PCWorld

JULY 2016

FROM IDG

Intel's 10-core Broadwell

You wanted more cores, and Intel is ready to give them to you. But sit down if you want to know the price.

PLUS: The wildest hardware from Computex 2016

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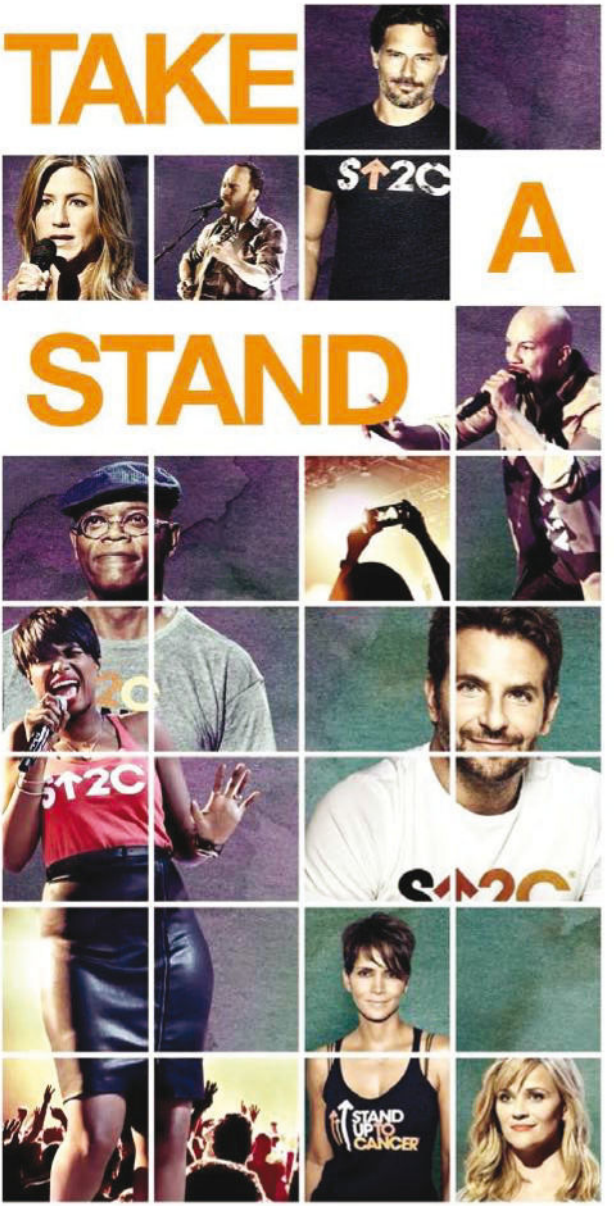

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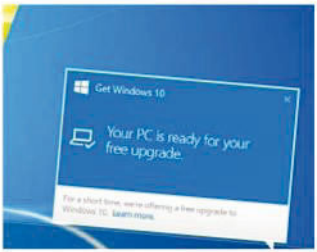

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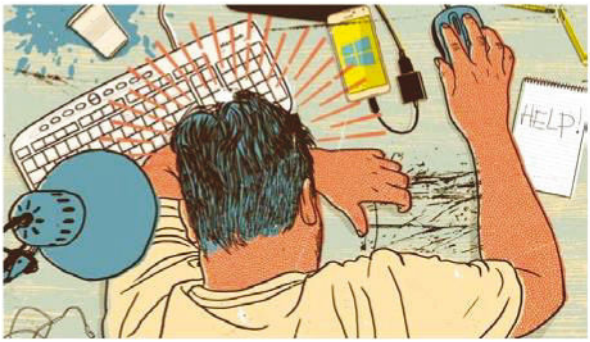

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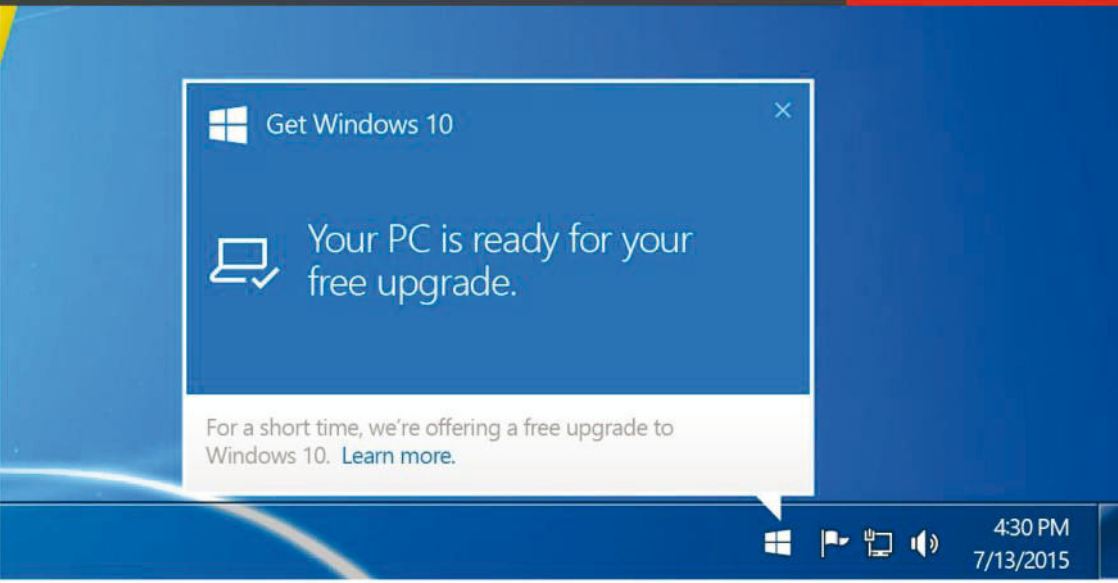


Microsoft says it will stop pestering users to 'Get Windows 10' in July

BY IAN PAUL

THERE WAS ONE issue that went unspoken in Microsoft's recent announcement that the free Windows 10 upgrade offer would end (go.pcworld.com/win10offer) on July 29. What would the company do about all those annoying, almost malware-like (go.pcworld.com/win 10prompt), pop-up notifications to upgrade to Windows 10 that appear on the PCs of Windows 7 and 8.1 users? The answer is that they will disappear.

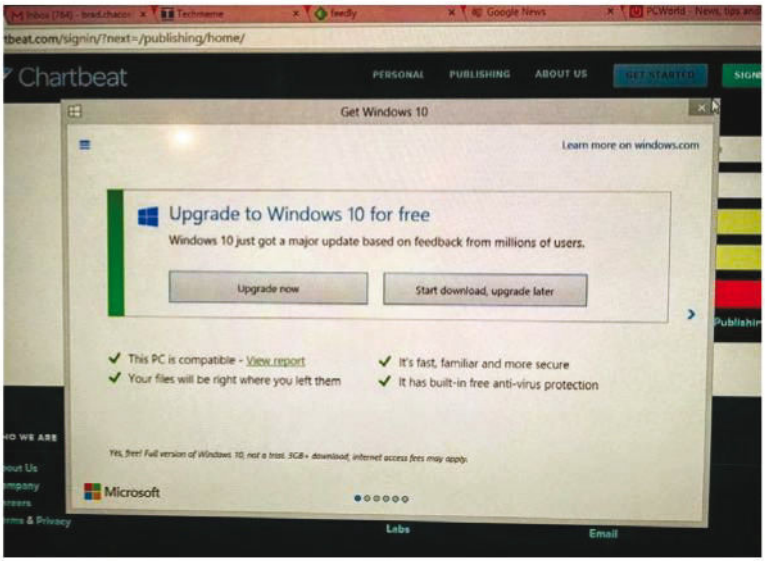
"Details are still being finalized, but on July 29th the Get Windows 10 app…will be disabled and eventually removed from PCs worldwide," Microsoft told WinBeta (go.pcworld.com/getwin10app) in a written statement.

The company warned that it may take some time to disable the upgrade pop-ups on computers worldwide.

Many people disliked the company's approach, but it appears Microsoft's upgrade push (go.pcworld.com/win10push) has been relatively successful. Microsoft said that there were now 300 million active Windows 10 devices worldwide—a bump of 30 million from late April when Microsoft said there were 270 million active users (go.pcworld.com/270musers).

Anyone currently on Windows 7 or 8.1 who doesn't plan on upgrading to Windows 10 can already disable the Windows 10 prompts. The easiest way is to use GWX Control Panel (go.pcworld.com/blockwin10), a utility that automates the process for you.

The impact on you: As with all things Windows 10, conspiracy theories abound. The big question is just how serious Microsoft is about ending the upgrade strategy on July 29? If the company backtracks and decides to extend the free upgrade offer—or keep it going in perpetuity as some critics have argued it should—then the upgrade pop-ups may remain.



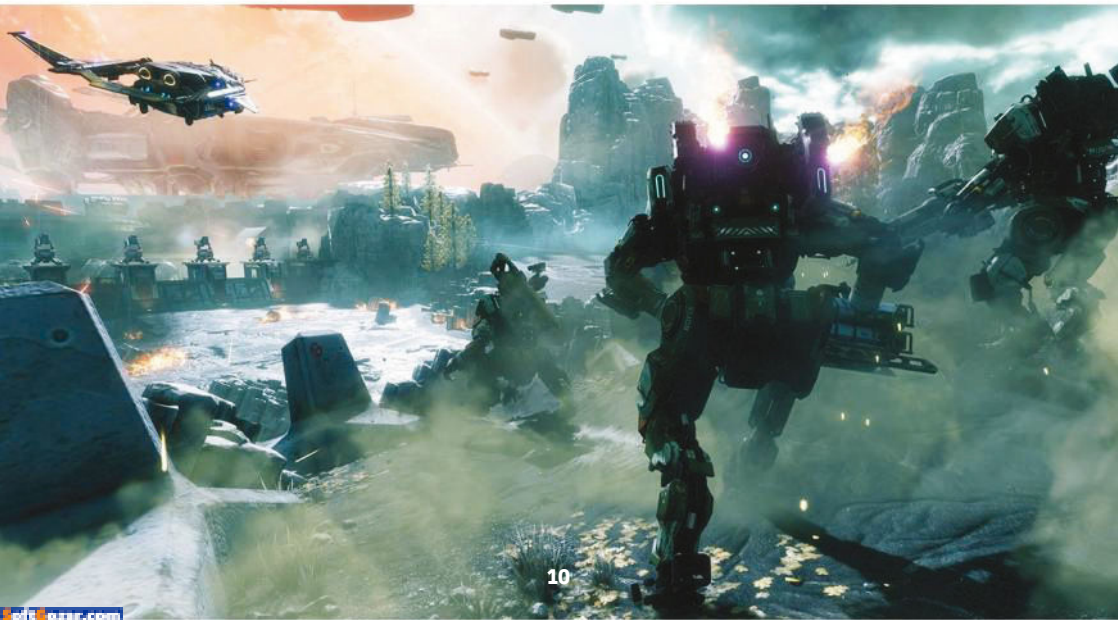
On a Windows 8.1 PC. Mostly full-screen pop-up. No clear No Thanks button, just download Windows 10 now or later.

E3 2016: All the glorious new PC games, graphics cards, and hardware you need to know about

BY BRAD CHACOS

GAME OVER, MAN. Game over! Another E3's done and gone, and E3 2016 was one of the most exciting conferences for PC gamers in a long, long time. Now that the new consoles pack PC guts, the number of new PC games revealed at the show far exceeded E3 2015's lineup. And that was just the tip of the iceberg!

Don't kick yourself if you missed any of *PCWorld*'s E3 coverage (pcworld.com/category/e3). Catch up on all the new games, graphics cards, PC gaming hardware, and more—right here, right now.



Games!

Let's get the most important part of E3 out of the way first. You know, the games.

A veritable deluge of new games hit E3 2016, from AAA blockbusters like *Titanfall 2* and the glorious return of *Quake,* to more PC-focused titles like *Dawn of War III* and the parade of indies displayed at the second annual PC Gaming Show (go.pcworld.com/2ndpcgaming). We covered Microsoft, Bethesda, EA, Ubisoft, and Sony's glitzy launch events individually, but you'll only need to check those out if you're interested in console news, too. Otherwise, check out *PCWorld*'s massive roundup of the 47 must-see PC games revealed at E3 2016 (go.pcworld.com/e32016reveals) for a computer-centric focus on the event, with the PC games cherry-picked from all six of those big publishers.

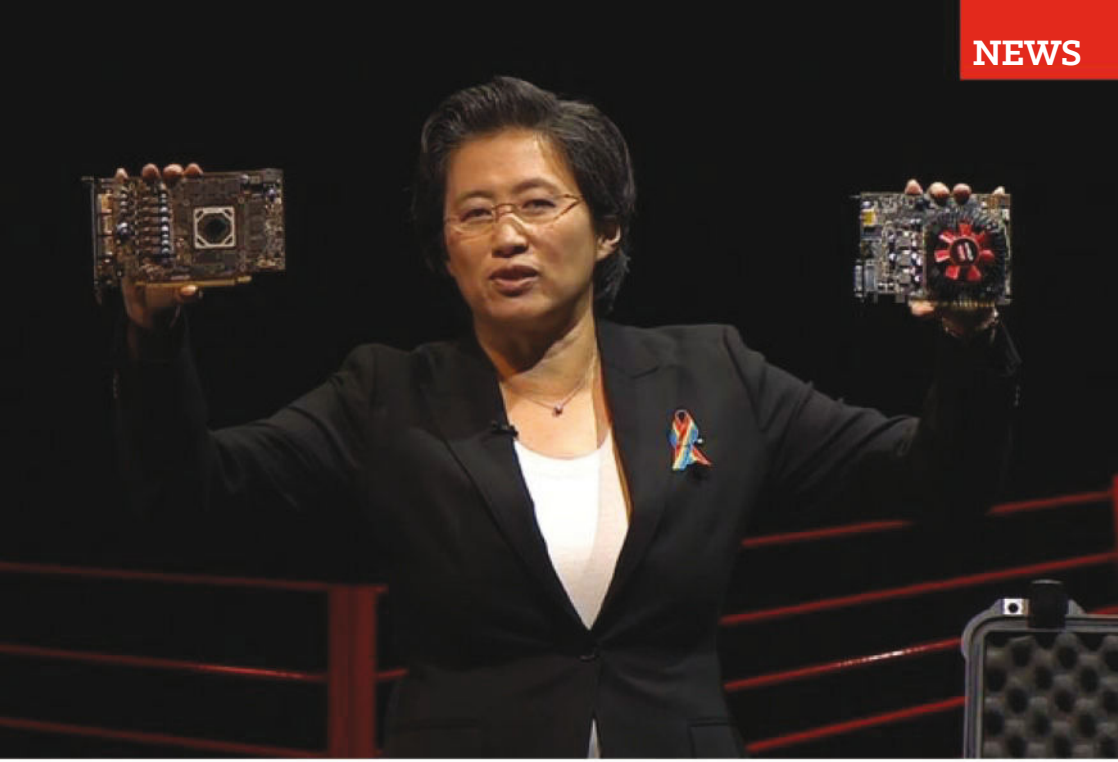
Or you can drill down even further and simply read the 10 PC games that got us personally excited at E3 2016 (go.pcworld.com/top10e32016). It's not your usual boring "best of" piece—these are the games that really got our individual hearts a-fluttering.

Microsoft pushes Xbox and Windows closer together

Microsoft revealed not one, but two, new consoles at E3 2016: the sleeker, slimmer Xbox One S (go.pcworld.com/xbox1x), and the 4K-ready "Project Scorpio" (go.pcworld.com/projscorpio) console that's powered by AMD and coming at the end of 2017. But what's interesting to PC gamers is the way Microsoft aggressively pushed Xbox and PC gaming together now that its console is powered by Windows 10.

The flagship feature is Xbox Play Anywhere (go.pcworld.com/xboxplayanyw), a fancy term for universal Windows apps. Once you buy a Play Anywhere game, it's unlocked for both the Xbox One and Windows 10 PCs, complete with cross-platform multiplayer support and cloud saves that follow you from device to device. Microsoft's even working on bringing keyboard and mouse support to the Xbox One. Cool!

Even cooler: Pretty much every major first-party title Microsoft announced is Play Anywhere-enabled, meaning one-time Xbox exclusives like *Gears of War 4*, *Forza Horizon 3*, and *Killer Instinct* are coming to Windows 10 PCs, too. Xbox chief Phil Spencer told *PC Gamer* that there's no ideological reason that would prevent even *Halo 6* from coming to PCs when it launches. Wild.



AMD Radeon RX 470 and RX 460

AMD's not just in the Xbox One's successor, of course. After revealing the Radeon RX 480 (see page 40)—a $200 graphics card with performance somewhere in the range of the Radeon R9 390 or 390X—at Computex earlier, AMD teased the rest of the Polaris GPU lineup (go.pcworld.com/polarisgpulineup) at the PC Gaming Show.

There's no Radeon RX 490 designed to challenge Nvidia's GeForce GTX 1070. Instead, the full Polaris lineup continues the RX 480's goal of bringing better gaming performance to mainstream price points. The Radeon RX 470 was teased as the ultimate 1080p gaming card, while the RX 460 targets gamers more focused on e-sports. And that's really all we know. AMD didn't delve into specifications, price points, or release dates.

Battlefield 1

We devoted more extensive one-on-one time with a handful of top-tier PC games to dig more deeply into them. First up: *Battlefield 1* (go.pcworld.com/battlefield1), the World War I–era *Battlefield* that we expected to dislike but wound up loving in a 15-minute Conquest mode match.

It's all about the physicality and scale. *Battlefield 1* will never match *Verdun*'s (go.pcworld.com/verdunrev) WWI accuracy, or *Valiant Heart*'s (go.pcworld.com/valiantheartrev) emotional core. But the game pulls off Michael Bay–esque spectacle in amazing fashion. There's just something about seeing a biplane crash into the ruins of an old church, or a tank rumble across the top of the trench you're lying in, or looking up and seeing a zeppelin blot out the sky, raining bullets and parachuting soldiers. It makes your jaw drop. Look for *Battlefield 1* to launch in November.

Star Trek: Bridge Crew

Rather than waxing poetic, I'm just going to say that Bridge Crew is a multiplayer game where you and three buddies man the key stations on the bridge of a *Star Trek* starship (go.pcworld.com/startrekvr), working together to battle Romulans, beam survivors on board from escape pods, et cetera. "Full power to shields, ensign," "Fire phasers on my command," all of it.

In virtual reality.

It's as amazing as it sounds.

Razer

Razer, meanwhile, was showing off a new second-generation open-source VR headset (go.pcworld.com/opensourcevr) that largely mirrors the Oculus Rift's specifications—but costs $200 less. Ouch. The company also trucked a ton of gamer-centric gear to the show, from gaming laptops to a graphics card dock to a MOBA mouse that defies its own name (go.pcworld.com/mobamouse). Check it all out in our E3 2016 Razer booth tour (go.pcworld.com/e32016razerbooth).

Alienware backpack PC

Virtual reality had a major presence at E3 2016, and not just VR games. Alienware was showing off a sleek Radeon RX 480-powered backpack PC (go.pcworld.com/radeonrx480pack) to enable pseudo-untethered roomscale VR experiences with the HTC Vive and Oculus Rift. Those headsets still need to be connected to a PC to function, but when the PC's strapped to your back, it's much less of a hassle.

Obduction and Wilson's Heart

Two more VR games stood out from the crowd at E3 2016: *Obduction* (go.pcworld.com/obductionhandson) and *Wilson's Heart* (go.pcworld.com/wilsonshearthandson).

Obduction's the spiritual successor to *Myst,* made by the same team, and its VR mode proves just how amazingly a node-based travel system can translate over to virtual reality. The sense of scale in the game's VR mode is downright wondrous, too—a 1,000-foot drop into the void is obvious on a normal screen, but you don't get the same sense of vertigo you might when you're standing on the edge of the same rickety iron walkway in VR.

Wilson's Heart, meanwhile, is a black-and-white VR horror title full of rats, creepy hospitals, and crazy teddy bears. But the really special thing about the game is how well it shows off the potential of the forthcoming Oculus Touch controllers, thanks to the way it blends psychological scares and the immersive possibilities of VR. It's amazing already.

Hit both links above for more details and video impressions for each game.

Shadow Warrior 2

Most of our favorite games from E3 2016 were built to be played on traditional displays, though.

Shadow Warrior 2 (go.pcworld.com/shadowwarrior2) takes the fast, furious, d*ck joke–filled action of its glorious predecessor, then cranks everything to 11 and adds four-person cooperative play to the mix. The weapon loadout is over-the-top, with a machine gun that shoots ice, a chainsaw that carves demons apart, and Lo Wang's trusty sword, especially when combined with Wang's various powers and abilities. The best? The ability to summon spikes out of the ground and impale enemies. Then, while they're stuck, you slice into them with the chainsaw.

Check out our *Shadow Warrior 2* hands-on (go.pcworld.com/shadowwarrior2handson) for deeper thoughts and full video impressions of this good ol' fashioned demon murder.

Alienware Alpha

That funky backpack PC wasn't the only new hardware Alienware debuted at E3 2016. The gaming PC specialists announced a refreshed version of the Alienware Alpha (go.pcworld.com/alienwarealpha), including a new Steam Machine (go.pcworld.com/steammachine) version of the teeny-tiny console-esque PC. The amped-up Alienware boxes added Skylake processors, DDR4 memory, and new GeForce GTX 960M or Radeon R9 M470X graphics options.

Not enough gaming firepower for you? The new Alpha also adds support for Alienware's Graphics Amplifier (go.pcworld.com/alienwaregraphics), a discrete box that accepts full-blown desktop graphics cards to power up your PC gaming even further. The Alienware Alpha R2 starts at $600, while the Graphics Amplifier costs another $200—far less than Razer's Thunderbolt 3-based Razer Core graphics dock (go.pcworld.com/razercore), which sells for $500.

Titanfall 2

The original *Titanfall* fizzled out quickly after it launched in 2014—and in a multiplayer-only game, that's the kiss of death. So *Titanfall 2*'s (titanfall.com) adding a fleshed-out single-player mode to offer a fuller-fledged experience.

Beyond that welcome tidbit, Respawn Entertainment's largely building atop the core gameplay of the original, which is nothing but a good thing, because *Titanfall*'s core gameplay was damned fine to begin with. A new grappling hook for pilots will make the game feel ever more mobile, while six new Titans—including ones with a bone-crushing melee fighting focus—beef up the heavy armor. Our lengthy *Titanfall 2* hands-on preview (go.pcworld.com/titanfall2handson) has much more information.

Will *Titanfall 2* prove more successful than the original? We'll know when the game launches on October 28.

Deus Ex: Mankind Divided

Deus Ex and *Deus Ex: Human Revolution* are two of the finest PC games ever created, thanks to their strong focus on player choice and system-driven gameplay. We managed to play *Deus Ex: Mankind Divided* for 30 minutes during E3 2016, and well, it feels like more Deus Ex. Though we didn't get a chance to spec out a Jensen of our own or make many story-altering decisions, that alone is enough to get us pumped for the game.

Check out our *Deus Ex: Mankind Divided* hands-on preview (go.pcworld.com/deusexhandson) for many more thoughts, and video of us playing (and commenting on) the game.

FIFA 2017 tryout: The game EA doesn't want you to see

Finally, what happens when a complete soccer rookie tries to play a game of what the rest of the world calls *football*? Nothing good, that's what. Watch Hayden Dingman's slow, frustrating descent into sadness (go.pcworld.com/fifa17tryout), or better yet, dig even deeper into E3 by checking out all the trailers for the 50-ish new PC games revealed at E3 2016 (go.pcworld.com/47mustseegames). Because nothing beats seeing new games with your own eyes.

The wildest and most powerful PC hardware from Computex 2016

BY BRAD CHACOS

CES MAY BE the show that gives you a glimpse of the future of computing, but Computex is where the gloves come off (go.pcworld.com/computexmatters), year in and year out. The PC industry emerges in full force for the annual Taipei trade show, lugging all the nifty new goodies it hopes to sell during the crucial back-to-school and holiday seasons.

This year's Computex was nothing short of glorious (go.pcworld.com/computex2016).

From the first-ever 10-core enthusiast CPU to the launch of the next generation of graphics cards to the rise of all sorts of wild, imaginative PCs built around that hot new technology, the world of computing's firing on all cylinders and looking more exciting than it has in years. Buckle up! This is going to be a great ride.

Intel Broadwell-E Extreme Edition

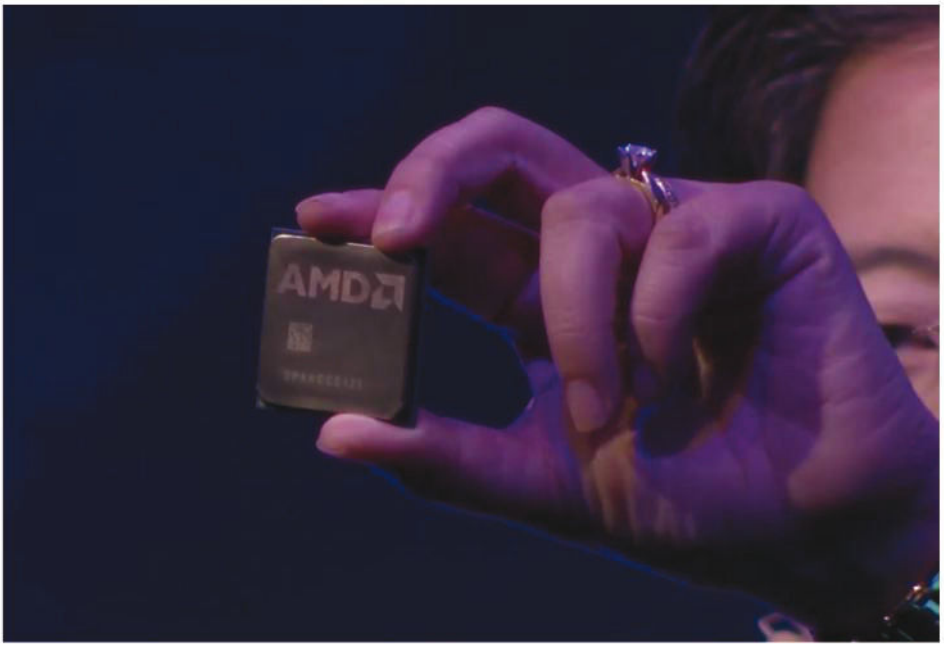
The rumors were true: Intel indeed had a monstrous 10-core enthusiast processor up its sleeve. The long-awaited Broadwell-E Extreme Edition enthusiast CPU lineup launched with a bang at Computex, spearheaded by the Core i7-6950X, a beast of a chip with 10 CPU cores, fancy per-core overclocking, Turbo Boost Max 3.0 technology, drop-in compatibility with Haswell-E motherboards, and more.

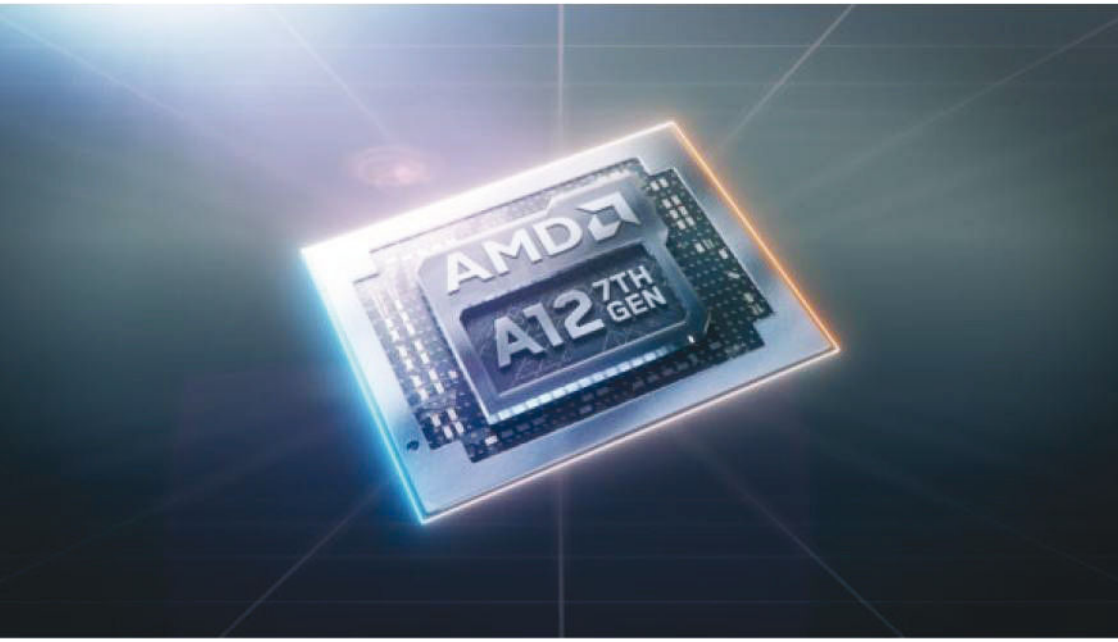
Its price is just as monstrous: $1,723, or $723 higher than the previous 8-core Haswell-E flagship (go.pcworld.com/8corehaswelle). That's a hell of a jump, and prices on all Extreme Edition chips went up across the board with this new generation. Our exhaustive Intel Core i7-6950X (on page 94) review has full nitty-gritty details, or check out the 10 things you need to know about Broadwell-E (go.pcworld.com/10core broadwelle) for a CliffsNotes version. Or you can just watch a video of overclockers cranking the beast (go.pcworld.com/overclockedbroadwelle) up to 5.7GHz.

AMD Zen

The very day after Intel launched its Core i7-6950X, AMD teased enthusiasts with a glimpse at a potential cure for $1,700 chips: Zen. Zen processors aren't due until closer to the end of the year, but they're promising a 40 percent increase in instructions per clock (IPC) over AMD's current-gen chips.

At Computex, CEO Lisa Su held up a working Zen chip (go.pcworld.com/workingzenchip) emblazoned with the AMD logo and revealed a few new details: The first Zen chips will pack 16 threads across 8 physical computing cores, with early samples scheduled to ship to AMD partners within a few weeks.





AMD 7th-generation APUs

Zen may represent the future for AMD's high-performance computing, but the company's APUs—which marry CPU and Radeon GPU cores together on one chip—serve as an avatar for AMD's all-around strengths. At Computex, AMD revealed two new APU lines, dubbed Bristol Ridge and Stoney Ridge.

These new APUs are designed for laptops, not desktops, and aim to deliver affordable computing solutions with graphics that stomp Intel's chips into the ground. Check out our Bristol Ridge and Stoney Ridge coverage (page 46) for full feeds, speeds, and feature details.

AMD Radeon RX 480

Processors weren't the only things on AMD's mind at Computex. Mere weeks after Nvidia kicked off the next-generation graphics war off with the GeForce GTX 1080 (go.pcworld.com/geforcegtx1080), a $600 card with unrivaled performance, AMD launched its counterattack. The Radeon RX 480 wasn't made to compete with Nvidia's flagship, though. Instead, the first Radeon based on AMD's 14nm FinFET Polaris GPU aims to deliver performance on a par with the R9 390X—but for a mere $200.

Hot damn.

Hitting that sort of performance at that sort of price could go a long ways toward making virtual reality affordable for the masses—if the prices of VR headsets ever drop from their lofty $600-plus heights, that is. But it's definitely a good thing for traditional PC gamers, who can now get uncompromising 1080p and pretty damned good 1440p gameplay without breaking the bank. (See our full report on page 40). The Radeon RX 480 should be available by the time you read this.

Nvidia GeForce GTX 1070

Nvidia didn't give AMD the spotlight without a fight, however. Just before AMD held the event where the Radeon RX 480 was announced, the reviews for Nvidia's new GTX 1070 launched—with universal acclaim. The $380 graphics card indeed delivers performance that outpunches the vaunted Titan X, just like Nvidia promised, and for a fraction of the power and price.

The GTX 1070 kicks butt. For a few more words (and many more graphs) on the topic, be sure to read *PCWorld*'s comprehensive GeForce GTX 1070 review (go.pcworld.com/geforcegtx1070rev).

Digital Storm Aura

PC enthusiasts don't tend to think highly of all-in-one PCs, which have long been powered by laptop hardware that isn't easily swapped out. But at CES in January, we witnessed a rebirth of sorts for the form factor, as boutique PC builders revealed a new breed of AIOs stuffed with powerful, standard PC parts.

The Digital Storm Aura (go.pcworld.com/digitalstormaura) is a paragon for potent all-in-ones. The Aura's 34-inch ultrawide display is powered by no less than the GeForce GTX 1080 and 10-core Intel chip previously mentioned—meaning this AIO will run circles around the vast majority of PCs being used in the world today.

MSI Backpack PC

All-in-ones aren't the only PCs receiving an overhaul inspired by recent trends. MSI unveiled its Backpack PC prototype (go.pcworld.com/backpackpcproto) at Computex alongside a slew of new gaming laptops, and well, it's exactly what it sounds like. The Backpack PC packs Nvidia's full-fat GTX 980 graphics processor and a portable design meant to enable semi-wireless virtual reality experiences. The Oculus Rift and HTC Vive both tether you to your PC, but if your PC is tethered to your back, your motion becomes much less restricted.

Strapping a gaming PC on your back seems like it'd be hot and heavy, but in practice, the burden mostly fades away when the combined armies of Zorg are firing photon weapons at you. Check out our Martyn Williams using MSI's Backpack PC to fight off (go.pcworld.com/gamingpcbackpacks) an alien horde.

HP Omen X

MSI isn't the only PC maker placing a bet on backpack PCs. The HP Omen X (go.pcworld.com/hpomenx) is basically the same thing, while Zotac's also toying with VR-ready backpack PCs. HP didn't show the Omen X in the plastic flesh at Computex, but the company says it'll weigh under 10 pounds and offer roughly one hour of endurance. Powering full-fledged VR experiences takes an awful lot of juice.

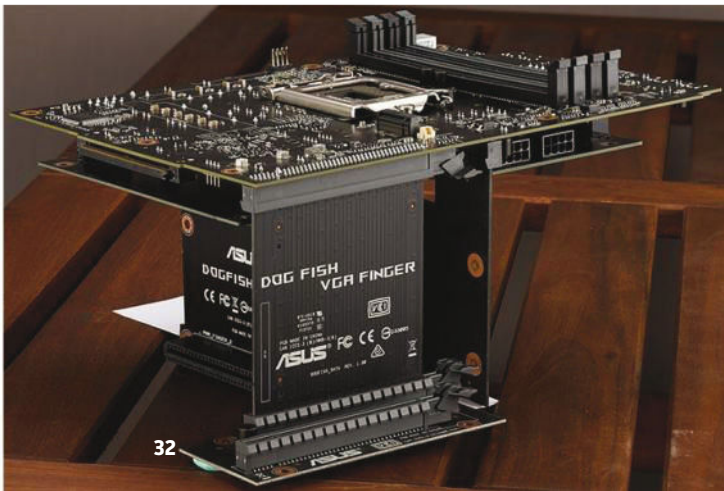
Asus Avalon concept DIY PC

Asus's Avalon concept PC, on the other hand, takes a stab at reimagining DIY PC design itself, by tightly integrating motherboard and chassis design into a more cohesive whole. The Avalon largely does away with wires and cables, connecting hardware using daughtercards and PCIe-based "edge connector" slots instead.

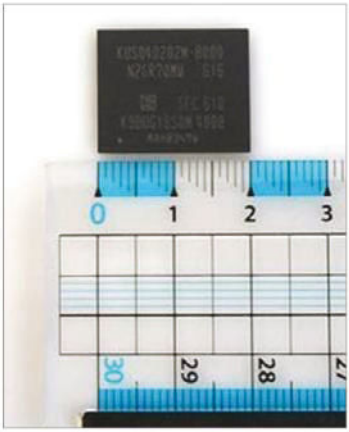
The end result: a sleek-looking machine that resembles a classy hi-fi system more than a traditional PC, and one with interchangeable I/O ports on the back and hot-swap-ready storage bays in the front. Every piece of hardware inside can still be swapped out as long as the replacement supports the edge connector—except for the motherboard, of course.

Asus Avalon motherboard

Speaking of, here's a shot of the Asus Avalon's motherboard, with capability-enhancing daughtercards jutting out underneath. Told you it was wild.



Samsung's stamp-sized SSD



PCs weren't the only hardware being revamped at Computex. Samsung announced the appallingly named PM971-NVMe—a complete 512GB solid-state drive built into a single chip (go.pcworld.com/sglchipssd) that fits on your fingertip. This SSD's smaller than a stamp and weighs less than a gram, but still packs in 512GB of NAND flash, a controller, and RAM. Crazy!

An SSD this tiny isn't really meant for desktop PCs, but big-time storage that's this small could wind up in laptops, 2-in-1s, tablets, and phones—none of which are getting any larger.

Asus GX800 water-cooled gaming laptop

Okay, I lied. At least one gaming laptop's expanding in size to outpunch its full-size desktop brethren. The Asus GX800 (go.pcworld.com/gx800rev) is the even crazier successor to the first-ever water-cooled laptop, and it cranks things to 11 with not one, but two, unnamed Nvidia GPUs and not one, but two, power supplies to keep up with the load. Plugging the laptop into the bulbous water-cooling dock (go.pcworld.com/gx700rev) ramps up clock speeds even further for kick-ass gaming performance.

How kick-ass? Asus says the GX800 pumps out more frames than Nvidia's vaunted Titan X graphics card.

Dell Inspiron 2-in-1 PCs

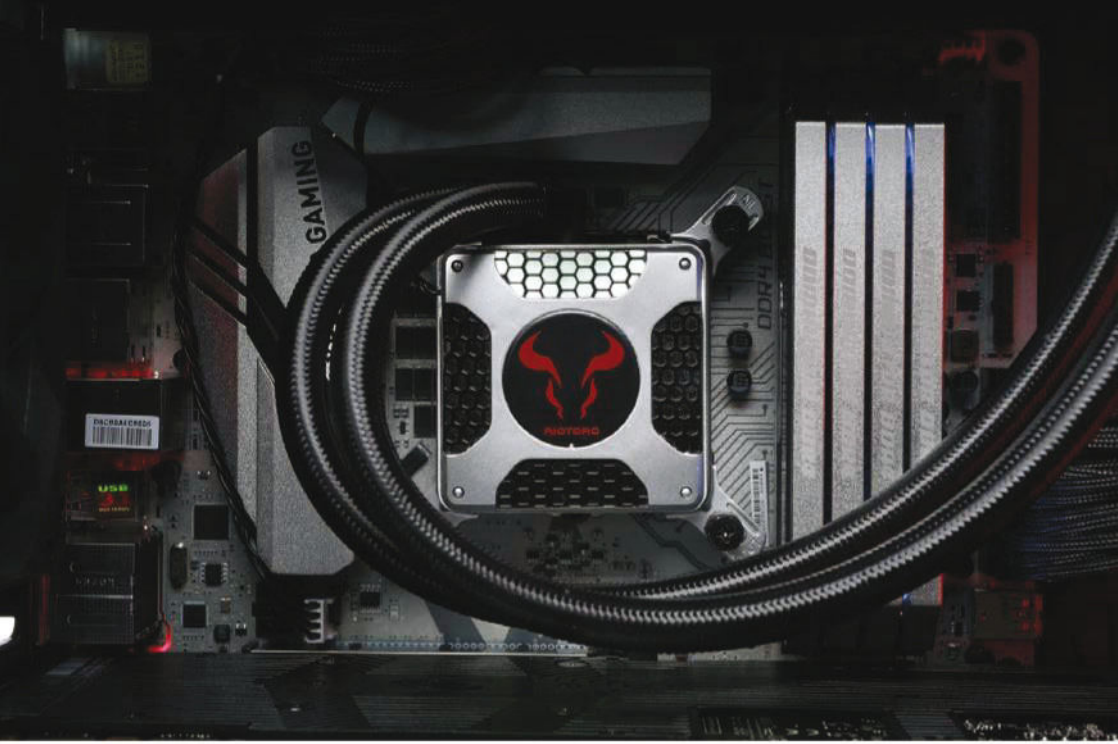
Dell unleashed a flood of new Inspiron hybrids (go.pcworld.com/dellhybrids) at Computex, all with very similar names but very different target audiences.

The Dell Inspiron 11 3000 is a Windows 10 laptop/tablet 2-in-1 with a 1366x768 display and a focus around web surfing. Starting at $250, you can consider it a Windows-based Chromebook rival. The $530 Inspiron 11 5000 adds premium touches like a backlit keyboard and Windows Hello biometric authentication to the mix, while the $730 Dell Inspiron 11 7000 fancies things up with beefier hardware, nicer display options, solid-state drives, and a USB-C port.

PowerColor Devil Box

USB-C ports might be more important for would-be gamers going forward. A slew of external graphics card enclosures have been announced in 2016, designed to allow you to connect your USB-C/Thunderbolt 3-equipped laptop to desktop graphics cards, allowing you to transform your notebook into a gaming machine at home. It's like having your cake and eating it too!

The latest is PowerColor's Devil Box, a Razer Core–like graphics dock that builds off PowerColor's Devil brand of extreme graphics cards and runs the AMD XConnect technology (go.pcworld.com/amdxconnect) developed with help from Intel. It'll support graphics cards up to 310mm in length and 375W, but if it's like the Core, laptop manufacturers will need to update their systems' firmware before you'll be able to use your notebook with the Devil Box.



Riotoro PC hardware

After quietly launching earlier this year, a new company comprising Nvidia and Corsair veterans emerged from the shadows more fully at Computex.

Riotoro's flashiest announcement may be its Bifröst closed-loop CPU coolers (pictured above), which will be available with radiators either 120mm or 240mm thick, depending on your PC's available space. The company also revealed a Ghostwriter line of mechanical keyboards with Kailh switches, a redesigned version of its Uruz gaming mouse, and two new lines of PC power supplies. Check out *PCWorld*'s Riotoro hardware coverage (go.pcworld.com/riotororev) for full details of each.

Corsair's hard-core computing blitz

Corsair's new hardware lineup (go.pcworld.com/corsair2016) at Computex was essentially a love letter to the most enthusiastic of deep-pocketed PC enthusiasts.

The company kicked things off with the Hydro GFX GeForce GTX 1080 (pictured), a water-cooled variant of Nvidia's beastly GTX 1080 graphics card developed in conjunction with MSI. Corsair also revealed new Vengeance LED DDR4 memory kits outfitted with LED lights—hence the name—and clocked at an utterly staggering 4,333MHz. If you prefer aesthetics to sheer performance, Corsair's new Dominator Platinum memory line comes clad in brushed aluminum and chrome finishes.

The icing on the cake? Colored PC case fans that use magnetic levitation bearing technology to offer supreme performance with next-to-no noise—and the ability to tell your friends "Yeah, I rock mag-lev fans in my rig."

Microsoft HoloLens

Microsoft didn't have any new hardware ready for Computex, but it revealed some nice new touches for its forthcoming HoloLens augmented reality headset. Most notably, it's opened up the HoloLens's underlying Windows Holographic operating system (go.pcworld.com/winholographics) to its partners, with the intent of making Windows Holographic the equivalent of Windows for augmented reality. The idea is that any hardware running Windows Holographic will be able to see creations made using the software, so a person using HoloLens and a person using the HTC Vive will be able to interact with the same content.

Microsoft also boosted the HoloLens' multi-tasking capabilities (go.pcworld.com/winholographic0516). Beyond 3D creations, HoloLens also works with traditional 2D "flat" apps, and now you'll be able to pin three programs next to each other for the equivalent of a bad-ass digital multi-monitor setup (pictured below). Groovy!

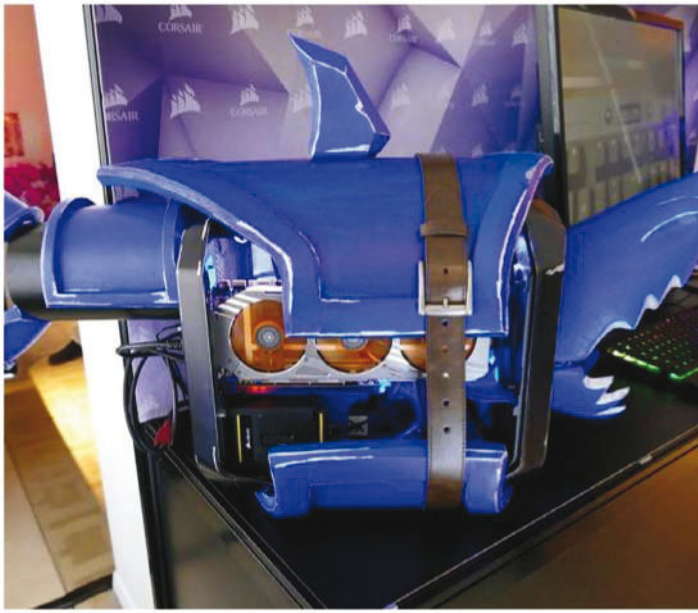
Asus Zenbo

It wouldn't be Computex without a touch of weirdness.

Zenbo (see page 168) is a cute little $600 companion bot with a touchscreen face that responds to voice commands. Asus is pitching it as a buddy for children and the elderly—it'll even read stories to kids—but it'll respond to general knowledge questions too, like Siri or Amazon's Echo. There's no word on when Zenbo will be available or its final feature set, but c'mon—seeing a real-life equivalent to Rosie from *The Jetsons* is pretty exciting, anyway.

Corsair case mods

Corsair's booth blended Computex's weirdness and hard-core computing focus, with large sections devoted to showing off the limits of what's possible. Now that you've got the scoop on all the new hardware out of the show, check out all the wild, weird PC rigs (go.pcworld.com/wildcomputex16) Corsair brought to Computex to see what you can do with a big budget and a little imagination.



AMD's Radeon RX 480 brings high-end graphics to the masses for just $200

BY BRAD CHACOS

THE NEXT-GENERATION GRAPHICS card war is officially on—though it's already shaping up very differently than previous versions. While Nvidia kicked things off with the overwhelming firepower of the enthusiast-only $600 GeForce GTX 1080 and $380 GTX 1070, AMD's attacking the mainstream instead.

In a livestream from Computex in Taipei, AMD announced that the Radeon RX 480 will be the first graphics card based on its forthcoming

Polaris graphics processors. And get this: The Radeon RX 480 stands ready to deliver performance equivalent to what today's $500 graphics cards offer, as first reported in the Wall Street Journal. That's roughly in line with the Radeon R9 390X, GeForce GTX 980, or air-cooled Radeon Fury.

But here's the real bombshell: The Radeon RX 480 costs only $200 (it should be available for sale by the time you read this).

Things just got real.

Bringing the future to the masses

Assuming that AMD's performance claims prove accurate in real-world gaming scenarios, the massive performance leap stems from the adoption of 14nm FinFET technology in Polaris, a leap forward by two full technological generations for graphics processors. Both AMD and Nvidia (which uses 16nm FinFET tech in its new Pascal GPUs) had languished at 28nm since late 2011, after 20nm technology proved to be a bust for graphics cards.

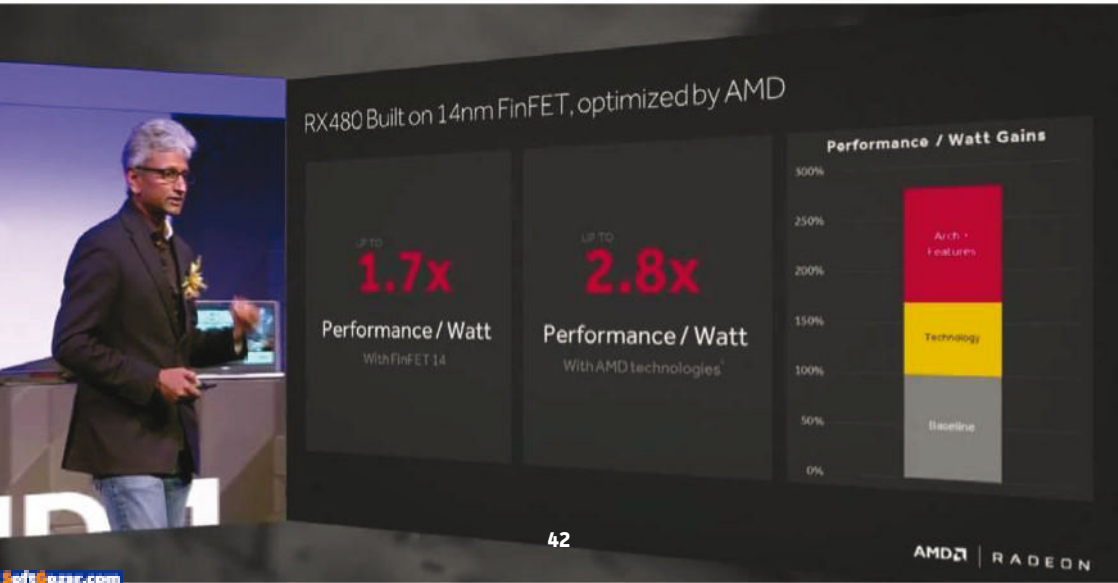
As you can see by the chart above, the Radeon RX 480 will be

available with both 4GB and 8GB memory configurations, with data sent over a 256-bit bus. One interesting tidbit that jumps out immediately is the power consumption: 150 watts over a single 6-pin connector is far, far, far, far less energy than the ridonkulously power-hungry R9 390X demands, but it's identical to the power requirements for the GTX 1070, which delivers higher Titan X–esque levels of power.

The exterior of the Radeon RX 480—at least the reference version—mimics the slick, attractive design found in AMD's own Radeon Nano and Fury X, and that's nothing but a good thing.

Dragging previously high-end performance down to an affordable $200 price point will let AMD dominate for the crucial mainstream graphics market until Nvidia releases a GTX 1060. Its rock-bottom price point could also help AMD compete well against the GTX 1080, as a pair of Radeon RX 480s running in CrossFire cost significantly less than Nvidia's flagship, but potentially deliver similar performance…assuming a given title supports multi-GPU setups well, at least.

The comparison on the next page stacks the deck for AMD a bit, as



The Radeon RX 480's power efficiency.

Ashes of the Singularity is a card that heavily favors AMD's cards in DirectX 12, but it still serves to drive home what's possible with a pair of Radeon RX 480s.

The Radeon RX 480 will also expand the total overall market for virtual reality—a key new battleground for computing. AMD's been beating the drum loudly with its LiquidVR development kit initiative and the Radeon Pro Duo, a dual-GPU beast of a graphics card devoted to VR game development.

"What I'm most excited about with Radeon RX 480 (Polaris) is that it could increase the penetration of both HTC Vive and Oculus Rift VR solutions and increase VR accessibility for more gamers," says Patrick Moorhead, founder and principal analyst at Moor Insights & Strategy. "A VR-ready GPU at $199 democratizes PC VR solutions and enables even lower-cost VR solutions in the future."

Let's say it again, because it's borderline mind-boggling: The first Polaris-based Radeon graphics card will cost only $200, and it will deliver roughly GTX 980–level performance according to AMD. That's crazy. AMD will sell Radeon RX 480s by the boatload at least until a GTX 1060 appears—and maybe even after. If the performance claims hold true, that $200 price point seems awfully competitive compared

to Nvidia's Pascal-based graphics cards, going by the GTX 1070's Titan X–like power and $380 cost.

The crystal ball is unclear

Beyond the immediate excitement of this particular announcement, what the future holds and what this means for every other graphics card out there is a real question.

The thought of a $200 Radeon with performance comparable to a Fury is mighty tantalizing, and the price gulf between this new card and the $380 GTX 1070 is more of a chasm. Still, the combination of those two next-generation graphics cards' entering the market basically renders every Radeon R300 and Fury card over $150 utterly irrelevant. There is zero reason to buy any Radeon graphics card but the new one for gaming right now, unless you need the Fury X or Nano's unique form factor for a specialty build. Everything else in the Radeon lineup is simply too high-priced compared to either the new Radeon or the GTX 1070.

The same can be said about everything Nvidia sells in the low- to mid-range: There's zero reason to buy a GTX 950 or 960 right now with the $200 Radeon looming. But it's easy to envision Nvidia rushing out a GTX 1060 or GTX 1060 Ti to combat the Radeon RX 480, while AMD's GPU road map indicates that its Fury successors—the Vega family of GPUs, with second-generation high-bandwidth memory—won't be out until around the end of the year.

The Radeon RX 480.

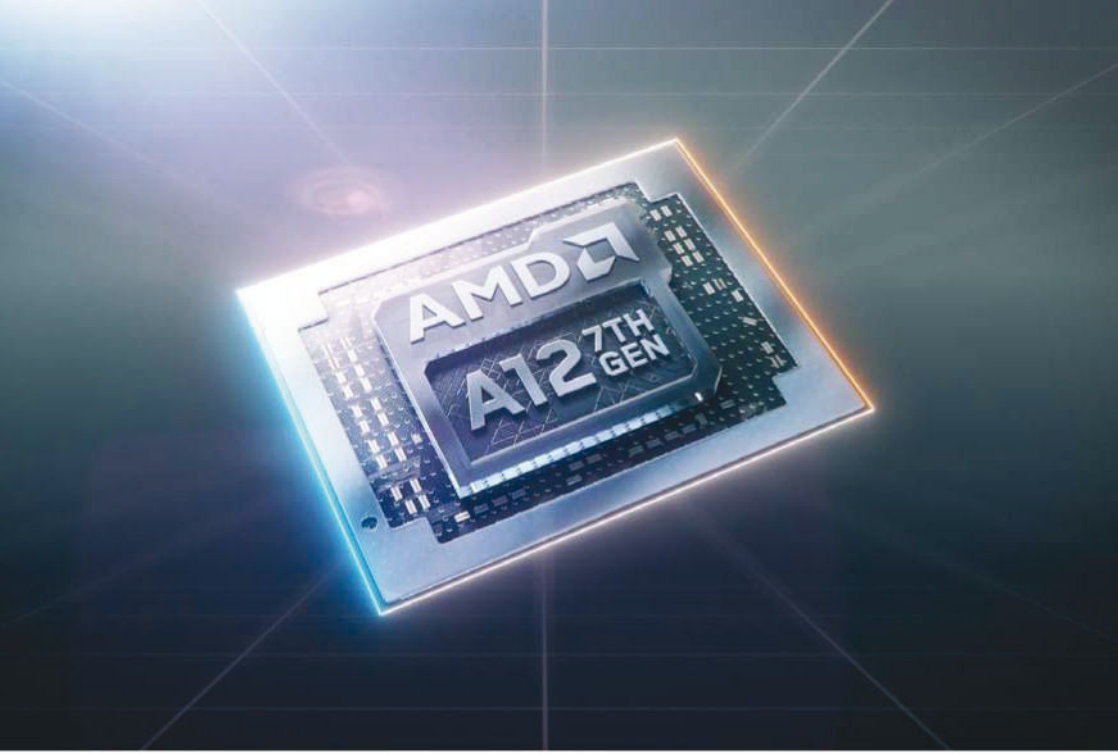
In fact, AMD's press info about the Radeon RX 480 specifically calls out a "new 'Water Drop' strategy aimed at releasing new graphics architectures in high volume segments first to support continued

market share growth for Radeon GPUs."

That leaves a tremendous amount of uncertainty in the graphics world. Will AMD indeed surrender the new high-end to Nvidia for months into the future? Will Nvidia be able to get a GTX 1060 out the door in short order and battle the new Radeon? Will future AMD Polaris GPUs be as aggressively priced as this initial one, potentially forcing Nvidia to drive down prices of the GTX 1070 and 1080 to match? It's all up in the air right now.

The next-gen graphics card war is on, and it's an exciting time to be a PC gamer.

One thing is certain: The release of AMD's first Polaris GPU, with a compelling price point and jaw-dropping performance, is nothing but a good thing for the PC gaming masses. The next-gen graphics card war is on, and it's an exciting time to be a PC gamer.



AMD pins its laptop hopes on the low-power Bristol Ridge and Stoney Ridge APUs

BY MARK HACHMAN

AS THE NOTEBOOK PC becomes ever more important to the company's future, AMD debuted its Bristol Ridge and Stoney Ridge integrated graphics APUs for laptops as the Computex show in Taipei kicked off.

Combined, AMD's new 7th-generation APUs represent a total of nine new products intended for low-end, budget notebooks on up to premium devices. Bristol Ridge and Stony Ridge represent AMD's first APU refresh in a year, since the company debuted the Carrizo chips last year.

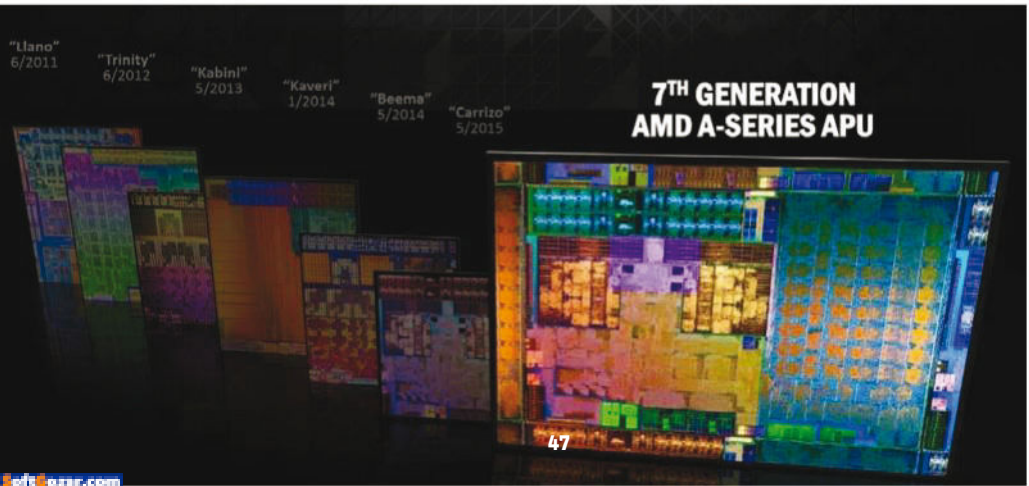
AMD's traditional argument for its APUs has been that they offer more graphics horsepower for a lower price. This time around, both the Bristol Ridge and Stoney Ridge APUs pack AMD's Excavator core, which will be paired with AMD's Radeon R7 graphics cores on the FX and A12 lines; AMD's R5 graphics on the A10 and A9 lines; and R4 and R2 graphics on the low-end A6 and E2 series, respectively.

All told, AMD is squarely focused on the PC, according to Kevin Lensing, the corporate vice president and general manager of the client business unit at AMD. "We're not really interested in drones, we're not really pushing hard in automobiles; we're pushing really really hard in PCs," Lensing said, in a swipe at Intel's recent refocusing on the broader device market.

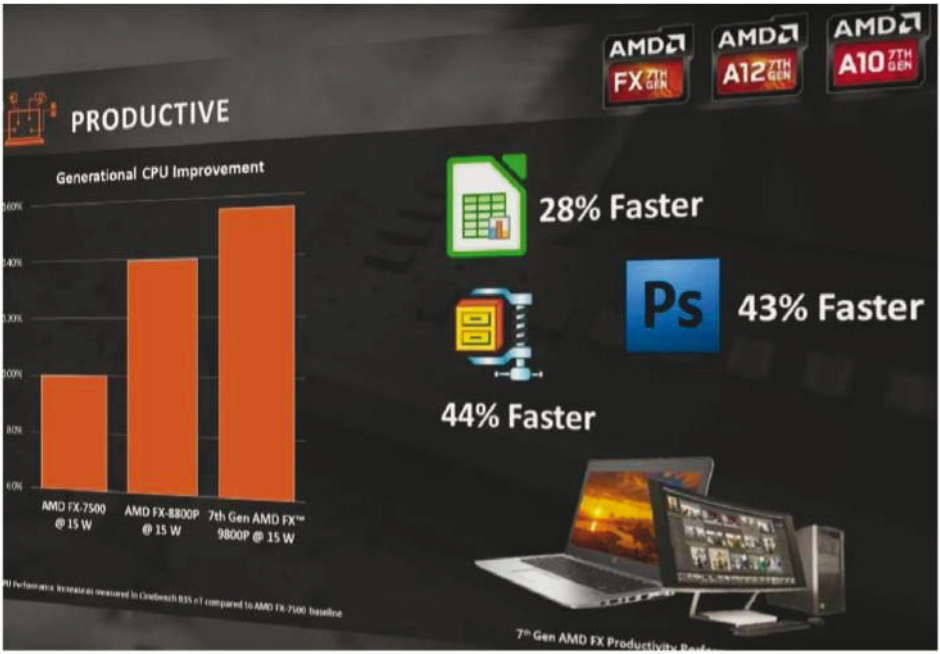
All of AMD's new cores consume either 15 watts or 35 watts, about the same power consumption as Intel's own Skylake parts. Though both 2015's Carrizo APUs and the Bristol Ridge parts used AMD's Excavator CPU cores, it's a first for the lower-end Stoney Ridge APUs. The improved CPU cores and graphics will allow AMD's low-end parts to take a crack at usurping Intel. AMD's A9 APUs will rival the Core i3 with "competitive graphics and system performance," according to AMD.

AMD claims that its Bristol Ridge APUs deliver significantly improved performance compared to years past.

Why this matters: AMD's future increasingly depends on the



AMD's APUs over the years.



notebook PC. During the fourth quarter, for example, AMD's shipments of desktop APUs decreased 4.3 percent from the previous quarter, according to Jon Peddie Research, while AMD's shipments rose 30.3 percent in notebooks.

The specs are a bit of a mystery

Unfortunately, AMD's being far more cagey about the specifications of the Bristol Ridge and Stoney Ridge parts than it is for, say, the AMD A10-7860K APU for the desktop that debuted in February. In the A10-7860K's case, the computing's handled by four CPU cores clocked at up to 4GHz in turbo boost, paired with eight Radeon R7 graphics cores running at 757MHz. It's also probably the last time we'll see the Excavator CPU cores before AMD bets big on the Zen CPU core next year; during a Computex press conference, AMD chief executive Lisa Su announced that the next APU would feature the AMD Zen core.

AMD would say only that its high-end Bristol Ridge chips ship with four CPU cores—implying, but not confirming, that they'll ship with eight GPUs as well. It also cherry-picked some head-to-head comparisons—the A12, AMD said, will outperform the Intel Core i5-6200U with 31 percent more gaming performance.

(AMD since clarified: the FX9830P and FX 9800P will have 8 GPU cores and 4 CPU cores; the A12 and A10-series parts will have 6 GPU cores and 4 CPU cores, the A9 and A6 parts will have 3 GPU cores and 2 CPU cores, and the E2-9010 will have 2 CPU and 2 GPU cores.)

AMD's Bristol Ridge APUs—the FX, A12, and A10 APUs—will support DDR4 memory running up to 2400MHz. They'll also include Adaptive Voltage and Frequency Scaling (AVFS), a technology AMD added to the Carrizo chips. AVFS enables what AMD calls the "optimal operating point" for a given mix of power and performance, theoretically allowing the chip to operate at its maximum speed but at a minimal voltage.

The Stoney Ridge APUs will be slightly slower, with support for

	APU Brand	Radeon™ Brand	TDP	Max / Base CPU Frequency
AMD FX 7TH GEN	7th Gen AMD FX™ 9830P	Radeon™ R7 Graphics	35W (25-45 cTDP)	3.7 GHz / 3.0 GHz
	7th Gen AMD FX™ 9800P	Radeon™ R7 Graphics	15W (12-15 cTDP)	3.6 GHz / 2.7 GHz
AMD A12 7TH GEN	7th Gen AMD A12-9730P	Radeon™ R7 Graphics	35W (25-45 cTDP)	3.5 GHz / 2.8 GHz
	7th Gen AMD A12-9700P	Radeon™ R7 Graphics	15W (12-15 cTDP)	3.4 GHz / 2.5 GHz
AMD A10 7TH GEN	7th Gen AMD A10-9630P	Radeon™ R5 Graphics	35W (25-45 cTDP)	3.3 GHz / 2.6 GHz
	7th Gen AMD A10-9600P	Radeon™ R5 Graphics	15W (12-15 cTDP)	3.3 GHz / 2.4 GHz
AMD A9 7TH GEN	7th Gen AMD A9-9410	Radeon™ R5 Graphics	15W (10-25 cTDP)	3.5 GHz / 2.9 GHz
AMD A6 7TH GEN	7th Gen AMD A6-9210	Radeon™ R4 Graphics	15W (10-15 cTDP)	2.8 GHz / 2.4 GHz
AMD E2 7TH GEN	7th Gen AMD E2-9010	Radeon™ R2 Graphics	15W (10-15 cTDP)	2.2 GHz / 2.0 GHz

The clock speeds and some of the features of AMD's new Bristol Ridge and Stoney Ridge APUs for notebooks: Though we don't know how actual performance will shake out, AMD is at least offering decently competitive clock speeds.

2133MHz memory. They'll be clocked at up to a gigahertz faster than the older Carrizo chips in those low-end categories, however, AMD said. To give you a sense of how the chips stack up, AMD is positioning the A9 chips against the Intel Core i3-6100U.

Lensing also said that AMD pushed hard to increase the performance versus its Carrizo, specifically the AMD A8-7410. Measured against the CineBench 11.5 benchmark, the performance of the A9 jumped by 52 percent.

"Honestly, this was a place we felt like we needed to move fast," Lensing said. "We fell a little back…there's a massive focus in the near term to accelerate the pace."

Both APUs include VP9 and H.265 /HEVC support in hardware, supporting up to 4K H.264 decoding, 1080p VP9, and 4K HEVC support. Basically, the message here is that the three codecs are the most popular used by services like YouTube and Netflix—and AMD supports them all.

AMD also made some bold claims regarding the performance of Bristol Ridge and the Intel Core i7. AMD's Bristol Ridge will also include AMD's FreeSync technology.

AMD will also toss in some games as an incentive to buy—Winning Putt, DiRT Rally, Batman 3, among others—but the real selling point will be the combination of low power, low price, and decent performance. It just remains to be seen what OEMs buy into it—and HP and Dell apparently have.

A representative from Dell announced the Inspiron 15 5000 series, available at $399, which will include the new APU as well as Radeon R7 series graphics and an optical drive. HP also showed off a consumer notebook boasting AMD's APU and discrete graphics to boot.

Sorry, there will never be a Bernie Sanders (or Colonel Sanders) version of Minecraft

BY MARK HACHMAN

DONALD TRUMP CAN BUY himself many things, but he will never be able to officially build a 10,000-block-high statue of himself in *Minecraft*. Your dreams of exploring a mammoth Taco Bell Chalupa? Dead. And no, don't expect to mine Moria as part of a *Lord of the Rings* server.

Microsoft and its Mojang subsidiary said recently that they will begin blocking corporations and politicians from using *Minecraft* to

As long as this doesn't explicitly promote a King Kong sequel, you're good.

promote their own agendas, including the sale of products, movies, or political views.

"We want to empower our community to make money from their creativity, but we're not happy when the selling of an unrelated product becomes the purpose of a *Minecraft* mod or server," Mojang wrote in a blog post. The new additions are now part of Mojang's Commercial Usage Guidelines (go.pcworld.com/minecraftcug).

Why this matters: The problem, according to Mojang, is that *Minecraft* has grown so large that it's now a viable platform for promoting products and services, especially through shared servers that can be accessed by just about anyone. According to Mojang, the company has sold over 23.5 million copies of the Java version of *Minecraft*, with additional sales going toward Windows 10's UWP version of the game. Many of those users are also watching *Minecraft*-themed videos on YouTube, which can also serve as vehicles to promote

products.

The new rules apply mainly toward players developing mods or shared servers, where they can control what content players see. Mojang now says that users who build a *Minecraft* mod won't be able to design a mod that promotes an "unrelated" third-party product, such as a Burger King.

CREDIT: BLOGCDN.COM

Let's hope that this wasn't Marco Rubio.

Likewise, mods and mapmakers won't be able to design a world specifically intended to market a movie or TV show, such as *Lord of the Rings*.

However, there's one enormous loophole: Fans of a show or a product "are still free to build things in *Minecraft* that represent or celebrate it so long as the goal or focus is not to promote or sell that stuff," Mojang wrote. So if you really want to build the world's largest Twinkie, you can—as long as the owners haven't asked you to build it.

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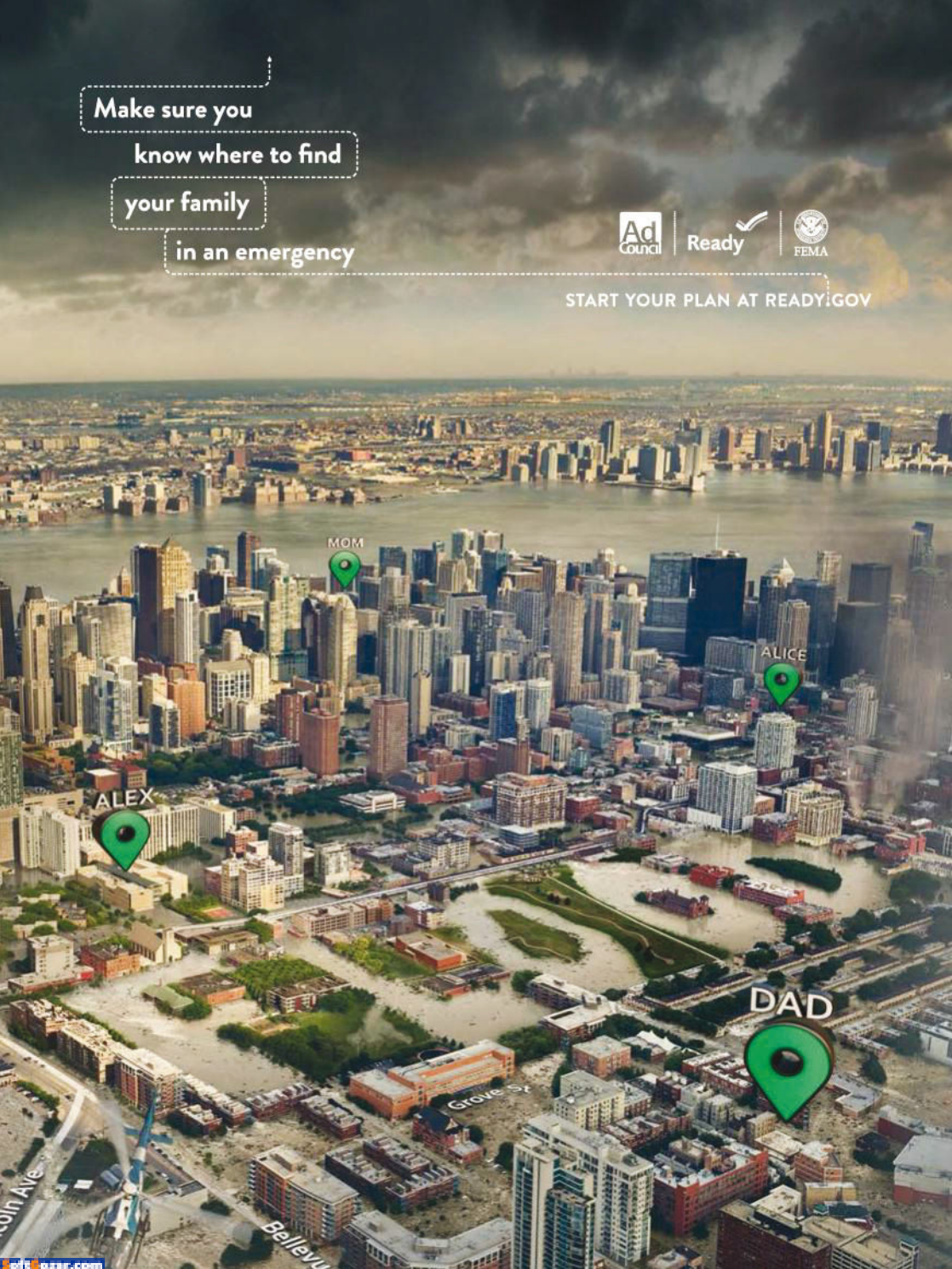
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Fearing forced Windows 10 upgrades, users are disabling critical updates instead

Some Windows 7 and 8 users would rather chance a malware infection than an involuntary Windows 10 upgrade.

BY BRAD CHACOS

PHOTO COURTESY OF MICROSOFT

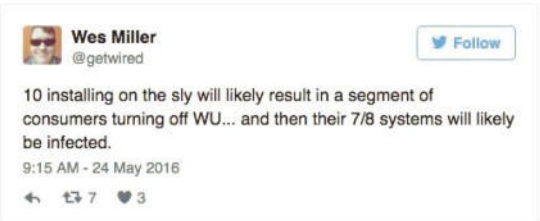
MICROSOFT STEPPED ON the gas in its quest to drive Windows 7 and 8 users to Windows 10 over the past couple of weeks, rolling the upgrade out as a Recommended update. Watch out! The only behavior that could deny the Windows 10 upgrade before—closing the pop-up by pressing the X in the upper right corner—now counts as consent for the upgrade, and worse, the upgrade installation can automatically begin even if you take no action whatsoever.

Over one week, I've received more contact from readers about this issue than I have about everything else I've written over the rest of my career *combined*.

It's nasty business, and it's tricking legions of happy Windows 7 and 8 users into Windows 10. Over one week, I've received more contact from readers about this issue than I have about everything else I've written over the rest of my career *combined*. But beyond merely burning bridges with consumers, these forced, non-consensual upgrades could have more insidious consequences.

"I fear some segment of consumers will turn off Windows Update as a result," Wes Miller, research vice president at Directions on Microsoft (directionsonmicrosoft.com), told me. "Which is a very bad side effect."

Indeed it is. Windows Update delivers critical updates to your PC, plugging holes in the operating system and slamming the door on potential hack attacks. Keeping your operating system patched is a crucial part of staying secure on the modern web. That's why *PCWorld* and many other technology experts advise users that the best course of action is usually to leave the Windows default intact, letting the OS download and install recommended updates automatically. Doing otherwise



is dangerous, unless you're an expert yourself.

Using that critical avenue to push Windows 10 on people—pardon, "make it easier for consumers to upgrade to Windows 10"—violates the trust people hold in the sanctity of Windows Update. And, yes, as a direct result of Microsoft's actions, at least some people are disabling Windows Update on their Windows 7 and 8 PCs.

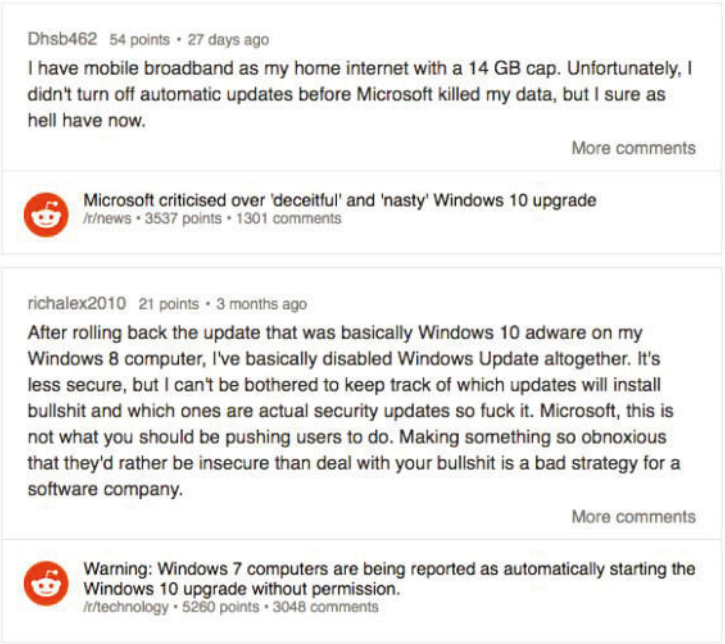
Ironically, improved security is one of Windows 10's selling points. But by pushing it on users in such a heavy-handed way, Microsoft is encouraging users who have very valid reasons to stick with Windows 7/8 (go.pcworld.com/w10holdouts) to perform actions that leave their machines open to attack. That's bad. Very bad.

For the record: *Don't* disable Windows Updates unless you're an advanced user who wants to parse and manually install Windows patches. Instead, leave them active but also install GWX Control Panel (ultimateoutsider.com/downloads) or Never10 (go.pcworld.com/never10), free tools that block the Get Windows 10 pop-ups and behavior. Microsoft's been known to push out new patches that work around those tools in the past, however—again, violating Windows Update's sanctity to push its new OS. Be sure to read the fine print if a GWX pop-up *does* appear in order to avoid being tricked into Windows 10.

Here are just a couple of the readers who reached out to me directly to say they've disabled Windows Updates to avoid being forced into Windows 10.

Windows 10 updates

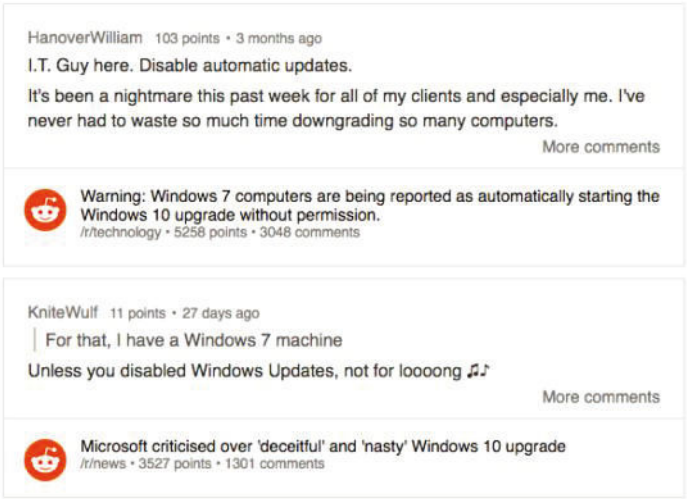
While the decision to abuse Windows Update is clearly burning goodwill with numerous Windows users, the people who suddenly find themselves on Windows 10 won't be able to prevent actions like this from occurring in the future.



Reddit and other forums around the web hold more tales of woe and disabled updates…

The consumer versions of Windows 10 don't allow you to disable or manually install Windows Updates. If Microsoft pushes out a Windows 10 update, you will receive it (go.pcworld.com/w10updhomeuser) eventually. Some versions of Windows 10, including Windows 10 Pro, allow you to defer feature updates—though not security updates—which bumps your computer off the consumer update path and onto the Current business branch, effectively delaying new features from hitting your PC for "several months." How-To Geek has an excellent write-up explaining Windows 10's deferred updates (go.pcworld.com/w10deferupgrades).

That's likely part of the reason Microsoft's willing to take this dangerous roll of the dice. A significant portion of average users won't have the technical knowledge to roll back to Windows 7 or 8 after a surprise upgrade. If you're a standard, non-technically inclined PC user pushed into Windows 10, there's no way to cut off Windows Updates



...and users explicitly encouraging other people to disable Windows Update.

even if you don't trust them anymore.

But angry Windows 7 and 8 holdouts certainly can, and some are. Microsoft's aggressive Windows 10 upgrade push began by adopting malware-like tactics to deceive users into upgrading, and it's evolved into something so annoying that users are now willing to risk malware infection in order to make the pop-ups and non-consensual upgrades stop.

And they should stop. Windows 10 is the best Windows yet and can speak for itself. Please, Microsoft. End this madness. Your users are begging you.

Further reading: How to escape the Windows 10 update you mistakenly agreed to (go.pcworld.com/escapew10update) and How to go back to Windows 7 or 8 after an unwanted Windows 10 upgrade (go.pcworld.com/gobackwin8).

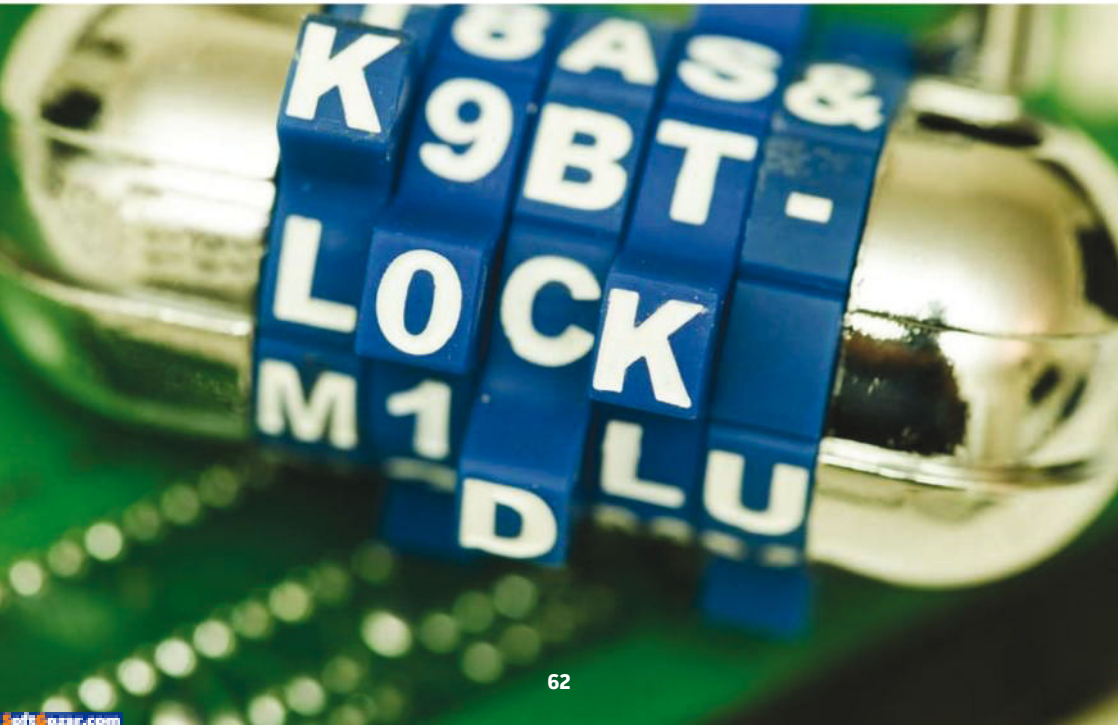
Senate proposal to require encryption workarounds may be dead

BY GRANT GROSS

A PROPOSAL IN the U.S. Senate to require smartphone OS developers and other tech vendors to break their own encryption at the request of law enforcement may be dead on arrival.

The proposal, released as a discussion draft (go.pcworld.com/fedencryptdraft) in April, may not be formally introduced this year because of strong opposition, according to a Reuters report.

The draft bill, pushed by Senators Richard Burr and Dianne Feinstein,



would allow judges to order tech companies to comply with requests from the FBI and other law enforcement agencies to help them defeat security measures and break into devices.

"All persons receiving an authorized judicial order for information or data must provide, in a timely manner, responsive, intelligible information or data, or appropriate technical assistance," the draft bill (go.pcworld.com/encryptionbill) said.

Spokespeople for Burr, a North Carolina Republican and chairman of the Senate Intelligence Committee, and Feinstein, a California Democrat, didn't immediately respond to requests for comment on the future of the proposal.

The proposal received a cool reception from President Barack Obama's administration, despite a long-running push by FBI Director James Comey to allow law enforcement agencies access to devices protected by encryption and other security measures. The FBI and parent agency the Department of Justice have gone to court to force Apple to help them defeat encryption on iPhones in a handful of recent criminal cases.

Several digital rights groups have also opposed the encryption proposal.

The FBI asked a California judge to order Apple to assist it with unlocking an iPhone used by a mass shooter in San Bernardino, California, in December, but the agency later backed off after it said it found an alternative method.

Several digital rights groups have also opposed the encryption proposal. Since mid-April, more than 70,000 people have opposed the draft bill by signing a petition (go.pcworld.com/opposeencryptbill) from progressive activist group CREDO Action.

Celebrity hacker Guccifer's confession gives us all a lesson in security

BY LUCIAN CONSTANTIN

THE ACTIVITY OF Romanian hacker Guccifer, who has admitted to compromising almost 100 email and social media accounts belonging to U.S. government officials, politicians, and other high-profile individuals, is the latest proof that humans are the weakest link in computer security.

Marcel Lehel Lazar, 44, is not a hacker in the technical sense of the word. He's a social engineer: a clever and persistent individual with a lot of patience who a Romanian prosecutor once described as "the obsessive-compulsive type." By his own admission, Lazar has no programming skills. He didn't find vulnerabilities or write exploits. Instead, he's good at investigating, finding information online and making connections.

This is the latest proof that humans are the weakest link in computer security.

Lazar pleaded guilty in May in U.S. District Court for the Eastern District of Virginia to charges of unauthorized access to a protected computer and aggravated identity theft.

Low-tech hacking, high-profile targets

According to the Department of Justice, Lazar admitted that from at least October 2012 to January 2014, he gained unauthorized access to the email and social media accounts of around 100 Americans with the intention of obtaining their personal information and correspondence.

His victims included an immediate family member of two former U.S. presidents, a former U.S. Cabinet member, a former member of the U.S. Joint Chiefs of Staff, and a former presidential adviser, the DOJ said.

While the victims weren't named in the indictment, Guccifer is known to have released documents, pictures and information that were stolen from the personal email accounts of former U.S. Secretary of State Colin Powell and several members and friends of the Bush family, including Dorothy Bush Koch, daughter of 41st U.S. President George H.W. Bush and sister of 43rd U.S. President George W. Bush.

In an interview with online publication PandoDaily in 2015, Lazar said that he gained access to Powell's AOL email account by guessing the password, which was based on the former secretary of state's grandmother's name. There he found correspondence between Powell and a Romanian politician named Corina Cretu, which led to him targeting her as well.

In the same interview, Lazar claims that he broke into Cretu's Yahoo email account after guessing the answer to her security question: the street where she grew up. First he found the name of the primary school that she attended on her public Facebook page. Then he methodically tried out street names close to Cretu's childhood school until he found the right one, correctly assuming that she attended a school close to her home.

This shows how apparently harmless information like a school's name can help criminals and why people should be careful with what they disclose about their lives online.

Preventing social engineering attacks

Of course, celebrities, politicians and other public figures can't always avoid information about their personal lives appearing online. If they don't disclose it themselves, someone else probably will, in Wikipedia pages, news articles, gossip blogs, biographies and so on.

This shows how apparently harmless information like a school's name can help criminals and why people should be careful with what they disclose about their lives online.

It might be a good idea then, especially for high-ranking politicians, to attend training courses on how to protect themselves and their online accounts from social engineering attacks. Other politicians whose personal email accounts were compromised in the past by hackers using social engineering techniques include former Alaska Governor Sarah Palin and CIA Director John Brennan.

Once they achieve a certain level of fame that could make them a target, everyone should go back and review their online accounts: Do those websites really need so much real personal information or can some be removed? Are passwords strong enough and different between accounts? Do the websites offer two-factor authentication? What account recovery or password reset options do they offer? Are they easy to bypass using public information? Are the answers to security questions for those accounts easily

guessable? Are those accounts even needed anymore? If not, is there an account delete option?

These are good issues for anyone—not just the rich and famous—to address. It might be a time-consuming process, but not more than having to later deal with a potential data breach and having your private conversations with friends, family, or past lovers dumped in the public domain.

Already in prison

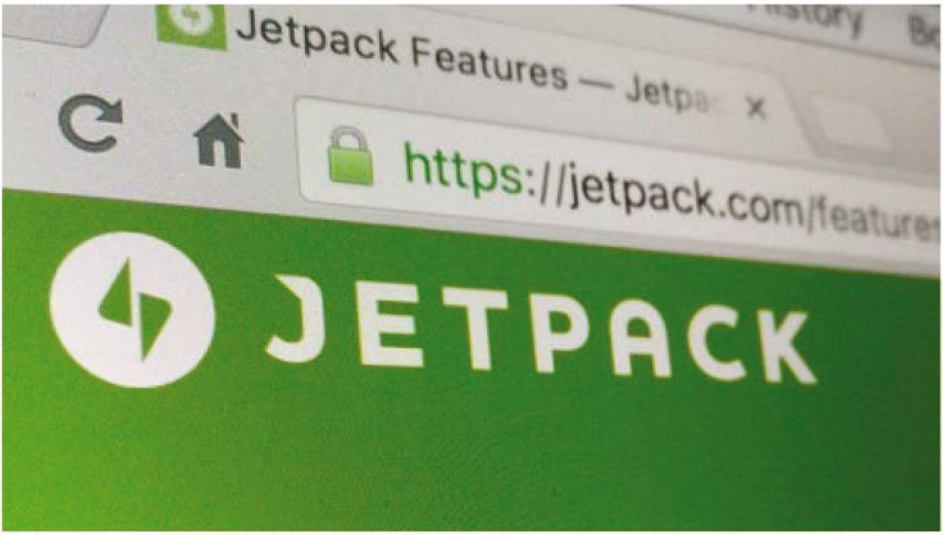
Guccifer was extradited (go.pcworld.com/gucciferextradited) earlier this year to the U.S. from Romania, where he was already serving a prison sentence for hacking into the email accounts of various local public figures.

His sentencing in the U.S. is scheduled for Sept. 1. After that he could be returned to his home country to serve out his sentence there, as the Romanian courts granted extradition for a maximum of 18 months.

In Romania, Lazar is serving two prison sentences, for a total of seven years. In June 2014 he was sentenced to four years in prison for hacking into the personal email account of George Maior, the former head of the Romanian Intelligence Service and current Romanian ambassador to the U.S.

However, at that time he was already under a six-year supervised release term after receiving a three-year suspended prison sentence in 2012 for hacking into the email accounts of other Romanian celebrities. Because he violated the release terms, the older three-year prison sentence got activated and he must serve seven years.

It's not clear if the U.S. sentence, which can carry a punishment of between two and seven years in prison, will be served separately.



Flaw in popular WordPress plug-in Jetpack puts over a million websites at risk

BY LUCIAN CONSTANTIN

OWNERS OF WORDPRESS-BASED websites should update the Jetpack plug-in as soon as possible because of a serious flaw that could expose their users to attacks.

Jetpack is a popular plug-in that offers free website optimization, management, and security features. It was developed by Automattic, the company behind WordPress.com and the WordPress open-source project, and has over 1 million active installations.

Researchers from Web security firm Sucuri have found a stored

cross-site scripting (XSS) vulnerability that affects all Jetpack releases since 2012, starting with version 2.0.

The issue is located in the Shortcode Embeds Jetpack module, which allows users to embed external videos, images, documents, tweets, and other resources into their content. It can be easily exploited to inject malicious JavaScript code into comments.

Since the JavaScript code is persistent, it will get executed in users' browsers in the context of the affected website every time they view the malicious comment. This can be used to steal their authentication cookies, including the administrator's session; to redirect visitors to exploits, or to inject search engine optimization (SEO) spam.

"The vulnerability can be easily exploited via wp-comments and we recommend everyone to update asap, if you have not done so yet," said Sucuri researcher Marc-Alexandre Montpas.

"The vulnerability can be easily exploited via wp-comments and we recommend everyone to update asap, if you have not done so yet," said Sucuri researcher Marc-Alexandre Montpas in a blog post.

Sites that don't have the Shortcode Embeds module activated are not affected, but this module provides popular functionality so many websites are likely to have it enabled.

The Jetpack developers have worked with the WordPress security team (go.pcworld.com/jetpk403securityupd) to push updates to all affected versions through the WordPress core auto-update system. Jetpack versions 4.0.3 (go.pcworld.com/installjetpk403) or newer contain the fix.

In case users don't want to upgrade to the latest version, the Jetpack developers have also released point releases for all twenty-one vulnerable branches of the Jetpack code base: 2.0.7, 2.1.5, 2.2.8, 2.3.8, 2.4.5, 2.5.3, 2.6.4, 2.7.3, 2.8.3, 2.9.4, 3.0.4, 3.1.3, 3.2.3, 3.3.4, 3.4.4, 3.5.4, 3.6.2, 3.7.3, 3.8.3, 3.9.7, and 4.0.3.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REVIEWS & RATINGS

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Intel Broadwell-E Core i7-6950X: The first 10-core enthusiast CPU is a beast

BY GORDON MAH UNG

MONSTROUS. BRAWNY. Or in the parlance of our times: OP for "overpowered." All are apt terms for Intel's new 10-core Core i7-6950X, a muscular CPU so over-the-top in power, that you'd have to be crazy to need one.

But Intel's Extreme Edition CPUs have never been about catering

to practical need. No, they cater to your desire for raw performance. This time, though, Intel is pushing both performance and your wallet to the very edge with a CPU priced at $1,723.

No, that's not a typo: $1,723. For just one CPU.

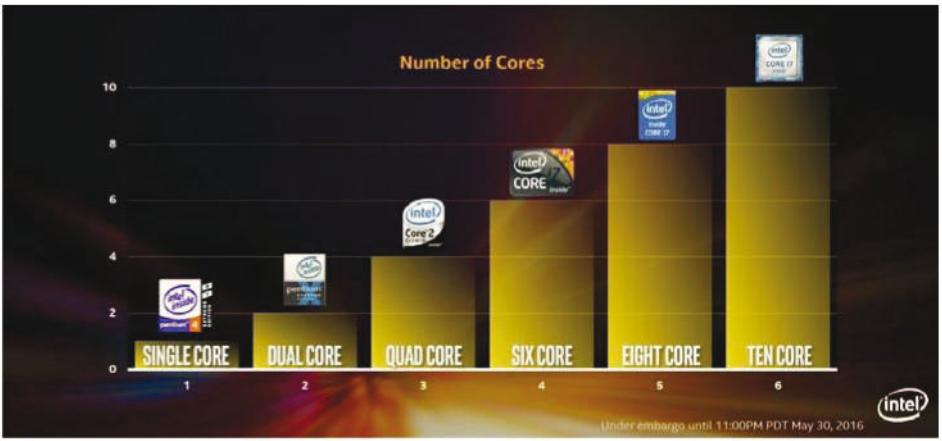
For more details on the chip, read Mark Hachman's deep dive (go.pcworld.com/broadwellerev). To find out if Intel's brutishly powerful chip is worth it, read on.

No surprises here

Broadwell-E has probably been one of the worst-kept secrets in the industry. Models and specs leaks have been floating around for months. All those rumors are merely that until we get it from the horse's mouth, and Mr. Ed has finally spoken. The chart on the next page gives full details on the Broadwell-E product line, including the current two Skylake K chips (outside the grey box.)

The Broadwell-E family essentially replaces the three Haswell-E family chips, which were introduced two years ago with the LGA2011-V3 platform. Except for the new 10-core Broadwell-E, which creates a new uber-chip tier above the others, the rest fall in line with the older Haswell-E chips they replace. See the details in the second

Intel has been pushing the Extreme Edition chips for a decade now but this one may top them all.



	Intel Core i7 Processor number	Base Clock Speed (Ghz)	Intel Turbo Boost Max Technology 3.0	Intel Turbo Boost Technology 2.0 Frequency[2] (GHz)	Cores/ Threads	Cache	PCI Express 3.0 Lanes	Memory Support	TDP	Socket (LGA)	Pricing (1k USD)
NEW	6950x	3.0	Enabled	Up to 3.5	10/20	25 MB	40	4 channels DDR4-2400	140 W	2011-v3	$1723
NEW	6900K	3.2	Enabled	Up to 3.7	8/16	20 MB	40	4 channels DDR4-2400	140 W	2011-v3	$1089
NEW	6850K	3.6	Enabled	Up to 3.8	6/12	15 MB	40	4 channels DDR4-2400	140 W	2011-v3	$617
NEW	6800K	3.4	Enabled	Up to 3.6	6/12	15 MB	28	4 channels DDR4-2400	140 W	2011-v3	$434
	6700K	4.0	Not Supported	Up to 4.2	4/8	8 MB	16	2 channels DDR4-2133 DDR31-1600	91 W	1150	$339
	6600K	3.5	Not Supported	Up to 3.9	4/8	6 MB	16	2 channels DDR4-2133 DDR31-1600	91 W	1150	$242

The Broadwell-E family includes four models all of which cost a little more than the Haswell-E chips they replace.

	Brand Name & Processor number	Base Clock Speed (Ghz)	Turbo Frequency[2] 3.0	Cores/ Threads	Cache	PCI Express 3.0 Lanes	Memory Support	TDP	Socket (LGA)	Pricing (1k USD)
NEW	Intel Core i7 5960X	3.0	Up to 3.5	8/16	20 MB	40	4 channels DDR4-2133	140 W	2011-v3	$999
NEW	Intel Core i7 5930K	3.5	Up to 3.7	6/12	15 MB	40	4 channels DDR4-2133	140 W	2011-v3	$583
NEW	Intel Core i7 5820K	3.3	Up to 3.6	6/12	15 MB	28	4 channels DDR4-2133	140 W	2011-v3	$389
	Intel Core i7 4790K	4.0	Up to 4.4	4/8	8 MB	16	2 channels DDR3-1600	88 W	1150	$339
	Intel Core i7 4690K	3.5	Up to 3.9	4/8	6 MB	16	2 channels DDR3-1600	88 W	1150	$242

Haswell-E introduced a new LGA-2011 V3 platform and 8-cores for "free."

chart from the original rollout of Haswell-E with the pair of smaller Haswell K CPUs (outside the grey box).

Besides the new cores, you also get a price increase—a perk of having basically no competition. Intel continues to offer a "budget" Broadwell-E, which has six cores and fewer PCIe lanes available in the chip. That decision isn't technical, it's marketing. If you want to build or buy a PC with 40 PCIe Gen 3 lanes turned on, you have to pay the extra price.

An easy upgrade

On the outside, the new Broadwell-E's heat spreader gets a more angular design that increases its strength for the more fragile 14nm

chip inside. Like Haswell-E, it uses solder interface material rather than thermal paste.

Broadwell-E was always intended as a drop-in replacement for Haswell-E, so for the most part (more on this later) there's no surprises. Just update your BIOS and socket in the chip and you're ready to rocket. The new chip also supports DDR4/2400 officially, which Haswell-E did not (though it did just fine with that memory anyway).

Broadwell underneath

The actual microarchitecture inside shouldn't surprise, either. It's built on a 14nm process using the Broadwell (5th-gen) cores that have been in laptops since 2015 (late 2014, if you count Core M). Broadwell actually made a very late appearance in desktops in the unwanted Core i7-5775C, which I reviewed (go.pcworld.com/i75775crev) in 2015 before quickly sinking into obscurity when the 6th-gen Skylake CPUs showed up (go.pcworld.com/skylakerev) days later.

Here's a shot of the die. As you can see, it's a native 10-core chip on the highest-end Broadwell-E part. Intel doesn't pull any funny business by using a chip with 12 cores and turning off two. The 8-core and two 6-core models use the same 10-core chip, with cores permanently switched off.

Turbo Boost Max Technology 3.0

Among the most notable changes to Broadwell-E is the new Turbo

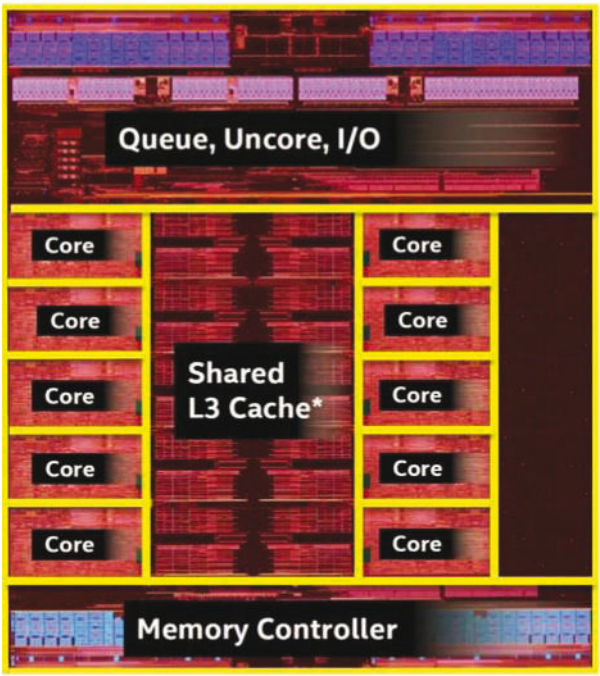
Intel's new 10-core Broadwell-E sits in the middle, with an eight-core Haswell-E on the left and an older Haswell quad-core on the right.

Boost Max Technology 3.0 feature.

Turbo Boost was introduced with the first Core i7 chips in 2008. Like the name says, it temporarily increases the clock speed of the chip to improve performance.

Turbo Boost Max 3.0, exclusive to the Broadwell-E, is quite different. Intel said it identifies at the factory which CPU core is the "best" and runs it at a higher clock speed than the others.

Turbo Boost Max 3.0 can then bind single-threaded applications to that one higher-flying core, for a performance boost of up to 15 percent.



The Broadwell-E die is a native 10-core part with all of them turned on. That mystery blacked-out portion isn't Area 51. Intel says it's Xeon functionality that isn't used.

Turbo Boost Max 3.0 can boost apps in the foreground, and it lets you assign a particular app to a particular core or cores.

In Windows, you've been able to bind a certain program or process to a particular core or thread by changing the affinity. Turbo Boost Max 3.0 does it for you automatically (once set up).

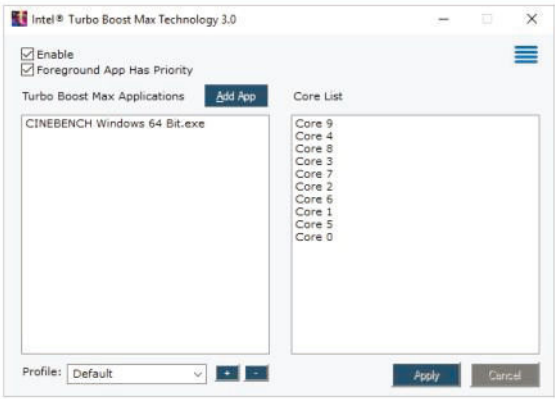
Per-core overclocking and more

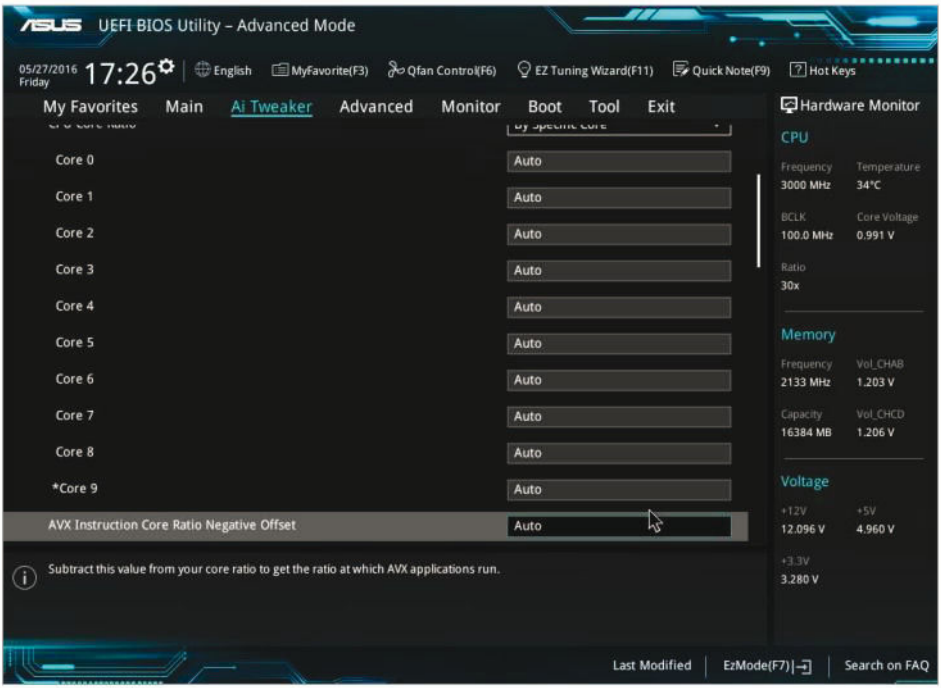
Broadwell-E has a few features catering specifically to the overclocking sports—nerds who push CPU clock speeds to multi-gigahertz levels using liquid nitrogen and other exotic cooling methods in competition. One feature, for instance, lets you crank back

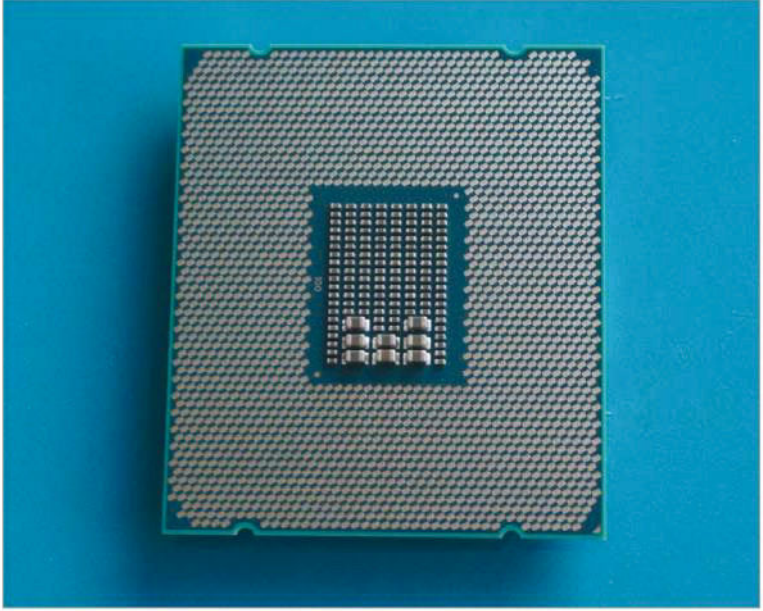
the AVX ratio to lower the power it consumes during benchmark runs.

Not everyone is into extreme overclocking sports, though. Many just want to tune a CPU to its highest actual usable performance. For them, Intel has added per-core overclocking. With older CPUs, overclocks were somewhat granular in that you could pick higher frequencies based on whether it was using, say, two cores. The cores picked, though, were

Top: The Turbo Boost Max Technology 3.0 utility lets you set an app to run on the fastest core. **Bottom:** The BIOS of the Asus X99 Deluxe II board shows the list of the cores and the asterisk indicates what is the "best" core of the litter.







Here's the backside of Intel's new 10-core Core i7-6950X chip.

random. With Broadwell-E you can overclock a specific core and even change its individual voltage.

When combined with Turbo Boost Max 3.0, you could, say, set an application to run on that particular overclocked core. That pays real dividends in performance for someone willing to put in the tuning time.

Lots of cores, lower clock speeds

It's no coincidence that so many of Broadwell-E's innovations are aimed at giving the chip better performance in single-threaded or lightly-threaded tasks. That's because Intel knows applications that can take full advantage of the resources of a 10-core chip, or even an 8-core chip, are rare.

That inconvenient truth has always put the company's big chips at a distinct disadvantage to the smaller quad-cores such as Intel's Core i7-6700K. With fewer cores and lower thermal overhead, those quad-cores can easily run at higher clock speeds. For example, the same Core i7-6700K has a base clock speed of 4GHz, while the top-end 10-core Broadwell-E has a base clock of 3GHz. All the tweaks Intel has put into Broadwell-E, the company said, should put it on far better footing with a nimbler quad-core, while giving it the capability to blow the doors off when the load needs more than four cores.

Performance and how we tested

For our performance testing, I set up three different systems to test the 10-core, plus three chips that I think should be compared to it: An eight-core Haswell-E Core i7-5960X, a quad-core Skylake Core i7-6700K, and a six-core Ivy Bridge-E Core i7-4960X.

All three systems received clean installs of Windows 10, and each was tested with a GeForce GTX 980 card and duplicate Kingston HyperX Savage SATA SSD. All three also had 16GB of Corsair RAM. We used DDR3/2133 in triple-channel mode for the Ivy Bridge-E system, and DDR4/2133 in quad-channel mode for the Haswell-E and Broadwell-E systems. The Core i7-6700K ran in dual-channel mode.

The Haswell-E and Broadwell-E were swapped into the same system for testing. The latest available UEFI builds were also installed on all three motherboards. Both the Skylake and the Ivy Bridge-E chips used Asus motherboards, while an X99-based Asrock board was used for the Haswell-E and Broadwell-E CPUs.

One big caveat

Before we get too far into the benchmark-o-rama, I'd like to point out that I ran into a snag early on that simply could not be remedied in time to make this story deadline. Intel has maintained that Broadwell-E is completely drop-in compatible with existing X99 motherboards on the market. That apparently means it'll work, but it doesn't mean all of the features work. When I tried to install the required driver and utility for the Turbo Boost Max 3.0, it bombed out because the Asrock X99 Extreme4 board doesn't support it.

Intel has maintained that Broadwell-E is completely drop-in compatible with existing X99 motherboards on the market. That apparently means it'll work, but it doesn't mean all of the features work.

When it'll be added I don't know. Intel said support can be easily added through a UEFI update, but it's up to the individual board vendor to do so. In other words, the numbers you see here for single-threaded tasks, which could be up to 15 percent faster in theory with Turbo Boost Max 3.0.

Very late in the process, I was able to get the chip into an Asus X99 Deluxe II board. That solved most of my problems, but I didn't have time to re-run all of my tests. The good news is the Turbo Boost Max 3.0 should impact only the single-threaded tests.

Cinebench R15 performance

We'll start this off with a test that's ideally suited for a 10-core chip: Maxon's Cinebench R15. This is a benchmark based on Maxon's Cinema4D rendering engine, which the company uses in its commercial products, so you can consider it a reflection of real-world performance.

Cinebench R15 loves CPU cores, and the result is pretty monstrous.

Cinebench R15 loves CPU cores, and the result is pretty monstrous. The Broadwell-E blows past the 8-core Haswell-E chip and stomps the quad-core Skylake chip. You have to give proper credit to that Skylake chip, though: Combined with its state-of-the-art 6th-gen cores and its 4.2GHz clock speed, it really punches above its class.

To get a little more insight into how the various CPU cores do when you don't factor in the difference in core count, I also ran Cinebench R15 in the optional single-threaded mode. The high clock speeds plus the newer 6th-gen cores put the Skylake chip in the front seat by a very healthy margin. The Ivy Bridge-E chip does fairly well, but running at a higher clock speed, too.

The worst score comes from the Haswell-E, which I'm going to attribute to its lower clock speeds. Broadwell-E does particularly well at 3.5GHz and this is without Turbo Boost Max 3.0 on.

Blender performance

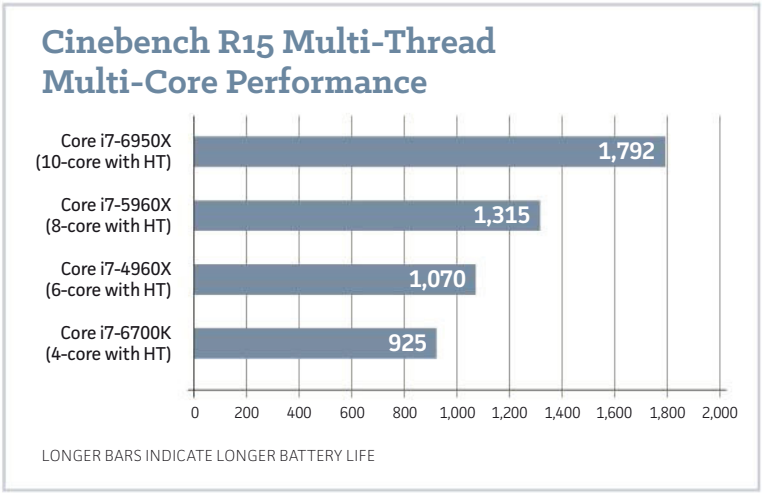
The second benchmark I'm going to detail is Blender, a free and popular 3D renderer used for visual effects by many indie filmmakers. The test file I used was Mike Pan's free BMW benchmark file.

The 10-core Broadwell-E still leads the pack, but by less than we expected. I've also seen Blender not offer the same core scaling as I've seen out of Maxon's Cinema 4D engine. Going from a dual-core to a quad-core laptop has also shown just average scaling.

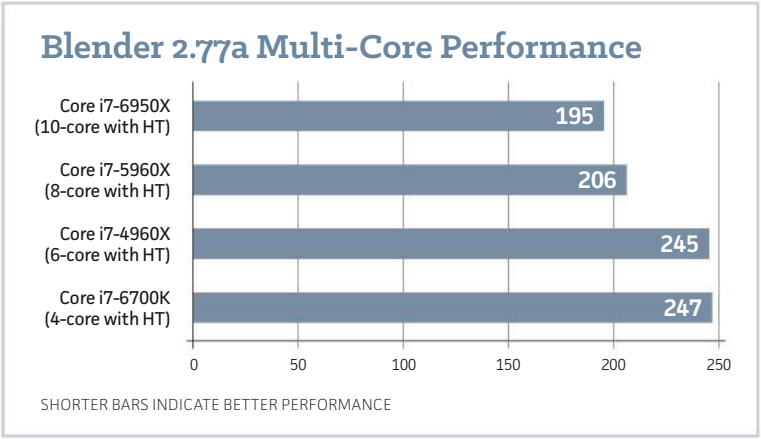
The upshot is if you're working on your indie film project and all the work is done in Blender, you'd be fine with a quad or six-core part. But hey, if you're an indie filmmaker anyway, you should be working on a shoestring budget, not dropping $1,723 for a CPU.

POV-Ray Performance

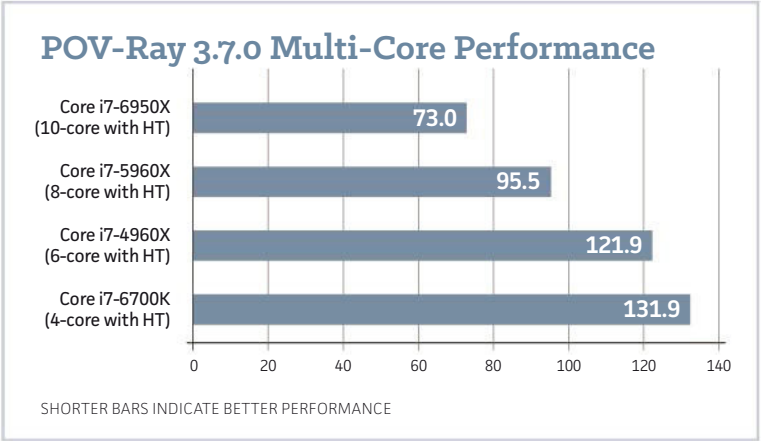
I'll close out my 3D rendering test section with POV-Ray. This 3D graphics program dates back to the Amiga and is available for free. We see very nice scaling from the 10-core Broadwell-E. Probably enough to warrant the expense if you really are doing POV-Ray projects and your renders are teeth-gnashingly long.



In multi-threaded tests, those 10 cores pay off very nice dividends.



The popular and free Blender render engine likes multi-core but not quite as much as Maxon's engine.



No surprise, POV-Ray also likes 10-core CPUs.

And yet again, that six-core Ivy Bridge-E Core i7-4960X is starting to look pretty moldy against the quad-core Skylake Core i7-6700K chip.

DirectX 11 gaming performance

Let me just get this out of the way by saying that no, in today's

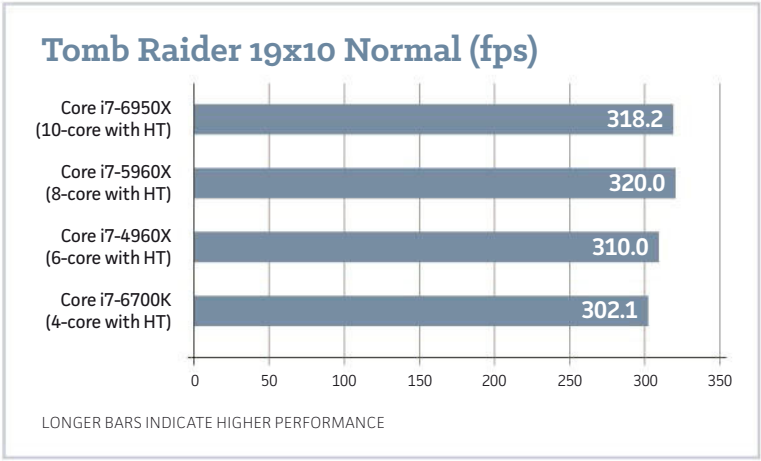
gaming experience, a 10-core CPU doesn't get you more performance. It just doesn't. That's because the vast majority of games don't exploit all those cores. Even the highly touted DX12 probably won't whip games into shape for at least another year or two. Still, you want proof so the first thing I'm going to run is the DirectX 11-based Tomb Raider.

Again, all of our tests were run on a GeForce GTX 980 with the same driver. For my runs, I set Tomb Raider at 1920x1080 resolution using the normal preset. For the most part, it's a tie. The real surprise is how Haswell-E and Broadwell-E pull ahead by a bit. Even the Ivy Bridge-E is technically faster, but let's not kid ourselves. This is a tie. I could run another six more games, but all you'd see is a tie across the vast majority of games. Gaming is still mostly 80 percent about the GPU.

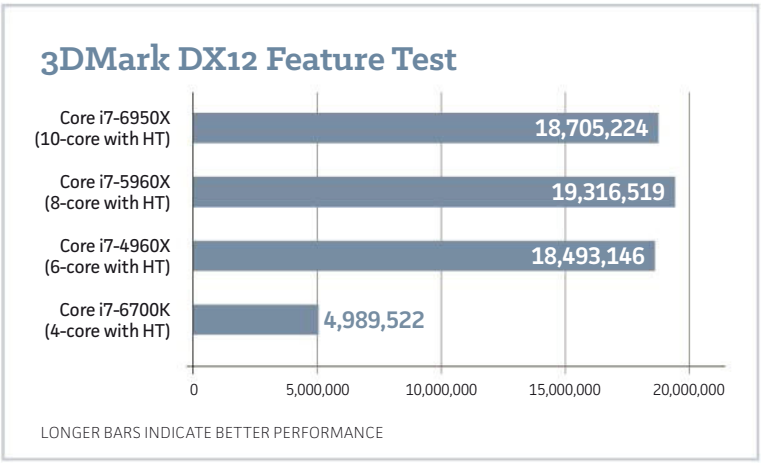
The lesson here is if your system is primarily used to play one game at a time, you don't need more than a quad-core chip with Hyper-Threading.

DirectX 12 gaming performance

Yes, but there's that DirectX 12 thing right? You know, the big move from Microsoft to make its gaming API actually exploit the multiple



No, you don't get more performance out of a 10-core chip in gaming but you already knew that right?



You can see 3DMark's DirectX 12 feature test can't stress more than the 12-threads of our Ivy Bridge-E chip.

CPU cores we've had in our PCs for half a decade.

To test it I first ran 3DMark's DirectX 12 feature test. It tests a PC's ability to issue draw calls or draw objects to a screen. You can see the Skylake Core i7-6700K gasses out at the 5-million-draw call mark. We then see a huge bump to the Ivy Bridge-E chip, and then we basically flatline from 12-threads all the way to 20-threads.

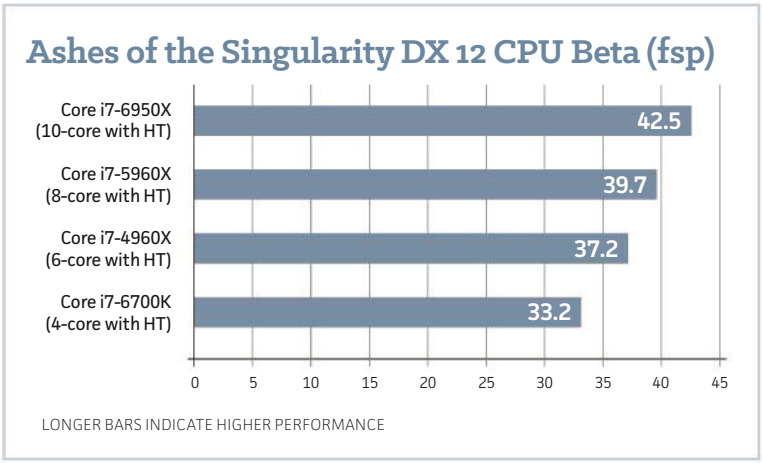
The upshot from the 3DMark DX12 feature test is you don't seem to really need more than a 6-core CPU with Hyper-Threading.

Ashes of the Singularity performance

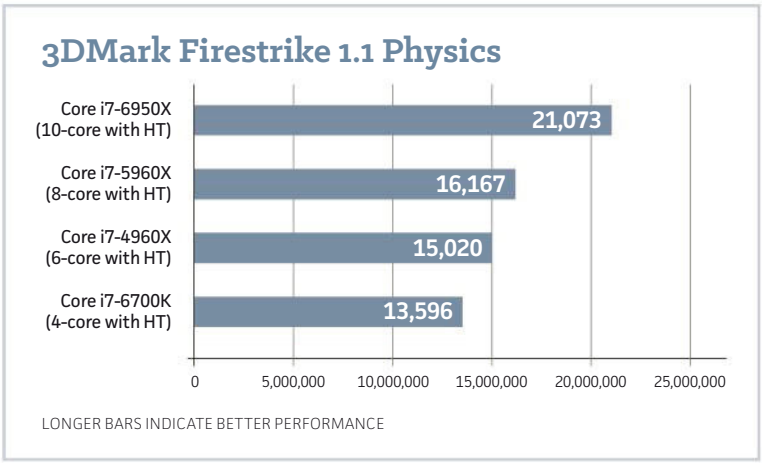
But what about a real game? To find out I broke out Oxide's Ashes of the Singularity, a new real-time strategy game that is the showcase title for DirectX 12 performance and draw call capability. Even better, Oxide provided us with a beta version of Ashes of the Singularity that adds a new mode specifically to test CPU performance, rather than GPU performance.

The scene adds a larger map and more complexity using the same engine to push CPUs harder. Oxide said it's still in the process of tuning the benchmark but was willing to let us run it ahead of time.

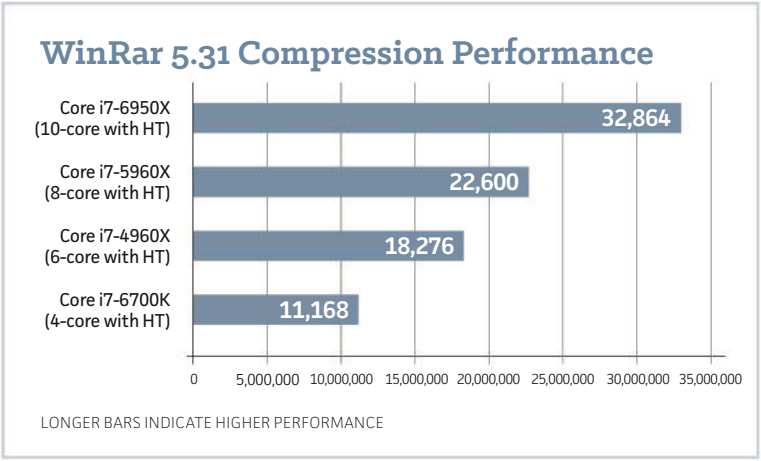
The result is certainly a little more promising for the new 10-core. In the return-on-investment category, however, at least at this point in Ashes, it has yet to justify a $1,723 outlay. We'll plan to revisit this test when it's finalized.



We got early access to a new CPU focused test in Ashes of the Singularity game to test multi-core performance under DirectX 12.



The physics test in 3DMark FireStrike gives the 10-core a very nice bump.



If you do lots of compression, you'll want lots of cores it looks like.

3DMark FireStrike Physics

We'll close gaming performance with a score from the physics portion of 3DMark FireStrike. It simulates up to 32 threads of game physics using the Bullet Open Source Physics Library that's also used in such popular games as Grand Theft Auto V and Red Dead Redemption.

Here we see a pretty hefty advantage for the 10-core chip. The surprise is the gap it opens between the 8-core Haswell-E chip.

While it's a victory for the Broadwell-E, I have to point out that this is a theoretical win, as few game developers are adding enough game physics to actually need 20 threads of computing. If they ever did though, that 10-core would be king.

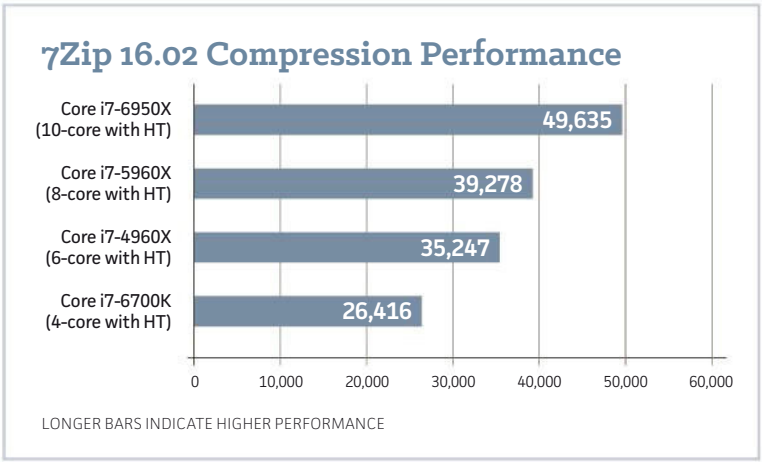
WinRar compression performance

To measure how fast the 10-core chip pushes compression, I used the built-in benchmark in RARLab's WinRar. WinRar loves lots of threads, and the 10-core Broadwell-E again opens up a can of whup-ass on all others.

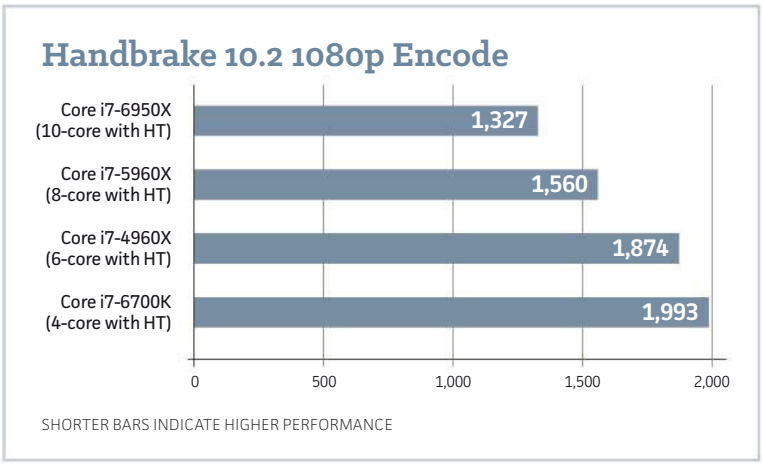
The results came as a surprise to me, but if your day job is compressing files in WinRar, a 10-core might be worth it.

7Zip compression performance

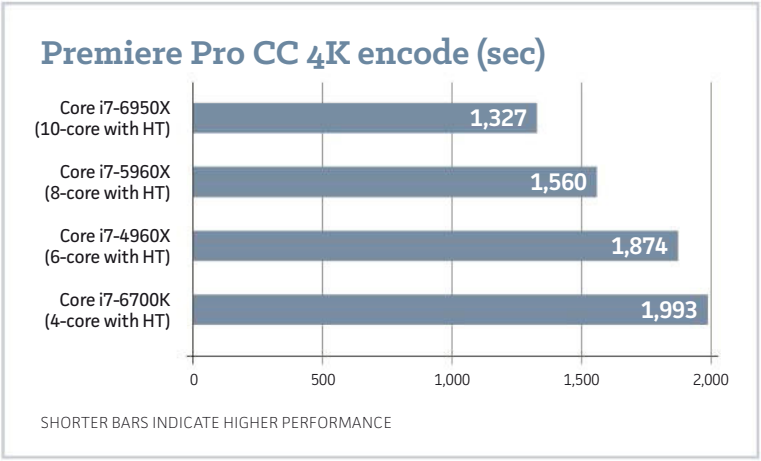
Interestingly, it's not just WinRar that loves multi-threading. I also fired up the free and superpopular 7Zip compression utility to see whether the WinRar results were fooling my eyes. 7Zip's benchmark lets you choose the workload based on the maximum amount of threads in the



7Zip loves dem cores too!



Handbrake 10.2 likes cores but our workload doesn't seem to stress it as much.



system. For each CPU, I matched the workload to the threads each chip has, so 20 for the Broadwell-E and 8 for the Core i7-6700K. The results, again, put the 10-core well ahead of all others. Nicely done, Broadwell-E.

Handbrake 10.2 performance

For our encoding test, we take a 30GB 1080p MKV file and transcode it using the free and superpopular Handbrake utility. Our target file format and size uses the Android tablet preset. The results here put the 10-core Broadwell-E in front, but I'm actually disappointed a tad. Sure, you shave off a serious chunk of time in an encode, but that Core i7-6700K is close behind.

Premiere Pro Creative Cloud performance

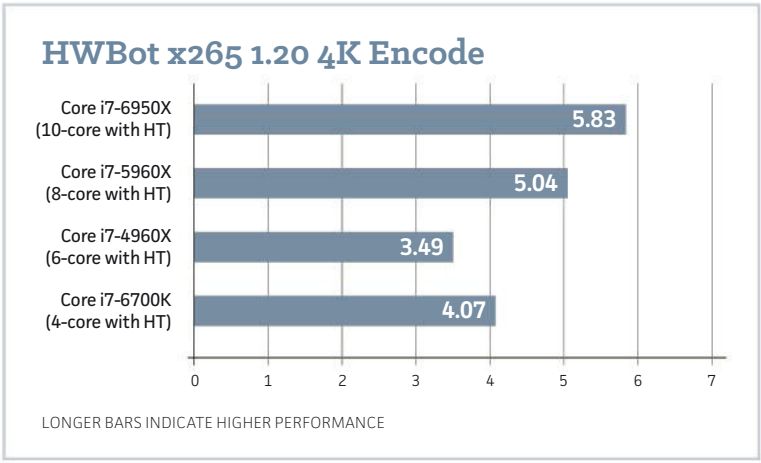
For a video test, I used Adobe's Premiere Pro Creative Cloud video editor. It's a hugely popular video editor with professionals and prosumers. Premiere Pro supports both GPU and CPU encoding, but to find out which CPU was the fastest, I opted for CPU encoding. The workload was a 4K project Intel provided. I tried using an actual working project created by our own video team, but I found the 1080p video from our Canon C100s didn't push our CPUs hard enough, with all four chips finishing our encode nearly at the same time.

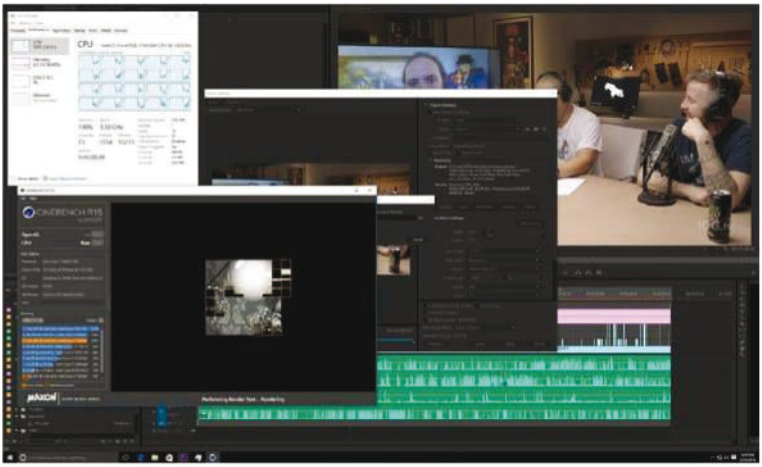
Intel's test files increase the resolution to Ultra HD 4K and are a bit more work. The result, though, isn't all that impressive. The Broadwell-E is the fastest, but that quad-core Skylake does pretty well considering its core count. Oddly, the 8-core Haswell-E underperformed too—I'm not sure why, but multiple runs all produced the same result. One theory is the Ivy Bridge-E chip can run up to 4GHz, while the stock Haswell-E clocks in around the low 3GHz range. Perhaps this workload favors the higher clock speeds of the Ivy Bridge-E chip and really doesn't need more than 12 threads to run. The overall win still goes to the Broadwell-E by a healthy amount, but I expected more.

HWBOT x265 performance

For my second encoding test, I decided to throw HWBot x265 at my test CPUs. It's a test created by Czech overclocker Havli and is built around an open-source x265 encoder. It's a punishing test. It loves CPU cores and supports numerous modern advanced instruction sets such as AVX2 and FMA3.

The 10-core wins this again quite handily. The interesting side note is even though the Ivy Bridge-E has two more cores than the Skylake chip, the newer instruction sets and efficiency of the 6th-gen chip





The 10-core Broadwell-E is great—if you happen to like to do multiple, multiple compute heavy tasks simultaneously.

appear to give it a nice edge.

How good is that result? Not bad. The world record (go.pcworld.com/recordoverclock) at overclocking enthusiast site HWBot.org is held by Slinky PC, who hit 12.59 fps using a 22-core Xeon E5 2696 V4 chip, apparently overclocked to 3GHz.

Megatasking performance

Even though the new 10-core Broadwell-E is a monstrous chip in many multi-threaded apps, you may be disappointed that it doesn't just wail on the quad-core Skylake chip by huge margins. It does, after all, have six more cores inside.

For one, it has a lower stock clock speed. Overclocking the Broadwell-E gets both within spitting distance; but on multi-threading, that Skylake chip will hang in there in most apps that just can't use all the cores on the 10-core Broadwell-E.

So what happens if you throw multiple tasks at it simultaneously? To find out I fired up Premiere Pro CC again and began rendering out a one-hour 1080p video. I then went ahead and ran Cinebench R15 on all four chips.

The result is probably more in line with the beat-down you would expect from a 10-core chip compared to that quad-core. While rendering

on the quad-core Skylake, the CPU was running at near 100 percent capacity. The 10-core Broadwell-E under the same load was cruising along at 55 percent. The quad-core Skylake chip, in fact, was so slow that I was able to run Cinebench R15 three times on the Ivy Bridge-E before the Skylake chip finished running it once. So take that, Skylake!

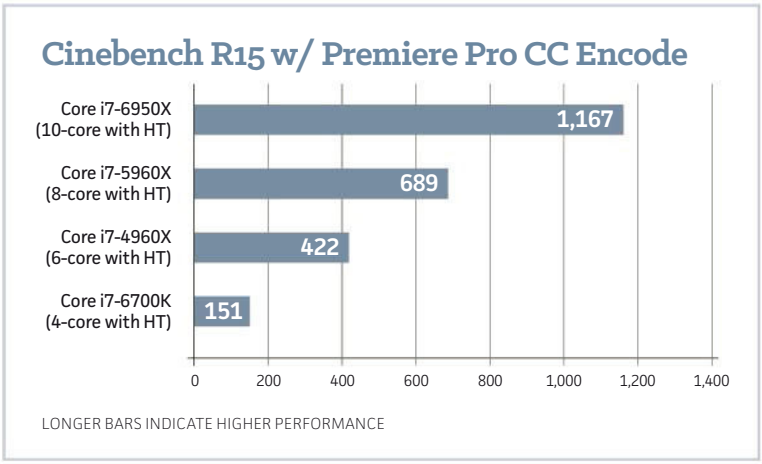
The upshot is you can run a 4K Premiere Pro CC encode while running another one or two content creation apps without seeing everything grind to a halt, like it would with a quad-core.

Is this realistic? For a content creation person or what Intel calls a "megatasker," yes. Most people start heavy compute tasks and take a walk around the block while it finishes. With the 10-core Broadwell-E you could keep working. If time is money, the 10-core chip is the natural choice.

How does it overclock?

I'm always a little hesitant to issue proclamations of how a new CPU overclocks based on a sample of one. Many times it's not about the overclocking capability of the chip, it's about the overclocking capability of the overclocker.

Intel itself, as usual, I won't say anything about what to expect. That's understandable, as overclocking is usually a crap shoot. I can at



It's hard to occupy all the threads available on a 10-core chip unless you megatask it.

least relate my own experiences.

First, I'd say it depends on the motherboard. The Asrock X99 Extreme 4 on which I ran most of my stock clock tests was a dismal fail. I couldn't push the chip much beyond stock and gave up after wasting an hour trying to get minimal overclocks out of the chip.

Very late in my review though, I received an Asus X99 Deluxe II board. A newer motherboard that supports Turbo Boost Max Technology 3.0.

With the Asus X99 Deluxe II board, I dialed up a 4GHz all-core, ratio-based overclock and booted into the OS. No muss, no fuss. That's without having to mess with voltage either.

That's really not bad, and I'll be the first to say I am not even remotely an extreme overclocker. I didn't do a formal stability test, but I was able to run numerous multi-threaded benchmarks without issue for several hours. I then overclocked the "best" core up to 4.5GHz and used Turbo Boost Max 3.0 Technology to bind particular applications to it.

Overall, I'm pretty happy my sample overclocked on the Asus X99 Deluxe II. Not so on the Asrock.

But what should you expect? It's still very early in the life of this chip. After speaking to various motherboard and system vendors, it sounds like you should expect at most 4.2GHz to 4.3GHz overclocks on all 10 cores. Beyond that, I'm told, it gets difficult to manage the heat and voltage. Its predecessor, Haswell-E, generally ran out of gas at 4.5GHz in practical use, so Broadwell-E seems to be within expectations.

You may recoil at the thought of loosing a little overall overclocking head room, but the greater efficiency of Broadwell cores over Haswell cores make up for it.

Conclusion

First, I'll sum up the performance aspects of the 10-core Broadwell-E by saying, damn, it's a freaking monster. In multi-threaded tasks it easily thrashes the 8-core Haswell-E. Combined with per-core overclocking and Turbo Boost Max 3.0, it can hang with the nimbler Core i-6700K

chip in lightly threaded and single-threaded tasks, too.

That's a win no matter how you cut it. Intel said it aimed to give you the best of both worlds for multi-threaded and lightly threaded, and it has achieved that.

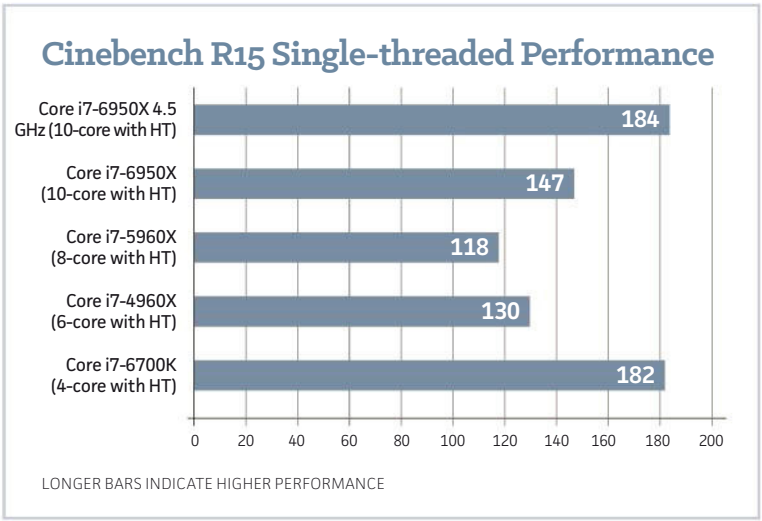
The elephant in the room is that $1,723 price tag.

Initial rumors last year indicated the 10-core chip would slot in at the same $1,000 price of the 8-core Haswell-E. A grand may seem excessive but if you got the 10-core version for the price Intel used to charge for an 8-core, it's like getting "free" stuff.

Intel actually did just that when it replaced the $1,000 6-core Core i7-4960X with the $1,000 8-core Core i7-5960X chip. Intel isn't giving away any freebies this time though.

At the price Intel wants, you could actually buy a 14-core Xeon. That Xeon, though, would probably be even more overkill and would not give you the single-threaded performance of the Core i7-6950X.

As it stands, the Core i7-6950X is easily Intel's most powerful consumer chip that it's ever made by a long shot. I just wish it were actually affordable.



Broadwell-E cores running at 4.5GHz pull even with Skylake cores running at 4.2GHz.

Intel NUC6i7KYK: This Skull Canyon NUC smashes all mini-PC preconceptions

BY ALAINA YEE

INTEL'S LATEST Next Unit of Computing (NUC) mini-PC shares just two traits with its dual-core, square-brick siblings: It follows the same unpronounceable naming structure, and it's an ultra-compact PC that can do real work.

Outside of that, the NUC6i7KYK (go.pcworld.com/nuc6i7kyk) forges a different path for itself. For starters, it looks nothing like the rest of Intel's signature line of tiny computers. This NUC is flat and long, comes shaded in black and gray, and has a huge skull emblazoned on

the lid. (Undoubtedly as a nod to the machine's code name, Skull Canyon.)

Its hardware also veers from the expected course. Stuffed inside is a beefy quad-core processor with top-of-the-line integrated graphics, meaning you can run content-creation tasks in more acceptable windows of time, and you can also play fairly recent AAA games at 1080p on this little machine. And yes, that's at reasonable frame rates.

The former king (go.pcworld.com/nuc5i7ryhrev) of the NUC mountain hasn't just been dethroned. It's been kicked so far off a cliff, someone needs to scrape its remains off the ground.

Price, specifications, and ports

Predictably, the kind of performance that Intel packs into this NUC doesn't come cheap. The list price for

The Skull Canyon NUC (front) with the Intel NUC5i7RYH (top rear), Gigabyte Brix GB-BXA8-5557 (middle rear), and Zotac Zbox CI321 Nano (bottom rear).

Intel Skull Canyon NUC6i7KYK Next Unit of Computing

AT A GLANCE

This completely revamped NUC raises the bar for what a mini-PC can do, handling both content-creation tasks and 1080p gaming with ease.

PROS

- Can perform content-creation tasks in a reasonable amount of time
- Iris Pro Graphics 580 makes it possible to play fairly recent games at 1080p
- Fairly quiet when idling, and tolerable under load
- Comes equipped with a large spread of high-end hardware

CONS

- Plastic-heavy design feels less sturdy than older NUCs

$650 (bare-bones system)

★★★★★

this bare-bones system is $650. Our review unit, which came equipped with a Samsung 950 Pro M.2 512GB NVMe SSD and 16GB of Crucial DDR4/2133MHz memory, totals just a little over $1,000 at current street pricing for hardware alone. Add in the cost of the Windows 10 license we used for testing, and we'd be over Intel's target of $1K total (go.pcworld.com/ $1ktarget) for the build. To hit that mark, you'll have to spend less on parts to afford Windows, or go Linux.

For that bare-bones $650, you get a 2.6GHz Core i7-6770HQ quad-core Skylake processor that can boost up to 3.5GHz, Iris Pro Graphics 580 sporting 128MB of eDRAM, and a whole bunch of cutting-edge hardware. Two M.2 slots support SATA 6Gbps and x4 PCIe Gen 3 (AHCI or NVMe) drives in either a 42mm or 80mm length, with the option to run two drives in RAID 0 or RAID 1. An Intel Wireless-AC 8260 card features 802.11ac 2x2 Wi-Fi, Bluetooth 4.2, and Wireless Display 6.0 support. Two SO-DIMM sockets can take up to 32GB of DDR4/2133MHz RAM, or even overclocked DDR4 RAM. Headers are accessible underneath the user-replaceable lid for NFC, two USB 2.0 ports, and two USB 3.0 ports. As with the Broadwell line of NUCs, you

can use plans provided by Intel (go.pcworld.com/intelnuckits) to design custom lids and make use of these connectors.

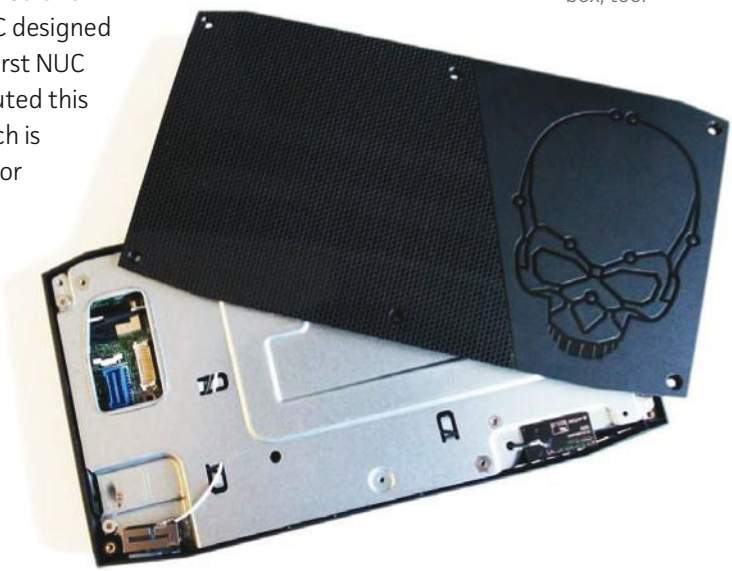
On the outside of the NUC6i7KYK's 8.31 x 4.57 x 1.1-inch (211 x 116 x 28 mm) chassis are a bevy of ports. (A note about that case: While the new form factor looks sleeker, its plastic shell makes it feel a lot less indestructible than its square-brick siblings.) You get three standard USB 3.0, one charging USB 3.0, a SDXC slot, gigabit ethernet, a 3.5mm headset jack, a combo rear speaker/TOSLINK jack, a Kensington lock slot, Mini DisplayPort 1.2, and HDMI 2.0 with HDCP 2.2 support (aka the ability to play copy-protected 4K content). An infrared receiver comes embedded in the front of the system.

A USB-C port supports Thunderbolt 3 and 10Gbps USB 3.1, as well as DisplayPort 1.2. Arguably, the Thunderbolt 3 support is a marquee feature of this Skull Canyon NUC—its implementation helps Intel bill the NUC6i7KYK as a gaming machine.

If you don't like the skull-embossed lid, a plain black lid comes with the system. You get a VESA mounting bracket and multi-country AC plugs in the box, too.

Let's discuss that marketing

Yes, Intel has positioned this machine as a mini-PC designed for gaming. It's the first NUC the company has touted this way, and the approach is two-pronged: superior integrated graphics on one side, and the dangled promise of using an external video card over Thunderbolt 3 on the other.



Selling a general premise of gaming is a curious gambit. PC

gamers with full-tower rigs would never dream of abandoning ship for a system whose size greatly constrains (and inflates the price of) performance. Even people playing on much humbler hardware would be giving up a lot.

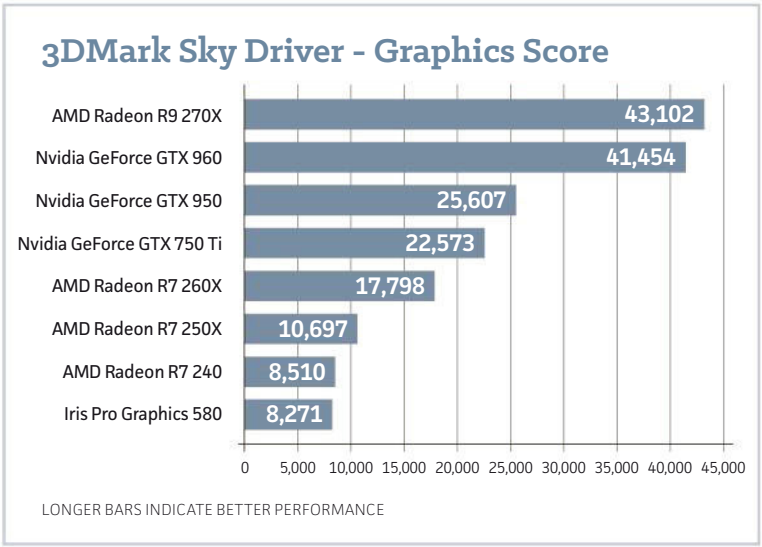
If you take a quick look at 3DMark's publicly available scores for its Sky Diver test, which simulates 1080p gaming on Medium settings, you can get a rough idea of the gap that still exists between the best integrated graphics and the budget end of current discrete graphics cards. While CPU performance can affect game performance, zeroing in on Sky Diver's Graphics score (instead of its Overall score) should minimize that influence.

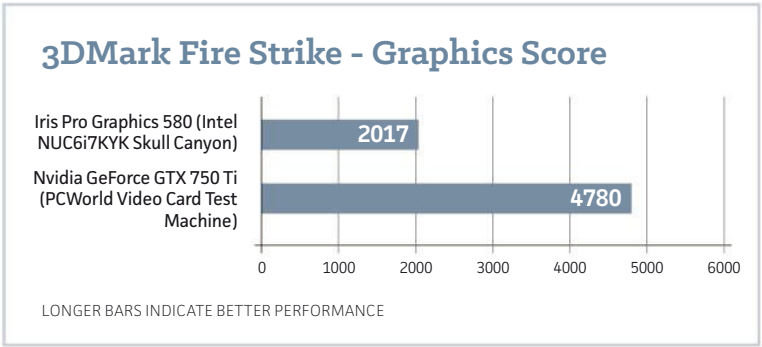
Because 3DMark's compilation of scores aren't performed on the same machine, and some cards are overclocked to varying degrees, I also ran 3DMark Fire Strike (which simulates 1080p gaming on Ultra settings) on the Skull Canyon NUC and the Nvidia GTX 750 Ti to grab a little bit of data under more controlled circumstances. As you can see, there's a long way to go before integrated graphics can handle Ultra settings. Even the 750 Ti itself can't make it, but it gets a heck of a lot closer.

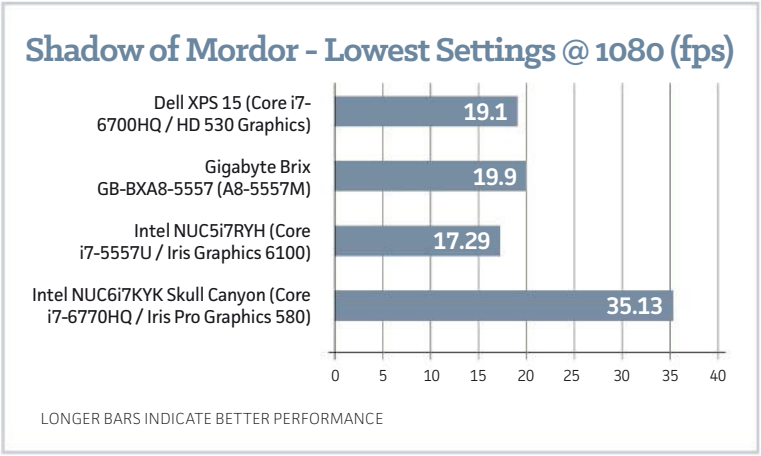
Briefly put, if someone needs or wants a system with a dedicated

graphics card (be it an Nvidia GTX 750 Ti or an AMD Radeon Fury X), the Skull Canyon NUC isn't worth consideration. Those gamers aren't the right group for this mini-PC, and it's odd that Intel didn't narrow the focus of its marketing campaign to avoid their questions and confusion (go.pcworld.com/skullcanyonqs).

Intel will argue that you can get better performance by buying a Thunderbolt 3 cabinet, installing a discrete graphics card, and then







plugging that complete unit into your Skull Canyon NUC. That would provide a way to play the latest releases at 1080p/60fps on Ultra settings. The problem is that Thunderbolt 3 cabinets haven't really filtered out into the wild yet. The Razer Core (go.pcworld.com/razer core) was slated to launch in April, but as of this writing, it's yet to appear.

So while I'm eager to see how this NUC would perform with an external video card, that'll unfortunately have to wait.

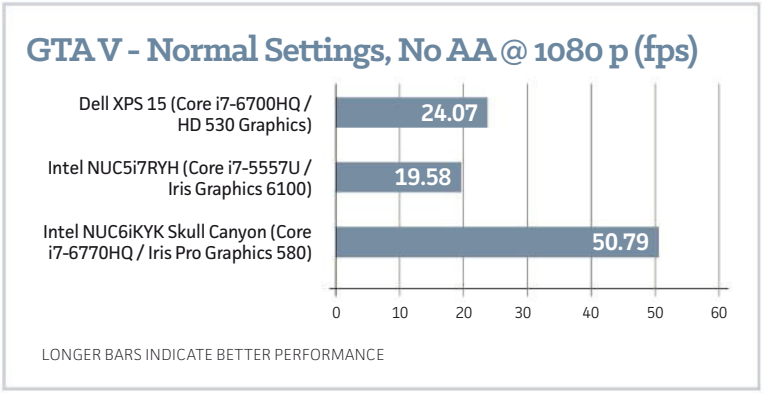
Gaming performance

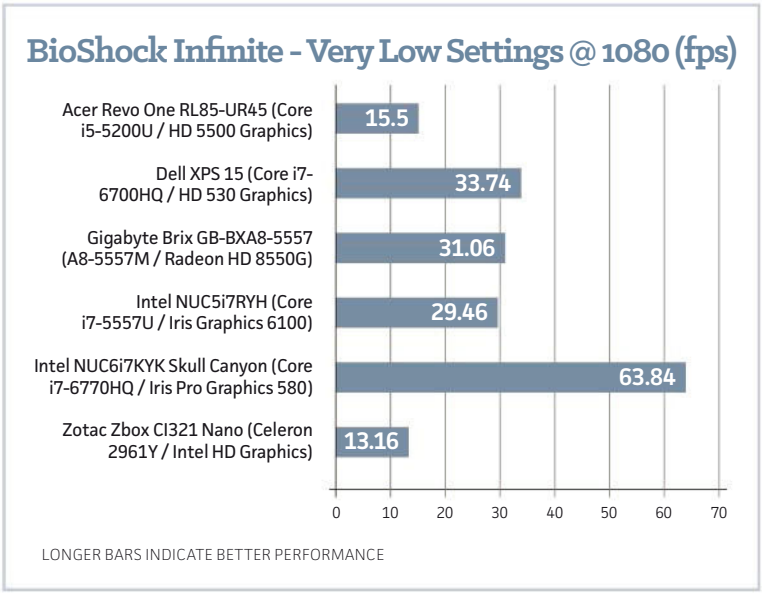
For the moment, what makes more sense is the NUC6i7KYK as a gaming machine for people who don't care about a big blockbuster's frame rates or looks. Instead, they want a portable workstation or a very high-end, compact HTPC that can still run a fairly recent AAA game at 1080p.

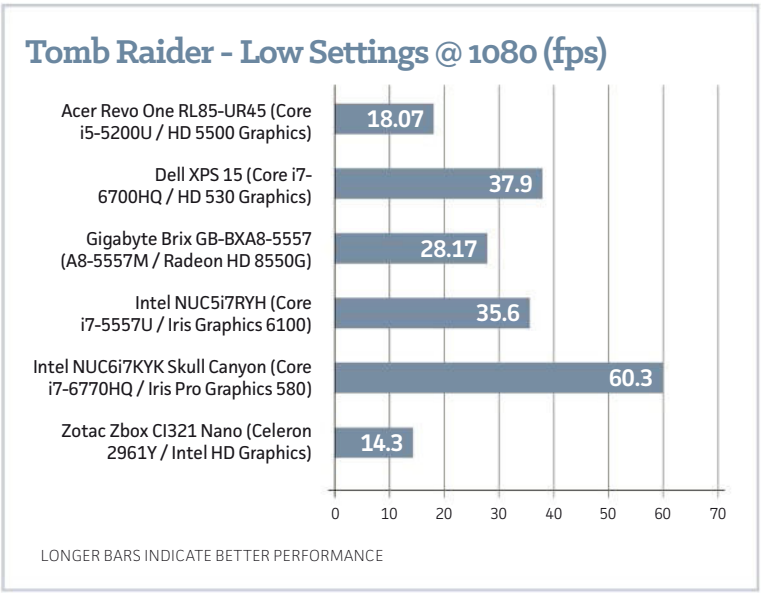
In this context, *run* means "frame rates above 30fps," which is playable if not all that fast. It also means dropping graphics settings down a lot, or even to rock bottom. Believe it or not, some people actually wouldn't mind these limitations, given that Steam's most recent survey (April 2016) shows quite a few users are rocking integrated graphics. In exchange, they'd get frame rates like 35.13fps

in *Middle-earth: Shadow of Mordor* or 50.79fps in *Grand Theft Auto 5*.

Honestly, these numbers are pretty exciting, given what integrated graphics achieved on the Broadwell NUCs. Even non-Iris graphics on the Core i7-6700HQ aren't all that spectacular. In three-year-old games like BioShock Infinite and Tomb Raider, the older mini-PCs put







up a valiant but futile struggle to show playable frame rates, and the i7-6700HQ's Intel HD 530 still gets trounced by the Iris Pro 580 in the Skull Canyon's i7-6770HQ.

(Note: The numbers for these older mini-PCs were obtained while running Windows 8.1, but we haven't seen enough of a difference between that operating system and Windows 10 to believe that the Skull Canyon's domination is affected by running the newer OS.)

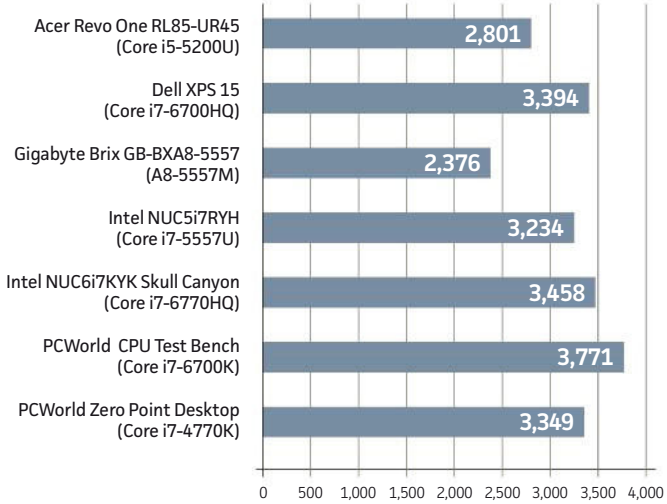
Because the older mini-PCs couldn't take much more stress, these charts show frame rates for each game's lowest settings. You can play with prettier graphical settings on the NUC6i7KYK, though. At 1080p, *BioShock Infinite* hit 38.39fps on Medium and 32.75fps on High, and *Tomb Raider* reached 61.2fps on Normal and 40.8 on High.

When you look at those numbers, it's pretty impressive to see just how far integrated graphics have come.

General Performance

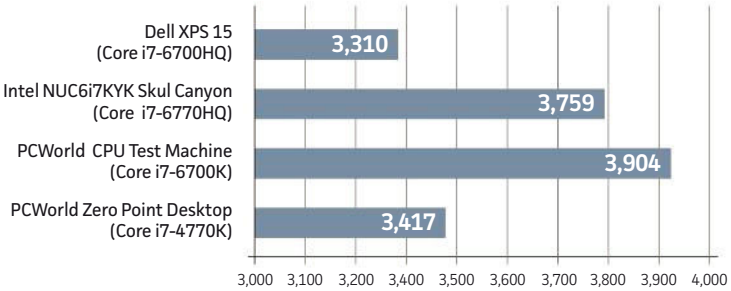
Make no mistake—this mini-PC is also powerful for non-gaming purposes.

PCMark 8 Work Conventional

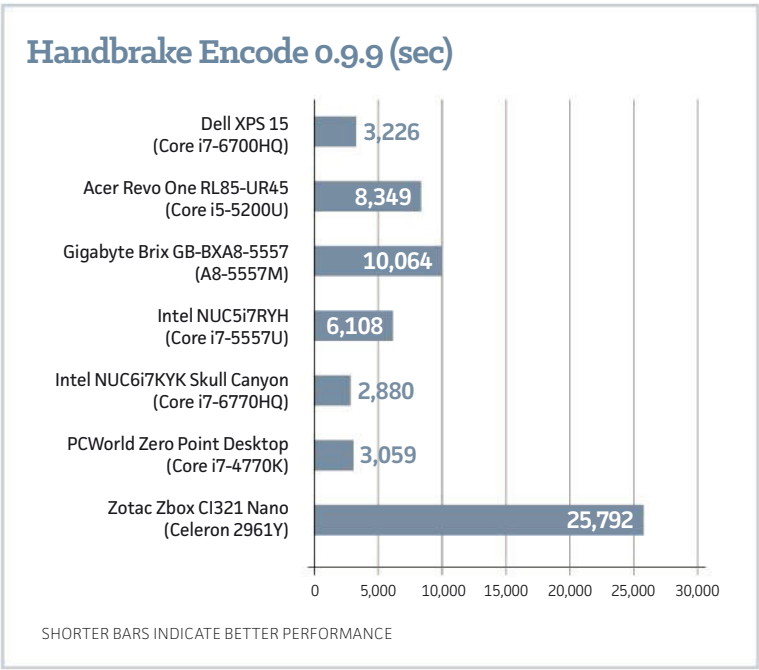


LONGER BARS INDICATE BETTER PERFORMANCE

PCMark 8 Creative Conventional



LONGER BARS INDICATE BETTER PERFORMANCE



As with gaming performance, plenty of people will misunderstand the point of buying a system this small, and say that for the same budget, you could build a full desktop or buy a laptop that includes a display, keyboard, and trackpad. However, you can't put a laptop or a full desktop into the front pouch of your backpack, and they won't weigh 1 pound, 5.8 ounces.

So let's talk instead about how fast this machine is for something so compact. In our PCMark 8 benchmarks, the NUC6i7KYK moved along briskly during the Work Conventional test, which simulates office tasks like spreadsheet entry, word processing, and video chatting. It netted a score of 3,458.

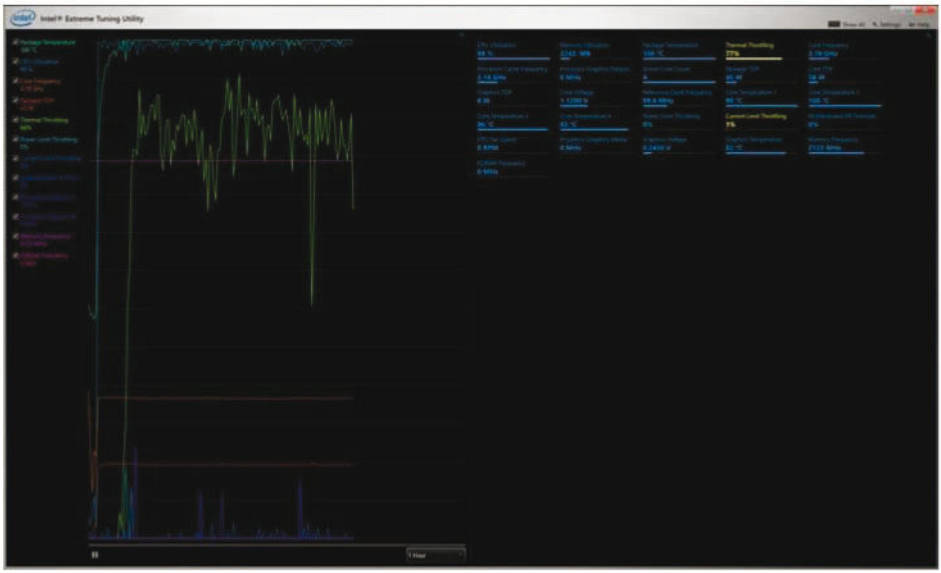
These kind of activities aren't very challenging—even systems with less powerful CPUs can manage decent performance. More interesting was the NUC6i7KYK's score of 3,759 in the Creative Conventional test,

which includes more intensive tasks like video editing.

As its PCMark 8 Creative Conventional score suggests, this tiny computer can realistically be used for content creation. The results of our Handbrake video encoding test, which involves converting a 30GB video file (MKV) into a smaller MP4 file using the Android Tablet preset, show this more clearly. The Broadwell NUC was one of the fastest mini-PCs with an encode time of 1 hour and 41 minutes—and the Skull Canyon NUC screams past it with a time of 48 minutes. That's slightly faster than the socketed Haswell part in our PCWorld Zero Point desktop system.

Granted, Haswell was two generations ago, but look again at the size of the Skull Canyon NUC. Intel's engineers cooked up some voodoo magic to coax this kind of performance out of a machine the size of a VHS tape, especially when you look at the temperature the NUC6i7KYK hits under full load.

So if you happen to notice your NUC6i7KYK's processor sailing along at the boiling point for water, it should be fine.

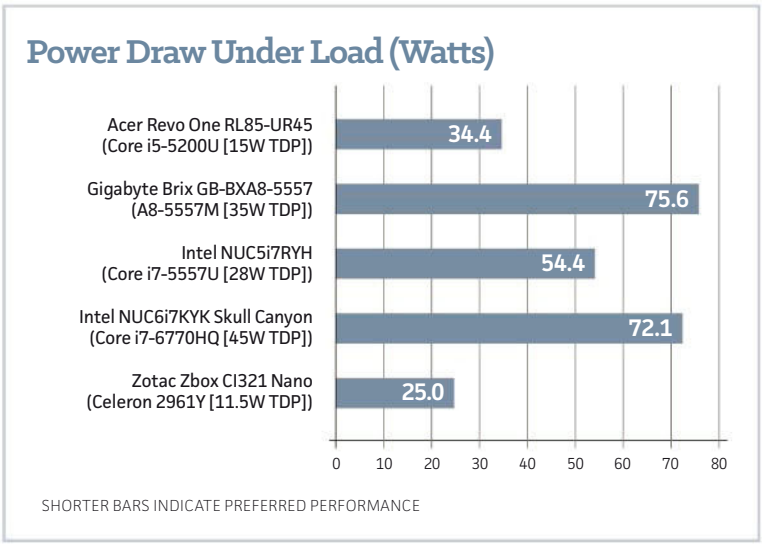


I typically don't see processors sustain 100°C for extended periods of time, much less for nearly the full 48 minutes of our Handbrake encode test. As shown in the screenshot, some thermal throttling does occur, but the stock clock speeds barely drop—maybe by about 0.1 to 0.2GHz.

When asked, Intel indicated this isn't abnormal behavior for the Skull Canyon NUC, and this temperature level isn't a cause for concern. So if you happen to notice your NUC6i7KYK's processor sailing along at the boiling point for water, it should be fine.

About the only downsides to the NUC6i7KYK are its power consumption and how loud it is, and they're not even that bad. Compared to the similar complaints I had about the Broadwell Core i7 NUC, the peak power draw of 72.1W under load seems more reasonable, especially given how much performance this Skull Canyon NUC delivers. And the fans are quieter than the Broadwell NUC's—they're on a par with a slightly noisier laptop.

If this Skull Canyon NUC is any indication of where Intel wants to push the form factor, mini-PC enthusiasts may have a golden future ahead.

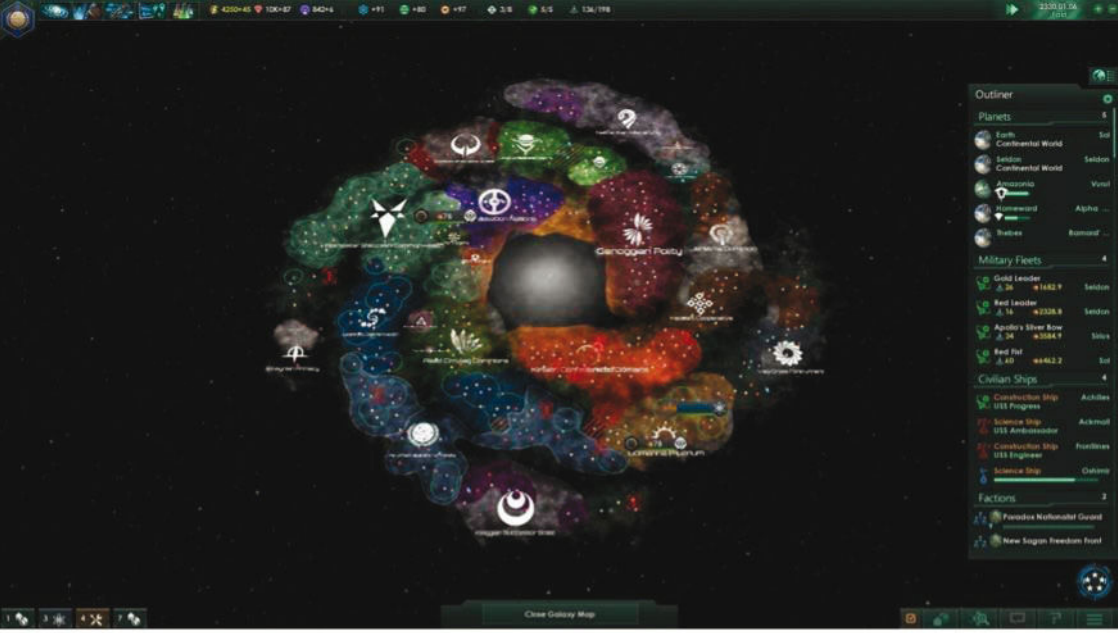


Final thoughts

If this Skull Canyon NUC is any indication of where Intel wants to push the form factor, mini-PC enthusiasts may have a golden future ahead. Even though I'd personally hesitate to categorize this system as a gaming machine, its performance is excellent across the board. The idea that the next Core i7 NUC could do even better is exciting.

That said, Intel told us there's no set plan to produce a direct successor to the NUC6i7KYK—rather, that will depend on how well it sells. There are potential challengers to this tiny system: Gigabyte could update its NUC-like Brix Pro line with Skylake models, or mini-STX (another of Intel's pet projects) could actually take off. Both the Brix Pro line and mini-STX use 65W processors, which would provide a little more compute power.

Either of those options would be a trade-off rather than an upgrade in performance, though. Neither can match the Iris Pro Graphics in this Skull Canyon NUC. On top of that, the Brix Pro line is infamous for its shrieking fans, while the slow start for mini-STX suggests it could go the way of thin mini-ITX. This Skylake Core i7 NUC, on the other hand, requires very little compromise. Paying top dollar should always result in having a fantastic computer, and that's exactly the situation here.



Stellaris: Etch your stories across the stars in Paradox's latest grand strategy game

BY HAYDEN DINGMAN

IN THE YEAR 2206, humanity left Earth. At least, some humans did. A selection of our civilization's best and brightest piled into a great big colony ship bound for the stars—for the brightest star system in Earth's sky, Sirius. A mere 8.6 light years from Earth, it was essentially like visiting an estranged neighbor.

And yet it was a momentous occasion for the self-styled United Federation of Planets, now a burgeoning empire of two worlds. Later, humanity spanning the galaxy, it would be easy to write this first step off as predestined, but the work entailed countless generations.

Or so I like to think.

The frontier was everywhere

Stellaris (stellarisgame.com) is the latest from the grand strategy veterans at Paradox. And it's very similar to the studio's previous games—a text-and-number heavy simulation of imperial governance, built on pausable real-time progression and a lot of warfare and diplomacy. But ditching the stodgy confines of history, *Stellaris* is the first to take concepts explored in *Crusader Kings* and *Europa Universalis* and *Hearts of Iron* and apply them to something more fantastical—space, the final frontier, the infinite black.

The appeal is evident. It's *Star Trek* and *Battlestar Galactica* and *Firefly* and *Farscape* and *Babylon 5* and *Foundation* and *War of the Worlds* and *Ringworld* and *Hyperion* and *2001: A Space Odyssey* and *Dune* and *The Forever War* and *A Fire Upon the Deep* and *Red Dwarf* and *Solaris* and *Sunshine* and *Planet of the Apes* and every other damned sci-fi classic you can think of, all brought together into one massive universe.

Because that's the secret: Though to any newcomer the grand strategy genre looks like a wall of information and spreadsheets, armies so many numbers on a map and the constant tick-tick-tick of resource counters, it is in fact a tool for stories. Big, sweeping epics! Tiny interpersonal dramas! The rise and fall of empires! The death of a beloved leader! These are the hooks in any grand strategy game.

So goes *Stellaris*. It's a loosely defined sandbox, up-front complexity hiding its emergent-narrative ambitions. Grand strategy doesn't so much care whether you win or lose. It's about whether you tried, and what happened when you did try.

Maybe you meet a race of benevolent birds, eager to share their research with the galaxy's newest interstellar travelers. Maybe you come across the gasping remnants of a dying empire, still

Stellaris

AT A GLANCE

Freed from the chains of history, Paradox takes grand strategy to the stars and creates a solid foundation that's begging to be expanded upon.

PROS

- Translates Paradox's grand strategy to a more free-form environ
- Easy for newcomers to get started

CONS

- A bit thin and inflexible at points for grand strategy veterans
- Mid-game slows down

$40

★★★★½

overwhelmingly powerful even in their death rattle and clinging to the few star systems they possess. Maybe robot workers revolt, tipping over the balance of a delicate singularity and ushering in a new era of machine-led imperialism.

Or maybe—just maybe—humanity spreads across the stars, finally putting aside its troubled past and forging out in common interest, arms wide to the universe and all its inhabitants on a mission of peace and insatiable curiosity.

We can dream.

The "Not Knowing" is key to *Stellaris*. I've spent plenty of time (perhaps too much time) with *Crusader Kings* and *Europa Universalis* and other Paradox titles, but there's always been a sense of inevitability, of history weighing on your actions. Sure you can send your explorers westward in *Europa Universalis* to discover the Americas, but *you already know America is there*.

Unbound from reality, *Stellaris* is free to imagine and explore. Every pop-up box of text reinforces that this is truly the frontier, insofar as any star system you enter could contain a second faction, a pod of space whales, a set of faction-less wildlife sanctuaries for endangered alien life, a civilization taking its first small steps into space or…

nothing at all. Sometimes—most times—there's emptiness.

Evoking Carl Sagan:

> "There are 400 billion stars in the Milky Way Galaxy. Of this immense multitude, could it be that our humdrum Sun is the only one with an inhabited planet? Maybe. Maybe the origin of life or intelligence is exceedingly improbable. Or maybe civilizations arise all the time, but wipe themselves out as soon as they are able. Or, here and there, peppered across space, orbiting other suns, maybe there are worlds something like our own on which other beings gaze up and wonder as we do about who else lives in the dark…Life looks for life."

Of course, in *Stellaris* we know there are others out there. But there's still a sense of mystery, an urge to explore that simply isn't present in other Paradox titles. Remember: Grand strategy is about stories.

It's worth noting *Stellaris* is also much better at presenting those stories (whether playing as humans or some alien civilization) than past games. This is the easiest grand strategy game for anyone new to the genre—primarily because you start small. With *Europa Universalis*

or *Crusader Kings*, it's like starting a book by reading the middle chapters. You're thrown in with no idea what's happening. "Here, you now rule this massive empire." In *Stellaris*, you start with a single planet and build up, both physically and conceptually.

And you only ever control so many planets at a time—at least, directly. Once you've conquered more than five planets you're urged to dump the rest into sectors, governed semi-autonomously by leaders you appoint. This allows you to expand without micromanaging every system in the galaxy, min-maxing their production and keeping an eye on their needs.

But *Stellaris* also feels a bit thin, I think. It nails the early period, the sense of exploration and the rush of colonization. It also does a fairly decent job with revamping the later parts of the game, as slow-boiling stories come to a head and the galaxy is cast into crisis.

The middle is a bit too much "run-the-game-at-full-speed-for-a-while," though. As always, I expect Paradox to flesh out *Stellaris* over the course of years with various expansions—a model familiar to the studio's fans, by now. And it's not like the game is too small per se—*Stellaris* is big enough to sustain you for dozens of hours as is, and the mod community

will undoubtedly do even more to prolong the base game.

Still, there are some notable areas in which *Stellaris* lacks Paradox's usual depth.

Diplomacy is extremely threadbare at the moment, especially for a game that seems set on making peaceful play as interesting as warfare. I'd like to see more nuanced options on immigration, on trade, on alliances—and I'd like to see more truly weird civilizations—the game all-too-often opts for generic, neutral factions.

I'd like to see broader Federation tools since something that should be a crowning achievement does little at the moment, and isn't even reflected on the map in any meaningful way. Nor does it open up any further diplomatic options, like (for instance) sending a representative of another ally to negotiate with factions. Or. . .well, anything really. Federations are merely fancy alliances with some ship-sharing benefits.

I've also found leaders to be lackluster. Prime Ministers, for instance, are elected with some sort of mandate—but in my case that mandate was "Build four research stations" nine times out of ten. Success is meagerly rewarded and there's no penalty for failure.

Mostly I'd like to see more mid-game surprises and anomalies. Starting a new campaign, seeing all those unnamed specks of light swirling through space, wondering what could possibly be waiting—that's the best part, right now. The "My god, it's full of stars" moment.

Stellaris just can't get around the fact that the unknown is often more interesting than the known, and it's compounded by the fact that interesting events peter out in the mid-game. Once you've put names to places, once the vast vacuum of the galaxy is filled with artificial borders and the game's run dry on surprises, it's a bit tempting to just wipe the slate and start over. See what a new galaxy brings.

Again, borrowing from Sagan: "The open road still softly calls." Thus goes humanity, always in search of a new frontier.

Bottom line

Stellaris is great. Maybe not *Crusader Kings II* great yet—give it a few expansions to fill out—but it's a compelling bit of player-directed science fiction. Freed from the chains of history Paradox has created something creative and bold and inspiring, something that illuminates just how vast and unknowable space is and how tiny our place in it.

Still there's something reassuring, watching the decades and centuries tick by and the tendrils of civilization creep across the galaxy, thinking "That could be us someday." Maybe.

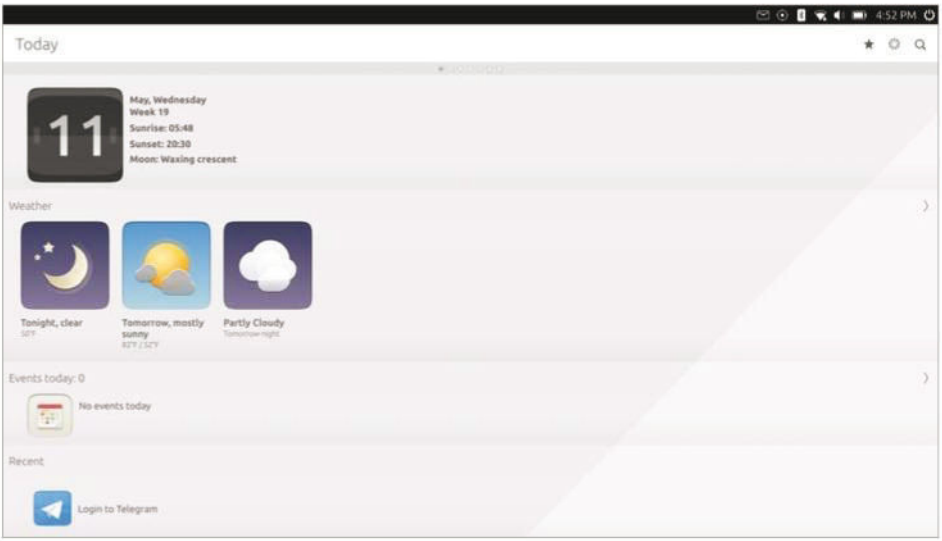
BQ Aquaris M10: The first Ubuntu tablet is here, but it's not quite finished

BY CHRIS HOFFMAN

THE BQ AQUARIS M10 is the first tablet running Ubuntu. It's also the first device in which Ubuntu delivers (go.pcworld.com/ubuntutablet) on the vision of convergence that started with the Ubuntu Edge campaign. Ubuntu fans will be thrilled to finally get their hands on this unique device, but Ubuntu's developers clearly have much more work to do.

Let's talk about the hardware

The BQ Aquaris M10 (ubuntu.com/tablet/devices) includes a 10.1-



inch touchscreen display. Under the hood, it packs an ARM CPU made by MediaTek, 16GB of storage, and 2GB of RAM. In addition to Wi-Fi, the device includes a headphone jack and SD card slot. There's a micro-HDMI port for HDMI out and a micro-USB port with OTG support, so you can connect the tablet to full-size USB devices, like keyboards, mice, and flash drives. Bluetooth is also available for wireless peripherals. You can buy the Aquaris M10 (store.bq.com/gl/ubuntu-edition) with a full HD screen for €279.90 (about $320) or get a lower-resolution model for €229.90 (about $262).

Like many modern tablets, it's a solid-but-lightweight piece of glass and plastic. But what's really interesting here isn't the hardware, it's the software. As the first Ubuntu tablet, officially supported by Ubuntu's developers, it's a one-of-a-kind device.

Unity 8's Scopes are designed to provide easy access to information without requiring apps.

Laying the groundwork for Ubuntu's future

The inaugural Ubuntu tablet doesn't run the mature Ubuntu desktop that Ubuntu fans are used to. This is Ubuntu Touch, as seen on Ubuntu phones (go.pcworld.com/ubuntuphone). The OS runs the Unity 8

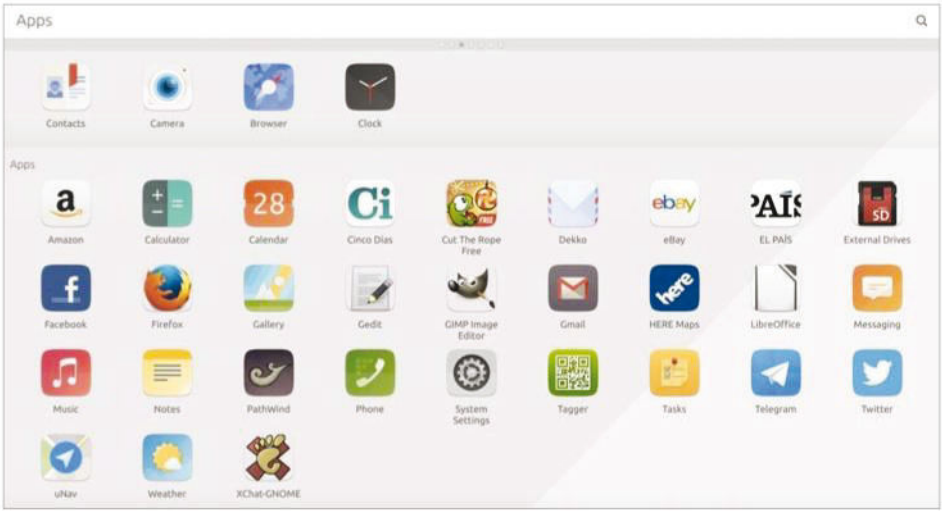
desktop with Ubuntu's Mir display server, and truth be told, this software isn't ready for prime time yet. That's why it isn't easily available in the recently released Ubuntu 16.04 LTS and won't be the default desktop (go.pcworld.com/unity8delay) in the forthcoming Ubuntu 16.10 release. Put simply: It isn't stable yet.

The experience here can be rough at times. The animations aren't always smooth and there are noticeable hitches, especially when running multiple apps at once in desktop mode. I experienced several freezes, requiring a hard reset to recover. The tablet also inexplicably failed to find my Bluetooth mouse even though a nearby laptop could see it. I ended up connecting a mouse with a USB OTG cable. At one point, the Wi-Fi wouldn't connect until I rebooted.

But this is the state of Ubuntu, shipping today, on actual hardware. It feels like the development platform Ubuntu developers will be building on.

Not built for Linux geeks

It's worth emphasizing that this won't necessarily appeal to Linux fans who want the Linux desktop and all that traditional software on a



Some apps, like Gmail, are just glorified Web apps.

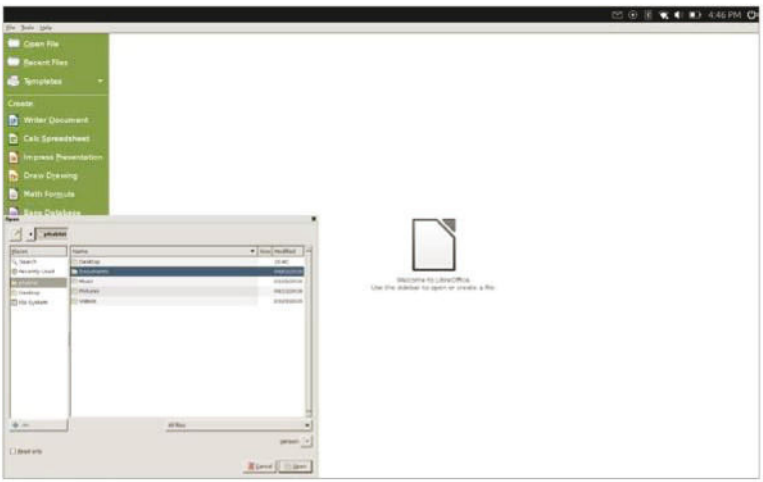
convertible tablet. Most of the apps included here are the same "converged" apps that appear on Ubuntu phones. Yes, the apps can scale up to fill larger interfaces, but it's a markedly different experience than Ubuntu on the desktop.

The device doesn't even ship with a file manager, much less a terminal. The included apps are very cloud-centric, and prefer that your data be stored on remote servers where they can interact with it. The Aquaris M10 is targeted at a general audience, but isn't yet ready for that audience.

You can go out of your way to install a terminal app, but the root filesystem is mounted read-only. This means no installing packages with apt-get. Setting up a full development environment will be difficult, which is ironic—soon you'll be able to set up a development environment on a Windows 10 tablet with Ubuntu's bash shell (go.pcworld.com/ubuntushell) more easily than you can on Ubuntu's device.

Traditional Linux desktop apps are hamstrung

While much about the platform is new, the OS includes several powerful, traditional Linux desktop applications: the Firefox browser,



Apps like LibreOffice don't even look like they fit in.

Connect a keyboard and mouse and you'll get a windowed desktop interface.

LibreOffice office suite, GIMP image editor, gEdit text editor, and XChat-GNOME IRC client. These old X11 apps run on the Mir display server through a technology called XMir.

But these applications aren't really optimized for the tablet. The first time I launched LibreOffice, for instance, the interface froze and I had to hard-reboot the tablet, after which LibreOffice opened fine. However, I discovered there's no way to open an on-screen keyboard with these desktop apps, so you can't use LibreOffice or, say, Firefox in tablet mode.

That's right: You have to connect a physical keyboard to type in these applications. Windows 10 offers a taskbar button you can tap to make an on-screen keyboard appear for older desktop applications, but Ubuntu offers nothing of the sort.

The good news is that Ubuntu's developers are working on fixing this (go.pcworld.com/onscreenkeyboard). As a platform, it's great that Ubuntu is always being refined. But, as a product that BQ and Canonical want to charge you money for, the Aquaris M10's software needs more time to bake.

Other little issues with the software also need fixing. There's no way to hide the on-screen keyboard if it's open, so you can't minimize it to see more of the screen—it will always appear if you focus on a text

field. On the lock screen, the password or PIN field isn't selected by default. Whenever you turn on the screen, you first have to tap the small password or PIN field before you can start typing your code. This gets old fast. These may seem like nitpicks, but it's all part of a general lack of polish throughout the interface.

Convergence is here, but so is Windows 10

This is the first device where Ubuntu really delivers on its vision of convergence. In fact, BQ's official product website (bq.com/uk/aquaris-m10-ubuntu-edition) proudly proclaims this device "the world's first convergent tablet" because it combines two different interfaces that allow you to use it as a tablet or a PC.

All the same apps that normally display in full-screen mode appear in windows, with full keyboard and mouse support.

But a lot has happened since Ubuntu started its convergence quest. Ubuntu lost the race (go.pcworld.com/ubuntuphone late). Windows 10 is already here, and it offers a converged experience on mobile devices. Unlike Windows 8, Windows 10's new Universal Windows Platform (UWP) apps can run full-screen in tablet mode and in windowed mode on the desktop. You can walk into any electronics store and purchase a Windows tablet with an Intel chip that can run all the old Windows desktop software, and you can easily spend less than a BQ Aquaris M10 will cost. Windows 10 is more polished, too.

Still, Ubuntu's convergence is certainly here. Connect a keyboard and mouse and you'll get a Ubuntu desktop environment. It looks a lot like the Unity 7 desktop environment Ubuntu users know, but it's still Unity 8. All the same apps that normally display in full-screen mode appear in windows, with full keyboard and mouse support. Apps like LibreOffice are actually usable once a physical keyboard is present.

On Windows 10, you can install practically any program, including many of the same open-source programs that run on Linux. A few desktop programs—like LibreOffice and Firefox—are present by

default, but it's not yet possible to install just any old Linux desktop app. This should be made possible by Ubuntu's Libertine (wiki.ubuntu.com/Touch/Libertine) project, but it's still a developer preview.

This particular tablet's use of an ARM chip means there's no hope of its ever running the library of Linux games on Steam, Minecraft, Skype, or any other closed-source app that needs an Intel chip, even if it could run in the new interface.

That's a lot of negativity, but those are the facts. Windows 10 beat Ubuntu to the convergence game and currently offers a more polished experience.

Who should buy this?

The BQ Aquaris M10 is in an awkward place. It's still too rough-hewn for the general consumer market, but it's also not a good fit for Linux geeks who want to run the whole universe of Linux desktop applications and set up development environments with powerful command-line tools.

If you're a Ubuntu fan who wants to see where things are going, someone who wants to report bugs and help contribute, or especially someone who wants to write apps and Scopes for Ubuntu's new interface—then yes, this could be a worthy purchase. It's a development platform that lets you stay up to date with how Ubuntu Touch is progressing and use the OS on actual supported hardware. But go in knowing exactly what you're getting: a development platform that remains a work in progress.

In the long term, it's great that Ubuntu and the free software community can offer a compelling alternative to Windows 10 for use on tablets and convertible devices. That mission certainly deserves support.

FEATURE

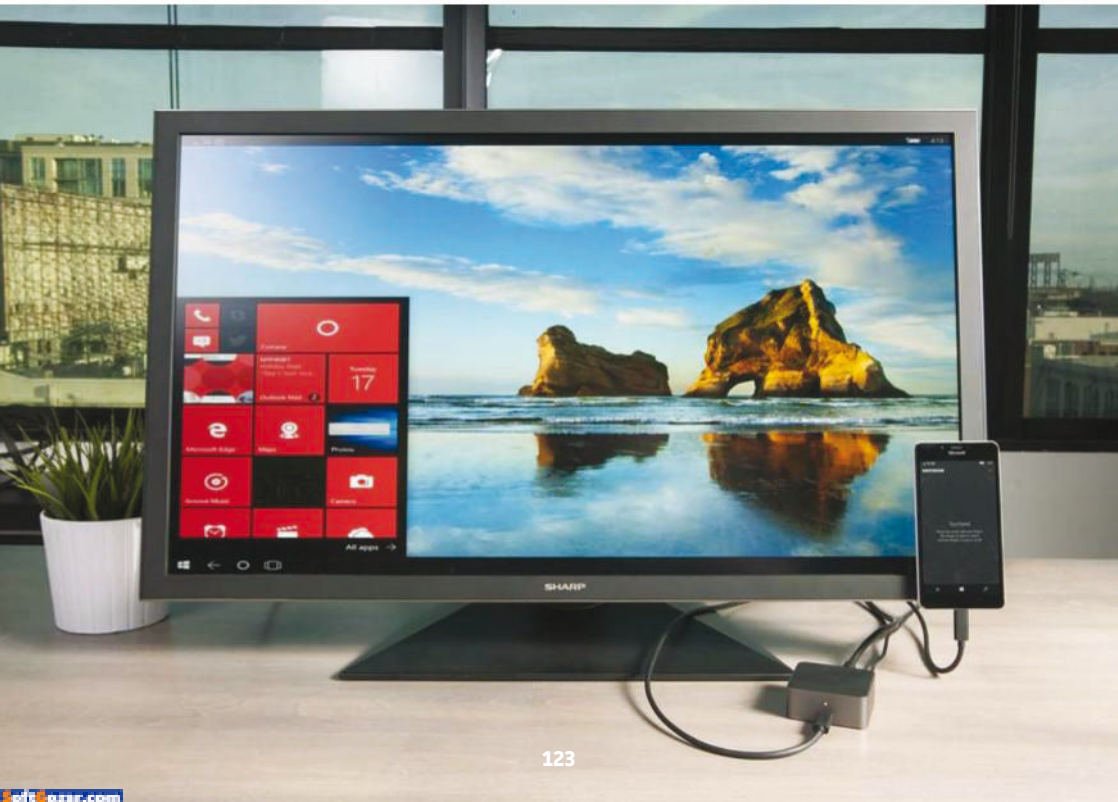
WINDOWS CONTINUUM:

What happened when I used a Windows 10 phone as my PC.

BY IAN PAUL

ILLUSTRATION BY PETER O'TOOLE

I'm sitting at my desk on a Monday afternoon, ready to smash something. I've spent the past four hours trying to finish a task that usually takes less than half that time. But this isn't a typical day. It's the first day in a week where I vowed to work exclusively in Windows 10 Mobile's desktop Continuum mode (go.pcworld.com/w10continuummode) via my Lumia 950 (go.pcworld.com/lumia950rev) instead of on my proper PC. Goodbye AAA games, traditional desktop applications, and easy multitasking. Hello, mobile software and a struggling app ecosystem. Why did I sign up for this again?



Windows 10 Mobile's Continuum interface and Start screen when connected to an external display.

Because Continuum offers an interesting premise: Instead of toting around a laptop, just plug a phone into an external mouse, keyboard, and monitor to switch to a desktop-like experience.

Imagine being able to leave the laptop at home, and just grab your phone and a few cords. Then, when you're out and about, scrounge up your peripherals and boom! Instant desktop replacement.

I'm not the only one thinking this way. HP hopes its upcoming Elite x3 smartphone (go.pcworld.com/hpelitex3rev) will convince IT departments to distribute the handset with accompanying laptop docks for corporate drones to use while away from the mother ship. Heck, in theory home users could even ditch a separate PC completely and use a Continuum-capable Windows 10 phone as the ultimate mobile computer.

After spending seven days inside Continuum, however, it's clear to me that Microsoft's desktop mode on phones just isn't ready to meet my needs.

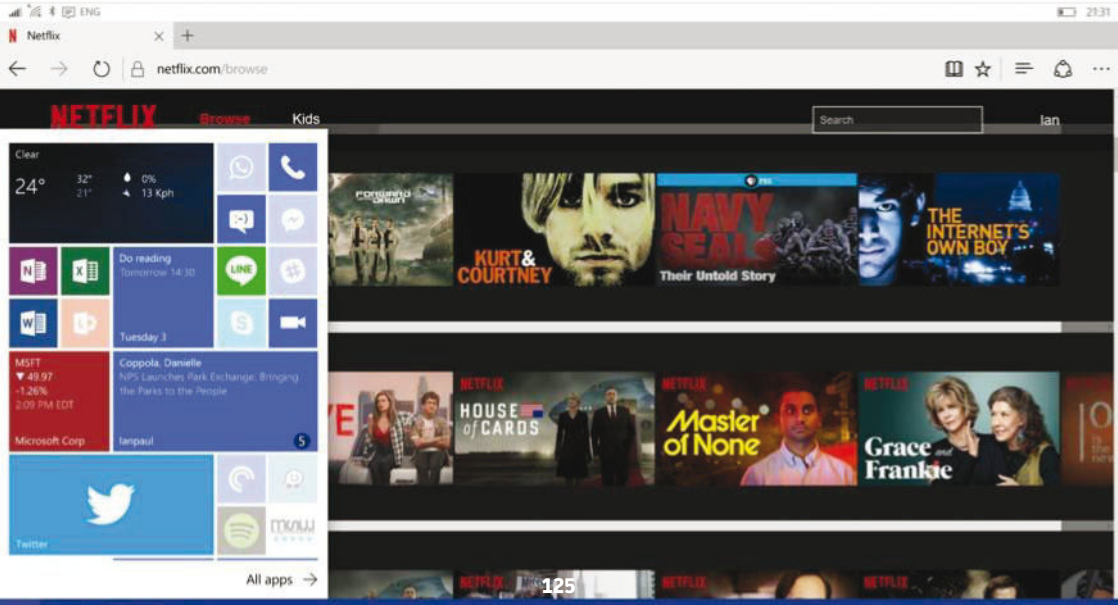
REALLY? I'M A TRUCK DRIVER?

How much computing power do I need to do my job anyway, I thought. Surely writers and reporters aren't part of the specialized, truck-driving class of computer users, based on the analogy made famous by the late Apple cofounder Steve Jobs. All I do is put words in a text editor, load them into a website back end, crop an image or two, and then hand everything off to my editor. Sure, I've got online research on top of that, but what's a few dozen browser tabs?

While a PC—even a Chromebook—can handle my daily needs without a stutter, my Lumia 950 just wasn't up for the task.

The core of the problem might be the software. Continuum is still in its early days and lacks some key productivity tools. For example, Continuum doesn't support the standard Windows snap mode, which allows you to view two programs simultaneously on a single screen. That means you have to use one full-screen app at a time. Hello, Metro Week experience from the bleak Windows 8 era.

Actually, that's a little unfair. While the basic concept of using one



Netflix in Continuum works well.

app at a time remains, Continuum is nothing like Windows 8's Metro mode. First off, there's a complete desktop UI that is immediately more familiar than the Windows 8 Start screen ever was.

Second, even though the app ecosystem is struggling on Windows Phone, it's far better than the Windows Store during the early days of Windows 8. Plus, in Continuum mode Windows 10's Edge browser (go.pcworld.com/w10edge) becomes surprisingly full-featured—so much so that it can run desktop Netflix without a hitch.

The mobile Office apps in Continuum mode also turn into replicas of their desktop counterparts. They don't have feature parity, of course, but a casual user would be hard-pressed to see the difference between the two.

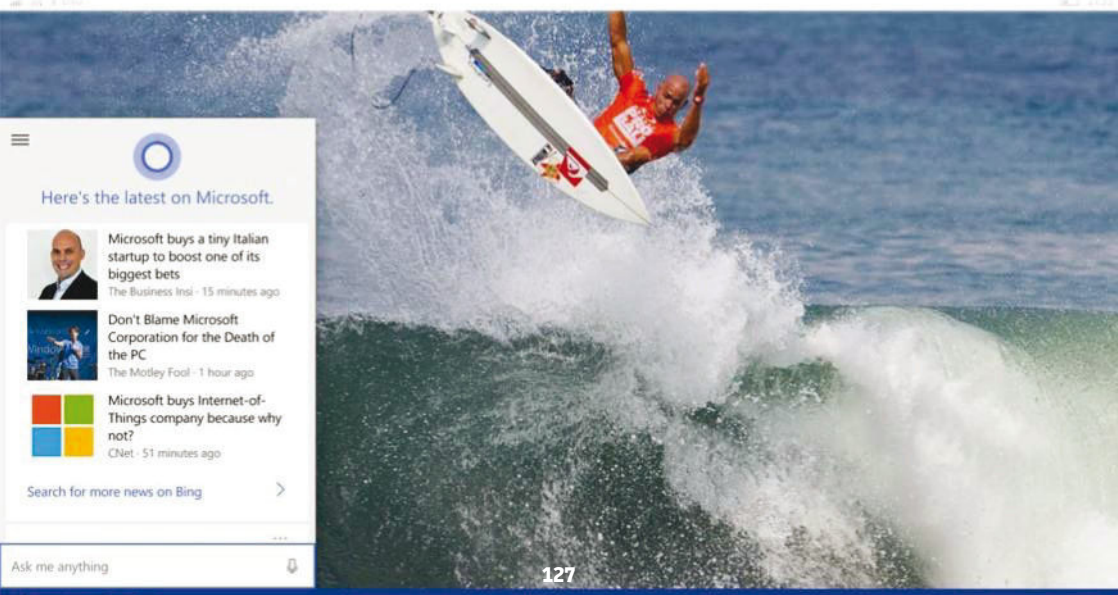
Many other Microsoft apps work fantastically well in Continuum, such as Mail and the Photos app. Third-party apps are where the problems start. Developers have to rebuild their apps as universal Windows apps (go.pcworld.com/universal) and explicitly add Continuum support—and many haven't done that yet.

Many popular Windows apps don't support Continuum, which meant I spent a lot of time using my Lumia 950 as a phone rather than a PC.

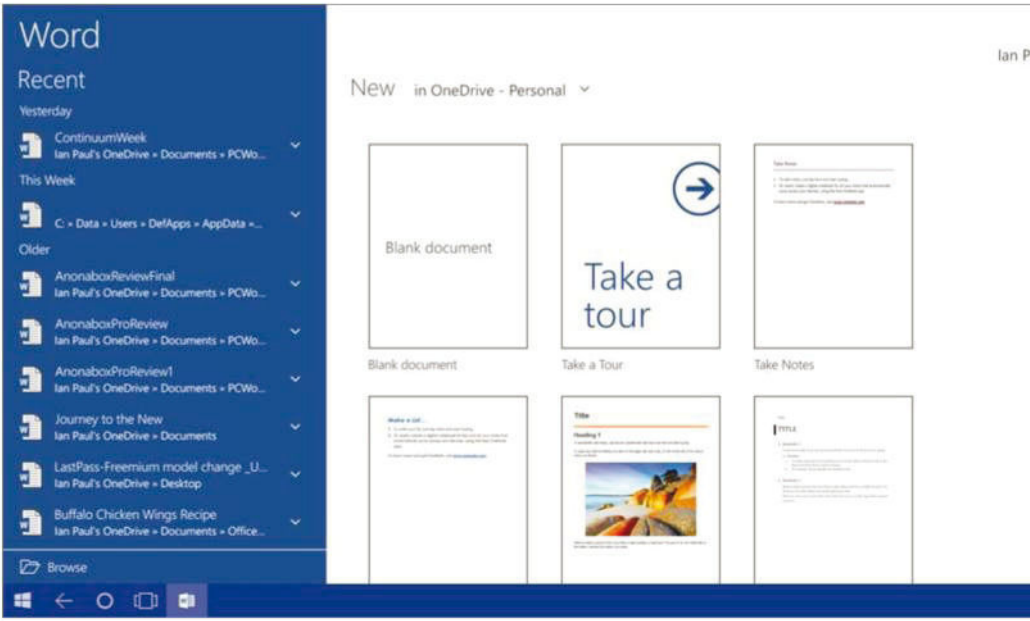
Spotify for Windows Mobile, for example, fails to work as a Continuum desktop app. The Spotify web app requires Flash, which Edge on mobile doesn't have. My only solution was to run the mobile app on the phone while using Continuum on the big screen. That let me get my music fix at work, but it wasn't ideal.

Things got even more problematic when I wanted to use Slack's collaboration tool for communicating with my editors. Slack doesn't support Continuum either, which means I had to choose between the web app or the app on my small-screen phone—not a great choice, because Edge doesn't support desktop notifications from websites. In the end, I was stuck between getting notifications on my phone and responding to my editor on the web app. Not a great solution, but it worked.

On top of all that I also had issues getting into *PCWorld*'s content management system (CMS) using Edge, which forced me to turn to my PC. Not willing to give up so easily, however, I used Cybele Software's free-to-try Thinfinity Desktop client (go.pcworld.com/thinfinity) to access my PC from my Continuum-enabled phone. It was



Cortana in Continuum.



The universal Office apps shine in Continuum.

a little ridiculous using Continuum to log into a PC less than a foot away from me, but Continuum vows must be kept.

I also ran into problems when I wanted to do some basic image editing. My needs are not extensive: crop a few photos, maybe paste a smaller image onto a larger white background to keep the CMS happy, or cut out any personal information from my screenshots.

With meager needs I was determined not to pay for a photo editing suite, which led me to Fhotoroom (go.pcworld.com/fhotoroom)—a free app that supports Continuum. But on my Lumia 950, the app slowed to an absolute crawl in Continuum mode. Even a simple cut-and-paste operation took minutes instead of seconds. Perhaps with a better GPU, Fhotoroom would've done a better job.

Speaking of graphics, gaming left a lot to be desired in Continuum. Two games I found that supported Continuum included *Crossy Road* and *Age of Empires: Castle Siege*. Both were fun, but I'd really hoped to play *Lara Croft GO*.

I assumed that because Croft is a Universal Windows Platform (UWP) app—or at least it appears to be, with cross-platform buy and cloud save support between Windows 10 PCs and phones—it would play nice with Continuum, but that's not the case. In fact, you really have no way to know whether a Windows Store app supports Continuum unless it says so in the developer-supplied description on the Windows Store, or by simple trial and error.

THE GOOD STUFF

I've spent a lot of time complaining about Continuum, but over time I grew to appreciate the feature. There's something futuristic about working all day on your phone, then taking it out of the dock to read a book on the couch or snapping a few photos of your kids. Everything you need contained in one device. Magical.

Overall, Continuum was a neat experience, but that's really all it was.

Continuum also supports some of the niceties you're used to on the desktop. Keyboard shortcuts like Windows Key + PrtScrn for screenshots works, as does Alt + F4 for closing programs. In fact, the latter is often the easiest way to close a program, because the traditional close button in the corner of a program window disappears (in favor of more screen space) until summoned by a hovering mouse.

A number of peripherals also worked with Continuum. My keyboard, mouse, and headphones had no trouble working. In fact, mouse response proved quite zippy—I expected the experience to be laggy. My Xbox 360 controller and Microsoft webcam, however, were both incompatible.

Overall, Continuum was a neat experience, but that's really all it was. For now, I am a Jobsian truck driver despite my meager computing demands, and my little handheld coupe just can't meet my needs. In fact, I wouldn't recommend Continuum for anyone who needs to use two apps simultaneously.

Microsoft's Lumia 950 and its Display Dock peripheral.

For simple paper-to-digital data entry on a spreadsheet, firing off email, or typing your thoughts into a document, Continuum will work just fine. It might even be an ideal solution.

The minute you need to use two or more productivity apps at once, however, Continuum's cracks start to show. Maybe one day Continuum will be ready for me, but not yet. In the meantime, I'll have to keep lugging that trusty laptop around wherever my travels take me.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RETRO TECH

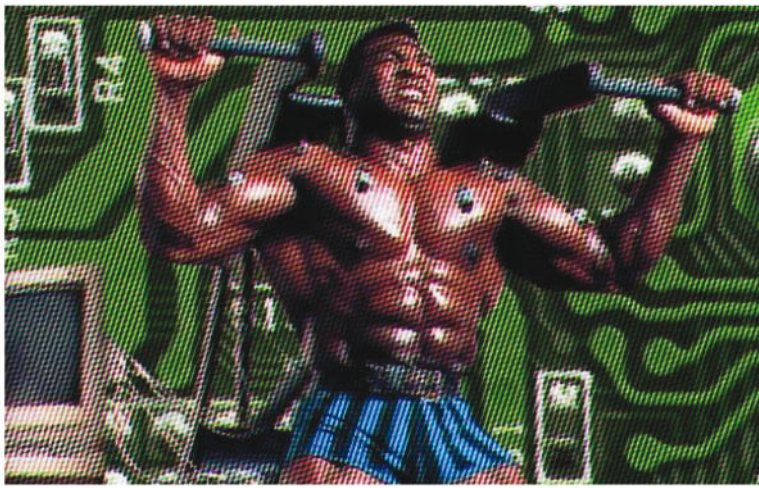
Vintage muscle machines that pushed the limits

BY BENJ EDWARDS

PUMPING RETRO IRON

Since the dawn of the PC market, most consumer users have been able to get by with the bare minimum of computing power. During the personal computer's first two decades, that typically meant performing functions like word processing, light gaming, and home finance. Typical low- or mid-range PCs could handle those tasks with aplomb.

But not long after the first personal computers launched in the 1970s, manufacturers began to target businesses, universities, and government institutions with beefier machines. Those organizations often needed extra computing muscle for advanced production or research tasks, and later, high-end computers also served creative users such as graphic designers, video producers, and musicians.



That's what we're going to look at here—eight vintage "muscle machines" of the 1980s and 1990s that pushed the limits of personal computer capability at the time of their release. Accordingly, most of these had a high price to match, which makes them hard to find (and largely forgotten) today.

I'd love to hear about your own adventures with vintage muscle machines—whether you used them back in the day or you simply tinker with them now.

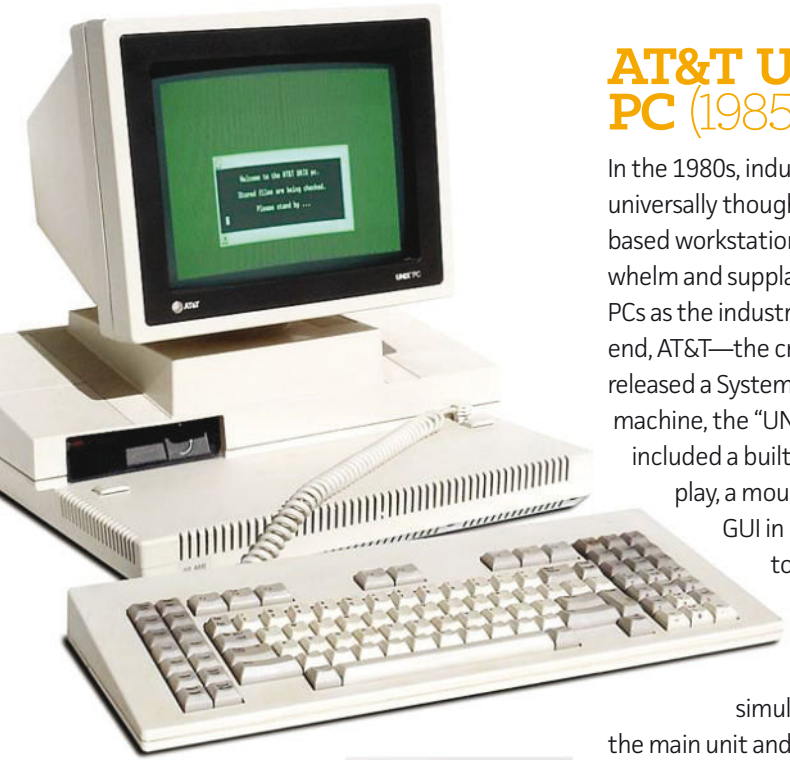
COMPAQ DESKPRO 386 (1986)

Let's start with the archetypical monster upgrade PC, the Compaq DeskPro 386. First introduced in 1986, this IBM PC–compatible beast was the first commercial PC to use Intel's 80386 CPU, which made it instantly perform twice as fast IBM's then-flagship AT computer—and faster than any other clone IBM PC on the market. The DeskPro 386 was basically the most powerful desktop PC in the world. Add to that the ability to support up to 10MB of RAM at a time when most PC users were happy with 640KB, and you had the recipe for a truly impressive piece of hardware. IBM wasn't too happy about being bested by Compaq on its home turf, of course; Big Blue released its own 386-based PC the following year, which you will see ahead.

BASE RETAIL PRICE:
$6,499

TODAY'S PRICE:
$14,120
(ADJUSTED FOR INFLATION)

CPU:
16MHz Intel 80386



AT&T UNIX PC (1985)

In the 1980s, industry pundits almost universally thought that powerful UNIX-based workstations would soon overwhelm and supplant DOS-based IBM PCs as the industry standard. To that end, AT&T—the creator of UNIX—released a System V UNIX-based machine, the "UNIX PC," in 1985. It included a built-in monochrome display, a mouse-based windowing GUI in ROM, support for up to 4MB of RAM, and, through serial card expansion, could serve up to six simultaneous users (one on the main unit and five on their own serial terminals). That's a lot of capability in a desktop form factor.

It's interesting that while UNIX did not reign supreme on the desktop in the 1980s or 1990s, today we see UNIX derivatives and workalikes with a huge global PC footprint in UNIX-based Mac OS X and iOS, and Linux-based Android. Taken together, those platforms outnumber Windows PCs. So maybe the pundits were right after all—but just off by a couple of decades.

BASE RETAIL PRICE:
$5,590

TODAY'S PRICE:
$12,371
(ADJUSTED FOR INFLATION)

CPU:
10MHz Motorola 68010

COMMODORE AMIGA 3000 (1990)

BASE RETAIL PRICE:
$3,379

TODAY'S PRICE:
$6,156
(ADJUSTED FOR INFLATION)

CPU:
16MHz Motorola 68030

Commodore made a big splash with its original Amiga in 1985 thanks to the machine's impressive graphics and sound capabilities and its preemptive multi-tasking GUI-based OS. After a few successor models, Commodore significantly upped the ante in the Amiga space with the completely redesigned Amiga 3000, which sported a then-impressive 16MHz Motorola 68030 CPU (later upped to 25MHz), support for up to 18MB of RAM, a new ECS graphics chipset with VGA support, and a new high-speed DMA SCSI controller for fast hard-drive and CD-ROM access. At the time, it was one of the most capable consumer-level PCs in the world—and for the price, it was very hard to beat.

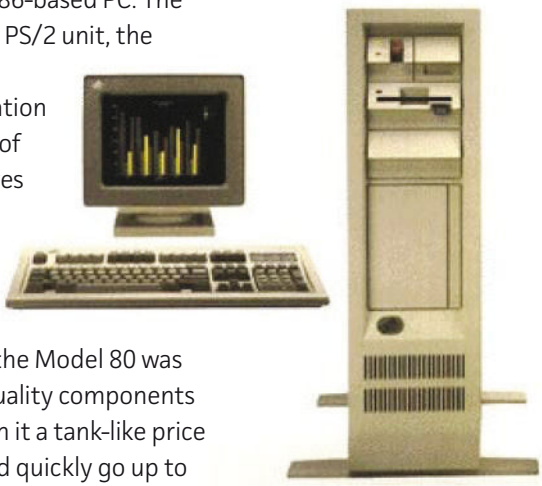
IBM PS/2 MODEL 80 (1987)

BASE RETAIL PRICE:
$10,995

TODAY'S PRICE:
$23,048
(ADJUSTED FOR INFLATION)

CPU:
20MHz Intel 80386

In 1987, IBM unveiled its next big step in the IBM PC space, the Personal System/2 (PS/2) line, which introduced innovations such as 3.5-inch floppy support, VGA graphics, OS/2, the Micro Channel bus, 72-pin RAM SIMMs, integrated mouse support (through the now-famous PS/2 mouse/keyboard ports), and most importantly, IBM's first 386-based PC. The 386 arrived in the highest-end PS/2 unit, the Model 80, which shipped in a hulking tower-based configuration that could support up to 2MB of RAM and two 115MB hard drives (consumer hard drives were typically about 20MB at the time, and still very expensive).



Like all IBM PCs back then, the Model 80 was built like a tank (out of high-quality components and materials) and carried with it a tank-like price to match: $10,995, which could quickly go up to $20,000 or more depending on the configuration. To add insult to injury, customers had to buy an operating system (PC-DOS 3.3) for their Model 80 as an add-on item. That'll be $120 extra, please.

APPLE MACINTOSH IIFX (1990)

BASE RETAIL PRICE:
$9,900

TODAY'S PRICE:
$18,037
(ADJUSTED FOR INFLATION)

CPU:
40MHz Motorola 68030

"Wicked Fast"—that's what Apple's advertising called this impressive workstation, the Mac IIfx, which was the first Mac to ship with a 40MHz 68030 CPU (its predecessor, the Mac IIx, sported a 16MHz 68030). At the time of its release, it was both the fastest and most expensive Mac to date—and beyond the Mac platform, it was one of the fastest personal computers, period. It could support up to 128MB of RAM, which was an insane number at the time, and like all members of the Mac II product line, the IIfx could be expanded with multiple internal NuBus cards, which allowed the IIfx, among other options, to support multiple high-resolution/high-color graphics cards (technically as many as there were slots). That made the IIfx the most versatile PC-based digital-graphics–editing and –production workstation in the world.

IBM THINKPAD POWER SERIES 850 (1996)

The PowerPC CPU project originated as a joint project between Apple, IBM, and Motorola to design a powerful next-gen microprocessor that would help to unseat the Intel microprocessor hegemony. At the time, Intel x86 CPU-based machines (often running DOS or Windows) had already devoured the desktop and laptop PC markets and were just beginning to eat into the workstation and server markets as well. The antidote, they hoped, would be the PowerPC CPU.

Most people probably recall Apple's PowerPC-based Macs, but few remember IBM's forays into the PowerPC architecture. Perhaps the most interesting of those products was the ThinkPad Power Series 850, a bona-fide IBM laptop which shipped with a meaty 100MHz PowerPC 603e CPU, 16MB or 32MB of RAM, and a 640x480 color LCD. For the OS, you could run Windows NT 3.51 (which supported PowerPC) or IBM AIX, a UNIX derivative. With a price starting at $12,399, however, few could afford such a beefy machine—and even fewer actually bought one.

BASE RETAIL PRICE:
$12,399

TODAY'S PRICE:
$19,374
(ADJUSTED FOR INFLATION)

CPU:
100MHz Motorola PowerPC 603e

RADIO SHACK TRS-80 MODEL 16 (1982)

BASE RETAIL PRICE:
$4,999

TODAY'S PRICE:
$12,335
(ADJUSTED FOR INFLATION)

CPU:
6MHz Motorola 68000 & 4MHz Zilog Z-80A

Motorola first introduced its 16/32-bit 68000 CPU way back in 1979, but it was years before the then-expensive but capable chip made it into any desktop PCs. One of the first such machines was the unusual TRS-80 Model 16, a derivative of the business-oriented TRS-80 Model II series, that came equipped with both the TRS-80 standard Z80 processor and a 6MHz 68000. Radio Shack positioned the Model 16 as a multiuser business machine that could run either TRSDOS-16 or Microsoft XENIX (Microsoft's version of UNIX). Thanks to the Z80, it was also backward-compatible with all 8-bit Model II software.

And your eyes aren't deceiving you: Yes, those are two 8-inch double-sided floppy drives tucked into the Model 16's massive case. The drives could store 1MB of data per disk—a very impressive number at a time when a typical IBM PC's disk drive could only write 160KB of data per side. This was a very powerful PC at the time of its release.

TADPOLE ALPHABOOK 1 (1995)

They said it could never be done: To stuff a 233MHz DEC Alpha CPU, one of the fastest and most powerful server/workstation processors in the world, into a laptop form factor. But Tadpole Computers did just that in 1995, resulting in the ALPHAbook 1, which was probably the world's most powerful laptop at the time. (For comparison, Dell sold a high-end $2,499 laptop with a 75MHz Pentium in December 1995.)

Due to the power-hungry nature of the DEC Alpha CPU, this trailblazing PC's internal battery only provided one hour of cordless run time. To remedy this, Tadpole sold an optional 4-pound external battery pack (the laptop alone weighed 7.5 pounds) that not only added more minutes of power, but also provided an easy way to lift weights on the go. Aside from a short run time, the Alpha CPU also made ALPHAbook 1 insanely expensive; with a $13,950 base price, you can be sure that few of these machines actually made it into customers' hands. As a result, it's quite the collectible today.

BASE RETAIL PRICE:
$13,950

TODAY'S PRICE:
$21,797
(ADJUSTED FOR INFLATION)

CPU:
233 Mhz DEC Alpha 21066-A

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HERE'S HOW

CONTENTS

When water, coffee, or liquid spills on your laptop, do this

Work quickly and you might be able to save it.

BY LINCOLN SPECTOR

AN 11-YEAR-OLD (whose name I won't reveal) accidentally spilled water on a laptop, and wanted to know how to clean it up before any parents found out.

Liquid and electricity don't mix. When the two meet, the liquid can destroy a great deal of electronic circuits. It can also send you a serious shock if you're not careful.

I'm going to assume here that you're not reading this on the wet PC.

Best not to use it until everything has dried up.

Immediately after the spill, make sure your hands, and the laptop's power button, are dry. Use a towel if necessary.

Turn off the computer. . .and I don't mean shutting down Windows properly. Press and hold the power button. The computer will shut down completely after five seconds.

Next, remove any source of electricity. Unplug the AC adapter from the wall socket. Then remove the battery, if the battery is removable.

You're now safe from shock. Unplug anything else that's plugged in—mouse, cables, flash drives, and so on. Open and remove anything that can be opened and removed with relative ease. For instance, remove the RAM and the hard drive or SSD.

If the liquid was something that dries sticky, such as alcohol or sugared drinks, send it to a professional for a thorough cleaning.

But if you just spilled water, you have a chance of drying it out yourself.

First, dry the outside thoroughly with a towel. Then clear off a table and put a fresh towel over it. Open the laptop as wide as you can, so that the screen and keyboard are on the same plane. Then put it, face and keyboard down, on that towel-covered table. Leave it there for at

least a couple of hours so that the water can drip out.

Then put it all back together and see if it works. If it doesn't, take it to a professional.

By the way, I gave entirely different advice to the young reader who asked the question. I recommended confessing and apologizing for the mishap.

How to keep USB thumbdrive malware away from your PC

BY ROBERT LEMOS

MAYBE *YOU* KNOW not to plug strange USB drives into your computer, but trends indicate that most people think nothing of it.

This is not a new risk. A decade ago, a group of penetration

testers—hackers who are paid to break into companies, à la *Sneakers*—dropped 20 USB sticks around the parking lot of a credit union (go.pcworld.com/usbbreach). Fifteen of them were found by employees, and each of those was eventually plugged into a computer, unwittingly running a program that communicated with a "bad" server.

In a recent and more rigorous experiment, a group of researchers from the University of Illinois Urbana-Champaign, University of Michigan, and Google, dropped nearly 300 USB thumbdrives around six campus locations and found that at least 45 percent of them were plugged into a computer and perused by the person who found them. While some of the people made an attempt to check the drive for malware—scanning it with antivirus software, for example—very few seemingly understood the risk of using an untrusted USB drive.

Would you open an email attachment from someone you did not know, or one that seemed suspicious?

While modern Windows and Mac systems no longer run programs on a USB stick by default, other attacks, such as BadUSB (go.pcworld.com/badusb), can make a USB drive appear to be something else, such as a keyboard, and then use that access to take malicious actions.

Would you open an email attachment from someone you did not know, or one that seemed suspicious? Opening files on an untrusted USB drive is similar, said Michael Bailey, an associate professor of electrical and computer engineering at the University of Illinois Urbana-Champaign and one of the coauthors of the research paper.

USB drives: Untrusted and ubiquitous

"In the current world, there is no advice…except to know the provenance of the USB drive," Bailey said. "Do not trust, don't plug or insert untrusted media into your computer."

For anyone tempted by the relative ubiquity of USB drives, this is hard advice to take. Security services provider Verizon, which publishes

the annual data breach report, recommends that companies attempt to keep track of whenever USB drives are used. When the company finds untrusted USB drives, it can test them, said Chris Novak, a director with the firm's RISK team, a computer investigations group.

"We have a lab environment, and we have isolated sandboxed systems," Novak continued. "We often do executive protection, where, when executives go overseas or to a big conference, we give them temporary equipment, and if something happens, we get it back. We review it to see if there are any threats that took place."

Yet, USB threats are often brought back home. In one case, which the company documented in its Data Breach Digest report, a Hollywood executive received a package seemingly from a well-known production company with a branded USB drive. Playing the movie trailer on the drive installed malware on the victim's computer, enabling the attacker to steal an unreleased movie.

The best that consumers can do is buy their own USB drives.

The fact that users plug such storage devices into corporate computers is a nightmare for IT security professionals, to the degree that they sometimes—and somewhat controversially—block USB ports on highly sensitive computers by gluing them closed (go.pcworld.com/superglueusb) with epoxy.

For consumers, doing without USB is not a solution. Yet, there seems to be very few ways to safely plug in a potentially malicious USB drive.

Run your own sandboxed environment? That could prevent damage from a file infector, but even a virtual system does not rule out a low-level hardware attack.

Erase the USB drive? This protects against file-based attacks, but firmware attacks, such as BadUSB, would not be prevented.

The best that consumers can do is buy their own USB drives. While that does not necessarily protect against all threats—flash memory has been known to be infected by a virus at the manufacturer—it does protect against the most common types of dangers.

Encrypted USB drives offer additional safety

When buying a drive, picking one with hardware encryption is also a good step. More advanced drives do not solve the basic problem of being a vector for malware, but they can protect the data on the drive and prevent firmware-based attacks such as BadUSB, according to Andrew Ewing, Flash Business Unit manager at storage-maker Kingston.

"The firmware is digitally signed, so it cannot be altered," Ewing explained. "If we [Kingston] needed to alter the firmware, we would have to have the customer send back the drive to Kingston, so we could reprogram the firmware using the production tool."

So, next time someone gives you a free USB drive, return it. If you find one on the ground, turn it in to lost-and-found. Plugging it into your computer is the worst digital hygiene, said Verizon's Novak. "Think of USB sticks like toothbrushes and then you will not be so quick to pick it up and share it," he says. (*Ew.*)

How to monitor, measure, and manage your broadband consumption

BY ERIC GEIER

FORGET THAT BASS; in the digital world, it's all about that bandwidth. You're paying your ISP for a given amount of bandwidth, but it's up to you to manage how it's consumed. Whether or not you have a data cap—and even if your data cap is high enough that you never bang

into it—simply letting all the devices on your network engage in a battle for supremacy is a recipe for problems.

You could experience poor video streaming, choppy VoIP calls, or debilitating lag in your online gaming sessions. And if you do have a data cap (and yes, they *are* evil), blowing through it can hit you in the pocketbook, expose you to throttling (where your ISP drastically, if temporarily, reduces your connection speed), or both.

Those are the problems, here are the solutions: We'll show you how you can keep your ISP honest by measuring your Internet connection speed, so you can make sure you're getting what you're paying for; we'll help you identify any bandwidth hogs on your network, so you can manage their consumption; and we'll show you how you can tweak your router to deliver the best performance from everything on your home network.

Make sure you're getting what you paid for

Your home network will most certainly be faster than your Internet connection, but it's the speed of your Internet connection that will have the biggest impact on your media-streaming experience—at least when you're streaming media from services such as Netflix, Amazon Video, Spotify, Tidal, and the like. So the first step in your bandwidth audit should be to verify that your ISP is delivering the speed you're paying for (the vast majority of ISPs offer their services in tiers, charging more for higher speeds.

The best way to do that is by visiting a third-party

Results from Speedtest.net for my home connection.

website such as Ookla's Speedtest.net (speedtest.net) or—if you don't like Flash—the HTML5-based Speedof.me (speedof.me). To get accurate baseline speeds, check from a device that's connected directly to your broadband gateway (i.e., your DSL or cable modem, not your router), with all other wired and wireless devices disconnected. You might even want to test a couple of times at different hours of the day, since speeds can vary. Additionally, run some tests while other devices are using the Internet to see the differences.

Compare your baseline results to the speeds your ISP has committed to deliver with the plan you're paying for. If you're seeing significantly lower speeds, call your provider and ask that it check your connection. It might be able to run some diagnostics at its end and offer some suggestions to fix the problem before it sends out a tech.

Devices that are hardwired into the network should achieve speeds on par with your baseline if other devices on the network aren't using much bandwidth.

You also want to check the Internet speeds from any device you're seeing performance issues on. Devices that are hardwired into the network should achieve speeds on a par with your baseline if other devices on the network aren't using much bandwidth. On wireless devices, the speeds can be greatly reduced when further away from the wireless router or if there's interference from neighboring Wi-Fi networks, other wireless devices, or appliances that can cause interference (such as microwave ovens, which produce tremendous amounts of noise in the 2.4GHz frequency spectrum while operating).

How much bandwidth do you really need?

Keep in mind, the bandwidth your ISP promises to deliver isn't a per-device ceiling—it's the total bandwidth available for your Internet connection, so it's shared among all the devices on your network. If you have a plan offering download speeds of 20Mbps and upload speeds of 1.0Mbps, for instance, and you have four devices connected to the

Internet, you could say each device might see a maximum download speed of 5.0Mbps and a maximum upload speed of 0.25Mbps.

In reality, it's not quite that simple. The manner in which your Internet bandwidth is distributed depends on your router and the demand from each device. With a simple router with factory-default settings, it's every client device for itself in a mad scramble for bandwidth. Client devices that are sensitive to lag—media streamers, VoIP phones, and online games—can suffer in this scenario because applications that aren't sensitive to lag—web browsers and email clients, for example—are treated the same as ones that are. I'll show you how you can manage your bandwidth later.

If you don't configure your router properly, all the devices on your network will be treated equally in terms of bandwidth allocation.

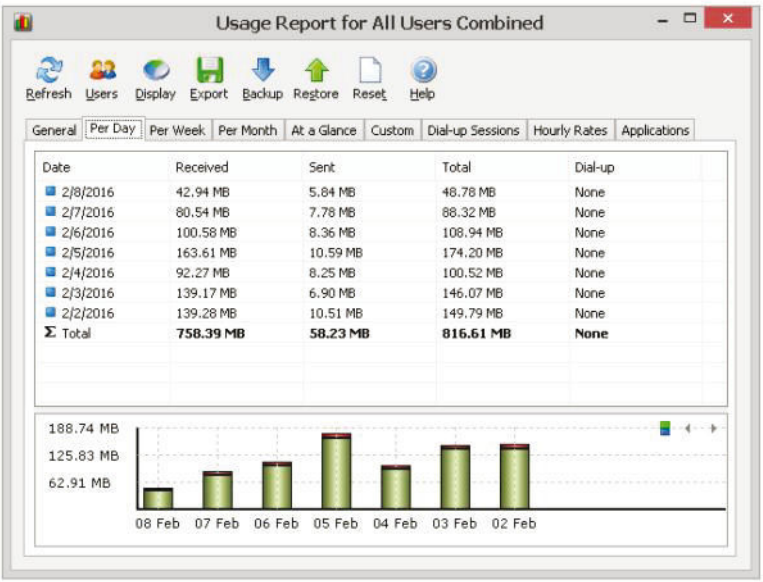
To give you an idea of what's acceptable for Internet speeds, I suggest having about 2.0Mbps of download speed per device for general usage (emailing and web browsing), and about 5.0Mbps of download speed for each HD video stream. So if one person on your network is watching YouTube videos, another is streaming a movie from Netflix, both are simultaneously using a tablet or smartphone to browse the web, while another is a on Skype video chat, I suggest having 19Mbps of download bandwidth: that's (5.0Mbps x 3) + (2.0Mbps x 2).

The maximum upload speed of your Internet connection typically isn't as crucial, because most people consume more content than they create and upload to the Internet. That's a good thing given that most ISPs deliver asymmetric service (i.e., download speeds that are much higher than upload speeds). Having said that, know that the upload speeds can make a huge difference for applications such as Skype or FaceTime since video is traveling in both directions—up and down—simultaneously. For high-quality (non-HD) video chats, I suggest adding about 0.5Mbps of upload bandwidth or about 1.5Mbps for full HD.

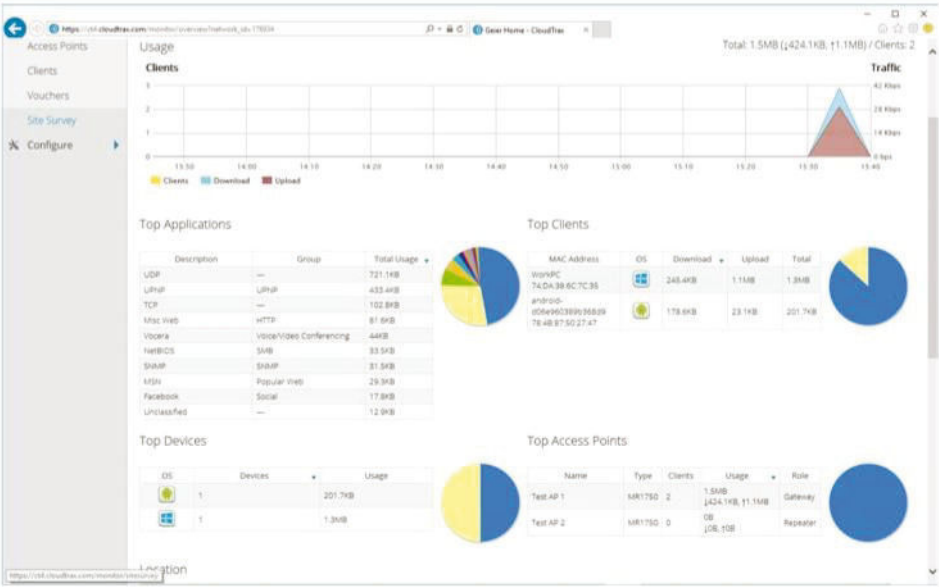
Your upload bandwidth also comes into play when you or others are remotely accessing devices or files on your network when you're away from home. It's hard to suggest a fixed number on that activity, though; just remember the faster the upload speed, the faster the file transfers and streams will be coming from your network.

Monitor your usage to identify bandwidth hogs

Whether you have a data cap or are having performance issues,



NetWorx provides detailed bandwidth reports, but only for the PCs on your network.

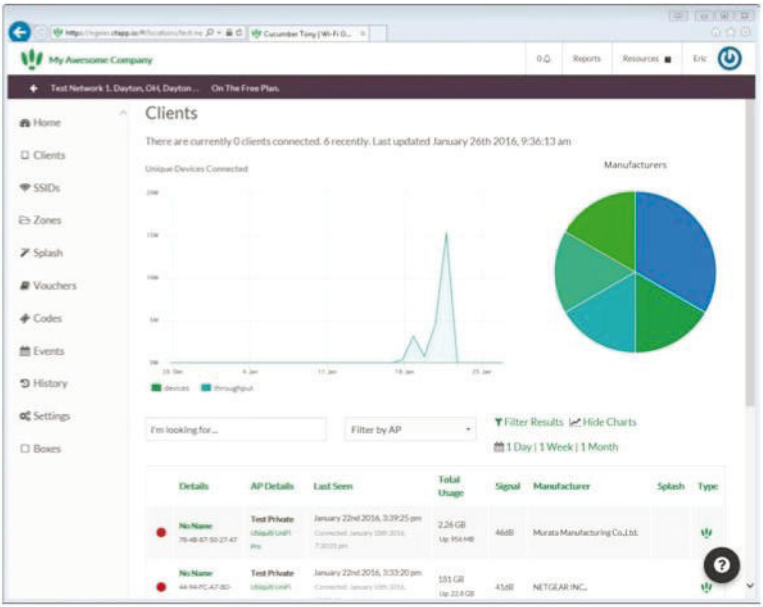


Open Mesh shows a graph of bandwidth usage of each client, top clients, top devices, top applications, and top APs on its Network Overview page.

consider tracking the bandwidth usage of all your devices to see who or what is hogging the most bandwidth.

You might consider using a Windows-based program like BitMeter OS (free and open-source; go.pcworld.com/bitmeteros) or NetWorx (also free; go.pcworld.com/networx), which are most useful if all or most of the Internet devices on the network are Windows PCs or laptops. These applications will track usage over time for the particular computer they're installed on, and offer up graphs and tables of data you can review. You can also set a data quota and be alerted when a device approaches or exceeds that limit.

If you're using multiple types of devices on the network—smartphones, tablets, gaming consoles, and TVs, in addition to computers running Windows—it would be ideal to track the entire network's bandwidth from a single point, so you don't have to set up



Cucumber Tony shows a graph and table of each device's bandwidth usage on the Clients page.

tracking on each device. Since the Internet traffic of each device needs to be monitored, it's not as easy as installing a simple program on a PC. The traffic must be monitored from the router or another device strategically placed between the Internet connection and the network clients.

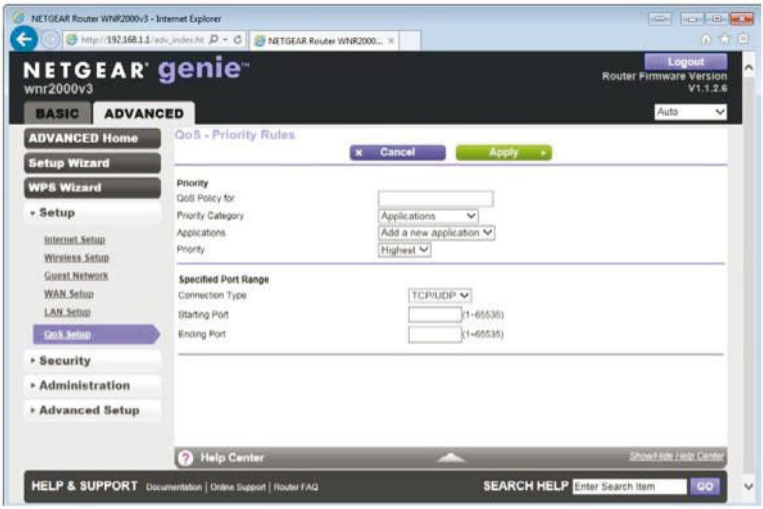
Although most routers don't track bandwidth consumption by network device, consider checking yours just in case. If your router doesn't support it, consider buying another router or flashing a supported router with aftermarket firmware that *does* support it. If you decide to buy a new router, the enterprise-oriented Open Mesh (openmesh.com) routers and access points provide quite a bit of bandwidth usage details. Their hardware can be managed via a free online account (cloudtrax.com), and they support wireless mesh-networking technology that makes it easier to broaden your Wi-Fi coverage.

If you don't want to replace your router, flashing it with aftermarket firmware is a good option, provided your router has that capability.

DD-WRT (dd-wrt.com) is one popular aftermarket firmware that supports many router brands and models (go.pcworld.com/routerdbs); but by default, it shows only your total bandwidth usage. To find the usage per client or device, you'd also need to install an add-on like DDWRT-BWMON (go.pcworld.com/ddwrt-bwmon).

Cucumber Tony (cucumberwifi.io) is a lesser-known firmware to consider. I reviewed it for *PCWorld*'s sister site NetworkWorld recently (go.pcworld.com/wifihotspotmgmt) and found that it supports a couple of different router brands (cucumberwifi.io/wifi-firmware). Gargoyle (gargoyle-router.com) is another firmware you might not be familiar with. It offers some good bandwidth monitoring and control functionality, with support for a few router brands (go.pcworld.com/gargoylerouters).

For the more adventurous, another option is to build your own router out of an old or spare PC, or even run it on your main PC with a virtual machine. Sophos UTM (sophos.com) and Untangle (untangle.com), for instance, are operating systems that provide routing, firewall, web filtering, bandwidth monitoring, and many more network functions.



This Netgear WNR2000 802.11n router has QoS pre-configured for a limited number of applications, but you must configure your own rules for anything the manufacturer didn't think of.

Utilize your router's QoS to distribute bandwidth

Most routers have a quality-of-service (QoS; go.pcworld.com/qosexplained) feature, but it's not enabled by default on some routers. The idea behind QoS is to regulate bandwidth usage in a way that ensures good performance on the network, particularly with more sensitive types of services such as video streams, VoIP calls, and online gaming, where any lag can be quite noticeable. It basically gives these types of traffic higher priority—on the network and to Internet access *from* the network—compared to services that aren't sensitive to lag (e.g., file downloads, torrents, software updates, and general web browsing).

The exact QoS features and settings vary by router brands and models, but most provide a way for you to give particular devices higher priority by tagging their MAC or IP address, or by marking types of services for higher priority. Some routers come with a collection of default QoS settings that you can tweak and customize.

Log in to your router and see if it has any QoS settings. Take a look at the default settings, as it might already give the most common services higher priority. If not, see if it allows you to classify traffic based upon the service type. I suggest going that route first to help alleviate any performance issues on the network. Secondly, you could consider prioritizing any critical devices you'd like to have higher priority.

You might not need superfast speeds for every device or online service, but the quicker any device is served by the router means the more time it has to serve the other devices on the network.

Optimize your network to increase speeds

At first thought, your Internet connection seems to be the bottleneck to the Internet. Your local network might be able to handle up to 1000Mbps of bandwidth, while your Internet-download speeds are likely less than 60Mbps (much less than that if you're relying on DSL

or—shudder—satellite Internet service). You'd think that your network could easily handle it, but sometimes that's not the case. This is especially true when you have many devices on the network, particularly Wi-Fi devices.

You might not need superfast speeds for every device or online service, but the quicker any device is served by the router means the more time it has to serve the other devices on the network. Thus, increasing the speeds of just one device could have an impact on the others. The more devices you get faster, the more noticeable the increased performance may be, especially for those sensitive services.

Whenever possible, connect computers and devices to the router or network via an ethernet cable. This helps alleviate the congestion on the airwaves, which is a much more complex and imperfect connection medium than a cable.

For devices that can't be hardwired, try to utilize router's 5GHz frequency band as much as possible, as the 2.4GHz band is much more congested and prone to interference. For network clients that can connect only to your 2.4GHz network, check channel usage (go.pcworld.com/wifinetworkfixes) so you can use the least-crowded channel available. Additionally, ensure you're using only WPA2 security for your Wi-Fi, as enabling the first-generation WPA (or the even older, insecure WEP) limits wireless speeds.

If your wireless router doesn't support 5GHz, I suggest upgrading to a dual-band router so you can utilize these faster and higher quality frequencies. Keep in mind, the Wi-Fi devices must also specially support 5GHz, otherwise they'll still be connecting via 2.4GHz. For computers and devices that can be upgraded to 5GHz Wi-Fi, I suggest doing so. If you have multiple devices without 5GHz, I suggest upgrading the ones with any performance issues first.

Finally, evaluate your Wi-Fi coverage to ensure that your wireless router is placed in the most central spot around where you use the wireless devices most often. If you still regularly have low or poor Wi-Fi signals, consider extending (go.pcworld.com/extendwifi) your network.

5 ways to search Gmail that everyone should know about

BY MICHAEL ANSALDO

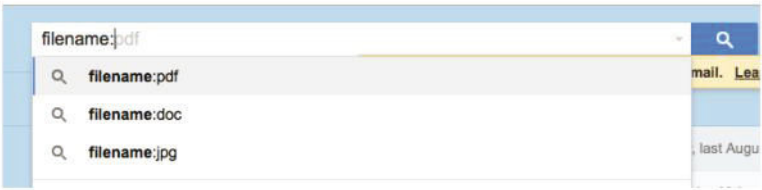
IN A PERFECTLY productive world, your inbox would have a place for every email with every email in its place. But it's easy to let messages stack up knowing Google's powerful search can usually bail you out when you need to find a months-old missive. Still, there will be cases when you need the help of an advanced search operator.

These terms can help you home in on what you're looking for more quickly and accurately than a simple search. There are dozens of operators you can use, but we've narrowed down five of the most handy.

1. Use 'in:anywhere' to search everywhere

It's a given that a general Gmail search crawls every nook and cranny of your inbox, right? Alas, no. Search ignores Spam and Trash unless you specifically tell it to look there. That's important to know because even Gmail's spam filter is imperfect. And who hasn't accidentally consigned some important message to the trash when furiously trying to get to inbox zero?

If you have no idea where the message you need is hiding, cast the widest net possible with the **`in:anywhere`** operator followed by a keyword. This should uncover your missing email, provided it hasn't been sitting in your trash or spam folder for more than 30 days, after which time Google will automatically delete it.



To search attachments by filename or type, use the **`filename:`** operator.

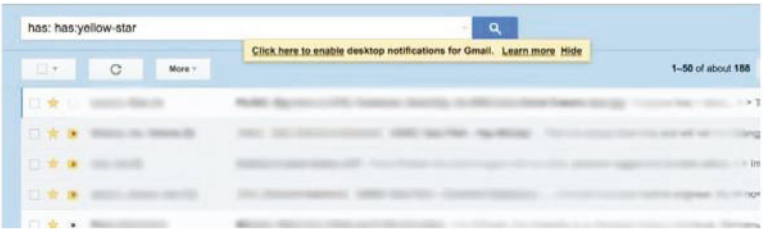
2. Find attached files with 'filename'

Your meeting is about to start and you still haven't found the Excel spreadsheet your colleague emailed you last week. There's no time to scroll through the hundreds of messages in your inbox looking for it—you needed it five minutes ago. Here, the **`filename:`** operator can save your day.

Just pair it with any part of the filename—for example, if the file was called fiscalQ3.xlsx you can type **`filename:fiscal`** to search for any attachment with *fiscal* in the filename. You can also use this operator to search by file type if you don't remember the filename. In this example, you'd type **`filename:xlsx`** to find any Excel attachments.

3. Use 'before' and 'after' to search time periods

Often you have a rough idea of when a message was received even if you



To find messages marked with a particular colored star, you can use the **has:** operator.

can't remember the exact date. That's when to use this pair of operators.

You can use them individually to find a message that was sent before or after a specific date by typing **before:** or **after:**, respectively, followed by the date in the ***yyyy/mm/dd*** format. You can also use these operators together to search within a window of time—**after:2016/02/15 before:2015/03/01**, for example.

4. Search by star for important emails

If you're not already familiar with the full range of Gmail's colored-star system (go.pcworld.com/gmailstars), it's time to bone up. It not only offers an easy way to prioritize important messages without having to drag them to different folders or set up complex filters, it also makes them easier to search for later.

Using Gmail's **has:** operator, you can search for messages tagged with a particular star. For example, **has:red-star**. This search is even more powerful when you pair it with the **from:** operator to find a starred message from a specific sender—type **has:red-star from:Frank** to find emails received from Frank that you've marked with a red star.

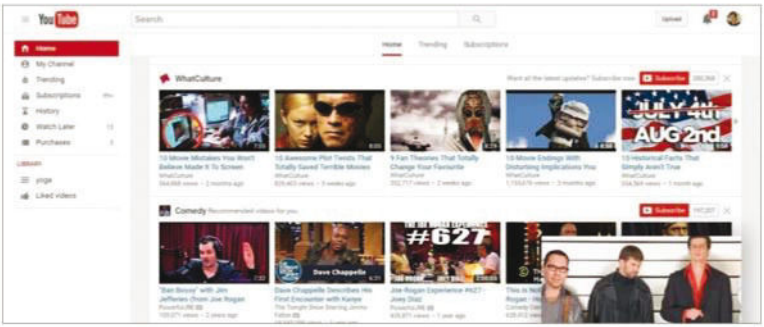
5. Don't forget to check Chat

A lot of work communication takes place in Google Chat because of its real-time nature. Fortunately, your chat logs are stored in your Gmail account and you can use advanced search to find important information buried in snippets of conversation. Just pair the **is:chat** operator with a keyword or the name of the person you chatted with—**is:chat Susan**, for example—to find what you need.

How to bring picture-in-picture mode to YouTube on your PC

ONE OF MY favorite features of YouTube's mobile apps is its multitasking mode. This genius feature allows you to continue watching a video in a smaller panel while searching for other items within the app. I've often wished I could do that on my PC since the only alternative is to open a new tab and use Windows' Snap feature to see the video and the rest of YouTube at the same time.

That is, unless you use a handy Chrome extension called YouTube



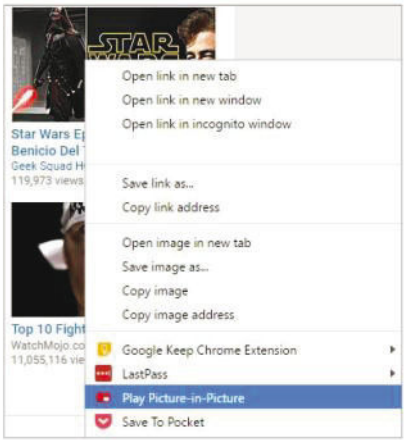
Picture in Picture (beta; go.pcworld.com/chromextpop), which brings YouTube multitasking to your PC.

First, of course, you have to download and install Picture in Picture from the Chrome Web store. Once that's done, you're ready to roll. There are no settings to tweak or functions requiring you to click on the extension icon.

Just go to YouTube to start using the picture-in-picture feature. To test it out, start watching a video. Once the video is running, click on the YouTube icon in the upper left corner to go back to the homepage. As you do so, the video you were watching should automatically collapse into a smaller, borderless window in the lower right corner of the YouTube page.

If you hover over the playing video, you'll see you have full access to the regular YouTube controls. Just above the video you'll also see three buttons for expanding the video to a slightly larger frame, closing the video entirely, or returning to the video's page.

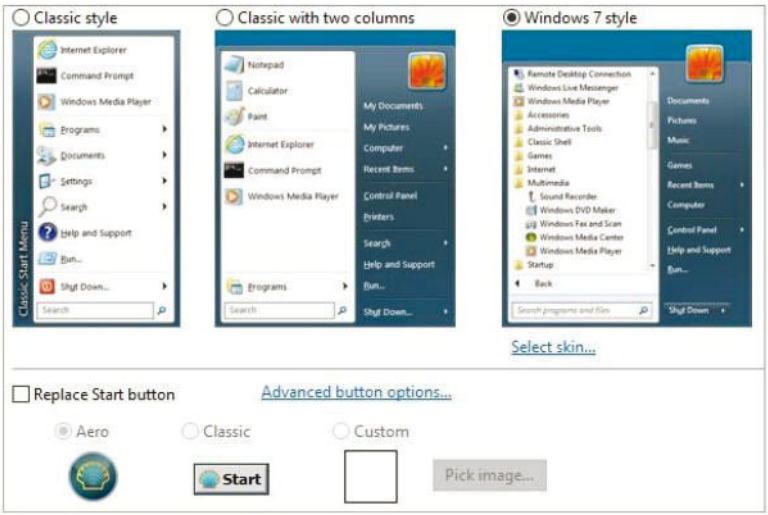
The only other feature in the extension is a single addition to the right-click context menu. When you are looking at a list of videos to play, right-click on the one you want to watch and you'll see the option to automatically play it in picture-in-picture mode.



Picture in Picture (beta) adds an option to the right-click context menu.

How to get Windows 7's Start menu in Windows 10

Not everyone likes the new Windows 10 Start menu. The good news is you can replace it with something more traditional.



John David Galt wants to "get rid of all those tiles, and go back to the cascading Start menus Windows XP had." I'll cover going back to the Windows 7 Start menu, as well.

No one would be happy if next year's cars all came with the gas pedal on the left and the brake on the right. Yet Microsoft clearly has no compunction about regularly changing its user interface. (To be fair, a new Windows Start menu isn't likely to result in highway collisions.)

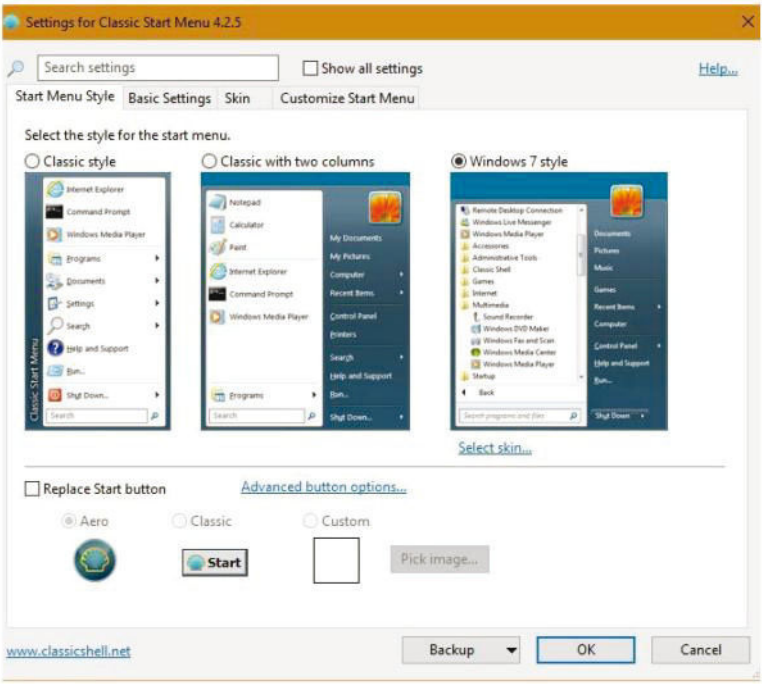
I personally like the Windows 10 Start menu (although I'd like it even more if it had collapsible groups and jump lists on the tiles). But if you

pine for an earlier menu design, read on.

You can get a very close facsimile of earlier Windows Start menus with Classic Shell. The program is free, but the website encourages donations—a nice gesture if you appreciate the product.

The first time you click the Start button after installing Classic Shell (classicshell.net), you don't get any menu. Instead, you'll get the program's Settings dialog box. If you close that dialog box and click Start again, you'll get Classic Shell's Windows 7–like default Start menu.

If you want to get back to that dialog box, right-click the Start button and select *Settings*.



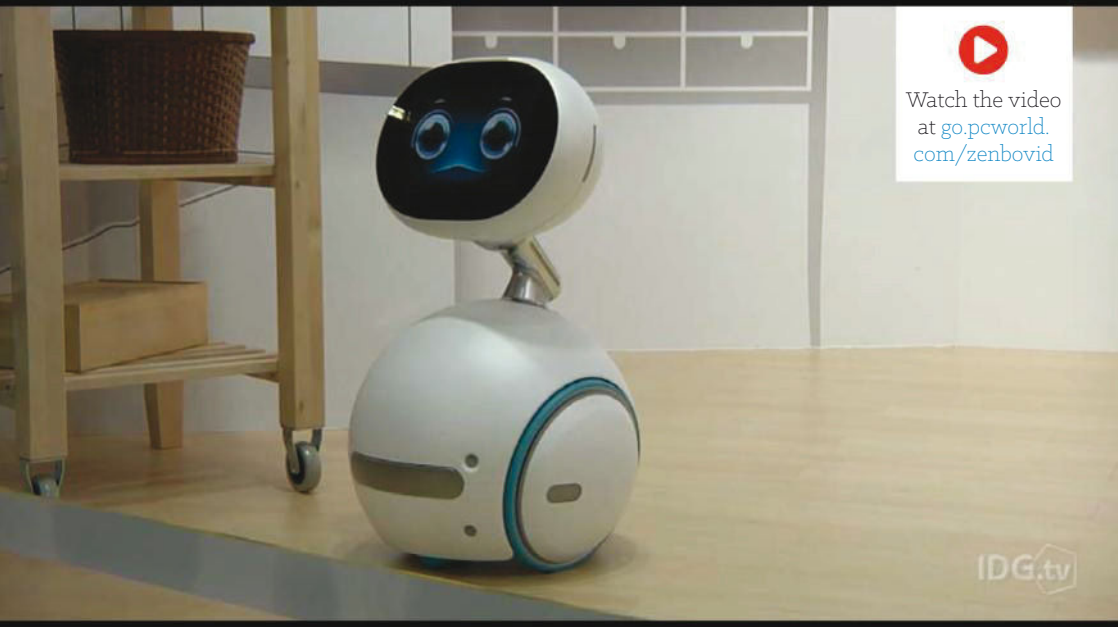
Here you'll be able to select your choice of three menu designs: Classic Style looks pre-XP, except with a search field (not really needed since Windows 10 has one in the taskbar). Classic With Two Columns looks sort of like XP, but even more like Vista. Windows 7 Style, the default, looks almost exactly like Windows 7.

Below the styles, you'll find options for changing how the Start button looks. The program offers only two options, but you can create and add your own.

It's worth checking out the other three tabs on the Settings dialog box. For instance, you can have the menu automatically revert to the Windows 10 interface when you switch to tablet mode (called *Metro* here—they need to update their terminology).

Tech Spotlight

A video showcase of the latest trends



Asus' Zenbo is a cute home robot

» The Asus Zenbo is a personal assistant that can help look after elderly relatives or read stories to the kids, but that might be selling it a bit short. The robot is about two feet high and rolls around on wheels, with a display that can show its animated face or be used for other things like making video calls and streaming movies.