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IN-DEPTH
GUIDE
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RUN YOUR OWN CLOUD

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BEYOND MOORE'S LAW

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Explore every game in the series and what makes each one so great. If you're a fan, you'll enjoy the trip through time. If you're a newcomer, we offer you this sage advice: "It's dangerous to go alone, take this!"

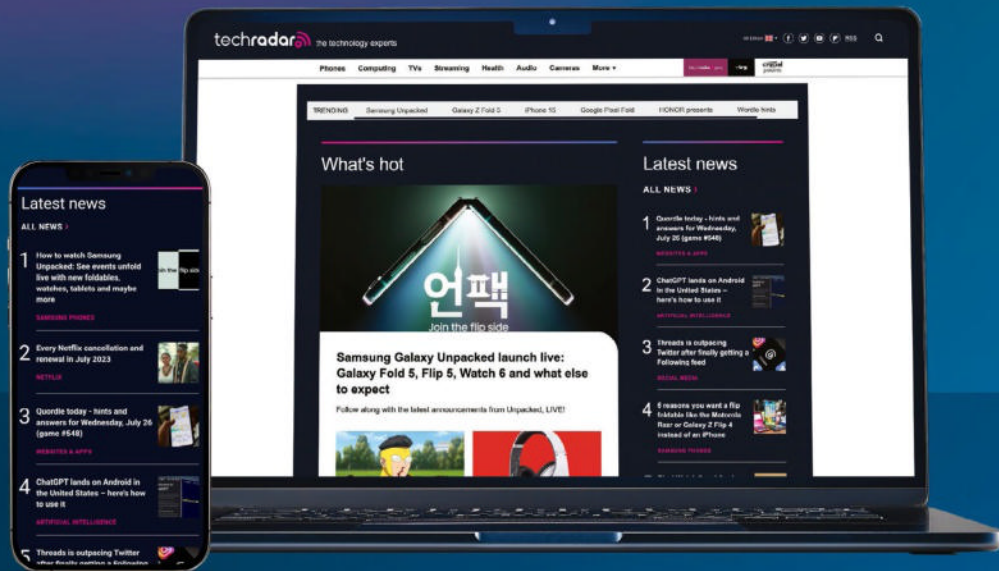


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VIDEO FILE

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Guy Cocker

AFFORDABLE AMD

LAST MONTH, we built a brand new Nvidia/Intel-based system for under a grand. This issue, we're doing it again, but with AMD, in our cover build, masterminded by our in-house expert Sam Lewis. Just as the RTX 4060 finally enabled us to get down to the magic three-figure budget with Team Green, so does the Radeon RX 7600 for Team Red, allowing 1080p gaming on high settings in titles such as *Dead Island 2*, *Cyberpunk 2077* and *Resident Evil 4*.

We paired this \$299 card with the \$160 Ryzen 5 5600X processor, which is no slouch when it comes to everyday computing. It'll chew through any CPU-heavy task you throw at it, and should be good for years to come. We have our reservations about graphics cards with only 8GB of video memory, such as the Radeon RX 7600, but this system will be upgradable down the line thanks to a roomy chassis that's easy to build in. On the plus side, AMD's card comes with an AV1 hardware encoder that allows you to stream your gameplay at super-high quality with little to no impact on your gameplay performance. All in all, it's a nice little system at a great price, and you can find out how to build it yourself from page 16, including mine and Sam's video chat in the Story of the Build.

As I've been discussing with news writer Chris, it's been a slow month for news, aside from Gamescom in Germany starting as I write this. It appears as though we might have to wait now for new GPU and CPU releases, and that's if they appear at all—the RTX 4090 Ti appears to have been canceled. So, we'll be building more high-end machines in our upcoming cover builds, hopefully including the AMD Radeon RX 7900 XTX that has somehow eluded us until now. I also have our best technical writers, Jarred Walton and Jeremy Laird, working on features for upcoming issues, looking at whether

8GB is enough video memory, how to upgrade your Steam Deck, and who's likely to win in the battle of ARM versus x86 architectures. This month, Jeremy has an update on where Moore's Law is at—Nvidia's CEO Jensen Huang has declared it dead, but is that the whole story? Find out on page 38.

We've had lots of letters asking about hosting your own storage, what sort of redundancy to use, and what operating system is best. So, I set NAS-loving Nick Peers the task of building his own cloud storage, then writing an eight-page feature about it (see page 28). I tend to go for the relative safety of an off-the-shelf solution from Synology or QNAP, but as Nick shows, doing it yourself isn't that difficult, is much more customizable, and can even be quite fun. I've started treating my cloud storage like I do my email hosting and pay for a company to manage it for me, but this fun weekend project is actually making me want to give it another go.

By the time you read this, 2023's biggest game will be released—I am, of course, talking about *Starfield*. As I write, my colleagues on GamesRadar and PC Gamer are holed up trying to play as much of it as possible before the embargo lifts and we find out if it's another Bethesda classic like *Elder Scrolls*, or closer to the disappointment of *Redfall*. I'll be throwing my RTX 4090 at it either way. I just also hope it's worth spending weeks of my life playing as we head toward Christmas.

Enjoy the issue!

Guy Cocker

Guy is Maximum PC's editor-in-chief. He built his first gaming PC in 1997 to play Tomb Raider on 3dfx, and has been obsessed with all things PC ever since.

submit your questions to: editor@maximumpc.com

THE NEWS

Intel's messy roadmap

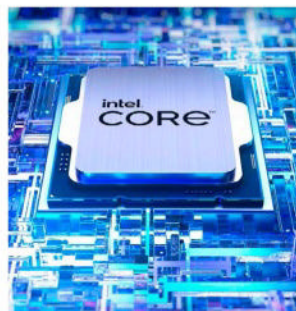
Three lakes, two sockets, and lots of confusion

INTEL'S RECENT great burst of development has seen some remarkable technical developments and some big promises for the future. From being behind the curve for process nodes, Intel is back at the front of the pack. Only a couple of years ago, Intel was selling 14nm chips but now we're rapidly approaching using angstroms as a metric, even if it's not exactly comparing apples with apples. However, recent hiccups have slowed Intel's ambitious plans.

The most obvious sign is the Raptor Lake refresh—a stop-gap measure to buy time for the mainstream desktop market, as Meteor Lake struggles. These are marketed as 14th-generation, but Intel isn't fooling anyone, they are tweaked 13th-generation chips, technically the same, bar the DDR4 support. The first three due to appear are the Core i9-14900K, Core i7-14700K, and Core i5-14600K. We're close enough to the launch in October for details, and

early benchmarks to appear. The i9-14900K is 200MHz faster than the 13900K, reaching 6GHz. The KS version reportedly manages to reach a heady 6.2GHz, which no doubt will be the focus for many of the first round of tests. Who doesn't love the top chip? This will have to brave AMD's V-Cache Ryzens to declare gaming supremacy. The Core i7-14700K gets more of an improvement with an extra four efficiency core bringing the count to 8P+12E, as well as a 200MHz bump in the boost clock. The Core i5-14600K gets the 200MHz bump in boost clock, but no extra cores.

Before Intel slipped in this refresh, Meteor Lake was set to replace Raptor Lake in pretty much all market segments. However, Intel scaled back expectations and targeted the mobile market instead. The pressures of the new design and process node just couldn't deliver the core count and clock speeds required. Enter our stop-gap refresh, which leaves



Intel's i9-14900K, due in October, promises 6GHz speeds.

Intel using two generations, two architectures, and two sockets simultaneously. Now an image has emerged of a desktop Meteor Lake, which is also the first we've seen of an LGA 1851 socket chip. It's not clear if this is an aberration, a sample of what could have been, or if we're going to see some desktop versions after all (don't hold your breath!).

Other rumors suggest we are too pessimistic about Meteor Lake. One leak says Intel engineers have pushed chips to over 5GHz. Meteor Lake is built on the Intel 4 process, boasts integrated AI, and uses a chiplet design. The inclusion of AI is relished and CEO Pat Gelsinger claims it will "usher in a new class of applications, major upgrades, and ISV excitements". It's clear Meteor Lake's development hasn't gone to plan, though.

The desktop chip launch many are waiting for is Arrow Lake, which will mark a real generational shift. We get the new P and E-core architectures, but with core counts of up to 24, and decent clock rates, meaning high-power desktop versions. It'll get Meteor Lake's technical improvements, but give them room to breathe. It's due to be built using the Intel 20A process, but some sources are suggesting it will appear using the Intel 3 process first. An accurate source of leaks has claimed that Intel is also planning to increase the L2 cache on Arrow Lake to 3MB per performance core. Raptor Lake currently runs 2MB per core, so this is a welcome extra, particularly for gaming.

Intel needs to get Arrow Lake right to put it back on form after a messy transition between technologies and generations. The Raptor Lake refresh is the best of the previous technology, while Meteor Lake brings new chiplet construction, socket architectures, and other goodies, but Arrow Lake will bring everything together across the market. The Raptor Lake refresh and the first Meteor Lake chips are due this fall. Arrow Lake is currently due to arrive next summer at the earliest. **-CL**



Intel has to get Arrow Lake right to put it back on form after this messy transition.

WIN11 TO CUT BLOAT

FINALLY! A WAY TO GET RID OF WINDOWS' UNNECESSARY FLUFF

WINDOWS COMES WITH A LOT of applications, extras, and other fluff. Some things it insists on installing are excellent tools, others are barely used by anyone. A new preview build of Win11 (2593) has included a welcome new feature—the ability to delete a selection of Win11 apps. Currently, it enables you to clean your drive of the Camera, Photos, People, Remote Desktop, and Cortana applications, which was recently replaced by Bing AI. The Camera app is designed for tablets and isn't very good, the Photo app has many better rivals, the People app is sometimes handy, while the Remote Desktop barely gets much use in the era of cloud computing—all are ripe for removal. As with all preview builds, there are no guarantees that new features will filter through to the next update, due in September. A lot depends on the reception from the previewers. The chance to remove superfluous apps will be welcome and we hope that the list of applications you can purge is expanded. **-CL**

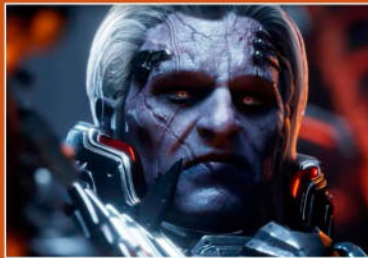


HDR MADE EASY

Samsung's gaming standard HDR format

GETTING HDR to work on games can be a bind, as you need a compatible monitor, graphics system, and software, and then make sure the various versions work together.

Samsung has a fix, called HDR10+. It's been around since 2018, but now we have the HDR10+ Gaming Standard, which, given compatible games, should make it all just happen. The standard involves a layer of metadata that gets all the moving parts to cooperate and includes real-time communication for optimization. If a game is compatible and your hardware can run HDR, it should give you the richer colors, deeper shadows, and better contrast of HDR. Sounds good, but for now it's limited to a small number of Samsung monitors. The only compatible game is a free-to-play shooter called *The First Descendant*, built using the Unreal 5 engine. Samsung claims HDR10+ heralds "a new era of PC gaming", which is a step in the right direction. **-CL**



Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

TELEPORT BOX

Proto built a cabinet that displays 3D holographic images, dubbed 'holoportation', and used William Shatner to promote it.

EXTINCT WORM LIVES ON

They died out 46,000 years ago, but scientists have thawed out nematodes in permafrost.

FIFTH FORCE

Scientists working on the Muon g-2 project claim they have evidence of a fifth fundamental force that could change physics.

TRAGEDIES

AI READS PASSWORDS

AI can read your password by listening to keystrokes from a recording. Is nothing safe?

INCEPTION FIX SLOWS ZEN

The microcode used to fix the vulnerability in Zen chips can hit some applications hard—28-54 percent in some cases.

TESLA RANGE EXTENDER

A new class action claims Tesla misrepresents a vehicle's range by deliberately not taking some variables into account.

NVIDIA'S AI GOLDMINE

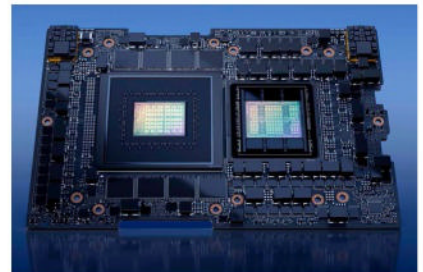
Big tech orders half a million cards

LARGE-SCALE AI PROJECTS are the hot thing of the moment as every big tech company and hopeful start-up scrambles to build AI systems. Those systems need chips, and the best for training LLMs is Nvidia's H100 Tensor Core GPUs. The success of a new AI project is measured by how many AI cards you can bring to the party. A large project, such as ChatGPT, needs around 50,000 cards. Projects from Google, Meta, and Microsoft will need similar amounts. Start-ups will need 10,000 or so each.

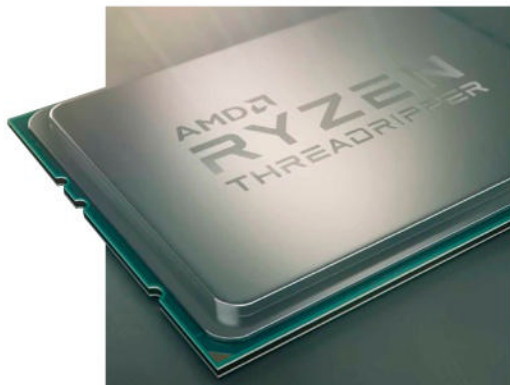
This is good news for Nvidia, and it is expected to sell over half a million H100 GPUs this year. Its cards sell for at least \$30,000 each. Demand is such that they reach a \$10,000 premium on eBay. Profit margins on GPUs aren't spectacular, but Nvidia is making a fortune on AI GPUs. Analysts estimate that a \$30,000 AI accelerator card costs Nvidia \$3,320 in parts. Despite considerable development costs, that seems like rich pickings.

The bad news is that this frenzy for AI silicon is spilling over into other markets. Nvidia has scaled back production of Ada Lovelace GPUs and is limiting new card supplies. Sales have been weaker than expected, so some shift was expected. Nvidia has contracts with TSMC which it will honor, but any capacity that can be switched to AI silicon means more profit.

Firms unable to get the AI cards they want are also turning to regular GPUs to do the math. A recent bulk purchase of Radeon RX 7900 XTX cards went to an AI outfit, which stated it was aiming for exaFLOP scale. This would require tens of thousands of graphics cards. If the demand for AI continues, we could see cards disappearing into warehouse racks instead of gaming rigs. AI could be big enough to distort the GPU market as crypto mining did before it. **-CL**



These are what power the AI systems that tech companies are busy building.



THREADRIPPER REACHES 96 CORES

New Zen 4 chip is a beast

IN 2017, AMD released Threadripper, a monster of a Zen-powered chip sporting up to 16 cores. If you wanted to build the ultimate in desktop rigs there wasn't much that could touch it. It had more PCIe lanes and was cheaper and faster than anything Intel could field for the HEDT market. Since then, Threadrippers have moved upmarket, with Pro versions appearing in 2020 with Zen 2 cores. Then the 5900-series, using Zen 3 architecture was all Pro, all OEM, and aimed at workstations. Intel also abandoned the HEDT arena as potent high-end desktop chips killed the whole scene.

AMD has a new Zen 4 Threadripper, opening a new range with the Threadripper Pro 7995WX, and once again it's a stormer. It's based on the silicon for the EPYC Genoa server chips but with faster clocks and more cache. It's the first Threadripper to go above 64 cores, carrying 96 of them. It also gets 384MB of L3 cache, 96MB of L2, and the clock sits at a boost of 5.1GHz. It has a TDP of 350W, comparable to a Xeon Platinum, and sits in an AMD SP6 socket. Early benchmarks are startling. Multi-threaded performance is outstanding, even setting an unofficial world record. It is 50 percent faster than the Threadripper Pro 5995WX, and every other processor in its class gets thrashed.

Will we see this Threadripper iteration return to the HEDT segment? There are no rumors yet of non-Pro variants, but it would make a splash, even if sales were left to a few well-heeled enthusiasts. The Threadripper Pro 7995WX is expected this October with lesser 7945WX, and 7985WX chips in tow. Prices are as yet unknown, but don't expect a bargain. **-CL**

Apple buys up 3nm

TSMC WAS THE FIRST CHIP FABRICATOR to build 3nm process silicon late last year, and Apple was its first customer. That partnership has grown, and now Apple has ordered so much 3nm silicon that it will be over a year before there will be excess capacity for any other customers. The deal, which cost Apple around \$17bn, means it will be the only company offering TSMC's 3nm chips in its hardware for some time.

The first of many 3nm chips will appear this fall in a round of updates to the M-series processors. Of most interest is the M3 Ultra, the chip destined for the Mac Pro and Mac Studio. It puts together two M3 Max chips into one die with up to 80 GPU cores, 24 performance cores, and eight efficiency cores. The M3 Max is half of this, naturally, and will power the 16 and 14-inch MacBook Pro. The M3 Pro will sport eight performance and six efficiency cores with a 20-core GPU. This goes into lesser MacBook Pros and the Mac Mini. All represent decent upgrades over the existing silicon. The M3 Max and Pro are due early next year. The first 3nm chip to surface will be the new iPhone which gets the A17 Bionic chip, in the Pro versions at least.

Apple's gamble on TSMC and the 3nm process is potentially risky, but looking good for both companies so far. The yields on 3nm have reportedly been better than expected, at around 70 percent, and Apple alone is responsible for 23 percent of TSMC's revenue. In three years, Apple has managed to push itself to the front of processor technology, both in terms of design and process node. Quite a feat. **-CL**



Apple has cut a deal with TSMC, and will hog all 3nm production over the next year.

RTX 4090 Ti canceled

Nvidia will not release the GeForce RTX 4090 Ti, despite teasing it for a while. It was rumored to sport 18,176 CUDA cores with 24GB of GDDR6 and consume a whopping 600W. Was Nvidia expecting the card to combat AMD's RDNA 3 family? The 4090 manages that comfortably for now unless AMD pulls some V-Cache trickery. The fire-breathing Ti would have been an expensive, low-volume distraction. Instead, Nvidia will update its mid-range cards: good news for the average gamer. The 4060 has just 8GB on a 128-bit bus, and the 4070 has 12GB, yet costs \$600 or so, and both could do with more. The new cards are due to arrive next summer. **-CL**

No new gamer Chromebooks

Google had three new Chromebook reference designs in the wings, Agah, Hades, and Herobrine, but all three have been canned, as Google pulls back from gaming Chromebooks. Google started work on these in 2021, however, the use of integrated GPU limited their use to cloud gaming for the most part. The company isn't giving a reason for the cancellation, but problems getting the ChromeOS to work with big title games, getting decent Linux Nvidia GPU drivers, and storage requirements could be to blame. A Linux-based gaming system that could compete with a Windows-based one was going to be hard work, and it seems Google wasn't prepared to put that in. **-CL**



Jarred Walton

TECH TALK

Nvidia DLSS 3.5 and Ray Reconstruction

DLSS ORIGINALLY STOOD FOR 'Deep Learning Super Sampling' but since its introduction in 2018, Nvidia has used it as an umbrella term for any graphics technology that leverages AI. Now, Nvidia has introduced Ray Reconstruction and DLSS 3.5, which will use AI to improve the quality of ray tracing effects. So how does Ray Reconstruction work and who benefits?

The second part is much easier to answer. DLSS 3.5, unlike DLSS 3.0 Frame Generation, will work with any and all Nvidia RTX GPUs. That makes the new features potentially far more interesting than if they were only limited to the latest generation RTX 40-series hardware. Ray Reconstruction only benefits games that use ray tracing effects, so if you're playing a game that only uses rasterization, DLSS 3.5 has nothing to offer. AMD and Intel GPU users also have nothing to gain from DLSS 3.5.

As to how it works, an AI model gets fed tons of data, "learning" to produce high-quality outputs from lower-quality inputs. In this case, Nvidia has trained the model with surface colors, motion vectors, and normal maps along with the reference images showing high-quality ray-traced renders. Ray Reconstruction works with multiple different ray tracing effects as well, including reflections, global illumination, shadows, and more.

Ray Reconstruction has some similarities to upscaling in that both temporal and spatial components get considered by the training.

Temporal means that samples are used across multiple frames, while spatial indicates a form of interpolation or "filling in the blanks" from adjacent pixels. Denoising can provide a higher quality output even with a limited number of pixels, and that's what Ray Reconstruction aims to do.

DLSS 3.5 will launch this fall, with *Cyberpunk 2077 Phantom Liberty* one of the first games to incorporate the feature. The most demanding ray-tracing games will deliver the biggest improvements and Nvidia used *Cyberpunk 2077* with RT Overdrive mode enabled as a demo. But Ray Reconstruction will be more about improving quality than boosting framerates.

Cyberpunk running at native 4K on an RTX 4090 managed around 20fps in RT Overdrive mode. DLSS 2 upscaling in performance mode (1080p to 4K upscaling) boosted that to 63fps. Adding DLSS 3 Frame Generation increased to 100fps. Finally, turning on DLSS 3.5 Ray Reconstruction resulted in 108fps. That eight percent increase from Ray Reconstruction won't be typical, however, as the bump in framerates is down to the replacement of

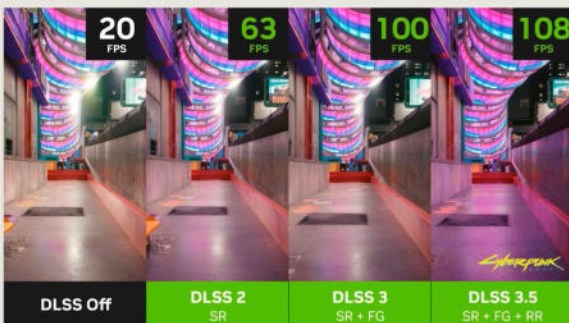
multiple denoiser algorithms with Ray Reconstruction.

Still images don't do the technology justice. The lights above the walkway cycle through different patterns and, while regular *Cyberpunk* shows some changes, with Ray Reconstruction, the whole environment is lit up in different hues. Developers could mimic this via other rendering techniques that are far less demanding, but those wouldn't be as accurate as ray tracing.

Professional path tracing applications are planning to add DLSS 3.5 support, with D5 Render and Chaos Vantage already committed to the technology. It's not clear when support will be available, but Ray Reconstruction should allow even better real-time previews of complex renderings.

The uptake of Ray Reconstruction may be more muted than DLSS 3 Frame Generation, as there aren't many games that will massively benefit. On the other hand, the existence of another tool in the DLSS suite could mean that we'll see more "full ray tracing" games in future. Just don't expect them to run great on non-Nvidia GPUs.

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

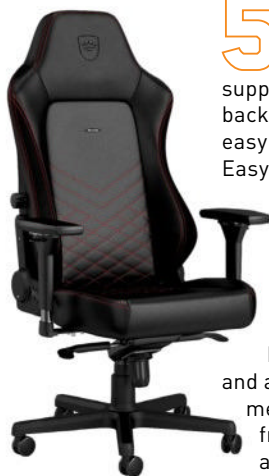


Cyberpunk 2077 Phantom Liberty will be one of the first games to incorporate Ray Reconstruction.

THE LIST

THE BEST GAMING CHAIRS

WHEN IT COMES TO THE BEST gaming chairs, it's all about build quality, comfort, and customization. You'll be spending an awful lot of time sitting on one, so go for something that will last. We've tested numerous gaming chairs from reputable companies, and these are the pews that proved their worth. So while cheaper office chairs may seem tempting, investing in ergonomics is a decision your body will thank you for in the long run. Treat yourself to something special and give your posterior the care it deserves.



5 NOBLECHAIRS HERO
If you need lumbar support, Noblechairs has your back. Fully adjustable, it's easy to justify the price tag. Easy to assemble, it's firm and supportive, and very sturdy. The chair is height adjustable, and the backrest has a rake mechanism so you can adjust the angle with its handbrake contraption, and an independent lock tilt mechanism so you can rock freely, or lock yourself almost horizontally. **\$589, www.noblechairs.com**

4 HERMAN MILLER EMBODY
The Herman Miller Embody oozes the premium vibes you'd expect at this premium price. With superb comfort and a warranty spanning over a decade, it's absolutely the chair of choice if you're willing to invest in ergonomics. The tried and tested Embody design is simply one of the best chairs for office work or gaming. It's incredibly comfortable over prolonged use, supports an active and healthy posture, and is easily fitted to your frame. It even comes fully assembled, so there's no fussing with screws or throwaway tools. **\$1,256, www.hermanmiller.com**



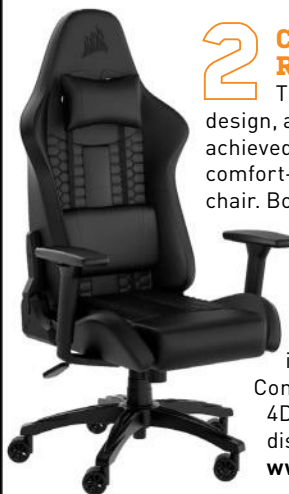
3 SECRETLAB NEUECHAIR

It's arguably more of a "task" chair than a gaming chair, but it's one of the most comfortable chairs you'll ever sit in, and if you're going to be at your desk most of the day working, as well as into the night gaming, then it's worthy investment. It's also backed by a hefty 12-year warranty, which goes some way to offsetting the high price. **\$749, www.secretlab.co**



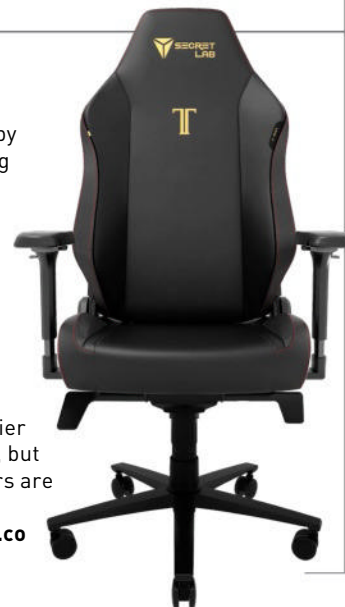
2 CORSAIR TC100 RELAXED

The thick cushion, broad design, and refined styling—achieved without compromising on comfort—make this a great gaming chair. Both the leatherette and fabric versions come in at the same price. The one drawback are the 2D armrests—you only benefit from up, down, in, and out adjustability. Compared to chairs with 4D armrests, it's a bit disappointing. **\$328, www.corsair.com**



1 SECRETLAB TITAN EVO

The benchmark by which we judge gaming chairs. It's comfy, supportive, and looks great. Available in three sizes, it's an amalgamation of Secretlab's previous gaming chair models, the Titan and Omega. But this feels better in every regard. It is pricier than its predecessors, but the upgrades it delivers are genuinely worth it. **\$449, www.secretlab.co**





Jeremy Laird

TRADE CHAT

AMD has canceled some GPUs, but don't panic!

SPEND ENOUGH TIME in this game and you get a feel for rumors that are very likely true. And I'm getting the sense that the latest ones suggesting AMD has ditched the high-end variants of its next-gen RDNA 4 graphics family are on the money. At first glance, this seems pretty disastrous, especially given how expensive gaming GPUs have become and how desperately we need somebody to put Nvidia under pressure. But is it? Is it actually?

The bones of the story go like this. AMD has canceled not only the top Navi 41 GPU but also Navi 42. It's the mooted cancellation of Navi 42 that's most worrying. Navi 41, just like Navi 31 and Navi 21 before it, was slated to be the big boy of the RDNA 4 series. It's the most exciting GPU of the family, but also the least relevant.

That's because few gamers can afford high-end GPUs. Navi 31 in the form of the Radeon RX 7900 XT and XTX were released at the end of last year. But it wasn't until July that a sole 7900 board, the XTX, appeared in Steam's Hardware Survey, clocking up a mere 0.17 percent of gamers. If you combine the 7900 XTX with all variants of the previous-gen high-end, the 6800 and 6900 Series based on Navi 21, they don't even add up to 1 percent.

So, Navi 41 is no great loss. Hardly anybody would buy it anyway. AMD's mid-range cards like the 6700 XT and 6750 XT hardly dominate the survey. But they do rack up a few percentage points and they help to keep Nvidia honest with the likes of the RTX 3060 and 3070 series. At least they would if AMD had direct competitors.

We're still waiting on the 7700 XT and 7800 XT, though those two GPUs should have been

announced by the time you read this. It's not clear which GPU those cards will be based on. At the least, the 7700 XT will be Navi 32-based, and possibly the 7800 XT, too.

Anyway, the point is that Navi 32 and, in turn, Navi 42 are more mainstream GPUs. And the loss of not only Navi 41 but also Navi 42 implies that AMD might not even be able to field what would presumably be known as the 8700 XT. It would only be competing at the very low end, leaving Nvidia without any competition for anything above what will presumably be then—and we're talking early 2025 for any of these GPUs to actually go on sale—be known as the RTX 5060.

Well, unless Intel can get its act together with Arc. That's not impossible, but you'd hardly bet on it. So, that's the potential horror story for PC gamers. No mid-range or high-end AMD GPUs for the next generation, allowing Nvidia to price its cards even more offensively. Except that may not actually be what's happening.

I don't mean that Navi 41 and 42 aren't canceled—that part of the story is more than likely true. What's also likely is that the reason why they're canceled is that AMD can't get an even more complex version of its chiptlet engineering

working or at least not for a sensible price and in time for RDNA 4's launch. I think both Navi 41 and 42 were advanced chiptlet designs and AMD has decided to roll that approach over to RDNA 5, allowing more time to refine the approach and make it cost-effective.

With that in mind, we're left with Navi 43 and Navi 44. My hunch is that Navi 43 has probably been adjusted in response to the cancellation of Navi 41 and 42. It was likely always going to be a monolithic design, rather than chiptlet based. But AMD will adjust the scale and scope of Navi 43, pushing it up into the mid-range.

That's probably why all this news leaked in the last month or so. It's just far enough out from the launch of RDNA 4-based Radeon RX 8000 Series GPUs to allow AMD to revise Navi 43 and Navi 44 to account for the loss, primarily, of Navi 42. And so there's been a flurry of activity, increasing the odds that some of AMD's new plans would escape out into the wild. All of which means Navi 41 and 42 are probably dead. But there's no reason to panic.

Six raw 4K panels for break-fast, laced with extract of x86... Jeremy Laird eats and breathes PC technology.



AMD probably won't be replacing the 7900 XTX. But that definitely doesn't matter.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

- > Gaming emulation
- > Save bricked router
- > Foolproof Mac boot

EmulationStation DS query

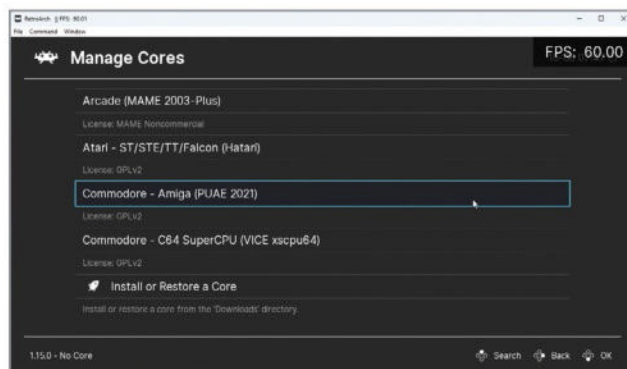
I was intrigued by your mention of EmulationStation DS in your retro-gaming feature. I set up Batocera Linux as per your instructions, love the ES user interface, and I'd like to replicate that on my PC. Is it really such a hassle to set up the DS version in a standard Windows installation?

—Jon R Hurst

THE DOCTOR RESPONDS:

The biggest issue with the DS build of EmulationStation (ES) is that you must install and configure RetroArch, the underlying tool powering your various emulators, separately. There's a lot of configurability beneath the hood, and it'll take some trial and error to get things working the way you want them to. However, as a quick guide, start by downloading and installing RetroArch from www.retroarch.com—we recommend the 64-bit installer for maximum emulator support.

Once installed (there's no need to select DirectX during the installation process), launch RetroArch. Navigation can be done using the mouse, keyboard,



Retroarch underpins many gaming frontends on the PC.

or any controller you've installed. Select Load Core, followed by Download a Core to download, and install your choice of emulators from the list. If you're looking to emulate arcade machines, we recommend MAME 2003-Plus as the one most likely to work with the widest range of games.

With some emulators—including MAME—that's all you need to do. Others—including Hatari (Atari ST) and PUAE 2021 (Commodore Amiga)—require you to source ROMs separately and place them in a specific folder, which you can determine by visiting <https://docs.libretro.com/guides/install-windows/> and exploring the 'Core Library:

Emulation' section. Once you've sourced the files and placed them (typically C:\RetroArch-Win64\system) navigate to 'Settings > Core > Manage Cores' and select the emulator to verify that it registers the required files as present.

Other sections you need to visit include Settings > Input, where you can configure your controller, as well as RetroArch's own hotkeys, which allow you to access such controls as fast forward, pause, and a mini menu. By default, these keys override any customizations you make for game control, so we recommend selecting 'Hotkeys > Hotkey Enable' and setting a key like Windows, which you'll need

to hold down in conjunction with the other hotkeys to trigger them. Also, check out 'Port 1 Controls', where you can configure keyboard mapping for game controllers alongside your existing controller.

Then, head to Settings > Video > Fullscreen Mode, and set Fullscreen Mode to On—this is required for ES DS to work correctly. Once done, you can quit (press Esc, then Esc again).

Next, download and install ES DS (www.es-de.org). After installing, launch the program and select 'Create Directories', followed by OK, Yes, and Quit. Copy your ROMs to the relevant subfolder inside C:\Users\{username}\ROMs, relaunch ES and wait while it scans for games. Press Esc (or the Start button on your controller) to bring up its menu. Navigate to Other Settings > Alternative Emulators, and select the correct emulator for each platform. You should now be able to play any detected games, but be prepared to spend some time in both RetroArch and ES familiarizing yourself and getting things set up just the way you like them.

∨ submit your questions to: doctor@maximumpc.com

MKV or MP4?

I'm as frustrated as you are that there's no simple subtitling solution for Windows. I know Plex can automatically find subtitles for most shows and movies, but I'd like a local fallback option from my HD rips. It occurs to me that the problem lies with the MP4 format's inability to handle image-based subtitles, while MKV files work just fine. Is there actually any pressing need for me to output in MP4, or can I get away with just ripping to MKV format?

—Sheri Miller

THE DOCTOR RESPONDS: In theory, there shouldn't be any problem outputting to MKV rather than MP4: MKV supports the same underlying audio and video codecs as MP4, so in theory Plex should handle the format. However, it comes down to a combination of what file types (as opposed to codecs) are supported by your playback devices, along with your personal preferences and priorities.

MP4 is more widely supported—particularly on mobile devices, so if you're streaming to multiple devices (or indeed sharing your library with others), you're less likely to run into problems or complaints from friends when Plex is forced to either direct stream or transcode the files before streaming them, which may lead to errors or buffering. However, you can minimize this by ensuring your MKV files—like MP4—are encoded using standard codecs, which we recommend as H.264 for video, and AAC or AC3 (or better still, one of each) for audio.

On the other hand, if you're the only user and your server can transcode or remux MKV files on the fly without too many problems, there are two major advantages to switching to MKV. First and foremost, you won't need to worry about

converting image-based subtitle tracks—including those that contain icons and other graphics. Secondly, while Plex ignores any custom audio track and subtitle titles in MP4 files, it will display that information in MKV files, which means you can provide descriptive names for your tracks (such as a commentary track) and easily identify them within Plex itself.

Recover bricked router

My Synology RT2600ac router has served me well over the years, but I'm afraid that it has reached the end of its life. I don't know if it was linked to a recent firmware update or not, but whatever I do, I cannot access it, even though the status light flashes green. I've tried restarting it multiple times, and resetting it, all to no avail. Right now, I'm connecting to the internet through my phone's mobile hotspot capabilities. Do I need a new router?

—Graham Francis

THE DOCTOR RESPONDS:

We suspected the process of resetting the device had made it impossible for Graham to connect to using his previous network settings. We directed him to Synology's Synology Assistant tool, which although designed for its range of NAS devices, can detect routers too. Head over to www.synology.com/support/download, and select NAS followed by any model number, then switch to Desktop Utilities, where you'll find a download link.

Once downloaded, you'll need to connect your PC directly to the router via a LAN cable, but you need to make sure it's plugged into the router's blue WAN socket instead of one of the yellow LAN ports. Now, simply install and run Synology Assistant on that computer, and let it search for your router. Graham was able to report that it not only

detected his router, but was able to help him set it up again in order to restore his home network.

Mac boot glitches

Hi, I don't know if you can help me. I've been given an old MacBook Pro (2012 vintage), and I want to wipe it clean and start again. I've successfully created a macOS installer flash drive, but try as I might, I cannot seem to get the MacBook to boot to the start-up disk selection screen. However, I try holding the Option key, it just bypasses it and goes straight to login screen—the same happens when I try to boot to recovery mode (Apple + R). Is there some way to force the Mac to boot in either mode without me having to get involved?

—Lance Rabago

THE DOCTOR RESPONDS: Ah yes, Macs are notorious for refusing to work with the very key combos Apple builds into them. This is linked to the NVRAM—a small portion of memory that the Mac uses to store certain system settings. You can try to reset this as well as PRAM, which stores similar settings, but guess what? It relies on the same keys your Mac is ignoring at boot.

Thankfully, all is not lost—while the Mac doesn't have an equivalent to Windows' useful msconfig utility, it is possible to force it to reboot in either mode through the Terminal. Open this via Applications > Utilities, and then issue the following command to force it to display the boot manager:

```
sudo nvram manufacturing-enter-picker=true
```

When prompted, enter your user password. Now, reboot your Mac, and you'll go straight to the start-up selection screen. Note, this setting will remain in place every time you boot until you remove it:

```
sudo nvram -d manufacturing-enter-picker
```

As an aside, the following command lets you reboot into recovery mode:

```
sudo nvram recovery-boot-mode=unused
```

When you're done in recovery mode, open a Terminal window via Utilities, and issue the following command so you can reboot into normal mode:

```
nvram -d recovery-boot-mode
```

Finally, to clear the contents of NVRAM:

```
sudo nvram -c
```

Note: performing this final step will wipe certain settings from System Preferences, so be prepared to have to reapply favorite tweaks when you're done.

Another PrtScr hijack

I read your reply to Emory Allen about removing OneDrive's hijacking of the Print Screen key. I accidentally pressed Print Screen before launching my screen capture tool, and now it appears the Snipping Tool has taken it. Even after I close the window, then close and restart my screen capture tool, it refuses to give up the Print Screen capture tool. I can restart my PC, but is there another way?

—Loren Leach

THE DOCTOR RESPONDS: A recent Windows 11 update changed the mapping of the Print Screen key to Windows' own Snipping Tool. It's supposed to respect any existing mappings, but if you've recently installed an update, it's possible that Windows has hijacked control of the keyboard shortcut.

Thankfully, the fix is simple, and if the issue surfaces again, you should be able to repeat it: navigate to 'Settings > Accessibility > Keyboard', scroll down and flick the 'Use the Print screen key to open Snipping Tool' to Off. Once done, relaunch your tool, and you should find it now has control of Print Screen again. ⏻

AMD RADEON ON A BUDGET

Team AMD or Team Intel? Which sub-\$1,000 machine should you side with?

IN A SIMILAR VEIN as last issue, we wanted to tackle the same MO but switch from Team Blue to Team Red. That's right, we're moving to the AMD side of the fence with this build, but sticking with the sub-\$1,000 budget. This gives you the latest AMD GPU, a very competent budget-friendly AMD Ryzen 5 5600X CPU, and plenty of RGB lighting. The latter is the least important, especially if you're sticking to a budget, but it's a good way of adding to a room's theme. You can change the lighting to suit your needs, and if you aren't a fan of the Rainbow Road from *Mario Kart* aesthetic, don't worry—we aren't either. We prefer keeping the lights to a static color or, if feeling adventurous, we might push the boat out and apply a breathing effect. How fancy!

Lighting aside, we're pushing for similar, or if not better, performance as last month's budget Intel machine. We're still aiming for solid 1080p gaming, but with the help of AMD's latest tricks, we may be able to push our frame rate up and enter the QHD domain. Elsewhere in the build, we're using a microATX motherboard. Last time, we avoided any motherboards other than standard ATX for future-proofing reasons,

but microATX still offers enough room to add more components going forward, and is more versatile than a Mini-ITX board. We've gone with the Asus TUF Gaming B560M Plus Wi-Fi— at under \$150, it fits the rest of the machine and sticks within our budget, too.

We save some extra bucks on our RAM by going down the DDR4 route, specifically with some Kingston Fury RGB sticks. Running at 3,600MHz and with a capacity of 16GB, they're fast enough for a system at this level, and come in at a wallet-friendly \$60. For our primary storage, we were very impressed with Lexar's NM790 drive that we reviewed last month, so much so that we wanted to include it here, too. It comes in at under \$100, and has incredibly fast read and write speeds—what more could you want when building on a budget? All of this will be housed within BitFenix's Saber case, a budget chassis that offers easy access and some RGB lighting, too.

So, how will this AMD machine compare to our budget Intel build? Will the Intel PC win out or should you be rooting for the red team? Let's find out... **-SAM LEWIS**





SPECIFICATIONS

Case	BitFenix Saber	\$70
CPU	AMD Ryzen 5 5600X	\$160
CPU cooler	AMD Wraith Prism	\$30
Mobo	Asus TUF Gaming B550M Plus Wi-Fi MicroATX	\$149
GPU	AMD Radeon RX 7600 8GB	\$299
Memory	16GB (2x 8GB) Kingston Fury Beast RGB DDR4-3,600MHz	\$60
SSD	1TB Lexar NM790 PCIe 4.0 NVMe	\$70
PSU	650W NZXT C650 80 Plus Gold Fully Modular ATX	\$110
OS	Windows 11 Home 64-bit OEM	\$32
Total		\$980

THE COMPONENTS



CPU
AMD RYZEN 5 5600X

This chip has been a strong budget-end competitor for a while now, and although it isn't the newest kid on the block, it holds up strong. Boasting six cores, 12 threads, and a max boost clock of up to 4.6GHz, it's an excellent pickup for around \$160. \$160, www.amd.com



GPU
AMD RADEON RX 7600 8GB

This reference card sits at the bottom of the latest GPU offerings from AMD, but that shouldn't steer you away. As a budget card, it offers some of the latest technology, is good value for money, and it looks pretty neat, too. Will this be the best choice for 1080p gaming? \$299, www.amd.com

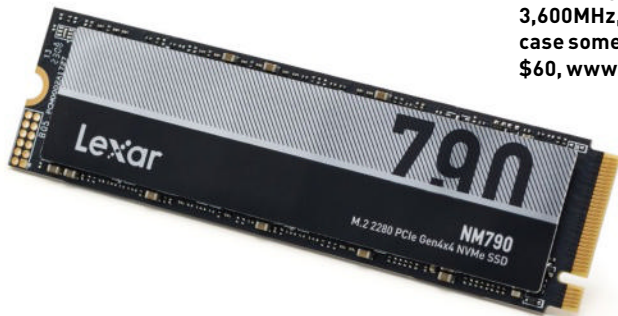


CPU cooler
AMD WRAITH PRISM

Although our Ryzen 5 5600X comes with an AMD Wraith Stealth in the box, we had some extra budget to play with and wanted to not only improve cooling on our build but also add some color. The more premium Wraith Prism checks both these boxes and can also be picked up for a street price of around \$30 or so. \$30, www.amd.com

SSD
1TB LEXAR NM790 PCIE 4.0 NVME

Lexar's NM790 boasts fantastic read and write speeds of up to 7,400MB/s and 6,500MB/s respectively. You can pick up a 1TB model for \$70, making it a very attractive storage solution. We were very impressed when we reviewed it, so adding this to our build was a no-brainer. \$70, www.lexar.com



Memory
16GB (2X 8GB) KINGSTON FURY BEAST RGB DDR4-3,600MHZ

Opting for a DDR4 system saved us a few valuable dollars. Despite this, our RAM performance is still strong with the 16GB Kingston Fury RGB kit we have here. Running at 3,600MHz, it's no slouch and should give our case some extra ambience, too. \$60, www.kingston.com





Motherboard

ASUS TUF GAMING B550M-PLUS WI-FI

Not quite as capable as the NZXT ATX motherboard we used in the Intel system that our current build is up against, this microATX isn't far behind with its support. It offers two M.2 SSD PCIe 4.0 slots, Intel Wi-Fi 6, and plenty of USB ports—and it's still more than enough for this system. \$149, www.asus.com



PSU

650W NZXT C650 80 PLUS GOLD FULLY MODULAR ATX

To play it safe, 650W is technically more than we need for this system, but it gives us room for potential upgrades without needing to change it later. Rated at 80 Plus Gold, it's an efficient power supply, too. \$110, www.nzxt.com



Case

BITFENIX SABER

Costing around \$70, and providing some external RGB lighting, too, the BitFenix Saber is a good choice for a sub-\$100 chassis. It's Aura Sync/Mystic Light RGB compatible and can easily house our microATX mobo, with room for a full-sized ATX replacement down the line if required. \$70, <https://bitfenixshop.us>



AMD RADEON ON A BUDGET

A NEW GO-TO AMD GPU FOR 1080P GAMING?



LENGTH OF TIME: 1-2 hours

DIFFICULTY: Easy

1 The housing

As usual, we like to know exactly what we are working with before diving head first into a build, and this involves stripping the case down by removing all the side panels and any mesh filters on the chassis, too. This enables us to plan potential cable routes and have easier access to fit all of our components. Trust us, you want as much space as possible when building PCs, and starting a build this way saves you a lot of time and hassle down the road.

To begin, you need to remove the four thumbscrews from the front of the tempered glass panel. Lay the case on its back before doing this to avoid dropping the glass (we've been there,

it's not pretty). Next, remove the two thumbscrews that hold the back panel on—these require a Phillips screwdriver if they are too tight to undo by hand. The front panel pulls off without requiring any tools, but be careful not to damage the clips. With these removed, you can take off any magnetic mesh filters at this stage, too, and put all the panels in the original box for safekeeping.

2a Adding the CPU

We can now move the case safely to one side and focus on what makes this machine tick: the processor. This, of course, needs the motherboard to function, so unpack that, and place it on top of its box when adding parts to it. This protects the back of the board more than a flat hard surface, such as a

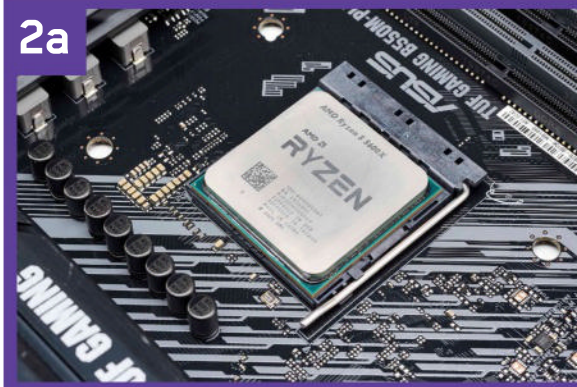
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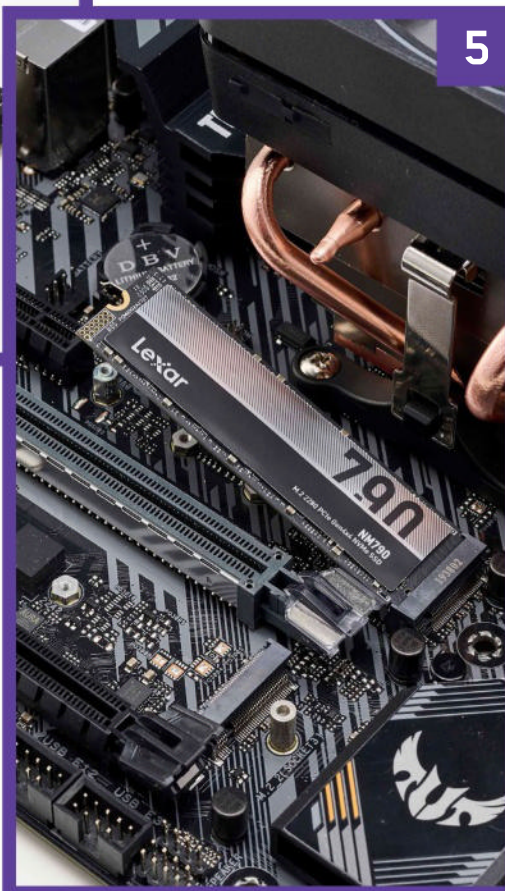
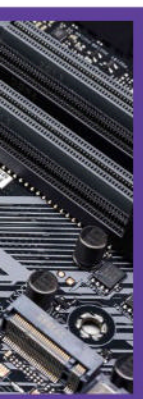
2a



table, would. Release the retention bar on the CPU socket and it opens up. Then, grabbing the AMD Ryzen 5 5600X by its sides, align the triangle on the CPU with the one on the motherboard, and gently rest it on the socket. After this, pull the retention bar back into its original position, and it should lock the CPU down.

2b CPU cooler bracket

Before installing the AMD Wraith Prism cooler, it needs the correct bracket in place. This is the standard stock AMD cooler bracket. First, you need an AM4/AM5 backplate to go behind the socket; the screw holes should line up perfectly and come through the back of the motherboard. Then, using the original AMD stock cooler brackets, rest these above the screw holes (one above the



socket and one below). Afterward, use the stock screws to secure these to the backplate and the motherboard. The clips on the brackets should face outward from the CPU—this is what the cooler is going to clip on to.

3 Wraith Prism

Now we have everything in place with the CPU and brackets, we can add the impressive Wraith Prism cooler. Before we even touch the cooler, though, we need to add a pea-sized amount of thermal paste to the center of the CPU. Then place the cooler on top, making sure the AMD logo is in the top-left corner when looking at the board straight on. With the cooler resting in place, take the clips and hook them on to the brackets we have just installed. The cooler will still be loose, so to secure it down, there is

a lever on the top side of the cooler that needs pulling to the side—this holds it in place on the processor.

4 Furious memory

As menacing as our Kingston Fury Beast RAM sounds, installing it couldn't be less intimidating. In fact, it's one of the quickest and easiest installations when it comes to PC building. Even if you upgrade your RAM down the line, you shouldn't need to take your PC apart—just make sure it's fully shut down! Anyway, as we're using two sticks, we have to determine which of the four slots we need to use. In most cases, it's slots two and four. Refer to your official motherboard manual to double-check first, though.

To install, open up the DIMM slot clips above the slots, take a RAM stick, make

sure the notch on the connector lines up with the notch in the slot, and push it down into place. When you hear a click, you know it is done.

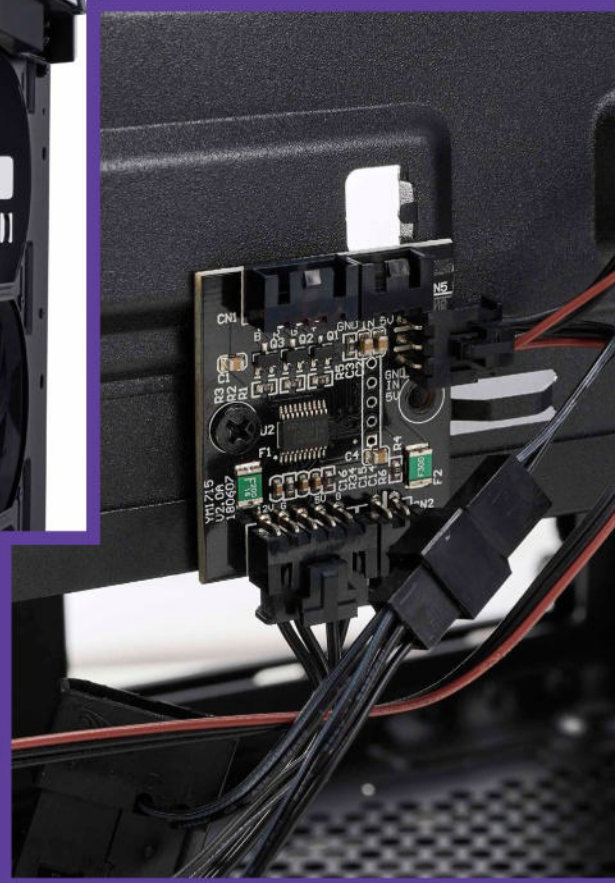
5 Storing the storage

After adding the RAM, we can move on to installing the M.2 storage. To get the most out of our drive, we're going to use the uppermost slot on the motherboard. Unfortunately, there is no heatsink with our SSD or with the motherboard, but this shouldn't be too much of an issue with our system. It's preferable to keep your components as cool as possible, but in this instance, it's not the end of the world. To install, place the connector end of the SSD into the M.2 drive, and lower it down flat. Then take the tiny M.2 screw and secure it down into the motherboard.

6



7a



6 Motherboard install

Now that our board has all the components installed except the GPU, we can fit it inside our BitFenix Saber case. Our board has a separate I/O panel cover, so first clip this into the back of the case. For our microATX board, we need to move the stand-offs up to the MATX screw holes in the case. Then we can position the motherboard and tighten it in place with the case screws. Make sure you use all the available screw holes, and tighten the screws in a diagonal pattern to ensure even pressure as the board is fitted in position.

7a Case RGB

It's now just a matter of connecting the dots—and by dots, of course, we

mean cables. In order for our BitFenix Saber chassis to display all of its full RGB glory, we need to connect all the lighting cables both from the fans and from the case to the RGB header on the motherboard.

At first glance, there's a lot to deal with here, and it can seem overwhelming, but life is made a little easier by checking the motherboard manual. The case has one rear 120mm RGB fan that connects to the motherboard and also to the RGB header at the back of the chassis, which we will touch on in a moment. We need to connect the RGB Aura Sync cable to the RGB header at the bottom of the motherboard first before we can deal with the controller. At this stage, it's also worth adding the fan cables to any available motherboard fan headers.

7b RGB controller

With the fans and the Aura Sync cable attached, we can take a look at the RGB header at the back of the case. This is secured to the cable via two Phillips screws. You'll find that the position where it's initially installed means that some cables can't reach it, so you need to take it off and move it toward the bottom of the case. When re-installing it, you'll see there is only one screw hole available, so that's all you can use—nevertheless, it fits firmly in place and its new position means that there is less tension on the wires. You probably don't need to use all the connectors on the back of the RGB controller—it just comes down to finding out which one fits in the end. Oh, and a lot of help from the manual.



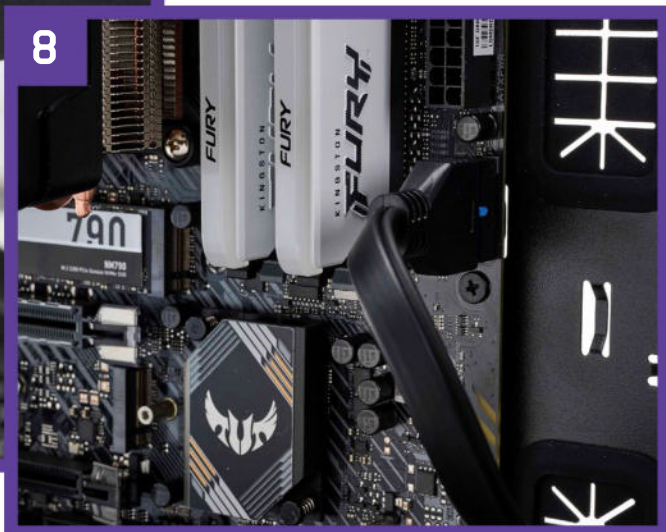
7b



9



10



8

8 Case cables

With all of the RGB sorted, it's probably worth plugging in the rest of the case cables, right? We get it—the lights look cool but there's no real point if the rest of the ship doesn't sail. So, before we even start to steer toward Isle Power Supply, we need to connect the USB, HD audio, SATA, and power switch cables from the chassis to the motherboard.

If you refer back to the motherboard's official manual, it makes this step a breeze. Well, it would be a breeze if we didn't have individual power switch pin connectors. Regardless of what machine you're building, if your case has these, you are in for a choppy ride. Go back to the manual to check where to put each individual pin on the motherboard. This is

a tricky and awkward step, but just take your time and be careful not to bend any of the pins.

9 Isle PSU

You've nearly arrived at your destination. However, to get our lights working, there is one essential thing missing: Power. Well, thanks to our NZXT C650 PSU, that shouldn't be an issue. This part of the install is nearly on par with the RAM when it comes to ease, but technically for this one you do need to use a Phillips screwdriver. Take the PSU and place it in the bottom of the case with the fan facing downward. Then, using four case screws from the original box, tighten evenly, from corner to corner, until the PSU is securely attached to the case.

10 Power veins

As the power supply is now installed, it only seems right to add the PSU cables to the mix. For this build, we need one for the CPU, one PCIe for the GPU, a 24-pin motherboard cable, and a SATA cable for the RGB. In this case, it is very tight toward the top, so installing the CPU cable in the top-left corner isn't the easiest of tasks, but we get there by attaching the CPU end first before the PSU end.

As for the rest, there is plenty of room to easily create cable paths. We can thread the PCIe cable through a rubber sleeve at the bottom to try to keep it as tidy as possible, and as for the back of the case, well, that's pretty tidy, too. Velcro tabs and cable ties keep our newly created cable paths in place.



11 The final hurdle
 OK, “hurdle” is a stretch, but we have to add some drama once in a while. Again, like the PSU and RAM, this is a fairly easy installation. The issue here is that the GPU is usually the most expensive component, so there’s always some nervous tension until it’s properly installed. To set up, you need to remove the second and third GPU PCIe shrouds from the back of the case. These are both secured with Phillips screws. Annoyingly, you can’t get the screwdriver straight on with the screws in this case, and have to approach at a very slight angle, so take your time and be careful not to strip the screw.

Once these are removed, put the screws to one side—you’ll need these shortly. On the board, open up the top PCIe port, just as you did with the DIMM slots for the RAM. Then carefully lower the GPU connector into the port and line up the slot end of the GPU with the gap in the case where the shrouds were. Push the GPU down until it clicks into position—use both hands while doing this to keep the graphics card stable and ensure

the pressure is evenly distributed. Then take the two screws you put aside and tighten the GPU on to the case. Last but by no means least, take the PCIe cable that we passed through the rubber sleeve and insert it into the front of the GPU.

12 Updates...
 As the hardware is now complete, we can turn to focus on the software side of things. Our system booted up first time, which caught us off guard, because this isn’t always the case. Regardless, it’s always worth updating the BIOS to ensure it is running at its best. Our Asus TUF Gaming B550M-Plus doesn’t feature a BIOS flashback button, but we can still use the standard EZ Flash method with a USB drive.

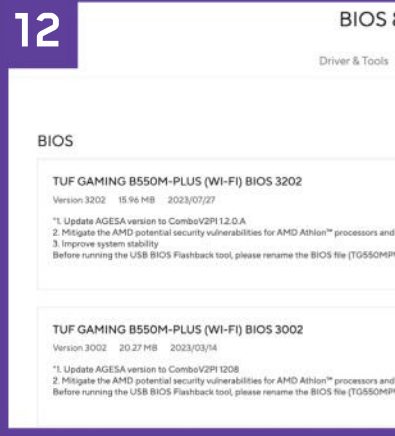
For this, you need another PC and a clean USB drive that has been formatted to FAT32. Head over to the motherboard’s official website and go to the support page. Here you should find a “Drivers & Tools” section—click that and then you’ll see the “BIOS & Firmware” page. From here, download the latest version of the

BIOS, and then extract that on to your USB drive.

Next, safely eject the USB stick and insert it into your new PC. Start up the new system and hit the Del key to enter the BIOS. Once in, you need to select “Advanced Mode,” then go to the “Tool” window, and find the EZ Flash Utility. Find your USB in the drive window, and then choose the BIOS file—it should have a CAP file extension. Accept the on-screen instructions and the system begins the update. Do not switch off the PC while the update is underway—once done, it automatically restarts.

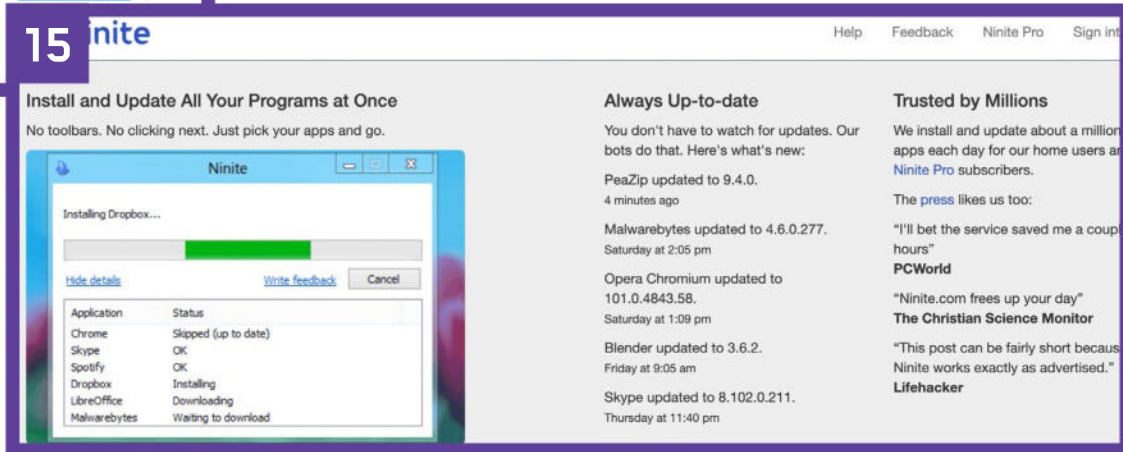
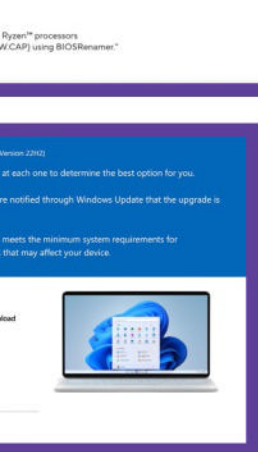
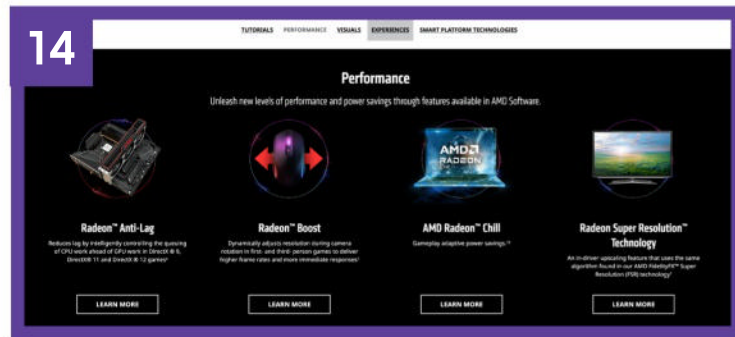
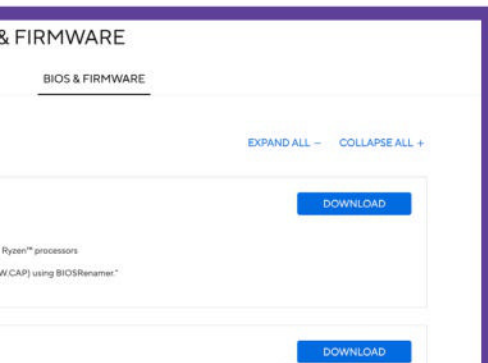
13 More updates...
 Just as having the latest BIOS update is important for keeping your system stable, having the latest OS is crucial, too. Again, we need to use another PC and a clean FAT32 USB drive of at least 8GB. Head to Microsoft’s official Windows 11 download page and download the second option under “Create Windows 11 Installation Media.” Open the file once the download is complete and it runs an installation

12



13





program. Keep clicking through until you get to the installation location—now select your clean FAT32 formatted USB drive and install it on there. Once that has been selected, the download begins. Keep following the on-screen instructions and then safely eject the USB stick when finished.

Then, with your new PC off, insert the USB drive and boot it up into the BIOS. On the right-hand side of the BIOS, you should see a menu for the “Boot Priority.” Hopefully, you can now see your USB drive on that list—if it isn’t already, drag your USB drive to the top of the hierarchy, then save and exit from the BIOS. Once the system has restarted, it should open straight into the Windows 11 OS installation software. Keep following along with the prompts and you can customize the operating system to your liking. With this installed, it’s time to have some fun.

14 You guessed it... Before we start diving into a world of fun and games, there are just a few more

updates to complete to ensure we are getting the most out of our new PC. First and foremost, we need to update Windows and any drivers it’s using. Head to the system settings and go to “Windows Updates.” Here, you can perform a check, and download and install any available options. You can also install optional updates, which are found in the “Advanced Options” section of the “Windows Updates” page.

Once your system is fully updated, it’s time to install CPU and GPU drivers by downloading the AMD Adrenalin program. This is found on the official AMD website and provides all the necessary drivers to keep both our processor and graphics card working as smoothly as possible. There are plenty of tweaks we can do here to improve the overall performance of the system by selecting presets or playing with some of AMD’s Radeon features. These include Radeon Anti-Lag, Radeon Boost, Radeon Chill, and Radeon Super Resolution Technology. All of these can be combined to improve the performance and your frame rate in-game. Even if you don’t take advantage

of these features, it’s worth having the software just to keep your CPU and GPU ticking along smoothly.

15 Ninite We know you’re itching to get all of your favorite games and programs on to your fresh new PC—but don’t worry, we have you covered. This is usually a very time-consuming task and it still depends entirely on your internet connection, but we have something that can help nonetheless. Ninite is an all-in-one solution, with which you can download multiple applications at the same time, all at the click of a single button.

Go to the official Ninite website and you’ll find a multitude of popular programs to select from. These are listed in categories such as browsers, media, utilities, imaging, developer tools, and more. You simply check the boxes of the software you want, then click the big blue “Get Your Ninite” button underneath. The program downloads all the selected programs automatically and also keeps them up to date. Not bad.

ALL-INTEL OR ALL-AMD?

WHICH IS THE KING OF 1080P GAMING?

WE STARTED THIS build to see whether it is better to side with Team Intel or Team AMD when you have a \$1,000 budget. The battle between AMD and Intel is age-old, however, and there is never really a definitive winner. As with most things in life, there are pros and cons for both sides. We wanted to create a fair test with these builds, though, and we feel we hit the mission objective here. Both systems have proved that you can build a solid 1080p gaming machine using some of the latest components for under the \$1,000 mark. However, to save some of the budget on both sides, we did opt for some slightly older bits of gear, such as DDR4 and older motherboards, but that's all to do with saving a few extra bucks.

Anyway, let's rewind the clock to the build process. Thankfully, with this machine, we didn't encounter many issues. The keyword here being "many." The thing that had us slightly stumped was the RGB controller with its myriad

cables—there was even a Molex cable on one of the fans, but that didn't need to be connected because we used a daisy chain on the other fan as a substitute. We took a look at the guide that came with the case but, unfortunately, that wasn't much help. We had to take a quick trip over to the world wide web for some inspiration. With plenty of head scratching involved, we managed to work it out in the end, but it meant we had to also move the fan controller toward the bottom of the case because the cables wouldn't quite reach. The ARGB header on the motherboard was at the bottom and this was a three-pin connector, which is what we needed. The alternative header was at the top, but it was four-pin.

Other than the RGB controller causing a few worries, the individual pin headers for the power switch caused some further aggravation, as usual. If there are any case manufacturers reading this, please stick to a fixed cable instead of the tiny

individual pins—for our sake, if nothing else. Joking aside, these can be awkward and you need to really take your time when installing. It's very easy to bend the pins, trust us, and also easy to get the order wrong, so always refer to the manual.

Aside from these rather small issues, the rest of the build process went smoothly and quickly. It's a relatively easy machine to put together and there's plenty of room for working inside this case when using the microATX form factor. Touching on that for a moment, we did have to move the stand-offs from the ATX to the MATX form, but this was visible inside the case and didn't take much time at all. So, all in all, a successful build, but how does this fair against its Intel rival, and how was the performance on our all-AMD machine?

And the results are...

Well, we have to say, as with our Intel build, we're very pleased with the overall benchmarking results. We took a slightly

BENCHMARKS

ZERO-POINT

Cinebench R23 Single-Core (Index)	1,529	1,556 (2%)
Cinebench R23 Multi-Core (Index)	7,209	11,310 (57%)
CrystalDisk QD32 Sequential Read (MB/s)	7,085	7,444 (5%)
CrystalDisk QD32 Sequential Write (MB/s)	6,700	6,120 (-9%)
3DMark Fire Strike (Index)	22,211	26,802 (21%)
Cyberpunk 2077 (fps)	87	96 (10%)
Metro Exodus (fps)	83	75 (-10%)
Total War: Three Kingdoms (fps)	85	83 (-2%)

Our 1080p zero-point consists of the next-gen on a budget PC from last issue with an Intel Core i3-13100F, an MSI Ventus GeForce RTX 4060 2X Black OC 8GB GPU, an NZXT N5 Z690 ATX, 16GB of Corsair Vengeance RGB RS DDR4-3200, and a 1TB ADATA XPG GAMMIX S70 Blade PCIe 4.0 NVMe SSD. All games tested at 1080p Ultra graphics presets. XMP/AMP for RAM speed turned on in all tests. No manual CPU overclocking.

different approach from the one on the Intel build, because that way we entered via the gateway CPU. Sure, the Intel Core i3-13100F is part of the latest generation offered, and the AMD Ryzen 5 5600X isn't. However, our slightly older AMD chip is the stronger of the two. When glancing at our Cinebench results on the multicore score, the Ryzen 5 5600X was 57 percent better than the i3-13100F. For an extra \$40 or \$50, this is certainly worth the upgrade, and Team AMD takes the win here. The single-core scores were practically identical, so in that regard they're very evenly-matched. This makes the AMD machine better when it comes to productivity-based work, such as image manipulation and rendering. Of course, with any custom PC build, it comes down to what your end goal is. If you're building a machine purely for 1080p gaming, both CPUs will meet your needs.

As for the SSD results, it was a tight match against the 1TB ADATA XPG GAMMIX S70 Blade from last issue's budget Intel machine. Our Lexar NM790 put up a very good fight, winning on the CrystalDisk QD32 sequential read test, scoring a strong 7,444MB/s. That's 5 percent better

than the ADATA, which scored 7,085MB/s. However, on the sequential write scores, the Lexar SSD was 9 percent behind the 6,700MB/s of the ADATA XPG, so again, it was evenly matched. Both drives provide great performance for the money, and either would impress as a primary drive.

OK, we are starting to sound like a broken record here, but these two machines performed very competitively. Where our AMD machine leaped ahead was with the 3DMark score, with a result that was 21 percent better than the Intel machine. The Fire Strike index tests the combined performance of the CPU and GPU, and as the AMD machine has the stronger processor, it showed in these tests. On the rest of the game results, though, it was the same old story: A very even match, with each side taking the upper hand on different games.

Cyberpunk 2077 was a strong point for the AMD Radeon 7600 GPU, with a frame rate of 96fps when tested on Ultra settings with no manual overclocking. This was 10 percent better than the score we got with the MSI Ventus 2X Black OC RTX 4060 card. Unfortunately for our build, it sat behind on the *Metro Exodus* and *Total*

War: Three Kingdoms tests. Only very marginally, though, we must add.

All in all, this makes choosing between Team Intel and Team AMD a tough decision. Both offer very compelling results for the money, with a near 50/50 split in the results. Both come in at under the \$1,000 mark—however, the Intel build has newer components if you're more worried about longevity. Saying that, the AMD processor was still the better choice, even though it's slightly longer in the tooth.

Many points can make you sway from side to side, but if we had to decide, we would choose the AMD processor coupled with the MSI Ventus 2X Black OC RTX 4060. Although both cards are 8GB, and have a very similar performance and cost, the more impressive AI performance with technology such as DLSS 3.0 in the Nvidia arsenal just edges the RTX card ahead of the AMD Radeon 7600 GPU. We have to say, though, that if you go down either route with the aim of reliable 1080p gaming, both systems can provide this. We would just recommend dialing down the sliders for a medium to high preset for a smoother gaming experience and higher frame rates. ⚡



- 1 To add even more lighting in the case, we could have doubled up our RAM, although it may be a tight squeeze.
- 2 Custom cables would have kept this build slightly tidier.
- 3 We are fans of the look of the Lexar NM790 SSD, but a heatsink would provide better cooling here.
- 4 Additional intake fans would help with cooling next time around.





BUILD YOUR OWN CLOUD STORAGE

Don't trust third parties with your data? Nick Peers has the answer...

IN THESE DAYS of password breaches and encroaching government agencies, how much do you trust any third party with your data? Cloud storage is baked into Windows with Microsoft's OneDrive, but despite the generous 1TB of storage space with any subscription, how sure can you be that your data is truly beyond the reach of bad actors?

If you'd rather not trust the internet with your precious data, Nextcloud Hub is the solution for you. It offers the same features you find in any good cloud storage solution—backup and synchronization between all your devices—but goes further to add a secure self-hosted chat platform as

well as private solutions for your contacts, calendar, and projects, all of which can be accessed on your phone as well as your desktop and laptop. There's even a powerful web-based office suite—based on LibreOffice—that you can deploy to edit documents on the go.

Better still, you can sign up trusted friends and family to free accounts to give them access to your server, providing you with all the tools you need to chat, share, and collaborate on projects without worrying about who might be snooping on your data. It's time to free your data from the tyranny of others. It's time for Nextcloud.

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BEFORE YOU BEGIN, you need a suitable server to host Nextcloud on. Our small server build from the September 2022 issue is perfect, but you can use any Windows, Linux, or macOS computer running Docker. For the purposes of this feature, though, we'll assume you're running Ubuntu Server on a headless small PC, accessed remotely through the Cockpit interface in your PC's web browser. This means you can copy and paste commands from your text editor directly into Cockpit's terminal, which saves no end of time.

We're also going to assume you plan to access Nextcloud from outside your network, so you need a suitable domain or subdomain to point to your home's public IP address. Use the ddclient container (<https://docs.linuxserver.io/images/docker-ddclient>) to ensure it keeps pointing home even when your public IP address changes, and use Nginx Proxy Manager (<https://nginxproxymanager.com>), which we featured on page 62 of the April 2023 issue, to set up a reverse proxy.

We've opted for the official Nextcloud AIO Docker container, too, which downloads and installs all required containers—as many as 13 depending on the components you choose.

Instructions for installing Nextcloud AIO are at <https://github.com/nextcloud/all-in-one>—ignore the standard setup and click the “Reverse-proxy.md” link for instructions. Configure your reverse proxy by expanding the Nginx-Proxy-Manager section.

Install Nextcloud

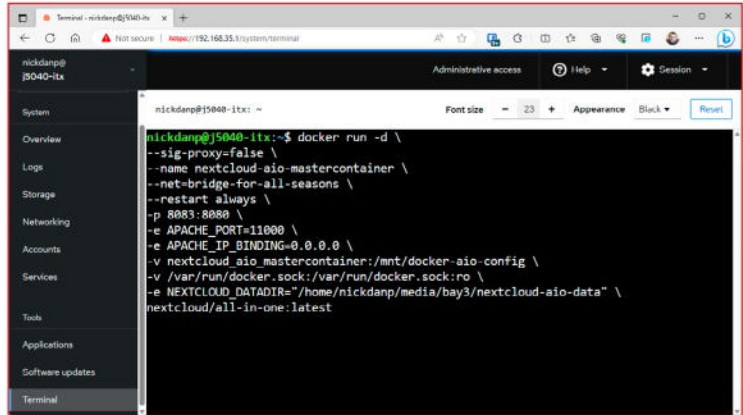
Now switch your attention to Nextcloud AIO. Copy and paste the code under “Use This Startup Command” into your text editor. As things stand, this code won't work. We need to add two lines, so the full instructions can be seen in the screenshot above.

You need to change “--net=bridge-for-all-seasons” to point to the same bridge network your reverse proxy is on, then point NEXTCLOUD_DATADIR to the path where you plan to store your synched files and other Nextcloud data. You probably also have to remap port 8080 if it's in use elsewhere on your server—for example “-p 8081:8080” or something similar.

Now save the text file, copy it all to the clipboard, switch to Cockpit's terminal, press Shift-Insert to paste the code in, and hit Enter. If all is well, Nextcloud AIO is up and running.

Initial setup

Wait around 30 seconds or so, then open a new browser tab and point it to <https://192.168.x.y:8080> (substitute x.y with your server's



Create your Nextcloud AIO with a variant of this code.

IP address, and 8080 with whichever port you mapped to it). You'll see the Nextcloud AIO setup screen, with the password (or more precisely, passphrase) you need to access the AIO interface. Copy this to the clipboard (and paste it somewhere for safekeeping, say your password manager), then click “Open Nextcloud AIO Login” to open a new tab. Paste in the password and click “Log In.”

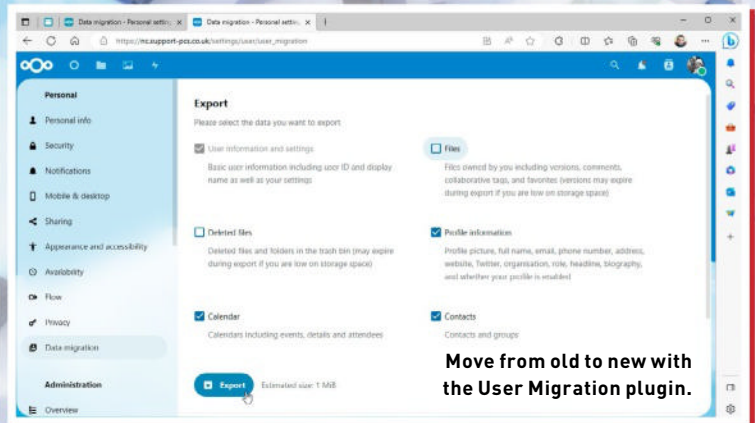
Input the domain you've configured in Nginx Proxy Manager to point to your Nextcloud instance, and click “Submit.” If you run into problems, check your Nginx Proxy Manager configuration is correct, and try navigating to <http://192.168.x.y:11000> in your browser, followed by <https://domain.com> (substituting domain.com with your domain or subdomain). If both are functioning correctly, you see a hexadecimal string. If after you see this, Nextcloud still claims that port 443 isn't open, destroy the container (`docker stop nextcloud-aio-mastercontainer && docker remove nextcloud-aio-mastercontainer`), and recreate it.

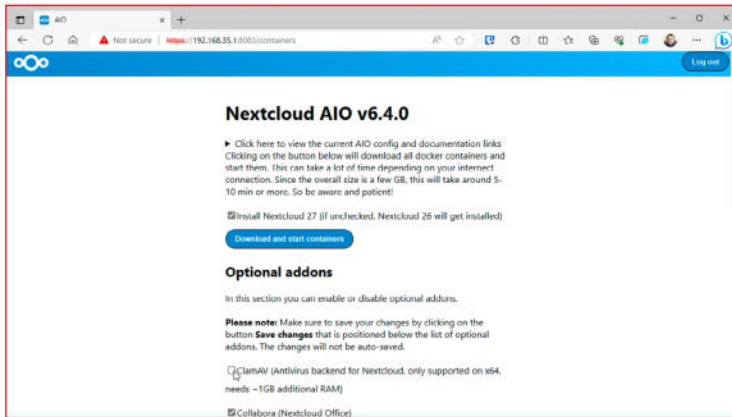
If—as is expected—things are working smoothly, you're now prompted to download Nextcloud itself (check the box to install the latest version—27 at time of writing). You're then shown a list of optional components, some of which are checked by default. These include an antivirus backend (ClamAV), web-based office suite (Collabora), full text search component, file preview add-on (Imaginary), and the Nextcloud Talk component for integrating chat, video, and audio conferencing into Nextcloud. There's no need to install these all now—they can be added later—but if you make any changes, click “Save Changes.”

Below this are Nextcloud's system requirements. With everything enabled, you need a hefty 6GB RAM and quad-core CPU, but for a leaner setup—say, just the Files cloud storage

© NEXTCLOUD

MIGRATE TO NEXTCLOUD AIO





Choose which components you wish to install during setup.

component—2GB RAM and a dual-core CPU are sufficient. Finally, input your timezone and click “Submit Timezone.”

Once done, click “Download and Start Containers,” then wait. When the spinning circle vanishes—and it can take a while if you’re installing everything at once—you’re taken to the Nextcloud status page, indicating everything is set up and ready.

First login

The status page displays the credentials of the master admin user, which you need to log into Nextcloud for the first time. Copy the admin password to the clipboard, then click “Open Your Nextcloud,” which opens a tab to the domain you set up. You’ll see this offers a login page to Nextcloud proper, so log in using the admin’s credentials—don’t forget to save it to your password manager.

You’re taken to the admin user’s homepage, which firsts display a quick orientation slideshow that includes links to all the Nextcloud client apps required to connect to Nextcloud on a day-to-day basis. Once you’ve gone through it, click “Start Using Nextcloud.”

Step one is to set up user accounts for each person—including yourself—who will be using Nextcloud. Click the A badge in the top right-hand corner, and select “Users” from the menu. You’ll see a list of users along with a “New User” button on the left. Let’s start with your own user account—as the main user, you’ll probably want to continue using the admin account, so click the pencil icon to change the display name

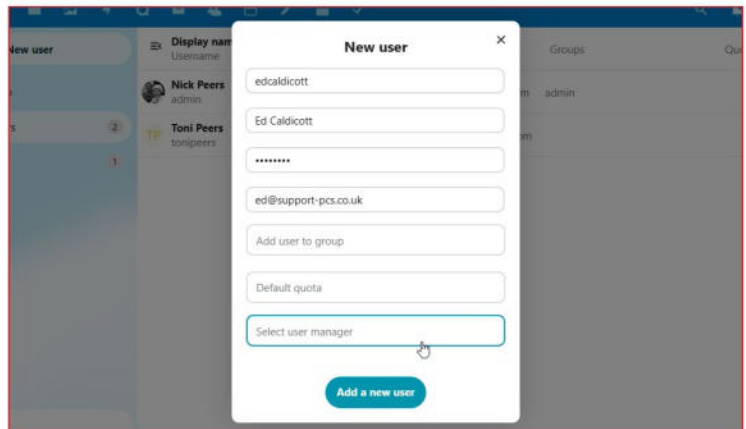
and password if you wish, plus add an email address. Click the check mark button when done.

Other users can be added using the “New User” button. This pops up a dialog that’s mostly self-explanatory, although two sections need addressing: “Add User to Group” enables you to organize users into groups, but it also allows you to give them administrative privileges by adding them to the admin group, so use with caution. There’s also a “Default Quota” button—this determines how much storage space you’re willing to allocate to that user, and it is set to unlimited by default, so enter a figure in GB if you want to prevent someone eating up all the space.

Personalize your account

Once set up, each user—including yourself—can log into Nextcloud through their own web browser to set up their account. Once logged in, click your user icon in the top right-hand corner to reveal your profile menu. All users should see two items of interest: “Appearance and Accessibility,” and “Settings.” Administrators like yourself will see two separate settings options: “Personal Settings” (which apes the “Settings” menu for regular users), and “Administrative Settings.”

All are relatively straightforward to follow—“Appearance and Accessibility” is, in fact, a shortcut to a subsection within the personal “Settings” menu on the left. It enables users to change themes, switch on the OpenDyslexic font if required, plus tweak some other related settings, from disabling all



You need to set up accounts for all your Nextcloud users.

IF, LIKE US, you’ve previously run Nextcloud using a third-party container, there’s a lot to recommend switching to Nextcloud AIO, not least the effortless integration of all its services. However, there is one wrench in the works you need to consider: Migrating your users from your current instance to your new one.

The following assumes you’re installing Nextcloud AIO alongside your Nextcloud installation, which runs perfectly in parallel. This

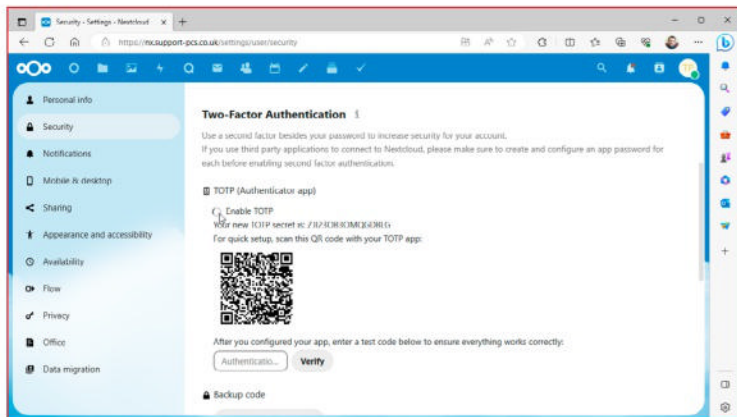
means giving the AIO instance its own dedicated domain or subdomain. Once set up, create users for each person you’re migrating. Navigate to “Apps” on your existing Nextcloud instance to search for and install “User Migration.” Once in place, a new “Data Migration” option appears under “Personal Settings.”

Each user must access this and decide if they want to migrate everything—including data—or just a subset of their profile. Once exported to a

file, which is stored in your current Nextcloud instance’s root directory, you can install “Data Migration” in the new AIO instance and then each user must choose the “Import” option under “Data Migration,” and upload the exported file.

Depending on how much data you’ve got stored in Nextcloud, this may be impractical—if your data runs into the tens of gigabytes or more, you’re better off simply exporting everything except files and deleted files, then

porting these across manually. The simplest way to do this, once you’ve imported your account settings, is to log out of your current instance on the Nextcloud desktop app, then log into your new instance. When prompted to set up the new sync folder, point it to your current Nextcloud folder on your desktop, and it starts syncing back to the new instance. Once everything’s been ported across, remove the old instance, and delete its data folders to free up space.



Protect your user accounts (and instance) with TOTP authentication.

keyboard shortcuts to choosing different wallpaper for the Nextcloud web interface.

Elsewhere in this section, “Personal Info” enables you to add extra contact details, plus upload your own avatar or photo, which appears in place of the basic icon displaying your initials. We strongly advise all users to visit “Security,” where they can set their own password, plus enable two-factor authentication, which can be done through a TOTP app such as Authy. Other TOTP methods—including using the desktop client or mobile app on another authenticated device—can be added by administrators via the “Apps” section (see the box on page 34 for more on apps).

You can be notified of all kinds of activity in your account via “Notifications,” configure sharing to allow sharing across other Nextcloud servers, and transfer ownership of files and folders you’ve uploaded to other Nextcloud users. You can also configure your availability by setting working hours, create various automated file workflows (such as setting up file access control or automatically tagging files), and set up your own templates directory for use with Nextcloud Office. You can also connect to Zotero (www.zotero.org), a personalized research assistant tool.

As an administrator, you should also trawl through the various Administration settings on offer—the box below reveals what key settings to look out for.

Start synching files

Before we delve any further into configuring Nextcloud, let’s start setting up its core reason for being—namely as a cloud storage and sync tool. To do this, you need to download and install the

desktop client—head over to <https://nextcloud.com/install/> and expand “Download for Desktop” to access links for Windows, macOS, and Linux.

The Windows client installs with minimal fuss—uncheck “Launch Nextcloud” before clicking “Finish” as you’re prompted to reboot your machine after installation finishes. Once rebooted, open Nextcloud and click “Log In” at the startup page. Enter your domain as the server address, and after clicking “Next,” a browser window opens—follow the prompts to finish logging in the desktop client to your account.

After clicking “Grant Access” and closing your browser, you’ll see Nextcloud offers to sync everything from your online account (which comprises some sample folders and files totaling 26MB in size) to a single folder on your PC. By default, “Use Virtual Files” is selected, which is the equivalent of OneDrive’s OnDemand feature, with placeholders

taking up a fraction of the space of the actual files themselves. It speeds things up on a mature Nextcloud installation where you already have gigabytes of files stored online, but you can choose “Synchronize Everything From Server” to keep actual physical copies on your hard drive—this ensures at least two copies of the files exist on separate computers.

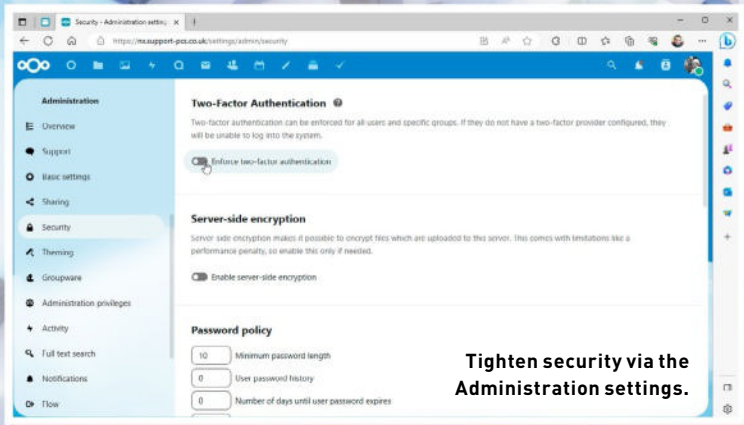
A third option, “Choose What to Sync,” enables you to sync just a subset of the files stored on Nextcloud—perfect if you have folders that only need to sync with a specific device.

Whatever your choice, you need to understand that everything must reside in a single folder on your PC, just like with OneDrive and other cloud storage solutions. If you’re planning to sync your personal folders, such as Documents and Photos, to Nextcloud, this might seem like an insurmountable problem, but it’s not.

Simply navigate to “Home” in File Explorer. Right-click the “Documents” shortcut under “Quick Access,” and choose “Properties > Location tab,” then click “Move.” Select the Documents folder inside the Nextcloud folder, and click “Select Folder” followed by “Apply.” When prompted, opt to move the contents of your old Documents folder into here. Once complete, Nextcloud starts uploading them to your server in the background, and you’ve already started the process of migrating your data to Nextcloud.

The good news is that this Nextcloud folder can reside anywhere on your PC—it’s in your user folder by default, but you can choose another location (such as an external drive) by clicking “Choose Different Folder.”

Once you’re happy with your choices, click “Connect,” and wait while your chosen folders upload to Nextcloud (plus download



Tighten security via the Administration settings.

TWEAK NEXTCLOUD SETTINGS

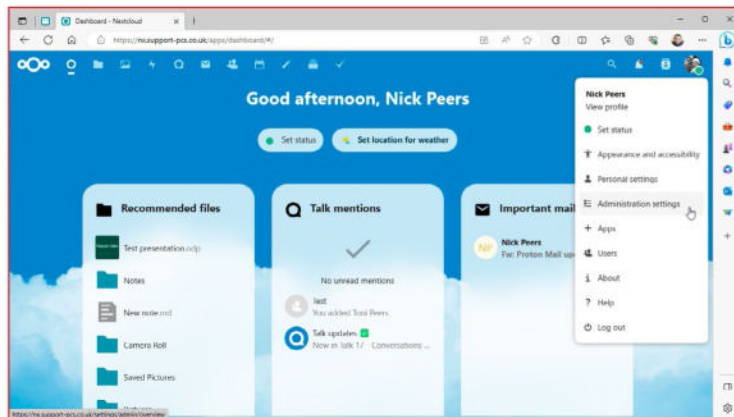
any files—such as the samples provided—to your hard drive in turn). Going forward, simply copy files or make changes to existing files as you usually would—Nextcloud detects any changes and synchronizes them to your server and from there to any other devices you’ve linked to your account.

The desktop client

The Nextcloud icon can be found in your Taskbar’s notification area—this changes depending on whether everything’s up to date: Green check mark for everything’s in sync, blue semi-circles indicating synchronizing is taking place, yellow exclamation point for something requiring your attention, and red cross indicating a configuration error.

Click the icon to reveal a pop-up notifications panel, which tracks the progress of your syncing as well as providing other useful info and options, such as a “Sync Now” button for forcing a manual sync, or to approve logins when you’ve enabled two-factor authentication on your account.

Click “...” next to a recently synched file to reveal options for sharing that file with others, or to view its own personal activity log, revealing when the file was created, and each time it was modified. This is useful because Nextcloud doesn’t simply store files, it also stores multiple versions of a file, enabling you to roll back to an earlier version. You need to do this through the Files section of the web interface—navigate to the file and click the sharing button next to it to reveal a slide-out menu with four



Get an overview every time you log into Nextcloud Hub.

tabs: “Activity” and “Sharing,” as with the desktop client, but also a “Comments” tab and, more importantly, a “Versions” tab, enabling you to preview and restore an earlier version of the file.

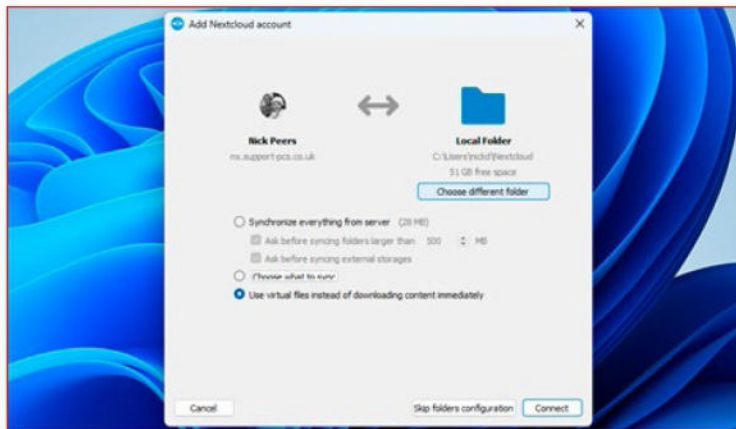
The desktop client’s notifications panel is also the place to resolve file conflicts, which occur when Nextcloud discovers two versions of the same file on different devices, but can’t determine which one is the correct version to keep. When this happens, the Nextcloud icon displays a yellow exclamation point—the file conflict is highlighted in the panel, and clicking it enables you to compare the two and choose which version to keep.

The desktop client also offers other tools—rather than go into detail here, visit <https://docs.nextcloud.com/desktop/3.9/> for a complete guide.

Use the mobile app

You can also make use of the Nextcloud mobile app to gain access to your files on the go. Once logged in, you can browse through your files and share them with others from your phone; better still, you can also upload content from your phone to your Nextcloud storage using its sharing functionality—tap the Nextcloud icon, then choose exactly where you’d like the file uploaded.

When in the app, tap “More” followed by “Settings,” and you’ll see an “Auto Upload” option—enabling this automatically uploads any photos or videos you take on your phone to your Nextcloud storage. You can choose where files are automatically uploaded to



Configuring the desktop client doesn’t take too long.

AS ADMINISTRATOR, you should go through the Administration settings, which let you set up system-wide defaults for all users. The “Overview” screen provides a shortcut to the Nextcloud AIO interface for adding, updating, and removing components. It’s also the place to review security and setup warnings—you’re prompted to set up an email server so Nextcloud can notify users by email, for instance.

This can be achieved by visiting the “Basic settings”

section, while a trip to “Security” enables you to force all users to log in with two-factor authentication, a recommended step for a public-facing service such as yours. You can also enable server-side encryption, but note the performance penalty. Most other settings here—including the Antivirus for Files feature (assuming you enabled ClamAV during setup)—should be left as they are.

Select “Sharing” to fine-tune Nextcloud’s sharing

behavior—you can, for example, force users to set expiration dates for shared links, set default shared permissions, and restrict access to other servers. Visit “Theming” to personalize the look and feel, not just of your web interface, but of any supported clients, too (you can also prevent users overriding these settings).

If you’d like to grant limited access to certain parts of the administrative settings, use “Administration “Privileges”—

add users to trusted groups, then assign those groups to specific settings. You can also find dedicated settings for each of the optional components, from the full-text search to Groupware features, as well as Office and Talk.

Finally, scroll down to the bottom of the settings and click “Logging” to see the instance’s performance and discover any errors or warnings you need to be aware of, or “System” to gain access to information about your underlying server.



(plus choose an organization structure and file name mask), limit uploads to Wi-Fi only, plus retrospectively upload your entire camera roll—be warned, this can take a long time if you have loads of photos, so plug your phone in, and be prepared to upload in batches.

Beyond backup and sync

So far, we've focused on Nextcloud's core functionality—its Files app. But Nextcloud Hub offers so much more—primarily aimed at office workers, but easily adapted to more personal uses, too. In addition to Files, you'll find Nextcloud Talk, offering private conferencing tools like those offered in Skype or Teams. There's also Nextcloud Office—a web-based office app derived from LibreOffice, with built-in collaboration tools such as shared files and group editing—and Nextcloud Groupware, which enables you to run your own calendar, contacts, and mailbox.

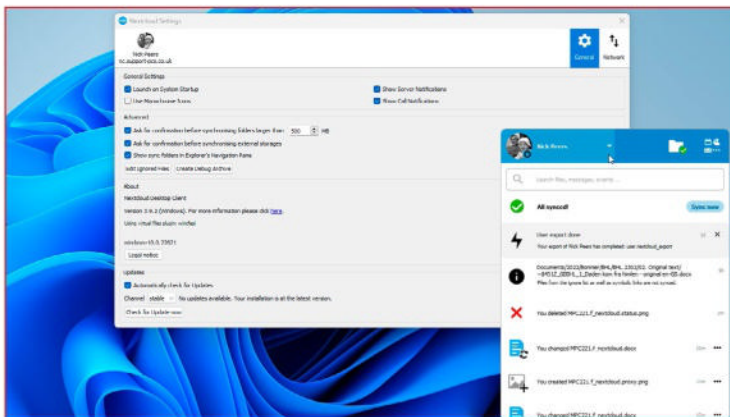
These all run as independent Docker containers but are managed by the primary Nextcloud container, so they all work seamlessly together. If you chose not to install these during the initial setup, but now wish to do so—or you want to check for updates to the underlying containers—click your user icon in the web interface and choose "Administration Settings," then click the "Open Nextcloud AIO Interface" button.

You'll see the same summary page you saw when completing the initial installation. If you've not yet done so, now would be a good time to configure periodic backups of your Nextcloud installation—it goes without saying you should store these on a different drive than where your Nextcloud data currently resides (/var/lib/docker/volumes/ on your server's boot drive).

Now click "Stop Containers," which shuts down the rest of Nextcloud (so warn anyone else using it). Once stopped, you may be prompted to install an update to the main Nextcloud AIO container—click "Update Mastercontainer" to do so. When it restarts, scroll down, and check the elements you wish to add, then click "Save Changes." Once done, click "Start Containers" or "Start and Update Containers," then wait—it may take 5-10 minutes. A status screen reveals the containers' progress as they restart (yellow, then green icons)—click "Reload" periodically until they all turn green. You're ready to continue.

Nextcloud Talk

If you're looking for a secure chat medium, Nextcloud Talk (<https://nextcloud.com/talk>) should appeal. It'll be familiar



Once in place, the client keeps you fully updated.

to anyone who has used Facebook Messenger, WhatsApp, or Skype—you can set up one-to-one or group-based chats, which can mix and match text-based chat (with attachments) with both audio and video conferencing.

By default, you need to set up separate Nextcloud accounts for everyone you'd like to communicate with—this gives them access to all aspects of your Nextcloud installation, including Files, Groupware, and Office. Nextcloud Talk can be accessed through a dedicated mobile app or via their desktop web browser (direct them toward <https://domain.com/apps/spreed/#/> for a shortcut to the Talk app).

Once logged in, click "+" next to the "Search Conversations" box. Here you can set up a conversation with title, description, and thumbnail image, plus either open up the conversation to other users on your Nextcloud instance or to guests (via direct web link), or alternately lock it down further with a password. Once done, you choose which users or groups to add, then click "Create Conversation" to add it to everyone's conversation lists.

Once opened, the conversation is easy to navigate—you can set up shared documents to collaborate on using Nextcloud Office, run polls, set up breakout rooms, and share all or part of your desktop during video calls. Install the Nextcloud Talk Recording server and you can record calls for sharing and future reference.

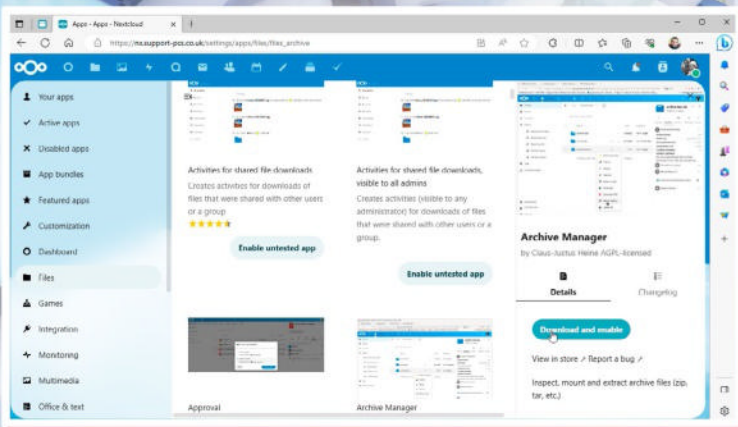
Nextcloud Groupware

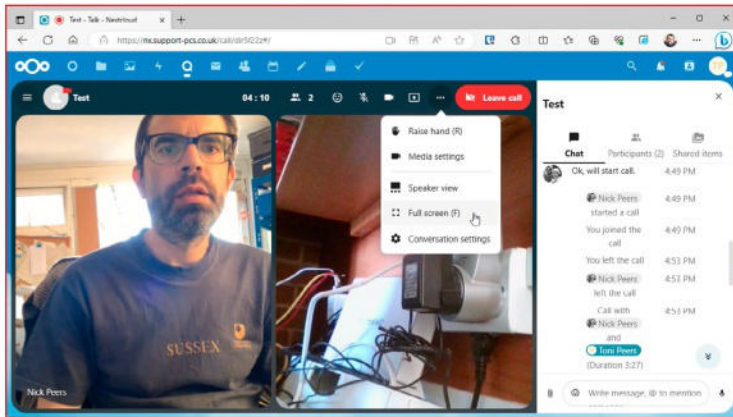
Install the Nextcloud Groupware component, and you have access to your own securely self-hosted calendar, contacts, email client, and Kanban-style deck for managing to-do lists

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EXPAND NEXTCLOUD'S CAPABILITIES

Expand Nextcloud's capabilities even further with additional apps.





Enjoy a secure chat platform by installing Nextcloud Talk.

and other projects. Each is effectively its own self-contained application, with its own shortcuts at the top of the web interface. The only one missing is Mail—the app isn’t installed by default, so you need to click your user icon and select “Apps,” then type “Mail” into the search tool at the top of the screen. Mail should be listed with “Featured” next to it—simply click “Download and Enable” to install.

You’ll see a new Mail icon appear in the list—click this to connect your chosen email account. If you’re lucky, simply entering your email address and password is sufficient to get it detected and set up; if not, switch to “Manual” to enter your mail server’s IMAP settings.

Switch to “Contacts” and you’ll see any other Nextcloud users that you have set up appear here by default, along with any groups that you have organized them into. You can also import contacts from other sources—simply click “Contacts Settings” to do so manually using individual vCard files or by connecting CardDAV-compatible contact lists. It’s a similar process for Calendars—you can start from scratch or import .ics calendars. Both apps work in much the same way other applications do—they integrate nicely with other Nextcloud apps, too, and can also be synchronized to other clients, including your operating system’s native desktop and mobile apps, as well as Thunderbird.

Rounding off the productivity tools are Notes, which is a powerful markdown-compatible editor, Deck, a Kanban-style project manager, and Tasks,

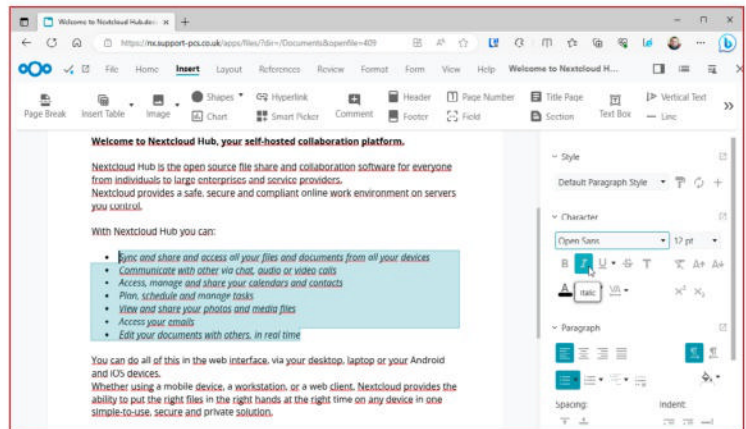
which, as you’d expect from the name, is a simple to-do list manager.

Nextcloud Office

The final major component of Nextcloud is its web-based Office tool. This is built on Collabora, the online office suite built on the back of LibreOffice. There’s no shortcut to Nextcloud Office—instead, you access it through Files by double-clicking a compatible file (typically Office files), or by clicking the “+” button and opting to create a new text file, document (word processing), spreadsheet, presentation, or diagram.

You’re prompted to give your file a new name (note that these files are created in LibreOffice’s native formats, so .odp rather than .pptx, for example), then prompted to choose from a template, if applicable, before finding yourself in the Office web-based interface. It’s a slick, ribbon-like affair, with all the tools you’d expect from your desktop office app. Crucially, you can opt to save your file in Microsoft Office formats for compatibility purposes.

And with that, we reach the end of our tour of Nextcloud Hub, your new self-hosted productivity suite. Whether you’re looking for a simple way to sync files between devices without entrusting them to a third party or want a full-blown productivity suite and secure chat medium for you and your friends, Nextcloud has you covered. And that merely scratches the surface of what it can do—check out the box below to discover what else you can add to it through the Apps store. ⏻



Edit files using Nextcloud’s web-based Office component.

NEXTCLOUD HUB is almost infinitely customizable thanks to its support for plugins, better known as apps. Select “Apps” under your profile menu to see that dozens come pre-installed with your Nextcloud instance—the “Administrative Settings > System” screen is one example of this (it’s the Monitoring app).

There’s a wide range of categories in the left-hand menu—you can add social sharing buttons for files, warnings for users when

they exceed a certain quota, add protection against brute force attacks, and integrate Nextcloud into other services, such as file viewers, translation services, other online apps (like the Draw.io diagrams editor), and more.

Think of all the services offered on your phone through Google, Apple, and various third parties, and imagine having access to similar services—from maps and phone trackers to form-creation tools—without having

to worry about who can access your data.

To learn more about an app, click it to reveal a slide-out that provides details, offers a changelog, and gives you a “Download and Enable” button. Apps with an “Enable Untested App” button haven’t been updated to work with the latest Nextcloud build. A future update might be forthcoming, or it may be that the app has been abandoned.

There are literally hundreds of apps to choose from—you

can also browse the list at <https://apps.nextcloud.com>—and your best bet is to just try them. Simply input your password when prompted, then wait for the app to download. Some, such as the Face Recognition app, may fail with unmet dependencies—sadly, these can’t be added through Docker, so save yourself time trying to troubleshoot the issue, and instead source an alternative, or move on to the next plugin that piques your interest.

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BEYOND MOORE'S LAW

Moore's Law is mostly dead, yet it stumbles ominously forward. *Jeremy Laird* investigates whether the Lord of Light can revive computing's prospects or are they already zombified?



MOORE'S LAW is dead. So says no less an authority on the subject than Nvidia CEO and leather jacket aficionado Jensen Huang (pictured below). Actually, Huang has been composing Moore's Law's obituary since at least 2017, when he expressed doubts over its long-term viability at the GPU Technology Conference in Beijing. Then at CES in 2019, Huang unambiguously decreed "Moore's Law isn't possible anymore."

It was last year during a Q&A to promote the then-hot new RTX 4090 GPU that Huang figuratively unloaded the final cap, simply saying "Moore's Law is dead." But here's the thing. If you plot the transistor count of cutting-edge chips right up to the present day, it doesn't seem like there's been any slowdown in technological progress. But surely Huang knows what he is talking about?

Actually, Huang isn't wrong. And yet transistor density in the latest chips is still increasing. You only have to glance at that logarithmic graph plotting transistor count progress since the 1970s to see that perfect straight line extends right up to today. So what, exactly, is going on?



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LET'S BEGIN with a tale of transistor counts. Specifically, in the 1970s, when transistor counts topped out at about 10,000 in a single chip. By the end of the 1980s, that count had exploded to about one million in the Intel 486 CPU. The late 1990s saw that increase to 50 million in the Pentium 4. The 2000s delivered 2.5 billion in an eight-core Nehalem-class Intel server CPU. And that RTX 4090 that Huang launched in 2022? The AD102 chip it uses packs about 75 billion of the tiny switches. And so the logarithmic increase in transistor density continues to this day.

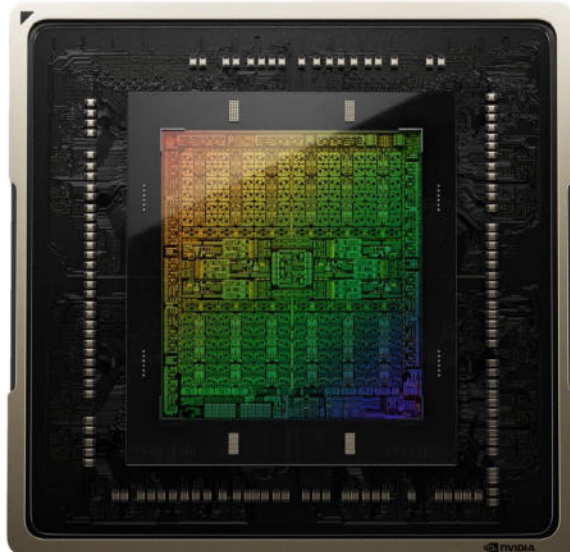
Huang's counter-analysis hinges on an often-overlooked aspect of Moore's Law that involves cost. The standard exposition of Moore's Law centers on the observation by Intel co-founder Gordon Moore that transistor densities were doubling every year back in the mid-1960s. Moore revised that down to doubling every two years in 1975. And that's been the metric ever since.

Yet it misses out a key component of Moore's observations as published in April 1965. They weren't just about transistor density. Cost per component was also critical. Moore's Law is as much about the cost of each transistor falling on the same logarithmic scale as it is about transistor density increasing. After all, if transistor density improves but



The man who started it all, Intel co-founder Gordon Moore.

Nvidia's 75 billion transistor AD102 GPU proves that transistor densities are still scaling.



the cost of each transistor doesn't come down in proportion, you end up with the prospect of exponentially more powerful chips at exponentially higher prices. Which is of no use to anyone. And that's where Huang's latest comments come in.

"A 12-inch wafer is a lot more expensive today than it was yesterday," Huang said. "It's not a little bit more expensive, it is a ton more expensive. Moore's Law is dead. The ability of Moore's Law to deliver twice the performance at the same cost, or the same performance for half the cost every cycle, it's over. It's completely over. The idea that the chip is going to go down in

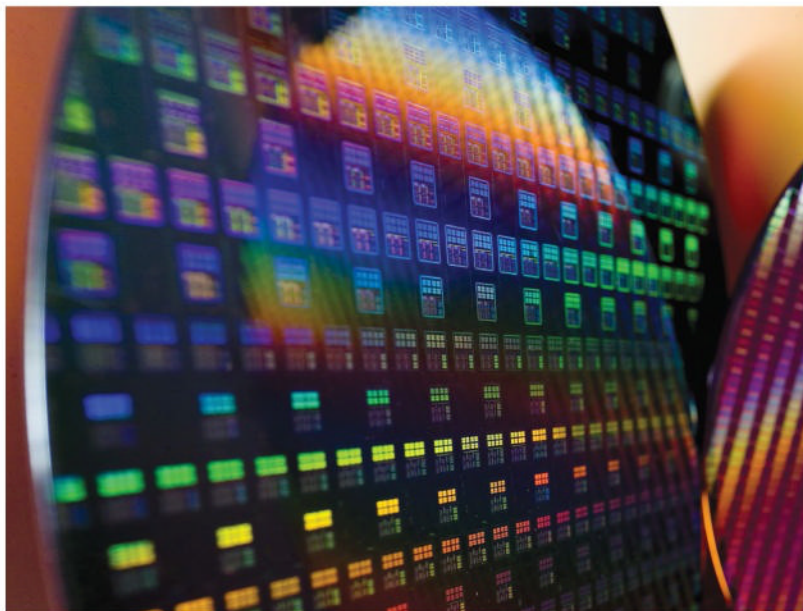
cost over time, unfortunately, is a story of the past."

As for how Huang's observations map to the reality of chip prices, it's tricky to be entirely definitive. The prices the big fabs that produce pretty much all the world's high-performance chips charge for cutting-edge wafers—and here we're talking primarily about Taiwanese megafoundry TSMC and South Korea's Samsung—amount to closely guarded commercial secrets.

Partly that's because each customer gets its own price. Apple, to take the most obvious example, won't pay the same fee per wafer of chips that AMD pays. That said, various analysts and industry observers agree on rough pricing. And it goes something like this. Back in 2018, TSMC was charging \$10,000 for each wafer produced on its then-new 7nm (or 7N in TSMC parlance) node.

In 2020, that fee increased to roughly \$16,000 for the 5N node. Launched in late 2022, TSMC's latest and greatest 3N node commands a hefty \$20,000 per wafer. Again, the prices that each customer pays will vary. So the takeaway here isn't the precise figure, but the likelihood that TSMC's customers are paying roughly double in inflation-unadjusted dollars for 3N wafers versus 7N wafers of five or six years ago.

Of course, TSMC crams many, many more transistors into a 3N wafer than its older 7N counterpart. Exactly how many varies depending



TSMC's 3nm technology is painfully pricey.

© TSMC, INTEL, NVIDIA

on how you measure, who you're asking, and which of the various iterations of a given node you're talking about. But in rough terms, TSMC 3N is at least twice as dense as 7N and, in some cases, maybe as much as 2.5 to three times as dense.

So, factoring in wafer costs, a TSMC 3N wafer offers individual transistor cost anywhere from roughly on par with 7N to about 25 percent cheaper. But the point is that the cost isn't scaling down in proportion to how the density is scaling up. That explains how Nvidia's Jensen Huang can be right about the demise of Moore's Law while transistor densities keep on increasing. Both are true.

Of course, TSMC isn't the only fab in the world. But if you want absolutely the most advanced chip manufacturing currently available, it is the only choice. Moreover, Samsung's wafer prices are also widely reported to have increased. There is one further important trend that applies to the current state of Moore's Law. Unfortunately, it's not good. Everything we've discussed so far only applies to main logic transistor density. But there's more to a CPU or GPU than just logic transistors.

Chips also contain SRAM and analog circuitry. In simple terms, the actual CPU or GPU cores, the bits that do the processing, pretty much by definition get the full density scaling from one node to the next. While this used to be the case for all parts of the chip, more recently, density scaling for other elements such as memory controllers or video output blocks has slowed.

For instance, SRAM cells in TSMC's 3N node are only five percent smaller than its 5N node. Similarly, the density of analog circuitry in TSMC's newest 3N node has only improved by 10 percent. Now, this isn't a complete disaster. The complexity of some non-logic elements doesn't really increase from generation to generation of chip architecture. It's different from adding cores or shaders to a CPU or GPU, where increased density is critical.

MOORE'S LAW IS DEAD? LONG LIVE HUANG'S LAW

OK, no prizes for who we're talking about here. But what, exactly, is Huang's Law? That's not quite as straightforward to define as Moore's Law. It's much newer and its definition hasn't quite coalesced into the same sharp relief as Moore's Law.

However, Huang's Law arguably kicked off at the Graphics Technology Conference in 2018 when Nvidia's Jensen Huang observed that his company's GPUs were 25 times faster than five years previously. Moore's Law would have only implied a circa 10 times increase in performance. So, in its simplest form, Huang's Law says that some GPUs gain performance much more rapidly than other GPUs.

So, where Moore's Law is all about transistor density and cost, Huang's Law is more about the resulting performance increases, which depend on everything from that transistor density to other elements including advances in architecture, interconnects, memory technology, algorithms, and the addition of new circuitry for accelerating specific tasks.

More recently, Huang's Law has become associated with an even steeper increase in the performance of GPUs optimized for AI workloads. By way of example, Bill Dally, chief scientist and senior vice president of research at Nvidia has observed that between November 2012 and May 2020, the performance of Nvidia's chips increased 317 times for an important class of AI calculations. Again, that's way, way beyond any expectations that could be derived from Moore's Law.

That generational increase is continuing with Nvidia's latest AI-specific chips. Nvidia says that its latest H100 AI chip offers between 2.2 and 3.3 times the performance of its predecessor A100. With roughly two years between the 2020 launch of A100 and the 2022 announcement of H100, Nvidia's performance scaling is continuing to outpace the equivalent Moore's

Law transistor density scaling, even though Moore's Law itself is no longer truly on track.

The big question is whether Nvidia and indeed other players in the AI hardware space can keep up that kind of pace or if recent advances are the function of low-hanging fruit, with future gains more reliant on the generic improvements in chip complexity in the traditional Moore's Law idiom.

There's ultimately no way to be sure. But it does seem unlikely that Huang's Law will enjoy the same 40-plus year run that Moore's Law achieved. That said, if it does, it really will be time to welcome our new AI overlords. Because the implications of 40 years of Huang's Law go beyond mere super intelligence and flirt with notions of god-like AI processing power. Exciting? Yep. Scary? Hell, yeah.



Nvidia's boss Jensen Huang has declared Moore's Law dead.

© NVIDIA

MORE THAN MOORE INTEL'S FIVE NODES IN FOUR YEARS

Moore's Law is dead, but somebody forgot to tell Intel. After all, Intel's CEO Pat Gelsinger has committed the company to delivering no fewer than five new chip production nodes in just four years. That is far beyond what even Moore's Law would dictate. Indeed, Moore's Law as it is typically interpreted would only require a new node every two years given the improvements in scaling that Intel typically delivered in its heyday. And in case you have forgotten, just keeping up with Moore's Law has been entirely beyond Intel's capabilities of late.

Arguably Intel was already struggling in the early 2010s. But it was in the latter half of that decade when the wheels well and truly came off. 2014 saw the rollout of Intel's 14nm process, itself somewhat delayed. In 2016, Intel ought to have made the jump to 10nm. But it wasn't until 2019 that the company began shipping 10nm CPUs in any significant volume, and it took another two years before you could buy a 10nm desktop CPU from Intel.

So, it was seven years between nodes when it came to desktop CPUs from Intel. After which, we are to believe that Intel will introduce five nodes in just four years. Yup, we want some of what Intel is smoking.

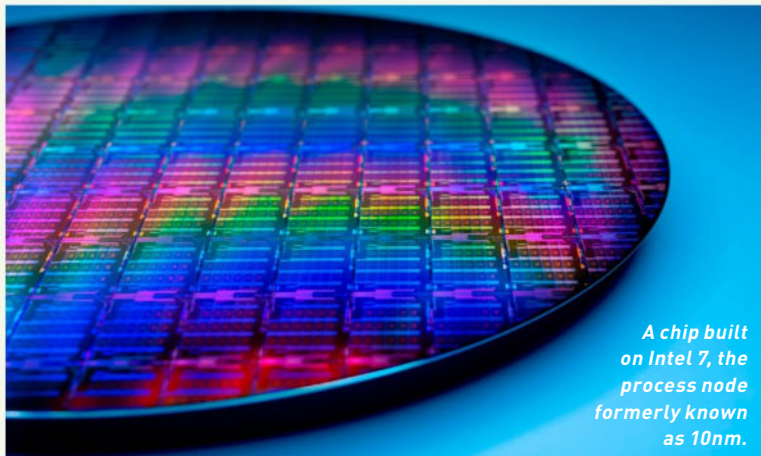
Of course, some of this hinges on the definition of a node. The nodes

in question are Intel 7, Intel 4 which is supposedly in production right now but has yet to appear in a chip that can be bought, followed by Intel 3, Intel 20A, and then, finally, Intel 18A, which will bookend Intel's great technological leap forward in 2025.

If you parse those nodes in detail, the plan isn't quite as ambitious as it first seems. Intel 7 turns out to be Intel 10nm rebranded, Intel 3 is basically a fancied-up Intel 4, and the same applies to Intel 18A, which isn't truly a fully new node and instead an enhancement of Intel 20A.

In truth, we're talking about only three nodes. But still, that's three nodes in four years right after at best a five-year gap in nodes and arguably more like six or seven years. By any standard, three nodes in four years is still ambitious. And, if Intel pulls it off, it will likely regain its traditional status as the producer of the world's most advanced computer chips.

Will it happen? Our best guess is no. There are already signs that Intel 4 isn't flying out of the door as rapidly as planned. And the self-imposed schedule leaves almost no margin for error. Really, the only thing in Intel's favor is that much of its plan involves catch-up rather than actual innovation. So, the know-how for that already exists. But the odds Intel really is leading the world again in 2025? Slim at best.



A chip built on Intel 7, the process node formerly known as 10nm.

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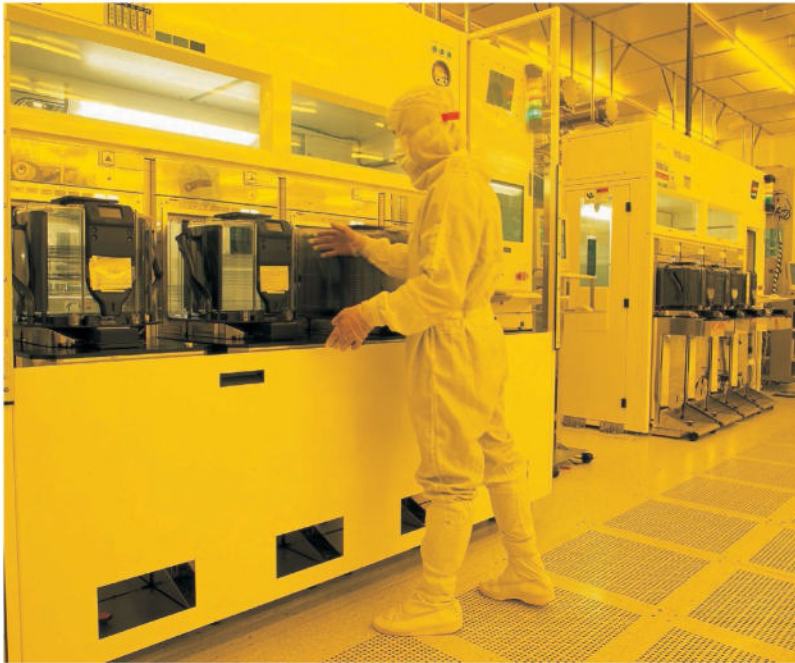
But it does mean that, at best, some elements aren't getting much smaller. Indeed, this is one of the main reasons why AMD has shifted to a chiplet architecture for its latest GPUs and CPUs. For AMD's CPUs, functions like the memory controller and I/O, which aren't scaling well now in density terms, are placed into a separate die from the CPU cores. Since the latest nodes don't offer huge density advantages for the elements of the non-core die, it makes sense to use an older, cheaper node for that chiplet, reserving the pricey cutting-edge node for the CPU core chiplet.

AMD has taken the same approach with its latest Radeon RX 7900 Series graphics. Those GPUs contain a main GCD or Graphics Complex Die with all the shaders and other processing elements. The GCD is surrounded by a number of MCDs or Memory Complex Dies housing memory controllers and cache. Again, the GCD elements scale well with the latest nodes and the memory controllers and cache less so. And so AMD has the GCDs built on TSMC's 5N node and the MCDs on 6N, with 6N really being a slightly revised version of TSMC's 7N node.

Anyway, the point here is that not only are the costs going up, but at least some parts of chip scaling are slowing significantly, too. By the strict definition, then, Moore's Law is already dead. Transistor costs are no longer falling at the requisite rate and the density scaling itself has become at least in part problematic.

But that doesn't quite address what we all want to understand when we worry about the possible demise of Moore's Law. Which goes something like this. If Moore's Law is dead, does that mean that CPUs, GPUs, and the rest will no longer become more powerful? Has the assumption that, a few years from now, you will be able to buy the same amount of PC power for a lot less money—or a lot more PC for the same money—keeled over?

The simple answer is yes, that assumption can no longer be fully



TSMC's transistor density is keeping up with Moore's Law, but not its costs.

relied upon. A more complicated one is that it won't stop computing devices from becoming more powerful in some cases, much more powerful. The main immediate solution is the broad category of heterogeneous computing. In fact, it's already happening and has been for years.

Heterogeneous computing basically involves the use of specialized circuitry designed to do specific tasks well. The most obvious example is, of course, the GPU itself. It processes graphics orders of magnitude faster and more efficiently than doing the same job on general-purpose CPU cores. Indeed, GPUs themselves are arguably heterogeneous computing devices. Modern GPUs have all manner of different circuits for doing everything from processing geometry and rasterizing pixels, to accelerating ray tracing and processing AI algorithms for tasks like upscaling.

It is possible, for instance, to fully process ray-traced graphics purely on a GPU's shader cores. But it's far slower than running the same workload on Nvidia's specialized RT cores. Energy usage often falls dramatically with heterogeneous computing devices. Again, video is one of the best examples here. Hardware-accelerated video

decoders can stream high bitrate 4K video for a fraction of the energy consumption of the same job on the main CPU cores of a PC, laptop, or smartphone.

One of the best things about the heterogeneous computing paradigm is that it can be done at a relatively low cost. It doesn't require any exotic new manufacturing processes, but it does need investment in new circuit designs. In many cases, heterogeneous computing does dictate new software coding and support requirements. But it's very much the real world and here today tech that is already helping to keep the progress in effective compute power with which Moore's Law has been associated on track, if not Moore's Law itself.

As for other options to reboot Moore's Law or get it back on track, inevitably there is a long list. One obvious candidate is 3D transistor stacking, again, a technology that already exists. But to drive Moore's Law, it will need to be radically developed. Moreover, 3D stacking is surely only a short-term fix. If the underlying silicon doesn't evolve, there will be a limit to how many layers of transistors that can practically be stacked upon one another.

Beyond that, we're entering speculative territory, including the use of novel materials, including gallium nitride, boron arsenide, and graphene on the one hand, or new technological paradigms, such as room temperature superconductors,



AMD has gone multi-chip with its latest graphics cards thanks to the increasing cost of silicon.

on the other. It's possible that such new materials and technologies could entirely revive Moore's Law. But equally, we're nowhere near commercial availability yet and there's no reason to assume that will ever happen.

All of which means that Moore's Law is at best zombified. Though it's technically dead, it is still stumbling around and it will take the Lord of Light and all his powers of revival to bring it back. Even if that does happen, we wouldn't bet too heavily on it surviving all that long before being struck down again, at least in terms of the traditional measures of chip complexity and cost. If we're being entirely honest, we doubt that even measures such as heterogeneous architectures will do more than temporarily delay the looming winter.

In fact, perhaps the best hope for something akin to a long-term resuscitation of Moore's Law probably hinges on the development of AI tools. These will, in turn, enable new and hitherto unimagined innovations to come to fruition. But whether the result will be a golden new summer for advanced computing or feel like a zombie march into a whole new kind of winter, time will tell. Our advice? Wrap up warm. One way or another, winter is coming. ☹️



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- Restore the Windows Start menu to its 'classic' design.
- Restore useful tools Microsoft removed from the taskbar.
- Safely reinstall the original version of Windows Movie Maker.
- Remove the Bing Chat button from Windows 11 search.
- Expand the Windows clipboard to store up to 500 items.
- Add tabs to File Explorer windows in Windows 10.
- Stop Microsoft showing ads in different areas of Windows.

MICROSOFT HAS NEVER been guided by the principle of 'if it ain't broke, don't fix it'. Over the years, it has made many pointless and controversial changes to Windows for the purposes of innovation.

Notable blunders include the botched introduction of User Account Control in Windows Vista, which constantly asked for your approval to perform the simplest of tasks; the ill-advised scrapping of the Start menu in Windows 8 in favor of a touch-optimized Start screen; and its strict system requirements for Windows 11—plus more messing around with the Start menu.

In fairness to Microsoft, it often backtracks on its decisions when enough users complain and now actively

seeks the feedback of members of its Windows Insider programme (tinyurl.com/bdf3k8bw) before it makes 'improvements'. However, there are still plenty of things that annoy us about Windows, from unnecessary changes to useless tools Microsoft has forced on us and useful ones it has removed.

In this feature, we explain how to solve these problems and take back control of your PC. As Windows 10 won't receive any more updates (apart from security patches), it's up to you to apply your own, while Windows 11 remains a work in progress that keeps finding new ways to irritate us. We start by revealing the 10 worst changes Microsoft has made to Windows, and how to reverse them.

10 WORST CHANGES MICROSOFT HAS MADE

1 Messing up the Start menu

The Start menu is the most frequent target of Microsoft's tampering. It was ditched in Windows 8, then restored in 8.1, but bloated with live tiles that carried over to Windows 10. In Windows 11, Microsoft moved the Start menu from its traditional home in the bottom-left corner of your screen, and replaced its list of programs with a grid of pinned and recommended apps, which now includes ads for its products and services.

HOW TO FIX IT

The easiest way to restore the Start menu to its former glory is to install Open-Shell (tinyurl.com/mr2rdhh2). This free tool changes the Windows 10 Start menu to a classic, compact list, which gives you easy access to your programs, recent items, Windows settings, shutdown options, and more. You can then customize it using different layouts and skins.

In Windows 11, because Microsoft has put a Widgets button where the Start button used to be, you first need to open Open-Shell's Menu Settings, click the Start Menu Style tab, and tick the 'Replace Start button' box (see screenshot above right). Choose your preferred button design, and the Start menu will be restored to its rightful place in the bottom-left corner. To hide the Widgets button, right-click the taskbar, choose 'Taskbar settings', and switch off Widgets.

Alternatively, you can keep the Windows 11 Start button and menu, but place them in their traditional position, bottom left. Select 'Taskbar behaviors' in 'Taskbar settings', then click the 'Taskbar alignment' dropdown menu, and change the setting from Center to Left.

2 Forcing its Edge browser on users

The Chromium version of Edge is a great browser (especially compared with Internet Explorer), but with so many

other options to choose from—including Chrome, Firefox, Brave, and Vivaldi—not everyone wants to use it. Microsoft annoyed many Windows 11 users by making it difficult to set anything other than Edge as your default browser, and though it's now rectified this blunder, it still won't let you uninstall Edge.

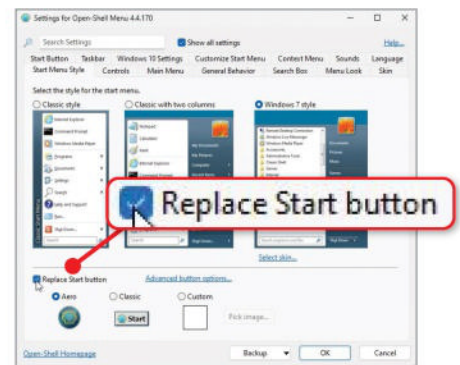
When you try to remove the browser through the Apps section of the Settings app in Windows 10 or 11, or through 'Programs and Features' in the Control Panel, you'll find that the option is grayed out or unavailable. Microsoft says this is because Edge is "an essential component of our operating system", but we beg to differ.

HOW TO FIX IT

Even powerful uninstallers such as BC Uninstaller (www.bcuninstaller.com) and O&O AppBuster (tinyurl.com/bpasarhb) can't remove Edge from Windows 10 or 11. The only method we've found to work involves running a batch script created by a GitHub developer called AveYo.

Visit the Edge Removal.bat page at tinyurl.com/39e5dyhv and click the 'Copy raw file' icon in the top-right corner of the script—this looks like two overlapping squares. Open the Notepad app on your PC, and paste the batch script's code into it. Click the File menu, choose Save As, and select All Files in the 'Save as type' dropdown menu. Enter a name for the file, and type .bat at the end—for example, Uninstall_Edge.bat—then click Save.

Make sure Edge isn't running, then double-click the batch file to run it. Click 'Yes' to allow Windows PowerShell to make changes to your PC. PowerShell will then run the script to uninstall Edge from Windows (see screenshot below left)—ignore the bit at the end about setting up another browser. The script also removes the Edge Update component that automatically reinstalls the browser.



Restore the classic Start button and menu to Windows using Open-Shell.

If you experience any problems with Windows after the removal, visit tinyurl.com/27b8s45m to download and install the latest version of Edge. You'll need to delete the registry key: HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Image File Execution Options\msedge.exe\0.

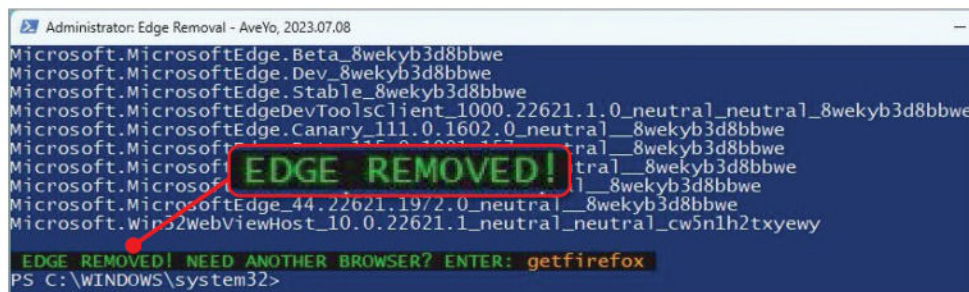
3 Removing useful taskbar options

Microsoft's obsession with 'streamlining' Windows tools has resulted in several useful options disappearing from the taskbar. Most notably, in Windows 11 you can no longer move the taskbar to the side or top of your screen—it's firmly rooted to the bottom; its icons are centered rather than aligned to the left; and there aren't any labels to show you, for example, the title of the active tab in your browser or which folder you have open in File Explorer.

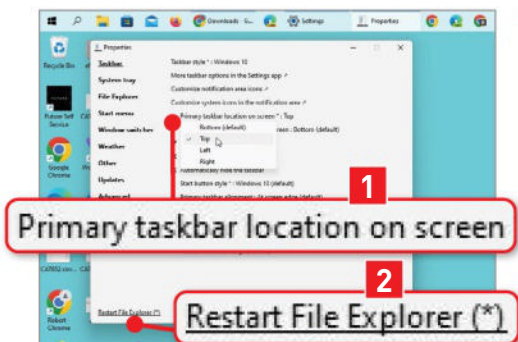
HOW TO FIX IT

We've already explained how to move your Start button and other icons to the left, but to fix other taskbar problems you need Explorer Patcher. Download this excellent free tool from tinyurl.com/vfj72xst—click the 'ep_setup.exe' link under Assets—then run the installer. Click 'More info' then 'Run anyway' if you see a Microsoft Defender SmartScreen warning—the program is completely safe to use.

Explorer Patcher will automatically apply a Windows 10-style taskbar to Windows 11, including left-aligned icons and proper labels that tell you the title of each open window. Best of all, you can move the taskbar



A batch script is the only reliable way to remove Edge from Windows 10 and 11.



Explorer Patcher can move Windows 11's taskbar to the top or either side of your screen.

elsewhere on your screen. Right-click it and choose Properties, then Taskbar. Click 'Primary taskbar location on screen' (1 in our screenshot above) and select either Top, Left, or Right. Click 'Restart File Explorer' (2 to move the taskbar to your desired position.

We also like the option to display a Windows 7-style visual clock in both Windows 10 and 11. Click 'System tray' in Explorer Patcher's Properties, select Clock, and choose Windows 7 to restore the classic design when you click the taskbar clock. You can also add seconds to the clock.

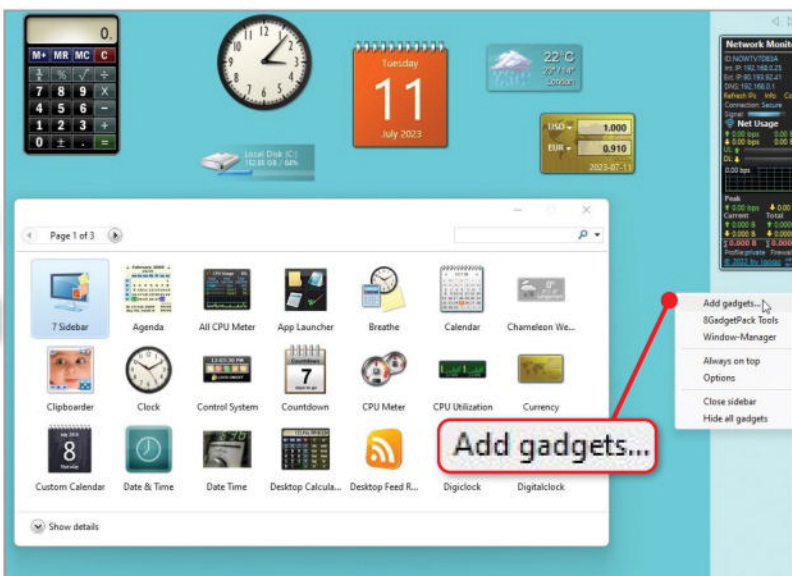
4 Discontinuing desktop gadgets

One of our favorite features in Windows 7 was Gadgets, which let you add small apps to your desktop that displayed the time, weather, your CPU usage, an audio player, and other useful tools and information. Gadgets were discontinued from Windows 8 onwards, partly for security reasons, but also because Microsoft wanted to promote its app store instead. "Some apps are better versions of the gadgets you love," it claimed (tinyurl.com/a7rpm8kd).

The Widgets feature in Windows 11 is no substitute, because it doesn't let you move widgets around, but presents them all in a pop-up panel. However, there are rumors that Microsoft plans to introduce widgets that work more like gadgets (see tinyurl.com/y725ajk9), so perhaps it regrets ditching them.

HOW TO FIX IT

Until gadgets—or something like them—are formally revived, you can use 8GadgetPack (8gadgetpack.net) in Windows 10 and 11. This unofficial—

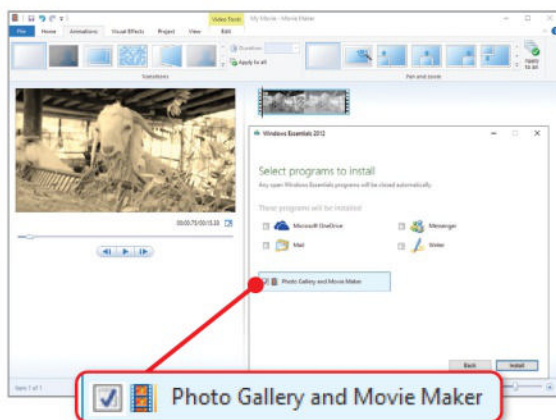


8GadgetPack brings Windows 7's Gadgets feature to Windows 10 and 11.

but completely safe—program offers more than 60 gadgets, including a clock, calendar, calculator, currency converter, sticky notes, and monitors for your hard drive, network, and laptop battery.

Click the plus sign in the top-right corner of its side panel, or right-click it and choose 'Add gadgets' (see screenshot above) to select the gadgets you want, then drag them to suitable positions on your desktop. You can then resize them, configure their content and design settings, adjust their opacity, and move and remove them as required. You can also access your gadgets by right-clicking your desktop.

To hide your gadgets and get a clearer view of your desktop, right-click the sidebar (select the 7 Sidebar gadget if you can't see this) and choose 'Hide all gadgets'.



Restore Movie Maker to Windows using a Wayback Machine workaround.

5 Abandoning Windows Movie Maker

Microsoft's popular video-editing program Movie Maker was included in every Windows version from XP to Vista, then made available in Windows 7 as part of the Windows Live Essentials suite. Following its final release in 2012, Movie Maker was officially discontinued in 2017 and replaced by the video editor in Windows 10's Photos app.

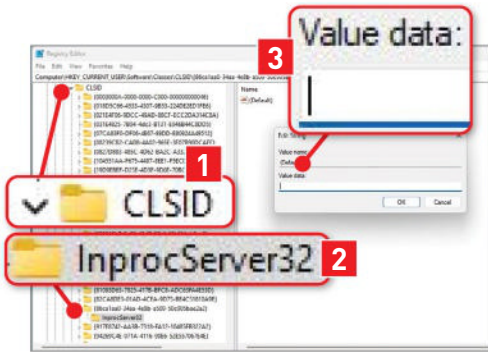
Windows 11 also includes the Photos app, as well as Microsoft's new video-editing tool Clipchamp, but many of us still miss the speed and simplicity of Movie Maker, and believe it should never have been scrapped.

HOW TO FIX IT

Clipchamp, which you can install in Windows 10 from tinyurl.com/24fhe9vd, is a versatile video editor, but it's not as easy to use as Windows Movie Maker. It also limits some features to its paid-for plan, and you need to create an account to use it.

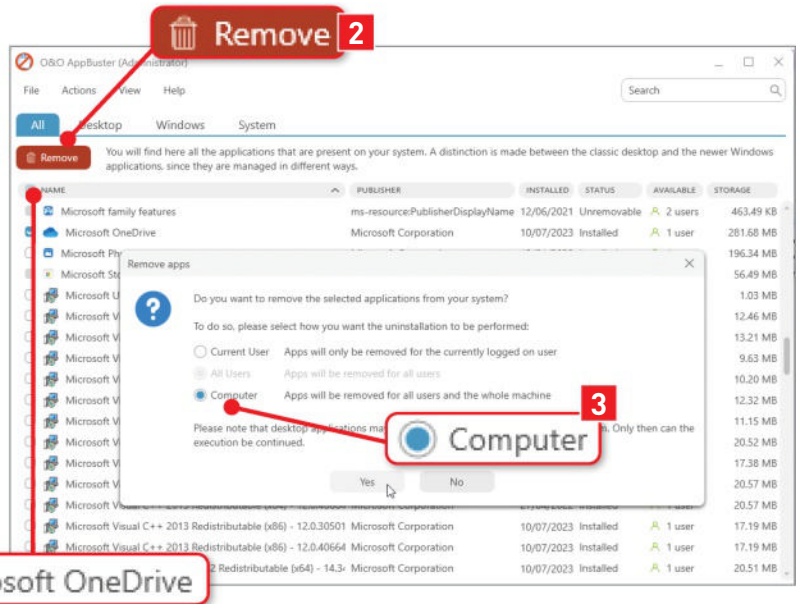
Some websites claim to offer the original Movie Maker, but these downloads are usually fake or infected with malware. One workaround is to use the Internet Archive's Wayback Machine to access an archived version of Microsoft's Windows Essentials 2012 download (tinyurl.com/y736e2tx—the download will start immediately).

Run the installer, click 'Choose the programs you want to install', and untick everything except 'Photo Gallery and Movie Maker'. Click 'Install'



Tweak the Windows 11 registry to restore the classic right-click context menu.

O&O AppBuster removes all traces of OneDrive from your Windows PC.



to add Movie Maker to Windows 10 or 11, where you can launch it from the Start menu.

If you don't feel comfortable installing 11-year-old software, the best modern alternative to Movie Maker is OpenShot Video Editor (www.openshot.org). This is packed with useful features and effects, and is free and easy to use.

6 Truncating the right-click menu in Windows 11

Your right-click context menu can gradually become bloated with unnecessary options, so we understand Microsoft's reason for truncating it in Windows 11. But having to choose 'Show more options' every time you want to see the full list of entries adds an extra step, which is pointless when the menu isn't particularly long.

HOW TO FIX IT

You can tweak Windows 11's registry to make it show you the full context menu when you right-click. To do so, type 'regedit' into the search box and click 'Run as administrator' under Registry Editor. Navigate to the registry key HKEY_CURRENT_USER\SOFTWARE\Classes\CLSID (1 in our screenshot above), then right-click it and choose New, then Key. Name the new key {86ca1aa0-34aa-4e8b-a509-50c905bae2a2} (you can copy and paste this from our Pastebin account at tinyurl.com/2tswafne), then right-click it and choose New followed by Key.

Name this key InprocServer32 (2), press Enter, and double-click Default

in the right-hand pane. Ensure the new key's 'Value data' is blank (3) then click OK. Restart your PC, and when you right-click you'll now see the classic Windows 10-style context menu.

7 Replacing the original Snipping Tool

The Snipping Tool in Windows has a pretty convoluted history. Introduced in Vista as a way to capture screenshots without installing a third-party program, it was replaced in Windows 10 by an app called 'Snip & Sketch'. However, perhaps because users didn't take to the new tool, Microsoft never removed Snipping Tool from Windows 10.

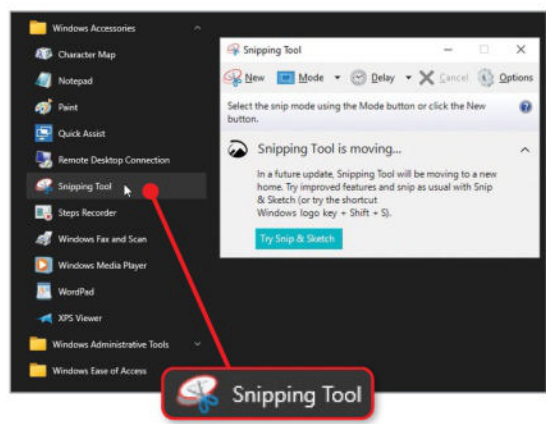
In Windows 11, it created a hybrid of the two options, again called Snipping Tool, but which lacks the simplicity of the original. Matters were made worse this year when it was reported that a security

flaw in 'Snip & Sketch' for Windows 10 and Snipping Tool for Windows 11 allowed other people to see parts of a screenshot you'd cropped out. The classic and—some would say—superior Snipping Tool suffered no such problems.

HOW TO FIX IT

You can still use the original Snipping Tool in Windows 10, though it displays a warning that it will be "moving to a new home in a future update" (it won't, because Windows 10 won't receive any more updates). Either type 'snipping tool' into the search box, or browse to the Windows Accessories section of the Start menu (see screenshot below left) to launch the tool.

If you upgraded your PC from Windows 10 to 11, the old Snipping Tool should still be available on your hard drive. Browse to the folder C:\Windows.old\Windows\System32 and look for the file 'SnippingTool.exe', then the folder C:\Windows.old\Windows\System32\en-GB and find the file 'SnippingTool.exe.mui'. Move, or copy and paste, these files into the folders C:\Windows\System32 and C:\Windows\System32\en-GB respectively. Right-click the first file and choose 'Send to' then 'Desktop (create shortcut)' to create a desktop shortcut for the classic Snipping Tool.



You can still use Snipping Tool in Windows 10 instead of 'Snip & Sketch'.

8 Forcing OneDrive on Windows users

As with Edge, Microsoft integrated OneDrive with Windows in the hope that you'll use it for all your online

storage needs. This gives you a convenient means of backing up your files to the cloud, but if you prefer a rival storage service, OneDrive just gets in the way. It consumes memory in the background, slows your boot time by running on startup and nags you to sync your files, even if you never use it.

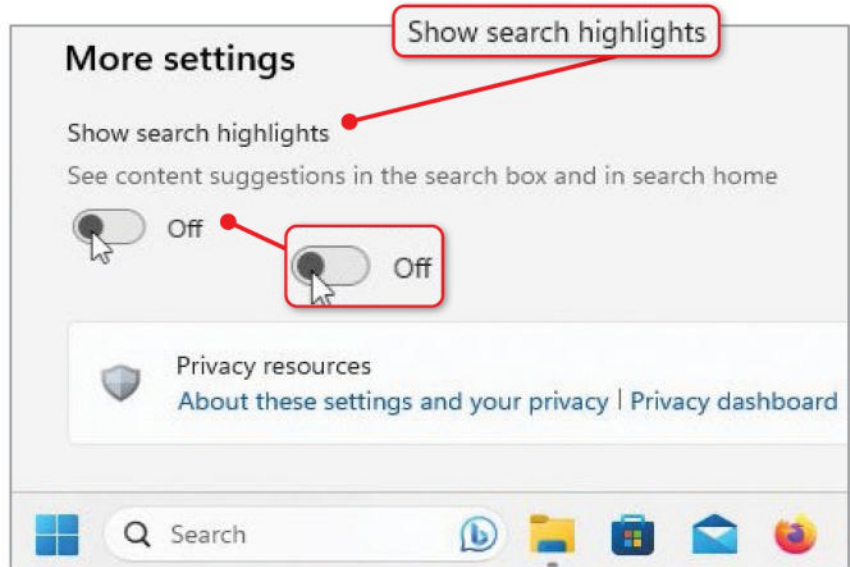
HOW TO FIX IT

To disable OneDrive without uninstalling the app (in case you ever need it), click its system-tray icon, then the cog in the top-right corner, and choose Settings. Click the Account tab, and select 'Unlink this PC'.

You can uninstall OneDrive through the 'Apps & features' list in Windows 10 or 'Installed apps' in Windows 11. However, this won't remove every trace of the service from your system, which means it may be reinstalled by a future Windows update. To permanently purge your PC of OneDrive, we recommend running O&O AppBuster. Select 'Microsoft OneDrive' in its All list (1 in our screenshot above), click Remove (2) and choose Computer (3). Click Yes, then optionally create a system restore point, and OneDrive will be gone. You can reinstall it from tinyurl.com/yc5yd356, should you need to.

9 Ditching Windows Media Player for Groove Music

When Microsoft introduced Xbox Music (later renamed Groove Music) in Windows 8, it intended the app to replace the aging Windows Media Player. By combining an audio player with a streaming service (Groove Music Pass), it hoped to compete with Apple iTunes and Spotify. However,



Remove the Bing Chat shortcut from the Windows 11 search box.

the majority of Windows users weren't impressed and preferred the features and traditional design of Media Player.

Microsoft eventually admitted defeat and, although Groove Music was initially included in Windows 11, it was soon replaced by a new version of Windows Media Player. This brought back options Groove lacked, including video playback and the ability to rip tracks from audio CDs.

HOW TO FIX IT

This is one mistake Microsoft has rectified itself, but if you're running Windows 10, you may still have the old version of Media Player installed. This hasn't been updated for ages, so earlier

this year Microsoft made the new Windows 11 app available to Windows 10 users too.

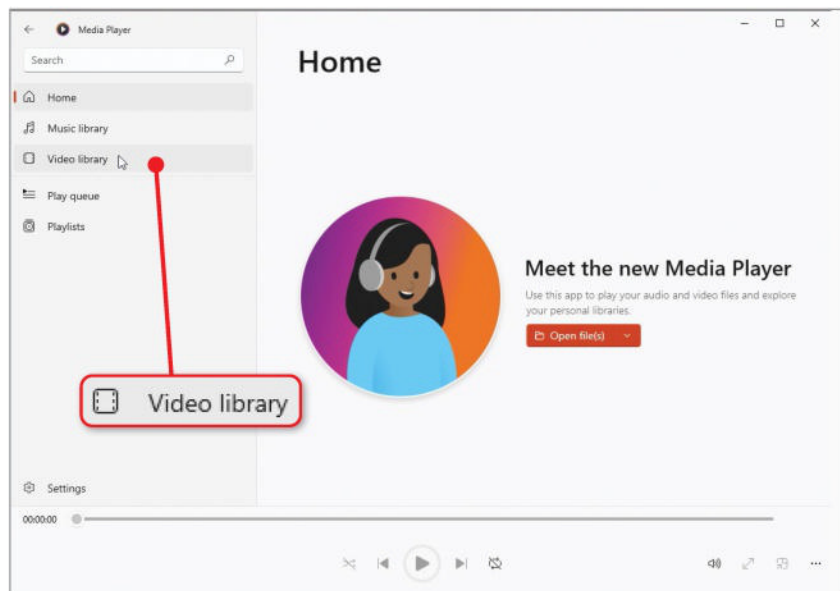
Install the new Media Player app from the Microsoft Store (tinyurl.com/2rsrsx92) and it will automatically import your music library and playlists from the old Media Player and Groove Music. To add videos, click 'Video library' (see screenshot below left), then the Open Settings button. Switch on 'Allow apps to access your videos library', and grant access to Media Player.

10 Adding Bing Chat to Windows 11 search

Microsoft is so keen to promote its new AI-powered Bing Chat that it's added the feature to tools including Edge, Skype, its SwiftKey keyboard, and—rather pointlessly—the Windows 11 search box. Currently, all the button does is open Bing Chat in the Edge browser—you can't interact with the chatbot directly from your desktop. This means it just brings more clutter to the taskbar, and is even less helpful than Microsoft's much-maligned—and now abandoned—voice assistant, Cortana.

HOW TO FIX IT

Thankfully, it's possible to remove Microsoft's latest unasked-for addition to Windows, though the option is tucked away. Press Windows key+I to open the Settings app and select 'Privacy & security'. Click 'Search permissions' and, in the More settings' section, switch off 'Show search highlights' (see screenshot above). The Bing Chat shortcut will now disappear from the Windows 11 search box—you can eventually restore it when it actually does something.



Use the new Media Player in Windows 10 and 11 instead of Groove Music.

IMPROVE WINDOWS TOOLS THAT MICROSOFT IGNORES

Modernize the Run command

The Run command, which you access by pressing Windows key+R or right-clicking the Start button and choosing Run, has been around since Windows 95 and hasn't changed much since. You can now perform most of its actions via the Windows search box, which might be why Run was overlooked in Microsoft's recent refresh of 'classic' tools, and remains tucked away.

The best way to upgrade the Run command is to replace it with the flexible free tool Flow Launcher (flowlauncher.com). This lets you quickly search and run files and programs on your PC, as well as websites in your browser, through a simple box that you launch by pressing Alt+Space (or your preferred keyboard shortcut).

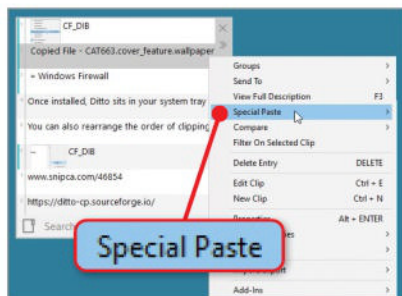
You can customize Flow Launcher's appearance using colorful themes; adjust its size and default position on your screen; and add lots of extra features using plug-ins created by other users. These include searching sites using DuckDuckGo bangs, performing calculations and conversions, cleaning up your desktop and much more. Right-click the search box, and choose Settings then Plugin Store (see screenshot above right) in order to browse the full range.

Flow Launcher triggers a SmartScreen warning, but it's safe to use, so just click 'More info' then 'Run anyway'.

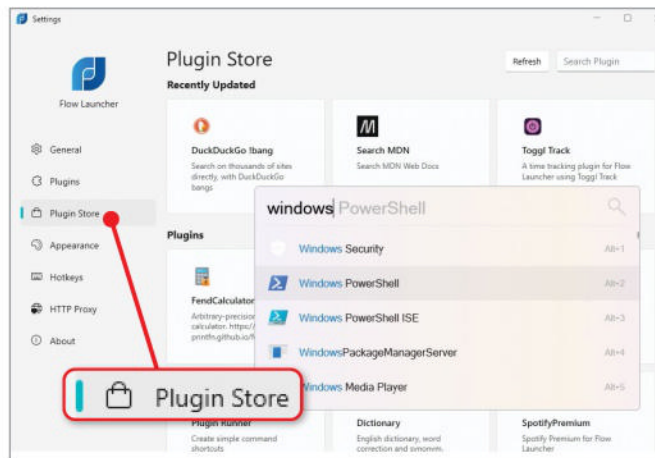
Expand the Windows clipboard

The clipboard is another essential but often overlooked Windows tool, which most users don't realize can do more than just copy and paste selected items. Windows 11 slightly improved the clipboard history (which you access by pressing Windows key+V) by adding a 'Clear all' button, but it remains very basic.

To get the clipboard you really deserve, install the brilliant free tool Ditto



Ditto extends the Windows Clipboard to improve your copying and pasting options.



Flow Launcher offers a speedy way to find and run Windows files and tools.

QTTabBar adds Windows 11-style tabs to File Explorer in Windows 10.

(ditto-cp.sourceforge.io), which gives you more control over how you copy and paste content. It can store up to 500 items, compared with the Windows clipboard's 25, including text, images, web links, and more, and doesn't delete them when you switch off your PC.

Once installed, Ditto sits in your system tray and saves whatever items you copy to its clipboard, either by using the standard Ctrl+C keyboard shortcut, or by right-clicking and choosing Copy. To launch the tool itself, press Ctrl+, and to keep it constantly visible, click the three-dot button, and select Quick Options then Always On Top.

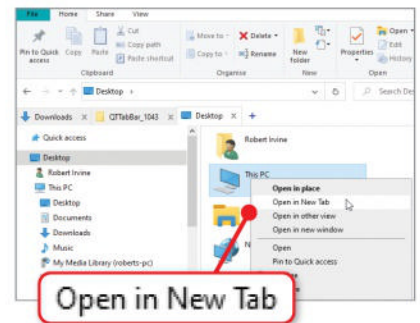
You can search your clippings for specific words; edit the content of text you've copied; and simply double-click an item to paste it wherever your cursor is positioned. Alternatively, press Ctrl+V, or right-click the item and select Special Paste (see screenshot below left) to change its formatting.

When you install Ditto, tick the box to allow an exception in the Windows Firewall to stop it being blocked.

Add tabs to File Explorer in Windows 10

Microsoft has been lavishing attention on File Explorer in Windows 11, streamlining its interface, adding the long-awaited tabs, and promising more new features later this year (see tinyurl.com/2yjxh8c). In Windows 10, File Explorer will remain forever unchanged unless you do something about it yourself.

One option is to replace File Explorer with the feature-packed free alternative Files (<https://files.community>), which we've recommended several times over the last year. But if that seems too drastic, you can at least add tabs to File Explorer



using QTTabBar (tinyurl.com/vk3f6m5c). This lets you open File Explorer folders in new tabs by right-clicking them and choosing 'Open in New Tab' (see screenshot above), or by clicking the plus button and selecting a folder. You'll first need to click the View tab in File Explorer, and select QTTabBar in the dropdown Options menu.

Apply better desktop wallpapers

Windows 11 has a feature called Spotlight, which displays a different image from Bing on your desktop every day. These high-resolution photos are often stunning, and you can 'like' or 'dislike' them to influence future pictures you see.

To activate the feature, right-click your desktop and choose Personalize then Background. Click the dropdown menu next to 'Personalize your background', and select 'Windows spotlight' to apply your first image.

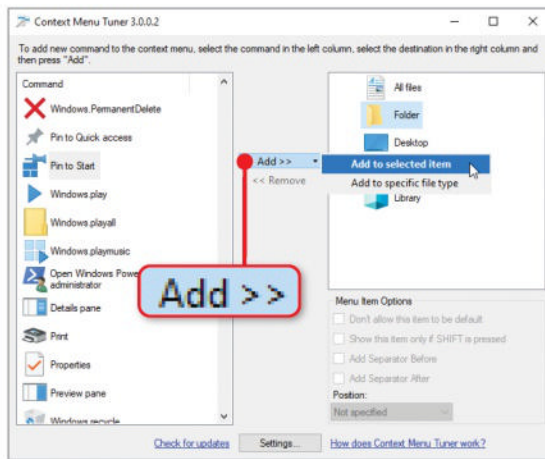
In Windows 10, Spotlight pictures can be displayed on your Lock screen, but Microsoft has never extended the feature beyond that. To get Bing backgrounds on your desktop, you need to install its Bing Wallpapers tool (tinyurl.com/39x6mpww), which allows you to "explore the world one photo at a time".

As in Windows 11, the background image changes daily, and you can click the tool's taskbar icon to apply pictures from the previous seven days. Make sure that you untick the boxes that set Bing as your homepage and search engine.

Customize the Windows context menu

Microsoft shortened the right-click menu in Windows 11, so clearly it doesn't think that the feature is as important as we do. It's true that a long context menu can be unwieldy, so it's worth customizing its entries so that they include all of the options you need, as well as excluding any you don't.

Our favorite free tool for adding options to the right-click menu is Context Menu Tuner from Winaero ([tinyurl.com/5n7w6jfe](https://www.tinyurl.com/5n7w6jfe)). Select a command in the long list on the left, then click Add (see screenshot above right) and choose whether to add it to the context menu for your desktop, hard drive, folders,



Context Menu Tuner adds useful new options to your right-click menu.

somewhere on your hard drive. Rather than improve the tool's capabilities, Microsoft has focused on adding web options that open its Edge browser and Bing search engine.

To make your Windows searches faster and more accurate, install Everything from www.voidtools.com. This free

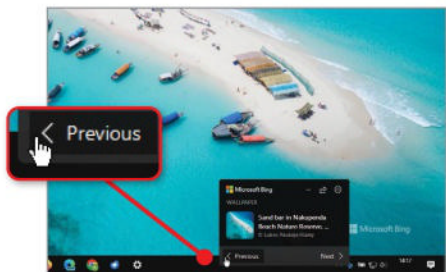
program focuses on local searches rather than online ones, and quickly indexes all the files and folders on your hard drives. It displays results as soon as you start typing a query into its search box, and lets you filter them by type—click the Search menu, and choose an option such as Document (see screenshot below), Folder, Executable, Picture, or Video. You can also sort them by size, date created and other attributes by clicking the View menu and choosing 'Sort by'.

To add Everything to your taskbar, so you don't need to open the program to use it, install EverythingToolbar ([tinyurl.com/yyvtjcnj](https://www.tinyurl.com/yyvtjcnj)). Launch the tool by clicking its magnifying-glass taskbar icon, and type your search query. If you can't see this icon in Windows 10, right-click the taskbar, choose Toolbars, then Everything Toolbar and restart your PC. In Windows, choose 'Taskbar settings', then 'Other system tray icons', and switch on Everything Toolbar.

The search tool built into the taskbar in Windows 10 and 11 is slow and inaccurate, often failing to find files you know are

The program has an option in its Preferences to 'Replace Start menu search', but this is experimental and doesn't seem to work yet. Click 'More info' then 'Run anyway' if you see a Smart Screen warning during installation.

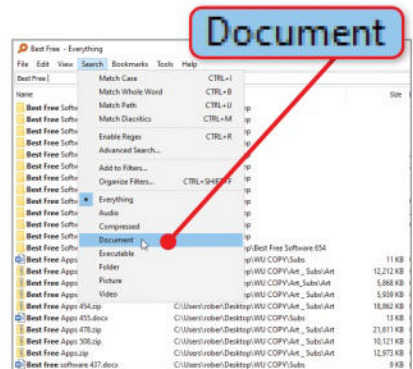
You can filter Everything's comprehensive Windows searches by file type.



Apply stunning photos to the Windows 10 desktop using Bing Wallpapers.

Speed up and improve Windows searches

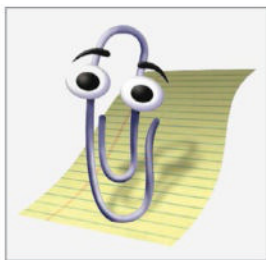
The search tool built into the taskbar in Windows 10 and 11 is slow and inaccurate, often failing to find files you know are



You can filter Everything's comprehensive Windows searches by file type.

Bring back Clippy in Windows 10 and 11

Microsoft's old Office assistant Clippit, commonly known as Clippy, was roundly mocked in its heyday (from Office 1997 to 2003). The animated paperclip would pop up uninvited to observe that you were writing a letter (even when you weren't), and offer to help. Nowadays, Clippy has nostalgic appeal, and can even be seen as a precursor to AI chatbots, so an enterprising developer called FireCube has brought him back—with new AI capabilities.



paperclip (pictured), click the link to get an OpenAI API key. Sign up for a free trial (you need to provide your phone number for verification), then click Personal in the top-right corner. Select 'View API keys', click 'Create new secret key', and click the 'Create secret key' button to generate a key.

To add Clippy to Windows 10 or 11, install 'Clippy by FireCube' from the Microsoft Store ([tinyurl.com/2fn75fjx](https://www.tinyurl.com/2fn75fjx)). When the app opens to show the

Next, right-click the Clippy icon in your system tray to open the app's settings, select 'OpenAI Api' and paste your API key. Click the Save icon, close and reopen Clippy, and you'll be able to interact with the AI assistant. Note that OpenAI's free trial limits your number of API tokens to \$5 of credit, which expires after three months.

SETTINGS TO CHANGE TO MAKE WINDOWS GREAT

Turn off ads and suggestions

Windows often displays notifications to recommend particular tools and promote Microsoft software such as Microsoft 365. These 'suggestions' and ads can be annoying, so disabling them will improve your Windows experience.

In Windows 10, open Settings, choose System, then 'Notifications & actions', and untick the 'Get tips, tricks and suggestions as you use Windows' box (see screenshot right). It's also worth disabling 'Show me the Windows welcome experience' and 'Suggest ways I can finish setting up my device' to block them.

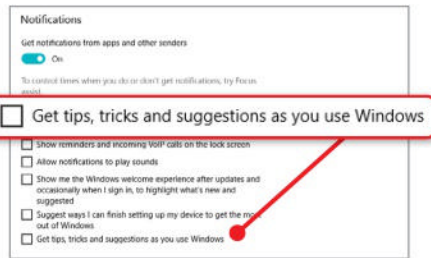
To access these options in Windows 11, open Settings, select System, then Notifications, and click 'Additional settings' at the bottom of the screen.

You should also disable ads in your Start menu. Go to Personalization in the Settings app, choose Start, and switch off 'Show suggestions occasionally in Start' (in Windows 10) or 'Show recommendations for tips, shortcuts, new apps and more' (in Windows 11).

Tighten your privacy settings

Windows is set up to collect data about how you use your PC and software, and share it with Microsoft for various purposes, including troubleshooting, personalization, and advertising. Its privacy settings are confusingly spread across several screens to make it difficult to plug every hole that lets Windows spy on you. Rather than simplify these options, Windows 11 adds more, and most are enabled by default.

Thankfully, help is at hand from the fantastic free 'antispy tool' O&O ShutUp10++ (tinyurl.com/y8zrtuh7), which is frequently updated to address



Make Windows less annoying by disabling its suggestions and ads.

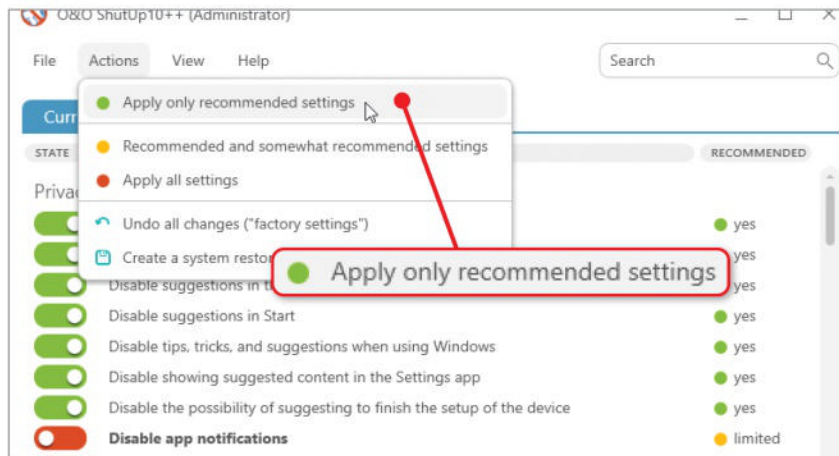
the latest Windows privacy concerns. The most recent version (1.9.1435) adds an option to stop the new Windows Media Player (see page 53) sharing diagnostic data with Microsoft.

The easiest way to use ShutUp10++ is to click its Action menu and select 'Apply only recommended settings' (see screenshot below). You can also browse its long list of options to configure them individually—either just for you (Current User) or your whole PC (Local Machine).

Ensure System Restore is enabled

Considering the importance of System Restore when something goes wrong (letting you go back to when everything was working), we're baffled as to why Microsoft has buried it in Windows 10 and 11. Rather than access it via the Settings app, type 'system restore' into the search box and click 'Create a restore point', or open the Run box and type `sysdm.cpl`.

Still, it's vital you ensure that System Restore is enabled, in case disaster strikes. Check the list of drives in the Protection Settings box to confirm that protection is 'On' for your main hard drive. If not, click Configure, select 'Turn on system protection' and click OK.



Apply ShutUp10++'s recommended privacy settings to stop Windows spying on you.

5 Windows tools we're glad Microsoft ditched

CORTANA

Microsoft's virtual assistant never really took off, with most Windows users finding it more annoying than helpful. Cortana has already vanished from the Windows 10 and 11 taskbar, and will be discontinued later this year, as Microsoft focuses on its new AI-powered Copilot tool.

INTERNET EXPLORER

The death of IE has been a protracted one, with traces of the much-maligned browser still remaining in Windows 11. Microsoft ended support for Internet Explorer in June 2022, before finally retiring the browser in February in favor of Edge.

GROOVE MUSIC

As we mentioned on page 50, Microsoft has now replaced Groove Music with a revamped Windows Media Player. Groove Music had its fans, but its clunky interface couldn't compete with Spotify and Apple Music.

TIMELINE

Introduced in 2018 as a way to track and sync your PC activities, Timeline was a privacy nightmare. As well as storing your activity history so anyone who accessed your PC could see what you'd been doing, it shared the data with Microsoft.

TEAMS CHAT

Later this year, Microsoft will remove the Teams Chat feature from the Windows 11 taskbar. We suspect that this is because most home PC users never used it, so it just served as another taskbar annoyance.

CHOOSE THE BEST VPN PROVIDER

Nate Drake gives you the rundown on how to select the very best VPN service for your needs

1996 WAS A GREAT YEAR. Major League Soccer came to the US for the first time, and the N64 was released in Japan and the USA. It's also the year that brilliant Microsoft and US Robotics employees helped to create PPTP (Point to Point Tunneling Protocol), birthing the very first VPNs (Virtual Private Networks).

The original idea was that employees working remotely could securely 'dial in' to their corporate network to access resources. This meant any internet-connected computer could effectively become a part of any intranet.

PPTP has since been superseded, but the basic mechanics of modern VPNs

are much the same—the 'client' creates an encrypted 'tunnel' to a VPN server, through which they can then access the network and the internet.

Recent years have seen the rise of many dedicated VPN online services, which allow users to connect to the internet via the provider's own servers.

Connecting in this way means that a user's IP matches that of the server itself, so they can appear to be in a different country. This is a good way to access geo-restricted content like Netflix.

Still, not all VPN services are created equal. In this guide, you'll discover how to pick the best one for your needs.

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WHY WOULD YOU WANT A VPN?

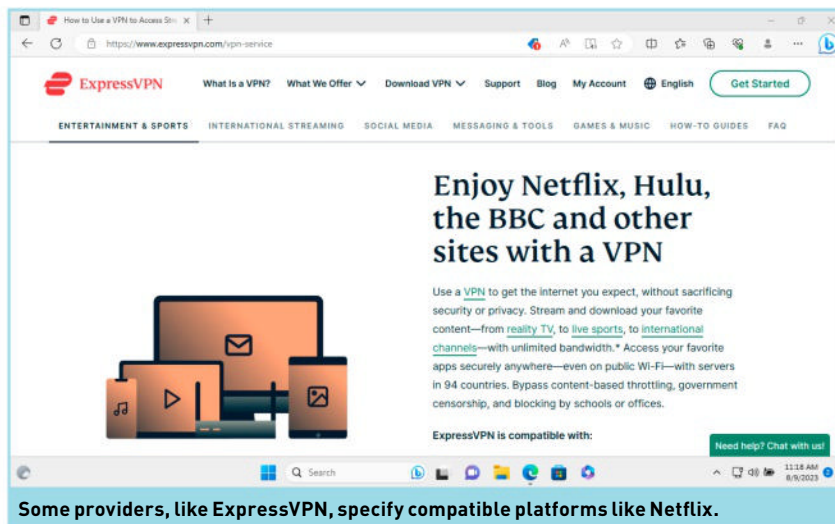
This may seem like an obvious question, but they have many uses. If you've been researching VPN services online, you may already think that you have the answer, since many offer protection from malware, safety from hacking, and guarantee online privacy.

If you believe this, it's time for some hard truths. Firstly, using a VPN in itself doesn't guarantee your privacy online. While your client device can establish an encrypted connection to the VPN server, even if set up correctly this simply makes it much harder for your ISP to track your online activities.

In simplest terms, the VPN server to which you connect fetches online content for you, so if that server is compromised by a hacker or corrupt VPN employee, your personal data is at risk. If your VPN client software is compromised or your VPN service only supports weaker protocols, you can also be targeted by hackers directly. Of course, connecting to the internet directly is no guarantee of online safety either, but it's important to understand that when you subscribe to a VPN service, you're just shifting your trust from your ISP to your VPN provider.

This may not trouble you as much if you want to use a VPN for other reasons. For instance, if your VPN provider has servers in multiple countries, you can use it to access content that would otherwise be geo-restricted. This can be handy if, for instance, you're on vacation in Europe and want to watch shows on Netflix USA.

If you plan to use your VPN service in this way, first check their website to make sure they have multiple server locations for the country in which you appear to be. This is important, as some online platforms like Netflix actively scan for



Some providers, like ExpressVPN, specify compatible platforms like Netflix.

VPN usage and may not play content if you appear to be connecting from the IP of a known VPN server. If your provider has hundreds of different server locations then all you usually need to do is switch VPN servers and try again.

Ideally, try to sign up to a VPN service that offers a free trial so you can test it out with your chosen platform. That way there's no risk if you're still blocked.

Aside from securing your connection and watching TV abroad, VPNs have other uses. For instance, ISPs often engage in bandwidth 'throttling' or 'shaping', where they deliberately slow down types of content, like streaming video. If you connect via a VPN, however, all data is encrypted, so your ISP can't discriminate in this way. Some VPN providers like NordVPN even have specialist servers for content like P2P downloads.

Some websites (particularly for airlines and hotels) can also display

different prices, depending on your location. You can take advantage of this 'price discrimination' by connecting via a server based in another country.

Thinking about why you want to use a VPN will help you make better choices when deciding on a service. Privacy lovers will want a VPN with a "no logs" policy and strong encryption protocols. People who want to access geo-restricted content will be more motivated by the number and locations of servers. Research your chosen provider to be sure that they meet your needs before clicking 'Subscribe'.

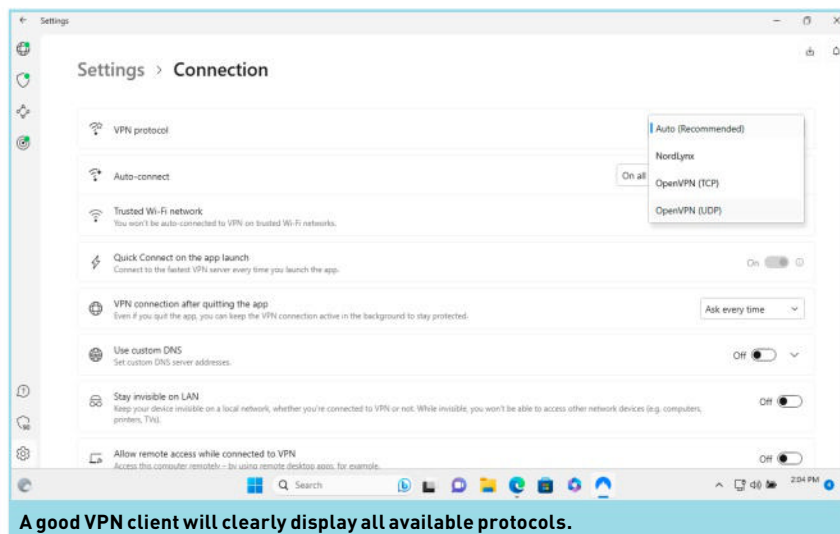
CONFIGURING CLIENTS

Now that you have a clearer idea of why you need a VPN, it's time to peek beneath the hood of your chosen provider. It stands to reason that if you want to make use of the VPN on a certain device, like your PC, you'll need to be sure that your provider offers a compatible client.

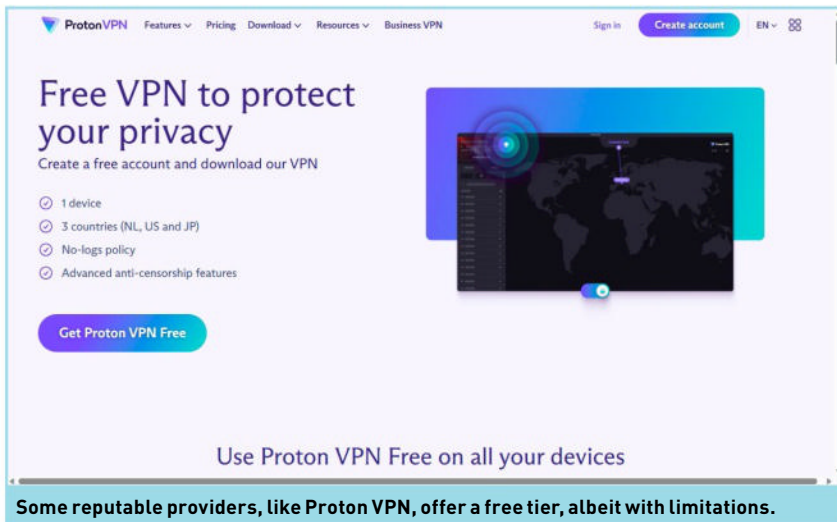
This isn't quite as simple as it sounds, though—some VPN providers place a limit on the number of devices linked to your account that can connect to their service. For instance, NordVPN is limited to six simultaneous connections, though you can install the software on as many compatible devices as you want.

Check that the VPN client is compatible with the specific version of your operating system. For instance, Surfshark users can now use the fully featured GUI client, but only if they're using a relatively recent Debian-based distro.

If you're connecting to a VPN for privacy reasons, then the best VPN providers are those like Mullvad, which use an open-source model for their clients. This means the code used to develop the programs is publicly available, so can be checked by experts for any security bugs/backdoors.



A good VPN client will clearly display all available protocols.



BYOC (BRING YOUR OWN CLIENT)

If you have your heart set on a VPN provider whose own client isn't open-source, you may still be able to connect via the open-source OpenVPN or Wireguard clients.

If your provider supports the OpenVPN protocol (see below), you should be able to connect to their OpenVPN servers via the dedicated Connect Client (<https://openvpn.net/client/>) available for all major platforms. Your VPN provider will usually provide you with server details via simple configuration (.ovpn) files, which you can download via your account.

There's also an open-source client that supports connecting to VPN servers via Wireguard (<https://www.wireguard.com/install/>). It runs on Windows, macOS, and most forms of Linux. This usually involves generating encryption keys and downloading configuration files via your account.

THE POWER OF PROTOCOLS

VPN protocols govern how your client communicates with the VPN server. Set up correctly, these can secure your data and make for a nearly seamless experience. There's debate about which is best, so it's best to familiarize yourself with the most popular ones and make your own choice.

PPTP

PPTP (Point to Point Tunneling Protocol) is the original VPN protocol. Due to its age, it's supported natively by most operating systems. It also runs fast as it uses MPPE (Microsoft Point to Point Encryption) to secure connections, which has many known weaknesses. It's also fairly easy to detect and block. It's very unlikely that a VPN provider will use this protocol, but we mention it here for completeness.

SSTP

SSTP is a (slightly) more secure successor to PPTP, first introduced in Windows Vista. It's also supported natively in subsequent versions of Windows. SSTP uses SSL/TLS to encrypt connections, which is much more secure than MPPE. As it works on the same port used by HTTPS traffic (TCP 443), so VPN traffic is harder to detect and block. SSTP uses SSL 3.0 to authenticate and encrypt connections, which makes it vulnerable to data being intercepted via the POODLE attack.

L2TP/IPSEC

Layer 2 Tunneling Protocol (L2TP) was originally released in 1999 as a joint creation of work done by both Microsoft and Cisco. L2TP doesn't authenticate or encrypt any data by itself, but can work with IPsec protocols to encrypt data between client and server using AES encryption. Using L2TP with IPsec effectively involves encapsulating your data twice, which can slow down data processing and transmission speeds relative to more modern protocols.

IKEV2/IPSEC

Internet Key Exchange Version 2 (IKEv2) is a protocol that was developed by Microsoft and Cisco. It has a number of features, including NAT-T (Network Address Translation Traversal), minimal latency, and MOBIKE (Mobility and Multihoming Protocol) support. These make for a fast, stable VPN experience. It's supported by virtually all devices, and reestablishes broken connections automatically.

Like L2TP, IKEv2 is usually combined with IPsec. It supports a number of encryption algorithms, including 256-Bit AES. IKEv2 is closed-source and usually needs to be manually configured.

FREEDOM ISN'T FREE

Running a VPN is an expensive business. The provider has to maintain multiple servers and provide huge amounts of bandwidth. This means that if a VPN service is claiming to be 100 percent free, you have to wonder how they keep the lights on.

Some "free" providers pay the bills by selling customer data to marketers, which can undermine your privacy. Others may restrict bandwidth via a data cap, which means they monitor your usage.

In 2019, research by Top10VPN revealed that one in five of the top 150 free Android VPN apps could be a potential source of malware, while a quarter of the apps contain privacy-compromising bugs such as DNS leaks, which can give away a user's location.

Given that free VPN services don't have many resources behind them, they tend to have fewer servers, meaning that it's easier for online services like Netflix to detect and block them. They also tend to employ older protocols using weaker encryption.

In 2022, "free" Chinese VPN app 'Airplane' was found to have leaked nearly 6 billion users' data entries, including names, IP addresses, and domain requests. This means that the VPN provider was spying on user activity.

Note that we're drawing a distinction here between supposedly "free" VPN services and reputable paid services like Proton VPN, which offer a free tier. It's clear how these providers are making their money, and usually you only pay extra for more features, such as a wider selection of servers.

If you're on a tight budget, we recommend signing up with a reputable, low-cost VPN provider. Our sister website, TechRadar, maintains a list of the best of these, along with in-depth independent reviews. (<https://www.techradar.com/vpn/cheapest-vpn>). You can also reduce pro rata VPN prices hugely by paying upfront for 12 or 24 months.

PLUGGING THE LEAKS

Using client software from a reliable VPN provider means your connection will be routed via their servers, so your real public IP address is hidden.

If, however, your provider allows DNS requests still to be handled by your ISP so your DNS queries are plain to see, this could give bad actors a complete list of what sites and other online services you've accessed. This is known as 'DNS Leak'.

Check with your chosen VPN provider before signing up that they do, in fact, process DNS requests via their own service. Even if they confirm you're safe, you should always run some tests of your own.

The easiest way to do this is to use your VPN client to connect to a server in a country other than your own. Next, load up one of the many DNS leak test websites out there. (Our personal favorite is <https://ipleak.net>).

Under 'DNS Address', you should see the IP address for a DNS server in the same country as your VPN server, not that of your ISP. If you don't see this and your VPN client is connected, contact your provider to check your settings.

Sharp-eyed visitors to sites like these might also see want to check for leakage by WebRTC. This implements STUN (Session Traversal Utilities for NAT), a protocol that can allow websites to discover your public IP address, even if you're using a VPN. Luckily, this is easy to disable in-browser.

The new IPv6 standard is still not supported by many VPN providers. Your VPN client should block all IPv6 traffic automatically to prevent your public IP from being exposed in this way, but if not, you can disable IPv6 altogether by changing your Network Adapter Settings in Windows. Most routers can also be configured to automatically block IPv6.

The screenshot shows the Ipleak.net interface. At the top, there's a search bar and a navigation menu. Below that, a message states: "This is the kind of information that all the sites you visit, as well as their advertisers and any embedded widget, can see and collect about you." The main content area is divided into three sections:

- Your IP addresses:** Shows a public IP of 157.194.36, located in the United States - Washington, PacktHub S.A. It also indicates "No forwarded IP detected. If you are using a proxy, it's a transparent proxy." There are buttons for "Browser default: IPv4 (225 ms)" and "Fallback: Fail (error)". A red dot indicates "IPv6 test not reachable. (error)".
- Your IP addresses - WebRTC detection:** A message says "If you are now connected to a VPN and you see your ISP IP, then your system is leaking WebRTC requests".
- DNS Address - 1 server detected, 52 tests:** Shows a DNS server IP of 193.229.64.223, located in the United States - Washington, PacktHub S.A. It also shows "104 hit". A message below says "If you are now connected to a VPN and between the detected DNS you see your ISP DNS, then your system is leaking DNS requests".

At the bottom of the screenshot, a blue banner reads: "Sites like ipleak.net can check your public IP address isn't exposed whilst you're connected to a VPN."

Your VPN provider may be able to help with this.

OPENVPN

This protocol has been around since 2001. It's secure, open-source, and highly configurable working via both UDP and TCP. Authentication and encryption are handled by OpenSSL, so like SSTP, VPN traffic is harder to distinguish from regular HTTPS.

OpenVPN is also open-source (hence the name), and is supported on virtually every platform.

WIREGUARD

This open-source VPN protocol is the new kid on the block, having first been developed in 2016. It uses around 4,000 lines of code, which makes it much easier to audit than OpenVPN, which weighs in around 70,000. Wireguard employs the very latest encryption protocols, such as Curve25519 and ChaCha20.

Connections to VPN servers using Wireguard are much faster than OpenVPN, though if your provider supports OpenVPN DCO (Data Channel Offload), which also operates in the kernel space, speeds are more comparable.

CUSTOM PROTOCOLS

Recognizing the pros and cons of various popular protocols, some VPN providers have taken it upon themselves to develop their own.

For instance, WireGuard has no built-in way to allocate dynamic IP addresses. In other words, you could be using the same IP each time you connect to your VPN provider, making it easier for you to be tracked. This is why NordVPN developed their own 'Nordlynx' protocol

based on WireGuard, which uses Double NAT (Network Address Translation) to circumvent this problem.

Other providers have created protocols to solve other issues. For instance, VyperVPN developed their own 'Chameleon' protocol based on OpenVPN to try to disguise traffic and prevent VPN blocking.

If you're privacy conscious but still want to use a custom protocol, remember again that the gold standard is open-source ones such as ExpressVPN's 'Lightway'.

The fact that a provider uses their own protocols isn't in itself cause for alarm, but as a minimum you should expect them to support OpenVPN and Wireguard. If they become cagey when asked about which specific protocols they support, change your VPN service immediately.

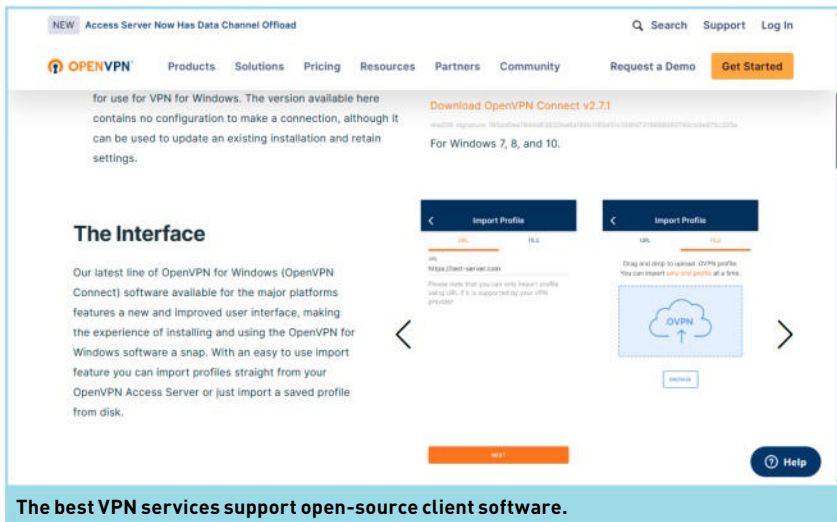
KILLING YOU SOFTLY

If by now you're connected to your VPN service and have plugged the various IP leaks, you can rest assured that your public IP address will appear to match that of the VPN server.

This has a number of advantages. We've already discussed how appearing to be in a different country makes it easier to access geo-restricted content. If you're gaming or engaging in some otherwise innocent activity, it also makes you harder to target by hackers, who can only launch attacks against the server, not your home network.

Still, this only holds true for as long as your connection is established to the VPN service. If it drops out for any reason, you could mistakenly go online and reveal your real IP.

This is where the "kill switch" comes in. It's a failsafe built into your client



software, which means if the VPN connection drops, the kill switch activates and blocks your device's internet access. This prevents you accidentally sending data outside of the secure VPN tunnel.

The most popular type of kill switch, such as ExpressVPN's "Network Lock", only blocks your internet access if the VPN drops unexpectedly. If you manually disconnect, or close the VPN app, the kill switch is disabled.

Other types of kill switch won't allow any kind of internet access unless you're connected to the VPN, even if you manually disconnect.

The only way to know for sure whether your client software supports this is to check with your VPN provider. If they don't have this feature yet, consider setting up the OpenVPN Connect App to connect, as it has its own kill switch.

LOGGING OFF

Pretty much every VPN provider boasts that they have a "no logs" policy. In other words, when you connect to their service, they don't record any personal information about users that would later be used to monitor their browsing habits.

This means if a VPN server were hacked or the provider were subpoenaed, none of your personal data would be stored. This is hard to accomplish in practice. Most providers require you to log in via email address and password. Customers also usually pay for accounts via credit card.

You can mitigate this risk a little by setting up a separate email to log in to your VPN and choosing a provider who supports payment via anonymous methods like cryptocurrency. Still, the best you can really hope for is a provider who doesn't store any of your web activity on their servers once you disconnect.

When selecting a provider, first establish where they are based. If their main office is in a jurisdiction like the USA, then they could be subjected to a secret court order to record your location, as happened to Ross Ulbricht, founder of the underground website 'Silk Road'.

If your provider is subjected to such an order, they're usually forbidden from revealing this to the user they're monitoring. This is why some providers, like NordVPN, maintain a 'warrant canary'. This is a regularly published statement to say that they have not been subjected to such requests. If the canary fails to sing on cue, users know their privacy is at risk.

Presuming your provider is in a 'safe' jurisdiction, check their privacy policies to confirm that they mean by "no logs". Select providers like ExpressVPN, who regularly submit to independent audits to check their no-log policy is in place.

DOUBLING DOWN

The most common way users deploy a VPN service is to establish a direct connection between their device and a VPN server, which they can then use to access online content.

This is usually sufficient to protect your privacy, but if your VPN server was compromised, your browsing data could be leaked. In 2018, NordVPN suffered a breach to a server in Finland operated by a third-party data center. This was patched and no user data was leaked, but the risk to anyone connecting via that server was real.

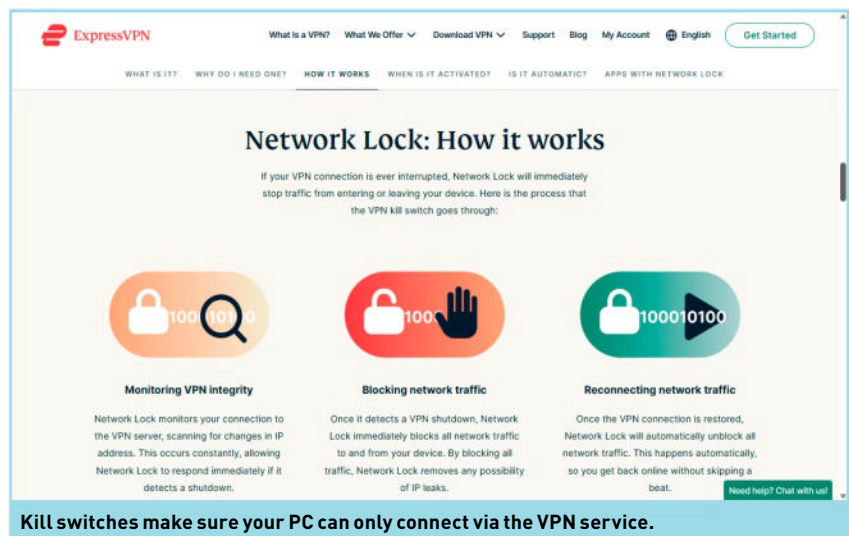
Even if the server itself isn't breached, anyone monitoring a connection to a single VPN server can carry out "correlation" or "timing" attacks to try to compare incoming/outgoing connections to encrypted network traffic, undermining anonymity and privacy. This is a particular worry when using a VPN in countries that practice strict internet censorship.

This is where "Double VPN", also known as "multi-hop", is useful. It involves adding a VPN server to your existing one, linking the connections together. Web traffic is encrypted twice and only processed via the second VPN server.

This means the first server can identify you from your real IP address/login credentials, but has no record of your web activity. The second server processes your web activity, but doesn't know your real IP address or login credentials.

While using double VPN, your IP address appears to be that of the second server. 'Correlation' attacks are much harder, and someone who wanted access to your web activity would need to compromise both servers.

Naturally routing your traffic through two servers rather than one increases



latency, so it's not ideal for streaming or online gaming. Not all providers offer Double VPN/Multi-hop, so check their support pages if you want to do this.

THREAT LEVEL MIDNIGHT

Certain providers do more than just offer a VPN service by coupling it with some form of "threat protection". This may take the form of extra apps to help you stay safe online or a simply block lists of domains known to contain malware.

This is probably why the myth persists that VPNs can provide protection from malware or other types of hacking. The bottom line is that no VPN service is a substitute for using common sense online, as well as dedicated security software.

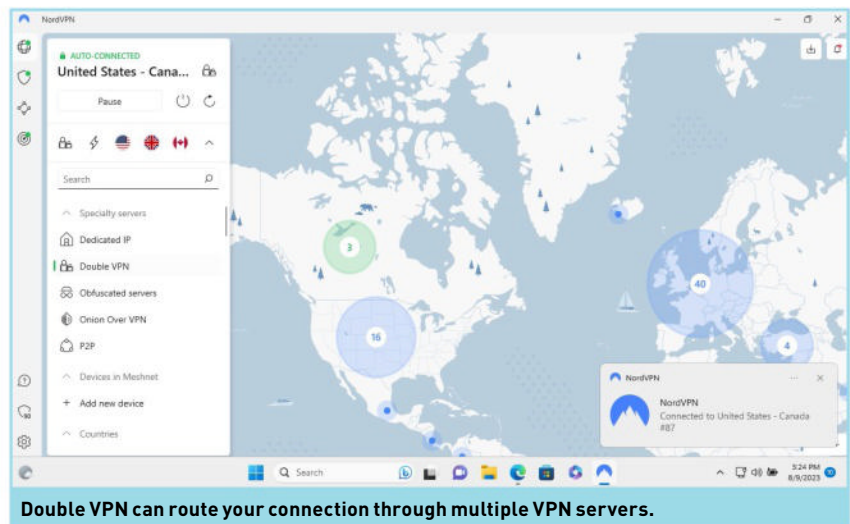
This isn't to say that such extras aren't useful—for instance, NordVPN's 'NordPass' is a respectable password manager. Still, it's best to make your own arrangements for malware protection. If you don't already have an ad-blocker, consider uBlock Origin (<https://ublockorigin.com/>) for screening out annoying ads and potentially harmful domains. Don't rely on your VPN to do it.

STATIC SHOCK

While we're on the subject of extras, you may notice your VPN provider offers a 'static' or 'dedicated' IP, usually for a few extra dollars per month.

Having a fixed IP address effectively means you have your own personal VPN service through which you can connect to the internet. As the IP address is created just for you, it means you're far less likely to be blocked by platforms like Netflix, which scan for known IP addresses of VPN servers.

This can also be useful for gamers playing via a VPN, as well as other



online services that block users via IP. If other users have broken the TOS while connected via a VPN server, anyone using it will also be unable to access the service. If, however, you have your own IP, you won't suffer for other people's mistakes.

Using a shared IP also usually triggers CAPTCHAs or security alerts for websites like banks, so having your own dedicated IP address can save a lot of headaches.

Naturally, using a static IP address means if it ever does leak online, you'd be more easily targeted by bad actors like hackers. They're also easier to link to your identity, as your VPN provider will need to link the IP address to your account.

WIPING FOR PRINTS

Assuming you're using a shared IP address, you still have to employ some best practices while connected to your VPN service to avoid being identified online. This is due to 'fingerprinting',

which is a process used to track you as you move across websites based on your online activity.

Some of the ways in which this happens are fairly superficial, such as how websites store cookies in your browser. You can usually avoid being identified in this way by using your browser in 'private' or 'incognito' mode, whereby no permanent record of your browsing history is saved to your device.

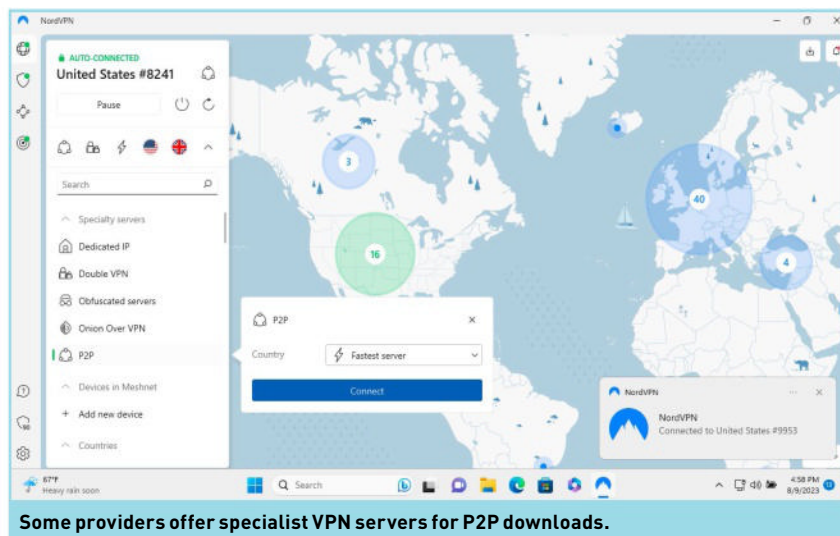
Unfortunately, this isn't the only method that can be used to identify you, even when connected to a VPN. Each time your browser visits a site, it provides certain information in 'User Agent' headers, such as your system language, display resolution, and what extensions you may be using. This 'browser fingerprint' can be used to build a unique identifier. This is the main reason it's not advisable to use VPN browser add-ons. These plug-ins can be convenient if you only want to connect to the VPN when visiting websites, but can also be used to track you.

You can check the uniqueness of your browser fingerprint via the EFF at <https://coveryourtracks.eff.org/>. Certain browsers, such as Brave (<https://brave.com/>), have built-in protections, such as using a randomized fingerprint each time you go online.

SPEEDING UP

If the focus of your VPN is for bandwidth-intensive tasks like gaming or streaming video, then speed is of the essence.

Connecting to the internet via a VPN server isn't usually as fast as connecting directly, though as we've discussed, encrypting your connection does prevent your ISP from deliberately slowing down certain types of traffic through bandwidth throttling.





Many providers boast about their speed, but your best guarantee of this is to choose one that has servers close to your physical location. Even if your chosen VPN service claims to have servers nearby, check these are physical, as virtual servers may have an IP address that seems closer by, but can be associated with a server somewhere far away. Reputable VPN providers usually include checks in client software to connect automatically to the fastest server.

Your choice of protocol can also play a role in how well your connection performs. Generally, WireGuard provides the best balance between speed and security.

If, despite choosing a nearby VPN server and zippy protocol, you're still experiencing lag, try to isolate the issue. Test your connection both while connected and not connected to the internet. Remember, internet speeds in your area will vary based on how many others are online in your area. Ideally, use a direct cabled connection to your router to avoid wireless interference. This is useful information if you need to contact your VPN provider's support channels.

SPLIT TUNNELING

One way to avoid your traffic being slowed down, blocked or otherwise affected by using a VPN is to employ split tunneling. This is particularly useful if you use your PC for work, as your employer's business apps may not accept incoming connections via VPN servers. Banks also tend to refuse connections from VPNs, so you may want to make an exception for any financial software you use.

As the name suggests, split tunneling involves you choosing which apps to route through your VPN's encrypted 'tunnel'.

The pros are obvious in that you'll use any services outside the VPN in the usual way. The major con, of course, is that it can reduce your online security. Anyone with access to your ISP's records will be able to build a picture of your browsing habits based on which data's encrypted and which isn't. Split tunneling is usually managed by your VPN client software, so contact your provider for help with this.

MIND YOUR PEERS

If you plan to use your VPN service for P2P downloads, first check with your chosen VPN provider to make sure this is supported. You may be surprised, as some services like NordVPN actually offer dedicated servers for this purpose.

Providing they support the protocol, be sure to also check your VPN's T&C to see if there's any kind of 'fair use' data cap. The last thing you need is to run into this halfway through downloading a 4K movie.

If certain file-sharing websites are blocked by your ISP, a VPN should allow you to access them if they're allowed in the country where your server is based.

IF ALL ELSE FAILS...

Even the most experienced PC user occasionally needs support. Since you're trusting your VPN provider with your internet connection, your need for quick and effective advice is even more critical.

Most major VPN providers' websites have support pages for tackling common issues like slow streaming. This can be just a series of articles, or may be integrated with helpdesk software to help your search.

Bigger providers like ExpressVPN offer live chat, as well as support via email. Sadly, none we've found so far offer support over the phone. ☹️

THE ROUTER GAMBIT

As you've learned, VPN protection only applies while your device remains connected to the server. Some providers also place a limit on the number of simultaneous connections.

If you have a larger number of devices, you can segue around this problem by connecting to a VPN service directly from your router. This means that any devices connected to the router's network will themselves be connected via the VPN without installing any client software to them. As far as your provider is concerned, the router only counts as one device, so other connected devices won't contribute towards your limit.

Another big advantage of connecting to your VPN service in this way is that if your provider doesn't provide client software for a particular device, like a 1st Gen Apple TV, you can still connect it to the router's WiFi network and access the VPN that way.

If you want to go down this road, check if your router supports OpenVPN. If not, websites like Flashrouters (<https://www.flashrouters.com/vpn-types>) sell ones that have been preconfigured to virtually every VPN service. Your VPN provider may be able to recommend specific models.

You can also consider flashing your router with open-source firmware like DD-WRT or OpenWrt, which supports VPN connections. Aside from the very real risk of 'bricking' your router if you don't know what you're doing, maintaining a VPN connection on a router requires regular maintenance, so we only recommend this for power users.

Other potential downsides to configuring your router in this way is that it may not be as easy to switch between VPN servers. This could be problematic if you want to change the country from which you appear to be connecting and/or your server's IP has been blocked by an online platform.

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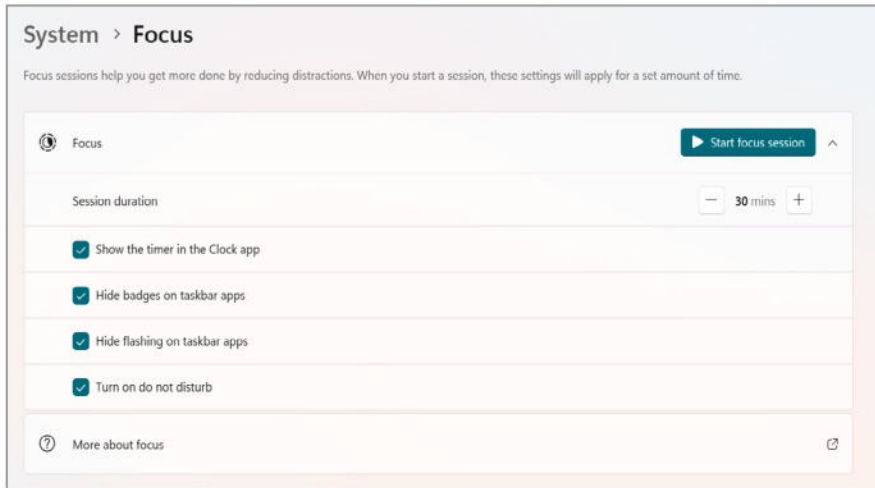
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TIP OF THE MONTH



SAM LEWIS
STAFF WRITER

A QUICK SPRUCE UP

I've been on a mission recently to clear out clutter and tidy up my personal spaces. It felt as if I only had to take one step into my office for a mess to happen. For a place where I sit still for hours at a time, it still baffles me how this happens, but here we are.

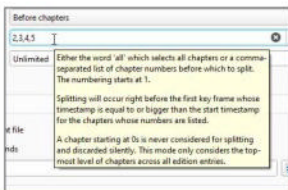
I realized I couldn't concentrate in a messy environment, so I purchased a few cable-management items, such as desk trays, cable tubes, and desk cable runners. These were inexpensive, but have helped arrange my desk space. After that, I bought a few storage boxes and labels, thinking that if I ever needed someone to grab something for me, they would help. I used these boxes for miscellaneous items, extra cables, and other components and accessories. I then applied the same TLC to my bedroom and, to my surprise, it has helped greatly. Sure, it can look like a huge task but if you set time aside and stick to it, the results are worth it.

With this extra space, I decided to set up my Nintendo Wii U again—I'm one of the 450 people worldwide who still have one (rough estimation). A big part of my childhood, it ticks a huge nostalgia box. I can use it to play original Wii games, as it's backward compatible with older titles. I cable-managed the heck out of this too, of course!

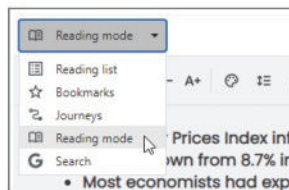
FOCUS SESSIONS

With so many distractions from news alerts, text messages, and social media, keeping your concentration is hard. However, there's a feature in Windows 11 that could help. Focus Sessions minimizes distractions by turning on Do Not Disturb. You'll see a focus timer on the screen, taskbar apps won't alert you, and badge notifications will be hidden. To enable this, go to Start > Settings > System > Start focus session and stay in the zone.

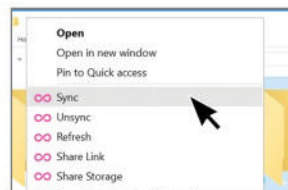
MAKE – USE – CREATE



62 Perform major surgery on your video files.



68 Keep your adblocker working.



70 Store your files online for FREE.

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submit your How To project idea to: editor@maximumpc.com

Perform major surgery on video

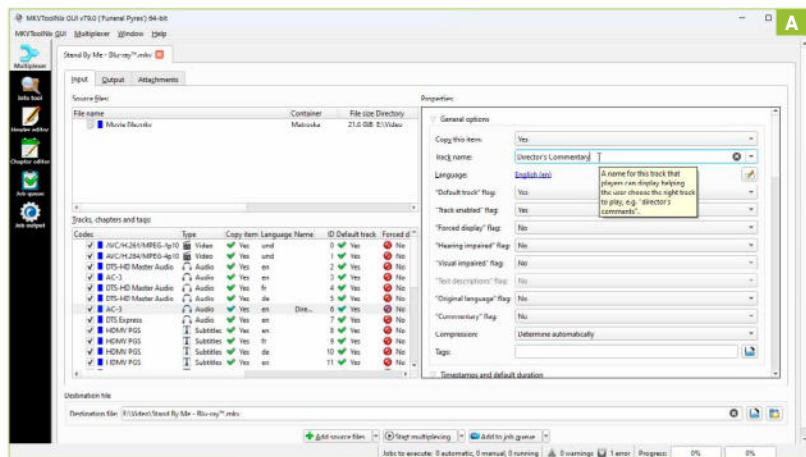
YOU'LL NEED THIS

MKVTOOLNIXGUI

Your Swiss army knife for editing, splitting and merging video files. Optional extras include BOX4 to remux your outputted MKV files back to MP4 after editing them

WHEN IT COMES TO YOUR MEDIA streaming toolkit, make sure you leave space for MKVToolNixGUI. There is MakeMKV for ripping discs and Handbrake for converting them to space-saving (and universally compatible) formats, but what happens when you want to perform surgery on a file? MKVToolNixGUI is the operating knife you need to splice, dice, and edit the attributes of your media files. Despite the name, MKVToolNixGUI can import most popular video formats.

Not only can you combine files into one single video or split a video into separate files, but you can edit their properties, rename commentary audio and subtitle tracks so they're easier to spot and select in compatible players, remove unwanted tracks from your video to save space (or splice in a track from another source), and even construct your own chapter structure to help you navigate a lengthy movie quickly. MKVToolNixGUI is even the place to go to correct display issues with files due to incorrect aspect ratio settings. We'll show you how to do all this and more, but your journey with MKVToolNixGUI won't end there. We've barely had time to scratch the surface of what this powerful program can do. —NICK PEERS



what's in that track—the number of channels and bit-rate for an audio track, or the display resolution in pixels if it's a video.

2 EDIT AND REMOVE UNWANTED TRACKS

If you'd like to make changes to a track's properties, select it from the list to reveal a more complete list of its attributes. You'll see them in the Properties pane on the right, which is divided into multiple selections. Start with the 'Track name' field under 'General options'. This lets you provide a more descriptive title for the track in question. For example, if your media has a commentary track, it will be listed as 'Stereo' by default if it's an audio file, or left blank if it's a subtitle track—so why not change it to 'Director's

Commentary' [Image A] to help make it easier to identify in programs that display this information, such as VLC Media Player?

» You might also wish to rename audio tracks from files you've previously processed in Handbrake. There, audio track names are determined by the first

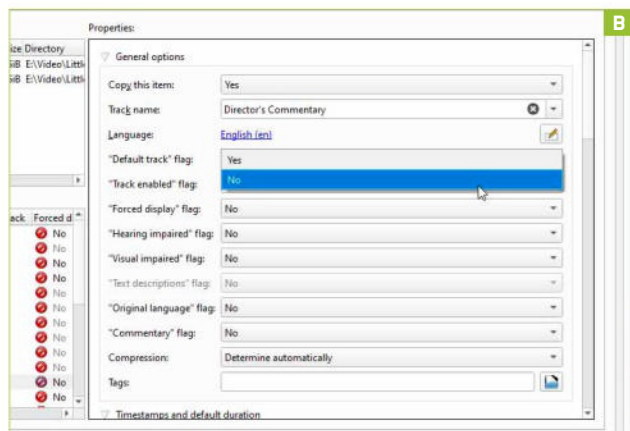
1 FIRST STEPS

Head to <https://mkvtoolnix.download/downloads.html>, where you'll find download links for all major operating systems. Click Windows to reveal both installer and portable versions are available. Installation is straightforward, while the .7z portable archive can be extracted using 7-Zip (www.7-zip.org) and then placed in your portable apps directory.

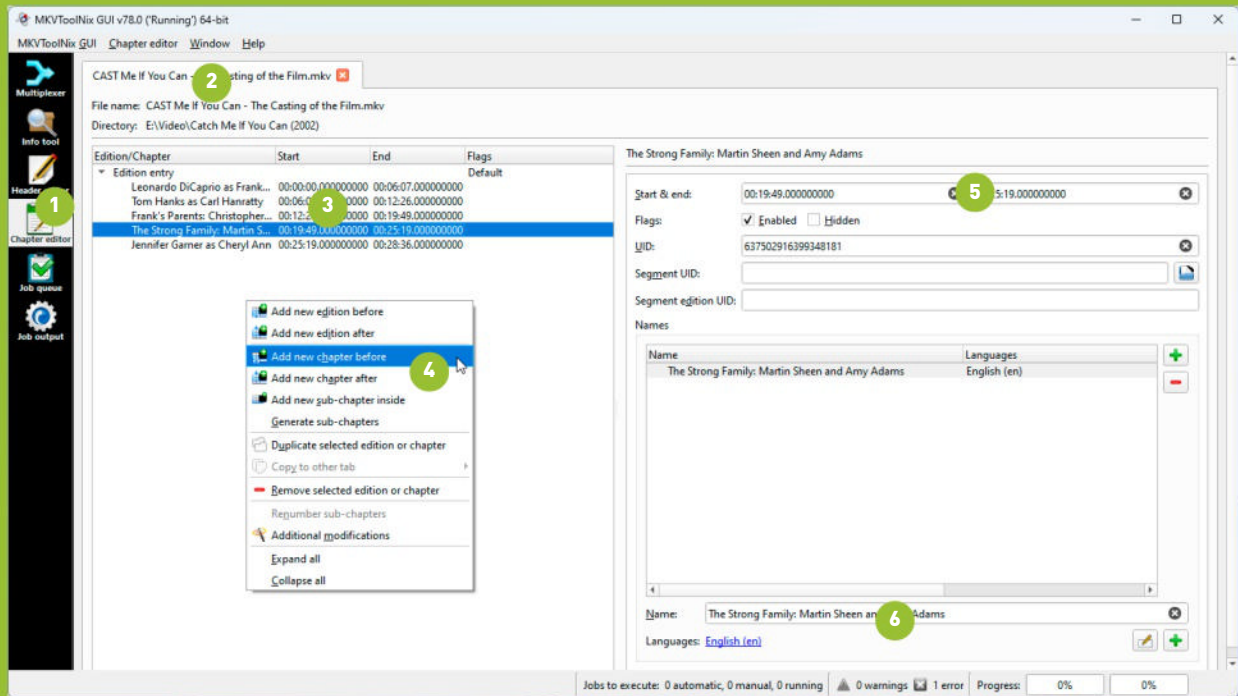
» Once in place, open MKVToolNixGUI and you will find yourself at its primary screen: the multiplexer. This is the heart of the tool and allows you to perform all kinds of surgery on your media files as we'll see over the following steps. Start by right-clicking inside the Source files box and choose 'Add files' to add the first file you need to perform surgery on.

» MKVToolNixGUI may only export video files in MKV format, but you can import a wide range of media files into it. Click the 'All supported media files' dropdown next to the 'File name:' field to see which video, audio, and subtitle formats it can work with.

» Once a file is opened, you'll see information about its tracks (video, audio, and subtitle) appear in the panel below it, split into multiple columns (right-click the column header to customize what's shown). The available information includes the track type, the codecs used, whether it's the default track chosen for playback, and a Properties field providing a handy summary of



EDIT CHAPTERS



1. ACCESS EDITOR

Simply click Chapter editor in the left-hand pane to switch to the Chapter editor screen. You can work on supported chapter files like .cue and .xml as well as chapters inside MKV and WebM files.

2. FILE TABS

You can work on multiple files at once (Ctrl + N or Ctrl + O to add others). Simply switch between them using the tabs.

3. CHAPTER ENTRIES

Existing chapter entries within the file are listed here, displaying the title and start and end points. Select one to edit its properties in the right-hand pane.

4. ADD NEW ENTRIES

Right-click to add additional chapters and sub-chapters. MKV files also support Editions, a way to offer alternative chapter titles within a single file.

5. EDIT CHAPTERS

Use the Start & end fields to change when the selected chapter starts and stops. If necessary, play the file in VLC Media Player to calculate timings.

6. RENAME CHAPTERS

Use the Name field to change the chapter's title to help viewers identify where they are in the movie. You can add multiple titles for different languages too.

selected track's original settings, so even if you downmix from 5.1 surround sound to stereo, the track name will remain '5.1 Surround' unless you remember to manually change it. If you forgot, you can edit it now in the properties pane.

» Another use for the properties pane is when you encounter a video that doesn't display in the correct aspect ratio (that's occasionally a problem with some movies from DVD). Check the sleeve for the correct aspect ratio, such as 1.85:1 or 16:9, then select the video track in MKVToolNixGUI and scroll through the Properties pane to the 'Video properties' section. Select 'Set aspect ratio' and click the dropdown menu to select the correct preset, which MKVToolNixGUI will then add to the file's properties when you multiplex it.

» You may also wish to strip out unwanted audio and subtitle tracks from the file to make them easier to process or simply reduce the file size. To do this, simply remove the check next to the track name and where you see 'Copy item', change this to No.

» Once you've made all your changes, choose where you would like to save your amended file (and also what to call it), then click 'Start multiplexing' and wait for the progress bar to hit 100 percent.

3 MERGE TRACKS FROM DIFFERENT FILES

Usually, media files come with all the tracks you wish to include in them. Sometimes, however, tracks are split between two versions—or you may have two versions of a movie, one with the director's commentary and the other without. MKVToolNixGUI allows you to combine tracks from two or more files into a single output file. To do this, open your first file as before, then right-click inside the Source files box and choose 'Add file' to add your second file.

» You'll now see that the 'Tracks, chapters and tags' box lists tracks from both files, color-coded to help you identify which file each track comes from. You then simply uncheck those tracks you don't want to include in the combined file. If necessary, choose which video, audio, and/or subtitle track should be the default [Image B], and then output the file as before.

» If you're lucky, the file will be processed with no warnings or errors. In some cases, however, a warning may be triggered: click the 'Job output' button on the left to review this in the Warnings box. You'll typically get this

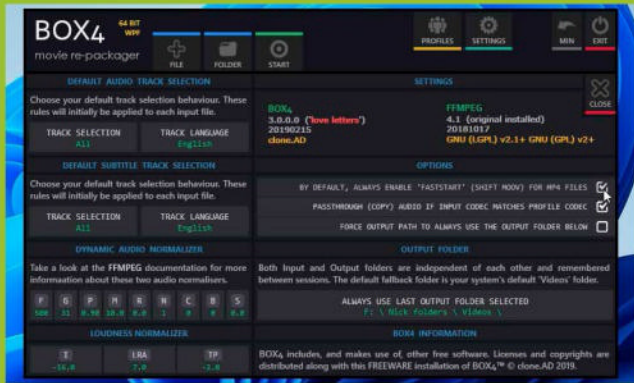
REMUX YOUR FILES

MKVToolNixGUI can perform surgery on many video file types but can only output changes to an MKV file. At times, you'll want to remux that file to a more compatible format, such as MP4. For this, you'll need a free program called BOX4 (www.voidhelp.com/software/BOX4).

It's simple to use, you can download an installer or run it as a portable app. Once open, click Settings and check the 'FastStart...' and 'Passthrough (copy) audio...' boxes under Options to ensure your audio tracks are left untouched and that the files are optimized for

streaming. Once done, click 'Track Selection' under both default audio and subtitle sections until they're set to All, so no tracks are lost in the remuxing process.

Now click Profiles and click the Matroska button on the right so it reads mp4 before clicking File (or Folder if you have a folder of MKV files you wish to remux to MP4) to select your input file(s). You should see a list of files confirming the output file is .mp4. Verify the audio tracks and any subtitle tracks are set to green (see *Doctor*, July 2023 issue if they aren't) before clicking Start to remux the files.



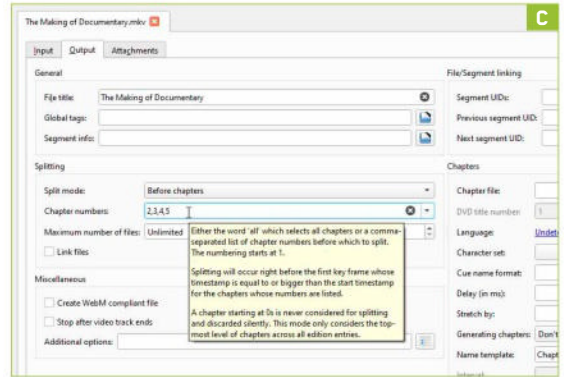
if MKVToolNixGUI spots potential (but non-critical) problems, or it needs to perform some minor adjustments, such as changing track IDs where they might otherwise clash.

4 SPLIT FILE

Another popular use for MKVToolNix is to split one video file into multiple parts or to split one specific part off from the rest. The software allows you to split the file by whatever means you like. To do this, first play back your file in VLC Media Player (or similar) to work out where you want to cut the file. Make a note of the relevant chapter or timestamp, then import your file into MKVToolNix and switch to the Output tab.

» You'll see the Output tab contains six sections, including a General tab where you can change the title of the movie as displayed in VLC Media Player, but focus on the Splitting section. Start by clicking the 'Split mode' dropdown menu. You'll be presented with a choice of seven ways to carve up your file, but four of these are probably of most use.

» 'After output size' and 'After output duration' will effectively split the file as many times as necessary after a certain file size or time is reached. For example, if you set the output duration to 01:30:00 (one hour, 30 minutes, and zero seconds), then a four-



hour file would produce three separate files: two 90 minutes long, and the final one 60 minutes long. Make a note of the 'Maximum number of files' option, which allows you to limit the number of files created.

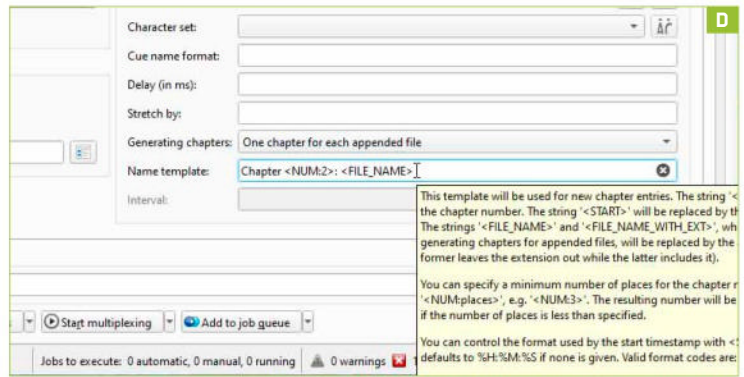
» In most cases, you'll probably want to split a file at precise points, in which case you'd select either 'After specific timestamps' or 'Before chapters'. If you chose the former and entered 01:30:00 into the 'Timestamps' box, your four-hour movie would be split into two parts: one 90 minutes long, the other 150 minutes long. Multiple timestamps can be entered, separated by commas, if you want to split the file into more than two parts.

» If your media file contains chapters, this is usually by far the simplest way to split a file into its constituent parts as shown in [Image C]: the key thing to remember is the 'before' bit, so if you want to split off chapters 1-8 of a movie, you'd enter 9 into the Chapter numbers box.

5 MERGE FILES

You can also stitch multiple files into a single file. From the Input tab, add your first file in the usual manner, then right-click its entry in the Source files box and choose 'Append files' to add the first file you'd like to attach to the original file, then repeat for any other files. They should appear in the list nested beneath the main file, to confirm they'll be added to it.

» When you click 'Start multiplexing', the files will be stitched together, preserving their original video, audio, subtitle, and chapter tracks. If any don't match, you may see a warning appear—review this via the Job Output section, where you can click 'Abort job' should you wish to end the multiplexing process. If you receive an error message, it means the files can't be stitched together due to an incompatibility—often because there's a mismatch between codecs, video sizes, or bit rates.



» If you switch to the Output tab before multiplexing, look at the Chapters section, which allows you to create your own chapter structure for the output file. Start by investigating the 'Generating chapters' dropdown—an obvious choice is 'One chapter for each appended file' but you can generate chapters at fixed intervals. If you select this option, uncheck any chapters listed in the 'Tracks, chapters, and tags' panel on the Input tab.

» Beneath the dropdown is the 'Name template' field, which is how your chapters will be named (and so appear in your media player). Available wildcards include <NUM> (track number), <FILE_NAME> and <START> (chapter start timestamp), and can be mixed and matched [Image D]: For example, 'Chapter <NUM:2>: <FILE_NAME>'.
» One final tweak: click 'Undetermined (und)' to change the language tag for each chapter to English. Click the Language dropdown menu, then scroll up to choose 'English (en; eng)'.

6 CHANGE VIDEO TRACK

Some videos come with more than one video track in place—Picture-in-Picture commentary on a movie, for example. Sadly, neither MakeMKV nor Handbrake allow you to choose which video track to use. Instead, they merely select the first available track and discard the rest.

» If you load a media file with more than one video track into MKVToolNixGUI then you'll see all tracks are listed. The default track is the one you normally see, so you can simply uncheck this, set up your export settings, and click 'Start multiplexing' to generate a file with just the secondary video track.

» But how do you create a file that gives you access to this secondary video track in the first place? The solution lies with MakeMKV, but instead of extracting the file in the usual way, you'll need to generate a full backup of the disc instead. After the disc has been recognized, choose 'File > Backup', make sure 'Decrypt video files' has been checked, select your backup location and then click OK.


» Once the backup has completed, click the disc icon to open the disc in MakeMKV—you need to do this to identify the file to open in MKVToolNixGUI. Select the track in question and make a note of its Source file name—this is what you'll need to open in MKVToolNixGUI. You'll find it in the BDMV/Playlist section directory in many cases, and if it's a .mpls file, click 'Don't scan, just add the file' when prompted [Image E].

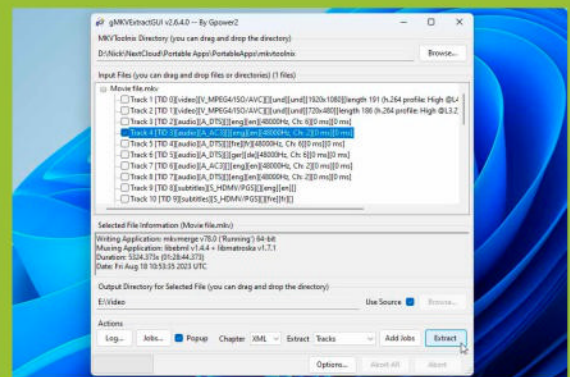
7 OTHER TOOLS

MKVToolNixGUI also allows you to edit the header info for Matroska (including MKV) and WebM files. In most cases, the attributes you need can be set from within the Properties panel on the Input tab on the Multiplexer screen as we saw in step two, but advanced users can switch to the Header editor and click 'Open Matroska or WebM file'. Once your file is open, you'll

see a series of expandable sections in the left pane. Expand these and browse the available options to make changes directly. Press Ctrl+S to save changes directly to the file, which is usually quicker than multiplexing it.

» MKVToolNixGUI also features a fully-fledged chapter editor, which allows you to not only rename chapters but also change where they're placed in your movie file. The chapter editor works with a wide range of chapter files as well as chapters embedded into MKV and WebM files. Select Chapter Editor where you can open a supported file or start a new one from scratch. The annotated screenshot provides a tour of the interface to reveal what you can do with this handy tool.

» Finally, if you have a lot of surgeries to perform, MKVToolNixGUI allows you to add each edit as its own job rather than process it right away (click 'Add to job queue'). Review these in the Job queue where you can right-click and choose 'Edit in corresponding tool...' if you want to make changes before processing them via the 'Start multiplexing' button. 

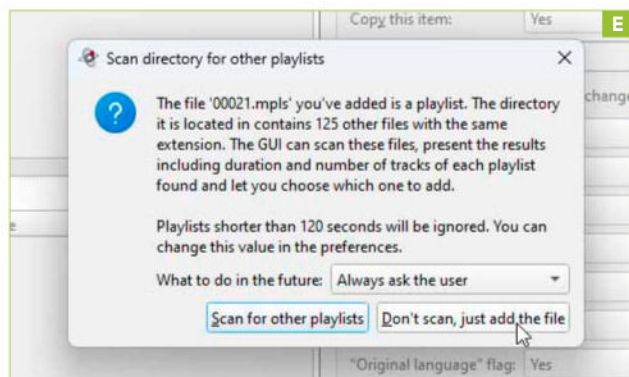


EXTRACT INDIVIDUAL TRACKS FROM FILES

One thing MKVToolNixGUI doesn't excel at is allowing you to extract individual video, audio, or subtitle tracks from your files in their native format. When you uncheck all but the track you wish to keep, then click 'Start multiplexing', you'll see that you're restricted to Matroska formats, such as mka for audio and mkv for video.

MKVToolNixGUI sits on top of several command-based utilities, each of which can do more than the sum of their parts. This is also true for the mkvextract tool that MKVToolNixGUI uses, but rather than learn Terminal-based lingo, you'll be pleased to learn that MKVToolNixGUI ships with another user-friendly frontend, gMKVExtractGUI, which works exclusively with mkvextract. Simply type its name into the Windows search tool to locate it.

Simply drag and drop the file containing the track you wish to extract into the program window. Then check the track to extract, choose where to save it, and click Extract. The file will be extracted in its native format, such as .dts or .aac for audio tracks, giving you more options to play with. Find out more about gMKVExtractGUI, which is a separately developed tool, at its home page: <https://sourceforge.net/projects/gmkvextractgui/>.



Make e-mail easier with Thunderbird

YOU'LL NEED THIS

THUNDERBIRD

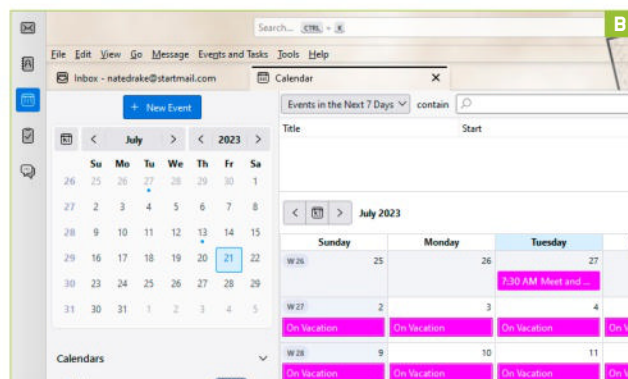
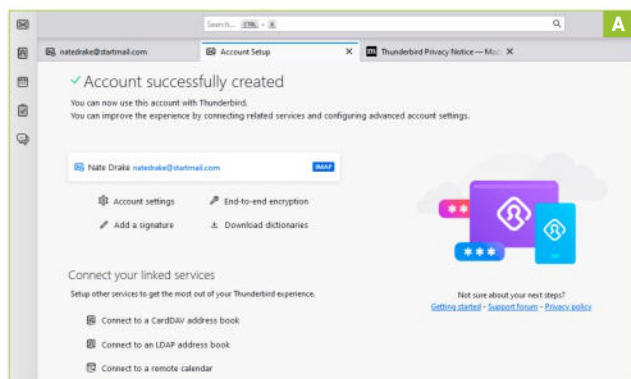
The latest version (115.0) is compatible with Windows 7 onwards and most versions of Linux, provided you have at least a 1GHz Intel/AMD CPU and 1GB of RAM

PC LOVERS ARE SPOILED for choice when it comes to email clients, so it's strange that so many just stick with the programs that come bundled with their OS.

Thunderbird is a free, open source, cross-platform email client, originally developed via the Mozilla Foundation (of Firefox fame).

As it's funded by user donations, you can rest assured that Thunderbird won't spam you with ads or train AI on your personal emails. Its UI is incredibly clean and easy to follow, plus you'll find that setup is a breeze. Aside from supporting email, the client can also help you manage your calendars, news feeds, and even certain chat protocols.

Thunderbird is also very customizable. You can alter aspects such as the layout of panes and messages with a few quick clicks. Thunderbird also supports thousands of 'add-ons', which can change the look and feel of the client, and even add extra functionality. **—NATE DRAKE**



1 INSTALL & SET UP

If you've decided to make the switch to Thunderbird, head to <https://www.thunderbird.net/en-US/download/>. The installer will begin downloading automatically.

» Once the Setup Wizard launches, click 'Next' then select a 'standard' install. (You can add extra features later.) Confirm the install location and click 'Finish'. Thunderbird should launch automatically, but if not the installer creates a desktop shortcut.

» On first run, take a moment to read the 'Privacy Notice' to see how serious Thunderbird is about protecting your data. Next, go to the 'Set up your e-mail address' tab. **[Image A]** If you feel like a change, choose 'Get a new email address' to buy one from Mailfence or gandi.net. Otherwise, just fill in your name, email address, and password. Thunderbird has an online configuration database with settings for most providers, but you can click 'Configure Manually' to enter the settings yourself. Click 'Finish' to complete setup. From here, you can set Thunderbird as your default client for calendars and news feeds, as well as mail.

» After setting up your existing email address, Thunderbird should automatically detect your remote address books and calendars based on the information you provided.

» If you have a local mail folders/contacts already set up in an existing e-mail client like Outlook though, you can import these into Thunderbird. Follow the steps at https://kb.mozillazine.org/Importing_and_exporting_your_mail to do this.

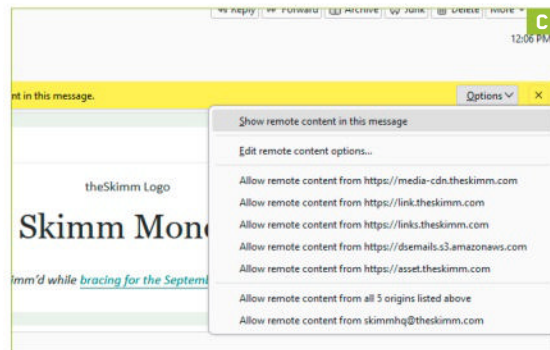
» If you use an online calendar, click the corresponding icon in the 'Spaces' toolbar on the very left of the Thunderbird window to view it. **[Image B]** If your calendar wasn't automatically imported,

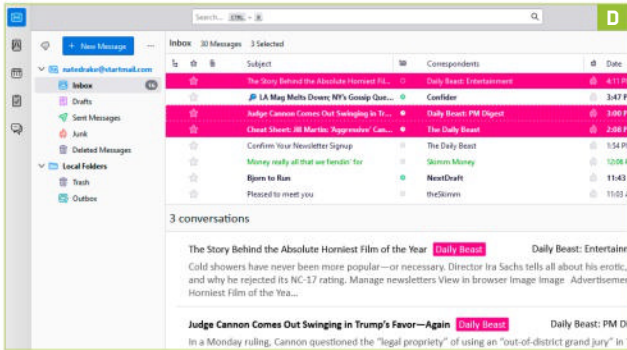
follow the steps at <https://support.mozilla.org/en-US/kb/creating-new-calendars> to manually input settings.

» The 'Unified Toolbar' can be used to search your Mail, Address Book, Calendar, and so on. Right-click here to enable the 'Menu Bar'. You can now choose 'File' > 'New' to set up additional mail accounts or calendars.

2 MANAGING THE MAIL WINDOW

The latest version of Thunderbird (Supernova) has an overhauled main window. There are many different possible layouts, including 'Classic' and 'Vertical' views. For a full rundown of all features, visit <https://support.mozilla.org/en-US/kb/getting-started-thunderbird-main-window-supernova>.



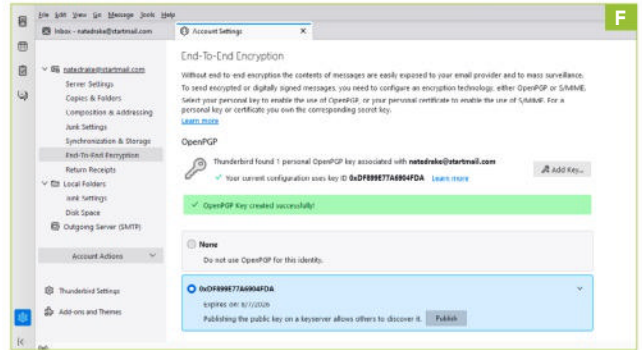
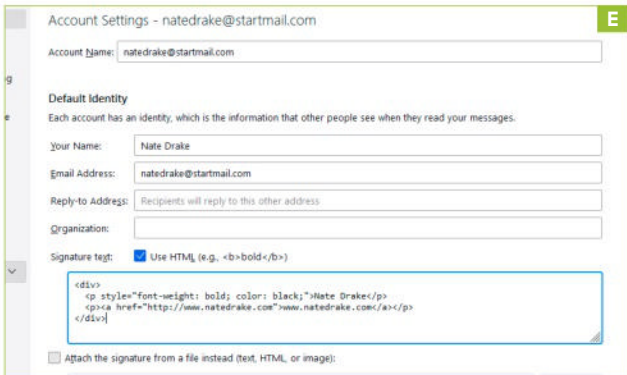


» The 'Message List' pane has messages listed from oldest to newest. Click on a message to update the 'Message Header' pane. By default, Thunderbird blocks remote content—choose 'Options' to allow certain domains. [Image C]

» Use the 'More' button in the Message Header pane to categorize emails. From here, choose 'Tag' to color-code messages from several presets or create your own. [Image D] If you have IMAP/Local folders, right-click selected messages in the Message List pane, and choose 'Move To'. Right-click your inbox or 'Local Folders' in the Folder Pane, then 'New Folder'.

» Feel free to adjust the dimensions of any pane using the mouse until you're comfortable with the interface. Once your inbox is just so, it's time to think about composition.

» Choose 'Tools' > 'Account Settings' from the Menu Bar, then scroll to 'Signature Text' to enter your own. Check 'Use HTML' to add formatting and hyperlinks to your signature. [Image E] By default, your signature is placed at the bottom of emails when replying to messages. If you prefer to have it underneath your response, select 'Composition & Addressing' in the left-hand pane, then under 'when quoting', click the dropdown menu next to 'and place my signature' > and choose 'below my reply'.



» Thunderbird now supports OpenPGP for signing and encrypting emails. To start, choose 'End to End Encryption' from the left pane, then 'Add Key'. You can import an existing key or generate a new pair. [Image F]

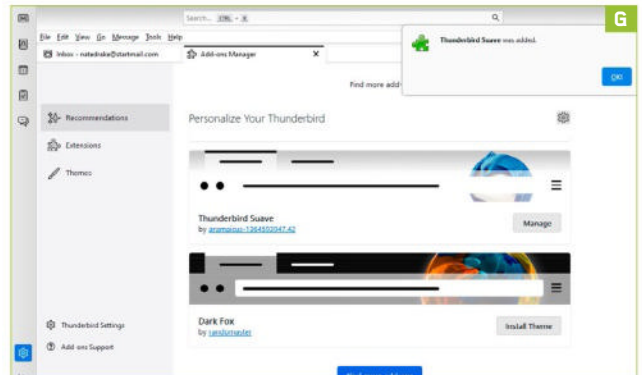
3 EXCITING EXTENSIONS

Once your signature is set up, just click 'New Message' at the top left or 'Reply' in the Message Header pane to fire off your first Thunderbird email.

» Next, choose 'Tools' > 'add-ons and Themes'. Thunderbird will display 'Recommendations' for extensions and themes from <https://addons.thunderbird.net/>.

» Scroll to a theme you find appealing, then select 'Install Theme'. Visit <https://addons.thunderbird.net/en-US/thunderbird/static-themes/> to see a list. Click 'Themes' in the left pane to switch. [Image G]

» Use the search bar at the top to find more add-ons, such as 'Provider for Google Calendar', which allows bidirectional access to Google Calendars. Select 'Extensions' in the left pane to view and manage. ⏻



TROUBLESHOOTING:

If Thunderbird refuses to accept your email account's password during setup, log in to your webmail and check that access by IMAP/POP is enabled. Some providers may require you to create an app-specific password for security reasons.

If you find that messages still aren't downloading or being sent directly, go to 'Tools' > 'Account Settings', then

select 'Server Settings' from the left-hand pane to make sure they match the information from your email provider.

Not all add-ons are compatible with every version of Thunderbird; some extensions can also prevent others from running properly. You can filter out incompatible add-ons just by searching within the client rather than directly on the website. To remove

an add-on that's interfering with the smooth operation of others, just go to 'Extensions' in the left-hand pane, select options [...], then 'Remove'.

Mozilla maintains an excellent knowledge base for other common issues, as well as a dedicated forum. You can access these via <https://support.mozilla.org/en-US/products/thunderbird>.

Keep your ad blocker working

YOU'LL NEED THIS

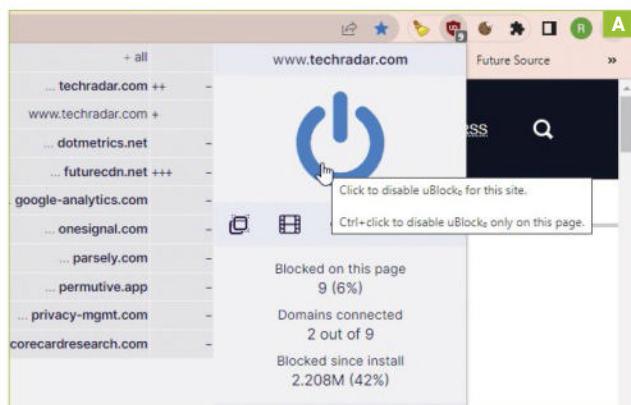
CHROME OR EDGE, UBLOCK ORIGIN OR ADBLOCK

(free) Your choice of browser and favored ad blocker

YOUTUBE RECENTLY STARTED testing a three-strikes policy for viewers who use ad blockers on its website. If it detects that you have one installed, it will give you three chances to disable the tool before it blocks you from watching any videos.

This strict new policy is intended to discourage us from using ad-blocking extensions such as uBlock Origin (ublockorigin.com) and instead subscribe to ad-free YouTube Premium for \$13.99 a month. But Google is far from the only company to clamp down on ad blockers, and many sites now insist that you disable yours before you can access their content.

Here, we explain how to block ads without being blocked yourself. —ROBERT IRVINE



1 ADD SITES TO YOUR AD BLOCKER'S WHITELIST

Whitelisting a website that demands you disable your ad blocker is effectively caving in, but it does mean you'll be able to access its content without being scolded. Putting up with ads on one site is preferable to seeing them everywhere.

» The quickest way to whitelist a website is to click your ad blocker's toolbar button and switch it off for the site you're trying to view [Image A]. It will turn back on automatically on the next site you visit. The popular extension Adblock (getadblock.com) lets you 'pause' ad-blocking rather than permanently whitelist a site. Click its toolbar icon and select 'Once' below 'Pause this site', then refresh the page.

» Alternatively, go into your ad blocker's Options or Settings, and select Whitelist, 'Trusted sites' or similar. Enter the URL of the site you want to disable ad blocking on, and click Save or 'Apply changes'.

» In the Brave browser, which blocks ads by default through its Shields feature, you can whitelist a site by clicking the Shields (lion-head) button. Click the 'Advanced controls' menu and choose 'Allow all trackers and ads'. Similarly, in the new DuckDuckGo browser, click the shield icon at the start of the address bar and click the 'Protections are On for this site' slider to change the setting to Off.

2 TURN OFF JAVASCRIPT IN YOUR BROWSER

The most common way websites detect that you have an ad blocker is using JavaScript. This code allows them to check if certain elements related to advertising are missing or hidden. If so, they will conclude that you're using an ad blocker and ask you to disable it to access their content.

» Turning off JavaScript for the site may let you bypass its ad-blocker warning, though it can also prevent content from loading properly. On YouTube, we found that it removes all the videos, so obviously isn't an ideal solution, but you may have more luck on other sites.

» In Chrome and Brave, you can disable JavaScript by clicking the padlock icon in the address bar and choosing 'Site settings'. Click the dropdown menu next to JavaScript, select Block, then reload the web page. You'll now see a slider for switching JavaScript on and off in the padlock icon's panel for that site [Image B].

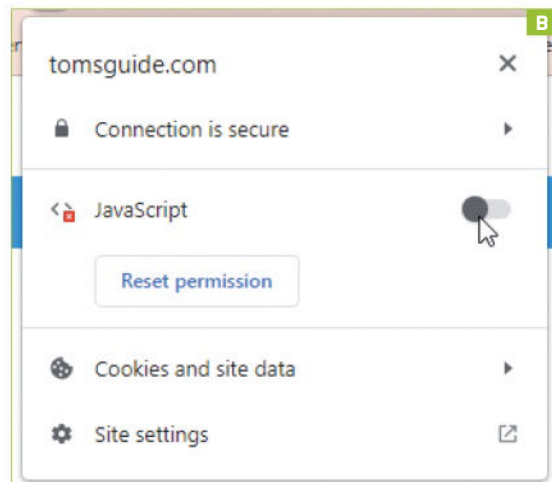
» In Edge, click the padlock icon, select 'Permissions for this site', and block JavaScript there.

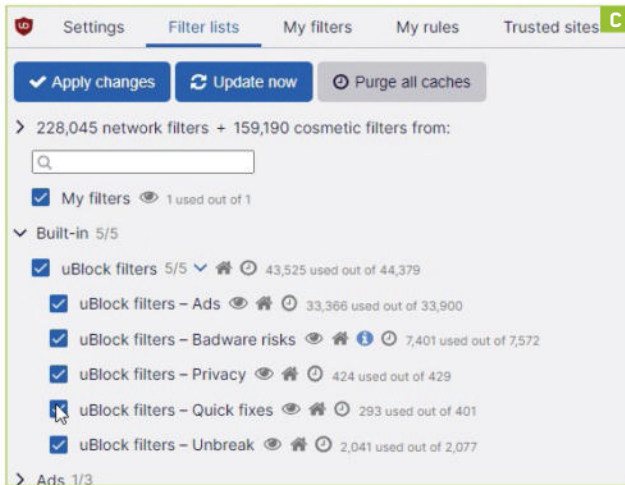
» Firefox doesn't offer a specific setting for blocking JavaScript, but you can install the Disable JavaScript add-on (tinyurl.com/nzh89ke6). Click its toolbar button to block or allow JavaScript as required.

3 TWEAK YOUR AD BLOCKER'S FILTERS

Ad blockers use filter lists to detect and block adverts and trackers in your browser, which you can augment with additional filters that block other annoyances, including scripts that detect the ad blocker.

» In uBlock Origin, for example, open the dashboard by clicking the cog icon in the extension's panel or right-clicking its toolbar button and selecting Options. Click the Filters tab and tick the box next to 'uBlock filters—





Quick fixes' [Image C], which includes code for removing 'Ad blocker detected' messages, then click 'Apply changes'. It's also worth applying a general 'annoyances' filter such as 'AdGuard'—Annoyances' or 'EasyList—Annoyances'.

» In Brave, you can access similar options by going to Settings, then Shields and clicking 'Content filtering', while AdBlock includes a dedicated filter called 'Adblock Warning Removal list'.

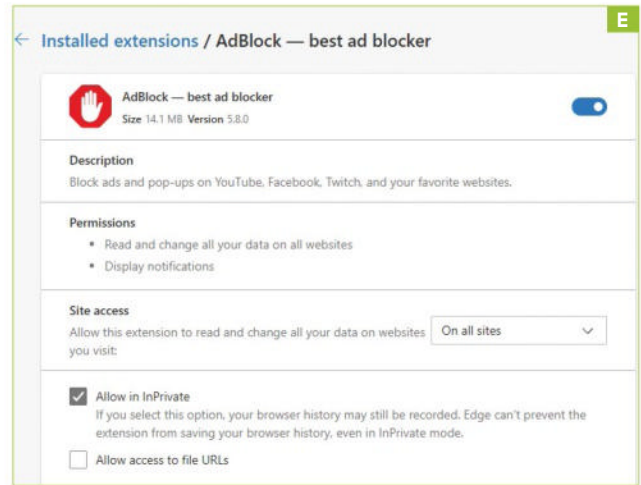
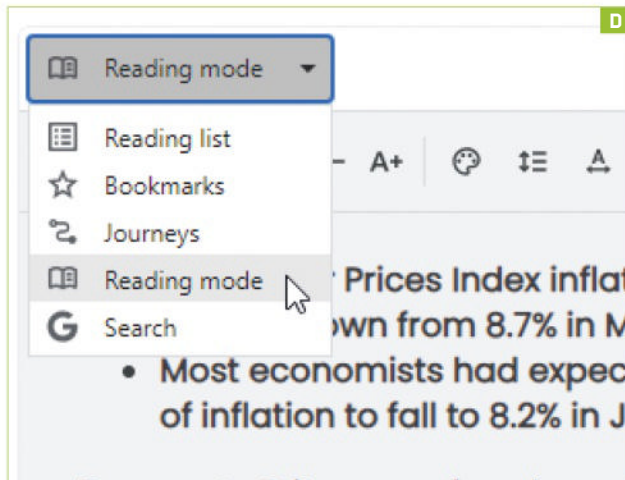
» If these filters don't stop YouTube blocking your ad blocker, find the option for adding new filters to your blocker—click 'My filters' in uBlock Origin or Customize in AdBlock—then copy and paste the code from our Pastebin account into the text box: tinyurl.com/yhv53nw5. Click 'Apply changes' or Save to add the filter to your ad blocker, and prevent YouTube from detecting one.

4 SWITCH TO YOUR BROWSER'S READING MODE

One way to access text content without disabling your ad blocker is to switch to your browser's reading mode. This strips all the clutter from web pages, including adverts, and also blocks scripts that detect you're using an ad blocker.

» Chrome has just added a long-awaited 'Reading mode' feature, though you may need to enable it via <chrome://flags>. Click the 'Show side panel' button in the browser's toolbar, select 'Reading mode' in the dropdown menu [Image D], and the decluttered text from the current page will be displayed in the panel, without any nags about ad blockers.

» In Edge, click Enter Immersive Mode in the address bar to switch to reading mode, and in Firefox click the 'Toggle reader



view' icon (or press F9). In Brave, go to <brave://flags> and enable Reading Mode to activate the feature.

» However, this won't work when you're trying to view image and video content without seeing ads.

5 VISIT THE SITE IN PRIVATE BROWSING MODE

Your browser's private—or incognito—mode disables cookies and trackers that potentially allow websites to detect your ad blocker. However, it also disables extensions, so to avoid seeing ads, you need to make an exception for the blocking add-on.

» In Chrome, open the Extensions page at <chrome://extensions>, click the Details button next to your ad blocker, and choose 'Allow in incognito'. In Edge, tick 'Allow in InPrivate' [Image E], and in Firefox choose Allow next to 'Run in Private windows'. Brave's built-in ad blocker works automatically in private windows so you don't need to change anything. 🔄

BEAT YOUTUBE'S NEW AD-BLOCKER RULE

We've explained how to stop YouTube detecting you're using an ad blocker, but Google is unlikely to tolerate such workarounds for long. Indeed, we expect it's already developing ways to stop them.

To avoid seeing any adverts in YouTube videos without having to pay for YouTube Premium, you can use an alternative front-end for the streaming service that removes all ads and trackers.

On your PC, FreeTube (freetubeapp.io) provides an ad-free YouTube experience, and prevents Google from tracking your viewing habits.

On your Android device, you can ditch the YouTube app for NewPipe (<https://newpipe.net>), which also lets you watch videos without ads or tracking. Instructions are provided at tinyurl.com/2ws5ww4n.

On your Android/Google TV or Amazon Fire TV device, SmartTube (tinyurl.com/3mvhcavf) lets you enjoy YouTube without ads.

Store your files online for FREE

YOU'LL NEED THIS

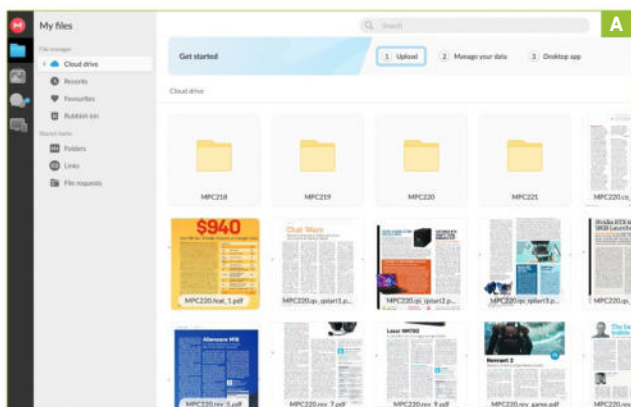
MEGA ACCOUNT

New Zealand-based cloud storage provider with generous 20GB free limit.

APPLE HAS JUST HIKED THE PRICE OF ICLOUD+. The online storage service, which helps sync your iPhone and iPad with Windows, is still free if you use 5GB or less, but beyond that 50GB costs \$0.99 a month, 200GB costs \$2.99 and, if you need the maximum of 2TB, it's \$9.99.

Apple increased those prices in June by up to 29 per cent, rising from \$0.79, \$2.49, and \$7.99 respectively. Granted, iCloud+ offers more than just storage, also giving you automatic photo backups, custom email addresses and more (see full pricing options at support.apple.com/en-us/HT201238), but not everyone needs all of those features.

If that's left you wondering whether you could find cloud storage for free elsewhere, the answer is: yes. And that's true for Android and Windows as well as Apple's iOS and macOS. As we'll explain, if you unlock hidden storage and combine services, you might accumulate enough space to downgrade your paid accounts—or get rid of them altogether. —**NIK RAWLINSON**



1 GET FREE STORAGE WITHOUT CATCHES (MOSTLY)

Let's start with the big-name storage services. Google Drive (<https://drive.google.com>) is the most generous, giving you 15GB for free. That's much higher than Microsoft's OneDrive (www.onedrive.com) and Dropbox, which offer only 5GB and 2GB respectively. Bear in mind though that Google's 15GB storage is shared across all your Google accounts, including Gmail and Photos. Likewise, Microsoft counts Outlook.com email attachments in your OneDrive storage.

» You should also consider Box (www.box.com), which gives you 10GB for free. However, it limits file uploads to a maximum of 250MB, which makes it impractical for large audio or video files. It's ideal for documents though.

» You can get even more than Google's 15GB if you're prepared to choose a lesser-known name. Mega (www.mega.io, [Image A]), based in New Zealand, gives you 20GB and offers end-to-end encryption (E2EE) for all file uploads.

» However, Mega limits how much data you can upload into six-hour chunks. If you hit your limit, you have to wait for this six-hour period to complete before starting again. This limit varies day by day, and is based on factors including where you're based and how busy the service is. From our experience and reports from other Mega users, we'd say that you can usually upload 1GB during the six hours before hitting your limit.

» Icedrive (www.icedrive.net), which is headquartered in the UK, also gives you 10GB for free. But don't bother with iDrive (www.idrive.com), which appears to have recently scrapped its

free 10GB and replaced it with a 30-day trial (see tinyurl.com/23594dk4).

» All of these services are compatible with Windows, Android, and iOS, which greatly simplifies the task of sharing files between your devices.

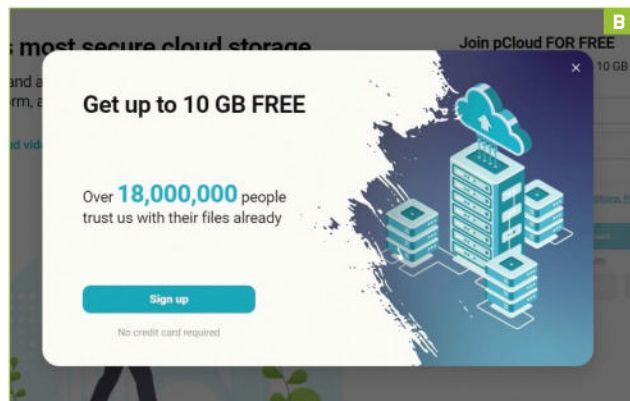
2 UNLOCK HIDDEN FREE STORAGE

Some services increase your free storage if you perform certain tasks. The idea is to incentivize you to use more elements of the service, and to recommend it to others.

» The Swiss-based service pCloud (www.pcloud.com) is a great example. It gives you 2GB for free, but [Image B] raises this to 10GB for completing tasks such as verifying your email when you sign up for an account; uploading a file; downloading pCloud Drive to your desktop; installing pCloud on your phone; turning on automatic photo uploads; and for inviting two friends who subsequently sign up.

» That might sound like a lot of tasks, but you'd perform some of them anyway—particularly verifying your email address, uploading a file, and installing pCloud on your phone. It's tempting, especially because pCloud is covered by Switzerland's privacy regulations.

» Mega is even more generous, letting you unlock storage in 5GB blocks by installing the mobile app, referring a friend, installing the desktop program, and





more. Mega calls these ‘achievements’—see <https://mega.io/achievements>. There’s a catch, though: they all expire after a year. But as welcome bonuses go, they’re among the most attractive you’ll find.

» Google also lets you unlock storage—100GB—though you’ll have to buy a Chromebook first. If you decide to, visit tinyurl.com/36whszxz and click ‘Get perk’ in the ‘Google One’ box [Image C]. Again, like Mega, this only lasts for one year. After 12 months, you’ll have to pay \$19.99 a year to keep the 100GB, but this is good value compared with rivals. There are also 200GB (\$29.99) and 2TB (\$99.99) plans—see tinyurl.com/yc52j3a7.

» Google One includes extra features, such as editing tools for Google Photos and a VPN for multiple devices. You can also share your membership with up to five people, helping you to spread the overall cost. Dropbox Basic (the free package) also has a ‘refer a friend’ offer, giving you 500MB per referral up to 16 GB—see tinyurl.com/327zmbx3.

3 SIGN UP FOR LIFETIME ACCOUNTS

It can also pay dividends to take a long-term view and sign up for lifetime accounts where available. Although the initial spend is higher than with a monthly subscription, they’ll ultimately work out cheaper. At the point when the one-off amount you’ve paid is equivalent to what you’d have paid in subscriptions, every subsequent month of your lifetime plan is effectively free.

» At the time of writing, Icedrive is offering discounted 150GB, 3TB, and 10TB lifetime accounts for one-off payments of \$99, \$499, and \$999 respectively [tinyurl.com/bde258ta]. Meanwhile, pCloud is offering 500GB, 2TB, and 10TB for a \$175, \$350, and \$990 [tinyurl.com/3zwsc5h5].

» To put these deals into perspective, the \$350 you’d pay for a lifetime of 2TB pCloud storage doesn’t even get you four years with iCloud+.

4 HOW TO SWITCH STORAGE SERVICES

If recent price rises mean you’re looking to switch providers, moving from one cloud to another is relatively easy. The simplest option, if your existing and new providers sync files to your hard drive, is to copy from the existing provider’s folder on your hard drive into the new one, which will also be on your hard drive. This will allow the new provider to sync and upload files in the background.

» You could alternatively install [odrive](https://www.odrive.com) (www.odrive.com), through which you can log into multiple online storage services simultaneously. Even if you don’t plan on switching providers, but you do use multiple cloud services, opting for [odrive](https://www.odrive.com) can save you running multiple syncing tools.

» You can browse and open [odrive](https://www.odrive.com) files like you would normal files and folders through File Explorer. Right-click a file or folder to see your sharing and syncing options [Image D].

HOW MUCH SPACE DO YOU NEED?

Storage capacities are fairly abstract, so it helps to consider what you could store in any given quantity. A 3.5-minute MP3 track at CD quality takes up around 37MB, according to Omnicalculator’s Audio File Size calculator [tinyurl.com/8tf6zjj4]. Round this up to 40MB to cater for longer tracks, and you could store 250—around 21 albums’ worth—on a 10GB account.

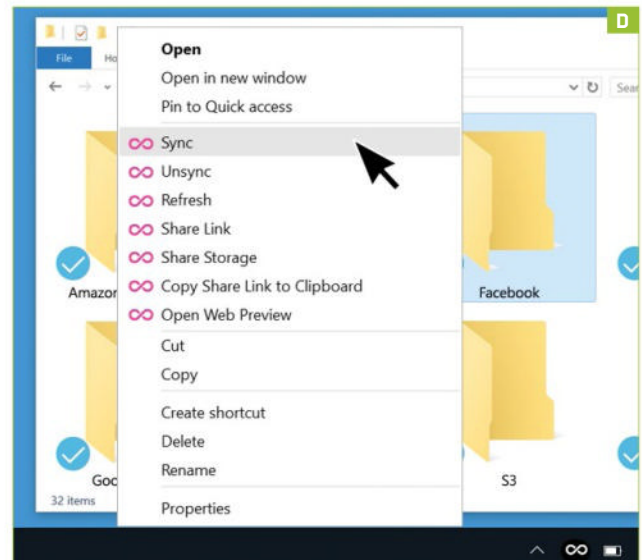
A 12-megapixel photo, as might be produced by your smartphone, weighs in at around 36MB, so unless you apply compression before uploading them, expect to fit around 277 into 10GB (use this image-file calculator at tinyurl.com/4e4t6ehb).

You’ll use up your space more quickly if you start to upload movies, with 16 minutes of high-definition video (H.264 1080p format) tipping the scales at just over 9.9GB (use this video-file calculator at tinyurl.com/3rsf7wfc).

If you stick to standard documents, you can eke out space for years. This feature amounts to 10.4KB when downloaded from Google Drive in Microsoft Word format, which would fit into a 10GB folder more than 961,500 times.

» If you use a cloud service for more than just storing files and photos, make sure you’ve exported any additional data, including contact lists, emails, and calendars. Often, the easiest way to do this is to use the data-export service that each service provides. If you want to move from Google, for example, use its Takeout service at <https://takeout.google.com> where, after logging in, you can select the data sets you want to export. You’ll receive an email when the archive is ready to download.

» If you want to do the same from iCloud+, follow Apple’s comprehensive instructions for each service at tinyurl.com/2p8wez4n.



LAB NOTES

JEREMY LAIRD, CONTRIBUTOR



Falling behind the curve

Why AI is going to make our PCs a bit dumber

IN THIS JOB, half the fun is playing with cutting-edge kit, the latest CPUs and GPUs with the most advanced silicon in the world. But thanks to AI, I've got a feeling that's not going to be the case for much longer. The problem is that there's just too much money to be made from inferencing chips for AI.

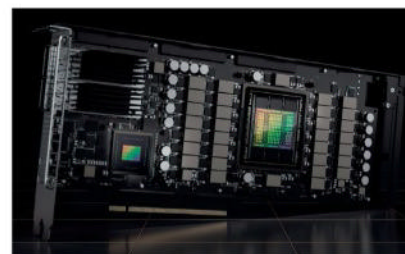
It's recently been alleged, for instance, that it costs Nvidia about \$3,000 to bang out its new H100 AI inferencing GPU. But it's sold to customers for something in the region of \$25,000 to \$30,000, depending on who is paying and how many they're buying. As Nvidia's Jensen Huang recently said, the more you buy, the more you save.

Anyway, Nvidia says it expects to ship roughly 550,000 H100 GPUs this year. I'll save you the sums, that's the thick end of \$15 billion in profit. Now, H100 is built on TSMC's N4 node, which is the most advanced node currently used for any chip

you can buy today. The point here is that H100 is a huge chip, over 800mm² and about one-third bigger than the AD102 in the RTX 4090 graphics card and seven times bigger than the puny AD107 GPU in the RTX 4060.

In other words, H100 is eating up a lot of cutting-edge capacity at Nvidia's production partner TSMC. And it's obvious that selling H100s is more profitable than any gaming GPU. There will no doubt be a little leeway built into the contract between Nvidia and TSMC to allow for greater overall production capacity. But equally, there will also be a point at which upping the H100 production numbers will mean making fewer gaming GPUs.

Reportedly, we are already well past that point. As long as demand for AI chips continues to spiral upward, and there's a chance that the current boom could be the start of something altogether more



Nvidia's H100 AI is hogging all the production volume at TSMC.

massive, Nvidia and eventually AMD will de-prioritize everything else when it comes to advanced chip manufacturing.

That doesn't mean no more GPUs or CPUs. But they will be knocked out on older and less advanced production nodes—and will be less powerful than they might have been and simply less exciting.



SAM LEWIS

Staff Writer

After reviewing the Kingston XS1000 external SSD for this issue, I went out and picked one up immediately. Now, before I took up writing about PCs, I studied graphic design, so transferring large files and coursework has always been a battle. I've had countless Photoshop, Premiere Pro, Indesign, and Illustrator files that have

corrupted, causing me plenty of stress at the time.

Thanks to faster and more reliable external SSDs, such as the Kingston XS1000, gone are the days of having huge portable SSDs that made odd noises and got so hot you could fry an egg on them. I just wish I could have gotten my hands on one of these external drives back then!

So far, I've used it to transfer the benchmarking games we use for our main feature builds from one PC to another. My internet speeds are prehistoric, to say the least, so this has saved me so much time! I'm also glad to see the use of a USB-C cable here too. My old 1TB drive used an odd USB 3.0 cable which always had a

loose connection. It meant that during file transfers you couldn't touch the hard drive in case the cable slipped out.

The best feature though has to be the palm-sized form factor. It's well worth picking up one of these drives to keep with you, as you'll never know when you might need it. Our 2TB model was impressive considering how small it was.

If you want the top gaming experience on a mobile phone right now, the RedMagic 8S Pro fits the bill.



Editor's Pick: RedMagic 8S Pro

Forget video calling and Insta snaps, this is the best gaming phone right now



THE REDMAGIC 8S PRO is the best gaming phone on the market right now. If you care more about playing *Genshin Impact* than you do posting snaps to

Instagram, then this is the phone for you. It boasts insane performance, brilliant triggers and gaming controls, a ridiculous 6,000mAh battery, and sells for \$649. What it doesn't do is take the best photos, offer the most polished software experience, or have the highest-resolution display.

That's really all you need to know about this Chinese-manufactured smartphone that has been specifically designed to meet the needs of gamers. And while many people will scoff about using a phone to game on, especially in the era of the Steam Deck and ASUS ROG Ally, there is something to be said for Android gaming. Publishers such as Netflix have released brilliant titles like *Kentucky Route Zero*, *Twelve Minutes*, and *TMNT: Shredder's Revenge*. Xbox Game Streaming has gotten better and, if you're an emulation fan, the Snapdragon 8 Gen 2 chip in this phone is a beast, capable of emulating consoles including Nintendo Switch with improved graphics and higher frame rates.

The phone itself is aesthetically pleasing, with a boxy design reminiscent of the latest iPhones. The internals are ridiculous, with the highlights being the overclocked 'Leading Version' of the Snapdragon latest-gen processor, 12GB of RAM, and 256GB of storage (our sample boasted 16GB/512GB for \$779). Other specs are less impressive to hit that \$649 price point—the display is only 1080p, it used the older Gorilla Glass 5 for protection, and there's no water resistance or wireless charging.

That's because there are lots of holes to allow airflow through the device, plus a vapor chamber cooling system, both of which prevent the quality-of-life features that are a mainstay of devices such as the similarly priced Samsung Galaxy S23.

In terms of raw performance, this phone beats the Samsung S23 Ultra, which uses the same chipset, and you can control the system's fan speed to keep the device cool while it's running *Fortnite* at max settings. The 960Hz touch-sampling rate is great for responsive gaming, while the touch-sensitive triggers give it an edge in shooters. I prefer putting the phone in a stand and connecting an Xbox Controller over Bluetooth, as I do on my Samsung S23 Ultra, especially as the phone still gets warm, despite all that fancy cooling.

As you'd expect from a gaming phone, camera quality isn't great. There are three sensors on the rear, a 50MP main, 8MP ultrawide and 2MP macro, plus a 16MP selfie camera hidden under the display. Colors are fine but low-light photos lack detail. The selfie cam is a letdown, with a weird fuzzy effect to images and washed-out colors meaning you won't be posting any award-winning selfies. As someone who struggles with battery anxiety, I loved this phone's 6,000 mAh battery, which will easily make it through a full day. It charges quickly, too, with the 65W charger (included in the box!) charging to 87 percent in 30 mins and to full in 40 mins.

There are other rough edges, such as the grammatically poor English menu translations, while RedMagic doesn't make a commitment to future OS updates like other manufacturers do. But if you want the top gaming experience on a mobile phone right now, nothing fits the bill better than the RedMagic 8S Pro. —GC \$649, www.redmagic.gg

Reviewed...



74 Samsung Odyssey OLED G9 G95SC



76 Sketch Chronos 2

78 Kingston XS1000 SSD



80 Razer Blade 14

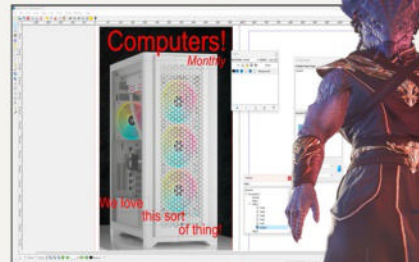
82 AOKZOE A1 Pro

84 Asus ROG Rapture GT-AXE16000

87 Corsair HS80 Wireless

88 Drop Lord of the Rings Dwarvish ENTR

89 Mountain Makalu Max



90 Baldur's Gate III

92 Scribus vs. Affinity Publisher



Samsung Odyssey OLED G9 G95SC

An OLED
experience on
an absolutely
epic scale

SAMSUNG AND LG dominate the OLED TV market and that contest for the ages is now making its way onto the PC. Every OLED gaming monitor you can currently buy uses either a Samsung or LG panel. So far, we've preferred Samsung-based screens, primarily on account of their superior full-screen brightness and reduced tendency to exhibit automatic brightness limiter-induced weirdnesses.

That bodes well for the hot new Samsung Odyssey OLED G9. If anyone can make the most of a Samsung OLED panel, it's surely Samsung itself. In rough terms, it's much like the numerous 34-inch 21:9 aspect OLED monitors that use Samsung panel technology, just on an even wider scale. So, you get the same 1,440 vertical resolution and 109dpi pixel density, but the 32:9 aspect ratio takes the horizontal resolution out to fully 5,120 pixels and the diagonal to 49 inches.

All of that also applies to previous Samsung G9 monitor models. Except they

were all LCD-based and this is the real OLED deal. That said, the LCD models were even more curved at 1000R. The OLED G9 has a more gentle 1800R bend. Anyway, other highlights include full-screen brightness rated at 250 nits, which is par for the Samsung OLED course and about 100 nits more than you typically get from an LG-equipped OLED monitor.

There is VESA DisplayHDR True Black 400 certification, but Samsung doesn't quote a peak brightness. The odds are that it's in the same circa 1,000 nits territory in a small window as other monitors with Samsung OLED panels. As for refresh rate, you're looking at a generous 240Hz while the response time is quoted at 0.03ms.

That's impressive, but arguably the latter figure is relatively moot. Modern OLED panels are so quick when it comes to response times that comparative numbers have lost their meaning, but in a good way. Connectivity-wise, there's

© UNSPLASH

If bigger is better, the G9 is in the running to be the best OLED gaming monitor yet.



DisplayPort, HDMI, and mini HDMI, plus a USB hub with USB-C, though the latter is only for the hub, it isn't a display interface and doesn't support power delivery.

Oh, and this is a gorgeous physical specimen in design and engineering terms. Samsung really knows how to make a screen look expensive. The only design drawback is the big, ugly PSU and its utterly shonky barrel connector, which feels all too AliExpress.

But what of the main factor, namely image quality? In most regards, it looks just like the Samsung-based, 34-inch Alienware 34 AW3423DWF. That too has a glossy panel coating that really lets the OLED tech sing. The sense of contrast is off the scale while the inherent precision of OLED's per-pixel lighting control makes each and every LCD monitor with full-array local dimming look like a hopeless kludge. And, of course, the added scale of the 49-inch form factor ramps up the visual drama and immersion.

In brightness terms, the G9 is pretty punchy all the time, which is not something you can say about OLED monitors with LG WOLED panels. LG panels usually dip pretty dramatically when you light up most of the panel, but there's none of that automatic brightness limiter nonsense to put up with here. The 240Hz refresh and 0.03ms response ensure this monitor is ridiculously quick, too.

All of which makes this an exceptional gaming monitor. You could take issue with the basic form factor. 32:9 isn't the best aspect ratio for some games and it's far from ideal for watching video. For all-around computing, the pixel density and font rendering are a little on the rough side, while Samsung's QD-OLED panel tech also comes with a slight question mark when it comes to image retention and burn-in. And this thing is far from cheap. But as a pure gaming experience, the Samsung OLED G9 is just about as good as it currently gets. —JEREMY LAIRD

VERDICT

9

**Samsung Odyssey
OLED G9 G95SC**

▣ **OSCAR WORTHY** Outrageous 32:9 OLED panel; How HDR is meant to be.

▣ **GOLDEN RASPBERRY** That 32:9 aspect isn't for everyone; Mediocre pixel density.

\$1,999, www.samsung.com

SPECIFICATIONS

Screen size	49-inch
Resolution	5120 x 1440
Brightness	250 nits full screen SDR
Color coverage	99% DCI-P3
Response time	0.03ms
Refresh rate	240Hz
Contrast ratio	1M:1
Features	QD-OLED panel, adaptive sync, 1x DisplayPort 1.4, 1x HDMI 2.1, 1x mini HDMI, USB hub, 1800R curve



Aesthetically, the mesh-fronted Chronos 2 is ever so slightly last year.

Skytech Chronos 2

Cost-effective gaming that comes with a couple of caveats

WE'VE BEEN LOOKING to get our hands on a Skytech PC ever since the Ontario-based system builders rocked up on the scene with supremely affordable pre-built gaming PCs. These machines absolutely ace the bang-for-buck thing. Question is, does that come with corner cutting?

Core specs-wise, we're talking RTX 4070 for graphics and AMD's slightly elderly Ryzen 5 5600X doing CPU duties. Skytech could have slapped an AIO cooler on the CPU, but with a max CPU temp of 67.4 °C in our testing, there's not much to complain about. When you're splashing out \$1,600, it's not unreasonable to expect a non-stock cooler, though. Thankfully that's what we've got, albeit not the nice RGB faceplate on the cooler you'll see on Skytech's website.

So far, so good. However, when it comes to some of the lesser components, those corners have had a bit of a trim. For instance, the MSI Spatium M371 SSD is disappointing. Relatively slow game level load times and a mediocre 3DMark storage benchmark result make it clear that you're getting a fairly ancient \$35 Gen 3 NVMe SSD. On the plus side, having a full 1TB PCIe drive means you

can download a few of your favorite AAA games at once, with space left over for a few 4K movies.

It's a similar story when it comes to the 16GB of OLOY RAM, a brand often chosen to keep the price down. It is at least configured in ideal dual-channel arrangement rather than a single 16GB stick, which really would have been cheaping out. But by way of example, running something like Cities: Skylines with hundreds of mods does show up the limitations of 16GB versus 32GB.

The main star of the show is, of course, that RTX 4070. In the Skytech Chronos 2, it only topped out at 67°C after a day of hard benching. Small but mighty, that curvy 12GB Zotac Twin Edge packs the same 2,475 MHz boost clock speeds as the Founders Edition. It means there's hardly a game in our benchmarking suite it can't handle.

In some ways, it would be a shame to pair it with a mere 1080p gaming monitor, but the Chronos 2 certainly has the potential to make the most of something with a 240Hz-plus refresh rate at lower resolutions. However, you'll want to bag a 1440p beast to really make the most of the Chronos 2. It does actually put out

tolerable numbers at 4K, but 1440p is really where it's at with an RTX 4070.

Build-wise, Skytech has been cognizant of how much components can wobble around during transit with a prebuilt gaming PC, stuffing every inch of space inside with airbags and foam. There's also a one-year warranty for parts, labor, and shipping, plus lifetime tech support for your machine. As for style, the mesh on the front of the chassis is a little last year, but you do get a dollop of RGB lighting with two control options.

Which just leaves the sordid matter of money. In broad brush CPU and GPU terms, the Chronos 2 is priced right for an RTX 4070-powered gaming machine. But the secondary components, the SSD and the RAM, don't quite hit the mark. Moreover, discounted last-gen machines running, say, an RTX 3080 present a real challenge to a rig like this, especially as they can be picked up for less cash. There is, however, a saving grace. Officially, the Chronos 2's sticker price is \$1,600.

One of the key attractions of Skytech rigs is that they routinely enjoy hefty discounts on Newegg. As we write, a Skytech machine with identical specs to our review rig is on offer for just under \$1,400. Suddenly, the slightly below-par SSD and cheaped-out RAM don't seem so bad after all. —KATIE WICKENS

VERDICT

7

Skytech Chronos 2

■ **GOOD TIMES** Strong GPU; Nice cable management;

Good packaging.

■ **TIME'S UP** Last-gen CPU; Ancient SSD; Only 16GB.

\$1,600, www.skytechgaming.com

BENCHMARKS

	Skytech Chronos 2	VRLA Tech Titan	Lenovo Legion T5i
Cinebench R23 multi-core (Index)	10,897	13,815	21,885
x264 video encoding (fps)	38	48	67
PCMark 10 (Index)	5,573	6,824	6,571
Far Cry 6 1080p (fps)	99	135	144
Far Cry 6 4K (fps)	72	81	73
Metro Exodus Enhanced 1080p (fps)	111	119	102
Metro Exodus Enhanced 1440p (fps)	56	75	68
Total War: Warhammer III 1080p (fps)	133	138	132
Total War: Warhammer III 1440p (fps)	91	92	87

Best scores are in bold. We pitted the Skytech Chronos 2 against two other RTX 4070-powered gaming PCs. The \$230 more expensive VRLA Tech Titan runs an AMD Ryzen 5 7600, 16GB of DDR5-5200 memory, and a 1TB PCIe 4 SSD, while the \$400 more expensive Lenovo Legion T5i sports an Intel Core i7 13700F, 16GB of DDR5-4400, and a similar 1TB SSD.

SPECIFICATIONS

CPU	AMD Ryzen 5 5600X
GPU	Zotac Twin Edge GeForce RTX 4070
Cooling	RGB Tower Cooler & 4x Skytech RGB 120mm Fans
Motherboard chipset	B550
Memory	16GB (2x8GB) DDR4-3200
Storage	MSI Spatium M371 1TB
Power	Gamdias Helios Gold P1 650G
Warranty	1 year parts, labour & shipping, lifetime technical support
Peripherals	Skytech Gaming mouse and keyboard



The XS1000 offers productivity in the palm of your hand.

Kingston XS1000

Good things
come in small
packages

WHEN YOU IMAGINE a typical external SSD, 'compact' and 'palm-sized' aren't the first things that come to mind. For most of their existence, these storage devices have been rather brick-like and rudimentary in their design, however, with its new XS1000 SSD, Kingston has reduced the SSD to the bare minimum. From floppy disks to ultra-portable drives with thousands of times more capacity, the world of storage technology is moving rapidly. So, are the days of inconveniently slow file transfers and corruption finally over? And is Kingston's latest iteration of a portable external hard drive the shape of things to come?

The XS1000 certainly embraces the XS part of its title. This thing is tiny, almost adorably so. Measuring just 2.73x1.28in, it's more like an 8GB USB thumb drive than a typical fire-breathing 2TB external SSD. The only concern we have with the size is that it's entirely possible to lose it. It's a shame it doesn't come with a small clip to loop a keyring or a carabiner on it. We also need to mention how thin this little device is too—a slimline 0.5 inches to be precise. This, combined with its soft-touch matte finish, makes it a comfortable device to hold in the palm of your hand. You can chuck this into any bag on your travels and you will have an easy 2TB at your disposal.

The XS1000 also only weighs a measly 0.06lbs, which only adds to its impressive portable characteristics. The rest of the design is subtle, it only comes in a matte black finish and features the Kingston logo in white as its only branding. Design-wise, there isn't too much going on here, and at the time of writing, there are just two variants—a 1TB and a 2TB model, the latter of which we have here. These are distinguishable from the sticker on the reverse of the drive. Other than that, both models are almost entirely identical. Although the design is somewhat lacking, as an external SSD, it doesn't need to look fancy. The more minimal and discrete the better in this instance, so the design and form factor get a thumbs up from us.

So what kind of technology is this micro device packing? As we mentioned, our model boasts a 2TB capacity, which is a fantastic amount of storage for such a small SSD. Sure, we've been accustomed to this technology for a while and all of our builds over the last few years have featured M.2 SSDs of the same physical size, but it's great to see this now in a portable fashion.

Unfortunately, one thing we aren't seeing from the Kingston XS1000 is the same read and write speeds as the top-performing M.2 SSDs, but we can't have everything we want. This device provides read speeds of up to 1,050MB/s and write speeds of up to 1,000MB/s, both of which are more than good enough for moving important documents, photos, memories, media, applications, and more. If you want to double the speeds then the older and more premium XS2000 model is still available. We have to praise Kingston here for the simplicity of its naming scheme on these devices instead of giving it a totally unrelated number.

Anyway, the XS1000 uses a USB 3.2 Gen2 cable, Type-C to Type-A, which is far better and more convenient than some of the older cables used on external larger

SSDs. It gives a secure fit and ensures that the cable won't slip out accidentally and potentially lead to file corruption.

One last thing to mention is the price. Our 2TB model costs \$110, which for what you are getting is a highly attractive price point. Not only is this incredibly versatile, portable, lightweight, and packs a mighty large capacity, it gives you peace of mind that if you have one with you, you can easily transfer files on the go, stress-free. It won't take up space in your bag, can easily be stored in your pocket, and it's a great addition to an on-the-go tech carry. If you like to take the minimal approach in life, this is the drive to have with you.

Amongst all the positive things we have to say, it does lack hardware encryption, which could be an issue if you are planning to use it for business purposes. However, this device appears to be aimed more at creatives. Finally, a rubberized case would have been a nice addition but as we noted earlier, it still offers value for money. As it is, this is an awesome little device! **-SAM LEWIS**



VERDICT

Kingston XS1000

■ **SLEEK SLIM DRIVE** Ultra-compact form factor; large capacity; USB Type-C.

■ **SLIGHTLY SLOW DRIVE** Faster option available; lacks hardware encryption.

\$110, www.kingston.com

SPECIFICATIONS

Format	External 3.2 Gen 2 SSD
Capacity	2TB (version tested)
Interface	USB 3.2 Gen 2
Read speeds	Up to 1,050MB/s
Write speeds	Up to 1,000MB/s
Dimensions	0.53 x 1.28 x 2.73 inches



Razer's update Blade 14 is slightly bigger and a whole lot better.

Razer Blade 14

Good things come in small packages

THIS A LOVELY LAPTOP. It's the very epitome of Razer's superbly refined and surprisingly restrained notebook design ethos. We love the 14-inch form factor, too. This smaller scale makes the Blade 14 a laptop that can be equally at home both as your home gaming machine and your daily driver office notebook.

The catch? It simply isn't good value. It's just so damned expensive for the core components and the resulting performance. Take the Acer Predator Helios 16, with one of the best displays in any gaming laptop. That's a \$2,300 machine. Or how about the excellent Lenovo Legion Pro 7i? That's a \$2,500 system, and one you could find for just \$2,200 over the recent summer sales period.

And the Razer Blade 14? \$2,700 buys you an AMD Ryzen 9 7940HS CPU and Nvidia RTX 4070 GPU combo.

You also get the now basic standard of 16GB DDR5 memory and a 1TB SSD, which is the sort of minimum spec you'd require in

a \$1,500 notebook, not an almost \$3,000 one. You can at least upgrade the RAM in this 2023 edition, which you couldn't with the previous Blade 14 machines.

And those other two systems? They're both 16-inch gaming laptops with an Intel Core i9 13900HX CPU and a Nvidia RTX 4080 graphics chip. Consequently, it's a veritable bloodbath in the benchmarking stakes, with the Blade 14 taking an absolute hiding. Even a budget gaming laptop like the Gigabyte G5 with its RTX 4060 GPU can occasionally stick a shoe in the Razer's ribs. Ouch.

And yet, the Blade 14 is about much more than raw performance numbers. Calling it a holistic experience might sound pretentious, but with this kind of premium high-end system, it's more about how it hangs together as a whole than the individual components.

That said, some of the specifics are nice, including the pin-sharp 14-inch 2,560 by 1,600 pixel panel running at a slick 240Hz. It's also handy that the Ryzen 9 7940HS ships with the Radeon 780M iGPU inside it. That's the same 12CU RDNA 3 graphics silicon in both the ROG Ally and AOKZOE A1 Pro gaming handhelds, and it delivers impressive 1080p gaming frame rates. Switching to the iGPU gives more gaming uptime on battery.

This is also a slightly different machine to the previous two Blade 14 laptops Razer released in 2021 and 2022. The chassis is a bit thicker, longer, and wider. We're talking millimeters, so it still feels compact. But the upside is improved cooling (and therefore less noise) and a 16:10 rather than 16:9 aspect display.

Of course, the build quality is outstanding and that solid aluminum

chassis feels incredibly robust. The chiclet keyboard has decent spacing between keys for a compact machine and trackpad is deliciously large, even if it's not the most sensitive pad on the planet. That increased chassis size means Razer has been able to jam in a slightly larger battery compared to the two previous models, too. You get a full 68Wh battery as opposed to the 61Wh battery the Blade 14 shipped with before.

As it happens, our review unit nails a good spec compromise. The RTX 4060 version is \$300 cheaper than this RTX 4070 edition, but \$2,400 for such a low-end spec feels even harder to choke down. Ultimately, the latest Blade 14 spoils you for other laptops. The new category of 16-inch machines is certainly appealing, but now that Razer's jammed a 1600p screen into this still compact frame, the benefit of something bigger has narrowed.

Ultimately, then, this is not the most powerful machine for the money. It's likewise impossible to justify with cold, hard numbers. But it is, overall, just about the most appealing gaming laptop available at almost any price. —DAVE JAMES

VERDICT

8

Razer Blade 14

■ BIGGER ISN'T ALWAYS BETTER
Bright, pin-sharp 1600p screen; 14-inch is where it's at; Beautiful build.

■ SIZE MATTERS Hugely expensive for an RTX 4070 machine; Poor comparative performance.

\$2,700, www.razer.com

SPECIFICATIONS	
CPU	AMD Ryzen 9 7940HS
Cores Threads	8 16
Boost clock	5.2GHz
GPU	Nvidia RTX 4070 (140W)
Cores	4608
VRAM	8GB
System memory	16GB DDR5-5600
Storage	1TB NVMe SSD
Screen	14-inch
Resolution	2560 x 1600
Refresh rate	240Hz

BENCHMARKS

	Razer Blade 14	Acer Predator Helios 16	Gigabyte G5 KF
Cyberpunk 2007 1080p RT (fps)	38	55	53
Metro Exodus 1080p RT (fps)	77	102	57
Hitman 3 1080p Ultra (fps)	184	249	158
Cinebench R23 (pts)	15,115	19,347	12,344
3DMark storage (MB/s)	461	457	352
Max GPU temp (C)	73	90	80
PCMark 10 gaming battery life (mins)	101	94	62

Best scores are in bold. The Acer Predator Helios 16 runs an Nvidia RTX 4080 GPU in 175W spec, while the Gigabyte G5 KF has an RTX 4060 in 75W configuration.

AOKZOE A1 Pro

Definitely more than a Deck, but is it better than a ROG Ally?

THE AOKZOE A1 PRO is a handheld gaming PC in the mold of the Asus ROG Ally, sporting essentially the same excellent AMD processor and a bigger screen, but without some of the restrictive Asusness. Does that make this the ultimate gaming handheld? Or should that be the ultimate Windows-powered handheld?

Before the Steam Deck launched, there were plenty of handheld rigs to choose from, but they all suffered from substandard integrated graphics. With the release of the AMD Ryzen Z1 Extreme and Ryzen 7 7840U APU twins, things have taken a dramatic turn for the better.

That was first proven by the Asus ROG Ally, but that was only 1080p. The new

AOKZOE A1 Pro ups the ante to 1200p thanks to its 16:10 aspect display. The AMD Ryzen 7 7840U chip at the heart of the A1 Pro is effectively the same as the Z1 Extreme in the ROG Ally, so that's eight Zen 4 processor cores running at up to 5.1GHz. More importantly, it comes with the RDNA 3-based Radeon 780M integrated GPU inside it.

It comes with up to 64GB of LPDDR5 and 2TB of SSD storage, but the 16GB/1TB spec here makes more sense. That said, as we go to press, AOKZOE is only shipping 32GB of RAM with the lowest-spec \$999 version—significantly more than the ROG Ally, which can be had for just \$699.

Unfortunately, the extra money doesn't net you a better handheld interface. The OneXConsole software overlay is pretty effective, and gives you simple shortcuts for enabling Radeon Super Resolution and changing the power limits of the APU. But the game library doesn't have the style or utility of either Asus's Armory Crate or Steam's Big Picture mode. Valve and the OneXConsole actually clash if you set the machine to boot into Big Picture mode for that Steam Deck experience.

Still, the hardware is excellent, and that's arguably what matters more. Sure, the A1 Pro is chunkier than both the Deck and Ally, but it doesn't feel restrictively awkward in-hand. That also allows it to deal with the thermals of the AMD APU better than the Ally.

It also has a selection of buttons around the 8-inch display, including the standard start and select buttons, one that takes you to the Windows desktop, and another that brings up the on-screen keyboard or enables the left thumbstick to act as the mouse input.



The A1 Pro's chunky proportions allow for better cooling than Asus's ROG Ally.

Speaking of the thumbsticks, they're smooth and accurate, though the trigger buttons are oddly placed, and the D-pad makes a clicking sound when it resets after you press in a given direction.

As you'd expect, in-game performance is similar to the ROG Ally. There's maybe a couple of frames per second in it, but for all intents and purposes you're getting great gaming performance if you stick to 1080p medium settings.

The other thing that pleases me about the A1 Pro is the battery. You can't even get a full hour out of the Ally's 40Wh

battery, while the 65Wh in the AOKZOE will net you an easy 90 minutes. Clock down to 15W, and you still get decent performance, looking at nearly two hours and 40 minutes of game time.

In the end, that hefty asking price is the sticking point. If you want a cheap handheld gaming PC, the Deck's 64GB and 256GB options are tempting, while the ROG Ally has the extra AMD performance. The extra \$300 is a lot more money for a bigger screen, double the RAM, and some extra USB ports. It's a nice machine, but the price gap is just too big. **-DAVE JAMES**

BENCHMARKS

	AOKZOE A1 Pro	Asus ROG Ally
Hitman 3 Dubai 1080p Medium (fps)	62	66
Cyberpunk 2077 1080p Steam Deck setting (fps)	37	37
Horizon Zero Dawn 1080p medium (fps)	66	66
Cinebench R23 (pts)	12,788	14,113
PCMark 10 Gaming battery life (min)	90	57

Best scores are in bold.

VERDICT

8

AOKZOE A1 Pro

FULLY DECKED OUT Great performance; Lots of ports; Cool and quiet performance.

RUNNING OUT OF STEAM Expensive compared to an Asus ROG Ally; Software is clunky.

\$999, www.aokzoe.com

SPECIFICATIONS

Processor	AMD Ryzen 7 7840U
GPU architecture	RDNA 3
Compute units	12
VRAM	4GB
Memory	Up to 64GB LPDDR5X-7500
Screen	8-inch IPS-level
Resolution	1200p
Refresh	60Hz
Peak brightness	350 nits
Storage	Up to 2TB PCIe 4.0 SSD
I/O	1x USB 4.0 Type-C, 1x USB 3.2 Type-C, 1x USB 3.0 Type-A, MicroSD slot, 3.5mm headphone jack
Battery	65Wh
Weight	729g (1.61 lbs)





This enormous spider-shaped router does it all.

Asus ROG Rapture GT-AXE16000

A lot of router for a lot of cash

HERE AT MAXIMUM PC, we like devices of a large stature. We like them fast as well, and Asus's enormous router fulfills all our needs. This is a Wi-Fi 6E router with six Ethernet ports and a startling array of leg-like antennas sprouting from the edges of its casing.

It's so large that it's like a PC in its own right, and is certainly an eye-catching sight. There's a translucent panel on top of the casing that's highly reflective when it's dormant, but once the router comes alive, it lights up in a flurry of logos and LEDs. Finding a home for this unit that keeps it close enough to the source of a fast data connection, and yet doesn't keep the family awake all night, is going to be a quest, though even if you do find somewhere, it's so large that it might not fit on a shelf like most routers will.

You can turn the RGB off, but doing this doesn't turn it into a sensible member of your home network ecosystem. The GT-AXE16000 is designed to ingest a lot of data and move it around quickly, and to this end sports a 2.5Gbps WAN socket. Alongside one of the antennas sits a pair of 10Gbps Ethernet ports, suitable for creating a network backbone across your house (which had better be enormous to deserve a router like this), over which you can transfer data quickly.

There are four of the more usual gigabit ports too, which is usually enough for most people, though you may start to consider them a bottleneck as broadband access speeds rise. Luckily, you can aggregate two of them together for a 2Gbps link to your gaming PC if that helps.

It's the Wi-Fi that gives the AXE16000 its name, and if you add together the maximum speeds of all four available bands (2.4GHz, two 5GHz networks, and the 6GHz available only with Wi-Fi 6E) in a generous fashion, you will indeed reach 16000Mbps, or thereabouts. The 2.4GHz connection tops out at just over a gigabit, so you'll want to reserve it for low-priority devices. It does all the usual Wi-Fi 6 tricks to expand the amount of data you have, with beamforming, MU-MIMO, OFDMA, and beamforming.

During our testing in a house that admittedly isn't as large as the one we

dream of, we found it impossible to catch the router out. We were always in range, even when outside the main building, and while the distance between the router and client device has an effect on the speed of data transfer, there's enough overhead on an average internet connection that we were quite some distance away before we noticed the drop. If you live on a ranch or a really big house, the router is compatible with Asus's AiMesh system, so you can have repeaters dotted around.

You'll need to have a good reason to consider buying the Asus ROG Rapture GT-AXE16000. Needing the fastest is a good reason, as is a desire to own a router so big, and containing so much PC-like electronics that it could probably be used as a games console. However, not everyone needs to share a 2.5Gbps internet connection between devices at full speed, and not everyone needs to have multiple laptops and tablets streaming HD video at the same time. If all you need is to get a PC and a few phones online easily, this router is absolute overkill. But that's why we love it. **—IAN EVENDEN**

VERDICT

9

Asus ROG Rapture GT-AXE16000

SPIDERY Fast, long-range Wi-Fi; High-speed Ethernet hub.

DERISORY Very large and expensive; Probably overkill.

\$690, [asus.com](https://www.asus.com)

SPECIFICATIONS

Wireless standard	Wi-Fi 6E
Max speeds	1,148 Mbps (2.4GHz), 4,804 Mbps (5GHz x2), 4,804 Mbps (6GHz)
MU-MIMO	Yes
Ethernet ports	Six
WAN	2.5Gbps
CPU	2GHz quad-core
USB	1x USB 2.0 Type-A, 1x USB 3.2 Gen 1 Type-C
Dimensions	19.3 x 35.3 x 35.3cm
Weight	2.4kg

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Corsair HS80 Max Wireless

Revised mid-tier headset from Corsair has plenty of features in its arsenal

THE HS80 MAX is a headset that doesn't just lead with its audio quality but has a plethora of tricks up its sleeve. The previous iteration of the HS80 was a great all-rounder and had a rich warm soundstage, a comfortable headband, and a clean aesthetic. The HS80 Max is a revised version of the previous model that aims to further these points.

In terms of its design, it doesn't stray from the previous look with its almost boxy ear cups, suspended headband, and flip-to-mute mic that has been copied and pasted into this updated version. It comes in either black or white/gray colorways for a slightly muted look. The only shock of color is with the RGB logos and the LED indicator on the end of the mic. The majority of the HS80 Max is made of durable plastic with the headband reinforced with lightweight aluminum. One of the typical weak points of a headset is the yolks attached to the earcups. Thankfully, these are made of aluminum ensuring resistance to a lot of wear and tear.

Other than a little more clamping force than we would like, the comfort here is spot on, just like on the previous headset. It features the same ski-band style suspended headband made of a soft fabric. You can adjust this to alter the size of the headset, unlike the traditional method where you pull down on either cup. Soft cushy earpads round off the overall comfort of the headset allowing hours of wear without issue. Weighing in at 0.77lbs, it's not the lightest headset we've experienced, but it's light enough.

The HS80's physical controls are pretty minimal. There's a power button and volume wheel behind the left earcup, while a Bluetooth button sits behind the right. The microphone is controlled by lifting it up to mute or down to use. One hidden and cool feature for PC users is that when the volume wheel is pressed, it opens up the Corsair iCue app. Here, you can access EQ settings, lighting options, and other general operations.

So, it's an overall thumbs up for the HS80 Max so far, considering it's gone for the "if it ain't broke don't fix it" approach, but how about the sound quality? If there's one thing the Corsair HS80 Max is not, it's neutral. It has a boost in the low-mids with the highs slightly rolled for a sound that can be described as warm.

IMMERSIVE GAMING

Now, we're not saying this is a bad-sounding headset. In fact, it sounds good. But the flip side is it loses a lot of detail for something in this price bracket. Despite those gripes, overall, it's pleasant to listen to and performs better with games than with music due to the low-mid boost that gives a deep, immersive feel to the sound. To help further with immersive gaming, this headset supports Dolby Atmos which is accessible via the Dolby Access app. Although verging on subtle it does give a little more three-dimensional space to game audio without washing it out the way some spatial audio can.

The HS80 Max steps up a gear when it comes to features. The ability to map the scroll wheel button to a whole set of functions in iCue is one of them. Another is that it supports both 2.4GHz and Bluetooth connectivity so you can connect it to many different platforms, though sadly it doesn't have multipoint connectivity. There's a ten-band EQ, which is much more powerful than in a lot of companion apps, along with some EQ presets. There's also a way to create a personalized EQ or sound profile via the Sonarworks SoundID personalization giving you more control to get the exact

sound you need. One final positive point to mention is the 65 hour battery life, which impressed us, although that is with RGB turned off.

At \$180, it's the epitome of mid-range. You won't be shaken with fear just by looking at the price tag, like the Audeze Maxwell, yet it isn't as good a deal as the Corsair HS65 Surround. Having spent some time with the HS80 Max, we'd say that the price tag offers an appropriate amount of performance, comfort, and features. **-JAMES HOLLAND**



VERDICT
8

Corsair HS80 Max Wireless Headset

MAX POWER Feature-rich; comfortable fit; long battery life with RGB; warm, clean sound.

MIN POWER Non-extendable headband; no multipoint connectivity; too many low-mids.

\$180, www.corsair.com

SPECIFICATIONS	
Driver type	50mm neodymium driver
Frequency response	20Hz - 40,000Hz
Impedance	32 Ohms
Connectivity	USB-C, Bluetooth, wireless 2.4GHz
Compatibility	PC, Mac, PS4 & PS5
Battery life	Up to 65 hours w/o RGB
Design style	Closed-back



Drop Lord of the Rings Dwarvish ENTR

As sturdy as a stout dwarf but basic under the skin

BUILT AROUND Drop's ENTR mechanical keyboard, the Lord of the Rings Dwarven edition speaks to us deeply, with each press of its keys resounding like drums. Drums in the deep. But the most pertinent question for slightly less pathological Tolkien pupils is this: What price are you willing to pay for something that, while studded with impeccable artwork, is essentially a rather basic keyboard underneath that Dwarvish facade?

Hold that thought—we'll come back to it. Each keycap is either lovingly decorated with thematic Dwarvish iconography by Oshetart, or spread with Khuzdul phrases, such as the space bar's Dwarven battle cry, "The axes of the dwarves! The dwarves are upon you!"

Each letter key also suggests a dwarven equivalent legend or two, though the accuracy of the board's Cirth legend has been put into question. One online commenter makes it known in the Q&A section, stating, "Every book I own and images I have found online say that the runes correlate with different letters and numbers than the keyboard shows."

While it may not be the greatest purchase for anyone looking to practice their Dwarvish, it's nice to be greeted with familiar, runic inscriptions. What's more, swapping the keycaps around with the helpfully included keycap puller is a breeze. However, the lack of shine-through on the keycaps, along with the limitation of white LEDs, is a little disappointing. It means you can't have the Eye of Sauron wreathed in flaming orange RGB lighting. Bummer.

As with any cult franchise-associated gaming gear, it's difficult to placate your inner nerd without incurring a premium price. The decision for Drop to up the

standard ENTR's \$99 price tag by \$100 for all that *Lord of the Rings* artwork is pretty hard to justify. But at least you get a sturdy anodized aluminum board, with lovely recessed keycaps.

As for actual key actuation quality, where the standard ENTR has the option of Halo True or Gateron Yellow switches, the *LOTR* version is limited to Holy Panda X only. Yes, they were once considered the switch GOAT, but you're a bit stuck on the customization front if you decide the soft, oozy keystroke feel isn't for you.

BUY, YOU FOOLS

Anyway, for the same \$200 price tag as this board, you could nab Logitech's wireless G715. It's also TKL, but with the addition of inline media controls, keycap shine-through, and a selection of switches to pick from. Alternately, there's the full-size gaming keyboard, the Wooting Two HE—our favorite gaming keyboard right now—which comes in at a few dollars less, even. The Wooting comes with adjustable analog switches, and a numpad built in, which makes it really hard to recommend a pretty-but-boring board like the *LOTR* ENTR, accurate runic inscriptions or none.

You could also snag the best 60 percent keyboard on the market—the Mountain Everest 60—for \$140. With that, even Drop's standard ENTR board looks less appealing at \$99, let alone this one at the steep price of \$199. Granted, you are getting a few more keys than with the Everest, but you're missing out on hot-swappable key switches, keycap shine-through, and the ability to attach a numpad at either end of the board.

Really it comes down to weighing up the kind of benefits you could get from the

alternatives against the gorgeous *Lord of the Rings*-themed artistry. Of course, the precious (sorry) *LOTR* ENTR design is all too tempting to any Tolkien fan. If lovely switches, beautiful artwork, and finger-cupping keycaps are your speed, then great. But the overall upshot is more style than substance with the *LOTR* ENTR board. For those who prioritize functionality and customizability, you can do much better for your money elsewhere. —KATIE WICKENS

VERDICT

7

Drop Lord of the Rings Dwarvish ENTR

MY PRECIOUS Gorgeous design; soft tactile key switches; satisfying recessed keycaps.

WICKED, TRICKSY, FALSE No shine-through or colorful RGB; lack of key switch options; cost.

\$199, www.drop.com

SPECIFICATIONS

Size	TKL
Connection	USB-A to USB-C
Switches	Holy Panda X
Backlight	White only
Pass-through	None
Rollover	N-key
Keycaps	Dye-subbed PBT
Dimensions	14.2x5x1.25 inches
Weight	33 ounces
Warranty	Three-year standard

Mountain Makalu Max

A great wired gaming mouse, but sometimes a frustrating wireless one

HOW YOU HOLD your mouse can be as personal to you as your fingerprints. Mountain's Makalu Max comes with a host of customization options, meaning it appears to be well suited to a range of different hand sizes and grips. This strategy of user customization is what has made the company's keyboards so successful, after all.

We really want to like the Makalu Max. And most of the time, we really do. It's got a classic PixArt sensor, offering up to 19,000dpi should you need such a level of sensitivity, but it also comes with interchangeable weights. That's not hugely innovative on its own—many other mice have done this in the past—but few have gone with the sort of weights that enable you to balance that weight around different areas of the mouse body.

You get a set of three rings to use as clip-in weights: One solid, for the heaviest option; one cut out, for the lightest; one with a third filled in and the rest cut out. This last one can be dropped in with the heaviest part of the ring at any point positioned around the circle, skewing the heft toward different sides.

That's pretty niche, but the aspect of customization that will appeal to more people is the option to completely change the mouse's shape. As standard, it comes as a pretty straightforward, symmetrical shape—although, because of the position of the sniper and forward/back buttons, not ambidextrous. But there are two magnetic side panels you can swap in that add support for your pinky or thumb.

That broadens the sweep of mouse grips that can be comfortably accommodated by the Makalu Max, and the breadth of meaty hand that can hold it, too. For those of you with monster paws, you should be well supported by Mountain's latest rodent. You can mix and match the options, leading to very



different-looking mice. But we have to say we're so damned vanilla that our absolute preference is for the simple, more slimline symmetrical layout.

If you're really into customization, Mountain offers the STL files for you to download and tweak before 3D printing your own side panels.

WAKEY, WAKEY!

Aside from the custom side of things, the Makalu Max is also a wireless mouse, with no noticeable latency and a reliable connection. But it's also this aspect of the device with which we have the most issue. We've adjusted the soft and deep sleep timings as much as we dare and just can't get to a situation where we're using it without getting deeply frustrated when we set aside the mouse for a moment and have to click a button to wake it up again. We get that it's important to maintain battery life, but we want our mouse to be there, ready to roll when we need it.

And if we set it up like that, we feel as though we have to charge it up far too much. The USB Type-C charging cable is soft and the fabric coating makes it easily flexible and comfortable to use as a wired mouse, but we still get frustrated seeing the neat RGB LED ring around the mouse wheel start flashing red.

All that said, we do still have a soft spot for the Makalu Max. We've been using it solidly for a good long while now, and have been swaying back and forth between "Yeah, we would happily carry on using this" to "Damn it, why do you keep going to sleep so often?"

It's at a decent price for a responsive, customizable, reliable wireless gaming

mouse right now, and that makes it tempting. But there are just some quality of life issues that mean it can't be a definite recommendation.

The Makalu Max is almost a great gaming mouse, but we find the wireless experience frustrating in a way its rivals aren't. The customization options are great, it feels comfortable in the hand, and the sensor is reliable and accurate, but it's just a little short of being the full package. —DAVE JAMES

VERDICT
7 **Mountain Makalu Max**
+ **MOUNTAIN** Easy and effective customization options; design feels good in the hand; responsive.

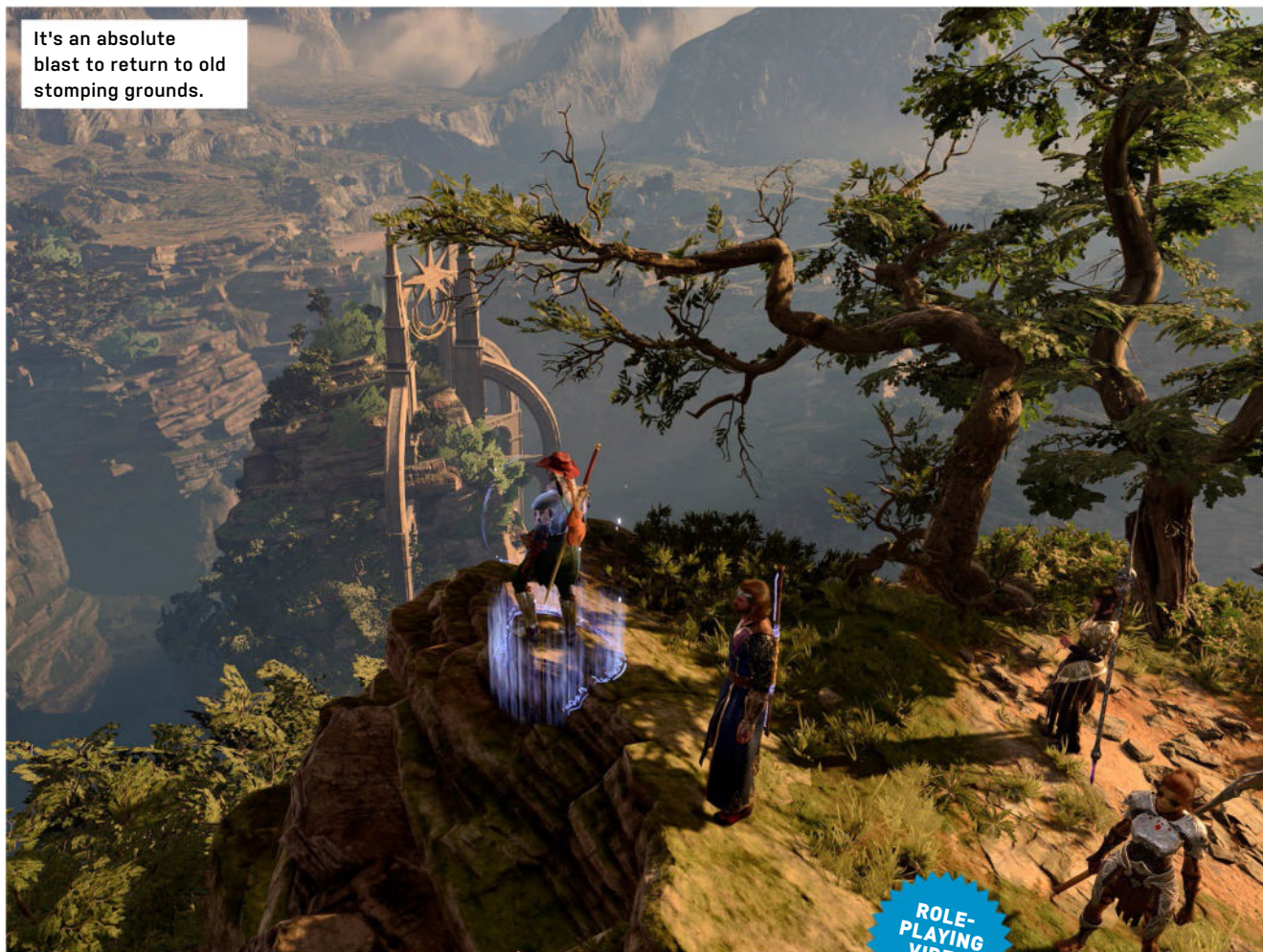
■ **MOLEHILL** Waking up wireless is annoying; battery life isn't great; software is an issue.

\$90, www.mountain.gg

SPECIFICATIONS	
Connection	2.4GHz wireless and USB Type-C
Sensor	PixArt PAW3370
Max DPI	19,000
IPS	400
Tracking speed	50G
Configurable buttons	8
Polling rate	1,000Hz
Weight	4 ounces (without extra weights)
Accessories	2x side grips, 3x weight discs



It's an absolute blast to return to old stomping grounds.



ROLE-PLAYING VIDEO GAME

Baldur's Gate III

Larian's latest is worth the 20-year wait

GATHER YOUR PARTY, folks, because *Baldur's Gate III* is finally upon us. A whopping 23 years after the Bhaalspawn and their buds took a trip to Athkatla in *Baldur's Gate II*, we're back in the Sword Coast slaughtering goblins, getting spooked by mind flayers, and spewing out magic missiles. And even for a jaded old hack like your current correspondent, returning to old stomping grounds is an absolute blast.

No question, this is an absurdly impressive CRPG. As I've fought, stolen, and sang—yes, I'm a Bard—my way through the Forgotten Realms, it's felt like I've been playing the Greatest Hits: the best parts of *Ultima*, *Baldur's Gate*, *Planescape: Torment*, *Arcanum: Of Steamworks and Magick Obscura*, *Pillars of Eternity*, *Divinity: Original Sin*—all the heavy hitters.

Rather than being a direct sequel, *Baldur's Gate III* takes a very Larian approach to *D&D*, turning it almost into an immersive sim where anything goes. Every quest and combat encounter has a ridiculous number of ways for you to tackle it, rewarding creativity and curiosity at all times.

Spells, skills, and physical manipulation of the world around you opens up so many doors, literally and metaphorically. You can make a fight against a trio of ogres go your way by smashing the rickety pillars holding up the building they're hanging out in, turn into gas to sneak your way through tiny cracks, or use magic to persuade animals to turn on their masters.

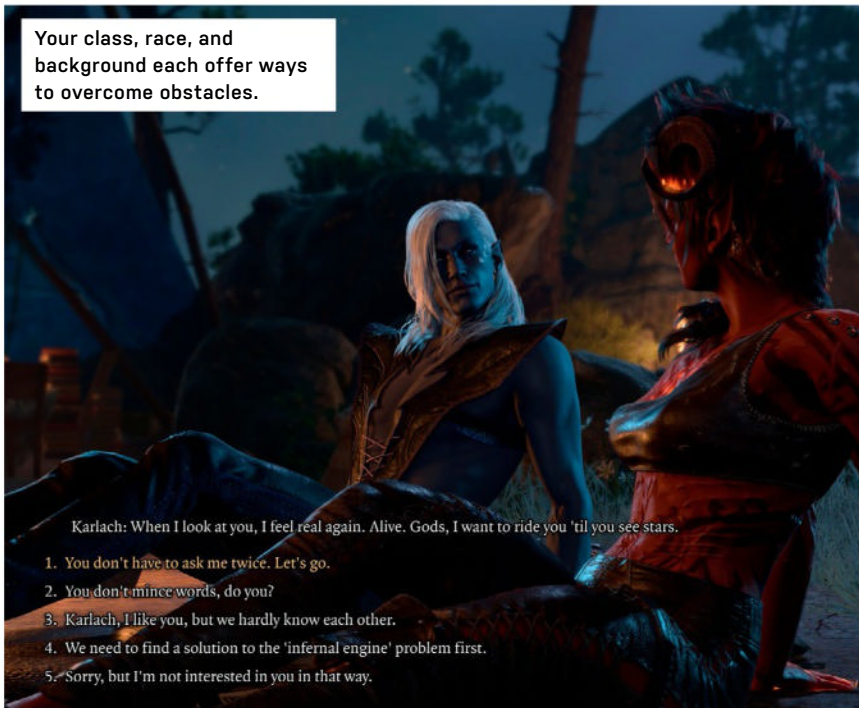
Your class, race, and background each offer myriad ways to overcome all manner of obstacles and situations. At the

most basic level they inform your dialogue choices and the way NPCs react to you. So as a Bard, I crack a lot of jokes, come up with the best insults, and tell the most colorful lies.

Sometimes, challenges crop up during conversations, necessitating the roll of ye olde d20. The charlatan background, for instance, gives you skills like deception and performance, which can increase your chances of success when you tell tall tales to get out of a sticky situation, or compose a poem on the spot because your life depends on it.

All sorts of modifiers come into play, effectively buffing your roll. As a Bard, my charisma ability score can be used to help me make a more persuasive argument. My Friends spell, meanwhile, gives me Advantage, allowing me to roll two d20s, with the highest roll being picked.

Your class, race, and background each offer ways to overcome obstacles.

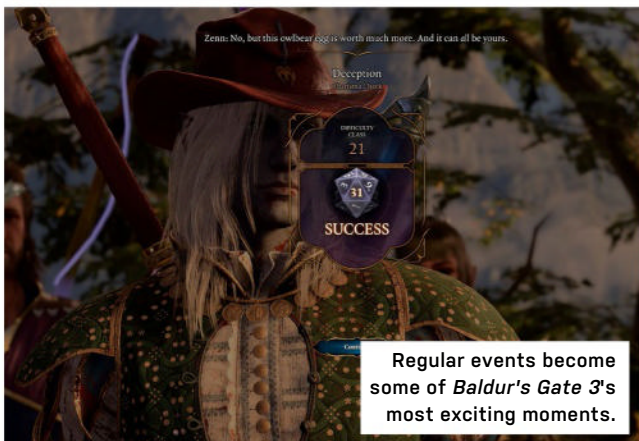


Karlach: When I look at you, I feel real again. Alive. Gods, I want to ride you 'til you see stars.

1. You don't have to ask me twice. Let's go.
2. You don't mince words, do you?
3. Karlach, I like you, but we hardly know each other.
4. We need to find a solution to the 'infernal engine' problem first.
5. Sorry, but I'm not interested in you in that way.



Spells and skills open up many doors, literally and metaphorically.



Regular events become some of *Baldur's Gate 3's* most exciting moments.



This is turn-based, and thus slower than its predecessors.

Even my companions can help with their own spells.

These mechanics also crop up when you're disarming traps, picking locks, and getting into fights, though when it comes to the latter you don't make the rolls yourself. That would make combat drag on for hours and hours, and a lot of fights are already marathons. If you were hoping for something more in the vein of the classic *Baldur's Gate*, however, you'll still be well served as you delve into sprawling, trap-infested dungeons, listen to your bickering but delightful companions, and deal with a curse that's not a million miles away from the legacy of Bhaal.

See, you've got a mind flyer tadpole in your brain, but instead of swiftly transforming you into one of these psychic, tentacled monsters, it gives you telepathy,

mind-control abilities and, should you choose to consume more tadpoles from others with a similar curse, a whole web of weird abilities. But at what cost? Well, that's the conflict at the heart of *Baldur's Gate III*: how much do you give in to your new powers, and when do you stop being an elf or a human and start becoming a mind flyer yourself?

By today's standards, the system requirements are modest—rejoice, for you don't need a \$1,600 RTX 4090 to play *Baldur's Gate III*. It's remarkably bug-free, too, for a brand new game of this scale and scope. After reviewing a game this ridiculously large, there's usually a sense of relief when I'm done. But not here. To be honest, I could have easily reached the game's climax days earlier, I just couldn't bring myself to call it. I felt compelled to see as much

as humanly possible because it's all just so bloody incredible. Whenever I found a new quest to distract me, I was overjoyed. I'm genuinely gutted that it's over. So I guess there's only one solution: start all over again. I'm buzzing with excitement.

—FRASER BROWN

VERDICT

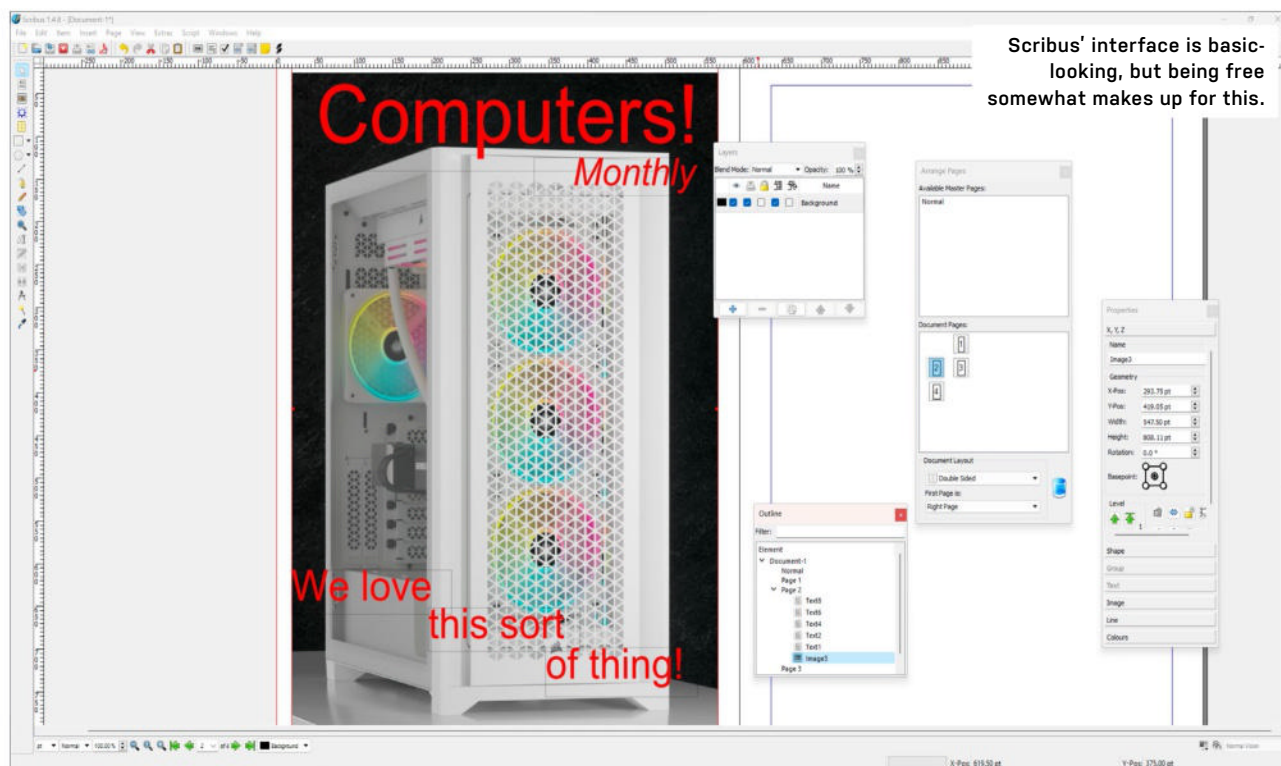
9

KICK ASS!

Baldur's Gate III

- ON A D20 ROLL An absurdly impressive CRPG; Relatively modest system requirements.
- UNLUCKY THROW It'll take over your life; Not exactly cheap at \$60.
- RECOMMENDED SPECS CPU, Intel Core i7-8700K / AMD Ryzen 5 3600. GPU, Nvidia GeForce RTX 2060 Super / AMD Radeon RX 5700 XT. RAM, 16GB.

\$59.99, www.baldursgate3.game, rated 18



Scribus vs Affinity Publisher

Enter the world of publishing with these apps

FIRST, let's address the elephant in the room. There is one app that has come to dominate the world of desktop publishing, and that is Adobe InDesign. If you're working for a company that uses InDesign, there's no point having anything else. The same goes for QuarkXPress, the former leading light in the industry that has been somewhat eclipsed by the rise of Adobe's app.

It's the same argument that has been put forward for Photoshop or Premiere Pro. If the entire workflow for your project—which involves lots of other people collaborating—is built on Adobe software, then you need Adobe software. Substituting for something else will probably cause the whole thing to collapse.

However, if you're not running or working for a graphic design company, but want something you can keep on your home PC and use to design flyers, posters, greetings cards, or even entire fanzines for hobbies like... err... what do people do when they're not building or using PCs? We're not sure, but there must be something.

Anyway, Adobe takes a lot of fire for its subscription model, which sees you pay each month for a license to use its software rather than just once. If you stop paying the subscription fee, your software stops working, which annoys a lot of people. The benefits of the model are the stream of updates and beta versions Adobe pumps out, and that a small monthly fee can be more affordable than several hundred dollars at once, and means you can rent it for the amount of time it takes to complete a project, then stop paying. However, we've got something that's potentially even better.

One of the applications we're looking at this month is completely free. It's open-source, and available on Linux and FreeBSD (you can even get an OS/2 Warp 4 version), as well as Windows and Macs. The other is available for a single payment, which isn't even all that much compared to a new graphics card.

SCRIBUS

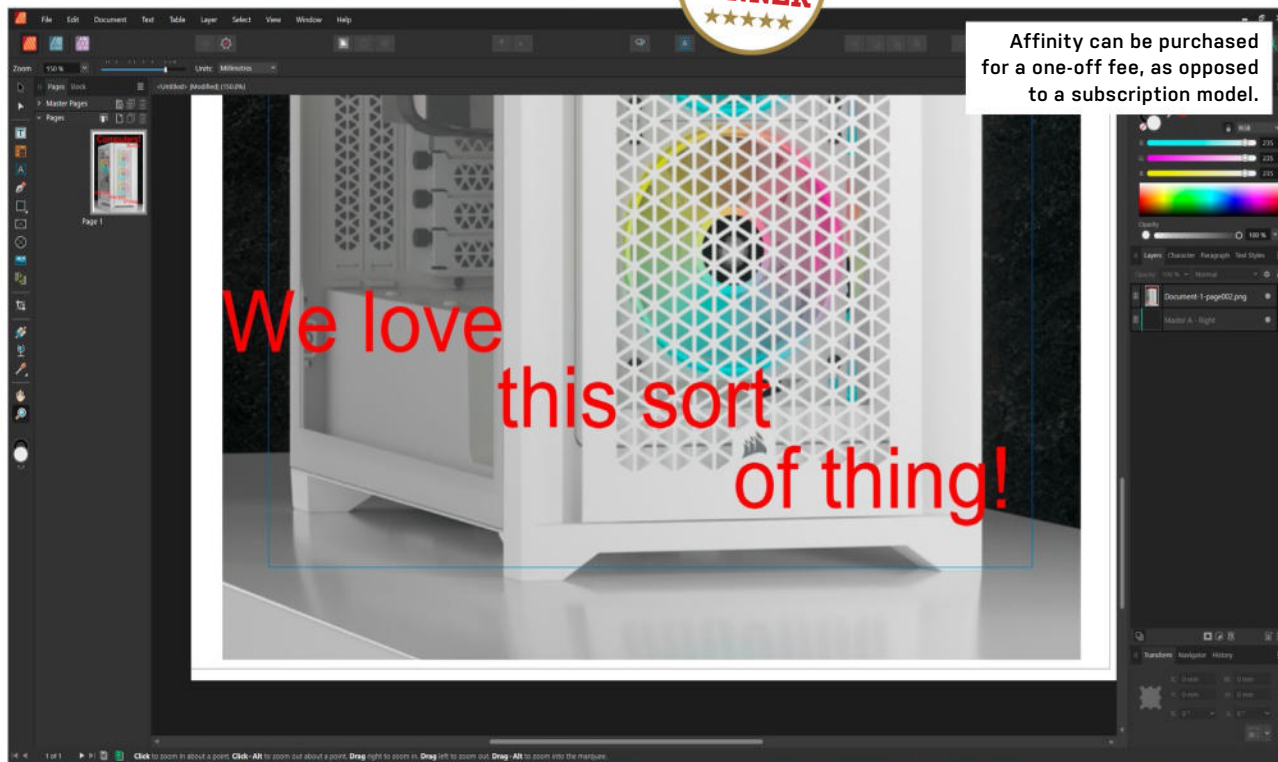
This is the open-source free app. You can download it from scribus.net (although at the time of writing the website was

throwing an error that we hope is fixed by the time you read this), or from SourceForge, and the most recent stable version is 1.4.8, released in 2019. The latest preview release, 1.5.8, came in January 2022, and version 1.6 is expected to be the next stable release, but with only two core developers, progress can be slow.

You'll need to install the GhostScript PostScript interpreter if you want to work with PDF files or PostScript printers, which is available under the AGPL free software license, and will prompt you when you install Scribus. Otherwise, the Windows installer gives you everything you need, without having to fiddle about with extra files.

Once installed, you're able to create a new document as a single page, or one with as many as four folds in it, set up facing pages if you're making a mag, then margins and bleeds to satisfy your printer. There's full CMYK and spot color support in Scribus too, including custom profiles.

Once you've got a document open, Scribus can make you pause as you work out where everything is, especially



Affinity can be purchased for a one-off fee, as opposed to a subscription model.

if you're used to Adobe applications. Having the toolbar at the top of the screen is probably the first thing that will get changed, slotting it into place at the side instead, then learning that the Properties window is where you need to go to change things like text size or image fitting rather than having it on display at the top of the interface like InDesign does.

However, once you've used it for a while, it all starts to make sense, and while there are some features that are simply not there, you can usually find what you want by searching the comprehensive forums and wiki, where you'll find a lot of knowledge and a helpful community trying to spread it.

Scribus can work with GIMP, the open-source image-editing program, to do round-trip editing if you need to tweak an image, and it's possible to import PSD files with any spot colors intact.

AFFINITY PUBLISHER 2

Affinity is an entire suite of creative apps available from Serif Software. The three programs—Designer, Photo, and Publisher—fulfill the roles of Illustrator, Photoshop, and InDesign, but without the monthly fee. You pay once up front for them, around \$69 each (or a \$170 universal license with everything), and they get updates until Serif decides to release a whole new version, which has

happened once already when version two of the software arrived in 2022, eight years after version one. There are Mac, Windows, and iPad versions of all the apps, but Linux users are overlooked.

Publisher 2 acts not only as a standalone page layout app, but as a hub for the other two. As long as you've got them installed, you'll be able to edit a photo in a Publisher 2 layout using the Photo 2 tools instead of having to open that app, then find the file, edit it, and update it in Publisher. The same goes for vector images in Designer. This is called Studio Link, and is Serif's big idea in the Affinity suite. You can use all the apps on their own, of course, but being able to open a specific toolset inside Publisher saves time and aggravation.

Elsewhere, Publisher 2 is set up to be an InDesign rival. There's full color separation support, the ability to import PSD and IMDL files in addition to PDFs, and the usual array of raster and vector image formats. Its interface owes a debt to Adobe (and Quark), with tools down the left-hand side and palettes like Layers and the color picker on the right. You'll feel right at home if you've used a DTP app before, though it can take a moment to work out where a particular tool is if you're not already aware.

Serif is extremely good at software support, and there are tutorial guides and

videos, as well as an online manual that's completely searchable. The app's New Document dialog got a thorough refresh in the move to version two, and now shows a real-time preview of what your pages will look like once you've finished fiddling with bleed settings. It also has a Recent tab that will save you literally seconds each time if you create a lot of documents from scratch.

Affinity definitely feels better than Scribus to use, though it requires more system resources. But it's hard to argue with getting Scribus for free, especially if it's the sort of app you don't use very often. —IAN EVENDEN

VERDICT	Scribus
8	SCRIBBLE Free software; Pro features; Good image support.
	DRIBBLE Clunky interface; Slow development.
	Free
VERDICT	Affinity Publisher
9	PUBLISH No subscription; Very professional feeling; Studio Link.
	BE DAMNED Steep learning curve; Not as common as InDesign in pro settings.
	\$69 (single app), \$170 (universal license)

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

- > GPU face-offs
- > AI building
- > No love for Win11
- > Home servers

CPU comparison

I wanted to ask if you could adapt something you covered in one of your previous features that I still really enjoy using to this day. Last year, in the June 2022 issue, you provided a great GPU resource, listing out a ton of GPUs and comparing them with each other on a graph. The two graphs showed one GPU at 1080p and another at 4K. I think it would be a fantastic thing to replicate with Intel/AMD CPUs along with an updated 2023 list for GPUs.

Doing something like this every six months or so and adding in new equipment as it is launched would be so cool to see. Using that chart was how I decided on what GPU to get to replace my aging GTX 1080. I can't think of any other place where you could easily get the comparisons on so many products effectively doing the same thing.

Perhaps it could go right before your "Builds" section? — **A. Press**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: I'm glad that even over a year on, Jarred Walton's feature is still being discussed and referenced. I remember when he pitched the feature thinking, "That sounds like a huge amount of work".

For those who missed it (digital subscribers can find the issue on Pocketmags), he compared different graphics cards from multiple generations to see how they all compared to each other, exposing which ones were the true greats and which ones were the also-rans. That required a huge amount of testing and data processing from our GPU expert, who does tend to love this kind of stuff, but it was impressive nonetheless.

Jarred and I have been discussing features for upcoming issues, as I did get feedback from other readers that they'd been missing his work. Next month, look out for a deep dive on the best

Steam Deck SSD upgrades you can make to not only increase your storage on Valve's portable games console but also which will be the fastest and most reliable. Then, as we head to the end of the year, he will be taking a look at the contentious GPU VRAM issue—with budget cards from AMD and Nvidia only coming with 8GB of memory, is that going to be enough for the latest gaming titles in the years to come?

I'll talk to him about the CPU comparison feature, although I fear for his sanity a little if he's going to go into the same level of depth as he did with graphics cards! But watch this space...

EPYC PCs

Given all the developments in the AI world these days, I was wondering whether you guys might like to do a piece comparing the latest and greatest Intel Xeon and AMD EPYC processors, or some other such comparison that might be

appropriate at the time of writing. Maybe you could do some builds that make use of them, and pit Team Blue against Team Red as you often do. I'm not much into gaming, but I love your publication and would really enjoy such a piece. I'm guessing I'm not alone!

— **V. Thompson**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: There's a lot of coverage in this issue about the impact that AI is set to have on the consumer graphics card market over the coming years (see *News* on page 9, and *Jeremy's Lab Note* on page 72).

Basically, with such high demand for AI applications and huge profits to be made on manufacturing that equipment, it makes good business sense for the likes of Nvidia to focus on that. There's no sign yet that it'll be at the expense of the RTX cards the company produces, but you can see a possible outcome being that GPU prices get

↘ submit your questions to: editor@maximumpc.com

more expensive, or aren't easy to purchase because they're being snapped up for AI purposes. It's like the crypto mining craze of 2020 all over again!

While we are *Maximum PC*, these high-end CPUs you mention (as well as other AI-focused products like Nvidia's H100 cards) are possibly still a bit niche, even for us.

As I look online right now, the H100 cards are going for around \$40,000 on eBay! However, I'm happy to throw this one out to the audience—are *Maximum PC* readers looking to build their own AI-focused systems? Let me know!

Legacy Windows love

I was reading your May 2023 issue and tripped over the following sentence: "...open File Explorer and navigate to your Home directory. Right-click the Documents folder under Quick Access and choose the Properties>Location tab. Click Move..."

I thought to myself, "I didn't know that was an option!" so I went to look for it on my version of Windows and it wasn't there. I can only assume that Windows 11 is built that way, but previous versions are not.

Yes, I know it was mentioned at the beginning of the article that Windows 11 would be used for the instructions, but this is a pet peeve of mine. Microsoft has been flogging Windows 11 for nearly two years now and market share is (according to gs.statcounter.com): Europe: 21%, North America: 28%.

So, not even one-third of your likely audience. That means the other two-thirds of your likely readership gets to trip over incorrect instructions in every article except ones about hardware. Every

new build gets...Win11. I've seen this same ignoring of the market for years with each new version—Win8, Win7, etc. Sigh!

— C. Steinway

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS:

You make a fair point about the consumer adoption of the latest software, particularly operating systems. As we well know, certain versions of Windows are very popular (think 7 and particularly 10, the latter of which is still dominant today). Also, some people are just reticent to move their work and/or gaming machines onto an OS until it's proved to be completely stable.

I don't have the stats to prove it, but I expect that a higher percentage of *Maximum PC* readers have now made the leap to Windows 11, given as you say it's now been out for nearly two years. I've been using the OS myself since those first three months, when a laptop I purchased came with it. I've had no problems, and find these kinds of tutorials really useful.

Of course, nothing stands still—I was in a meeting today with the other tech titles at Future where I heard the first mention of Windows 12, so expect more references to that on these pages soon! But I do think that as *Maximum PC*, covering technology and software for those on the cutting edge, we should be referencing the latest software. Thank you for your feedback.

Server recommendations

I'm writing because I want to build a replacement home server. I started my love of servers after reading an article about the HP MediaSmart Server in your magazine many years ago. It saved my

bacon when my wife's laptop hard drive failed. I was able to go to CompUSA to buy a new HDD, and within 90 minutes, I had restored her laptop to the position it was in the night before the failure.

Sadly though, my current server is on its last legs, which isn't surprising given that it uses a 4th Gen Intel Core i7 CPU on an ITX ASUS board running Windows Server 2012 R2 Essentials.

I use my server to back up mine and my wife's laptops, along with running a Plex server. It's too funny—no sooner is my wife shouting down the stairs telling me she can't find the Christmas card list, than I've restored it from the server before she can even finish her sentence.

I'm planning on building a server that is more modern and accessible online when I travel. I would like to stick with an ITX processor and try to continue using Windows Server since I'm somewhat familiar with it.

I would also like to have the following: 4 or more SATA slots, a current-gen CPU that's not a power hog, 2 NVME slots, 32GB of RAM, and possibly a BluRay burner.

— R. Fletcher

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS:

Your mention of the HP MediaSmart Server made me feel nostalgic, as I too was introduced to the world of servers just over 10 years ago via a similarly small HP server.

It was cheap, easy to use, and enabled me to get all my media files on one device and stream them anywhere—a revelation at the time! It seems quite quaint now, but I have very fond memories of running my first server.

Your server needs are what I would term as

high-end, not necessarily in terms of drive capacity, but in the RAM, NVME slots, and Blu-Ray drive you desire. The only way to go, at least that I'm aware of, is in a build-your-own server, but it sounds as though that's something you're comfortable with doing.

I'd probably look for the Intel Core i3-13100F CPU that Sam built with in our September 2023 edition, as it's current-gen and has a relatively low peak power draw at around 75W, although it hopefully won't be operating under load very often as I'm assuming you want this machine running 24/7.

I'd also point you toward a couple of features from previous issues that might be relevant to your interests. In our September 2022 issue, Nick Peers described how to put together your own 5-bay NAS and make a Ubuntu server. You very specifically mentioned you wanted to run Windows, which you can still do on this machine, although it won't support the latest CPUs as you requested on your spec sheet. It might give you some ideas, though!

And I would also suggest you also check out page 28 of this very issue, in which Nick runs you through how to build your own cloud storage solution using Nextcloud. Again, it's not Windows, but it might just give you some ideas about what else is out there in terms of servers in 2023.

Personally, I also had a Plex server running on a Synology DS918+ up until recently—it probably won't meet your transcoding needs, but it is a nice off-the-shelf solution to a lot of what you want to achieve. I would buy a newer model than I had, though! Good luck! ☺

THE BUILDS

THIS MONTH'S STREET PRICES...



OUR BUDGET MACHINES may not be the best of the bunch, but the fact you can piece together a whole machine costing around two-thirds of the price of just one 4090 is crazy. And that whole machine is capable of 1080p gaming on ultra settings too—it's a whole lot better value for money. After our previous two budget

builds, we decided it was time to bring some new components into the mix. Our recent Intel and AMD cover build proved they could game at 1080p ultra, so we added those GPUs into both builds. While the Intel Limited Edition Arc A750 8GB can game at 1080p, the RTX 4060 we tested recently does so at much higher frame rates. With the help of DLSS 3.0, we reached over 200fps on *Cyberpunk* with ray tracing and we won't get that with the Intel card. The MSI VENTUS 2X BLACK OC costs \$70 more, but it's worth every cent for the consistent Nvidia support and AI tech.

We've kept the impressive entry-level Intel Core i3-13100F CPU that we introduced last time. At \$110, it's a great way to experience 13th-gen Intel technology, it's power efficient and works well in a 1080p gaming machine. Another component we introduced was the recently reviewed Lexar NM790 SSD. This 1TB drive comes in at \$70 and doubles our capacity for an extra \$10 over the Corsair SSD. We also added the Lexar to the AMD side and a new PSU to both. The Corsair CV450 was out of stock so we swapped it out for the 600W EVGA 600 GD and an extra \$10.

Aside from the PSU and SSD change on the AMD machine, the only other component we swapped out was the GPU. Out goes the Radeon RX 6600XT and in comes the ASRock Phantom Gaming OC Radeon RX 7600. An 8GB card may raise some issues, but the newer generation card outperforms the 6600XT and is a strong competitor against the RTX 4060. Despite a new SSD, PSU, and GPU, our AMD machine has gone up by a mere \$1. The Intel build increased by \$100—but at \$866, it's still cheaper than the AMD.

AMD INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	\$95
PSU	600W EVGA 600 GD 80+ Gold NEW	\$70
Mobo	MSI B550M PRO-VDH WIFI Micro ATX AM4 Motherboard	\$119
CPU	AMD Ryzen 5 5600	\$138
GPU	ASRock Phantom Gaming OC Radeon RX 7600 8GB NEW	\$270
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3600MHz	\$45
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD NEW	\$70
HDD	2TB Seagate Barracuda Compute 7200	\$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$889

INTEL INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	\$95
PSU	600W EVGA 600 GD 80+ Gold NEW	\$70
Mobo	ASRock B660M Pro RS Micro ATX GA1700	\$95
CPU	Intel Core i3-13100F	\$110
GPU	MSI VENTUS 2X BLACK OC GeForce RTX 4060 8GB NEW	\$299
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3600MHz	\$45
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD NEW	\$70
HDD	2TB Seagate Barracuda Compute 7200	\$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$866


MID-RANGE

MOVING UP TO THE NEXT LEVEL, our mid-range machines enter into the QHD category of gaming. Not only are they more than enough for competitive and high-quality casual gaming experiences but also commercial creative work. Here, we are aiming to improve these great all-rounders by adding a few premium components.

Despite the Intel Core i5 12600K still being mighty impressive, we are bringing in the 13th-generation variant in its place. This costs just over \$100 more but inevitably brings more power, with more cores and threads and stronger overclocking potential. We were always huge fans of the 12600K and the 13600K takes all that was great about that chip and improves upon it.

As before, we brought in the 1TB Lexar NM790 SSD as this was too good to pass up. With read and write speeds of 7400MB/s and 6500MB/s, it's overkill for our budget machines and more appropriate for the mid-range machines. However, we couldn't exclude it from both due to its great value performance. Apart from that, the Intel machine remained the same. There were no real component price changes other than a \$5 drop on the MSI MAG CORELIQUID 240R V2 used in both systems. The overall cost of the mid-range Intel build went from \$1,332 to \$1,447.

Moving over to team AMD, we're keeping the CPU firmly in place this time but making our main alteration to the GPU. The previous ASRock Challenger Pro OC Radeon RX 6750 XT 12GB is making way for a Radeon RX 6800 16GB—specifically, the XFX Speedster SWFT 319 Radeon RX 6800. This model outperforms the 6750XT and has an additional 4GB of VRAM. Sure, it costs an extra \$80, but we feel it's worth it for a more solid QHD gaming experience. As we mentioned earlier, we brought in the Lexar SSD here too but besides that, the rest of the AMD mid-range machine stayed the same. This meant that the overall cost of our AMD competitor went up from \$1,370 to \$1,430.

AMD INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	\$130
PSU	750W EVGA 750 BP 80+ Bronze	\$90
Mobo	ASRock B650M PG RIPTIDE Wi-Fi Micro ATX AM5	\$200
CPU	AMD Ryzen 5 7600X	\$240
Cooler	MSI MAG CORELIQUID 240R V2	\$90
GPU	XFX Speedster SWFT 319 Radeon RX 6800 16GB NEW	\$430
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$98
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD NEW	\$70
HDD	2TB Seagate Barracuda Compute 7200	\$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$1,430

INTEL INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	\$130
PSU	750W EVGA 750 BP 80+ Bronze	\$90
Mobo	Gigabyte Z790 UD AC ATX LGA 1700	\$180
CPU	Intel Core i5-13600K NEW	\$317
Cooler	MSI MAG CORELIQUID 240R V2	\$90
GPU	MSI VENTUS 2X BLACK OC GeForce RTX 4060 Ti 8GB	\$390
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$98
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD NEW	\$70
HDD	2TB Seagate Barracuda Compute 7200	\$50
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$1,447



TURBO MACHINES MEAN ultimate performance. We do also bear the budget in mind, but there's a lot more financial leeway with these builds. One of the biggest issues we face is how often the market fluctuates between these guides, so we aim to make the best decisions we can at the time of writing. Our turbo builds are designed to be the most fun and allow us to construct something

approaching our ideal build, so let's get straight into it, starting with the AMD system. Last time around, the ASRock Phantom Gaming OC 7900XTX GPU was the cheapest variant available and that remains the same. This 24GB card packs an almighty punch and, being a 7900XTX, it sits at the top of the AMD GPU hierarchy. It's also far cheaper than the competitor on the Intel/Nvidia side, the RTX 4090.

Turning our attention to the CPU, this is still the most powerful AMD chip available, so we knew we wanted to keep it in place. It's expensive though, and has increased by a further \$10 this time around. Other parts went up in price too—our NZXT cooler was on sale in the previous issue but has now gone back up to \$300—that one stung a little, we have to admit. There were no price fluctuations on the other components and as we recently overhauled many of the components of both turbo builds, we didn't feel the need to change much. So, for the AMD turbo machine, nothing was swapped out and the overall price went up by nearly \$100. On the bright side, it's still an impressive PC!

We applied the same thinking to the Intel turbo machine, keeping the Zotac GeForce RTX 4090 GAMING Trinity OC GPU in place as this was still the cheapest RTX 4090 available—if you can call \$1,599 cheap! Alongside our RTX 4090 is the Intel Core i9-13900K, but yet more bad luck as the price of this lightning-fast processor has now gone back up to \$556 from its previous sale price of \$409. While we're used to the price of components fluctuating, it seems like most of them have crept back up slightly this month. There are no further changes we can make to bring the price down on this Intel PC, so with a total cost of \$3,431, it has gone up by over \$200.

AMD INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	\$190
PSU	1000W NZXT C1000 80+ Gold	\$180
Mobo	ASRock X670E PG Lightning ATX AM5	\$260
CPU	AMD Ryzen 9 7950X3D	\$660
Cooler	NZXT Kraken X73 RGB 360mm	\$300
GPU	ASRock Phantom Gaming OC Radeon RX 7900 XTX 24GB	\$940
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$165
SSD	2TB WD Black SN850X M.2 PCIe 4.0	\$99
HDD	6TB WD Blue 5400 HDD	\$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$2,926

INTEL INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	\$190
PSU	1000W Corsair RM1000x Shift 80+ Gold	\$210
Mobo	Gigabyte Z790 UD AC ATX LGA 1700	\$180
CPU	Intel Core i9-13900K	\$556
Cooler	NZXT Kraken X73 RGB 360mm	\$300
GPU	Zotac GeForce RTX 4090 GAMING Trinity OC 24GB	\$1,599
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$165
SSD	2TB WD Black SN850X M.2 PCIe 4.0	\$99
HDD	6TB WD Blue 5400 HDD	\$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$32

Approximate Price: \$3,431

Maximum PC (ISSN 1522-4279) is published 13 times a year, monthly plus a Holiday issue following the December issue, by Future US LLC, 130 West 42nd Street, 7th Floor, New York, NY 10036. USA. Website: www.futureus.com. Future US LLC also

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