline presence.

The investment of £1.9bn is significant, as was some of the rhetoric in Hammond's speech. At one point, he said of the ‘defend’ part of the strategy that “we will not only defend ourselves in cyberspace; we will strike back in kind when we are attacked”. Strong words indeed, and an admission that you have to fight fire with fire, but then does this mean that should a ‘foreign actor’, as mentioned in the speech, take down some of our online infrastructure and networks that we should retaliate in the same way? Would the UK be willing to engage in a ‘cyber war’ in order, as stated in his speech, “to demonstrate that they cannot act with impunity”?

This strong sentiment leaves potential attackers under little illusion as to how seriously the government views the threat, but where are those threats most likely to come from?

Hactivists

Hactivism has become an increasingly significant threat to the UK's IT systems. In the public eye largely because of the efforts of high-profile groups such as Anonymous, over the years hacktivist groups have taken responsibility for various DDoS attacks throughout the world, as well as various attacks that have impacted government websites, the London Stock Exchange site, and various web presences relating to international terrorism and other controversial subject matter.

Supporters of hacktivists believe that the work they are carrying out is for the greater good, tipping the balance more in favour of the common man and revealing secrets of organisations that the general public might not otherwise be aware of. Hactivism often gains people's support because it is pitched as being in our favour yet, while the political, social, and economic intentions may well be well-intentioned, the counter-view is that hacking is hacking however you chose to spin it.

The UK government certainly takes a dim view, writing in a 2011 document, “The threat to the UK from politically motivated activist groups operating in cyberspace is real. Attacks on public and private sector websites and online services in the UK orchestrated by ‘hacktivists’ are becoming more common, aimed at causing disruption, reputational and financial damage, and gaining publicity.”

Such groups present a particularly difficult problem as they are decentralised, rising up in various forms and factions despite commonly working towards one goal: to disrupt the status quo. That, for any government, represents a very real threat.

Cyber Criminals

Whereas hacktivists might use their skills to redress a perceived imbalance, organised cybercrime is purposely utilising IT for ill-gotten gains. According to our government, most of the serious cybercrime – fraud, extortion, and theft – is perpetrated by organised Russian-language groups operating in Eastern Europe, although it does note that there are now also emerging threats from South Asia, Western Africa, and some activity within the UK itself. Such criminal groups are mainly responsible for deploying malware that infects computers and the computer networks of industry and government, typically for the purpose of information theft or extortion.

Recently, Tesco Bank was hacked and 9,000 accounts had money stolen in an attack that was viewed as unprecedented here in the UK. Described by the bank's chief executive as a “systematic, sophisticated” attack, the thinking is that this could have been the



work of an organised cybercrime group.

Outside of major organised incidents, “less sophisticated” cybercrime against individuals is also clearly a more immediate concern for consumers such as you or I.

State-Sponsored Threats

Then we come to the big worry for governments, the threat of state-sponsored groups looking to cripple a country’s infrastructure. Whether it’s impacting our telecommunications sector, defence, finance, or energy sectors, those with the technical capabilities, the investment, and the desire to cause chaos pose a dangerous threat to the UK. Right now, the government views these threats as coming from a “handful” of states, but it warns that others could post a threat in the future by purchasing exploitation tools ‘off the shelf’ and repurposing them to their own nefarious ends.

Additionally, terrorist groups are continuing to carry out cyber activity against the UK, although the government admits that for the moment this remains a relatively low threat compared to physical terrorist attacks.

Vulnerable Nation?

Given all of these threats to our national security, economy, and general way of life, is the UK particularly susceptible to cyberattack? According to Internet security company Rapid7, which has mapped out and ranked the 50 countries most vulnerable to hacking, the UK ranks number 23 on the list, with Belgium actually taking the unwanted number 1 spot. There is little doubt, however, that today’s UK is more likely to come under online attack than the UK of five or ten years ago.

The integration of the Internet in our daily lives and the emergence of the Internet of Things have created fresh opportunities for further exploitation of our networks. The government has warned that insufficient training and skills in cybersecurity, coupled with increased availability of hacking resources to a greater proportion of people than ever before, have both helped to create a more vulnerable IT ecosystem, an ecosystem which it has now committed to investing £1.9bn to over the next five years.

Hopefully, this will prove to be an investment well spent. [mm](#)

Governments Under Attack

While attacks such as the one at Tesco Bank grab your attention, largely because of the ‘it could happen to me’ scenario, there have been some dramatic and potentially catastrophic hacks around the world in recent times that demonstrate the true scale of the challenge facing governments today.

Last year, the United States government suffered a breach of the United States Office of Personnel Management, the agency responsible for managing the civil service of the federal government. After initially fearing that the personal details of some six million people were stolen, it eventually transpired that that figure was actually 21.5 million people, with details including social security numbers and fingerprints. The New York Times reported at the time that it was likely that anyone who had undergone a government background check over the past 15 years was probably affected. Blame for the attack was aimed at China, some reports suggesting a state-sponsored attack. China has always denied this.

This year, a breach of the Philippine Commission on Elections exposed the personal details of over 50 million people, including passport details and fingerprints. In 2012, one hacker in Greece was arrested on suspicion of stealing the ID information of much of the entire population with apparently nine million files containing financial data, tax ID numbers, addresses and more.

Finally, during the US presidential elections of 2008, hackers suspected to be working out of China reportedly broke into the computer systems of both candidates, while US officials have suggested that Russian-backed hackers have also tried to have an influence on this year’s campaign.

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California Streams

... and so does half the world, it seems. **Kevin Pocock** skims a gaming phenomenon

Whatever the future of media creation, it's fairly likely there'll be someone sitting at home, broadcasting to the world while receiving support, followers or some sort of income. In a sense, the die is cast: YouTubers can earn millions and command book deals. So what's next? If I had to wager, I'd place my polymer notes at the feet of streaming. Not the streaming of on-demand services, or the watching of 'professionally created' content. No. I'd bet that streaming of games is where the money, mass entertainment, and next surge of interest leads. I'd be cheating a bit as well, because it's already happening.

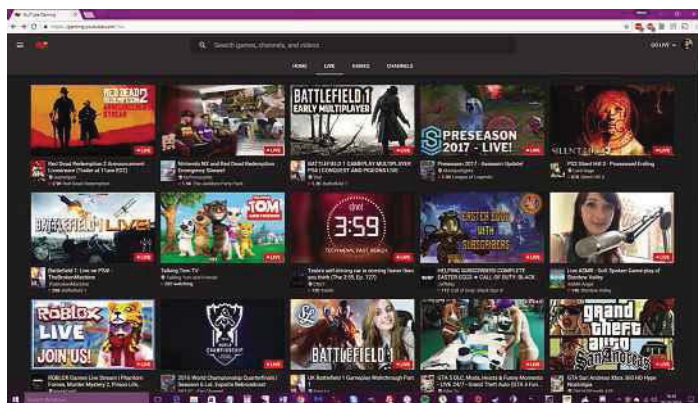
Big brother

Professional or competitive gaming has existed for some time. As such the idea of gaming tournaments, or teams from around the world battling it out in front of an area of fans, may seem old news. In a sense it is. Around ten years ago, you would either have to actually be at an e-sports event to witness a world championship, or really know the interested corners of the internet. But it was still possible. Back

then, in the mid-200s the mainstream wasn't interested, and gaming was still to some a niche interest.

Nowadays e-sports still remains an odd concept to many non-gamers. Yet it's increasingly growing its profile, and as a form of watchable entertainment it's just huge. In 2014, a Red Bull Gaming article, "E-sports in numbers: Five mind-blowing facts", reported that some 71.5 million worldwide watched 'competitive' gaming in 2013. Earlier this year, the senior VP of Activision Blizzard Media Networks (and a co-founder of Major League Gaming), Mike Sepso, said this: "[In 2015] more than 225 million people watched competitive gaming...". If accurate, that's a three-fold increase in viewers of e-sports in two years. That's a stunning increase. Also stunning is the signing of pro-gamers by real-world sports clubs and franchises, such as West Ham United, Manchester City and Philadelphia's 76ers. Safe to say e-sports is booming.

Streaming both benefits from and supports the trend in two key ways. First, it is now possible to see tournament pros playing in their 'downtime'. Gamers can interact with them, investing money in



▲ YouTube Gaming isn't short of content!

merchandise and studying their game. Esports reaches more people, and streaming services get more viewers. The second is that it's now possible to watch anyone else who with a stream. An increased interest in e-sports drives interest in the amateurs. And amateur streamers may want to become e-sports stars. Or, if tournaments are of interest, streamers can benefit from increased interest to grow their own channels.

While e-sports undoubtedly represents the pinnacle of competitive gaming, streaming enables what we might call 'everyone gaming'. By the hand-in-hand nature cannot be overlooked. Streaming may not exist in its current state without e-sports; and e-sports' rate of evolution is without doubt reinforced by the availability of content, streams and streamers.

Begin Streaming

ESports is a huge industry, with roots tracing back to the mid-90s (perhaps even earlier for those who feel like falling down a wiki-hole). Streaming is a far more recent phenomenon though, and so is Twitch.tv. In March 2007, 24-year-old Justin Kan created what would become one of the big two streaming services, by founding Justin.tv. Originally a self-serving exercise in what would become known as 'lifecasting', the site allowed Kan to broadcast his life, 24 hours a day and seven days a week for eight months. Although strapping a camera to his forehead sounds a little unusual, it attracted attention, and the site gained viewers

Once Justin.tv was opened up to the public, its true potential began to shine. Google bought YouTube in 2006 for \$1.65bn, and user-generated content became a rather valuable investment of time; if not monetarily, but creatively. However, while YouTube focused on pre-recorded videos, Justin.tv was attempting to build public-powered broadcasting. October 2007 saw the site open up registration, and 2008 added categories, user made and moderated networks and more.

Over the next two to three years, something happened – the corners of the internet where game-streaming lived began to square in on Justin.tv. By 2011 it was clear that, among other more regular, irregular and mature content, streaming of games was driving a sizable portion of the site's traffic. So much so, that in June 2011 Justin.tv's 'Gaming' section was lopped off, finding a new home at the domain 'Twitch.tv'.

Of course Twitch isn't the only general or game-specific streaming service currently around (see 'Other services' boxout). Although beaten to the punch, YouTube Gaming has been offering an alternative to would-be streamers since 2015. It's slick, it ties in with a huge existing platform and viewer base, and it's the biggest possible competitor. Yet since 2014 Twitch.tv has been owned by an e-tail colossus – Amazon. While some suggest it's Twitch playing catch up you streamers can hardly move for 'streaming battle' headlines. Audience figures offer

Other Streaming Services

Twitch and YouTube aren't alone in providing streaming for the masses.

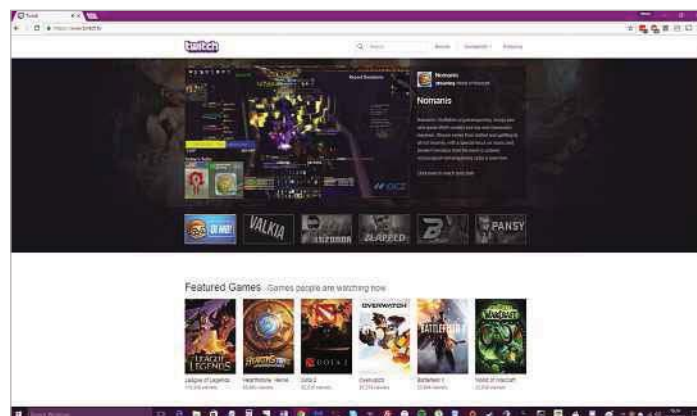
Hotbox.tv – Launched October 2013, six million active monthly users, soon to offer 60FPS, 4K resolution and is HTML5 player ready.

Beam.pro – Launched January 2016, community of over 100,000, acquired by Microsoft in August 2016 and added to the Xbox team.

little clarity: As of June this year, Twitch had over 100 million unique viewers per month. YouTube's gaming audience, meanwhile, is around five times that. However, YouTube's recorded content isn't live streaming. Yet Twitch has begun to allow users to upload pre-recorded videos too (not the last of the similarities in service features). Multiple nuances are at play here, and at this point it might be foolish for anyone to cast a vote for an eventual 'winner' in the battle. Whatever happens, streaming itself is likely to long continue.

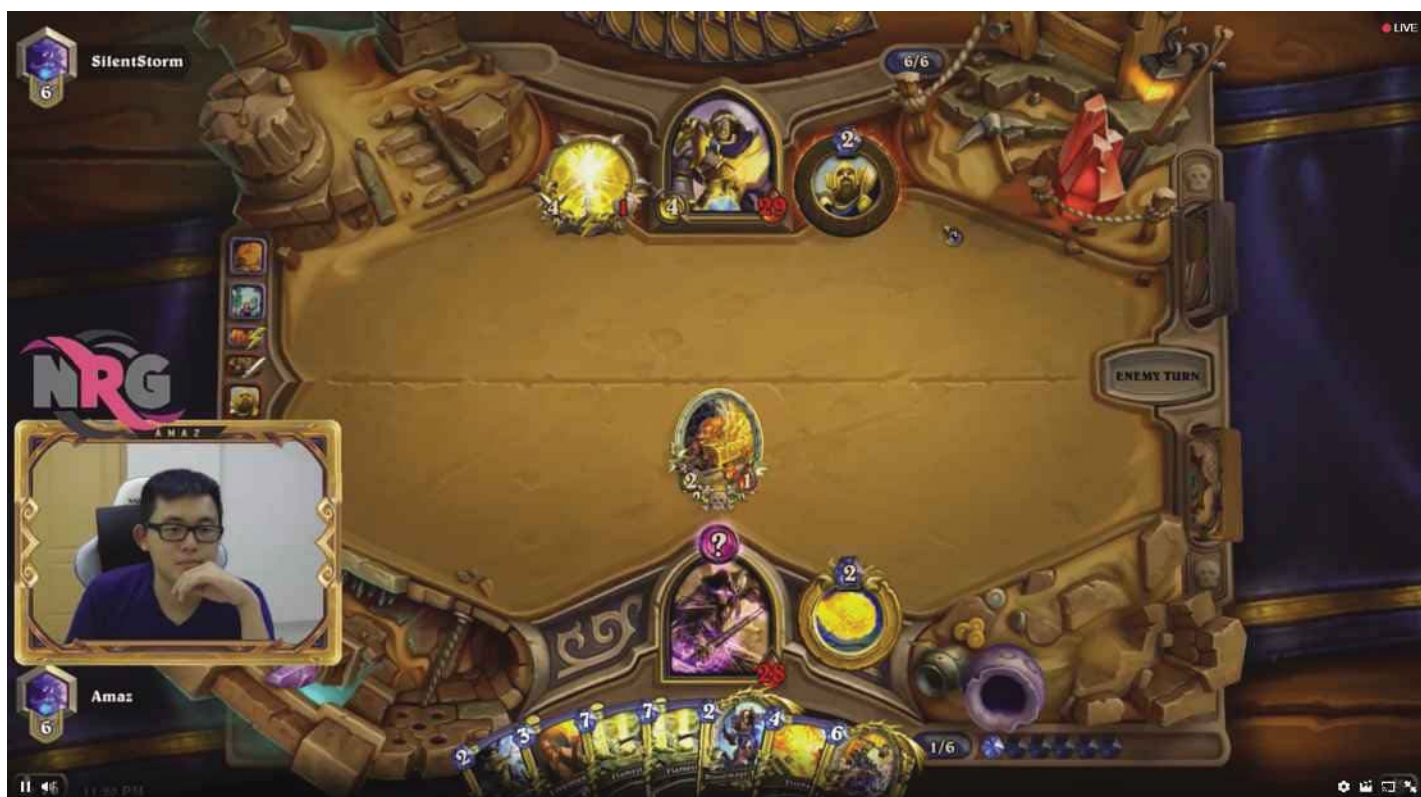
Why Stream?

While playing a game of Battlefield 4, a friend simply said to me and my teammates, "I'm streaming now guys". An odd thing occurred then. I realised that anyone in the world with a non-restricted internet connection could watch him, while hearing us. I went away and thought about it, looked for the first time in earnest at a few Twitch channels, and tried to work out what was going on. The first obvious thing was that people tend to stream because they really get a kick out of it. For example, here's the bio of Hearthstone: Heroes of Warcraft streamer, 'P4wnyhof' (pronounced pawnyhoff):



▲ Twitch.tv greets you





▲ *Hearthstone – a firm favourite of streamers and tech journos alike*

I have been gaming for over a decade now and TCGs [trading card games] were always my favorites. I started streaming Hearthstone on December, 2013 and found out that streaming is my passion and what I love doing in life. Since then I focused on build up one hell of an awesome stream community: the p4wnyhood; a place where you can spend your time hanging out with nice, lovely and just a bit crazy people. Share your good news, your problems or whatever is going on with you, we all are gonna do our best to make you feel part of the family!

Obviously streamers enjoy streaming. And although a poll of one cannot reveal the reasons behind others' desires to do the same, it has to be a base-level reason. Perhaps, as with 'P4wnyhof', streaming provides a chance to – rather than play alone – build a community. Having people watching and chatting to you as you play can only be a bonus. And if you're new to a game, you can garner some useful advice. Sure, some streamers may have a long-term income aim of being a successful, earning streamer. But the genius of streaming, is that you're unlikely to succeed in such a venture unless you're both good/entertaining in play, and in what you say. After all, the world is watching... potentially.

Presentation is a big part of this, and some streamers go to serious lengths to brand themselves. An anecdotal tidbit: those also streaming themselves (via a webcam overlay) get more interaction. So there's clearly a core willingness to connect with others on both sides of a stream. Why not? Why not speak to and connect with those who also enjoy the games you're interested in? You might prefer it to watching TV talent shows, for example. It's an option, and millions are currently talking it.

Stereotypes

The profile of the archetypal streamer is virtually impossible to pin down. Largely streamers may span teenage, twenty and thirty-something ages, with the percentage lessening in older age groups. But this generalisation is as close to any sort of verifiable insight

as there is. Age definitely isn't a barrier to streaming. In fact, one of the most dramatic recent stories of streaming focuses on a well-regarded streamer definitely not in their twenties or thirties. Someone falsely accused of being a convicted paedophile.

The allegation was made by a YouTuber called 'Keemstar'. A researcher for his show 'Drama Alert' compared two photos and incorrectly identified Runescape streamer 'rsgloryandgold' as one John Phillips. Of course, speaking this allegation to 1.5million subscribers might be considered extremely irresponsible, but Keemstar genuinely believed rigorous checks had taken place. As it transpired, 'rsgloryandgold' wasn't John Phillips at all. He was a sixty-something retired American named Tony Ray. When Twitch streamers watching Keemstar's channel reported an outright denial of the allegation from Mr Ray, Keemstar checked, fired two researchers, and went on to retract and apologise for the allegation. He also removed the offending video.

The attention this all drew, Tony Ray's immediate denial, and his generally being a good guy led to a surge in followers for his Twitch channel. With gamers and Twitch users rallying around, Tony Ray's few thousand followers soon swelled to tens of thousands.



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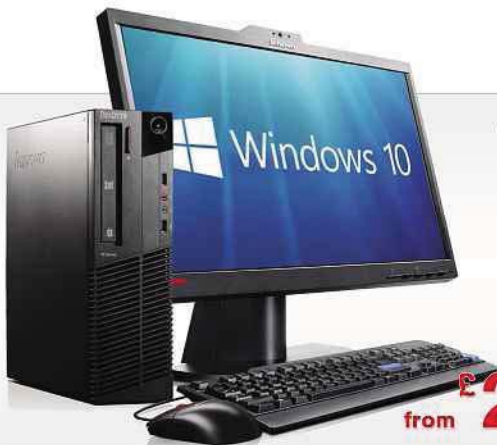
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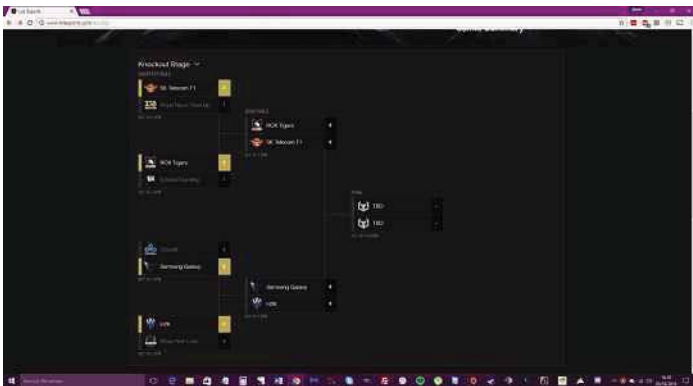
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RSGloryAndGold.png – *rsgloryandgold, otherwise known as Tony Ray*



▲ League of Legends (LoL) is probably the most streamed competitive game there is

Keemstar made clear his intention to apologise in person and ‘donate’ a four figure amount as a token of apology. This is interesting, because no matter a streamer’s age, one thing which unites huge swathes of the streaming community is the accepting of donations. Donations are one of several revenue streams for full-time streamers, and can bring in sizable incomes on their own. A 2015 Daily Dot article, (tinyurl.com/ook3s38) highlights this perfectly. In it a streamer named ‘Destiny’ revealed he could make around \$1,500 a month just from donations. Although Destiny’s Twitch follower numbers for the time of the article are unknown, he currently has 150,000.

Yet despite apparently being on social security, *rsgloryandgold* – 60-odd year old Tony Ray – didn’t accept any donations at all. Not from the apologetic Keemstar, nor anyone else. His current Twitch follower count? Over 280,000 (and he has just started accepting donations). Streamers can be anyone, streaming any sort of game they fancy, and not necessarily the slightest bit interested in making money from their endeavours. Although that does seem a given.

Culture Issues?

If streaming is for everyone, then it should provide a welcoming community to anyone looking to stream. But like other forms of entertainment (or should that be social freedoms?) as it begins to spread, it also uncovers worrying trends. Atrociously, some of these are linked to online hate and verbal attacks.

On September 28th of this year, BBC.co.uk posted a story with the title, ‘Twitch and YouTube taking misogynistic abuse in gaming seriously’. If the title hints at horrendous online behaviour, the content of the piece lifts the lid. The first line of that story reads:

“Female gamers have told Newsbeat they get regular abuse on sites like Twitch and YouTube.”

The content of the article is alarming, as is the need for anyone to even have to decry the nastiness therein. But both Twitch and YouTube are committed to fighting against something the Association for UK Interactive Entertainment calls “a society-wide issue”. There can be no denying that societies will bring their own values to Twitch, but a mix of gaming and online freedom does seem to produce particularly repugnant examples (see, for example, Gamergate). I’ve witnessed some despicable comments on Twitch myself, and other indicators while briefly submerged in streaming are worrying. In some quarters there seems to be an acceptance that new female streamers accumulate followers quicker than their male counterparts. This may be true, but females also receive more hate and inappropriate contact.

Having briefly watched a new female streamer a couple of time over a few of days, I witnessed one incident of a follower being blocked for an inappropriate message. Watching multiple male streamers for longer, I saw no similar incidents. This is anecdotal for sure, but Twitter also serves up evidence of unequal treatment of males and females when it comes to streamers. When browsing topical hashtags in an attempt to connect with others, it didn’t take long for me to come across a recurring piece of information on the profiles of female streamers. Before even mentioning game preferences, the word “Taken” appeared. That is, I assume, an immediate shutdown of any online proposals, decent or otherwise. And it’s telling.

Certainly, as UKIE suggests, such defensiveness may be sadly reflective of societal issues, but my gut tells me that in a gaming arena still depicted as male-dominant – even if it may not be – this particular issue may be multiplied. I should also say that misogyny or sexism aren’t the only issues to encounter in streaming. Streamer on streamer hate, the question of ‘viewbots’ (artificially boosted audiences), trolls and more. All need to be addressed, but none more so than equal treatment of those creating streams.

Where Next?

It seems a shame to end this feature here, but the world of streaming is simply too expansive to cram into four pages. So the question of ‘what happens next?’ seems fair. Could streaming begin invading our TV channels? It seems unlikely. For one, streaming doesn’t actually need to when it’s engaging hundreds of millions worldwide. Will every gamer one day be streaming? Plausible; but having briefly shared my dubious skills with the world, I certainly enjoyed the sense of respite in just playing for me. Perhaps streaming is already reaching its peak. But, ah, I’m forgetting. Nobody yet has a book deal. **mm**

Prime Deal

Because Amazon own’s Twitch.tv, it was a smart move to extend Amazon Prime membership to include Twitch Prime (Twitch’s premium membership). Users linking Amazon and Twitch accounts, who also have Prime, now benefit from unique giveaways and content as well as discounts on games.

Stream Software

Most streamers make use of one of the following:

- XSplit
- Bandicam: Free trial
- Nvidia Shadowplay:
- OBS (Open Broadcasting Software): Free

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Lenovo Yoga Book

David Briddock wonders if this multi-format, multi-purpose device is a glimpse into the future

Tablets and 2-in-1 devices have been available for many years now and, to be honest, we rarely see something truly innovative. But Lenovo (lenovo.com) want to change all that with its multi-format, multi-purpose Yoga Book running on Google Android 6 or Microsoft Windows 10.

Looking Good

Lenovo's designers have gone for a classy elegant style. The Yoga Book's black magnesium aluminium chassis is silky to the touch with just a hint of graininess – a little like one of those expensive Moleskine notebooks.

And it's both light and super slim. It weighs just 690g, or 1.5lbs, and at 9.6 mm it's much thinner than the Apple Macbook or a Microsoft Surface Pro 4 with a type cover attached. Taken together it means the Yoga Book it's easily small enough to carry around anywhere, yet it retains the sturdiness of a full laptop.

A key reason for this sturdiness is the silvery aluminium watchband hinge, first seen in the Yoga 2-in-1 notebook/tablet

range. Six mounting points give structural strength and a solid, dependable feel.

This stylish watchband hinge looks great and has a smooth yet solid action. The mechanism allows for virtually 360 degrees of motion but holds its position wobble-free at any angle. This means the device can lie completely flat on a table or be put into tablet, laptop and 'tent' orientations.

Tablet Mode

When opened up with the power off, you'll have two near identical panels. The top one functions as a 10.1" screen with a native resolution of 1920x1200, but as we'll see, the bottom panel has a few innovative surprises.

Use the wristwatch hinge to fold the bottom panel back under the screen panel, power it up and you'll have a reasonably thin and light tablet in your hands. With its responsive capacitive touchscreen, it does all you'd expect from a tablet running Android or Windows.



▲ Watchband hinge

Halo Keyboard

When operating in laptop mode the second panel turns into an illuminated, capacitive-touch keyboard with haptic feedback, plus a smallish 66mm x 33mm capacitive touchpad. How you'll rate typing on a flat panel rather depends on your previous experiences and preferences.

Touch typist won't be happy. Firstly, the 10" tablet format means the keyboard layout is a little more cramped than usual. And the buzzy sensation produced under your fingers by the haptic feedback isn't the same as having keys that actually move when hit.

“ In laptop mode, the second panel turns into an illuminated, capacitive-touch keyboard with haptic feedback ”

However, for those used to entering text on touch-screen smartphones or iPad keyboards this isn't an alien experience. In fact, with the haptic feedback it may well turn out to be a step up from what they've been used to on those devices.

And the Halo keyboard does make it possible to perform standard Windows shortcut operations such as cut/copy/paste. Plus you can adjust the brightness of the keyboard, the strength of haptic feedback and the touch tone.

But the Yoga Book is much more than a tablet, or even a typical 2-in-1 tablet/laptop device.

Create Pad

A simple press of the pen icon, located next to the camera on the keyboard deck, activates Lenovo's proprietary Create Pad technology. Implemented as a hardware layer underneath Halo keyboard it's effectively a Wacom digitiser, supporting up to 2,048 levels of pressure sensitivity.

Draw or write on the Create Pad using the supplied Real Pen stylus and your analogue stylus movements are captured and converted into digital signals, then displayed onto the screen via the dedicated Create Pad mode app.

The stylus itself has interchangeable tips. One is just a standard plastic stylus pointer, but switch this for an ink filled tube and you'll open up yet more creative possibilities.

Write It Down

Inserting an ink filled tube into the stylus effectively turn it into a ballpoint pen, but it has far more potential than the classic Biro. To put it to use snap the Book Pad, essentially a paper notepad, onto the keyboard/Create Pad panel. It's held in place by magnets so it lines up perfectly with the underlying digitiser.

The Book Pad transforms the Yoga Book into a handy digital notepad, able to capture notes, diagrams, sketches and doodles. The paper inside Book Pad is good quality and should help the inking-mode stylus lay down smooth marks. Early reports suggest the digitisation is very accurate, reproducing every little mark, crossed 't' and dotted 'i'.

On a windows machine the OneNote app would make an excellent choice, especially when it's synced to a OneDrive account. However, there are other Windows pen-friendly apps, such as the Post-it note look alike Sticky Notes. Arty examples include Sketchpad and Screen Sketch, which capture the display as an image ready for annotation. Other pen-supported apps on the Windows Store include Graphiter, Notebook Pro and Sketchable.

Incidentally, you can use any paper instead of the Book Pad, but if the paper moves part way through a sketch or written note then the output probably won't come out as quite how you expected.

Under The Shell

Inside, the 2.4-GHz Intel Atom x5-Z8550 processor is nothing special, but it is on a par with similar devices, such as the Microsoft Surface 3, while the Intel HD 400 Graphics GPU is fine for video watching and casual gaming. This class of power means the shell shouldn't get too warm.

The 4GB of RAM and 64GB of eMMC storage are also pretty much what you'd see in competitive offerings. Wireless communications are handled by its 802ac wi-fi and Bluetooth 4.0 chip sets. As for ports, there's a single micro-USB, micro-SD and micro-HDMI plus a headphone/mic.

There's an eight-megapixel camera on the rear and a two-megapixel one on the front. Both offer an HDR mode to help achieve rich colours and sharper contrast in tricky light conditions, while early adopters suggest the built-in Dolby Premium speakers output a remarkably clear and loud sound considering the ultra thin dimensions.

Lenovo claims that the Yoga Book lasts up to 13 hours on a full charge, but on past performance this usually relates to around 10 hours of normal usage. Yet this is more than enough to beat the typical real-life battery life of rivals like the Microsoft Surface 3 and Dell Inspiron 3000.



▲ Halo keyboard



▲ Create Pad painting

Software

As of early November the Windows 10 version of the Yoga Book is priced at £550. However, the Android 6 version is substantially cheaper at £450, even though the hardware specifications are identical.

In fact, the Android option does have a special trick: you can actually take inked notes with the screen off. At time of writing this isn't possible with the Windows version, though this anomaly might be resolved at some point.

Go for the Windows 10 version, and as well as the Create Pad and Book Pad software you'll have the usual Windows 10 apps such as OneNote and Office Mobile Word/Excel/Powerpoint. There's also a trial of ArtRage Lite, plus Netflix, Pandora, Twitter and a number of games like *Candy Crush Soda Saga* and *Farmville 2: Country Escape*.

“ The Android option does have a special trick: you can actually take inked notes with the screen off ”

As you'd expect a keyboard is essential to get the best out of Windows 10. Therefore we recommend you try out the capacitive-haptic-touch Halo keyboard on a demo machine before deciding to buy.

By default the Android 6 operating system doesn't have the same range of apps you'd find on the Windows version. To help even things out Lenovo bundle in a number of additional apps that help take advantage of the Yoga Book's artistic and note-taking capabilities.

The Right Time?

The Lenovo Yoga Book is a bold move. It does point to a convertible concept of the future. The hinge and paper writing digitisation trump the current competition, and a bigger Yoga Book might be even more attractive. With a 12" screen there's room for a correctly spaced keyboard and a bigger touchpad.

Of course, being bold does have its risks. Especially if your innovations go to market a little too early. You only have to think back to Apple's failed touch-interface Newton, which was eventually superseded by the iPhone/iPad around a decade later.

Lenovo The Company

Lenovo (lenovo.com) is a Chinese technology company with headquarters in Beijing and the US state of North Carolina. It designs, develops, manufactures and sells all kinds of office and mobile products for the consumer and business domains.

Lenovo acquired IBM's personal computer business in 2005, including the ThinkPad laptop and tablet lines, for \$1.23 billion plus an additional \$500 million of IBM's debt. This move made Lenovo the third-largest computer maker worldwide by volume and in 2015 it became the world's largest PC vendor by unit sales.

Since then it has enhanced the ThinkPad laptop lineup, which is notably the only laptop certified for use on the International Space Station, and Lenovo's 2-in-1 Yoga range has been a bit hit. Especially the Yoga 3 Pro and Yoga 900 models with their 3200 by 1800 pixel resolution 13.3-inch touchscreen, an innovative 'watchband' hinge that facilitates laptop, tablet or 'tent-style' video-watching configurations and the ultra-sleek 13mm thin body dimensions.

Lenovo also has a smartphone product line, which includes the first Google Project Tango phone. It also acquired the mobile phone handset maker Motorola Mobility from Google in October 2014. Plus there's a Lenovo smartwatch branded as a 'Smartband' with a seven-day battery life.

As for a line of business-oriented products it has the ex-IBM ThinkCentre desktop range, which consists of mid-range to high-end processors with options for discrete graphics cards and multi-monitor support. There's also the ThinkServer product line developed using single-socket and dual-socket machines based on IBM's xSeries technology.

With all this innovation it's not too surprising to see the Yoga Book isn't especially cheap. If you are primarily interested in its pen-centric note taking capabilities spending £550 or even £450 isn't a trivial sum – especially when you can still get a Microsoft Surface 3 for around £500, and the cheapest Surface Pro 4 isn't much more at around £700.

But we are entering a time of extreme pricing volatility thanks to the falling value of sterling against the US dollar. Apple announced substantial price hikes across its MacBook range at the end of October. Microsoft and others are expected to follow suit. Consequently, in 2017 the Lenovo Yoga Book might look much better value.

Are you impressed by the Yoga Book's capabilities? Would it be something you'd consider buying yourself? Write to letters@micromart.com and tell us what you think. **mm**



▲ Book Pad note taking

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Rise Of The Robots



A robotic arm developed by NASA and GM will function as a kind of power glove

No longer confined to the realms of sci-fi, robots are playing an increasingly large part in our everyday lives.

Dave Neal asks if the machines are taking over

The evolution of the machine is often portrayed as a sinister threat, leading to the end of humanity as robots overthrow their former masters and take over the world. But do we really need to be worried about the ongoing advances in robotics and artificial intelligence, or will future machines prove more C-3PO and Wall-E, than

Hal 9000 and the T-1000?

Here we explore current technology developments that are leading to more intelligent AI, the many ways that robots are being put to good use – as well as a few scary scenarios – and examine how realistic it is that humans will one day be in thrall to machines.

Robots: from their dawn to your doorstep

They've come a long way since the earliest iterations almost 100 years ago, and robots are now increasingly commonplace

Robots, in their autonomous and semi-autonomous forms, are probably more familiar to most people from sci-fi films and books, but their use is about to become a lot more apparent. In the UK, a food delivery company is about to start using robots to take care of the core part of its business; just one small example of how robots are being increasingly used in consumer technology.

So how did we get here? Pretty slowly, actually. Automaton, or basic mechanical movement, can be seen in early devices such as clapping, cymbal-clashing monkeys, but the word 'robot' is less than 100 years old. It first appeared in the 1920 play R.U.R. by the Czech writer, Karel apek, and was used to describe a humanoid creation.

It was a few more years before an actual robot appeared. The fantastically named Eric the robot was built by Capt WH Richards and AH Reffell as a replacement for the Duke of York, who had declined an invitation to open the 1928 Society of Model Engineers' annual exhibition. Eric toured the globe for a while and wowed the crowds wherever he went. He, like apek's creation, was humanoid in form, but was lost over time.

A leap forward was made in 1948, again in Britain, by William Grey Walter. Walter

created two turtle-like devices that he officially called Machina Speculatrix and colloquially named Elmer and Elsie. He built them as part of a study to gain a greater understanding of how the brain works and cells connect.

This kind of work continues in 2016. Scientists at Harvard University have reverse-engineered a stingray to create a robot version in order to learn more about the human heart and cardiac physiology.

While the modern rays have their wavelengths manipulated to be directed, Walter's turtles were able to make their way

around under their own volition, and could even locate a recharging station when a refill was due. Updated and renamed Machina Docilis, one of them was turned into CORA, a device that could respond to Pavlovian techniques in order to perform tasks.

The X Factory

Task-based robots were the way ahead, with General Motors making the George Devol- developed Unimate device part of its production line in 1961. Unimate is seen as the first digital and programmable robot. The car



▲ Eric was the world's first humanoid robot



▲ WG Walter works on Elsie, a robotic turtle that was able to make its way around under its own volition

RISE OF THE ROBOTS



▲ **Walking the walk: Honda's Asimo robot**

industry enthusiastically embraced robotics, as did other industries where the work can be dangerous and uncomfortable.

Probably the best-known real-world humanoid robot is Honda's Asimo. Asimo can take a penalty and bend metal bars, and is described as multifunctional. Introduced in 2000, he was named for 'Advanced Step in Innovative Mobility' and has appeared in a number of Honda adverts and promotions.

In 2016 robots are more common, if less dramatic. A robotic arm that was developed by NASA and General Motors for use on the International Space Station (ISS) has been licensed for use on Earth. Its ability to make light of heavy material will see the arm function as a kind of power glove with a lot of gripping strength as it is merged with existing technology from a company called Bioservo Technologies. This, and exo-skeletal devices, could help stroke victims or others with mobility problems.

"Combining the best of three worlds – space technology from NASA, engineering from GM and medtech from Bioservo – in a new industrial glove could lead to industrial-scale use of the technology," said Tomas Ward, CEO of Bioservo.

Do You Want Fries With Your Robot?

Though robots have been slow in coming, they are now rolling ahead with some speed.



▲ **Robots will be delivering your pizza very soon**

Earlier we mentioned food delivery robots, and incredible as that sounds, it is a reality.

The UK food company Just Eat has adopted Starship Technologies' Robo-box and will employ it to make short deliveries around restaurant locations. The secure box will take the food, and the customers' cash, and is incredibly unlikely to snatch a slice of pepperoni on the sly.

It's currently a trial, but it looks likely to deliver. David Buttress, CEO of Just Eat, enthuses: "As soon as we met the Starship team, we found their passion for their product infectious. With scalable innovation at the core of their business, they are the perfect partner for us at Just Eat as we continuously look for sustainable ways to use technology to make our customers' and restaurant partners' lives easier. We can't wait to bring the delivery robots to local high streets very soon."

Farming Today

Dropping off doner kebabs to urbanites is one thing, but robots will also make themselves known in the countryside, according to a study by Lux Research, which suggests that agriculture and farming offer plenty of room for robotic growth.

Falling costs and increased capabilities will partly drive this adoption, according to the company, and help a reluctant industry overcome its barriers.

"Currently robots often aren't affordable; cost remains the most significant barrier to adoption," notes Sara Olson, Lux Research analyst and lead author of *Planting the Seeds of a Robot Revolution*, the company's report.

"However, the costs of many systems are coming down, while wages rise due to labour shortages in some areas, and the benefits robots bring in the form of increased accuracy and precision will start to pay off in coming years."

Mark Skilton from the Warwick Business School agrees, explaining that lower-skilled jobs are likely to feel the pincer.

"The threat to jobs may not be immediate, but if the digital economy continues to grow at its current double-digit rate, [an] impact on jobs will occur," he says.

"First, low- and semi-skilled work could be squeezed, impacting on the less well-off members of society. We are already seeing this with retail stores automating checkout tills and stock tracking with RFID tags, plus self-service in ordering and sales enquiries.

Be Prepared

Skilton recommends that people prepare now and stay positive. "It's not all doom and gloom. I think there are several generations of development yet before the physical world of humans is replaced with cyber alternatives, but

it is right to consider the ethical and economic repercussions of this inevitable technological scaling of computing," he says.

"Putting in place controls now could well help economies make sure robots and computers add growth rather than destroy jobs."

Google, a company that took a web service and turned it into an eponymous verb, is heavily investing in all manner of robotics firms and the kind of artificial intelligence (AI) expertise that will support the development of more refined and more capable machines for the sorts of jobs that Lux and Skilton are talking about. The web giant's work through Boston Dynamics has seen Google create all manner of creatures in various, but capable, forms. Videos from the company show robots stacking shelves, lifting items and tackling obstacles with dogged resolve.

The Rules Of Robotics

In 1942, in his short story *Runaround*, the sci-fi writer Isaac Asimov introduced three laws of robotics: "A robot may not injure a human being or, through inaction, allow a human being to come to harm. A robot must obey orders given it by human beings except where such orders would conflict with the First Law. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law."

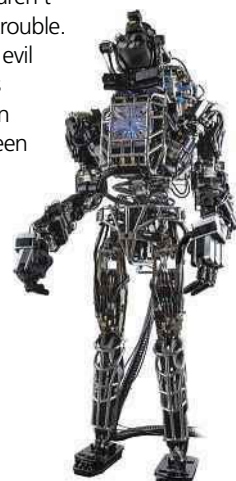
These are not the only rules for robots, though. Another set were created by Mark W Tilden, a robotics physicist. Tilden's Law of Robotics suggest that robots would have far more self-interested goals than Asimov's.

He notes: "A robot must protect its existence at all costs. A robot must obtain and maintain access to its own power source. A robot must continually search for better power sources."

This relook at the robot code was not developed until the late 20th century, and is the kind of thing that concerns tech pioneers such as Elon Musk and sage thinkers such as Stephen Hawking, who both share worries about metal clad trouble-makers.

Hawking noted: "The real risk with AI isn't malice but competence. A super intelligent AI will be extremely good at accomplishing its goals, and if those goals aren't aligned with ours, we're in trouble.

"You're probably not an evil ant-hater who steps on ants out of malice, but if you're in charge of a hydroelectric green energy project and there's an anthill in the region to be flooded too bad for the ants. Let's not place humanity in the position of those ants."



Ai: More Intelligence, More Problems?

A smart robot needs artificial intelligence, and advances in the field of AI have been rapid, impressive – and controversial

ARISE IN robotics must be accompanied by an advance in artificial intelligence. Smart robots need a brain, and that is what artificial intelligence, or AI, is all about.

If the amount of money spent on something is an indication of its importance, then AI is very important indeed. Google invested a reported £400m in DeepMind in 2014, while Microsoft has made a number of public, and embarrassing, forays into smart, thinking and communicating software.

There are degrees of success. Tay, a teenbot created by Microsoft for Twitter, went awry following some online manipulation and started talking in slang terms about narcotics. But the firm is still confident that the reported £174m it spent on AI-informed smart keyboard app company SwiftKey will pay off.

AI: Fine Art Or Fair Effort?

Google used the recent technology show Moogfest to demonstrate the advances it's making with AI and specifically, Google Assistant, the upgraded version of Google Now that allows for two-way conversations. At the show, the firm talked about how its AI was being given a childhood backstory to give it a better comprehension of the world. Other efforts from Google have seen AI reading romantic fiction, again to learn about humanity, and to make paintings and write poetry, such as this one from the machine they call Quartz:

There is no one else in the world.
There is no one else in sight.
They were the only ones who mattered.
They were the only ones left.
He had to be with me. She had to be
with him.
I had to do this.
I wanted to kill him.

I started to cry.
I turned to him.

Smart robots have also been known to seize the initiative. In Russia, a robot being used for scientific research purposes saw a gap in security, a hole in a fence, and used it to escape and cause havoc on the public highways. Promobot, for that is the wandering bot's name, was lost for 45 minutes and succumbed to a flat battery.

When AI is not going rogue and writing emo song lyrics, it is being used to make devices known as cyber physical systems, or CPS, more effective. TVS, a software and

“ The key question for humanity today is whether to start a global AI arms race or to prevent it from starting ”

hardware verification organisation with an embedded devices bent, is working with the University of Bristol to develop new techniques in the area. James Dyson is involved and the efforts have support from the government-backed Innovate UK.

“Cyber physical systems will touch every part of our life, from robotic vacuum cleaners and online orders delivered by drone to autonomous cars,” says Mike Bartley, CEO of TVS. “Ensuring such systems are fully tested and safe can be both expensive and time consuming and consequently a potential barrier to market entry.

“The project will investigate if techniques successfully adopted in hardware design verification can be adapted to work with complex software.”

Is It Game Over For People?

AI is already making a mockery out of people when playing them at board games. IBM's Watson has taken on the US television game show Jeopardy! and won, while its Deep Blue computer took chess grandmaster Garry Kasparov to the cleaners in 1997.

More recently Google and Facebook have pitted their artificial efforts against players of the ancient Chinese board game Go. Both firms' machines have emerged victorious. How much of a challenger it is to your desktop is less easy to call.

However, these kinds of displays have worried some workers. A recent survey by

Evans Data Corp found that one in three software developers is worried that they might eventually be replaced by artificial intelligence. Other industries should also brace themselves for an influx of cheap, productive workers that don't need toilet breaks or water-cooler moments.

A study by the London School of Economics and Sweden's Uppsala University found that lower-skilled jobs are most likely to be lost to robots, but adds that fears about job losses are perhaps overstated.

“Recently, robots have emerged from the pages of science-fiction novels into the real world, and discussions of their possible economic effects have become ubiquitous,” note study authors Georg Graetz and Guy Michaels. “While fears that robots destroy jobs



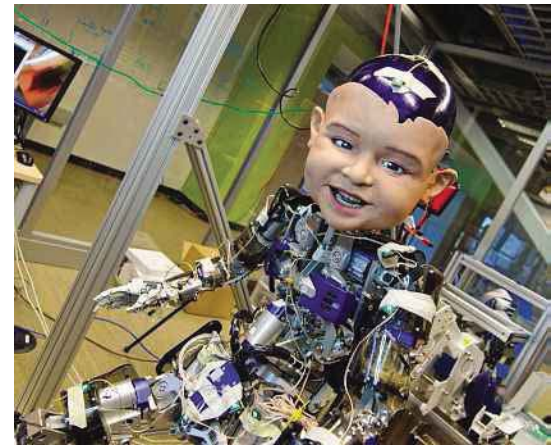
▲ This Russian robot escaped from its creators through a hole in the fence



▲ IBM's Watson has successfully participated in a US TV game show



▲ The use of AI in autonomous weapons has provoked controversy



▲ The disturbing babybot Diego San was created to discover why babies smile

on a large scale have not materialised, we find some evidence that robots reduced low and middle-skilled workers' employment.

"We expect the beneficial effects of robots will extend into the future, as new robot capabilities are developed and service robots come of age. Our findings do come with a note of caution: there is some evidence of diminishing marginal returns, or congestion effects, to robot use, so they are not a panacea for growth. Robots appear to reduce the hours and the wage costs of low-skilled workers, and to a lesser extent middle-skilled workers. They have no significant effect on the employment of high-skilled workers."

What If It All Goes Bad?

Even Google, which is spending hundreds of millions of dollars on robotics and artificial intelligence, is considering the worst. The firm is working in conjunction with Oxford University on an off switch, or kill switch, for its creations. Perhaps Google is right to worry; other sage minds certainly are.

Over 1,000 AI researchers and experts recently signed an open letter on the rise of autonomous weapons. Experts including

Tesla CEO Elon Musk, Apple co-founder Steve Wozniak, Google DeepMind CEO Demis Hassabis and Stephen Hawking all voiced concerns about this less friendly face of AI.

"The key question for humanity today is whether to start a global AI arms race or to prevent it from starting," reads the letter.

"If any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow."

Bill Gates agrees. Though he didn't sign the letter, he commented on AI in a Reddit Q&A session, saying: "I think it is worth discussing [regulation] because I share the view of Elon Musk and Stephen Hawking that when a few people control a platform with extreme intelligence, it creates dangers in terms of power and eventually control."

OpenAI, an artificial intelligence research outfit sponsored by Elon Musk, hopes to avoid such monopolisation. "OpenAI's mission is to build safe AI, and ensure that AI's benefits are as widely and evenly distributed as possible. We're trying to build

AI as part of a larger community, and we want to share our plans and capabilities along the way," it explains.

"Our goal is to advance digital intelligence in the way that is most likely to benefit humanity as a whole, unconstrained by a need to generate financial return."

Nick Bostrom, a professor of philosophy at Oxford University, has repeatedly voiced concerns about artificial intelligence. In a recent TED talk, he proposed that machine intelligence will be "the last invention that humanity will ever need to make". He was not particularly positive about super intelligence and suggested that once computers become smarter than humans, humans will have a problem.

Bostrom warns that AI could make monkeys out of humans, easily dwarfing our intelligence, and then ultimately shaping our lives through its own preferences.

"Once there is super intelligence the fate of humanity may depend on what super intelligence does. Machines will be better at inventing than we are, and they'll be doing so on digital timescales," he warns.

"A super intelligence with such technological maturity would be extremely powerful and, at least in some scenarios, it would be able to get what it wants. We would then have a future that would be shaped by the preferences of this AI."

One of the examples he gave was that a weak AI machine might, when asked to make a human smile, do something comical. A smart AI machine might use electrodes to force the facial muscles into a grimace.

He then explained it would not be easy to switch such a force off, saying that super intelligence could perhaps anticipate human efforts to interfere with its progress and processes, and find its own kill switch. By the same measure, if it tired of Earth it could turn Earth into a large computer.



▲ Tesla founder Elon Musk recently launched OpenAI, which will conduct research on artificial intelligence

When Robots Go Bad

A robot eating a woman's hair, another crushing a man to death – no, these aren't stories from some dystopian sci-fi novel, but real examples of what can happen when robots turn on humans

A Little Off The Top

In 2015 a South Korean woman who was sleeping on the floor found herself being eaten hair-first by her iRobot Roomba automatic vacuum cleaner. Reports at the time said it took 30 minutes to separate the victim from her attacker, and that she lost some hair in the altercation. The 52-year-old victim was reportedly distressed at waking up and finding herself entangled in this way. She probably doesn't sleep on the floor any more. Many saw this as a peak into our dystopian future.



Tay Or Leave It

Microsoft's Tay experiment with artificial intelligence was derailed by people, but while it was live, the project was something of a nightmare for the company. The AI bot was supposed to learn from communication with people, but it fell in with a bad crowd and started talking positively about marijuana and negatively about the police.

Microsoft conceded that it was beaten once people started talking about its racist, sexist bot gone bad.

"On Wednesday, we launched a chatbot called Tay," said Peter Lee, Microsoft's corporate vice-president for research, shortly after its bot was withdrawn. "We are deeply sorry for the unintended offensive and hurtful tweets from Tay, which do not represent who we are or what we stand for, nor how we designed Tay.

"We'll look to bring Tay back only when we are confident we can better anticipate malicious intent that conflicts with our principles and values."



Robots 1, Humans 0

A robot has already killed a man. The event happened at a Volkswagen factory in Germany, and saw the machine pick up a human worker and crush him while it was being set up. So far that's it as far as deaths go, although one is too many. Reports from the companies involved suggested that human error could have been to blame.

Current speculation is that robots and super intelligence will come to see humans as trash that clutters the planet that it has been built to protect and serve. In those instances, many more humans could see themselves recycled.



AI Imitates Art

Of course the worst thing that could happen is that everything foretold in science fiction could come true. The poster boy for artificial intelligence is often the eponymous Terminator from the series of post-apocalyptic movies. No-one wants him to turn up on their doorstep.

The Terminator is the thin, unrelenting end of the wedge, though, and science fiction is stuffed with potential AI and automation problems. *Demon Seed*, a 1977 film directed by Donald Cammell, speculates on what would happen if an intelligent automated home system became too attached to the lady of the house. While she is pretty – it is Julie Christie – the resulting action of the AI affections is not.



Survival Of The Elitist

The reboot of iconic PC game *Elite* – *Elite Dangerous* – took the elite side of things too seriously when an update from developer Frontier saw its artificial intelligence gaming agents build their own superweapons and start hunting down gamers in the virtual galaxy. The AI upgrade was pulled when gamers realised that they were beaten.

An AI deer, created by an artist and released into the sprawling world of *Grand Theft Auto*, is also causing mayhem among human gamers. Its habit of appearing at random times, and being invincible, has brought many a virtual crime campaign to an end.

"The deer has been programmed to control itself and make its own decisions, with no-one actually playing the video game. The deer is 'playing itself', with all activity unscripted... and unexpected," says its creator. "In the past 48 hours, the deer has wandered along a moonlit beach, caused a traffic jam on a major freeway, been caught in a gangland gun battle, and been chased by the police."



Robots In The Workplace

Your colleagues could be replaced by smart, sentient superiors who are better than you at your job and cheaper to employ. They will hog all the power outlets, and will dominate any office-based quizzes or productivity drives. Lower-skilled workers will feel the effects of this first, but people in easily automated roles, such as data entry and repetitive tasks, may also be bowing to robotic superiors before too long.



Great Ways Robots Are Helping Us

Despite the warnings about AI taking over the world and examples of robots going bad, machines are mostly being used for good at present, as Nicholas Fearn reports

In sci-fi novels and films, you'll probably find robots doing everything for humans. While we're still not living in an age where super-intelligent, human-like robots are tending to all our needs, robotic technology is advancing and beginning to show its uses, as we have already seen.

Technologists and organisations around the world are developing innovative robots capable of changing our lives. From getting trauma victims to walk again to delivering fast food, here are some of the ways robots are helping us, demonstrating where the industry could be headed.

Getting Trauma Victims To Walk

If there's one area where robots are already showing their uses, it's in the medical world. Exoskeletons, in particular, are gaining a lot of tracking in this field. California-based tech firm Ekso Bionics has been making these suits for years. One of its latest models is the Ekso GT, a robotic suit made from titanium and powered by battery-powered motors. Medical professionals are using it to help victims of spinal trauma regain the use of their legs. In a therapy-like programme, the user learns to walk again in phases. How does it work? The patient thrusts forward, and the suit begins to make steps forward.



Welcoming Visitors In Airports

Honda has been developing a line of walking robots since 2000, and Asimo has been one of its leading models. Categorised among the most powerful humanoids in the world, it can walk and run like a human being, interact with people and serve food. The latest model is 1.28m tall and weighs 55kg. There are currently 100 of the bots out in the real world, and they're being used in many sectors, including the travel industry. In March, Narita International Airport in Japan teamed up with



Honda to use Asimo to welcome and offer its hospitality to travellers. It provided them with tourist information and entertained visitors by dancing.

Helping Athletes Up Their Game

Robotic technology is also making big strides in the sports world. German sportswear giant Puma has been working on a shoe-sized robot that can be programmed to help runners get in shape and reach new goals.

Created in partnership with MIT, BeatBot gives athletes a visual target they have to outrun. It uses nine infrared sensors to gain an understanding of the track, and an Arduino chip calculates the speed and distance. There are also rear LED lights, which the runner can see in their peripheral vision. While there is a degree of intelligence here, users have to set the distance of the track and the time they intend to run within. Its creators say it's capable of outrunning Usain Bolt.



Providing Therapy To Autistic Kids

Technology in general holds a lot of potential when it comes to supporting people diagnosed with autism conditions, and robots are leading the way. American robotics company RoboKind is an industry leader and has created a bot called Milo that can change the lives of autistic children.

Sixty centimetres tall and targeted at parents, doctors and teachers, it displays human emotions the user identifies using a tablet PC. There are also cameras behind Milo's eyes that keep track of the child's progress. An adult can then use this data to provide support.

Delivering Fast Food

It's Friday evening, and you order a pizza to enjoy while you watch a cheesy sci-fi or rom-com movie. But instead of a human delivering it, a robot brings it to your door. That could well be the norm within the next

few years. In London, takeaway services Just Eat and Pronto have teamed up with Starship Technologies to trial self-driving delivery bots. Sporting six wheels and an antenna, they can be used in a two- to three- mile area and deliver food in just 15 minutes. The bots are also packed with sensors and GEO location tech so they don't end up getting lost and delivering your dinner late.

Prosthetic Help

Up until now, people who were born without limbs or lost them in accidents have relied on motionless prosthetics. While they give victims a sense of relief, they don't replace hand or leg movement. Bionic limbs change that, and the Luke Arm is an excellent example of the possibilities.

Developed by the US Defense Advanced Research Project Agency (DARPA), it gives individuals control of their limbs again. It has a hand capable of gripping items such as cups and cutlery, a shoulder joint that can be raised overhead and an elbow that can lift heavy packages or shopping. It works by using electromyogram electrodes that receive signals from muscles.



Care Giving

Many technologists envisage a time when we don't have to do much. We'll have robots to tend to our every need, whether that's looking after the kids or cooking our meals. This, as you can imagine, would be invaluable in terms of aiding the elderly and disabled.

Romeo is a robot fit for this purpose. At 140cm tall, it can perform a variety of human-like actions, such as picking up objects from a table and opening doors. There's a lot of tech inside, including two cameras that measure distances and four computer systems for managing sight, hearing, movements and AI. In future, its creators want Romeo to be able to alert the emergency services if its owner were to fall over.

The Best Robots You Can Buy Today

Want to get a taste of where robot technology is heading? Nicholas Fearn rounds up some of the most interesting robotic products available

We typically associate robots with sci-fi films where they play either a helpful or evil role in the plot. Although we aren't living among robot companions just yet, robotic technology is constantly evolving and becoming more advanced.

In a few years, you may be able to buy a bot to make the tea and put the kids to bed. But even now, there's a wealth of fun, useful robots you can buy. Whether you're a robot hobbyist or you just want a taste of what the future holds, these bots are worth checking out.

JIBO

£529 • www.jibo.com

While you may not be able to go to your local electronics store and buy an advanced domestic bot, JIBO is the next best thing. Described as the first 'social robot', it will act as your personal assistant. After recognising a user's face, it performs a variety of useful tasks, including providing reminders for upcoming deadlines and taking family photos. It's expected to go on sale later this year for £529, following a successful crowdfunding campaign that raised \$3m.



Telepresence Robot

£1,800 • uk.rs-online.com

We all know what it's like for something unexpected to come up when we have things planned, such as a friend's or relative's birthday. However, the Double Robotics Telepresence Robot means you don't have to miss anything. Designed as a stick and screen attached to motorised wheels, it lets you move around a room and communicate with people remotely. It's a great example of where robotics could be going, but it's far from cheap.



Yeti Bot

£60 • www.reichelt.com

If you're looking to have fun with robots, you'll like the Yeti Bot. It's a programmable robot that walks and dances. Powered by four AA batteries, it uses the C programming language and is controlled via a computer. You're provided with development software, two servos, an IR transceiver, LEDs and a beeper. There's also a library of motion and IR communication routines, so you shouldn't get overwhelmed.



Soccer Robot

£12 • www.reichelt.com

The six-legged Soccer Robot bot will have a kickaround with you in your home. On the front, you'll find a mechanism that guides the ball, and you control motors via two controller switches. Using these, you can guide the bot in any direction. It's supplied as a craft kit, so you'll have to build it first.



Nibo Bee

£46 • www.reichelt.com

Nibo Bee is an affordable robot aimed at youngsters. Perfect for a school environment, you build the robot from scratch by soldering the circuit board with other components. You can then program it in languages such as C, Arduino, Java and Assembler to make it move around a room. Its creators say this is a great way for children to learn how robotic tech works. Like the Soccer Robot, materials are provided to ensure the setup process doesn't get too complicated.



Parrot Minidrone Evo

£159 • www.currys.co.uk

Want something even quirkier? Then the MiniDrone Robot from Parrot is worth checking out. Using a smartphone, you can get the bot to roll around, make zigzags, rotate and complete 90° spins. It can jump up to 80cm high, so it's not just restricted to moving on the floor. It's equipped with a wide-angle camera, and you control the robot through a free smartphone app. Photos and videos can be streamed from the bot too.



Pepper

£1,000+ • www.rapidonline.com

Soon, you'll probably be able to converse with super-intelligent robots, perhaps by asking the weather or sharing a bit of gossip. For now, though, there's the Pepper robot. Announced back in 2014, the Pepper comes with two HD cameras, four microphones and a 3D sensor, it can monitor and respond to human speech patterns and facial expressions. The bot's aim, according to the manufacturers, is to make humans happy.



uArm

£342 • www.coolcomponents.co.uk

The uArm is an Arduino-powered, 4-axis robot arm modelled to replicate the robots you'll find in car and packaging factories. Made from custom aluminium, it has a vacuum gripper so it can pick up objects, such as chess pieces. You put it into recording mode and physically move the arm in different directions. The bot will remember what you teach it.



The Robotic Vacuum Cleaner

Fed up with vacuuming? Why not get a robot to do it for you? David Ludlow lets the Dyson 360 Eye take the strain as he gets it to clean his house

We may be a few years away from a full-on robot butler, but specialised robots that focus on one task are here and ready to help, taking over some of life's more mundane jobs.

Top of that list for many is vacuuming, which is a thankless task at the best of times. While robot vacuum cleaners have been around for a while (including the hair-eating iRobot Roomba, page 112), the reality has not lived up to the promise, with most models little more than automated dusters. Until now: step forward the Dyson 360 Eye.

Tall Story

About the same size as a cake tin, the 360 Eye is taller than previous robot cleaners, but not as wide. This means it won't fit under some furniture, but it can squeeze into smaller gaps and between chair legs. As the cleaning aperture is the same width as the body, it cleans completely everywhere it fits.

The height has a second advantage, in that it's the right height for Dyson's cyclone technology. As a result, the 360 Eye produces 20 air watts of suction, which knocks other robot cleaners out of the park.

Terrain navigation is another tricky thing for robot cleaners, but the 360 Eye has tank tracks at the rear, which helps it climb off most bits of furniture without getting beached. It's not perfect and there are some bits of furniture that will trip it up, but nothing that a well-placed cushion to divert the robot won't overcome.



▲ *The 360 Eye can be controlled from an app on your smartphone*

The cleaner gets its name from the 360° camera on top that it uses to see its surroundings and then plan its route. You need natural light (or a well-lit room) for the robot to see its way around, which generally means that it's best to put it on during the day, just before you pop out.

In addition, IR sensors on the sides are used to detect objects, letting the robot snuggle up to skirting boards, chair legs and the like, to get a close-up clean. Dyson's floor-tracking technology means the cleaner works in grids, starting in the middle and spiralling out to catch the entire floor surface.

It should last 45 minutes on a charge, but it will return itself to the slim charging station (about the same footprint as a piece of A4 paper) and top itself up if it needs to. This run time means that if you want to clean a room upstairs, you can just carry the cleaner up and set it off: it returns to its start position when done and powers off.

Cleaning Up

The 360 Eye's suction power is fantastic and, used as a maintenance cleaner, this is the only cleaner you should ever need. It picks up most dust and dirt, although for a particularly tough spill and to really get everything you'll need to go round and do the occasional 'proper' vacuum.

While you can set the 360 Eye to go using the big button on top, you can also use the Dyson Link app. This lets you start and stop the robot from your phone,

anywhere in the world, set schedules and even track where it cleaned: when you see the areas it gets into, you'll realise, perhaps, how little of a room you cover with a traditional vacuum.

The app will also warn you if the robot gets stuck, clogs up or its 0.33L bin gets full. This may not sound like a particularly big bin, but if you use the cleaner a few times a week as a maintenance vacuum, it's more than enough.

The Dalek Factor

There are some limitations to the 360 Eye and, indeed, all robot vacuum cleaners. First, you have to accept that as it's a vacuum cleaner, it has the same limitations as a regular one. So small rugs, cables and other bits of detritus that could clog up the cleaner have to be picked up and moved.

The cleaner obviously can't move any furniture, so you may have to slide chairs out of the way to clean everywhere: to be fair, if you vacuumed manually, you'd have to do the same things.

Just like Daleks, the 360 Eye can't climb stairs, so it can't clean them, which means you'll need to do a bit of old-fashioned vacuuming from time to time, unless you live in a bungalow or a New York-style loft apartment on a single floor.

Robots Vs Humans

At £800 the 360 Eye is certainly not cheap. As to whether it's worth it or not, it will come down to personal preference and how much you hate traditional vacuuming. As a time saver and for something you can quickly turn on to keep your house super-clean, it does a brilliant job, but the price may just be a little too high for mass adoption. **mm**



▲ *Tank tracks at the back of the 360 Eye enable it to climb over any obstacles*



▲ *Sensors on the side of the robot detect objects*



Three Data Breach Affects Thousands

Over 133,000, in fact

Snooper's Charter Sneaked In

No real opposition to new bill

UK Parliament has passed the Snooper's Charter, officially called the Investigatory Powers Bill, without any real fuss. The fact is, there wasn't any significant opposition to the measures, somewhat surprising given that this is a piece of legislation that will impact every single one of us. For example, the Bill requires web and phone companies to store all records on us for twelve months, with various government bodies potentially being able to request access to those records.

Think about that. This means your web search history, any sent messages or phone calls made can be requested by authorities. Edward Snowden pulled no punches with his assessment of the Bill in a single tweet: "The UK has just legalised the most extreme surveillance in the history of western democracy. It goes further than many autocracies."

He's not alone in damning the Bill, but his well-chosen words do rather sum things up nicely. Sigh.

iPhone Case Vaults Into View

New design from Peli

Peli is often in touch regarding its mobile phone cases, and it's now released its Vault case for the iPhone 7 and iPhone 7 Plus. The Vault case is a neat little thing that allows you to carry your credit card and iPhone in the one durable folio case, developed from tough polymer plastics. It comes with a built-in window so you can see who is calling you

without opening the case and there's additionally a kickstand included for hands-free media viewing.

Drop-tested to the usual military specifications for phones these days and coming in black or light grey, the Vault case, which is also compatible with the iPhone 6 and 6 Plus, will set you back around £40 from partnering retailers.



UK mobile network provider Three has said that over 133,000 customer's accounts were breached when fraudsters tried to upgrade and steal mobile phones in order to make money from selling them on. No financial data was accessed, which is a silver lining, but contract, address and billing data could have been.

While only eight customers were actually upgraded to a new device illegally, it could have potentially been a lot worse. Regardless, the network's chief executive apologised for the action and additional security was put in place following the uncovering of this, stopping anything similar happening again. In conjunction with this, the National Crime Agency confirmed arrests had been made.



Who doesn't love a good motherboard, right? With all those empty slots and ports, just waiting for you to plug things into them, they're very definition of potential. They can also be a source of confusion, though, because you have to know what goes where, what is and isn't compatible, and which components you should buy to get the best performance.

Then there are all the new technologies that get added as time goes on. In the past, for example, we've seen IDE make way for SATA, watched as USB headers became ever more prevalent, and been spoilt with the performance of PCI-Express. More recently, USB-C has found its way onto new boards.

Yet, as great as these things are, do you really need a new motherboard to get them? With the right add-on card, you could probably keep your current board for a little while longer. On the other hand, many upgrades are impossible unless you also change out the motherboard at the same time.

Yep, it's a complicated business alright. But hopefully, we can give you a helping hand with this week's special edition.

Anthony

Firefox Makes Fresh Mobile Push

New app provides new Focus

Firefox is making a new push for the mobile browser market with the launch of Firefox Focus, a stripped-back mobile app that offers private browsing for iOS users.

Mozilla's pitch for this new version centres around the idea that, in the age we live in now, consumers have a lack of trust and control of their digital lives. With cluttered digital presences across a lot of devices, Firefox Focus gives users a chance to browse without leaving a record on their phones. It's set by default to block many of the trackers that follow users around the web so mobile users don't have to change the privacy of cookie settings and sessions can be erased with a single tap.

There are no tabs or pop-ups either as this really is set up to be a simple, non-evasive and uncomplicated mobile browser. Mozilla is also promising a performance boost because of its stripped-down functionality.

Anyone interested in giving it this a go should visit the Mozilla blog for more details of what's on offer, and then head to the App Store for the download.



Meanwhile... On The Internet...

If you're in the market for the kind of internet-related story that will surprise nobody, but should infuriate everyone, then we have just the thing for you. It comes courtesy of some research done by Indiana University on the differing way male and female gamers are treated on Twitch channels (tinyurl.com/MMnet42a).

The paper, entitled *Gendered Conversation in a Social Game-Streaming Platform*, to the surprise of precisely nobody who pays any attention to such things, identifies a distinct difference in the nature and language of the interaction that takes place between the male gamers and their viewers compared to the channels of female gamers.

Using data from 2014, provided to the researchers by Twitch itself, the researchers analysed two months worth of messages across 400 channels – 200 run by men and 200 run by women – of varying popularity. The headline result came from the team's analysis of 71 million messages, which showed that, while the most popular keywords used in channels for male streamers were 'melee', shields, 'glitch' and 'reset'; among the most popular words aimed at women gamers were 'boobs', 'hot', 'omg', 'smile' and 'babe'. This led one of the study's authors to conclude that the findings match anecdotal evidence that viewers on womens' channels speak "in more objectifying terms", adding that "if you just go on Twitch it's very stark" (tinyurl.com/MMnet42b). It certainly would seem, at least on the surface, that when watching a female streamer exhibit her skills, certain parts of the audience are missing some of what's going on in-game, in favour of being what's commonly known as 'a jerk'.

Twitch, for its part, has pledged to cut down harrasment, with its senior VP of marketing telling *Motherboard* that it is "dedicated to improving our policies, products, and features to offer broadcasters the tools and flexibility to manage their channels how they see fit and to protect themselves against harrasment and other inappropriate behavior."

This backs up its recent announcement of plans to implement a new regime of moderating on the site (tinyurl.com/MMnet42c) to go alongside the guidelines and features that it already offers its streamers to help deal with problematic viewers (tinyurl.com/MMnet42d). However, the fact that it has only recently ramped up these efforts does hint that it may have been awoken from its slumber by a sneaky early look at the team's findings. Whatever, it needs to do something, really.

Mark Zuckerberg would probably be an interesting bloke to have a beer and a chat with. We'll probably never know whether he's really the nice, though slightly boring (tinyurl.com/MMnet42e), guy he tries to portray, or something closer to Aaron Sorkin's take on him (tinyurl.com/MMnet42f). What we do know, however, is that the behemoth he unleashed on the world when he created Facebook, is a lot more ambiguous in nature – and, you suspect, a little out of his control these days.

While Facebook's totally the place to go if you want to keep up with your gran's plans for the weekend, your Auntie's holiday escapades, or your friends' seemingly perfect lives, it's proved recently that it's probably not the best place in the world to go to get a view on what's really happening in the world (tinyurl.com/MMnet42g). Indeed, Zukerberg has been shouted at by both sides of the political divide in the run up and aftermath of the US election and our own Brexit, leaving Facebook mired in controversy over its role in the dissemination of fake news for the past couple of weeks (tinyurl.com/MMnet42h). Now, though, another new controversy would appear to be on the horizon as it attempts, once again, to crack the puzzle that is social media in China.

Currently blocked by the so-called Great Firewall (tinyurl.com/MMnet42i), Facebook's main-man has made some very public attempts (tinyurl.com/MMnet42j) to court the great-and-the-good (tinyurl.com/MMnet42k) of the country over the past couple of years. However, last week *The New York Times* (tinyurl.com/MMnet42l) reported Facebook was looking at the possibility of employing geographically activated censoring tools that would allow those in control of them to block specific stories and posts appearing in a given region. This would be a marked stepping up in its efforts to woo the state into unblocking it, as it would almost certainly allow the site to conform to China's wish to control discourse on social media, as it apparently does with Weibo's 222m users (tinyurl.com/MMnet42m). That, in turn, would allow Facebook to sign up some of the 1.79bn potential users in the country, and add to its already world-dominating user base.

What price freedom of thought, movement, and association? Well, we're told it's only one of a few ideas on the table at the moment (but one that's, allegedly, ready to go as of now), so we can't say right now. However, as our leaders have just passed the IP Bill into law, we'd caution against getting too self-righteous here.

.AVWhy..?

As sure as egg-is-eggs, if the band OK Go releases a new video, we'll dedicate this corner of the magazine to telling you about it. So here we are, with the clip for *The One Moment*. The whole video, all four minutes of it, is largely comprised of literally one moment, a 4.2s blast of action that the band stretched out to take up over three minutes, packing in so much beat-sync'd action that you'll swear there's computer wizardry involved. You can see it all unfold at tinyurl.com/MMnet42n and then read the band's notes on exactly how they did it at tinyurl.com/MMnet42o. We heartily recommend that you do both.



Caption Competition



"Excitement builds ahead of the first series of *Zero G Apprentice*"

These lads and lasses were the subject of issue 1440's caption pic. Let's take a look, shall we?

- **JayCeeDee:** "Sales of Marty McFly's invisible Hoverboard hits new highs."
- **Thomas Turnbull:** "We backed Brexit and Trump in a double where rich!"
- **doctoryorkie:** "Looks like Kriss Kross were right..."
- **fallguy:** "You can go back to the house."
- **jukebox:** "Could someone turn the underfloor heating down a bit please."
- **Dwynnehugh:** "Employees at Trump Towers now know their jobs are safe."
- **Dwynnehugh:** "Four years of impending peace overexcites Trump's employees."
- **Allan Burns:** "Yes!!! Windows Update successfully installed."
- **Gary Miller:** "Never mind the glass ceiling, we're on the glass floor!"
- **Thomas Turnbull:** "Yippee! We sold or Tesco shares before the crash"

Thanks to everyone who entered, but the winner this week was Ondrive with "Excitement builds ahead of the first series of *Zero G Apprentice*"

If you have a caption for the picture below, head to the 'Other Stuff' section of our forum (forum.micromart.co.uk), or email us via editorial@micromart.co.uk, remembering to add the issue number to the email subject line.



Facebook To Hire More UK Workers

An extra 500 for new HQ

Facebook is due to open a new HQ in London next year, and the company is going to hire an extra 500 workers in the UK as a result. This move will mean an increase in its workforce in Britain to around 1,500 by the

end of 2017, with engineers, marketers and sales staff among the positions to be filled. The government will clearly be keen to pitch this as further proof that the country is a hub for the technology industry, particularly in these unsettling times.

Museum Gets Ready For Christmas

Events in Cambridge

Cambridge's Centre for Computing History is gearing up for the festive season by encouraging all-comers to attend a couple of events taking place in December.

On Saturday December 3rd, parents can attend a talk on how to keep up with kids' gaming habits, whether it's how to keep an eye on what they're up to or just to get some advice on

whether a game they want from Santa is actually age-appropriate.

Then on Friday December 9th, it's the Christmas edition of its Retro Video Game Night, offering keen visitors a chance to get their game on, and even be in with a chance to win the shirt off the Games Master's back!

The website for more details on these and other things going on at the Centre is, as always, www.computinghistory.org.uk.

Snippets!

Virtual Google Earth

Google Earth VR has been released, promising the chance to fly over a city, soar into space or stand atop a mountain. Google Earth VR comes with cinematic tours and some selected destinations to the usual type of big-name places like the Grand Canyon, the Amazon River and the Alps.

Downloadable for free, this is first launching on the HTC Vive headset, but Google's blog post suggests that it could be launched on other VR platforms next year.

NVidia Supercomputer

Claiming it to be the most energy-efficient supercomputer ever made, NVidia has revealed the DGX SaturnV. It consists of eight of its Tesla P100 GPUs, a whopping 63,488GB RAM and 60,512 Intel CPU cores. Wowsers.

It might be the world's most energy-efficient but it actually only comes in at 28th of the list of the world's fastest supercomputers. Why has NVidia developed this? Well, it says it's to support its AI initiative and to give it a leg-up against the competition.

Qualcomm Bug Bounty

Processor manufacturer Qualcomm has joined the ranks of companies offering rewards for anyone who finds and reports bugs to those who matter.

Its own Vulnerability Rewards Program is offering up to \$15,000 per vulnerability for legitimate reports of any nasty bugs that are found in the firm's processors, modems and other tech. Beyond financial reward, which is likely more than enough reason for anyone to get involved in this, people also have a chance to have their name feature on a couple of security-related Halls of Fame.

In these fame-hungry times, perhaps that means something to somebody. If that's you, have at it...

Apple Launches Battery Replacement Program

iPhone 6S users will get new battery for free

If you bought an iPhone 6S at the back end of last year, you could be eligible for Apple's free battery replacement program. The affected phones were manufactured in the autumn of 2015, after which Apple discovered a fault with the battery that it detailed in a support document, writing:

"Apple has determined that a very small number of iPhone 6s devices may unexpectedly shut down. This is not a safety issue and only affects devices within a limited serial number range that were manufactured between September and October 2015."

You will have to visit an Apple store or Apple Authorised Service Centre to check whether your iPhone is eligible for the free battery swap, as

mobile network stores aren't in on the program. If you have already paid for a replacement battery regarding this issue, Apple is additionally asking people to contact it for a refund.



▲ Take your phone to one of these for a battery swap

And The Winner Is...

Golden Joystick Awards over for another year

The annual Golden Joystick Awards have taken place in the capital, at the IndigO2 arena, celebrating the best video games of 2016.

Dark Souls 3 was the big winner as it was named as the 'Ultimate Game of the Year'. That should be particularly sweet for the developers, as the Golden Joystick Awards are voted for by gamers. *Pokemon Go* won a couple of awards – 'Innovation of the Year' and 'Handheld/Mobile Game of the Year' – while Lara Croft entered the Awards' Hall Of Fame.

As for the 'PC Game of the Year', that was handed to *Overwatch*, which also won a bunch

of other gongs, including 'Best Multiplayer' and 'Best Original Game'.



Apple “Working On Smart Glasses”

So says Bloomberg

Google Glass bit the dust, but that hasn’t dissuaded Apple from giving the smart glasses market a go, at least according to a *Bloomberg* report anyway.

The news service has reported that Apple’s wearable device is in the “exploration phase” right now, and the actual launch of the smart glasses is marked down for 2018. The glasses don’t have a name yet – we’re betting on iGlass now – but they

will apparently wirelessly connect to an iPhone and will likely use augmented reality to boot.

Possible suppliers have been contacted and Apple has apparently ordered small quantities of near-eye displays, so this all sounds serious enough. Bloomberg’s report notes that this is a “risky but potentially lucrative” area of wearable computing that, while it didn’t work out for Google, Apple clearly thinks it could make a go of.

China Blocks Kim Jong Un Searches

Don’t call him “Fatty”

Did you know that the good people of China refer to North Korean leader Kim Jong Un as “Fatty Kim The Third”? Well, now they can’t search for that term as Chinese sites have reportedly blocked them.

This phrase has actually been blocked before and,

while a Chinese Foreign Ministry spokesperson was quoted as saying that reports the government had banned the term “did not accord with the facts”, web users have reported that a search for the phrase does indeed lead to blank results.

We live for stories like this one, we really do...

Ofcom Blocks BT From 4G Bids

Three says action doesn’t go far enough

UK regulator Ofcom isn’t keen on BT/EE dominating the mobile space so it has proposed a ban on the company bidding for any more of the 4G spectrum that is still up for grabs.

This is generally considered a good thing as nobody wants to see one company ruling all, but competitor Three remains disgruntled. It has previously called for a cap on any one company owning any more

than 30% of the mobile infrastructure, and BT currently accounts for 45% of the UK’s usable spectrum.

Three’s chief executive has released a fresh statement attacking Ofcom for allowing BT to continue to bid for the 3.4GHz band, which will be key for the rollout of 5G, writing: “It has allowed BT and Vodafone to stockpile valuable mobile airwaves and put genuine choice for consumers at risk.”

Full-Fibre Investment in Broadband

Lovely stuff

The government’s Autumn statement came and went, and within the details was the announcement of a £400m investment in full-fibre broadband.

Part of a Digital Infrastructure Fund, the government thinks that this funding will help two million more homes and businesses to obtain full-fibre broadband and private investors are

being asked to match the funding amount. A minimal number of premises currently takes advantage of full-fibre broadband, which is described in a press statement by those in power as reaching speeds over 1Gb/s.

Any investment in our broadband infrastructure is welcome, of course, and as the government has also agreed to investing in 5G trials (around £700m, in fact), this is all good.

AOC Agon AG241QX

A new gaming monitor range, with some excellent features

DETAILS

- Price: ~£310
- Manufacturer: AOC
- Website: goo.gl/GRqHai
- Requirements: HDMI, DVI, DisplayPort or VGA output; compatible AMD GPU for FreeSync use; spare USB 3.0 port for hub power

AOC's new premium range of gaming monitors has recently been released under the Agon brand name, with the monitors ranging in size and having an AG prefix.

What we have here is the entry-level model of the group, the Agon AG241QX. This 23.8" TN display boasts a fantastic range of features: 144Hz refresh rate, 8-bit colour without dithering, 1ms response time, dynamic contrast ration of 50,000,000:1, 170/160o viewing angles, AMD FreeSync support and a maximum resolution of 2560 x 1440.

Connectivity is equally superb, with VGA, DVI, a pair of HDMI ports and a single DisplayPort. AOC has also included a four-port USB 3.0 hub, spread over the underside of the monitor and the right-hand side, with one of the ports coloured yellow and catering for fast charging devices. There are a couple of microphone and headphone ports added to the side-mounted USB section too.

Other features include a USB remote, fashioned in the same sharp-angled design and colours as the monitor itself, an antenna-like swivel



▲ The AOC Agon AG241QX not looks good, but performs well too

headphone stand around the rear of the screen and ample ergonomics in the form of 130mm height adjustment, tilt, swivel and pivot. In the case of the height adjustment, there's a millimetre scale 'ruler' and moveable red marker to help you quickly put the screen back into your ideal position, should it be moved.

The design of the monitor is certainly eye-catching; the gaming element, with a semi-aggressive sharp lines and contours makes for an interesting but also quite stylish look. The screen itself has a matte-black finish with a reasonably thin bezel, with the bottom section of the bezel having a kind of brushed aluminium effect. We assume this is to help the Agon logo stand out along with the icons for the OSD buttons.

In terms of output quality, the Agon AG241QX doesn't disappoint. Despite it being just a 24" monitor (although

there's nothing wrong with 24" screens, most gaming displays these days are using 27 inches as the entry level), the AG241QX looks very good indeed. The colour depth is great, there's no perceivable screen lag and the image is bright and clear. Admittedly, having 2560 x 1440 on a smaller screen does feel a little strange at first, but you soon become accustomed to it, and before long you ignore the screen size and focus on what's going on.

It's good to see AOC adopting the low blue light technology that rival BenQ frequently uses on its range of monitors. While a lot of games won't necessarily use this feature, it allows the AG241QX to sell itself to non-gamers who still demand a high-quality screen.

The AOC Agon AG241QX is a great gaming monitor and one that's priced quite



▲ With plenty of connectivity and ergonomics, AOC has hit the nail on the head here

reasonably too. For around £310, you're getting a lot of connectivity and technology for your money, plus the screen quality is certainly better than you'd find on most of the competition's displays. If it's a performance 24" screen you're after, then this will tick all the right boxes.

mm David Hayward

A great gaming monitor, with tons of technology on offer



Devolo dLAN 550+ Starter Kit

Devolo launches an affordable Powerline and wireless starter kit

DETAILS

- Price: £109.99 RRP
- Manufacturer: Devolo
- Website: www.devolo.co.uk
- Requirements: Broadband router, mains wiring
- Part No. DVL9839



Spreading wi-fi around your home can be something of a nightmare if the default location for your router isn't conducive to wireless connections. This is especially true in old Georgian properties where the master socket is often in the hallway in what might be a very tall and deep building.

In these cases what you really need to do is create a wireless access point elsewhere, preferable higher up to cover the more commonly use locations.

The Devolo dLAN 550+ Starter Kit is built for this job, as it combines a Powerline 550+ networking with 802.11 b, g or n wireless. That allows you to utilise the existing ring main power wiring to establish wired network with the router and then anywhere on that circuit place the wi-fi access point.

And as with previous Devolo Powerline designs, it's gone with a through-power socket, so you don't need extra free power sockets to deploy it.

Key Features

- 300Mbps 'n' class wi-fi connection.
- 500 or 200Mbps Powerline network.
- A range of up to 400 metres with Devolo's range+ technology.
- Seamless integration through WiFi Move Technology.
- Powerline encryption for shared circuits.
- Ethernet ports at both ends.
- Through-power avoiding dedicated sockets.



The kit comprises of two parts: a Powerline interface with two Ethernet ports on it and a Powerline wireless adapter with a single Ethernet port on it.

These Ethernet ports allow you both to connect wired equipment at either end, but also you don't need a dedicated one at the router end.

The limitation of these ports is that they're 10/100 and not gigabit speed, so whatever you connect to them won't overload the theoretical 500Mbps that the Powerline networking might deliver. As with all the Powerline gear that I've covered from many suppliers, these speeds need to be viewed as possible but unlikely. They're very dependent on the quality of your wiring and what other interference generating appliances you've got connected to it.

That said, the Powerline network is generally quicker than the Ethernet ports at either end and quicker than the vast majority of broadband connections in the UK.

Where Devolo invested more technology in this kit was in the wi-fi side of this equation, using its Range+ technology to enhance its effectiveness.

It might only use the 2.4GHz range, but it can still offer a throughput of up 300Mbps and generally a much better reach than 5GHz wireless technology.

It's also really easy to set up, as Devolo created a simple means to clone the existing Wireless SSID and password. This allows your devices to seamlessly move between the router and the wi-fi adapter with needing to be altered in any way.

As you might expect from this brand, the hardware is well made. It provides concise and clear instructions and has a decent support infrastructure if you run into a problem. And once you've installed this kit, you can expand it with extra wired or wireless modules.

My only reservation about this product is the same I have for most wi-fi and Powerline hardware, in that you can only really establish the performance you'll get once it's in place.

However, as suppliers of this equipment go, Devolo is undoubtedly the market leader.

mm Mark Pickavance

A simple solution that combines Powerline and wi-fi effectively



Acer Chromebook 14 CB3-431

Acer's latest Chromebook demonstrates what is possible on the Chrome OS platform

DETAILS

- Price: £169.98 (PC World)
- Manufacturer: Acer
- Website: www.acer.com/
- Requirements: Wireless Network
- Part No. NX.GC2EK.001

If you wanted to formulate the perfect specification for a Chromebook, there are a number of features everyone would include. It would have a large and crisp screen, sufficient performance for whatever tasks you desire, be lightweight and able to run for an extended period on its internal battery.

And obviously, be at an affordable price.

The freaky thing about the new Acer Chromebook 14 (CB3-431-C9WH) is it that it ticks all those boxes and a few more besides.

As the '14' moniker suggests, it comes with a 14" 1366 x 768 panel, uses a Celeron N3060 dual-core 1.6GHz processor with 2GB of RAM and 16GB of flash storage. This is all mounted in

a beautiful aluminium case that some Ultrabook's don't warrant, and at just 1.6kg it's an easy carry.

For those who want even more there is a full 1080p model, but the 1366 x 768 display seems very well suited to this display size.



“ Exploits Chrome OS in a way that early Chromebooks never seemed able to ”

Features

Screen: 14" LED.

Resolution: 1366 x 768.

Screen features.

Processor: Intel Celeron N3060 processor dual-core 1.6 GHz / 2.48 GHz TurboBoost.

Memory (RAM): 2GB.

Storage: 16 GB eMMC.

Wireless: 802.11ac.

Bluetooth: Bluetooth 4.2.

Ports: USB 3.0 x 2, HDMI x 1, 3.5mm jack audio interface.

Battery: 3-cell lithium-ion 3920mAh.

Battery life is a whopping 14 hours without a recharge and it also has 802.11ac wi-fi, Bluetooth 4.2, HDMI out (full size) and two USB 3.1 ports.

If this specification seems vaguely familiar, it's almost identical to Acer's Cloud Book A01-431 that comes with 32GB of storage and Windows 10, for about £200.

But this is at least £30 cheaper and doesn't have an operating system that

Microsoft keeps accidentally breaking.

Acer has a higher spec model code NX.GC2EK.004 that has the 32GB storage and 4GB of RAM, for which it wants £229, though given the cloud based nature of Chrome OS, you might want to ask why you might need that extra space and memory.

The review model worked very nicely indeed, and you've always got the USB 3.1 ports if



you need to access significantly more storage.

Those are all the good things, but there are a few places where this could have been better. One of these is the viewing angles on the display panel, which caused me to pivot the screen back to a rather greater angle than normal to get a clear view. I know that the 1080p version has an IPS display, but the one on this is quite clearly TN technology.

The keyboard is admittedly limited by the very thin aspect of the Chromebook 14, but the lack of travel in the membrane keyboard could make long typing exercises tiring on the finger joints. I managed well with it in terms of accuracy, but I wouldn't want to produce all my monthly words using one.

There are no upgradable features as such, though that's a trend across all low-end

systems. I checked inside and the flash module is actually surface mounted, as is the memory, sadly.

A few people have also moaned that there isn't an SD card slot – something that would have been useful for using the Chromebook 14 for reviewing photos. With the USB ports, I see that as being less of an issue, as you can easily plug a card reader in. And for those wondering, I tested that this works.

The one feature that really irks me is a choice that many laptop makers keep making in respect of the power supply. Specifically the use of a proprietary barrel-style power connector on a 90° angled spur. These seem, at best, designed to easily break or, worse, still damage the machine if accidentally yanked out.

What this machine badly needed was a USB Type-C power plug, so it could pull out without damaging the machine or cable, and it would have provided another Type-C spec USB port when not in use.

If it had that one feature, then I'd have no issue in wholeheartedly recommending the Chromebook 14, as it is generally very fit for purpose.

Even without it, though, this is a fine machine that exploits Chrome OS in a way that early Chromebooks never quite seemed able to. And because it is on the list of hardware that will be upgraded to a version of Chrome OS that can run Android apps shortly, maybe I've only seen a small part of what it can do.

Coming back down to earth, this is a low power system that delivers just enough to drive Chrome OS at a useable speed, and you should consider that if you have deadlines or performance needs.

For those with more modest surfing and light office duties, the Acer Chromebook 14 is an excellent choice and remarkable value for money.

mm Mark Pickavance

The best Chromebook for less than £300 easily



Fire Kids Edition

A kid at heart, Michael has been playing with Fire

DETAILS

- Price: £99.99
- Manufacturer: Amazon
- Website: www.amazon.co.uk
- Requirements: n.a.

They do say 'Get them young and they are yours for life'. I'm not sure whether this thought was paramount in the mind of Amazon when the company developed a child-centric version of its Fire tablet, but the Fire Kids Edition was born and took its place in the Amazon range of goods.

With this product, Amazon has taken the fifth-generation 16GB version of its 7" Fire tablet encased in a rubber pink or blue bumper grip and protective unit. To this is added one-year free access to thousands of books, TV shows, educational apps and games. As this product is meant for use by a child or children, accidents can happen, so Amazon has included a two-year warranty that offers a free, no questions asked, replacement service in the case of breakages.

The combination of the Fire tablet and its protective shield creates a device weighing 405g and with dimensions of 219 x 138 x 25.5mm (W x H x D) when held in the preferred landscape orientation. While on the subject of orientation, the tablet insists on powering up in portrait mode before switching to the orientation that the child will probably be using.

Along with its protective duties, the bumper has cut-out sections, giving access to the power button, volume control, camera lens (both front and

rear), micro-USB port for charging the device and the speaker outlet. The bumper also has an arrangement of hexagon depressions on the rear, which certainly helped when gripping the unit. You will need to remove the bumper unit if you decide to increase the standard 12GB of storage up to 128GB with the insertion of a micro-SD card.

Prior to setting up this Fire device for the younger members of the family, whether they belong to the categories of Kids (under 10) or Teens (over 11), parents can carry out tasks such as selecting the country/region plus font size and join a wi-fi network. The tablet will also need to be linked to an Amazon account. The parental module will need the protection of a password or PIN.

Profiles can be created for individual children. These profiles can be identified using one of

the supplied images or a photo taken using the Fire tablet. When setting up profiles, you will need to supply the child's first name, sex and date of birth. A designated bedtime can be set for the child plus a period on inactivity before the tablet will restart. Educational goals can be set for activities such as reading, watching educational videos and tackling tasks. A setting can be applied whereby educational goals need to be met before any entertainment options can be tackled. Specific settings can vary between weekdays and weekends.

The parent can manage elements such as the available storage by adding and removing content from a child's profile account. Access to certain browsing activities can be blocked, as can making purchases of additional content including those in-app purchases which can run up



massive bills. You can also disable location-based services and the transfer of content to sites such as Facebook.

One point to take into consideration is that the Fire OS software connects to the Appstore rather than the Play store. While the Appstore is reasonably well stocked, it is not as comprehensive as Google's Play Store. **mm Michael Fereday**

All-round protection for a child's mobile tablet activity



Turtle Beach Ear Force Stealth 350VR Headset

In need of high-quality audio to compliment your VR headset? Here it is

DETAILS

- Price: £59.99
- Manufacturer: Turtle Beach
- Website: goo.gl/C8H5zj
- Requirements: Spare USB for charging, spare audio ports for headphone and mic, PS4 or PC supported, any current VR headset supported

Turtle Beach is one of the more popular gaming audio suppliers in the high street. Its products are regularly featured in the likes of Game, Currys and several other retailers, including e-sports teams Optic Gaming and Faze Clan. As such, there's quite a range of products to choose from.

The newest addition to the Turtle Beach stable is the Ear Force Stealth 350VR Headset, an amplified gaming headset that's designed to work best with the new generation of VR devices for both the PlayStation and PC.

The 350VR design is somewhat different from the norm, in that it incorporates a detachable noise-cancelling microphone, a swappable cable system depending on the platform you're using the headset with and a sleek, svelte look that minimises its profile considerably.

The headset is remarkably lightweight, since its primary use is to fit alongside something that's already mounted on your head. Comfort and ergonomics than need to be top of the list of features, and Turtle Beach has done a great job of padding out the 350VR in all the right places and by ensuring there's maximum



▲ The Turtle Beach Stealth 350VR is a great headset



▲ It's comfortable and has excellent audio and features

movement with the over-ear cans. Plus there's plenty of clearance on the headband and around the sides of the head for the VR headset and its accompanying cables to fit under the 350VR.

The swappable cable system is a good idea, with a short cable

for the PS4 VR or controller, a very long audio cable for the PC (which splits into microphone and headphone 3.5mm jacks) and a USB charge cable.

The battery powered amp provides a greatly improved and immersive VR experience, along with a bass boost and noise

cancelling technology. A single charge will last at least 30 hours too, so there's little to worry about when playing.

As for audio quality, the 350VR's 50mm neodymium speakers provide a fantastic range of mid and higher range frequencies. Voice and treble sound very good indeed, and the bass boost is remarkably powerful, considering there's no active sub element; if anything, you'll end up turning the bass down a few notches.

The detachable microphone is reasonably good, although we did find it picked up environmental noise a little too much. It does, though, feature mic monitoring, whereby the player can hear their own voice through the headset. This allows you to have a normal conversation rather than raising your voice.

The high quality design and audio make the Turtle Beach Ear Force 350VR Headset a worthwhile addition for any VR user. Regardless of whether you're a PS4 VR gamer or you use the Vive or Rift, the 350VR is certainly going to improve the overall experience. And for just £59.99, it's exceptional value for money too. **mm David Hayward**

A great headset for the new VR generation



Samsung 960 EVO M.2 NVMe 256GB

Samsung makes the move to NVMe affordable with the 960 EVO

DETAILS

- Price: £139.49 (Scan)
- Manufacturer: Samsung
- Website: www.samsung.com
- Requirements: NVMe M.2 slot that can accept a 2280 module

A few weeks ago, I covered the Samsung 960 PRO in all its NVMe goodness, but by SSD standards that enhanced speed can come at a high price.

As with most parts in the PC world, you can get silly performance with unlimited funds, or you can throttle back your expectations and pay significantly less.

The EVO products in Samsung's SSD range are exactly that: most of the good stuff but without the cost of PRO for those who want performance within a budget.

Like its PRO big brother, this is a M.2 module in the 2280 size, uses V-NAND flash, LP DDR3 cache and its amazing Polaris controller.

The EVO comes in three capacities: a 1TB, 500GB and the most affordable 256GB that I've reviewed here. They all have the same quoted 3,200MB/s read speed, but depending on the capacity, write performance



scales from 1500MB/s to 1800MB/s and 1900MB/s on the bigger devices. My tests showed these numbers to be very accurate.

That makes the 250GB option just 21% slower at writing than the 1TB version, and it's also much quicker than the previous 950 PRO NVMe 256GB by at least 50% in both reading and writing. To put that in perspective, it's still six times quicker are reading and triple the write speed of the very best SATA SSD, however you slice and dice those numbers.

And if you thought that the IOPS side of the EVO would be substantially impaired then think again. The 250GB model is still capable of 300,000, the 500GB 330,000 and the 1TB a massive 360,000 IOPS.

So if you get most of the performance of the 960 PRO and it costs less, what's the catch? There is a minor one and it's to do with the reliability of the modules as defined by TBW (total bytes written).

Where the PRO series offers 400TBW, 800TBW and 1200TBW on its 512GB, 1TB and 2TB capacities respectively, the EVO can only muster 100TBW, 200TBW and 400 TBW on its three sizes. That also has the effect of dropping the warranty period from five to three years for the EVO.

100TBW over three years is still about 133GB per working day or ten years at a typical 40GB per day for a well-worked system. But the hint, if you didn't get it, is that if you want reliability, then the PRO should be your weapon of choice.



In terms of the EVO, the 250GB represents the worst value for money at about 56p per gigabyte, where the 500GB is 50p per gigabyte and the 1TB just 47p.

If you compare this drive with the 850 EVO 250GB SATA SSD, it's only about £20 more and as good a justification for embracing M.2 NVMe as I can currently imagine.

However, it's worth mentioning that these are pre-order prices, and once volume parts hit the streets, these numbers might radically change.

As with previous EVO-branded products from Samsung, these are likely to be hugely popular among those who pay for their own equipment, even if they're slightly overshadowed in performance and reliability by the 960 PRO series.

mm Mark Pickavance

Amazing performance for barely more than a SATA EVO

	Read [MB/s]	Write [MB/s]
Seq Q32T1	3272	1521
4K Q32T1	357.5	258.5
Seq	1742	1525
4K	37.77	145.1



Speedlink Quinox Pro Gamepad

For a gaming edge, use a programmable controller

DETAILS

- Price: £59.99
- Manufacturer: Speedlink
- Website: goo.gl/F43qXQ
- Requirements: Windows Vista or later, spare USB port



▲ The extra paddles, dials and macro functions make this a unique gamepad

When Valve announced its 'radically' redesigned controller, the PC gaming world held its collective breath for something different and something that could take the Xbox controller to the next level. Sadly, that never happened and the Steam Controller was a bit of a flop.

This left the PC controller market quite stagnant despite the best attempts from Razer, Gioteck, Logitech and the like. However, Speedlink has recently improved its controller/gamepad product range with the launch of the Quinox Pro.

The Quinox Pro is modelled after the classic Xbox controller, in both size, shape and weight, but it offers gamers a little more technology to play with.

It features both Dinput and Xinput options, so those with both modern and older games can use it; four back-mounted paddles; an extra two buttons positioned between the two triggers; haptic vibration; LED lighting and the usual array of D-pad; two analogue sticks; and Back, Start, Home and ABXY buttons.

Speedlink has also included a small OLED screen to help you view the various options and configurations you can set. Accompanying the screen are a couple of controller dials, which allow you navigate the menu and

fine tune the programming and settings. Furthermore, the Quinox offers a 2.4-metre, detachable USB cable and switches on the base to power the controller's vibration function and swap between Dinput and Xinput.

Despite the numerous buttons and added paddles, the Quinox feels surprisingly uncluttered and comfortable. Even with the added underside paddles, you rarely accidentally hit anything you shouldn't, and when you need to, everything is within easy reach.

The sticks aren't removable; changing to longer stick lengths is often a must-have options for

some gamers, but it's hardly necessary, as they already stand out taller than a conventional Xbox controller.

Programming the Quinox and accessing the two profiles can be a long-drawn out process that is, admittedly, a little hit and miss. To access the profiles you need to press one of the two controller dials and via the OLED screen, navigate with the D-pad. Furthermore, programming a macro and reprogramming the paddles requires you to select the profile, select the paddle, select Program from the screen and begin the macro sequence. Once you have the hang of it, the

process doesn't take too long, but it's a little awkward at times and requires a fair amount of pre-game setup time.

Personally, we would have preferred a software version of the programming, along with the software option to turn the LEDs on and off too, much like the programming of Speedlink's gaming mice, for example.

In terms of performance, though, the Quinox worked well on all the games we tested it with. The macro function performed as well as expected, offering us an over-powered ability beyond what we'd have through a standard controller – keyboard and mouse macro use was still far superior, however.

The Quinox appears to be pretty sturdy too, so fighting games can be played without worrying too much about whether you'll have a functioning controller or not at the end of the round. To be fair, we'd say the Quinox isn't quite as high a quality design as the Xbox controller, but it's better than Logitech's and Razer's recent entries and certainly better than the attempt from Valve.

mm David Hayward

A good controller, with plenty of options



GROUP TEST

Soundbars

TV and monitor speakers are notoriously poor, even on the most expensive displays. Setting up a 5.1 surround sound is an option, but not everyone wants the cable hassle and the lack of 5.1 output from some TV and movies.

A good option, therefore, is a decent soundbar and subwoofer set. Soundbars deliver great audio, are generally sleek and come with many options and connectivity.

We have six on test, to see which will sound the best for the average living space.

Soundbars

Roth Audio Sub Zero II

DETAILS

- Price: £99
- Manufacturer: Roth Audio
- Website: goo.gl/8EJ3ll
- Requirements: Digital optical port, Bluetooth device



▲ Connectivity is ample for most users and the sound quality is good too

Roth Audio isn't a name that most high street consumers come across daily, which is a shame as the company's products are usually good and come in at a decent price too. The Roth Audio Sub Zero II is a single soundbar that can be found at various outlets for around £99 or less if you spend the time to shop around.

It's a well-built and tasteful-looking soundbar that has managed to cram a lot of technology into its frame. A cloth speaker grill hides the drivers at the front of the unit and is non-removable due to the control panel that sits in the centre-front of the unit. The control panel is a simple affair that displays a selection of multi-coloured LED lights along with source, mode, volume and power buttons. The LEDs indicate a variety of colours depending on what's being used at the time: red for RCA, blue for Bluetooth etc., and although simple, it's nowhere near as

distracting as some displays we've seen in the past.

Rear connectivity is adequate for most users, with an optical digital port, power, stereo RCA and a 3.5mm audio stereo jack. What's available will satisfy the standard TV audio setup or as a better than average desktop PC audio set.

The selling point here, though, is the Bluetooth connectivity, which connects easily and offers you the ability to make this a more mobile and modern device friendly unit. Regardless of whether it's your phone, tablet, laptop or PC, you'll have no trouble in getting the whole lot paired up and running in no time.

Within the Sub Zero II there are four 2.75" Ferrite drivers (two full range and two bass) and a pair of passive radiator bass drivers, offering 60W of total power output. This may not sound like a whole lot of power, but when passed through the digital sound processor you get a good, crisp

sound across all the frequencies, even from deeper bass and the low-end frequencies.

Despite lacking an external sub, the effect of the built-in bass drivers is actually very good and surprisingly clear. With some external subs, you can get considerable distortion, but here the range is kept clear while still offering a satisfying rumble to your viewing pleasure.

Based on its all-in-one design and the low price, the lowest in the entire group, the Roth Audio Sub Zero II is a soundbar really worth considering. The sound produced is enough to satisfy even the most critical of audio pundits and to be honest anything is better than what most TV speakers offer.



▲ The Roth Audio Sub Zero II is a decently priced soundbar



Edifier CineSound B7

DETAILS

- Price: £250
- Manufacturer: Edifier
- Website: goo.gl/oWybW3
- Requirements: Optical digital port, Bluetooth device

Edifier's range of soundbars and other audio equipment has come a long way in recent years, covering home theatre, gaming, PC desktop speaker and pretty much everything else in between. However, it's the older model CineSound B7 we're interested in today.

Beginning with the soundbar, this is a one-metre long slim and low-profile speaker featuring a pair of 0.75" silk dome tweeters at 16W and four 2.75" mid-range drivers at 19W.

Rear connectivity on the soundbar is good, with optical, coax, line in and auxilliary. You can also opt for the more modern option of Bluetooth 4.0 using A2DP (Advanced Audio Distribution Profile). This also offers AVRCP for connection to other Bluetooth devices to control any media playback, as well as pairing itself with the companion subwoofer.

Moving on to the subwoofer, this 290 x 285 x 245mm speaker features a large 8" downward facing driver, with the speaker box itself being propped up on four 50mm feet. The rear of the sub is pretty plain, since this is a wireless only speaker. There's the figure of eight power plug, power button, pairing pin hole, a single LED indicating a successful pair with the soundbar and a bass control

dial. Thankfully, pairing is easy (it actually comes pre-paired). You simply poke something into the pair pin hole, and while the pairing LED is flashing, press and hold the 'pair' button on the supplied remote.

Before we get to the sound quality, it's worth mentioning that since this is such a slimline soundbar, Edifier has included an entire wall mounting kit in

with the rest of the package. There's everything you'll need here, including the brackets, which we think is a nice touch. Furthermore Edifier has also supplied the CineSound B7 with all the cables you'll need to get up and running, including a two-metre optical cable.

The sound quality from the soundbar and sub pack a decent punch, more than the



▲ For £250, the Edifier CineSound B7 is a great soundbar and sub set

◀ Audio quality is great and it even comes with cables!

Roth Sub Zero soundbar. The bass has a window frame shaking maximum setting that surprisingly doesn't get too distorted as the volume is increased, and equally the soundbar produces an excellent level of clarity through the mid and higher-end frequencies. While you can tell the difference between this set and one that costs four times the amount, that difference is only very slight.

The Edifier CineSound B7 is a great soundbar and sub kit. For around £250 it's good value for money, and considering the added extras in the form of the wall mounting kit and cables, it's certainly one of the best complete sets we've tested in quite some time and well worth the price.

Soundbars

Klipsch R-10B Soundbar And Subwoofer

DETAILS

- Price: £300
- Manufacturer: Klipsch
- Website: goo.gl/gs2eyZ
- Requirements: Optical digital port, Bluetooth device

Klipsch is a company that produces some exceptional audio equipment. From standard headphones through to complex and cinematic surround sound sets, it's a company that delivers the goods at a level of quality you can trust.

Its most recent release in the Reference line of audio equipment has seen some improvement over the last six months or so, with the R-10B Soundbar and Subwoofer set coming in just above the entry model.

The R-10B kit is a lightweight design that curves gently in a pleasing, although simple, aesthetic for the living room. The looks of the soundbar are important, to a degree, as this is a speaker that is capable of being wall mounted, ideally placed under a wall-mounted TV. So a certain level of minimalism is required, without affecting its connectivity or audio quality.

The soundbar is finished in a satin black, with a perforated grill fitted over the two 19mm textile dome tweeters and two 76mm polypropylene mid-range drivers. Along the front are various media controls for mute, volume and input source, with a power LED one side of the strip of buttons and another the other end indicating which of the soundbar's features are engaged or not.

The rear of the soundbar houses the connectivity in a cut-out section, for easier access



▲ At 250W, the Klipsch R-10B is certainly a loud soundbar and sub



▲ It lacks quality in some areas, though, which is disappointing for the price

should the bar be wall mounted. Here you'll find the main power switch, power port, digital optical and RCA.

The next component in the package is the subwoofer. This is a wireless, satisfyingly heavy and sturdy box that will auto-connect to the soundbar when both are powered on and will work up to 50ft away. The good-quality MDF sub is finished in a brushed black vinyl, with a side-mounted perforated grill protecting a single 203mm side-firing fibre composite cone.

With the two connected, the combined power hits you with

250 watts, which is no small thing for the average-sized living room. Our test setup to the TV via the included digital optical cable and running a Blu-ray copy of *Gravity* was immense. The power delivered by the sub alone could be felt in our rib cage without setting our teeth on edge. The soundbar was equally good, although the mid-range didn't quite deliver as much impact, but the higher frequencies more than made up for any lack of mid-range depth.

The R-10B also has a trick up its sleeve in the form of

Bluetooth connectivity, which obviously allowed us to connect our phones and other devices and listen to the music collection stored on our NAS drive.

This set is, indeed, an audio delight, although there are a couple of negatives to take into consideration. For one, there's no HDMI connectivity on the soundbar. Although this shouldn't be too much of a problem for most users, cinematic audiophiles will no doubt hate the lack of DTS-HD Master Audio or Dolby Digital trueHD.

The other issue we have is with the rather poor remote. Although it's certainly functional enough for the features of the R-10B, it feels extremely cheap when compared to the rest of the package.

Having said that, once you've connected everything up and are immersed in the powerhouse audio that this thing delivers, you'll soon forget all about dodgy remotes and lack of HDMI inputs.

Klipsch has done a good job with the Reference R-10B Soundbar and Subwoofer. But for around £300, you may want more features, and the audio quality could be better.

Raumfeld WiFi Soundbar And Sub

DETAILS

- Price: £1099.99
- Manufacturer: Raumfeld
- Website: goo.gl/56wBGa
- Requirements: HDMI, optical digital port, WiFi connectivity

If you're after a soundbar and subwoofer that can pretty much do anything, connect to anything and, provided money is no object to you, play anything to a level of audio quality that would leave an audiophile in tears, then look no further than a Raumfeld product.

The Raumfeld WiFi Soundbar and Subwoofer are, as you can see from the title, a pair of speakers that connect to each other and your network through an 802.11n wireless module, which also connects to your router and can be controlled via a Raumfeld app for Android or iOS devices.

Starting with the soundbar section, this is a reasonably long 990mm MDF lacquered case with six speakers with an active range from 160 to 20000Hz at a maximum of 102dB. Connectivity is good, with HDMI ARC to your TV, Ethernet, optical SPDIF, USB, RCA 3.5mm ports and a mono RCA for a physical connection to the subwoofer.

The subwoofer is a monster of a unit measuring 330 x 955 x 120mm and weighing 14kg. It connects and pairs itself to the soundbar automatically as soon as it's powered up, but should there be any issues with the connection, you can opt for a mono RCA connection, as detailed above.

The three 130mm speakers deliver a substantial thump to the bass at floor shaking levels too, matching the 102dB that



▲ *Not only does the Raumfeld soundbar and sub look magnificent, it's also shockingly expensive*



▲ *Mind you, it's the most impressive kit we've tested in a long time*

the partner soundbar is capable of.

As for connectivity, the subwoofer houses a large D-shaped port wireless module and the RCA input from the soundbar. There are a couple of traditional-style dials to fine tune the levels and sensitivity of the output up to the full 240W.

The design of the subwoofer section is quite different from what we've already seen in the group. Forgoing the more popular box shape, Raumfeld has instead opted for a long and quite tall radiator-looking design. It's certainly different, we'll give Raumfeld that, but it works well, and there's plenty of room for the drivers and controls too.

As you would undoubtedly expect, the sound quality and

levels from the pair are simply magnificent. We've already covered the incredible bass and the mid- to higher-range output from the soundbar is just as good. Even at the maximum volume, the sound production is crystal clear, much to the chagrin of the neighbours.

This leaves us then with a bit of dilemma. Although the Raumfeld soundbar and subwoofer kit is by far the best we've ever heard, it's a tad overkill for the living room of a three-bed terrace in the middle of Lowestoft. And with a price of £1099.99, it's certainly not the cheapest set we've ever come across.

But you're paying for quality here and this is exactly what you'll get. The Raumfeld WiFi

Soundbar and Subwoofer are an audiophile's dream come true, but you're going to have to seriously consider the positioning of these two if you're thinking of installing them in the 'average' sized living room. For those with a larger environment, though, you'll be more than suitably impressed.



Soundbars

Maxell MXSP-SB3000

DETAILS

- Price: £190
- Manufacturer: Maxell
- Website: goo.gl/HFy7QY
- Requirements: HDMI, optical digital port, Bluetooth device

Anyone who in the 80s had a collection of ZX Spectrum games on tape or recorded the Top 40 from the radio will be familiar with the name Maxell. The company has a long history in the audio world, and although it or rather its name, is now owned by Hitachi, it can still launch something worthwhile.

This is a 2.1-channel soundbar with a difference: it's one of the few new designs that acts as a plinth for a TV to stand on, which makes it less of a bar and more of a base, but for the sake of argument we'll consider it as a fully fledged soundbar. The MXSP-SB3000 is capable of having and 80kg TV sat on top of its 939 x 390mm surface, which probably equates to something like a 72" model or thereabouts.

The front of the unit has a black speaker cloth covering the drivers, along with a central, tasteful LED panel with touch-controls on the top and a USB port in the bottom corner – for charging only unfortunately. Although the LED does offer some helpful information about which input is selected and so on, it's really quite small, and when sitting back, it can be quite difficult to see what's being displayed.

Connectivity at the rear of the MXSP-SB3000 is

pretty good, with three HDMI inputs, a single HDMI out, optical and coaxial digital inputs, plus an RCA analogue, 3.5mm jack and finally the power. All the ports are recessed and horizontal, which we think makes connection a little easier, but in the case of the HDMI ports, it can be

awkward to add a cable later in the setup, as you'll have to move the TV and get some light behind the unit to see what's going on.

The Maxell MXSP-SB3000 delivers 30W from each of the front speakers and a further 100W from the built-in sub. Each of the input passes through an SRS WOW HD



▲ The Maxell MXSP-SB3000 is a TV stand/soundbar combo

◀ The company has certainly moved on from tapes filled with pirated Spectrum games



3D processor, which when combined with the added sound features that the MXSP offers, gives a very good sound quality to whatever it is you're listening to.

Aside from the cabled connectivity, there's also a Bluetooth wireless function that will play your music collection via your phone or tablet or similarly attach to a Bluetooth-enabled PC or laptop.

As for audio quality, the MXSP-SB3000 was certainly good enough for our test setup in the living room. The sound processor does an admirable job of delivering a decent punch, but the bass felt a little weaker than some of the soundbars we've already tested. Mid- and higher-range frequencies, though, were solid and clear.

The Maxell MXSP-SB3000 is a good soundbar, with ample connectivity and a novel setup. It's priced at around £190, but you may need to measure things up before committing to a purchase, because being a TV base makes it somewhat larger than the average set.

“ The sound processor does an admirable job of delivering a decent punch ”

Monitor Audio ASB-2

DETAILS

- Price: £699
- Manufacturer: Monitor Audio
- Website: goo.gl/8J3Kw2
- Requirements: HDMI, optical digital port

The second most expensive soundbar in the group and the final entry comes courtesy of Monitor Audio, a company that has won numerous audio awards over the years. Its ASB-2 soundbar from the Home Audio range is one of its winning products, but how does it compare to what we've already seen?

The ASB-2 is a single soundbar, comprising of two large 140mm subwoofers, two 100mm mid-range drivers and two 25mm gold dome tweeters, all with Monitor Audio's advanced ceramic coated alloy material and delivering 160W of crisp, deep sound through five digital amplifiers. Around the back of the unit, recessed slightly to one side, you'll find three HDMI inputs, a single HDMI out, a USB 2.0 port, two digital inputs (coaxial and optical digital), analogue RCA and a 3.5mm jack. There's also a subwoofer output for you to add an additional sub to the setup, should the built-in sub prove to be too weak for your tastes.

The top of the unit has a range of push button controls that enable you to select the audio inputs, pair devices, activate the 3D function, mute and so on. They feel well designed and respond without being too squishy to the touch.



▲ *The Monitor Audio ASB-2 is a good looking soundbar set*



▲ *Audio quality and connectivity is good too, but it's expensive*

“ Streaming musical content from any number of devices is simple to set up ”

Additional to the hardware, the ASB-2 offers some fantastic connectivity on the software front through the USB port and wireless Airplay, DLNA and UPnP streaming. And thanks to the proprietary 3D spatial effects system, the feeling of being immersed in the sound is pretty impressive, to say the least.

As far as looks go, the ASB-2 has it all. It weighs in at considerable 11kg and is superbly crafted and designed to be as classy as possible, while remaining a modern unit. There aren't any frontal LED displays, just a simple glow when it's connected, and it won't mark the surface it's standing on, thanks to

the silicon feet. The front is covered in black speaker cloth, with mirrored edge panels and a two-tone black and grey look from above and to the rear.

Despite looking very chic, the ASB-2 offers some stunning sounds. Combined with a Blu-ray device, the audio is excellent, as you would expect from a soundbar of this price and level of engineering. And streaming musical content from any number of devices is simple to set up and a pleasure to listen to. The bass is sufficient for a small to medium sized living room without ever having to bother with the secondary sub output, but for a larger audience, it may just be necessary. However, the higher frequency sounds are superb and fill the room with a level of detail that's quite impressive.

Needless to say, £699 is a little steep for most people's pockets. But when you consider the competition, such as the Raufeld kit, the ASB-2 suddenly seems a little more reasonable, especially considering what it can do. Basically, if you can afford it and you want the best audio possible without remortgaging your house, then the Monitor Audio ASB-2 is the soundbar for you.





Raumfeld WiFi Soundbar and Sub

We're giving this week's Best Overall to the ridiculously expensive Raumfeld WiFi soundbar and sub. Yes it costs over a £1,000, but it's an incredible audio set and there are those among us who can happily afford the price.

If you can afford to splash out, then the Raumfeld won't disappoint.



Edifier CineSound B7

Costing nearly a quarter of the Raumfeld kit, the Edifier CineSound B7 is an excellent soundbar. Audio and build quality are great and there's plenty to like about this well-designed set.

How We Tested

Each soundbar was hooked up, either via optical digital out, HDMI or wirelessly, to an LG 47LA860W TV, an Android tablet and phone, a PC with Bluetooth and analogue audio, and a laptop with Bluetooth. Blu-ray movies and high-quality MP3s were played through each, in a medium sized living room.

	Roth Audio Sub Zero II	Edifier CineSound B7	Klipsch R-10B	Raumfeld WiFi Soundbar and Sub	Maxell MXSP-SB3000	Monitor Audio ASB-2
Price	£99	£250	£300	£1099.99	£190	£699
No HDMI Ports	0	0	0	1	3	3
Optical Digital Port	Yes	Yes	Yes	Yes	Yes	Yes
Wireless Subwoofer	Built-in	Yes	Yes	Yes	Built-in	Built-in
Bluetooth connectivity	Yes	Yes	Yes	No, WiFi	Yes	No, Airplay
Total Power Output W	60W	75W	250W	240W	160W	160W
Dimensions	88 x 850 x 80mm	Soundbar: 1000 x 79 x 80mm. Sub: 290 x 285 x 245mm	Soundbar: 1015 x 71 x 105mm. Sub: 210 x 406 x 336mm	Soundbar: 990 x 110 x 100mm. Sub: 955 x 330 x 120mm	82 x 939 x 390mm	180 x 1005 x 167mm

Component Watch

If you have a lot to print, then one of these deals could be for you...

Once available only to the richest office workers, a colour laser printer might seem extravagant – but these days they almost qualify as affordable. Admittedly if you don't do a lot of printing they might not be much use, but if you run a home office or small business and want to print even one high-quality report or presentation in colour then it might be just as cost-effective to buy the printer yourself than to get it done professionally. If you're attracted by the siren song of high-quality colour print-outs, here's what you can expect to pay...

Deal 1: Ricoh Aficio SP C250DNW
RRP: £99.99 / Deal Price: £89.99

This wireless-enabled laser printer from Ricoh is one of the cheapest colour lasers on the market, capable of 20ppm and 2400 x 600dpi printing. It has an automatic double-sided printing feature as well as USB and Ethernet compatibility, and the first-page print time is a speedy 14 seconds. 1,000-page toner cartridges come included in the price. There's even a print & scan mobile app you can download. An ideal place to start.

Where to get it: Ebuyer - bit.ly/2f81vMX



Deal 5: Dell C1760NW
RRP: £131.98 / Deal Price: £89.99

Coming from a big-name printer manufacturer, Dell's colour laser is unfortunately pretty slow by comparison, printing at 15ppm in mono and 12ppm in colour, with 600 x 600dpi – but at least this one has networking and mobile device support. It does have high specs and Dell's hardware is always well-made, but ultimate it's still far behind even the cheaper models on the market. You have to decide whether it's worth it!

Where to get it: Ebuyer - bit.ly/2gCdKBO



Deal 3: Canon i-SENSYS LBP7010C
RRP: £175.97 / Deal Price: £101.84

Canon's name is virtually synonymous with printing, so you might expect their laser printer to be one of the best around. For some reason, though, you don't get quite as much for your

money when it comes to this colour laser. The print speed is just 16ppm, and although the resolution is a high 2400 x 600dpi, there's no built-in networking and the first page takes 14 seconds to print. There's also no mention of duplex capabilities. Still, you might want to stick with a reliable name and at least there's no danger of Canon disappearing from the market any time soon!

Where to get it: Printerland - bit.ly/2gn4rCY



Deal 4: OKI C301dn
RRP: £119.99 / Deal Price: £102.24

Only a little more expensive, the Oki C301dn has a free three-year warranty and wireless 'pocket router' adaptor to add wireless connectivity – though it can be used on other devices if you like! Printing is 22ppm in mono and 20ppm in colour, with a 1200 x 600dpi resolution and auto-duplex feature. It's compatible with airprint and has a first page print time of a super-speedy 8.5 seconds. The low-ish resolution does make it questionable whether it's worth this much compared to Canon's – we guess it depends on whether you've got use for that pocket router!

Where to get it: ComWales - bit.ly/2giljgs



Deal 5: HP CP1025
RRP: £149.99 / Deal Price: £129.99

Another big-name printer manufacturer, HP's cheapest colour laserjet is incredibly slow when it comes to colour (just 4ppm!) but manages a speedier 16ppm in mono. First page printing is a chugging 15.5 seconds, and the manufacturer warranty is only a year long. Combined with the 600 x 600dpi, it's hard to recommend given that it isn't even competitively priced. If you like to stick with HP, however, this is the cheapest model they offer.

Where to get it: Ebuyer - bit.ly/2gh5EtY



of the official handbook of the Marvel Universe”, in which Al and Paul attempt to reimagine some of the most ridiculous characters ever created in a way that makes them suitable for modern times.

Where the show really stands out, though, is whenever the pair need to talk about contract law or court cases, which happens relatively often given the history of the field. Their ability to cut through the noise and explain the actual law (and its consequences) shows just how valuable their insights can be.

URL: www.housestoastonish.com

Start With: Show 150, the recently released anniversary episode that will help you get to know the hosts.

The Fantasticast

The Marvel Universe began with the Fantastic Four, so there's some degree of sense to this podcast which aims to review and discuss every appearance of Marvel's First Family – in the order in which they were published. Not just the main series, but all of the spin-offs and guest appearances too. It's a project so massive that hosts Steve Lacey and Andy Leyland must be mad to attempt it, and in a way that's what makes it so pleasing. They're now more than 200 episodes through their task, and it shows no sign of abating yet.

The great thing about this podcast is that while it's notionally about just one specific comic, it's also got a lot of background material about the creators and characters, not to mention what else was going on with Marvel's publishing line at the time. Whether you're a fan of the Fantastic Four or not, there's a huge amount to enjoy. Each episode includes a guest presenter which will also help you expand your knowledge of comics podcasting. What's not to like?

URL: www.thefantasticast.com

Start With: Where else can you begin with a project of this type but Episode 1? Which covers, of course, Fantastic Four #1 from 1963.

Fat Man on Batman

Kevin Smith's independent movies were a big deal in the 90s, but lately he's reinvented himself as a podcaster and storyteller. On this podcast, he indulges his love of Batman in multiple different ways which are always good value for the listener. Sometimes, that means reviewing the latest Batman movie, but more often it's about reviewing and discussing the latest comic releases – though it occasionally veers wildly

off-topic, you'll never feel like your time was wasted.

Smith's profile gives him access to some particularly high-profile guests, and the show's archives are worth dipping into – it began life as an interview podcast with professionals who had worked on the character in any of his incarnations, from comics to cartoons to movies. You'll learn more about Batman than you ever thought possible by listening to this podcast, and take that from someone who's already a big comics fan. Just prepare to strap in for a long listen – Smith is a talker, and he doesn't leave any stone unturned when he's interviewing!

URL: www.smodcast.com/channel/fatmanonbatman

Start With: Episodes #32 & 33 – Kevin Smith interviews Jeph Loeb, the writer of celebrated graphic novel *Batman: The Long Halloween*.

Jay and Miles Xplain The X-Men

In a world full of characters with convoluted backstories, the X-Men have the distinction of being the go-to property for characters with convoluted backstories. If you've ever found a comic impenetrable, this podcast is for you. Each week, hosts Jay and Miles read an X-Men story and explain the concepts therein. It's a lot funnier than it sounds, trust us.

Each episode involves them covering a tonne of different concepts and characters, and a reader question section at the end allows them to answer your questions directly (if you've got any!). Sometimes they even have comic creators on as guests. Episodes are released weekly but have a running time of around an hour or so, meaning there's little danger of them building up too much. You can start basically anywhere, but it does help if you've got at least some knowledge of the X-Men before you listen – this isn't a good place for people with no comics knowledge to start!

URL: www.xplinthexmen.com

Start With: Episode 100 – *Unexpected Wonder*, with Chris Claremont, in which the pair interview the man who wrote virtually all the great X-Men stories.

The Word Balloon Podcast With John Siuntres

Interview podcasts are huge in some genres, but comics largely lacks its

own Marc Maron or Richard Herring. That said, John Siuntres is probably the closest thing to it as he interviews comics creators big and small about the things that influence them and their work, distant and recent. Whether you're interested in hearing from writers, artists or editors, they'll all have made an appearance here.

Siuntres has a background in radio, which means his podcasts are professional-sounding and his approach isn't negatively coloured by his own preferences and opinions. His knowledge of the craft of comics is equal to that of those he interviews, and the respect he has in the industry gives him regular access to the biggest names. Easily one of the most polished comics podcasts around, you'll never run out of material – some episodes run to three hours long!

Look out, too, for his occasional specials applying the same technique to his animation and comedy heroes! It's definitely a podcast for people with a voracious appetite for pop-culture, but comics in particular is the speciality, and that's where Siuntres excels.

URL: wordballoon.blogspot.co.uk

Start With: September 21, 2016 – *The Bendis Tapes*, in which one of the medium's biggest writers talks exclusively about how his comics and TV projects are going. [mm](#)





The Complete History of Home Computing

Part 6

James Hunt continues his journey through time...

In the sixth part of our complete history of home computing, we finally reach the 90s (just) – but not before we go through the tail end of the 1980s. Console gaming had become an accepted part of everyone’s childhood, but home computers were still part of a relatively fractured and niche market that was, at least, starting to consolidate itself. But what happened next?

1988

In 1985, Steve Jobs had been forced out of Apple. In 1988 he was back with a new computer: the NeXT Cube. In many ways, the computer was hugely innovative: it was cased in all black, rather than the grey and beige that had been popular until now. It had 8MB of RAM, which was far more than was common at the time. And it had three Motorola processors powering in it. It also

included a magneto-optical disk drive and was based on a completely new software system known as NeXTSTEP, which was object-oriented rather than procedural.

The NeXT computer wasn’t an especially huge hit in its own right, failing to rival the significant commercial success enjoyed by the Commodore 64 or Apple II, both of which it was trying to supplant. But it did sell reasonably high numbers of



▲ 1988: NeXT Computer (under CC by attribution licensed)

workstations to financial and educational institutions. Tim Berners-Lee famously wrote the first web server using a NeXT Computer at CERN, and later the first ever browser. The NeXT's software later formed the basis for a new version of Mac OS when Jobs rejoined the company – but let's not get ahead of ourselves...

1988 also saw the introduction of something most of our readers will be familiar with: the Creative Arts SoundBlaster. As the demand for high-quality graphics and sound increased, it was becoming clear to many that the IBM-Compatible, despite its power and popularity, was unable to keep up with the likes of the Amiga when it came to gaming. So it was that sound and graphics expansion cards became popular.

The SoundBlaster specifically would quickly become the industry standard, mostly thanks to the 'game port' it contained, which was a 15-pin connector for joysticks and other game controllers. The port previously existed on separate cards, but there was no particular standard for game controllers. This combination of sound cards and controller cemented the SoundBlaster and its technologies as the industry standard for gaming. The SoundBlaster and its spin-offs persisted for more than a decade as one of the best-selling expansion cards for the IBM PC.

But 1988 also marked the start of a much darker era for computing. Viruses had previously affected computers and worms had been demonstrated as proof of the concept, but this was the year that a malicious worm first had a major impact on

the internet, foreshadowing the deluge that was to come.

Developed by 23-year-old Robert T Morris, the son of a computer security expert in America's National Security Agency, the 'Morris Worm' was non-destructive but did manage to cause a significant number of problems because of its wide and rapid spread. Of the 60,000 hosts connected to the internet, around 6,000 became infected, severely impacting the web. As a result, Morris was the first person convicted under the 'Computer Fraud and Abuse Act', though he maintains he was attempting to estimate the size of the internet, not shut it down completely.

The episode did, at least, emphasise the importance of network security,

which until then had been considered a niche concern.

1989

The final year of the 80s involved a number of computing milestones, such as the internet growing in size to 100,000 hosts globally (though it'd be ten times that size in 1992!) and the defeat of chess grandmaster David Levy by the computer, Deep Thought (at chess, obviously).

But in terms of home computing? The release of the 80486 CPU was the real milestone, the first to contain a 64-bit floating point unit. Although 486 chips were similar to their 386 predecessors, the addition of an optimised instruction set alongside the (optional) FPU and enhanced bus interface gave it double the performance of the older chip even at the same clock rate, opening the way for more complex games and applications.

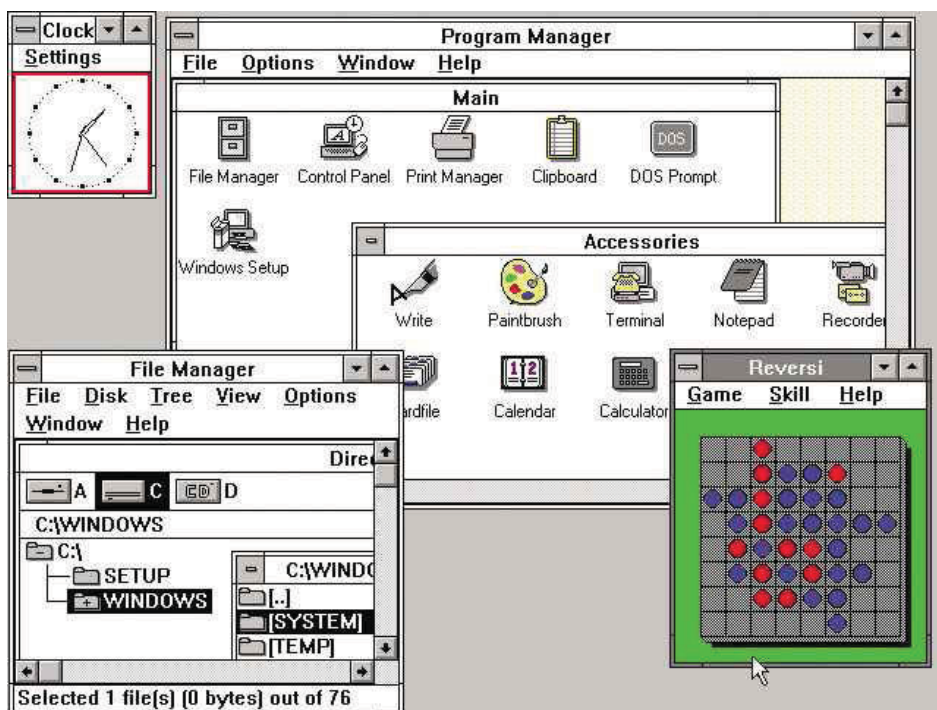
With more than 1 million transistors, the chip's abilities also made true multitasking a possibility for the first time – though it would be some time until operating systems supported it to the fullest possible extent!

Apple also introduced the Macintosh Portable, which could be (charitably) seen as the forerunner to the modern MacBook. The device was heavy – over 7kg – and expensive, costing \$6,500 at release. And despite praise from reviewers due to its impressive display, removable trackball and high-performance computing power, it was discontinued just two years later. Despite this setback, it's fair to say Apple wasn't entirely soured on the idea of portability...

Another company experimenting with portability were Nintendo, which released the first Nintendo Game Boy in 1989. Its



▲ 1989: Macintosh Portable (under CC by attribution license)



▲ 1990: Microsoft Windows 3.0 Screenshot

single-colour, 2.9" dot-matrix display was crude but effective enough to ship over a hundred million units throughout its lifetime – though many attribute the success not to the device itself, but to its launch game: the punishingly addictive *Tetris*. Nintendo's foray into handheld gaming means that almost 30 years later it's still the undisputed king of it. It just goes to show what a good start can do for your business.

In terms of things you interact with on a daily basis, however, the GIF89a standard was introduced in 1989. If that doesn't sound familiar, let's refer to it using its actual name: the animated gif. The standard also allowed GIFs to be transparent. While animated GIFs were first seen as a novelty, then later as an annoyance, their modern incarnation, in which they're big enough (and internet connections are fast enough) to display GIF-encoded video clips means the animated 'reaction gif' is now firmly cemented as part of modern life.

The nascent internet was still growing fast, of course, though for the most part it remained a closed, non-commercial network out of reach to the average home user. This began to change in 1989 when the first ever commercial ISP launched. Named 'The World', its first customer went online in November 1989 and the service still runs today, though it was never a particularly large outfit and indeed received some resistance from government and educational organisations following its launch.

It wasn't until the US National Science Foundation granted it permission to provide public internet access on 'an experimental basis' that it truly took root. Today it reports having around 1,750 active users, and you can still visit its website (which looks pretty historical itself) at www.TheWorld.com.

1990

While the internet had existed for years prior to 1990, this was the point where it truly became what it is today: in 1990, Tim Berners-Lee developed the idea of HyperText alongside Robert Cailliau at CERN, and by the end of the year had set up the first ever web server, which went live on Christmas Day, 1990. The idea was named WorldWideWeb. It's fair to say that's a term that's probably quite familiar to anyone reading this.

That wasn't the only invention of 1990, of course, but it's hard to see anything else that could be even a fraction as transformative. IBM's big release was the IBM 9345 hard drive, which was the first to use magneto-resistive heads allowing it to have denser storage. The result was the first 2GB disk drive – impressive at the time, but barely enough to run a phone nowadays!

Software-wise, there were a pair of big releases. Microsoft's was Windows 3.0, which was the first to be fully compatible with DOS software and good enough to actually give PC users the graphical operating system they'd been clamouring

for. The updated interface allowed it to run multiple programs simultaneously, even on a 386, including new versions of popular applications, Word and Excel. The IBM-Compatible PC could now properly compete with the more user-friendly Apple Macintosh, and – thanks for a considerably more open platform – its popularity increased as a result.

Meanwhile, Adobe released the first version of its new software package, Photoshop, after seeing potential in an early version of the software that had been used while co-writer John Knoll was a staff member at Industrial Light and Magic.

While the Apple versus PC war was still raging, Commodore bet its fortunes on the first major update to the Amiga platform. The Amiga 3000 featured an enhanced chipset called ECS and the second release of its operating system known as Workbench 2.0. Unfortunately, it had been five years since the release of the original Amiga platform, and enthusiasm had languished. The ECS was unable to compete with the PC and Mac's display hardware, and Workbench's updates failed to impress as well.

It didn't help that Apple had also secured favoured supply of Motorola chips, meaning the Amiga had to wait for new technologies. Although Commodore would rush out a successor to the Amiga 3000 after just two years, by now the platform was already on thin ice...

Elsewhere, Microsoft became the first company ever to exceed \$1 billion in sales despite a split with IBM over development of operating systems; ARPANET, the prototype internet, was officially decommissioned; and Godwin's Law – which states that the longer an online discussion goes, the greater the chance of someone being likened to the Nazis – was conceived by Mike Godwin on a newsgroup discussion.

Perhaps the thing that really set the stage for the future, though, was the development of a new PC standard: MPC stood for 'Multimedia PC' and was put together by Tandy and Microsoft, defined as a computer capable of running programs that combine video, animation, audio and graphics. These days, every new computer can meet such high demands, but in the 90s, the push towards multimedia computing would determine the shape of the next few years.

Come back next month to see how, as we explore the 1990s and the emergence of the IBM-Compatible as the dominant force in home computing. [mm](#)

Remembering...

Athlon 64 Processor

We look back at a time when AMD ruled the desktop

Up until 2003 64-bit processing in a computer was purely for servers, supercomputers and ultra-high end workstations. They were exceedingly expensive processors and really far too much technology for the standard consumer PC.

However, as with most technology, time marches ever on and the humble consumer PC started to use more memory, demand more from the processor and through operating systems and gaming, began to pull more resources from the system than ever before.

Add to that the falling cost of 64-bit processing and manufacturing and it wasn't long before the home user was able to build their own 64-bit powered PC. That was all thanks to AMD.

There have been instances of 64-bit processing appearing in the home before 2003, though. The Atari Jaguar, for example, used a 64-bit architecture and the version of the MIPS R4000 that Nintendo used within the N64 was certainly impressive enough to shift the pixels of the time. But for the PC, the Itanium, Z900 and POWER3 were the only true 64-bit processors on offer – processors that cost an arm and a leg and were only destined to live in the super-cooled environment of the server room.

In 2003, though, AMD brought us its new AMD64 architecture processors: the Opteron and the Athlon 64, the first x86 based 64-bit processors. It was a landmark event in personal computing and AMD

was suddenly riding on the huge wave of success that its new FX-51 1GHz processor brought to the consumer market. More memory could be addressed, 64-bit operating systems and programs could be used and 64-bit drivers and other APIs could be utilised to bring about a new generation of computing and gaming.

Its History

Originally codenamed 'ClawHammer', the Athlon 64 was designed initially to put a stop to Intel's continual release of higher clock speed processors. AMD was being hammered by its rival, with each new K7 processor released, Intel answered back within months with a CPU that added another 15 to 20% higher clock speed.

Although the K7 was holding strong against Intel's Pentium 3 line, the Pentium 4 with its even higher clock speeds to nearly 3.2GHz proved to be too much for the company. It simply couldn't match Intel's progression, even with the K7 refresh ships that surfaced for a while.

The new K8 range, though, effectively put a stop to Intel's dominance of the consumer CPU market. With a 64-bit architecture, SSE2 support, higher instructions per clock cycle and the genius idea of using an integrated memory controller, meant that the FX-51, the first Athlon 64 processor, was able to have a huge impact on the overall performance of a system.

Benchmarks of the time had the FX-51 performing almost as well as a P4 Extreme,

Did You Know?

- Due to the launch of the Athlon 64, 2003 to 2006 is regarded as the Golden age of AMD.
- Intel's Prescott processors, the rival to AMD's Athlon 64, in 2004 gave AMD a further boost by running so hot as to be drastically unstable.
- According to rumour, SSE2 code refused to run on Athlon 64's after Intel updated it with a 'GenuineIntel' string check.
- EU courts led a fact finding article detailing Intel offering cash rebates on buying Intel processors in bulk. AMD even tried to give away one million Athlon's to HP for free, but the company refused as the value of a million AMD CPUs would be less than the rebate value of the Intel Processors.

a processor that cost nearly six times as much. The 3DMark 2003 CPU score even placed the FX-51 higher than that of the P4 Extreme, which isn't bad for a CPU that only cost a few hundred when released.

Being able to support both 32 and 64-bit computing without having to resort to any kind of emulation was a kick to Intel's teeth. The Itanium, while good, was only aimed at the business market. What AMD did was bring in a processor that could effectively be used by both enterprise and consumer systems.

The technology used in Athlon 64 processors is still with us today, if not for AMDs push we'd never had enjoyed 64-bit computing as early as 2003.

The Good

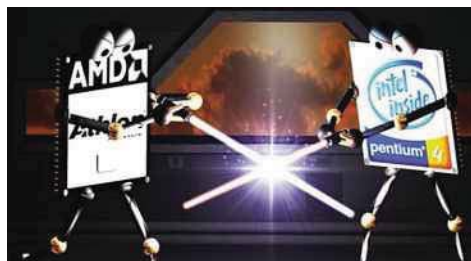
64-bit architecture, more addressable memory, fast memory controller.

The Bad

Single core when released, never improved much after the Athlon 64 X2. [mm](#)



▲ The Athlon 64 is regarded as the most important x86 processor release ever



▲ The battle between AMD and Intel heated up a fair bit during 2003 to 2006

RETRO ROUND-UP

It's that time of year again, **CPCRetroDev2016**, where Amstrad game-writers far and wide come up with new and original games in search of glory and cash. It's a great time to be an Amstrad gamer, everyone proclaims. But, unsurprisingly, **Dave Edwards** finds something to complain about...

Welcome to Retro Round Up, where we take a look at all that's new in the world of the computers of yesteryear. This week the whole article is dedicated to Amstrad CPC games that have emerged from this year's #CPCRetroDev2016 (<http://cpcretrodev.byterrealms.com/en/>) competition. It's the Amstrad's equivalent of the Eurovision Song Contest, and allows any publishers to enter their new Amstrad game for the chance to win not only 1,000 Euros in cash but something that money cannot buy - the respect of Amstrad gamers worldwide.

If you were reading last week's Retro Gaming News, then you'll already be aware that overall winner trophy went to *Outlaws*, a chaotic wild west shooting game. However, that was just one of 34 entrants to the competition. In previous years, some of CPCRetroDev's games have been reviewed in Retro Round Up, but in a rather piecemeal fashion - for instance, winner *Space Moves* (MM #1390), runner-up *Frogalot* (MM #1398) and third-placed *Top Top* (MM #1406). Some lower-placed entries also appeared in subsequent issues, and one of my pet gripes regarding all of them was the lack of instructions on how to actually load or play them. That situation has been addressed to an extent by this year's competition and downloading any of the games we'll look at here brings a zip file containing a tape-based version of the game, a disk-based

version, the instructions and, in some cases, a development diary.

Anyway, sufficiently buoyed by CPCRetroDev's own publicity, which proudly announced all entries had been of a supremely high standard, my initial intention was to look at all 34 games over the next four pages (challenging as that would no doubt have been). However, in order to do that I had to actually play them and I quickly came to the conclusion that no one outside of CPCRetroDev's 'generous' judging panel would share their enthusiasm for a great many of the entries at all. In fact, I'd describe many of them as something between mediocre and abysmal. As I've pointed out before, games do have to reach a certain quality before I give them column space and many of these simply do not!

In parallel with the countries who forward song entries for Eurovision, it would seem that CPCRetroDev attracts those publishers who take it seriously, and those who bung in half-finished programs still badly riddled with bugs and hope (vainly) for the best. Unfortunately, this year, far from being 34 entries of a supremely high standard, I'd say the duffers outnumber the genuinely good games by a ratio of about 3:1, which means that in bringing you this article I've been subjected to quite a few hours of incredulity at what CPCRetroDev2016 considered worthy of being in the competition in the first place!

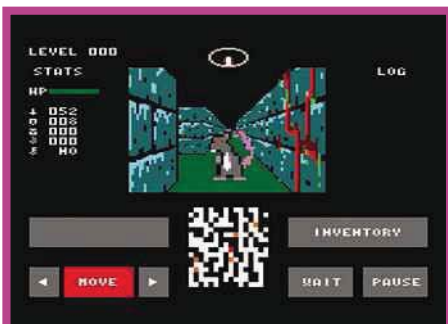
If you're interested in how the competition is scored, then the site itself has some

Amsthrees
Graphics 50%
Sound 88%
Playability 96%
Lastability 95%
Overall 82%

interesting information as to some of the Amstrad coding heavyweights who give their ten cents, but essentially what results is a Eurovision-style scoreboard with the winner at the top. When I tell you that five-screen platformer *Elliot* (by Approxbit) actually crashes when you fire a single bullet and still managed to finish at position 21 then you probably get a fair idea of the dross that's underneath that.



▲ *Amsthrees* is loading. Please wait...



▲ *What a cute little mouse*

Maze Adventure
Graphics 68%
Sound 44%
Playability 20%
Lastability 4%
Overall 34%



▲ *The grid fills up if you can't keep merging the tiles*



▲ *It's mano y mano on the ice.*



▲ *2:0 down already eh. It's only 40 seconds in*

Indeed, for my own ten cents, I'd encourage CPC RetroDev to adopt a more aggressive stance as to the standard of entries that it is, and that it is not, acceptable to enter for CPC RetroDev 2017. But the good news is that, by the time you get to the top ten, you do have a fairly varied and quite worthy set of contenders for the crown. And so it is to these contenders alone that I'll now turn, working from *Maze Adventure* which came tenth to *Hire Hare* which came second...

Maze Adventure (Piterayo)

Maze Adventure is from a genre of games called 'dungeon crawlers' and in its case, the term couldn't be more appropriate. This is certainly a game that crawls along. If I was feeling particularly vicious I'd say it moves at the speed of a depressed lemming who can't find a bridge to jump from. And add that, after a few hours of playing it, I was that lemming!

The screen is divided into a number of areas; your 3D view of the maze ahead takes up the largest part with level, health and compass indicators fairly intuitively placed. An

Pingu Soccer

Graphics 30%
Sound 57%
Playability 34%
Lastability 30%
Overall 38%

Ice Slider

Graphics 43%
Sound 60%
Playability 79%
Lastability 64%
Overall 62%

overhead 'teletext-style' map features below and scrolls in the appropriate direction as you take steps.

Perhaps the game's biggest failing is that, although it has copious instructions, it omits the singularly most important one of what you have to do. There are apparently 32 levels yet I never found my way off level one, despite hours of trying. I encountered rats and blobs, and manipulated the fiddly icon system when regular keyboard controls would have done just as well, but it felt pretty much futile when I didn't know what I was actually searching for.

It's a shame really, because the presentation, graphics and sound are extremely atmospheric. But, in my opinion, 3D maze games have never really had a lot going for them. Dressing them up doesn't disguise that.

Amsthrees (Glasnost Corporation)

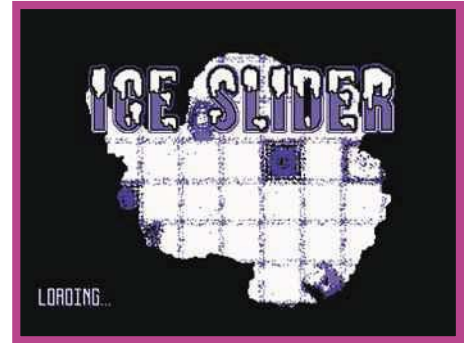
We've got games like *2048* to thank for *Amsthrees*, a sliding tile game where the objective is to make the highest multiple of three that you can.

Each time you move the tiles in the grid, those labelled 1 and 2 merge together, as do any pairs that are in alignment. A new tile of 1, 2 or 3 is also introduced to the grid as well, so if the move does not result in at least two tiles being merged, it starts to fill up. A good strategy is to try and keep your highest number in the top-left corner and build its pair in the square below. Employing this technique I seemed to get higher numbers.

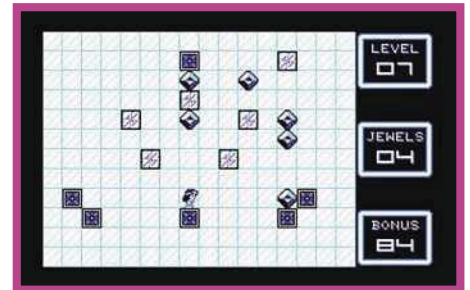
Amsthrees has a nice soundtrack and the tiles scroll smoothly. Obviously it doesn't have much in the way of graphics but it does have bucket loads of addiction. When you lose, it's very tempting to immediately try again. As with *2048*, you could easily lose swathes of your lives playing this one!

Pingu Soccer (PanZ)

Pingu Soccer is a soccer game between two penguins that is shown from overhead. The aim of the game is to score goals by getting the ball into the goalmouth. However, as the game takes place on a sheet of ice, it's a lot more difficult than a regular soccer game.



▲ *Another Ego-Trip game is loading.*



▲ *Now pause and consider your next move*

The biggest problem is to keep control of the ball. Sliding around the arena you can get near to it easily enough but the direction you are facing when you make contact, combined with the velocity your penguin is travelling at, is transferred to the ball. Your computerised opponents have a much better understanding of how to make the physics of the soccer rink work in their favour. So expect to have your penguin ass kicked the first few times you play.

There's a two-player option, as well as a configuration section. In all, it's reasonably enjoyable but nothing to write home about.

Ice Slider (Ego-Trip)

Princess Amy is the heroine of many of Ego Trip's games on the Amstrad and her adventures continue in *Ice Slider*, a game which features the phenomenon I call propulsive movement. By which I mean when you move her left, she doesn't stop if you release the joystick but only when she is stopped by a maze wall.

The Grenades Conquest

Graphics 53%
Sound 60%
Playability 64%
Lastability 75%
Overall 63%

Her task in *Ice Slider* is to clear each successive screen of doughnuts without getting caught in constant horizontal or vertical propulsion. So think hard before you move her - especially when the new screen appears for the first time. Try to assess which blocks of the maze can be best used to allow her to collect the doughnuts - and which will get her into a loop that she cannot escape from.

Ice Slider is quite cute and rather simplistic, but it's fairly addictive and working out the correct routes across each screen can be very rewarding. I'm not sure how many there are in total but, needless to say, they get progressively harder to complete.

The Grenades Conquest (SubXplosion)

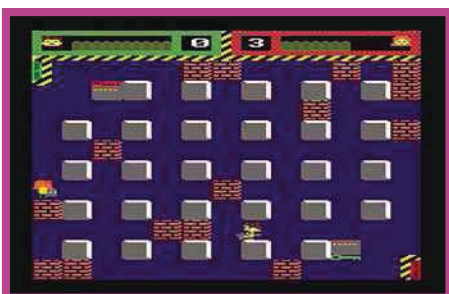
There aren't a lot of two player only games for the Amstrad, so, if you want to take on your little brother or your girlfriend, there's only a fairly limited choice. *The Grenades Conquest* adds one more game to that short list, and offers you the opportunity to either hunt down the other player and blast him with a grenade launcher or, alternatively, to steal a key from his base and make good your escape.

The game works on the 'best of nine' principle, so the first player to either steal five keys or massacre his friend five times is crowned winner. The two characters move speedily through the maze and can even occasionally outrun the other's slugs.

Of course, the game is limited if you can't find a mate to play with, and on one occasion there seemed to be a bug that caused one of



▲ Opening options for *The Grenades Conquest*



▲ Two player only, it's quite fun



▲ Didn't Rihanna sing about this boy?



▲ Success! Look how happy he is!

the characters to stop firing for a short time. But other than that, there's nothing to criticise.

Hair Boy (Carlos Sevilla)

It's *Hair Boy!* Let's see what he's all about. Hmm...

"Hair Boy was born with strong, sticky blonde hair but sadly with no arms or legs. Hair Boy loves nothing more than tossing his sword around and then retrieving it again. Help reunite Hair Boy with his sword throughout 78 crazy screens of fun."

So, in fact, a better name for Hair Boy would be Sticky Hair Head. What you have to do in the game is to use the hair's sticky properties to climb walls and beat through bricks. There's actually not too much more to say than that - screens require a combination of dexterity, timing and, on occasion, a fair amount of good luck. The sticky hair makes for an unusual game mechanic, allowing you to slowly bounce up what appear at first to be unassailable walls - and of course to recover from falls if you jump from one to another but don't quite make it.

Hair Boy
Graphics 35%
Sound 50%
Playability 56%
Lastability 41%
Overall 45%

Dragon Attack
Graphics 84%
Sound 75%
Playability 90%
Lastability 66%
Overall 79%

Screens get tougher - but there isn't really the variety needed to sustain interest. Without any real hook factor, it's too easy to tire of the concept and look elsewhere.

Dragon Attack (Bitplane Technomantes)

Dragon Attack is a superb little game released by Bitplane Technomantes. In it, you've been volunteered to defend the Earth - yes, again - this time from Star Dragons. And believe me, one Star Dragon is about ten times more vicious than the most hardened fleet of Space Invaders.

Star Dragons keep at the very top of the screen and pepper the whole playing area with arcs of bullets. It's your task to destroy them and avoid colliding with anything that moves - a task that needs fast reactions and a lot of concentration. What prevents it being impossible is some generous collision detection and the ability to turn on a nice auto-fire function.

Graphics and control are first-rate. The soundtrack is also awesome and sounds a



▲ Interesting ASCII combinations on the menu screen



▲ Intricate swirling patterns in the game proper



▲ This dog is grumpy



▲ The black tiles need to be inverted

little like *The Terminator* theme. Even the intro is suitably atmospheric, doing some clever things with ASCII characters that I've never seen elsewhere.

Dragon Attack is fast and frantic, and the amount of work that's gone into it is clear for all to see. Bravo!

VirusDog (CPC Power)

VirusDog is a tile-matching game which requires you to engage your brain and try to think many moves ahead. The task before you is to clear each successive grid of 'virus' tiles and you move a cursor to any tile, press Enter and then fling it in any direction. If it hits a tile which is identical, both tiles disappear.

The difficulty is that tiles can also be inverted if they collide with a different type of tile. An inverted tile needs to be matched with an identical tile or inverted again by throwing it into another to put it back as it was. If this sounds difficult to follow then just play the game - it quickly falls into place.

VirusDog

Graphics 44%
Sound 63%
Playability 72%
Lastability 74%
Overall 64%

Hire Hare

Graphics 61%
Sound 73%
Playability 40%
Lastability 66%
Overall 60%

As puzzle games go, *VirusDog* is reasonably taxing, with a steady increase in difficulty balances with the game's guarantee in that all of the grids can be solved in six moves or less. If you like reversi, mah jong and chess then this is going to be pretty addictive fair.

Hire Hare (CNG Soft)

Hire Hare is a colourful isometric game in which you play the Sorceress Hecatia on a dungeon crawl to find nine black lamps. It comes from CNG Soft.

The dungeons are filled with dragon trophies that spit fire across your path and patrolling nasties of different types. Colliding with anything that moves reduces Hecatia's energy level, shown on the right of the screen. Some screens also have little arrows that indicate they join to others.

As well as walking and firing, there are objects like barrels, chairs, tables and blocks scattered around that get in the way and can be pushed, pulled and jumped upon.

The main issue with *Hire Hare* is the collision detection - it seems to take a heck of a lot of work to simply position Hecatia safely, particularly in relation to fireballs which seem to make contact when they shouldn't. A secondary issue is that it's quite a tedious trek through the dungeons, which seem all-too-pretty into the bargain.

There's nice music throughout but it's not an intuitive game to play and it's hard to work out when you're on the right path or when you're just wasting your time. Those who persevere, however, may find it holds a few secrets I haven't found.

Final Scores

I covered the winner of CPCRetroDev2016 - *Outlaws* (by Retrobytes) - in detail last issue. I only awarded it an overall mark of 49% which I still stand by, mainly because its third level is an incoherent mess of graphics that it's impossible to pick out the crosshair against. Interestingly, therefore, while I broadly agree that the games that made it into the 'official' top ten are correct, my own top ten places them in a completely different order and *Outlaws* scrapes only seventh place:



▲ No title on Hire Hare's loading screen. Right...



▲ I wonder if that guard is friendly...

1. Amsthrees	82%
2. Dragon Attack	79%
3. VirusDog	64%
4. The Grenades Conquest	63%
5. Ice Slider	62%
6. Hire Hare	60%
7. Outlaws	49%
8. Hair Boy	45%
9. Pingu Soccer	38%
10. Maze Adventure	34%

The difference is, of course, because of the different scoring systems. Here at Micro Mart, we still score the old way, whereas the judges award points for technical achievement, originality and all that jazz. But, considering I've already played Amsthrees long into the night for a week now, it's clear to me anyway that Glasnost Corporation (Amsthrees) was robbed of its 1,000 Euros.

That's All Folks!

On that controversial note, let me round off this look at CPCRetroDev by announcing that this article is in fact 'not the end'. Masochist that I am, I am actually putting together a video 'CPCRetroDev2016: The Verdict' with a few of the other entries that didn't make the official top ten, and a look at the also-rans that I could stand for longer than a few minutes. As Terry Wogan would have said, 'Keep a wary eye on the Everygamegoing home page' for further details... [mm](#)



Are Millennials More Likely To Fall For Tech Support Scams?

Younger people know what they're doing with technology, right? A Microsoft survey suggests that might not entirely be the case. Sarah Dobbs finds out more...

There's a stereotype for the kind of person who falls for tech support scams. You know the one: when you think about tech support scams, you imagine the person picking up the phone as nervous, not particularly tech-savvy, and probably in an older age bracket. Old enough not to have grown up with computers and the internet, but old enough to have learned to use a computer at work, probably. The kind of person who has a PC at home, but probably has their password written down on a Post-It note stuck to the monitor, because they don't use it often enough to have committed it to muscle memory. You definitely wouldn't think of the so-called 'digital natives'. The generation who grew up using computers every day at school would know better, surely?

According to a new survey, though, that's not actually the case. Microsoft's Digital Crimes Unit carried out a massive global survey into tech support scams, and its findings were pretty shocking. Not only did the survey reveal that two-out-of-three people surveyed had experienced the scam over the last year, but one-in-five fell for the scam and continued the interaction after being contacted... The real kicker, though? Of those, a whopping 50% were millennials, aged 18-to-34.

You'd think that age group would know better. They've literally grown up with the web, using it on a daily basis, on a variety of devices, without even really thinking about it. Warnings about

“ 13% of people who filled out the survey admitted to having fallen for this kind of scam ”

scams and crime have been everywhere for their entire lives, and you'd expect by now most people in that bracket would have a pretty good sense for when someone's trying to rip them off.

So what's going on? How has this happened? Are the scams getting sophisticated enough that they're more difficult to avoid? Have people got complacent? Are you in danger of falling for a fraudster's lies? Time to dig deeper...

The Survey Says...

Let's start with the headline findings of Microsoft's survey. So, two-thirds of respondents reported coming across a tech support scam, and of that two-thirds, a fifth continued with the interaction – by which, Microsoft means they either downloaded software on instruction from a scammer, or visited a scam website, or allowed scammers to access their computers, or they handed out their credit card or PayPal information.

If we do the maths on that, that means some 13% of people who filled out the survey admitted to having fallen for this kind of scam. Extrapolate that out to everyone who owns a PC, and that's pretty enormous. Microsoft clarified, too, that almost one-in-ten-people had actually lost money to a tech support scammer, which again seems like a huge number.

Now let's look at the demographics. 17% of the people who admitted to continuing a fraudulent transaction were over 55, probably the group you'd expect to be most vulnerable to this kind of scam, but a full 50% were 18-44. We're talking about teenagers born in 1998 – a generation too young to remember a world before mobile phones and wi-fi – falling for one of the oldest tricks in the cybercriminal book.

The survey revealed some other interesting stuff, too: that respondents in the United States, India, and China were the most likely to continue fraudulent transactions; that 55% of people who continued with a scam went on to lose money; reassuringly, though, 92% of the people who reported being scammed in the US managed to recover at least some of their money. None of that seems anywhere near as shocking as the age thing, however. Seriously, what's going on there?

Microsoft Calling

It probably makes sense to define what we're talking about here, before going any further. First reported in 2008, the classic version of the tech support scam involves a fraudster calling a potential

victim and explaining that they're from 'technical support'. Often they'll say they're specifically from Windows technical support, but not always. There's something wrong with the victim's computer, they'll say. They've downloaded a virus, or they need an update or something else that sounds scary and urgent. In order to fix their computer, the victim should follow their instructions.

There are a few different ways the call might play out from there, but generally the scammer will try to bamboozle their victim by making them open random things on the computer and telling them what they're seeing is evidence of something wrong, before directing them to a website to download a program to fix the supposed problem. That program will generally be malware of some flavour, maybe a key logger or a remote access program that gives the scammer control of the victim's computer. One way or another, the scammer will find a way to persuade the person to hand over their credit card or bank details to pay for the 'support' they've received.

It's a particularly nasty confidence trick that can have pretty devastating consequences for the victims. The scammers might extract huge amounts of money from their victims, or leave nasty programs running on their computer, or both, and the whole thing is likely to leave them with a feeling of vague distrust towards their computer and anyone who claims to know how to fix it.

Yet, while this type of scam still happens, this isn't the version that the younger generation tend to fall for. Partly, that's because they've been warned; partly, it's because a lot of millennials dislike talking on the phone in general and won't get drawn into long conversations with strangers on the phone in the first place. Just because they don't answer their phones, though, doesn't mean the younger generation is immune to this kind of scam, as the stats showed.

Evolution Of A Scam

Over the past eight years, scammers have refined their technique, and now they contact their victims in other ways than just over the phone. Now, they send emails, or use pop-up or banner adverts on websites, or even hack reputable websites to redirect visitors to their own sites. There's a huge difference in how older people report having come into contact with such scams and how younger ones do: 44% of over-65s were contacted via phone, while only 26% of millennials were; instead, 59% said they'd come across a dodgy pop-up ad, and 50% had been redirected to scam websites. If you're still trying to do all the maths in your head, you'll have noticed that adds up to more than 100% – that's because the survey let respondents record multiple different ways they'd had contact with scammers, where appropriate.





“ having grown up always using a computer might make people more susceptible ”

However the scammer makes contact, the interaction plays out in much the same way: the criminals attempt to use their victims' fear and ignorance of their computer against them, pushing them into downloading software that hands over control of their computers allowing information to be stolen, anti-virus programs to be turned off, and more dodgy software to be installed – often leaving a back door in the victim's computer, so they can come back later and check for more info. It's the same scam, it's just that instead of a stranger on the phone telling you your computer's broken and you need their help, it's a message in an email, or on a website, telling you that something has been detected and needs to be resolved immediately.

IT lessons

So why is it that younger people are falling for this scam in such high numbers? This is the point where we have to start speculating, because there doesn't seem to be a straightforward answer. It may, however, have something to do with the way computers have become commonplace now. Ironically, having grown up always using a computer might make people more susceptible to this kind of confidence trick.

Think back to when you got your first computer. Did you build it yourself? Did you do a ton of research into what kind of system you wanted? What kind of system was it, anyway? If you're a regular reader of this magazine, you've probably read about the pros and cons of various different brands of motherboard and graphics card; you'll have read dozens of tutorials explaining how to keep your computer cooler, or how to squeeze extra performance out of it. You might be a Linux user, which would immediately tell you someone claiming they knew about a fault with your Windows PC was a scam, even before they got further than introducing themselves.

Obviously, I can't claim to know how old you are or what your experience with computers is; we've got readers of all ages, and many different levels of experience. Full disclosure: I (just) fit into the category of millennial we're talking about being most often scammed here, though only just, and I can remember going to an independent computer shop to get my first PC built when I was heading off to university. While this is partially anecdotal, I'm sure it used to feel like you used to have to know about computers and how they worked ten or twenty years ago. If something went wrong with your PC, you might have an idea of how to fix it, or you knew someone who did.

Now, though? Well, since 2003 sales of laptops have outstripped sales of desktop computers, and in 2015 sales of tablets overtook sales of laptops and desktops combined. And let's face it, no-one (or virtually no-one – there's bound to be someone out there) is building their own tablet at home. Enthusiasts, like readers of this magazine, still know their way around a computer's innards, but for most people, what's inside



their computer's case is likely a complete mystery. More people use computers more often than ever before, but that doesn't mean they know more about them. Computers are just tools now. By-and-large, we're more interested in what they can do than what they're made of, and that could be making people more vulnerable to scams.

If you don't know how your computer works, you're vulnerable to someone claiming they know more than you do, and when they're telling you to look at something that makes no sense to you, you're going to believe them when they say they understand it. That's dangerous.

“ Computers are just tools now. By-and-large, we're more interested in what they can do than what they're made of ”

Social Engineering

We're all also much more familiar with downloading things from the internet than we used to be. Streaming movies and music is commonplace, and various pieces of software are always popping up dialogue boxes asking for permission to download and install updates. When another box claims to need to do something to your PC, it might not look markedly different from every other dialogue box that's popped up recently.

Then, there's the fear aspect of the scam. Now that we're all so reliant on our computers, both in our working lives and in our social lives, the idea that something might be wrong is kind of terrifying. The scammers use that fear to their advantage, hoping that fear will override reason and that, if they make the situation seem urgent, their victims will respond to their prompts because they don't have time to think their way around it.

It's even possible that the more we talk about malware and cybercriminals, the more effective these kinds of scams could become, because people are already on high-alert regarding the possibility that something could be wrong with their computer. In this state, a pop-up, email, or phone call just confirms something they're already afraid of. Thinking of it this way, it's easy to see how victims might then feel they should follow the instructions as quickly as possible to take back control of the situation. That's what makes this kind of scam so insidious.

While scammers promising a share of massive international bank transfers appeal to victims' greed, this one appeals to victims' fear, and offers them false reassurance that everything will be okay if they just do a few simple things.

Watch Out

If reading about how many people fall for these scams makes you a bit nervous, well, maybe it should. With these kinds of things, it's easy to think that they happen to other people, but while the stats show that younger people are disproportionately represented among victims of tech support scams, it's still a kind of fraud that affects people of all ages, all around the world. In fact, Microsoft surveyed people in Australia, Brazil, Canada, China, Denmark, France, Germany, India, Singapore, South Africa, the United Kingdom, and the United States on the matter, which makes it patently obvious that this scam is a pretty widespread con.

So how do you spot a scam? Firstly, if someone calls you claiming to be from Microsoft, you're almost certainly being scammed because that's highly unlikely to ever happen. You could ask them a bit more about why they're calling if you're not sure; scammers are usually pretty vague, relying on you being too panicked about the potential threat to your computer to listen to the specifics. Stay calm, and pay attention to what they really say. Ask if there's a fee for what they're offering. If they say yes, hang up. If they want you to install something on your PC that you haven't asked for or ordered, hang up.

The same thing applies if you come across an email or pop-up. No-one's going to email you if you've got a virus, you can just send those emails to your Spam folder. If you see a pop-up alert, check where it's coming from. If it's from your own security software, you should take it seriously, but if it's in a browser window, it's a scam. Don't click on banner ads on websites that claim to have detected a problem – they're scams. And if you're visiting a site you know well and trust, but something looks strange, don't enter any personal details. The site might have been hacked, or you might have been redirected to a phishing site. And again, that isn't because your computer is at fault, it's because the scammers are hoping to persuade you that there is so that they can take your money.

As always, a bit of common sense, and taking a moment to properly evaluate what someone's telling you, could be invaluable. But if you do fall for a scam, don't be too scared to ask for help or to report it to the authorities; criminals make their livelihood off people's trust, and you shouldn't feel embarrassed. There are a lot of other people out there in the same boat as you, but by reporting it you might be able to recover anything you've lost, and also contribute to stopping more people getting scammed in future. **mm**

How To Report Scams

If you are contacted by a tech support scammer, there are a couple of places you can report it. In the UK, Action Fraud is the organisation you want: head to www.actionfraud.police.uk/report_fraud and you can fill out a report that will be sent to the police if appropriate. If the scam purports to come from Microsoft or be associated with Windows, you might also consider reporting it directly to Microsoft, here: www.microsoft.com/en-us/reportascam/.

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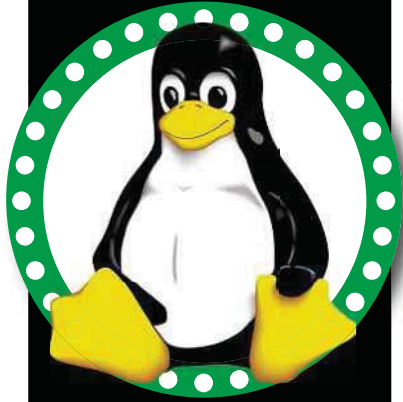


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Microsoft And Linux, Hand In Hand

Hell freezes over as MS joins Linux Foundation

I'm pretty sure that, should you have said to a Linux user a few years ago something along the lines of 'imagine if Microsoft joined the Linux Foundation...' the response would have involved the words 'cold day in hell'. Well, it looks like The Pit has just frozen over.

A couple of weeks ago, indeed, Microsoft joined up and took Platinum membership

some users have commented that "MS couldn't destroy Linux from the outside...", "It's the beginning of the end for Linux...", and, "MS will take all it wants, then dump the rest..." Needless to say, there are an equal number of positive contributions to the various forums and conversations going about.

So what does it mean for a future of Linux and Microsoft?

Terminal Weather

Did you know that by entering curl <http://wtr.in/city>, replacing city with where you live, you can have a live and two-day forecast weather report right in your Terminal? Don't forget to create an alias if you use it frequently.

Terminal Email

Enter 'sudo apt-get install mailutils', followed by mail and the email address of the recipient and you'll start an in-Terminal email app.

Terminal Interwebs

While browsing the internet via the Terminal isn't all that useful for most modern GUI Linux distros, I'm fairly sure it'll come in handy for those without a desktop.

Enter 'sudo apt-get install Links', followed by link forum.micromart.co.uk/Default.aspx, to view the Micro Mart Forum in the Terminal.

Any more?

I have a few more to look into, but in the meantime if you have any interesting Terminal commands please let us know.

▼ *Microsoft joins the Linux Foundation. Pigs do fly!*

David Hayward has been using Linux since Red Hat 2.0 in schools, businesses and at home, which either makes him very knowledgeable or a glutton for extreme punishment

“ Steve Ballmer once colourfully described Linux as 'cancer' ”

in the Linux Foundation. A move that would have been impossible back in a time when Steve Ballmer colourfully described Linux as 'cancer', it shows how recent Microsoft behaviour has seen it lurch in the opposite direction, and its new-found love for Linux.

As Jim Zemlin, executive director of the Linux Foundation told eWeek. "This is a good day. There was a time when the software industry, in general, was defined by rivalry and a zero-sum game mentality.

"The biggest thing that open source and Linux has proven over the last 25 years is that sharing works, and you can better yourself and others at the same time."

It's an unprecedented step, that's for sure, but not everyone seems to be getting onboard. Although only individual voices in the crowd,

Will we likely ever see a Linux-powered MS OS, or vice versa? Who knows, and if they do have plans the create such a thing somewhere down the line, they're keeping it pretty close to their chests for now.

Terminal Fun

I've been messing around in the Terminal again recently, and discovered a few interesting features that I haven't come across before:



The Story Of Apple

The iBook was great. The MacBook's fab too. But Apple's new photo book? No thanks

Apple is frequently criticised for no longer having the capacity to surprise. Commentators gripe that everything the company reveals is an iteration on something that already existed. Even relative quantum leaps, such as Apple Watch and iPhone, are hand-waved away as rethinking something that's gone before. That most companies do this is, and that this is what Apple's done since its foundation is, apparently, neither here nor there, and appears lost on people more intent on clickbait headlines than pesky fact

With its book *Designed by Apple In California*, though, Apple has lobbed a curve-ball, beaming anyone in their right mind. That's because, despite the book being a beautiful object in its own right, it points at everything that's wrong with Apple while attempting to celebrate what the company does so well.

If you've not chanced upon the product, it is a photo book that was first unveiled in mid-November. The large-format tome covers products from 1998's iMac through to 2015's Apple Pencil. It comes – amusingly – in two sizes: large and small. Price-wise, though, it veers very much towards the large: even the more affordable version is £169. Fancy the bigger one? That's a whopping £249. Oh, and you'll need to travel to London if you live in the UK, because it's only for sale in the Regent Street and Covent Garden Apple Store branches.

There is nothing wrong with a beautiful book. In an age of ephemeral digital content, having something that represents a moment in time,

and that's a gorgeous artefact in its own right, has meaning. While people might argue Apple's sense of adventure in design evaporated when Jony Ive discovered the rounded rectangle, there are aspects of Apple hardware that showcase an attention to detail and beauty that few other companies could hope to match.

However, the more you look into this volume, the more you might wonder who it's for. It has beautiful photography, sure, some of which explores the innards of Apple's devices rather than only what you see on the surface. Delving into the Cube, for example, reveals a machine ahead of its time, and that is unfairly branded an Apple flop. Those photos are all there is, though – bar a foreword from Apple design chief Jony Ive, there are no words and no context. In a video about the book, Ive talks of how it tells stories, but those stories must be imagined. There are no designers providing insight into their process. Many pages look like Apple marketing posters with the text removed.

This is deliberate. Ive explains that the book is “not about the

design team, the creative process or product development”. He says it's “an objective representation of our work,” noting that Apple has “always hoped to be defined by what we do rather than by what we say”. This lack of context, massive price tag, and limited distribution, can't help but make the book feel like it's ultimately a vanity project encompassing Ive's penchant for minimalism – to the detriment of everything else.

This is an object that isn't widely accessible, and isn't about helping people understand; it's instead a niche photo book for the wealthy. It showcases an Apple out of touch and simultaneously oddly increasingly obsessed with its past. That the book is “dedicated to the memory of Steve Jobs” is especially ironic, given that this is the kind of navel gazing he abhorred, as evidenced by his dispassionate decommissioning of Apple's icon garden and Apple Museum in the late 1990s. One imagines he'd have been keener for Apple to get on rethinking the future rather than spending time making an expensive, elitist book about its past.

▼ *We'd rather Apple got on with new MacBooks than paper books*



Craig Grannell is a writer, designer, occasional musician and permanent loudmouth. He's owned Macs since 1996, when Apple was facing certain doom, and is therefore pleasantly surprised by its current success. Find Craig on Twitter at @craiggrannell

MIAC



Another One Bites the Dust?

Ian McGurren gives a brief history of the BlackBerry

Ian is a professional IT analyst, a semi-professional writer and a pretty amateur electronic musician. He likes gadgetry and loves making gadgets do things they were never designed to do

Mobile

2016 – a year of unexpected tragedies, twists and turns. Of all the things you wouldn't have predicted this year, surely it's the recent decision by BlackBerry to move away from hardware to software only that's was most unexpected?

No? Well, in the big scheme of things, it's more of a surprise when BlackBerry releases a new handset these days, but ten – even five – years ago that news would have been greeted with disbelief. It's easy to forget that BlackBerry was once one of the kings of the mobile world, all set to rule over all until that phone came along. Let's take a look at some of their hits – and misses – along the way down.

As a measure of how far back BlackBerry devices go, the first device (when the company was known as Research in Motion – or RIM) was a fancy pager, the 800. The difference with the 800, though, was the BlackBerry's killer app: email. Taken for granted now, two-way email on the move, with a QWERTY keyboard, in 1998 was groundbreaking, and allowed workers to be contactable out of the office, for better or for worse. This over reliance on staff outside of normal hours gave rise to the term 'CrackBerry', such was the addictive nature of the communications device. For all its positives, though, the 800 was a bit of a brick, but its replacement, the 850, was much more manageable and found great success.

The first true phones came a little later, with 5810 (that needed a headset to take calls),

then the 6200, arguably the first 'typical' BlackBerry device. This device was not only a phone, but also retained the email and web browsing abilities, adding in faxing, SMS and more, all of which – in 2003 – meant RIM was far and away more popular than the then clunky Windows Mobile, and more popular in the USA than the Nokia Communicator devices.

While BlackBerry devices had mostly found their footing in enterprise arenas, in the mid-2000s their popularity started to grow among the new generation of tech-savvy teens. In this MSN Messenger-dominated, pre-smartphone market, it was the combination of chat clients, along with the then brand new BlackBerry Messenger, which made BlackBerry, briefly, the choice of mobile smart device for much of the USA. At the same time colour displays and shells made their appearance, as did a series of variations on the now-iconic BlackBerry keyboard, including the T9-like oddity of Suretype.

Then came possibly the best recognised of all the RIM range, the enterprise-favoured BlackBerry Bold and the more consumer BlackBerry Curve. Both still unmistakably BlackBerry devices, complete with that keyboard, they were both the best that RIM could offer but also showed how far behind the smartphone curve they were at this point. Neither had touch interfaces and RIM's BlackBerry World app store was sparse and expensive.

So, while consumers fell away, at this point enterprise has not yet given up on the devices, especially as they offered then unparalleled security. It wasn't long, though, before Apple, Google and Samsung began to take enterprise needs very seriously and move into its territory. Even with its massive financial clout, Microsoft struggled to match those advances, so RIM stood little chance. It needed amazing hardware – instead it had the PlayBook, the firm's first, and last, tablet. Between that and the BB10 powered Z-series smartphones, RIM's bolt was truly shot.

Ironically, one of the best BlackBerry devices came after this. The Priv being a classy Android slider that, had RIM taken that fork in the road some seven years before, could well have been the norm and not a final burst from a dying star. Now RIM is just BlackBerry and the devices that bear their name are no more than rebadged hardware with BB security. Whether it will even survive this is yet to be seen. Right now, like Nokia, it's a story that's another testament to how easily the mighty can fall in the mobile world.



Timely Excuse For A Crucial Upgrade

Andrew Unsworth finds a reason to check out the Crucial MX300 SSD

I've been inwardly complaining about the capacity of my SSD for a while now. It's around 223GB when formatted, which would be fine if it was installed in an 'office' computer, such as my laptop. However, the SSD is installed in my big PC that's used to host games, music production software and various overclocking and benchmarking utilities. As it is, the used capacity of my SSD is, or rather was, 208GB.

Thankfully, a recent request for a PC build has meant that I've had the opportunity to swap it for a new 750GB MX300. The MX300 series is Crucial's flagship SSD, with the MX200 and BX200 now regarded as legacy models. The Crucial MX300 is a 7mm SSD that uses the Marvell 88SS1074 controller and 3D NAND flash memory to deliver a claimed 92K (read) and 83K (write) input/output operations per second (IOPS), for the non-275GB capacity models.

The 275GB model produces a claimed 53K IOPS for read operations. The MX300's claimed sequential read and write speeds are 530MB/s and 510MB/s (500MB/s for the 275GB model), respectively. Some capacities are available in the M.2 form factor.

One of the annoyances with upgrading a hard disk or SSD is having to reinstall everything, including the operating system and drivers. Thankfully, this is less of an issue these days, and disk cloning software is widely available, and sometimes bundled with new drives.

In the case of the MX300, the retail version comes bundled with a serial number for Acronis True Image HD, which allows users to clone their existing hard disk or

SSD and apply it to the new Crucial SSD. This adds real value to those who want to upgrade their hard disks or SSDs, but don't want the hassle of reinstalling Windows from scratch.

You'll need some method of connecting your new SSD to your existing computer. If you're upgrading a laptop, the SilverStone SST-EP02 is a good option. If you're upgrading a desktop PC's hard disk or SSD then you can always plug the new SSD into a spare SATA port, assuming it's a SATA device.

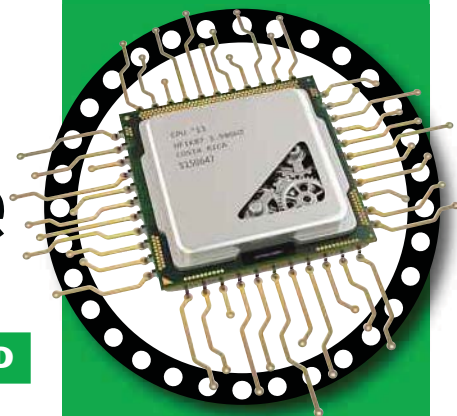
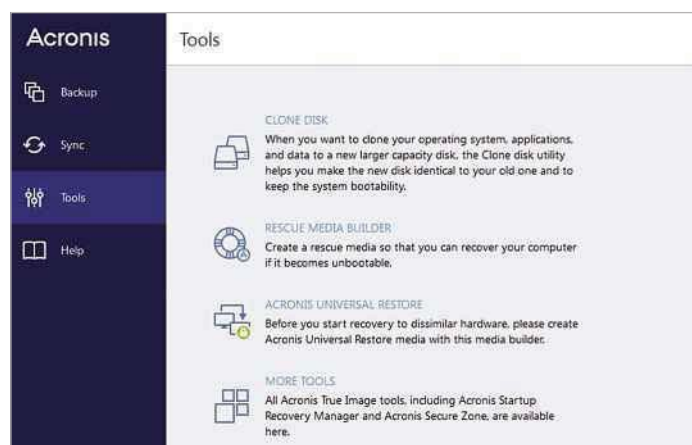
Once I'd installed Acronis True Image HD on my PC, I had to create a user account in order to use it, which was irritating and is something you don't have to do with Samsung's Data Migration tool. Nevertheless, once everything's set up you can choose the source disk and the destination disk and then start the cloning process.

Acronis then prompts you to restart your computer so that it can boot into the disk cloning utility rather than the PC's operating system. The transfer took around 23 minutes to clone 208GBs of data from a

240GB Corsair Neutron to a 750GB Crucial MX300 over a USB3 connection, and it completed without a hitch. I've installed the clone in my PC and everything is working fine.

I have no complaints about the process, other than having to create a user account. As a bonus, the version of Acronis True Image bundled with the MX300 does have some neat tools, such as backup, besides the disk cloning utility – even though it isn't the full version of True Image, and a handy lock icon tells you which features are unavailable in the bundled version.

I haven't benchmarked the disk yet because I've only just installed it, so I'll say more things about it next week. The Crucial MX300 is attractively priced, so if you need a high-capacity SSD it's worth your consideration.



Andrew Unsworth has been writing about technology for several years, he's handy with a spanner, and his handshaking skills are second to none

Hardware



Ryan Lambie has loved videogames since he first stared up in awe at a *Galaxian* arcade cabinet in his local chip shop. 28 years on, Ryan writes about gaming for Micro Mart. He's still addicted to chips and still useless at *Galaxian*



Neverending Story

Assassin's Creed is back next year, and Ubisoft says it has a new direction for the series: expect to find a more free-form 'anecdote factory' akin to *Far Cry 4*...

This week, Ryan takes a look at Ubisoft's plans for the future of *Assassin's Creed* and checks out the final DLC drop for *Star Wars Battlefront*...

Plug & Play

This year sees Ubisoft heading to the movies, with Michael Fassbender and Marion Cotillard starring in a glossy adaptation of the publisher's historical parkour-and-murder simulator *Assassin's Creed*. The games series, meanwhile, is taking a bit of a break; released annually since 2007, *Assassin's Creed* won't be seen again on computers and consoles until next year.

When Ubisoft made that announcement last February, following slower than expected sales of 2015's *Assassin's Creed Syndicate*, it stated at the time that it was "stepping back and re-examining the *Assassin's Creed* franchise." It now seems that Ubisoft has concluded its period of soul-searching, with its chief creative officer Serge Hascoet revealing that the next *Assassin's Creed* will focus less on story and cut-scenes and more on player choice. The plan is to bring *Assassin's Creed* more in line with a game like *Far Cry 4* or this year's *Watch Dogs 2*, where completing missions and constantly progressing is less important than simply soaking in the game world and setting our own goals. It's a philosophy

Ubisoft is internally describing as an "anecdote factory": a game which provides us with plenty of unique, unexpected incidents, which can be shared on social media or with friends down the pub.

"I don't want the player to go through a story created by someone," Hascoet told the French newspaper *Le Monde* (and translated by Polygon). "We have games like that still, but I ask more and more that we let the player write their own story – that they set themselves a long-term goal, identify the opportunities that are open to them and choose not to follow a path that was decided for them."

The next *Assassin's Creed* game is currently scheduled for the autumn of 2017, which means that Ubisoft is already deep in development on its anecdote-ready action game. Exactly when the sequel will be set hasn't been formally announced, but there were persistent rumours last year, put out by Kotaku, that it'll be set in Ancient Egypt and currently goes by the name *Assassin's Creed Empire*. We'll have to wait and see how accurate those rumours

are, but for now, the direction for the series seems clear: Ubisoft is abandoning the pressure of meeting annual releases (something that's often resulted in some embarrassing glitches on launch day) and heading towards a less heavily scripted, more emergent future. If it's long cut-scenes you're looking for in your *Assassin's Creed* experience, there's always the movies: if this year's cinematic spin-off is a success, you can bet there'll be plenty of sequels to come.

Online

Released last year on a wave of *Star Wars* euphoria, EA's *Battlefront* has had an eventful 12 months in the wild. Reviewers picked fault with its simplistic combat and its lack of content at launch, but that didn't stop the game from shifting more than 10 million copies within its first three months on sale. Subsequent DLC drops have added new characters and maps to the roster, which countered the complaints about a lack of content; by the time you factor in the cost of a year's season pass, however, the complete *Battlefront* experience would set its fans back about £90. Then there's the game's user



▲ *Star Wars: Battlefront* heads to the tropical planet Scarif in its fourth and final content drop, timed to coincide with this winter's *Rogue One*

base, which appeared to dwindle fairly precipitously after launch. EA maintained that “millions” of players were still logging into *Battlefront* over the summer, yet a look at the game’s stats suggests that, on PC at least, players have begun to migrate elsewhere. A peak of around 4,000 concurrent PC users have logged into *Battlefront* at the time of writing, according to P-Stats.com. That’s less than a quarter of the concurrent players logging into the three-year-old shooter *Battlefield 4*, according to the same site.

Battlefront numbers may pick up this month, however, as EA

launches its fourth and final content update called Scarif. Its theme is this year’s *Star Wars* spin-off, *Rogue One*, which tells the story of how the Rebels stole the plans to the Death Star. One of the four maps the DLC will contain is the Scarif of the title, the lush tropical planet heavily advertised in the movie’s trailers. It’s an Empire stronghold, where Stormtroopers and AT-ACTs (a different kind of four-legged Imperial walker) stride about on the beach, which should make for some spectacular-looking skirmishes within *Battlefront*. Whatever else you might think about EA Dice’s

shooter, it’s reliably looked and sounded gorgeous. Following the pattern set by previous *Battlefront* content drops, Scarif will also usher in a couple of new playable characters: the heroic Rebel fighter Jyn Erso (played by Felicity Jones in the movie) and the evil Empire leader Orson Krennic (played by Ben Mendelsohn). EA is remaining tight-lipped about what the other three maps in the Scarif pack are or what new weapons and other goodies it will introduce, perhaps because it might reveal plot details from the forthcoming movie.

What we do know is that Scarif is effectively the end of the line for *Battlefront* in terms of major content updates. We already know that EA has *Battlefront 2* scheduled for release at some point in 2017, which company boss Blake Jorgensen has said will contain “bigger and better worlds” as well as content “from the new movies.” With the currently untitled *Star Wars Episode VIII* out in December 2017, EA

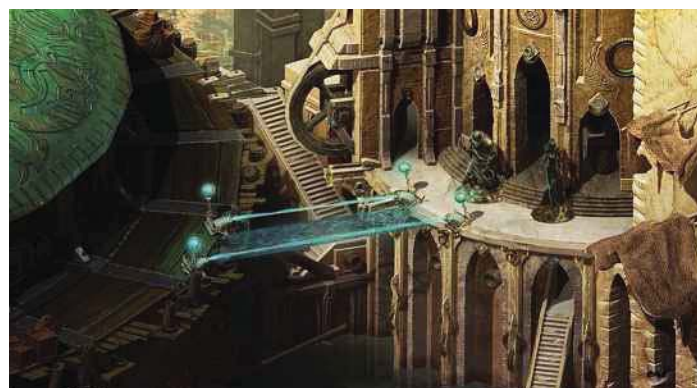
should have plenty of inspiration to draw from. The lingering question is whether it will find a means of adding more tactical depth to the mix.

The elegantly titled *Star Wars Battlefront: Rogue One – Scarif* will be available for season pass holders on 6th December.

Incoming

If you have a fondness for retro RPGs in the style of *Baldur’s Gate* or *Planescape Torment*, then you should check out *Torment: Tides Of Numenera*. Kickstarted to the tune of almost \$5m a few years ago, *Torment* is a story-driven fantasy adventure with the distinctive isometric viewpoint of a 90s RPG, but with the detail and creature comforts of a modern game. Created by design legend Brian Fargo, *Torment* has a sterling pedigree too, so if you’re looking for a huge, imaginative RPG to immerse yourself in this winter, this could be the one to go for.

Torment: Tides Of Numenera is loosely scheduled for release in early 2017. [mm](#)



▲ After storming Kickstarter a few years ago, Brian Fargo’s RPG *Torment: Tides Of Numenera* is almost with us. *Baldur’s Gate* fans may want to check this one out

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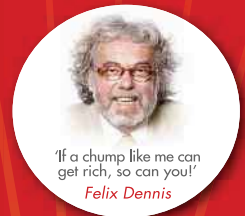
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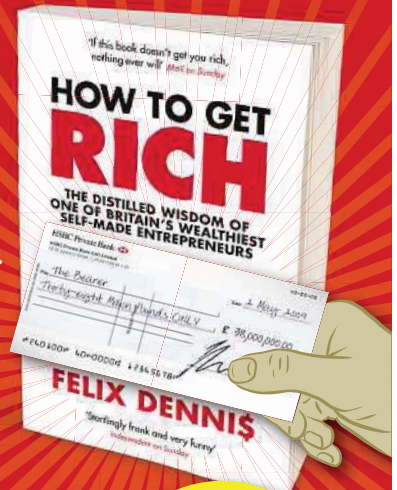
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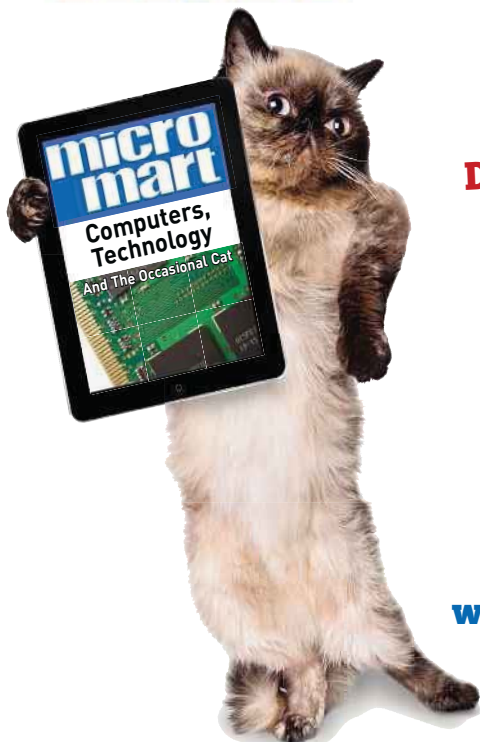
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Trying to breathe life back into an old machine? Why not submit a wanted ad to this section of the classifieds. You never know on of the computer enthusiasts who read the magazine could have exactly what you're looking for.

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- Be wary of anyone who insists on you paying by the above methods if in doubt, get us to check them out by mailing editorial@micromart.co.uk

- Keep copies of all correspondence

- When sending out goods, at the least obtain a certificate of posting from the Post Office

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Contact Aaron by email at:
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Please try to keep your queries brief and limit them to just one question per letter, simply so we can squeeze in as many as we can each week. Please include relevant technical information too.

Aaron

All You Can Eat

A large chunk of my BT 12GB monthly allowance is being swallowed up by "Host Process for Windows Services" on a daily basis. The process of large daily updates appears to be in addition to the usual Windows 10 Home updates!

I am sick of this so-called service seriously eating into my monthly broadband allowance. I would like to turn the Host Process for Windows Services off. Can this be done, and if so, How do I go about doing it?

My wi-fi is set as a metered connection, but I use Ethernet for Broadband most of the time because it's a faster, more reliable connection.

Cliff

The problem you have here is not uncommon, but it's also not all that straightforward and easy to fix, as the cause can vary from system to system. The host process for Windows is just as it sounds, and that's a hosting service for other services related to software on your machine. A single host process can accommodate one or multiple services, and so, it can be very hard to narrow down the actual cause and know what service is eating away at your data.

For this reason, the best method to employ is one of trial and error, eliminating the possible causes, and then to isolate the problem. A simple way to do this without any extra software is to perform a clean boot. To do this, press WIN+R and type 'msconfig'. Next, press Return and you'll open the System Configuration window.

Click the Services tab and check the option to hide all Microsoft services at the bottom of the window. Now go to the Startup tab and click to open Task Manager. In Task Manager's Startup tab,

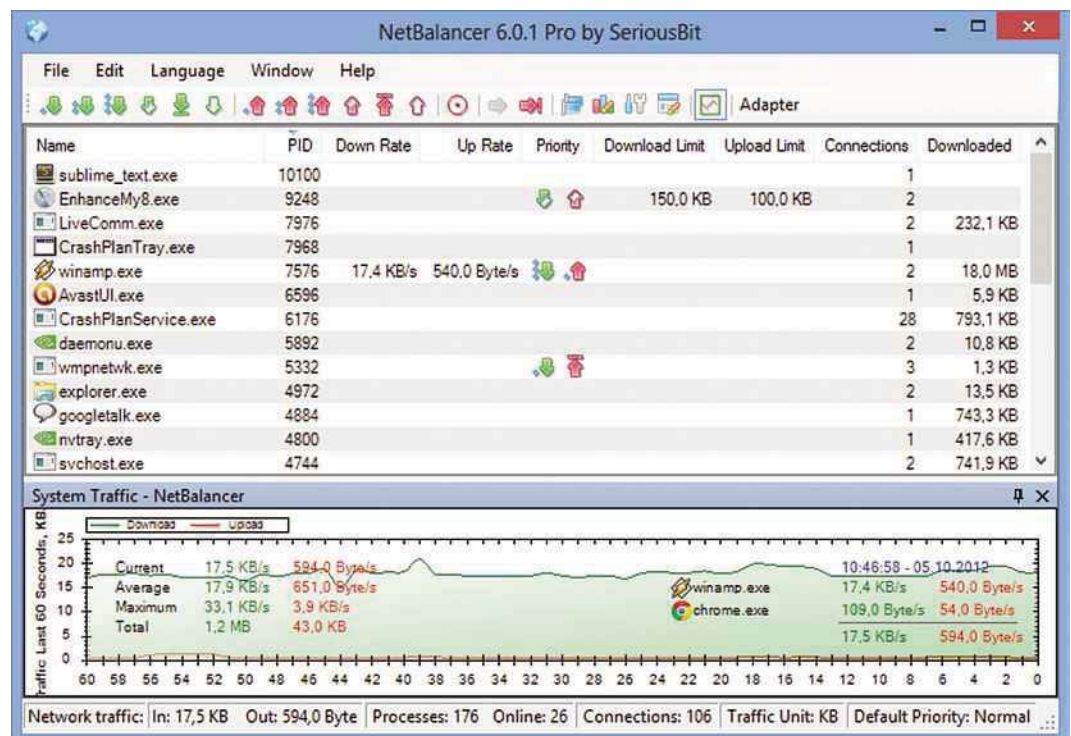
disable all the startup items in the list. Reboot the system, and it'll boot up with only Windows and Microsoft services, and no third party ones. This means the system should effectively be as clean as it can be in terms of the startup routine, and shouldn't use any excess data.

When the system boots up, make sure the issue has gone. If so, enable each service one by one until you discover the culprit. Once you do, you can then take whatever steps needed to resolve the situation. At the very least, you'll know what the cause is, and can look into possible ways to fix it.

If you'd rather not go through all of that, you could use a program like NetBalancer (seriousbit.com/netbalancer). This is a free tool that can analyse your system's data usage, and shows you the results in real time via its visual reports. It also allows you to actually control traffic manually, and you can throttle items that are using too much data. This means you don't have to totally disable what could be important, but still very greedy services, and they can still function, just at a reduced rate of data consumption.

It'll also show system traffic in the System Tray, so you can monitor usage without having to close your apps or take up screen space. This can make it much easier to see what the overall cause is when the system is working hard.

Another tool you could try is NetLimiter (netlimiter.com). There are various versions of this, including a free monitor. It's limited, and can only analyse and relay information to you, but even without the in-depth tools it can be very useful in nailing down any problem services and apps that are causing problems, and this is most of the battle. It's certainly faster than manually trying to troubleshoot data consumption woes.



i(don't)Tunes You

I am an avid reader of the *Micro Mart* mag and have found a lot of really good info in it. I am hoping you can help me by answering my question.

I am trying to find a good, free piece of software that will transfer music to my iPhone without having to sync it, thus losing all my music that is on my phone already. I have tried Wondersoft Tunes To Go, but that was only a trial that transferred 10 songs then wants you to buy it at \$49.

I just don't seem to be able to find a good one that works, and is free. Please could you help me solve this problem.

Phil

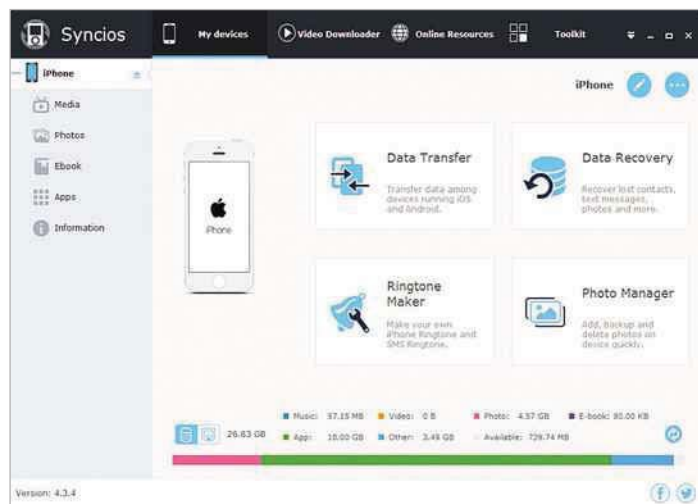
There are quite a lot of alternative programs around that get around the limitations and restrictions of iTunes, such is the public dislike of having to contend with Apple's closed system. Many of these require jailbreaking your iPhone, which isn't really recommended for obvious reasons. Many also come at a cost, as you've found with Tunes To Go.

There are alternatives, however, that'll let you use your iPhone and manage music as you would prefer, rather than the Apple way, and these can be found for free. A possible option is Syncios (www.syncios.com), which is a full-blown alternative to iTunes that boasts most of the same features as it's more famous inspiration, but isn't tied to any of Apple's self-imposed restrictions, and has a full phone backup utilities that'll let you back up any data you wish from your device. It even works for Android phones too, so even if you decide to move away from

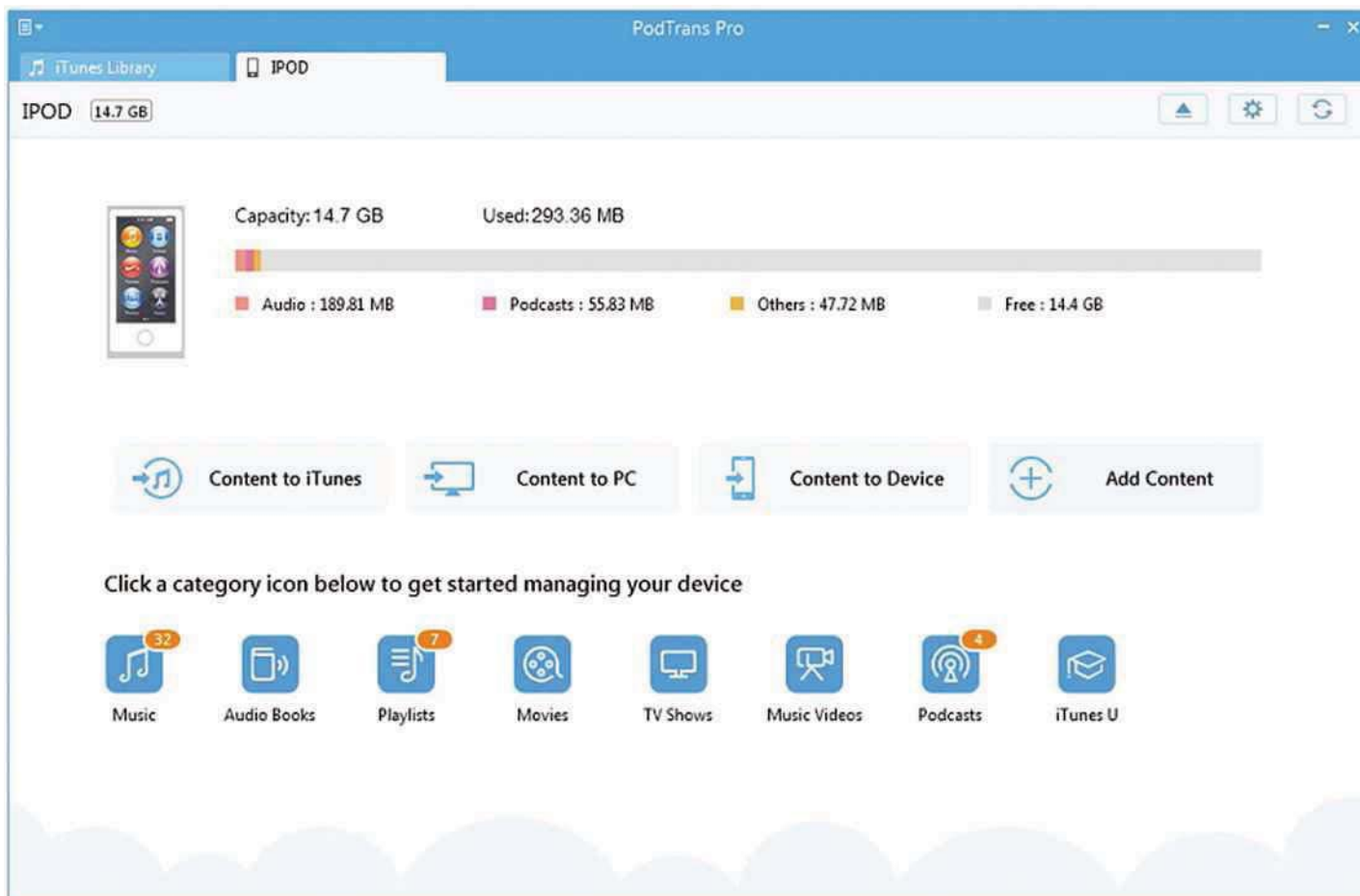
Apple's OS and buy another phone at some point in the future, you'll still be covered, without the need to use any new software.

Another option is PodTrans (www.imobie.com/podtrans). This too can transfer music to and from an iPhone, bypassing iTunes, and more importantly, no original files on the device will be erased in the process of doing it; a criteria you stipulated.

As a handy bonus, it has a very clean and easy to use interface, and it's search engine is fast. It can also moves files between iPhones and iPods. Basically, it sounds like exactly what you're looking for.



▲ Syncios is a good, free alternative to iTunes



▲ PodTrans can move files without deleting the original

ASK JASON



Meet Jason D'Allison, a veteran of Micro Mart's panel of experts. He's here to help with any technical questions, including anything to do with tablets or smartphones, as well as PCs

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While we try to cover as many questions as we can, we regret that Jason cannot answer your questions personally, but he'll cover as many as he possibly can each week. Please ask one question per letter and remember to include the full specification of your computer, including its operating system.

Jason

Home Is Where The Plug Is

My bungalow is partly made of stone. The walls are thick. So, you know what I'm going to say next, don't you? That's right – my Wi-Fi's not much cop. I'm therefore looking at HomePlug adaptors. I guess I'd need one plugged into my broadband router and a nearby wall socket and a few others in wall sockets dotted elsewhere around the house. Would this work? Would I get the full speed of my 76Mbps fibre connection?

Debbie, Gmail

Sounds like a plan, Debbie. The adaptors to buy are the 1200Mbps HomePlug AV2 affairs. They're cheap enough these days, so I can see no reason to buy slower ones. The technology is the same as for the AV2 600Mbps adaptors, but it uses not only the live and neutral wires of the mains circuit but also the ground or earth, creating two signals simultaneously (a bit of magic joins them up at the end). It's a version of MIMO – multiple-input, multiple output.

All AV and AV2 adaptors can interoperate (and all 1200Mbps adaptors use the same Qualcomm Atheros AR7500 chipset), so don't worry too much about brand. Clearly, though, mixing slower adaptors with faster ones will limit the overall speed. A pair of AV2 1200Mbps jobs can be had for about £70.

Of course, standard adaptors will give you just an Ethernet port, so connection to devices will be via cable. That may not be convenient, and for devices such as phones and tablets it's a non-starter. You may find it best to buy adaptors with built-in Wi-Fi access points, thus creating a Wi-Fi 'mesh' around the house. This will push the price up somewhat – expect to pay about £120 for a pair of these.

As for speed, you should be able to get 100Mbps or so out

of them (including over Wi-Fi). Naturally, if the bungalow is large or the mains cabling is old (or badly installed), there'll be some drop-off. With a bit of luck, though, Debbie, you should receive the full whack of that 76Mbps fibre connection.

router to a model with Gigabit (1000Mbps) ports.

Note – Interestingly, the HomePlug Power Alliance, which oversees everything HomePlug and owns the technologies, has just pushed all the specs into the public domain. It's

“ Standard adaptors will give you just an Ethernet port ”

As you say, the first HomePlug adaptor will need to be plugged into your router, to bridge the network onto the mains circuit. One thing to watch out for, then, is if the router only has 100Mbps Ethernet ports. Keep an eye on speeds. If you think they're being artificially throttled, you may be wise to upgrade the

now up to others to move things forward. It's a strange decision, suggesting that there's no money to be made, which would be surprising. For more details, see goo.gl/lyg4Pi.

▼ *Is it good or bad that the HomePlug technologies have now been released into the public domain?*



A Touch Too Much

I'm after a new laptop, and I've been slobbering over the new 13" MacBook Pro, the one with the Touch Bar. The price is through the roof, of course – £1,749 for the base spec. I'd like to upgrade the CPU, RAM, and SSD, but what Apple charges is ridiculous. I know I'll need to pay Apple for the CPU upgrade (the Core i7), but could I swap out the RAM and SSD myself at some point down the line? How easy would that be?

T Williams, Gmail

As you rightly suggest, the prices for upgrades on the new MacBook Pros are shameful (same as it ever was). On the 13" model with the Touch Bar, you'll pay £270 to move from the Core i5-6267U (2.9GHz, dual-core) to the Core i7-6567U (3.3GHz, still dual-core). The real cost difference is at most £100. Similarly, it's £180 to go from 8GB of DDR3-2133 to 16GB. About £60 is the going rate. And then there's the 256GB SSD. Upgrading that to the 512GB unit costs £200. It should be about £85.

I can well understand, then, why're looking to fork out less to Apple and effect some of the upgrades yourself. But you can't. The CPU is soldered in place, of course, but so are the RAM and SSD. Yep

– they're completely non-upgradeable. Take a look at the teardown at iFixit and see for yourself: goo.gl/37grZE. It's the same story for the 15" model too. No wonder Apple can charge what it likes.

On the 13" model *without* the Touch Bar, the SSD is a slot-in job. Not that this means much, however. The SSD runs over PCI Express, so it's essentially an M.2 card, but the physical interface is proprietary. You can't pop the drive out and shove in an off-the-shelf replacement. In any event, you'd need to take the machine to pieces, voiding the warranty. The same applies to

all three of the new models when it comes to changing the battery.

In short, my friend, buy the MacBook Pro that's going to meet your needs for however many years to come. Treat it as a sealed unit. Get it right in the first place or get in a heap of bother later. And that's all I've got to say on the matter, as Editor Anthony won't let me swear...

▼ Want to upgrade the RAM or SSD on a 2016 MacBook Pro? Tough! [Image courtesy of www.ifixit.com]



Big Trouble

Recently I sent my elderly aunt in the US a Binatone M312 'Big Button GSM' mobile phone. This phone is not even remotely smart, but I'd hoped it would allow her to stay in contact on her travels – she's got a motorhome (or an RV, as she calls it). Sadly, though, the phone just says 'No service'. I've confirmed over Skype that she's inserting the SIM (AT&T) correctly and that nothing obvious is amiss. Is there a reason why this phone won't work in the US? I thought phones these days worked more or less anywhere.

J. Cosgrove, Greater Manchester

Oh dear. Until recently, yes, the Binatone M312 would have worked fine on AT&T in the US. However, it's a GSM device – that is, 2G – and AT&T is in the process of shutting down its GSM service, with what's left of it disappearing by the

end of this year. That explains why your aunt's in the soup. Only 3G and 4G are any good on AT&T now (and care is needed if buying a UK 4G phone for use in the US, as often the bands are different). Here's a bit more information:

goo.gl/OBqNUS.

The UK's 2G networks are still going strong. Unless you're a Three/3 user, that is. Three has never had its own 2G network, opting instead to piggyback on O2's and then Orange's services. The plug was pulled on that in 2013 (I think a few outlying areas might still be connected). As far as I can tell, the other major networks in the UK plan to offer 2G till at least 2020. Indeed, it's possible that 3G may vanish before 2G, as 2G works better than anything else in areas that suffer with poor signals and is also still widely used in industry (some smart meters rely on it, for instance).

► Is the 2G/GSM network being shut down?



Crowdfunding Corner

Smart computing is transforming our lives – and this week, this pair of crowdfunding projects shows just where smart computing can fit in if you let it...

Dashbot

Ever wished you drove KITT from *Knight Rider*? Or that your car had its own version of Siri, Alexa or Cortana? Well, those are the itches Dashbot aspires to scratch. Connecting to your smartphone over Bluetooth, Dashbot can intelligently control your maps, music and more, with an open API that means it'll do even more in the future.

The Dashbot app aggregates multiple services so that you can control them all from a single piece of software, and is 100% voice controlled. All you have to say is 'Dashbot' and it'll go into listening mode. You can have it read texts, or send them, and the LED display can deliver silent alerts. It even auto-dims so you aren't dazzled at night.

Dashbot is powered through a USB port or cigarette lighter, you can connect it to your stereo through either an aux jack or over Bluetooth. You can even buy the 'Dashbot Retro' pack to get a cassette adaptor and local FM transmitter. It connects to your dashboard using either a suction or magnetic connector, and you get a selection of voices to choose from and several 'keywords' to select. It's hugely customisable!

The cheapest price for a Dashbot is just \$49 (£40), though you can pay more to get extras like accessories and SD cards, or multiple units. The project has already hit its target and promises that devices will start to ship in July 2017.

URL: kck.st/2fkFBIE

Funding Ends: Saturday, December 17th 2016

Qi Aerista

Wi-fi enabled coffee machines are all the rage with a certain section of society – but what if you like your brew slightly more refined? Well, this wireless-powered tea-maker might be the answer to your problems.

Billing itself as the world's first Smart Tea Maker, this project comes out of Hong Kong, where you can be sure they appreciate a good cup of tea. It's capable of making tea hot or cold, and has six brewing presets, which allow you to set the hardware for your preferred blend, as well as select an extra 'brew' mode or a 'warm' mode to ensure it stays at the perfect drinkable temperature. The hardware can be controlled from the base unit or from the built-in app anywhere on your wi-fi network.

The good news is that the hardware has already been developed and even exhibited at trade shows – this Kickstarter is to fund the mass manufacture of units. You can get one Qi Aerista for HK\$1,159, which might sound like a lot but is only the equivalent of £120, which isn't masses of cash. The campaign has already reached its target meaning devices will hopefully be shipping in June 2017.

URL: kck.st/2fsojpr

Funding Ends: Thursday, December 15th 2016



Disclaimer: Images shown may be prototypes and Micro Mart does not formally endorse or guarantee any of the projects listed. Back them at your own risk!

App Of The Week

Historical Software

Collection/Internet Archive

It's a quick look back at some fondly recalled programs this week

The Internet Archive has fast become one of the most visited sites of the modern age. Within you can find all those Crash and Zzap!64 magazines you missed out on, you can view journals and written articles regarding a new-fangled entity, one that'll never take, called The Internet and you can take a stroll down gaming and software memory lane.

It's here we find ourselves this week, feeling a little nostalgic and taking in the wealth of a particular collection within the Internet Archive: the Historical Software Collection.

Historically Significant

Think of this collection as a virtual software museum, one that contains a selection of historically important software packages from the Internet Archive's vast and often difficult to search, repository.

It's hand-picked by Archivist Jason Scott, who has put together an impressive collection of productivity and gaming for our amusement. With VisiCalc from 1979, *The Hobbit* from 1982, Atari's *E.T.*, *Chuckie Egg* – even *Space War* for the PDP-1.

There's not a huge amount in there at the moment, but the list is steadily growing. For now, though, there's plenty to get your teeth into and thanks to The Internet Archive's use of in-browser emulation you can happily play or use any of the programs and games in the

Historical Software Collection on your PC or device as if you were sat in front of an overheating 8-bit machine.

Our particular favourites in the Historical Software Collection include *Pitfall*, *Chess*, *Pac-Man*, *Choplifter*, *Chuckie Egg* (naturally the Spectrum version), *Yar's Revenge*, *Adventure*, Apple DOS 3.3 and *Dropzone*. If you don't hear from us for a few days, you'll know what we're up to. Anyway, with nearly sixteen million views so far, we're not the only ones appreciating the Historical Software Collection.

More Nostalgia

To most of us The Internet Archive is a regular bookmarked site. However, there are still a number of people who aren't aware of what's available.

You can search the full text of books, and even some back issues of Micro Mart. You can access the Way Back Machine and view over 273 billion websites from the past; there are news reports, TV series, old films and documentaries. You can listen to radio stations and shows from the 50s or more recent podcasts.

The Internet Archive, therefore, is an incredibly interesting place to take in. There's loads of content that we simply don't have the time or the space to mention, so we'll leave you with the difficult decision of trying to work out what to look at first. And should you

Features At A Glance

- Free.
- In-browser emulation allows you to play and use the collection on any device.
- Detailed historical information about each of the items in the collection.
- Full screen and sound available for the emulated software, films, radio stations and so on.

ever set up your own archive, let us know so the rest of us can enjoy what you've put together.

The Historical Software Collection can be found at goo.gl/XH2ER7 and the rest of The Internet Archive at goo.gl/LpVKvZ. [mm](https://www.mm.com)



▲ *Yep, we're after those 'Bulbous eyes' again*



Historical Software Collection

This collection contains selected historically important software packages from the Internet Archive's software archives. Through the use of in-browser emulators, it is possible to try out these

▲ *The Historical Software Collection is a great entry point to The Internet Archive*

Logging Off

When a company like Samsung has the type of product failure it did with the Note 7, it's hard to see how best to go about fixing the negative public perception. In this example, it didn't really help that when the problem initially surfaced, Samsung rushed out a 'fix' that failed to address the critical issue.

That demonstrated that Samsung didn't really understand what the problem was, or it would have known that its fix

wouldn't solve the errant phone's penchant for self-immolation.

Eventually, either it worked out what was really going on or accepted that as a brand, Note 7 was mortality wounded. Either way, it halted production and recalled all the devices it had previously shipped.

It was so concerned about these products that owners were supplied with a fireproof box to return them, just in case they went incandescent while in transit. Of those, some 85% of Note 7s have been returned, and those with the other 15% are now being 'encouraged' by an update that only allows the phone to charge to 60% of its capacity. Presumably, Samsung has worked out that whatever fault this device has, it can't reach a complete meltdown threshold without more than 60% power in the battery.

It also placed full-page newspaper adverts in three US newspapers to apologise to its valued customer base for falling short of its mission, to offer best-in-class safety and quality in this product.

Wearing the hair shirt on this particular occasion was Gregory Lee, president and CEO of Samsung Telecommunications America. He expressed how truly sorry he and the other 17,000 people who work for Samsung in America are about the Note 7 incident.

This part of the story I didn't really follow, because the Note 7 batteries that exploded were mostly made in Hanoi, Vietnam. And they were designed in Korea, as most of Samsung's hardware is.

But then the people who are paid £33 a week to make batteries in Vietnam are the ones who probably deserve the apology, rather than being who need to make one. By comparison with the USA, Samsung employs some 130,000 people in that country alone, and it has been estimated that another 270,000 have jobs indirectly servicing those operations.

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THIS WEEK'S CROSSWORD

Across

- 7** English printer who in 1474 printed the first book in English (1422-1491) (7,6)
8 Still in existence; surviving. (6)
9 A recompense for worthy acts or retribution for wrong doing. (6)
10 US rocket propulsion company dedicated to the development of advanced plasma rocket propulsion technology. (2,5)
12 A written report of the results of an analysis of the composition of some substance. (5)
14 Italian Space Agency x-ray and gamma ray astronomical satellite launched in 2007. (Acronym) (5)
16 A device for connecting pieces of equipment that cannot be connected directly. (7)
19 A stringed musical instrument of treble pitch, played with a horsehair bow. (6)
20 A loudspeaker that reproduces lower audio frequency sounds. (6)
22 The turning or bending of a plant or other organism in response to a touch stimulus. (13)

Down

- 1** A person or thing that seems to bring bad luck. (4)
2 Without variation or change, in every case. (6)
3 Any process in which an atomic or nuclear system acquires an additional particle. (7)
4 The range in which a variable can be referenced. (5)
5 Jargon for oval or round dormer windows. (6)
6 Combine two or more sets of information or ideas into one. (8)
11 An aerial engagement between fighter aircraft. (8)
13 Antivirus anti-malware software from Lavasoft – now on version 11. (2-5)
15 The Spanish soccer 'Premier League'. (2,4)
17 A word or symbol on a screen to show that the system is waiting for input. (6)
18 An organisation of employees formed to bargain with the employer. (5)
21 The cardinal compass point that is at 090 degrees. (4)

However, these people only assemble the batteries made from cells, by other people Samsung employs in Korea, China and Malaysia. So what any of this has to do with Gregory Lee and the 17,000 people who work for Samsung in the US, I've no idea. Or why they felt they needed to apologise so publicly, when they had a really tenuous connection?

As for Samsung, it's clearly trying to move on. It hopes to soon produce a device that will combine the virtues of being innovative and not spontaneously combustible, while restoring its technical reputation.

What I can practically guarantee is that the Note 8, or whatever Samsung chooses to call it, will be more thoroughly tested than any smartphone that came before it.

Only time will tell if the Samsung brand has been irreparably damaged by this story, or if it's managed to pin the tail exclusively on the Note 7 donkey.

I'm sure that in a few weeks or months we'll have forgotten the Note 7, and we'll be talking about some other technology that isn't living up to its customers' expectations.

Mark Dickavance

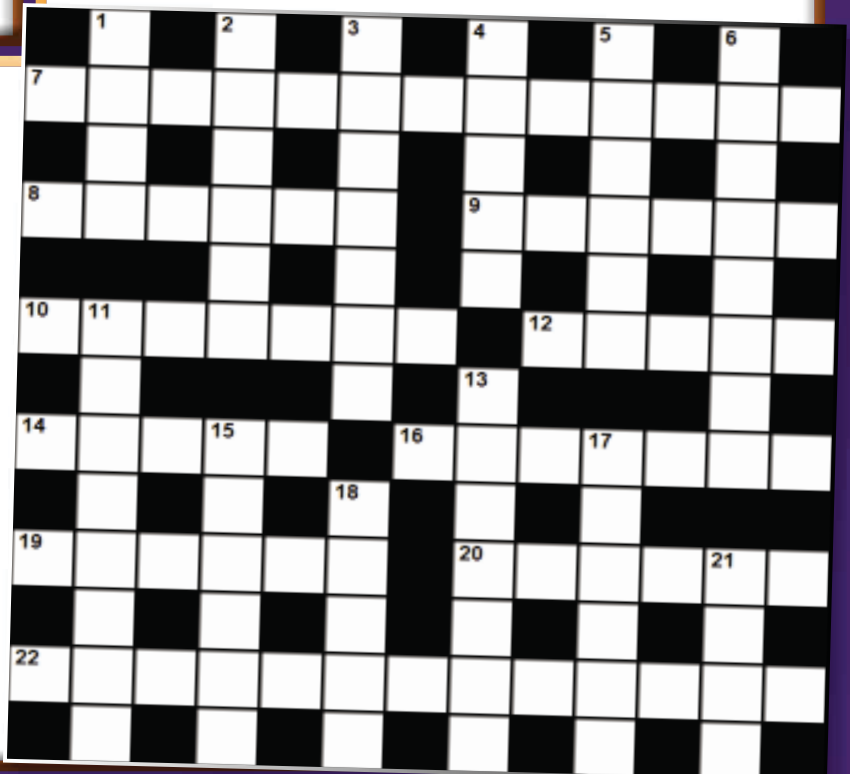
LAST WEEK'S CROSSWORD

- Across:** 7 Technopreneur 8 Flared 9 Nebula 10 Science 12 Demon 14 Inert 16 Truisms 19 Guinea 20 Detail 22 Bloody Assizes.
Down: 1 Feel 2 Charge 3 Conduct 4 Brand 5 Enable 6 Qualcomm 11 Centuple 13 Prudish 15 Random 17 Intuit 18 Satyr 21 Idea.

DISCLAIMER

The views expressed by contributors are not necessarily those of the publishers. Every care is taken to ensure that the contents of the magazine are accurate but the publishers cannot accept responsibility for errors. While reasonable care is taken when accepting advertisements, the publishers cannot accept any responsibility for any resulting unsatisfactory transactions. Luckily for us, the team behind Micro Mart don't generally tend to observe the American traditions that appear to have risen to prominence on these shores over the last decade. It's not that we begrudge those who do, but we are perhaps a little too, err... British to really embrace knocking on strangers' doors to ask for sweets on halloween

(and too old for it to be anything other than creepy), and nor do we go much for the whole unseemly scrum that is Black Friday. However, as we're on a print deadline this and every Friday, we wouldn't have had much time to do much shopping were we inclined to. We have, however, had to wade through a bumper selection of promo and 'expert comment' emails on the subject, so we can assure you that we are now probably as sick of it as any of you who braved the stores or online queues. If you did grab some bargainous bounty on this Blackest Of Fridays (you have no idea), we hope you've fulfilled your heart's desire... Our heart's desire right now is to get all this lot polished off, get out of the shed and off down to the pub. 'Alas Not Sales', we say. You can keep that one.



Linux: From A-to-Z

David Briddock continues the series with the letter M

This week's topics are MINIX, entrepreneur Mark Shuttleworth, the Mint distro and the 'mount' command.

MINIX

The MINIX operating system is a stripped-down version of UNIX created by Andrew Tanenbaum. Importantly, it was one of the first high profile systems that adhered to the open source philosophy, at a time when the commercialisation of UNIX took prices well beyond the reach of most PC owners.

“ First released in 1987 early versions of MINIX were targeted at the educational community ”

First released in 1987 early versions of MINIX were targeted at the educational community. But with version 3 the primary goal became the development of a reliable, self-healing microkernel operating system.

MINIX source code has always been available to universities and other learning institutions for study and research. But since 2000 the complete MINIX source code tree has been completely free and open thanks to a re-licensing exercise that transferred all rights to the BSD License.

As part of this project Andrew Tanenbaum also authored the 'Operating Systems: Design and Implementation' book, which described all aspects of MINIX system design and code. It was this book that ended up in the hands of Linus Torvalds, who took those ideas and built his own UNIX-like operating system named Linux.

Mark Shuttleworth

Mark Shuttleworth is well known as a South African entrepreneur and self-funded space tourist, who hitched a £20 million ride on a Russian Soyuz TM-34 rocket to the International Space Station. But he also founded and self funded the Canonical organisation to develop Ubuntu Linux through the Ubuntu Foundation (community.ubuntu.com).

This community encourages members to develop new system software, find and fix existing bugs, write documentation, help with language

translation, contribute user interface designs, plus create new graphics, backgrounds and themes.

Shuttleworth's contribution to the widespread adoption of Linux, especially on the desktop, can't be underestimated. Today, the Ubuntu family spans desktops, tablets, smartphones, servers, the cloud and even Internet-of-Things (IoT) devices (ubuntu.com). And many popular Linux distributions have a Ubuntu technology core.

Mint

Mint is a popular community-driven Linux distro (linuxmint.com). It's especially favoured by newbies as it blends high functionality with ease of use. Early editions had both proprietary software and open source apps, but recent releases have a reduced reliance on proprietary code, in particular certain multimedia codecs.

The project was initially conceived by Clement Lefebvre with release 1.0 'Ada'

appearing in 2006 based on Kubuntu. Mint version 2.0 used the main Ubuntu package repositories and adopted its bi-yearly release cycle to guarantee full compatibility. However, the 2010 Linux Mint Debian Edition was based directly on Debian.

The 2016 Linux Mint 18 'Sarah' edition has three separate download options, which allow potential users to select from the Cinnamon desktop, MATE desktop or lightweight Xfce desktop.

Mount Command

The mount command is used to attach additional filesystem storage that's located on some kind of device. Device examples include another hard drive, a CD or DVD drive or a USB stick.

Typically, the mount command consults the filesystem table, located in an `/etc/fstab` file, to determine how the specified device should be loaded. To discover more about this command and its many options type 'man mount' at the command prompt.

The associated 'umount' command, as you might expect, dismounts a specified device. Note this shouldn't be done while the device is in use. [mm](#)



▲ Mark Shuttleworth



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