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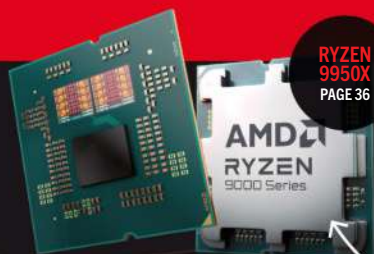


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**HOW TO**

## LOCK DOWN YOUR BROWSER

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**RYZEN  
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PAGE 36**

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# The hype-free AI train

Your job is to know more.

**Standing back from the AI hype-train and attempting to take stock, it might all seem like a mysterious forward-lurching thing with nobody at the wheel. It's moving way too quickly for regulation to keep up – let alone predict where it's heading – and a week in AI seems like a year in just about every other field in tech.**

There's no shortage of long-term vision, the problem is that everyone's opinion is different and it's basically impossible to have any reliable and realistic perspective that's not tainted with doubt and concern. Yes, my PC can now draw a kitten that looks like Shannon Noll in a few seconds, but, what about me? Will I still have a job as an editor in five years? My boss says yes, but I'm sure there's a great deal of growing alarm as the headlines all proclaim the impending AI job takeover disaster.

However! Here at APC we see many huge gains to be made for just about every job. We're taking a positive view on things and after talking to many industry experts that work in all sorts of areas, we now feel quite sure that it's all sunny side up.

So, embrace the impending AIpocalypse, we say. Turn to page 54 and get to reading all about the hows and whys your job is probably looking

rosier by the day. I'm talking about your job security and do your job so much better than before. The goal is to enhance your value as an employee, and for anyone that runs their own business, how to get ahead with AI before the competition does.

This is important, obviously. But who to turn to for guidance? The likes of Nvidia, Lenovo, Intel, Midjourney, AMD, OpenAI, Microsoft and many other organisations are all moving forwards and expanding outwards at an extraordinary rate, with each having a vision of the AI future that may or may not actually suit the way you want to live your life, or do your job.

To some APC housekeeping. A couple of issues ago (537) we decided to drop the 'month' moniker from each issue because the onsale dates weren't always calendar-correct due to there being 13 issues per year, so it seemed the sensible thing to do. But we've since realised – in no small part via reader feedback – that the month title was valuable as a reference. So! The 'months' have returned. Thanks to the readers that politely requested this, and apologies for not realising how valuable that was for record keeping and making it easier to find old content.

Ever onwards, always learning!

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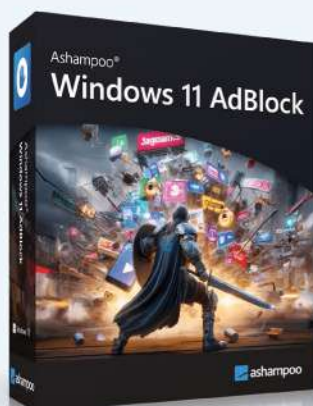


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## ASHAMPOO WINDOWS 11 ADBLOCK

REMOVE ADS IN WINDOWS 11.

Ashampoo Windows 11 AdBlock helps you get rid of the ads that come with Windows 11. This free and handy software instantly disables ads without the need for major system modifications. Microsoft has added ad-based recommendations to various spots in Windows 11, including the lock screen and the start menu. Ashampoo Windows 11 AdBlock offers a super simple solution for those who don't want to fiddle around with system settings or dive into the complicated world of Registry editing.



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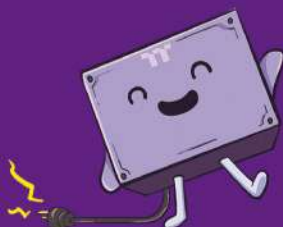
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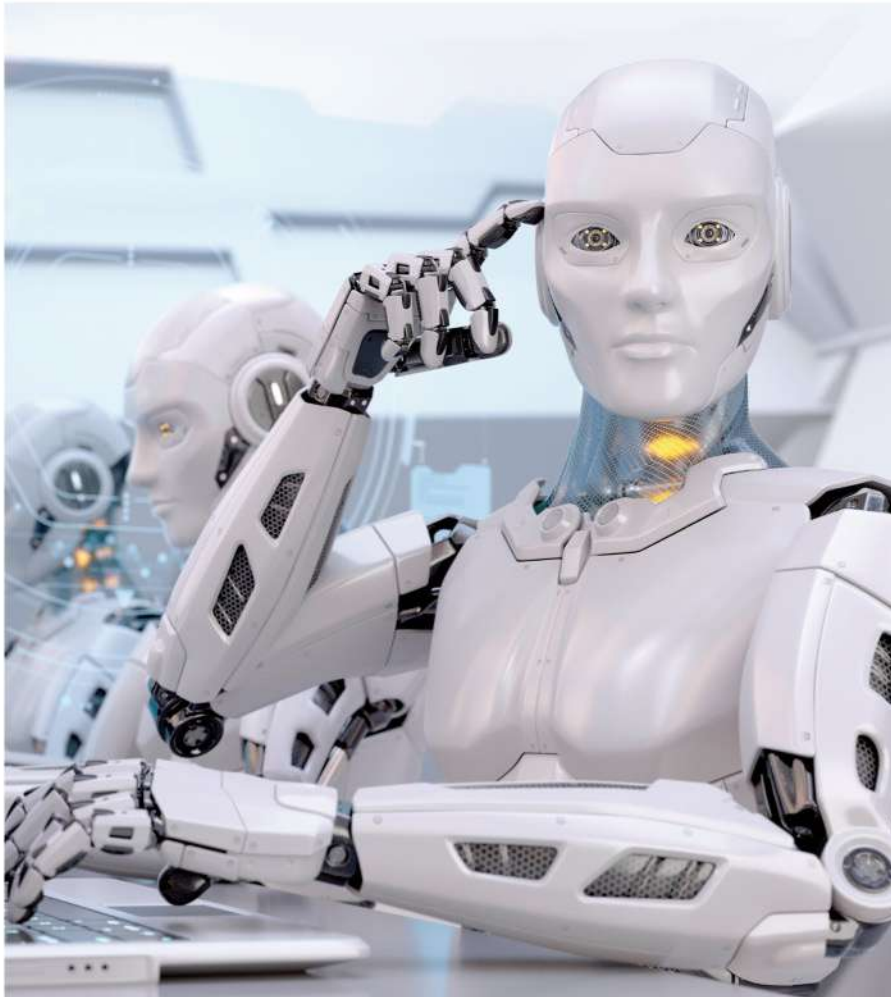
-  Stress-Free
-  Local Support
-  Swift-Replacement



FIND OUT MORE

# CONTENTS

This month in APC



54

## Make AI your partner for success

Stop thinking of AI as a threat and start using it for work. Barry Collins reveals how AI is being used in a variety of industries.



34



38



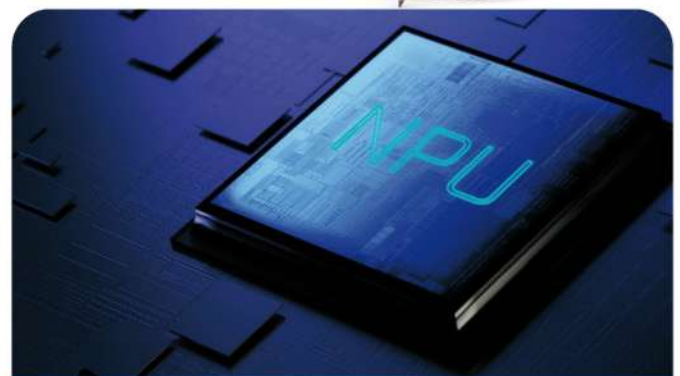
41



68

## CPU architecture deep dive

New AMD and Intel processors take centre stage, APC deep dives the new tech.



70

## What is an NPU

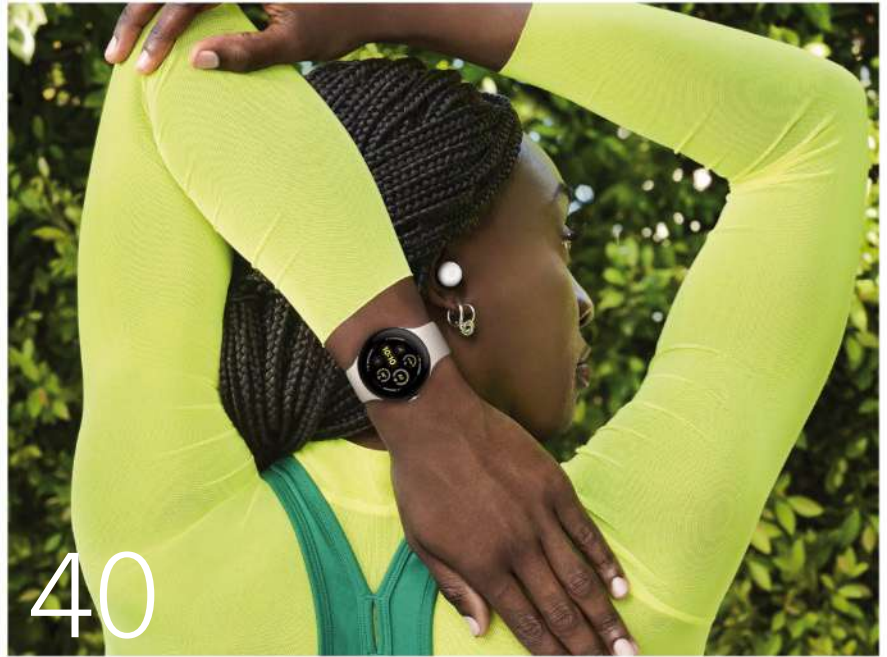
The latest specialist chips put AI at your fingertips. Darien Graham-Smith finds out what's new in neural processing.





**“Will it still be worth getting on the plane for a painful long-haul flight when you can enjoy a fully immersive “really being there” experience from your sofa at home?”**

Jon Honeyball - **One More Thing**  
page 15



40

## INSIDE

### Technotes

#### 08 News

What’s been going on in the world of technology in the news that affects you

#### 10 Tech brief

AI is integral to next-gen graphics tech

#### 12 End user

What is the point of the PS5 Pro?

#### 13 Tech talk

Intel issues fix for Raptor Lake degradation

#### 14 Trade chat

AMD’s turn to drop the ball?

#### 15 One more thing

As Jon Honeyball welcomes the arrival of his grand-niece, he wonders what kind of digital future awaits her

#### 18 Futures

The future of work is already here, so what’s next?

#### 22 Autopsy

Apple iPad Pro 13

#### 24 A-list

The best products on the market as rated by the APC team

#### 27 The List

Best mouse pads

#### 28 Head to head

Nvidia DLSS vs AMD FSR

#### 30 Gadgets

New things you don’t really need but will surely want

### The Lab

33 TCL RayNeo Air 2s

34 Acer Nitro V 16

35 Lenovo Slim 7x

36 Ryzen 9950X

38 Google Pixel 9 Pro Fold

40 Google Pixel Watch 3

41 Remarkable Paper Pro

42 Hyte Thicc Q60 AIO cooler

43 Nzxt C1500 Platinum PSU

44 Benq X300G 4K Short Throw Projector

45 Kingston XS1000R portable SSD

### Software

46 Arc 1.13, Thunderbird 128, O&O DeskInfo 1.3.1347, WiseImageX

48 ESET Home Security Ultimate

49 Q4OS 5.5

### Features

54 Make AI your partner for success

68 CPU architecture deep dive

50 IFA report

76 What is an NPU?

62 The Apple products that time forgot

### PC Builder

#### 80 System news

Ryzen rejected, and Radeon rebooted, Mark Williams explains AMD’s recent struggles and plans.

#### 81 Market watch

A sampling of PC systems currently available

#### 82 Blueprints

Value- and performance-driven hypothetical builds

### How to

86 Q&A

88 Expert tips for Windows

89 Make Office better

91 Lock down your browser

94 Restore your old photos

96 Open legacy Microsoft documents in Linux

98 Do more with your smartphone

100 Simulate your Pi Pico projects with Wokwi

### Downtime

102 Gaming reviews

High-performance playtime

106 Game changer

Hades

110 Retro

Evercade retro consoles

114 Know How

Fake PC activity by “mouse jiggling”



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Turn to page 18 now to find out how

# TECHNOTES

Everything you need to know from the month in tech

## Instagram rolling out a restricted app for teens

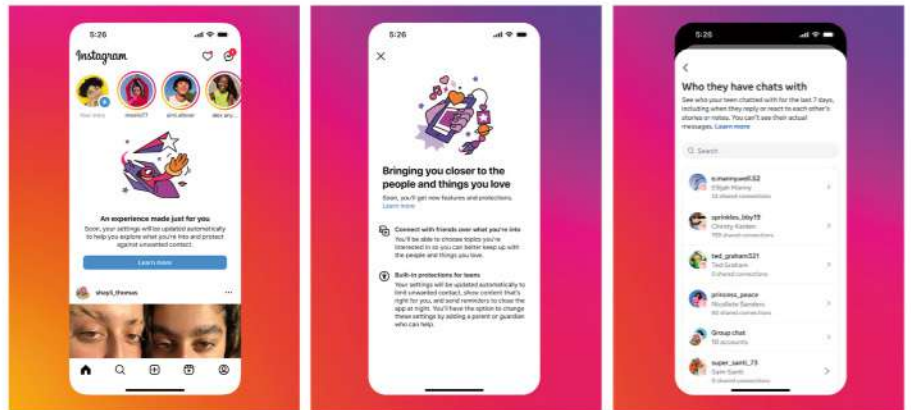
Will limit who can reach teens & control what content they see.

Instagram is now automatically setting some teen accounts to limit who can reach out to them and what content they're exposed to. The new "Teen Accounts" feature aims to protect teens under 16 from unwanted messages. This means only people they follow or are already connected with can message them, keeping strangers out of their DMs. By default, teen accounts are set to private, meaning they get to approve new followers, and random people can't creep on their content or interact with them.

Parents can now check who their teen has been messaging recently. However, they won't be able to read the actual messages. Meta is also auto-setting all teen accounts to Instagram's strictest content controls. This applies to both new users and those already on the app. With the "Sensitive Content Control," it will now be tougher for teens to stumble upon sensitive content or sketchy accounts in places like Explore and Reels.

For good measure, parents can check out the age-appropriate topics their teen has selected based on their interests.

The announcement means that teens under 16 will need parental permission to



change these settings, while those over 16 can adjust them on their own – unless their account is being supervised, in which case they'll need a parent's okay to make any changes.

To further boost safety, teen accounts will be set up to allow tagging and mentions only from people they follow. Plus, the "Hidden Words" feature will be turned on by default, filtering out offensive language from comments and DMs.

Instagram is also introducing a new feature called "Daily Limit" to help teens manage their screen time. After 60 minutes, the app will gently nudge teens to

take a break. Younger teens will need parental approval to extend their time limit beyond that.

Additionally, Instagram is rolling out Sleep Mode, which stops notifications after 10pm and before 7am, so teens can get a good night's sleep. This new feature replaces Quiet Mode and Night Nudges. Parents can also choose to block Instagram completely at night using the parental supervision tool.

Instagram initially plans to roll out Teen Accounts in the U.S., UK, Canada, and Australia within the next month or so, with the EU getting them later this year.



### Intel launches Lunar Lake

CLAIMS ARM-BEATING BATTERY LIFE, WORLD'S FASTEST MOBILE CPU CORES.

Intel has revealed performance benchmarks for its Lunar Lake Core Ultra 200V-series processors, touting 'historic x86 power efficiency' coupled with the world's fastest mobile CPU cores and 30% faster gaming performance than competing processors.

Intel says the 50% reduction in package power consumption over its prior-gen models delivers twice the performance per watt, equating to up to 20.1 hours of

battery life, beating Qualcomm's Snapdragon X Elite by almost two full hours. Intel also took shots at Qualcomm's compatibility issues, highlighting that 23 games and numerous applications it used for benchmarking refused to run on the X Elite chips.

If the chips deliver on Intel's promises, they'll be a strong retort to AMD's Ryzen AI 300 series 'Strix Point' chips and Qualcomm's X Elite.



## Three Mile Island nuclear plant to power Microsoft's data centres

WAS THE SITE OF THE WORST NUCLEAR POWER ACCIDENT IN US HISTORY.

If everything goes to plan, a nuclear reactor at the famous Three Mile Island power plant in Pennsylvania – the site of a major accident in the '70s – will be restarted to fulfill an agreement with Microsoft for carbon-free energy to power its data centres.

The reactor coming back online is not the one that had a partial meltdown in 1979, which has remained dormant since the accident. That was TMI-Unit 2. The adjacent reactor, TMI-Unit 1, went

back into operation in 1985 and continued to operate until 2019, when it was shut down due to “poor economics,” according to operator Constellation.

After refurbishing it and obtaining the necessary federal and state approvals, Constellation hopes to have TMI-Unit 1 operating by 2028, and says that restarting the reactor will “add approximately 835 megawatts of carbon-free energy to the grid.



### MSI outs 'world's first' ATX 3.1-ready m/boards

UP TO 420 W OF MOTHERBOARD POWER, AND THAT'S NOT EVEN COUNTING THE CPU.

MSI has outed its new X870 and X870E motherboards for AMD AM5 processors, including the new Ryzen 9000-series chips. The big news is ATX 3.1 support and a big boost in PCIe power supply.

MSI says the boards' new supplemental PCIe Power feature delivers a major boost in overall board and GPU power supply. That could well come in handy, what with expectations of ever greater power draw from upcoming GPUs, particularly Nvidia graphics cards like the rumoured 550 W RTX 5090.

The power boost comes courtesy of an integrated 8-pin PCIe power connector on the motherboard itself. Conceptually, it's a little like the supplemental power connectors that already feed power to the CPU socket.



### Microsoft promises boost for modern Windows 11 apps

BUT DEVELOPERS NEED TO UPDATE THEIR APPS FIRST..

Microsoft has introduced major improvements to apps built with Windows App SDK, claiming up to 50% faster load times and a significant reduction in app sizes. These changes are driven by new technologies like Native Ahead-Of-Time (AOT) compilation, though performance gains will depend on developers updating their apps.

Microsoft has acknowledged performance issues with several of its own apps, including Photos and Phone Link, which are known to have longer-than-expected splash screens and slow response times.

These issues are especially noticeable when launching apps for the first time after a reboot. While these optimisations will not immediately make apps faster, they lay the groundwork for noticeable improvements as developers adopt the updated SDK.



### Intel outlines plan to get back in the game

BUT WHEN AND WILL IT HELP?

Intel chief executive Pat Gelsinger revealed the company's next steps in the form of three main goals that might turn around the struggling technology company. But tech enthusiasts worry: Will it be enough? Notable announcements include a multi-billion-dollar partnership with Amazon Web Services (AWS) and the decision to put fab and packaging facility projects in Germany and Poland on hold for the next two years while continuing to build capacity in the U.S. Intel's internal manufacturing remains crucial to the company's long-term success. However, the company plans to make Intel Foundry an independent subsidiary, completing the separation of profit and financial reporting from Intel Products started earlier this year. For CPUs, Intel's x86 instruction set architecture (ISA) and expertise in its enhancement have been its core strengths for decades, so Intel is certainly not giving up on x86. Instead, Intel is streamlining its portfolio, including developing competitive x86 offerings across its client, edge, and data centre lineups. Intel's collaboration with AWS exemplifies its commitment to providing customized x86 solutions for customers to better compete against Arm and RISC-V.

### Modder hacks ChatGPT & apps onto TI-84 calculator

CREATES 'THE ULTIMATE EXAM CHEATING DEVICE'.

YouTube ChromaLock uploaded a video showcasing his “ultimate cheating device,” which is almost indistinguishable from a TI-84 calculator. However, there are hardware modifications and an open-source suite of software modified for the TI-84 that he made, allowing the user to run ChatGPT. The software for the mod is shared on GitHub under the TI-32 repository, which is described as “A mod for the TI-84 Plus Silver Edition and TI-84 Plus C Silver Edition calculators to give them Internet access and add other features, like test mode breakout and camera support”.

ChromaLock demonstrates the invisible nature of the modification and its varied functionality. This includes a chat function, a monochrome image viewer, and a ChatGPT input window. ■

# AI is integral to next-gen graphics tech

It's easy to dunk on AI, but when it comes to practical use cases, Nvidia CEO Jensen Huang may have a point.

**Unless you've been living under a rock, you may have noticed a trend in PC gaming in recent years – and that trend is upscaling. While AMD's compute-based FSR has improved over its various iterations, as we recently found in our testing, it's still not a patch on Nvidia's AI-powered DLSS for image preservation. And according to Nvidia CEO Jensen Huang, we're now at a point where AI has become all-but-essential for next-generation graphics tech.**

Speaking at the Goldman Sachs Communacopia + Technology Conference in San Francisco in September, Huang spoke about a variety of topics, including the benefits of AI in a variety of industries. When asked which of these use cases he was most excited about, he said:

“Well, in our company, we use it for computer graphics. We can't do computer graphics anymore without artificial intelligence. We compute

one pixel, we infer the other 32. I mean, it's incredible. And so we hallucinate, if you will, the other 32, and it looks temporally stable, it looks photorealistic, and the image quality is incredible, the performance is incredible.”

“Can't” is an interesting term to use. While you can of course create computer graphics without any AI interference, what Huang is likely referring to here is the top-end of graphics technology, which has become increasingly hardware demanding – and thereby increasingly reliant on hardware-based AI upscaling like DLSS to run at acceptable frame rates.

“Computing one pixel takes a lot of energy. That's computation. Inferencing the other 32 takes very little energy, and you can do it incredibly fast. So one of the takeaways there isn't just about training the model...it's about using the model.”

Reducing the load on a GPU by

inferencing pixels and creating extra frames via the use of AI, à la DLSS Frame Generation, has certainly changed gaming since its introduction. AMD's competing solution, FSR, is still a compute-based upscaling approach – although there has been speculation that RDNA4 may have an AI hardware based method to rival Nvidia and Intel's solutions.

Looking at the wider picture, however, AI of course has more practical use benefits than simply making our games look better, and run faster:

“If not for AI, the work that we're doing in robotics, digital biology... just about every tech bio company I meet these days [is] built on top of Nvidia”, he continued.

“Small molecule generation, virtual screening. I mean, just that whole space is going to get reinvented for the very first time with computer-aided drug discovery because of artificial intelligence. So, incredible work being done there.”

While it's easy to criticize many aspects of the AI boom – from the massive power requirements of the vast amounts of hardware used to train it, to AI search suggestions gone awry – when it comes to our beloved computer graphics, it's now difficult to imagine games without AI or AI-based upscaling in some form or fashion.

And as for things like biotech? Well, by the looks of what Jen-Hsun is saying here, it may play a key role in the next generation of healthcare, too.

Continued graphical improvements, and better medical technologies? Perhaps this whole AI shebang has some real-world benefits after all. Now, if we could only make it more accurate instead of better at hallucinating, that'd be dandy. ■







MSI MPG 321URX 240HZ AND 271QRX 360HZ

# ENDGAME QD-OLED MONITORS



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# What is the point of the PS5 Pro?

Audiences have moved on from iterative graphical improvements in games, writes Shaun Prescott.

**The home console isn't dead. The PS5 has sold over 61 million units worldwide since 2020. The Nintendo Switch has sold over 141 million units since 2017. The Xbox has, well, endured. Into the mix is a burgeoning category of PC handhelds led by the Steam Deck, which isn't technically available in Australia but will reportedly hit our shores later this year.**

The appeal of the console is pretty obvious: You turn them on and they work. There's no fiddling. Perhaps more crucially, they're relatively inexpensive compared to a gaming PC. In 2020, it made more sense to buy a PS5 than a PC with roughly equivalent specs. Fast forward to 2024, does it make sense to buy Sony's PS5 Pro for the unprecedentedly high price of \$1,199?

The PS3 famously launched in Australia for \$1,000, so it's perhaps not as bad as it looks. But the PS3 was a huge generational leap; the PS5 Pro just does what the PS5 does, but in a prettier fashion. Oh yeah, and it doesn't have a disc drive. If you want one of those, that'll be another \$160, please.

Though price has dominated chatter about the PS5 Pro, the general lack of enthusiasm around the device seems to be borne of a natural shift in what excites us about videogames. For younger generations who cannot remember the great graphical arms races of the 1990s and 2000s, iterative changes in graphics technology are far less interesting than for any resident 40-year-old who remembers the *Wolfenstein-Doom-Quake* continuum. Getting a better framerate in *Ratchet & Clank* on performance mode doesn't mean much to a generation more likely to sink hundreds of hours into *Minecraft* or *Fortnite*.

*Minecraft* and *Fortnite*, by the way, run brilliantly on the PS5. As does *Apex Legends*, *Valorant*, *Grand Theft Auto 5*, *Roblox*... the list goes on. Thanks to the industry's fixation on low-cost remakes and remasters this generation, a wealth of classic games look better on the base PS5 than they ever have. Sure, when *Grand Theft Auto 6* launches next year it may be conspicuously prettier on the PS5 Pro, but increasingly, people who care about that are in the minority.

The success of Steam Deck also demonstrates that high-specs and jaw-dropping graphical power isn't really the drawcard it used to be. And that's leaving aside the hundred million selling Nintendo Switch, which was technically long-in-the-tooth even in 2017. It's fair to say that after eight years of gaming on that platform, consumers will lap the Switch 2 up whether it's exorbitantly priced or not.

The PS5 Pro, though? I have my doubts. When PS4 Pro launched last generation, it wasn't yet standard for most games to offer discreet performance and quality modes. Some games did seem to struggle. I review games for a living, and play most of the heavy hitters, and none but the most pedantic or passionate about graphics are likely to worry about any performance issues on the base PS5. The PS5 Pro doesn't need to exist. ■

Shaun Prescott is an Australian editor for *PC Gamer*, *GamesRadar* and *PLAY*, and writes for *APC*, *TechRadar* and more.







# Intel's bad batch

The company issues fix for Raptor Lake degradation.

**Earlier this year, I wrote about difficulties I was having with a Core i9-13900K processor. Little did we realise that we were only seeing the tip of the iceberg. While most complaints have involved the unlocked Core i9 Raptor Lake CPUs, it appears the instability problems build up and potentially impact many Raptor Lake – 13th and 14th Gen Core – CPUs, with Intel identifying 22 different desktop parts.**

Everything from the Core i5-13600K and above rated for more than 65W base power, including i7 and i9 65W chips, is affected. That means T-class parts should be fine, as well as vanilla models like the Core i5-14600, but popular unlocked K-class processors are impacted. There are also reports of problems extending to server and laptop parts.

Intel has a microcode fix that has begun rolling out via BIOS updates. It supposedly targets the root cause, but if your CPU has already shown problems, there's no fix other than replacing it. Intel isn't issuing a recall, but I can smell the class action lawsuits. However, it has extended warranty support on the affected

CPUs by two years. The official statement reads, in part: "Intel's current analysis finds there is a significant increase to the minimum operating voltage (Vmin) across multiple cores on affected processors due to elevated voltages. Elevated voltage events can accumulate over time and contribute to the increase in Vmin for the processor. The latest microcode update (0x129) will limit voltage requests above 1.55V as a preventative mitigation for processors not experiencing instability symptoms."

Our understanding is that this goes back to the integrated voltage regulator (IVR) in Raptor Lake CPUs. Modern processors are designed with some 'intelligence' when it comes to voltages and the IVR monitors functioning of the chip, and can increase the delivered voltage. Two chips of the same CPU model can have small low-level differences, so having the hardware detect what's required and adjust normally works. But Raptor Lake may have pushed clock speeds and voltages too far, and when the IVR sends higher than expected voltages, the result is a cascade effect.

Over time, the effect can cause the IVR to slowly increase the baseline voltage. But the spikes continue, further degrading the CPU structures, then the IVR has to keep edging upward on voltages. Eventually, it reaches the critical limit, at which point you basically have a paperweight CPU.

That seems to be what happened to my 13900K. Eventually, the chip reached the point where I couldn't install Nvidia's GPU drivers, and other applications began misbehaving. A clean install of Windows 11 crashed before I could get things up and running. At that point, I had to RMA the CPU.

The new chip has been working fine. Intel also says that the microcode updates shouldn't affect performance – this is about limiting voltages, and high transients weren't helping. Future CPUs should also be unaffected – these issues appear to be specific to the Raptor Lake generation. But the damage to Intel's reputation will be harder to overcome.

I can't help but think some of this goes back to motherboards pushing the limits a bit too far. Don't be surprised if future Intel chips come with more strongly enforced power and voltage limits to prevent similar problems from occurring. ■

**"While most complaints have involved the unlocked Core i9 Raptor Lake CPUs, it appears the instability problems build up and potentially impact many Raptor Lake – 13th and 14th Gen Core – CPUs, with Intel identifying 22 different desktop parts."**

*Jarrod has been described as an AI by people he meets at parties.*



# AMD's turn to drop the ball?

2024 hasn't been a banner year for CPUs, from any company.

**With Intel's Raptor Lake CPUs falling over, AMD must have been enjoying the view – until its new Ryzen 9000 desktop CPUs rolled out. So, is AMD's CPU a minor stumble or game-changing fumble?**

The first Ryzen-branded CPUs launched way back in summer 2017. From there, AMD iterated, improved, and generally delivered. Each new Ryzen generation was an unambiguous step up from its predecessor.

That's impressive, but it arguably comes to an end with the new Ryzen 9000 generation. Certainly, Ryzen 9000's 'new' Zen 5 architecture is disappointing by pretty much every measure. When it comes to IPC or instructions per clock, it's essentially a single-digit percentage improvement.

There's talk of issues around internal latency impacting performance, but whatever the reason, there's no getting round the fact that Ryzen 9000 is a bit of a disappointment. That's doubly true when you consider that AMD is sticking with the same core counts as before.

Put it this way, in a blind test, there's no chance you'd be able to feel the difference of an 'upgrade' to Ryzen 9000 in games, or any other application. In mitigation,

the new chips can be quite a bit more efficient in some scenarios. That's going to be a tangible benefit for server applications, and it will probably be enough to maintain AMD's steady erosion of Intel's market share.

Back in the PC, it's not worth all that much. What's more, the Ryzen 9000 doesn't seem to be fully baked at launch. As I write these

words, it's not officially confirmed, but it looks like AMD is going to release a microcode update that may actually increase the TDP of certain models in the new 9000 range.

If that helps put some air between the new processors and last-gen chips, it will be welcome. But honestly, customers shouldn't have to worry about updating their CPUs weeks after buying them. Likewise, AMD was under no pressure to roll these new CPUs out, and it must have known how they performed and that little to no improvement in many benchmarks was hardly going to be met with widespread applause.

It all feels a little like the AMD of old; the one that struggled to get almost any new CPU generation

out the door without tripping itself up in the process. So far, it's not really a disaster, and I have a hunch that AMD is actually going to get away with this one. For starters, you'd still buy AMD rather than rolling the dice on an Intel Raptor Lake CPU that may or may not truly be fixed by Intel's own microcode patches.

The real test of whether Ryzen

9000 and Zen are a flop will come in a month or so when Intel's own new CPU, known as Arrow Lake, is due to appear. But all the indications are that Arrow Lake, like Ryzen 9000, is a disappointing step over existing CPUs. If

so, Ryzen 9000 will be competitive in performance terms, and won't suffer the reliability concerns that will lumber Intel CPUs for a while to come.

And yet, Ryzen 9000 is a pity for AMD. To mix my sporting metaphors, just as it has Intel on the ropes, AMD has fumbled the ball. Maybe it won't matter. But maybe, just maybe, it will give Intel that little bit of breathing space it needs to get back in the game. ■



**"Certainly, Ryzen 9000's 'new' Zen 5 architecture is disappointing by pretty much every measure."**

*Jeremy has a black leather jacket just like Jensen's.*





# Being there

As Jon Honeyball welcomes the arrival of his grand-niece, he wonders what digital future awaits her.

**Back when I was somewhat younger, “the computer” was that thing on your desk, or hauled around in a heavy laptop case. Today it is everywhere: on my wrist, in my pocket, in my TV. Connectivity then was slow and extraordinarily limited. Today it’s available in every location around the world, at all times and in unlimited quantities.**

Born in the mid-1960s, I have been privileged to see this happen. But what of tomorrow? My eldest nephew, Matthew, and his wife Lisa have just welcomed their first child Hannah into the world. Nearly 30 years ago, when Matthew was born, he grew up only a few kilometres away from me and I saw him regularly. Today, Hannah and her parents live in Norway. And I get daily video, photos and updates. I’ll be able to FaceTime with her and help with her homework in a few years. With Vision Pro, I will be able to be in the room with her.

“Will it still be worth getting on the plane for a painful long-haul flight when you can enjoy a fully immersive “really being there” experience from your sofa at home?”

So “plus ça change, plus c’est la meme chose”. We still have the same, but the technology has allowed for a massive increase in geographical reach. And we are converging on a new era of true geo-translocation, where you can place yourself anywhere, and see what others are currently seeing.

We can live anywhere, but I wonder if we’re approaching a tipping point when it comes to travel. Will it still be worth getting on the plane for a painful long-haul flight when you can enjoy a fully immersive “really being there” experience from your sofa at home? Of course, it won’t be quite the same – you won’t be able to wander around at will, but much of that is simply getting to the bits you want to see anyway.

My worry is that the increased pace of technology and connectivity will ultimately lead to us leading a more singular, static life. With the pressures on global warming, transportation and the time and eco-cost of moving around – not to mention the near-instant spread of viruses. I can see a future where a Google list of virtual places to visit replaces what we now might call “travel experiences”.

The industry keeps telling us that we will have the time to enjoy all of this, because of the reduction of work time caused by

robotics and other AI-driven capabilities. But today, to quote an oft-repeated meme, it seems that the AI is doing the art and music, and I am doing the work.

What sort of world will Hannah have when she is 30? Extrapolating from the past 30 years is almost impossible, because of the rate of change. Will we have fully immersive holodecks, food replicators and endless social and personal time? Or will we have dropped into a dystopian *Bladerunner* future where every thought is used to data mine you? And don’t imagine I’m being ridiculous: Ford recently filed a patent application that would allow it to listen to every conversation you have in the car and use this to drive targeted advertising to you.

The temptation to switch off and go live on a hillside can be strong. Give me a wind turbine, a clean stream of water, sufficient food supply and maybe the increasing noise of the world could be kept at bay. Oh, and a Starlink connection. Just to say hi to Hannah. ■

*Jon Honeyball fully intends to be around in 2054 to update this column.*

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# FUTURES

We explore the trends and technologies that are set to shape the future



## The future of work is already here, so what's next?

AI will let you work asynchronous hours – and maybe fewer days, predicts Nicole Kobie. At least that sounds like a nicer future than robots taking our jobs.

**You work from home, at least a few days a week, keeping up to date with colleagues via Zoom and Slack. Meetings are recorded or transcribed so offline workers can catch up. Line managers engage with employees to avoid quiet quitting, rust out and bare-minimum Mondays. AI helps you code more quickly, manages workflows and suggests email responses, and there's a trial at your office for VR training.**

This isn't the future of work. This is now. But how is it working out for all of us – and what's next?

### Hybrid life

Some workers prefer office life. Others would rather work from home. Some companies want all hands on deck all the time, others appreciate the cost savings of downsizing corporate headquarters. The

answer is, of course, hybrid working.

Ever since the Covid lockdowns began to wind down, many workers became reluctant to give up the many benefits of staying at home to work. Thus emerged the hybrid model with many companies specifying a set number of days required for being in the office. It's difficult to estimate exactly how many office workers have hybrid options, but the Flex Index surveyed 5,000 companies that employ three million people, finding three-quarters offer flexibility to corporate employees, with 44% using a structured hybrid model, with the largest percentage requiring two or three days in the office.

Hybrid work requires staff to be able to work anywhere, and that does cost companies. "All – literally all – capabilities need to be available for both in-person and remote work environments," said Mike

Schumacher, founder and chief strategy officer of Lakeside Software. "And the service and support need to be the same for both workstyles."

Business support company Town Square Spaces shifted to remote during the pandemic, but that eventually evolved into hybrid working. While that came easily for a company that sets up coworking spaces, there were technical challenges – though many were solved when everyone worked from home during lockdowns.

"That's not just things like videoconferencing," said Mandy Weston, cofounder and chief operating officer. "Improvements to items such as security on cloud technology have been important and probably wouldn't have advanced as quickly if the world hadn't been forced to adopt remote, 'access your data anywhere', working practices."



## Hybrid for all

Schumacher believes most tech workers will end up in a hybrid environment as it simply makes the most sense. Staff can work how, when and where suits them, but it maintains personal interactions and collaboration that are key to team building and training.

“The organisation benefits most from in-person work while some individuals enjoy the freedom of work from anywhere,” he said. “There is a happy medium that allows both to achieve their goals.” That is backed by research: Stanford economist Nicholas Bloom studied hybrid working, finding it a “win-win” for productivity, performance and retention.

If you’re not already offering hybrid working, your staff will eventually demand it. Or they’ll go work someplace else. A Skillshub survey of employees found 43% of respondents would quit if their employer mandated a full return to the office.

## Virtual first

One way of looking at hybrid working is the idea of “virtual first”: enable staff to work remotely, and give them an office space set up for collaboration. That’s what Dropbox did, turning to its own platforms to build its company as digital first, in office second.

“While it is important to develop the right culture to underpin the Virtual First model, technology is critical to facilitate this level of work,” said Caroline Nangle, HR business partner at Dropbox. “As practically all office-based work is now digital, our own technology provides a streamlined and centralised database to store and organise all digital content.”

Networking company Cloud closed six of its eight offices, rejigging them into collaboration hubs for teams to gather – they’ve even been used on weekends as a birthday venue and daycare. “Simply using Zoom or Teams in a conventional manner was never going to create a great experience,” said Jeff Dewing, CEO of Cloud.

“I decided to invest in the best camera and microphone

technologies, large 90in screens resulting in the people that are present mixed with the people that are remote feeling like they are in the same room,” he added. “We also invested in pinpoint cameras, enabling remote personnel [to be] able to see what’s being written on flip charts in the present meeting room.”

Does it work? Dewing reports that productivity is up, employee retention is better and staff are taking fewer sick days.

## Time no longer matters

If you’re not working in the same place, why work at the same time? This is the idea behind asynchronous working, and it’s perhaps the next office trend.

Nangle says Dropbox is working towards an “async by default” mindset to combine true workplace flexibility with in-person connections. This is partially necessary for Dropbox because the vast majority of its staff work with colleagues in another time zone, but it can also be helpful to smaller businesses offering flexible work times to staff to fit around school drop-offs and the like.

“We set up core collaboration hours and hold these for real-time connection, including one-to-ones, brainstorming sessions and key decision-making forums,” she said. “These overlap between time zones and encourage employees to design their own schedules when it comes to dedicated focus time, while still enabling collaboration without hindering individual effectiveness.”

There are plenty of tech tools to help shift to asynchronous working. Videoconferencing software such as Zoom and Teams can record calls, transcribe every word using AI, and even summarise key notes, making it easier to catch up on missed meetings. Collaboration tools such as Slack make it easy to indicate whether you’re available and to share working times, and keep messages in one place so discussions can happen when you’re away from your desk without missing out.

If that all sounds like a lot of messages to work through, you’re right. Andy McCaul, managing director of The Bigger Boat, notes that sometimes older tech is the

answer. “For example, a colleague might rely on messaging, when a call would be quicker and more accurate,” he said.

Nangle says Dropbox found that its “virtual first” model led to more messages, meetings and notifications. “As a result, some employees are having a hard time finding what they need because of the overwhelming number of notifications from the tools required to get work done,” she said, citing Dropbox research that revealed that the average worker spends 122 hours per year recovering focus after sifting through their inbox or attending a meeting.

To address that, Dropbox offers guidance on how to communicate

**BELOW** Video meetings are just one part of the shift towards hybrid working.



asynchronously, so employees all stick to the same method. And, Nangle says, AI can help by making it easier to search through all tabs and apps to find what they need.

## AI in the office

Ah, AI: a problem to workers facing job losses, but also the solution to workplace challenges. And while other cutting-edge technologies are also likely to make an impact – be it virtual reality for training, immersive metaverses for meeting up in digital environments or smart sensors for watching employee health – everyone we spoke to failed to mention those innovations in favour of AI. It’s just on everyone’s minds.

“Every job in every company will be impacted by AI,” predicted Lakeside’s Schumacher. “What job today doesn’t use a computer, a spreadsheet or email? Similarly, every position will leverage AI.

Some positions won't exist – they will be completely automated. But in the shorter term, you might be replaced in your job by somebody that is better at using AI than you are. At one time, knowledge of Excel was novel; you need to learn to use AI now."

So, what should you use it for? "In the short term, using AI to augment the current business approaches will yield benefits," said Schumacher. "But the huge benefits will derive to those that reinvent business processes in light of an entirely new approach."

Yes, but how, exactly? As we cover in our main feature on p54, much depends on your business and sector. The easy way to get started with AI is to test out the tools that are increasingly embedded in the software you already use, such as Microsoft Copilot or Zoom AI Companion. There may be costs associated, though some tools are offered for no extra charge.

The other way to consider AI is to figure out what problems you have in your business – your bottlenecks, the dull routine tasks staff have to do repeatedly, what annoys your customers. Then see if AI can be applied to address those challenges, perhaps sending a handful of keen



staff on AI training so they can consider the issue on behalf of the company. AI guided workflows and chatbots might not solve your problem, of course, but it's worth a shot.

As Schumacher notes, using AI to tweak business practices this way really is the low-hanging fruit. Once you've gotten to grips with AI, it's time to consider bigger ideas, he says.

### Four-day weeks

Here's a big idea: work four days rather than five, on the same pay.

**ABOVE** It can be hard to keep track of all your messaging tools.

Effectively all the research shows that productivity either stays the same or increases, showing how much time we waste at work when we could be living our lives. The idea is beginning to grab attention, with massive trials showing positive results across different sectors.

Gareth Hoyle, founder of Marketing Signals, shifted his team to a four-day week in 2022 with no loss of pay. "I already measured my teams based on output not attendance, meaning it's incumbent on team members to produce results, rather than to demonstrate how many hours they spent working on something," he said.

The firm covers the full week by having two shifts: one working Monday to Thursday, the other working Tuesday to Friday. The shifts flip every week, so the team has alternating two-day and four-day weekends. "While regular group calls on a Tuesday, Wednesday or Thursday [when both teams are working] help, I've found that investing in task/project management software is the best way to promote a seamless workflow," Hoyle added.

Productivity is of course a valid goal for any company, but it's reasonable to expect all this extra tech could allow us to work less, too – sharing the benefits with companies and workers. That largely happened with the shift to hybrid working – companies could cut real estate spend, employees can take their children to school – so perhaps the AI-fuelled workplace revolution could have upsides for both, too. ■

## Digital access

The shift to flexible working powered by digital technologies has helped businesses recruit from a wider range of people, be it those unable to commute daily because of health reasons or caring responsibilities, or people from different geographies. That's the good news. The downside is that digital technologies aren't always inclusive.

Beyond setting up secure access to corporate networks and upgrading the Zoom account, companies need to remember to avoid digital exclusion. Jonathan Hassell, CEO at digital accessibility consultancy Hassell Inclusion, notes that as businesses become more reliant on digital technology, it makes it harder for those with additional challenges – perhaps because of reduced vision or fine-motor difficulties.

"Often this 'exclusion' starts in the recruitment process, which means that employers are effectively falling at the first hurdle, disabling people from applying for positions, or performing to their best in online interviews," he noted. "Beyond that, there are at least ten other points in the employee journey where accessibility needs to be considered in digital tools and comms, including onboarding, training and meetings – all of which also contribute to employee retention."

He added: "In a technology-first world, a proactive approach to digital accessibility is not a 'nice to have', it is a business essential."



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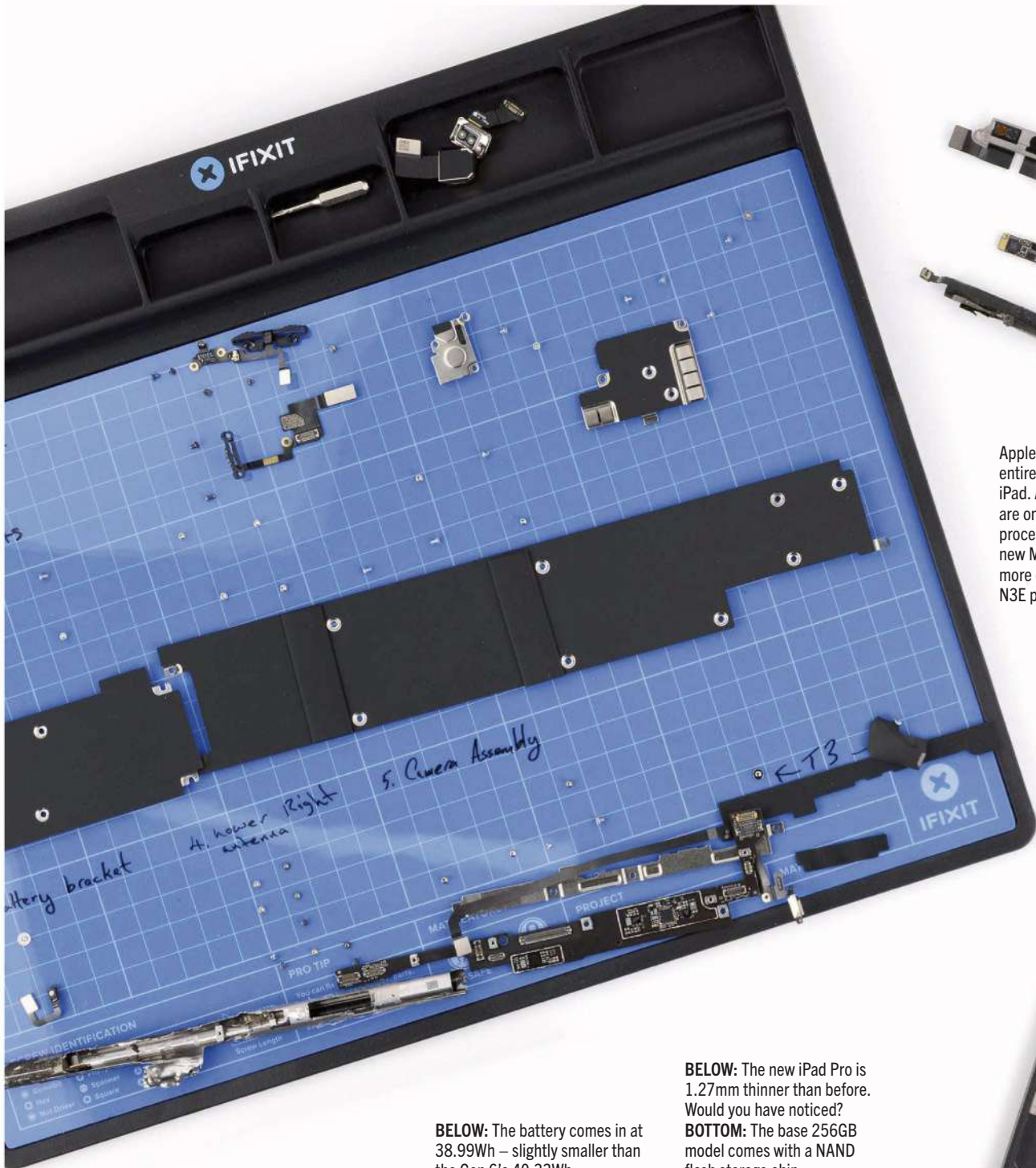
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# AUTOPSY

This month we dissect...



Apple skipped the M3 entirely for the new iPad. Apple's M3 chips are on TSMC's N3B process node, and the new M4 is on the slightly more energy-efficient N3E process node.

**BELOW:** The battery comes in at 38.99Wh – slightly smaller than the Gen 6's 40.33Wh.

**BELOW:** The new iPad Pro is 1.27mm thinner than before. Would you have noticed?

**BOTTOM:** The base 256GB model comes with a NAND flash storage chip.

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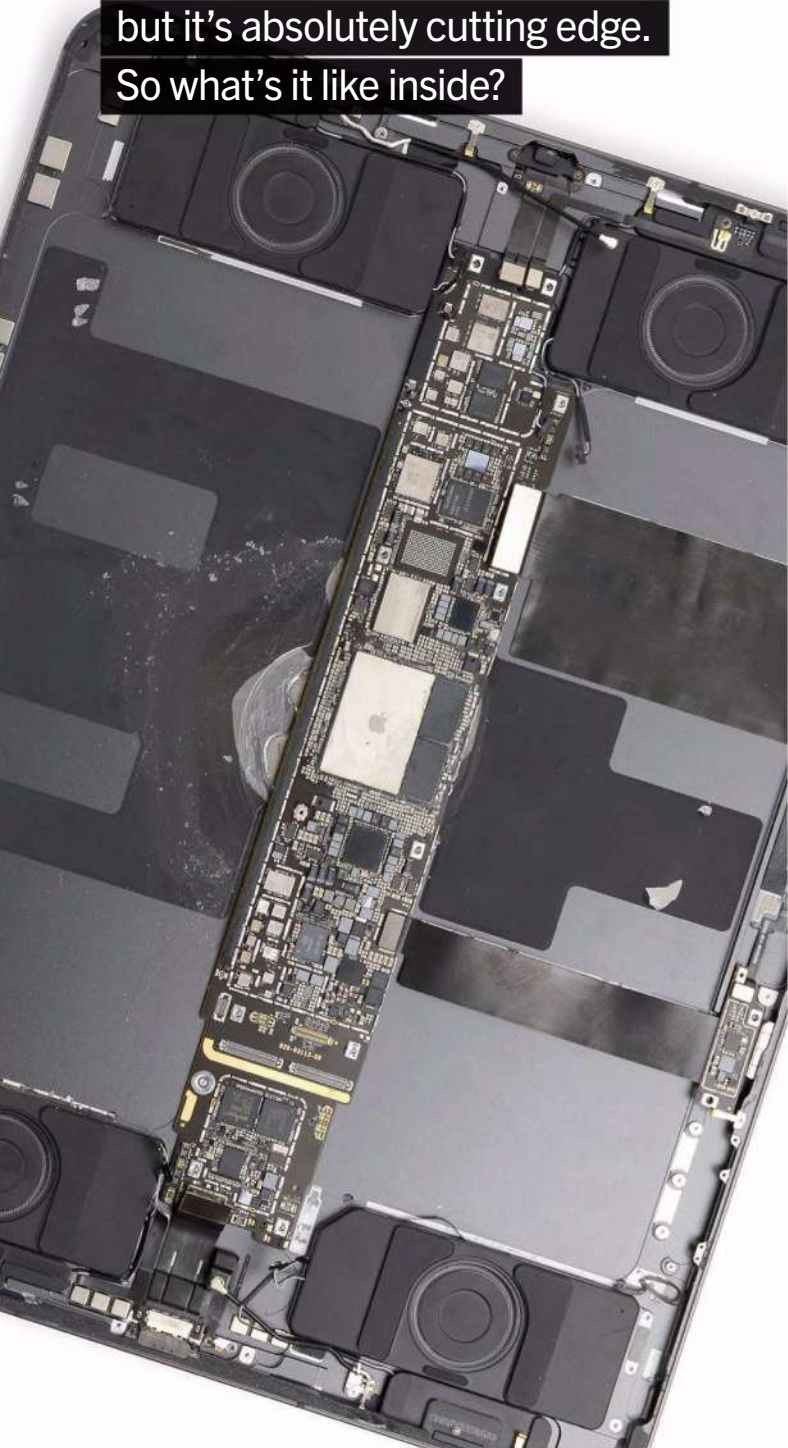
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# Apple iPad Pro 13

New 3nm M4 chip, tandem OLED, and ultra-thin. Say what you want about the new Apple iPad Pro, but it's absolutely cutting edge. So what's it like inside?



## MAJOR TECH SPECS

- M4 SoC with up to four performance and six efficiency cores, 10-core GPU and 16-core neural engine
- 13-inch Tandem OLED display, 2,752 x 2,064 pixels, 1,600 nits HDR
- 12MP Wide camera, *f*/1.8 aperture, digital zoom up to 5x, up to 4K 60Hz video
- Up to 16GB memory and 2TB storage
- 5G (sub-6 GHz) with 4x4 MIMO7, Gigabit LTE with 4x4 MIMO and LAA7, Wi-Fi 6E with 2x2 MIMO8, Bluetooth 5.3
- Thunderbolt / USB 4 port with support for charging, DisplayPort, Thunderbolt 3 (up to 40Gb/s), USB 4 (up to 40Gb/s), USB 3 (up to 10Gb/s)
- 38.99Wh rechargeable lithium-polymer battery, up to 10 hours of surfing the web on Wi-Fi or watching video

## KEY FINDINGS

- First off (pun intended) is the Tandem OLED, a.k.a. Ultra Retina panel. Like its LCD siblings, the internals are only accessible via the screen. The glue holding it down isn't terrible, but this repair is not going to be for the faint of heart. Guaranteed, this Ultra Retina panel is going to be expensive to replace long after the battery starts losing its efficiency. Opening the device will certainly risk breaking it.
- The new panel is an impressive bit of engineering. The Samsung and LG-manufactured Tandem OLED panel provides a peak SDR brightness of 1,000 nits – a significant increase over the SDR brightness of 600 nits on the 6th generation iPad Pro. The contrast ratio has doubled, too, meaning brighter whites and darker blacks.
- For the first time in an iPad Pro, we're able to remove the battery immediately after removing the screen. Well, 'immediately' is relative. There are still some screws and brackets, but this is a major improvement over previous-generation iPads, where a two- to three-hour ordeal saw the logic board and kitchen sink removed before the battery could be accessed. This comes in at 38.99 Wh – slightly smaller than the 6th Gen's 40.33 Wh.
- While we can celebrate this victory, it's inevitable that an even thinner product would come with some unrepairable compromises. From the daughterboard to the speakers and coax cables, we found a whole bunch of stuff that's glued down because there just isn't enough space for screws. That means speakers will get destroyed if you try to remove them, the daughterboard gets bent out of shape if you look at it the wrong way, the heat-sensitive cameras are subject to a risky prying operation to remove, and other shenanigans.
- All this to reduce the thickness by 1.27mm – nearly imperceptible even if you place the 6th generation iPad Pro 12.9 next to it. Nobody asked Apple for this, and had they not made such a big deal of it, few people would have noticed.
- Repairability Score: 5 out of 10 (10 is easiest to repair). Everyone is already celebrating the technological wonders of this device, but we're also happy to see Apple prioritise repairability a little. It's great to see the battery being designed for accessibility and replacement, yet that victory is soured a bit by the compromises required to create a needlessly thinner device. Perhaps Apple's engineers can innovate themselves toward repairability, even at these extremely tight tolerances. ■





# The A-List

The best products on the market, as picked by our editors.

## Premium laptops

### Apple MacBook Pro 16in (M3)

#### STUNNING CREATIVE POWER.

A reasonable processor upgrade to device with an impressive screen and unparalleled battery life. The new M3 3nm processors is more efficient, so you'll be able to run the same tasks as the M1 using half the power draw, which helps battery life.

From \$4,299, [apple.com/au](https://apple.com/au)



## Business laptops

### HP OmniBook X THE QUALCOMM CPU REALLY DELIVERS.

The latest Qualcomm CPU helps create a standout laptop that will impress compared to Intel powered alternatives. The OmniBook X has been on sale across all major retailers for \$2,079. At this sort of price the X is the cheapest Snapdragon X Elite laptop going, and a compelling buy.

From \$2,079, [hp.com](https://hp.com)



#### THE ALTERNATIVES

##### DELL XPS 16 9640

An up-sizing for the iconic XPS. The XPS 16 9640 is quite expensive, and despite a few niggles, it offers great performance and battery life in a minimalistic package.

\$4,498, [dell.com](https://dell.com)

##### APPLE MACBOOK AIR

The MacBook Air M3 replaces the M2 model previously listed here. It's a powerful and quiet ultraportable with an unbeatable battery life and screen.

From \$2,099  
[apple.com/au](https://apple.com/au)

##### MICROSOFT SURFACE LAPTOP 7

A shining example of just how good a Windows laptop can be. Despite a few minor drawbacks, the Surface Laptop is a fantastic package that offers performance and battery life.

\$1,899, [microsoft.com](https://microsoft.com)

#### THE ALTERNATIVES

##### DELL LATITUDE 7340

This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs).

\$2,475

[lenovo.com/au](https://lenovo.com/au)

##### ASUS ZENBOOK S 16

The Asus Zenbook S 16 offers premium performance in the ultraportable category and competes well with alternatives such as the Surface Laptop 7 or Macbook Pro.

\$3,499, [asus.com.au](https://asus.com.au)

##### LENOVO THINKPAD T14S GEN 6)

This Copilot+ PC with a Qualcomm Snapdragon Arm processor is a superb choice. It's light, it's fast and its all-day battery life is genuinely 24 hours.

\$1,899, [lenovo.com/au](https://lenovo.com/au)

## Gaming laptops

### Alienware m16 R2 A PREMIUM AND AFFORDABLE GAMING & WORK MACHINE.

There are cheaper gaming laptops, and faster ones too, but we love the balance offered by the m16 R2. Who doesn't want a big 16in gaming laptop, featuring a Ultra 9 CPU, a RTX 4070 GPU and 32GB of RAM? And for a decent price, considering it's from Alienware.

\$3,300, [dell.com](https://dell.com)



## Everyday laptops

### Asus Zenbook S 13 OLED ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER.

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals.

Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

\$2,099, [asus.com](https://asus.com)



#### THE ALTERNATIVES

##### LENOVO LEGION 5I

Best in class performance from the powerful RTX 4070 GPU and stand out features such as 140W PD charging.

\$3,499

[lenovo.com/au](https://lenovo.com/au)

NEW

##### ACER NITRO V 16

It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.

\$1,500

[store.acer.com](https://store.acer.com)

##### ASUS ROG STRIX SCAR 18

It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere.

From \$4,599

[asus.com/au](https://asus.com/au)

#### THE ALTERNATIVES

##### MICROSOFT SURFACE LAPTOP GO 2

Runs cool and quiet, and has up to 30 percent better battery life than its predecessor, all in a beautifully designed form.

From \$1,199

[microsoft.com](https://microsoft.com)

##### APPLE MACBOOK AIR 15

An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here.

From \$2,199

[apple.com/au](https://apple.com/au)

NEW

##### LENOVO YOGA SLIM 7X

This is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.

\$2,909, [lenovo.com](https://lenovo.com)



## Chromebooks

### Acer Chromebook Spin Core 5

Simply the best Chromebook around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this convertible. \$997, [acer.com](https://acer.com)



### Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix. \$367, [lenovo.com/au](https://lenovo.com/au)

### Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice. \$297, [lenovo.com/au](https://lenovo.com/au)

## Tablets

### Apple iPad Air (M2)

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes. From \$1,299, [apple.com/au](https://apple.com/au)



### Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing \$2,199. From \$2,199, [apple.com/au](https://apple.com/au)

### Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software. \$1,999, [samsung.com](https://samsung.com)

## Everyday monitors

### Asus ROG Swift OLED PG32UCDP

We've seen several ultimate gaming monitors in recent months but, from the specs alone, Asus might just have made the most *ultimate*: 480Hz refresh rate, matte-screen HDR OLED, 32-inch 4K. \$2,399, [asus.com.au](https://asus.com.au)



### BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent. \$459, [benq.com](https://benq.com)

### MSI MEG 342C QD-OLED

Quantum Dot technology combines with an OLED self-emitting panel to offer brighter, more efficient and more colourful visuals than your average OLED screen. \$1,799, [msi.com](https://msi.com)

## Professional monitors

### Eizo FlexScan EV3240X

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment. \$2,696, [eizoglobal.com](https://eizoglobal.com)



### Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage. \$5,500, [eizoglobal.com](https://eizoglobal.com)

### BenQ PD2706U

If you can't stretch to Eizo budget levels then this 4K 27in screen is definitely worth investigating. It has several features aimed at professionals, including a Hotkey Puck to switch between profiles, plus great coverage of the sRGB and DCI-P3 gamuts. \$739, [benq.com](https://benq.com)

## Home office printers

### Epson EcoTank ET-2810

Don't expect flashy features, but do expect fast print speeds, high-quality prints, scans and copies, plus phenomenally low running costs – even after you've exhausted the 6,000 pages' worth of bottled ink that comes with it. \$399, [epson.com.au](https://epson.com.au)



### HP OfficeJet Pro 9012e

So long as your print volumes aren't huge – the running costs mount up – this is a superb all-in-one for home office usage. It's fast, robust, prints double-sided and produces strong all-round results. \$228, [canon.com](https://canon.com)

### Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years. \$329, [brother.com](https://brother.com)



## Wireless routers

### Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden. \$419, [synology.com/au](https://synology.com/au)



### Asus ROG Rapture GT-AX16000

The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available. \$999, [asus.com/au](https://asus.com/au)

### Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait. \$1,499, [netgear.com](https://netgear.com)

## Mesh Wi-fi

### TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises. \$1,299 (2-pack), [tp-link.com](https://tp-link.com)



### TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. \$227 (2-pack), [tp-link.com](https://tp-link.com)

### Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect. \$939 (2-pack), [asus.com/au](https://asus.com/au)

## NAS servers

### Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick. Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices. \$889, [asustor.com](https://asustor.com)



### QNAP TS-264

The TS-264 combines strong specifications and performance for a reasonable price. We wouldn't choose this NAS as a starting point for a small business, but it is a good choice as a home NAS if you'll be using it for both work and entertainment. \$649, [qnap.com](https://qnap.com)

### QNAP TS-253E

The TS-253E is a sensible business NAS that's ideal for rolling out to multiple small offices. If you're buying for business, and particularly if you've got an eye on minimising support headaches across a group of premises, this is an excellent choice. \$858, [qnap.com](https://qnap.com)

## Security software

### Avast Ultimate

Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection. ~\$65, 1 device, [avast.com/en-au](https://avast.com/en-au)



### NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates. \$59 per year, [nordvpn.com](https://nordvpn.com)



### Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. Free, [bitwarden.com](https://bitwarden.com)



#### THE ALTERNATIVES

##### G DATA TOTAL PROTECTION

Despite its quirks, G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system. 1 device, US\$50, [avast.com](https://avast.com)

##### AVAST ONE ESSENTIAL

Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools. Free, [avast.com](https://avast.com)

#### THE ALTERNATIVES

##### PROTONVPN

ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options. Free, [protonvpn.com](https://protonvpn.com)

##### SURFSHARK

A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services. \$79.61 for one year, [surfshark.com](https://surfshark.com)

#### THE ALTERNATIVES

##### DASHLANE

A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan (\$60 per year) as this extends the service to six people. \$55.99 per year (Premium), [dashlane.com](https://dashlane.com)

##### 1PASSWORD

1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. \$54.99 per year (individual), [1password.com](https://1password.com)

# THE LIST

## The best mouse pads for gaming



The best mouse pads offer slick movement and awesome aesthetics, no matter what surface you prefer. At the most basic level, you want something that offers a smooth and precise surface for your mouse, which thankfully can be bought for not much more than a couple of coffees. Beyond that, you might want features like USB passthrough, RGB lighting, and maybe even less of a mouse pad and more of a deskpad. Here are our favourites.



### 5 NOVELKEYS DESKPAD

If you're the sort of person who feels constrained by a traditionally sized mousepad, then why not try a deskpad? NovelKeys does a lot of custom designs based on themes like *Ghostbusters* or *Star Wars*, but they feel good to use and last a long time. Most mouse pads come in at an accommodating 900 x 400 x 4mm size, with a rubber bottom, cloth top, and outer edge stitching to match.

\$13-75 [www.novelkeys.xyz](http://www.novelkeys.xyz)



### 4 LOGITECH G440

Nothing compares to a solid, hard surface mousepad when it comes to pure speed and low tactile resistance, and thanks to Logitech, you don't have to pay the earth to get those things. There are lots of different hard surfaces available, but we like the simplicity and ultra-smooth surface of the Logitech G440. The polyethylene surface features microtextures that offer the perfect amount of resistance, providing just the right level of feedback without any excess noise.

\$25 [www.logitechg.com](http://www.logitechg.com)



### 3 CORSAIR MM100

There's not much to say about the Corsair MM100, but it's that sort of simplicity, and its low price tag, that we like. If you want a nondescript black rectangle with minimal branding that your mouse will glide across, then this is your pad. It's smooth on top and rubberised on the bottom. The only downside is there's no stitching on the edges, so repeated scuffs can cause some frays.

\$19 [www.corsair.com](http://www.corsair.com)



### 2 RAZER STRIDER

Think of this as a hybrid mouse pad, offering the flex and soft finish of a fabric mat with the stick-to-itiveness and glide of a more rigid model. The reason we love it is the anti-slip rubber base that clings to your desk, with zero chance of lateral movement. For a no-fuss and well-made pad, look no further than this.

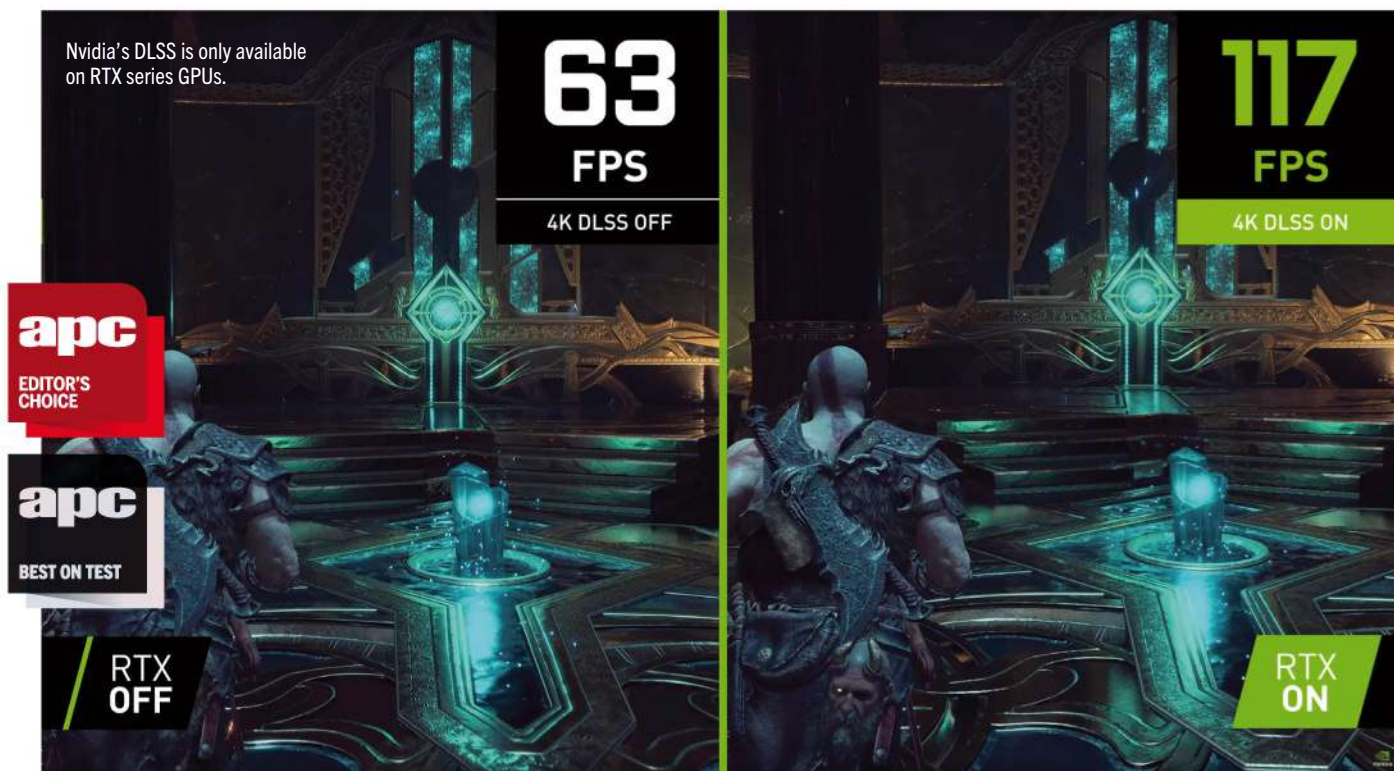
\$84 [www.razer.com](http://www.razer.com)

### 1 RAZER FIREFLY V2 PRO

There's no finer a mouse surface than the Razer Firefly V2 Pro, a hard-top mat that also comes with some very alluring RGB lighting. Of course, you don't need the latter, but you'll love the way your mouse moves as if it's a hovercraft. It's also easy to wipe down and clean with a damp cloth. This is the best mouse pad we've ever used.

\$154 [www.razer.com](http://www.razer.com)





NVIDIA DLSS Free, [www.nvidia.com](http://www.nvidia.com) AMD FSR Free, [www.amd.com](http://www.amd.com)

# Nvidia DLSS vs AMD FSR

Which AI upscaling technique has the edge? Zak Storey investigates.

**4K gaming is a problem. It's always been a challenge to render at that high a resolution. If anything, the res arrived long before any graphics card or console could touch it. The problem is simple: compared to 1080p, 4K represents a 300 percent increase in the number of pixels on display at any given time. We effectively quadrupled the total workload overnight by shifting to a 4K resolution. Not only that, but even in 2024, eliminating jaggies is as important as it ever was. Anti-aliasing efforts similarly are incredibly graphically intensive. Jaggies occur because games render textures in pixels, and because pixels are square, you end up with artifacts creating a jagged texture, often along the edge of a model.**

We ended up in a challenging situation where the resolution and refresh rates increased, and although pixel density had shot up, jaggies were still a thing, and the methods we were using to eliminate them via anti-aliasing likewise cost even more performance when processed at 4K.

To get around this, Nvidia began to implement DLSS in its first-generation RTX graphics cards. With the added benefit of Tensor cores in its cards, it could finally leverage machine learning and AI supersampling (predominantly done on its own supercomputers to create models for the tensor cores to utilise) to effectively eliminate that jaggie problem and upscale textures. Initially, DLSS 1.0 focused mainly on anti-aliasing. It was only with DLSS 2.0 that we received the supersampling as well. In that case, instead of rendering a game at 4K by enabling DLSS, the GPU would drop native resolution and upscale that back to 4K, using AI to identify the patterns based on the models provided by Nvidia's own supercomputers, and simultaneously improve frame rates in the process.

DLSS has come a long way since then, and we're now in its 3.5 iteration, complete with Ray Reconstruction and AI Frame Generation, as well improving things further (as long as you have Nvidia's low latency mode enabled, frame-gen does add lag). It's now featured in over 400 titles and growing.

It's not alone in the battle for Super Sampling dominance. AMD launched its own form, known as Fidelity FX Super Resolution, and it operates in a similar manner to how Nvidia runs its own DLSS. However, AMD's variant does not rely on AI Machine Learning models for general upscaling, instead using them to polish some Fluid Motion Frames. That's probably a good thing, as AMD's own AI accelerators found in its latest generation of cards still aren't on par with Nvidia's dedicated Tensor units. But the question lies in which has a competitive edge over the other? Which should you be using?

## The case for DLSS

On the surface, DLSS feels like a much more rigid AI technique. It's limited to Nvidia cards, it's bound to the hardware itself, and if you're running anything other than an RTX series GPU, you're out of luck. That said, the one major advantage it does seem to have is that when DLSS is updated, it goes live on every game at the same time. In AMD's case, the latest versions of FSR require developers to go back and update their



AMD's FSR is available on pretty much every GPU, but requires dev support.

4K "Extreme" graphics preset with "Extreme" raytracing setting and FSR 2.2 "Performance" mode. See endnote RS-513

titles with support for it. That is problematic, as not every development team has the capacity or even desire to do that. DLSS now has a massive game database as a result.

On the flipside, FSR is open to any graphics card – you don't necessarily need an AMD GPU to run it. In fact, you can run it directly on an Nvidia card, or an Intel GPU. In fact, we've done some testing with exactly that premise in mind.

Utilising an Nvidia RTX 4080 and Intel Core i9-14900K, we've tested *Cyberpunk 2077* at 4K. Bear in mind that we're using the Ray Tracing Ultra preset, and AMD's FSR 2.1, and DLSS 3.5. Although FSR 3 is not yet implemented in-game, it does support Frame Generation in a similar manner to Nvidia, with its own low latency adjustments embedded in the driver. However, it's worth noting that you can add Frame Generation into FSR 2.1 while using an Nvidia GPU.

In DLSS's Ultra Performance mode, it nets 115.47fps on average (146.98fps with frame gen), on Balanced that drops to 62.88fps (89.98fps with gen), Quality nets 50.93fps (76.69) and with no DLSS you get 26.99fps. The difference is staggering.

That doesn't come without some loss, however. Most of the changes come in the form of eliminating jaggies and improving image clarity. Anything below balanced is somewhat underwhelming. Still frame generation is the biggest net benefit, and doesn't impact quality of the image itself.

### FSR under the microscope

In the case of AMD, FSR performs admirably in the scenario, even despite being an older variant. With Ultra Performance, it lands in at 110.97 (145.61 with frame gen), 60.54 on balanced (86.80 with fg), and on quality you get 49.96 (and 74.85 with frame gen).

Generally speaking, the difference isn't massive – DLSS does have an edge on its quality presets, particularly when it comes to AA. There's a number of scenes in the *Cyberpunk* benchmark with grates on the floor and edges of worktops, and in those cases DLSS has an edge, but it's still hard to spot the difference. Nvidia similarly does seem to have an advantage with ray-traced reflections under DLSS over FSR, with anything above 'Quality' looking more blurry under AMD's tech, while the same result only occurred with Nvidia above the 'Balanced' preset.

As you can see, performance between the two is tight. Nvidia does have an edge with DLSS in *Cyberpunk*, but again, we're talking about a new version of its DLSS tech, running in one of its latest GPUs, while FSR is an older version on a non-AMD GPU. The reality is they're likely both close to even in overall performance.

### The Winner?

Both are phenomenally good at what they do. They represent a categorical change in how we can render graphics in-game, and for the most part, both are free.

Nvidia is a touch more exclusive and locked off – you do need an Nvidia GPU alongside an RTX card, and 3.5 in particular is further locked behind its 4000 series GPUs, while in AMD's case, a broader range of GPUs are compatible with FSR 3 and its Fluid Motion Frames tech. Still, it's not as widely supported, and requires developer intervention, which is where Nvidia has the edge. Although it has Frame Generation too, the number of titles with support is incredibly limited.

If you have an RTX card, we recommend checking out how your game looks on a case-by-case basis, and how each form impacts frame rates. This does vary from title to title. Some games look better and run smoother with FSR 2 over 3, and some are better with DLSS entirely. Still, there's no better time to be a GPU enthusiast, that's for sure. ■

### VERDICT



**Nvidia DLSS** More widely adopted and easier to deal with updates. It performs incredibly well. But the hardware is locked, latest tech often requires latest GPU gen and frame gen leads to latency.



**AMD FSR** Compatible with far more cards and performs just as well, latency is better. Requires developer time to implement, slightly worse AA performance, Reflections not quite as tight.



# GADGETS

Nice things to have



The Cambridge Audio Evo One can stream wirelessly from Spotify, Tidal and more.

## Cambridge Audio Evo One

**Combining retro chic with high-tech features, the low-slung Cambridge Audio Evo One has everything you need to really make your music and movies sing. Chief of these is its 180-degree sound array, which uses 14 speakers to deliver sounds in all directions, and you can even use it as part of a multi-room setup, thanks to its support for AirPlay 2, Google Home and Roomb.**

Made from 50% recycled materials with a FSC-certified real

wood walnut veneer, it also includes a 6.8-inch colour display that can be used to show album artwork, a clock, or digital VU meters.

Onboard you'll find Bluetooth, HDMI and RCA (phono) stages for connecting to your other devices, a TV, and even to a turntable. Plus, it also includes support for music streaming services (such as Spotify and Tidal) and has an internet radio, so you can enjoy your favourite DAB stations too. **\$2,499, [cambridgeaudio.com](http://cambridgeaudio.com)**



Enjoy the sound blasting from six woofers, four midrange drivers and four tweeters.

**“Cambridge Audio Evo One has everything you need to really make your music and movies sing. Chief of these is its 180-degree sound array, which uses 14 speakers to deliver sounds in all directions.”**



## AOC 16T3E

The last time we looked at a portable monitor from AOC, it was the Gaming 16G3. As stylish and as accomplished as that was, the new 16T3EA may be more up your street. Designed to look much more business-like, it comes with a 15.6-inch Full HD IPS display with ultra-narrow bezels, stowed in a robust metal body with a pop-out stand on the back. And yet it's still 12.5mm thin and weighs just 830g. Capable of a maximum 250 nits of brightness, it also includes a single USB-C port for power and connection to your PC or Mac. It's also just as capable when watching movies and playing games as it is for when you just need to get work done, thanks to its built-in speakers and 3.5mm headphone jack. You can even use it in portrait orientation.

**\$179, [aoc.com](http://aoc.com)**



**“It comes with a 15.6-inch Full HD IPS display with ultra-narrow bezels, stowed in a robust metal body with a pop-out stand on the back.”**



### HOZO NeoRulerGO

The Measure app is great for sizing things up in a pinch, but if you really want to measure things accurately give the NeoRulerGO, erm, a go. This pocket-friendly laser tape measure comes with 93 built-in scales ranging from architecture to maps — all of which can be shown on the built-in 1.14-inch colour display or via the free MEAZOR 2.0 app. Accurate to within 1mm and able to be used continuously for up to 10 hours using its built-in battery (it also offers up to 90 days charge on standby), the NeoRulerGO weighs just 45g.

**From \$120, [amazon.com.au](http://amazon.com.au)**



### JBL Tour Pro 3

While Apple is rumoured to be adding a display to the case of its AirPods, it's far from the first — as these wireless earbuds from JBL show. Available in Black and Latte finishes, the earbuds come with a Smart Charging Case that has a colour 1.57in touchscreen display on the front — handy for viewing track details, Caller ID and more. The earbuds, meanwhile, last for up to 44 hours between recharges (when used with the case) or 11 hours when not. They also include fast pairing, spatial audio and Bluetooth 5.3.

**\$TBC, [jbl.com.au](http://jbl.com.au)**



### Audio-Technica AT-LP70XBT

The perfect partner for the Cambridge Audio Evo One opposite, this is a great turntable for anyone looking to get their vinyl fix. Available in bronze, black and white with silver highlights, it can spin both 33 and 45rpm discs, connecting to your hi-fi gear either via Bluetooth or by using its built-in phono output. The turntable's tonearm comes with a AT-VM95C stylus cartridge included, with the option to upgrade to a higher quality version if needed. And the turntable can be set up and ready to play in minutes.

**\$539, [audio-technica.com](http://audio-technica.com)**

# REVIEWS

Expert reviews and recommendations to help you buy with confidence



33 TCL RayNeo Air 2S 34 Acer Nitro V 16 35 Lenovo Slim 7x 36 Ryzen 9950X 38 Google Pixel 9 Pro Fold  
40 Google Pixel Watch 3 41 Remarkable Paper Pro 42 Hyte Thicc Q60 AIO cooler 43 Nzxt C1500 Platinum PSU  
44 Benq X300G 4K Short Throw Projector 45 Kingston XS1000R portable SSD

APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

## Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to

invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

## Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.



### APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.



### APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

**SPECS** 2 x 0.55in 120Hz microOLED displays; 1,920 x 1,080 resolution per eye; 600cd/m<sup>2</sup> peak brightness; 2 x microspeakers; beamforming mic array; 175 x 154 x 47mm (WDH); 79g; 1yr warranty.



**PRICE** \$628 **WEB** amazon.com.au

# TCL RayNeo Air 2S

Finally – smart glasses we actually want to use.

**Smart glasses are an idea that keeps coming around. However, no one's yet managed to drag the idea into the mainstream: could TCL RayNeo's new Air 2s AR glasses be the ones that hit the big time?**

They certainly make a style statement. The general shape resembles a pair of classic Ray-Ban Wayfarers, but RayNeo's design eschews the Wayfarer's thick rims in favour of a futuristic full-front visor. The silver temples offer three-point tilt adjustment and ultra-flexible hinges, and at just 79g in weight they're comfortable to wear, even over long periods.

Getting started with the Air 2s glasses is easy. Plug them into any laptop, smartphone, gaming handheld, or tablet and – as long as your device can output DisplayPort over USB Type-C – they'll immediately start mirroring the display. The twin Full HD microOLED displays project a virtual impression of a 201in display in front of your eyes at a perceived distance of six metres, and in practice this looks gigantic.

Beyond display mirroring, these glasses don't offer a huge amount in terms of AR tricks. The RayNeo XR app for Android

lets you explore a selection of visual demos, small games and a web browser, but it's of little practical use. The Mirror Studio app for Windows is a bit more ambitious, allowing you to project selected desktop windows into 3D space, but I found it confusing to use, and even once I had my windows successfully floating, interacting with them felt fiddly and unnatural.

Thankfully, when it comes to entertainment, the Air 2s glasses do a simply stunning job. The virtual display is beautifully crisp and ultra-smooth (with a refresh rate up to 120Hz); colours are vivid, highlights are bright, and blacks are rock solid, thanks to a 100,000:1 contrast ratio. In fact, the heavy tint helps here, as it provides a dark backboard against which your content can really shine out.

Games and movies on the Air2s glasses look simply jaw-dropping. Watching *Blade Runner 2049* I was practically awestruck by the neon hues and irradiated oranges that dress Los Angeles and Las Vegas. If you want a less eye-socking experience, the right-hand temple rocker switch lets you easily adjust the brightness of the display, or you can tap the action button to

bring up an on-screen menu and switch between standard, vibrant, and soft colour profiles.

Perhaps even more impressive is the audio experience. The little speakers you typically find built into AR glasses tend to lack power and low-end warmth, but the TCL RayNeo Air 2s' quad-driver audio system sounds fantastically rich and solid, while spatial audio support adds an extra level of immersion to compatible movies and media.

In all, the RayNeo Air 2s AR glasses are a terrific entertainment accessory. The only disappointment is that the bundled apps are so limited: the Air2 could also be a powerful tool for productivity, or a handy AR companion for when you're out and about, but the software just isn't mature or versatile enough.

Still, if you like the idea of immersive media experiences on an enormous virtual screen, the RayNeo Air 2s AR glasses are a brilliant piece of hardware. I'm hopeful that TCL and RayNeo will keep developing the software and realise more of these glasses' potential in the future. ■

“Plug them into any laptop, smartphone, gaming handheld, or tablet and – as long as your device can output DisplayPort over USB Type-C – they'll immediately start mirroring the display.”

➤ **VERDICT**



Matches the best for visual hardware and audio quality, but TCL needs to work on its software.  
Rael Hornby



PRICE \$2,199 WEB acer.com

# Acer Nitro V 16

Is this the affordable AMD gaming laptop you've been waiting for?

The Acer Nitro V series of laptops has long been one of our favourite options for portable gaming on a budget. The Acer Nitro V 16 is the latest model, with a large 16in display, and equipped with a powerful AMD Ryzen 7 CPU and Nvidia RTX 4060 GPU. The Nitro V does have a few limitations compared to more expensive laptops, but considering the street price (at the time of writing) is just \$1,500, we aren't complaining. .

The Nitro V 16 (as tested) ships with a grunty Ryzen 7 8845HS CPU, RTX 4060 GPU, 16GB of (upgradeable) RAM and a 1TB SSD. The big 16in display has a 1920 x 1200 resolution, 3ms GTG response time, and can handle up to a 165Hz refresh rate. The rest of the Nitro V spec is decent enough, with Wi-Fi 6E, a backlit keyboard and a gaggle of ports that includes a Type-C USB4 connection supporting video out and 100W charging.

The Nitro V does make a few sacrifices to the gaming gods to keep the price down. For a start, the RTX 4060 is limited to a max of 85W – rather than the 140W possible. The Nitro V uses a mostly plastic build, and while perfectly serviceable, it does have more flex and bounce than a



metal laptop. And sure, the IPS display isn't exactly very high resolution, and the 300-nit brightness could be better, but at least the 100% sRGB colour gamut makes for vibrant gameplay.

But most importantly, how does the Nitro V 16 handle itself when gaming? Turbo fan mode is needed to reach full performance (resulting in a dull roar), but the combination of robust cooling and 85W power envelope keeps the 4060 from

throttling too much, and the Nitro V 16 gives noticeably better performance than the (4060-equipped) 2023 Nitro V 15.6in. The 1TB NVMe SSD is fast (plus large enough to hold loads of games) and there's a Gigabit LAN port if using Wi-Fi is blowing out your pings.

All-in-all the Nitro V 16 gives very playable frame rates at the display's native 1200p resolution, and even with the settings cranked up, games such as *Cyberpunk 2077* can happily hit 90+ fps. Or you can drop the details back to low, and leverage DLSS and the 165Hz refresh rate to get a buttery smooth 130+ fps gaming experience.

The Nitro V 16 is a competent productivity desktop when plugged in, and the Ryzen 7 has plenty of grunt. Trying to game on battery will see the 59Wh available drained in an hour, but set to efficiency mode, the Nitro V can last a better than expected 6.5 hours doing lighter tasks such as word processing or web browsing.

The 2.5kg weight and up to 3.1cm thickness (including the foot pads) means the Nitro V is fairly chunky, but it's still not too bad for carrying on the go – especially if you use USB-C charging and leave the power brick at home. ■

## BENCHMARK RESULTS

	Acer Nitro V 16	Acer Nitro V 2023
CPU	Ryzen 7 8845HS	Intel Core i7-12650H
GPU	RTX 4060 85W	RTX 4060 85W
RAM	16GB DDR5	16GB DDR5
Street Price	\$1,500	\$1,700
PCMark 10 - Overall (score)	7,750	6668
Geekbench 5 - Single Core	1,929	1,654
Geekbench 5 - Multi Core	10,110	9,413
Geekbench 5 - GPU	114,100	100,618
Cinebench R23 - CPU Single Core	1,841	1,702
Cinebench R23 - CPU Multi Core	15,911	14,290
3DMark Port Royal	5,999	5,711
3DMark Time Spy Extreme	4,885	4,380
RDR2 - 1080p Ultra (fps Av.)	76	74
Cyberpunk 2077 - 1080p Ultra (DLSS)	91.5	84.9
Cyberpunk 2077 - 1080p High (DLSS)	130.9	121.2
F1 2023 1080p Medium	122	118
CrystalDiskMark Read (MB/s)	6,425	6,589
CrystalDiskMark Read/Write (MB/s)	4,099	3,816
PCMark 10 - Battery Work (HH:MM)	06:40	05:13

**SPECS** W11 Home; 16in, 1920 x 1200 pixel resolution, 300 nits, 100% sRGB colour; Ryzen 7 8845HS CPU; Nvidia RTX 4060 (85W); 16GB (2x8GB) DDR5 5600MHz RAM; 1TB SSD; 59Wh battery (6h 40min PCMark 10 Work battery life); 36.1 x 27.8 x 2.6 – 3.1cm; 2.5kg.

## VERDICT



It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.

Lindsay Handmer

PRICE \$2,909 WEB [lenovo.com](https://www.lenovo.com)

# Lenovo Yoga Slim 7x

A very sleek laptop that gets strong performance yet amazing battery life from the new Snapdragon X Elite CPU.

Lenovo's entry into the rapidly growing world of Arm-based Windows laptops is based on the excellent Yoga Slim 7 series – though in this case, it's the Slim 7x. The laptop features the same Snapdragon X Elite X1E-78-100 (turbo to 3.4GHz) used by competitors such as the HP OmniBook X, which is about 10% slower than the fastest 4.2GHz X1E-84-100 CPU. The Slim 7x stands out thanks to a gorgeous 14.5in 3K (2944 x 1840) OLED display, offering a 500 nit typical brightness (1000 nits peak), 100% DCI-P3 colour, and a 90Hz refresh rate. The display is also a touchscreen, and folds back through 180 degrees to (almost) lay flat.

The Yoga Slim 7x is (as the name suggests) rather thin, and measures in at just 1.29cm thick – excluding the rubber feet that add another few millimeters. It's 32.5cm wide and 22.5cm deep, which combined with the low 1.3kg weight, makes the 7x an extremely portable laptop.

The Slim 7x is sold by Lenovo with two configurations – 16GB of RAM and a 512GB SSD, or 32GB of RAM and a 1TB SSD. The RRP is on the higher side, and the 16GB variant costs \$2,609, while the 32GB model will set you back \$2,909. The good news is that we've already seen decent discounts down from the RRP (as is the way from Lenovo), and the 32GB model has been



**SPECS** W11 Home; 14.5in touchscreen OLED display, 2944 x 1840 pixel resolution, 500 nits, 100% DCI-P3; Snapdragon Elite X (3.4GHz) CPU; 32GB LPDDR5 RAM; 1TB SSD; 70Wh battery (23h 31min video playback); 32.5 x 22.5 x 1.29 cm; 1.34kg.

available for as little as \$2,237.

While not the very fastest CPU from Qualcomm, the X Elite X1E-78-100 is more than powerful enough to run all your everyday tasks (and then some) but isn't much good for gaming. The 7x has a reasonably large 70Wh battery, which can keep the laptop running for up to 15 hours when working. The Qualcomm CPU is especially efficient for light duty tasks, and in our tests the Slim 7x managed a very impressive 23 hours, 31 minutes of video playback.

The Snapdragon CPU has an inbuilt NPU, enabling Microsoft's array of (currently) half baked Copilot AI features. These are not yet a selling point, but will likely become more useful in the future. The Arm CPU in the 7x

means non-native apps run in emulation mode, but we didn't find any particular compatibility issues. That said, if you have a specific app that you can't do without (especially if obscure), it's worth double checking compatibility.

The 7x has a very premium build quality overall thanks to generous use of aluminum, and the backlit keyboard (with dished keycaps plus 1.5mm of travel) is a delight to type on. The large trackpad is responsive, the touchscreen works well, and the inbuilt speakers sound better than they have any right to in such a thin laptop. While the 7x doesn't have a fingerprint reader, it does feature an 1080p IR webcam for facial recognition, which responds very quickly for easy Windows logins. The 7x doesn't wow with the port selection, and has just three USB-C connections – though happily each is USB4 40 Gbps, and they support DisplayPort output plus 65W charging.

The Yoga Slim 7x RRP feels a bit pricey, but when making a direct comparison with alternative options, the value proposition is better than its similarly equipped competition. If you are patient enough to wait for a sale and can snap it up for a price closer to \$2,000, the Yoga Slim 7x is a steal. ■

## ➤ BENCHMARK RESULTS

	Lenovo Yoga Slim 7x	HP OmniBook X
CPU	Snapdragon X Elite X1E-78-100	Snapdragon X Elite X1E-78-100
GPU	Qualcomm Adreno (3.8TFLOPS)	Qualcomm Adreno (3.8TFLOPS)
Battery Capacity	70Wh	59Wh
RRP	\$2,609 (16GB)	\$2,599 (16GB)
Cinebench R24 - CPU (multi-threaded)	1,001	814
Cinebench R24 - CPU (single-threaded)	108	101
Geekbench 6 - Multi-core (score)	13,857	13,006
Geekbench 6 - Single-core (score)	2,589	2,363
Geekbench 6 - GPU (score)	20,241	20,249
CrossMark	1,301	1,239
3DMark Time Spy	1,930	1,815
3DMark Steel Nomad Light	1,935	1,933
3DMark Night Raid	25,001	24,981
Battery life - 1080p video playback (h:min)	23:31	26:19
CrystalDiskMark Read (MB/s)	6,141	3,381
CrystalDiskMark Write (MB/s)	4,474	2,963

## ➤ VERDICT



The Lenovo Yoga Slim 7x is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.

Lindsay Handmer





PRICE \$1,099 WEB [amd.com](https://www.amd.com)

# AMD Ryzen 9 9950X

The most expensive and powerful Zen 5 chip in the Ryzen 9000-series enters the arena.

If you didn't know anything about Zen 5, you'd think the new Ryzen 9 9950X is a step backwards from its predecessor, the Ryzen 9 7950X. They both have the same number of cores and threads (16 and 32, respectively) and the same total amount of L3 cache (64 MB). The 5.6GHz boost clock is the same for both and the new chip even has a lower base clock (4.3 vs 4.5GHz). And yet, the Ryzen 9 9950X is by far the better processor.

To understand why, you need to delve into the guts of the two CCDs (Core Complex Dies) that nestle next to the IOD (Input/Output Die) underneath the heatspreader.

The architectural changes are too many and too complicated to go through in detail

here, but it suffices to say that everything AMD has changed results in notably better performance, depending on the application.

The Zen 5 architecture can offer some substantial gains, especially in productivity and content creation tasks, though the outright improvement in gaming is somewhat understated.

However, in those chips, differences in clocks and power limits mask the true potential of Zen 5. As you'll soon see, when it comes to pitching the Ryzen 9 7950X against the Ryzen 9 9950X, the benchmark results are almost entirely down to the architectural differences between Zen 4 and Zen 5.

Unlike the lower tier models, AMD hasn't reduced the power limit for the

9950X and, like its predecessor, it's configured to have a TDP of 170 W and a peak package limit (PPT) of 230 W. That's a far cry from the 105 W TDP for the Ryzen 9 3950X, AMD's first 16-core processor for the desktop market, and at face value, seems to be just as power hungry as Intel's Core i9 14900K (which is nominally rated at 125 W TDP, 253 W). As with many things in the world of tech, paper numbers never tell the full story, though.

## Performance

Let's start with what the Ryzen 9 9950X is best at and that's productivity, content creation, rendering, video editing, and so on. As you can see, it's not just good at it, it's the best CPU for these tasks full stop. Only a mega-expensive AMD Threadripper or Intel

BENCHMARK RESULTS	AMD Ryzen 9 9950X	AMD Ryzen 9 9900X	AMD Ryzen 9 7950X	Intel Core i9 14900K
Cinebench 2024.1.0	139	138	116	131
Blender 4.2.0	197	149	170	149
7zip 24.07 compression	190	160	174	174
Handbrake 1.8.1 CPU encoding	132	111	122	102
Avg temp in Baldur's Gate 3	64C	64C	64C	73C
Avg package power in Baldur's Gate 3	129W	124W	123W	176W



Xeon would likely achieve better results.

That said, it's only notably better in certain applications than the Ryzen 9 7950X. In the multithreaded Cinebench test, the 9950X is 15% faster than the 7950X and 16% better in Blender. However, the 9950X's lead over its predecessor is 8% in Handbrake and just 5% in the photo editing benchmark.

This is all pretty much in line with AMD's performance claims when it announced the Ryzen 9000-series with the launch of the Zen 5 architecture, so I'm not criticising the 9950X for having varied results in our tests – that's just the nature of how it all works.

The same is true of the chip's gaming performance. As with all of the Zen 5 chips I've tested, there's nothing wrong with how the Ryzen 9 9950X runs gaming workloads – compared to the Core i9 14900K, it generates 3% lower average frame rates, although the 1% lows are further behind, being 5% and 8% down respectively.

That's close enough to not really be noticeable in real-time gaming, and our other game tests put the Ryzen 9 9950X on par or slightly ahead of the Core i9 14900K. Naturally, this is how it will be across the myriad of other games out there, where some will favour AMD, and others will work better with Intel chips.

One aspect of all of this that strongly leans in AMD's favour is power consumption. Recording the average CPU package usage in *Baldur's Gate 3* and the multicore test in Cinebench provides clear evidence for this: where the Ryzen 9 9950X consumed 129 W and 196 W in those two tests, the Core i9 14900K demanded 177 W and 271 W—that's 37% and 38% more power.



“Let’s start with what the Ryzen 9 9950X is best at and that’s productivity, content creation, rendering, video editing, and so on. As you can see, it’s not just good at it, it’s the best CPU for these tasks full stop.”

### The best, with caveats

I was eager to test the 105 W Eco mode with the 9950X as the previous generation of high-tier Ryzen chips still worked really well with a reduced power limit and one of my favourite all-round processors, the Ryzen 9 7900, gets by with just 65 W. However, using Eco mode with the Ryzen 9 9900X, the 12-core variant of AMD's Zen 5 lineup, produced disappointing results, especially in gaming.

So, taking all of the above into consideration, it's clear that the Ryzen 9 9950X is the best desktop CPU you can

buy – it's not the outright fastest when it comes to gaming, but it's more than good enough in this respect, and its multithreaded performance is second to none. It also doesn't use huge amounts of power and it's very easy to cool.

But none of this comes cheap. At \$1,099, the 9950X has a \$100 lower RRP launch price than the previous model, the Ryzen 9 7950X, but one can pick up that chip for \$663 on Amazon at the moment.

This is a problem that all new processors have to contend with, of course, but in the case of the Ryzen 9 9950X it does mean it's not particularly good value for money. I'm certain that some applications will really favour the new architecture but unless one is specifically looking for a CPU for such specific workloads, then you might as well save yourself over \$436 and get the last-gen Ryzen 9 7950X.

And if all you care about is PC gaming, then avoid the Ryzen 9 9950X altogether, as there are better and cheaper options, such as the Ryzen 7 9700X and still the mighty Ryzen 7 7800X3D. ■

### VERDICT



For productivity and content creation workloads, the Ryzen 9 9950X is second to none. It's no slouch in gaming but there are far cheaper options to go for that perform just as well.

Nick Evanson



**TESTBED** Motherboard: Asus ROG Crosshair X670E Hero; Cooling: Asus ROG Strix LC III 360 mm AIO; Memory: 32GB Lexar Thor DDR5-6000; Graphics: Nvidia RTX 4070; Storage: 2 TB Adata XPG Gammix S70; PSU: MSI MAG AB50GL 850W; OS: Windows 11 23H2.



PRICE \$2,699 (256GB), \$2,899 (512GB) WEB [store.google.com](https://store.google.com)

# Google Pixel 9 Pro Fold

The world's smartest foldable includes a huge 8in display and longer battery life, but the price is too high.

**The Pixel 9 Pro Fold is Google's second stab at a folding phone – but there's enough here that's new and improved over last year's Pixel Fold that it feels like a fresh start. As well as a name change to better align with the rest of the Pixel 9 family it brings the largest folding display we've yet seen, Google's Tensor G4 chip and all of the Pixel 9 series' new signature AI features.**

Design-wise, it's a huge improvement over the Pixel Fold. The wider aspect ratio, subtler crease and smaller bezels all look smarter; I also prefer the new rectangular camera cutout to the old horizontal bar.

The new model feels great too. It's more solid, with a reassuring IPX8 rating, yet is one of the lightest and skinniest foldables around, weighing 257g and measuring 10.5mm thick when folded and 5.1mm unfolded. It's available in tasteful Obsidian and Porcelain finishes, although there are no coloured options for those wanting more personality.

## Display of power

The Pixel 9 Pro Fold's headline feature is surely the inner screen. It's almost square, with a native resolution of 2,076 x 2,152, and measures a full 8in across the diagonal. This makes it palpably bigger than the displays on the Samsung Galaxy Z Fold6, and the wider shape works brilliantly when you want to run two apps side by side.

The internal OLED panel is stunningly crisp and detailed, and is far brighter than its predecessor. I measured a peak brightness of 2,319cd/m<sup>2</sup>, which is more than double the Pixel Fold's top brightness, and on a sunny day I was able to read the screen much more easily than any other notebook-style foldable out there. Colour and viewing angles are a

treat too: quite simply, the Pixel 9 Pro Fold has the best inner screen of all folding phones.

## Snap happy camera

I love taking photos on Pixel phones, partly because of the power and flexibility of Google's camera app. New features this year include a revamped panorama mode (which also now works with Night Sight) and the Add Me feature that uses AI to insert the photographer into group shots. There's also a cute new feature specific to the Fold format called "Made You Look", which displays animations on the cover screen to get kids to look at the camera.

The camera hardware in the Pixel 9 Pro Fold is similar to that of the last-

**"The Pixel 9 Pro Fold's headline feature is surely the inner screen. It's almost square, with a native resolution of 2,076 x 2,152, and measures a full 8in across the diagonal."**

**SPECS** 8-core Google Tensor G4 processor; 16GB RAM; Mali-G715 MC7 graphics; 8in foldable 120Hz AMOLED screen, 2,076 x 2,152 resolution; 6.3in cover 120Hz AMOLED screen, 1,080 x 2,424 resolution; 256GB/512GB storage; nano SIM and eSIM; IPX8 rating; triple 48MP/10.8MP/10.5MP rear camera; 10MP/10MP front cameras; Wi-Fi 7; Bluetooth 5.3; 4,650mAh battery; USB-C 3.2 Gen 2 connector; Android 14; folded, 77 x 10.5 x 155mm (WDH); unfolded, 150 x 5.1 x 155mm (WDH); 257g; 1yr warranty.

generation Fold. It incorporates a 48MP main camera, a 10.5MP ultrawide and a 10.8MP telephoto with 5x optical zoom, plus a 10MP selfie shooter on the front. The main camera gets the job done as well as you'd ask for, with decent dynamic range and detail, but low-light performance still suffers from distorted colours and smearing. The 10.5MP ultrawide camera meanwhile offers a slightly wider 127° field of view than the Fold, and I found it produced brighter images too, with better overall exposure.

### So-so speeds

The Pixel 9 Pro Fold is powered by the latest Google Tensor G4 chip, paired with 16GB of RAM. Like previous Tensor processors, this is optimised for core OS and AI tasks rather than raw number-crunching: its multicore score of 4,813 in Geekbench 6 put it some way behind the Snapdragon 8 Gen 3-powered Samsung Galaxy Z Fold6, which managed 6,901.

Similarly, when it comes to graphical power, the Pixel 9 Pro Fold lags well behind the Samsung. In 3DMark's Wild Life Unlimited test, Google's foldable averaged 56fps, exactly half of the amazing 112fps rate of the Galaxy Z Fold6.

These numbers don't tell the whole story, however. In use the Pixel 9 Pro Fold delivered the instant responses and fluid actions you'd expect from a high-end phone. Side-by-side app multitasking was no problem: I was able to effortlessly watch a YouTube clip on one side of the screen while scrolling through Instagram, jotting down an email reply in Gmail or even playing a game on the other. And despite the Pixel 9 Pro Fold's middling GPU score, I didn't see any glitches in *Age of Origins*, even with intense action happening on screen.

Where the G4 wins is efficiency, with the Pixel 9 Pro Fold's 4,650mAh battery lasting a very decent 11hrs 36mins in our battery benchmark test – more than an hour longer than the old Pixel Fold. Again, it's not up there with the other, non-folding Pixel 9 handsets, but it's better than the Samsung Galaxy Z Fold6, which only managed 10hrs 35mins.

### Soft advantage

While the Pixel 9 Pro Fold is physically quite different to other Pixel 9 phones, the software is almost identical. That's a good thing, because it means you get all of Google's latest AI features, such as the Google Gemini assistant (including a year of Gemini Live), the Call Notes



**“In use the Pixel 9 Pro Fold delivered the instant responses and fluid actions you'd expect from a high-end phone.”**

feature that automatically summarises your phone calls and the Pixel-exclusive screenshot app that can analyse screen grabs and instantly pull out useful information in response to your queries.

There are some fun image-based tools too. I've mentioned the Add Me camera feature, and you can also use the more drastic Reimagine tool to seamlessly insert AI-generated elements into your photos. Pixel Studio can also produce entirely new images based on your text prompts – something I haven't seen running locally on any other phone.

All of these features are fun and intuitive to use, and they're a big part of what makes the Pixel 9 Pro Fold special among foldable phones. The only disappointment is how little effort Google has made to exploit the foldable format: the only really notable exclusive feature is the Made You Look feature. Yes, you can use the big screen for multitasking, but the Pixel 9 Pro Fold can't store multiple sets of side-by-side apps in memory, which limits its productivity. I wish Google had copied OnePlus' Open Canvas feature that lets

you dynamically arrange up to three apps simultaneously, or thought about optimising the OS for use in a propped-up “tent” mode.

Still, the Fold gets the same seven years of major software and security updates as all other Pixel 9 phones, starting with an upgrade to Android 15 in the very near future – so there's always the possibility of more features to come.

While this phone is an undoubted step forward, I would have liked to see a bigger camera upgrade and more features that take advantage of the folding design. Without the latter, it falls behind both the Galaxy Z Fold6. ■

### VERDICT



The Pixel 9 Pro Fold is exactly what the original Google Fold should have been from the start. The hardware is more polished in every way, while the new AI features further elevate the experience.

John Velasco





PRICE \$579 (45mm), \$669 (45mm) WEB [store.google.com](https://store.google.com)

# Google Pixel Watch 3

Third time's a charm for Google's watch.

Google's third-generation Pixel Watch introduces some big upgrades. The most obvious one is a new size option: you can still get the familiar 41mm format, but there's now a version with a larger 45mm face, in a selection of three tasteful colour options.

Those extra millimetres make a big difference. The plus-sized model looks and feels much more luxurious than the standard model, yet it's no thicker, and weighs just 6g more. It helps too that Google has slimmed down the bezels, and pumped up the brightness on both models to a claimed peak of 2,000cd/m<sup>2</sup> – double the maximum of the Pixel Watch 2. The maximum refresh rate has been doubled too, to a smooth 60Hz.

Aside from the display, the main selling point of the Pixel Watch is its improved health and fitness capabilities. Google says the Pixel Watch 3 incorporates the company's most accurate heart rate sensor yet, plus better running data with new metrics such as stride length, step cadence and vertical ratio joining the regular measurements of calories burned, distance

covered, pace, elevation gain and average heart rate.

All your progress and performance details can be viewed in the new running dashboard in the Fitbit app, along with a new Cardio Load score that tracks how hard your heart is working while exercising, and a Readiness Score based on your activity and recovery needs. This requires you to regularly wear the device to bed, but that's more convenient than ever thanks to a new auto-bedtime mode, which detects when you fall asleep and disables the display and notifications.

The best part is that all of these features are available as standard, and don't require a Fitbit Premium subscription.

Alongside health and fitness features, the Pixel Watch 3 brings improved integration with Google apps. As well as accessing Google Maps, YouTube Music, Google Home and Google Wallet from your wrist, you can now view security camera feeds directly on the watch, control Google TV devices and record voice memos that sync to your Pixel phone. The addition of an ultra-wideband radio means that

owners of compatible BMW and Mini vehicles can now lock, unlock and start their cars right from the wrist, although there's no word on other partnerships. It's also worth mentioning a new Loss of Pulse Detection feature, which can alert loved ones or call emergency services if the safety feature is triggered.

As always with smartwatches, the big question is battery life. I found the 41mm model lasted about a day of use before needing to recharge – in line with previous models. With the bigger model though I was excited to find that I consistently got through a full two days before needing to return it to the charger.

The Pixel Watch 3 is a tempting upgrade from previous models, with a better screen, new health tools and metrics and broader integration with other devices. The 45mm version in particular is a winner: as well as being big and stylish, it's the first non-rugged, full-featured smartwatch I'm aware of to blow past the 24-hour battery life mark. ■

**SPECS** Qualcomm Snapdragon W5 Gen 1 chipset; 1.4in 456 x 455 AMOLED touchscreen; 32GB storage; Wi-Fi 6; Bluetooth 5.3; GPS; UWB; NFC; IP68; optional eSIM; loudspeaker; body temperature sensor; blood-oxygen sensor; heart-rate sensor; altimeter; compass; gyroscope; water resistance to 50m; 420mAh battery; Wear OS 5; 45 x 12.3 x 45mm (WDH); 37g; 2yr RTB warranty.

## VERDICT



Simply put, for most Android owners, this is the best smartwatch around.

Dan Bracaglia

PRICE \$929 WEB remarkable.com

# ReMarkable Paper Pro

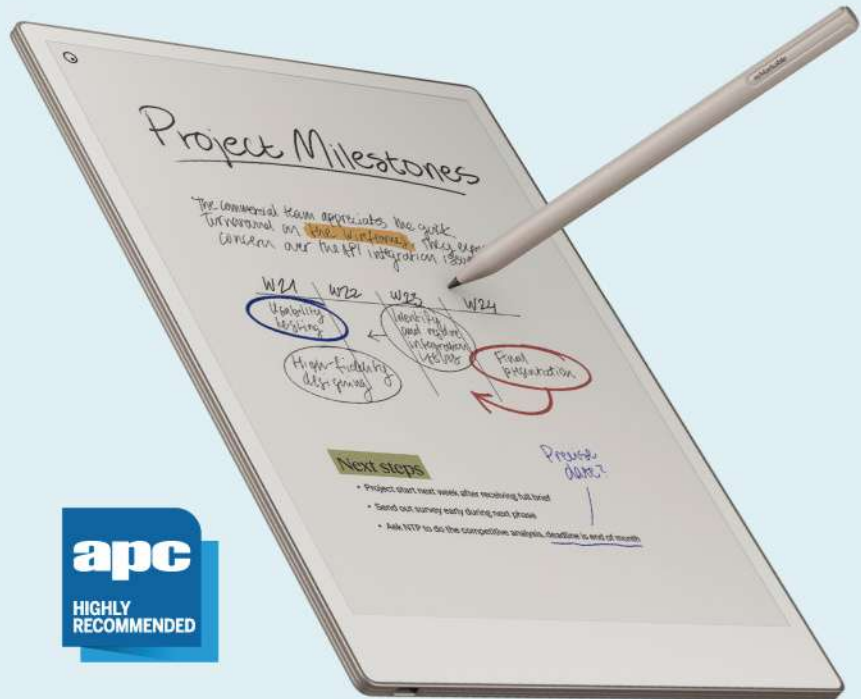
The best digital notebook we've tried for reviewing and annotating documents.

Many tablets aim to dazzle with their shiny designs, but the ReMarkable Paper Pro has a different goal: it wants to replicate the feeling of writing and sketching on paper. This isn't the company's first tablet to attempt the feat, but the Paper Pro is its first device to do so with a colour screen.

The screen in question is ReMarkable's new Canvas Color display, based on E Ink's Gallery 3 technology. It's an 11.8in panel with a reasonably sharp density of 229ppi, and it supports a variety of digital brushes in nine main colours, which you can use to annotate documents, colour in diagrams or add bright highlights to reference works in PDF or EPUB format. It's an idea that really appeals to me: I've always loved doodling in the margins of documents and drawing silly figures in my own notes, and the Paper Pro does a great job of recreating that feeling.

There are several reasons why it feels so good to use. The screen and stylus are textured to feel as much like paper and pen as possible, and when you're writing or drawing on the tablet there's a gap of less than 1mm between the tip of the ReMarkable Marker and the digital "ink" that appears on the display, so you really feel like you're in direct contact with the surface. The stylus' 4,096 levels of pressure sensitivity further add to the sense of tactility.

The responsiveness of the display has also been improved from previous models. The older ReMarkable 2 tablet had an input lag of around 21ms, but the manufacturer claims that the Paper Pro's latency can be as low as 12 milliseconds. I can confirm that handwriting feels snappier on the Paper Pro than on other e-ink tablets I've tried: it's not quite



instant, but you can quickly almost forget you're scribbling onto a screen.

The drawing tools take more getting used to, but once you get a feel for how to twist and push on the Marker Pro to get the lines you want they too are beautifully responsive. While the colours sometimes look washed out on the e-ink display, you can use the various art tools to add depth and tone.

While ReMarkable has done an impressive job of making writing on the Paper Pro feel natural, the e-ink display inevitably still feels a little sluggish when flipping through a document. While skimming books on the tablet I often found myself missing the instant

response of an LCD screen. And on the few occasions when I wanted to quickly check something online, I had to pull my phone out of my pocket: ReMarkable's Linux-based operating system is strictly focused on reading and note-taking, and doesn't support distractions such as web browsing (although it does integrate with various cloud storage services for easy document access).

Keeping those limitations in mind, though, I really like the ReMarkable Paper Pro. If I ever want to edit a draft or mark up a downloaded document, it works brilliantly. I can just grab the file from the cloud (or transfer it using ReMarkable's desktop and smartphone apps), pick up the Marker and immediately start scribbling onto the page like I would a physical document. It feels good, it's convenient and most importantly, it's completely intuitive. ■

## VERDICT



Still troubled by lag, but this is premium e-paper tablet that benefits from both a backlight and colours

Alex Wawro

"While ReMarkable has done an impressive job of making writing on the Paper Pro feel natural, the e-ink display inevitably still feels a little sluggish when flipping through a document."

**SPECS** 4-core 1.8GHz Cortex-A53 processor; 2GB RAM; 11.8in Canvas Colour display, 2,160 x 1,620 resolution; 64GB storage; Marker stylus; Wi-Fi 5; USB-C 2; accessory port; 5,030mAh battery; reMarkable OS; supports PDFs, EPUB; 197 x 5.1 x 274mm (WDH); 525g; 1yr limited warranty.



**SPECS** Compatibility: LGA 1700, 1200, 115X, 2011\*, 2066\* - AMD Socket AM5, AM4, TR4\* (\*available from Hyte support); Dimensions: 120 x 288 x 52mm (cold plate: 56 x 56 x 1.5 mm); Radiator: 288mm, aluminium; Pump: Ceramic, up to 4,500 RPM; Fans: 2x Thicc FP12 120 mm, Fluid Dynamic Bearing, up to 3,000 RPM; Lighting: Full RGB on radiator logo, array behind screen; Screen: 5-inch IPS, 60Hz, 300 nits, 720 x 1280 resolution; Storage: 32GB eMMC; Memory: 2GB DDR4.



PRICE \$499 WEB [hyte.com](http://hyte.com)

# Hyte Thicc Q60

Almost more mobile phone than CPU cooler.

**Take a look at the Hyte Thicc Q60, and you might come to the conclusion that this is an all-in-one liquid cooler that pushes appearance over performance. That's not strictly true, however. Yes, the Q60 is adorned with a 5-inch screen, a litany of RGB LEDs, and some tidy cabling, but there's also a chunky CPU cooler beneath it all.**

The Q60 is a big beast. It comes with a radiator double as thick as some, coming in at 52mm. That's reportedly to use space that's not often utilised to its fullest in modern PC cases, according to Hyte – it's opting for a thicker radiator in the place of a longer one.

The Q60 is billed as a 240mm radiator on account of the two 120mm Thicc FP12 fans included, but it's actually 288mm from top to bottom. The remaining space is taken up by the pump, which takes residence on the radiator rather than in the more traditional spot behind the cold plate. The benefit of this, for the Q60 at least, is more room for the enormous screen above the CPU.

The 5-inch screen on the Q60 is best described as a tiny computer. It includes a quad-core Arm Cortex CPU, with 2GB of DDR4 running at 2,666 MT/s, and running at 1.3GHz. It also

has 32GB of eMMC storage, all to run the many widgets, which Hyte has named 'faces', available via the Nexus application, which is pretty much a must-install with this cooler.

I've opted for a parade of system-monitoring 'faces': liquid in temp, liquid out temp, CPU temp, and GPU temp. Oh, and the clock, which I cannot seem to remove. There are a lot of options to choose from, and a few more 'coming soon' – clock speeds, fan speeds, and throughput are all reportedly on their way.

Yet, as we mentioned at the beginning, the Q60 isn't only about appearances; it is a capable liquid cooler in its own right. In balanced mode, with the PC idling, the Q60 is nominally audible. During gaming, it's only a little noisier – we've been running the *Metro Exodus* benchmark many times over, and the only noise coming from the Q60 throughout is a steady, polite hum. It doesn't noticeably fluctuate between speeds, either, which makes the noise it does produce much less distracting.

Only during more CPU-intensive workloads did we begin to take note of the sound coming from the fans and pump unit. In return, this cooler delivered the lowest temperatures while gaming out of those we tested,

which included a 360mm AIO. The Q60 isn't as capable as others when it's pushed to the limit, however.

There are other reasons to consider the Q60. It's extremely neat and tidy, for one. It requires only a handful of cables, collected into a single dual-USB Type-C connector, and plugged seamlessly into the radiator. The fans can also be bought separately and daisy-chained together with a dedicated cable-free connector or specially fitted cables. It also comes with a six-year warranty, which matches the likes of Corsair and Arctic.

The Hyte Thicc Q60 is smart, good-looking, and quiet. It delivers exceptional cooling performance, too, though trips up in more demanding thermal tests. It's by no means essential, but it embodies everything great about custom PC building by working well and looking cool while doing it. ■

## VERDICT



Quiet with impressive cooling performance for gaming, handy for system monitoring, Zero-RPM modex. Less impressive with demanding CPU workloads and high idle temperatures, expensive.

Jacob Ridley





PRICE \$550 WEB [nzxt.com](https://nzxt.com)

# Nzxt C1500 Platinum

Top-tier performance and efficiency.

**The C1500 Platinum, the latest addition to Nzxt's power supply lineup, is priced at \$550. That alone limits it to a niche audience, along with the few people who actually need that sort of power in 2024. 2025, with its rumoured even higher-powered GPUs, could be another matter.**

However, if you do find yourself in that camp, you'll be pleased with its exceptional performance and reliability. With features like fully modular black nylon-sleeved cables, a Sunon MagLev 140mm fan, two PCI Express 5.1 12V-2x6, and world-class electrical performance, it's also designed to meet ATX 3.1 standards.

Considering the tier of this PSU, its bundle is surprisingly minimalistic. Nzxt provides only the necessary mounting screws, an IEC C19 AC power cable, and a purple bag for the modular cables. The highlight here is the presence of two 600 Watt 12V-2x6 connectors and six PCI Express 6+2 pin cables with just one connector on each, forgoing piggybacking multiple PCI Express connectors on a single cable.

It's housed in a chassis that measures 180mm in length – significantly longer

than the standard ATX dimensions. This length is unsurprising, bearing in mind its high power output, so it requires a case with ample clearance to fit properly.

The Nzxt C1500 Platinum PSU is equipped with a Sunon MagLev MFE0251VX-1Q010-S99 140mm fan, featuring a magnetic levitation engine. The patented Sunon engine design offers superior performance, and the fan's performance is not affected by orientation. While MagLev fans can be noisy at higher speeds, they excel in high-temperature environments, with the fan in this model reaching the terrifying maximum speed of 2,500rpm.

In our tests, the Nzxt C1500 Platinum PSU easily meets the 80Plus Platinum certification standards, missing the 80Plus Titanium certification by a hair when tested with an input voltage of 115 VAC. When tested with a 115 VAC input, it achieves an average nominal load efficiency of 92.6 percent, which increases to 93.7 percent with a 230 VAC input. The unit's efficiency peaks at around 40 percent of its capacity. Also, the PSU demonstrates impressive efficiency even at low loads, nearing 87 percent with a load of just 70 Watts.

During hot testing, the Nzxt C1500 Platinum PSU displays a minor decrease in efficiency under heavy loads, with recorded figures of 92.2 percent at 115 VAC and 93.3 percent at 230 VAC, compared to 92.6 percent and 93.7 percent during cold testing. This reduction is inconsequential, and occurs almost linearly across the load range. There are no signs of thermal stress, even at maximum load. The PSU is rated to perform efficiently at ambient temperatures up to 50 C, and operates seamlessly under these conditions.

All of this means this is an exceptional PSU for performance and efficiency. The 140mm Sunon MagLev fan, equipped with a magnetic levitation engine, ensures superior cooling performance and durability. However, its price tag is a drawback. This substantial cost positions it in a niche market, appealing primarily to the few users who require its massive 1500W power output. For many, the performance may not justify the premium price, especially when comparable alternatives exist at lower price points. ■

## VERDICT



Very high efficiency and superior cooling, 10-year warranty. High price, niche market appeal, large size

Emmanouil Fylladitakis

**SPECS** Outputs: 1 x 24-pin ATX Power Cable, 1 x 4+4-pin CPU Power Cable, 1 x 8-pin CPU Power Cable, 6 x 6+2-pin PCIe Power Cable, 2 x 16-pin (12+4) 12V-2x6 PCIe Cable, 12 x SATA Cable, 4 x Peripherals Cable;  
Fan: 140 x 140 x 25mm; Noise: 41.0 dBA max; Warranty: 10 years.

PRICE \$2,799 WEB [benq.com/en-au](http://benq.com/en-au)

# BenQ X300G 4K Short Throw Projector

**Priced high, yet punchy.**

**This is a beautiful piece of kit. The X300G from BenQ sits somewhere in the middle of its latest projector product stack. It's complete with 4K 3LED projection lens, exceptional keystone accuracy, auto-adjustment, and impressive brightness and response times, all packed into a nice, attractive little box. It's advertised as portable, and to a certain extent it kind of is, but it also very much kind of isn't.**

We actually looked up the word 'portable' to find a modern definition. Google sums it up as a smaller version of something that can be easily carried. By that logic, the X300G is absolutely that: portable. Don't confuse that with being able to use this anywhere and everywhere, however, at least without an electric hookup. There's a notion in tech that 'portable' means battery powered. Certainly, the XGIMI Halo+ ticks that box, if only for a few hours, but sadly it's not something that the X300G can muster in response. It's dinky, and that's about it.

That is one of the few marks against the X300G. The reality is that this thing is an absolute beast when it comes to projection. It's got an awesome lens, capable of driving 2,000 lumens of brightness at 4K, 1440p or 1080p, with a 30-bit colour setup for 1.07 billion colours, and you can tell, because the images from this thing are awesome to look at.

We do a few tests when it comes to projectors: one up against a grey wall (a bit of a torture test), and the other against a white projection screen. On the grey wall, surprisingly this still pops. The darker tone does affect the brightness, but it only makes it look like a standard SDR monitor, and that alone is incredible.



Throw up some HDR 4K content, and you're blown away by the colour accuracy and clarity. On a white wall, though, you're in for a hell of a time.

The one area it does struggle in, however, is on the audio front. BenQ has a patented underside 'air radiator' that acts as a miniature subwoofer. Otherwise, the audio is relatively tinny and underwhelming, certainly compared to something like the X500i or X3100i, which both feature punchier audio.

Cooling is pretty good – there's plenty of ventilation on either side, and you can barely hear the fans, which is ideal when you're scrolling through menus. If you are looking to game on it, however, 4K might be something to avoid. As standard, it lands with a 16ms response time, making it sluggish at best, particularly with that 60Hz refresh rate.

It's okay for console gaming or less competitive play, but if you're keen to jump into some PvP gaming on a PC, then running at 1440p with 8ms response or 1080p at 4ms is the better way to go. Similarly, it supports 1440p at 120Hz and 1080p at 240Hz, too.

Otherwise, the overall chassis design is impressive. It's small, compact, the I/O is somewhat limited, but bearable, and the Google TV implementation is great. The only problem? The price. At \$2,799, it's not cheap, and it makes the X300G a hard pill to swallow. At the time of writing though it's discounted to \$1,999 via the Benq site ([benq.com/en-au](http://benq.com/en-au)). If you can get one for that price, or close to it, this is a winner. ■

## VERDICT



Outstanding projection tech; Form factor is adorable; Google TV implementation is solid. Audio is sub-par; No battery; Pricing is a bit skewed.

Zak Storey

**SPECS** Resolutions: 4K@60 Hz, 2K@120Hz, 1080p@240Hz. 60Hz limited to 16.7ms, 120Hz 8.3ms, 240Hz 4.2ms; Display Colours: 1.07 billion; Contrast Ratio: 600,000:1; Brightness: 2,000 lumens; Light Source Life: 20,000-30,000 hours; Zoom Ratio: 1.2x; Throw Ratio: 0.69 - 0.83; Projection Offset: 102.5%; Connectivity: USB 2.0 Type A, HDMI 2.1, USB-C DP; Weight: 3kg; Dimensions: 212 x 180.9 x 194.8mm.





PRICE \$215 (2TB), \$119 (1TB) WEB [kingston.com](http://kingston.com)

# Kingston XS1000 External SSD

Like the XS2000 for less cost but reduced performance.

**In early 2022 Kingston launched the XS2000, a tiny external USB SSD that supported the USB 3.2 Gen 2x2 protocol and could read at speeds of up to 2,000MB/s. What was missing then was a more affordable Gen 2 drive option with 1,000MB/s transfers, and logically the name for that would be the XS1000.**

What the delay has given us is what looks like exactly the same enclosure, but this time in black or red, and inside is a Gen 2 specification drive in either 1TB or 2TB capacities that comes with the same 5-year warranty.

Being only 7cm long and 28.7g in weight makes the XS1000 remarkably easy to pocket, and the drive that will work with any computer or mobile device with a USB Type-A port. You can also plug into USB-C ports if you own a spare cable with that receptacle at both ends.

What's missing from this package which previously came with the XS2000, is the rubber sleeve and any mention of the IP55 rating that the previous design was certified.

There are two disappointments with this design, the first being that it doesn't support hardware encryption. That's something SanDisk and Crucial both offer in their latest external SSDs, and for Business users, the lack of it might be a deal-breaker. Another issue is that most competitors now offer 4TB as their biggest capacity, whereas the XS1000 only comes in 1TB or 2TB sizes.

Those points aside, this is a serviceable design that costs less than the XS2000 at the same capacities, and Kingston has a good track record of producing high-quality parts. Being so small and under 30g in weight, the XS1000 is very pocketable, almost irrespective of what pockets you possess.

The maximum speed of any USB 3.2 Gen 2 drive is limited by the bandwidth of that interface, which is typically 1050MB/s in both reading and writing. Kingston managed to get the full read performance at around 1054MB/s, but the write speed is slightly below that at 970MB/s, using the CrystalDiskMark 8.0.4 default profile. The real-world

numbers, as supported by AS SSD, AJA and ATTO, show closer to 900MB/s reads and 820MB/s writes, which is respectable.

Where this drive works well is when it is subjected to an extended write session, as under the AJA System Test, is managed to maintain 871MB/s over the writing of a 64GB file without any drop-off.

If this drive is used to back up files from a computer, the XS1000 will work with the majority of systems and deliver good speeds for those with Gen 2 ports. It will work on Gen 1 ports, but the performance is likely to be much nearer to 500MB/s as a result.

Recently, the fall in NAND flash spot prices has created a feeding frenzy amongst buyers as 1TB and 2TB drives are now highly affordable, and most brands have stopped making smaller capacities.

With that backdrop, the XS1000 seems slightly out of step with the other external SSD makers' products, competing with products like the Crucial X8 that first appeared in 2019. ■

## VERDICT



The XS1000 doesn't stand out as anything new, and its lack of hardware encryption or USB-A cable undermines the business user premise.  
Mark Pickavance & Ben Mansill

“Being so small and under 30g in weight, the XS1000 is very pocketable, almost irrespective of what pockets you possess.”



NEEDS Windows 10 or 11, or macOS **WEB** arc.net

# Arc 1.13

## Web browser

**This much-hyped new web browser was initially only available for macOS, before launching on Windows 11 earlier this year. It has now finally arrived on Windows 10, so everyone else can see what the fuss is all about.**

Arc is described by its developer, The Browser Company, as “a browser that doesn’t just meet your needs – it anticipates them”, and it certainly looks different to Chrome, Edge and Firefox. Its tab bar is on the left-hand side instead of across the top, and its minimalist interface has a bold, modern feel.

When you install Arc, you need to create a free account so it can sync

your data across devices. It then lets you import your bookmarks, passwords and history from other browsers; turn on its AI assistant, Arc Max; and set it as your default browser (you can decline all these options, if you prefer).

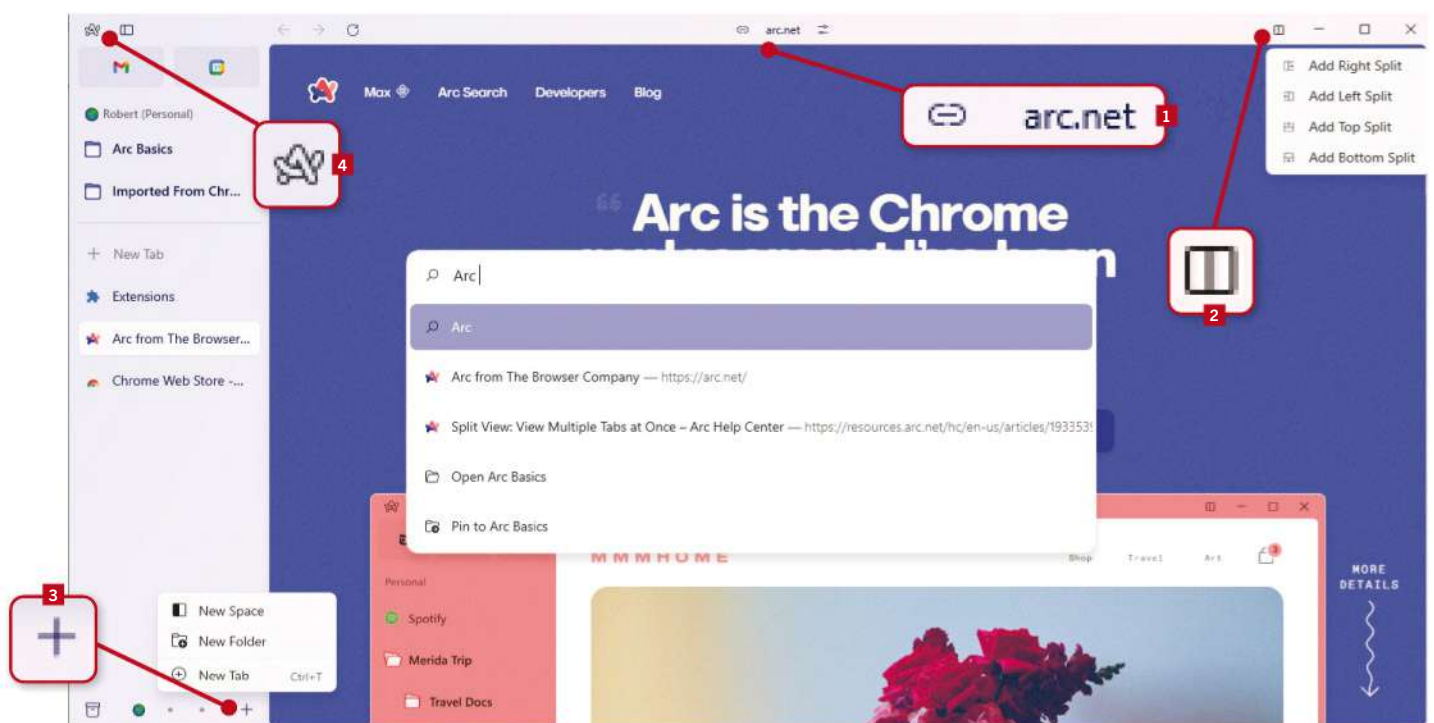
Arc’s most notable feature is Spaces, which combines the profile manager you get in other browsers with the ‘workspaces’ found in Edge and Vivaldi. It lets you create ‘distinct browsing areas’ that contain different tabs and files, and have their own colour themes. For example, you can have a Work space and a Personal one, and switch between them by clicking their dots at the bottom of the sidebar.

Other notable features include Split

View, which lets you view two tabs side by side, and an Archive Tab option that closes and stores tabs so you can reopen them later – or you can simply pin them to the sidebar. Arc has ‘favourite’ buttons for Gmail and Google Calendar in its top-left corner, but these can be replaced with sites of your choice.

Because Arc is based on Chromium, it lets you install extensions from the Chrome Web Store and import them from other Chromium browsers.

Usefully, the brilliant content blocker uBlock Origin is enabled by default, to shield you from ads and trackers from the outset. We reckon uBlock Origin has long been the best blocker out there and welcome this addition.

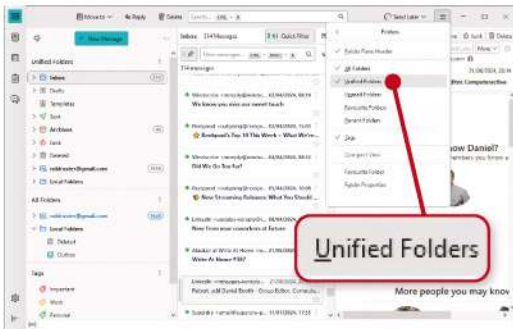


**1** Click the ‘Search or Enter URL’ box to open Arc’s combined search box and address bar. Start typing a search query or URL and Arc will suggest matching results from the web, your open tabs, browsing history and bookmarks.

**2** To browse two web pages simultaneously, click the Split View Options button in the top-right corner of the browser. You can split tabs to the left or right to view pages side by side, or to the top or bottom to stack them horizontally.

**3** The plus-sign button in the bottom-right corner of the sidebar lets you open a new tab or a new folder to organise tabs into. Choose ‘New Space’ to create a new ‘space’ in Arc, then give it a name, choose a theme and add tabs and content.

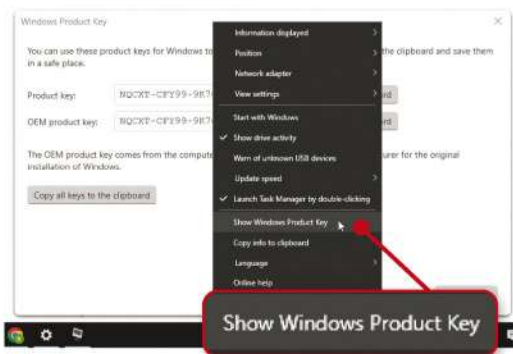
**4** Click the Arc logo in the top-left corner to open the main menu. Here you can access your extensions and settings, import data from another browser and set Arc as your default. The menu also lets you switch to an incognito window.



## EMAIL CLIENT Thunderbird 128

**WEB** [www.thunderbird.net/en-US](http://www.thunderbird.net/en-US) **NEEDS** Windows 10 or 11, macOS or Linux

Dubbed 'Nebula' by Mozilla, Thunderbird 128 brings several welcome changes to the popular email program. These include a redesigned Cards view for browsing email discussion threads. Cards are now larger and clearer, so it's easier to find and read individual responses. Thunderbird's Unified Folders feature, which combines messages from all your email accounts in one place, has also been improved to let you search folders and check for new messages faster. To activate the feature, click the three-line menu button in the top-right corner and select View then Folders, followed by Unified Folders (see screenshot). This opens a new section in the left-hand folder pane – click the three-dot button and choose Move Up to move Unified Folders nearer the top. Other changes let you assign different colours to your email accounts and dismiss notifications by clicking them.



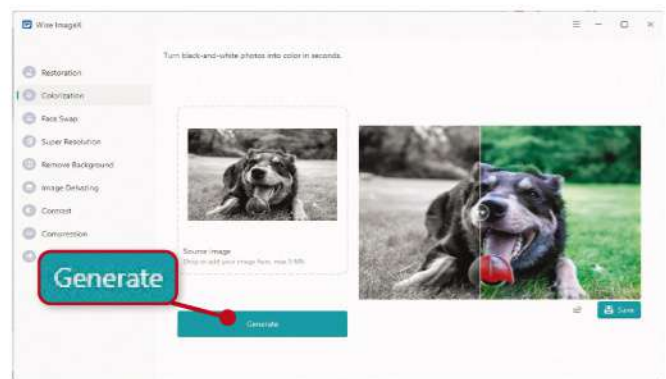
## SYSTEM-INFORMATION TOOL O&O DeskInfo 1.3.1347

**WEB** [www.oo-software.com/en/odeskinfo](http://www.oo-software.com/en/odeskinfo) **NEEDS** Windows 10 or 11

From the company behind APC favourites O&O AppBuster and ShutUp10++, DeskInfo displays useful information about your system on your desktop. Click its blue tab to open and close a panel of data on the right-hand side of your screen – you can move this to the left, if you prefer. You can customise the colour and size of its text and even integrate the info with your desktop wallpaper. The latest version supports Windows' 'Efficiency mode', which means it can detect when you have set background processes to use less RAM and CPU power, and adjusts its data accordingly. It also lets you open the Windows Task Manager simply by double-clicking the DeskInfo taskbar icon. However, the most notable addition lets you see your Windows product key by right-clicking the taskbar icon and choosing Show Windows Product Key (see screenshot).

## Should I pay for?

### Choose the right version of software



## Wise ImageX

**WEB** [www.wisecleaner.com/wise-imageX.html](http://www.wisecleaner.com/wise-imageX.html) **PRICE** From US\$8.95/m  
**FREE TRIAL** N/A **NEEDS** Windows 10 or 11

The latest freemium software from Wise comprises nine AI-powered tools for editing and enhancing your photos. Options include Restoration, which repairs "damaged, blurry and faded old photos"; Colorisation, which transforms old black-and-white snaps into colour; and Super Resolution, which 'upscales' images to make them larger, increasing the resolution without affecting quality. There are also tools for removing the backgrounds from pictures, erasing unwanted elements and even swapping people's faces around.

Most of the features in Wise ImageX work in the same one-click way – you select a photo, choose Generate (see screenshot) and let the program's AI technology work its magic. It couldn't be easier to use, though some users may find it too basic because you can't fine-tune the results before you save them.

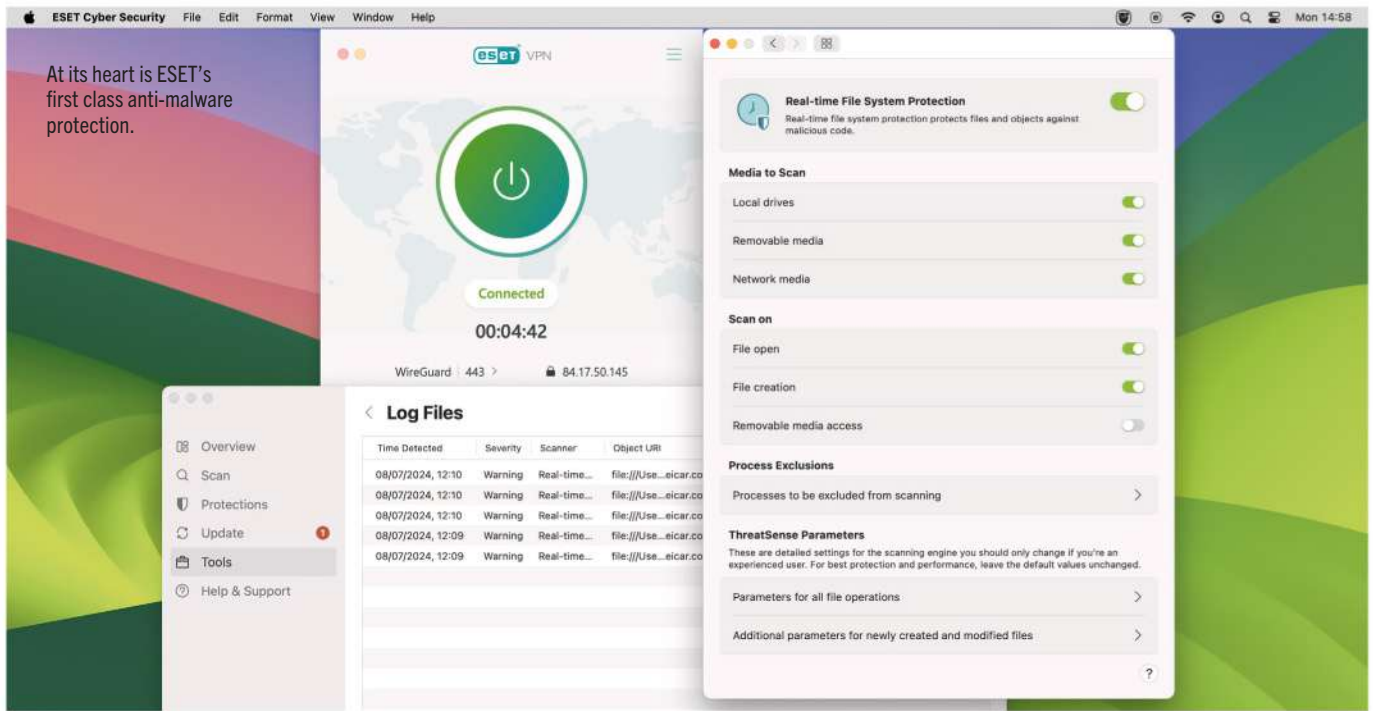
ImageX supports images in JPEG, PNG, BMP and WEBP format, but they need to be smaller than 5MB in size. Sadly, you're also limited to processing five images for free, after which the program prompts you to buy a licence key to "active [sic] the product".

Wise's monthly plan costs a fairly steep US\$8.95, but if you pay for a whole year it's only US\$19.95 (currently discounted to US\$13.96). Buying the program outright costs US\$49.95 (currently US\$34.96). However, all three licences limit you to enhancing 200 images per month.

### OUR VERDICT: DON'T PAY FOR IT

We were impressed by the variety and quality of Wise ImageX's AI tools, and its yearly plan is good value. However, the limits on file size and the number of photos you can enhance are annoying, and we think it should let you process more than five images for free. ■

"Sadly, you're also limited to processing five images for free, after which the program prompts you to buy a licence key to "active [sic] the product."



**PRICE** Essential \$63.99/year; Ultimate (as tested) **NEEDS** macOS 11 or later; iOS 11 or later **WEB** eset.com/au

# ESET Home Security Ultimate

Security and anti-malware in an all-in-one package.

**Instead of paying out for individual subscriptions for malware protection, a VPN service, password manager, and a software firewall, you might be looking for a different approach. Assembled around its thoroughly capable anti-malware engine that we reviewed a year ago, ESET Home Security's aims to offer all-in-one protection.**

The ESET Password Manager comes at the added cost of a Premium subscription (\$71.99), and is a browser extension rather than a full app, so looks unlikely to match Sequoia's new bundled app unless you need to integrate with Windows or Android. ESET's unlimited VPN has excellent geographical coverage, is easy to use, and works well. However, that only comes with the Ultimate subscription covering up to five devices running Windows 11, macOS, Android or iOS.

Each of these is a separate

installation, and in the case of the core Cyber Security app it's a fussy affair, as it's handled simultaneously by both ESET's website and the local macOS Installer app, which interrupts to satisfy the demands of macOS security. This isn't helped by instructions that haven't been updated for changes brought in System Settings. After you've ploughed through, ESET installs its endpoint security and network System Extensions, and is good to go.

ESET's malware protection is versatile and highly configurable, although few of us might need to tweak its extensive controls. Its checks have no discernible effect on performance, and apart from one previous disagreement with a macOS update, fixed quickly by ESET, the anti-malware engine seems first-class.

As ESET Cyber Security uses endpoint security, it could broaden its scope to include checks on the security

protection provided by macOS, in particular Apple's anti-malware scanner XProtect Remediator. ESET doesn't though take advantage of this, and can't even tell you whether those scans are taking place, let alone whether it's removed malware before ESET had a chance to do so.

An Ultimate subscription comes into its own when there's a Windows 11 PC or Android device among its five supported systems. The former gets a software firewall, metadata cleanup for privacy, additional data encryption, parental control, a network inspector and more, none of which are offered for macOS, and iOS has to make do with the password manager and VPN, without malware protection.

While ESET is heading in the right direction, at present its macOS and iOS features aren't extensive enough to justify their expense. ■

## VERDICT



Limited features on macOS and iOS make it expensive unless you include Windows or Android devices.

Howard Oakley

"ESET's malware protection is versatile and highly configurable, although few of us might need to tweak its extensive controls."



DEVELOPER Q4OS development team WEB <https://q4os.org> LICENCE Mainly GPL

# Q4OS 5.5

Nate Drake is on cue to explore the latest Q4OS and comes away amazed at its speed and simple setup.

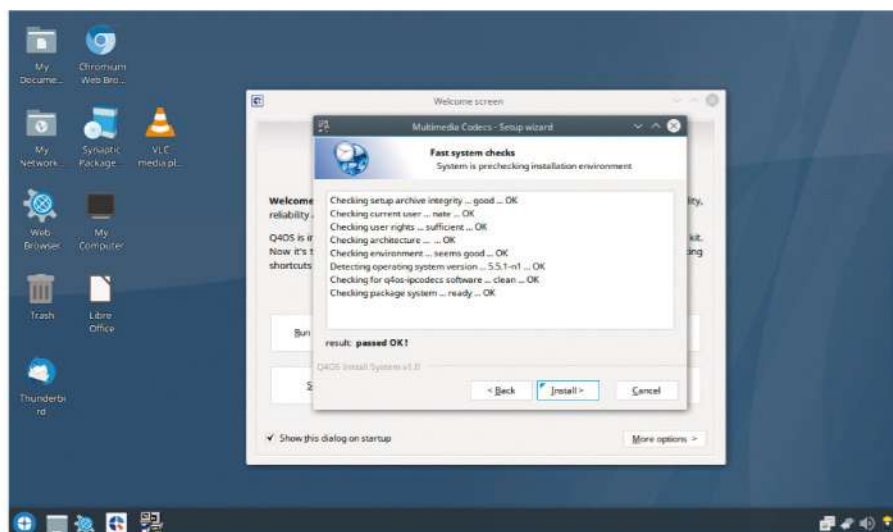
The Q4OS website describes this distro as a “fast and friendly, desktop-oriented operating system based on Debian Linux”. The current version (code name Aquarius) is based on Debian 12.6 Bookworm. Aquarius is a long-term support release, with security patches and updates until at least June 2028.

The OS can be downloaded as a live DVD ISO as well as a basic install DVD. There’s a version with the KDE Plasma desktop but Q4OS is best known for its Trinity desktop environment (TDE). Originally a fork of KDE 3.5, TDE offers a traditional and lightweight user interface.

After firing up the live DVD, we were keen to test this using the bundled KSysGuard. On first boot the system used only 180MB of RAM and the CPU load was so minimal it barely registered.

After quitting, we were presented with Q4OS’s handy welcome screen. From here you can launch the Desktop Profiler, a utility so useful that it has a dedicated manual on the Q4OS website. The profiler’s simple interface enables you to choose from a fully-fledged install with web browser, office suite and other common applications, or a basic install with minimal tools, or even a minimalist setup, where you’re free to configure your own packages. From here you can also install additional desktop environments including Plasma, Cinnamon, Budgie and Gnome.

Unfortunately, if you’re booting from the live DVD, loading profiles via this utility isn’t supported, so we opted to run setup instead, which is handled by the Calamares installer. Here we discovered that the Software section enables you to choose from a number of install profiles such as Desktop, Live and Pure (minimal). Setup also supports installation of Q4OS



Installing packages such as proprietary media codecs in Q4OS involves using a Windows-style wizard on a case-by-case basis.

alongside other Linux operating systems.

Despite the warning that setup would take a while and the fact that Calamares needed to download packages from Debian repos, installation of the Q4OS Desktop version completed in under seven minutes.

On rebooting, we saw that the Q4OS desktop now contained a respectable selection of shortcuts to default apps including Chromium, Thunderbird, VLC and LibreOffice. As the OS is Debian-based, we also took the chance to launch the Windows-esque Install Proprietary Codecs wizard from the welcome screen.

From here, you can also click Install Applications to launch the Q4OS Software Center. By default, this offers a small list of 57 featured apps, such as Okular, which you can select and install. Doing so launches yet another setup wizard to download the software in question, which seems a little redundant.

You can also launch the Synaptic package manager via the Software Center

to access all other software in Debian’s repos. During our tests, Synaptic installed the point-and-click classic Beneath a Steel Sky in seconds.

This gave us a chance to explore the Trinity menu system, neatly divided into Programs and Documents. Our newly installed game wasn’t in the relevant category, but we found it using the built-in search bar.

The built-in Konqueror web browser defaults to the Q4OS homepage, where we learned the Software Center also offers Lookswitcher, which allows for easy switching between desktop themes. The main page also boasts a Dual Desktop option whereby users can install and use both Plasma and TDE. On closer inspection, we discovered this means you can choose different desktop environments from the login window. As useful as this is, it is hardly specific to Q4OS. ■

“Q4OS’s nostalgic interface is just the tip of the iceberg. It’s a highly customisable OS, perfect for older hardware. The software centre could be slightly more intuitive, though.”

## VERDICT



Offers stability through being based on Debian, a blazingly fast desktop environment and a very easy setup process.

Nate Drake

# BEST OF IFA 2024

Contributors: Tim Danton, with contributions from Steve Clark, Timothy Coleman, Jason England, James Frew, Hamish Hector and Josephine Watson



Europe's biggest consumer technology show celebrated its 100th anniversary this year, but more importantly it produced a bunch of products we're now desperate to review. Here are our picks.

## LAPTOPS

### Acer Swift 16 AI (Intel)

[acer.com.au](http://acer.com.au)

AVAILABILITY December 2024

Three out of the four Acer Swift AI laptops announced at IFA featured 14in panels, but it was the 16in version that stood out for us. The spec sheet says it's 1.5kg, but it feels light in the hand and the grey aluminium alloy chassis looks far more stylish than it should. We played with the OLED version, but the IPS panel shares its 2,800 x 1,800 resolution. And, with Intel's new chips inside – up to the Core Ultra 9 288V – it's packed with power.



### Acer Travelmate P6 14 AI

[acer.com.au](http://acer.com.au)

AVAILABILITY January 2025

We're suckers for sub-1kg business laptops, so the new Travelmate P6 14 AI had us at "carbon fibre chassis". The range starts with a Core Ultra 5 226V processor and so ticks Microsoft's Copilot+ PC for business boxes, and that's not the only plus point: think cutting-edge connectivity such as Wi-Fi 7, a bright IPS display (either 1,920 x 1,200 or 2,880 x 1,800) and all the ports you need. The keyboard has plenty of travel despite the slender chassis, and while the ThinkPad X1 Carbon below still wins for its cushioned action, there's no hiding from the Travelmate's price.

### Honor MagicBook Art 14 Snapdragon

[honor.com](http://honor.com)

AVAILABILITY Late 2024

Honor announced that its new MagicBook Art 14 would ship with first-gen Core Ultra chips and a Snapdragon version at IFA, and it's the latter that



earns a Best of IFA 2024 award. It will pack an Elite X1 chip to handle on-PC AI tasks with ease – so long as they require an NPU – whilst hopefully giving battery life close to 20 hours. And this sleek, stylish, sub-1kg laptop has one last trick: the webcam is detachable, sliding into a slot on the left-hand side when you don't need it. Perfect for privacy lovers.

### Lenovo ThinkPad X1 Carbon Gen 13 Aero Edition

[lenovo.com](http://lenovo.com)

AVAILABILITY November 2024

For such a ridiculously compact and lightweight laptop, the X1 Carbon has an oddly long name. This particular incarnation is the love child of Intel and Lenovo, who spent many long nights together these past two years to







create AI-enhanced “Aura Edition” software that takes advantage of the Core Ultra 200V chip within. This will provide the ability to tap a phone – Android or iPhone – against the side of the screen and connect it, with your phone’s photo gallery immediately appearing. Drag and drop to your heart’s content. Expect a full day’s working life, even with the 14in OLED screen shining bright.



### Lenovo Yoga Slim 7i Gen 9 Aura Edition

lenovo.com  
**AVAILABILITY** Now

Is it possible to release too many laptops at once? Lenovo certainly came close at IFA, with seven additions to its consumer lines alone. The 15.3in Yoga Slim 7i Aura Edition sits at the top of that tree, featuring the same Aura software as the ThinkPad above but adding Lenovo’s Creator Zone software, which allows people to use the new Core Ultra chip’s AI power to create images based on text prompts. Much like DALL-E or Midjourney, but on your PC. And it produces decent results, too. Weighing 1.5kg and measuring as thin as 13.9mm, the Yoga is a typical high-end Lenovo laptop with a 120Hz IPS panel.



### Samsung Galaxy Book5 Pro 360

samsung.com  
**AVAILABILITY** Now

Good luck telling the new Book5 Pro 360 apart from its Book4 predecessor, but that isn’t a negative: the fact that it’s just as thin and light is fine by us. The gorgeous AMOLED touch display remains, providing vivid images when watching videos and allowing you to use this 1.7kg 2-in-1 as a giant Windows 11 tablet to sketch, take notes or read a digital comic. If its Lunar Lake CPU lives up to the company’s promise of a 25-hour long battery life, it may soon find itself on the A List.

### Lenovo Auto Twist

The Lenovo Auto Twist concept is, essentially, a face-tracking, Windows 11 2-in-1 with a motorised hinge. And one



### Intel “Lunar Lake” Core Ultra 200V

Could Lunar Lake be the fillip that Intel needs to help it through this roughest of years? We think it just might be. The reason is that it’s very nearly a match for Qualcomm Snapdragon chips in terms of efficiency while beating it out of the park for gaming – and with no worries about compatibility. But what really should give Intel cheer is that laptop manufacturers are so behind it, with dozens of new models announced at IFA 2024 based around the Core Ultra 200V series (formerly Lunar Lake).



**apc**  
 ★ BEST OF IFA 2024 ★

that responds to simple commands, such as “open the lid”. Although it’s a proof of concept, this device is more accurately named than other Lenovo

devices here, as its 13.3in display does indeed twist, rotate and tilt automatically. During our demo, Auto Twist captured a panoramic photo of attendees, but you might also use it during video calls to track you as you pace around. You might be asking yourself, “but why?”, but there was a genuine gasp during the demo. Could this be the future?



# PHONES & TABLETS



## Honor Magic V3

honor.com

AVAILABILITY Now

Here's the TL;DR version of a 'review' of the Honor Magic V3, which made its debut at IFA 2024: stunningly slim, gorgeous photos, bags of power. Sure, the huge camera mount dominates its rear, but this surprisingly sturdy foldable phone is so slender that you forget it's a foldable until it's time to take advantage of that 7.9in inner screen.

## TCL 50 Pro Nxtpaper 5G

tcl.com

AVAILABILITY Now

From our time with this in the IFA halls we can tell you the TCL 50 Pro delivers on its main promise: the

phenomenal matte screen that's a joy to read in its default colour mode, but that you can switch to a focus mode via a simple button. This cuts out interruptions, but also transforms the screen to mono. It sounds like a gimmick, but if you suffer from phone addiction then this looks to be a brilliant and affordable buy.

## TCL Nxtpaper 14

tcl.com

AVAILABILITY Now

Size isn't quite everything, but if you're looking for a big-screen tablet then direct your eyes towards the Nxtpaper 14. As the name gives away, this includes a 14in version of TCL's superb paper-like panel, with the



“Ink paper” mode particularly good if you need to read long documents. It isn't the fastest, with a mid-range Helio G99 chip in place, but you do get Android 14, 256GB of storage and a surprisingly respectable set of speakers considering this tablet's price.

## Honor MagicPad 2

honor.com

AVAILABILITY Now

Honor can't match the reach of Apple's tablet ecosystem, particularly its rich selection of apps, but if you're after a productivity-focused tablet then the MagicPad 2 is a great choice. The Snapdragon 8s Gen 3 chipset offers plenty of speed, but it's the striking 12.3in OLED panel and 5.8mm-thin design that amazes for the price. When you consider that you also get a pleasant keyboard and stylus for probably \$1,000, it's a stunning buy. And this tablet plays even nicer with Honor phones and laptops, acting as a second screen and making it easy to share files, while Honor's AI Defocus Display promises great things for those with myopia.



# GAMING

## Acer Project Dual Play

What happens when one of the best gaming laptops and a Nintendo Switch get busy in the bedroom? It's a question we never thought needed answering, but in doing so Acer has created arguably the stand-out concept of IFA 2024. Simply push a button towards the top of the laptop, and the touchpad pops up and disconnects from the base. Turn it over and you'll discover a fully featured controller, so gamers aren't limited to a keyboard and mouse when on the go. And because those controllers are magnetically connected, you can pull them apart à la Switch and get your fill of split-screen fun.



## Acer Nitro Blaze 7

acer.com

AVAILABILITY Early 2025

Acer gave a handful of IFA visitors a chance to play with the Nitro Blaze 7 at its invite-only stand, and most liked what they saw. It feels more comfortable in the hand than the MSI Claw, with a better curvature to the back for a proper hand grip, while the Ryzen 7 8840HS promises even higher frame rates than Intel's Core Ultra 7 258V. But, as with the MSI, you have to wonder if this will stand up to the incoming Ryzen Z2 models in early 2025 given the fact that this includes more advanced AI capabilities that can run the next generation of FSR frame generation.

## MSI Claw 8 AI+

au.msi.com

AVAILABILITY Early 2025

MSI only announced its Claw 8 in March, but the response to this 8in handheld gaming device was, shall we say, underwhelming. MSI is hoping that this update, with the second generation Intel Core Ultra chips inside, will answer the criticisms around both performance and gaming – and frankly they should. The challenge for MSI is that by the time it's released in early 2025 the competition will have caught up, including from rivals powered by AMD's Z2 Extreme – which AMD confirmed was on course for release in early 2025 during IFA 2024.



# HEALTH & FITNESS

## RingConn Gen 2

ringconn.com  
AVAILABILITY Now



After a successful Kickstarter launch, the RingConn Gen 2 smart ring made its first public appearance at IFA 2024, and even at US\$299 (\$90 higher than its Kickstarter price) it promises many advantages over rivals such as the Samsung Galaxy

Ring – perhaps top of those being that there's no subscription fee. You'll enjoy up to 12 days of battery life, depending on the size of your ring, "90.7%" accurate sleep apnea tracking, and integration with Apple Health and Google Fit.

## Amazfit T-Rex 3

amazfit.com.au  
AVAILABILITY Now



The Amazfit T-Rex 3 runs on Zepp OS 4, which includes the GPT-powered Zepp Flow – ask it a question about your workout data and good things should happen. But its exterior is all about the great outdoors, with large stainless steel bezels, a bright display and four easy-to-whack physical buttons. It also has dual-band GPS support for precise location tracking, a Readiness Score (similar to the Training Score you find on the best Garmin watches), and the battery can last up to 27 days.

## Withings ScanWatch Nova Brilliant Edition

withings.com  
AVAILABILITY November 2024

Who said smartwatches couldn't be beautiful? The Withings ScanWatch Nova Brilliant Edition not only looks great, with a sleek shape, titanium bezel, durable sapphire glass and either a silver or gold finish, it's packed with a whole host of health features. These include the Cardio Check-Up tool, an in-app service that offers a clinical review of your heart health from board-certified cardiologists within 24 hours – all without you needing to leave your home.



# ODDS & ENDS



apc  
★ BEST OF IFA 2024 ★

## Keychron K2 HE

keychron.com  
AVAILABILITY October 2024

One smaller hall within IFA was almost totally taken by mechanical keyboard manufacturers, many of which were pushing magnetic switches. These make it even easier to adjust the actuation point of each key and should last longer than conventional switches. Keychron's new K2 HE set stood out thanks to its design and keen price. Not a bargain, perhaps, but this heavyweight (in every way) keyboard features a stylish wooden finish that will look great for years. And it's available with black or white keys.

## Timekettle W4 Pro Interpreter Earbuds

timekettle.co  
AVAILABILITY Now

Timekettle launched its W4 Pro earbuds at IFA 2024, with two in the charging box. Looking like a pair of early-2000s Bluetooth earpieces, both units have a soft, rubbery feel where it rests on the ear, with a hardened plastic mouthpiece. Speak, and your words are translated into the target language in two to three seconds – either via a softly spoken human-sounding voice in your ear or on a phone app. While we'd like

translation to be faster still, it's a potential deal-maker for businesses in foreign climes.



apc  
★ BEST OF IFA 2024 ★



## DJI Neo

store.dji.com  
AVAILABILITY Now

This tiny 135g drone can take off from the palm of your hand to shoot stabilised 4K videos, complete with AI subject tracking, or 12MP photos. It's incredibly easy to go from drone novice to creating stunning aerial videos, even if you stick to the basics and pair it with your phone using DJI's Fly app. Or you can pay extra for its Fly More Combo, which adds two batteries and a handy remote controller. Once airborne, the Neo sticks close to you via six automated flight moves (Boomerang, Helix, Circle, Rocket, Dronie and Spotlight), and the only downside is its real-world battery life of around 15 minutes.

## LG Self-Driving AI Home Hub

This isn't the first small, rolling smart home robot we've seen – remember Amazon Astro? – but it has the most personality, and is the first one that actually made us go "Oh, maybe that's worth getting". For a start, it's so expressive – not only does it have great animated eyes, but when it's responding or talking



CONCEPT

to you, it can wobble with enthusiasm. With ChatGPT-4o powering its ability to understand and respond, this feels like a step beyond what came before. It also self-navigates around your home and acts as a smart home hub, and while it can't make a cup of tea it can read your kids a bedtime story.

## Plaud NotePin

plaud.ai  
AVAILABILITY Now (limited)

Some readers will already be familiar with the Plaud NotePin, a device that can hang on a pendant, sit on a wristband or clip onto a shirt. The idea is that it's always with you, so if you have a thought or need to record a meeting then you can press a button and it will capture your voice notes – and then transcribe them via the cloud. And it doesn't sting you with a costly subscription, with the bundled Starter Edition including 300 minutes of use. Our live listeners on Discord weren't impressed, but we're keeping an open mind until we test it. ■



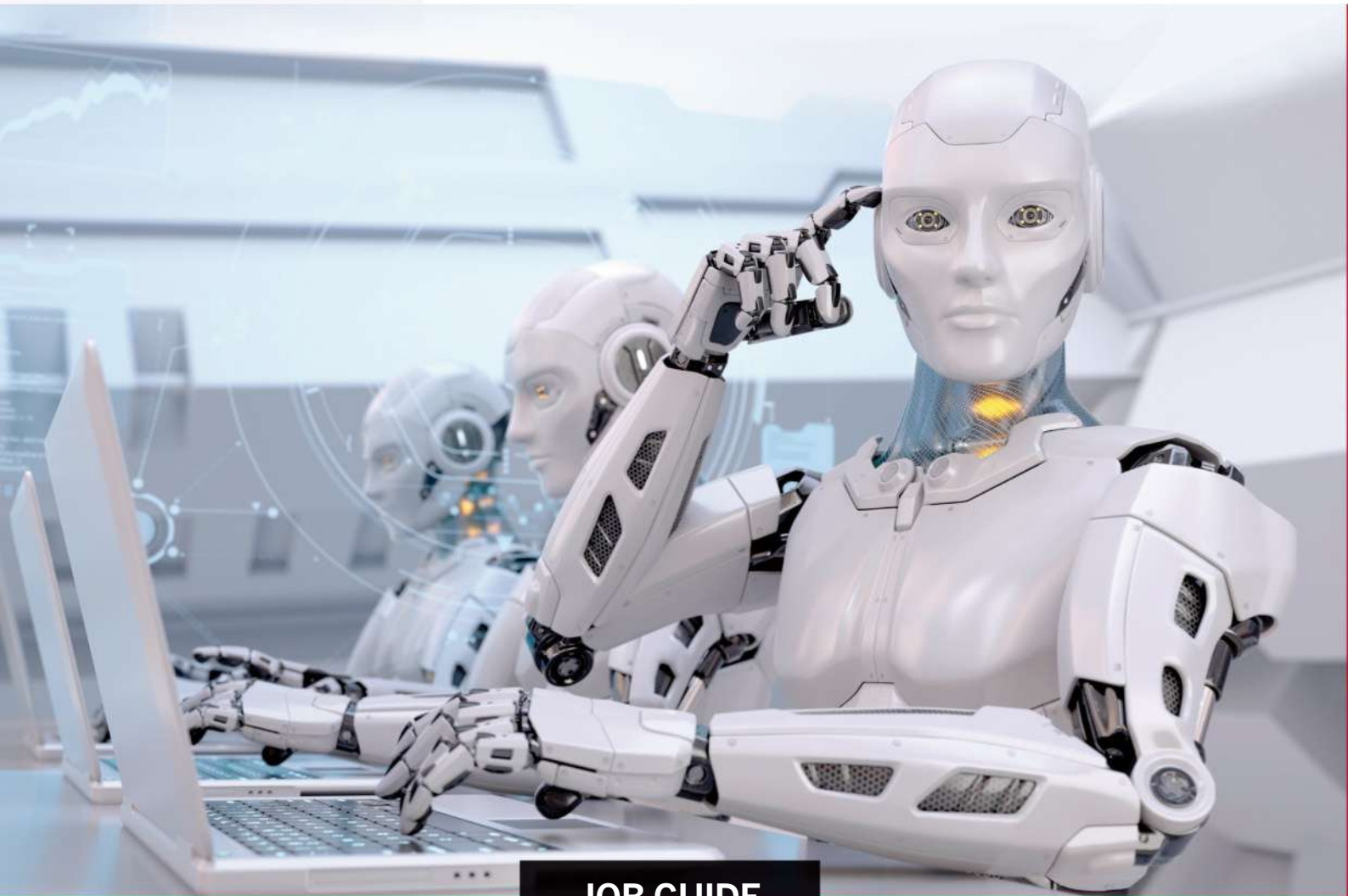
## Bluetooth 6

The Bluetooth Special Interest Group (SIG) made Bluetooth 6 official at IFA 2024, with a whole bunch of promised improvements. Top of the list is Channel Sounding.

Supported devices can identify the distance between them to a centimetre, making "find my device" services hugely accurate and hopefully making smart locks work better, too. There are a bunch of other improvements as well, most around efficiency and reliability, so we look forward to Bluetooth 6 landing on devices soon.







**JOB GUIDE**

# **MAKE AI YOUR PARTNER FOR SUCCESS**

**STOP THINKING OF AI AS A THREAT AND START USING IT FOR WORK. BARRY COLLINS REVEALS HOW AI IS BEING USED IN A VARIETY OF INDUSTRIES.**



**There's a dismal tendency with every new technological development to regard it as a threat. Computers, the internet and now AI have all been heralded as a threat to our livelihoods, ignoring our unshakeable ability to adapt.**

Yes, AI will likely take many jobs. It already has. But it can also be a tremendous assistant in the workplace, a technology which – if mastered at this still early stage – could lead to you becoming indispensable, rather than ready for the scrapheap.

We've interviewed people who are using AI across a wide cross-section of professions to find out how it's transforming the way they work. From teachers saving hours on lesson planning, to a gardener despatching invoices from voice memos, to market researchers using AI to rapidly scale the quality of research they're able to conduct, AI is making an enormous difference in the workplace. And almost all the people we've spoken to are using AI tools that are available to everyone for free or at a relatively modest cost.

By all means spend your time fretting over when AI is going to take your job. Or get ahead of the curve and find out how to exploit it for yourself. You never know, it might just work out.

## TEACHING

Teaching is one of the professions that has been most disrupted by AI becoming mainstream. With students able to generate essays in seconds – complete with convincing-looking typos and grammatical errors if you know the right prompts – the profession's response has often been defensive, looking for ways to combat AI rather than embrace it.

Others are taking a more open-minded approach, finding ways in which AI can enhance learning. Robert Harrison, director of education and integrated technology at ACS International Schools, is among those using AI to lift the burden on teachers, rather than treat it as the enemy.

Two of the big admin headaches for teachers are lesson planning and report writing, two areas in which AI can lend a hand. There have long been websites where teachers can



download lesson plans created by their peers and tweak them for their own needs, but it's a time-consuming process. Both the mainstream AI providers (ChatGPT and Google) and specialist providers are stepping into the breach, using AI to create tailored lesson plans rather than adapting someone else's slides, for example.

"There are a couple of providers who do this really very well for us, whose native product was about collaboration," said Harrison. "They have lots of teachers who collaborated in the past... and so they can use that knowledge base to generate lots of really good and relevant ideas that are already lined up with your teaching philosophy.

"It's a curated set of materials from which to work, and it can work intelligently and learn what teachers do as they refine the lesson. Then

**ABOVE** AI can take mundane tasks such as lesson planning out of teaching.

that machine learning goes back into the algorithm to produce better results for people the next time."

The AI can go a step further, creating specific lesson plans or exercises for students with different needs. Previously, time constraints on teachers may have made it difficult to create bespoke plans for different abilities within a class, but the AI is able to generate tweaked lessons more quickly. "If your students' profiles include a number of students who have an auditory processing disorder, for example, you may be able to look for a learning strategy which addresses their particular learning needs," said Harrison.

"Or if you have a student who has dyscalculia and so is unable to function with particular number patterns, you can generate specific exercises which allow them to practise and to strengthen that particular learning ability."

Schools do, of course, have to be particularly careful around data protection and not enter any personally identifiable information about a pupil's ability into an AI system that doesn't have sufficient

**It can work intelligently and learn what teachers do as they refine the lesson**

safeguards. “I think it will become like most things in the ed tech industry: you will have to pay your money and take your choice, but do a lot of your own educator consumer research as to what’s good value for money and who’s actually working ethically with you,” said Harrison.

Lesson planning isn’t the only teaching admin job that AI is helping with for the ACS schools. It’s also taking some of the time-sapping work out of student reports, with AI systems used to proof-read the reports before they are sent to parents. Harrison describes this as a “spell check on steroids”.

The AI can make sure the teacher doesn’t make potentially insulting errors, like referring to the wrong gender in their comments about a student, for example. Previously, headteachers or other school leaders would “spend a lot of time proof-reading and going through their teachers’ comments as a quality assurance measure,” said Harrison. “That could be outsourced to machine really pretty easily, and we’re having good success with that.”

He added that the school has been “transparent with parents that we don’t all have the privilege of having an executive assistant, but technology can give some of that power to teachers”.

It’s not only teacher admin that will be eased by AI, but parent admin, too. Anyone who has school-age kids will know the horror of getting a dozen different emails each week, asking for contributions to trips, reminding you about after-school activities, or amending the uniform policy, all of which are forgotten within seconds of landing in your inbox. Well, AI might soon save you from having to plough through those emails ten minutes before you shove the sprogs out of the door on a Monday morning. “We’re not there yet, but we’re hoping to develop AI applications with which you can open the school’s chatbot,” said Harrison.

“It will know who you are. You can say what time is my daughter supposed to be at choir practice tomorrow, which could [otherwise] mean looking through six newsletters or for three text messages in a WhatsApp group. But if the knowledge base is there, that closed universe is also possible.”

I think I speak on behalf of all parents when I say: please make this happen. Yesterday.

## Pretty much every team in the business cites that as something that they found really valuable



### LEGAL & HR

Nobody could accuse Advania of not eating its own dog food. Well, Microsoft’s dog food.

Advania is a technology services company and Microsoft partner, which advises companies on how to implement various Microsoft products, including the Copilot AI. Which is one of the reasons why the company decided to roll out Copilot to each of its 1,000+ employees and see what they would do with it.

There were some common uses of the AI to which almost everyone in the company gave a big thumbs up. Things like having the AI sit in on Teams meetings, creating an auto-generated transcript of the meeting with a summary and action points. “I would say that pretty much every team in the business cites that

**ABOVE** AI is cutting workloads for legal teams and HR departments.

as something that they found really, really valuable,” said Chris O’Brien, Advania’s products and services director, and a Microsoft MVP.

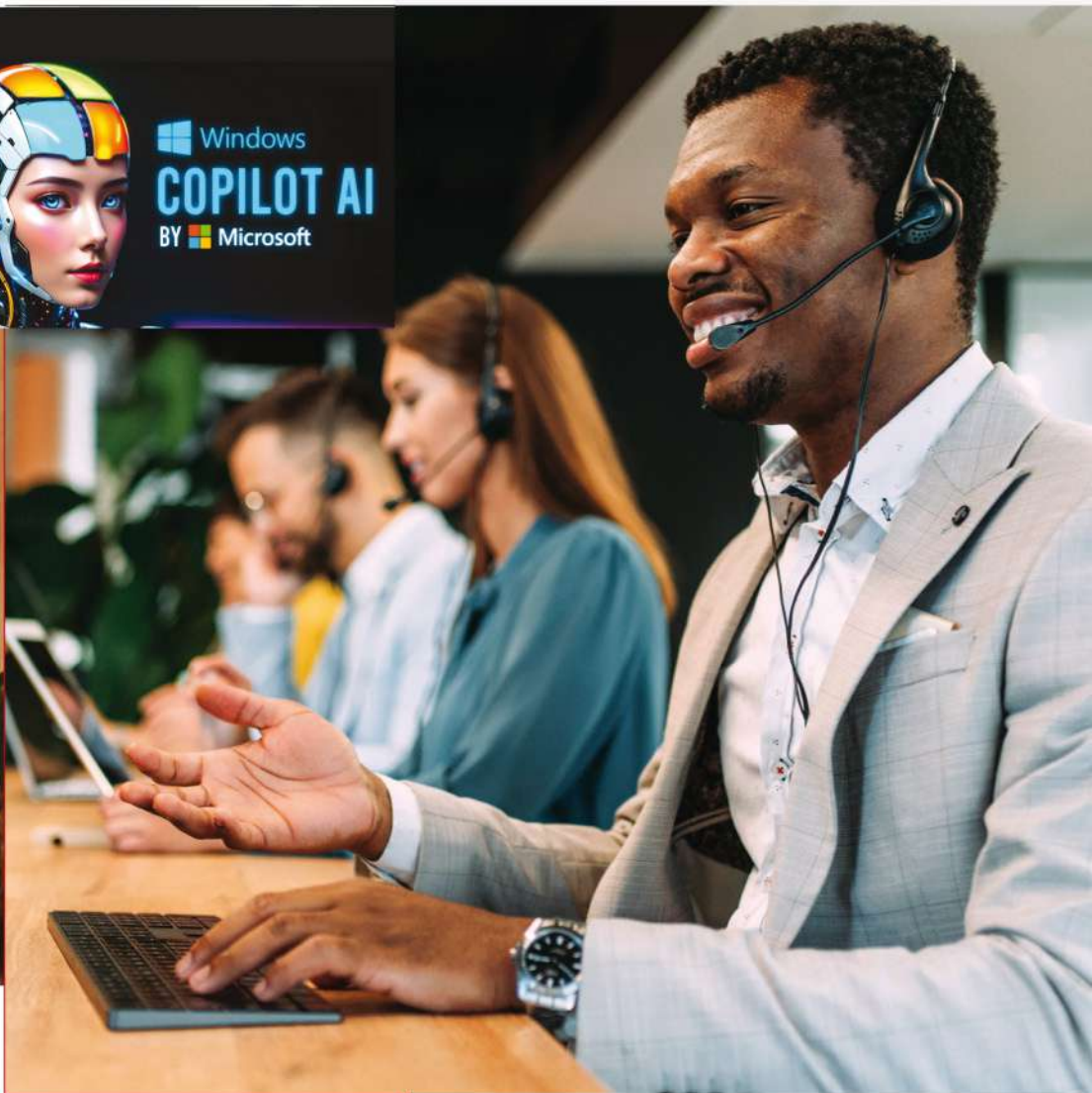
However, there were also specific uses for individual departments that really stood out, not least within the legal and HR teams. “Our legal team are using it for contract reviews, to help identify potentially dangerous things in this contract that are outside of our norms,” said O’Brien.

“They’re using Copilot to identify things like where the liability cap is a lot higher than what we would accommodate, or clauses in IP ownership that are different to what we would want.”

The ability to train Copilot on the company’s own data also comes in handy for the legal team when they’re reviewing such contracts. “They’re now putting every contract through Copilot and often cross-referencing a ‘known good [contract]’, having it do the analysis,” he added.

HR is also putting its Copilot accounts to good use. “We’re a business of 1,200 people across Europe and





South Africa,” said O’Brien. “Our HR team is scaled for that, but what we’re trying to do is scale differently. As we hire the next 100 or 200 people, let’s maybe try and scale these supporting functions in a lower way. And what they [HR] say is they just never draft a new communication, or policy, or a job description, or even the selection process for a role. They would just never write that from a blank sheet of paper any more. They are always starting with Copilot.”

The AI also plays a role in “sensitive meetings”, where staff may have previously recorded the audio from such a meeting or taken notes. “They’re using Copilot to record the call and generate the legally required consultation notes,” said O’Brien.

Copilot isn’t perfect, and “occasionally there’s a point that gets dropped that needs to be on there”, meaning staff have to carefully check each set of AI-generated consultation notes. But, according to O’Brien, the HR team say that “what we’re now doing is the 10% rather than the 100%”.

## CUSTOMER SUPPORT

Before we leave Advania, there’s another use for Copilot that the company didn’t anticipate when it rolled it out across the fleet: helping to provide customer support.

“We’re a managed services provider,” said O’Brien. “Our service delivery managers are doing interesting things, like they are exporting from our ticketing system the last quarter of incidents and requests, and giving it to Copilot to ask for key findings

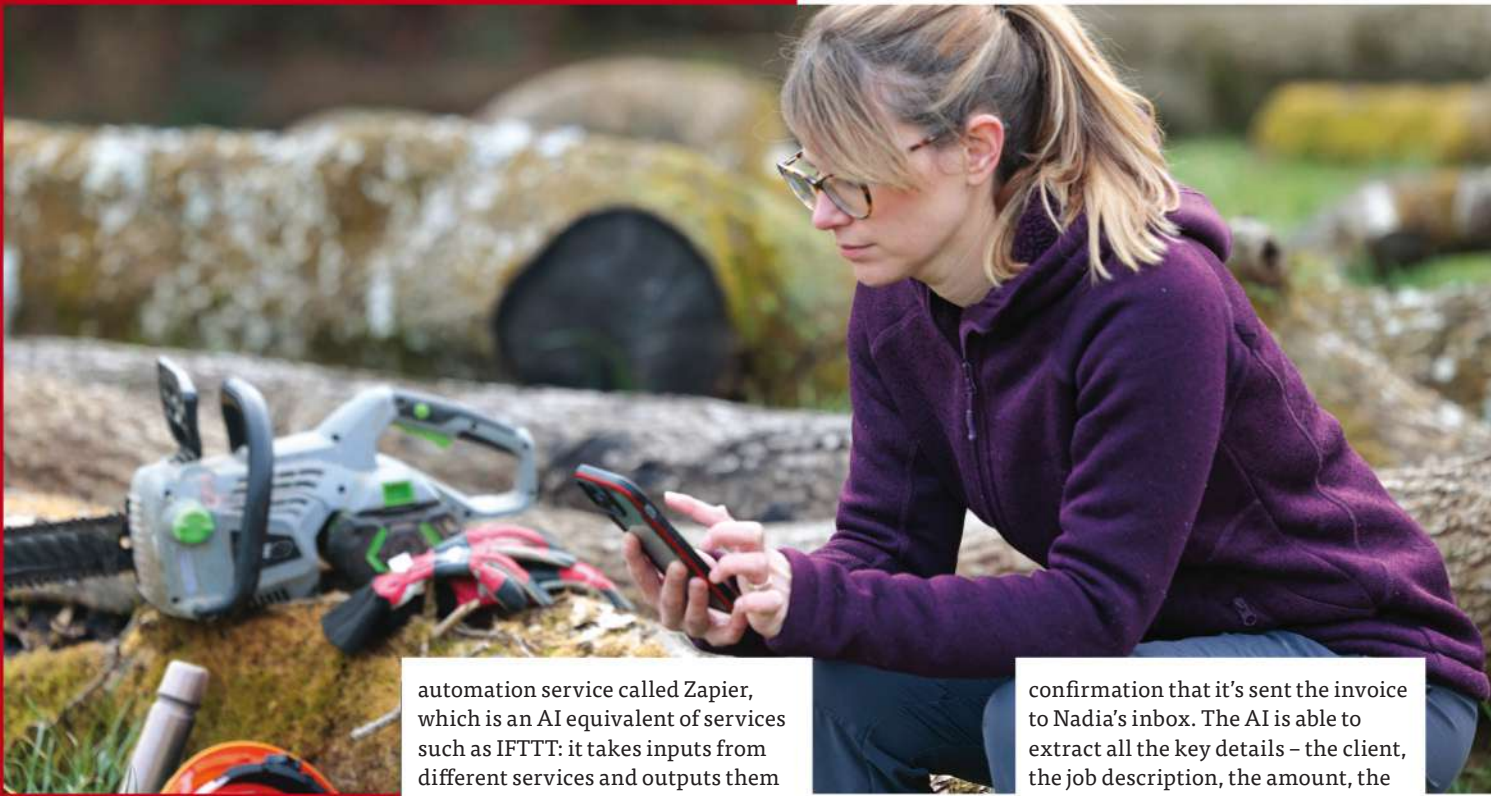
**ABOVE** Customer support services are using AI to answer queries.

and recommendations.”

That involves exporting data from the ticketing system and feeding it into an office document that Copilot can understand. But the firm has also deployed a private ChatGPT instance trained on the company’s knowledge base to help support staff answer technical queries. “We’ve indexed 97,000 documents and it’s pulling answers specific to Advania, almost as if it was known by GPT,” said O’Brien.

Even for general support queries, the AI is replacing the tried-and-trusted Google search for answers. “We’ve got service desk engineers that have pretty much stopped using Google, because actually Copilot and the underlying LLM knows the answer,” said O’Brien. “They’re doing things like ‘give me the script to close the port on this Cisco firewall’, some operational thing that is quite esoteric and specific.”

## The AI is replacing the tried-and-trusted Google search for answers



## SKILLED TRADES

Without wishing to descend into stereotypes, one of the reasons people take up a trade such as plumbing or carpentry is that they're not great at "paperwork". AI can certainly help tradespeople complete the mundane admin jobs they have to deal with, even when they're doing something else with their hands.

Just over a year ago, Nadia Richman gave up her career as an academic researcher to set up her own gardening company. Her business quickly took off, and one of her biggest problems was finding time to invoice customers, provide quotes for new projects and all the other little admin jobs that any small business owner will be familiar with.

Her husband, SEO expert Danny Richman, decided to lend a hand, cobbling together a variety of AI tools to ease the admin burden. Nadia's bespoke AI system allows her to send an invoice, send a quote to a potential customer or add a task to her to-do list simply by speaking the rough details into her phone. "She's halfway up a tree, lobbing some branches off, and she'll say [into her phone] 'send an invoice to Penny Smith for weeding her front garden and removing the tree stump from her drive. And I did that job last Tuesday and I'm going to charge her \$1,200'," said Danny.

That voice note is then sent to an AI

automation service called Zapier, which is an AI equivalent of services such as IFTTT: it takes inputs from different services and outputs them as something new. In this case, Zapier feeds the voice note to OpenAI's Whisper, which is the company's voice-to-text model. Richman describes Whisper as "awesome".

"I downloaded a clip of this Scottish guy speaking on YouTube, telling a story in which I could not understand a single word that he said, and Whisper handled it perfectly," he said. Aside from strong accents, Whisper can also cope with background noise, such as chainsaws or a van engine, meaning Nadia doesn't have to repeat herself six times to be understood.

Zapier takes the audio recording, has it transcribed by Whisper, and it then forwards the text transcript to OpenAI's GPT API. The first thing that does is classify the transcript into one of three categories: to-do, invoice or quote. Each of these categories has a separate path created in Zapier, outlining what the AI should do for each.

For instance, if it determines that Nadia is creating an invoice, it will extract the relevant information from the GPT transcript, generate the invoice in Zoho Books, then send a

confirmation that it's sent the invoice to Nadia's inbox. The AI is able to extract all the key details – the client, the job description, the amount, the invoice date – and automatically fill this information into the invoice template.

If Nadia is providing a quote for a customer, the process is similar, with the AI using a quote form in Zoho Books and sending it to the customer. If it's a to-do item, it will create a card in Trello, where she can review her outstanding tasks when she's finished cutting back begonias.

The AI is accurate enough that Nadia doesn't need to manually review quotes or invoices before she sends them. "We tested it for a while to make sure it wasn't messing up, and one thing we found is she needs to make sure that she's not being ambiguous when she makes the recording," said Danny.

"So, for example, one of the things we found is sometimes she would say, 'I'll go and see Barry and speak to him about his oak tree'. And sometimes it misclassified it as a quote rather than as a to-do task. So now she knows that when she's using it, she just says at the beginning of the recording 'add to my to-do list, blah blah blah', or 'send a quote to Barry, blah blah blah.'"

Danny posted the workflow on social media and there was huge interest in it from a range of professions. "There's a lot of people in trade who are out and about all day," he said. "This is just one example of having a little thing on your phone where you can just make a recording and then take actions based on that recording. It could be applied to so many different areas."

**ABOVE** AI can help take the strain out of dealing with paperwork.

**Nadia's AI system allows her to send an invoice or a quote by speaking into her phone**



## AI doesn't only allow for a greater volume of research to be conducted; it's more accurate, too



### MARKET RESEARCH

Qualitative research such as focus groups can be enormously helpful for companies testing out new products or services, helping them to find out what customers really think before they unleash something on to the market. But collating the feedback from such research isn't easy. It often requires hours of poring over recordings or transcripts, and there's always the risk that the people doing the analysis are listening for what they want to hear, not what the customer actually said.

AI is helping to cut through the grunt work of qualitative research, according to Seamus McCauley, head of public affairs at Holiday

Extras, and delivering more reliable results. McCauley cites the example of sending out a survey to hundreds of customers, in which you might include a free text box to let them tell you what they think of a particular product without being constrained to pre-determined answers or blunt ratings out of ten. Before AI, "analysing the free text was so horribly laborious, nobody bothered," he said.

Now, however, "it will give you a very good summary of what the 20,000 words that have come back is. And from there, you've got a much better view of the market."

This is one of AI's core strengths, so-called sentiment analysis, where it can make a determination of whether a customer is satisfied, disappointed, frustrated or

**ABOVE** Collating information from focus groups is a key AI strength.

whatever in a tiny fraction of the time it would take a human analyst to wade through all those responses and make a determination.

ChatGPT is allowing companies to do the type of research that would have been prohibitively expensive and time consuming before. He cites the example of focus groups, where you might interview people one-on-one or in a small group. "AI is enormously helpful with that because, historically, you do that in a room, you have to write it down and get somebody else to write it down. You'd have one guy behind a one-way mirror watching. You'd have one person transcribing and recording it, and then afterwards you'd have to work out what was said, plus a moderator.

"I can now do it single-handedly because me on the end of a video call, plus an AI transcription bot, just running the transcript through a summary machine at the end, means I can do ten video interviews over the course of a day. At the end of it, I run the whole thing through [the AI] and say, 'what did I hear?' and the AI will almost invariably get it spot on."

AI doesn't only allow for a greater volume of qualitative research to be conducted; it's more accurate, too. "If I'm doing the talking and the note-taking, I'll write down bits that sound interesting and, inevitably, the bits that sound interesting are the bits that confirm my biases," said McCauley. "Whereas if the AI writes down everything, especially from ten people over the course of a day... you've got an objective view of what's been said."

That doesn't mean it's entirely bias-free. "It has a different set of biases implicit in however it was taught or the models it was taught on. But it doesn't happen to have my arbitrary biases – it's got a collective average of human biases, which is as good it's going to get."



## MARKETING

One look at your inbox is all you need to confirm that a vast amount of marketing is done via email these days. AI's copywriting abilities make it easier – and cheaper – than ever before to target customers with mail shots.

Ross Jenkins is the CEO of email marketing agency DigitalME. The arrival of ChatGPT has broadened the range of services he can offer to clients. "An e-commerce shop came to us two days ago and said 'we're coming up to Black Friday. We want to have an email series, one email a day. Can you get them built?'"

Jenkins said he gave the client the option of creating the emails, including text and graphics, with AI or with a human creator. They replied: "Whatever's cheapest."

If cost is the driving factor, "AI's always going to win" according to Jenkins, although that doesn't mean the emails are completely devoid of the human touch. "We build it with AI, show the client a draft, then we go back and we edit it and make changes just to make it more personal, because AI just isn't all there," said Jenkins.

Email marketing is very much a numbers game. It's possible to see the open rates and how many people click on links on every email you send, among other metrics. Jenkins claims he's "not seeing much difference" when it comes to the open or clickthrough rates of emails generated by AI and those created by humans.

The big difference is volume. "People will come to us and say, 'I want do an email a day or an email every other day', whereas before for \$500 every email, they might not want to do 30 emails over the course of a month, because it's obviously going to drain the bank. Now, with AI, they're like, 'go ahead, do whatever you can.'"

While a big increase in email marketing might not fill the average customer with joy, Jenkins believes the big opportunity for AI will come from being able to target messaging much more accurately to the individual consumer, because AI can generate thousands of personalised versions of the same campaign. "AI in the future will be amazing for segmentation," he said. "I think you'll be able to segment beyond your wildest dreams, and that's where I think AI will become massive in terms of email marketing."

## PROMPT LIKE A PRO

If you're using AI tools such as ChatGPT for work, there are ways to increase the quality of results you're getting back. Here's how to prompt like a pro – and avoid mistakes that could cost you your job.

### TELL THE AI WHAT YOU'RE DOING

If you want to avoid the generic, bland mush that AI is more than capable of producing, you've got to give it tight instructions on how you want it to behave. For example, if you're a restaurant owner using AI to write emails to confirm bookings, you might want to adopt a more informal, personal tone than a lawyer writing to a client. So state your business up front. For example: "We're a friendly, family-run Italian restaurant. Write a short email to Mr Hanson confirming his booking for 4 people on 12 June at 7.30pm."

If you're using ChatGPT, you can create a GPT dedicated to this specific task, so you don't need to keep re-entering the first sentence every time you want a new email drafted.



### SET AN EXAMPLE

Been sent an email marketing campaign that you felt had great impact? Seen a logo design that you would like to adopt for your own business? Tell the AI the kind of thing you're looking for and it will normally deliver. In ChatGPT, you can do this by clicking the attachment button and uploading the text or image that you would like it to take inspiration from. For example, we uploaded the logo of our local football club (below right) and asked it to "create a logo of a wolf in this style".

If you're asking ChatGPT to create a spreadsheet of data, you might tell it what you want as the headers for each row and column to ensure consistent formatting with what your company ordinarily produces, or even upload a previous example.

### TRAIN IT ON YOUR DATA

You get the best business results with AI when it's trained on your data, not relying on a generic knowledge base. To give an

example from APC's sphere, we could upload a spreadsheet of all the benchmark results we've recorded for laptops we've reviewed over the years. Then when the next laptop comes in for review and we enter its scores into the AI, we can ask it for a summary of how it compares to, say, all laptops costing between \$2,000 and \$3,500 that have been reviewed in the past year.

### APPLY AI TO YOUR EXISTING TOOLS

There's a tendency to think AI is a siloed application, only available through, say, the ChatGPT website or its app. However, services such as Zapier can be used to bring AI to the services or apps that you already use for your business. Let's say, for example, your business has a Google Sheet for new sales leads that's automatically populated every time someone fills out a form on your website. You can use a Zapier "Zap" to have a message sent to a Slack channel every time a new row is added to that spreadsheet, ensuring someone chases that lead as soon as it lands. You might even add a GPT layer in between that summarises the sales lead and gives it a rating, so you can prioritise the most promising leads. That's just one of a million different examples of how Zapier can interact with the software you already use.

### DON'T SHARE SENSITIVE DATA

We've shared examples here – such as lawyers using AI to examine contracts or teachers using AI to check student reports – where sensitive data is being shared. But in these instances, the AI was used in carefully controlled environments where sensitive data was adequately protected. Such guarantees don't exist on free ChatGPT accounts or Claude or Microsoft Copilot in Bing. Don't share sensitive data unless you're 100% sure of the data controls, and always check your company's policy on using AI services before doing so for work. Otherwise AI really could cost you your job. ■





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## Discover the weird, the wonderful and the ‘what were they thinking?’

Written by Carrie Marshall.

**T**he journey from the scrappy Apple of the 1970s to the world-conquering trillion-dollar titan of today has been long, and Apple hasn't always travelled that road in a straight line.

Nestled among Apple's many blockbuster products, you'll also find many products that didn't quite catch in the same way as the iPhone. Some were years ahead of their time, some were ideas that Apple simply decided not to explore further, and some really should have been left in the meeting room.

As we'll discover, Apple has also made some very beautiful versions of its best-known products in order to raise funds for the charity Product (RED) – products that have sold for more than most people spend on a house.

Over the next few pages we're going to look at the times Apple followed its motto of 'Think Different' – sometimes a little different, sometimes very different, and sometimes a bit too different. These are the deepest of deep cuts, the products Apple tends to keep locked away in its vaults, the weird and the wonderful. Come with us as we discover Apple products made of gold, strange hybrids of different devices, possibly the ugliest Mac ever made and six pairs of rather funky-looking socks...



**1**  
**iMac G3 Flower Power / Blue Dalmatian (2001)**

These were only on sale for a few months, but the Flower Power and Blue Dalmatian Macs are among the most memorable Macs of the late 90s and early 00s – possibly because they were so divisive. Then again, even the original Bondi Blue iMac attracted derision when it first launched, and that turned out to be the most important Mac since the Apple II. These somewhat ‘wackier’ models might not have been the biggest sellers for the company but they represent the Steve Jobs-era Apple at its most creative and playful.

**2**  
**Product (RED) Mac Pro (2013)**

This is one of several one-off designs that legendary Apple design chief Jonathan Ive made to raise funds for the Product (RED) charity. And if you thought the normal Mac Pro was pricey, then make sure you’re sitting down for this one: this Mac Pro sold at auction for a little bit more than its already frightening \$40,000 list price. The winning bidder paid a whopping \$977,000! While we’re all for charity Macs it’s a shame that this was a one-off, as the Mac Pro really does look great in this colour.

**3**  
**Apple Watch Edition (2015)**

When Apple launched the Apple Watch, it wanted to be noticed by the high-end watch wearing community. The Apple Watch Edition was designed to show that Apple was a serious watchmaker for the money’s-no-object crowd, and it came in 18K gold with an equally golden price tag of \$26,000. The response was lukewarm because, of course, tech products, and especially first-gen tech products, have a limited lifespan. Apple discontinued it the following year, stopped software updates in 2018 and officially made it obsolete in 2023.

**4**  
**Apple Pippin (1995-1997)**

Apple made a games console years before anyone had even imagined the Xbox. The idea came from Bandai, who wanted a Mac dedicated to gaming, and it was based on the Mac Classic II. Apple thought it could turn out to be a game changer, a device that would replace multiple household devices and deliver the internet too, but the Pippin was eclipsed by the SEGA Saturn and a little box from Sony called the PlayStation. Steve Jobs canned the Pippin on his return to Apple in 1997.



## 5 things you didn't know Apple still made

### USB SuperDrive

When Apple got rid of optical drives in its mobile and later its desktop Macs, it offered the SuperDrive as a solution, and it's still on sale today. It's compatible with current Macs via a USB-A to USB-C adapter.

### EarPods with 3.5mm plug

Apple ditched the headphone jack long ago, and today's wired earbuds are available with either USB-C for current iPhones and Macs or Lightning for older ones. But a 3.5mm version is still being made for older and non-Apple hardware.

### 30-Pin to USB cable

The 30-pin connector was canned back in 2012, but if you've got an old iPod kicking around it still needs to connect to your computer and to a charger. It's slow by today's standards because it's USB 2.0, but it's nice to know you can still get one if you need one.

### 12W USB power adaptor

We suspect Apple just has these lying around in a warehouse, but if you fear the power of Apple's USB-C adapters this one's suitable for the same old iPods as the 30-pin connector.

### MagSafe to MagSafe 2 Converter

This is available from multiple retailers and does exactly what you expect: it turns original mid-2000s MagSafe charger connectors into the thinner second-gen from the 2010s.



7

6



5



5

### AirPort Express (2004)

Apple doesn't get the credit it deserves for turning Wi-Fi into a mass market technology: its AirPort cards and AirPort Express Wi-Fi access points took the tech and made it effortless, and AirPort was introduced in typical style as "one more thing" by Steve Jobs in 1999. The AirPort Express was the most consumer-friendly version of Apple's wireless hardware and could stream audio from iTunes and send it to a connected audio device. Apple stopped developing wireless routers in 2018.

6

### iPod U2 Special Edition (2004-6)

Apple doesn't really do branded products any more, but for a brief period in the heyday of the iPod it released special editions, such as its multiple U2-branded iPods. The first U2 iPod was a 20GB 4th-gen model with a distinctive red scroll wheel; the third version, based on the 5th-gen iPod, swapped the standard chrome back for black metal, and the fourth and final version came out in 2006. All four editions are now commanding big prices on the collectors' market.

7

### iPod HiFi (2006-2007)

Part of Apple's iPod era of making pretty much every conceivable kind of iPod accessory from speakers to socks, the iPod HiFi was Apple's first go at what would later become the HomePod. It was an Apple-made speaker that delivered high-quality sound. Unlike most iPod docks of the time the iPod HiFi was seriously big, seriously loud and seriously pricey: its \$549 price tag was greeted with silence when it was announced to journalists, and it was gone from the Apple Store a year later.



**1**  
**OS X Lion Thumb Drive (2011)**  
 When OS X Lion was released in 2011, Apple was already moving away from optical discs – and that meant there was an issue for anyone who wanted Lion but didn't have a suitably speedy internet connection to download the OS. This was Apple's solution: a tiny flash drive you could use instead of the OS X download. While the flash drive was more convenient there was an important caveat: you needed to make sure you didn't lose it, because you needed it for any reinstalls.

**2**  
**Apple QuickTake (1994-1997)**  
 The QuickTake was one of the very first consumer digital cameras and Apple made three different models between 1994 and 1997. *Time* ranked the original as one of the 100 greatest gadgets of all time, and it delivered a then-amazing resolution of 640 x 480 pixels with a built-in flash but no zoom controls: the lens had a fixed focal length equivalent to a 50mm lens on a 35mm camera.

**3**  
**Pro Speakers (2001)**  
 We loved these little orbs: Apple's Pro speakers resembled the ones that were made for the Power Mac G4 Cube the previous year and were designed to accompany the Power Mac G4 'Digital Audio' version. They featured audio technology from Harman-Kardon and delivered surprisingly meaty sound from their relatively small drivers, but the black rubber used in some of the earliest ones didn't last very long and eventually fell apart, requiring replacement.

**4**  
**Rose Gold EarPods (2013)**  
 We mentioned earlier that Apple design chief Jonathan Ive had created several one-off Product (RED) designs to raise awareness of and money for Bono's charity, and this is arguably the most beautiful: a pair of EarPods in 18K Rose Gold, which is gold blended with copper, silver and zinc to deliver that unmistakable colour. Once again these were auctioned, and their list price was a hefty \$25,000. They went for slightly more: the final bid was for \$461,000.





5

### 5 Power Macintosh G4 Cube (2000-2001)

This distinctive Mac is known as one of the most innovative and most flawed Macs of all time. It's absolutely gorgeous – it looked like it had travelled from a more exciting future – but it was also ruinously expensive and suffered from cosmetic problems with that clear case. It was canned after selling just 150,000 units and is considered one of Apple's rare Steve Jobs-era flops, but its influence is apparent in modern Macs such as the Mac Studio.

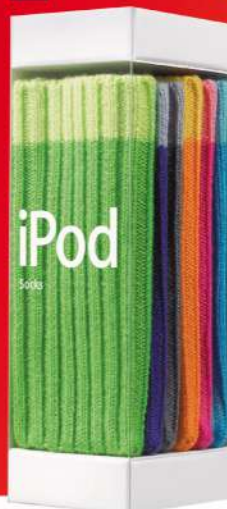


6

### 6 Battery Charger (2010-2016)

If you were to ask which Apple product is the dullest, we'd suggest this one. The Apple Battery Charger is exactly what it sounds like, a charger for AA batteries. It was marketed towards buyers of the Apple Magic Mouse, Magic Trackpad and Apple Wireless Keyboard, all of which used traditional batteries: the move to internal rechargeables was still some years away. Annoyingly the charger could only charge two batteries at a time, but some Apple keyboards needed three...

7



### 7 iPod Socks (2004-2012)

Described with tongue firmly in cheek by Steve Jobs as "a revolutionary new product", the protective socks designed to keep the iPod cushioned and cosy came in a pack of six colours and cost \$29. The going rate for a genuine unopened pack is now around \$120. Apple helpfully provided instructions: "Just slide your iPod into the sock to keep it safe and warm. Slide it out to dock or change playlists. It's as easy as... putting on a pair of socks."



8

### 8 Apple Studio Display (1998-2004)

Apple's Studio Displays were highly visible around the new millennium because they looked like no other monitors. The displays were CRT and LCD panels with non-widescreen aspect ratios. They were priced fairly aggressively, especially for the LCD models: panel prices were finally starting to come down. Of all the models, we liked the blue and white one best: it made monitors fun!

**2024**

# CPU Architecture DEEP DIVE

## New AMD and Intel processors take centre stage. By Jarred Walton.

**AMD and Intel have traditionally released new processors every year, often with the biggest updates arriving for the summer season. 2024 continues that trend, but there are new processors, and there are new processors. In what has become mostly a two-year cadence, both AMD and Intel have major architectural overhauls going on, promising bigger changes than the off-year refreshes.**

It's not just about desktop CPUs, either. As another sign of the current state of affairs, where mobile solutions continue to outsell desktop parts, both companies have laptop-centric designs coming out. Intel even leads off with its mobile-focused Lunar Lake architecture, which has some important differences from the upcoming desktop-centric Arrow Lake designs that we'll cover here. AMD likewise has its Granite Ridge line of CPUs that target desktops, with Strix Point processors going after the mobile market. Both use AMD's latest Zen 5 architecture, but there are plenty of under-the-hood differences to discuss. There are server designs from both companies happening as well, but we won't get into those.

All told, we have a collection of CPU architectures to discuss, with numerous changes from the traditional approach we've seen in the past. Intel is moving away from being the sole or even primary manufacturer of the silicon used for many elements of its latest CPUs (see last month's Tech Talk), turning to rival TSMC for many aspects of its multi-tile solutions. AMD has used TSMC for years, and will continue to do so for this round of updates, but there's news to discuss there as well.

There's a lot to cover, so turn the page to join us as we seek AMD's Zen for the fifth time while swimming in some Intel lakes.

### AMD Zen 5 architecture

AMD is first out of the gate with its new Zen 5 microarchitecture, powering the latest Ryzen 9000-series desktop CPUs, as well as the Ryzen AI 300-series laptop parts. Officially, AMD has announced four desktop chips and three laptop parts, but we can expect that number to increase over time. Zen 5 gets further split into 'regular' Zen 5 cores, as well as density-optimised Zen 5c cores (see Zen 5c sidebar), but most of the functional units are the same.

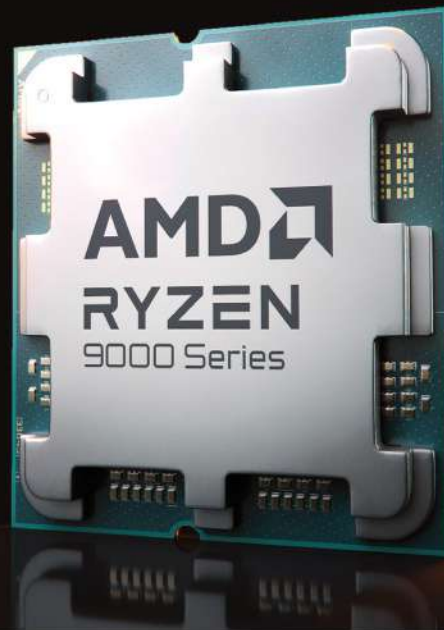
Every new CPU architecture looks for ways to improve overall performance, using some combination of improved IPC (Instructions Per Cycle) and higher clock speeds. Adding performance alone isn't enough, however, as we learned in the clock speed wars of the mid-

The block diagram overview of Zen 5 shows significant changes compared to prior Zen designs, with larger buffers and a wider pipeline.



© AMD





2000s. Ideally, new architectures offer improved performance along with better efficiency, which is why clock speeds haven't seen massive changes over the past couple of decades.

The first CPUs to hit 1GHz came out in March 2000 with AMD's Athlon 1000 and Intel's 1GHz Pentium III models. Clock speeds doubled to 2GHz and more just 18 months later with Intel's Pentium 4 processors, and by late 2002 there were 3 GHz Pentium 4 chips available. That's when CPU designers ran into a wall and clock speeds began increasing much more slowly. We didn't get a retail 4GHz processor until ten years later with the AMD FX-4170! AMD's infamous FX-9590 broke the 5GHz mark in 2013, but with rather extreme power draw for the time, and we only just hit 6GHz CPUs with

the Core i9-13900KS in early 2023.

What we're saying is that increasing CPU clocks generally hasn't been the best way to boost performance for over two decades, so

instead, CPU designers have focused on boosting IPC. There are multiple tactics that can improve IPC, including wider data paths, deeper buffers, more execution units, better branch prediction, simultaneous multi-threading (SMT), and larger caches. Zen 5 basically ticks off every one of those boxes in its quest for higher instruction throughput.

AMD reworked the front end for Zen 5 to include dual 4-wide instruction decoders, along with an 8-wide dispatch unit. Previous Zen architectures were 6-wide designs, so this represents a potential 33 percent increase in

instruction throughput. The branch prediction has also been improved to have lower latency and improved accuracy – key factors for increasing performance.

L1 cache throughput has been improved, and the L1 data cache has increased to 48KiB, up from 32KiB on prior Zen chips. Along with the wider dispatch unit, there are more execution units. For integer work, there are six ALUs (Arithmetic Logic Units), three of which support multiplication, alongside four AGUs (Address Generation Units). Floating-point and vector units support full AVX-512, with six pipelines to handle the various instructions.

Together, the above changes provide an average improvement of around 16 percent relative to Zen 4, according to AMD. That's a significant jump, and represents a continuation of AMD's claimed double-digit percentage gains for each Zen generation. Zen 1 offered a 52 percent increase in IPC compared to the previous Bulldozer architecture, Zen 2 was a 15 percent improvement; Zen 3 was 19 percent, and Zen 4 was 16 percent. It's a great track record for AMD's CPU team.

Zen 5 desktop CPUs continue AMD's chiplet tradition, with a single IOD (Input Output Die) that has the memory controllers, basic graphics support (two RDNA 2 CUs), PCIe lanes, USB controllers, and more. It's the same IOD as with Zen 4, built on TSMC's N6 node to save on costs, so base connectivity will be the same as Zen 4.

The CCD (Core Chiplet Die), meanwhile, uses TSMC's N4P node, a refinement of N5 that improves the overall performance and efficiency. AMD will also offer Zen 5 CCDs that use the newer N3B node, though that will presumably be for EPYC variants, rather than Ryzen CPUs.



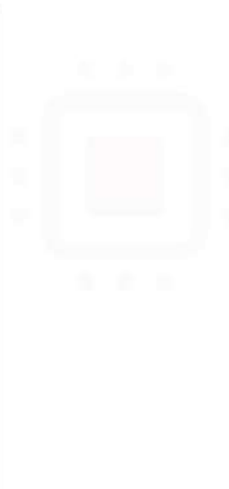
**Every new CPU architecture looks for ways to improve overall performance, using some combination of improved IPC (Instructions Per Cycle) and higher clock speeds**

## AMD Strix Point

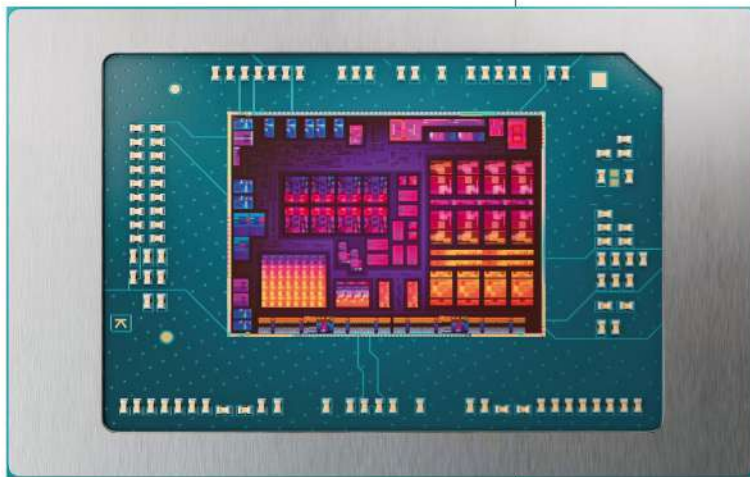
For laptops, AMD's Strix Point makes similarly major changes to the underlying architecture for CPUs that will be sold under the Ryzen AI brand. As with the previous-generation Phoenix Point and Hawk Point, this is a monolithic design – no chiplets here. The single large die contains all the IO connectivity for memory and PCIe devices, CPU cores, an RDNA 3.5 GPU, and an XDNA 2.0 NPU (Neural Processing Unit).

The top two Ryzen AI models (Ryzen AI 9 HX 375 and 370) have 12 CPU cores: four standard Zen 5 cores and eight Zen 5c cores. All the cores have SMT enabled, letting the chips execute 24 concurrent threads of work. The previous generation 7000- and 8000-series laptop CPUs – which were basically the same architecture – topped out at eight cores: four Zen 4 and four Zen 4c, so in addition to architectural advances, the Ryzen AI processors have a 50 percent increase in core count.

As impressive as the CPU aspect might seem, it's



AMD's Ryzen AI processors use a large 232.5mm<sup>2</sup> die built using TSMC's N4P node – that's 68 percent larger than Hawk Point's 138mm<sup>2</sup> die.



the other areas of Strix Point that show real promise. Hawk Point and Phoenix Point offered integrated RDNA 2 graphics with up to 12 CUs (Compute Units), each with 64 shader ALUs. Strix Point moves to the RDNA 3.5 architecture, and then increases the CU count to 16. That's at least a 33 percent potential boost to graphics performance, and likely more than that for real-world workloads.

As with the CPU architecture, it's not just about adding more cores and improving performance. RDNA 3.5 contains optimisations specifically to boost efficiency, with double the texture sampling rate, twice the interpolation and comparison rates for shaders, and improved memory management, with better compression techniques and additional tuning for LPDDR5 memory.

The third leg of Strix Point is the new XDNA 2 NPU, which support both INT8 and FP16 data types to better handle a variety of AI workloads, along with a new 9-bit Block FP16 data type that offers nearly the precision of FP16 with close to the

performance of INT8. AMD's Phoenix Point processors (7040-series) were the first to include an NPU, rated at just 10 TOPS (INT8 teraops); Hawk Point was basically the same chip, but with a boost in clocks allowing up to 16 TOPS of performance. Strix Point's NPU sees an expansion from 20 AI tiles to 32, with each tile offering much higher performance, yielding a total of 50 TOPS of compute.

The net result of all these elements is that not only do the new Ryzen AI chips have higher CPU, graphics, and AI performance than the previous generation parts, but the fastest models are also rated for 28W TDP compared to 45W on the previous top-end Ryzen 9 8945HS. Strix Point is also the first x86 chip that's Microsoft Copilot+ certified, although we're still waiting to see what that means in practice after Recall got sent back to the drawing board.

## Intel Lunar Lake architecture

Intel has multiple new CPU architectures in the works, although the desktop and laptop parts appear to be even more wildly divergent than what AMD is doing with Zen 5. The first parts to launch will be the Lunar Lake processors for laptops and other portable devices. Much like last year's Meteor Lake, Intel is leading with mobile chips, building on many elements of the previous generation, but with newer, faster, and more efficient designs.

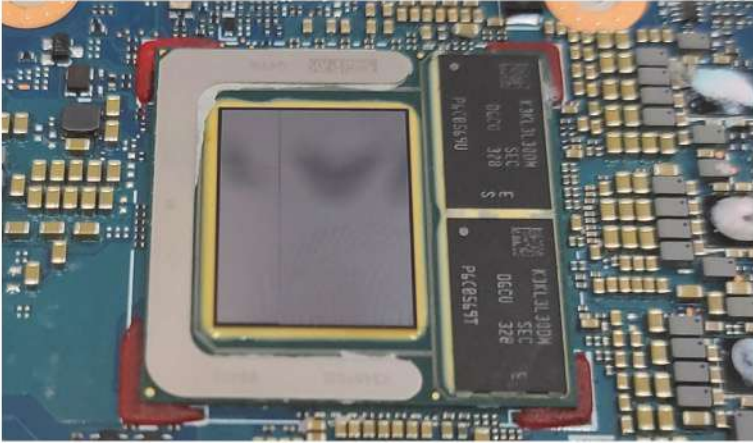
As a recap, the previous-generation Meteor Lake (Core Ultra) processors use a multi-tile approach with four tiles, plus the base Foveros tile. The CPU tile is made using the Intel 4 process node, and sports a hybrid architecture similar to Alder Lake and Raptor Lake desktop parts, with Redwood Cove P-cores and Crestmont E-cores. The GPU tile uses TSMC's N5 node and handles graphics work. The largest tile is the SoC tile made on TSMC's N6 node, and it includes an NPU, two lower power E-cores, the memory controllers, and video decoding support, plus display outputs. Finally, the IO tile also uses TSMC N6, with Thunderbolt 4 and PCIe 5.0 connectivity support.

Lunar Lake builds on Meteor Lake's concepts, but it condenses things into just two main tiles this time: a large Compute tile that's made using TSMC's cutting-edge N3B node, and a Platform Controller tile that's made on the older TSMC N6 node. The only Intel-made silicon for Lunar Lake is the Foveros base tile that links everything together, which is made on Intel's 22FFL (now called Intel 16), originally used to make 3rd Gen Core Ivy Bridge CPUs back in 2011. Moving to just two processing tiles should reduce costs somewhat, but outsourcing both of those to TSMC means that Intel



**All of this is good, but one of the most noteworthy changes is that Intel has worked to make the core design far more portable between different process nodes.**





will end up paying more money per chip as it only handles the packaging internally.

The Platform tile houses all the external I/O functions for the chip, including Wi-Fi and Bluetooth, USB 3.0 and 2.0, Thunderbolt 4, PCIe 4.0 and 5.0 interfaces, and the memory controllers. Most of these technologies don't need the latest process nodes, and so there are cost savings by using TSMC's N6 node. The Lunar Lake Compute tile is where all the exciting stuff resides, with four Lion Cove P-cores, four Skymont E-cores, a new Xe2 GPU, and the NPU 4.0 AI processor. We've got sidebars on the GPU and NPU, but let's tackle the two CPU architectures in more detail.

### Intel's Lion Cove P-Cores

Intel uses a hybrid architecture on its processors, with performance-oriented P-cores and efficiency-focused E-cores. Lion Cove is the codename for the latest iteration of the P-core, following on from the Golden Cove architecture used in Alder Lake and Raptor Lake, though Intel renamed this to Raptor Cove for the 13th and 14th Gen chips.

A lot of the changes with Lion Cove echo what we saw with Zen 5. Intel is adding more execution resources, along with deeper buffers and other improvements. For example, Lion Cove uses an 8-wide design, up from 6-wide on the prior generation. It also can retire up to 12 instructions per cycle, up from eight. To help, it has 18 execution ports, up from 12 on Golden Cove.

All of this is good, but one of the most noteworthy changes is that Intel has worked to make the core design far more portable between different process nodes. Previous generations used large numbers of 'Fubs' – functional blocks – often with tens of thousands of cells each. These were designed for a specific node – for example, Raptor Lake and Alder Lake use the Intel 7 node. With Lion Cove, Intel is using larger partitions that can range from hundreds of thousands of cells up to millions.

Lion Cove is far more portable between different processes – for example, Lunar Lake will leverage TSMC's N3B node for the compute tile, while Arrow Lake will be the first chip to use the Intel

Intel's Lunar Lake package includes a large Compute tile, smaller Platform tile, and a tiny square 'filler' tile for stability, along with two LPDDR5x chips.

20A node. A key factor behind the change was Intel's stalling out on 14nm for so long, which allowed TSMC to pass it by while newer CPU architectures were delayed while Intel worked out the kinks in its 10nm process.

Both Arrow Lake and Lunar Lake will omit Hyper-Threading, but Intel has a separate variant of the Lion Cove P-cores where SMT remains enabled. That will be for P-core only designs used in upcoming Xeon 6 chips. Another interesting change is that Lion Cove will allow for CPU clock speed adjustments in 16.67 MHz steps as opposed to the 100MHz steps used on current CPUs.

Taken together, Intel says that Lion Cove will deliver an overall 14 percent average IPC improvement over the Redwood Cove cores used in Meteor Lake, which were basically the Intel 4 process node variant of the Raptor Cove and Golden Cove cores used in Raptor Lake and Alder Lake.

### Intel's Skymont E-Cores

Skymont marks Intel's third E-core design for its hybrid processors, following Gracemont in Alder Lake and Crestmont in Meteor Lake. While the 14 percent IPC improvement with Lion Cove sounds good, Intel claims up to a 38 percent improvement in IPC with Skymont on integer workloads, and up

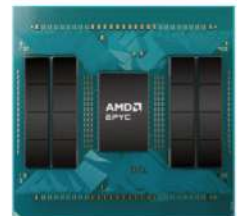
## THE ZEN 5c 'COMPACT' CORE

As far as we know, Zen 5c won't make an appearance on the desktop parts, but will instead be used with mobile processors, as well in certain high core count EPYC server CPUs. Fundamentally, it has the same instruction set and features as the bigger cores, but AMD focused on reducing die size. The result is a core die size that's 25 percent smaller than the Zen 5 core, with reduced clocks and other tweaks to improve efficiency.

Zen 5 uses a standardised CCD for desktops and servers, with eight CPU cores and 32MB of L3 cache. It's broken down into two CCXs (Core Complexes), each with four cores and 16MB of cache. AMD can use one or two CCDs on

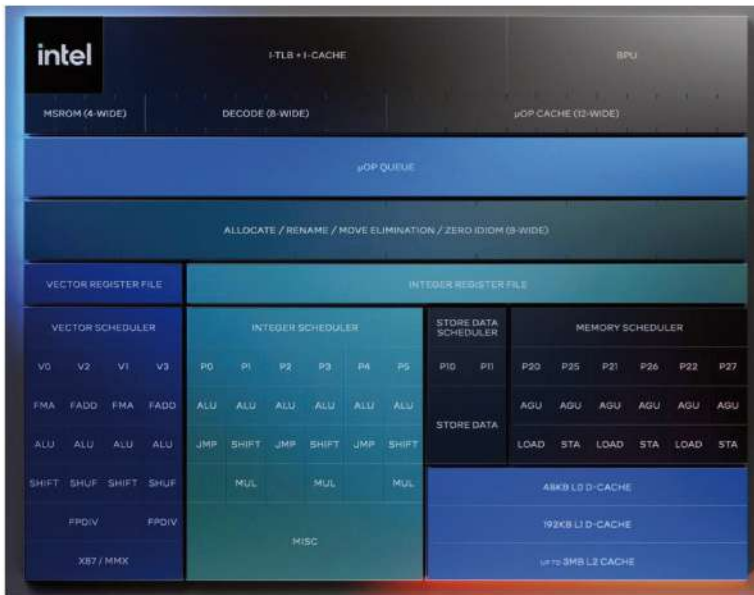
a package for its desktop parts, and up to 12 CCDs on chips like EPYC 9684X – with 16 CCDs coming in future EPYC designs.

Zen 5c for laptops uses a dual-CCX design with two 4-core clusters and a combined 8MB of shared L3 cache. That's one fourth the L3 cache of a Zen 5 core. AMD has lowered the clock speed targets, using fewer but larger functional logic blocks that can be packed closer together. To put it another way, the last several hundred megahertz of speed on the big Zen 5 cores requires more space to dissipate heat and additional tuning of data pathways, resulting in each core being about 33 percent larger than Zen 5c.



AMD's EPYC 'Turin' will use Zen 5c and pack 12 CPU cores per chiplet, giving it up to 192 cores.

Zen 5c still supports SMT (Symmetric Multi-Threading), and it's fundamentally different from Intel's P-core/E-core approach. Where Intel can pack four E-cores into the same area as a single P-core, AMD's Zen 5c dual-CCX (eight cores plus 8MB L3 cache) ends up being about the same size as a single Zen 5 CCX (four cores plus 16MB L3 cache).



to a 68 percent improvement for floating-point work. That's huge, although there's a caveat that warrants mention: Intel is making those comparisons to the weaker low power E-cores used in Meteor Lake's SoC tile, not the standard quad-core cluster of E-cores used in the compute tile.

Lion Cove went wider with an 8-wide design, and Skymont takes that further with a 9-wide (3x3) decode cluster, up from a 2x3 decode on Meteor Lake. The allocation of instructions uses an 8-wide design, up from 6-wide in Crestmont. Skymont also has a larger out-of-order window, bigger physical register file, and deeper reservation stations for Int, Mem, and Vector work. The micro-op capacity is also 50 percent larger, with 96 entries (up from 64).

Intel targeted a doubling in vector performance,

Block diagram of Intel's Lion Cove performance cores that will be used in Lunar Lake and Arrow Lake CPUs.

by including four 128-bit SIMD pipelines versus the two used in Crestmont. The E-core cluster has also received a bump in L2 cache capacity – up to 4MB from the 2MB previously offered.

It's a bit difficult to say precisely how much of an improvement Skymont will be, compared to Crestmont, but all indications are that even if the 38 percent IPC boost may be exaggerated, it's still likely to be in the 20 percent or higher range. Combined with the use of newer, more efficient process nodes – TSMC N3B for Lunar Lake and Intel 20A for Arrow Lake – Skymont should deliver some excellent generational gains in performance.

### Intel Arrow Lake

Arrow Lake CPUs will basically be the desktop alternative to the Lunar Lake mobile CPUs. After the relatively ho-hum Raptor Lake refresh last year with 14th Gen Core updates, Intel looks to deliver substantial changes and upgrades for desktop users. Intel hasn't officially confirmed specifications or model numbers, but the rumour mills and leak-mongers are running wild, and motherboards sporting the new LGA1800 socket were on display at this year's Computex show in Taiwan.

Like Lunar Lake, Intel will use a mix of Lion Cove P-cores and Skymont E-cores for Arrow Lake, which will also mark the switch to Intel's new Core Ultra branding and nomenclature. The top model is expected to have the same 125W TDP as the 14900K, but indications are that they'll be more efficient than the prior generation, and probably have lower peak power draw – the Raptor Lake 125W chips could draw up to 253W, and many motherboards would default to removing power limits, and could let the 14900K, as an example, draw over 350W! Arrow Lake CPUs should reign things back in, thankfully.

One of the biggest changes will be the lack of Hyper-Threading support (SMT), the first time a new

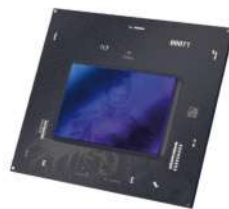
## BATLEMAGE ARRIVES IN XE2 GRAPHICS

Xe2 is Intel's second-generation high-performance GPU, codenamed Battlemage – with Xe-LP, Xe-LPG, and Xe-HPG all counting as first-generation parts. We expect to see dedicated Arc GPUs using the Battlemage architecture before the end of the year, but the first Battlemage GPUs to hit the streets will come via Lunar Lake.

Intel's graphics division spent much of the past two years refining and improving

its graphics drivers, and Xe2 will benefit from those efforts. In addition to all the efforts on the software and drivers side of things, Intel has repartitioned resources into a native SIMD16 engine to improve efficiency, added support for new data types, and boosted the ray tracing capabilities.

The Xe2 GPU in Lunar Lake comes with eight Xe-cores, the same count as in Meteor Lake, but under the hood there are significant



Intel's next-generation Battlemage dedicated GPUs will aim to compete with the best mainstream graphics cards when they arrive in late 2024.

differences. Xe-LPG in Meteor Lake had 16 256-bit vector engines per Xe-core while Lunar

Lake has eight 512-bit vector engines. While the total shader ALU count might be the same – you basically get 1024 shader operations per clock – Intel claims that Xe2 will deliver roughly 1.5X higher performance than Meteor Lake's Xe-LPG, thanks to improvements in various architectural enhancements.

One of the other important changes is that Xe2 will also have eight 2048-bit XMV (Xe Matrix eXtensions)

engines. The Arc Alchemist architecture includes XMV support on the dedicated desktop and laptop solutions, but it was removed from Meteor Lake's GPU to save on die space. Adding XMV back into the iGPU with Lunar Lake will mostly be useful for AI workloads, with up to 67 TOPS of compute, but things like XeSS upscaling can also benefit.



desktop architecture has omitted that feature since it was reintroduced with Core i7 Bloomfield CPUs in 2008. Intel's rationale is that Windows often won't schedule tasks on the second thread for the P-cores until the E-cores have been filled, and the extra plumbing to make SMT work results in a less efficient design. Applications that can benefit from lots of threads will do better leveraging all the E-cores in terms of overall efficiency.

The number of P-cores and E-cores will remain the same as in the previous 14th Gen chips, topping out at eight P-cores and 16 E-cores. That means the total number of threads will drop from 32 on the 14900K to 24 on Arrow Lake, but presumably the architecture changes will more than make up the difference. Lesser models will have six P-cores, and some might have four P-cores, while E-core counts can be as low as four, increasing in multiples of four up to the maximum 16 E-cores.

The integrated graphics for Arrow Lake will continue to use the Xe architecture, though they'll get a bump up to 64 Xe-cores (compared to 32 in Raptor Lake). Clock speeds may also take a step backward from the 6.0 GHz Raptor Lake chips to a rumored 5.4 GHz peak clock on the fastest models.



Arrow Lake-compatible motherboards using socket LGA1800 were shown at Computex in June, with the chips expected to begin shipping this summer.

## AMD THREAD SCHEDULING WOES

Some questions have come up with Zen 5 performance on certain CPUs. It goes back to AMD drivers that were created for the Ryzen 7950X3D and 7900X3D – the dual-CCD Zen 4 processors. Because only one of the CCDs has stacked cache, AMD's drivers work in concert with Windows 11's Game Mode feature to detect games and assign them to the most appropriate

CPU cores for use. The driver uses a 'known good list' of games that benefit from the stacked L3 cache or higher clocks. If a detected game is on the list, the software will park the cores on the non-optimal chiplet, and target threads to the faster chiplet – that's usually the X3D CCD, but some games might prefer the higher clocks of the non-X3D chiplet. The same

basic idea can also be used with the Ryzen 9950X and 9900X to improve communication latencies by keeping all threads for a game on the same chiplet, so AMD elected to use the same software on the dual-CCD Zen 5 CPUs. It makes sense on one level, and it generally works as expected with a CPU like the 7950X3D or 9950X. There's one problem: once you've installed

the necessary chipset drivers that enable the core parking and thread scheduling, you're stuck with them. The only way to get rid of them is to either fully reinstall the OS, or reimage the drive to an earlier state. This can create problems when the drivers reduce performance on single-CCD CPUs. You'd think that AMD could simply disable the driver on CPUs that don't need

it (ie. the Ryzen 5 and Ryzen 7 parts), but AMD says it's a Microsoft problem. Whatever the case, it seems like incredibly poor software design, something that should have been fixed soon after the feature became available. But here we sit, over 18 months later, and it remains a problem that may have impacted performance on some reviews of the 9600X and 9700X chips.

### AMD 3D V-Cache Performance Optimizer Driver



Originally introduced for 3D V-Cache Zen 4 CPUs, AMD's Performance Optimizer Driver and PPM Provisioning File Driver can cause reduced performance on CPUs that don't need them.

## Conclusion

You might think that after more than 40 years of x86 processors, there wouldn't be much room left for improvement, but AMD and Intel continue to find plenty of areas in which to innovate and improve with each passing generation. We'll see two new families of processors from both companies before the end of the year, with AMD's Ryzen 9000 and Ryzen AI 300 processors already available.

AMD's laptop chips look extremely promising, and while there's certainly a lot of hype behind the AI movement – which shows up here with a rebranding to Ryzen AI – there are major improvements on tap in the core CPU and graphics areas as well. It's interesting to note that neither Arrow Lake nor Granite Ridge, the desktop-centric CPUs from the two x86 juggernauts, are including NPUs. Presumably that's because power efficiency is less of a factor, and you can always add a GPU if you want fast AI performance. We'll have to wait and see whether Microsoft's Copilot features can make the leap from marketing hype to truly useful tools in the coming months.

The desktop Ryzen 9000 CPUs also look good, but AMD runs smack into a problem of its own making. It touted up to a 12 percent average improvement in gaming performance from Zen 5 – when compared with the older Ryzen 7 5800X3D.

Faster gaming performance would be nice, but benchmarks show that if you care about gaming, the Ryzen 7 7800X3D remains the fastest chip for now. We'll have to wait for Ryzen 9000 X3D CPUs to see how those stack up.

As for Intel, it has struggled of late, not just with CPU failures (see Tech Talk on page 13), but also with profits in general. Intel recently announced major cuts to its workforce, along with cuts to R&D – never a good thing for a company that strives to innovate. But what we really need to see is how Lunar Lake and Arrow Lake fare when compared with AMD's offerings, not to mention Qualcomm's Snapdragon X Elite SoC that's finally making Windows on Arm a good platform.

If you're not in a rush to upgrade or build a new PC, or to buy a new laptop, waiting until later this year to see how things shake down is the most sensible approach. Perhaps we'll even get some new GPUs to go along with our CPU upgrades before we say goodbye to 2024. All indications are that this year will end with a bang in terms of new PC hardware. ■

**We'll see two new families of processors from both companies before the end of the year, with AMD's Ryzen 9000 and Ryzen AI 300 processors already available**

## INTEL NPU 4.0

Lunar Lake will feature Intel's fourth-generation NPU, though we're not entirely clear on where the first two generations were used. It lists a 0.5 TOPS NPU 1 from 2018 as the first offering, which seems more like a CPU core than an NPU. There was a 7 TOPS NPU 2 in 2021 as well, but for most people, the

first true NPU from Intel was the 11.5 TOPS model integrated into last year's Meteor Lake chips.

NPU 4.0 takes the base design of NPU 3.0, and then triples the number of compute units, boosting the maximum performance up to 48 TOPS – basically the same level of performance as

AMD's XDNA 2 NPU in Strix Point. Obviously, there's more going on than just adding compute cores. Clock speed increases appear to account for another 40 percent boost, and Intel has reworked many other elements of its NPU design to improve performance and efficiency.

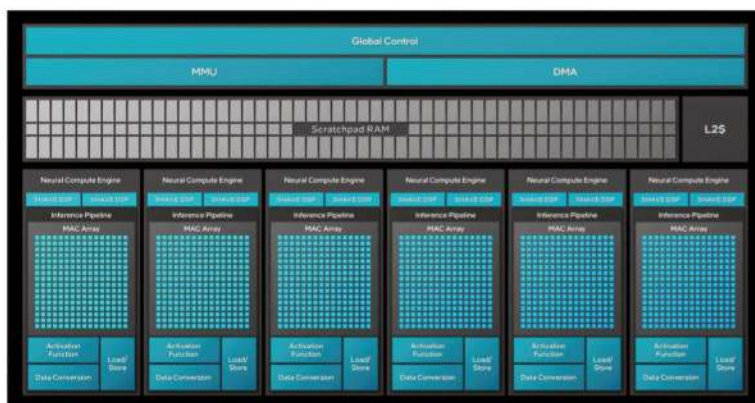
Efficiency is a key

element of NPUs. Nvidia points out that if you're looking for maximum TOPS to run AI workloads, its GPUs have offered more performance than most NPUs for the past six years. The RTX 2080 offered up 170 TOPS of INT8 compute back in 2018 – over three times the performance of the Strix Point and Lunar Lake NPUs. The difference is that NPUs will be able to deliver their 48–50 TOPS with a fraction of the power draw of a GPU – an RTX 2080 likely consumes around 120–150W to deliver its 170 TOPS.

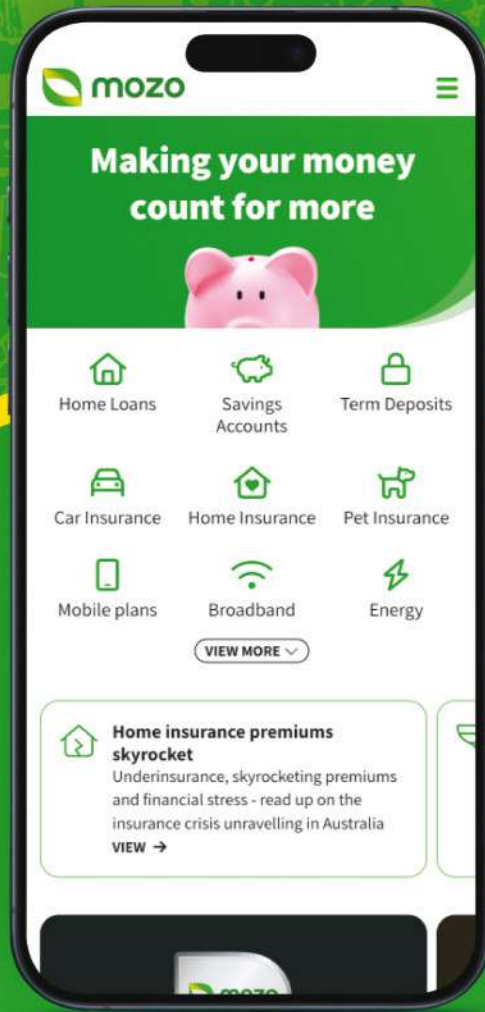
Intel claims up to a 2X improvement in performance per watt

for its NPU 4 compared to the previous NPU 3, with improvements in local bandwidth, the SHAVE DSPs, and Scratchpad memory. It has twice the memory bandwidth this generation, and as an example of the generational gains, Intel says that Meteor Lake's NPU could do 20 iterations of Stable Diffusion in 20.9 seconds using 9.0W of power on average, while the Lunar Lake NPU can complete the same task in just 5.8 seconds while averaging 11.2W, yielding a 2.9X improvement in overall efficiency.

Intel's latest NPU packs 12,288 MACs – Multiply and Accumulate units – triple the number found in Meteor Lake, for triple the performance.







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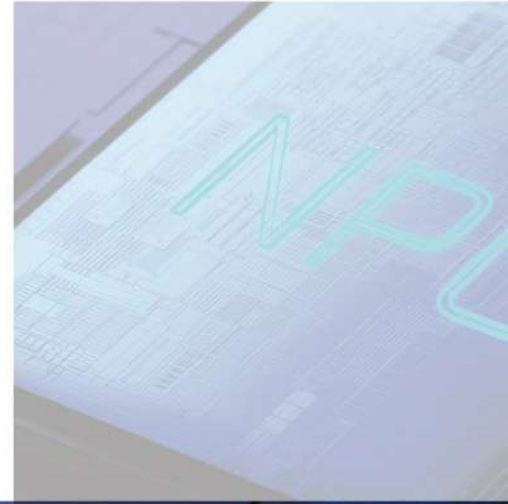
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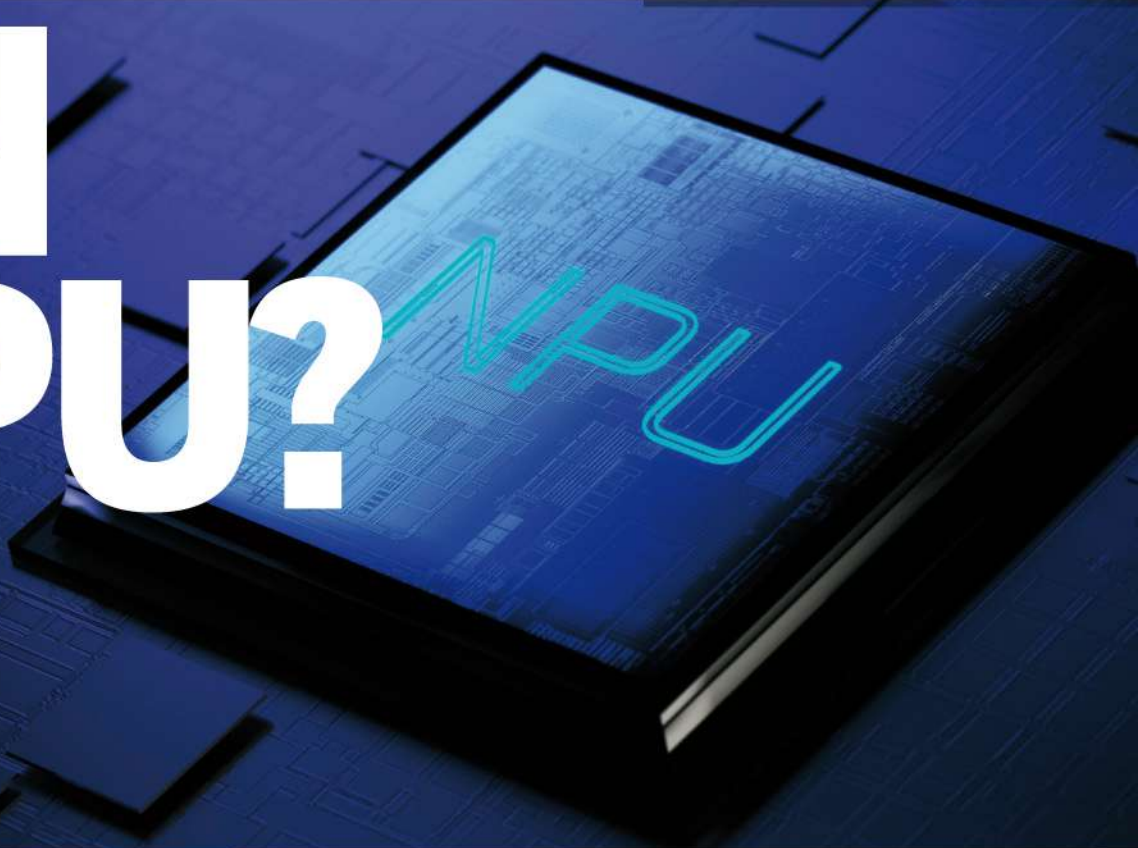
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# WHAT IS

The latest specialist chips put AI at your fingertips. Darien Graham-Smith finds out what's new in neural processing.



# AN NPU?



**We're all familiar with the CPU and the GPU - they sit at the heart of almost every PC made in the past 40 years (albeit the GPU has sometimes been built into the CPU). Lately, though, they've been joined by a new friend: the neural processing unit, or NPU.**

NPUs aren't a brand-new idea. The first implementations appeared, with little fanfare, in mobile chipsets in 2017. But in the past few years, as AI workloads have exploded onto the scene, they've become more and more important. Today it could be reasonably argued that the rise of this new type of processor is the

most significant development in systems architecture in 50 years.

The reason is that, while the NPU is simpler and more specialised than either the CPU or GPU, it opens up a whole new dimension of computing capabilities, enabling the sort of complex on-device AI processing that a regular CPU would struggle with.

This doesn't mean you can run a complete ChatGPT or Midjourney engine on your personal laptop. But it does mean that almost any application can now take advantage of the sort of AI processing functions that power those platforms - and it provides a



standard hardware model for growing and improving these capabilities in the future. When you next buy any sort of consumer electronic device, from a high-end laptop to a smart TV or a home security, there's a good chance it will include an NPU.

### What does an NPU do?

NPUs are designed specifically for AI operations, which in practice means working with data structures called tensors. Entire books have been written about exactly what tensors are and what can be done with them, but the simple way to think about a tensor is as a matrix of values that can have any number of dimensions.

While that may seem like quite an abstract concept, it happens to neatly mirror the way the neurons in our brains connect together to store and process information – hence the description of these processors as “neural”. Rather than stepping sequentially through a big list of operations, as a CPU might, our brains and NPUs both work on large sets of information all at once, identifying relationships between values and applying previously learnt connections to generate new outputs.

To be clear, NPUs aren't the only type of silicon capable of tensor operations. This sort of highly parallel workload is also a good fit for GPU architectures, and the distinction between NPU and GPU products can be hazy.

Some major AI services, such as ChatGPT, are powered by Nvidia's H100 cards, which are effectively GPUs optimised for tensor operations, while Google's Gemini AI runs on a combination of custom-designed NPUs (which Google calls TPUs, for “tensor processing units”) and Nvidia cards.

Many laptops – including Microsoft's Copilot+ PCs – now feature a chip with a discrete NPU, separate from the GPU. And pretty much all high-end phones do, too. This allows a tight focus on carrying out tensor operations as quickly and efficiently as possible, without having to build in additional graphics functions. It also provides a clean route to increasing AI power in future designs, without incurring the cost and energy consumption of scaling up the entire GPU.

### Getting to the bottom of TOPS

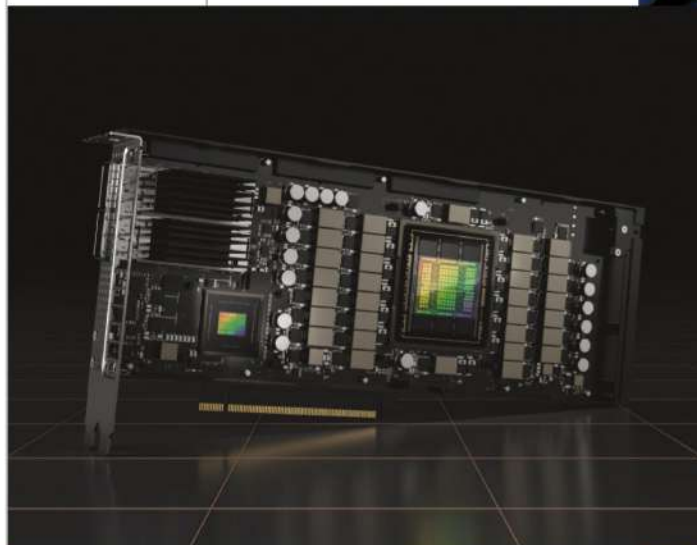
It goes without saying that the NPU in your phone or laptop isn't as powerful as the data centres that run ChatGPT or Google Gemini. But how powerful is it? As a rough indication of how much AI power a given device has, the industry has settled on a measurement called TOPS, short for trillion operations per second.

If you've been involved in computing for a while you may be rightly dubious of this sort of metric – it calls to mind the old “MIPS” measure of CPU performance (million instructions

per second), which was largely meaningless for comparing processors with different architectures.

TOPS is a bit more useful, however. Because an NPU will normally only be tasked with a few specific types of calculation, we don't need to worry so much about differing implementations. It's true that the overall system design could have an impact on, for example – the speed at which the NPU can be fed with data to process. And even in the most efficient systems, a TOPS rating won't necessarily translate directly to real-world performance, as not all AI tasks will push the NPU up to 100% utilisation. *Ceteris paribus*, however, a TOPS rating provides a reasonable yardstick for comparing the capabilities of different NPU models and designs.

It's worth bearing in mind that



**ABOVE** The mighty Nvidia H100 card drives the world's most powerful AI services.

there's no magic number of TOPS. Given enough time and enough RAM, any NPU should be able to complete any AI task. The real question is whether performance is acceptable, which is a rather subjective measure. To bring some clarity to the situation, Microsoft recently drew a line in the sand, declaring in May that its new “Copilot+ PC” badge would only be granted to Windows laptops containing NPUs offering more than 40 TOPS of AI power.

**LEFT** Microsoft has decreed 40 TOPS to be the minimum for Copilot+ PCs.

### What platforms have NPUs?

The prize for the first mass-market NPU goes to Apple. Back in 2017



the company introduced its “Neural Engine” as part of the A11 chipset, as used in the iPhone 8 and X. With a performance rating of 0.6 TOPS this was hardly a powerful chip, but it got rapidly faster with each subsequent revision, and by 2020 the NPUs used in Apple’s A14 and M1 chips were claiming 11 TOPS – an 18-fold increase in just three years. Today the Neural Engine in the latest M4 processors can manage up to 38 TOPS.

Android phones, meanwhile, have been gaining AI capabilities of their own, courtesy largely of Qualcomm’s Hexagon NPU. This was first built into the Snapdragon 845 chipset, released in 2018, and offered 3 TOPS of AI power; since then, as with Apple, the NPU has seen huge performance gains, with the latest top-end Snapdragon 8 Gen 3 SoC claiming 29 TOPS for mobile devices.

While mobile platforms have made great strides in neural computing, traditional laptops have been slower off the mark. Almost all of the first wave of Microsoft Copilot+ PCs have been powered not by AMD or Intel, but by Qualcomm’s Arm-based Snapdragon X Elite chipset, which offers 45 TOPS of AI power alongside snappy desktop performance.

But if the x86 giants were caught napping, they’re now making up for lost time. AMD’s mobile “Hawk Point” Ryzen 8000-series processors, launched at the end of last year, include an NPU rated at up to 16 TOPS, while the new Ryzen AI 9 HX 365 and HX 370 laptop chips boast 50 TOPS of NPU power. The chipset also leans on the CPU and GPU for extra AI help, adding up to a claimed total of 80 TOPS for the entire system – always presuming that you’re not using the hardware for anything else at the time.

Intel’s offering has been similar. The mobile Meteor Lake platform, launched at the end of 2023, was the first to use the company’s new Core Ultra branding, and also the first Intel chip to include a

dedicated NPU. While this neural processor is rated at only 11 TOPS, Intel calculates that the integrated GPU provides an additional 18 TOPS of processing power, with the CPU adding a further 5 TOPS.

Intel’s new Lunar Lake chips have massively boosted AI speeds with around 100 TOPS in total (the exact amount depends on the chip) and from 40 to 48 TOPS in the NPU.

Across all platforms, it’s striking how quickly NPU capabilities are growing, with the sort of generation-on-generation performance gains that CPU and GPU designers can only dream of. By the end of the year there should be no shortage of x86-powered systems powerful enough to qualify for Microsoft’s Copilot+ branding – and by the time Christmas 2025 rolls around, the 40 TOPS requirement will probably seem laughably low.



**ABOVE** Apple’s AI services use the NPU to ensure personal data is processed locally.

**BELOW** Google’s Gemini Nano engine is compact enough to run on your phone.

### Cloud vs local AI

If you’ve recently bought a Copilot+ PC, you may be feeling pretty good about its onboard AI capabilities – but don’t get too smug, as there’s a huge gulf between consumer NPUs and professional-grade AI hardware. A single Nvidia H100 card, as used by ChatGPT and other cloud-based AI services, can deliver 3,026 TOPS over a PCI Express slot, or 3,958 TOPS using the server-specific SXM interface.

And if you were thinking about investing in one of these cards to turbo-charge your own PC, be ready





for a severe case of sticker shock: H100 cards typically change hands for around \$40,000 per unit.

Even if you did save up and treat yourself to an H100, you'd still be some way off matching the capabilities of the big AI services. Elon Musk recently boasted that his xAI company was running off a cluster of 100,000 H100 cards, while Microsoft reportedly uses 150,000 cards to power its Azure AI offerings and other services. Most impressively, Meta's AI hardware portfolio combines Nvidia silicon with in-house designs to achieve a claimed equivalent to 600,000 H100 cards, or about 2.4 billion TOPS.

When there's such a vast gulf in capabilities between online services and on-device AI processors, you might wonder why we even bother with local NPUs. But there are good reasons, one being latency. While a remote cluster might be many millions of times more powerful than your phone or laptop, it takes time to send an AI request over the internet and receive a response. By contrast, local processing can be effectively instantaneous – which makes a big difference to the user experience in tasks such as voice recognition or photo editing. It also enables appliances such as smart TVs and security cameras to carry out real-time AI upscaling or audio enhancement that wouldn't be viable over an internet connection.

Then there's cost. If you want to create high-quality AI images then you'll need to hand over a monthly wedge of cash to Adobe, Midjourney or Leonardo. If you can produce such images on your PC for free, you could save a lot of money over the course of a year.

The other big advantage of on-device AI is privacy. In the early days of ChatGPT (which is to say, last year) Samsung famously banned all employees from using the service, after it emerged that employees were "leaking" commercially sensitive information in their queries. ChatGPT's terms of use allowed OpenAI to store the data indefinitely, and even to use it for further training – raising the

possibility that the chatbot could at some point start regurgitating the trade secrets that it had learnt.

On-device AI helps address such concerns. If your private queries and conversations can be handled locally, there's no need to transmit them to a server somewhere, and much less danger of a leak.

### Who got the power?

All of this is very well, you might say, but one big question remains – how can a personal device offer a useful AI experience when it has only a tiny fraction of the power of the mainstream cloud services?

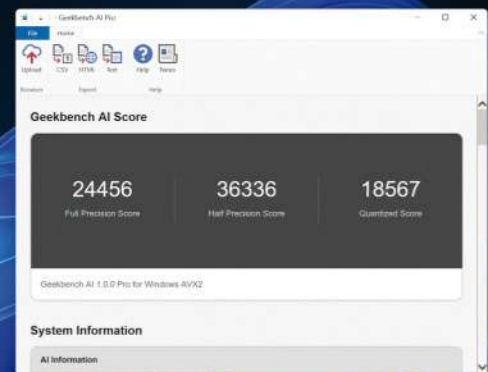
Again, the answer comes in a few parts. First, the really demanding part of AI is the training. This is the process of analysing a corpus of existing data – typically text, images or audio files – and building up the tensor mappings that enable the computer to "make sense" of input and generate valid output.

Training a powerful AI system such as ChatGPT or Dall-E involves terabytes of data (including, controversially, works of cultural relevance that may be protected by copyright) and, as you can imagine, the process of identifying and inferring connections between the words and phrases across such a vast body of information is tremendously compute-intensive. Once the model has been created, it takes far less power to feed input into it, and get responses out.

This isn't to say that a full implementation of ChatGPT or Google Gemini could run on your phone. But it gets close enough that AI operators can create cut-down versions of their models that do run on personal devices, by methods including judiciously reducing the mathematical precision of the original model (quantisation) and removing data and connections that aren't likely to be needed (pruning). In the above cases, OpenAI offers the GPT-4o mini engine, while Android's on-device AI uses a slimmed-down version of Google's platform called Gemini Nano. Both engines are technically much simpler than their parent models, but still work perfectly well for common tasks.

## How many TOPS do I have?

If you're eager to try out local AI, you might be wondering just what your own devices are capable of. There are a few AI-focused benchmarks available, but one of the most versatile and user-friendly is the brand-new Geekbench AI test. Launched just last month, it can be downloaded for Windows, macOS and Linux from [geekbench.com/ai](https://www.geekbench.com/ai), with Android and iOS versions available in the respective app stores. Geekbench AI performs a series of tasks that test the AI performance of your CPU, GPU and NPU. The benchmark takes just a few minutes to run on most devices, and when it's finished you can compare your score to other users' systems in the Geekbench database, to get a clear all-round view of your AI-readiness. The one thing that Geekbench AI can't give you is a TOPS score for your system. That's because TOPS ratings reflect 100% silicon utilisation, whereas real AI workloads have more of an ebb and flow. For this very reason, though, TOPS isn't something you need to worry about – despite what Microsoft might have you believe.



Even when you make an AI request that your device can't handle on its own, the NPU can help by breaking down your input as far as possible, before passing the data upstream to a cloud service for processing. This might not be any faster than going directly to the cloud, but the service provider will be grateful for anything that reduces the load on its very expensive AI hardware.

On-device preprocessing also allows for personal information to be stripped out of the query that's sent to the servers, so you can get the benefit of full-power AI without having to worry about your private data being transmitted over the internet – a big selling-point of Apple's new Apple Intelligence services. If you're concerned about this, though, it's always worth digging into the specifics of whatever AI functions you're using, as the "black box" nature of AI means it's often unclear what's being carried out locally and what's being sent up to the data centre. ■

# PC BUILDER

From the front lines of the Australian PC market



## System news

Ryzen rejected, and Radeon rebooted, Mark Williams explains AMD's recent struggles and plans.

**AMD's Ryzen 9000 series sales have had a rocky start. Despite some large performance improvements in specific use cases, it offers little advantage over Ryzen 7000 for most consumers in regular tasks, including gaming, and can even be slower in rare cases. Additionally, it costs around 25% more. This has led to dire sales, with some retailers reporting single-digit sales in the first week. Now a month after launch, Ryzen 9000 has sold as much as Ryzen 7000 did in its first week, despite Ryzen 7000 having a slow start due to the new and expensive AM5 platform and DDR5 requirements. AMD seems to have miscalculated the value of Ryzen 9000 over the previous generation and needs to change something. The upcoming X3D lineup, expected around CES in January, may be needed to adjust product pricing to attract consumers once again.**

### Radeon revamp

In a recent interview, AMD's Jack Huynh, senior vice president and general manager of AMD's Computing and Graphics Business Group, discussed the future of AMD's Radeon. Despite efforts with

the RX 6000 and RX 7000 series, AMD hasn't significantly impacted Nvidia's market share, which remains dominant in many regions, including Australia.

Huynh revealed three strategies to address this. First, AMD will secede the gaming crown to Nvidia for the time being in order to focus on mid-range products, where most of the volume and revenue in the gaming market come from, rather than competing at the top end. This approach, similar to the RX 5000 series, may last for several generations however while Radeon reconfigures itself and gains mind share. Huynh stated "ATI has tried this King of the Hill strategy, and the market share has kind of been... the market share. I want to build the best products at the right system price point. So, think about price point-wise; we'll have leadership."

Second, AMD is developing a new unified architecture called UDNA, which combines the gaming-focused RDNA and compute-focused CDNA architectures. This will make it easier and more accessible for developers targeting the AMD ecosystem. Huynh explained, "Going forward, we're thinking about not just RDNA 5, RDNA 6, RDNA 7, but UDNA 6 and UDNA 7. We plan the next three

generations because once we get the optimisations, I don't want to have to change the memory hierarchy, and then we lose a lot of optimisations." He added "From the developer's standpoint, they love this strategy. They actually wish we did it sooner, but I can't change the engine when a plane's in the air. I have to find the right way to setpoint so that I don't break things."

Lastly, AMD is pivoting from an analytical-based algorithm for FSR to an AI-based one, similar to Nvidia's DLSS. The analytical version was made to expedite the time to market, but the AI-based approach should improve image quality and close the gap with Nvidia's DLSS. It remains to be seen if this means AMD will move FSR4 away from being an open-source cross-platform solution as a result, something the company is currently quite proud of.

These strategies may take a couple of generations to show results, but they are promising steps forward for AMD and the Radeon brand. ■

*Mark Williams is an IT professional with a strong interest in voiding warranties.*



# Market Watch

A sampling of PC systems available this month



## JW COMPUTERS GMR FURIOSO

\$2,399, [tinyurl.com/APC538JW](https://tinyurl.com/APC538JW)

A modest but modern Ryzen 5 7500F here means you won't be ripping through compute heavy productivity workloads, but for average daily use and moderate gaming it's completely adequate.

32GB of DDR5 is sufficiently future proof and with the RTX 4060 Ti will be capable of playing the latest games easily for a couple years to come. The same can be said for the 2TB SSD.

Considering the 7500F comes with a free and very capable Wraith OEM cooler, the Hyper 620S here is rather a waste of money, but does provide some headroom for future CPU upgrades opportunities. A great starting point for someone that's keen to upgrade parts later.

**CPU** AMD Ryzen 5 7500F; **COOLER** CoolerMaster Hyper 620S; **MOTHERBOARD** Asus TUF Gaming B650-Plus WiFi; **GRAPHICS** GeForce RTX 4060 Ti 16GB; **MEMORY** 32GB Kingston Fury Beast RGB DDR5-6000MT/s; **STORAGE** 2TB Kingston NV2 PCIe Gen4 SSD; **POWER SUPPLY** 750W; **CASE** CoolerMaster Masterbox MB520 Mesh.



## COMPUTER ALLIANCE CIPHER

\$2,429, [tinyurl.com/APC538CA](https://tinyurl.com/APC538CA)

With a similar price to the JW Computers system, this goes all in on offering the best gaming performance for the price. The 5700X3D is a great gaming CPU and will punch above the 7500F found in the JW system in games however isn't worth upgrading further as you'll have the best of an outgoing platform, but that means you're stuck with it short of a whole platform upgrade.

The reason this aging, cheaper, CPU is used is to pour extra funds into the GPU, and with the included RTX 4070 you can expect a solid 30% more performance above the JW system!

Great for those not interested in performing upgrades later as this maximises your gaming dollar out of the box.

**CPU** AMD Ryzen 7 5700X3D; **COOLER** MSI Coreliquid 240mm RGB AIO; **MOTHERBOARD** MSI MAG B550 Tomahawk Max WiFi; **GRAPHICS** MSI RTX 4070 Ventus 2X 12GB OC; **MEMORY** 32GB Corsair Vengeance RGB RS DDR4 3600MHz; **STORAGE** 2TB Kingston NV2 NVMe M.2 PCIe 4.0 SSD; **POWER SUPPLY** MSI MAG A750GL 750W; **CASE** MSI MAG Forge 100R.



## SCORPTEC NORTH RTX 4070 TI SUPER

\$3,549, [tinyurl.com/APC538SCO](https://tinyurl.com/APC538SCO)

As the most expensive system in this month's roundup, it does live up to the price in terms of raw capability. The Intel 14700K is great at both gaming and productivity and with the 360mm AIO temperatures should remain tamed. A top end Z790 chipset motherboard also gives you maximum IO flexibility and with 32GB of RAM, 2TB of SSD space and an 850W PSU, this system is quite future proof for the time being. However, the RTX 4070 Ti Super is around 16% slower than the 7900 XTX found in the lower priced PC Case gear system though is more capable if you like raytracing or running CUDA accelerated tasks. If you like to work and play, this system can make a lot of sense.

**CPU** Intel Core i7 14700K; **COOLER** Thermalright Frozen Edge 360; **MOTHERBOARD** Gigabyte Gaming Z790 X AX V2 Motherboard WiFi; **GRAPHICS** Gigabyte Windforce GeForce RTX 4070 Ti Super OC 16GB; **MEMORY** 32GB Kingston Fury Beast 6000MHz DDR5; **STORAGE** 2TB Kingston KC3000 M.2 SSD; **POWER SUPPLY** Corsair RM850e 850W; **CASE** Fractal Design North Charcoal Black.



## PC CASE GEAR SPECTRE 7900 XTX

\$3,399, [tinyurl.com/APC538PCGG](https://tinyurl.com/APC538PCGG)

Coming in quite a bit cheaper than the Scorptec rig, this system forgoes productivity capability and focuses on gaming performance and in that regard with the Ryzen 7800X3D has the fastest gaming CPU currently available. Paired with the RX 7900 XTX it also has AMD's fastest graphics card as well, meaning around RTX 4080 Super levels of performance (so long as you ignore raytracing). With a midrange motherboard and cheaper quality PSU and case this system trims the unnecessary stuff to maximise the bang-for-your-buck factor, and with 32GB of RAM and 2TB SSD as well while coming in \$150 cheaper, for gamers specifically, this system is a fantastic pick.

**CPU** AMD Ryzen 7 7800X3D; **COOLER** Kolink Umbra Void Performance 240mm AIO; **MOTHERBOARD** Asus TUF Gaming B650 Plus Wi-Fi DDR5; **GRAPHICS** ASUS Radeon RX 7900 XTX TUF Gaming OC 24GB; **MEMORY** 32GB Team T-Force Delta RGB 6000MHz CL38 DDR5; **STORAGE** 2TB Team T-Force Z44A5 M.2 PCIe Gen4 NVMe SSD; **POWER SUPPLY** Kolink Regulator 850W; **CASE** Kolink Unity Cascade ARGB.

# Blueprints

Value- and performance-driven hypothetical builds

## Budget. A perfect balance between price and performance.

**Ah, 2024, a time of change. Here we have it folks, a new generation of CPUs. The cycle continues, and AMD has finally debuted its latest Ryzen 9000 generation chips to the masses. Only one problem: they're a bit underwhelming on the price to performance front, and they're currently beleaguered with some pretty significant Windows bugs, too, causing performance to be sub-optimal. This may change, but for the time being, given how great value the 7000 series is, we're sticking with the last gen.**

This does mean that prices for everything else are ping-ponging around faster than a bat out of hell, which makes it particularly difficult

to price these builds up. Nonetheless, we've come up with a list of six fine builds.

Our budget systems have remained relatively solid at this price point, though we have had to make a few changes. Our AMD build received a new motherboard, as the price had bounced up considerably. By changing to the capable MSI PRO B650-S WiFi from last month's Asus B650-S WiFi from last month's Asus Prime B650-Plus ATX we've managed a decent \$50 saving. A few smaller discounts here and there helped, our 600W Thermaltake Toughpower GX1 80+ Gold falls from \$99 to \$80, while the Intel Arc A750 8GB, which was previously the \$349 Intel's-own model, has been replaced with the

cheaper but equal Asrock Challenger version of that GPU. All up we've gone from \$349 to \$299 for that swap.

For our Intel system, things have stayed relatively stable, too. Our RX 7600 had increased, so we've gone for the Asrock Challenger OC variant instead to offset that. In better news, the 12600KF is also down in price, and we've paired that with Nzxt's T120 RGB air cooler for a nice little saving.

One other thing to note: the Corsair 4000D is back up to its \$130 price mark. Given how old this is getting at this point, and pricey it remains, this should hopefully be one of the last months we see the aging giant before swapping it out.

### AMD BUILD Approximate Price \$1,394











Case	 Corsair 4000D Airflow	\$130
PSU	 600W Thermaltake Toughpower GX1 80+ Gold	\$80
Mobo	 <b>NEW</b> MSI PRO B650-S WiFi	\$249
CPU	 AMD Ryzen 5 7600	\$289
GPU	 <b>NEW</b> Asrock Challenger D Arc A750 8GB	\$299
RAM	 Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	\$149
SSD	 512GB Adata Legend 840 PCIe 4.0 M.2	\$55
SSD	 1TB Kingston NV2 PCIe 4.0 M.2	\$83
OS	 Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

### Intel BUILD Approximate Price \$1,445











Case	 Corsair 4000D Airflow	\$130
PSU	 600W Thermaltake Toughpower GX1 80+ Gold	\$80
Mobo	 Asrock B760M-HDV/M.2 Micro-ATX	\$179
CPU	 <b>NEW</b> Intel Core i5-12600KF + Nzxt T120 RGB	\$310
GPU	 <b>NEW</b> Asrock Challenger OC RX 7600 8G	\$399
RAM	 <b>NEW</b> Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	\$149
SSD	 512GB Adata Legend 840 PCIe 4.0 M.2	\$55
SSD	 1TB Kingston NV2 PCIe 4.0 M.2	\$83
OS	 Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60



**AMD BUILD** Approximate Price \$2,456

Case		Nzxt H7 Flow	\$165
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	\$145
Mobo		Asus Prime X670-P WiFi	\$339
CPU		AMD Ryzen 7 7700X	\$489
Cooler		Noctua NH-D12L Chromax.Black	\$145
GPU		Asus Dual OC Radeon RX 7700 XT 12GB	\$609
RAM		32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	\$190
SSD		1TB Lexar NM790 w/Heatsink M.2 PCIe 4.0 SSD	\$119
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	\$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

**Intel BUILD** Approximate Price \$2,616

Case		Nzxt H7 Flow	\$165
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	\$145
Mobo		MSI Z790-S Wifi ATX	\$299
CPU		Intel Core i7-12700K	\$449
Cooler		Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO	\$135
GPU		<b>Zotac Twin Edge OC 4070 12GB</b>	<b>\$859</b>
RAM		32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	\$190
SSD		1TB Lexar NM790 w/Heatsink M.2 PCIe 4.0 SSD	\$119
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	\$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

**Mid-range. A game-ready machine that can also handle demanding work.**

**In the mid-range department, price fluctuations have hit us, but it's not so bad. In our AMD build pricing has actually been very stable, which is a surprise as many of these components have seen big price jumps in the US market, and yet we seem protected from that locally to a large degree.**

Word of warning: there are a lot of Nzxt H7 Flows out there at this point, all with slightly different prices. The best thing you can do is go onto PC Part Picker or Staticice, and find the Flow that's right for you, certainly on the pricing front. It's likely that this is just a case of the 2022 and 23 models becoming EOL, and the 2024 variant taking its position here

instead. Regardless of which one you pick, you shouldn't have any compatibility issues with the build below.

Also for our AMD system, the U12S Chromax Black CPU cooler we're using fell a very welcome \$54 from last month, coming down from \$199 to a far more appealing \$145. That's via the bigger online shops like Scorptec and Mwave, among others, and this item is listed as a sale discount, so it could jump back up at some point.

For Intel, changes are similarly minimal. We picked up the Zotac Twin Edge OC 4070, as it's the cheapest 4070 available to date at the time of writing.

Interestingly, Intel's 12700K is actually holding steady at that \$449 mark, making it an incredibly tantalising proposition, despite being a few years out of date. We're still not ready to recommend 14th gen again just yet, at least until we've had more time with the latest BIOS micro-code updates that have been released to motherboard partners by Intel.

Overall there's fundamentally no notable difference between the Mid Range builds last month, compared to what we've seen for this issue. The AMD build fell by a meagre \$54, while our Intel Mid Range build yielded a barely worth mentioning saving of \$30.

## High-end. The ultimate do-anything-with-ease PC.

Unsurprisingly, we've seen the biggest price changes on our Turbo systems this month. The storage we've been using has seen increases, with the 2TB MSI Spatium M570 HS PCIe 5.0 M.2 jumping from \$464 to \$580, but it still represents relatively good value so it stays in.

Still, there are some big wins here, too. Again with 9000 launching and yet selling poorly, demand is up for earlier gen AM5 CPUs, the 7950X CPU has held its price steady at \$839, which is a bit of a surprise when we see prices falling overseas for these chips, so we expect Australia to follow soon and see drops.

Our Ryzen 9 7950X is in hot demand and is listed as sold out at many larger online sellers,

including PC Case Gear. It's still an absolute steal, particularly given the 16 cores and 32 threads you get for that investment. Even if you want to upgrade later down the line in a year or so, the X670E AM5 boards still have compatible with all the 9000 series chips, so you'll be in more than a stable enough position for that.

On the graphics card front, our Radeon RX 7900 XTX is a popular card and we're seeing quite a few 'sold out' labels beside many on sale, but the Gigabyte Radeon RX 7900 XTX Gaming OC 24GB is readily available, and best of all it's discounted to just \$1,499 via a few shops, including PC Case Gear.











We've saved a big chunk with our motherboard switch, going from the \$499 Asus Prime X670E

Pro WiFi - AM5 to the remarkably good value Asus Prime X670-P Wi-Fi CSM DDR5 which is a mere \$339.











Then we come to our Intel build, and that was a whole lot of fun. Motherboard? Changed. Cooler? Changed. CPU? Changed. For the CPU we dropped down from the KS to the KF, though you do lose the iGPU by doing that, but that's not important in this build.

Similarly, our cooler pick, the Corsair H150i Elite, had shot up. The company's going through a bit of a stock market downturn right now, so we suspect that this may be a result of that. Still, we managed to keep it fairly tight by switching to the fairly priced and well performing Asus ROG Strix LC II ARGB 360mm AIO.

### AMD BUILD Approximate Price \$4,728

Case		Phanteks Enthoo Pro 2 Tempered Glass	\$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	\$329
Mobo		Asus Prime X670-P Wi-Fi CSM DDR5	\$339
CPU		AMD Ryzen 9 7950X	\$839
Cooler		Nzxt Kraken 360 - 360mm AIO	\$279
GPU		Gigabyte Radeon RX 7900 XTX Gaming OC 24GB	\$1,499
RAM		64GB (2x32GB) Teamgroup T-Create Expert @ 6000 C34	\$319
SSD		2TB MSI Spatium M570 HS PCIe 5.0 M.2	\$580
SSD		2TB Lexar NM790 PCIe 4.0 M.2	\$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60

### Intel BUILD Approximate Price \$4,888

Case		Phanteks Enthoo Pro 2 Tempered Glass	\$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	\$329
Mobo		Gigabyte Z790 Pro X ATX	\$649
CPU		Intel Core i9-12900KF	\$599
Cooler		Asus ROG Strix LC II ARGB 360mm AIO	\$269
GPU		PNY GeForce RTX 4080 Super Verto Triple Fan 16GB	\$1,599
RAM		64GB (2x32GB) TeamGroup T-Create Expert @ 6000 C34	\$319
SSD		2TB MSI Spatium M570 HS PCIe 5.0 M.2	\$580
SSD		2TB Lexar NM790 PCIe 4.0 M.2	\$195
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60



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# The problem solvers

The APC team field problems across the spectrum of devices and software.

Learn a new trick or fix you can use.

## Access web vault

I read with interest your advice on how to use WireGuard VPN to make it possible to take sensitive services 'offline' by making them accessible only through your network. My only disappointment was that it prevents me from accessing my Vaultwarden web vault remotely due to the issue with https. Is there really no workaround for this?

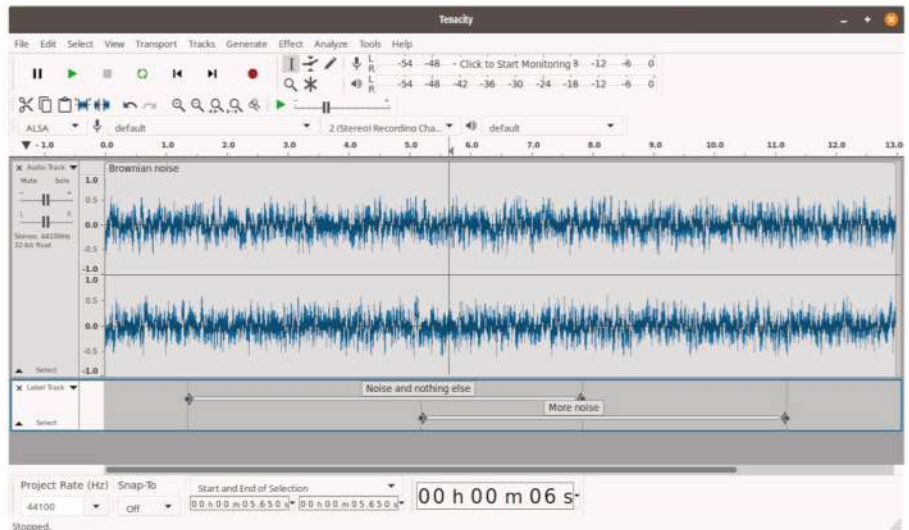
Sean F Maxfield

**APC Responds:** We've done some extra digging and found one workaround you can use involving a domain name you own. APC assumes that you've configured subdomain redirection using Nginx Proxy Manager, and that in this instance you have a subdomain (such as **bw.domain.com**) set up with an SSL certificate already attached to it.

In the short term, all you need to do is instruct your domain provider to point your subdomain to a local IP address instead of having it redirect to your public IP address. Log into your domain provider's control panel and locate the entry you created for **bw.domain.com**. Delete this and then create a new 'A record' (not 'A+ Dynamic DNS Record') for **bw.domain.com**, pointing to your proxy server's local IP address (such as 192.168.0.1). Leave your existing proxy server redirection in place – don't disable or delete it.

This means any device attempting to connect to **bw.domain.com** is redirected to 192.168.0.1 on its own local network, which means the domain only works when anyone is connected at your home or through your Wireguard VPN server.

This leaves one problem: When the time comes for Let's Encrypt to renew **bw.domain.com**'s SSL certificate, the HTTP challenge will fail because it can't access your Vaultwarden server via your domain provider. The band-aid approach would be to temporarily redirect **bw.domain.com** back to your public IP address from your domain provider's control panel. Run the SSL renewal again from inside Nginx Proxy Manager – after it succeeds, redirect **bw.domain.com** back to 192.168.0.1 until the SSL certificate next



Tenacity is a viable alternative to the popular audio app Audacity, though updates are rare.

needs renewing in 90 days' time.

If you're feeling brave, there's a potentially permanent fix you can try. This involves creating a wildcard SSL certificate (\*.domain.com) that can be linked to all your subdomains, including **bw.domain.com**. The problem with this approach is that you need to configure your setup to allow a DNS challenge instead of an HTTP one, which is more complicated. Visit <https://letsencrypt.org/docs/challenge-types/> for more details.

If your domain/DNS provider is listed, obtain the API token following your provider's instructions, then log back into Nginx Proxy Manager, switch to the 'SSL Certificates' section, and click 'Add SSL Certificate'. Type '\*.domain.com' (replacing domain.com with your own domain) and flick the 'Use a DNS Challenge' switch on. Now select your domain provider from the drop-down menu and input details of the required API token as shown. All being well, on clicking 'Save' you're granted a wildcard certificate you can use not just for Vaultwarden but any other services you'd like to take 'offline' in a similar manner going forward.

## Cheap music streamer

Can you suggest a cheap solution for streaming music on my network? I'd like to cannibalise existing components like my hi-fi if possible  
James D Gusman

**APC Responds:** APC is a long-time fan (and user) of the open-source Logitech Media Streaming platform. It's recently been renamed Lyrion Music Server (<https://lyrion.org>) with a user interface refresh, but the underlying tech remains the same. It's a three-tier structure: server, controller, player.

You can run the server on any hardware, including your main Windows PC or self-built NAS server running Linux (either natively or through Docker/Podman). Full instructions and downloads can be found on the website under 'Getting Started', but if you're a Podman user, the following should get you up and running (adjust the '-v' lines to point to your personal folders as needed):

```
podman run -it -d \
  --name=lms \
  --net=host \
  -v "/home/yourname/container-data/logitech/config":"/config":rw \
  -v "/home/yourname/Music":"/music":ro \
  -v "/home/nickdanp/container-data/logitech/Playlists":"/playlist":rw \
  -v "/etc/localtime":"/etc/localtime":ro \
  -v "/etc/timezone":"/etc/timezone":ro \
  docker.io/lmscommunity/lyrionmusicserver:dev
```

You then access the server through a controller, which can be any web browser via <http://192.168.x.y:9090> (substitute x.y with your server's IP address), a mobile app or dedicated piece of hardware, such as a Raspberry Pi with a touchscreen.





**“I’m fed up to the back teeth of Microsoft’s ever-increasing assault on privacy. I’d like to switch to Linux full time but am aware many key apps don’t come with Linux builds. What would my options be if I wanted to force this switch?”**

The controller can be used to direct output to any player on your network, from your phone or tablet to Bluetooth audio receivers and Logitech Squeezebox devices you might still have gathering dust somewhere. You can also build a dedicated music player to output through a hi-fi – we recommend pairing a Raspberry Pi of any vintage with a suitable audio DAC. For example, you can source a Raspberry Pi Zero 2 W with pre-soldered headers, HiFiBerry DAC+ ZERO with phono connectors and essential extras (case, microSD card, and microUSB power supply) from [raspberrypi.com.au](https://raspberrypi.com.au) for under \$110 plus shipping. Pair this with PiCorePlayer (<https://picoreplayer.org>) and you have yourself an audiophile-friendly player.

## Ditching Windows

**I’m fed up to the back teeth of Microsoft’s ever-increasing assault on privacy. I’d like to switch to Linux full time but am aware many key apps don’t come with Linux builds. What would my options be if I wanted to force this switch?**

**Ann Reyes**

**APC Responds:** We feel your pain, Ann. Without serious pushback, Microsoft will simply continue to poke its nose further into Windows users’ activities to monetise them. Linux is the ultimate antidote to this, but the problem is finding a practical workaround for apps that won’t run in Linux.

Attempts to emulate Windows directly through a genuine open-source OS have resulted in ReactOS (<https://reactos.org>). Sadly, this has never developed beyond the alpha stage and while you might like to play with it in a virtual environment, it’s not suitable for use on a daily basis.

This leaves you with macOS or Linux. The former requires an expensive outlay on Apple gear, but you’ll find more native support for popular apps like Office. Linux is completely free, but your first job will be to choose a suitably accessible flavour – we recommend Ubuntu or an Ubuntu-derivative such as Linux Mint ([www.linuxmint.com](https://linuxmint.com)) or Zorin OS (<https://zorin.com>) for Windows switchers.

From here you then see if you can source usable open-source alternatives to any core apps that aren’t supported in Linux, such as LibreOffice ([www.libreoffice.org](https://www.libreoffice.org)) or GIMP ([www.gimp.org](https://www.gimp.org)). Where none can be found, try Wine ([www.winehq.org](https://www.winehq.org)) or one of its more user-friendly front ends, such as CrossOver (US\$60 after free trial, [www.codeweavers.com](https://www.codeweavers.com)) to see if your app can run using a Windows compatibility layer.

You’ll typically have more success with older versions of apps, such as pre-2016 flavors of Microsoft Office as well as the Windows build of Steam, which opens up access to many Windows-only games found on the Steam platform. Use CrossOver’s compatibility database ([www.codeweavers.com/compatibility/](https://www.codeweavers.com/compatibility/)) to see what might be possible.

Your final option is to set up a virtual machine inside Linux using VirtualBox ([www.virtualbox.org](https://www.virtualbox.org)), inside which you’d set up a Windows installation to continue running those apps that can’t be emulated or replaced.

## Tenacity vs. Audacity

**I’ve been using Audacity 3.5, but am concerned about the privacy issues surrounding the program and I’m considering Tenacity as an alternative. However, I’m unclear on the key differences between the two. Does Tenacity follow Audacity releases, or has it forged its own separate path?**  
**Frank S Lauber**

**APC Responds:** Tenacity’s own history is complex as it was one of several Audacity forks made after the Muse Group acquired Audacity in April 2021. Within a year, most of these – including Tenacity itself – had virtually ceased to function. Eventually, two other projects merged with Tenacity to resume development. However, at time of writing, the project hasn’t been updated in over nine months, following the minor 1.3.3 release.

According to Tenacity’s own release notes, its first major stable release (1.3) compared itself to Audacity 3.1, released in October 2021. Since then, Audacity has rolled out five major point releases, each

containing new features. For example, version 3.6 added support for master effects as well as a new compressor and limiter. In other words, despite the controversy over privacy, Audacity has evolved significantly in positive ways since the Muse Group first took control.

Visit <https://support.audacityteam.org/additional-resources/changelog/older-versions> and make a note of the new features added since version 3.1 to help determine which app you wish to use. You can always configure your firewall to block Audacity’s access to the internet if you don’t trust it, although you lose access to its new cloud saving feature if you do.

## Consolidate folders

**I’m looking for a tool to go through folders and strip out duplicate and visually similar photos. Most of the tools I’ve seen come with a price tag attached – can you recommend any freebies?**  
**Mary Martelli**

**APC Responds:** There are several free duplicate image finder tools, but one of the simplest is Awesome Duplicate Photo Finder ([www.duplicate-finder.com](https://www.duplicate-finder.com)). Select one or more folders, click ‘Start Search’, and wait for the program to run through the folder – you’re shown how many photos have been found and scanned, and the number of visually similar images that have been found.

Once the scan is complete, a list is shown in the bottom pane. Check the Similarity column, which gives each match a similarity score – the higher the score, the closer the match. Click the column header twice to sort the results with the closest matches shown first.

Select the top entry and you’ll see a preview of each image, complete with image stats (such as resolution, size, and file type). You’ll also see options to move the file elsewhere, delete it, or browse the parent folder should you need context about this particular copy of the photo.

Other tools offer more options, such as setting ‘protected’ folders, but add complexity – our favourite alternative is AntiDupl, which is also free and open source (<https://github.com/ermig1979/AntiDupl>). ■

# Make Windows better

Expert tips for a better experience.



## WINDOWS 11 INSIDER Drag icons from the Start menu to your taskbar

A new preview build of Windows 11 lets you drag pinned programs from your Start menu to the taskbar, to create a shortcut.

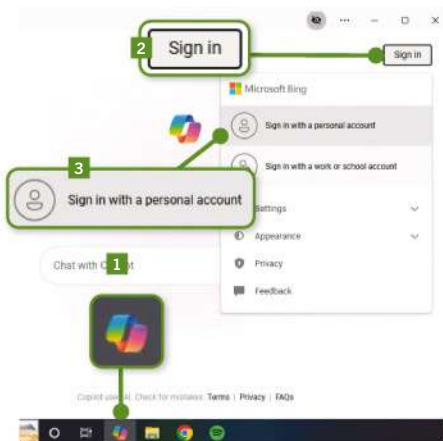
In our example, we did this with PowerPoint by clicking the Start button (1 in our screenshot below) then left-clicking the PowerPoint icon and dragging and dropping it to our taskbar (2). You can remove this shortcut by right-clicking on it and clicking 'Unpin from taskbar' as normal.

This feature is part of the 22631.3951 build of Windows 11, which is available to Windows Insiders in the Beta Channel.

## WINDOWS 10 Launch Copilot from your taskbar

With the latest Windows 10 update (KB5040427), released on 9 July, you can use Microsoft's AI assistant Copilot in a window like any other app, meaning you can maximise and minimise it, and snap it to a half or quarter of your screen.

Microsoft has also added a Copilot



## Windows 11

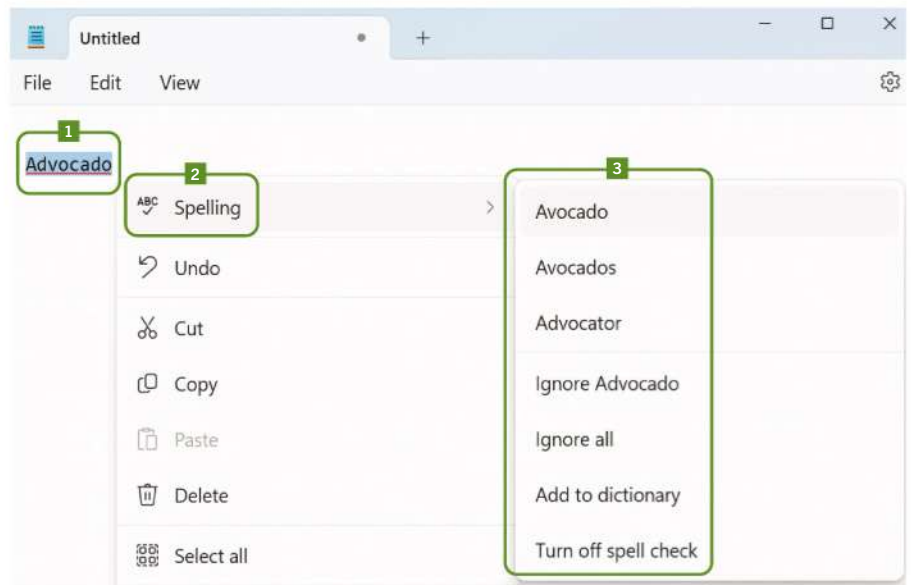
### Use spellcheck in Notepad

Microsoft has added several new features to Notepad in the past year, including writing notes in different tabs within the same window. The latest update (version 11.2405.13.0) adds spellcheck and autocorrect, both of which are turned on by default. Notepad should update to the newest version automatically when you open it. To check this has happened, click the top-right cog icon and look under

'About this app' at the top right.

You should be running version 11.2405.13.0 or later. Also scroll down to the Spelling section and make sure both sliders are turned blue.

When you type a misspelt word, Notepad will underline it in red (1 in our screenshot). Right-click it then hover your cursor over Spelling (2) and choose from a list of possible corrections (3).



icon to the taskbar (1 in our screenshot below left), which you can click to launch. Next, click the 'Sign in' button (2), followed by 'Sign in with a personal account' (3). Now follow the instructions to log in. You can also still launch it in a panel on the right when you press the keyboard shortcut Ctrl+G.

## WINDOWS 11 Access your account from the Start menu

Update KB5040442, also released on 9 July, added the option to access your Microsoft account directly from the Start menu. Previously, you had to open Settings, then Accounts. Click the Start button (1 in our screenshot right), followed by your profile picture (2). Next, click 'My Microsoft account' (3) and the Settings menu will open, which lets you



manage your account. To access system options like 'Sign out' and 'Switch user', click the three dots (4). ■



# Make Office better

## Expert tips for a better experience.

### EXCEL ONLINE

#### Resize columns and rows quickly

Microsoft has overhauled Excel for the Web ([www.microsoft.com/en-au/microsoft-365/excel](http://www.microsoft.com/en-au/microsoft-365/excel)), redesigning the way it looks as well as adding new features. The toolbar ribbon menu is now grey instead of green, for example, and there are a handful of new tools that you can use.

One of the most useful additions is handlebars that let you resize columns and rows by dragging them. These appear when you hover your cursor between rows. We left-clicked and dragged the handlebar between rows 4 and 5 (1 in our screenshot below). The two solid green lines (2) show the boundaries of the original column, and the dotted green line (3) where the new boundary will be. We released the mouse click and the size of the column changed. For details of what else is new in the online version of Excel, visit [tinyurl.com/APC538excel](http://tinyurl.com/APC538excel).

### LIBREOFFICE CALC

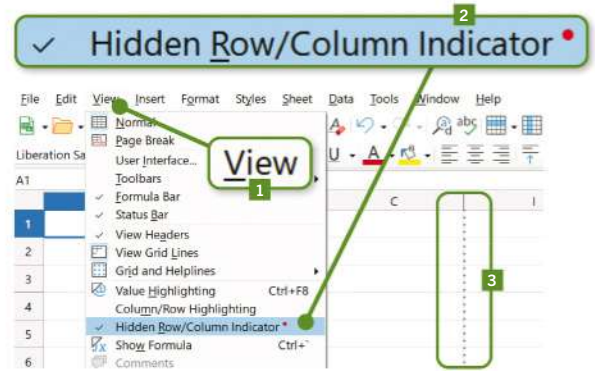
#### Show where hidden rows and columns are

When hiding columns or rows in LibreOffice Calc, it can sometimes be difficult to see where they are just by glancing at your spreadsheet. To help, LibreOffice uses a dotted blue line to show their position, but without revealing the data inside. First, click View (1 in our screenshot above) then Hidden Row/Column Indicator (2). In our example, we've hidden columns D, E, F, G and H, so the line appears between column C and I (3).

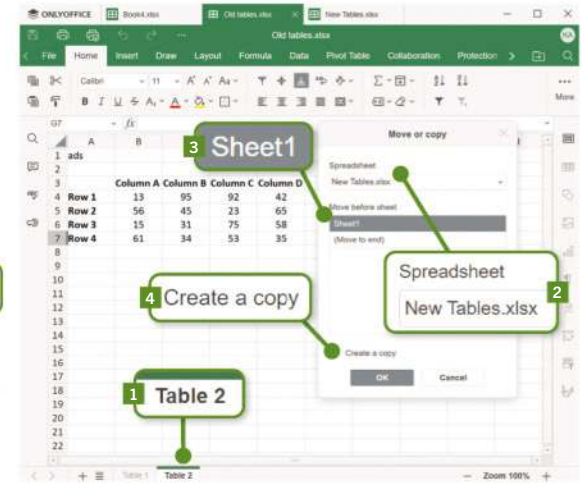
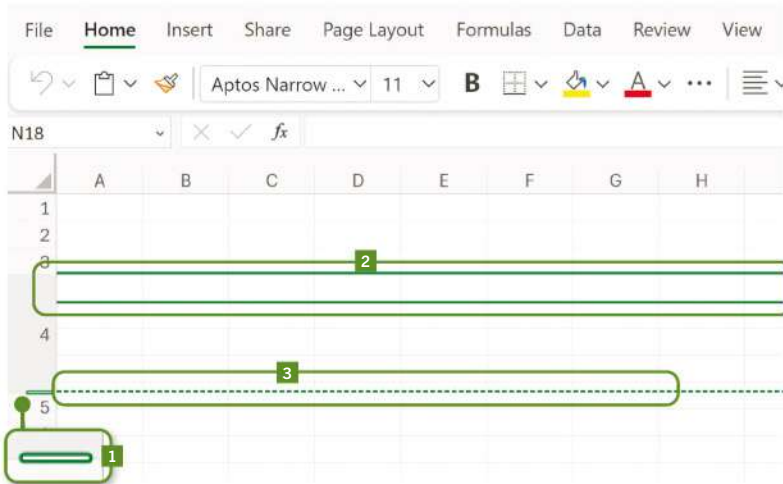
### ONLYOFFICE

#### Move sheets between workbooks

Version 8.1 of OnlyOffice, released in June, lets you move a spreadsheet between multiple workbooks. First, right-click the sheet you want to move,



then choose 'Move or copy'. In our example, we right-clicked 'Table 2' (1 in our screenshot below) and moved it to 'New Tables.xlsx' in the Spreadsheet dropdown menu (2). We then chose 'Sheet1' from the options (3), so it appeared at the start of our Workbook. Click OK to confirm. You can also tick the 'Create a copy' box (4) if you want to retain the sheet in your original workbook and create a copy in the new one. ■

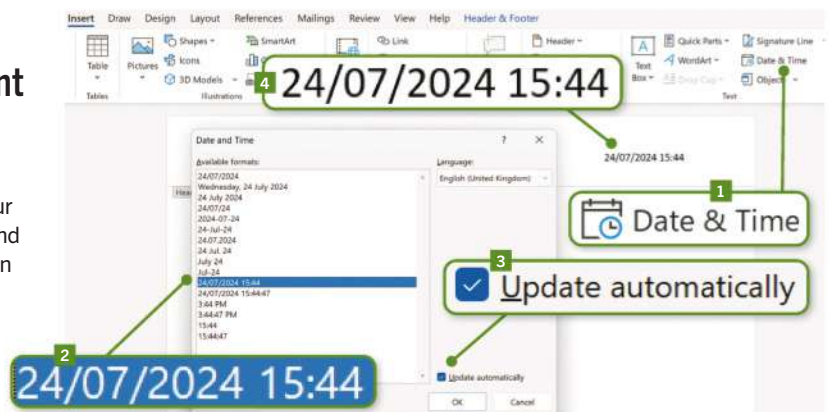


## Microsoft Word

### Add a live timestamp to your document

If you need to keep updating the same document with the current date and time, consider adding a live timestamp that updates automatically.

In our example, we wanted to add a live timestamp to our document's header. We double-clicked the header area and right-aligned the text. We clicked Insert on the toolbar, then 'Date & Time' (1 in our screenshot). In the box that appeared, we chose our format – '24/07/2024 15:44' (2) from the list. We then ticked the box next to 'Update automatically' (3). Finally, we clicked OK, and the live timestamp appeared in our header (4).



# Lock down your browser

Nate Drake is here to help you secure what is probably the most dangerous vulnerability in your computer.

**YOU'LL NEED**

- A stable internet connection

**Adaptive and evasive malware, phishing domains, harmful links, and packet sniffing can all target a common point of weakness: your web browser.**

In May, Google was forced to release an emergency security update for the Chrome browser, which exploited a bug in the V8 JavaScript engine to allow remote code execution attacks. In August, vulnerabilities were also discovered in Edge that targeted out-of-bounds memory access in the ANGLE graphics backend to divert users to malware domains.

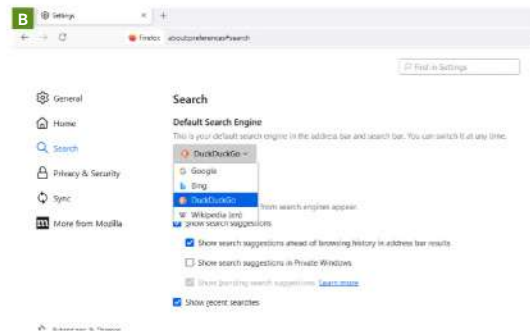
2024 has also seen a spike in ‘malvertising’ whereby legitimate-looking web page ads lead to malware. Given that browser developers are constantly releasing patches, it’s obvious that regular updates are one of the best ways to surf safely.

Still, by default, most browsers display online ads without first checking their legitimacy. Sites are free to download tracking and session cookies to monitor your online activity. Many programs also send User-Agent request headers to sites to make it easy to ‘fingerprint’ your browser and device. Although connections to many sites are secured by TLS, bad actors can easily monitor which sites you’ve visited through your browser’s unencrypted DNS requests.

In this guide, we’ll explore how to choose a secure browser. You’ll also learn how to configure it to maximise your online security while web surfing.

## Best of browsers

At just under 66 percent, Chrome dominates the browser market, but this doesn’t make it the safest browser [Image A]. In late 2023, Google settled a multi-billion dollar lawsuit over alleged user tracking, even when the browser was in Incognito



mode. The Manifest V3 API will also make it harder for ad blockers to function on Chromium-based browsers.

The most secure browsers are fully open source. In the words of Linus Torvalds, “Many eyes make bugs shallow.” In other words, security bugs are easier for the community to detect. If an open-source browser introduces an unpopular feature like Manifest V3, developers can create their own ‘fork’.

The Chromium web browser, on which Chrome is based, is free and open-source. Many proprietary browsers like Chrome, Edge, and Opera use it as a code base. However, there are also open-source Chromium-based browsers that include more secure features.

For example, both Iridium and Brave have removed any code that ‘dials home’ to Google. Both browsers also incorporate features to block ads and third-party trackers.

While Mozilla Firefox doesn’t enjoy the popularity it used to, it also has some excellent features for safer web browsing, including enhanced tracking protection, DoH (DNS over HTTPS), and fingerprinting protection.

The Firefox fork LibreWolf includes all of the above, with extra security enhancements, such as disabling cloud sync and sponsored shortcuts.

We’ve not recommended a specific open-source browser, as it’s important to research one that suits your needs. If you need help, visit <https://privacystests.org> for a comparison of privacy features in major browsers.

For the purposes of this tutorial, we will focus on locking down a standard install of Firefox.

## Configure browser privacy features

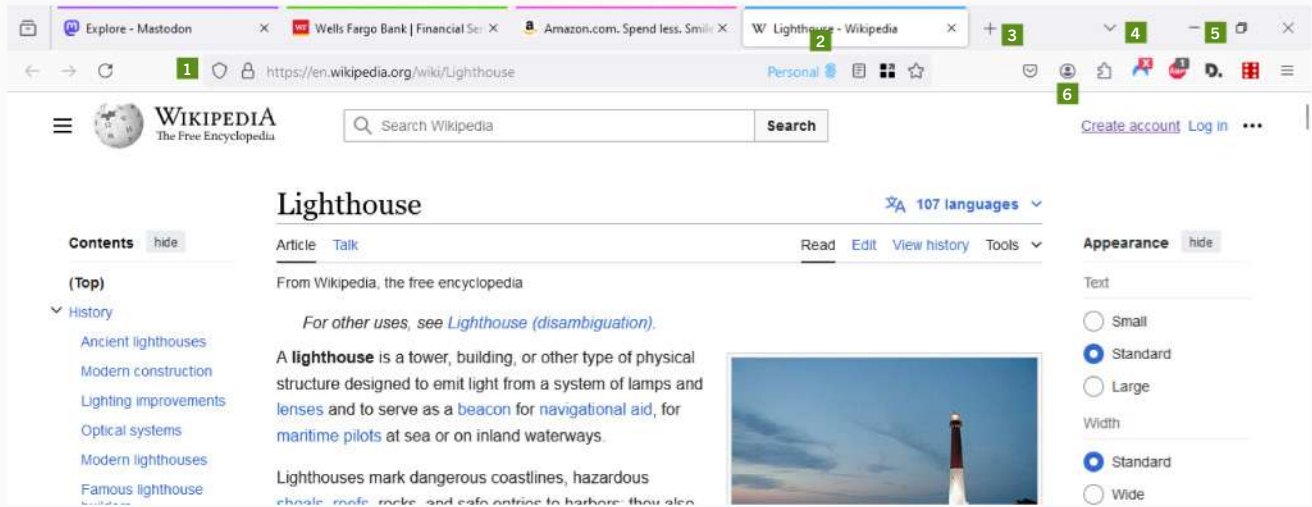
Despite Firefox’s impressive array of security features, by default, the browser can run certain tests and collect data on your computer.

To fix this, go to Settings > ‘Privacy & Security’. Next, and scroll down to ‘Firefox Data Collection and Use’. Here, you can untick the boxes to allow

Browser	Brave	Chrome	Edge	Firefox	LibreWolf	Mullvad	Opera	Safari	Tor	Ungoogled	Vivaldi
Desktop Browsers	1.67	126.0	126.0	127.0	128.0-2	13.5	112.0	17.5	13.5	126.0	6.8
State Partitioning tests											
Alt-Svc	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
blob	✓	✗	✗	✓	✓	✓	✗	✓	✓	✗	✗
BroadcastChannel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓



## A Secure Browser



### 1 Anti-tracking features

The best browsers integrate features to automatically detect and prevent social media trackers, cross-site cookies, and cryptominers. You can also make exceptions so that trusted domains load correctly.

### 2 Containerised browsing

Firefox containers isolate browsing sessions using colour-coded tabs. Web data in one container cannot be accessed by others. You can even sign in to multiple accounts on the same site.

### 3 Fingerprint resistance

Some browsers, like Brave, have built-in features to provide websites with randomised fingerprints. For others, you can disable features that could be exploited by fingerprinting scripts.

### 4 VPN

While we recommend using client software over a browser extension, VPNs provide a secure connection between your device and the VPN server. As your traffic is encrypted, it's almost impossible to monitor.

### 5 Secure extensions

Ad Blockers like Adblock Plus can block targeted ads from loading in web pages. Other extensions, like Disconnect, can prevent trackers. Add-ons need to be configured to be fully effective.

### 6 Local password management

Many browsers support syncing your passwords across devices, but it's safer to store credentials locally. Ideally, these should be encrypted with a master password. Use Diceware for password generation.



sending data back to Mozilla, as well as to install and run 'studies'. Once this is done, scroll to the 'Browser Privacy' setting at the top. 'Standard' protection is usually sufficient for blocking most trackers, cross site cookies, cryptominers, and fingerprinting code. You can, however, enable 'Strict' mode to disable suspected fingerprints at the risk of causing some sites to load incorrectly.

Like most browsers, Firefox also has the option to ask websites to include a 'Do Not Track' request in HTTP headers. Remember, there's no way for your browser to actually enforce this rule.

From here you can also have Firefox delete cookies and site data each time the browser closes, though it's far better to use a browser's 'Private' or 'Incognito' mode, which we'll explore later.

The default search engine for most web browsers is Google. While it has an excellent reputation for serving relevant content, alternative search engines like DuckDuckGo don't track your search data to serve you targeted ads [Image B]. DDG also blocks tracking code in embedded social media posts.

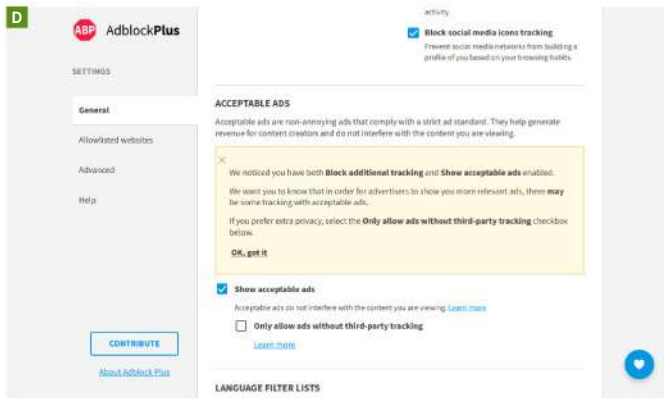
To make the switch in Firefox, select the 'Search' section from the left-hand pane, then choose an alternative from the drop-down menu under 'Search Engine'. From here, you can also disable 'Show Search Suggestions' based on your browsing history.

These days, browsers are much better at enforcing HTTPS. In other words, the software will access only secure versions of websites protected by SSL/TLS. When there's both a secure and a non-secure version of a website, hackers sometimes try to direct your device to the latter in order to monitor your traffic.

To prevent this in Firefox, return to 'Privacy & Security', and scroll down to 'HTTPS Only Mode'. Choose to enable it for all windows.

## Configure DNS and history settings

The DNS (Domain Name System) acts as a virtual phonebook to convert human-readable domain names into



machine-readable IP addresses. Most internet users have a local 'resolver' provided by their ISP to handle DNS queries. **[Image C].**

By default, these are unencrypted, so it's easy for bad actors to monitor the websites you visit. Some cybercriminals also engage in 'DNS Poisoning', whereby they set up their own DNS resolver to redirect your browser to malicious 'phishing' domains designed to resemble legitimate sites.

DNS over HTTPS (DoH) offers an excellent solution by encrypting your DNS queries in the same way as for a web page secured by an SSL certificate. Its implementation varies from browser to browser.

For instance, Firefox's 'Privacy and Security' section uses 'Default Protection'. In plain English, this means the browser will use DoH in supported regions, but default to your regular DNS resolver if it's unable to do so.

To ensure you're always using Secure DNS, scroll down to 'Enable DNS over HTTPS using:' and select 'Max Protection'. This will require Firefox to always use DoH. Use the drop-down menu to select from one of the preconfigured providers (Cloudflare or NextDNS), or choose 'Custom' to enter your own.

Even if your DNS queries can't be detected by your ISP, by default, your browser will store visited websites in its cache, along with cookies and other temporary files. This means anyone with access to your device can monitor your browsing activity.

If you use a 'private' or 'incognito' window to access sensitive websites, your browsing history won't be saved, and any temporary files will be cleared when you close the browser.

You can also configure your browser never to store your browsing history. In Firefox, there's a check box in the 'History' section of 'Privacy & Security' labeled 'Always use Private Browsing Mode'. Restart the browser to enable this.

### Enabling extensions

You should only have one browser extension for each purpose. For instance, you're unlikely to gain better protection by choosing two ad-blockers simultaneously.

Your extensions may need some tweaking for you to benefit from them fully. For example, AdBlock Plus (<https://adblockplus.org>) allows some 'non-intrusive' advertising'.

To fix this, you need to access extension settings once AdBlock Plus is installed, then uncheck 'Show Acceptable Ads' **[Image D]**. Alternatively, just install uBlock Origin (<https://ublockorigin.com>), which blocks virtually all advertising out of the box.

For the same reason, we recommend installing Disconnect (<https://disconnect.me>) over Ghostery. While the latter is better known for blocking trackers, Disconnect doesn't send telemetry to the developers.

If you followed our suggestion to use Firefox, you can also take advantage of container tabs. This allows you to separate your browsing experience into groups of coloured tabs. Each container is isolated, so any browsing data saved in one container session can't be accessed by another. This means you can sign in to multiple accounts on the same website using different container groups.

To get started, install the Multi-Account Containers extension (<https://mzl.la/3SNjid3>). Next, go to Firefox settings and find the 'Tabs' section. Click 'Settings' to view the default container tabs.

Click 'Add New Container' and enter a relevant name, eg. 'social media'. Choose a fitting colour and icon, then hit 'Done'.

Open a new tab and go to an appropriate website for your new container, like <https://mastodon.social/explore>. Next, right-click the tab itself and choose 'Open In New Container Tab' > 'Social Media'. The website will open in a new tab color-coded for that particular container. The container name will also be displayed in the address bar.

Take some time to open tabs for other categories like 'Shopping' and 'Banking' to get used to working with containers.

## THE MANIFEST V3 CONTROVERSY

In late 2021, Google announced plans to deprecate its Manifest V2 API. As of June, browser extensions using Manifest V2 are no longer supported.

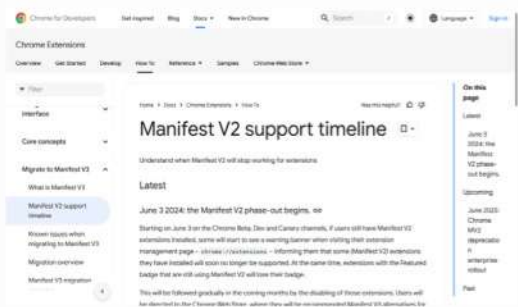
This change has proved controversial, as Manifest APIs manage how extensions interact with Chromium-based browsers like Chrome, Edge, and Opera. V3 has introduced some changes, supposedly to make browsers safer and improve user experience. This means that all browser extensions must contain all the code they run. Extensions will require permission from Google to implement any in-browser changes.

The consequences for ad blockers could be disastrous. Such extensions

work by downloading lists of HTTP requests. Accessing and updating these quickly is an essential part of keeping ad blockers functioning.

Manifest V3 forces browser extensions to use declarativeNetRequest API, with a limit of 30,000 coded 'rules'. As most ad blockers need at least ten times this, they won't run well in Chromium-based browsers. Google relies on targeted advertising, so it's easy to be cynical about Manifest V3.

These changes won't affect ad blockers in non-Chromium browsers like



Firefox, as Mozilla currently has no plans to deprecate Mozilla V2. Some Chromium-based browsers, like Brave, have built-in ad blocking features, so also won't be affected.



## Encrypting your connection

While SSL/TLS can do wonders to encrypt traffic between your device and websites, it's still trivial for anyone with access to your ISP records to know what sites you've visited.

The Tor Browser ([www.torproject.org](http://www.torproject.org)) is a fork of Firefox designed to route traffic through the 'darknet'. As your data is encrypted and routed through multiple 'relays', it's almost impossible for others to trace your device location or read your internet traffic.

Unfortunately, routing traffic through multiple Tor relays can significantly slow page loading times. If you're accessing regular 'clearnet' websites, your traffic also can be intercepted and read by owners of 'exit relays'. You can sidestep this issue by only accessing Tor hidden services (.onion addresses).

Using a VPN (Virtual Private Network) offers much better surfing speeds with comparable anonymity. If correctly configured, your device can establish an encrypted connection to the VPN server [Image E]. This means that anyone with access to your ISP's records won't be able to view your browsing history. Most modern VPN services also manage DNS requests. You can double check this is happening correctly by visiting <https://ipleak.net>.

If you plan to use a VPN with your browser, we recommend installing dedicated client software rather than a browser extension, as this way, all your internet traffic is protected. If you do install the extension, make sure you enable it for 'Private' windows. In Firefox, you can also right-click the extension to 'Pin to Toolbar'.

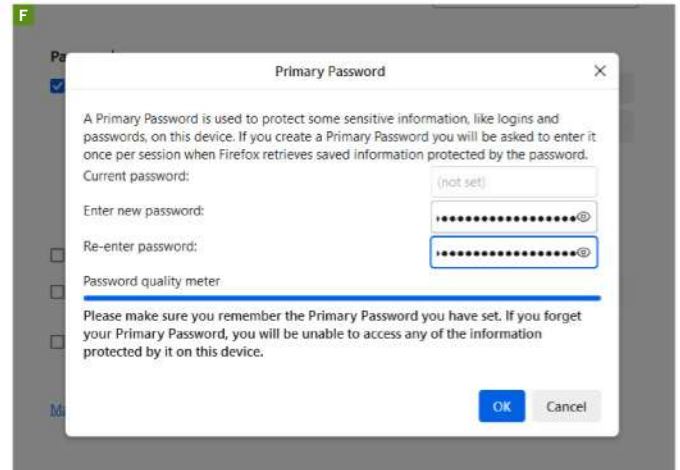
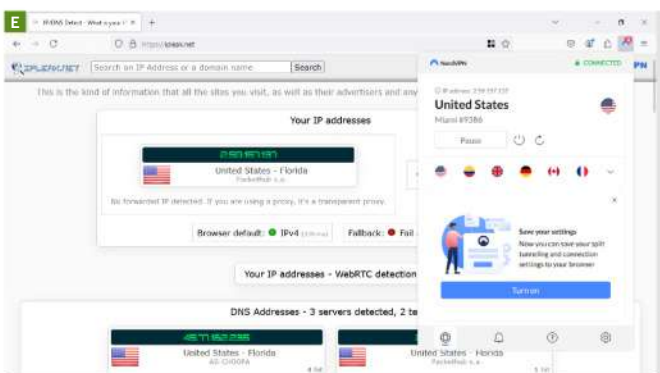
The best VPN services regularly submit to an audit of their 'no log' policy, to independently verify that they don't monitor your internet activity.

## Resist browser fingerprinting

When connecting to a web server, every modern browser sends a User-Agent request header. This header includes information like your browser version and screen resolution. Sites can also inspect installed plugins and other types of software configuration to build a 'unique' fingerprint of your browser to identify you. As this information is stored server-side, using 'Incognito mode' or changing your IP address won't protect you from being profiled in this way.

The Tor Browser uses several techniques to resist fingerprinting such as 'letterboxing'. This technique adds margins to the browser window to make it harder to detect screen size.

The browser also uses NoScript (<https://noscript.net>). This extension, which is available for all major browsers, blocks scripts running on web pages, allowing users only to manually enable legitimate ones. As most types of fingerprinting rely on



JavaScript, this can stop it in its tracks, but NoScript can prevent pages from loading properly unless you enable the right code.

Canvas Fingerprinting is a very common method to identify your device. It uses the HTML5 canvas element present, which is deployed by the Web GL JavaScript API to render 2D and 3D graphics in your browser. The fingerprinting technique involves a site inserting invisible text or images, then formulating a hash of how your browser renders the pixel data. As this will be slightly different, depending on your software, GPU, and graphics drivers, it's easy to identify specific devices.

If you don't want your browser to be tracked across websites and sessions in this way, the easiest fix is to disable WebGL from your browser. In Firefox, you can do this by typing 'about:config:' into the address bar. Next, search for 'webgl.disabled', and change 'false' to 'true'.

If you use Brave, Canvas and WebGL are already blocked for third-party APIs. The browser also uses a technique called 'farbling' to provide randomised values for common APIs, making it harder to fingerprint consistently.

## Password protection

As impressive as online password managers are, there's a risk in trusting your credentials to them. LastPass users discovered this the hard way in late 2022 when they found certain customer data had been stolen. Since many password management platforms are closed-source, it's also difficult to verify that credentials are being encrypted properly.

Using an open-source browser password manager allows you to store your credentials locally. Of course, this isn't much good if a bad actor accesses your device.

Firefox resolves this by letting you set a 'Primary' password. This is required the first time in each web session to access the credentials database. To set this up, go to Firefox settings > 'Passwords'. Click the ... at the top right, then 'Options'. Check the box marked 'Use a Primary Password', [Image F], then enter a passphrase.

Most browsers allow you to sync passwords across devices. Firefox handles this by creating an online account, into which you can sign in (remember though you'll need to set a new primary password). Brave automatically generates a 'sync chain' series of words that you can enter into other browser installs to load your credentials.

Most browsers can also suggest unique passwords, though they aren't always very complex. We recommend using Diceware (<https://diceware.dmut.org>) for generating high-entropy passphrases. ■



### 1 Artificial intelligence

To fix torn edges, we can use AI to extend existing features, such as our subject's leg (and chair).

### 2 Wear and tear

Photoshop's Neural Filters can replace scratches and creases with appropriate details, and smooth out grain.

### 3 Eye contact

Photoshop's AI has a huge database to draw upon to help make soft-focused faces look crisp and clear.

### 4 Add colour

The Neural Filter menu's Colourise tool can make a dull mono shot look vibrant and interesting in a click.

# Restore your old photos

Remove signs of wear and tear, and add colour to monochrome prints.

#### IT WILL TAKE

15 mins

#### YOU WILL LEARN

How to counteract keystone distortion, remove grain and scratches and add colour to a mono print

#### YOU'LL NEED

Apple Photos (iOS 12 or later), Adobe Photoshop (macOS 11 or later)

This scratched and creased photo is also distorted thanks to the position of our iPhone. It needs an AI makeover!



In part one of this feature last month (APC 537), we explored a variety of hardware and software solutions to rescue old analogue prints, slides or negatives and give them a new lease of life as digital format files. Being digitised is the first step to rescuing an old photo as much more work needs to be done to restore it to its original look. Indeed, you can even improve on the original by adding extra properties such as colour and facial detail courtesy of artificial intelligence (AI) tools as we'll demonstrate.



This tutorial features a grainy old photo from an early 20th century family album. The picture suffers from faded tones due to the passage of time. There are also scuffs from handling that have scraped off surface details and a diagonal crease across the soldier on the right. The lens used to take the original photo has created a soft focus look, so the faces lack definition. Also, because we snapped the original using an iPhone it suffers from keystone distortion (where the photo's vertical edges converge towards the top of the frame).

### AI assistance

Traditionally, we'd use Photo's Retouch Brush (or Photoshop's Clone Stamp tool) to manually paint over a scratch to replace it with clean adjacent pixels. However, this is a time-consuming task. Thanks to Photoshop's AI-assisted Neural Filters, we can remove scratches and creases with ease, as well as restoring facial detail to soft focus stills and making 'eye contact' with our ancestors. We can even add colour to monochrome prints to give them a new lease of life.

George Cairns ■



## How to Remove distortion, damage and grain



### 1 Counteract distortion

In Photos, tap Edit. Then tap Crop, followed by the vertical correction icon. Drag the slider until the converging vertical edges of the photo run parallel with the edges of the screen. Adjust the Straighten slider if necessary.



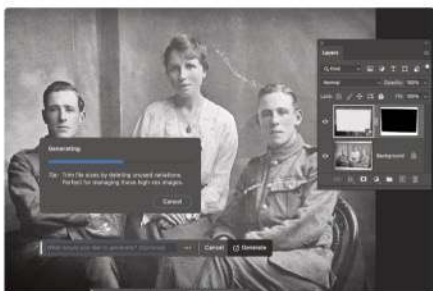
### 2 Make it mono

To lose the old-fashioned sepia colour, tap Filters. Some black and white filters (such as Silvertone) can lose shadow and highlight detail. Tap Mono. AirDrop the shot to your Mac and open it in Adobe Photoshop.



### 3 Select edges

You could crop out the photo's worn and damaged edges, but there's a more creative option thanks to AI. Use the Polygonal Lasso selection tool to make a selection around the edges of the photo. Choose Select > Inverse.



### 4 Analyse and fill

Click the Generative Fill button in the floating toolbar. Leave the text field blank, then click Generate. Photoshop's AI (Adobe Firefly 3) will analyse the photo's content and automatically add suitable details to fill the empty spaces.



### 5 Reduce grain

Choose Layer > Flatten Image to combine the AI-created edges with the photo. Choose Filter > Neural Filters. Go to the Restoration section and toggle on Photo Restoration. Drag Photo Enhancement right to smooth out grain.



### 6 Improve the detail

To give the soft focus faces more impact, drag the 'Enhance face' slider to the right. This uses AI to add more detail to eyes and hair so that we can see our subject's expressions more clearly! Click the Before/After icon to compare.



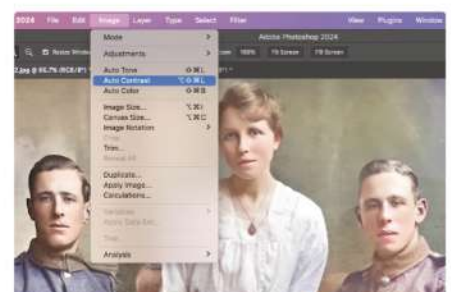
### 7 Remove scratches

To fill in scrapes and scratches, drag the Scratch Reduction slider to the right. Don't go too far or it will remove fine detail such as buttons. Open the Adjustments options and set Noise Reduction to 13 to remove more grain.



### 8 Add some colour

To help your restored vintage shot stand out even more, you can quickly add colour using AI. In the Colour section, toggle Colourise to on. Tick 'Auto Colour image'. Photoshop will add colours to skin tones and clothing.



### 9 Add finishing touches

Click OK to apply the Neural Filter menu's AI-enhanced changes. To give a faded shot more impact go to Image > Auto Contrast. This creates a wider tonal range. Choose Filter > Sharpen to create a print with more punch. ■

# Open legacy Microsoft documents in Linux

Say goodbye to proprietary formats, as Nate Drake helps give your old Microsoft files a new lease of life on Linux.



In 1989, the father of the internet, Tim Berners-Lee, made a momentous decision. To give HTML and the world's first web browser to the world freely. Since then, there's been much speculation about what would have happened if he'd tried to patent his code or web browser. The most likely scenario would be a fragmented internet behind paywalls, which not even Google could access.

As we continue to reap the benefits of a relatively open internet, it's easy to forget the main advantages of embracing Linux and royalty-free code. Even if an open source project is abandoned, as recently happened to Neofetch, the source code is freely available for others to maintain and fork.

Sadly, the gods of Microsoft haven't always read this particular memo. For decades, the company has released a number of closed-source products using proprietary formats.

Chief among these was the Microsoft Works productivity suite, which contained a basic word processor, as well as spreadsheet and database software. Official support for Works ended in 2012 and the software isn't available for purchase through official channels.

Microsoft did make some half-hearted attempts to help users who'd switched to

## PROPRIETARY PUBLISHER PLANS

While it's not a legacy app just yet, you can prepare for the inevitable by exporting existing Microsoft Publisher projects. You can save pages as HTML/PDF, but if you want to print Publisher pages professionally, it's best to use EPS (Encapsulated Postscript) format.

If you still have access to Publisher, do this by going to File > Print. In the Print dialog box, select Print Setup > Properties. Choose EPS as the PostScript output format. For best results, save each page individually. You can configure options for this from Print To File.

If you no longer have access to a Windows machine and/or don't want to pay for a Microsoft 365 subscription to open your old PUB files, you can also access them via LibreOffice Draw.

During our tests with documents created in Publisher 2002, we found LibreOffice rendered them faithfully both when being opened and when converted to ODF Drawing (ODG) format.

```
nate@ubuntu2404: ~/Documents
nate@ubuntu2404: ~/Documents$ wps2odt --help
`wps2odt' converts MS Works documents to ODF.
If OUTPUT is omitted, the result is printed as Flat ODF to standard output.

Usage: wps2odt [OPTIONS] INPUT [OUTPUT]

Options:
--help                show this help message
--version             print version and exit
--encoding ENCODING  set the INPUT encoding. Use --list-encodings
                    to see which encodings can be used.
--list-encodings      show the available encodings and exit
--password PASSWORD  set password to open the file
--stdout              print the result as flat XML to standard output

Report bugs to <https://sourceforge.net/p/libwpd/tickets/>.
nate@ubuntu2404: ~/Documents$ wps2odt Editor.wps --encoding CP875 Editor1.odt
nate@ubuntu2404: ~/Documents$
```

If Works word processor documents don't open correctly in Writer, use wps2odt to configure encoding for the output document.

the official Office suite, including limited support in Microsoft Word and Excel for opening newer types of Works files.

Still, this isn't much help these days to users who have older files in this proprietary format. Fortunately, the open source community has proved equal to the task through the development of the libwps C++ library, incorporated into software such as LibreOffice.

Microsoft's Money suite also enjoyed a brief vogue between 1991 and 2010,

allowing users a way to store information like account balances and investments. Support was officially dropped for the software and its proprietary (MNY) format but the tech giant did release a 'sunset' application to open and export the data.

In this guide, we discuss how you can use libwps as implemented in LibreOffice to open Microsoft Works documents. You'll also discover how to import account information from Microsoft Money into Linux apps such as GNUCash.

Microsoft's desktop publishing program Publisher has been around since 1991. It's currently available with various Microsoft 365 (formerly Office 365) subscriptions, but as of October 2026, support will be discontinued. For this reason, we've covered how to export Publisher files in EPS format, as well as how to open them in LibreOffice Draw (see boxout, left).

We were able to get both Microsoft Works Suite 2002 and Microsoft Money 2004 running in a Windows 11 virtual machine on Linux.

This remains the best way to preserve as much of the original file formatting as possible, as both Works and Money support exporting files to more universal formats such as DOC and QIF.





Microsoft Money is very glitchy under Wine but should be sufficient to let you export your data in Quicken (QIF) format.

If this isn't feasible, your best bet for opening Works files is to have a recent install of LibreOffice. This suite comes installed in many popular distros, such as Ubuntu.

If you don't have it already, you can follow the steps on the LibreOffice wiki to install the correct version for your particular distro: <https://wiki.documentfoundation.org/Documentation/Install/Linux>.

## Word processor documents

Once LibreOffice is installed, technically you can right-click WPS documents to choose Open With, but on our Ubuntu 24.04 test machine, the only option offered was the Calc spreadsheet software.

Instead, open LibreOffice Writer. From here you can then open the WPS file. Once this is done, choose File > Save As, then select a more flexible format, such as Open Document Text (ODT).

During our tests, we found the WPS document opened readily enough – but the previously colourful formatting was gone.

If you experience similar issues, you can also convert WPS files via the command-line utility `wps2odt`. To get started, first install via the terminal:

```
$ sudo apt install wps2odt
```

Once this is complete, use `cd` to go to the folder where your WPS document is located. You can now convert the file to a different format by specifying both the input and output file – for example:

```
$ wps2odt Editor.wps Editor.odt
```

If the output document doesn't display correctly, you can run:

```
$ wps2odt --list-encoding
```

This lists various types of encoding, which you can attempt to use for your output document, such as:

```
$ wps2odt Editor.wps --encoding CP875 Editor1.odt
```

## Other Works documents

Once you've mastered opening WPS documents in LibreOffice Writer, you can do the same with the corresponding applications for other proprietary Works formats.

For instance, Works spreadsheets (XLR format) open seamlessly in LibreOffice Calc, although you may want to change the default Comic Sans font to something a little more appealing before you use Save As to save your spreadsheet in a more universal format, such as Open Document Spreadsheet (ODS).

LibreOffice Base can also open Works Database (WDB) files but with the caveat that it only uses table view. In other words, the raw data is preserved but isn't displayed in jazzy interactive forms.

## Money talks

Former users of Microsoft Money will remember that once you got past the constant demands to sign up for MSN services and on-screen narration, the software was perfectly serviceable for personal finances.

Although the proprietary MNY format is no longer supported by Microsoft, after discontinuing the software in 2010 the tech giant did release Money Plus Sunset. The program doesn't contain all the features of the original software, but it's free and is sufficient for exporting MNY data in a more accessible format.

### QUICK TIP

To import Quicken files in GnuCash, simply install the app via Software. Next launch and choose File > Import > Import QIF. Once you've selected the file, choose Forward to configure import options.

To get started, you need to download Wine via the terminal:

```
$ sudo apt install wine64
```

Next, enable 32-bit architecture support:

```
$ sudo dpkg --add-architecture i386
```

You can now add the Wine repo suitable for your distro – for example:

```
$ sudo add-apt-repository 'deb https://dl.winehq.org/wine-builds/ubuntu/ noble main'
```

```
$ wget -O - https://dl.winehq.org/wine-builds/winehq.key | sudo apt-key add -
```

```
$ sudo apt update
```

```
$ sudo apt install --install-recommends winehq-devel
```

Microsoft no longer offers the Sunset app for download but we were able to get our hands on it via the Internet Archive:

```
$ wget https://archive.org/download/MSMoneySunset/USMoneyDlxSunset.exe
```

Once the download is complete, right-click and select Open With Wine Windows Program Loader. The software installs the necessary dependencies. You can now use the terminal to launch the Sunset program:

```
$ cd ~/.wine/drive_c/'Program Files (x86)'/Microsoft\ Money\ Plus/
```

```
$ wine msmoney.exe
```

On first launch, click Next to open an existing file. Wine assigns drive letter Z to the root drive – so, for instance, we were able to access the Microsoft Money project file in our documents via:

```
Z:\home\nate\Documents\My Money.mny
```

Once the project file is open, go to File > Export. Next, select Strict QIF. This ensures the exported data is accessible to other applications that support the Quicken format.

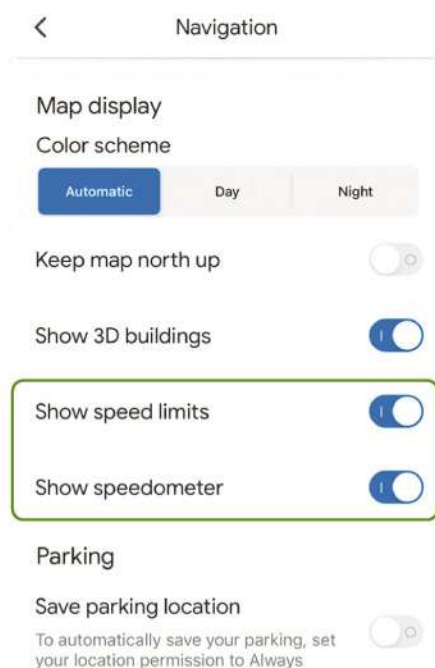
You can choose to save info for all your accounts, or just your investments. Make your choice using the interactive forms. Next, give the file a meaningful name, such as `budget.qif`.

The resulting file can be opened in various native Linux finance apps. We recommend GnuCash. ■

# Phone & tablet tips

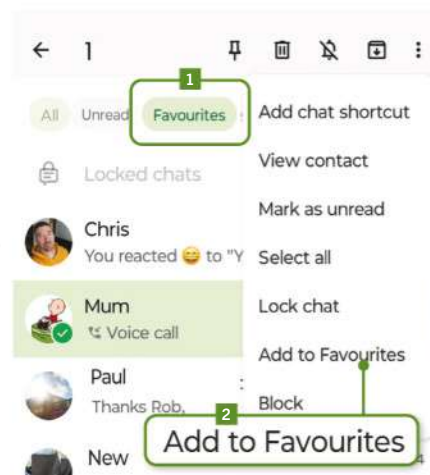
Brilliant things to do on your device.

iOS  
**Keep within the speed limit using Google Maps**  
 The Google Maps app for iOS ([tinyurl.com/APC538maps](http://tinyurl.com/APC538maps)) has been updated with two handy features for drivers, which were already available in the Android version – a speedometer that shows how fast you’re driving, and a speed-limit feature that informs you of



speed limits and warns when you exceed them.  
 To activate the new features on your iPhone or iPad, tap your profile picture in the top-right corner of the Google Maps app and select Settings, then Navigation. Swipe down to the ‘Driving options’ section and switch on ‘Show speed limits’ and ‘Show speedometer’ (see screenshot below left).  
 If you don’t see the speed-limits option, it may not be available in your area – some users have reported that it appears once you start driving. Both features work with the CarPlay system in your car so you don’t need to keep glancing at your phone.  
 Google says the speedometer in Maps is for “informational use only” and that you should use your vehicle’s speedometer to confirm your actual driving speed. Its speed-limit information combines data from local authorities with Street View imagery and AI models, so that limits can be updated based on traffic and weather conditions (see [tinyurl.com/APC538mapsai](http://tinyurl.com/APC538mapsai)).

ANDROID & iOS  
**Save people as ‘favourites’ in WhatsApp**  
 WhatsApp has added the option to save specific people as ‘favourites’, so you can message and call them more quickly. The feature also works with group chats to



give you instant access to your most important conversations.  
 There are several ways to add and manage favourites in WhatsApp. The simplest is to tap the Favourites filter at the top of the Chats tab (1 in our screenshot above) – you may need to swipe down to see this. Tap ‘Add to Favourites’, choose the contact(s) you want to save, then press the green tick button.  
 Once you’ve added one favourite, tap ‘Manage favourites’ then ‘Add favourite’ to save more – you can also delete and rearrange favourites as required.

Alternatively, long-press an individual or group chat in the Chats list, then tap the three-dot menu icon and select ‘Add to Favourites’ 2. Choose ‘Settings’ then Favourites to manage your favourites.  
 Your favourites will also appear in a new section at the top of the Calls tab. This serves as a form of speed dial, allowing you to start voice and video calls with close friends and family members at the touch of a button.

## Best new apps What you should install this month



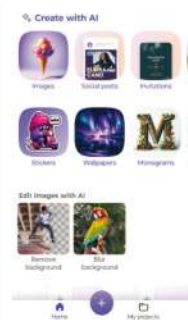
**WINAMP**  
 Free  
 Android [tinyurl.com/APC538winamp](http://tinyurl.com/APC538winamp)  
 iOS [tinyurl.com/APC538winampio](http://tinyurl.com/APC538winampio)  
 Now out of beta, Winamp’s long-awaited mobile app lets you play music stored on your phone or tablet, and compile tracks into

playlists. However, most of its features relate to Winamp’s Fanzone service, which lets you stream radio shows and podcasts, listen to new music from ‘creators’ and pay a subscription to support your favourites.



**CLAUDE BY ANTHROPIC**  
 Free\*  
 Android [tinyurl.com/APC538claude](http://tinyurl.com/APC538claude)  
 Now available on Android (it launched on iOS in May), this smart ChatGPT rival specialises in analysing photos and documents to provide useful

information and insights about their content. Claude can also look up information online, translate foreign languages, rewrite text and generate emails, blog posts, stories and poems.

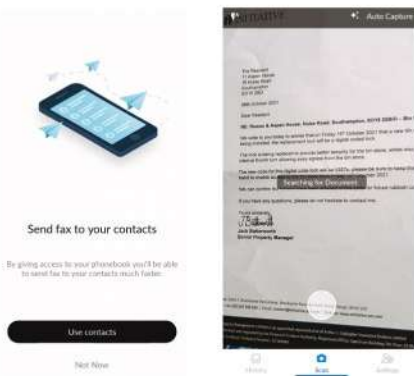


**MICROSOFT DESIGNER**  
 Free\*  
 Android [tinyurl.com/APC538mdes](http://tinyurl.com/APC538mdes)  
 iOS [tinyurl.com/APC538mdesio](http://tinyurl.com/APC538mdesio)  
 Microsoft’s fantastic free AI tool now has its own mobile app, so you can create your own images everywhere you

go. Enter a description or select a template, tap Generate and Microsoft Designer will turn the text into pictures. It can also generate avatars, stickers and wallpapers; remove image backgrounds; and much more.



## Best apps for... Older communication methods



### FAX.PLUS

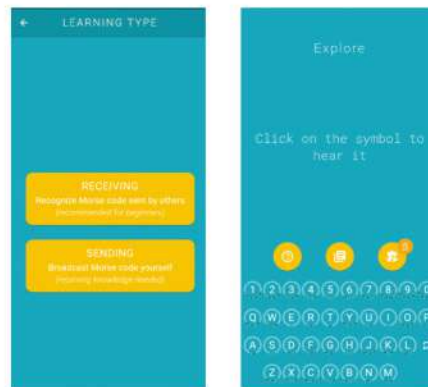
Free\*

Android [tinyurl.com/APC538fax](https://tinyurl.com/APC538fax)

iOS [tinyurl.com/APC538faxio](https://tinyurl.com/APC538faxio)

If you need to send or receive a fax but don't have access to a machine, Fax.Plus can help. It lets you scan documents using the camera on your phone or tablet, or attach them from online storage. You can send 10 pages for free, then will need to buy a subscription, which also gives you a dedicated fax number for receiving faxes.

**Best For:** Sending and receiving faxes



### MORSE MANIA

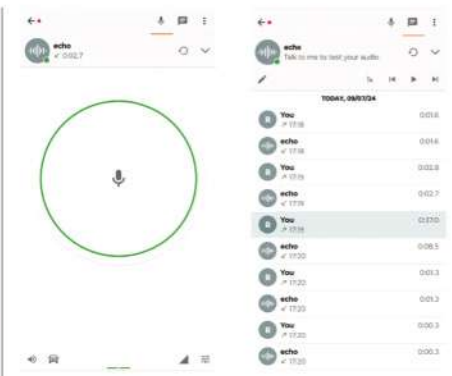
Free\*

Android [tinyurl.com/APC538morse](https://tinyurl.com/APC538morse)

iOS [tinyurl.com/APC538morseio](https://tinyurl.com/APC538morseio)

This app offers a fun but effective way to learn Morse code. Starting with the simplest letters – E (dot) and T (dash) – you progress through the levels to master the whole alphabet, followed by numbers and symbols, before tackling whole words and phrases. Choose between sending and receiving modes, and beeps or vibrations.

**Best For:** Mastering Morse code



### ZELLO PTT WALKIE TALKIE

Free\*

Android [tinyurl.com/APC538zello](https://tinyurl.com/APC538zello)

iOS [tinyurl.com/APC538zelloio](https://tinyurl.com/APC538zelloio)

When you can't get a good mobile signal, and you don't have time to type a message, Zello provides a speedy way to talk to friends and family, provided they also have the app installed. Just press the big push-to-talk button to chat to your contacts over Wi-Fi or any available network. You can also record your conversations for posterity.

**Best For:** Walkie-talkie conversations

## ANDROID & iOS Unblur fuzzy pictures in Google Photos

In our 'Best free apps for your videos, music and photos' Cover Feature in Issue 537, we explained how to use the new Magic Eraser tool in Google Photos. This clever feature uses AI to detect unwanted people in the background of your photos, and lets you delete them with a single tap.

Another useful, AI-powered addition to the app is Unblur, which – as its name suggests – makes unfocused pictures less blurry. Open a fuzzy shot in Google Photos, then tap the Edit tab. You should see a new Unblur option in the toolbar below the photo (see screenshot above) – if not, tap Tools to access it there.

Drag the slider to adjust the strength of the unblurring effect and make your subject look as sharp as possible – without overdoing it. Tap Done when you've finished and save the result as a copy of the original image.

Unlike Magic Eraser, which limits you to saving 10 edited photos a month



unless you have a Google Pixel phone or Google One subscription, Unblur can be used without any restrictions.

The other new AI feature in Google Photos is called Portrait Light. This recognises pictures of people (provided there are fewer than four) and lets you change the direction and intensity of the light source, to create or reduce shadows. As with the other new AI tools, Portrait Light can be found in the Tools

section of the app.

## ANDROID & iOS Identify songs by humming in YouTube Music

We do generally like the new YouTube Music app for Android ([tinyurl.com/APC538ytmusic](https://tinyurl.com/APC538ytmusic)), which lets you identify songs by humming, whistling or singing part of the melody. Annoyingly, the option was

removed from the app shortly after it was released, which is more than a little disappointing.

The good news is that it's now available for all YouTube Music users – on both Android and iOS ([tinyurl.com/APC538sound](https://tinyurl.com/APC538sound)).

Officially called Sound Search, the feature now recognises music playing in the background, much like the Apple-owned app Shazam, as well as your own vocal efforts. Grant YouTube Music permission to access the microphone on your phone or tablet, then either hum, whistle or la-la-la a few bars of the tune you want to identify, or

let the app listen to music playing nearby (see screenshot left).

Once YouTube Music displays its best guess, you can tap the Play button to hear the full song, or Save to add it to your library. The feature seems to work better with new tracks than old classics, failing to identify our renditions of Shannon Noll songs, but perhaps that was down to our offkey warbling. ■



# Simulate your Pi Pico projects with Wokwi

Claiming he's saving resources, Les Pounder simulates an electronics project because he is too lazy to get up and build it for real.

## YOU'LL NEED

- Pi Pico or Pico W
- A half-size breadboard
- A 100 ohm resistor (brown-black-brown-gold)
- 3x M2M jumper wires
  - A push-button
- Code: [tinyurl.com/APC538picode](https://tinyurl.com/APC538picode)

Two identical circuits: one is a simulation, the other is very real. Both work exactly the same way.



Sometimes we want to test electronics projects without having access to the technology. We're on a train, waiting at the airport, or in the classroom, sharing a kit. For these occasions, we need a simulator and we have a great one with Wokwi.

Wokwi is a free, online circuit simulator where we can create projects for the Raspberry Pi Pico, STM32, Arduino and ESP32. The simulator provides an environment to build a simulated circuit and write the code to control it.

In this tutorial, we will create an example circuit for the Raspberry Pi Pico and write some MicroPython code to control it. We'll then port the code to a real Raspberry Pi Pico and show the same circuit running on real hardware.

Open a browser and go to <https://wokwi.com>. Click on the Pi Pico icon, scroll down to the Starter Template and select MicroPython. Do not select Pi Pico or Pi Pico W, because these run Arduino code examples.

The Wokwi simulation interface is split in two: a coding section and the simulation. In the simulation, we can build the electronic circuit. This is where we'll start.

We start with just a Raspberry Pi Pico. To add components, click on the + icon at the top of the simulation section. From the list, select LED to drop an LED into the simulator. Move the LED down to the bottom-right of the Pico. Look to the

top of the simulator and you will see different colour options, plus mirror, rotate and delete icons. With the LED selected, click on the rotate icon and the LED will rotate 90 degrees clockwise.

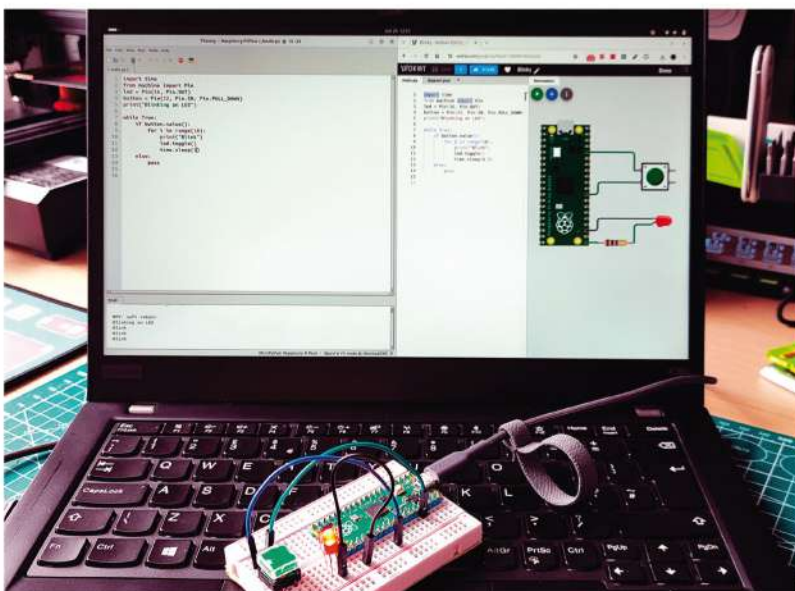
The next component is a resistor. Click on the + icon and select Resistor. Drop a resistor into the simulator and with the resistor selected, change its value to 100 ohms (brown-black-brown-gold). Rotate the resistor so that it is horizontal and then drag it down to the bottom-right of the Pico.

We have two components floating in the simulator – let's connect them to the Pico. The bottom-right GPIO pin of the Pico is GPIO16. Click on the pin and a green wire appears. You don't need to hold the mouse button down, but drag the wire to the left leg of the resistor. Click on the green square that appears on the resistor. You've just made a connection. Now do the same from the right leg of the resistor to the crooked leg of the LED (anode). The final connection for the LED sees the remaining leg (cathode) connected to a GND pin, two pins up from GPIO16.

We've got an output, so let's now add an input. A button (momentary switch) is the ideal introduction to inputs. From the + icon, select PushButton and you will see a huge button appear in the simulator. Drag the button so that it is at the top-right of the Pico. We need to connect the top-left leg of the button to the 3V3 pin of the Pico. Hover the mouse over the top-right GPIO pin of the Pico. Now move the mouse down the pins and you will see a pin number/function appear. Look for 3V3 (not 3V3\_EN), which is five pins down. Make a connection from this pin to the top-left leg of the button. Now, from the bottom-left leg of the button, make a connection to GPIO22 on the Raspberry Pi Pico. Remember to hover the mouse over the pins to find GPIO22. You may notice that the wire is hidden or obscured. We can fix this. Click on the wire and you will see an animation play. More importantly, there are a few purple dots. Click on the dots and move the wire away from the Pico.

We've built the circuit, but right now it doesn't do anything. That's because we need to write some MicroPython code.

On the left side of the interface, we have a





MicroPython editor. Highlight and delete any code in there. We'll start afresh.

Import two modules: `time` and, from the `machine` module, `Pin`. We'll use `time` to add delays to our code, while `Pin` is used to control and read GPIO pins:

```
import time
from machine import Pin
```

Now we create two objects that refer to the LED at GPIO16 and the button at GPIO22. The LED is a simple output device, so we tell MicroPython to set GPIO16 to an output – this will send current to the LED via the resistor. Because the other leg of the LED is connected to GND, an electrical circuit is completed.

```
led = Pin(16, Pin.OUT)
```

The button object is an input. We press the button and connect the 3V3 pin to GPIO22, changing the state from LOW to HIGH. The low state is achieved by telling MicroPython to pull the pin down:

```
button = Pin(22, Pin.IN, Pin.PULL_DOWN)
```

Add a quick print function to tell the user that the code is running:

```
print("Blinking an LED")
```

The main loop is a `while True`. It runs a conditional test that checks for a button press. If the `button.value()` changes from LOW to HIGH (False to True, 0 to 1), the code triggers:

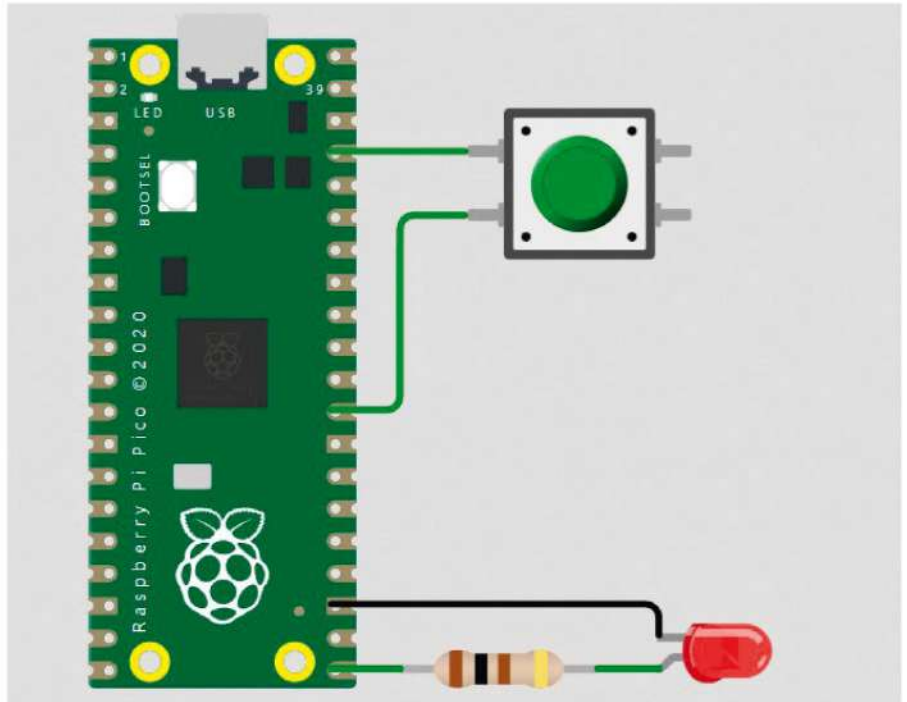
```
while True:
    if button.value():
```

What runs is a for loop that iterates ten times. Each time it loops, it prints "Blink" to the Python shell, then uses a toggle to turn the LED on and off. A sleep of 0.2 seconds is enough to see the LED change state.

```
        for i in range(10):
            print("Blink")
            led.toggle()
            time.sleep(0.2)
```

## INSTALLING THONNY

While holding down the BOOTSEL button, connect your Raspberry Pi Pico to your computer. Go to [www.raspberrypi.com/documentation/microcontrollers/micropython.html#drag-and-drop-micropython](http://www.raspberrypi.com/documentation/microcontrollers/micropython.html#drag-and-drop-micropython) and download the version of MicroPython for your Pico or Pico W. Open your file manager, then go to the downloaded file and copy it to the root of the RPI-RP2 drive. This flashes the new firmware to the Pico.



Wokwi's simulated circuit for this project can be used as a reference to build a real circuit on a breadboard.

If the user doesn't press a button, we want the loop to keep running. Using an `else` condition, we just pass the code so that the main loop repeats:

```
    else:
        pass
```

Click on Save and name your project. We chose `APC_Blinky`, but feel free to change the name of your project. The project can be public or unlisted. Choose as you wish. Click Save when done.

In the simulator, click on the play button to start the code. In the bottom-right is a Python shell. It should show "Blinking an LED". Now click on the push-button in the simulator. The LED blinks on and off!

You've just created a simulated circuit and controlled it with real MicroPython code. Now let's try it on real hardware.

In real life, set up your Raspberry Pi Pico circuit to match the simulation (there's a high-resolution circuit diagram in the download). You need Thonny installed on your machine – we cover that in the boxout (below).

In Wokwi, click on the down arrow next to Save. Download the Project ZIP and extract the contents. In Thonny, click on File > Open and select This Computer. Navigate to where the extracted files are located, and select the `main.py` file. Click File > Save As and save the file as `main.py` to the Raspberry Pi Pico. Click on the green Run arrow to start the code. The Python shell will show the "Blinking an LED" message. Press the real push-button to blink the real LED.

You've just created a real project from the simulated project code and circuit design. ■

Using your distro's package manager, install Thonny. For the latest Ubuntu release, we used a Snap package:

```
$ sudo snap install thonny
```

Open Thonny and connect the Pico to your machine. Go to Tools > Options and select the Interpreter tab. Set the interpreter to MicroPython (Raspberry Pi Pico) and set the Port to match the location of your Pico. Click OK. Thonny now connects to the board and we can start writing code.

Thonny is our preferred Python editor these days. Capable of writing Python, MicroPython and CircuitPython, this free app is designed for learners and eager makers. It has a package manager for Python and MicroPython, so we can easily install modules without using pip. Thonny has been the default Python editor for a few years now, moving away from the IDLE Python editor.

Thonny is easier to use and very user-friendly.



Aiming is also sometimes optional. Shoot, and you will hit.

PRICE \$87.95 PLATFORM PC, PS4/5 WEB [tinyurl.com/APC538force6](http://tinyurl.com/APC538force6)

# Earth Defense Force 6

Elevates B-movie action with a smart time-travel twist.

**Earth Defense Force 6 is one of the most joyful shooters I've played in years, delivering mega-scale slapstick gunfights like nothing else while walking a tightrope-fine line between genius and idiocy in its design. It's also a janky, rough-hewn piece of software with a mediocre PC port and egregious recycling of assets.**

The original PS2 *EDF* was a simple third-person retro B-movie shooter about a little soldier guy fighting oversized alien ants and wobbly UFOs using skyscraper-flattening guns that could send your own ragdoll body flying if you got caught in your own blast.

That core remains unchanged, although *EDF* now has four classes of soldiers, online co-op and more enemy variety. The joy of being a little guy fighting hordes that blot out the sky remains unchanged, and is only amplified when the game gives you a lumbering *Pacific Rim*-esque mech to punch out some skyscraper-sized kaiju.



If it bleeds, you can kill it. And some bleed a LOT.

*EDF* is pure meathead gaming. You shoot giant aliens, pick up the red and green boxes they drop, and you repeat, alone or with one to three friends. Easy to pick up, but with tactical nuance, each enemy type and battlefield demanding a different approach and experimenting with hundreds of stockpiled guns.

*EDF 6* picks after *EDF 5*'s pyrrhic victory against the giant shiny alien god-emperor. After a few warm-up missions, the invaders play their trump card: time travel. One time-portal later and you're stuck in an even more doomed timeline where humans are being hunted by wobbly giant robots – a whole new threat. So it's off to the past to break the aliens' new toys.

And that's the trick. The budget-saving re-use works as it's all framed as a game of temporal one-upmanship. The aliens send some new threat to the past, and you kick its butt across an abridged version of *EDF 5*'s campaign remixed with new twists.

It works in perfect harmony with *EDF*'s progression loop, as you grow

more resilient and your arsenal ever-larger. The new enemies keep things fresh, robots swarming like ants but having trickier hitboxes (thanks to their wire-thin limbs) throwing rocket-punches from awkward angles and heights. Ten-metre-tall octopoid soldiers join in, wielding two guns and two energy shields at once, their physics-driven limbs and hyper-reactive bullet-blocking AI making them feel properly alien.

*EDF 6* avoids its predecessor's grind through overly similar missions. Each time loop feels like a fresh escalation, resetting the scale of battles, introducing new threats and building to a spectacular climax each time. It ends up feeling less like a regular *EDF* sequel and more like four or five smaller ones played back-to-back.

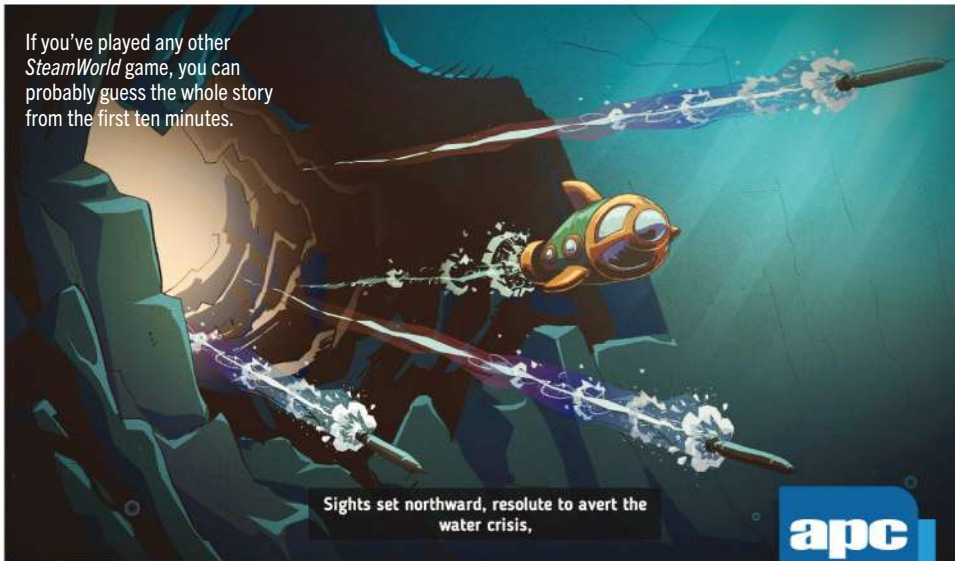
## VERDICT



Sandlot's *Earth Defense Force 6* is big, dumb co-op fun and a masterclass in the recycling of assets.

Dominic Tarason





**PRICE** \$43.95 **PLATFORM** PC, PS4/5, XBS/X, Switch **WEB** steamworldgames.com

## SteamWorld Heist 2

The most ambitious *SteamWorld* game yet.

The original *SteamWorld Heist* was the most impressive of the bunch – a turn-based tactical RPG, its clever twist was manual aiming and ricocheting bullets, allowing you to pull off wild trick shots. *Heist 2* takes that great core combat and expands out everything around it, adding an overworld to explore, more progression and equipment for your crew, a more elaborate story and a lot more fights to blast your way through.

You play as Leeway Krakenbane, a downtrodden pirate struggling to make a name for himself. Your journey across the world plays like a sort of very lightweight *Metroidvania*. Piloting a little submarine, you can search for loot and secrets, battle enemy ships, and earn abilities that allow you to access new areas, such as being able to smash through rock barriers or submerge into deeper water.

To be honest, though, none of this exploration is especially fun, mostly just feeling like filler. The missions, scattered around the map, are the real meat of the game.

- 1 Your submarine controls like a wonky shopping trolley, which makes exploration and ship battles a pain.
- 2 Bosses up the ante with strange special abilities.

Each is its own combat scenario, usually focused on stealing important loot as fast as possible before blasting your way to an extraction point while the ever-escalating alarm threatens to overwhelm you with summoned reinforcements.

Normally I do applaud ambition, but in the case of *SteamWorld*, it feels like restraint has always been part of the series' USP. It's not a dealbreaker – *Heist 2*'s combat and progression are brilliantly evolved from the previous game and make for a really sharp yet accessible strategy experience, and those looking for maximum value may well applaud a more substantial offering. But for me it's hard to shake the feeling that this still impressive machine would have run even more smoothly with a few less bells and whistles.



### VERDICT

*SteamWorld Heist 2* employs some sharp strategy with a clever new progression system, if a bit overlong.

Robin Valentine



**PRICE** Free **PLATFORM** PC, LINUX  
**WEB** tinyurl.com/APC538night

### ARMORED SHELL NIGHTJAR

MOVE OVER MARIO, HERE'S MECH-BASED PLATFORMING. *Armored Shell Nightjar* offers an experience mech-heads will be unable to resist: the chance to pilot a giant stumpy mech from behind its imposing dashboard, by physically pulling levers, pushing buttons and adjusting sliders – with just the mouse.

Controlling the mech is incredibly cumbersome, then, which is the best thing about it, of course. In fact, the best part of the whole game is prodding the dashboard to see which bits of it are interactive, discovering what they do through lumbering trial and error. It's a surprisingly detailed dashboard screen, with an external camera you can use to gauge your position, and analogue levers that respond to your clicking and dragging.

This is a mech game about platforming. And it's platforming from a first-person perspective and from behind the tiny window in front of your pilot's chair. Do the controls I just described sound like the perfect fit for clambering up narrow slopes and walkways? Well no, they are not, and one mistake will often send you tumbling down the tower, probably to your doom.

### VERDICT



A wonderfully mean and inventive mash-up of mech simulation and hardcore platforming. Will you love it, hate it?

Tom Sykes





**PRICE** Free **PLATFORM** PC  
**WEB** [tinyurl.com/APC538teeth](http://tinyurl.com/APC538teeth)

### TEETH OF GLASS

THE TOOTH IS OUT THERE..

You wake up in the abandoned hospital to find that, among other oddities, a pile of chains is now smothering the only exit. Alone, you have to figure out what's going on and whether you even want to return to normality at the end of it. It's a tiny game world – if a corridor can even be described as such – but, like PT's singular hallway, it's a corridor that changes as you progress through the story, though to a less dramatic extent. An eldritch entity has trapped you here, although it's some time before they introduce themselves.

The best horror stories have such uncanny imagery: something to lodge the story in your memory. The glass gnashers make a decent stab of that, even making a disturbing guest appearance round the patient's bullet wound, although the overall horror level of the game is fairly low. Despite a few standout moments, we're not shown enough of this eldritch world to understand why it's supposed to be scary, and the endings lack weight as a result.

**VERDICT**



The pixel art is exquisite and the puzzles are enjoyable to solve.  
**Tom Sykes**



**PRICE** \$41.99 **PLATFORM** PC, Mac, Linux, Switch **WEB** [worldofgoo2.com](http://worldofgoo2.com)

## World of Goo 2

### Definitely goo-d enough for two.

It's been 16 years since *World of Goo* squiggled its way into our hearts, the much loved physics-based puzzle game that became one of indie gaming's earliest and biggest successes. Who needs more *World of Goo*, considering the original was very much done and dusted years ago? Me. I do. We all do, really.

Playing this game is a lot like catching up with an old friend. Everything from the artistic stage-select design to more than a few goo types, environmental hazards, and puzzle pieces, look and behave just as they did before. Even the little time rewinding bugs have returned (thank goodness), making it easy to try again, even if it looked like I'd made a careless stage ruining mistake just before the end. Within moments it was as if not only had the game never been away, but I'd never stopped playing it either.

And because of that, clearing the first few challenges wasn't just easy – it almost felt instinctive. There I was, watching towers of goo dangerously sway as I grabbed and built and stretched an increasingly wobbly mass towards the exit pipe that would suck it all up and end the

level, same as last time. Just like the ancient past of 2008, sometimes I needed to hook balloons onto a mass of goo to roll in a particular direction. There were a lot of obviously recycled ideas in here. Good.

These old favourites don't exist in an innovation-free vacuum, but are thoroughly mixed in with high-speed train rides, little boating expeditions, tense journeys through the dark, and even a spot of goo-themed golf.

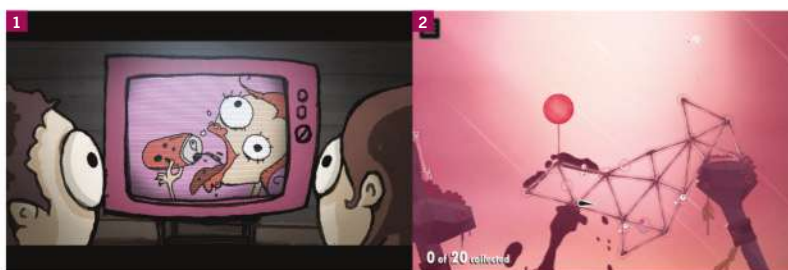
It's a fun, clever, and surprising game that celebrates all the goo that came before, all the goo here now, and even offers a cheeky glimpse at all the goo yet to come. I didn't just have a good time playing it, I finished it feeling pretty confident that the developers had a good time making it too. It's so goo[d] to be back.

**VERDICT**



Familiar and inventive, tough yet easy going, *World of Goo 2* is a whole world of fun.  
**Kerry Brunskill**

- 1 Surreal cutscenes offer a glimpse of Goo's wider dystopian world.
- 2 Soft pastel shades can help soothe a puzzle-battered soul.







You can use the pattern designer to try novel attack strategies, or trust in the mighty big straight line.

**apc**  
HIGHLY  
RECOMMENDED

**PRICE** \$43.95 **PLATFORM** PC, PS5, XBS/X **WEB** [tinyurl.com/APC538cygni](http://tinyurl.com/APC538cygni)

## Cygni: All Guns Blazing

An accessible shoot-'em-up with some clever twists.

The average level in *Cygni: All Guns Blazing* is about 15 minutes long, give or take, but it doesn't feel that way. It feels like a two-and-a-half hour special effects showcase that ought to have ended with a fade to black and 'Directed by Michael Bay' in big, bold letters. *Cygni's* audio-visual bombast is difficult to overstate, with its Unreal Engine 4-powered hordes of alien jet fighters screaming toward you from above and below.

Its shoot-'em-up antics will be quite familiar to any fans of *Ikaruga* or *Radiant Silvergun*. All the bedlam of bullet hell is on offer, but its pace is more palatable for those who don't infuse their tap water with Red Bull. The most dangerous enemy in *Cygni* is also my aforementioned favourite thing about it: visual chaos.

Where a genre classic might prize clarity and clean, obvious visual cues, *Cygni* is eager to drown the player in heaps of enemies from every angle. But while it's easy to miss a few shots and get lost in the tapestry of grinding metal and neon lights, it's forgiving enough that it never feels inescapable.

Each level starts you off with enough shields to take five hits before a game over,

but certain enemies drop extra shields when they die. You can also reroute shield power to your guns, trading a hit point for extra damage and spending that power outright for rockets, which can hit enemies to your flanks and rear.

You can always trade that damage back for those hit points, but don't do it in time and you're toast – it adds a delightful pinch of high-stakes strategy where I just expected undiluted, twitchy action.

*Cygni* left me itching for more of its moment-to-moment play. It's lean with only seven levels, but there's additional postgame tinkering in various equippable upgrades and weapons for your ship. You can even design custom firing patterns for your main air-to-air gun, which is sure to stimulate the imaginations of anyone looking to achieve optimisation.

**VERDICT**



A rollicking bullet hell-inspired blockbuster that never takes its foot off the gas.

Justin Wagner

**1** The tactical applications of the 'spiral pattern bullet machine' are still in the R&D phase.

**2** If all else fails, the face is the place.



**PRICE** Free **PLATFORM** PC, Mac, Linux  
**WEB** [anderwund.itch.io/factory](http://anderwund.itch.io/factory)

## THE INVISIBLE SMOKE FACTORY

BACK IN A FLASH

The Flash game era is sadly behind us, but here's a new point 'n' click adventure in its spirit. After finding an eviction notice and going to bed, you wake up in a dream realm that populates your apartment complex with mildly unsettling sights.

In ominous office and factory environments, sketchily drawn people go about their business, playing their few frames of animation on a loop. This is as much a short film – or a multimedia installation – as it is a game, just like the Flash games I used to enjoy back in the day.

What will you see after you go up the next flight of stairs? It's not random nonsense, but related to the theme of work, and in a subtle, uncanny and dreamlike way. The dream world changes as you make progress, and sometimes you are required to (briefly) wake up in order to move things forward.

The vibes are immaculate: the *Silent Hill*-esque sound effects, and the hand-drawn animations that play over grainily repurposed photos of dreary work environments.

**VERDICT**



It's not horror, but it's close, and I find that almost a cosy place to be.

Tom Sykes



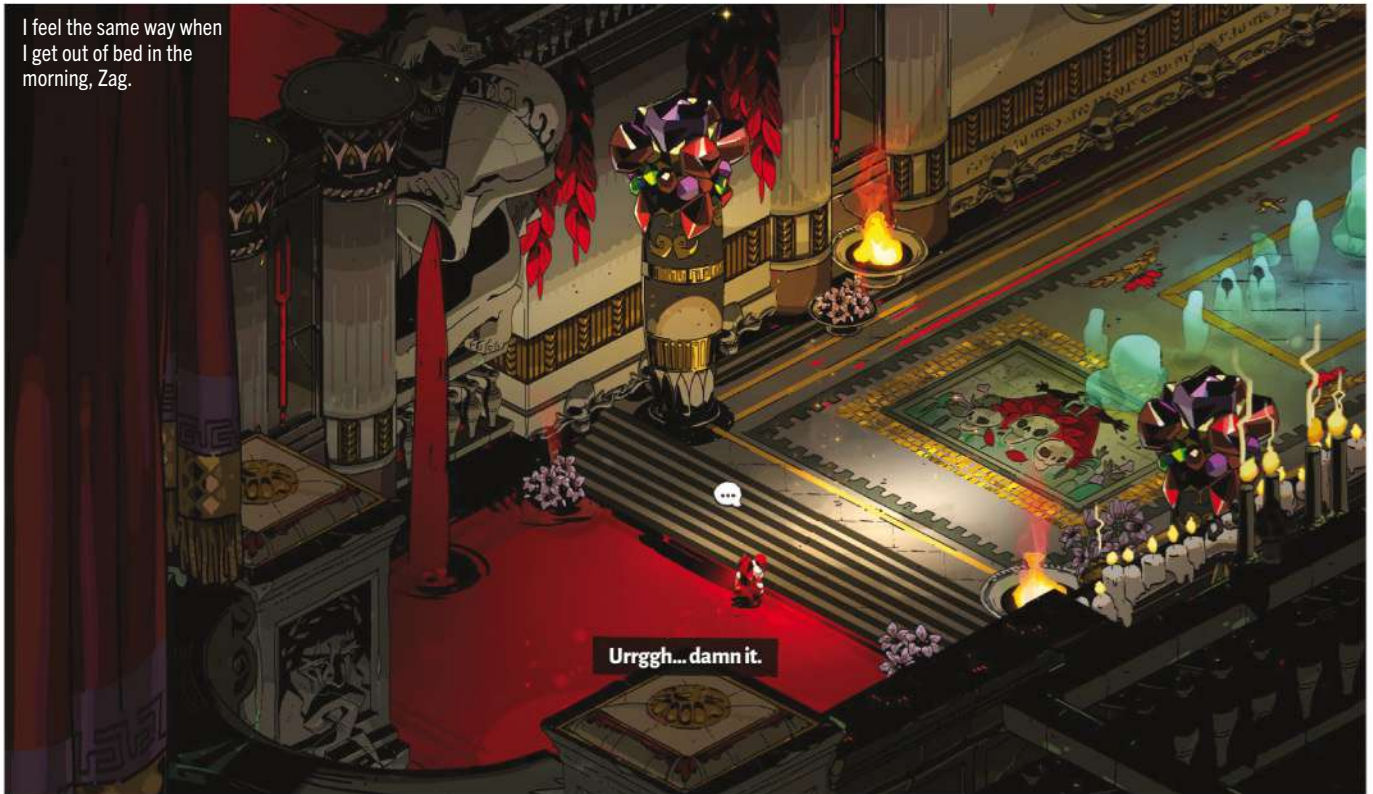




# GAME CHANGER

Old games, new perspectives

I feel the same way when I get out of bed in the morning, Zag.



RELEASE 2020 DEVELOPER Supergiant Games PUBLISHER Supergiant Games LINK [supergiantgames.com](http://supergiantgames.com)

## Hades

Harvey Randall finds genius in every flaming step.

**When *Hades 2* released into Early Access this year, 34 hours of my life vanished before I said, “OK, if I play any more I’m going to spoil myself rotten, and the full thing won’t be out for ages yet. Time to stop”.**

I put down my controller. My hands began to itch, and I broke out into a feverish sweat. I felt the flames of Asphodel lick at my heels – the bloody waters of the Styx filled my mouth, and a deep, thunderous voice chastised me. “You didn’t finish me, boy,” it rumbled like a disappointed father. Flashes of hot, topless gods raked across my vision as I toppled into an abyss of my mind’s own creation. I then immediately reinstalled *Hades 1*, picked up my controller, and played about 40 more hours of that.

The sheer hunger *Hades 2* inspired in me had me so ravenous for more of developer Supergiant’s quality work that

I couldn’t help but tuck in. Especially since I’d never quite finished the dang thing: I’d beaten papa Hades himself, but I’d never completed the roguelike enough times to see the end of its main story, nor had I dug properly into its postgame.

*Hades*, in its now-finished state, gave me a singular thought: this might be one of the smartest roguelikes – nay, one of the smartest games I’d ever played. *Hades* feels effortlessly good, but there’s enough complex machinery under the hood to make Daedalus blush.

### Roguelite revolution

*Hades* is a roguelike – or more accurately, it’s a roguelite. In case you’re

completely green to the world of keyboards and thumbsticks, that means it’s a game where death sends you back to the start, as per 1980’s *Rogue*.

However, ‘lite’ refers to the way its persistent set of upgrades – earned with resources snagged on your runs – make each run both easier and more complex.

‘Persistent’ is a great word to describe *Hades*, actually, because Supergiant – not content with merely making some of the most impactful, beautiful, and incredibly scored indie titles out there like *Bastion*, *Transistor* or *Pyre* – decided to push the boundaries of what a roguelite can do.

Chiefly, *Hades* tells a compelling, linear RPG narrative despite always

“This might be one of the smartest roguelikes – nay, one of the smartest games I’d ever played.”

**“Hades is downright slick to play: Zagreus turns on a dime, he does exactly what you want him to do, and the room for skill expression is huge.”**

kicking you back to the start, which – until it arrived on the scene – was a complete rarity for a genre that had relied on procedural storytelling for years.

As I’ve grown older and more dependent on sleep (ah, how I miss those halcyon 3am gaming nights), I’ve also had to stop reading books before bed. It helps not to stimulate my brain right before I catch some Zs – but I mainly had to kick the habit because books that are page turners, inevitably, are going to make you want to keep turning pages. Who knew?

Instead of resetting the world and its stakes every time you die, *Hades* pulls the ingenious move of making every death diegetic. Zagreus can’t exactly die – so whenever you run the poor sod into a spike trap, he gets flung into the river Styx to be sheepishly coughed up back at his estranged father’s domicile. This allows *Hades* to tell its story – over 300,000 words of it – between runs. It creates a delightfully hellish cycle of fight, die, read, fight and die again.

Which means that, in its own way, *Hades* is a page turner just like the novels that were killing my sleep schedule – while embarking on another Sisyphean romp through *Hades*’ underworld is far tougher than flicking to the next page, the emotional sensation is much the same. I wanted to get to the next bit, and who needs sleep, anyway? Me. I did. I didn’t get much, though.

However, it’s the whirring gears behind *Hades*’ storytelling that really turned me into an obsessive – it’s nothing short of revolutionary for the genre, setting out a template that many roguelikes have tried to emulate since.

### Story beat, repeat

In People Make Games’ excellent video *The System Behind Hades’ Astounding Dialogue*, creative director Greg Kasavin lays out the

game’s secret recipe: *Hades* randomly assigns lists of potential conversation topics to every social interaction you have. From there, it sorts what conversations do and don’t happen in two different ways.

Firstly, *Hades* locks conversations behind specific circumstances. Nothing too wild there. Then it assigns a priority system to those conversations to ensure they’re delivered appropriately. The example of a high-priority conversation the video gives as an example is, naturally, beating your first run of the game. High off the adrenaline of teaching your old man a lesson, any *Hades* player will want the entire world to react to your achievement instead of, say, getting your mitts on a new sword. This forges a sense of linear progression through the game’s narrative that stops it from buckling under the weight of variable player speeds.

I was hot stuff after gorging on *Hades 2*, beating up my (Zagreus’) dad in about 12 attempts. Despite this, I never felt like I was actively missing anything. The story (which certainly doesn’t stop after your first win) proceeded at a perfectly acceptable rate through the character arcs, plotlines, and romances therein.

So – *Hades* spins a good yarn in a genre not built for it, making

use of some very clever techniques to great effect. But it’s a videogame, I hear you ask, what about the ‘game’ bit? Gods being good, it holds up in the realms of mechanical design and combat with similar ingenuity, too.

### Boons, beautiful boons

*Hades* is downright slick to play: Zagreus turns on a dime, he does exactly what you want him to do, and the room for skill expression is huge. But its boons system – aside from being a nice way to tie in further story beats (since it lets you chat to the gods) is also a great way to divide the cognitive load of putting a build together.

Once you grab a boon from a certain god, there’s some behind-the-scenes wizardry going on that ‘locks’ that god into one of four slots – if my first four boon choices are from Zeus, Ares, Aphrodite and Poseidon, I’ll only get upgrades from that quartet for the rest of my attempt (keepsakes, which you’re able to equip in-between zones, can bump that limit up to five or six). Chaos, fittingly, doesn’t factor into this system.

This is ingenious for three separate reasons. First, it means that you’ll naturally encounter synergies every time – especially when duo boons enter the scene. Despite having a pool of ten gods to choose from, you’re rarely left up Styx creek without a paddle.

Secondly, the boon system simplifies the game for newer players, making each run a tutorial that teaches you about four specific Olympians’ shticks,

## SMARTY PANTS STORYTELLING

*How Hades keeps you on-track*

- 1 DIALOGUE**  
*Hades* keeps a list of potential dialogue for every character on tap.
- 2 SCENES**  
Then, *Hades* locks and unlocks scenes based on your actions.
- 3 PRIORITY**  
Lastly, it gives every scene a priority to keep things moving.





Alright, no need to rub it in, dad.

## HADES GOD OF THE DEAD

Stupid boy. I told you nobody gets out of here, whether alive or dead. Though, how was your wanton ransacking of my domain?

compartmentalising the absolutely heretical amount of build diversity inherent to the game.

The third reason is that, once you really start getting into the nitty-gritty of aiming for certain builds, you can remove the amount of luck required to do so. This rewards experienced players with the keys to the city – savvy boon choice nets you some incredible power.

These three design elements are far from the only things that make 2020's *Hades* a masterwork, but to get into all the rest of it would require more pages than I've been given to talk about them.

I've enjoyed the game's sequel, sure – but part of my patience in refusing to sink another 30 hours into the thing until it's done baking is, in part, now fuelled by a fierce desire the first game has instilled in me.

I want to see just how Supergiant manages to tie *Hades 2*'s more disparate, complex mechanics into a beautiful whole, and while it's already a pretty frictionless experience, I know this dev's pedigree enough by now to realise that I'm only seeing the scaffolding. All of this to say: wow, *Hades* is bloody clever. ■



1 The floor is, quite literally, lava.  
2 Chaos calls. 3 These two, again.



# RETRO

Inspirational stories from computing's long-distant past



ABOVE The original Evercade handheld launched in 2020.

## Let's get physical

David Crookes looks at the ongoing success of Evercade's growing range of retro consoles.

**Gamers are passionate people, and they often like to display their allegiance in the starkest of ways. "We're still amazed by the one person who got a tattoo of the Evercade console, possibly before it was even released," said Andrew Byatt. And, given he is the CEO of Blaze Entertainment, the company behind that machine, it's a story he tells with a smile.**

Evercade is a relatively recent success story built upon a hunch that a good number of gamers aren't purely interested in the games they play. They are, as Byatt pointed out to APC, just as fascinated by the paraphernalia that has traditionally accompanied games – or at least did before digital distribution became far more

commonplace – which is why Evercade predominantly releases retro games on cartridges and places them in nice robust cases together with a printed colour manual.

In the same way that some music lovers feel an emotional attachment not only to the depth and texture of vinyl but also the liner notes and artwork that adorns the sleeves, many gamers find great value in physical media. They prefer their games on cassette, floppy disk, cartridge, CD, DVD, Blu-ray and even VHS (yes, that was briefly possible). And they'll pretty much seize upon any opportunity they can get for something tangible.

To ignore the power of packaging is to cast aside such greats as cover artist Bob

Wakelin, the mind behind the splendid drawings that adorned the boxes of *The NewZealand Story*, *Wizkid* and more. And to deny the lure of the physical would ignore nostalgic quirks such as Chris Sievey's *The Biz* – a cassette that contained a rock band management simulation game as well as eight singles and an interview with Sievey's alter ego Frank Sidebottom.

It's why companies such as Strictly Limited and Limited Run Games have sprung up, catering for those who still care about physical media, and why Evercade is proving such a hit. Sure, anyone wanting a retro fix need only download an emulator to a modern machine and (illegally, it has to be said) grab some ROMs from the internet. "But it doesn't match the experience of having a physical cartridge, opening up the box, smelling a freshly printed manual and the satisfying click of the cart going into your system," Byatt said.

### Cart attack

The Evercade story began five years ago in 2019 when news of the first Evercade device

"In the same way that some music lovers feel an emotional attachment not only to the depth and texture of vinyl but also the liner notes and artwork that adorns the sleeves, many gamers find great value in physical media."



– a handheld console – first emerged. Capable of being connected via HDMI to a television for 720p big-screen play, it should have been released later that year. Instead, there were delays and the device ended up launching in May 2020 – and the worst period possible.

“Fate engineered us to release during the Covid pandemic and lockdowns, which was a feat in itself,” Byatt lamented. But despite the poor timing, the handheld still sold well, initially appealing to gamers of a certain age who were not only keen to find a fresh way to play old favourites from yesteryear all over again, but to do so with something tangible.

The console was based on Linux and included a 4.3in 480 x 272 screen, 256MB of RAM and a 1.2GHz Cortex-A7 SoC. That was more than sufficient for emulating 8-bit and 16-bit games and, as the company told our sister magazine *Retro Gamer* at the time, the emulators were either licensed or developed for the console from scratch. Systems included such giants as the Atari 2600, NES and Mega Drive.

Byatt recalls working non-stop during the first wave of Covid, never quite sure if the idea would take off. “My house was full of stock and we were packaging and shipping units to press and media for review,” he said. To convince gamers, the company also had ten cartridges lined up, among them *Atari Cartridge Collection 1*, which, to ensure value, contained 20 games including *Adventure*, *Missile Command* and *Tempest*.

On the one hand, the decision to release a cart-based machine felt nostalgic – the technology was commonplace from the late 1970s to the mid-1990s. On the other hand, it felt hassle-free. “The hard work of setting up and making everything work was already done by us,” Byatt said, pointing to the steep learning curve and hoop-jumping associated with getting some emulators to work.

Evercade released more cartridges over time, each costing less than \$40 and containing between six and 20 titles. “We provided a curated experience and people had a lower sense of decision-paralysis about what to



Blaze launched the VS-R to make it easier to play Evercade games on your TV.

“The console was based on Linux and included a 4.3in 480 x 272 screen, 256MB of RAM and a 1.2GHz Cortex-A7 SoC.”

play,” said Byatt. “It also meant a lot to fans that everything was legally licensed.” Indeed, you can play games on Evercade without fear that you’ll ever get a knock on the door from the authorities.

### Ever ready

Such advantages continue to this very day. Evercade launched a second-gen handheld called the Evercade EXP in September 2022, following the launch of the home console, Evercade VS, in December 2021. This output at 1080p via HDMI and allowed up to four players to enjoy all of the games released for the handheld. Powered by an Arm Cortex-A53 chip running at 1.5GHz, it included 512MB of DRAM and 4GB of internal storage. It also had two cartridge slots so gamers wouldn’t need to swap them as often.

Rather than rest, however, Evercade is undergoing another refresh with redesigned versions of the EXP and VS. The Evercade VS-R home console has now moved away from its original white styling and comes in charcoal grey. It also supports TATE screen rotation if you have a swivel monitor so you can play vertically as well as horizontally.

The \$200 Evercade EXP-R

handheld, meanwhile, comes in the same grey colour but adds a textured rear grip. Delayed until November when a problem (thought to be a faulty component) was found in 20% of the stock, this loses the pre-installed games collection by arcade game publisher Capcom and axes the mini-HDMI port, so you can’t connect it to a TV any more. Yet it includes a new, more efficient chipset and comes with a head-turning set of games: *Tomb Raider Collection 1*, covering Lara Croft’s first three adventures.

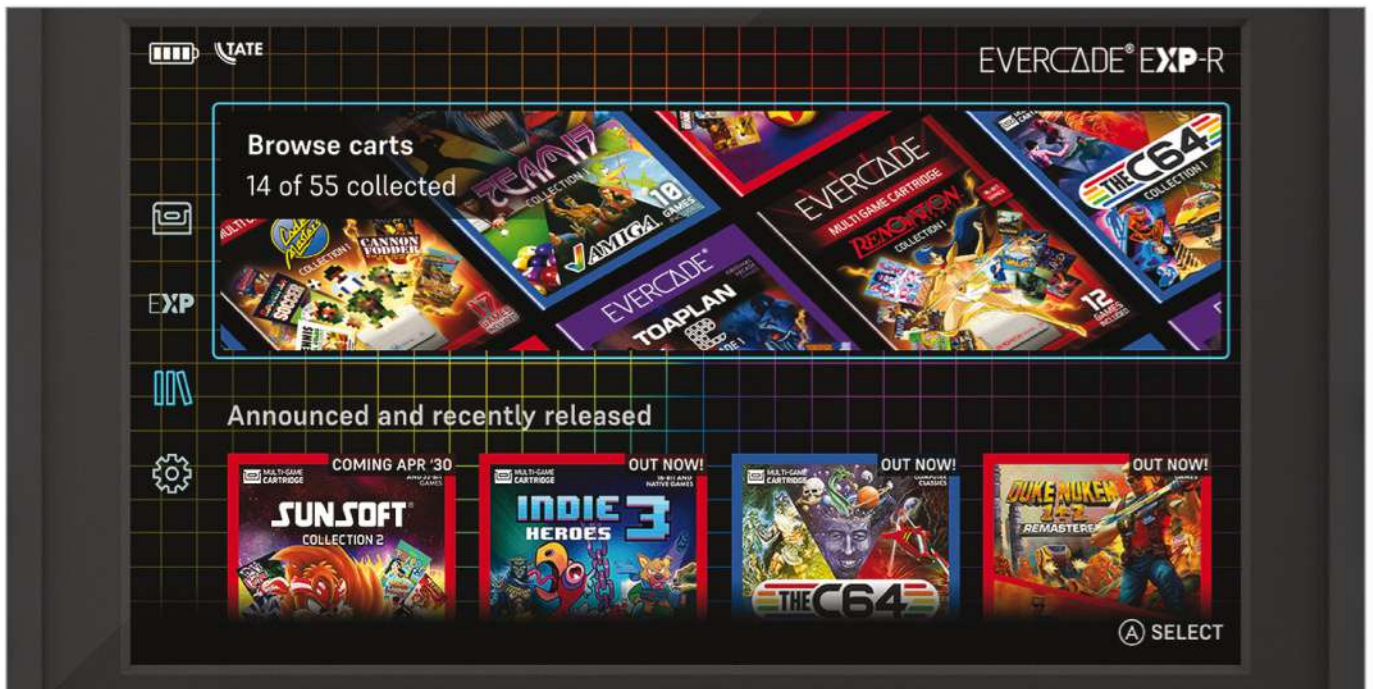
“The EXP-R came about because of the licence expiring on the built-in games and the desire to get the product under the \$200 ceiling,” Byatt explained. “We looked at what else could go and we found the HDMI-out wasn’t a heavily utilised feature outside of game capture, which many used a VS for

anyway. So we have a much more simplified offering that is more affordable.”

### Indie vibes

Keen to continue expanding the appeal of Evercade, the company has recruited Dominic Wheatley as chairman. If the name sounds familiar, it’s because he launched *Tomb Raider* at E3 in 1996. Wheatley understands the appeal of





retro games, which tend to trade on playability rather than graphics, and that people can find modern blockbuster titles to be unfathomably complicated and time-consuming.

Blaze Entertainment has also unveiled the Alpha, a bartop arcade machine that comes in two designs – one with *Street Fighter* visuals and another with *Mega Man* – along with six pre-installed games from Capcom. Set to arrive in November, it includes dual cartridge slots so users will be able to play any of the Evercade carts. With more than 50 of them now available, that’s a lot of choice.

“The introduction of the Alpha gives people another interesting way to play,” Byatt said. “We’d always thought about an arcade machine and our deal with Capcom gave us the opportunity to explore the form factor while bringing something new to the table in terms of both games and our cartridge system. It opens us up to a new audience who otherwise wouldn’t have taken an interest in us.”

This is also great news for indie developers, a good number of whom have been creating entirely new games for the Evercade systems. Although age-old retro titles are the bread-and-butter of the Evercade systems

and the catalyst behind the company reaching an impressive sales milestone of a million physical cartridges, Byatt has been keen to bring fresh ideas on board and says indie devs have been hugely enthusiastic.

This has led to a few carts dedicated to modern-retro indie titles, including Big Evil Corporation’s puzzle-platformer *Tanglewood* bundled with Bitmap Bureau’s multidirectional homebrew shooter *Xeno Crisis*. There have also been three *Indie Heroes Collection* carts, a bunch of NES games created relatively recently by Morphcat Games and *Alwa’s Awakening* by Elden Pixels. Such signings fit with Blaze’s remit of

**ABOVE** The EXP-R has a 4.3in screen, a 1.5GHz processor, 4GB of memory and Wi-Fi connectivity.

**BELOW** The Super Pocket handheld comes with built-in games and a cartridge slot.

helping gamers discover new titles, whether they’re from the past or being created today. It’s always on the lookout for fresh talent.

“We are approached by developers and licence holders and we approach them too,” Byatt said. “Take *Full Void* by OutOfTheBit as an example. That came about from going to meet the developer after an initial conversation about something completely different. It led us to seeing a yet-to-be-released game and realising how we’d love to have it on our platform.”

*Full Void* became Evercade’s first single-game cartridge (all of the others have had at least two titles) and the developer was enthused by the reaction from the device’s user base. But then the OutOfTheBit team put in a huge amount of effort, enriching the release with unique extras.

“We poured our hearts into creating the manual for the game and a backstory comic book, along with an artbook filled with early concept art and development insights, included in the Special Edition,” said Ali Motisi, director and lead developer at OutOfTheBit.

Motisi now wants to see even more curated indie games appearing on Evercade carts, saying the consoles offer an opportunity for devs to find creativity within limitations. “One potential





challenge could have been the size of the game needing to fit the cartridge,” said Motisi. “But *Full Void* is only 46MB thanks to our highly efficient custom engine.”

### Striking a balance

Sales of *Full Void* were helped by Blitz’s very early decision to number each release to make all of its cartridges collectible. This approach – inspired by comic books, according to Byatt – means some people will have purchased *Full Void* simply because they want to complete their set. Yet this will help indie developers achieve a better return (“financial rewards are always a consideration and we are extremely happy with the outcome so far”, said Motisi). It also means there’s extra scope for experimentation and more chances of word-of-mouth advertising.

The collectable nature of Evercade isn’t purely beneficial for the bottom line, either. It gets around the issue of cartridge manufacturing being less eco-friendly than digital downloads. “The cartridges are cherished and they are not throwaway products. The plastics and construction of our carts reflect that,” said Byatt.

What’s more, in an era where retro collecting has become an expensive, often unobtainable, hobby, Evercade fulfils another desire. “It can be a blessing for many collectors otherwise priced out,” Byatt said. But to continue being desirable, the main challenge is to ensure that each cart contains games people want to play. “Balance is key,” Byatt added. “Quality of the device is very important given the history of licensed retro gaming products, but quality of the games means we have something people will come back to.”

To that end, the company has sought to group games as much as possible for greater appeal, and it carefully picks popular themes. Hence collections involving games by Atari, Jaleco, Namco, Data East, the Oliver Twins, Piko Interactive, Team17, Codemasters, the Bitmap Brothers, Gremlin, Intellivision and lots more. These are spread across a host of systems that include the Game Boy, Commodore 64 and Sega Master System.

Blaze had something of a head

start in this regard as it used to concentrate on making Atari-related products, allowing it to build relationships and confidence.

“We’ve been incredibly lucky to be able to work with Atari, one of the most important and well-known brands in all of gaming,” Byatt said. “Their legacy and quality of games helps a product like ours establish itself with great support from licence partners from the off. That helps build a community.”

But what of the future? Most sales so far are online, and Blaze wants to change that. “Getting more products on shelves is the plan,”

current cartridge list and anything that isn’t currently there you can assume we either want or are trying hard to bring it to Evercade.”

To that end, Evercade has been widening its scope. Whereas it once concentrated on 8-bit and 16-bit games before taking in 32-bit, it’s gone one step further. “We released the 64-bit version of *Glover* on *Piko Interactive Collection 4* and we’re always looking at new systems, but 64-bit is likely our current ceiling at present.”

Caution is understandable, though, because Blaze doesn’t want to over-complicate matters. “It’s

“Blaze has another trick up its sleeve: inexpensive Super Pocket handheld devices with built-in games and an Evercade cart slot.”

Byatt said, with the major target being the North American market. It’s no easy feat given retail space for games is dwindling, but Blaze has another trick up its sleeve: inexpensive Super Pocket handheld devices with built-in games and an Evercade cart slot. “It’s helped us break that barrier,” said Byatt.

Work also continues on identifying retro and indie games that will run on the devices. “There are more arcade games we’d love to see come to Evercade – lots more out there from IP owners across the 80s and 90s that everyone has fond memories of or would be discovering for the first time,” Byatt said. “You can pretty much see our

important to remember why and how people play these games,” said Byatt. “Simplicity is key and games need to be playable on a control pad – we don’t want to have complex control schemes or swings and roundabouts to make something work.”

With more releases on the way, including a second *Bitmap Brothers* cart and a *Legacy of Kain* collection, Blaze seems to be going down the right path. “We wouldn’t say there is a set way to go about licensing because people’s tastes in games are varied and fluid,” Byatt said. “But we make sure we do enough to ensure we have something that everyone can enjoy.” ■

**BELOW** The new EXP-R costs \$200 and bundles the first three *Tomb Raider* games.



# KNOW HOW

Wondering if he can make his cursor move automatically during idle times, Robert Irvine tries to...

## Fake PC activity by mouse-jiggling

I was intrigued by the recent news story about US bank Wells Fargo sacking more than a dozen employees for 'mouse jiggling'. This is the practice of using software or hardware to make your cursor move automatically, to imitate PC activity.

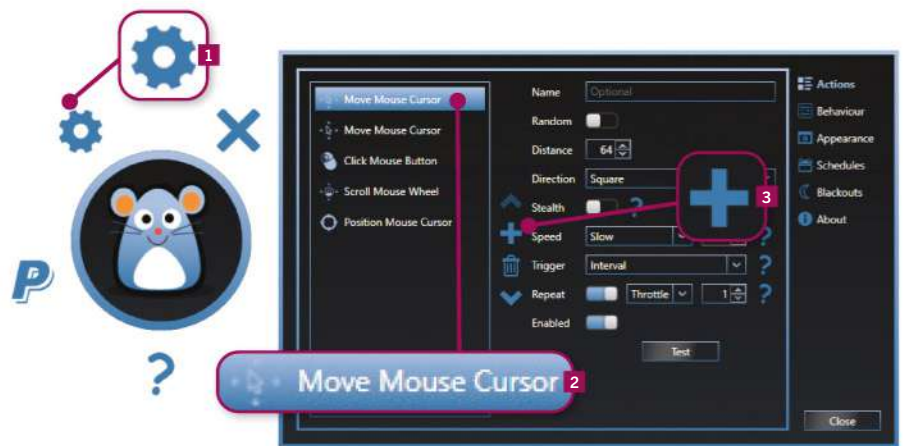
Wells Fargo didn't disclose how it exposed the mouse jigglers, so it's unclear whether they were just jiggling to cover long lunches or to bludge off for the whole day, before they were fired for "unethical behaviour". As an honest, hardworking type, I've never considered this sleight of hand, and I'm sure my eagle-eyed editor wouldn't be fooled by a bit of bogus clicking.

However, I could see some (ethical) benefits to jiggling, such as preventing impatient websites from signing you out, or keeping your PC awake while you make a cup of tea.

To discover if I could fake PC activity by mouse jiggling, I downloaded a free tool called Move Mouse: "a simple utility that can be used to simulate user activity", which can be "deployed in a wide range of scenarios". It's available as a Microsoft Store app ([tinyurl.com/APC538move](https://tinyurl.com/APC538move)) and a traditional program from the developer's GitHub page ([github.com/sw3103/movemouse](https://github.com/sw3103/movemouse)).

I opted for the latter by clicking the 'movemouse-4.18.2.zip' link (under Assets) on the Releases page. After extracting the EXE from the ZIP file, I double-clicked it, sighed at the inevitable SmartScreen warning, and chose 'More info', then 'Run anyway'.

Move Mouse launched with a cartoon mouse in a circle, which blinked at me as if eager to start jiggling. I clicked the



Robert used Move Mouse to jiggle his cursor around his screen while his PC was idle.

friendly mouse to display a ring of options and selected the Settings cog (1 in our screenshot), which opened a less friendly panel of Actions.

This baffled me at first, so I checked Move Mouse's wiki page ([github.com/sw3103/movemouse/wiki](https://github.com/sw3103/movemouse/wiki)) and learned that the key element is the action shown on the left-hand side of the panel. By default, this is Move Mouse Cursor (2) and the other settings relate to how you customise and augment it, such as by adding further actions.

With this in mind, I increased the Distance setting to 100 – to make my cursor move 100 pixels; left the Direction set as Square – so my cursor would trace a square shape; and switched the Speed to Slow – to ensure I could verify its movement. I then clicked Test and watched in delight as Move Mouse slowly moved my cursor in a square without me touching anything.

Emboldened by my success, I clicked the plus-sign button (3) to add some more

actions to the chain. I chose Move Mouse Cursor again, this time specifying a lengthier and speedier swipe in a north-easterly direction, and followed it with Click Mouse Button, Scroll Mouse Wheel and Position Mouse Cursor.

Each of these actions had its own settings, such as choosing which button to pretend to click, and the distance and direction of the scroll. Move Mouse even has options to activate specific processes, such as your browser or File Explorer, but I decided to keep things simple.

Next, I clicked the Behaviour tab and set Move Mouse to repeat its actions every 30 seconds and pause them when it detected genuine user activity – then resume its tricks after my PC was idle for three minutes.

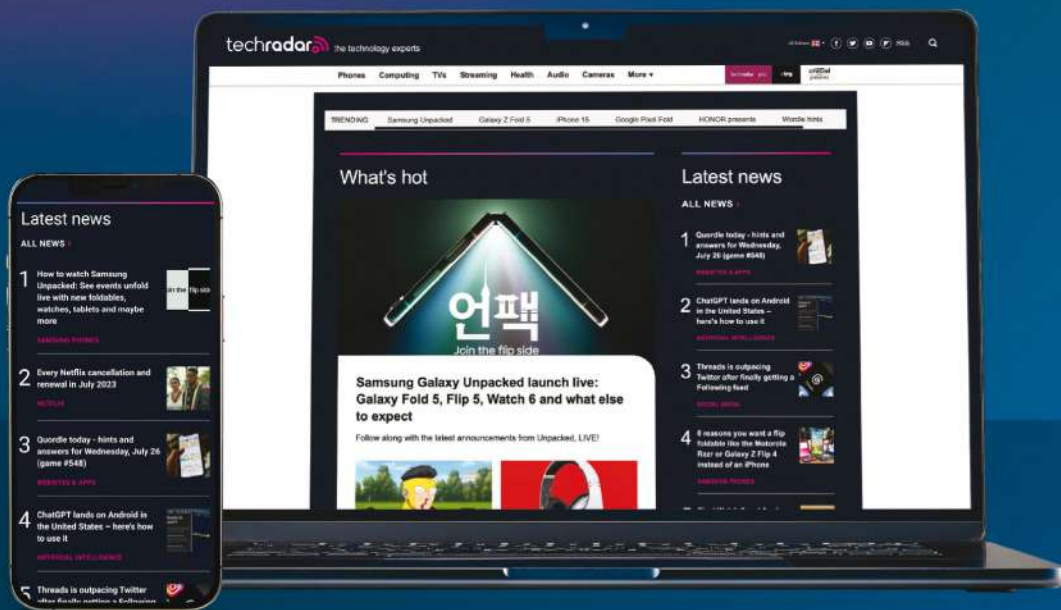
To test that it worked, I stepped away from my PC for that time duration and watched as Move Mouse counted down to start performing its actions – this is indicated by a green line moving clockwise around the cartoon mouse.

Sure enough, once the timer was complete, my cursor moved and clicked exactly as I'd instructed, then began counting down again. I noted that Move Mouse's Schedules tab would let me set it to start and stop at specific times, so I could potentially leave it jiggling for the whole working day. ■

"As an honest, hardworking type, I've never considered this sleight of hand, and I'm sure my eagle-eyed editor wouldn't be fooled by a bit of bogus clicking."



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