PC MAGAZINE

SPACE FOR SALE

DIGITAL EDITION
AUGUST 2017

PC MAGAZINE

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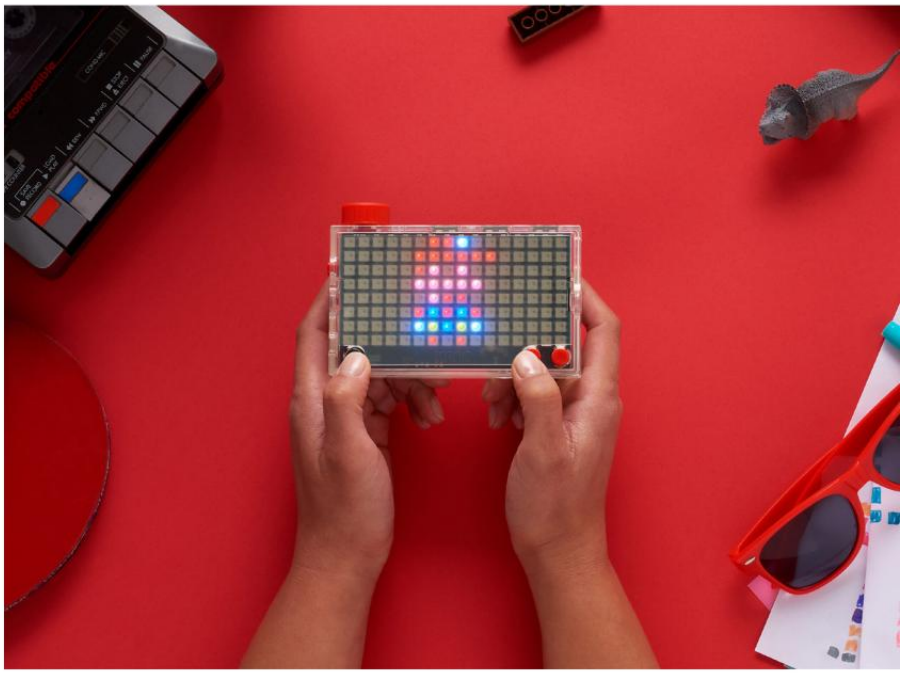

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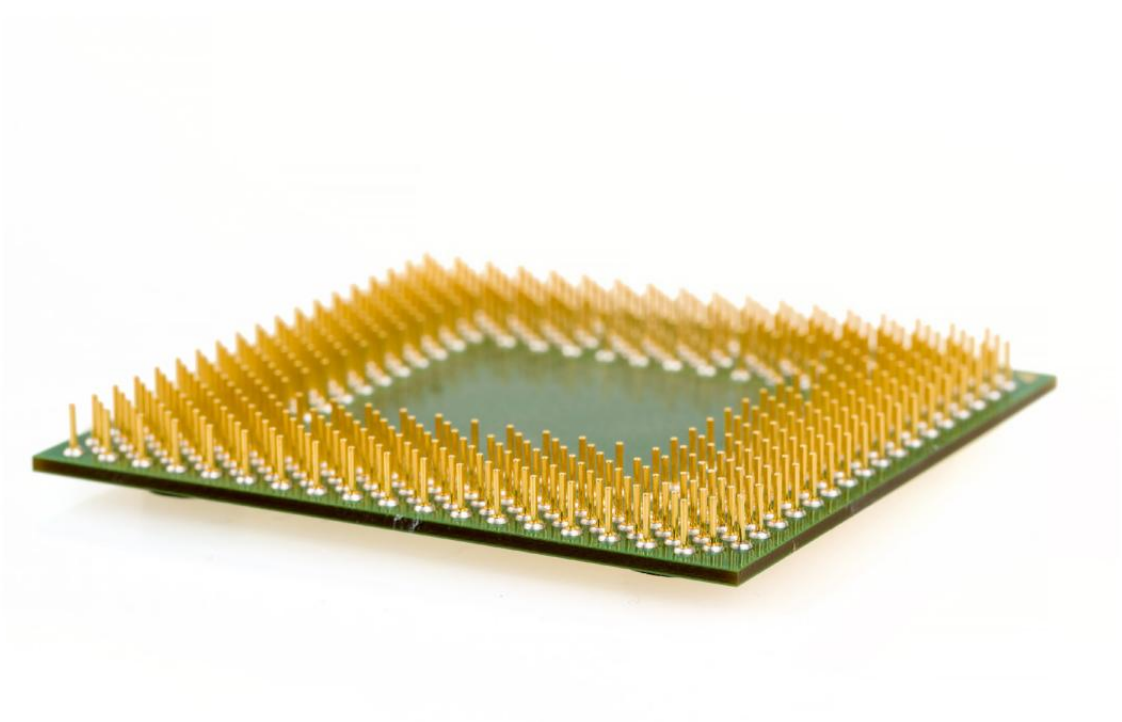

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We Need a New Space Treaty

There is only one law in space, and it's called, appropriately enough, the Outer Space Treaty. Approved by the United Nations in 1966, its primary purpose was to prevent the militarization of space. Back then, the U.S. and the Soviet Union were at the height of the space race, and what the world feared most was the prospect of nuclear weapons orbiting miles overhead like so many swords of Damocles. The treaty forbids any government to place weapons of mass destruction into orbit and requires the moon be used only for "peaceful purposes." It also makes states liable for "any damage caused by their space objects." Pick up your stuff, nations!

So far, the treaty has worked. The problem is, lots of things have changed since 1966. The Outer Space Treaty hasn't.

When the treaty passed, just two countries could reach space. Today, more than 70 countries claim to have space programs, and most have their satellites in orbit. Even more complicating is the rise of private space exploration, the subject of Evan Dashevsky's cover story this month. Dozens of firms are regularly operating in space today. Elon Musk's SpaceX is probably the best known, but Richard Branson's Virgin Galactic and Jeff Bezos' Blue Origin are also launching vehicles. And those are just the transport companies.

Once you get to space, there's real money to be made. Deep Space Industries and Planetary Resources are two of the firms formed specifically with the idea of mining extraterrestrial bodies for rare minerals. Building asteroid-grabbing rockets isn't cheap; Caltech estimates one craft could cost $2.6 billion to construct, but the potential payoffs are even bigger. Planetary Resources estimates the platinum mined from a football field–sized asteroid could be worth $25 to $50 billion. (Ironically, this kind of abundance would crush the market value of this "rare" metal.)

With so many players and so much money involved, space is becoming too complex for the current Outer Space Treaty. Many members are considering dropping out of the treaty or simply ignoring it. Unfortunately, there doesn't seem to be an international consensus on what the new rules of space should be, and in that vacuum, the tendency is to do nothing. This unregulated state is also exactly what private companies want—a new frontier outside the reach of all governments.

So what do you do? If you're Dr. Phil Davies of Hampshire, England, you point a 100mW laser at Mars and declare you own the place. For the last seven years, Davies has been sending quadrillions of photons 33.9 million miles to the surface of the red planet. These photons have heated the surface and released an admittedly infinitesimal amount of carbon dioxide. Davies is using this process to claim he is terraforming the planet, a form of "effective possession," and hence, he owns Mars. According to existing international law, he might be right.

For the last seven years, Davies has been sending quadrillions of photons 33.9 million miles to the surface of the red planet.

Of course, Davies doesn't really want to own the planet—he wants to use his claim as a lever to get the United Nations to rewrite the Outer Space Treaty. If you think that's worth doing, Davies is willing to sell you some of his planet online (at mars.sale). The Early Bird sale is over, so now parcels of 25 to 100 square kilometers of land start at $21. All proceeds go towards Davies' legal bills as he submits Martian land-registration forms to both the U.K government and United Nations.

Full disclosure: I bought a plot of Martian land. It is less volatile than bitcoin, and when it comes right down to it, I'd rather have Dr. Phil Davies run Mars than Jeff Bezos. See if you feel the same way after reading Evan's story.

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Advice From the Experts

This month, we offer answers to a couple reader questions and a tip provided by our incomparable software analysts.

REAL RANSOMWARE?

On two of our computers at home (Windows 10) we had what I think is ransomware come up on the screen. I immediately did a hard shutoff and waited 5 minutes and turned them back on, and the ransomware message did not come back. On one of the machines, this happened before I installed the free Malwarebytes anti-ransomware. On the other, [Malwarebytes] was installed, and I got the screen. I assume it's still on the machines. Can you tell me the best way to deal with this?
—Nick Bagileo

NEIL RUBENKING'S REPLY:

Shutting down the machine was smart. I'm wondering if you may be encountering the kind of ransomware that's just a bluff. Did it show up in the browser? Look at the screenshots in this article: How to Call Ransomware's Bluff (http://securitywatch.pcmag.com/hacking/320316-how-to-call-ransomware-s-bluff). If that's what you ran into, it's nothing—it's just trolling for gullible people. And none of the anti-ransomware tools I've seen bother with that stuff. If it doesn't try to encrypt your files, the tools don't identify ransomware activity.

DOWNLOAD DILEMMA

I'm a pretty big torrent downloader. In the past six months I've gotten two letters from my ISP (Xfinity/Comcast) warning me about downloading illegal copyrighted torrents. The letters always cite very obscure torrents that I download simply because they're so old or rare that I can't find anyplace to purchase them...

Instead of buying a monthly VPN subscription, which I understand slows down internet speed, I found a product called BT Guard, which basically sets my torrent client (uTorrent) to use a VPN while leaving the rest of my internet VPN-free. So far, so good, but I would love to know how effective BT Guard is and if it's worth the nominal price I pay for it.
—Shane Lear

MAX EDDY'S REPLY:

You're talking about something called "split tunneling." It's a rare feature among VPN providers but not impossible to find. It basically dictates what kinds of traffic move through the VPN's encrypted tunnel and what doesn't.

As to VPN's efficacy protecting your identity while torrenting: Using a VPN definitely makes it harder to find your torrenting traffic, which would probably be enough to deter most copyright enforcers. A VPN can protect your data from observation by your ISP, but once your data exits or enters the VPN server, it is theoretically observable. If a rights holder was able to determine that you were downloading files through its own detective work, it could simply inform your ISP, which would in turn issue a cease and desist order like the writer described. ISPs have to take some action because of the Safe Harbor portion of the DMCA.

TIP: PASTING ON AN IPHONE

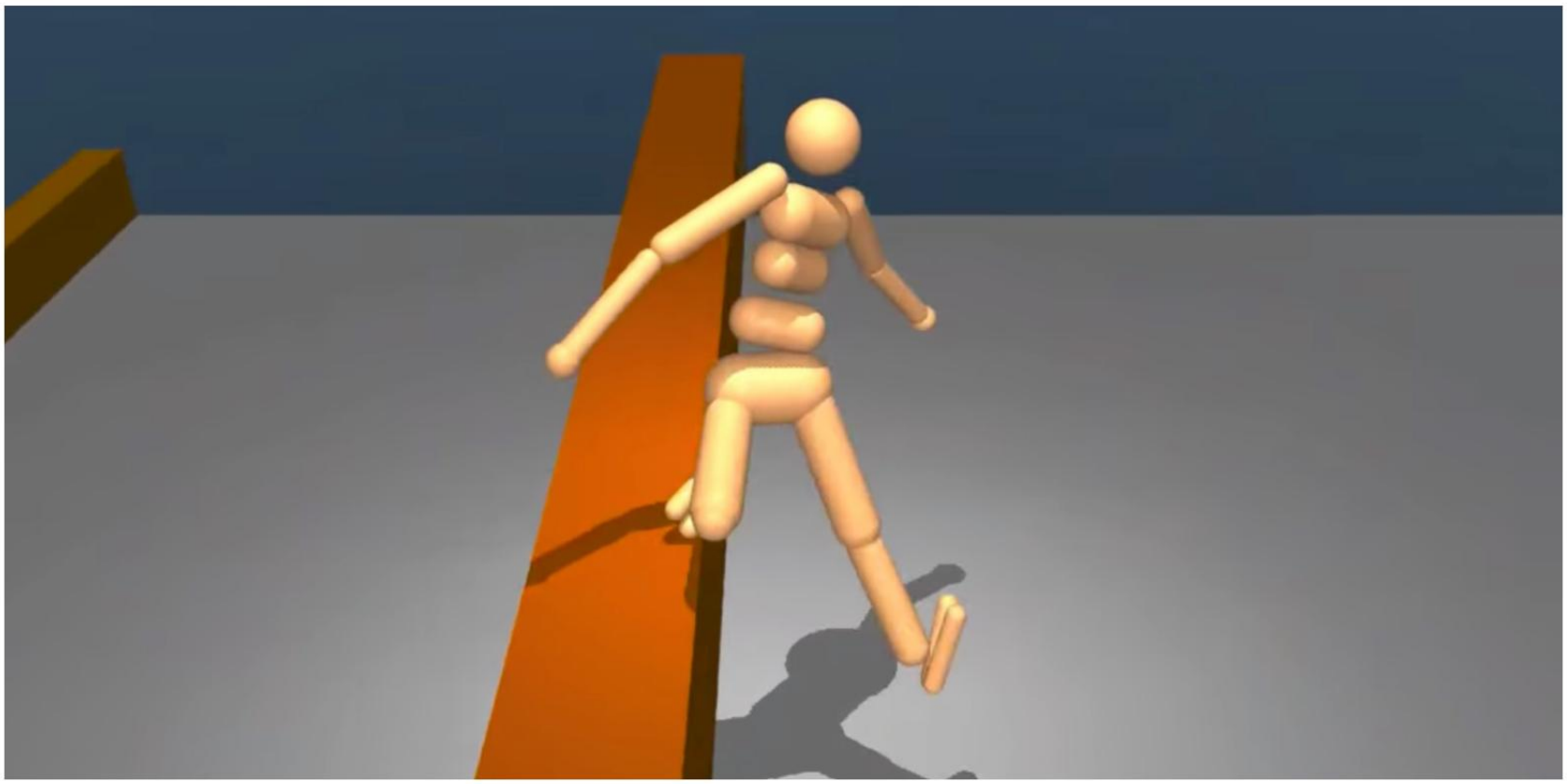
Sometimes you need to copy/paste information into a blank field on your iPhone. For example, you may want to copy a password from your password manager into the corresponding field in an app. It can be hard to tap the exact right location that will bring up the Paste option. So, try tapping out some left-right text string (say, djdjdjdj). Now tap that, choose Select All, and then choose Paste. Much easier!
—Neil Rubenking

Ask us a question

Have a question about a story in *PC Magazine*, one of the products we cover, or how to better use a tech product you own? Email us at **letters@pcmag.com** and we'll respond to your question here. Questions may be edited slightly for content and clarity.

Google's DeepMind Teaches AI to Navigate a Parkour Course

BY RYAN WHITWAM



Google began as a search and advertising company, but its behind-the-scenes efforts have increasingly veered into machine learning and AI. That's useful not only in search but also in driverless cars, computer vision, and more. The search giant's acquisition of DeepMind several years ago boosted its AI research into overdrive, and now we're beginning to see the benefit in Google's products. A new research project from DeepMind shows just how far a learning AI can go by teaching a simulated humanoid how to navigate a parkour course.

Teaching a machine to walk has proven tricky, because there are so many variables involved. Companies such as former Google subsidiary Boston Dynamics have succeeded in creating programs that tell robots how to walk, but it's difficult to prepare for all possible situations: When the robot encounters a new obstacle, it might have no idea how to navigate it. But what if you used a learning machine and simply rewarded it when it progressed? This is known as reinforcement learning (RL), and DeepMind has shown it could successfully be applied to a complex problem like locomotion.

The team used simulations in a complex world filled with obstacles, but the goal for the AI was simple: Make it as far as possible, as fast as possible. The parkour course contained walls, cliffs, hurdles, and tilting floors. The "reward" for the AI drove the simulations to discover new ways to traverse the terrain, and none of the movements were provided programmatically — this is all emergent behavior. For example, the AI tried many times to learn how to jump over a wall in search of a greater simulated reward. When it finally figured that out, the same movement was adapted by the AI to jump over all the walls.

DeepMind looked at non-human walkers as well. An "ant" walker was able to learn how to leap across chasms in a way the human simulations never would. And it also learned to do this via trial and error.

Actually, there's nothing to dictate that the movement of human-like simulations must look human-like. Some of the emergent behaviors include amusing quirks, like the stick figure's tendency to flail its arms about to keep its balance. And a robot with simpler "planar" walking legs used its knee to lever itself over tall walls.

This research shows that complex problems can be solved with very little input from humans. Just offer a learning AI an opportunity to solve the problem, and it can develop surprisingly complex behaviors.

Actually, there's nothing to dictate that the movement of human-like simulations must look human-like.

Audi A8 Can Take Over During Traffic Jams

BY ANGELA MOSCARITOLO

Sitting in a traffic jam isn't exactly enjoyable—but the 2018 Audi A8 might change that. Audi said the car is the "first production automobile in the world to have been developed for highly automated driving." A feature called "AI traffic jam pilot" can take care of driving in slow-moving traffic up to 37 miles per hour, on highways where a physical barrier separates the road. To activate the system, press the AI button on the center console, and the car will handle accelerating, steering, and braking.

"The driver no longer needs to monitor the car permanently," Audi said. "They can take their hands off the steering wheel permanently and, depending on the national laws, focus on a different activity that is supported by the car, such as watching the on-board TV. As soon as the system reaches its limits, it calls on the driver to take back control of the task of driving."

The car is equipped with radar and ultrasonic sensors as well as a front camera and a laser scanner to enable this feature. "During piloted driving, a central driver assistance controller ... computes an image of the surroundings by merging the sensor data," Audi said.

The A8 also has two autonomous parking features called "AI remote parking pilot" and "AI remote garage pilot." These features can autonomously steer the car into and out of a parking space or garage. You can enable the system from the myAudi smartphone app; you won't even need to be sitting in the car.

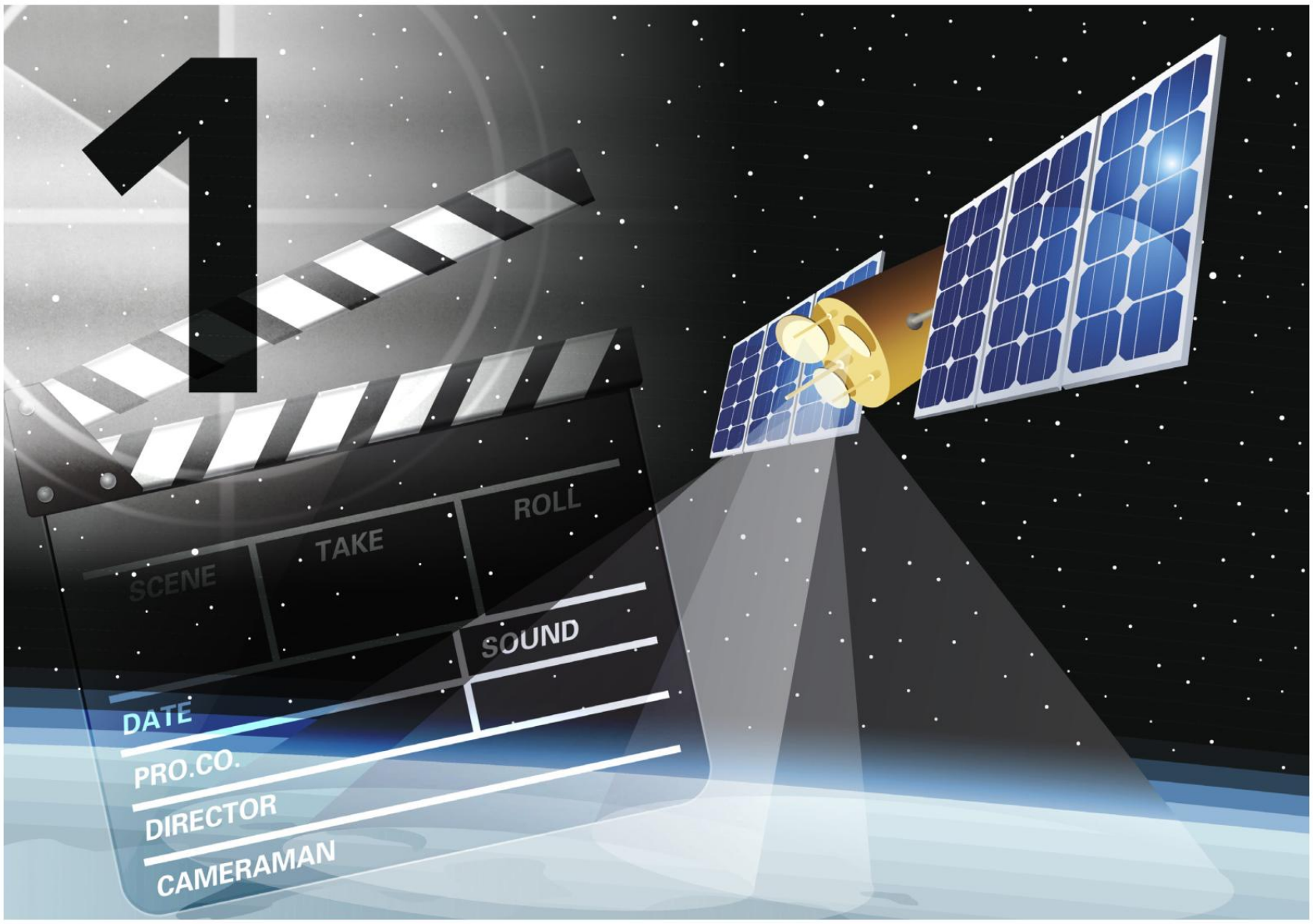
"A range of approval procedures and their corresponding timescales will need to be observed worldwide," Audi said. "Audi will therefore be adopting a step-by-step approach to the introduction of the traffic jam pilot in production models."

Audi plans to start selling the A8 this fall; the base model will set you back €90,600, or about $103,000.

"The A8 also has two autonomous parking features called 'AI remote parking pilot' and 'AI remote garage pilot.'"

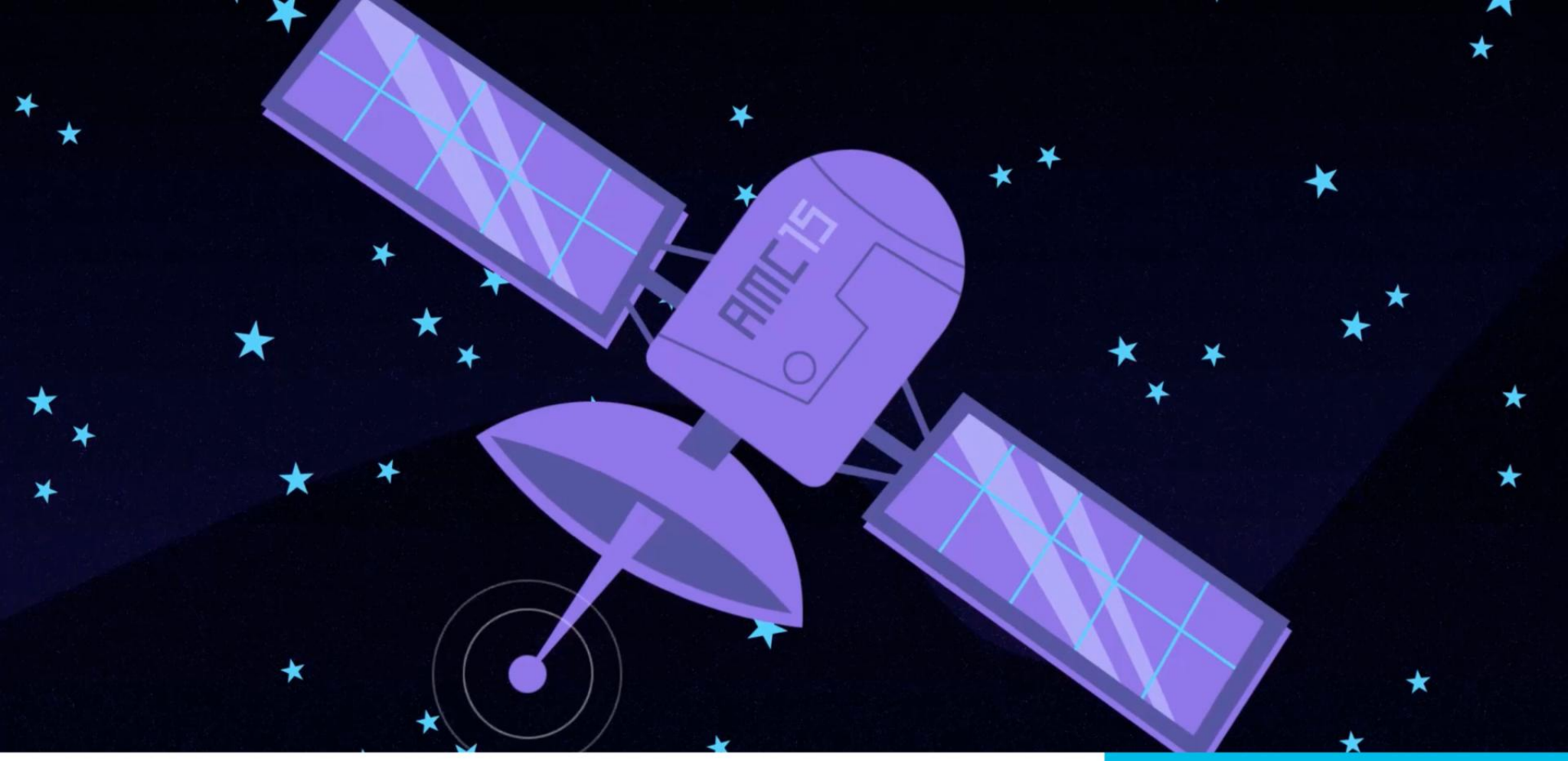
Movies—Brought to You By Satellite

BY SOPHIA STUART



When standing in line for the latest blockbuster, you're probably thinking about getting a good seat or digging into some popcorn. But if you're in one of the nearly 30,000 theaters serviced by the Digital Cinema Distribution Coalition (DCDC), take a moment to glance up at the roof—because your movie will be beamed in via satellite.

You likely don't give much thought to how your movie gets to the big screen, but in the case of DCDC, digital files from movie studios are delivered to a processing center in Burbank, CA and sent via high-speed fiber connection to DCDC's uplink in Arizona. Encrypted files are then transmitted to a satellite that's in geosynchronous orbit above the U.S. This satellite beams movies to dishes on theater roofs.



To learn more, PCMag met DCDC CEO Randy Blotky at Cinemark Playa Vista and XD, a massive cinema complex in Southern California. It's part of the $260 million Runway at Playa Vista project, which is transforming former aerospace land, once owned by reclusive mogul Howard Hughes, into a retail hub and modern office park. Nearby tenants include startups as well as established firms such as Yahoo and Google.

The DCDC distributes movies through "a specially created network comprised of next-generation satellite and terrestrial distribution technologies."

Blotky is a former Warner Bros. senior executive, but he has serious geek credentials: a B.S. in engineering physics from the University of California, Berkeley; graduate studies in astrophysics at MIT; and a stint as a physicist in the Southern California aerospace industry, where he worked on various classified projects. These days, his work is a little less cloak-and-dagger.

"The idea for electronic delivery of movies has been around [since at least 2007]," Blotky told PCMag. "But many of us in the industry thought that carrying around fixed media to deliver films to cinemas was something that was on its way out. In 2007, when Warner Bros and a few other well-known entertainment companies started talking about the best way to implement the idea, they realized that many other distribution and exhibition companies might also be interested in joining the effort. It all really came into being when, in 2013, DCDC was founded by Universal Pictures, Warner Bros., AMC Theatres, Cinemark and Regal Entertainment."

How did Blotky get the studios to sign up with DCDC and hand over digital distribution of their treasured blockbusters?

"It took a lot of hard work. There's a lot of inherent distrust in Hollywood," Blotky told PCMag. "For example, one potential client I went to see said, 'Randy, you seem like a nice guy, but why would I ever entrust my crown jewels of intellectual property to a company that is run by two of my largest competitors and the three largest theater chains?' So I needed to convince everyone that, as a user of the system, we would protect the integrity of their content and create an economic model that would accrue economic benefits equally to all. And that is what we have done."

DCDC now serves 75 percent of U.S. theater screens. While the digital delivery of movies is its main driving force, DCDC's ambitions for the industry are a lot bigger. In the future, Blotky explained, exhibitors will be "programming the cube," with the "cube" being the entire cinema complex, not just what's on the screens.

"For example, here at Cinemark Playa Vista and XD, in the future, DCDC might be able to [help] manage digital signage, ticketing, and loyalty programs with self-identifying apps/beacons as well as delivering live events," he said. "Eventually you'll have theaters that are outfitted for specific types of esports as well as movies designed around certain tech-heavy catchment areas, like here in Playa Vista. This means it won't just be about watching events, but competing, too."

While the digital delivery of movies is its main driving force, DCDC's ambitions for the industry are a lot bigger.

What We Love Most This Month

BY STEPHANIE MLOT

KANO PIXEL KIT

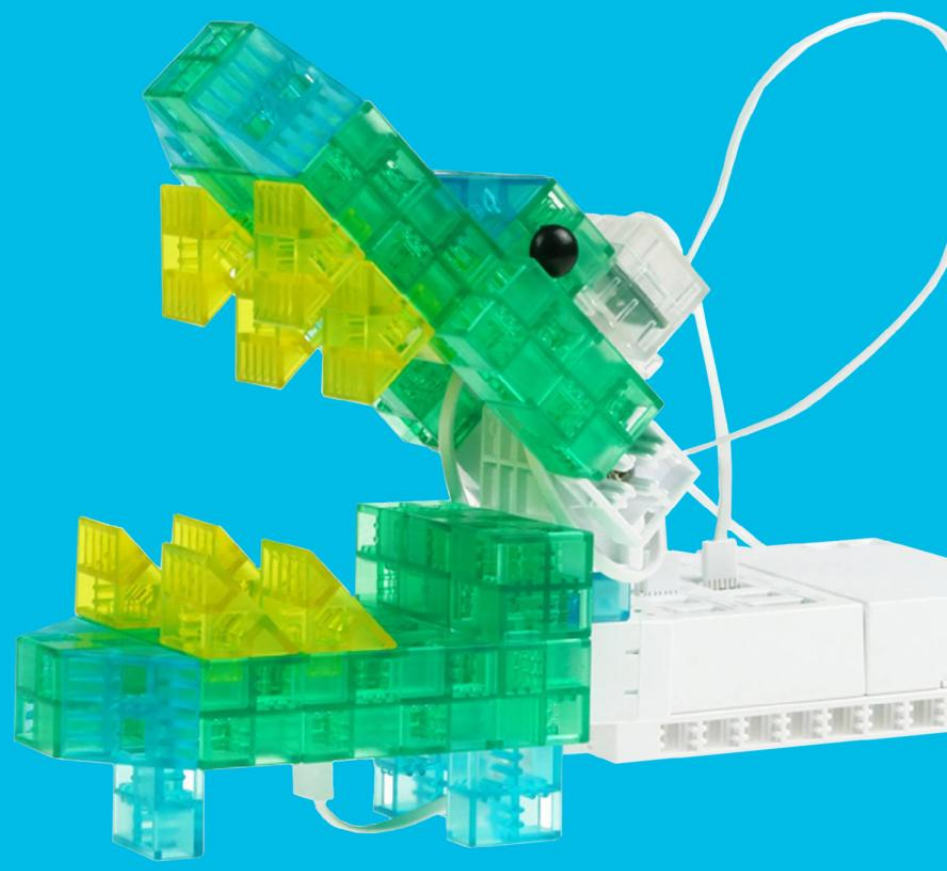
Nearly a year after its successful Kickstarter campaign, the Kano Pixel Kit is now available to the masses. The LEGO-like light board has 128 pixels that bring to life your own games, data, artwork, and music. You get a box of buttons, boards, batteries, books, and more. Build the Pixel Kit yourself, then connect it to a computer (Mac or PC) and download the Kano App. The program uses storytelling and game mechanics to simplify coding; it features more than 40 challenges and access to a handful of tools (including the ability to track the International Space Station). And each pack includes access to Kano World, an online community platform where millions of lines of code and DIY instructions are shared.

$79.99, www.kano.me

SONY KOOV

Koov is a coding and robotics kit designed to inspire innovation and teach kids ages 8 to 14 STEM skills along the way; it could make a fine intro for the less tech-savvy adult as well. The Basic ($199), Starter ($359), and Advanced ($499) Kits supply the hardware you need to build a robot—CPU blocks, motors, actuators, sensors, LEDs, and colorful plastic building blocks of varying shapes and colors (the colors are meant not to appeal to one gender over another). The included Koov app encourages you to start learning how to make and program a robot via the aforementioned educational course, which takes you step by step through the coding process with plenty of visual help. Koov kits are already being sold in Japan and China. For the U.S., Sony decided to launch Koov on Indiegogo.

www.indiegogo.com



EUROSTAR ODYSSEY

Eurostar Odyssey is a virtual experience designed to take the train company's passengers on an immersive adventure as they ride between England and France or Brussels beneath the English Channel. Log into the onboard entertainment system on your personal Apple or Android device; you can view directly on the device or unfold the free cardboard VR headset that's provided and pop your phone into that. Then sit back and relax as the "Odyssey" experience turns your train ride into a deep-sea dive. From Oceanarium to the mysterious HMS Victory to the Abyss, keep your eyes peeled for different species—including Esther the octopus, who guards the sunken ship's treasure. Eurostar Odyssey is available on new e320 and refurbished e300 trains running between London and Paris, Lille, Brussels, Lyon, and the south of France.

www.eurostar.com

Evan Dashevsky

COMMENTARY

How Genetic Engineering Fixed My Stupid Back

Around the age of 15, I began experiencing periodic bolts of searing pain shooting down the outer sides of my legs and up through my shoulder blades. The pain would occasionally grow so debilitating that I was forced to walk with a cane and could barely manage a flight of stairs. For sleepless months at a time, I would limp and grimace through my day. The worst part was that doctor after doctor was not able to diagnose the problem, and I resigned myself to a life of making the best of it.

Evan Dashevsky, a features editor for *PC Magazine*, has been writing about tech since 2010 for such publications as *PC World*, TechHive, ExtremeTech, and Digital Times.

Once I hit my mid-30s, I couldn't take the pain anymore and decided I had to do something about it. I tasked myself to keep seeing doctors until somebody could tell me what the problem was. After plowing through a series of specialists, I eventually found my way to a rheumatologist who diagnosed me with an inflammatory condition that isn't exactly fully understood by science, called ankylosing spondylitis (spelled just like it sounds).

Now, this condition can be treated somewhat with a special diet, but the food restrictions are pretty harsh, and results in my case weren't always consistent. But as it turns out, modern science has another fix.

My rheumatologist recommended that I begin a regimen of a type of medicine known as a "biologic" (or sometimes "biopharmaceutical"), which is synthesized directly from living organisms. I put a lot of trust in science and technology's ability to make the world a better place, so I was open to seeing what this cutting-edge treatment could do for me.

And I am happy to say that after a month or so, the treatments worked—in fact, they worked far better than I could have possibly imagined. I've been almost totally pain-free for the past two years and even taken up running. (I should note that the medications I was on came with some serious potential side effects—most notably, they suppress your body's immune system, including the ability to fight certain cancers. For me, the tradeoff was worth it.)

Now, this medication was unlike any other I had taken—I had to inject it. Most second-generation biologics used to fight inflammatory conditions have to be introduced directly into the body through a syringe or via an IV. I had to learn to use a disposable epi-pen–like contraption, which I keep stored in my refrigerator. There was a learning curve, but not a sharp one (and it certainly helped that I am not at all squeamish when it comes to needles).

So, what is this magic goop I inject into my body? It comes from natural sources, but at the same time—there really isn't anything natural about it.

MAGIC GOOP

Scientists have been deriving medicines from living organisms since forever—just about every

vaccine you've taken can be considered a biologic. However, the scope of these medicines have boomed in recent years with the advent of genetic-manipulation techniques.

While the exact definition of "biologic" varies from regulatory body to regulatory body, the term is often used today to refer to newer classes of drugs resulting from techniques that tweak cells at their fundamental genetic level to turn them into living factories.

According to the FDA's own description, "In contrast to most drugs that are chemically synthesized and their structure is known, most biologics are complex mixtures that are not easily identified or characterized." Many of these second-generation biologics (ones that have popped up in the past 15 years or so, as opposed the first-gen ones such as vaccines) are not recreatable—by humans. We just don't know how. However, scientists can use modern genetic-manipulation techniques to cajole living cell cultures to do it for them. Therein lies a wrinkle to the biologic story—they can be insanely expensive.

The manufacturing of these medicines is a complex undertaking, particularly on an industrial scale. Not only is there gene manipulation, but the cellular cultures are particularly susceptible to contamination and must be maintained under very aseptic and strictly temperature-controlled environments—all of which must take place under the supervision of a highly trained workforce. When you consider that the patient pools are relatively small, prices inevitably rise.

"The scope of these medicines have boomed in recent years with the advent of genetic-manipulation techniques."

WHY WE SEEK TO ANSWER STUPID QUESTIONS

I can only speak for myself and say that these drugs have been a godsend and truly improved my quality of life. But I'm also fascinated (and even humbled) to consider how this treatment would not be possible without decades of scientific inquiry that took place before it.

The line of scientific history—down through Darwin, Mendel, and the team of Watson & Crick—had no idea it would one day help a middle-aged tech blogger not have to limp in pain for months at a time. They all just wanted to know the answers to weird and impractical questions.

This is why I get annoyed when I hear politicians wanting to balance budgets on the back of scientific research. Its benefit is invaluable—just not always immediately. Quantum physics took decades to find a use in the function of smartphones, as it took years for Einstein's theories to be used in satellite configuration.

There is no way we can predict how the "impractical" research of today will affect some major breakthrough years down the line. That's why we should all want our tax dollars to fund inquiry into weird, unnecessary questions like, "Do gravitons exist?," "What does Pluto look like?," or "Is the whole universe a hologram?" Answering those questions might not necessarily bring us a new breakthrough today—in fact, they probably won't. But they leave us with the promise that they will someday.

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This is why I get annoyed when I hear politicians wanting to balance budgets on the back of scientific research.

Doug Newcomb

COMMENTARY

Don't Let Partisan Bickering Slow Self-Driving Car Development

There's no shortage of issues for Republicans and Democrats to disagree on. But judging from recent hearings held by the House Energy and Commerce Committee, which debated 14 bills that Republican lawmakers believe could clear a path for federal autonomous-vehicle legislation, the two parties are far apart on specific aspects of self-driving car policy.

Car tech expert Doug Newcomb has written for *Popular Mechanics*, *Road & Track*, and other publications, and is the author of *Car Audio for Dummies*.

Lawmakers do agree that they want autonomous vehicles to succeed for various reasons, not the least of which is to save some of the 30,000-plus lives lost to car accidents each year. Ohio Rep. Robert Latta, chairman of the Digital Commerce and Consumer Protection subcommittee, said in opening remarks that the "goal today is to enact the right policies to encourage self-driving technologies that can drastically reduce those numbers."

Automakers, tech giants such as Waymo and Apple, and ride-sharing companies such as Uber and Lyft are battling for self-driving supremacy, and in Waymo and Uber's cases, they're taking the fight to court. But they agree that regulation

needs to come from the federal level to avoid a patchwork of state laws, and many are members—including Google and Uber—of a lobbying group with that aim.

One of the most ambitious Republican proposals seeks to allow up to 100,000 autonomous test vehicles on public roads—a steep increase from an Obama-era policy that allowed only 2,500. Republicans also want to waive safety standards, such as requiring a steering wheel and gas and brake pedals, that don't apply to robo-taxis being developed by Ford, Waymo, and others.

Testing such large numbers of autonomous cars on public roads without safety measures in place raised concerns among Democrats and some safety advocates. And others worry that legislative gridlock in Congress over self-driving cars could prevent the U.S. from staying at the forefront of self-driving technology.

A sticking point for some Democrats is that President Trump has yet to appoint someone to head the National Highway Traffic Safety Administration (NHTSA), which oversees motor vehicle rules and is a linchpin in development of the self-driving car regulations. New Jersey Democratic Rep. Frank Pallone, for example, said none of the 14 bills should move out of committee without input from NHTSA. (No one from NHTSA attended the hearings.)

"This is a big moment for us," Pallone said. "We need to be sure that we get this right and that safety is the first priority."

Democrat Rep. Jan Schakowsky of Illinois is also resistant to such large-scale testing of autonomous vehicles if it involves waiving U.S. safety rules. “We need to figure out a responsible way to keep innovation moving forward, while ensuring safety at every stage,” she said.

Alan Morrison, a law professor at George Washington University and cofounder of the consumer advocacy organization Public Citizen with Ralph Nader in the 1970s, said in the hearings that he believes the proposed legislation would lead to “less safety and more preemption, all in the name of technological advancement.”

“I think there’s a way forward,” he added, “but these bills are not it.”

In the meantime, countries including China and Germany are rapidly moving forward with autonomous testing and development, and there’s worry the U.S. could lose its leadership position in self-driving technology. “America is the true innovation leader in this field, at least for now,” said Mitch Bainwol, CEO of the car industry trade group Auto Alliance, in written testimony at the hearing. “It is in the national interest to protect that advantage.”

It’s still early in the process and a good sign that Congress is working to move federal legislation forward (the Senate is working on its own series of bills). But it’s also in the nation’s interest that lawmakers on both side of the aisle put partisan politics aside and compromise, so that the U.S. isn’t left in the dust on self-driving technology.

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COMMENTARY

Google Classroom Could Bridge a Gap in Online Learning

Contrary to popular perception, faculty are not reflexively opposed to online learning. In a recent survey of 3,500 postsecondary faculty and administrators, Tyton Partners found that a majority of faculty—63 percent—valued the potential impact of courseware.

PC Magazine Contributing Editor William Fenton is a Teaching Fellow and director of the Writing Center at Fordham University Lincoln Center.

The trouble is, they lack the time and training to pursue it. The solution isn't another learning management system (LMS). Educators need an easy onramp to blended learning that leverages the tools and repositories they already use. Google might have the answer.

Google G Suite for Education is already a fixture in K-12 and higher education. According to Google, 70 million students and teachers rely upon the online suite—half of all primary and secondary students in the U.S. and more than 800 colleges and universities, as of last spring. Increasingly, Google's tools are the tools of education, as noted by the New York Times.

Google Classroom, which the company brands as "mission control" for G Suite, serves as a gateway to that popular suite. Classroom is no rival to a traditional LMS. But by prioritizing simplicity

and collaboration, it could serve as a bridge between classrooms and the technological infrastructure that administrators use to measure student learning.

CLASSROOM 101

Compared with established systems such as Blackboard (founded in 1997) and D2L (1999), Google Classroom is a toddler. August 2017 marks the product's third anniversary, and it's growing up fast. In May, for example, Google added the ability to invite students and co-teachers using Google Groups.

When the product is enabled by an administrator, educators can create electronic extensions to classes with just a few clicks. Instructors can share announcements with YouTube links, create assignments that leverage Google Forms, and share and annotate Google Docs. For their part, students can access classes on any device—desktop, smartphone, tablet, or Chromebook—using the same credentials they use for G Suite.

While some enterprising educators have found ways to pilot online classes through Google Classroom, it's designed to support traditional in-person classes. I don't regard this as a limitation. As I've noted before, there are often tradeoffs to taking classes online, whereas most research suggests that flipped classes—especially pre-class activities—promote active learning and improve educational outcomes.

Google Classroom makes it easy—exceedingly easy—for educators to flip classes or at least to channel some learning through a digital environment. It's a welcome addition for any

educator who uses G Suite for Education. In fact, now that Google has made Classroom available for personal accounts, it's a welcome addition for any educator who uses G Suite.

SIMPLICITY

Google Classroom's primary virtue is that it lowers the barriers to experimenting with technology-enabled instruction. Alice Keeler, who wrote the book on Classroom, trumpets its ease. "The genius of Classroom is that it's so simple," she said. "If you've sent an email, this is for you. I can get someone up and started, collecting assignments, in less than five minutes."

"I can get someone up and started, collecting assignments, in less than five minutes."

Google Classroom leverages the materials instructors have already loaded into Google Drive. That is, where an instructor would have to manually upload a syllabus into Canvas or Moodle, she can simply select it from Drive for use in Classroom.

When I spoke with Erin Horne, assistant director of professional education who co-initiated the Google Classroom pilot program at NC State University, she praised the product's interconnection with G Suite.

"Google Classroom worked well with all of the tools I was already using," said Horne. "From an instructor standpoint, Classroom makes it very easy for me to facilitate that collaboration. As opposed to creating one document and sending it around, with Classroom I can see the whole process and give them feedback throughout that process, as opposed to treating their work as this final product that they submitted to me."

COLLABORATION

Google Classroom is also more conducive to process-oriented assignments than a traditional LMS. Bethany Smith, associate director of instructional technology training, who co-initiated the NC State pilot with Horne, said Classroom is well suited to the project-based learning that occurs in education departments. “Every assessment is a project that needs to be turned in,” explained Smith. “For example, students develop a lesson plan over the course of the semester.”

With Google Docs, instructors can annotate lesson plans before students enter classrooms, and students can tag instructors with comments. Should they need to discuss an assignment in real time, students and instructors are only a tab away from the rest of G Suite.

“From a teaching standpoint, the greatest benefit of using Google Classroom over the other learning management systems that I have used is the opportunity for collaboration between students as well as collaboration with me as the instructor,” said Horne.

None of these collaborative features is unique to Classroom: For example, Moodle supports chat, video-conferencing, document versioning, and peer review. Google Classroom benefits from widespread familiarity with G Suite. There’s a reason Schoology and Edmodo have opted for interfaces similar to that of Facebook: The best tools are the ones that we already know how to use.

SCALING UP AND OUT

That Google Classroom extends G Suite doesn’t make it a capable course-management or learning-management system. Faculty and administrators agreed that the platform would benefit from additional assessments, discussion forums, and a gradebook that could calculate student grades based upon assignments completed.

Nevertheless, in some instances, limitations could break bad habits. Consider course duplication: While duplicating a course may expedite setup, it doesn’t always serve the interests of students.

"I think one of the best things about Google Classroom is that you can't reuse the whole class," said Keeler. "You can't just duplicate all of your assignments because every time you reuse an assignment, you should think for a second about whether it's good for your students. It forces me to be a lot more reflective and adaptive to student needs when I have to reuse materials one at a time."

In other instance, educators have improvised solutions. Smith noted that instructors can create groups assignments using their Classroom roster with add-ons Doctopus and Goobric. Others have used Google Forms to create self-grading multiple-choice assessments. But there are limits to the extent to which educators can scale up Google Classroom.

While Google has released an API to support third-party integrations, those integrations tend to be manual in nature. For example, developers have created tools (rosterSync, for example) through which educators and administrators may sync class rosters using a CSV file. But let's clear: an API will not enable large-scale adoption at institutions that rely upon automation. There's a reason that large universities such as NC State have constrained adoption to pilot programs: they're waiting for the tools that will automate the creation of courses and collection of student data.

"Google Classroom isn't going to replace our LMS," said Smith. "What I would personally love is for our LMS to integrate with Google Classroom, so we could use Moodle Modules to create Google Classroom assignments."

Google Classroom is also more conducive to process-oriented assignments than a traditional LMS.

That sentiment was echoed by Stan Martin, director of Outreach, Communications and Consulting at the university's Office of Information Technology: "I don't think our Learning Technology group sees it as a replacement for our current LMS, but they want to be able to leverage some of its functionality for the group work."

Google ought to acknowledge those institutional investments and interoperate with existing learning-management and student-information systems via the Learning Tools Interoperability standard. When it comes to higher education, integration isn't optional. (As it stands, most administrators aren't eager to support a second LMS.) If Google can address those administrative concerns, though, Classroom could provide a bridge between the students and faculty who already work in G Suite for Education and administrators who use LMSs to collect, manage, and report student data.

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"Classroom could provide a bridge between the students and faculty who already work in G Suite for Education."

Amazon's Alexa Gets a Screen of Her Own

Amazon continues to develop and expand its Alexa voice assistant, giving it new abilities and putting it in new devices. Speakers such as the Echo and Echo Dot are voice-only, but Alexa can display visual information on request when in a device connected to a screen, such as the Amazon Fire TV. The first Alexa-specific Echo hardware with a screen, the Echo Show combines the voice assistant features of the Amazon Echo with a 7-inch touch screen and a 5-megapixel camera. It's undoubtedly a technical upgrade, but the jury is still out on whether the addition of a display is worth the increase in price over voice-only alternatives.

Amazon Echo Show

$229.99

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DESIGN

The Echo Show has an oddly angular design that looks slightly dated compared with the Echo speakers and especially the Google Home. It's a black or white slab (the white version still has a black shell) with an uneven pentagonal profile, looking like a triangle with two shaved points when viewed from the side. It measures 7.0 by 7.4 by 4.0 inches (HWD) with a square front panel that faces slightly upward at an angle. The front panel consists of a 7-inch, 1,024-by-600 touch screen above a flat plastic rectangular speaker grill. The top panel holds Volume Up/Down and Microphone Mute buttons, and the back panel has a single connector for the proprietary power adapter.

The angular lines of the Echo Show might work with modern TV design, but they're blocky and stark for a bookshelf or desk speaker. The form factor is evocative of the ill-conceived fad of "internet appliances" intended for countertops and tables (remember the Chumby?). It's counterintuitive that adding features such as a screen and a camera make something look less advanced, but when everyone has a smartphone in their pockets and most voice assistant speakers are rounder and friendlier-looking, the chunky Echo Show comes off as awkward and almost quaint.

SETUP AND CONNECTIVITY

Thanks to its touch screen, setting up the Echo Home is simple and doesn't require any additional devices. When you plug the Echo Home in, the screen displays available Wi-Fi networks and asks you to pick one. After connecting to the network, it walks you through logging in to your Amazon account, then checks for any firmware updates. Once everything is up to date, the default home screen appears, and the Echo Show is ready to take your commands.

Amazon Echo Show

PROS Touch screen useful for discovery, selecting suggested items, and controlling playback. Full range of Alexa features with visuals.

CONS Limited touch control options. Drop In voice and video messaging works only with other Alexa users. Dated design. Unimpressive audio quality for the price.

The Show doesn't have any wired connections besides the power connector. It features dual-band Wi-Fi for fast internet access, but the Bluetooth capabilities are the really interesting part of the device: It functions as both a Bluetooth speaker as well a sound source. You can pair the Echo Show with your smartphone or tablet and play music through its speaker. You can also pair it with a separate Bluetooth speaker or headphones to stream audio from the Echo Show itself.

If you plan on listening to music directly from the device with voice commands, be careful when pairing the Echo Show with your smartphone or tablet. The Bluetooth pairing takes precedence over any music streaming from Amazon, which led to tracks stopping when I fired my iPad up. It's a small annoyance, but it's irritating when you're in the middle of a song and the Echo Show suddenly connects with your smartphone or tablet and breaks the stream. Of course, you can play music from any service through your mobile device, so you're ultimately making a tradeoff between two different types of conveniences.

It features dual-band Wi-Fi for fast internet access, but the Bluetooth capabilities are the really interesting part of the device.

The Echo Show has an oddly angular design that looks a bit dated compared with the Echo speakers and especially the Google Home.

THE MAIN EVENT: THE SCREEN

The Echo Show's home screen is a passive display rather than a main menu. It shows the current time over a rotating series of backgrounds, with additional information and cues fading in and out. By default, the home screen alternates between the current local weather, trending news stories, notifications from skills, upcoming appointments on your calendar, and the availability of anyone on your Alexa contact list for Drop In calls (more on those later).

You can manually navigate between active home screen cards by swiping left or right on the screen. If you aren't sure what to ask Alexa, the screen suggests different commands and questions to try out, like, "Alexa, wake me up in the morning" to set an alarm, or, "Wikipedia soccer" to bring up the Wikipedia entry for soccer, or, "Alexa, play the barista video" to play a suggested video about coffee art.

The screen is nearly identical to the one found on the Amazon Fire 7 tablet, and as such is fairly grainy at 171 pixels per inch (ppi) compared with even the 1,280-by-800 Fire HD 8 (189ppi). Text is legible, but it isn't as bright or vivid as text on a midrange smartphone or television; it's fine, but the display is clearly designed to provide information, not to be a primary means for media consumption. The touch controls are responsive when you're navigating the Show's settings menu but lag somewhat switching between tracks when you're playing music.

The Echo Show's home screen shows the current time over a rotating series of backgrounds, with additional information and cues fading in and out.

Swiping down on the touch screen displays a menu bar with Home, Settings, and Do Not Disturb buttons, along with a brightness slider. The Home button sends you right back to the home screen (you can also say, “Alexa, go home”). The Settings button lets you access the Echo Show’s settings menu, where you can change a lot of things without using a mobile device and the Alexa app; say, pairing with Bluetooth devices or changing the Alexa wake word from “Alexa” to “Amazon,” “Computer,” or “Echo.”

Don’t expect much more in terms of touch controls—or an app store, for that matter. The Show is primarily an Alexa voice assistant, and its screen is more for showing what you ask for than navigating directly to it yourself. There are no icons, no apps, and no menus to navigate besides the device settings. You’ll touch the screen to pause and skip music tracks, swipe across products Alexa suggests based on your search, and flick over light information cards.

ALL ABOUT ALEXA

As an Alexa-controlled device with a microphone array, touch screen, speaker, and camera, the Echo Show covers the full range of features Amazon’s voice assistant offers. All of the basic functions are here, letting you ask Alexa factual questions, request traffic and weather reports, check upcoming appointments in your calendar, and add items to your to-do list.

You can shop on Amazon with the Echo Show, giving you the voice-control benefits of the Amazon Dash Wand. Alexa can add items directly to your Amazon shopping cart and even place instant orders. The touch screen shows a list of products you can swipe through when it can’t identify the specific item you want. But you can’t directly check your shopping cart from the Echo Show; you need your mobile device or a computer to view or edit anything in your cart after you add items or to place an order of the entire cart.

Alexa can control your smart home devices as well. As with the Echo, you can tell the Show to turn your smart lights on, lock your doors, adjust your temperature, and manage any other Alexa-compatible (or IFTTT-controlled) device. Thanks to a recent update and API release, the Echo Show can even bring up video feeds of compatible security cameras, including the Netgear Arlo Pro and Ring Video Doorbell Pro. With the Ring, for instance, you can say, “Alexa, show me the front door,” to see and hear who is there.

The Show can make voice or video calls and send speech-to-text messages to your contacts. Drop In is Amazon's own Alexa-powered chat and messaging service, and that means everyone you want to talk to needs to either have an Echo Show or install the Alexa app on their mobile device.

DROP IN

Messaging features haven't always been Alexa's strong suit, but the Show's new Drop In system helps fix that. The Show can make voice or video calls and send speech-to-text messages to your contacts. Drop In is Amazon's own Alexa-powered chat and messaging service, and that means everyone you want to talk to must have an Echo Show or install the Alexa app on their mobile device.

Text messages, voice calls, and video calls are all sent through Alexa and are part of Amazon's closed communication system. This means you can't send text messages or place calls to someone's phone unless they have the Alexa app installed, and you can't make video calls on third-party services such as Skype or Google Hangouts. This small, closed scope can be handy for keeping households in touch (assuming everyone is on the same page with the Alexa app on their smartphones), but anything beyond that requires a more robust and universal communication service.

The closed system is limiting, but the call quality is quite good. The Echo Show's camera and microphone array send a crisp image and clear sound to whomever you're calling, and the screen and speaker convey the caller well. The speech-to-text messaging isn't quite as strong; messages I dictated to the Echo Show were full of confusing errors.

The camera can also take 5-megapixel photos, with a Photo Booth function that uploads snapshots directly to Prime Photos. The test photos we took looked crisp and sharp under the bright fluorescent lights of PC Labs. Since the Show is meant to be set somewhere stationary, and you can't adjust the angle of the camera, you may not utilize this feature too often (unless you like taking photos in the same spot).

ALEXA, PLAY SOMETHING

Amazon's various media libraries, both audio and video, are available on the Echo Show. You can ask Alexa to play any music from Prime Music or Amazon Music, or any show or movie from Prime Video. The video playback is a nice touch, but since the Show doesn't have any video output, you have to watch it through the 7-inch screen; an Amazon Fire TV Stick is a much better way to access this as well as video from other services, including Hulu and Netflix.

As mentioned above, the screen itself is grainy and clearly isn't designed as a primary method of watching video. Music services are more flexible, since Alexa supports Amazon's music libraries plus iHeartRadio, Pandora, Spotify, and TuneIn.

"Amazon's various media libraries, both audio and video, are available on the Echo Show."

AUDIO PERFORMANCE

The Echo Show features two 2-inch speaker drivers for stereo audio powered by Dolby processing. Despite this, it has only average sound quality for the price. Our bass test track, The Knife's "Silent Shout," distorts heavily at high volumes. The kick drum hits crackle and every bass synth note is followed by what sounds like a quiet, belabored breath as the drivers struggle to handle the low frequencies.

The Damned's "Nasty" gives a stronger sense of the speaker's range beyond ultra-low frequencies. The dense punk track at times gets overwhelmed by the low-mids of the bassline and drums, muscling in on any midrange presence the guitars and vocals have to offer. The higher frequencies of the noodling and singing still stand out, but it sounds like the disparate parts of the mix are all fighting for prominence a bit more than they should (even for punk music).

The speaker works much better for jazz and lounge tracks. Richard Cheese's cover of U2's "Bullet the Blue Sky" sounds clean and full. The low backing piano notes give the track a warm, round sound, while the higher piano notes and snare drum hits punch through the mix alongside Cheese's vocals to create a sculpted, balanced feel. Gorillaz' "On Melancholy Hill" also sounds good on the Echo Show, with the chirpy high notes and rolling bassline complementing each other in the mix without getting in the way of the vocals.

The Echo Show is certainly more powerful than the anemic Echo Dot (though you can plug the Dot into any speaker with a 3.5mm aux input, which you can't do with the Echo Show), and the Show can get louder than the portable Tap as well. It comes close to the original Echo in audio performance, though it isn't quite as loud, and the forward-facing directional drivers mean it really needs to face you directly to deliver the best sound. The original Echo sounds good regardless of where it is relative to you in the room, and its audio profile is a bit more balanced and not quite as stark as the Show's.

For Amazon Music or Prime Music users, the Echo Show's screen enables a fun karaoke feature. Tapping the Lyrics button on the screen on any song that offers it brings up its lyrics, scrolling in time with the music so you can keep up with (or sing along to) the song.

CONCLUSIONS

The Amazon Echo Show tries to do many different things with varying degrees of success. Functionally, it's the most capable Alexa-powered voice assistant available, with all of the vocal commands and media features of the Echo, Echo Dot, and Amazon Fire TV Stick, along with the advantage of a touch-screen interface for easy navigation and selection. It's also the first device to let you make video calls through Amazon's new Drop In messaging system.

But as a speaker, it's unimpressive given its price point; you can get better audio performance by pairing an Echo Dot with a less expensive option such as the JBL Block Party. The voice and video messaging features also feel very closed off as an Alexa-specific system, so it won't replace text messages or more broadly used voice and video call services such as Google Hangouts and Skype. The touch screen doesn't add much to the overall experience compared with a regular Echo, since Alexa can already do a ton of different, useful things without any video output.

If you're looking for your first Alexa device, the Echo Dot is less than a quarter of the price of the Echo Show and can get you acquainted with all of the voice-only features Alexa offers, with the ability to use your own speaker if the tiny built-in speaker isn't powerful enough for you. If you want visual information with Alexa, an Amazon Fire TV Stick is a similarly inexpensive option, and while you need to press a button to speak to Alexa instead of giving voice commands hands-free, it can load any Alexa-provided information on your television.

That said, the Echo Show is a handy little gadget you can put on your kitchen counter or bookshelf to get quick access to a lot of information using only your voice. And Amazon occasionally has sales on its devices—if you find the Show for around $200 on Prime Day, for instance, it becomes a much better value. You probably don't have any real reason to replace your current Echo for this chunkier version with a touch screen, but that could change. After all, we weren't sold on the voice-only nature of the original Echo at first until Amazon and third parties added to it after its release, making it far more useful. The same is possible with the Show, but only time will tell.

WILL GREENWALD

Lomo'Instant Is a Great Instax Mini Choice

PC MAGAZINE EDITORS' CHOICE

Fans of Fujifilm's Instax instant film format should pay attention to Lomography. The company has a growing line of cameras that use Instax, all of which offer more creative control than you get with models from Fujifilm. The Lomo'Instant Automat Glass is very much like the Lomo'Instant Automat; the difference is the lens. The Glass sports a—surprise—38mm f/4.5 glass lens for an ultra-wide field of view when paired with Instax Mini film. It captures the sharpest pictures I've seen in the format and is a lot of fun to use. It costs a little bit more than the standard Automat ($149), but if you crave a wider perspective, it's the Instax Mini to get.

Lomography Lomo'Instant Automat Glass

$189.00

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DESIGN

The Automat Glass is fairly small for an instant camera. It measures about 4.8 by 3.9 by 2.9 inches (HWD) and weighs in around 12.5 ounces. It won't fit in your pocket, but it's easy to stow in a small bag or carry with you when you're out and about. It has strap connectors, but you'll need to add your own strap and a standard tripod socket.

In addition to the camera you get a close-up filter, a lens cap that doubles as a wireless shutter release, colored gel filters, a few stands and clips to display photos, some glue dots for mounting images, and a book of shooting tips. You also get the Splitzer, a fun accessory that can black out half or three quarters of the frame for additional creative control when you're shooting multiple exposures.

The lens is a 38mm f/4.5 design, covering a field of view that's about equal to a 21mm lens on a full-frame camera.

The glass lens is a 38mm f/4.5 design. On the Mini format it captures photos with a field of view that's roughly equal to a 21mm lens on a full-frame camera. It's manual focus, with three set positions to lock onto subjects at about 1 foot (0.3-meter), 2 feet (0.6-meter) or from 3 feet (1 meter) to infinity. You can use the included close-up filter to lock on subjects closer than a foot, but you'll have to do some guesswork for framing, as the parallax effect means the viewfinder won't be accurate at very close distances.

Lomography Lomo'Instant Automat Glass

PROS Compact. Sharp, ultra-wide lens. Automatic exposure. Built-in flash. Selfie mirror. Multiple exposure support. Includes close-up filter and split frame mask. Color and monochrome film options.

CONS Uses CR2 batteries. Instax Mini format is a little small.

To turn the camera on, you'll need to press the lock button, which is next to the lens, and twist the focus ring. The shutter release is also on the front and doubles as a selfie mirror. Rear controls include a button to toggle the flash output, an MX (multiple exposure) button, plus and minus buttons to adjust exposure compensation, and an A/B button to switch between automatic and bulb exposure modes. If you're not familiar with bulb mode, it keeps the shutter open for up to 30 seconds—you just have to hold the shutter button down. It's a useful setting for long exposures and light painting.

A small optical viewfinder is positioned at the upper right corner of the camera. Film packs are loaded in the rear as well. You get 10 shots per pack, and images eject from a slot at the top. Images take about 30 seconds to start to emerge and a few minutes to develop fully. A bank of 10 lights, visible when looking down at the film eject slot, lets you know how many images are left in your pack of film.

Images eject from a slot at the top. They take about 30 seconds to start to emerge and a few minutes to develop fully.

The Automat Glass offers automatic exposure, but you can also use bulb mode for long exposure work.

The Glass is powered by two CR2 batteries. The small cells help keep the overall size down, but they aren't as readily available as the ubiquitous AA format. You can get them from Amazon, of course, and your local home supply superstore should have them, but don't expect to find them at a convenience store. Lomography doesn't state how long they'll last, but I used the same set of batteries with the Glass that I bought late last year to power the Lomo'Instant Automat—that's about six packs of film worth between the two reviews—and they're still going strong.

FILM AND IMAGE QUALITY

Instax Mini is an established format and is now available in your choice of color or black-and-white. Costs vary depending on how much you buy at a time—bulk purchases will reduce the cost per shot—but it's roughly $0.75 per image. Quality is quite high; the color film features natural, saturated colors, and the monochrome shows moderate contrast and strong detail.

I find the Mini format to be a little small, with the image area around 2.4 by 1.8 inches. The Instax Wide format, which costs about the same to shoot, is about twice as big (2.4 by 3.9 inches), but with it comes a bigger camera. Our favorite, the Lomo'Instant Wide, is roughly 5.8 by 7.5 by 3.8 inches.

The glass lens delivers crisper results than I've seen from other Instax cameras. It has a tendency to flare, creating a semi-circular ghost in photos shot on bright, clear days. Dim-light shots and images captured on an overcast day don't show this effect. There's also a noticeable vignette, darkening the corners of the frame, but that's not abnormal for a lens with such a wide field of view.

In addition to the camera, you get a close-up filter, a lens cap that doubles as a wireless shutter release, colored gel filters, some glue dots for mounting images, and a book of shooting tips.

The Glass is a stronger option than most Instax cameras for shooting in dim conditions. You'll still need to use a flash for indoor shots, but you can get better handheld shots at twilight thanks to the f/4.5 aperture. The standard Automat has a 28mm equivalent f/8 lens, and Fujifilm Instax Mini cameras all use a tighter 35mm equivalent f/12.7 lens. An f/4.5 lens gathers roughly four times as much light as an f/8 and about eight times that of an f/12.7.

The Automat Glass is a stronger option than most Instax cameras for shooting in dim conditions.

CONCLUSIONS

Instant film fans should take a close look at the Lomography Lomo'Instant Automat Glass. For less than $200, it delivers the best Instax output I've seen, and its wide field of view is a great option for capturing landscapes, environmental portraits, and architecture. We're naming it an Editors' Choice, although it doesn't supplant the Lomo'Instant Wide. If you prefer a smaller camera, wider field of view, and are happy with the Mini film format, the Glass is an excellent instant camera. If you crave a larger image, and don't mind the bulkier camera that comes with it, the Lomo'Instant Wide is a better fit.

JIM FISHER

Nintendo 2DS XL Supports Thousands of Games

The New 2DS XL is the best iteration of the Nintendo 3DS hardware so far—and that puts it in a very strange position. Nintendo released the Switch in March, and since then, the console has proven to be a very compelling handheld game system in its own right. Even the newest, nicest 3DS systems pale in comparison with the Switch. If money and availability aren't factors for you, we'd easily recommend the Switch. Still, while the New Nintendo 2DS XL isn't nearly as advanced as the Switch, it's only half the price at $149.99, and it lets you play countless excellent games from a massive library spanning 13 years; the Switch does not support backward compatibility in any form.

New Nintendo 2DS XL

$149.99

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THE MEANING OF "NEW"

Nintendo's use of the word "new" can get a bit confusing, and with so many different 3DS and DS systems released in the past, the New 2DS XL's purpose and capabilities might seem unclear. The easiest way to look at it is simply as a less expensive New 3DS XL that doesn't support 3D.

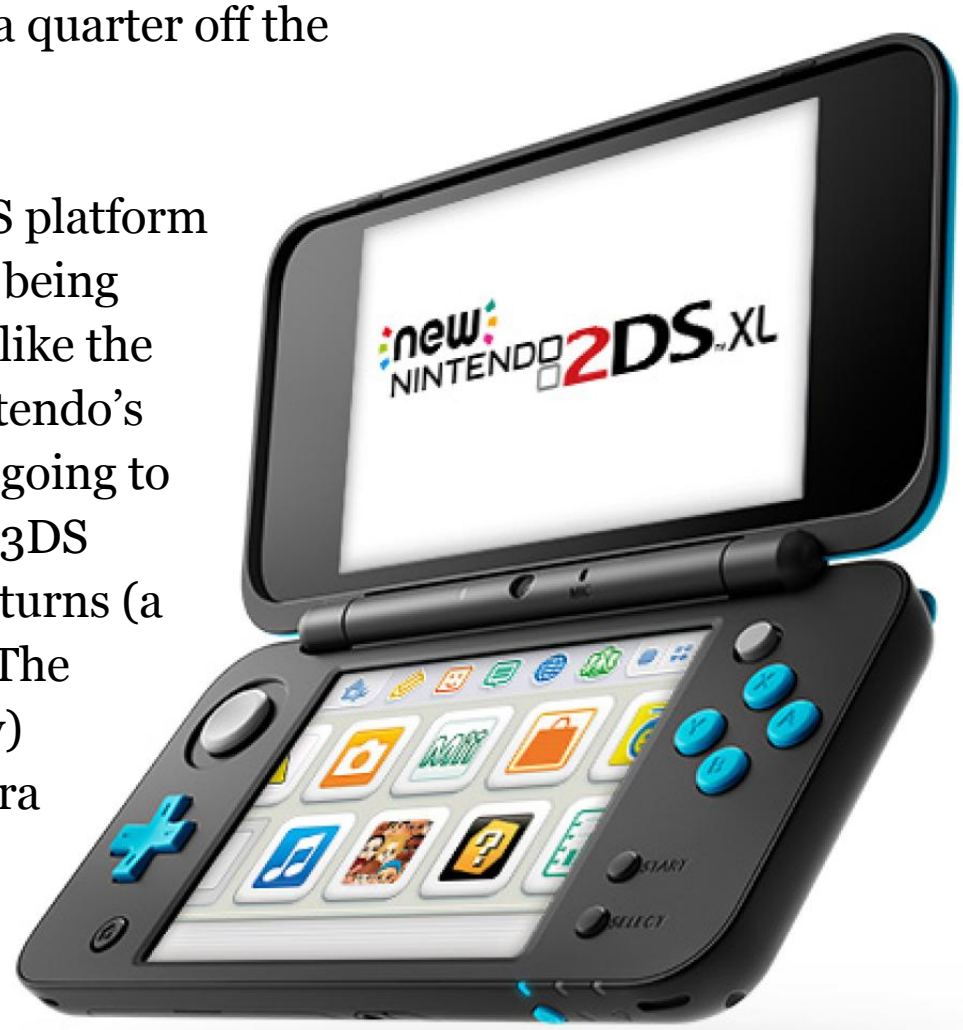
The New 2DS XL can run all of the same games as the New 3DS and the New 3DS XL (all 3DS game cards, most 2DS game cards, and any downloadable games available on the 3DS eShop), with both the higher processing power and analog control nub those two handhelds feature—features lacking on the the original 2DS, 3DS, and 3DS XL. It even has a pair of rear-facing cameras for taking 3D pictures (though you can't see them in 3D on the system) in addition to a front-facing camera on the inner hinge. There's also a built-in Amiibo reader on the touch screen for games with Amiibo support. The only thing you're missing, compared with the New 3DS XL, is the glasses-free 3D, and eschewing that feature chops a quarter off the price.

Nintendo plans to support the 3DS platform through 2018, and new games are being made for the system. But it seems like the biggest, newest games among Nintendo's major franchises will be primarily going to the Switch. The biggest upcoming 3DS games include Metroid: Samus Returns (a remake of the original Metroid 2: The Return of Samus on the Game Boy) and Pokemon Ultra Moon and Ultra Sun (half-generation sequels to Pokemon Sun and Moon).

New Nintendo 2DS XL

PROS Inexpensive. Functional, comfortable design. Supports library of thousands of DS and 3DS games spanning over a decade.

CONS Screen is very grainy and low-resolution next to the Switch. Feels redundant.



DESIGN

While the New 2DS XL's name and price indicate its place as a successor to the inexpensive Nintendo 2DS, it's leaps and bounds ahead of the single-body wedge shape of the 2DS, instead looking much more like the New Nintendo 3DS XL. It's a clamshell device measuring 3.3 by 6.2 by 0.8 inches (HWD) and weighing 8.9 ounces. The system is mostly black matte plastic with cyan accents on a border around the back of the top half, the power button, the face buttons, and the direction pad. The hinge on the device extends past the body, forming a bar-shaped protrusion when closed and disappearing under the top half when open.

Open, the New 2DS XL resembles the New 3DS XL in design, with a 4.8-inch screen on the top half and a 4.2-inch touch screen on the bottom half. The screen designs have been streamlined a bit from the New 3DS iterations. The top screen has no physically distinct border and is completely flush with the glossy black plastic panel that runs to the edges of the top panel. The bottom screen has a gentle, tapered bezel that flows into the matte black plastic of the bottom panel without forming the notable bumpy frame found on the New 3DS and New 3DS XL. It makes the New 2DS XL look and feel a bit slicker and more stylish than its predecessors.

The main controls are largely in the same place as on the New 3DS XL. A round analog control pad and cross-shaped direction pad sit to the left of the touch screen on the lower half, just above a Home button. An analog direction nub sits above A/B/X/Y face buttons, which in turn rest above small Start and Select buttons. L, R, ZL, and ZR shoulder buttons sit on the top edge of the bottom half of the device, while the power button and three indicator LEDs sit on the right side of the bottom edge of the system. A small slider on the left side of the bottom half of the device lets you adjust volume.

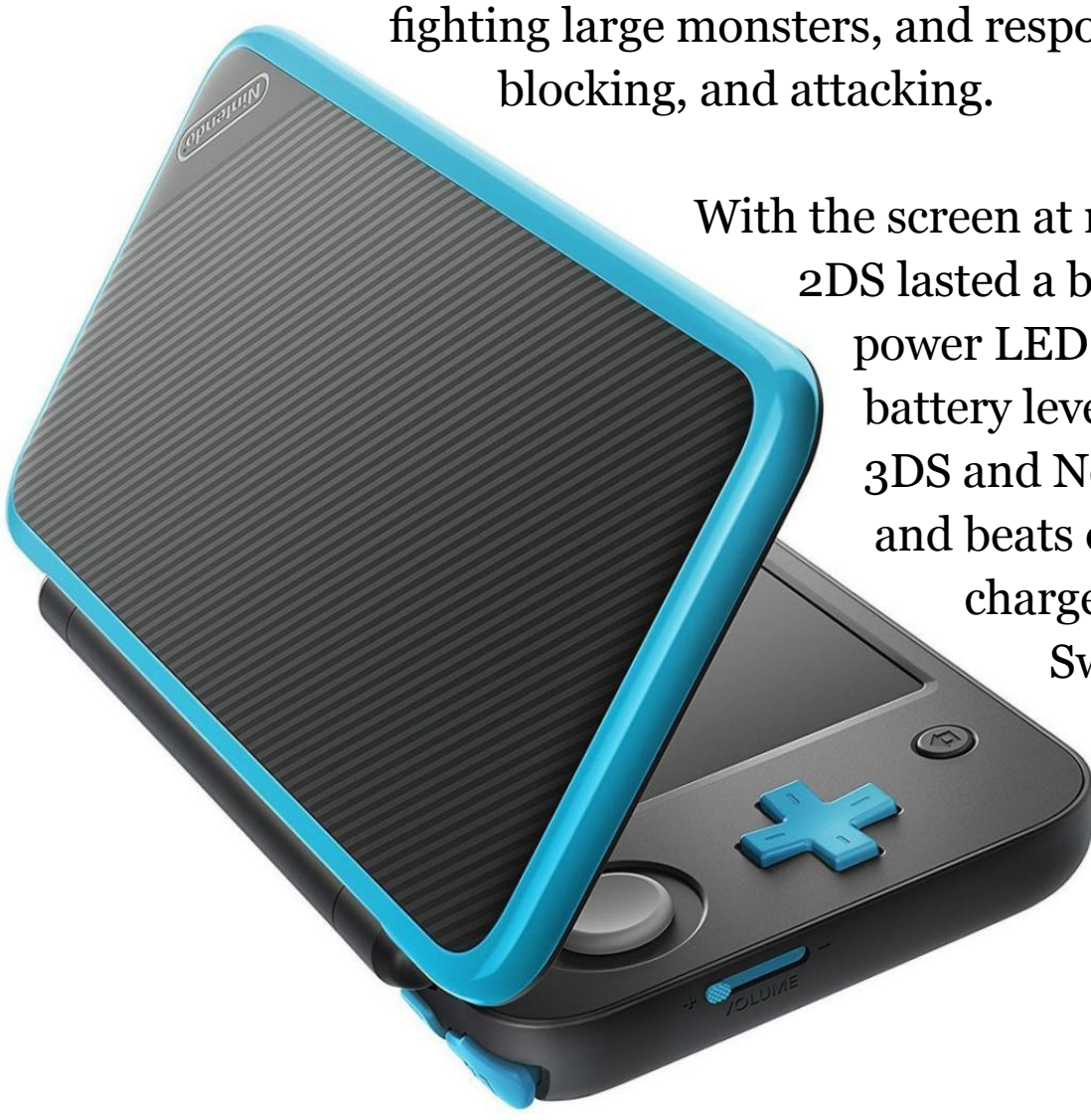
With so many 3DS and DS systems released in the past, the New 2DS XL's purpose and capabilities might seem unclear.

The game card slot sits on the left side of the bottom edge of the New 2DS XL, covered by a plastic door that also hides the microSD card slot (a 4GB card is included). The door is a nice touch, since previous 3DS systems have had uncovered game card slots, which can let the games pop out when being jostled in a bag or pocket, forcing a restart. The 3.5mm headphone jack is to the right of the door, next to a compartment that holds the included stylus when not in use. The power connector rests just under the right side of the hinge on the bottom half of the system, and a power adapter is included (the connector is the same one used by the 2DS, New 3DS, and New 3DS XL).

PERFORMANCE

I played Dragon Quest 8 and Monster Hunter Generations on the New 2DS XL, and they both worked just as well as it does on a New 3DS. Dragon Quest 8 plays very smoothly, and the analog control nub adjusts the camera easily. Like on the New 3DS and New 3DS XL, the nub feels very stiff, and isn't precise enough for aiming in an action game, but it's useful for camera controls and other activities that don't need a delicate touch.

Monster Hunter Generations runs well on the New 3DS, but infamously is nearly unplayable on the original 3DS and 3DS XL because of choppy graphics from the systems' lower processing power. I was pleased to see that it works perfectly on the New 2DS XL, with consistently smooth animations when fighting large monsters, and responsive controls for dodging, blocking, and attacking.



With the screen at maximum brightness, the New 2DS lasted a bit over five hours before the power LED turned red indicating a low battery level. This is in line with the New 3DS and New 3DS XL systems batteries, and beats out the Switch in time between charges by about an hour (though the Switch's battery life can vary significantly more depending on the type of game it's running).

AN AGING SCREEN

Both games' action take place primarily on the top screen, which looks excellent for a 3DS family device. It's fairly bright and vivid, and compares favorably with the New 3DS XL's top screen with the glasses-free 3D disabled. The 3D is seldom missed in most games, and I simply disabled it the vast majority of the time I played games on my New 3DS anyway.

However, the New 2DS XL can't hold a candle to the Nintendo Switch. The top screen has the same 400-by-240 resolution as every other 3DS device. The Switch's screen, meanwhile, is 720p (1,280 by 720), which means it has nearly ten times the number of pixels as any 3DS device's screen. While it's much larger at 6.2 inches, it still has a much higher pixel density at 236ppi compared with the New 2DS XL's 97ppi. The Switch is far brighter, crisper, and more vivid than the New 2DS XL, by far.

SOLID, BUT SECOND TO THE SWITCH

When considered on its own or when compared with other 3DS devices, the New 2DS XL is fantastic. It packs all of the New 3DS features into a well-designed package with a very attractive price tag. And since it's a New 3DS system, it can play games from the full life-spans of the DS and 3DS, and there is a lot of pure gold in that decade-plus of handheld gaming.

When held next to the Switch, however, it isn't nearly as appealing. The Switch costs twice as much as the New 2DS XL, but the superior screen, much higher processing power, and revolutionary handheld plus home-console gameplay options it provides easily justify that price. The New 2DS XL is great, but the Switch is simply better more than twice over. We can still wholeheartedly recommend the 2DS XL to anyone who doesn't have (or is looking to replace) a 3DS and wants to play a startling number of excellent, classic games. But if you already have a New 3DS or New 3DS XL, there's no reason to get a New 2DS XL, since it doesn't bring anything new to the table.

WILL GREENWALD

21.5-inch iMac Is the Mid-range All-In-One to Beat

PC MAGAZINE EDITORS' CHOICE

With only minor updates to the iMac's design and components since 2012, Windows all-in-one desktops (AIOs) such as the Microsoft Surface Studio have set their targets squarely on Apple's AIO. But most of those comparable models have larger screens and are priced well above $2,000, putting them more in line with the 27-inch iMac. The 21.5-inch model plays in an area without a lot of competition. Although the recent updates to Apple's smaller, more affordable AIO aren't revolutionary, it does get a nice bump in processor power, updated ports, the addition of discrete graphics, and a more vibrant 4K display. For artists on a budget or those whose daily tasks don't require a larger screen, the 21.5-inch with 4K Retina display is still the midrange AIO standard bearer and is our Editors' Choice.

Apple iMac 21.5-Inch With 4K Retina Display (2017)

Starts at $1,299; $1,499 as tested

●●●●○

SAME SLEEK ALUMINUM AND GLASS DESIGN

The design of the 2017 21.5-inch iMac is almost identical to the 2015 iteration, and at 17.7 by 20.8 by 6.9 inches (HWD), it's the same size. Despite the classic look, the stylish aluminum-and-glass iMac is still a design leader and more modern looking than the Lenovo B50, our last top pick for midrange AIO desktops, which is mostly black plastic.

On the left rear panel are a headset jack, an Ethernet port, an SD card reader, four USB 3.0 ports, and two USB-C/Thunderbolt 3 ports. While positioning them behind the screen supports the clean design, they're inconvenient to reach compared with the side-mounted port selection on thicker AIOs, including the Dell Optiplex 7450 All-in-One and the HP Envy 34 Curved.

Apple iMac 21.5-Inch With 4K Retina Display (2017)

PROS Bright DCI-P3 4K screen. Can drive 4K or 5K external displays. Discrete graphics. Hybrid SSD/HDD Fusion Drive. USB-C/Thunderbolt 3 ports. Wireless keyboard and mouse included.

CONS Shallow keyboard. Ports and SD card slot are on back panel. Lacks HDMI-in and DisplayPort-in connectors.

The rear of the system holds four USB 3.0 ports, two USB-C ports with Thunderbolt 3 (an upgrade from Thunderbolt 2 ports), an Ethernet jack, an SDXC card slot, and a headphone jack.

The USB-C/Thunderbolt 3 ports are notable because they replace the older Thunderbolt 2 ports of the 2015 iMac and are becoming increasingly popular, even on Windows PCs. They also mean faster and more versatile connections for data transfer. For those who are carrying over Thunderbolt 2 accessories like external hard drives or displays, Apple sells a Thunderbolt 3-to-2 adapter for $49. Similar third-party adapters are available for DisplayPort and HDMI monitors.

The system can support up to two additional 4K monitors or one 5K display, including the internal 4K screen. But there's no easy way to use the iMac itself as an external display for a notebook or another desktop, as you can with the Lenovo B50 or HP Envy 34 Curved, since it has no HDMI-in or DisplayPort-in connectors.

SUPERB SCREEN

The 4K Retina display is mostly the same as the previous version of the iMac, which, with its 4,096-by-2,304 resolution and stunning edge-to-edge glass, isn't necessarily a bad thing. The screen is brilliant and images appear sharp. The improvement here comes in the form of a 500-nit backlight, translating to a super-bright screen that most users will want to tame down a few notches for daily use.

Like the 27-inch iMac and the 28-inch Microsoft Surface Studio, the screen features DCI-P3 color gamut and 10-bit color, resulting in brighter and more accurate hues. Those who want the 5K Retina display will need to shell out the extra cash for the 27-inch iMac, as the 21.5-inch version tops out at 4K. And if a touch screen is part of your requirements, you'll need to look to a Windows machine. Apple announced a slew of new features in the upcoming update to macOS, High Sierra, but touch is reserved exclusively for iOS.

The screen features DCI-P3 color gamut and 10-bit color, resulting in brighter and more accurate hues.

A Kaby Lake Intel Core i5 processor and discrete AMD Radeon Pro 560 graphics supplement this iMac's vibrant 4K screen.

STRONG SPEAKERS, SOLID ACCESSORIES

The internal stereo speakers are aimed down at your desk or work surface, and they can fill a medium-size room with clear audio. Bass came through in some of our test tracks, though it doesn't sound as robust as with the Dell XPS 27 (7760), which has eight speakers and two passive radiators. The iMac's speakers are accurate enough to quality-check videos you're editing, though you'll want to use headphones for best results.

The familiar Apple Magic Mouse 2 and Magic Keyboard, both Bluetooth, come pre-paired with the iMac. You can opt for a Magic TrackPad 2 instead of the mouse for an additional $50 or both for $129. Apple's wireless accessories charge with the included USB-to-Lightning cable, which also lets you use the keyboard in wired mode. The only nit is that they are very shallow compared with typical PC keyboards and mice. Still, these peripherals are of much higher quality than, say, the wired plastic mouse and keyboard that come with the Lenovo B50. The iMac supports 802.11ac Wi-Fi and Bluetooth 4.2.

AN UNDER-THE-HOOD UPGRADE

The base version of the 21.5-inch iMac 4K ($1,299) comes with 8GB of RAM, a 3GHz Core i5 processor, and a 1TB hard drive. Our $1,499 test unit has the same amount of RAM, a faster 3.4GHz Core i5 CPU, and a 1TB Fusion Drive, which is Apple's SSD/HDD hybrid. The 32GB SSD component of the Fusion Drive helps the desktop boot and launch oft-used apps faster, especially compared with hard-drive-only systems such as the base-level non-Retina iMac or Acer Aspire Z3 (AZ3-715-UR15).

The new Apple iMac has the sleek design that the Apple faithful have come to know and love. It's our new Editors' Choice for the category.

This upgraded model can be equipped with 32GB of RAM for $600 more and a faster 1TB SSD for an extra $700. For that price, you may want to consider the 27-inch iMac or Microsoft Surface Studio for their larger screens and more powerful internal components. But no matter which version of the iMac you buy, you'll need to commit to a configuration before you order, because the chassis is effectively sealed, limiting future upgrades. (The one tweak you can make in the 27-inch is to upgrade memory via a slot in the rear.) The iMac comes with a one-year warranty with 90 days of free technical support.

STEADY PERFORMANCE

An Intel Core i5-7500 processor and discrete AMD Radeon Pro 560 graphics powered the iMac to solid results on our benchmark tests. It took 1 minute 4 seconds to finish the Handbrake test, 8 seconds behind the Dell XPS 27. It also took 3:08 to complete the Photoshop test, 18 seconds behind the Dell Optiplex 7450. Though these aren't the best scores we've seen, they're certainly respectable. In our experience, any system that breaks the 1-minute barrier on Handbrake and 3 minutes on Photoshop is a solid performer.

Performance is on a par with the larger, pricier competition, including the 2017 27-inch iMac, the Microsoft Surface Studio, and the HP Envy 34 Curved, in most areas. For example, the 21.5-inch iMac's Handbrake score was within 1 second or matching the other models, and its Photoshop score was within 5 seconds. Multimedia performance is similar to the 2015 iMac, though, so this isn't a must-have upgrade for someone who has recently bought the last-generation iMac.

Most AIO desktops aren't made for hardcore gamers, but the iMac showed respectable scores on our 3D gaming tests. It returned playable frame rates (above 30 fps) on the Heaven (45 fps) and Valley (64 fps) tests at medium-quality settings. When we ran the same tests at ultra quality in its native 4K resolution, the results were much too slow for smooth animation. That said, the 2017 iMac is measurably better at 3D tasks than are systems with integrated graphics, like the 2015 iMac 21.5-inch, and systems with entry-level GPUs, like the Acer Aspire Z3. The only system listed in our benchmark chart that could play either test smoothly at ultra resolution in Full HD was the Microsoft Surface Studio, which has a gaming-grade Nvidia GeForce GTX 980M GPU. You'll be able to play the occasional game on the iMac, but only in a small window or blown up to full screen from a 1,366-by-768 resolution.

The Radeon Pro GPU on our review unit is ready to take on VR, which Apple's macOS High Sierra will support when it's released later this year. Augmented reality (AR) isn't playable yet in macOS, but Apple has demonstrated it on the iPad Pro and iPhone.

IN A CLASS OF ITS OWN

The 27-inch iMac is more vulnerable to competition from Windows AIOs; the Apple iMac 21.5-inch with 4K Retina display is in a safer zone, at least for now. Windows systems such as the $4,199 Surface Studio and $2,799 Dell XPS 27 are admittedly attractive, but the 21.5-inch iMac is much more affordable, as long as the smaller screen size isn't an issue for you. An upgraded processor, discrete graphics, and a stunning screen help this smaller iMac replace the aging Lenovo B50 as the midrange AIO PC we'd recommend for creative types who don't have the deep pockets or desk space for a Microsoft Surface Studio, the 27-inch iMac, or the upcoming workstation-class Apple iMac Pro.

JOEL SANTO DOMINGO

"Most AIOs aren't made for hardcore gamers, but the iMac showed respectable scores on our 3D gaming tests."

Dell Inspiron 13 7000
(7378)
$799.99

Dell Value-Priced 2-in-1 Can Run With Costlier Rivals

PC MAGAZINE EDITORS' CHOICE

Convertible hybrid notebooks are often called 2-in-1s, not 2-for-the-price-of-1s; machines that can flip and fold between laptop, tablet, and other modes tend to carry a premium price. But Dell has kept the premium to a minimum with the Inspiron 13 7000 (7378). The $799.99 base model we tested features a seventh-generation Intel Core i5-7200U processor, 8GB of memory, a 256GB solid-state drive, and niceties including a USB-C port and an infrared camera for Windows Hello face recognition. It doesn't have the swank two-tone styling or the available 4K display, but it's otherwise an affordable rival to our Editors' Choice for high-end convertibles, the HP Spectre x360 13. As such, we're rating the Dell above the older, heavier Acer Aspire R 14 as our new top pick for midrange convertible hybrids.

The entry-level Inspiron, unlike some bargain systems with only half as much RAM or storage, is more than adequate for office and on-the-road productivity. For those who crave more power, a $999.99 model steps up to a Core i7-7500U CPU, and a $1,099.99 configuration combines the Core i7 chip with 12GB of RAM and a 512GB SSD. A 13.3-inch full HD touch screen is standard across the line.

Dell Inspiron 13 7000
(7378)

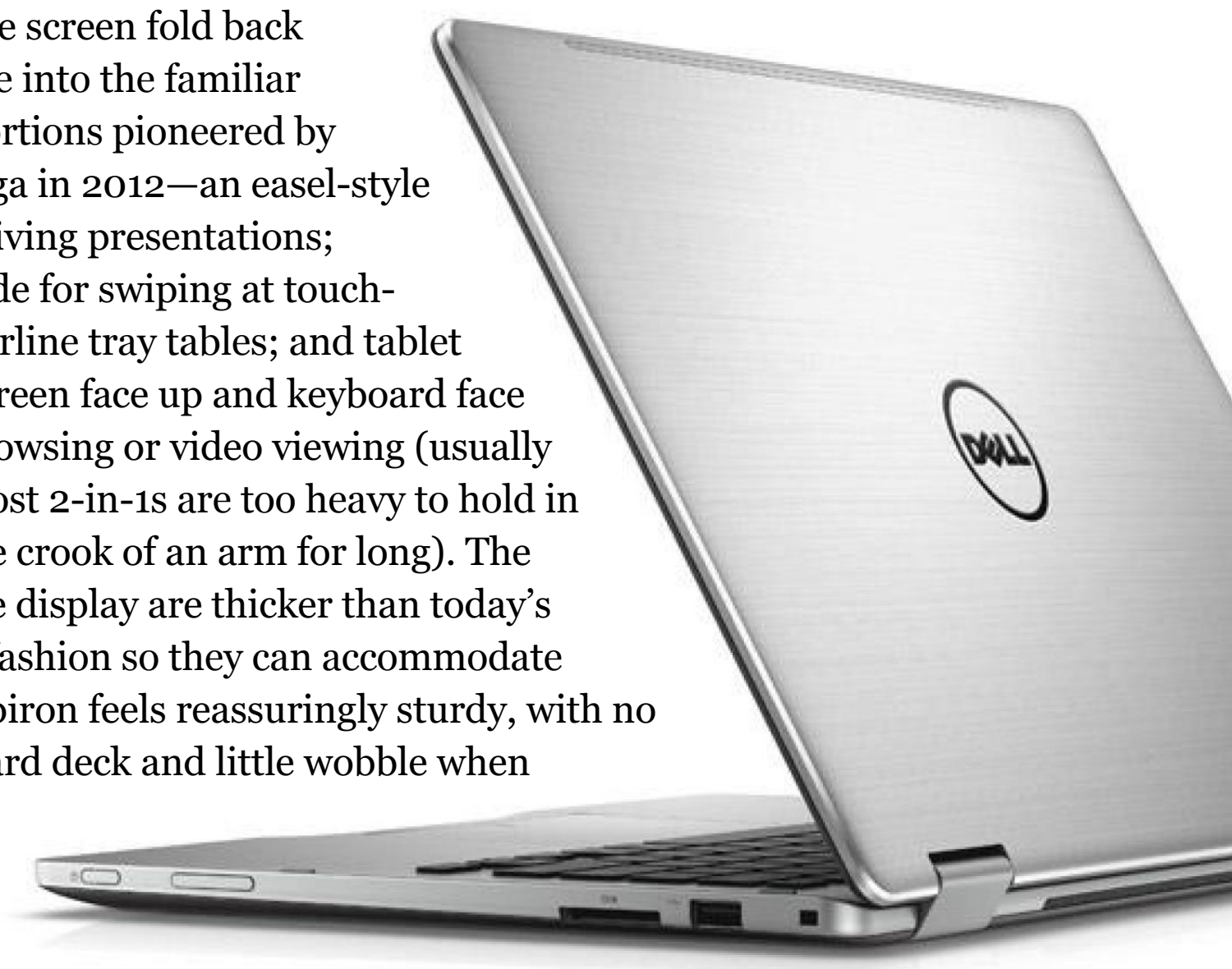
PROS Classy aluminum construction. Infrared webcam for Windows Hello. Good keyboard feel.

CONS Mediocre battery life. Lacks Thunderbolt 3 port.

HEY, GOOD LOOKIN'

A silver brushed-aluminum lid and keyboard deck, the former decorated with a dark Dell logo and a shiny wraparound beveled edge, give the 7378 an esthetic edge on its all-plastic competitors. At 0.76 inch, it's thicker than the Spectre x360 13 (0.5 inch) or Acer Spin 7 (0.43 inch), and its 12.7 by 8.8-inch footprint covers the HP's (12 by 8.5 inches) as well, but the 7378 still slips easily into a briefcase. You'll notice its weight there, however—3.5 pounds versus 2.8 for the Spectre and 2.7 for the Dell XPS 13 2-in-1.

Two hinges let the screen fold back from laptop mode into the familiar convertible contortions pioneered by Lenovo's first Yoga in 2012—an easel-style stand mode for giving presentations; A-frame tent mode for swiping at touch-screen apps on airline tray tables; and tablet mode with the screen face up and keyboard face down for Web browsing or video viewing (usually in your lap, as most 2-in-1s are too heavy to hold in both hands or the crook of an arm for long). The bezels around the display are thicker than today's ultrathin laptop fashion so they can accommodate thumbs. The Inspiron feels reassuringly sturdy, with no flex in the keyboard deck and little wobble when you poke the screen.



It's also well equipped with ports, though it lacks the Thunderbolt 3 port of the Spectre x360—you're limited to USB, not Thunderbolt, docking and storage solutions. On the left edge are a jack for the palm-sized AC adapter; a USB-C/DisplayPort connector; HDMI and USB 3.0 ports; and an audio jack. On the right side are the power button, a volume rocker, an SD card reader, a USB 2.0 port, and a Noble lock slot. As you'd expect, 802.11ac Wi-Fi and Bluetooth wireless are standard.

Besides letting you log into Windows with a glance instead of a typed password—a small convenience but a pleasing one that we're glad to see trickle down to a mainstream system—the webcam takes reasonably bright if not ultra-sharp images for Skype chats. The Dell's bottom-mounted speakers, backed by a Waves MaxxAudio Pro tweaking utility, produce averagely loud audio; one guitar riff sounded ragged, but voices and other instrumentals were clean and complete with a bit of bass.

NICE BACKLIGHT

The keyboard is a bit on the flat or shallow side, with a little less travel than we'd like, but makes up for it with crisp feedback and a snappy typing feel. We were cruising at high speed after only a few minutes' practice. The layout is easy to master, with cursor arrows in the proper inverted T, although they're small and paired with the Fn key in lieu of dedicated keys for Home, End, Page Up, and Page Down. The keyboard backlight caught our eye, too, with two brightness levels (plus off) and above-average focused rather than fuzzy white illumination. The touchpad works smoothly, with just a gentle press or flex required to click its lower corners.

The 1,920-by-1,080 screen isn't whiter than white or brighter than bright, and like many touch screens is prone to reflections in dark areas. But it offers wide viewing angles (helped by IPS technology) and good contrast. Colorful photos and 1080p videos looked sharp and accurate, though solid colors in PowerPoint slides didn't pop like poster paints. Touch operations were slick and precise in testing.

About the only aspect of the Dell that screams "entry level" is its one-year warranty with mail-in service; upgrading to a year of premium support with on-site service after remote diagnostics costs $69. Bundled software is minimal, aside from dueling Dropbox and McAfee pop-ups.

PERKY PERFORMANCE

As we mentioned, the Inspiron 13 7000 2-in-1 is built around the "Kaby Lake" Core i5-7200U, a 2.5GHz (3.1GHz turbo) dual-core processor with Hyper-Threading and Intel HD 620 integrated graphics, teamed with 8GB of DDR4 memory and a 256GB Toshiba SSD. In the single most important of our benchmark tests, Futuremark's PCMark 8 all-around productivity measurement, the Inspiron's score of 2,983 fell just short of 3,000-point bragging rights (see the Yoga 910 at 3,197, for instance). But it topped the HP Spectre's 2,713 despite the latter's Core i7 CPU—and the Spectre, like all the systems shown here, is more than capable of crunching through office apps such as Excel, Word, and Google Docs.

The 7378 also acquitted itself capably, virtually tying the HP, in our Cinebench rendering and Handbrake video editing tests. It fell off the pace, however, in our Adobe Photoshop image editing test, taking 4 minutes and 40 seconds—more than a minute longer than the Spectre (3:34) and Yoga (3:35)—to apply 11 complex filters and effects to a large JPEG. We'd assign blame both to its Core i5 versus Core i7 processor and slower SATA rather than PCIe solid-state drive.

"The 1,920-by-1,080 screen isn't whiter than white or brighter than bright and is prone to reflections in dark areas."

Neither the Inspiron nor any of these integrated-graphics convertibles set the world on fire in our graphics benchmarks, posting lackluster results in 3DMark and missing the 30 frames per second threshold for smooth gameplay in the gaming simulations Heaven and Valley. And the 7378 joins the Spectre at the back of the pack in our battery life test, each lasting for about eight hours of video playback—stamina that we would have applauded just a year or two ago, but that looks decidedly subpar in this age of freakish results like the Yoga 910's 21-plus hours.

The 7378 acquitted itself capably, virtually tying the HP, in our Cinebench rendering and Handbrake video editing tests.

But let's repeat one stat that helps bring the Inspiron 7378 into focus: $799.99. Convertible buyers have found the difference between a three- and four-figure budget might as well be the Grand Canyon in hardware capability; the Dell might not out-dazzle machines that cost half again as much, but you can hardly expect it to. For what it does for what it costs, we're happy to award this hybrid an Editors' Choice.

ERIC GREVSTAD

Apple macOS
High Sierra
Free download

A Beta That's Safe and Smooth in Testing

Apple has released the first public beta of macOS High Sierra, the next version of the Mac operating system that used to be known as OS X, and we've spent some time using it. High Sierra now begins a few months of intense real-world testing before its full release as a free download this fall. Meanwhile, anyone with a Mac made in 2010 or later (and even a few models made in 2009) can download the beta and give it a try. It's not final code, so, if you have one, you may want to run this early version on a spare Mac instead of the one you use to get work done. That said, in our testing, High Sierra is solid and reliable, and it has real advantages over the current version, macOS Sierra. We'll revisit this preview and assign an Editors' rating once High Sierra is out of Beta.

MOSTLY SEAMLESS

The best news about High Sierra is that most of its major improvements are invisible. The new Apple File System (APFS) makes disk operations faster and more reliable, with optional encryption tightly integrated. The new High Efficiency Video Codec (HEVC) is built into macOS and the forthcoming iOS 11 for fast, smooth 4K video, complete with hardware acceleration on recent Macs.

A technology called Metal 2 offloads graphics handling to a GPU, including external video cards attached via Thunderbolt. Virtual-reality headsets will be able to use native macOS support as soon as the vendors add Mac support to their software. I've been testing the beta on a 2017 15-inch MacBook Pro, and video performance is the smoothest I've seen on any platform.

For me, the very best thing about High Sierra isn't invisible—it's silent. By default, Safari won't autoplay video or audio when you visit a web page. So if you're listening to quiet music via iTunes and you browse to a news site, the announcer won't suddenly start shouting headlines. If you want to enable autoplay for specific sites, you can ctrl-click on the speaker icon in Safari's address bar or use a preference pane. Safari also claims to prevent advertisers from tracking your browsing in one site and displaying creepily relevant ads on other sites, but I haven't been able to test this terrific-sounding feature.

Apple macOS
High Sierra

PROS Enhanced video and graphic performance on recent Mac hardware. Fast, reliable new Apple File System. High-end editing tools and better navigation in Photos. Safari blocks websites from autoplaying audio and video.

CONS Beta versions of an OS are inherently risky, especially with special-purpose apps and third-party hardware. Microsoft Office 2016 requires "Office Insider" download for compatibility.

FILE THIS UNDER IMPROVEMENT

The biggest underlying technology in High Sierra is the Apple's new APFS file system, the successor to the current HFS+ system that predates OS X itself. The only difference you're likely to see on an APFS-formatted is faster performance on your disk and on Time Machine backups, but the new file system gives advanced and corporate users features like dynamic disks (a feature that Windows' NTFS file system has had for years) and nanosecond precision. HFS+ was designed for traditional hard disks, while APFS is optimized for SSD and flash storage, and, when used with the Fusion (combined flash and platter media) disks on some high-end Macs, automatically distributes files between the two media depending on whether the file will benefit from faster access.

When you upgrade a Mac to High Sierra, it will offer to upgrade the file system to APFS at the same time. In my tests on a new MacBook Pro and an ancient white MacBook with an SSD installed, this process was completely transparent. Incidentally, the current macOS version, Sierra, can read APFS partitions, so developers who need to test on multiple OSes can dual-boot the same machine to Sierra running HFS+ in one partition and High Sierra running on APFS in another partition.

PHOTOS UPDATES

The Apple Photos app gets High Sierra's most visible enhancements, including some added features that rival high-priced third-party apps. But if you have a third-party photo editing app, it will be accessible from a photo's context menu, so you can use the third-party app to edit the photo save the results into the Photo app. New tools called Curves and Selective Color add fine-tuned control over color. An expanded sidebar gives quick access to all recent imports, not just the latest. Less useful, but more entertaining, are loop and bounce effects for Live Photos (brief videos) that make them work like animated GIFs. For more details, read 10 New Apple Photos Features You'll Want to Check Out.

SHARING, MESSAGES, AND MAIL

Sharing options are enhanced throughout High Sierra. Files stored on iCloud can be shared with anyone via an invitation link, with optional editing privileges, so that everyone sees the current version of the file. A similar feature is built into Dropbox and other file-sharing services, but it's good to have it built into the OS.

Family sharing, already available in iTunes, makes iCloud storage available to other family members. Messages now automatically transfer between devices, so conversations that you start on your phone will also appear immediately on your Mac. A universal clipboard lets you copy text or images on one Mac and paste them in any other Mac that's close enough to use for AirDrop and where you're also signed into your user account.

The Mail app gets speedier searching and indexing—though you'll have to wait a few minutes after upgrading to High Sierra while your mail store gets upgraded to the new format. When you search in Mail, two Top Hits appear at the top of the list, chosen by Spotlight-style technology according to multiple factors, such as how often you've exchanged messages with a recipient.

With earlier versions, I got into the habit of using Spotlight for performing complicated Mail searches, but now Mail does the job itself. If you use Mail in full-screen view, the mail-composing window now opens by default in a split-screen pane instead of cluttering up the view with a separate window.

TINY TWEAKS

As always, minor improvements are scattered through the OS. The Notes app supports tables, in addition to bulleted lists and checkboxes. Siri has a Personal DJ feature that's supposed to let you speak requests for music. Maybe this will work better in later beta versions, but when I tried it in the current version, it only got one out of ten of my requests right. Spotlight adds flight tracking, a feature that Cortana users already have under Windows.

BETA AND BETTER

I've been running High Sierra for two weeks in the first and second developer betas and now the public beta, and my experience has been refreshingly smooth. The upgrade from Sierra took about half an hour, and that included the transparent upgrade from HFS+ to APFS.

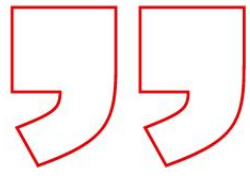
I encountered only one glitch worth noticing: an old version of the free LibreOffice office suite that ran under Sierra wouldn't run under High Sierra, but I fixed that by downloading the current version. A higher level of security wouldn't let me install an HP printer driver until I authorized it in the Security preference pane, but a dialog box from High Sierra explained what to do.

MINOR COMPLAINTS

High Sierra doesn't get everything right. The default folder icon is still a blinding shade of blue, and the optional Graphite-colored color scheme doesn't change that blue.

A feature added in Sierra that automatically saves files from your Desktop and Documents folder into your iCloud drive now works a bit faster than before, but I've turned it off, because it sometimes causes delays and glitches with files or apps that I open from the desktop.

For me, the very best thing about High Sierra isn't invisible—it's silent... Safari won't autoplay video or audio.



Advanced users will still need to customize the Finder so that its sidebar includes easy access to your entire hard disk. It's probably time to place the Dock by default at the right of the screen instead of the bottom for a more sensible use of desktop space. But these, except for those blinding blue folder icons, are minor details, easily customized by anyone.

IS THIS BETA FOR YOU?

Should you run the High Sierra beta on the Mac you use every day? The answer is no if you need your Mac to get your job done, because you don't want to risk your work on an OS that's not ready for wide release.

If you use your Mac mostly for rest and recreation, then the answer is a possible "yes." If you're running a Mac released in the past three or four years, your machine will almost certainly be more responsive, and, thanks to the new file system, probably more reliable. And if you want to run Office 2016 under the public beta, you'll need to open Microsoft AutoUpdate, check the box next to Join the Office Insider Program and choose Office Insider Fast from the dropdown menu.

The built-in silence from Safari on autoplay web sites will be music to your ears. Photos will be easier to manage. Features that aren't quite working yet, like Siri's new job as a DJ, are ones you won't miss, because you never had them before anyway. Apple's macOS has long taken its place as the most coherent and usable consumer-level operating system anywhere, and High Sierra maintains that position.

We'll continue to run and test the latest version of the macOS and provide a full review when it's released.

EDWARD MENDELSON

Five Top Low-Code Development Platforms

We live in an application-centric world. In a modern business environment, nearly everything we do flows through the Software-as-a-Service (SaaS) apps we open on a daily or even hourly basis. We communicate and collaborate with coworkers through apps. We track project and task progress using apps. We manage human resources, helpdesk tickets, and expense reports with apps.

In an effort to make the app-creation process easier on the IT department and, at the same time, more accessible to everyday business users, businesses have begun to turn to low-code development platforms. This emerging category of app-building tools lets organizations of any size design, build, customize, and deploy business apps with little to no coding.

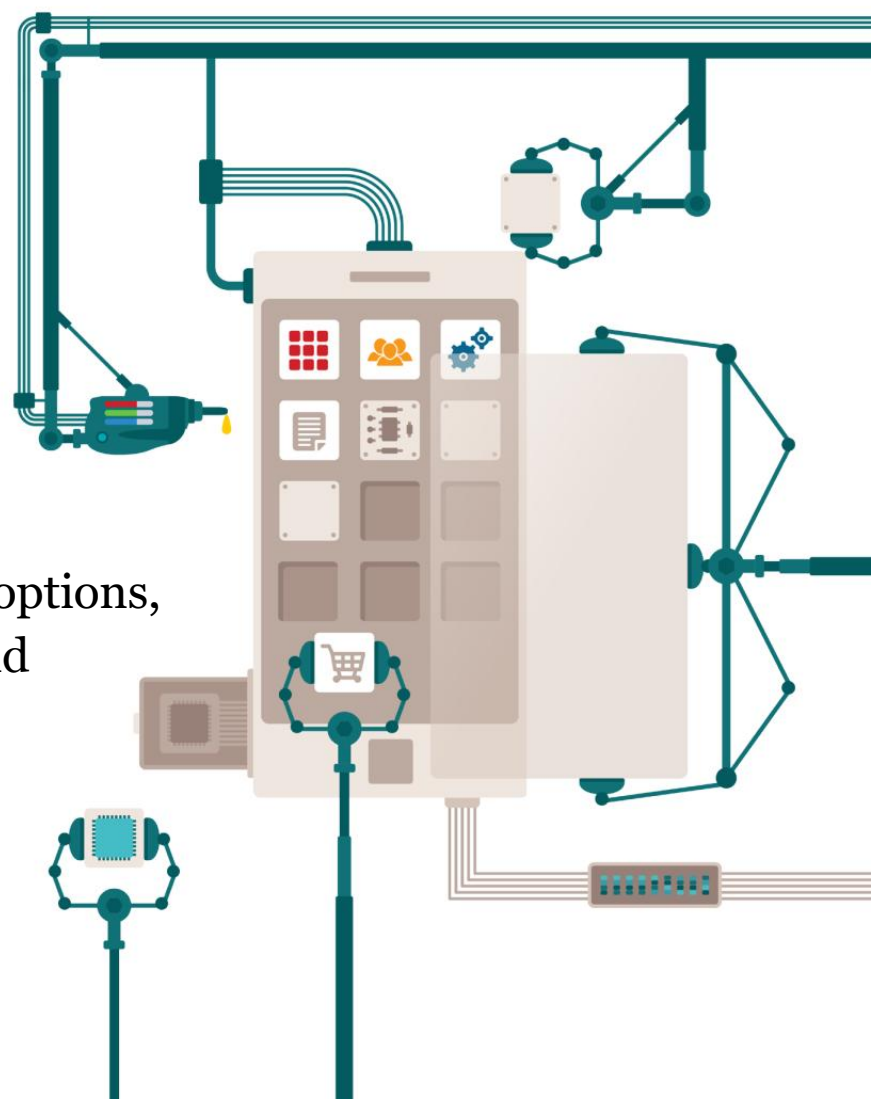
The feature set and customization ability varies from tool to tool, but the core function is the same: Through a combination of drag-and-drop user interfaces (UIs), form builders, and visual process modeling, you can use low-code development platforms to produce a working app that you can download, open, and start using in hours or less.

WHAT IS LOW-CODE APP DEVELOPMENT?

The term "low-code app development" didn't exist until a few years ago, but the concept isn't a new one. There's long been a notion in enterprises and SMBs of the "power user" or "citizen developer," meaning business users who see an opportunity to optimize a process and take it upon themselves to create their own apps. To do so, they use technologies such as Visual Basic for Applications (VBA) programming in Microsoft Excel. Low-code tools expand that user base from only the most tech-savvy of workers to average employees.

The other side of the equation is traditional developers and IT, for whom these low-code platforms are designed to accelerate software delivery by quickly building apps for specific business use cases. Rather than spend the time and effort to code from scratch an app that's made up of common features and components, low-code platforms let developers work from existing templates and drag prebuilt elements, forms, and objects together to get a particular department or team the app they need with a lot less hassle.

That's a tricky proposition, because the platforms have to cater to two categories of users with drastically different skill sets and preferences. Low-code platforms must give everyday business users a dead-simple UI which with to build an app, step by step, in relatable terms, and offering plenty of help along the way. At the same time, the tools should simplify the development process for IT while still offering a selection of customization options, plus the ability to pull in third-party services and additional data sources and layer on additional security and compliance. That's a lot for one platform to do while also keeping everything simple within a unified experience.



Not every tool is adept at doing both. Some platforms excel at providing an intuitive, guided experience in which most people can quickly get the hang of the process and start designing task-oriented apps to fill specific business needs. These needs include measuring progress on a project or building a simple form-based app for tracking employee shift scheduling.

Others platforms are a bit more difficult for the average user without much of a programming background to use. But these platforms give developers an environment in which they can build complex process models, map database objects to user workflows, and customize UI design without having to write their own code. The most mature low-code tools are adept at doing both.

The circular logic in all of this is that letting citizen developers quickly build their own basic apps fundamentally takes pressure off the IT department. Rather than inundating your development team with a queue full of requests for simple apps, the teams can build the apps themselves and to the specs for which they need them. IT can then come in after the fact to tweak and iterate on it after the bulk of the coding work is done.

It's important to look at low-code development platforms from all of these viewpoints. Ideally, you want the sales and marketing or helpdesk teams to be as comfortable using the tool as a software engineer from your IT department who needs to quickly pull in multiple data sources to build a website monitoring tool for a redesigned component of your website. In that light, we took a slightly different approach to testing these products than how PCMag normally conducts product reviews.

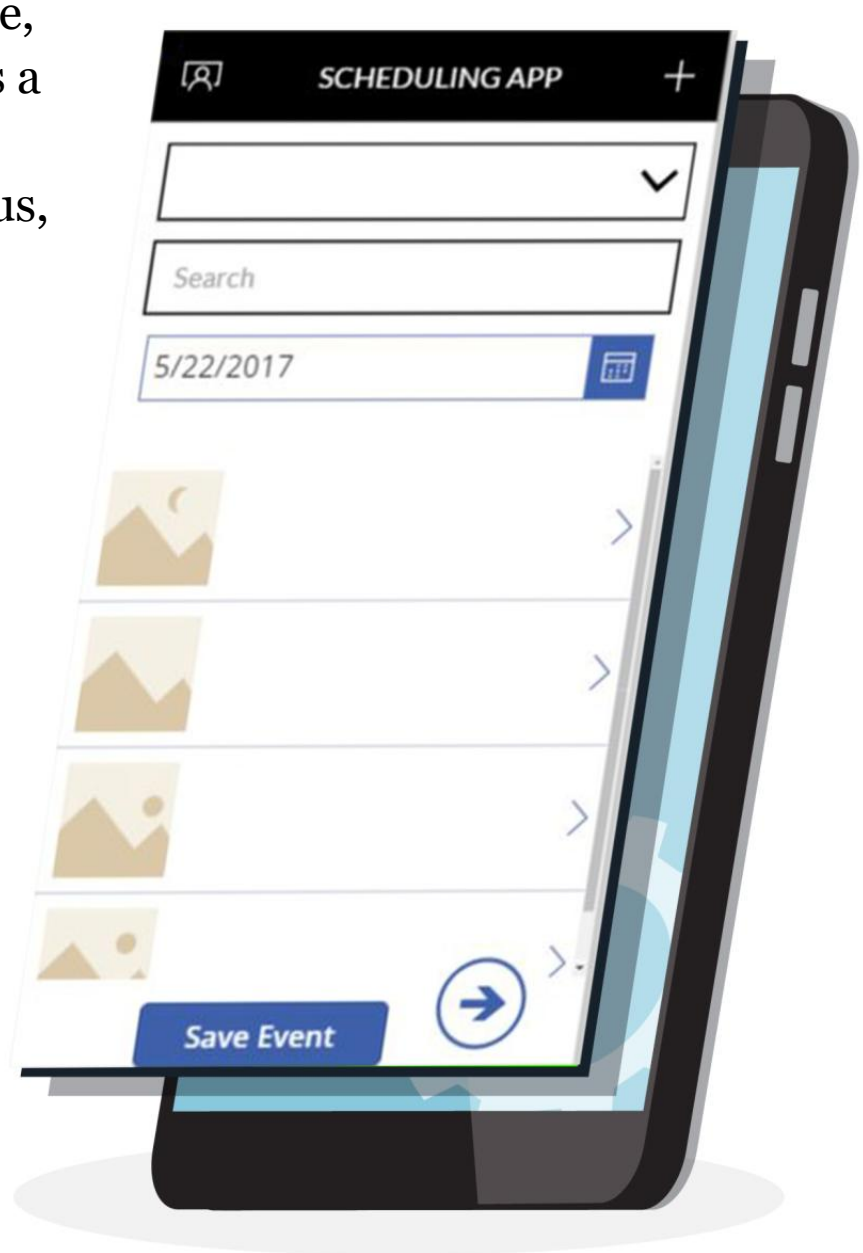
"Letting citizen developers quickly build their own basic apps fundamentally takes pressure off the IT department."

HOW WE TESTED

For each of the low-code development platforms reviewed in this roundup, we tested from the perspective of both an average business user and a seasoned app developer. Testing independently, we endeavored to see how the same tool handled varied levels of development expertise and a different set of requirements depending on the type of app we aimed to build.

To test from the perspective of your Average Joe business user, we used each respective low-code tool to build the same basic scheduling app. The goal was to build an app that could add a new event (name, date/time, duration), invite users to the event, a Save button to create the event, and the ability to view a list of events in Calendar view or via chronological list. Bonus points were given for added functionality such as notifications or a deeper ability to customize the UI. But the goal was to build and deploy a simple app—ideally available in both desktop and mobile formats—that executes one straightforward business process.

When testing from a developer/IT perspective, the standard app we built using each tool was a bit more complicated. Our professional programmer, who chose to remain anonymous, tested the tools by building a collaborative contact management app called Crowd Control. This app is intended to be a simple contact manager with a contact list page, a contact detail page, and a new contact page. We also wanted the ability to add photos and multiple notes to each contact, and the ability to pull in third-party services and add any additional features or automated logic to the app was a plus. We needed a slightly more complicated app that would be useful whether on the desktop or mobile, so Crowd Control was intended as a mobile, collaborative contact manager for a sales team.



For this side of the testing, we gauged success on a couple factors. Was our developer able to implement the full feature set, and also simulate changes to the app over time? IT departments have a regular need to push fixes and updates to business apps, so to simulate the project maintenance aspect of the process, our developer also tested whether the tools could handle adding a new field to the data model and pushing that change to the app, as well as changing an existing field to see whether the change is reflected without app errors.

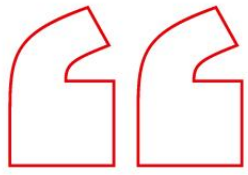
The changes I simulated were adding a new field to the data model and including that field in the app and changing an existing field in the data model and having that change properly reflected in the app.

We also aimed to answer the same set of basic questions about each low-code experience:

- Were we able to build a basic, working app?
- Was the form-based and drag-and-drop object modeling interfaces easier/time-saving or harder to use compared to traditional coding?
- What customization features and added capabilities were available during the low-code development process?
- Did the platform require any coding while building the app? If so, how much and in what context?

HOW THE TOOLS STACK UP

In totality, all of these tools are very close to one another in ease of use, breadth of functionality, and overall low-code feature set from a business user and a developer perspective. Our Editors' Choice awards this time around went to veteran platform Appian for everyday business users in enterprise organizations and to newcomer Microsoft PowerApps for power user and developer use.



We tested from the perspective of both an average business user and a seasoned app developer.

All five tools had helpful training resources, video and interactive tutorials, and documentation to help you through the process. Google App Maker and Microsoft PowerApps did the best job of integrating those help resources directly into the guided app creation experience. Salesforce has the most comprehensive training website with dozens upon dozens of Trailhead courses for various aspects of its platform, but inaccuracies between the training material and the updated interfaces in the platform itself made those hard to follow. Zoho and Appian both have comprehensive help websites as well that are structured more like traditional knowledge bases with resources and community discussion topics.

Depending on your business needs, any one of these tools might be ideal for helping your organization get started with low-code development. Democratizing access to simple app-building tools within your company has the potential to improve productivity, solve business problems faster, and give both your tech savvy and average Joe employee the means and ability to apply the innovation of SaaS and modern mobile apps exactly where they need it.

Appian

$75 per user per month

EDITORS' CHOICE

PROS: Appian Quick Apps is a true no-code experience. Breaks up app creation and customization into distinct processes for business users and IT. Built-in team collaboration, task management, and social intranet. Native mobile apps. Drag-and-drop process modeler. Decision engine for modeling complex logic.

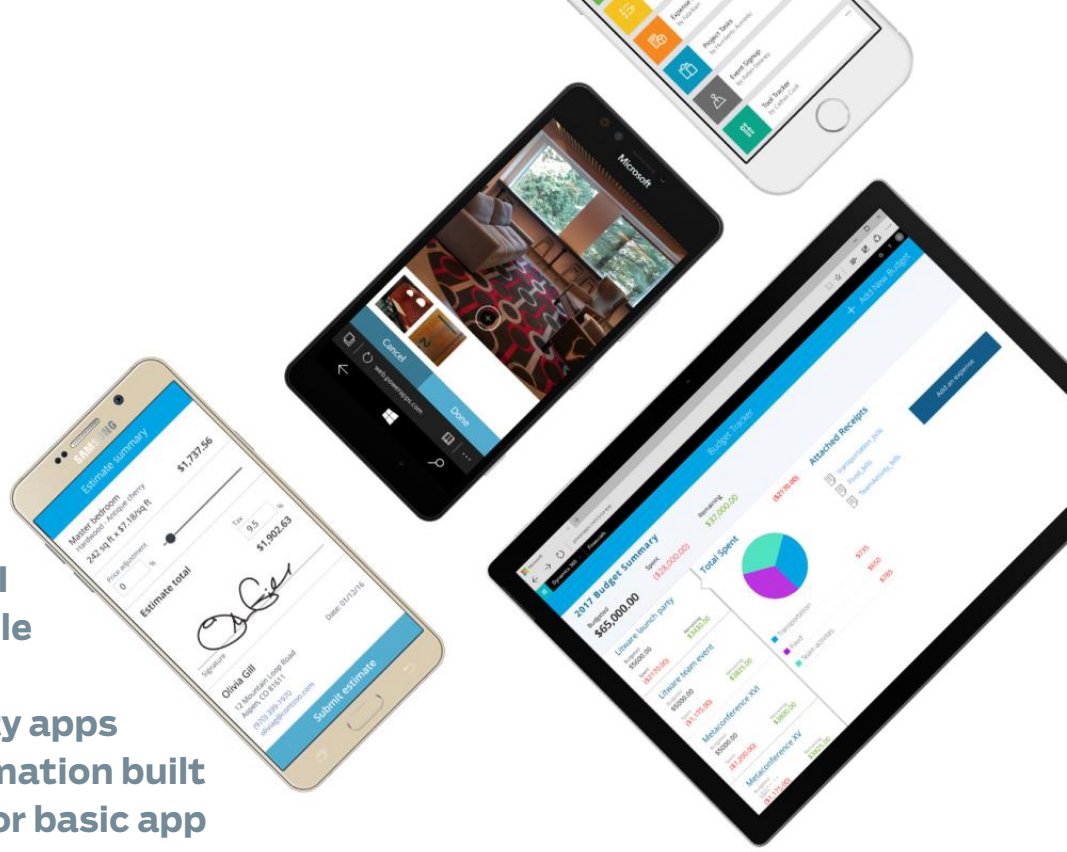
CONS: Expensive. Aspects of interface are somewhat dated. Appian Designer can be a disjointed experience for developers customizing various aspects of the application. Some required fields can be superfluous. Requires coding knowledge to fix errors, edit objects and fields, and to enable integrations.

BOTTOM LINE: For enterprise organizations willing to invest in the platform, low-code veteran Appian transforms app development into a social, collaborative, and productivity-driven experience for business users without a shred of coding experience.

Microsoft PowerApps

$7 per user per month

EDITORS' CHOICE



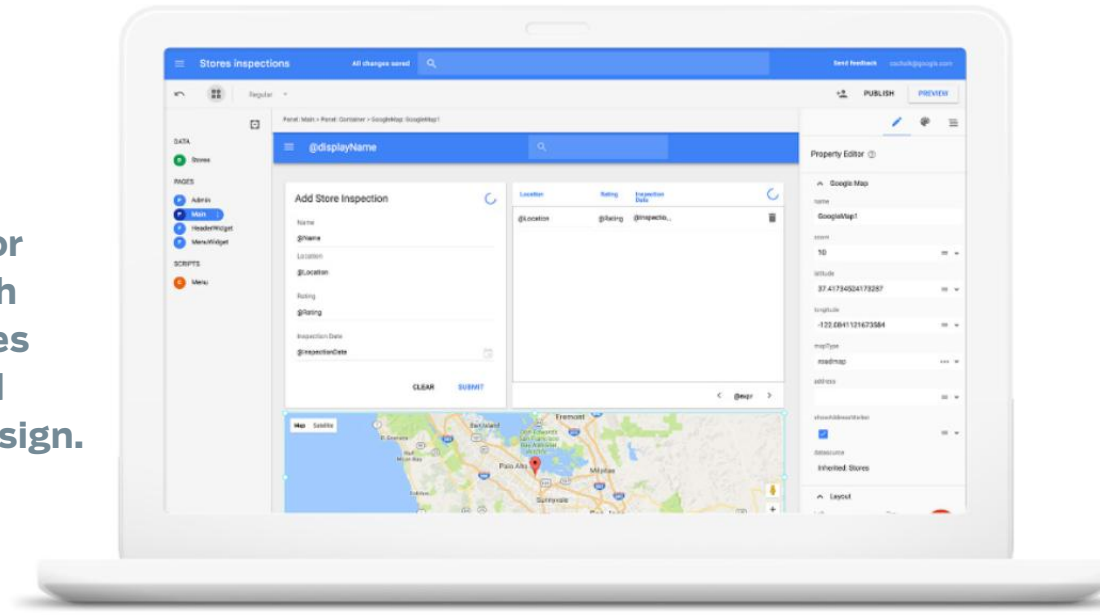
PROS: Powerful visual app designer with a look/feel combining Excel and PowerPoint. Integrates with Office 365, Dynamics 365, and Power BI by default. Wide selection of UI objects and pre-built templates. Great mobile and tablet development and app previews. Connects to Salesforce and other third-party apps and data sources. Advanced workflow automation built in with Microsoft Flow. No coding required for basic app development.

CONS: Creating and connecting data sources can be a pain. Somewhat longer load times. Adjusting UI elements in the property editor is a bit tedious. Customizing entities and form fields can be difficult for users without Excel proficiency.

BOTTOM LINE: Microsoft PowerApps is a slick, mobile-optimized, and integration-rich low-code development tool. The database connectors and customization aspects are a bit much for average business users to handle, but its familiar design and uncluttered-yet-feature-packed environment makes it our Editors' Choice for power users and IT departments.

Google App Maker

$10.00 per user per month



PROS: User-friendly. No coding required for basic app creation. Intuitive UI builder with drag-and-drop widgets. Google Drive Tables for simple data modeling. Straightforward dashboard built with Google's Material Design. JavaScript scripting and CSS in Property Editor for additional customization. Integrates with Google apps and services.

CONS: Only available for G Suite Business. No native mobile apps. No horizontal scrolling in design panel. Could use a broader selection of pre-defined templates and resources.

BOTTOM LINE: Google App Maker is a young low-code development tool with some growing up to do, but boasts a straightforward design, intuitive app creation process, and strong visual-oriented features to make G Suite app building a breeze for business users and developers alike.

Zoho Creator

$5.00 per user per month

PROS: Simple, straightforward interface. Easy-to-use form builder. Affordable. Apps responsively resize for mobile. Integrates with other Zoho apps. Strong selection of pre-built app templates and fields. Custom workflows. Supports barcode scanning. Pre-built Salesforce and QuickBooks integrations. Built-in auto translation.

CONS: Requires use of proprietary scripting language for app customization and automation. Mobile app development and pre-built template selection isn't as advanced as in some other tools. No third-party app marketplace.

BOTTOM LINE: Zoho Creator is an easy-to-use low-code development platform with a minimalist design and strong selection of pre-built apps and fields. While it requires use of a proprietary scripting language to unlock its full customization and automation power, Creator is an affordable, user-friendly choice for SMBs looking to invest in a business app creation tool.

Salesforce App Cloud

$25.00 per user per month

PROS: Extensive AppExchange marketplace of pre-built apps and components. Reusable objects and elements in Lightning App Builder. Drag-and-drop Process Builder and Schema Builder for creating complex automated logic. Best-in-class mobile and tablet app design capabilities. Salesforce1 mobile app with built-in collaboration. Kanban boards built in. Deep security and identity configuration features.

CONS: Cluttered interface with an overwhelming array of features. Confusing to navigate. Easy to get lost in other Salesforce apps. Trailhead tutorials don't always correspond accurately to what's in the interface.

BOTTOM LINE: Salesforce App Cloud is the most powerful low-code development platform on the market with a visual tool set and third-party ecosystem that can't be matched, but its cluttered and confusing UI and a messy collection of tutorials holds it back from unifying the sum of its impressive parts into a cohesive app creation process.

ROB MARVIN

SPACE FOR SALE

How the private space industry will reinvent economics, exploration, and humanity.

BY EVAN DASHEVSKY

The rise of the private space industry may be just what is needed to kickstart our much-delayed destiny in the final frontier. Throughout history, the pursuit of profit has proven to be a fantastic spur for advancement and innovation. Just how this will all play out is anyone's guess, for now. But the wheels are most definitely in motion.

Last September, Elon Musk, CEO and lead designer for Space Exploration Technologies (SpaceX), took the stage at the annual International Astronautical Congress conference in Guadalajara, Mexico to outline his vision for invading Mars. The plan—a combination of technical specificity and operational vagueness—sets the stage for making us a multi-planetary species by pre-stocking Mars via a steady parade of unmanned supply missions, which will embark every 26 months when the two planets align in their respective orbits.

LIVING ON THE RED PLANET
At a presentation in September 2016, Elon Musk speaks on the long-term technical challenges that need to be solved before humans can sustain themselves on Mars.

These initial one-way trips will take around 80 days with today's technology, but Musk believes they can eventually be shortened to 30-day voyages. Once Mars is properly supplied with a bounty of necessary Earth stuff, the humans will begin to arrive. If all goes according to plan, SpaceX's first robotic landers will touch down on Mars in the early 2020s.

Musk's interplanetary blueprint received a lot of attention when it was unveiled, but it's not exactly unprecedented. Over the past century, Earthlings have laid out plans of varying degrees of seriousness to colonize space. Back in the 1960s, Wernher von Braun, the father of rocket science and first director of NASA's Marshall Space Flight Center, predicted that a future incarnation of the Saturn rocket would begin sending humans to Mars by the 1980s. Around the same

time, the Soviets were developing plans to construct a moon base known as "Zvezda," also by the 80s. Then the Cold War lost its urgency, and those theoretical missions collided with reality. Since then, a few private space organizations have formulated colonization plans of their own, but they've resulted in little more than a few sparsely attended conferences here on Earth.

Yet somehow—even after all those decades of space disillusionment—Musk's plan feels refreshingly tangible. Perhaps it's because he has a well-earned reputation as a closer, an industrial-scale macher who sets bold goals and has the technical, financial, and operational prowess to make them a reality. The notion of space colonization is starting to feel less like inconsequential space-nerd pondering and more like a thing that can be turned into a viable space-nerd business.

Given the majesty of discovery and the fact that colonization is our best insurance policy should the Earth get into a bar fight with an asteroid (just ask the dinosaurs—oh wait, you can't), it might seem odd to focus on space's economic promise. But when it comes to making money up there, the sky is literally not even the limit. Space is the ultimate technological platform, teeming with opportunity and ripe for ethically uncomplicated exploitation! Some have predicted that it will be the first industry to produce self-made trillionaires. The privatization of space and the establishment of private outposts far from the watchful eye of mother Earth might prove to be one of history's most important developments.

THE STARTUP SPACE

SpaceX isn't the only organization going to Mars. NASA has scheduled a manned mission to orbit the planet in 2033, followed by "boots on Mars" in a subsequent but as yet undefined mission. (For the record, Musk plans to send a human crew to Mars by the late 2020s.)

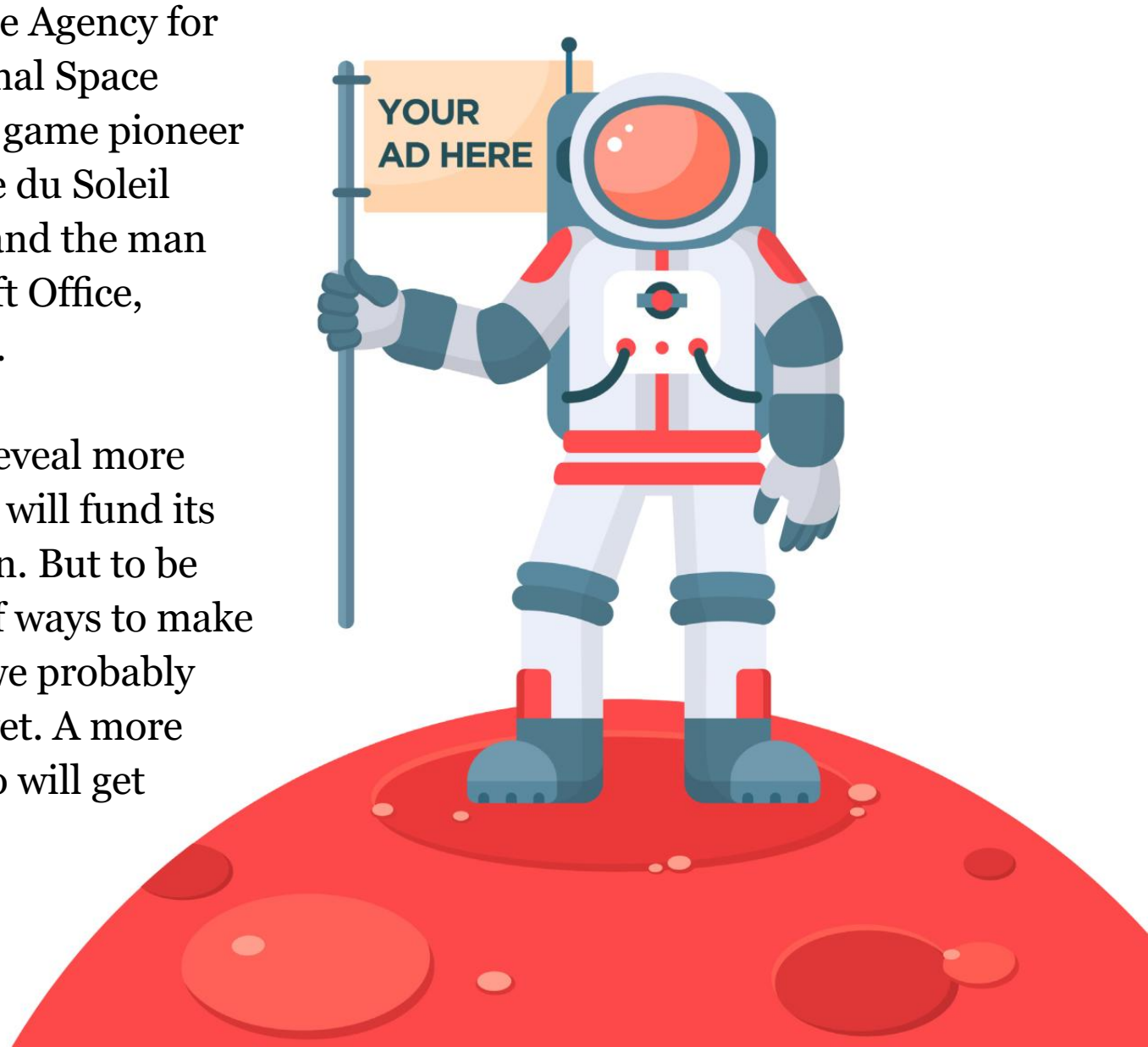
NASA's Martian plans haven't received nearly as much attention from the media and public as SpaceX's. This is probably because NASA's post-Apollo record of manned exploration has been a relentlessly evolving disappointment, with timelines shifting from administration to administration and budget to budget. But perhaps that lackluster lull was just part of the process the science had to go through before it got real.

Trailblazing scientific inquiry (which NASA has spent the last half century absolutely crushing) doesn't come with the expectation that it will immediately result in anything useful—pragmatic applications built on scientific discovery typically come later, sometimes decades down the line. Nobody could have guessed that quantum physics would one day bring about the iPhone, or that networking research computers over telephone lines would lead to Twitter.

Of course, in order for a science to become a business, it has to produce a product or service that people will actually pay money for. And lots of money will be necessary to get to Mars. Indeed, a recent *Wall Street Journal* expose called SpaceX's financial robustness into question as well as its ability to finance its Mars project (the company was dealt a serious blow following a pair of launch failures in June 2015 and September 2016).

But that same report revealed SpaceX's plans to supplement the costs of its "Interplanetary Transport System" by becoming a satellite-based ISP. The company has also entered the space tourism game with a deal to launch a pair of unnamed space tourists around the moon next year for an undisclosed (but surely hefty) fee. It's a viable plan; over the past 16 years, various people of means have paid tens of millions of dollars to Russia's Federal Space Agency for tickets to the International Space Station, including video game pioneer Richard Garriott, Cirque du Soleil founder Guy Laliberte, and the man responsible for Microsoft Office, Charles Simonyi (twice).

Musk has promised to reveal more about how the company will fund its Martian aspirations soon. But to be sure, there will be lots of ways to make money in space—most we probably haven't even imagined yet. A more pressing question is who will get there first.



SpaceX is the most famous of the new breed of for-profit space entities, but it's far from the only one. Jeff Bezos' Blue Origin aims to slash the cost of launches by (like SpaceX) developing reusable rockets and supplementing the effort through tourism. Richard Branson's tourist venture Virgin Galactic was recently joined by a sibling B2B company Virgin Orbit, which will launch small satellites into orbit. Paul Allen's Stratolaunch Systems recently unveiled a 385-foot wingspan plane from which it will launch rockets from high altitudes—it plans to have a first commercial launch by 2020. These are just a notable few.

BLUE ORIGIN
Jeff Bezos set up this privately funded aerospace manufacturer and spaceflight services company that plans to enable private human access to space.

Like traditional aerospace powerhouses (your Orbital ATKs, Boeings, and Lockheed Martins), many of these new space startups depend on contracts from NASA, the Department of Defense, and other public agencies to keep afloat. But unlike those old-school aerospace titans, these new startups have an aura of urgency, innovation, and gleeful disruption. It's perhaps not surprising that many of the new space companies have been seeded by libertarian-leaning Silicon Valley money monsters looking to stake their claim in this most disruptive of technologies (it also doesn't hurt that this particular technology has the added allure of being super sci-fi cool).

Given the current state of space tech, imagining anything resembling *A Space Odyssey* coming about in our lifetimes may be difficult. But history shows that big technological paradigms—home computing, the Internet, mobile tech—all have similar origin stories: They quietly emerge from the ether as glorified science projects, and no one really takes them seriously; but once they find their groove, they don't merely rise incrementally: They explode exponentially.

The rush of space startups already amassing concrete engineering accomplishments suggests that we may be witnessing the beginning of one of these exponential ascensions. The space-tech curve may be somewhat flatter than we've seen in the rise of other recent technologies, though, owing to the difficulty of the problem. Indeed, space is just about the hardest and most dangerous technological barrier humanity has ever had to overcome. But there's very little reason to think we won't get there—probably sooner than you think. The lure of history and potential for obscene profit are just too tempting for someone not to figure it out.

THERE'S WATER ICE IN THEM THAR ASTEROIDS

Planetary Resources is a Redmond, Washington–based startup with a unique business model: mining asteroids for profit. The company has been seeded by a cadre of Silicon Valley elites (Google's Larry Page and Eric Schmidt, as well as X-Prize co-founder Peter Diamandis, among them) and already has plans to send a swarm of unmanned, river-tube-size "Arkyd 200" satellites to a nearby asteroid in 2020 to prospect it for desired materials.

The company helps maintain itself financially through corporate and government contracts and licensing on its proprietary technology. In addition to developing prospecting satellites, the company is working with partners to develop space-based 3D printers that will shape construction-grade metals like iron, nickel, and cobalt, which are abundant in asteroids. These theoretical printers will be able to build machines, tools, and possibly even habitats and ships directly in space, therefore avoiding the great expense of shipping the materials from Earth. But perhaps more important, Planetary Resources will be prospecting for water. Not only is it necessary to keep us alive, but water will be essential to make even unmanned exploration feasible.

Once water is mined from an asteroid or comet (probably in solid ice form), electric currents generated by space-based solar panels can break it down to its atomic building blocks. The hydrogen and oxygen can then be recombined into a powerful propellant (i.e., rocket fuel). Once a network of celestial gas stations is established, the solar system becomes a lot smaller.

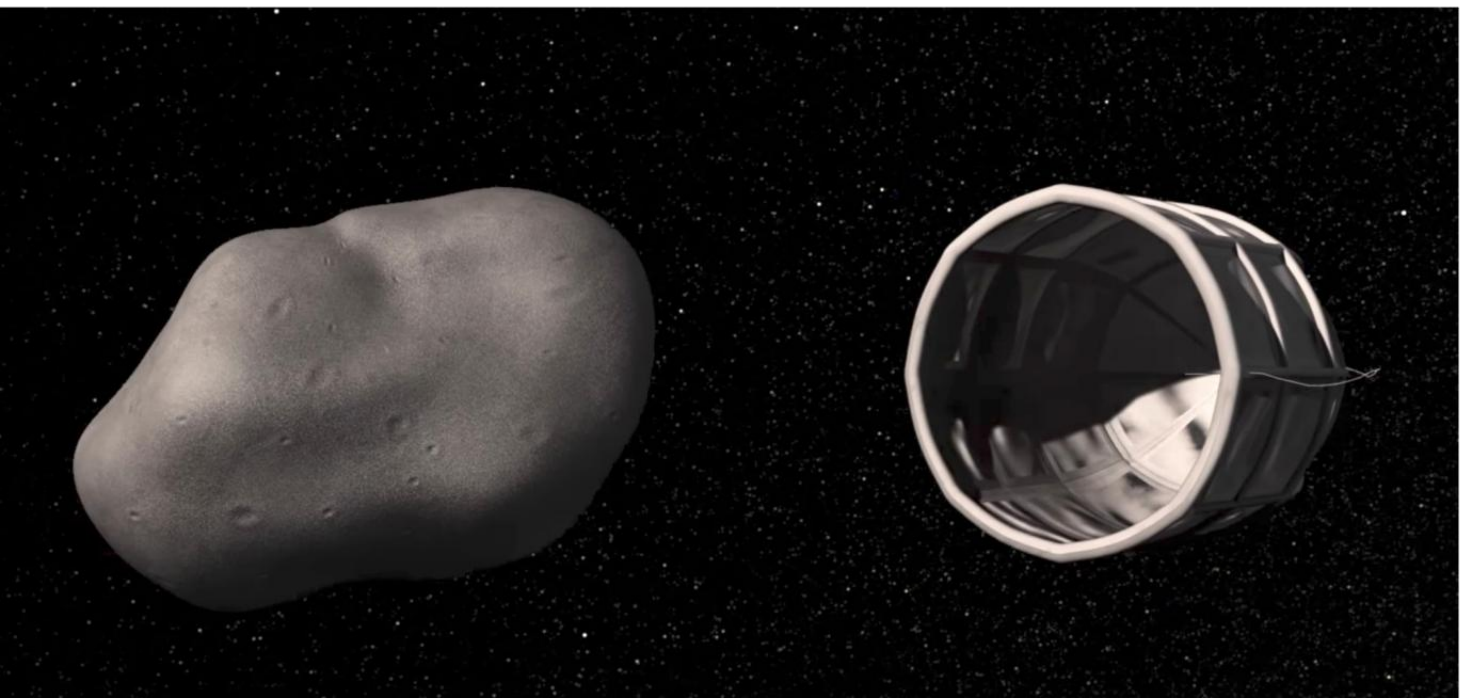
Planetary Resources takes advantage of technology previously designed for scientific missions, but it is an unabashedly for-profit enterprise.

“You start an asteroid mining company with the support of a lot of visionary people who have the capacity to take some risk in their business ventures, but it was certainly their demand that we create a business—not just something that is spending money for a very long time,” explained CEO (and former NASA engineer) Chris Lewicki when I interviewed him last year. With the Arkyd 200 expeditions, “We’re not trying to figure out how old the solar system is or find out how we all came to be; we’re asking a very simple business question… ‘Is there enough water on this asteroid for us to go back?’”

We’re asking a very simple business question… ‘Is there enough water on this asteroid for us to go back?’

That question becomes particularly interesting when you consider the potential windfalls. In 2015, President Barack Obama signed into law the Space Resource Exploration and Utilization Act (with assistance from lobbyists working on behalf of Planetary Resources), which stated that any citizen has the right to engage in the “commercial recovery of an asteroid resource or a space resource” without any interference from the U.S. government.

Lewicki foresees that some precious metals excavated in space will be so valuable that it will be worth the cost to bring them back home. The company’s future will mostly take place far from Earth, though, servicing a not-yet-existent space industry and the humans who work, live, and play in the outposts that support them.



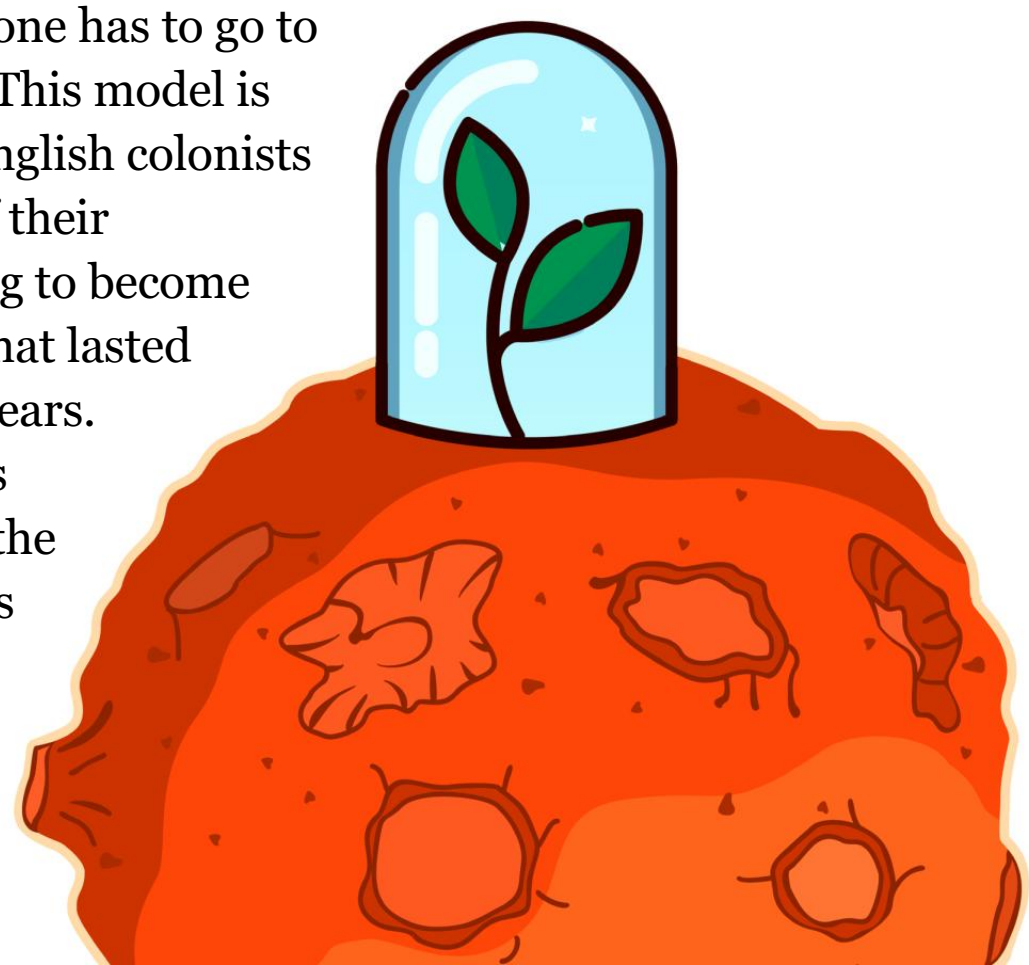
LIKE *NORTHERN EXPOSURE* BUT IN SPACE

Space isn't easy—not getting there and certainly not living there. We haven't even touched on how future Martian colonists will go about protecting themselves from solar radiation (there's no protective ozone layer on Mars), securing sources of oxygen and water (the good news is there are indications of reserves of water just below the Martian surface), or grow their own food (Matt Damon's character in *The Martian* resorted to planting potatoes in his feces). These first pioneers will have to be a hearty bunch.

Elon Musk has sketched out an economic model for luring workers willing to brave the harsh conditions in SpaceX City—he envisions that a ticket to Mars can be brought down to around $200K, close to the median home price in the U.S. today. That last detail is important in that, like a home mortgage, Musk foresees a model in which workers would pay off their debt over many years (maybe even decades).

"Not everyone would want to go. In fact, probably a relatively small number of people from Earth would want to go, but enough would want to go who could afford it for it to happen," Musk writes. "People could also get sponsorship. It gets to the point where almost anyone, if they saved up and this was their goal, could buy a ticket and move to Mars—and given that Mars would have a labor shortage for a long time, jobs would not be in short supply."

Terms like "indentured servitude" don't land very well on contemporary ears (which is probably why Musk opted to use "sponsorship"). But is it really all that different than the obligation one has to go to work each day to repay a mortgage? This model is analogous to how some of the first English colonists in North America covered the cost of their intercontinental journey—by agreeing to become indentured servants with contracts that lasted anywhere between three and seven years. (Or perhaps it's like Dr. Fleischman's service-for-education agreement on the TV show *Northern Exposure,* if that's how you roll.)



For some, the promise of adventure on a new world—no matter the cost—will be reason enough to make the interplanetary leap. But for others, Mars' endemic labor shortage might be the motivating factor. There's a very real possibility that in the future, we won't have be enough jobs for people (on Earth), thanks to advancements in technology. We should note that the prospect of impending mass "technological unemployment" is far from universally accepted gospel. Still, no doubt, a number of people will be willing to leave the Earth to work in SpaceX City—possibly for the rest of their lives.

These space pioneers will lay the foundation for a literal whole new world, but they might also play an important role supporting those of us who remain here on Earth. Civilization is under threat from asteroid impacts, global warming, and nuclear war; but it's also facing increasing pressure from a few centuries of unprecedented human progress. And colonization might be just the key to keeping it all going—on this planet and the ones that follow.

MARS, SAVE US FROM OUR OWN SUCCESSES

While cable news likes to highlight things like war, terrorism, and tragedy (and indeed, there are many problems we need to deal with), the world is actually quietly enjoying a golden age.

Consider the following: Despite some troubling hot spots, we are seeing some of history's lowest rates of war deaths around the globe. According to The World Bank, childhood mortality, defined by children under 5 who die per 1,000 live births, has fallen from 182.7 in 1960 to just 42.5 in 2015; and last year, for the first time ever, the percentage of people living in extreme poverty (those living on less than $2 a day) fell below 10 percent. That last one was a very big deal that didn't receive nearly enough attention. Not only has extreme poverty plummeted to historic lows, but it happened in the blink of history's eye.

These are all amazing trends that we should work to continue. In fact, there's little reason to think they won't continue, which leads us to a very interesting problem: How will the world respond when those communities that have finally risen above mere subsistence begin to expect (if not demand) things like nutritious food, clean water, electricity, access to information, and maybe even McMansions, SUVs, and bountiful backyards?

While technology helps us do more with less, a proliferation of middle class societies will place additional stress on a planet that is already long overdue for a vacation. Throw into the mix the prospect of a swelling population, climate change, and increased job competition, and you can see how things might get messy fast.

One possible countermeasure is physical expansion. In the past, expansions have managed to boost both parent and colonial societies.

“If you start moving people from where land is scarce and costly to where it is abundant and cheap, you’re going to raise their standard of living and also generate a growing output per capita that will benefit the economies of both societies,” explains Jan de Vries, professor emeritus of history and economics at the University of California at Berkeley. “One is benefited by less population pressure on their resources, and the other is benefited by high productivity for the new arrivals—and trade allows them both to become better off.”

According to de Vries, in order to produce any real economic benefit for the motherland (or mother planet, in this case), the “transaction costs” have to come down. Mars is indeed far away. The good news is that history shows that it’s well within our abilities to shrink barriers that once seemed insurmountable. It took a couple of months for Columbus to cross the Atlantic; by the 1830s, the steam engine sliced the time to 5 days; and a century later, Charles Lindbergh flew from Long Island to Paris in just 33 hours.

Our ability to shorten the gap between Earth and its outposts will become increasingly consequential—we need only look to the revolutionary founding of

STRATA AT BASE OF MOUNT SHARP
A view from the “Kimberley” formation on Mars taken by NASA’s Curiosity rover.

this country to understand why. After Europe's expansion into the New World, the two societies remained physically close enough to facilitate trade but were far enough apart that the colonies eventually began to think of themselves as something else. That philosophical break cleared the way for experimental forms of self-rule, which eventually had an impact on both sides of the Atlantic. We can only speculate about what kind of impact a similar interplanetary break might wreak.

Consider the prospect of trillions of space bucks flowing unfettered into highly organized corporate structures.

LET'S SPECULATE

Colonialism is a potent force that has the power not only to build new nations but also to transform existing ones. The post-Columbus colonial expansion fueled the rise of powerful nation-states in Europe, which ousted the volatile feudalism that ruled the continent since at least the 10th century. The European nations who benefited the most in the Age of Discovery were those with access to the most advanced maritime technologies; but in the Age of Discovery 2.0, those with the most advanced space technologies probably won't be European or American or Russian or Chinese. In fact, they might not be nations at all. SpaceX City might not just be humanity's most advanced science project yet; it could represent the beginning of a whole new political paradigm: the corporatocracy.

Consider the prospect of billions and trillions of space bucks flowing unfettered into highly organized corporate structures that have spent the past 30-plus years untangling themselves from government oversight. (Indeed, as mentioned above, we've already seen the private space industry successfully lobby U.S. regulators to loosen control over the nascent extraterrestrial economy.)

It's not difficult to imagine how a corporate-run outpost far from the Earth might trend dystopian, but there's reason for optimism as well. Absent a global calamity leading to widespread desperation, there's little reason to believe that people won't continue to expect certain unalienable rights. Any authority who attempts to tell them otherwise will have a fight on its hands.

In fact, human dignity's best chance for survival in space is a multitude of colonies that are close enough for trade and travel but far enough apart that they don't directly compete for resources. In this scenario, if you didn't like the way things were run in SpaceX City, then you could make a case of your usefulness to Planetary Resource's floating armada to buy your contract (like what T-Mobile will do today to get you out of your contract with Verizon). Once your debt is paid, you'd be free to try out Blue Origin Town on the moon of Europa. Or if you're feeling entrepreneurial, maybe even go out and start your own homestead. Just like a marketplace—a marketplace of nations.

Once a multitude of peacefully coexisting outposts is established, some intriguing possibilities arise. Just as the European colonies in the Americas ran real-world experiments featuring new forms of government, future space colonies would be free to experiment with novel societal models of their own. Some of these models will fail and some will flourish, but they'll all have the ability to learn from each other's missteps and improve over time.

Humanity's future in space is too far away to predict with absolute clarity. But it's close enough that it's worth our time to carefully observe it as it takes shape. And it's worth our collective effort to make sure it gets done right.

DATA RESCUE 2.0

After a post-election frenzy to save government data, open-access advocates are refocusing their energies toward a long-term strategy.

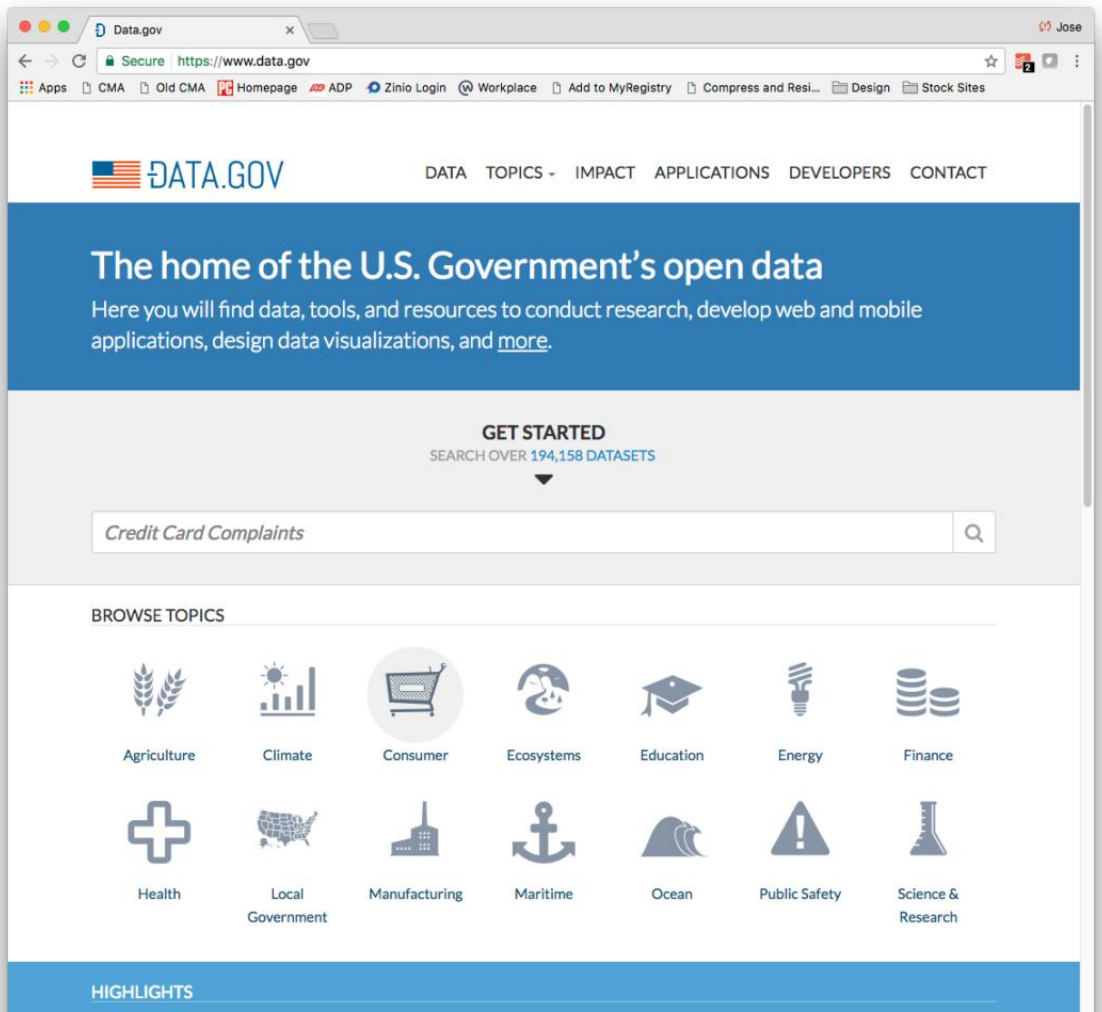
BY MICHELLE Z. DONAHUE

In late May of this year, exactly five months from the inauguration of the 45th President of the United States, a group of people concerned with the new administration's stance toward science and climate change marked its own special anniversary.

Not far from the campus of the University of North Texas, on the plains north of Dallas, several dozen individuals met up at Data Rescue Denton to identify and download copies of federal climate and environmental datasets. These hackathon-style gatherings received a great deal of attention in the days immediately preceding the inauguration; Denton was the 50th such event since January 2017.

Organizing initially out of concern that the new administration might erase or obscure climate and other environmental data, data rescuers' worst fears seemed to be coming true when one of the Trump White House's first actions was to delete climate-change pages from its website. Then the U.S. Department of Agriculture, after removing animal-welfare inspection reports from its website, responded to a National Geographic Freedom of Information Act request with 1,771 pages of entirely redacted material.

Anyone can access the more than 153,000 federal datasets through the central government open-data portal at data.gov. But that's only a fraction of the data that exist in the nebula of the government bureaucracy, never mind the even smaller fraction that is on a server.



“Somewhere around 20 percent of government info is web-accessible,” said Jim Jacobs, the Federal Government Information Librarian at Stanford University Library. “That’s a fairly large chunk of stuff that’s not available. Though agencies have their own wikis and content management systems, the only time you find out about some of it is if someone FOIAs it.”

To be sure, a great deal of information was indeed captured and now resides on non-government servers. Between Data Refuge events and projects such as the 2016 End-of-Term Crawl, over 200 terabytes of government websites and data were archived. But rescue organizers began to realize that piecemeal efforts to make complete copies of terabytes of government agency science data could not realistically be sustained over the long term—it would be like bailing out the Titanic with a thimble.

So although Data Rescue Denton ended up being one of the final organized events of its kind, the collective effort has spurred a wider community to work in concert toward making more government data discoverable, understandable, and usable, Jacobs wrote in a blog post.

LOOKING TO LIBRARIES

At the University of Pennsylvania, Bethany Wiggin is the director of the Penn Program in Environmental Humanities, where she has been central to the Data Refuge movement, the originator of the Data Rescue events. The focus has now shifted, she said, toward leveraging national frameworks for long-term efforts instead of locally based, periodic episodes.

This houseboat, an artwork created by the Penn Program in Environmental Humanities, asks questions of the future, such as “How can we change our ways of life to be more sustainable”?

“We realized the skills that were emerging in various places doing rescue-data events [were] something that could be scaled,” Wiggin said, particularly across research libraries. “But these efforts were all happening before we launched. The power of Data Refuge has been to thicken those connections; catalyze long-standing, slow-moving projects; and shine a light on how important they are.”

Wiggin has lately been helping to spearhead Libraries+Network, an emerging partnership of research libraries, library organizations and open-data groups catalyzed to expand libraries’ traditional role in preserving access to information. Participants include the Stanford University research library, the California Digital Library, and the Mozilla Foundation, with input and collaboration from entities as wide ranging as the National Archives and the chief data officers of several federal bureaus.

One project, for example, is LOCKSS (“lots of copies keep stuff safe”) which Jacobs has been coordinating for several years. This project is based on the same principle as a 200-year old network of libraries known as the Federal Depository Library Program; these libraries are official repositories of publications by the U.S. Government Printing Office (GPO).

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LOCKSS, by contrast, is a private digital version of this system, which so far consists of 36 libraries that harvest publications from the GPO with its cooperation. It’s a model for how digital information can be protected from deletion or tampering by having wide physical dispersal.

“You can’t assure preservation unless you have control of the content,” Jacobs said. “Part of what made the depository libraries important and useful for the last 200 years was that nobody in the government could edit a document without actually going to 1,500 libraries and saying ‘Yeah, change this one page here.’”

The software LOCKSS uses checks caches of content at the bit level and compares it with the content held by other libraries, which Jacobs said helps ensure long-term preservation through the repair of degraded files.

John Chodacki, another collaborator with the Libraries+Network, is director of curation for the California Digital Library, a virtual information facility that serves all 10 campuses of the University of California system. Working with Code for Science and Society developer Max Ogden and Philip Ashlock, chief architect at data.gov, Chodacki says their focus has been on using data.gov as a two-way street.

They first demonstrated that data rescue itself could be far more efficient by scooping up a copy of data.gov itself and placing it on an outside site, datamirror.org, with monitoring scripts that check for updates. Then Chodacki and collaborators also started looking at whether contributed datasets and metadata to the mirror could feed into agencies' existing data.gov workflows through stub pages on the mirror.

As per the 2013 Obama executive order that mandated publication of machine-readable data on data.gov, agencies would still be responsible for generation of the records that are listed on that portal; Chodacki and Ogden's idea is that crowdsourcing suggested datasets simply helps to spread the workload.

"We don't need to replicate the entire ecosystem," Chodacki said. "The federal government and these agencies have been dealing with data for way longer than it's been buzzworthy to talk about big data, in a much more robust way than anybody else."

PUBLIC-PRIVATE PARTNERSHIPS

The question of cost is an obvious one when it comes to how agencies are able to identify which datasets are most valuable for the public, then publishing links to their metadata or actual datasets through the government portal. A Congressional Budget Office (CBO) report for the OPEN Government Data Act bill currently in the Senate—which would codify the Obama executive order into law—estimates its full implementation would cost $2 million between 2018 and 2021.

In government money terms, that represents essentially no real increases in spending, CBO concluded.

Efficiency, however, is a different question, one that Ed Kearns at the National Oceanic and Atmospheric Administration is experimenting with along with private partners including Amazon Web Services and Google. Kearns, NOAA's chief data officer, said increasing public availability and usage of NOAA data is a major objective of the Big Data Project.

Companies identify which datasets they want, and NOAA passes it along at no additional cost to the public. Anything NOAA has is on the table, Kearns said, but the goal of the five-year partnership is not to get all NOAA data out on the cloud—just strategic chunks.

Hosting such datasets on private companies' cloud services offers several advantages to the 80s-style FTP access that is still standard for transfer of large datasets from federal agencies. To start, NOAA's datasets tend to be vast—the agency monitors the Earth's oceans, atmosphere, sun and space weather—and sometimes require weeks or months for public delivery.

One example is the agency's high-res NEXRAD Level-II Doppler radar archive. According to a study published in May by the American Meteorological Society, transferring the entire 270-terabyte NEXRAD archive to a single customer in October 2015 would have taken 540 days at a cost of $203,310. A full copy of the archive had never been available for external analysis before NOAA worked with Amazon and Google to put one on the cloud.

The experiment has also had some interesting early results with usage increases. NOAA's weather and forecasting web pages already receive some of the highest levels of traffic among government sites, but after Google recently integrated one climate and weather dataset, about a gig in size, into its BigQuery database, the company reported delivering 1.2 petabytes of this dataset from January 1 through April 30—far more than had ever been accessed in a similar timeframe from NOAA servers.

"Google was able to open it up to a whole new audience," Kearns said.

It's not just rain and seasonal temperatures. Datasets now available through the Big Data partners include fisheries information, marine weather, and a catalog hosted by IBM that lists current, forecast, historic and geospatial datasets from NOAA centers. Future datasets could even include information on ecosystems and fisheries genomics.

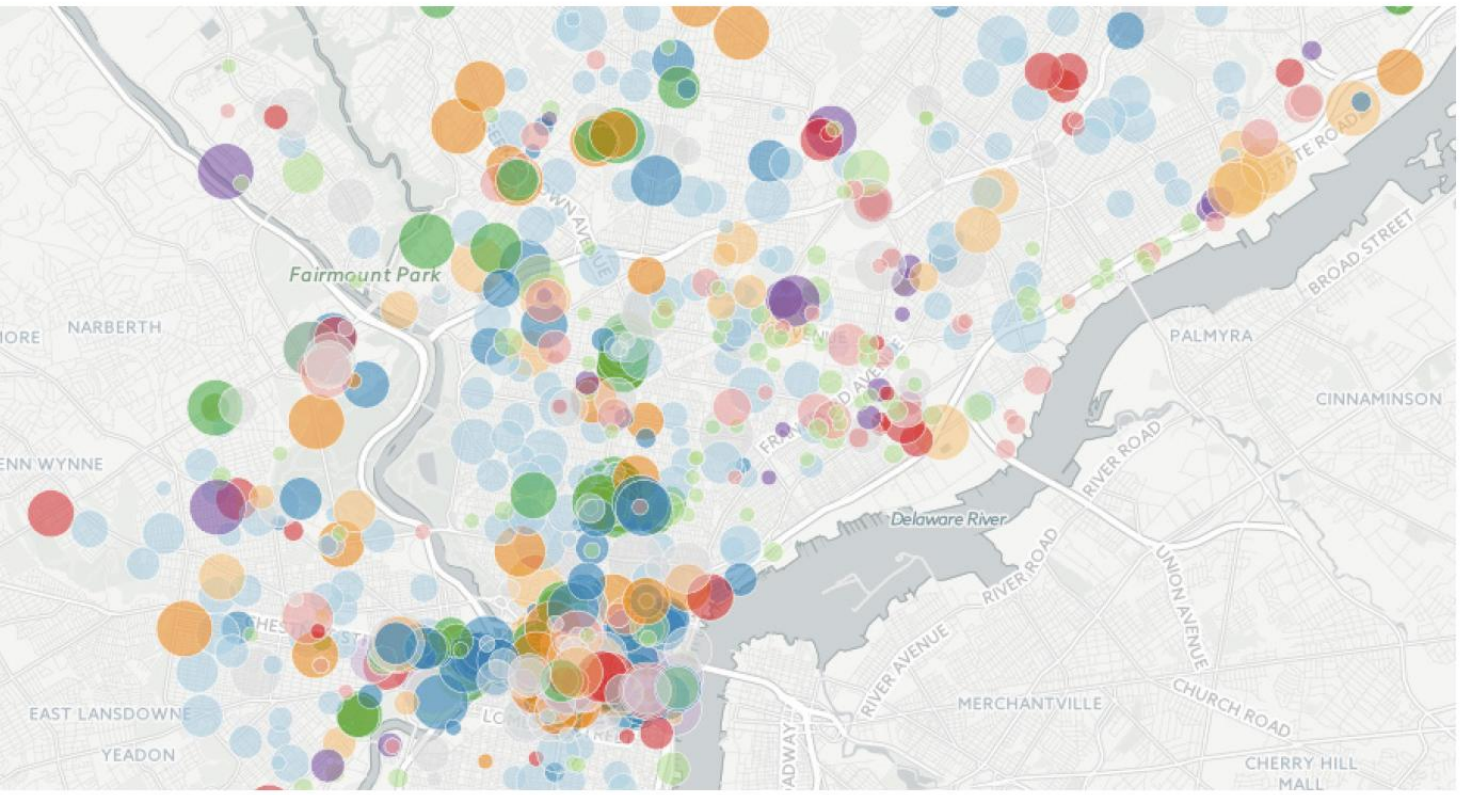
But by design, the partnership allows collaborators to cherry-pick what they want most, which carries the risk that obscure, yet potentially high-value datasets, won't see much daylight. Kearns says it's too early to say what may eventually be identified as valuable.

"The scale and reach of what [collaborators] can do with this data is staggering to us," he added. "We can't imagine all the possible uses."

On a smaller scale, the City of Philadelphia has also worked with a private entity towards publishing datasets the public has said it would find most useful. Though a city's size gives it more day-to-day operational maneuverability than a federal entity, Philly's model represents one approach for strategizing releases of as-yet unpublished datasets.

NOAA's weather and forecasting web pages already receive some of the highest levels of traffic among government sites.

Azavea, a Philly-based software firm specializing in data visualization, collaborated with the city's chief information officer, Tim Wisniewski, to develop a list of unpublished datasets that nonprofits in the city might have an interest in using. Wisniewski and Azavea used both the city's online metadata catalog and input from city departments to develop the list. Azavea and other partners then shopped the list out to Philadelphia nonprofits and launched OpenDataVote, a competition for the public to vote on projects put forward by those nonprofits for how they'd use their preferred datasets.



This dataset shows building and performance data for energy benchmarking in Philadelphia.

A recent winner was a proposal put forward by education nonprofit MicroSociety to use city data on donors to the Philadelphia School District to measure the impact of nonprofit programs in schools.

"We can say that this city nonprofit is interested in a particular dataset because they can do something with it, and that this many people voted to support them," Wisniewski said. "It lets us go to the departments with a solid use case in hand rather than saying, hey, release this data just because."

OLD DATA AND THE NEW

But what happens even when there's plenty of access to data that's already out there, when new policies and funding directives mean that the data itself just isn't being generated any more? That's a real concern, said Ann Dunkin, who served as the chief information officer at the Environmental Protection Agency under President Obama and now heads up IT for California's Santa Clara County.

"People are worried about the old data, but what worries me most is that new data isn't being being made available at the same rate as before, or not generated at all," Dunkin said.

What worries me most is that new data isn't being being made available at the same rate as before, or not generated at all.

In one analysis of the proposed 2018 federal budget by the magazine Science, many government agencies would realize significant reductions in their research budgets if the budget is passed as proposed. A roughly 22 percent cut at the National Institutes of Health would carve into payments to research universities; the NASA budget request would eliminate initiatives to monitor greenhouse gas emissions and other earth science programs. Climate programs at NOAA could also be shuttered with similar levels of cuts.

During her tenure, the EPA had been working towards making its collection of data into a tool for anyone to use to understand the health of their surroundings, and how to react to it. Bad air day? Don't go outside. Stream down the way polluted? Keep the kids away.

"My expectation is that will move backward," Dunkin added. "I could be wrong, but if you're saying we're not going to make data available, the logical conclusion is datasets that could help members of public also won't be available or not generated in the first place."

Data Refuge's Wiggin is working on a storytelling project related to this issue that she hopes will catalyze more people to demand ongoing releases of data, and create a groundswell of support for continuing existing data-collection programs throughout the federal government. "Three Stories in Our Town" narratives will portray the oft-hidden impact federal data has in unexpected places, starting first in Philadelphia, then in other places throughout the country.

"A crucial piece of the Data Refuge movement, as we move to the next phase, is helping people understand just how widely used federally produced data is in their lives," Wiggin said. "Whether you call it climate or health or public safety, it's still federal data. It's in communities, in city hall, in policing efforts, in the military. We need to keep remembering just how important that data is."

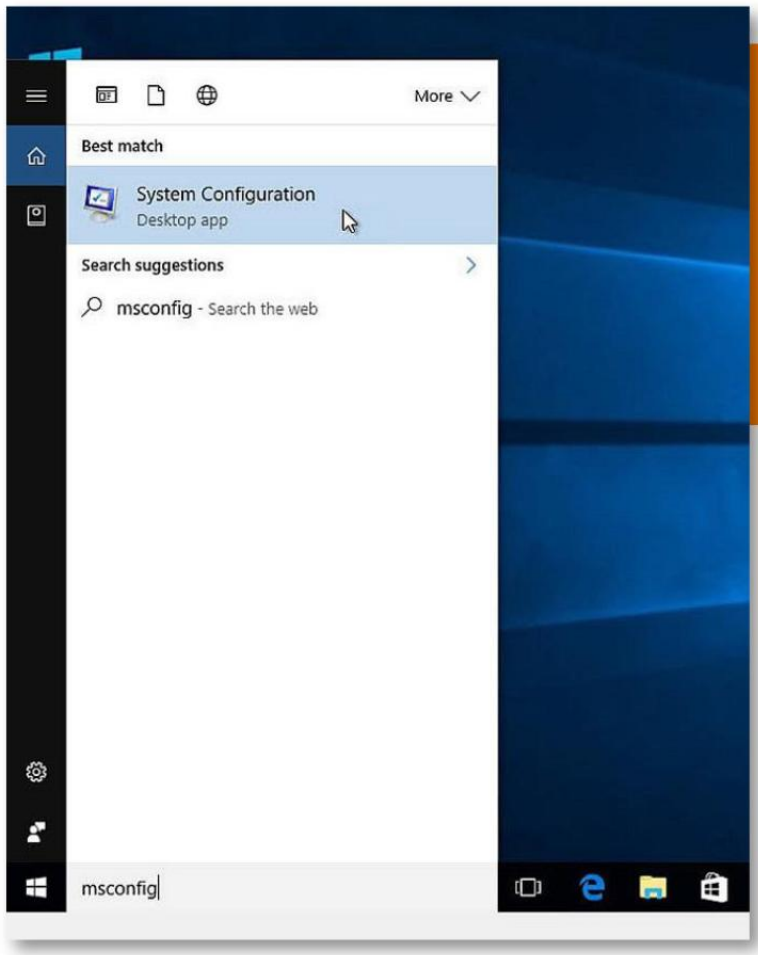
How to Use Safe Mode to Diagnose a PC Problem

BY LANCE WHITNEY

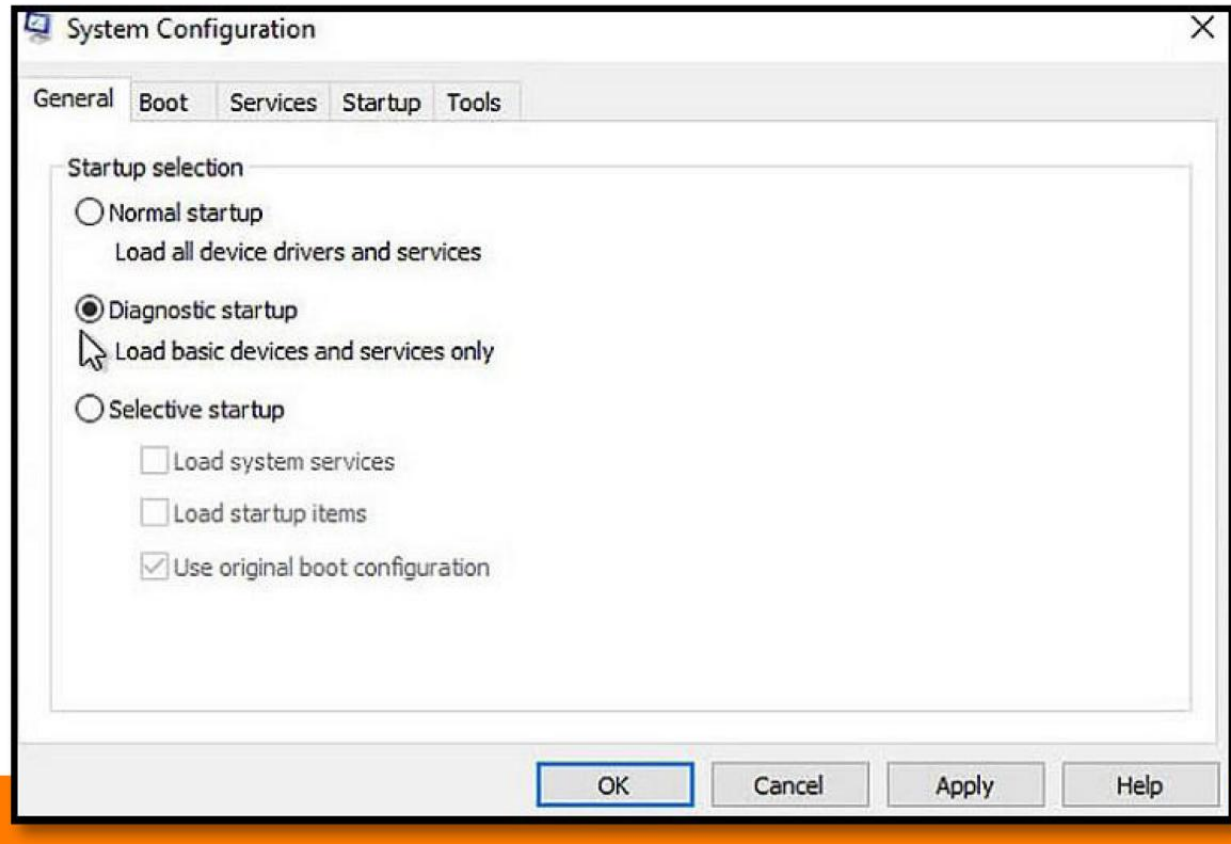
Is your Windows machine freezing, crashing, or just not up to snuff? It could be a bad application, a quirky driver, or even a faulty piece of hardware.

One way to get to the bottom of the problem is by starting the OS in Safe Mode, which launches Windows in a clean, pristine, bare-bones fashion by preventing certain drivers and other features from running. If Windows works happily in Safe Mode, that typically means the fault lies within a certain driver, service, or other item that would otherwise load.

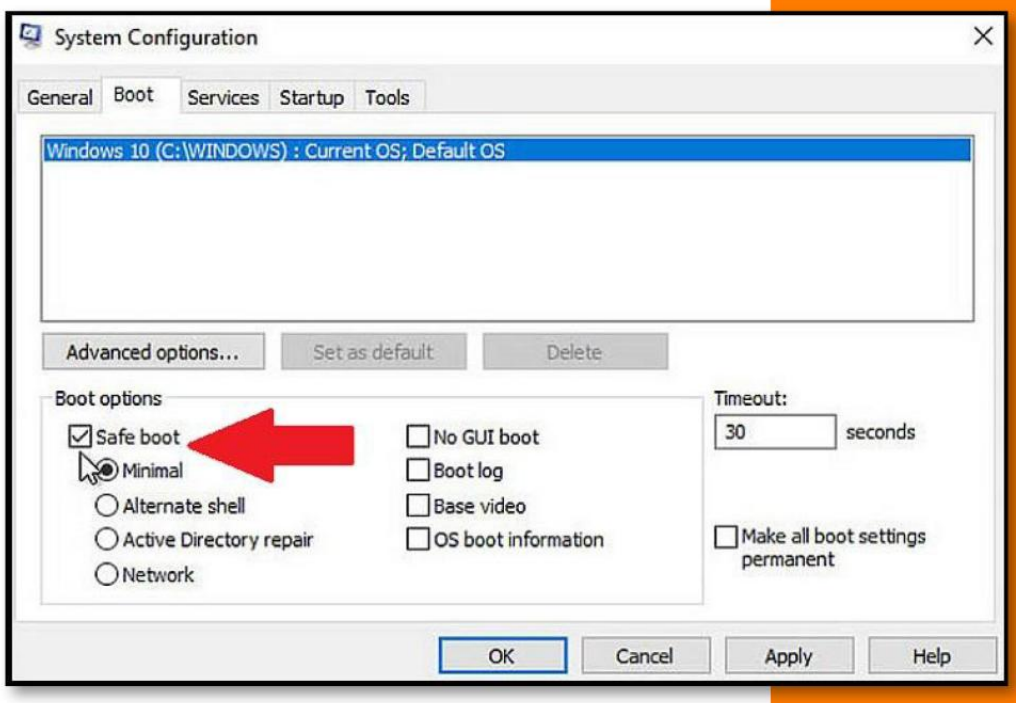
The steps offered here assume that you can at least boot into Windows and access the Safe Mode feature. Here's how to get started.



In the search field, type the command *msconfig*. At the top of the search results, click on the entry for System Configuration.

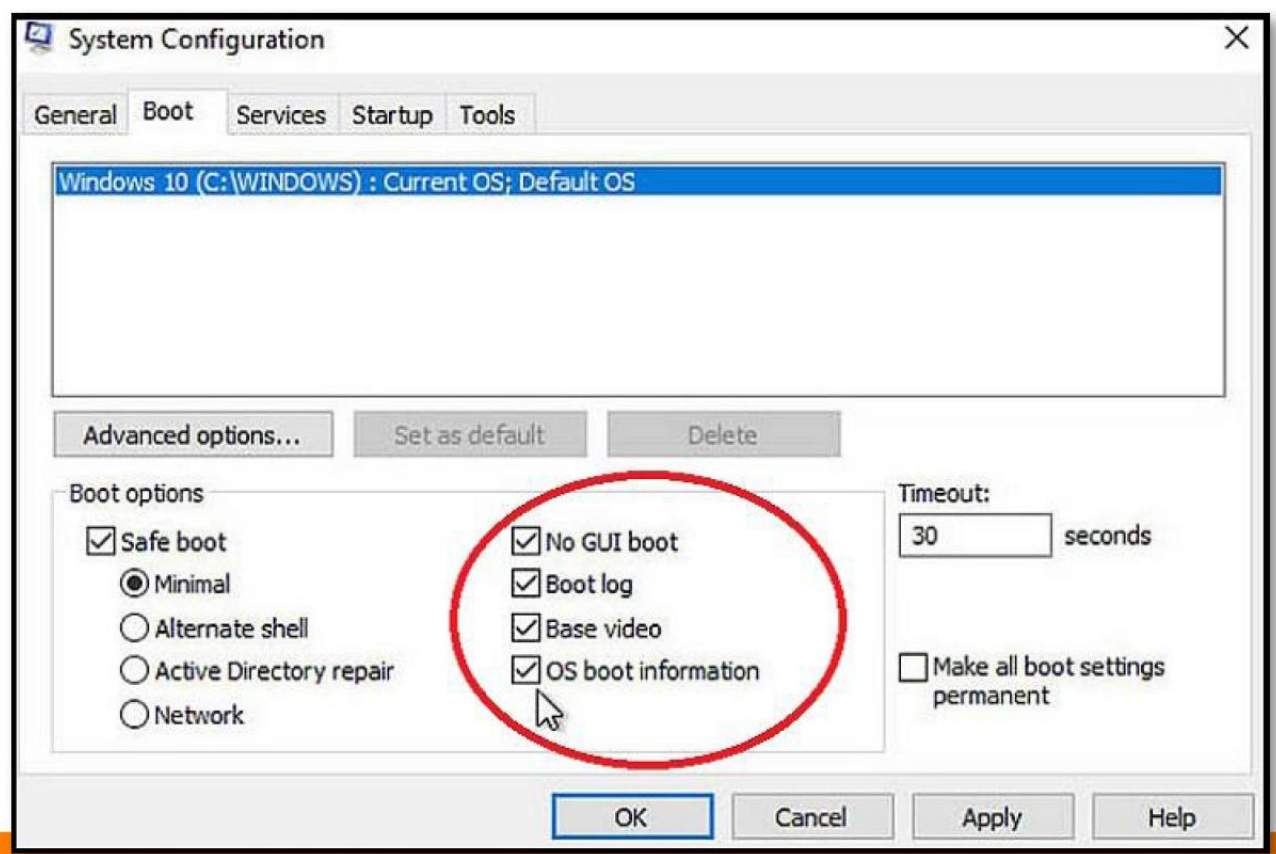


The System Configuration window appears. Your current setting is most likely Normal Startup or Selective Startup. Click on the second option for Diagnostic startup, which loads only basic drivers and services. Click OK and reboot Windows.

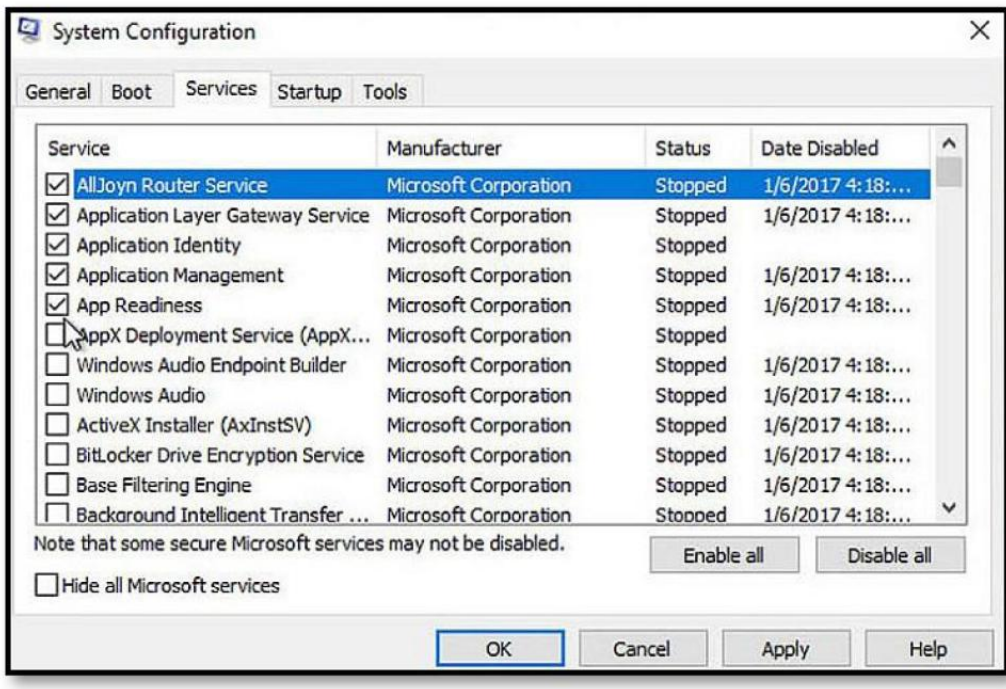


After Windows restarts, try to reproduce the problem you were experiencing. Whether or not the trouble has disappeared, you'll still need to run further testing to attempt to narrow it down. Open the System Configuration tool again and click on the Boot tab and the checkbox for Safe boot.

Then try the different options, such as Minimal, Alternate shell, and Network, rebooting with each selection. With each reboot, try to reproduce the original problem. If the problem goes away, then try booting into Normal mode and see if the problem is really gone.



Otherwise, move on to one of the other options. You can also try clicking on each of the different check-marks to the right—No GUI boot, Boot log, Base video, and OS boot information. Reboot your PC with each option checked one by one, and you should be able to see whether the problem is gone or still around.

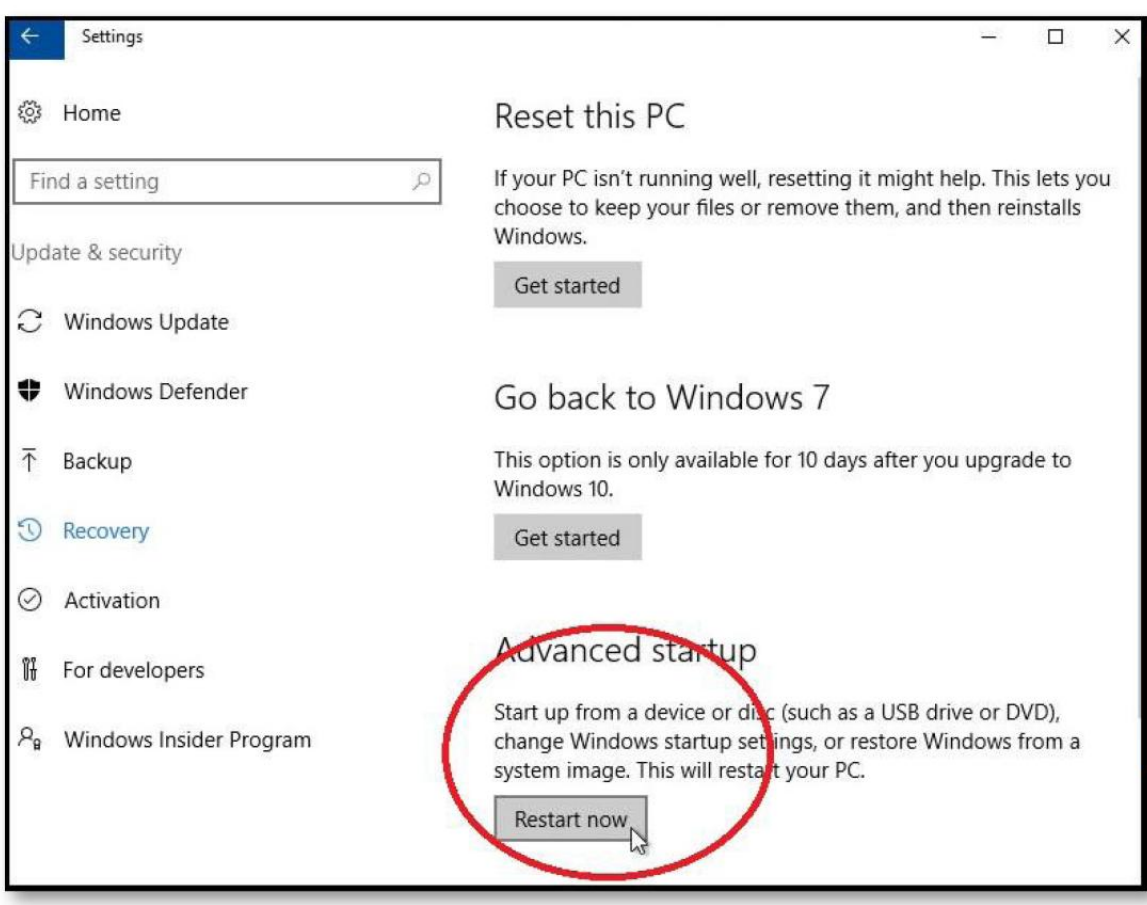


You can also check the Services tab. A lot of services may be listed here, but you can click on or off the checkmark for each service one by one and see whether the problem is related to a specific service.

At this point, if you can narrow down the problem to a specific driver or service, you can run a Google or Bing search for that item to see if other people are bumping into trouble with it and how they may have resolved the issue.

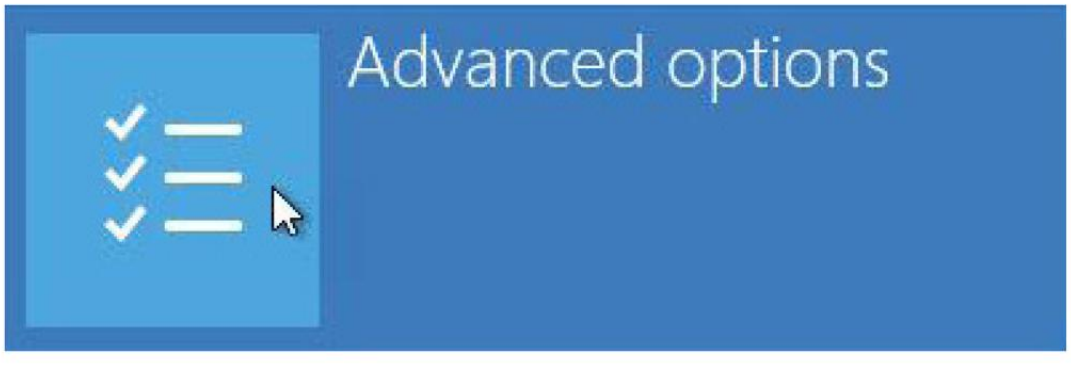
WINDOWS 10 AND 8.1

If you're running Windows 10 or 8.1, you have other options for booting into Safe Mode. In Windows 10, click on the Start button > Settings > Update & security > Recovery. In the Advanced Startup section, click on the button to Restart now.

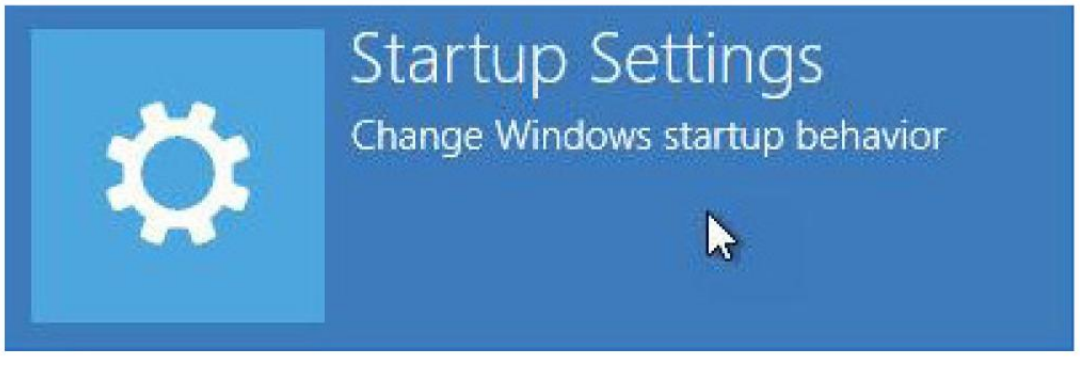


In Windows 8.1, launch the Charms bar, then click on the Settings charm > Change PC Settings > Update & recovery > Recovery. In the Advanced Startup section, click on the button to Restart now. Under Advanced startup, click on the button to "Restart now."

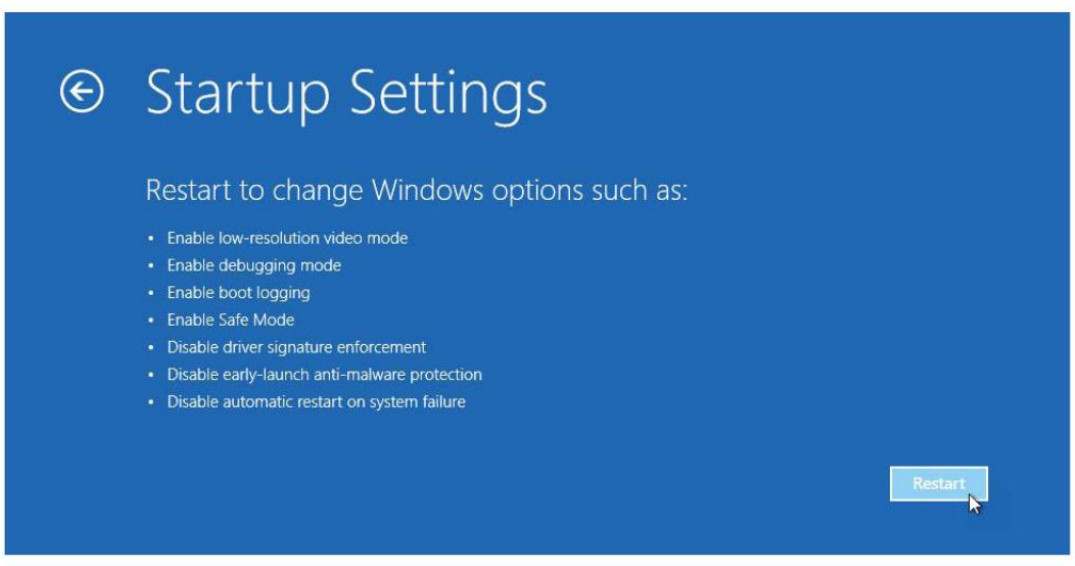
At the "Choose an option" screen, click on the Troubleshoot button.



At the Troubleshoot screen, click on the Advanced options button.



At the Advanced options screen, click on the Startup Settings button.



At the Startup Settings screen, click on the Restart button.

At the next Startup Settings screen, press one of the keys from 1 through 9 to select a specific startup type, for example, 1 to Enable debugging, 4 to Enable Safe Mode, or 5 to Enable Safe Mode with Networking. Then click on the Restart button. Your PC will reboot with the startup type you selected. You can now once again try to reproduce the problem you've been experiencing in Windows to see if you can narrow it down.

Which CPU Should You Buy? Intel Core i5 vs. i7

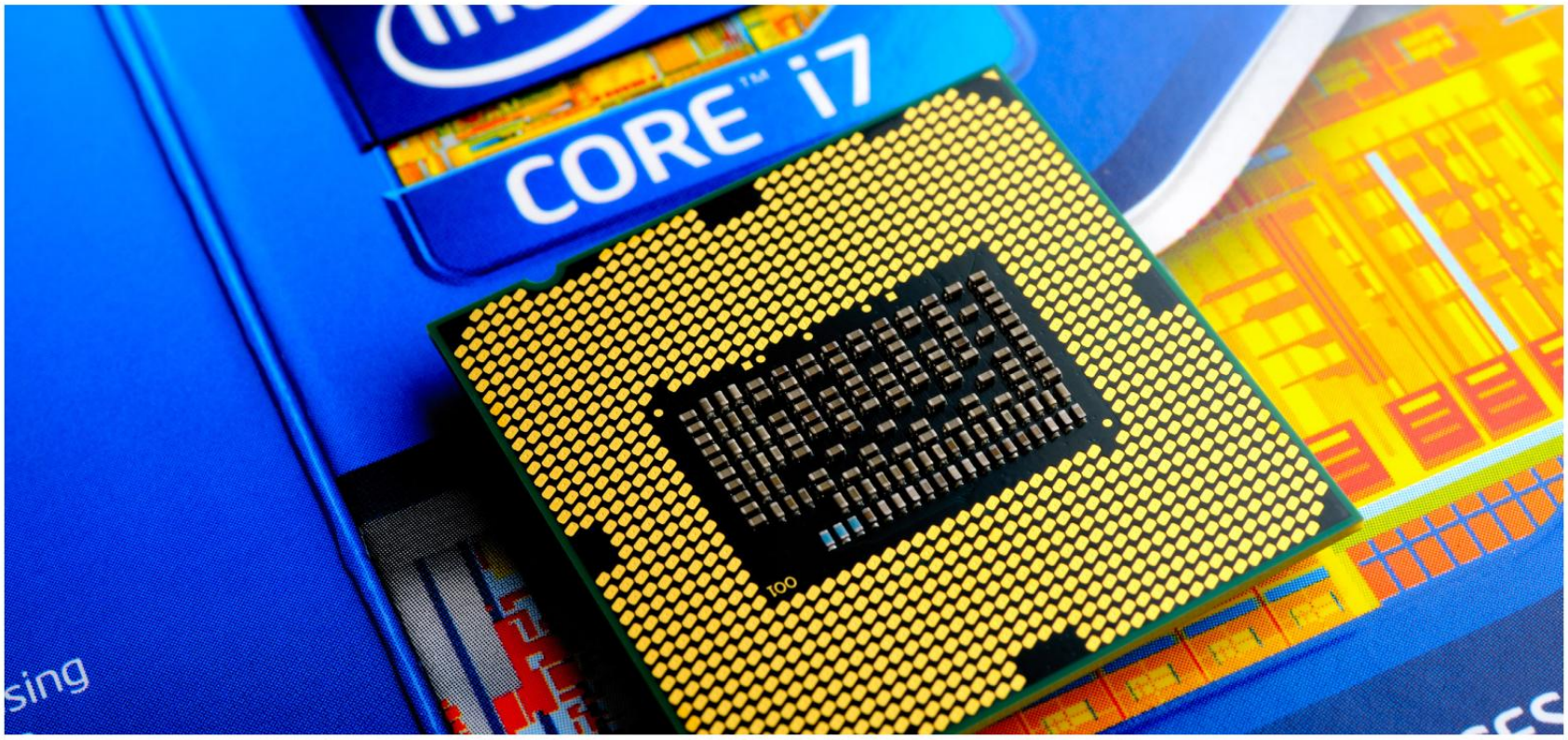
BY JOEL SANTO DOMINGO

For many of us who are on the hunt for a new desktop or laptop PC, one of the biggest considerations is the type of processor. Two of the CPUs most often in contention are the Intel Core i5 and Intel Core i7. Discounting Core i3 and m3 (mainly found in budget systems), Core i9 (powerful CPUs for gaming and performance PCs), and AMD processors (another story entirely), the difference between Intel Core i5 and Core i7 can seem daunting, especially when the prices seem so close together once they're in completed systems. We break down the differences for you.

PRICING AND MARKETING

Simply put, Core i5-equipped systems are less expensive than Core i7-equipped PCs. Intel has moved away from the star ratings it had used with previous-generation Core processors in favor of a capability-driven marketing message. Essentially, the Core i7 processors have more capabilities than Core i5 CPUs. They will be better for multitasking, multimedia tasks, high-end gaming, and scientific work. Core i7 processors are certainly aimed at people who complain that their current system is "too slow." Spot-checking a system such as the Dell XPS 13 Touch ultraportable, you'll find the Core i5 to be about $200 less expensive than a similarly equipped Core i7 system.

Simply put, Core i5-equipped systems are less expensive than Core i7-equipped PCs.



For the most part, you'll get faster CPU performance from Core i7 than Core i5. The majority of Core i7 desktop CPUs are quad-core processors, as are the majority of Core i5 desktop CPUs. But some mobile versions of both processors are dual-core. You might also see the rare six- or eight-core Core i7, but that's usually found with the desktop-only, top-of-the-line Core X and Extreme Edition models. To break it down simply, the more cores you have in your CPU, the faster it will perform.

The Core nomenclature has been used for several generations of CPUs. Haswell, Broadwell, Sky Lake, and Kaby Lake CPUs use four-digit model names (such as the Intel Core i7-7700). Thankfully, unless you're shopping the used-PC market, you'll find only Broadwell or older processors in closeout systems and budget PCs, and you'll find Sky Lake or Kaby Lake processors in most new PCs. Older-generation Nehalem, Westmere, Sandy Bridge, and Ivy Bridge cores generally have lower performance. The essential takeaway is that to get better performance in each generation, buy a processor with a higher model number. For instance, an Intel Core i7-7600U generally has better performance than an Intel Core i5-7200U.

GIVE ME THE CACHE

In addition to generally faster base clock speeds, Core i7 processors have larger cache (on-board memory) to help the processor deal with repetitive tasks faster. When you're editing and calculating spreadsheets, your CPU shouldn't have to reload the framework where the numbers sit. This info will sit in the cache, so when you change a number, the calculations are almost instantaneous. Larger cache sizes help with multitasking as well, since background tasks will be ready for when you switch focus to another window. On currently available desktop processors, most i5 CPUs have 3MB to 6MB of L3 cache, while most i7 processors have 6 MB to 8MB.

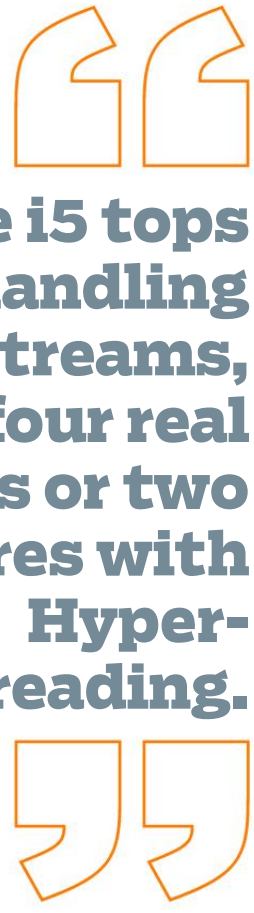
A WORD ON TURBO BOOST

Turbo Boost is an overclocking feature that Intel built into its processors. Essentially, it allows the processor to run faster than its base clock speed when only one or two processor cores are needed (like when you're running a single-threaded task that you want done now). Both Core i5 and Core i7 processors use Turbo Boost, with Core i7 processors achieving higher clock speeds.

HYPER-THREADING

Intel Hyper-Threading uses multithreading technology to make the operating system and applications think that a processor has more cores than it actually does. Hyper-Threading technology is used to increase performance on multithreaded tasks. The simplest multithreaded situation is a user running several programs simultaneously, but other activities take advantage of Hyper-Threading, including multimedia operations (such as transcoding and rendering) and Web surfing (loading different elements, like Flash content and images, simultaneously).

The quick explanation is that all Core i7 CPUs use Hyper-Threading, so an eight-core CPU can handle 16 streams, a four-core can handle eight streams, and a dual-core can handle four streams. Core i5 uses Hyper-Threading to make a dual-core CPU act like a four-core one, but if you have a Core i5 processor with four true cores, it won't have Hyper-Threading. For the time being, Core i5 tops out at handling four streams, using four real cores or two cores with Hyper-Threading.



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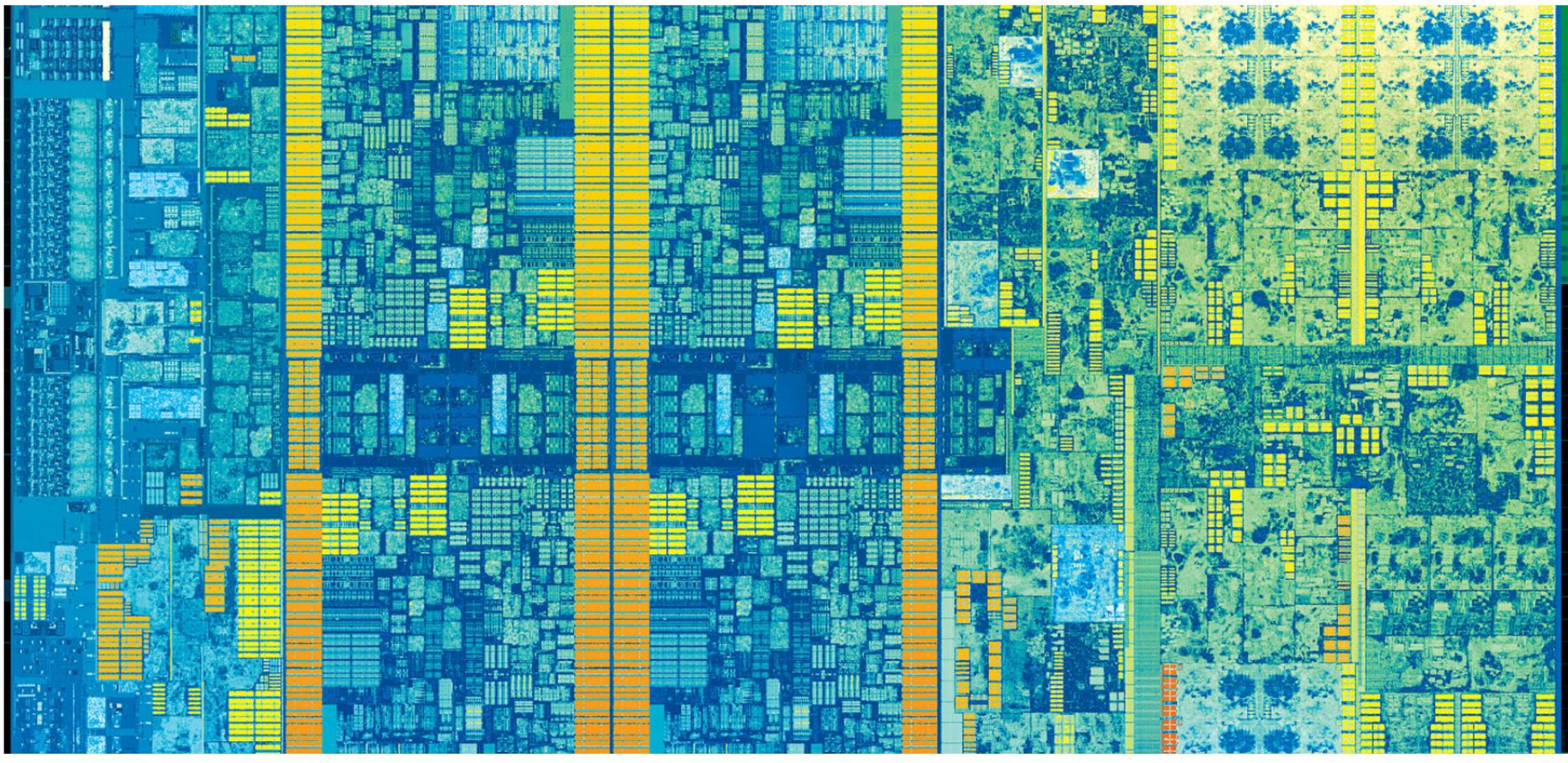
INTEGRATED GRAPHICS

The Westmere generation of Core processors introduced Intel HD graphics, which are integrated graphics built into the CPU core itself. Previous Intel-integrated graphics were built onto the motherboard chipsets rather than on the processor. You'll find Skylake sixth-generation and Kaby Lake seventh-generation processors have either Intel HD graphics (Intel HD Graphics 630, for example), or Intel Iris/Iris Plus options. Note that while high-end Intel processors will let you play 3D games at medium-quality settings, you'll still need discrete GPUs from AMD or Nvidia to play 3D games at 1080p or 4K resolutions with ultra quality settings turned on.



The same numerical rules apply here, so Intel Iris Plus 650 performs better than Intel HD Graphics 630, which performs better than Intel HD Graphics 510. You'll find Iris Plus and higher-end Intel HD graphics on Core i7 CPUs, while Core i5 processors feature one of the myriad versions of Intel HD graphics, depending on the part number. Integrated graphics save power, since there's no extra graphics chip on your laptop or desktop's motherboard using power.

CORE OUTLIERS: X AND Y

Intel has announced a new Core X processor family aimed at high-performance users, such as extreme gamers and video editors. The Core i9-7980XE Extreme Edition processor, for example, has 18 cores and can process 36 threads simultaneously. It also retails for $1,999 and is overkill for most users.

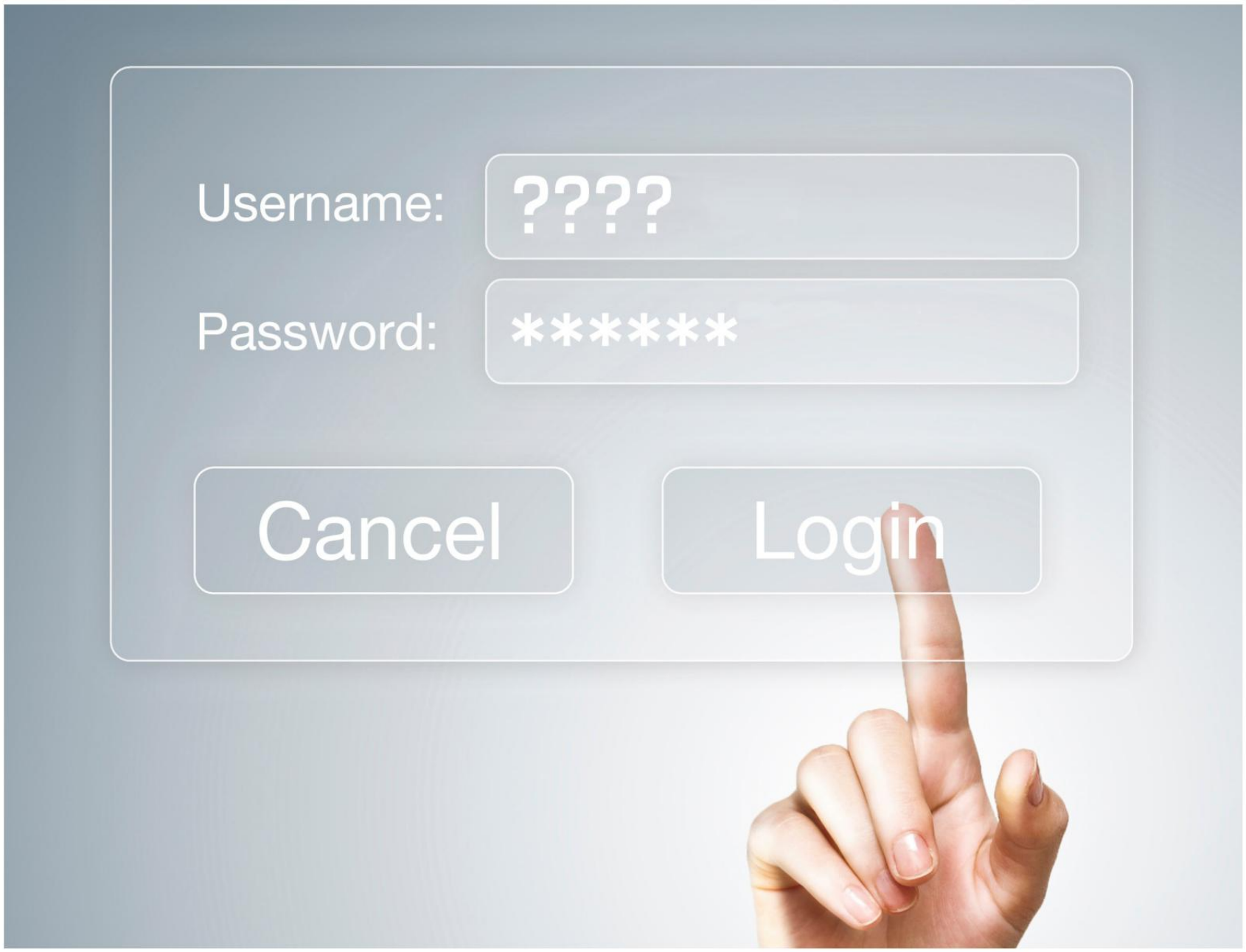
More reasonably priced X-Series processors include the Core i5-7640X ($242) with four cores and the Core i7-7820X ($599) with eight cores. These CPUs are based on both Kaby Lake and Skylake architecture, depending on the model, and are designed to work with Intel's new LGA2066 socket and X299 motherboard chipset. You'll need a new PC or at least a new motherboard to play in this arena. Direct reviews of these chips are still pending, but they're being positioned as high-performance hardware for 3D CGI rendering, mathematical calculations on large data sets, 4K video processing, and of course, gaming and game development.

One last complication involves the Kaby Lake versions of Intel's 4.5W mobile processors. Until recently, midrange and high-end versions of these power-saving CPUs were known as the Core m5 and Core m7, respectively. You'll find current and newer iterations under the Core i5/i7 Y-Series nomenclature—for example, the Core i5-7Y54 and its higher-clocked sibling, the Core i7-7Y75. In our testing, these Y-Series processors are comparable to the higher-wattage (15W) Core i5 and i7 processors on everyday tasks but are a bit slower performing in multimedia-creation apps such as Handbrake and Photoshop.

To sum up: Intel Core i5 is made for mainstream users who care about performance, and Intel Core i7 is made for enthusiasts and high-end users. Only extreme users need to consider Intel's Core X-Series.

How to Create an Anonymous Email Account

BY ERIC GRIFFITH



Not long ago, the sharing economy seemed to take over. Privacy was dead, and no one cared. But that was pre-Snowden. Now, for some, the need to be truly anonymous is more important than ever.

When you go to a service online and its first three choices for signup are to use existing Google, Facebook, or Twitter account credentials, though, it's almost like a subtle background check. Services such as Google expect you to share a phone number or an older email address to sign up as well, so you're not exactly hiding your tracks.

What do you do when you want to set up an email address that is completely secret and nameless, with no obvious connection to you whatsoever, without the the hassle of setting up your own servers?

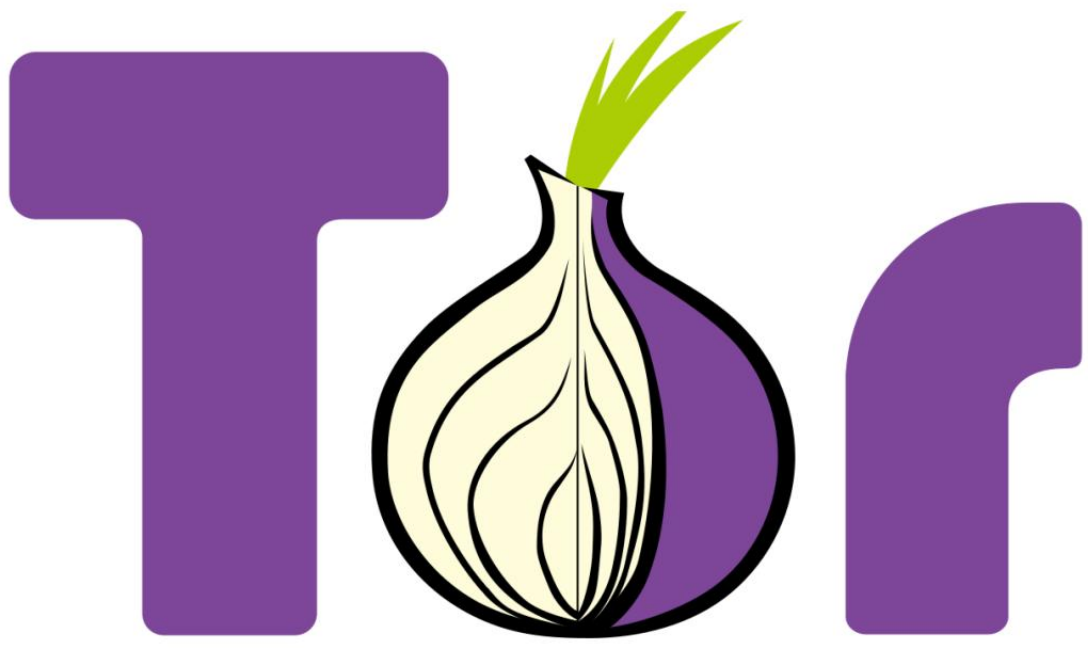
This goes beyond just encrypting messages. Anyone can do that with Web-based email such as Gmail by using a browser extension—Secure Mail by Streak, for example. For desktop email clients, GnuPG (Privacy Guard) or EnigMail is a must. Web-based ProtonMail promises end-to-end encryption with zero access to the data by the company behind it, plus it has apps for iOS and Android. But those don't hide who sent the message.

Here are the services you can use to create a truly nameless, unidentifiable email address. Be sure to use your powers for good!

FIRST STEP: BROWSE ANONYMOUSLY

Your Web browser is tracking you. It's that simple. Cookies and so-called unstoppable "super cookies" know where you've been and what you've done, and they're willing to share. Sure, it's mostly about making sure you see targeted ads, but that's not much consolation for those looking to surf in private. Your browser's incognito/private mode can only do so much—sites are still going to record your IP address, for example.

To browse the Web anonymously (and use that private time to set up an email), you need not only a virtual private network but also the Tor Browser, a security-laden, Mozilla-based browser from the Tor Project. Tor used to be called The Onion Router; it's all about keeping you anonymous by making all the traffic you send on the Internet jump through so many servers, people on the other end can't begin to know where you really are. It'll take longer to load a website than with Firefox or Chrome, but that's the price of vigilance.



The Tor Browser is available in 16 languages, for Windows, macOS, and Linux. It's self-contained and portable, meaning it'll run off a USB flash drive if you don't want to install it directly. It's totally free. Even Facebook has a Tor-secure address to protect the location of users—and to let users get access in places where the social network is illegal or blocked, like China. An estimated 1 million people use it. There is also a version for getting Tor access to Facebook on Android devices.

Tor is not perfect and won't keep you 1,000 percent anonymous. The criminals behind the Silk Road, among others, tried that and failed. But it's a lot more secure than openly surfing. Law enforcement agencies needed a lot of resources to get those bad guys.

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SECOND STEP: ANONYMOUS EMAIL

You can set up a relatively anonymous Gmail account; you just have to lie like a bathroom rug. That means creating a full Google account but not providing Google your real name, location, birthday, or anything else it can use (and signing up via a VPN and the Tor Browser, naturally).

You will eventually have to provide Google some other identifying method of contact, such as a third-party email address or a phone number. With a phone, you could use a burner or temp number; use an app like Hushed or Burner or buy a prepaid phone and lie through your teeth when asked for any personal info. (Just know that even the most "secure" burner has limits when it comes to keeping you truly anonymous.)

As for that third-party email, you can use anonymous email services—so why use Gmail at all? The Electronic Frontier Foundation (EFF) says it's smart to use a different email provider from your personal account if you crave anonymity; that way you're less likely to get complacent and make a compromising mistake.

Note that you also should use an email service that supports secure sockets layer (SSL) encryption. That's the basic encryption used on a Web connection to prevent casual snooping, like when you're shopping at Amazon. You'll know it's encrypted when you see HTTPS in the URL instead of HTTP, or a lock symbol shows up on the address bar or status bar. The big three webmail providers (Gmail, Yahoo Mail, and Outlook.com) all support HTTPS. Get the HTTPS Everywhere extension for Firefox, Chrome, Opera, and on Android, to ensure that websites default to using the protocol.

That's great for Web surfing, but neither HTTPS nor a VPN will keep you hidden when emailing. Pseudonyms in email aren't enough, either. Just one login without using Tor means your real IP address is recorded. That's enough for you to be found, provided the finder can get your provider to give up some records. It's how General Petraeus got nailed.

The point is, once you've gone this far, there's no reason to go back. Use a truly anonymous Web-based mail service; here are some of the best.

HUSHMAIL: Recommended by the EFF and others, Hushmail's entire claim to fame is that it's easy to use, doesn't include advertising, and has built-in encryption between members. Of course, to get all that, you have to pay for it, starting at $49.98 per year for 10GB of online storage; a free version offers 25MB of storage. Access it on the Web or iOS.

Businesses can use Hushmail starting at $3.99 per user per month for nonprofits (going up to $5.99 for small businesses and $9.99 for legal and healthcare entities), plus a one-time $9.99 fee setup fee for everyone (though then you need to obfuscate your info for the Whois database).

Note that Hushmail has turned over records to the feds before, and its terms of service state you can't use it for "illegal activity," so it's not going to fight court orders. But at least it's honest about that upfront.

HIDE MY ASS! ANONYMOUS EMAIL: Hide My Ass is a well-liked private VPN service that makes it a breeze for users to access content blocked at their locations, not to mention providing a much higher level of privacy (hence the name). The base price is $11.52 a month, but you pay only $8.33 per month when you commit to six months or $6.55 per month for a year.

HMA's Anonymous Email service is not just for VPN customers. You get an address @hmamail.com that can be set to last 24 hours, one week, one month, six months, or 12 months. There's a countdown clock to indicate just how long you have left when reading messages. At signup, it does ask for your existing email address, so HMA can send it a note when you get a message on the anonymous account, but that's not required. The interface won't win any awards—Hushmail's is infinitely nicer—but HMA gets the job done. Note that this is for receiving only; you can't send a message out.
HMA also has iOS and Android apps that provide secure mobile connections, plus privatized SMS texts and chat services with other HMA users.

GUERILLA MAIL: Guerrilla Mail provides disposable, temporary email. Technically, the address will exist forever and never be used again. Any messages received at the address, accessible at guerrillamail.com, last only one hour. You get a totally scrambled email address that's easily copied to the clipboard. There's an option to use your own domain name as well, but that's probably not keeping you under the radar.

Guerrilla Mail is the perfect way to create an email address to sign up for a different, more permanent-yet-anonymous email address, or to send a quick, anonymous email instantly—no signup required. You can even attach a file if it's less than 150MB in size or use it to send someone your excess bitcoins. Coupled with the Tor browser, Guerilla Mail makes you practically invisible. It's also available on Android.

JOHN C. DVORAK

Whatever Happened to Customer Support?

If you're having trouble on the internet—say, with Google or your Facebook account—who do you call? A lot of companies have customer-service phone numbers, but is there a person at the other end? You're often dropped into a hellish automated loop. ("If your problem is related to the moon, press one.")

When I had a water-line break in my neighborhood, I called the public utility company and had to wade through a series of questions that led to dead ends or information I didn't need, like my account balance. I finally just selected the wrong menu in the hopes it would lead to a real person, a tremendous waste of time.

Ironically, I'm reminded of WordPerfect in the 1990s. I always considered it a mediocre word processor, but WordPerfect's customer service support was so tremendous that it quickly became the top product, surpassing Microsoft and WordStar in its day.

The companies that do real customer service today are rare, though. Most figure you can do a Google search to fix the problem, the problem will fix itself, or it's not important. Solutions are offered up in public forums, but advice can be contradictory. And if your problem is with Google, what are you going to do—stop using it and switch to Bing? What's the alternative to Amazon? Walmart? Jet?

That said, I do want to compliment the customer service operations of—brace yourself—Comcast. For a long time, I had a bandwidth problem and groused online about it, a lot. But Comcast remained patient; eventually, an on-site technician found that a squirrel ate through some coax.

PayPal also is on top of its customer service game; it gives you a survey after each interaction, or so it seems. This keeps the call center on its toes and resolves things fast and without much hassle.

Though Comcast and PayPal are often listed among the most hated companies, I have yet to encounter bad mojo from either one. At least they actually run a customer-service operation, unlike most everyone else in the world of tech.

This raw neglect is the modern way. It's reflected throughout society, and the public at large is getting frustrated. But not enough to do anything about it. Yet.

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