

**PC**  
**MAGAZINE**

**COMPUTATIONAL  
PHOTOGRAPHY**

**IS READY FOR  
ITS CLOSEUP**

**EXCEPTIONAL  
PHOTOGRAPHERS**

**TWO  
PROFILES**

**THE  
PHOTO  
ISSUE**

**+ How to Sell  
Your Photos  
Online**

**10 Quick Tips  
to Fix Your  
Bad Photos**

**Transfer Your  
Photos From  
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**COVER STORY**

**COMPUTATIONAL  
PHOTOGRAPHY**

Is Ready for Its Closeup

**FEATURES**

**EXCEPTIONAL  
PHOTOGRAPHERS: TWO  
PROFILES**

Q&As with Sarah Blesener and  
Jessica Pettway.

**APPLE IPHONE 8 PLUS  
VS. OLYMPUS PEN E-PL9**

Can a phone camera rival a  
mirrorless camera in photo  
quality? We put them to the test.



# WHAT'S NEW NOW



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## AI THAT CAN ERASE NOISE FROM PHOTOS

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Oloclip Mobile Photography Box Set for iPhone X

Sonos Beam

Canon EOS Rebel T7



Oloclip Mobile Photography Box Set for iPhone X

## HARDWARE

Dell Latitude 5490

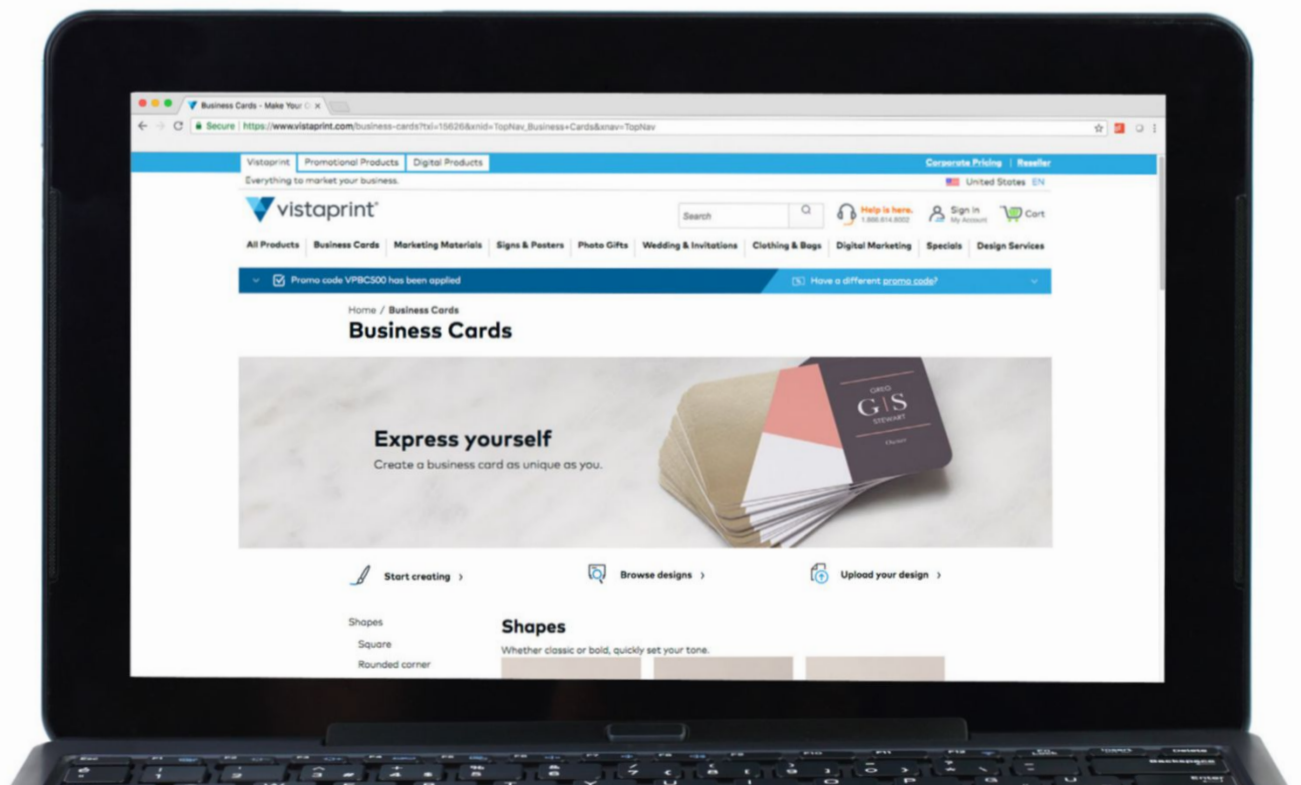
HP Sprocket Plus

## SOFTWARE & APPS

Vistaprint



HP Sprocket Plus





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**CAROL MANGIS**

First Word

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Can Blockchain Fix the Ad  
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**SASCHA SEGAN**

Why We Don't Recommend 2G  
GSM Phones in the US

“

**Discussions about  
voting over the  
internet emerge  
each election cycle,  
then are beaten  
back by reality.**

”

**JOHN C. DVORAK**

Last Word

## TIPS & HOW TOS



### **HOW TO SELL YOUR PHOTOS ONLINE**

Could you make money as a  
stock photographer?

### **HOW TO TRANSFER PHOTOS FROM YOUR PC TO YOUR MOBILE PHONE**

A step-by-step guide.

### **10 QUICK TIPS TO FIX YOUR BAD PHOTOS**

Our simple suggestions can  
vastly improve your shots.



## The (Technical) State of Photography

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**W**hen digital cameras first started becoming mainstream, pros were not impressed. I remember more than one experienced photographer back around the early part of the 21st century saying that digital would never come close to film.

That started to change with the advent of sophisticated digital SLRs and mirrorless cameras, which offered interchangeable lenses, large sensors, and other features resulting in high-quality output. They have all but replaced film cameras, with just a few outliers. And then, of course, smartphones came along, and their built-in cameras just keep getting better.

PCMag's senior analyst for digital cameras, Jim Fisher, elaborates: "Digital versus film is no longer a discussion. When we talk about photography in 2018, we talk about digital photography. For the vast majority of professionals, there is no question, especially those who specialize in sports, wildlife, and event photography. Film is still around, though the choices of emulsions are not as vast as they were in years past, and those who use it are doing so for very personal and artistic reasons.

"Instant film, though—particularly the Fujifilm Instax formats—has enjoyed a renaissance. It speaks to the younger generation, offering the instant gratification that they've come to expect growing up in a digital world along with the tactile feel of a real, physical print."



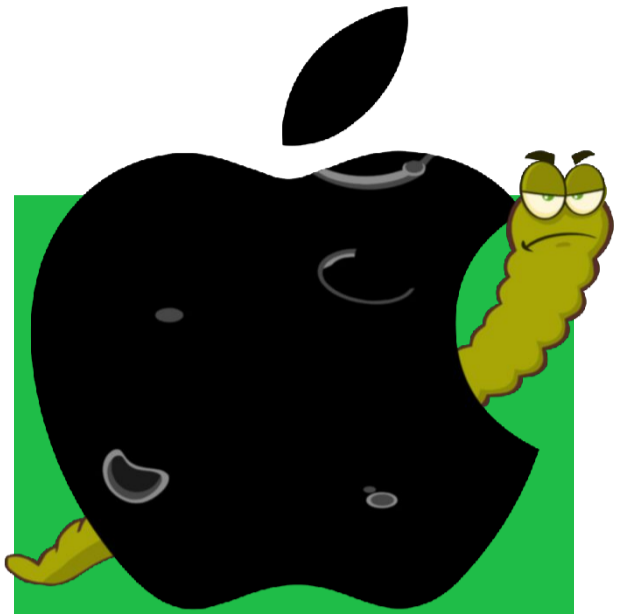
I confess that I've been extra excited about this issue ever since we started planning it earlier this year. I've been an enthusiastic amateur digital photographer (and a fan of art photography) for a while now, and I jumped at the chance to produce some stories that weren't just your average tech-magazine photo articles.

In our photo issue, you'll find a feature story on computational photography, a technology that's starting to make important improvements in digital image capture, in everything from AR and VR to smartphones. We also talked to two professional digital photographers whose journalistic and commercial work really stands out. And we decided to pit a D-SLR against an iPhone to see how both compare in taking indoor and outdoor portraits (the results may surprise you, if just a little).

We've also included several tips and how-to stories from our experts that focus in on specific tasks: how to sell your photos online, ways to transfer photos from your PC to your phone, and tips on fixing bad photos.

These days, just about everyone is a photographer—as a look at any social-media platform will confirm. We hope all you shooters enjoy our photo issue and find something to engage your passion.

*[carol\\_mangis@pcmag.com](mailto:carol_mangis@pcmag.com)*



## Is Apple in Denial?

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Lead Mobile Analyst Sascha Segan thinks so; in his July column he wrote, “There’s a lot that’s deeply wrong with Mac hardware, and Apple doesn’t seem to see it.” Our readers are (mostly) with him on this one.

It was the lack of ports that convinced me to stick with my four-year-old MacBook Air. At least the OS upgrades easily and seamlessly (not like Windows 10 on my Surface Pro). It was ludicrous to leave USB 3.0 out of the equation—hundreds of dollars in dongles would be useless. Plug in a dock? Ridiculous. Touch Bar instead of Touch Screen? Laughable. Maybe they will get it right in the future, but they seem to be stuck in a “form instead of function” mindset.

—*Firewallbill*

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There are some things I like about macOS, such as apps that are single ZIP files without needing to install to registries or smear their files across the OS. I like the soft color palette they use. I think the underlining unix OS renders graphics nicely. But overall, I prefer Windows 10 to macOS. I like Explorer over Finder, the Taskbar over Dock. I hate the wonky max/min of macOS. I like the Start Menu over Launcher. I help admin Macs and PCs at work, and way too many times, you have to go into the Terminal just to configure to fix things. Heck, when a Mac starts going south on you, the easiest thing to do is time-machine it or reload it.

—*Rann Xeroxx*

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The article is spot on. Poor keyboard and port nightmare. I’ll add the lack of a touch screen. I cannot count the times I have grabbed a stylus to draw on the Mac screen and said, “Oh, wait; can’t do that on a Mac.” I get around the Mac limitation by connecting my iPad Pro as a second screen to



the Mac and use the Apple Pencil on the iPad. This is less than optimal and doesn't match what I can do on my Windows 10 Surface Studio.

—*kris olberg*

Nothing wrong with the Mac. I've had my PowerBook for almost ten years now without a problem. Great computer and much less buggy than my PC, where I've had to fight scams and Trojan horses for years.

—*Metis*

## READER QUESTION

Love your article ["The 100 Best Android Apps of 2018"] but it is missing one point that is critical for me—how much data does each app collect? A few years ago, there was a flashlight app that literally gathered almost everything you did on your phone. Since then, I really like to know more about the app's potential for invasion and collection.

### MAX EDDY'S REPLY

You're right: The permission model up until Android 6 (I believe) was wide open and allowed such abusive apps to exist. The landscape is a little different now. Google implemented a new model that's similar to iOS, where users must opt in for specific requests. They've also worked to make some of the previous broad permissions more targeted and less open to abuse.

Unfortunately, there are likely many older apps still on the app store that don't use the new permission model or are in some other way overly nosey about your data. Hopefully the adoption of these new standards will push developers to create new apps that are more respectful of privacy that can compete with the old ones on the Play Store.

Last, while any app can (or could have been) abusing such privileges, most of the worst offenders were from small-time developers. As the Google Play Store has improved over the years, higher-quality apps from distinguished companies have gained prominence. Most of the entries in our 100 best app list are from developers of that caliber.



## 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](mailto:letters@pcmag.com) and we'll respond to your question here. Questions may be edited slightly for content and clarity.

# Adobe's Scott Belsky on the 'Creative Professional' Evolution

BY DAN COSTA



**T**oday, Scott Belsky is Adobe's Chief Product Officer. But he started out in finance before founding Behance, an online community for creative professionals acquired by Adobe in 2012, and launching the 99U conference. He recently stopped by PCMag Labs to discuss trends in digital design and why Adobe chose to make XD, its new interface design suite, available for free.

“The term ‘creative professional’ is going to be a weird term in the future,” Belsky says. “What company doesn’t say that design and creativity [is] important to them?” As Belsky sees it, labor is increasingly becoming commoditized and automated. AI is going to do everything for us.



“Everyone needs to be outfitted to be a creative,” Belsky says, and Adobe XD is going to be a part of that toolset. “I think this will be as big if not bigger than Photoshop. Experience design will involve spatial computing, augmented reality, and even voice interfaces.”

Creating those new interfaces will challenge what it means to be a designer, particularly when it comes to setting the defaults that consumers may never actually see. “When you tell Google that you want something, you get a lot of options. You have ads at the top, but you still have visual discovery.”

This will be very different in the voice-driven world of Google Home and Amazon Echo. “In a voice interface, you say you want to buy batteries. You have no idea what is happening under the hood. You don’t know if you are going to get Duracells or Energizers. It is kind of scary. There is a battle to be the default in these new mediums,” says Belsky.

According to Belsky, these default questions will plague the next generation of AR designers as well. “There is only a certain amount of real estate around you,” Belsky says. “Physical discovery is limited, just like voice.”

Ultimately, the question is a philosophical one: “What is the responsibility of the designer to preserve a consumer choice?” Belsky asks.

*Fast Forward is a series of conversations with tech leaders hosted by Dan Costa, PCMag’s Editor-in-Chief. You can see a video of the full interview and many more at [pcmag.com/podcasts/fast-forward](http://pcmag.com/podcasts/fast-forward).*

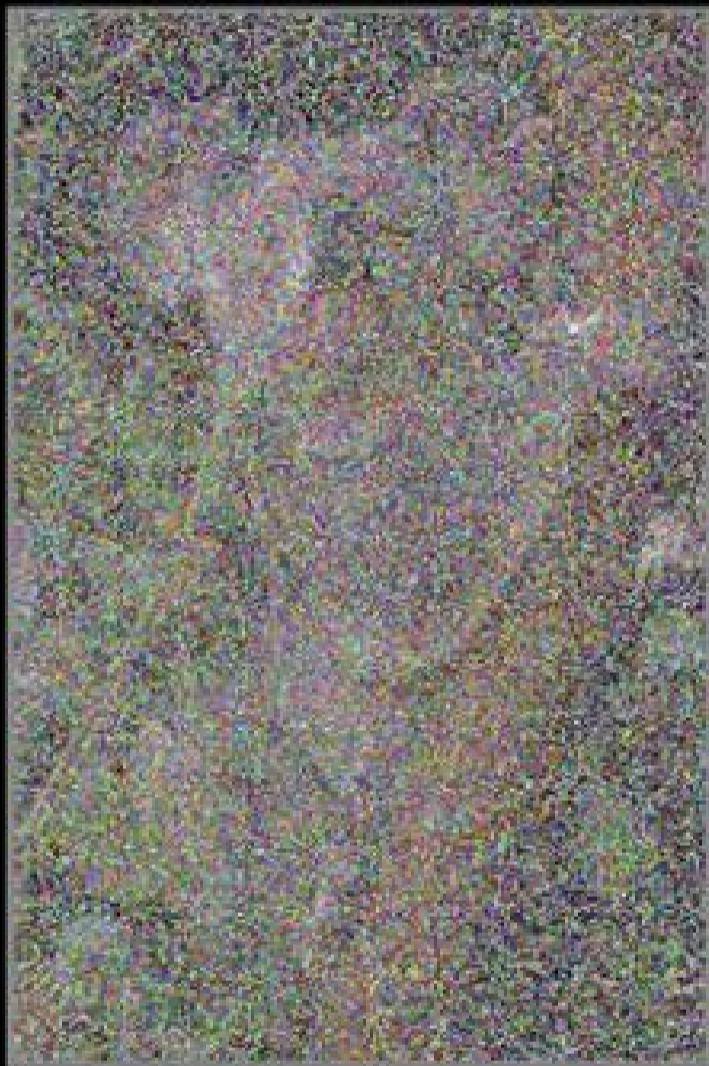


**In a voice interface, you say you want to buy batteries. You have no idea what is happening under the hood.**



# AI That Can Erase Noise From Photos

BY RYAN WHITWAM



**T**aking a photo in poor lighting can often result in something too pixelated and noisy to be useful. Advanced software processing on some phones and cameras can fix moderate noise, but a new project called Noise2Noise from Nvidia, MIT, and Aalto University uses AI to correct for extreme levels of noise. Even if Noise2Noise has never seen an image before, it can de-noise it to get something very close to the original.

Noise2Noise is a neural network, which means you need to train it with lots of data. The team used 50,000 images from the ImageNet database, which contains clear, high-resolution images. Of course, the network needs to see noisy images to understand how to remove the noise. So, the team added artificial noise to the images and used those to train the algorithm.



Nvidia contributed a bank of Tesla P100 GPUs to run the network training with the cuDNN-accelerated TensorFlow deep learning framework. The network was adjusted until it was able to take out photo noise and deliver something close to the original dataset image. The true test, though, is how the network handles new images that it hasn't seen before. The team reports that Noise2Noise can remove artifacts and noise with a high degree of accuracy.

Researchers point to several possible applications for Noise2Noise. Low-light photography is probably the one that would make the biggest immediate impact on your life. You could run your noisy photos through Noise2Noise and end up with something that looks much nicer. Also, astrophotography often involves very long exposures, and that leads to high noise. The same process could be applied to make images of space clearer. And MRI images suffer from similar noise issues; the team tested Noise2Noise as a way to clean them up.

Many camera and smartphone manufacturers have their own processing algorithms that strip noise out of RAW images before showing you the final JPEG. For the most part, they don't rely on the same technology as Noise2Noise. The only one that's close is Google, which has leveraged its machine learning technology in the Pixel camera to do similar noise reduction work. But it's nowhere near as extreme. Noise2Noise can resolve detail from an almost unrecognizably pixelated image. The final product can look unnaturally smooth, but that's an issue even with less powerful image processing.

Noise2Noise is still a computer-science curiosity at the moment, but image processing is big business. A practical application could be a big hit.



**The final product can look unnaturally smooth, but that's an issue even with less powerful image processing.**



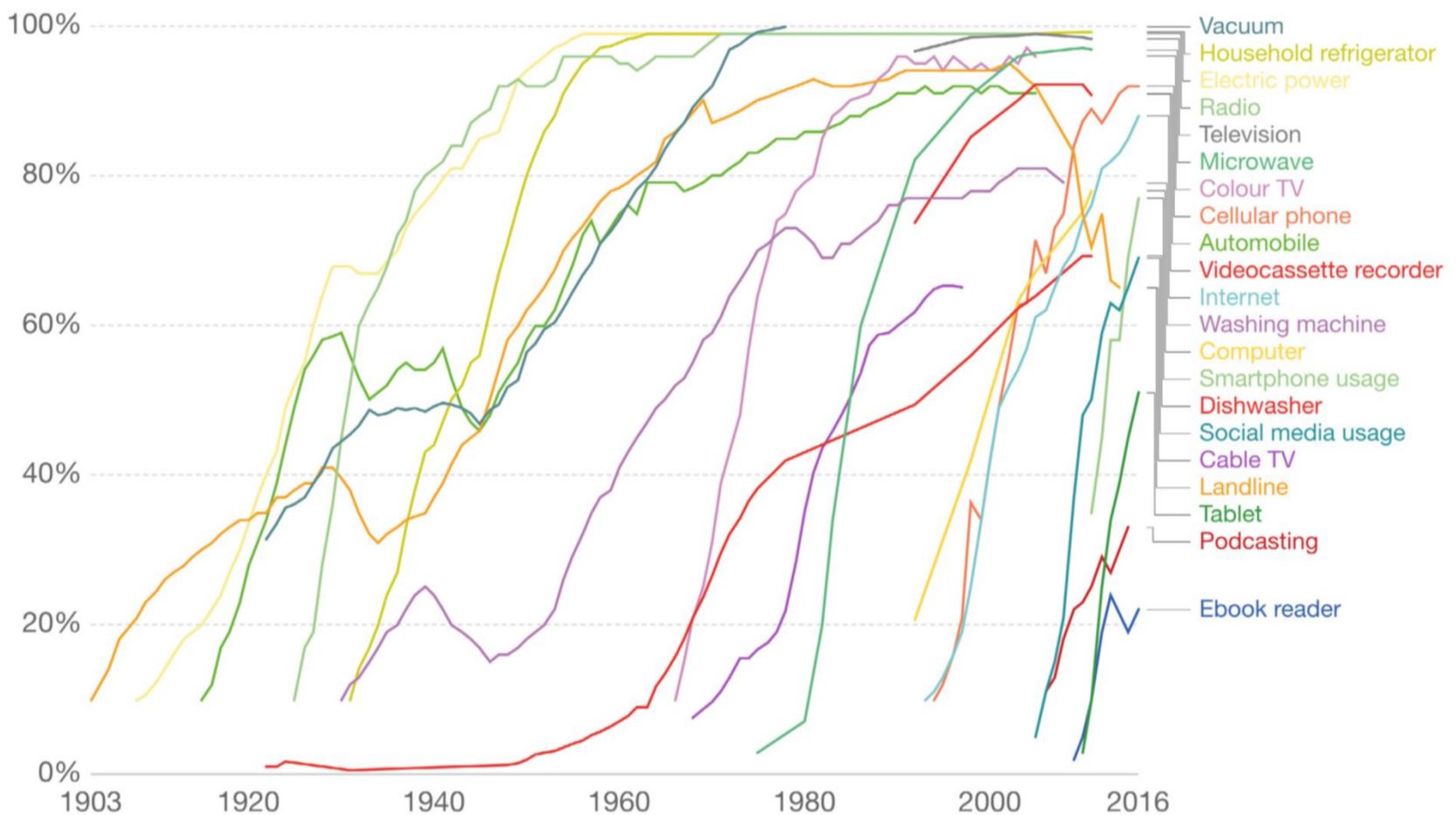
# A Century of Tech Adoption in a Single Graph

BY ROB MARVIN

## Technology adoption by households in the United States



Technology adoption rates, measured as the percentage of households in the United States owning, or the adoption rates of, a particular technology. See the sources tab for definitions of household adoption, or adoption rates, by technology type.



Source: Comin and Hobijn (2004) and others

OurWorldInData.org/technology-adoption/ • CC BY-SA

**S**ometimes innovation happens gradually, and sometimes it happens all at once. When you look at more than 100 years of technology adoption all at once, the trends come into focus.

Our World in Data looked at technology diffusion and adoption in the United States, measured by the percentage of households in the US owning a particular technology. Beginning with the landline telephone in 1903 and going all the way to smartphones, tablets, and social media today, there are a host of ways to slice and dice the data.



One thing that's quite obvious: The adoption curve has accelerated dramatically over the past century. In the first half of the 1900s, technologies such as telephones, electric power, and radio reached majority household adoption slowly, over decades.

If you look toward the late 90s and early 00s, though, the trends spike. Household appliances, water heaters, automobiles, and more all become ubiquitous necessities in far shorter time frames, and for internet use, social media, and digital devices, the adoption rates have sped up to 5 to 10 years or less. As new tech is built more efficiently and consumers embrace it more quickly, adoption rates are only going up.



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# Gear Envy: Inside the Bag of PCMag's Camera Expert

BY JIM FISHER



**D**espite the name, PCMag reviews more than just computers. I cover the digital photography space, reviewing scores of new cameras and just as many lenses every year. Because of this, I've got a different camera in my bag almost every week. They range from entry-level mirrorless models to pro-grade SLRs.

Here's a look inside my bag, including the camera and other items I carry.

## THINK TANK SIGNATURE 13

I have too many camera bags, a common problem among photographers. But my daily driver is the Signature 13 (\$279) from Think Tank Photo. It's attractive, with a slate-gray finish and brown leather accents, and it's spacious inside without being too bulky to use for a public transit commute.





### SONY A7R III

The Sony a7R III (\$2,999.99) the company's high-resolution full-frame mirrorless model, packs a 42MP image sensor and shoots video in 4K, offers in-body stabilization, and has much faster tracking, continuous shooting (10fps), and a larger battery than the older a7R II. It's shown here with the FE 12-24mm F4 G lens attached.



### SONY FE 100-400MM F4.5-5.6 GM OSS

I don't shoot a lot of sports, but I do enjoy photographing nature and wildlife. The FE 100-400mm F4.5-5.6 GM OSS (\$2,498.00) is currently the longest lens available for the Sony system. It delivers excellent image quality, even though it doesn't have the brightest aperture. It doesn't have the reach of my favorite telezoom, the Sigma 150-600mm Contemporary. But unlike the Sigma, it fits in this bag and works with the Sony system without the need for an adapter.





### **SONY ZEISS PLANAR T\* FE 50MM F1.4 ZA**

I love shooting with a standard-angle prime lens. The Sony Zeiss Planar T\* FE 50mm F1.4 ZA (\$1,498.00) is one of the best you can get for the Sony line of cameras. It blurs backgrounds with aplomb, focuses quickly, and delivers very sharp images.



### **THINK TANK SD PIXEL POCKET ROCKET**

You can never have too many memory cards. The SD Pixel Pocket Rocket (\$16.75) is a wallet that holds nine SD cards. It's also got a larger front pocket you can use to hold a CF, CFast, or XQD card when you're shooting with a camera that doesn't use SD.



## 13-INCH MACBOOK PRO

I've been a Mac guy for years. I like to pack on the lighter side, so I decided to sacrifice some screen real estate and opt for a 13-inch notebook. The MacBook Pro (\$1,754.20) delivers enough power to work with photos in Adobe Lightroom and can handle some lighter video editing too.



## SONY CARD READER

Sadly, Apple ditched the SD card reader from the latest generation of MacBooks. You can debate whether this was a bad decision (I think it was), but the end result is that I need to carry a card reader when traveling. This Sony model (\$59.95) supports SD and XQD with transfers at USB 3.0 speeds.

## APPLE IPHONE 8 PLUS

I finally upgraded my phone this year. I had been using an iPhone 6 Plus for the past three, and its battery life had gotten so bad that I had to use a battery case and carry a power bank just to get through a day of travel. I'm really enjoying the 8 Plus (\$799.99). It's a lot faster, and the dual cameras are a lot better than those of the 6 Plus.



**I like to pack on the lighter side, so I decided to sacrifice some screen real estate and opt for a 13-inch notebook.**







## B&W C5 HEADPHONES

I've still got wired headphones, so I'm living the dongle life. I can jam out to John Prine and Tom T. Hall during my commute, enjoying the solid audio quality delivered by the B&W C5 Series 2 earbuds (\$149.98). I've replaced the standard tips with memory foam for a better fit. And because they're wired, I can also use them to monitor audio when recording video on the a7R III.



## LUMU POWER

This little dome, the Lumu Power (\$249.99), is an add-on light meter for my iPhone. It's small, so I can keep it in my bag, and it comes in handy: I typically rely on the in-camera meter, but when working with strobes in the studio or in the field, I can use its flash meter function to nail exposure settings without any guesswork.



# Microsoft, ICE, and the Trouble With Technology Being ‘Neutral’

**W**hen you look for words to describe IBM, you think *solid* and *staid*, but it’s also *stained*. During WWII, under the direction of its chairman and CEO Thomas Watson, IBM assisted in mechanising the administrative work of the Third Reich.

The company’s German subsidiary, with the cooperation and coordination of the parent company, set up concentration camps with leased card-sorting machines that it maintained, customized applications for, and provided with paper to keep them in punch cards. The information churned out by those Hollerith machines played a part in putting Jews behind the razor-wire fencing that millions would not escape.

Today, thousands of children of immigrants and asylum seekers are in their own chain-link cages in US detention centers, barcodes wrapped around their wrists. Companies behind the technology that keeps track of them—or doesn’t—are not eager to boast about that fact.

In January, Microsoft talked up its partnership with Immigration and Customs Enforcement



PCMag Senior Features Editor Chandra Steele got her tech journalism start at CMP/United Business Media. She also writes fiction and has been published in McSweeney’s Internet Tendency.

(ICE), which uses Redmond's Azure Government cloud service. The post re-emerged recently amidst the uproar over the government's child-separation policy at the border, and for a brief time, any mention of ICE was scrubbed from it. Sources with knowledge of the issue told PCMag that an employee deleted it after seeing commentary in social media; it was restored shortly thereafter.

The source also said they do not believe Microsoft's Azure or Azure services are being used in the separation of families at the southern border, something CEO Satya Nadella echoed in a letter condemning the administration's policy of separating families. He said Azure is used by ICE only for legacy mail, calendar, messaging, and document-management workloads.

But really, he can't be sure exactly how the agency uses its services. Some Microsoft employees apparently agree; they wrote an open letter asking the company to end its contract with ICE. Developers on GitHub, which Microsoft recently acquired, did the same.

This is where technology companies need to make decisions on moral grounds. Do they want to do business with government entities engaged in work the UN High Commissioner for Human Rights has called unconscionable?

### **IMAGE-RECOGNITION CONTROVERSY**

While it's had a lower profile, Vigilant Solutions signed a contract with ICE for its license-plate-recognition (LPR) program, which is used to find and track people in real time. "Our LPR solution isn't just for finding stolen vehicles. It's for that and much more," the company's site says.



Vigilant Solutions did not respond to an inquiry about its work with ICE. And it's not the only company remaining tight-lipped about image-recognition technology being used by law-enforcement and government agencies.

Amazon's Rekognition uses deep learning to detect inanimate objects, people, and activities. When asked about legal but perhaps societally questionable uses should ICE become a customer, an Amazon spokesperson acknowledged the potential for abuse but said that Rekognition is subject to the Amazon Web Services Acceptable Use Policy.

A reading of the policy shows that it comes up short in ways that would stop objectionable behavior. The most relevant section would ban "any activities that are illegal, that violate the rights of others, or that may be harmful to others, our operations or reputation."

ICE isn't using Rekognition, but it is used by a few police departments. That worries some Amazon shareholders, who've asked the company to stop selling Rekognition to law enforcement. That pushback in part led the Orlando Police Department to end its Rekognition trial.

NBC News uncovered a raft of tech companies that have contracts with ICE, including HP Enterprise, Dell, and Motorola. One company that is assisting ICE should be of no surprise: Palantir. It has a \$41 billion deal for ICE's Investigative Case Management product, which is "mission-critical" to the agency, according to documents obtained by The Intercept.



**One company that is assisting ICE should be of no surprise: Palantir. It has a \$41 billion deal.**



Palantir's co-founder and chairman Peter Thiel has been a steady supporter of Donald Trump since his campaign. Thiel himself has not spoken about the situation at the border, but in 2008, he made a \$1 million donation to anti-immigrant group NumbersUSA, which is dedicated to reducing both legal and illegal immigration. Thiel apparently sees no irony in his becoming a New Zealand citizen by bypassing the usual process.

Government contracts are reliably lucrative, but profiting from activities that are so similar to those that have led to some of the worst atrocities in history comes at too high a price. Just ask Google, which has been grappling with objections to its work with the Pentagon on a controversial drone program. The social capital Silicon Valley has gained over the years and its capabilities and skills should be put to eradicating the horrors of our past for a better future.



**Thiel apparently sees no irony in his becoming a New Zealand citizen by bypassing the usual process.**



# Can Blockchain Fix the Ad Industry?

**F**ew would argue that the digital ads industry isn't broken. We've come to accept ads as a punishment for using free services, but they're invasive, annoying, and creepy; they collect too much information, and they can contain malware.

Even the companies running ads on their services know users hate them. Just watch a few videos on YouTube, and you'll eventually get a message box that encourages you to subscribe to the network's paid service to get rid of ads.

But users aren't the only ones complaining. Publishers are also finding ads less profitable; they're either bombarding their users with more ads or moving toward other methods, such as sponsorship programs and subscription-based business models.

Advertisers, too, are finding the practice increasingly inefficient, forcing them to spend more on ads, a considerable percent of which go to waste. (As a user, I don't even remember the last time I clicked on an ad in a website or streaming service.)

But this doesn't mean digital ads are completely dead. A handful of organizations, startups, and large tech companies believe they can fix the



**Ben Dickson is a software engineer who writes about disruptive tech trends, including artificial intelligence, VR and AR, the IoT, and blockchain. Ben also runs the blog Tech Talks.**



problems with blockchain, the distributed ledger technology that underlies digital currencies such as Bitcoin and Ethereum.

In the past year, blockchain has almost become like a hammer searching for a nail—or a marketing term for quick cash grabs. As someone who has been covering the space, I’ve seen companies trying to solve every problem with the internet by (nonsensically) “putting it on the blockchain,” “tokenizing” it, or “decentralizing” it, which are all different ways to say the same thing. Blockchain isn’t the solution to everything.

I think blockchain has a chance to deliver on its promise in this case, though: It could change digital advertising from a landscape riddled with hostility and questionable practices to one that promotes transparency and cooperation.

### **WHAT’S WRONG WITH DIGITAL ADVERTISING?**

“The biggest problems with the digital-ads industry are lack of transparency, fraud, and the big number of intermediaries,” says Ivo Georgiev, co-founder of AdEx, a blockchain-based advertising network.

Under current online-advertising models, an opaque patchwork of intermediaries stands between advertisers and publishers and gains the most, at the expense of other involved parties. These intermediaries are companies like Google and Microsoft, which stand as gatekeepers between advertisers and publishers. They decide which ads are displayed on publishers’ websites and also keep a large share of the revenue coming from those ads.

“Advertisers aren’t always in control of where their ads are being displayed, and the costs are continually rising,” says Saulo Medeiros, CEO of Kind Ads, another blockchain startup providing decentralized ads. Medeiros adds that on the other end of the advertising chain, publishers aren’t in full control of the ads their websites display.

“Publishers are suffering in terms of reputation, and of course, in terms of revenue. Without transparency, the many middle parties along the way take a huge cut, and the publisher does not know how much they would earn in a better system,” he says.

Revenue calculation formulas vary depending on the advertising platform a publisher registers with. For the most part, as their traffic and popularity grow, publishers can see their revenue grow. But they don’t always see the details of how much money advertisers bid for placing ads on their website and how much intermediaries shave from the revenues.

Intermediary fees are also hurting advertisers, who have to spend more and more on ads. But without full transparency, they can’t target their audience in an efficient manner.

“Without transparency, it’s difficult to know how much revenue you’re losing along the way as a publisher. For advertisers, the issue is the same: You’re paying more when you don’t need to. Also, we believe that the lack of transparency is a problem for targeting, as you cannot work directly with all the data that would be available to you in a transparent system,” Medeiros says.



**Advertisers aren’t always in control of where their ads are being displayed, and the costs are continually rising.**



Publishers also have to give into the vast decision-making powers of those intermediaries. A stark example is YouTube's demonetization, in which the streaming giant unilaterally decided to reduce the ad revenues of many content creators.

## PRIVACY ISSUES

Privacy is also a big concern with online ads. End users have little knowledge of how ad tech works and learn about the extent of its invasiveness only when they see creepy ads follow them across websites and ferret out their deepest secrets.

"Users don't trust publishers and advertisers," AdEx's Georgiev says. "They are afraid that their personal information is being misused."

Privacy-aware users use browsers and extensions that block ads and trackers, which again hurts the revenue of publishers that depend on ads to keep the lights on.

The EU's General Data Protection Regulation (GDPR), which came into effect last month, puts further strain on the way advertising technology is working. The GDPR requires publishers to be fully transparent about their data collection and mining practices. But publishers often don't even have access to or control all the details of the information that the technology they install on their website collects. That's why the deluge of notices and emails publishers have been sending to their visitors are mostly a reminder that using their websites is a consent to giving away personal information.

"With GDPR, website owners have to notify web users what kind of cookies are being used on their websites and how much of your personal information is being stored and used. This is supposed to stop the misuse of personal information (which affects ads), but I doubt most people will read these privacy policies and pay attention," Georgiev says.

"The current ad-tech world is fundamentally incompatible with the GDPR—a lot of data about the user is being collected in a non-anonymized way, and that will have to change," says Medeiros.



## BLOCKCHAIN'S SOLUTION FOR ONLINE ADS

Instead of storing information in centralized servers, blockchain uses a network of independent computers that replicate every record of data it generates. Data stored on blockchain is immutable, and no single company can own or manipulate it without controlling or hacking a considerable number of the computers in the network. Furthermore, public blockchains allow anyone to review and audit the information they store instead of keeping it in walled gardens.

With cryptocurrencies, blockchain's transparency and immutability has enabled true peer-to-peer exchange of monetary value without the need for intermediaries such as banks and financial institutions to establish trust between parties. The same concept is now being used in other applications, including the advertising industry.

Giorgiev believes that blockchain will play a key role in addressing the ad industry's transparency problem. "We believe most of the issues are solved with a decentralized (peer-to-peer) transparent system. The blockchain comes in when you need to solve the issue of payments, and when you need trustless trading between the publisher and the advertiser directly," he says.

Obviously, an advertising platform that removes intermediaries means more revenue for publishers and lower costs for advertisers. But publishers also get full control of their website's ad experience, says Kind Ads' Medeiros. And users get the opportunity to decide if and how their data is used and are compensated for being part of the cycle. But what would advertising look like on the



**Giorgiev believes that blockchain will play a key role in addressing the ad industry's transparency problem.**



blockchain? Kind Ads provides advertisers and publishers with a platform where they can directly negotiate and deliver ads without going through intermediaries. Payments are made in KIND, Kind Ads' proprietary crypto token, without extracting platforms or commission fees (although every transaction on the blockchain has a small fee that goes to miners—the computers that confirm and ensure the validity of transactions).

AdEx uses smart contracts, software that runs on the Ethereum blockchain, to enable advertisers to bid on publishers' websites with its ADX token. AdEx also keeps verifiable track of delivered ads on the blockchain and makes sure advertisers are paying for real impressions only, making it easier to prevent ad fraud.

Another interesting project is Brave, the decentralized browser created by Brendan Eich, the inventor of JavaScript and cofounder of the Mozilla project. Brave natively blocks ads and trackers on websites to prevent invasive data collection and to improve user privacy. When the user explicitly opts to view ads, Brave replaces displays ads that have been negotiated between advertisers and publishers on its blockchain platform. For each ad displayed, publishers receive Basic Attention Tokens (BAT). Every Brave user also has a BAT wallet integrated in the browser and receives a fraction of the BAT tokens delivered upon viewing ads.

This model could make ads much more enjoyable for users. It could also ensure that advertisers get more out of every dollar they spend on ads.

## **THE CHALLENGES OF BLOCKCHAIN**

While the proposition of blockchain is promising, decentralized advertising platforms will have to compete with the likes of Google, Microsoft, and Facebook, which already dominate the market. Despite their questionable practices, the centralized ad networks are what most advertisers and publishers use. Without convincing them to abandon the giants, nascent blockchain companies won't be able to create the network effect to make them profitable and efficient ad platforms.

Another problem with blockchain applications is the value of tokens. Bitcoin was worth around \$1,000 at the beginning of 2017; it spiked up to \$19,500 by the end of the year and then dropped as low as \$6,000 in 2018. Other cryptocurrencies and digital tokens have seen similar fluctuations, which casts doubt over their reliability as a means of storing value.

Cryptocurrencies also face a liquidity challenge. Since the advent of Bitcoin, proponents have hypothesized a future in which every store and online service accepts cryptocurrencies. But nearly a decade later, the adoption of Bitcoin is still very limited. Niche crypto tokens such as the ones offered by blockchain advertising platforms are used even less. Unless holders find an exchange where they can convert their tokens to Bitcoin or fiat currency, they won't be able to spend them anywhere. This could present a real challenge to all the publishers that depend on ad revenue.

Nonetheless, decentralized advertising is slowly but surely gaining traction among companies and drawing the attention of big names. Recently, IBM, which has its own blockchain development platform, partnered with advertising company Mediaocean to pilot a blockchain network for advertising. The platform has already attracted some notable participants, including Unilever, Kimberly-Clark, Pfizer, Kellogg's, and IBM's own Watson.

This might be a good first step toward the adoption of blockchain in the advertising industry. As with every evolving technology, a lot of initial solutions will likely die off and give way to their successors. But there's a strong belief that blockchain and its many applications are here to stay. It will be interesting to see what the online advertising space will look like in a year or two.



# Why We Don't Recommend 2G GSM Phones in the US

**W**hen you're shopping for a voice phone, an imported wireless device, or a kids' smartwatch, you need to look at the mobile networks these devices support. Especially down at the cheap end of the market, many of the phones and gadgets you'll find on Amazon are 2G GSM, also known as quad-band GSM, GSM/EDGE, or GSM 850/1900—all of which you want to avoid.

To repeat: Do not buy any phones or devices in the US that support only GSM or EDGE networks. CDMA, 3G, 4G—that's all fine for now. Just not GSM/EDGE.

It's frustrating, because the 2G GSM devices you find on Amazon fill gaps in the US market. They're flip phones for older people or inexpensive safety devices for kids. But the 2G GSM network situation in the US on AT&T and T-Mobile has become bad enough that those devices can't be relied upon anymore.

Now, if you're bringing in a phone from overseas, or you're not familiar with the US's wacky network standards, you may wonder, "What about Verizon and Sprint?" While both of those



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companies are running their 2G CDMA networks until at least the end of 2019, GSM devices do not work on their networks at all, and their CDMA networks will not accept devices that haven't been preapproved by the carriers.

### WHAT'S WRONG WITH 2G IN THE US

GSM equipment is very cheap, but compared with more modern standards, it's very inefficient. Old GSM networks can support fewer users per tower than newer 3G and 4G networks, and they have much slower mobile data speeds.

Many other countries still support 2G because it's cheap, it gets a relatively long range from a tower, and their customers aren't heavy data users. The range argument doesn't work in the US because our longest-range frequencies (600MHz and 700MHz) are new enough that 2G equipment doesn't support them. The way US carriers have implemented things, 4G can get better range than 2G because it's on lower frequencies.

Each carrier has only limited spectrum, and AT&T and T-Mobile haven't sold 2G-only devices for a few years now. So they had to decide whether to keep supporting an old network for very old devices and devices they don't sell directly or to turn over the bandwidth to newer, more efficient standards.

AT&T turned off its 2G GSM network in 2017, leaving T-Mobile as the only 2G provider. T-Mobile's network is designed primarily for very low-bandwidth, "machine to machine" data devices—parking meters, vehicle trackers, vending machines, and the like—which don't

need the consistent mobile connections we expect from phones and wearables.

T-Mobile reduced its 2G GSM allocation to a tiny, vestigial allocation in some metro areas, making it extremely unreliable for phones. I've seen this while testing devices in New York City. That's in contrast to T-Mobile's 4G LTE network, which has been getting better by leaps and bounds recently on both coverage and speed.

You will still find 2G GSM service in some rural areas, because it's still supported by rural carriers, but you can't rely on the system as a nationwide network.

3G UMTS devices, otherwise known as 3G GSM or WCDMA, still work on AT&T and T-Mobile. With those, though, you have to watch out for frequency bands, because imported devices often don't support our carriers' frequencies. For AT&T, you need both 850MHz and 1900MHz. For T-Mobile, you need 1700MHz in your device. It can be very difficult to find 1700MHz-compatible international 3G devices.

### **THE MISSING LINKS**

Here's where I disagree with AT&T and T-Mobile. I believe that inexpensive voice phones and kids' trackers are devices Americans need. I'm disappointed that they can't support the devices out there on the market today, which are often 2G, and that they aren't working harder to push for 4G development in these product areas.

AT&T at least has a 3G network on relatively common frequency bands, which can support



**T-Mobile reduced its 2G GSM allocation to a tiny, vestigial allocation in some metro areas.**





inexpensive 3G voice phones and kids' watches such as the Dokiwatch S.

T-Mobile's network really chokes down your options. The company offers only one LTE voice phone, the Alcatel Go Flip, which isn't very good. There are no US-compatible LTE-supporting voice phones available on the open market through Amazon, either.

It's certainly possible to make LTE-compatible voice phones. One of the world's most popular voice phones, the Reliance Jio Phone from India, is an LTE phone. But the LTE voice phones we've seen at trade shows, including that one and the Nokia 8110 "banana phone," typically don't support US network frequencies.

So if you're tempted to buy a 2G phone on Amazon, or bring one home to use on AT&T or T-Mobile GSM networks—don't. You'll be frustrated and disappointed with their performance. And if you have an old 2G phone that you've been struggling to use on the T-Mobile network, get rid of it and use a 4G device. It'll make a world of difference.

*[sascha\\_segan@pcmag.com](mailto:sascha_segan@pcmag.com)*



**One of the world's most popular voice phones, the Reliance Jio Phone from India, is an LTE phone.**





# Amazon Fire TV Cube: Just Add Alexa



Amazon's Fire TV devices have offered the Alexa voice assistant, voice search, and voice commands for a few years now. All you have to do is press the button on the remote and speak into the pinhole microphone to control the Fire TV with your voice. You can pair an Echo, an Echo Dot, or another Amazon device that lets you use Alexa with a Fire TV to control your streaming media experience by voice. Or you can get an Amazon Fire TV Cube and enjoy all the features of the Fire TV–Echo combination, including hands-free control of your home theater, in one package.

**Amazon  
Fire TV Cube**

\$119.99



The Fire TV Cube has a far-field microphone array that can pick up your voice and activate Alexa with a wake word instead of through a button press and a single mic on a remote. It's certainly more expensive than the Fire TV or the Fire TV Stick, but the addition of hands-free Alexa commands makes it an excellent media streamer for anyone who doesn't already own Fire TV and Echo devices—and earns it our Editors' Choice.

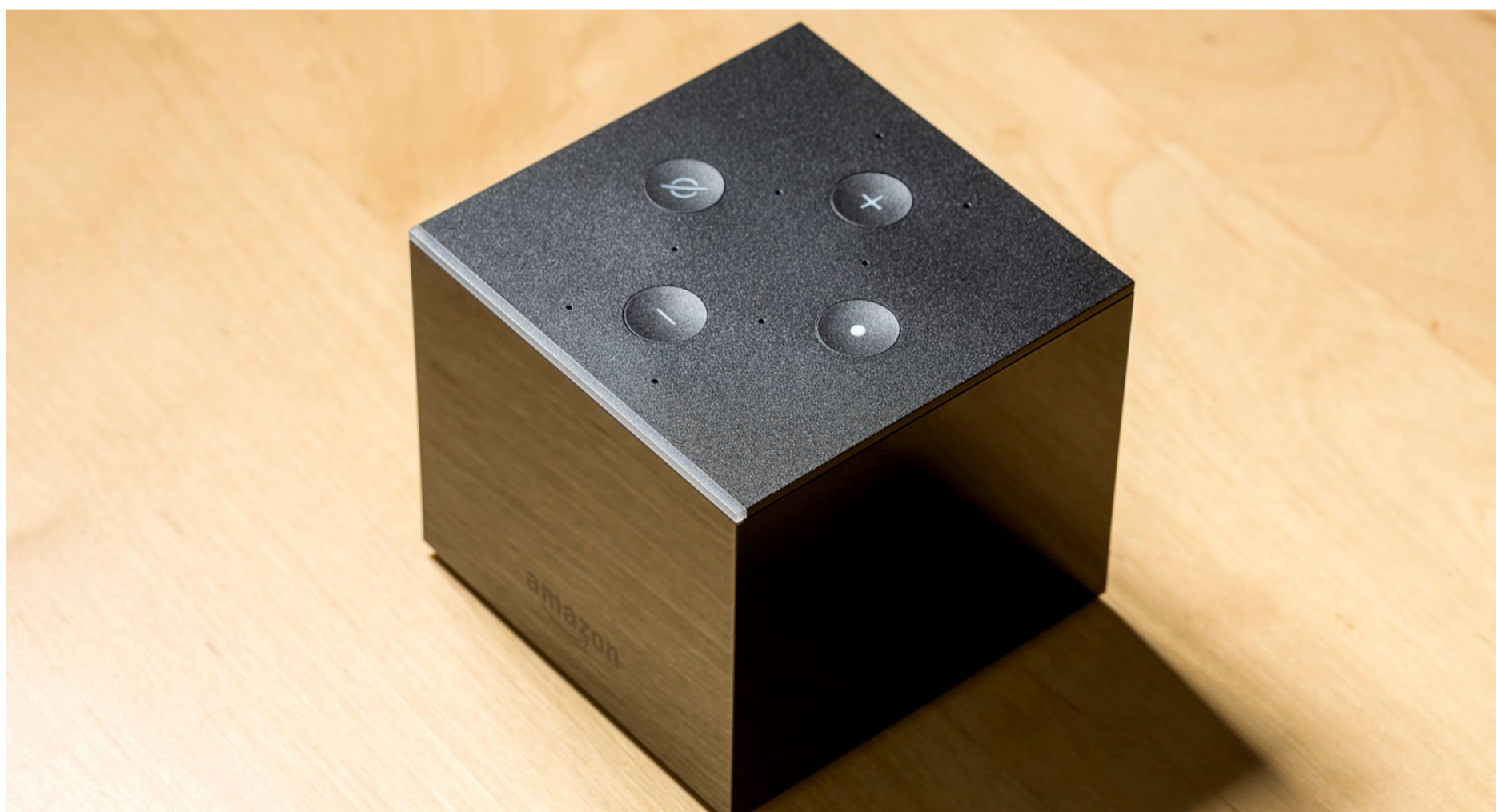
## DESIGN AND REMOTE

The Fire TV Cube is a near-cube that measures 3.0 by 3.4 by 3.4 inches (HWD), with sharp 90-degree edges between each side. The sides of the Cube are glossy-black plastic, the top panel a less shiny matte-black. The front face features an etched Amazon logo and a translucent bar on the top edge that lights up blue when Alexa is listening. The top panel has eight pinholes for the far-field microphone array, along with four buttons typical of most Echo devices: Volume Up, Volume Down, Microphone Mute, and Alexa (for manually activating voice control without using the wake word). The Cube sits on four very shallow rubber feet that lift the device up slightly so the downward-firing speaker on the bottom can be heard.

## Amazon Fire TV Cube

**PROS** Hands-free voice control with Alexa. Lots of connected apps and services. Far-field microphone array can understand your voice over TV audio. Voice control works for home theater as well as smart home devices.

**CONS** Does not support Google Play content. No Dolby Vision capability. Alexa can occasionally get confused by syntax.

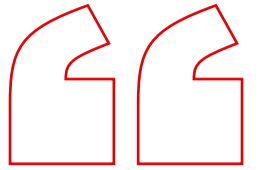




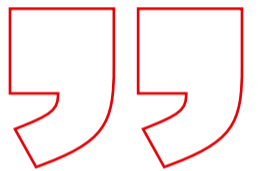
The back of the Cube holds a connector for the power adapter, a 3.5mm jack for the included infrared blaster, an HDMI output, and a micro USB port for service. No Ethernet port is present on the device. Instead, you can plug the included Ethernet adapter into the micro USB port to use a wired connection instead of the Cube's dual-band 802.11ac Wi-Fi. The adapter is a bit of a puzzling inclusion, because the Cube has plenty of space for a port on the back.

The included remote is identical to the Fire TV and Fire TV Stick remotes. It's a simple, narrow, 6-inch-long black plastic wand with a glossy circular navigation pad flanked by a microphone button above and six menu and playback control buttons below. A pinhole microphone above the mic button lets you use Alexa through the remote instead of the Cube's microphone, without a wake word. The remote connects to the Cube over Bluetooth, so you don't need a line of sight with it.

The remote doesn't have any volume control, which is a shame considering the Cube can adjust your TV's volume and has its own speaker with its own volume settings. To adjust the former on the Cube, you have to use voice control. To adjust the latter, you must press the buttons on the Cube itself.



**The Fire TV Cube has a far-field microphone array that can pick up your voice and activate Alexa with a wake word.**



**The included remote is a simple, narrow, 6-inch-long black plastic wand with a glossy circular navigation.**



## SETTING UP THE CUBE

Getting started is very easy, especially if you already have an Amazon account. (Amazon Prime isn't necessary, but it provides access to Prime Video and Prime Music.) Plug the Cube in, and connect it to your TV. Press the Play/Pause button on the remote to activate it and put the Cube in setup mode. The on-screen instructions walk you through connecting to your Wi-Fi network, then signing in with your Amazon account (or creating a new one).

After you're signed in, you can select additional apps and services for specific purposes, such as live TV (including Hulu, Sling TV, and PlayStation Vue), premium channels (including HBO and Showtime), and sports (including ESPN). After that, the Cube attempts to automatically identify your TV through the HDMI connection, then test its remote-control commands by turning it off and on again. If that works, as it did when connected to an LG OLED55E8PUA TV in testing, the Cube can then turn your TV on and off, adjust its volume, and switch inputs with voice commands.

The Cube can control multiple home-theater devices at once, thanks to HDMI-CEC, networked controls, and infrared blasters. The Cube itself has IR emitters on all sides, and the included additional IR blaster can be placed near devices inside a cabinet or otherwise outside of the Cube's infrared range. If your home theater setup changes after the Cube is configured, you can use the Equipment Control menu to add new devices to the Cube's command list, tweak individual devices' commands, or go through the equipment setup process again to start from scratch.



The Fire TV Cube includes a remote, Ethernet adapter, and IR blaster.





You can treat the Cube like one of Amazon's Echo devices. You wake it up by saying "Alexa" and talk to it without having to touch the remote. The microphone array on the Cube is powerful enough to pick up what you're saying from across a large room.

## **FIRE TV FEATURES**

Once everything is set up, the Cube looks and acts just like a Fire TV with the notable addition of hands-free voice control. You can treat it like an Echo device, waking it up by saying "Alexa" and talking to it without touching the remote. The microphone array on the Cube is powerful enough to pick up your words across a large room. Amazon says since the Cube will likely be placed near a TV or soundbar connected to a TV, it improved microphone sensitivity over other Echo devices to better hear your voice when audio is coming through the TV or connected speakers. Amazon still recommends placing the Cube at least a foot or two away from any active speakers in your home theater setup, including the TV.

The Fire TV Cube has largely the same hardware as the Fire TV but with 16GB of storage for apps compared with the Fire TV and Fire TV Stick's 8GB. The Cube supports all the apps and services of the Fire TV. That includes Amazon's own streaming services, Prime Video, Prime Music, Amazon Music, and Twitch, plus most major third-party video services, such as Crunchyroll, Hulu, Netflix, PlayStation Vue, and Sling TV. Google's apps are notably absent, though, so you can't access Google Play Movies & TV or Google Play Music. And YouTube is accessed through the Cube's pre-installed Silk and Firefox web browsers (though the YouTube experience on these browsers is nearly identical to the YouTube app on Android TV and supports voice search and controls).



Several music services are also available, including Pandora, Spotify, and Tidal. And the Cube's fully functional Firefox and Silk browsers are fairly intuitive to use with the navigation pad on the remote controlling the on-screen pointer, despite the lack of a touchpad or air mouse function for more computer-like control. It's a powerful smart TV platform with plenty of apps and services, despite a few frustrating omissions on Google's side.

The Cube also has the same media-playback capabilities as the Fire TV, outputting at 4K and supporting high dynamic range (HDR) in HDR10 format. Dolby Vision is not supported.

### **HANDS-FREE ALEXA**

The voice controls here are powerful and functional, which is to be expected considering how long Amazon has been improving its Alexa voice assistant. All the standard Alexa features with visual support are available, just as though you were using a screen-equipped Echo Spot, Echo Show, or Echo speaker/Fire TV combination. You can get broad trivia (celebrity information, unit conversion, ZIP codes for cities, and more), weather reports, sports scores and schedules, and other information from Alexa, with responses provided audibly through the Cube's speaker and visually on your TV. If the TV is turned off, Alexa will answer you only with voice. It isn't as powerful as the standard Echo, since Amazon assumes you'll mostly be using it with your TV and its speakers (or an attached soundbar), but it's louder than the Echo Dot.

Alexa's smart home controls are intact, letting you adjust any smart lights, thermostat, or other compatible home automation device with your voice. With an Amazon Cloud Cam or another compatible home security camera or video doorbell, you can get a live visual feed on your TV simply by asking for it. On top of this, the Cube can control your TV and many connected home theater devices through Alexa, as well. I had no problem telling Alexa to turn the connected TV on and off, adjust the volume, and change inputs. It can control a set-top box for cable or satellite service or a Blu-ray player, too.



The voice controls extend to the Cube's own navigation and Fire TV features. You can voice search for movies and TV shows by title, genre, actor, and other filters and get results based on your currently installed and registered streaming services. You'll see suggestions from Amazon Prime Video, but also from Netflix, Hulu, Amazon Channels and other premium channels with their own separate apps—HBO, Showtime, and other services. Search results are displayed as numbered tiles, and you can select different items by title or number or flip between different pages and screens with voice commands.

Most apps that aggregate search results with Fire TV on the Cube let you directly load content with your voice, jumping immediately into playing the movie, TV show, or song you want in the app without going through the app's menu system first (assuming you've already signed in on the app previously). Many also feature in-app voice controls, letting you play and pause video with your voice.

## **FIRE TV CUBE PERFORMANCE**

Voice commands worked quite well on the Cube in testing, even with my voice going up against the TV audio. I could use Alexa easily, loading live TV and on-demand video through Amazon, Hulu, and YouTube. Voice commands let me pause and resume video, mute and unmute the TV, raise and lower the volume, and even enable and disable subtitles while I watched, all completely hands-free.

Searching for unusual names is hit or miss, generally defaulting to more common terms (like bringing up Clubs when I asked to see MrClemps' videos on YouTube), but that's typical for voice search. Alexa was generally good at keeping track of what I was doing in the context of my voice commands, though the voice assistant became confused when I asked to watch SyFy on Hulu. The Cube first showed me results for the sci-fi genre in the app, then directed me to download the separate SyFy app, and finally switched to the channel when I specifically said, "Alexa, tune to SyFy on Hulu." Again, these are quirks that are pretty normal for voice assistants, though we see Alexa as a bit less flexible than Google Assistant when dealing with natural language versus formal voice command syntax.

While voice commands are functional, they aren't ideal for everything. Amazon recognizes this, which is why a conventional remote is included. I split my use of the Fire TV Cube roughly equally between voice commands and the remote. Broad playback controls, volume adjustments, and loading apps, channels, and shows with your voice is quick and easy, letting you ignore the remote most of the time for those functions. Browsing content and navigating menus is faster and more convenient using the remote.

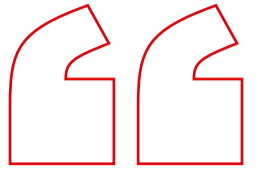
Outside of voice controls, the Fire TV Cube worked very well navigating menus, loading apps, and playing video. 4K HDR video loaded over Netflix quickly with a Wi-Fi connection, as did 1080p live TV channels on Hulu. Jumping between the different apps and the Fire TV menu felt snappy and responsive.

### **AN IDEAL FIRE TV—ECHO AMALGAM**

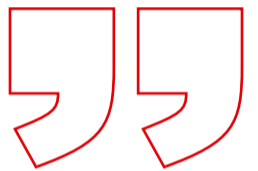
The Amazon Fire TV Cube is the best iteration of the Fire TV yet. For \$120, it offers all the functionality of both an Amazon Fire TV and an Echo speaker, letting you control your home theater, smart home devices, and the media hub itself with your voice. It's a pretty big premium over the \$70 Fire TV, but if you don't already have an Echo device to enable hands-free voice control with a Fire TV, that extra cost is absolutely worthwhile. For all its functionality and convenience, the Amazon Fire TV Cube earns our Editors' Choice for media streaming devices.

If you don't want hands-free Alexa, or if you already have an Echo device, the Fire TV and Fire TV Stick are both very capable streaming-media devices. You could also consider the Roku Streaming Stick+, which is more affordable than the Fire TV and has a more robust app selection with Google Play support but has far less voice-control functionality.

**WILL GREENWALD**



**Outside of voice controls, the Fire TV Cube worked very well navigating menus, loading apps, and playing video.**







## Olloclip Mobile Photography Box Set for iPhone X

**O**lloclip is bringing its add-on lens system to the iPhone X for the first time. The Mobile Photography Box Set (\$99) includes two lenses, one with dual functionality, that can be used with any of the lenses on the iPhone X—both the standard and 2x rear cameras and the front selfie cam. The lenses add some versatility to the already excellent camera system on the X, but it comes at a cost: The mounting clip blocks part of the screen, so you can't access the Control Center when it's attached. And the only protective case you can use with the system is one sold by Olloclip at an additional cost.

**Olloclip Mobile  
Photography  
Box Set  
for iPhone X**

\$99.99



## DESIGN

The Mobile Photography Box Set includes a mounting clip for your phone, a plastic stand with a carabiner attachment, and two lenses—the Super-Wide and the Fisheye + Macro 15x. The clip attaches to your phone at the top-right corner and includes mounts to cover the front and rear cameras. You can use the included lenses in either the front or the back, and you can put them in front of either rear camera, although there's not much point in using the wide lenses with the 2x rear camera.

The clear-plastic stand doubles as a carrying device for the mounting clip and can attach to a belt loop via carabiner. It unfolds to serve as a stand for the phone—a makeshift tripod—with support for both landscape and portrait orientation. I had some issues with the quality of the stand, though: First, it's very hard to open, requiring enough force that I was worried I'd break it. Of course, it's bound to loosen up over time. It's also a wobbly platform for holding your phone—you need to keep it on a flat surface.

The attachment point is also a concern. To cover both the rear and front cameras, the clip has to sit at the top-right corner of your phone—so you can't swipe down from the corner to launch the phone's Control Center screen. Long-time iOS users understand the importance of the Control Center, which provides instant access to a lot of functions, including the flashlight, music control, and Wi-Fi settings.

When you have a lens attached to the front of the clip, you also lose Face ID and the front portrait-mode option. You can still make animojis with anything but the dedicated macro lens attached to the front, though the effects of the lens are not apparent at all; the animojis look just like normal ones (if you can call a talking cartoon poop normal).

## Oloclip Mobile Photography Box Set for iPhone X

**PROS** Easily connects to phone. Includes wide-angle and macro lenses and stand. Works with all three iPhone X cameras. Strong optical quality.

**CONS** Blocks Control Center access. Using front lens prevents Face ID and automatic brightness adjustment. Doesn't work with front or rear portrait mode. Not compatible with most phone cases.



The front lens also blocks the iPhone's ambient light sensor. That's a big problem when you're shooting in bright sunlight, as the phone thinks you're in the dark and dims the screen way down. You can turn off adaptive brightness (it's buried in the accessibility options in the phone), but you'll have a hard time adjusting screen brightness on the go, since that's found in the Control Center interface.

In addition to the lenses included with the starter set, Olloclip offers several others: the Ultra-Wide (\$59.99), Telephoto 2x (\$79.99), Macro 14x + 7x (\$59.99), and Macro 21x (\$59.99). Optical designs are identical to the lenses Olloclip offers for iPhone 7s and 8s, and the housings look similar, but the lenses are not cross-compatible.

“  
**When you have a lens attached to the front of the clip, you also lose Face ID and the front portrait-mode option.**  
”



## **LENS QUALITY**

I was happy with the quality of all three lenses included with the Box Set. The Super-Wide broadens the scope of the iPhone's lens without adding distortion. Detail holds up well—there is an apparent loss of clarity when comparing shots captured with and without the lens side-by-side at a pixel level, but that's because of the limited resolution of the iPhone's 12MP camera and the wider field of view captured by the add-on lens.



Close-up shots made with the Super-Wide lens look quite crisp and contain lots of detail. Even though it's not billed as a macro lens, you can use the Super-Wide to get close to a subject and blur out the background behind it, as you can see in the following image:



The Super-Wide definitely nets better results with the rear lens than with the front. I snapped a few selfies with the Super-Wide attached to the front lens, and I was more struck by the lack of fine detail than anything else. It can be a useful tool for FaceTime chats when you want to include multiple people, but for any serious photography, you should keep it attached to the rear. That goes for selfies, too—the field of view is wide enough that you can snap an arm-length or selfie stick shot and keep yourself in frame effectively without having to view your phone's screen.





The Fisheye + Macro 15x is an intriguing lens pair. With the Fisheye lens, you get a field of view that's beyond wide, with the curved distortion that you expect from a fisheye, as well as black borders at the corners of the image.

When shooting wide, though, we saw a loss of detail—the ultra, ultra wide field of view has a lot to do with it.



Close-up shots, like the one below, show strong detail, and combining the fisheye look with macro focusing distances can make for some interesting photos. Of course, one of the things that defines a true macro lens is a lack of distortion.





Unscrewing the Fisheye lens from its base delivers that. It reveals a flat lens, the macro component. And this lens is very, very macro. To properly focus, you need to get so close to your subject with the phone that you're almost touching it. The lens basically turns your phone camera into a microscope. The photo below is representative—the focus point is a small bead of water on a blade of grass.



“  
**To properly focus, you need to get so close to your subject with the phone that you're almost touching it.**  
”

## CONCLUSIONS

There are a few things to love about the Olloclip Mobile Photography Box Set, including the quality of the included lenses and the price—it's definitely more affordable than lenses from Moment, which cost \$90 up and require you to buy a special phone case for mounting. But there are some frustration points, largely due to the way the mounting clip works with the iPhone X. Losing access to the Control Center is a big deal, and if you keep a lens over the front camera, you can't use Face ID or automatic brightness control.

**JIM FISHER**





## Sonos Beam: Multiroom Audio in a Small Soundbar



The Sonos One was one of the first third-party smart speakers to support Amazon's Alexa voice assistant, letting you treat it like a bigger, better-sounding Echo. The Sonos Beam takes that voice-assistant experience and puts it in front of your TV. This small soundbar offers hands-free Alexa, can play audio from your TV or wirelessly stream from the 50 different services Sonos supports, and gets surprisingly loud for its size. It's an ideal one-piece sound system for anyone looking to add audio power and a voice assistant to their living room without dealing with lots of different devices at once, earning it our Editors' Choice.

**Sonos Beam**

\$399.00



## A SMALL, STREAMLINED SOUNDBAR

The Sonos Beam is downright puny compared with the company's previous home theater speaker systems, such as the Playbar and the Playbase. The Beam is a 2.7-by-25.7-by-4.0-inch (HWD) bar that combines stark right angles and flat surfaces for the front, back, and top with semicircular curves on the left and right sides. It's available in black or white, with the color choice applying to the smooth top panel and wrap-around cloth grille on the front, sides, and back.

A molded Sonos logo sits in the center of the front of the soundbar, the only design breaking up the grille until you see the small recess for ports on the back. The recess holds connectors for the included power cable, the included HDMI cable, and an Ethernet cable (which isn't included) for those who want a wired network connection instead of relying on the Beam's 2.4GHz wireless connectivity. A setup button between the ports puts the soundbar into setup mode, activating an ad-hoc Wi-Fi network for configuring the system with your smartphone or tablet. No optical audio input is present on the back of the Beam, but you can still use an optical audio connection with the included optical-to-HDMI adapter.

## Sonos Beam

**PROS** Powerful sound for its size. Built-in Amazon Alexa voice assistant. Easily expanded with additional Sonos speakers.

**CONS** No Bluetooth. Optional subwoofer is expensive.



The top panel of the Beam holds the soundbar's touch-sensitive controls, which are nearly identical to those on the Sonos One. A row of three icons offers basic playback and volume controls: Tap the center icon for play/pause, tap the left or right icons for volume up/down, and swipe from left to right or right to left for track forward or back. A status light above the play/pause icon shows when the Beam is on and connected to your home network. A microphone icon above the status light toggles the soundbar's microphone; a smaller light above it glows white when the Beam is listening for the Alexa wake-up word.

Like the Playbar and Playbase, the Beam doesn't include a remote. This isn't a problem, because the soundbar can be configured to work with your TV remote control. When you're using an HDMI-ARC connection, the TV remote should adjust volume automatically. When using the optical adapter, you can manually set your TV remote by teaching it the remote's infrared commands through the Sonos app. Both control systems were simple to set up in testing.



**Like the Playbar and Playbase, the Beam doesn't include a remote. This isn't a problem.**





## SETTING UP THE BEAM

Setting up the Beam is just like setting up the Sonos One or any other Sonos speaker. Plug it in, open the Android or iOS app, and follow the instructions. When prompted, press the setup button on the back of the Beam to make the soundbar generate its own Wi-Fi network, which the app will connect to in order to tell the Beam how to connect to your own home network. You'll need to create a free Sonos account, which lets you manage all of your Sonos devices and set them up in groups. After that, the app will ask you to sign into your Amazon account to link the Beam to Alexa, and you're ready to use it.

Depending on your home theater setup, you might need to take a few extra steps to get the Beam working with your TV, and possibly, your media streamer as well. When you use the optical adapter, you'll have to teach the Beam your TV remote's commands to let you adjust volume (HDMI-CEC control through your TV's HDMI ARC port should automatically get everything working together if you just use HDMI). To use the Beam's hands-free Alexa to control your Fire TV media streamer, you'll have to link the Beam to your Fire TV device through the Alexa app; this integration is all on Amazon's side of the fence and out of Sonos' hands.

Sonos is one of the most well-established names in streaming multi-room audio systems, and that shows in everything you can do with the Beam. As part of the Sonos ecosystem, you can use the Beam on its own or group it with other Sonos speakers as part of a given room's sound system (including the home theater-specific additions of surround sound satellites). You can then control the Beam through the Sonos software on your smartphone (Android or iOS) or computer (Windows or OS X).

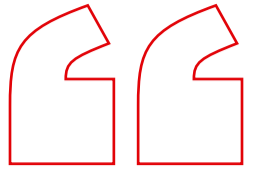


Of course, once the Beam is connected to your network, you can just ask Alexa to play music through it, and the wired audio connection from your television works without using the app. Support for Apple's AirPlay 2 will also be added in the near future. Bluetooth isn't available, so you can't set up simple, point-to-point music streaming from your phone without the Sonos software.

Sonos' platform is robust, with support for 50 music streaming services, including Apple Music, Amazon Music, Google Play Music, Pandora, Sirius XM, Spotify, and Tidal. Some services require signing in through the Sonos app and using that to navigate your music libraries, but several big names are much simpler to use. Google Play Music, Spotify, Tidal, and others support streaming directly to the Beam from each service's app, letting you effectively treat the soundbar like a Google Cast or Apple AirPlay speaker. These connection and streaming choices help make up for the lack of Bluetooth, although it would have been nice to see as a backup option.

### **ALEXA ON YOUR SOUNDBAR**

As an Alexa device, the Sonos Beam offers most of the same benefits and functions as an Echo speaker. You can use Amazon's voice assistant simply by saying "Alexa," followed by a voice command. Alexa can offer general information like weather forecasts and unit conversion, play music from a variety of streaming services including Amazon Music, and control Alexa-compatible smart home devices such as the Philips Hue lights and Nest thermostats. If you link the Beam to a Fire TV device, you can access streaming video through Amazon Prime Video, Netflix, Hulu, and other Alexa-compatible services. Several apps even support voice commands to control playback and navigation.



**Google Play Music, Spotify, Tidal, and others support streaming directly to the Beam from each service's app.**







Alexa on the Beam isn't quite as full-featured as what you get on Amazon's own devices, including the Echo and Fire TV Cube. You can't change the wake word from "Alexa" to an alternative like "Echo," "Amazon," or "Computer," and you can't use Amazon's Drop In voice-call system. Also, while some streaming video services can be controlled with voice, you can't use Alexa to bring up non-media visual information on your Fire TV—say, showing on-screen weather forecasts or accessing live feeds from Alexa-compatible home security cameras like the Amazon Cloud Cam.

### **MOVIE PERFORMANCE**

Considering its small size, the Sonos Beam packs a surprising amount of cinematic audio power. It doesn't reach into ultra-low sub-bass frequencies to rattle your walls (unless you pair it with a \$699 Sonos Sub subwoofer), but it easily fills the room with powerful sound from low-mids to highs. The Beam doesn't attempt to simulate directional surround sound, but the speaker's four woofers, three passive radiators, and single tweeter produce a nice, large-sounding audio field.

The swelling, epic soundtrack of *Pacific Rim* comes through with plenty of force, and the sounds of giant robots fighting and monsters screeching give the sense of a much larger sound system than the small soundbar would indicate. The bigger and more expensive Playbar and Playbase both produce significantly more low-end rumble, but the Beam manages to sound appreciably loud and bombastic. Voices come through clearly against the sounds of rain and rubble, demonstrating very balanced, sculpted audio that suits action movies well.



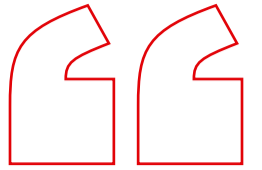
*Casino Royale* also sounds surprisingly large and satisfyingly clear on the Beam. The high-stakes poker scenes get plenty of high-mid and high frequency presence, making every spoken line easy to hear and bringing out every clink of the poker chips. In the short car-chase scene after the game, the roar of the engine is loud and exciting, giving the sense of power even without making tables or walls vibrate with sub-bass.

## **MUSIC PERFORMANCE**

The Beam also handles music very well, though without the optional subwoofer, it shares similar frequency and response limitations to the Sonos One. Our bass test track, The Knife's "Silent Shout," distorts a bit at maximum volume when the woofers try to reproduce the kick drum hits. Reducing the volume to about two-thirds keeps the track loud while avoiding the crackle.

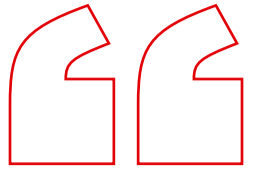
The low bass sounds in Massive Attack's "Teardrop" come through with a solid amount of force, giving the kick drumbeats presence to stand out in the mix despite not getting a wall-shaking amount of sub-bass response. The beats start to distort with volume pumped up to maximum, but cranking it down just a little reduces any crackle or popping. Just as important, the vocals on the track come through with plenty of clarity and texture, and even the quiet harpsichord can be heard against the heartbeat-like drums.

Peter Gabriel's "Burn You Up, Burn You Down" sounds full and rich on the Sonos Beam, with some caveats. The bassline gets plenty of low-mid presence to fill the room, while the snare and high-hat hits stand out in the high-mids and highs to balance it out. Gabriel's voice fights with the steady ride of cymbals for attention in that frequency range, and doesn't rise above the beat as much as we like to hear. It's a full, exciting mix that doesn't give the vocals quite enough presence to faithfully reproduce the track.



**The roar of the engine is loud and exciting, giving the sense of power even without making tables or walls vibrate with sub-bass.**





**The addition of hands-free Alexa makes it an even more useful speaker system, giving you Echo-like voice commands.**



### **A DO-IT-ALL SPEAKER SYSTEM**

The Sonos Beam is a compelling soundbar that puts out surprising power for its size. Movies sound large and exciting, and music comes through very nicely, with a generous amount of bass response even without a subwoofer. The addition of hands-free Alexa makes it an even more useful speaker system, giving you Echo-like voice commands in addition to the wired TV audio options and Sonos' loads of supported streaming services. It doesn't have the sheer power of Sonos' Playbase, but its smaller form and price tag combined with Alexa make it much more tempting for most users looking for some extra audio power for their TVs.

If you want lots of rumble for a little more money, and don't mind losing the voice assistant, the JBL Bar 3.1 includes a subwoofer and can put out even bigger sound thanks to its bigger size. For a one-piece Alexa-equipped sound system, though, the Sonos Beam sounds excellent for a reasonable price and earns our Editors' Choice.

**WILL GREENWALD**



## Canon EOS Rebel T7: Behind the Curve

Canon has finally put a modern 24MP image sensor in its least expensive SLR. But the EOS Rebel T7 doesn't offer any other significant updates from its predecessor, the T6, and it remains a woefully dated SLR when compared with more modern alternatives from both Canon and its competitors. We'd suggest you skip this half-baked upgrade and spend your money on a better entry-level D-SLR or mirrorless camera. The Nikon D3400 is a better camera that sells for about \$500 with a lens, and if you spend a little bit more you can get one of our Editors' Choice options, the mirrorless Sony a6000 (\$649 with lens) or the next model up in Canon's line, the Rebel T7i (\$899 with lens).

**Canon EOS**  
**Rebel T7**

\$499.99





## DESIGN: NOT MUCH NEW HERE

The T7 has the same body as the T6. It measures 4.0 by 5.1 by 3.1 inches (HWD) and weighs 1.1 pounds without a lens. It doesn't deviate from the SLR design paradigm in any way. The body is finished in black, with a modest handgrip, integrated pop-up flash, and a hot shoe atop the optical viewfinder.

Like the T6, the T7 is hard bundled with the EF-S 18-55mm f/3.5-5.6 IS II zoom lens. The lens isn't new—the EF-S 18-55mm f/4-5.6 IS STM, bundled with models like the T7i and SL2, is the latest iteration, two generations newer than the T7's bundled zoom.

Aside from the lens release button, there are no controls on the front plate. The Mode dial, power switch, flash release, control dial, and shutter release are on the top plate. The shutter release is the most forward, sitting at an angle on the top of the handgrip.

## Canon EOS Rebel T7

**PROS** 24MP image sensor. On-screen shooting guide. Raw support. Sharp LCD. Wi-Fi-enabled. Inexpensive.

**CONS** Fixed rear LCD without touch input. Dated image processor limits high ISO capture. Autofocus not available when recording video. Slow 3fps burst rate.



Rear controls are all to the right of the fixed LCD. The Live View button is just to the right of the viewfinder, and below it are the EV compensation, Q, Display, Menu, and Play buttons. There's also a four-way button arrangement to set ISO, AF, White Balance, and the Drive mode, with the Set button at its center. Finally, two buttons at the top-right corner are used to zoom in and out of images during playback, with the zoom out button doubling as a focus point selector.

The LCD is a 3-inch fixed panel without touch support. It's the same 920k-dot design used by the T6, sharp enough for image review and Live View. But it's not nearly as useful as the vari-angle touch screen in the Canon T7i.

Lack of touch makes the camera feel like a remnant from yesteryear, especially since Canon's on-screen "Q" menu system is so easy to navigate on models with touch support.

Wi-Fi and NFC are included. You can transfer images to your Android or iOS device using the Canon Camera Connect app, a plus for sharing images on social media. This model offers no Bluetooth, nor do you get the more advanced wireless functions available in more recent Canon cameras, such as the wireless desktop transfer available on the mirrorless EOS M50.

You do get a 2.5mm interface for a wired remote control, mini USB, and mini HDMI. The T7 supports SD, SDHC, and SDXC memory, which is in the same compartment as the battery. The battery powers up outside the camera in an included wall charger. Battery life is solid, with a 500-shot CIPA rating when using the optical finder; it drops to 240 shots when you're using Live View.



**You can transfer images to your device using the Canon Camera Connect app, a plus for sharing images on social media.**





## PERFORMANCE: UNDERWHELMING

The T7 uses the same 9-point autofocus system as the T6 before it. It takes about 0.6 seconds to power on and capture an image. Focus locks in 0.1 seconds in bright light but slows down to about 0.6 seconds in dim conditions. Subject tracking is available—you need to set the focus mode to AI Servo to turn it on—as is burst shooting, but at just 3fps. The Sony a6000 runs circles around it with 11fps subject tracking.

The shooting duration varies based on your file format. When you shoot in JPG mode, the T7 captures a solid 76 photos before its buffer fills. But if you're an advanced photographer who wants to shoot in Raw format, you'll get just 10 shots, and only six in Raw+JPG, and you'll have to wait about 15 seconds to clear the buffer and commit all images to a memory card.

Live View focus is painfully slow. In bright light, it requires about 1.4 seconds to lock focus using the rear display, and in dim light I clocked it at 5.7 seconds on average. This lag is unacceptable; if you step up to any other current Canon SLR, you'll enjoy Live View focus performance that is almost as quick as through the viewfinder.

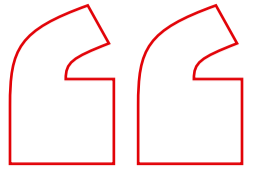
## IMAGE QUALITY: A BRIGHT SPOT

A camera is meant to capture images, which is one thing the T7 gets right. The 24MP image sensor puts it on the same level as the competition, even though the image processor that powers it is an older one. Images from our ISO test scene show that the T7 delivers crisp, clear JPGs through ISO 1600. There's a slight blur at ISO 3200, the top setting at which noise is less than 1.5 percent, and more significant blur at ISO 6400. ISO 12800 is the top setting, but you'll need to dive into a menu to turn it on and enable it manually when you want to use it—automatic adjustment tops out at ISO 6400.



**The camera's LCD is crisp, but it doesn't support touch input.**





**The T7 can set autofocus before you start recording, but it doesn't function when the camera is rolling.**



Shooting in Raw, the T7 captures crisp images without too much grain through ISO 3200. At ISO 6400, detail holds up well, but grain is stronger. You can't go any higher in either Raw or JPG format, a limitation of the image processor. The T7i and SL2 both support ISO 25600 capture, useful when the light is very dim.

### **VIDEO: WHERE'S THE AUTOFOCUS?**

Video tops out at 1080p, with 24fps and 30fps frame rates available. Video quality is fine—it's not the best 1080p I've seen, but by no means the worst. Nobody is going to use the T7 and expect to get pro results; there's no microphone input, for one thing, a must-have for serious videographers, most of whom will want a camera with 4K.

But more casual users will want a camera that can keep a scene in focus while recording video. The T7's autofocus system can set focus before you start recording a clip, but it does not function when the camera is rolling. You can adjust focus manually, but the SL2 and the T7i have video autofocus that's quick, smooth, and easy to use—for video recording, they are much better options.

## BETTER WAYS TO SPEND YOUR MONEY

Like the T6 that came before it, the T7 is a disappointing, underwhelming entry-level model from a trusted brand. Canon knows how to make a good camera, and with a few refinements, the T7 could be one. But it's too far behind other models. The affordable entry-level Nikon D3400 SLR is better all around. Its image quality is a bit better, and it can autofocus when recording video, although not as smoothly as a Canon SLR or most mirrorless cameras.

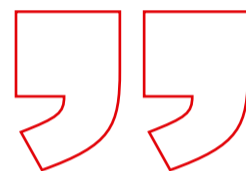
If you're committed to the Canon brand, you'll find that the SL2 and T7i are both much better cameras, though they are a little pricier. The Sony a6000 is a solid mirrorless choice, delivering strong image quality and speedy focus in a smaller form factor.

It appears that Canon has opted to rest on its laurels with the T7, which is a shame. Consumers should be able to trust that the number-one name in cameras delivers a product that is at least competitive with other entry-level SLRs and mirrorless cameras. No one expects low-cost choices to perform like pro cameras that sell for much more, but they should at least be in the same ballpark as similarly priced alternatives. That's not the case with the T7.

**JIM FISHER**



**Canon knows how to make a good camera, and with a few refinements, the T7 could be one. But it's too far behind other models.**





## Dell Latitude 5490: A Solid Work PC

**T**he Dell Latitude 5490 makes no bones about being an all-business laptop. Its style might be a bit dull, and it's not as thin and light as comparable models—but when it comes to performance, it's a solid workday companion. The model we tested runs on a robust eighth-generation Core i7-8650U CPU with 8GB of RAM and has more than 15 hours of battery life. It beats the performance of the Editors' Choice Lenovo ThinkPad T470 (which packed a previous-generation Core i5 in our test unit), but it lacks that model's comfortable keyboard and even longer battery life. But the Latitude 5490 is a strong performer that will please most business users.

### Dell Latitude 5490

Starts at \$799, \$1,459  
as tested





## READY FOR WORK

While you might make the case that the Latitude 5490 is subtle and restrained in its minimalist design, you could also say it comes off as slightly stodgy. It's not an unattractive design—but nothing about it really pops.

The dark-gray chassis is made of carbon fiber, with a Dell logo emblazoned in the center of the lid. At 0.8 by 13.1 by 9 inches, the 5490 is slightly larger in every direction than the ThinkPad T470 and the 13-inch Lenovo ThinkPad X1 Carbon (also an Editors' Choice). At 3.52 pounds, it's a bit lighter than the T470 but about a pound heavier than the X1 Carbon.



The 14-inch, 1,080-by-1,920 full-HD touch screen looks decent enough for apps, but it's rated for only 220 nits, identical to the Lenovo T470 but far dimmer and less pixel-packed than the 13-inch MacBook Pro's 2,560-by-1,600-resolution screen (rated at 500 nits). The glossy display does have a slight glare that's not too distracting; the X1 Carbon employs a protective layer to avoid this problem.

## Dell Latitude 5490

**PROS** Powerful performance. Great selection of ports, including VGA and Ethernet.

**CONS** Dull design. A tad heavy. Lackluster audio. Screen could be brighter.

**The 14-inch 1,080-by-1,920 full HD touch screen looks decent, but it's rated for only 220 nits.**



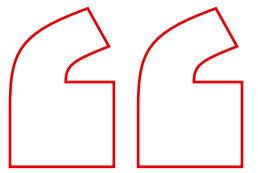
The webcam is centered above the display and captures decent images and video. The built-in speakers, located under the laptop's front edge, produce rather tinny audio. Aside from lacking bass and some lower mid-tones, though, the sound isn't distorted.

### **PRAGMATIC KEYBOARD, PLENTY OF PORTS**

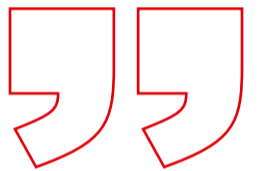
The island-style backlit keyboard and touchpad are responsive and feel comfortable. The touchpad is small, but you have the option of using the old-school rubber pointing stick in the middle of the keyboard. The large power button, in the upper right-hand corner of the keyboard, is nicely designed with a line of white light down the center and stands out from the other keys.

Unlike the 13-inch MacBook Pro, which tops out with just two USB-C ports and one audio port, the Latitude 5490 has a variety of ports across its sides and back.

On the right are an audio combo jack, a USB 3.1 Gen 1 port, a VGA port, and a receptacle for a security lock. On the rear is an Ethernet port (RJ 45), an HDMI port, another USB 3.1 Gen 1 port, and the AC power adapter. Finally, on the left are a USB Type-C port (without Thunderbolt support), a third USB 3.1 Gen 1 port, an SD card slot, and a Smart Card reader.



**The touchpad is small, but you have the option of using the old-school rubber pointing stick in the middle of the keyboard.**



**The island-style backlit keyboard and touchpad work well, are responsive, and feel comfortable for many tasks.**





The legacy VGA port, which we also saw on the Latitude 3490, comes in handy for connecting the laptop to an older monitor or conference-room display, but we'd gladly trade it for a more forward-thinking Thunderbolt connector. For wireless connections, 802.11ac Wi-Fi and Bluetooth 4.1 are included. Dell offers a one-year warranty with the 5490.

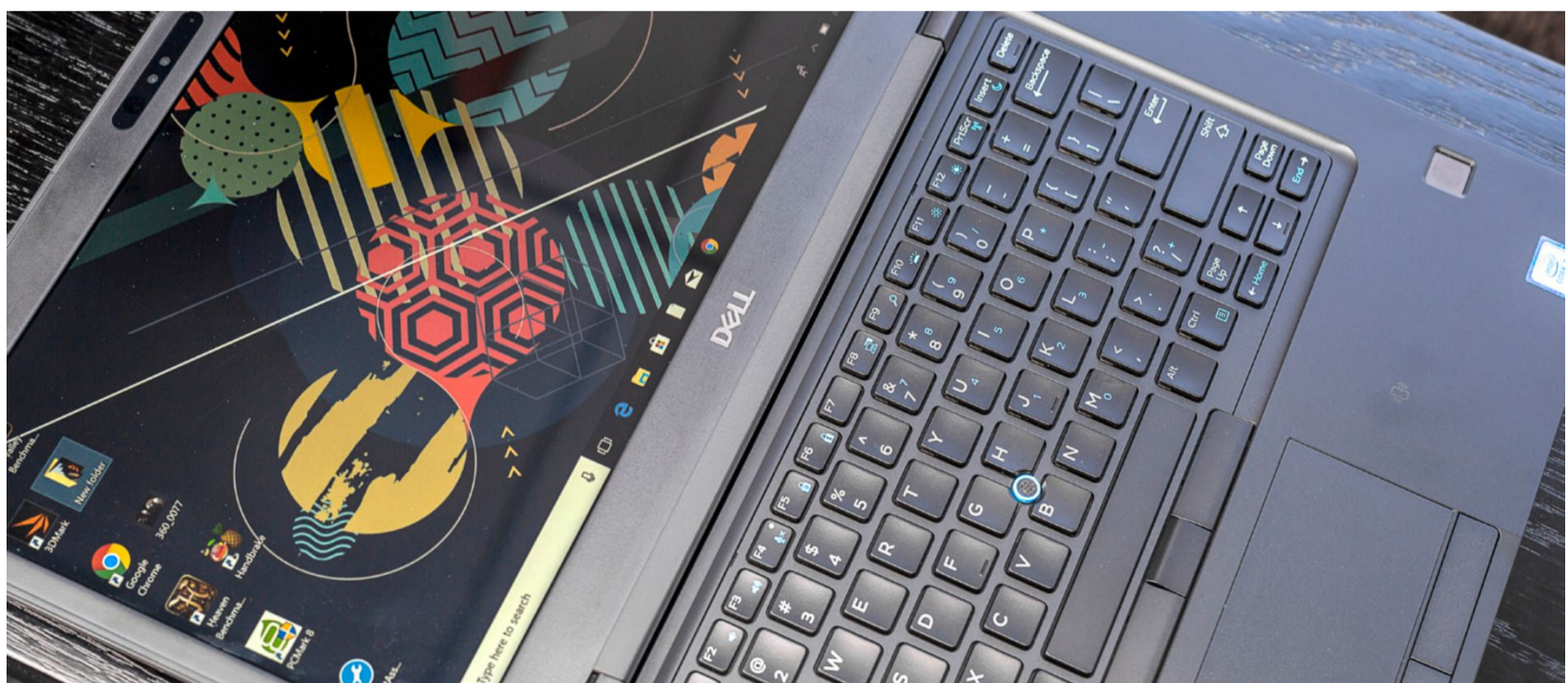
## **GOOD VALUE TO KEEP YOU COMPETITIVE**

Our top-end version of the Latitude 5490 is powered by the Core i7-8650U CPU with integrated Intel HD Graphics 620 and 8GB of RAM, and a 256GB solid-state drive. The entry-level version goes for \$799 and packs an eighth-generation Intel Core i3-8130U, 4GB of RAM, and a 500GB hard drive. Various configurations are available in between.

The 5490 did quite well on the PCMark 8 Work Conventional benchmark test, which measures general computing performance by simulating web browsing, video conferencing, and other basic tasks. In fact, it outscored the ThinkPad X1 Carbon, the ThinkPad T470, and even the HP EliteBook 1040 G4.

Although targeted at business users, the 5490 is well equipped to handle various multimedia tasks superbly—prepping images via Photoshop macros, for example. On our multimedia tests (Handbrake, 1:05; CineBench, 593 points; Photoshop 2:50), this Dell again proved to be a very capable laptop.

Like most laptops with integrated graphics, though, the 5490 earned underwhelming gaming performance scores. Three of the four scores in our Heaven and Valley game simulations were lower than 30 frames per second, which we consider to be the absolute minimum threshold for enjoyable gaming. You'll want to stick to Minecraft and Solitaire when you're not busy working.



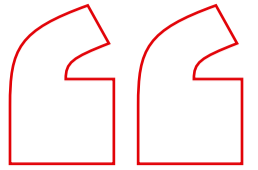


Long battery life, however, is crucial for a business-class laptop. Our battery-life test—playing a local video file continuously at 50 percent screen brightness—found the Latitude 5490 lasts more than 15 hours (15:39). That’s more than enough to get you through a long work day and some downtime at home, though the ThinkPad Carbon X1 outlasted it.

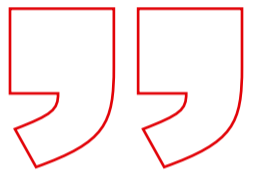
### **VERSATILE BUSINESS LAPTOP**

Although the configuration we tested is pricey, the Dell Latitude 5490 is a good value for those looking for an efficient, productive business laptop with lots of ports and power. It allows you multiple ways of navigating, via the touch screen, touchpad, or even the rubber pointer stick, and connecting peripherals such as a VGA monitor. It could also be a decent laptop to use for PowerPoint or other presentations, especially if you’re including multimedia and require long battery life, though you’ll want to use external speakers for audio. But if you’re looking for a laptop with a classy design and Thunderbolt support and don’t mind shaving an inch off the screen size, consider the Dell XPS 13 (9370). For even longer battery life and one of our favorite keyboards, check out the Editors’ Choice Lenovo ThinkPad T470.

**TERRY SULLIVAN**



**The Dell Latitude 5490 is a good value for those looking for an efficient, productive business laptop.**





## HP Sprocket Plus: Most Versatile of Its Kind



The HP Sprocket Plus is an update to the HP Sprocket portable photo printer we reviewed late last year. This newer iteration prints photos that are 30 percent larger (2.3 by 3.4 inches, versus the original's 2 by 3 inches), and the quality is better, too. The Sprocket and Sprocket Plus aren't unique; they compete with similar products from Canon, Kodak, Lifeprint, Polaroid, and a few others. While most of these pocket photo printers, in terms of print quality, speed, and running costs, are near equals, the slightly bigger prints and the new functionality in its app set the Sprocket Plus apart from the pack—enough to elevate it to our newest Editors' Choice for portable photo printers.

### HP Sprocket Plus

\$149.99



The Sprocket Plus comes in a pair of two-tone color schemes: all-red with a silver accent around the edge or all-white with a copper-colored accent. It measures 0.7 by 5.6 by 3.5 inches (HWD) and weighs half a pound, which is slightly smaller and lighter than its predecessor, apart from a little extra width to accommodate the larger output. It's also wider than both the Lifeprint 2x3 and the Lifeprint 3x4.5. (The latter model weighs more than twice as much, though.)

Because all of these devices get their instructions from smartphones or tablets, they have no onboard controls to speak of. On the Sprocket Plus, you'll note a printing (or "receiving data") light on the front, just above the slit where photos emerge as they print, and on the right side is a mini USB port for charging, as well as a power status light and the power button. You can see the unit below, compared with a typical smartphone (above it) in profile.



The Sprocket Plus is designed to print fully wirelessly, running off an internal battery. The unit will charge from just about any smartphone charging adapter (none is included) or from any PC or mobile-device USB port, and it comes with a 12-inch USB cable. Depending on the power-delivery capability of the USB port you use, the battery should take about an hour and a half to charge, according to HP, and should be good for about 30 prints. The prints use no ink but do require special HP paper; the print technology is known as Zink, which we'll get to in detail later in this review.

## **HP Sprocket Plus**

**PROS** Decent print quality for a Zink-based model. Makes slightly larger prints than Sprocket predecessor. App is easy to set up and use.

**CONS** Can't print from a PC. Running costs, like with most Zink printers, are a bit high.

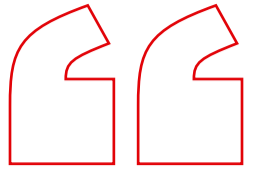
**The HP Sprocket Plus is a little bit thicker than the average smartphone, as well as similar in height and width.**



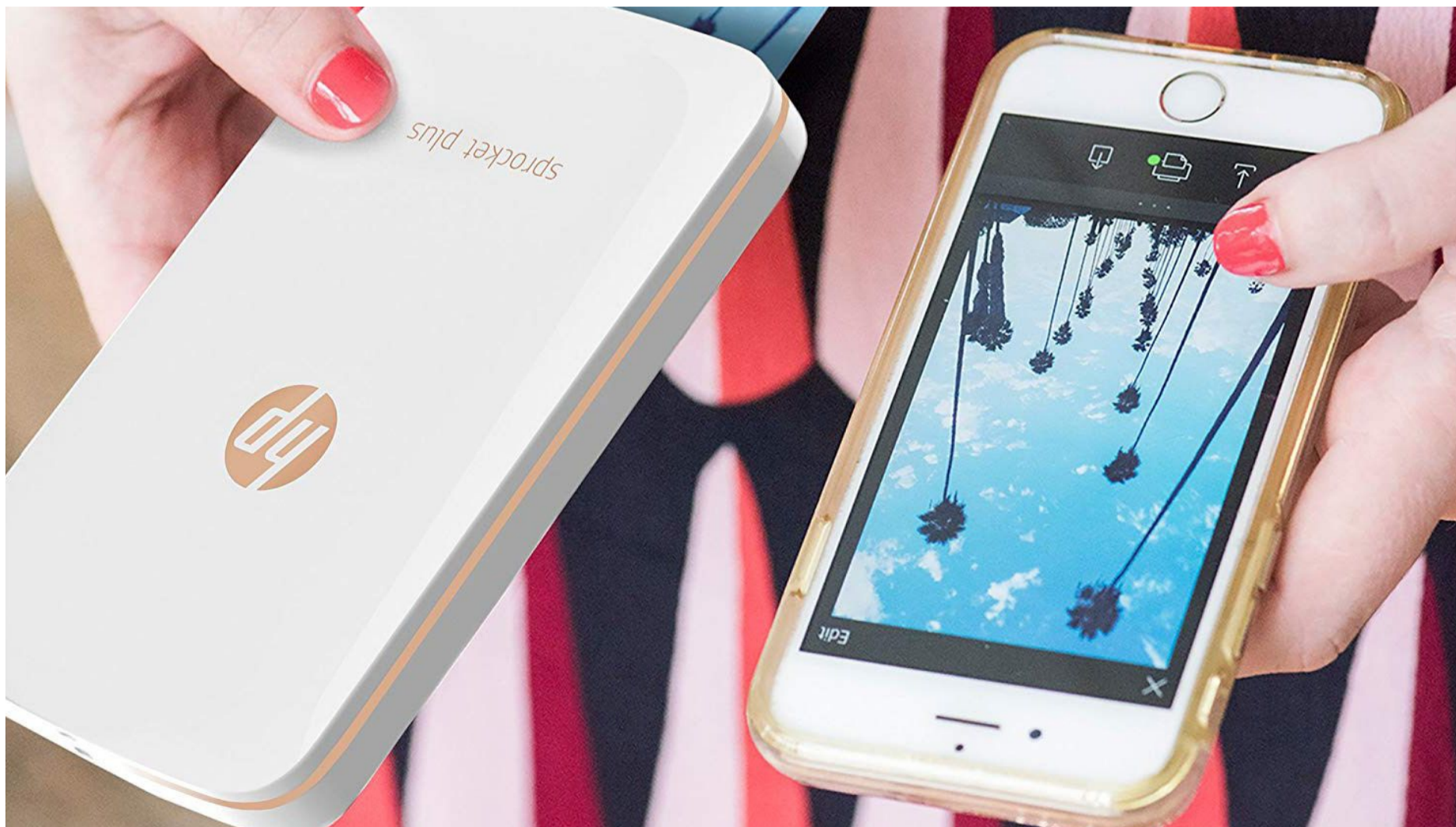
## THE SPROCKET APP

HP's Sprocket App works with all three of the company's Sprocket-branded products: the original Sprocket, the Sprocket Plus, and the Sprocket 2-in-1 combination camera-printer. As apps for these little photo printers go, the Sprocket app is similar to the interfaces that come with its competitors. You can use the app to load, edit, and enhance photos; apply filters and special effects; and connect to various social-media and cloud sites, such as Facebook and Google.

As with most of these little printers, you connect to the app and your smartphone via Bluetooth (in the case of the HP Sprocket Plus, it's Bluetooth 4.0). A few printers, such as the Kodak Mini 2 HD Instant Photo Printer and Kodak Photo Printer Mini, support other connection types, including Wi-Fi and Wi-Fi Direct, but the Sprocket Plus does not. These protocols allow you to print much more flexibly and let you print on devices that don't support Bluetooth.



**The unit will charge from just about any smartphone charging adapter (none is included) or from any PC or mobile device.**





The Sprocket app has changed with the introduction of the Sprocket Plus. The major changes include the following:

**MAGIC FRAMES.** The app contains a gallery of frames that change frequently according to the season. (In June, the app showed several graduation-themed frames, for example.) When you print these and then scan them with the app, the frame content changes. (For example, stars flash and move, or objects appear and disappear.) HP referred to this functionality as “augmented reality” in my briefing about this product, but it’s nothing like Lifeprint’s feature of the same name, in which the actual content of the photo changes (or at least appears to).

**TILING.** As with Canon’s IVY Mini Photo Printer, tiling allows you to print larger images or collages by piecing together content on the app’s display, which then prints in pieces, or tiles, that you then stick back together. Of course, using a larger inkjet or color laser printer gives you more aesthetically pleasing results (that is, without all the seams) when you’re printing a larger photo.

**SCAN MODE.** This feature is a bit closer to Lifeprint’s augmented reality (“Hyperphoto”) feature. In this case, you select a frame in a video and print the frame; when you or someone else scans the printed frame with a phone, the entire video plays on that phone. The app “remembers” where the video is—stored on your phone or on a social-media or cloud site—making it fairly simple to share your video clips with friends and family via Sprocket prints that you hand out.



**BROWSE THE LOCATION.** With this update to the Sprocket app, you can browse through your photos from social media or your phone's photo gallery, then swipe right to sort by location. You can swipe right again to get detailed information on the area where the photo was shot, and one last swipe reveals a Google Street View of the location.

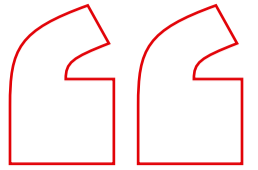
### **AVERAGE SPEED FOR A ZINK PRINTER**

As I pointed out in my recent review of Canon's IVY Mini Photo Printer, which is another 2-by-3-inch Zink (for the brand name "Zero Ink") machine, all of the portable photo printers of this type churn out photos at similar speeds, usually within 10 to 20 seconds of one another. During my speed tests, the Sprocket Plus averaged about 58 seconds per print. That's about 16 seconds short of its 2-by-3-inch Sprocket predecessor. Given that the Sprocket Plus has about 30 percent more coverage area than its sibling, those additional 16 seconds put these two HP machines on an even footing, when it comes to speed.

The Lifeprint 3x4.5, which churns out significantly larger photos, averaged 1 minute and 30 seconds per print, or almost half again the time of the Sprocket Plus, while the Kodak Mini 2 (a dye-sublimation, not a Zink model, with a 2.1-by-3.4-inch print area) printed at roughly 1 minute and 20 seconds per print. The Lifeprint 2x3, at 30 seconds per print, is the fastest of this bunch.

### **THREE INKS IMPACT PRINT QUALITY**

Both the Zink and the dye-sublimation technologies that power most of the portable printers in this class use a three-color CMY (cyan, magenta, and yellow) color model. That's in contrast to the traditional process-color model (CMYK, or cyan, magenta, yellow, and black) used by almost all inkjet and color laser printers.



**With this update, you can browse your photos from social media or your photo gallery, then swipe right to sort by location.**







**An update to HP's popular Sprocket portable photo printer, the Sprocket Plus prints larger pics, and its software packs a wide range of effects. It's the most versatile model of its kind and has earned an Editors' Choice.**

Beyond the black deficiency, Zink printers are very different from inkjets in how they actually print. Rather than using standard liquid ink, the Sprocket Plus and other Zink models use dry ink crystals that are embedded on the specialty Zink paper that these printers require. When a Zink printer prints, it activates the ink crystals on the paper via precise applications of heat, making them display on the page in specific patterns.

Dye-sub printers, in contrast, use sets of special paper paired with a kind of solid ink. (The ink is on a ribbon-like sheet inside a cartridge.) These printers also place ink on the page according to heat patterns generated by data sent from the smartphone or other mobile device to the printer.

Because of the absence of black ink in these processes, many colors and tints in the output aren't as deep and as rich as they should be. And, of course, black tones themselves tend to be lacking, leading to an overall lack of depth in many of the photos. This is evident not only with the Sprocket Plus but also with its Zink and dye-sublimation competitors.

The lack of dedicated black also causes some mostly minor (but noticeable) color shifts. Deep reds, for example, come out a little pink, and deep blues are a bit washed out. This is not to say that my test photos weren't nice-looking and completely recognizable, but several of them were not of the same vibrant and highly detailed quality you'd get from a photo-centric inkjet—such as, say, the printers in HP's Envy Photo line of machines.

## **COST PER PHOTO: ZINK'S NOT ZERO COST**

Given the small size of the photos printed on these little devices, their per-page cost of consumables is high. There's no getting around that, either, because this printer requires Sprocket Plus-specific Zink paper from HP.

When I wrote this in June 2018, HP offered only one paper-pack quantity for this printer: 20 pages for \$12.99. That comes out to 65 cents per print, which is around 15 cents more than its predecessor, the Sprocket, as well as the Canon IVY Mini and the Lifeprint 2x3. The larger-format Lifeprint 3x4.5's running costs are about \$1.25 per print, while Kodak's two dye-sub portable printers, the Photo Printer Mini and Mini 2, run 50 cents and 70 cents per print, respectively.

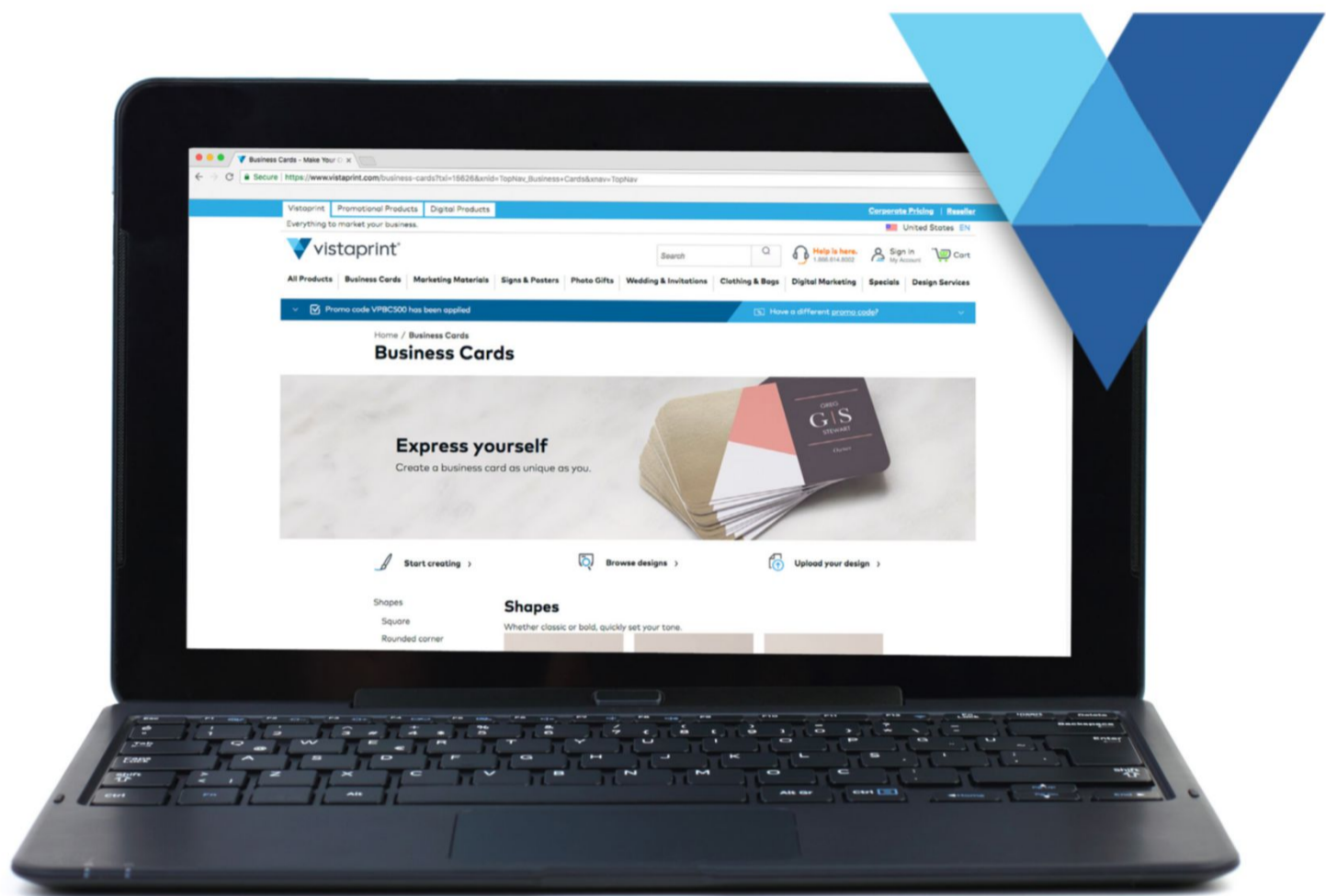
Note that the paper used for the Sprocket Plus has a peelable adhesive backing, making all of your prints de facto stickers. If you don't want this option on all of your prints, this is not the right printer for you.

## **A BIT BETTER THAN YOUR AVERAGE ZINK**

At last count, we had tested six or so of these Zink-based portable photo printers, as well as a few dye-sublimation-based models, that work exclusively from proprietary software on mobile devices. Most of them have a distinct feature or two that sets them apart from the others. The HP Sprocket Plus is no exception.

The Sprocket Plus stands apart for printing slightly larger photos than most of its competitors, at just an additional 15 cents per sheet. In addition, HP has greatly enhanced the Sprocket app, making the overall functionality of the printer and software together more attractive and useful. The printer's list price is a little higher than some of its competitors, but not by enough to keep the HP Sprocket Plus from edging to the top of the class among portable photo printers we've tested.

**WILLIAM HARREL**



# Vistaprint: Best Online Business Cards



If you've watched any local cable news programs in the past couple years, you've likely seen ads for Vistaprint. Though you may be suspicious of as-seen-on-TV tech products, in testing, we found that Vistaprint is indeed one of the best online business card printing web services around. The service offers reasonable pricing and decent design and paper options. It doesn't quite match GetPrint or PSPrint's bargain basement prices or MOO's advanced options like NFC cards, but Vistaprint delivers the best overall combination of quality products and reasonable prices.

**Vistaprint**

\$16.00





## PRICING AND STARTING UP

You can start designing your business card in Vistaprint without creating an account or providing any payment info. The minimum order has a list price of \$16 for 100 cards, though the service runs frequent discounts. You can pay less for cards at GotPrint and PSPrint, which both offer initial orders as low as about \$8. MOO, however, costs more, with entry-level pricing of \$19.99 for just 50 standard size cards with square corners. Staples charges that same price for 500 cards with same-day in-store pickup.

Vistaprint's premium cardstocks—soft touch, natural textured recycled paper, and colored paper—list at \$32 for a pack of 100. Ultra-thick and Folded cards take you over \$40 for a hundred, and adding backside printing and rounded corners knocks the price up by \$8 and \$16, respectively. By comparison, MOO's top-end Luxe cards cost \$69.98 for 100, PSPrint's Ultra cards cost \$43.99, and GotPrint's Trifecta (triple thick) cards cost just \$33.08 for the minimum 250 count.

## OTHER VISTAPRINT PRODUCTS

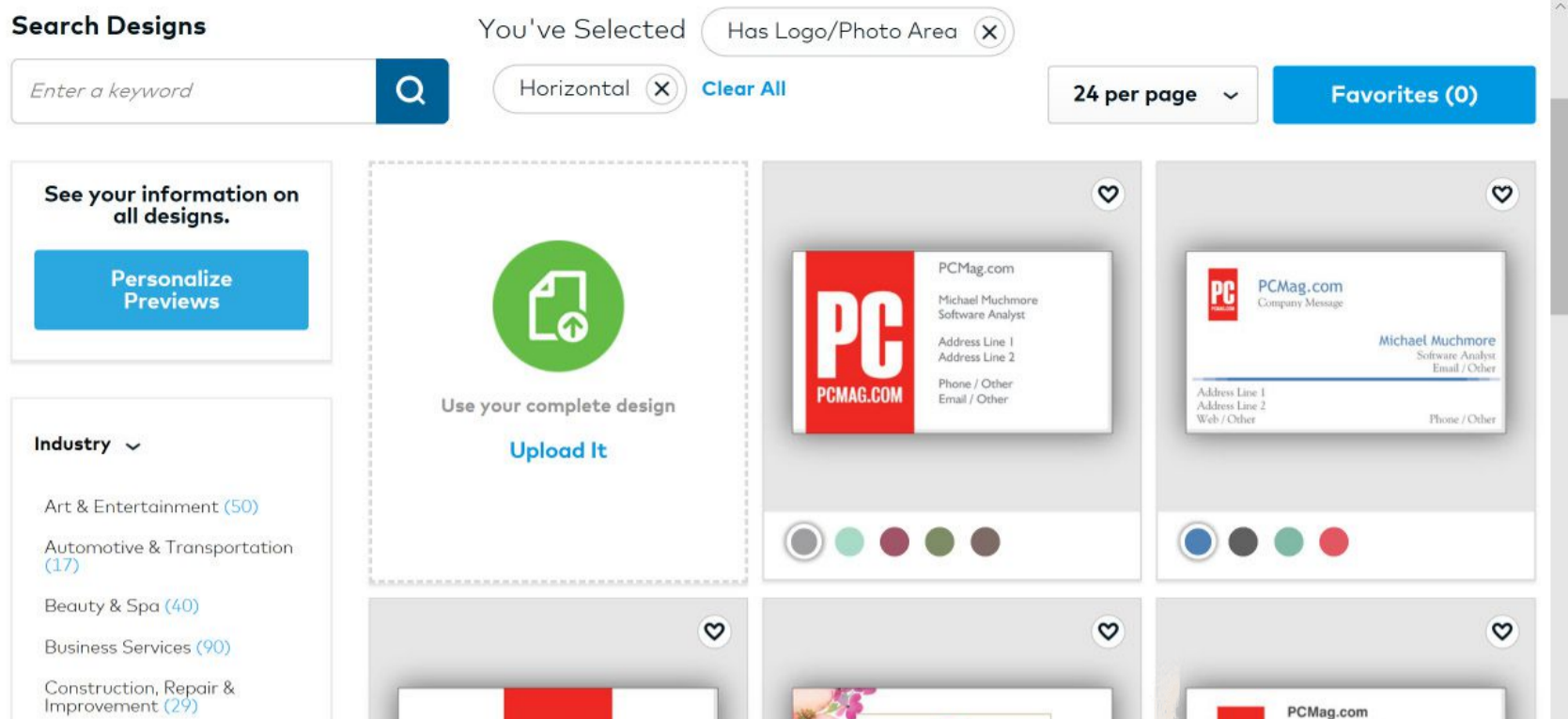
One of the things you want on your business card is your website address, and Vistaprint offers a website-building service to help you get one set up, if you haven't done so already. As with the cards, the company lets you either self-design or use their professional design services for your site.

Besides cards, Vistaprint can print marketing materials such as brochures, postcards, coasters, mugs, magnets, signs, posters, clothing, and even tablecloths. It's an impressive selection, one that extends even to tech items such as USB drives and mouse pads. GotPrint, MOO, and PSPrint also produce a range of non-card printed objects, but they're mostly limited to paper-based products.

## Vistaprint

**PROS** Excellent print quality. Good card-designing tools and paper selections. Reasonable prices. Tons of printed object options. QR code generator.

**CONS** Lots of upsell attempts. Templates aren't as slick as some competitors'.



## DESIGNING YOUR BUSINESS CARD

In general, Vistaprint's card-design interface is busier than competitor MOO's but gives you better control over the end result. When starting to build your business card, you first have to choose a shape. Vistaprint lets you create cards in three shapes: square, rounded corner, and standard. Other providers including GotPrint and MOO offer more size and shape options. I particularly like MOO's MOO Size, which is smaller, so it fits in more wallets. And GotPrint has circles, ovals, and what it calls "leaf shape." PSprint goes a step further, letting you order custom die shapes for your cards.

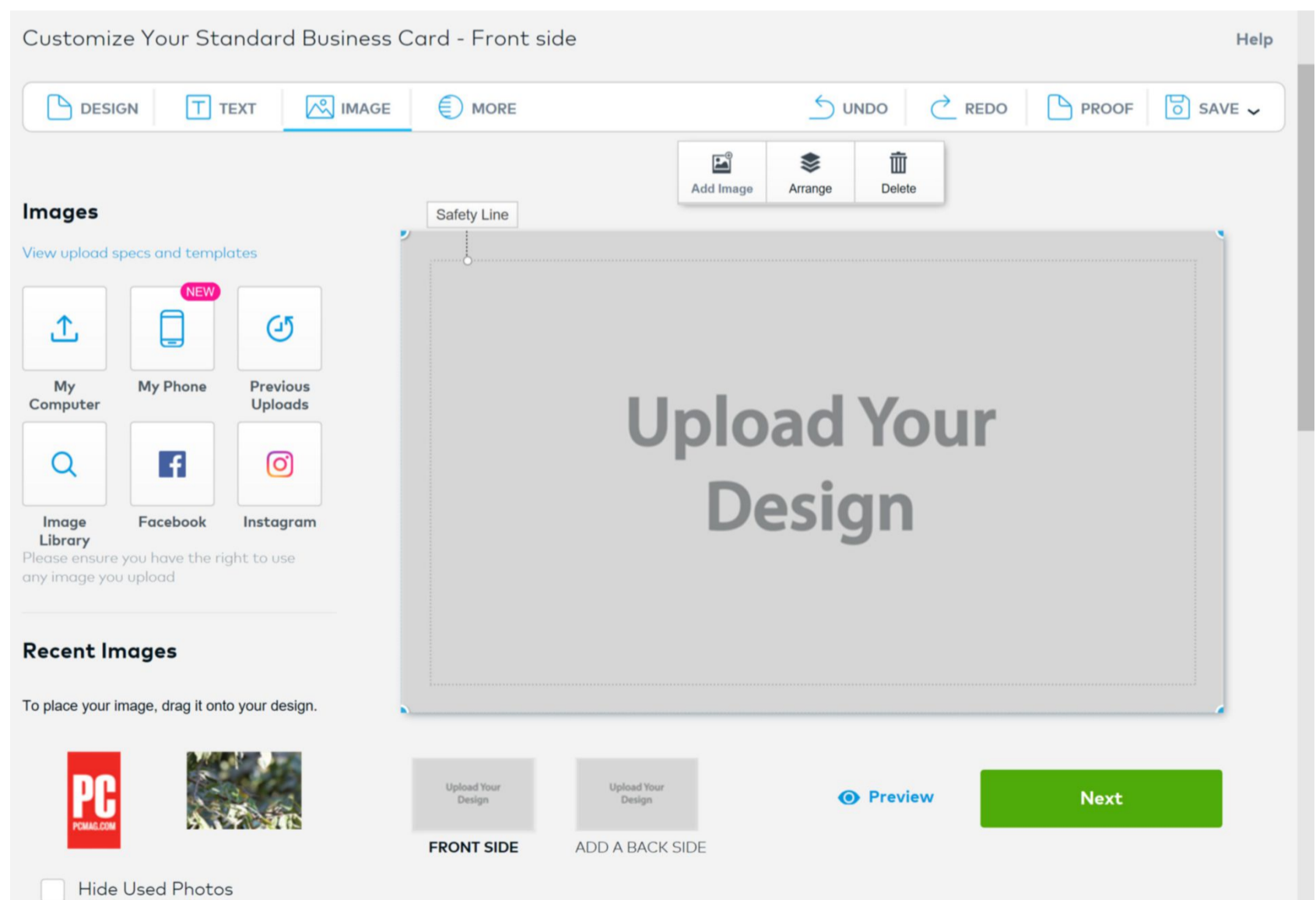
Next, you have to choose a paper stock. Vistaprint offers 10 options here: Pearl, soft touch, linen, natural textured, recycled matte, Kraft (light-brown, 90% recycled), colored, uncoated, matte, and, glossy. To those, you can add metallic or spot UV finishes. Specialty options include ColorFill (which has colored edges), ultra-thick, plastic, and folded cards. Of course, pricing shoots up when you choose such options, with folded cards starting at \$43.75 for 500. MOO offers only four stock choices—Original, Cotton (100% recycled), Super, and Luxe—but it also adds a gold foil option, as well as a unique NFC option, which opens your website on a smartphone when tapped.

You have three options when opening a business-card order: Start Creating, Browse Designs, and Upload Your Design. When going the upload route, you can use images from your Instagram and Facebook accounts and directly upload pictures from your PC or phone. I wish you could simply search the web for images or enter an image URL, however. I do like how your image shows up on the selection of design templates. The site also saves any images you upload, so you can switch back and forth.

To start by browsing the templates, you can filter them by a variety of industries (Art & Entertainment, Beauty & Spa, Manufacturing, and so on), personal (Events, Baby, Moving, and so on), by style, or by the designs' photo placement. Again, it's helpful that Vistaprint shows these template samples with your own info, if you fill in a dialog box. One minor annoyance is that you can't edit some template features. For example, I found a template that I liked, but I couldn't edit out clipart of a camera aperture that I didn't want.

MOO's templates are more cutting-edge, and I wish that Vistaprint's color selections were more versatile—the red of my template didn't match that of the logo, so a dropper tool would have been welcome. When I added an image, though, a dialog informed me that its colors were detected and would be available for later editing. When you run into design problems like this, Vistaprint can have a professional designer adapt a template for you—pretty reasonable!

Once you get to the point where you want to save your work for later perusal, you'll need to create an account—a simple matter of entering a name, email, and password.



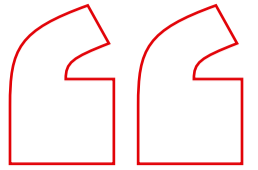


You can add and remove text boxes to taste and move them around so that everything fits. As you're moving text, guidelines helpfully let you align edges. This is something missing in MOO and GotPrint. I also like how you can pretty much add or remove any elements. When you choose a template in MOO, you can't even remove the back-of-the-card image that comes with the template, for example.

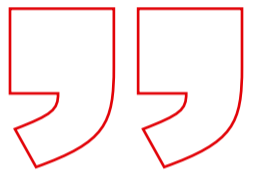
A very cool feature buried under the More menu is a QR code generator. Just enter your URL, email address, or phone number, and the site generates a code that, when scanned by a smartphone app like the Bing app, will open the page or offer to dial the number.

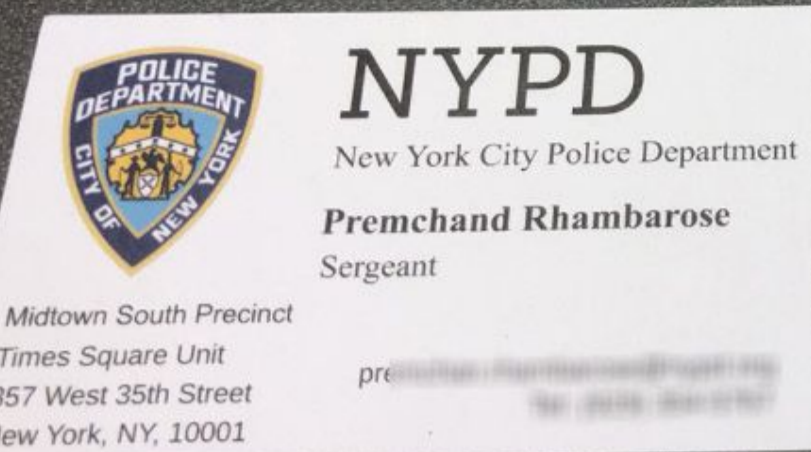
Once you're happy with your fonts and images, you move to the back of the card, which can be blank or include printing at extra cost. You then approve the design, choose the amount to print, add it to your cart, and enter payment info. A few upsells show up here, including thicker cardstock, wallets, and even a website builder option, but you can skip to the shopping cart.

My first test order of 100 standard cards with nothing on the back cost \$16, with three shipping options: Express (3 business days) for \$19.99, Standard (5 days, \$6.99), and Economy (8 days, \$4.99). That's a better deal than MOO, which charges \$5.50 for Economy. Before I could complete the order, I was offered return labels for \$12 more—yet another upsell attempt. I chose Standard shipping, and NY tax was \$2.04, so my whole order came to \$25.03. You get a preview of the card even on this page, but there's no button or link to go back and edit it if you see one last thing you want to change. You can, however, use your browser history to go back and tidy up your design.



**Once you're happy with your fonts and images, you move to the back of the card, which can be blank or include printing.**





**Vistaprint is the best online business card printing service we've tested, thanks to its combination of excellent print quality, good design tools, and reasonable prices.**

## **DELIVERY AND RESULTS**

Just four business days after placing my order, I received the first test pack of cards, even though I'd chosen the standard shipping method, estimated at five days. My Vistaprint orders did not fail to please: The printing was sharp and fully inked. The test image wasn't washed out as it was in the GotPrint low-end order comparison. Images and colored logos looked great, with deep rich colors.

The photo above doesn't really do justice to the card and printing qualities. For example, the two cards on the right are thicker and feel more impressive than those on the left. I've blurred phone numbers in software for privacy's sake. In both the least and most expensive categories, Vistaprint's cardstock and print quality are at the top end of the range among services I tested.

## **THE BEST BUSINESS CARD PRINTING SERVICE**

Vistaprint impressed us with its excellent and flexible card-designing interface, reasonable pricing, and quality of output. The service also offers a wide selection of cardstocks and lots of other items you can have your message printed on. Despite its less than up-to-the-minute template designs and its penchant for upsells, Vistaprint is a PCMag Editors' Choice for online business card printing services.

**MICHAEL MUCHMORE**



# FEATURES

## COMPUTATIONAL PHOTOGRAPHY

IS READY FOR ITS

**CLOSE  
UP**

TERRY SULLIVAN

CLOSE

UP



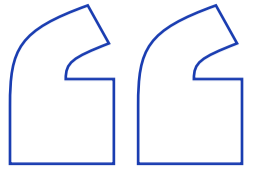
**M**ore than 87 million Americans traveled internationally in 2017, a record number according to the U.S. National Travel and Tourism Office. If you were among them, perhaps you visited a destination such as Stonehenge, the Taj Mahal, Ha Long Bay, or the Great Wall of China. And you might have used your phone to shoot a panorama, maybe even spinning yourself all the way around with your phone to shoot a super-wide, 360-degree view of the landscape.

If you were successful—meaning there were no misaligned sections, vignetting, or color shifts—then you experienced a simple yet effective example of *computational photography*. But in the past few years, computational photography has expanded beyond such narrow uses. It not only gives us a different perspective on photography but could also have an effect on how we view our world.

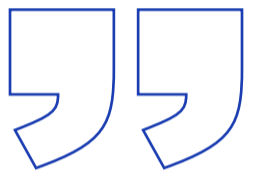
## **WHAT IS COMPUTATIONAL PHOTOGRAPHY?**

Marc Levoy, professor of computer science (emeritus) at Stanford University, principal engineer at Google, and one of the pioneers in this emerging field, has defined computational photography as a variety of “computational imaging techniques that enhance or extend the capabilities of digital photography [in which the] output is an ordinary photograph, but one that could not have been taken by a traditional camera.”

According to Josh Haftel, principal product manager at Adobe, adding computational elements to traditional photography allows for new opportunities, particularly for imaging and software companies: “The way I see computational photography is that it gives us an opportunity to do two things. One of them is to try and shore up a lot of the physical limitations that exists within mobile cameras.”



**Algorithms are used to determine what's considered the background and the foreground subject.**

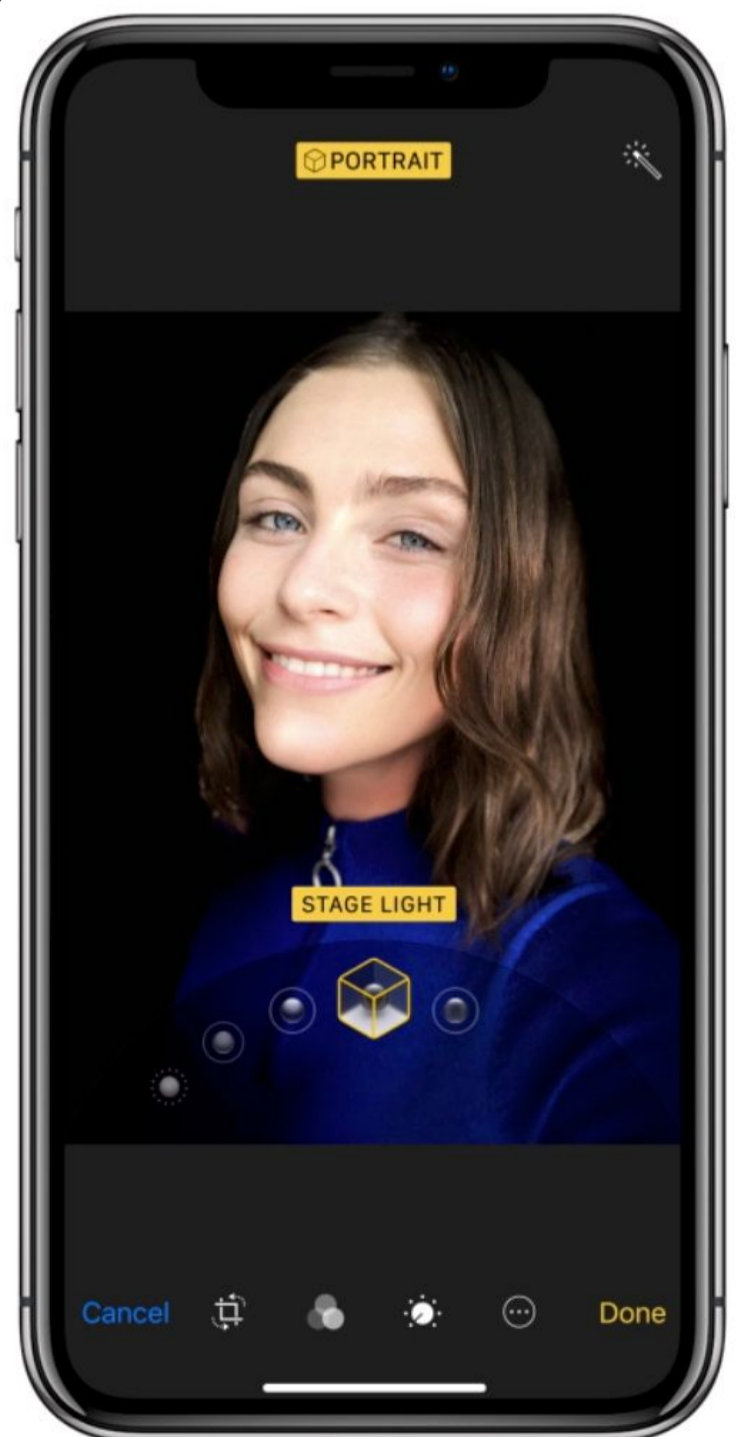


Getting a smartphone to simulate shallow depth of field (DOF)—a hallmark of a professional-looking image, since it visually separates the subject from the background—is a good example. What prevents a camera on a very thin device, like a phone, from being able to capture an image with a shallow DOF? The laws of physics.

“You can’t have shallow depth of field with a really small sensor,” says Haftel. But a large sensor requires a large lens. And since most people want their phones to be ultrathin, a large sensor paired with a big, bulky lens isn’t an option. Instead, phones are built with small prime lenses and tiny sensors, producing a large depth of field that renders all subjects, both near and far, in sharp focus.

Haftel says makers of smartphones and simple cameras can compensate for this by using computational photography to “cheat by simulating the effect in ways that trick the eye.” Consequently, algorithms are used to determine what’s considered the background and what’s considered a foreground subject. Then the camera simulates a shallow DOF by blurring the background.

The second way Haftel says computational photography can be used is to employ new processes and techniques to help photographers do things that aren’t possible using traditional tools. Haftel points to HDR (high dynamic range) as an example: “HDR is the ability to take multiple shots simultaneously or in rapid succession, and then merging them together to overcome the limitations of the sensor’s natural capability.” In effect, HDR, particularly on mobile devices, can expand the tonal range beyond what the image sensor can capture naturally, allowing you to capture more details in the lightest highlights and darkest shadows.



## WHEN COMPUTATIONAL PHOTOGRAPHY DOESN'T LIVE UP TO EXPECTATIONS

Not all implementations of computational photography have been successful. Two bold attempts were the Lytro and Light L16 cameras: Instead of blending traditional and computational photo features (like iPhones, Android phones, and some standalone cameras do), the Lytro and Light L16 attempted to focus solely on computational photography.

The first to hit the market was the Lytro light-field camera, in 2012, which let you adjust a photo's focus after you captured the shot. It did this by recording the direction of the light entering the camera, which traditional cameras don't do. The technology was intriguing, but the camera had problems, including low resolution and a difficult-to-use interface.

It also had a rather narrow use case. As Dave Etchells, founder, publisher, and editor-in-chief of Imaging Resource, points out, "While being able to focus after the fact was a cool feature, the aperture of the camera was so small, you couldn't really distinguish distances unless there was something really close to the camera."

For example, say you were shooting a baseball player at a local baseball diamond. You could take a photo up close to the fence and also capture the player through the fence, even if he's far away. Then you could easily change the focus from the fence to the player. But as Etchells points out, "How often do you actually shoot a photo like that?"





A more recent device aiming to be a standalone computational camera is the Light L16, an attempt at producing a thin, portable camera with image quality and performance on a par with a high-end D-SLR or mirrorless camera. The L16 was designed with 16 different lens-and-sensor modules in a single camera body. Powerful onboard software constructs one image from the results of the various modules.

Etchells was initially impressed with the concept of the Light L16. But as an actual product, he said, “It had a variety of problems.”

For example, Light, the camera and photography company that makes the Light L16, claimed that the data from all those little sensors would be equivalent to having one big sensor. “They also claimed that it was going to be D-SLR quality,” says Etchells. But in their field tests, Imaging Resource found that this was not the case.

Imaging Resource found other issues with the L16, such as that certain areas of the photo had excessive noise, even in the bright areas. “And there was practically no dynamic range: The shadows just plugged up immediately,” says Etchells, meaning that in certain sections of photos—including the sample photos that the company was using to promote the camera—there was hardly any detail in the shadows.

“It was also just a disaster in low light,” says Etchells. “It just wasn’t a very good camera, period.” (For more on the Light L16, check out the entire review on Imaging Resource’s website.)



## **WHAT'S NEXT FOR COMPUTATIONAL PHOTOGRAPHY?**

Despite these challenges, many companies are forging ahead with new implementations of computational photography. In some cases, they're blurring the line between what's considered photography and other types of media, such as video and VR (virtual reality).

For example, Google will expand the Google Photos app using AI (artificial intelligence) for new features, including the capability to colorize black-and-white photos. Microsoft is using AI in its Pix app (iOS) so users can seamlessly add business cards to LinkedIn. Facebook will soon roll out a 3D Photos feature, which "is a new media type that lets people capture 3D moments in time using a smartphone to share on Facebook." And in Adobe's Lightroom app, mobile-device photographers can utilize HDR features and capture images in the RAW file format.

## **NEW PERSPECTIVES: VR AND COMPUTATIONAL PHOTOGRAPHY**

While mobile devices and even standalone cameras are using computational photography in intriguing ways, even more powerful use cases are coming from the world of extended-reality platforms, including VR and AR (augmented reality). For James George, CEO and cofounder of Scatter, an immersive media studio in New York, computational photography is opening up new ways for artists to express their visions.

"At Scatter, we see computational photography as the core enabling technology of new creative disciplines that we're trying to pioneer... Adding computation could start to synthesize and simulate some of the same things that our eyes do with the imagery that we see in our brains," says George.

Essentially, it comes down to intelligence: We use our brains to think about and understand the images we perceive.

"Computers are starting to be able to look out into the world and see things and understand what they are in the same way we can," says George. So computational photography is "an added layer of synthesis and intelligence that goes beyond just the pure capturing of a photo but actually starts to simulate the human experience of perceiving something," he says.



The way Scatter is using computational photography is called *volumetric photography*, which is a method of recording a subject from various viewpoints and then using software to analyze and recreate all those viewpoints in a three-dimensional representation. Both photos and video can be volumetric and appear as 3D-like holograms you can move around within a VR or AR experience. “I’m particularly interested in the ability to reconstruct things in more than just in two-dimensional way,” says George. “In our memory, if we walk through a space, we can actually recall spatially where things were in relationship to each other.”

George says that Scatter is able to extract and create a representation of a space that is “completely and freely navigable, in the way you might be able to move through it like a video game or a hologram. It’s a new medium that’s born out of the intersection between video games and filmmaking that computational photography and volumetric filmmaking are enabling.”

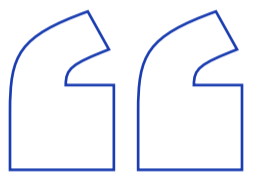
To help others produce volumetric VR projects, Scatter has developed DepthKit, a software application that lets filmmakers take advantage of the depth sensor from cameras such as the Microsoft Kinect as an accessory to an HD video camera. In doing so, DepthKit, a CGI and video-software hybrid, produces lifelike 3D forms “suited for real-time playback in virtual worlds,” says George.



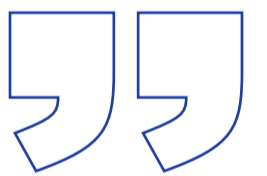


Scatter has produced several powerful VR experiences with DepthKit using computational photography and volumetric filmmaking techniques. In 2014, George collaborated with Jonathan Minard to create “Clouds,” a documentary exploring the art of code that included an interactive component. In 2017, Scatter produced a VR adaptation based on the film *Zero Days*, using VR to provide audiences with a unique perspective inside the invisible world of cyber warfare—to see things from the perspective of the Stuxnet virus.

One of the most powerful DepthKit-related projects is “Terminal 3,” an augmented reality experience by Pakistani artist Asad J. Malik, which premiered earlier this year at the TriBeCa film festival. The experience lets you virtually step into the shoes of a US border patrol officer via a Microsoft HoloLens and interrogate a ghost-like 3D volumetric hologram of someone who appears to be a Muslim (there are six total characters you can interview). “Asad is a Pakistani native who emigrated to the US to attend college and had some pretty negative experiences being interrogated about his background and why he was there. Shocked by that experience, he created “Terminal 3,”” says George.



**George says that Scatter is able to extract and create a representation of a space that is ‘completely and freely navigable.’**



One of the keys to what makes the experience so compelling is that Malik's team at 1RIC, his augmented reality studio, used DepthKit to turn video into volumetric holograms, which can then be imported into real-time video game engines such as Unity, or 3D-graphics tools such as Maya and Cinema 4D. By adding the depth-sensor data from the Kinect to the D-SLR video in order to correctly position the hologram inside the AR virtual space, the DepthKit software turns the video into computational video. A black-and-white checkerboard is used to calibrate the D-SLR and the Kinect together, then both cameras can be used simultaneously to capture volumetric photos and video.

Since these AR experiences created with DepthKit are similar to the way video games work, an experience like "Terminal 3" can produce powerful interactive effects. For example, George says, Malik allows the holograms to change form as you interrogate them: If during the interrogation, your questions become accusatory, the hologram dematerializes and appears less human. "But as you start to invoke the person's biography, their own experiences, and their values," says George, "the hologram actually starts to fill in and become more photorealistic."

In creating this subtle effect, he says, you can reflect on the perception of the interrogator and how they might see a person "as just an emblem instead of an actual person with a true identity and uniqueness." In a way, it could give users a greater level of understanding.

"Through a series of prompts, where you're allowed to ask one question or another," says George, "you are confronted with your own biases, and at the same time, this individual story."



**Malik's team at  
1RIC, his  
augmented  
reality studio,  
used DepthKit  
to turn video  
into  
volumetric  
holograms.**







Like most emerging technologies, computational photography is experiencing its share of both successes and failures. This means some important features or even whole technologies may have a short shelf life. Take the Lytro: In 2017, just before Google bought the company, Lytro shuttered its website so you could no longer post images on other sites or social media. For those who missed it, Panasonic announced a Lytro-like focusing feature called Post Focus, which it has since included in various high-end mirrorless cameras and point-and-shoots.

The computational photography tools and features we've seen thus far are just the start. I think these tools will become much more powerful, dynamic, and intuitive as mobile devices are designed with newer, more versatile cameras and lenses, more powerful on-board processors, and more expansive cellular networking capabilities. In the very near future, you may begin to see computational photography's true colors.



**Like most emerging technologies, computational photography is experiencing its share of both successes and failures.**





**FEATURES**

**EXCEPTIONAL  
PHOTOGRAPHERS:**

**TWO  
PROFILES**

BY TERRY SULLIVAN



**L**ast year, photographers around the globe captured 1.2 trillion digital photos, according to estimates from market research firm KeyPoint Intelligence. It's a statistic that suggests we've been exposed to more images in the past year than at any other point in history.

Now, imagine you take photos for a living. How do you create images that have a chance of being noticed? It's a challenge, to say the least. And yet there are numerous professional shooters who continue to distinguish themselves, creating provocative, compelling, powerful photographs that makes us laugh, wince, weep, and feel our connection to humanity.

Two such pro photographers are Sarah Blesener and Jessica Pettway. In very different ways, each produces exceptional photos that stand out in our image-saturated world. We talked to them about why they shoot what they shoot and the way they capture their vision of the world.



**“Elizabeth Nelson, 17, in the parking lot of Home Depot waiting for her friends after watching their team lose their first football game of the season, 25 August 2017, Omaha, Nebraska. Nelson enlisted in the Army the summer before her senior year of high school, and will ship out to boot camp three days after she graduates. ‘I feel like Omaha is not really the place for me. So, I definitely want to move out West if anything. I do kind of want to get the hell out of here.’” [photo: Sarah Blesener]**

## Sarah Blesener

Blesener is a photojournalist and documentary photographer from New York City whose work has appeared in *National Geographic* magazine and *The New York Times*, among other publications. Her latest work revolves around youth movements and culture in Russia, Eastern Europe, and the United States.

### **PCMag: What important characteristics do you look for when you're photographing people?**

**SARAH BLESENER:** The first thing I look for is there has to be some bit of contradiction. So I'm looking for individuals who can't be defined or described in one way ... I'm really drawn to photographing young people, adolescents, and teenagers. Almost all of my work revolves around that time period. Essentially, I like people who are in between states of being young and old, which is a complicated time of coming of age—of not being sure of who you are, of being somewhat fluid, and thinking you know everything, but still being very open to the world, which is the kind of contradiction that's very, very beautiful for me to photograph. That time period, of 15 to 18, is fascinating.

### **What photographers, artists, or works of art inspire you in your work?**

I read poetry and literature obsessively and am really inspired by words and writing. However, I do find inspiration from photographers, too, like Alec Soth and how he creates the environment surrounding his subjects. I like the nuance and delicacy that he delivers. I also find his photographs are very complicated. And I love the soft light he uses. I also like Anastasia Taylor-Lind. I love her portrait work and the way she photographs females and young people.

### **What draws you to working on long-term photography projects?**

I'm drawn to long-form stories because I have lots of questions. In the past, I've been disappointed when I've done shorter projects. I end up with "flat answers": The images don't beckon as many interesting responses or questions, and they're just not as complicated. What I'm looking for is that nuance between wanting to deliver a message and a story and also wanting to keep it open-ended. It's why I think long-term work has a really beautiful way of opening up that kind of dialogue.



When I'm working thematically, I generally don't focus on a one-person story. It's normally about a theme or a topic I'm interested in, or some of these deeper questions that are not easily answered, or probably not able to be answered at all. I'm asking questions about nationalism or indoctrination or topics like this, which take a lot of time, not only photographing it but wrestling internally with these questions and trying to find my own answers.

Also, practically speaking, I find I like the images I take toward the last months or weeks of a project, even if it's a three-year project. It just takes me awhile to really dig into a spot where I can see beyond the most obvious images and find those delicate and not-so-obvious pictures.

**Since your work is more about a series of photos, rather than a single image, how do you like to show your work?**

I like to show my work to audiences who aren't only photographers ... like having a panel in a town and having a lot of time to have a dialogue or a Q&A session with a larger group ... I think it really brings images to communities or the public where you can really talk about it together and digest it in different kinds of settings. For one of my current projects, "Beckon us From Home," which is basically about politics through the eyes of young people, I've been showing it in high schools, which has been the most fantastic way to have a home for this work.

**Do you enjoy speaking about your work in public settings?**

I'm actually not an outgoing person by any means, and I get terrified of speaking in front of people and am uncomfortable doing it. But for me, I get so much fulfillment [from] having this conversation happen. I want to talk to people who are completely different politically ... I want to have a real conversation about the content. I also want to hear different opinions, maybe hear, "I hate this, and here's why." Or "I think you're wrong." I want to hear every aspect of it.

It's a challenge for me, but it brings me a lot more understanding. I feel I have the opportunity to have people critique my work, not from a technical point of view but from an emotional or ideologically point of view. I don't want to hear people who just think like me. It's so fascinating, and it's really needed.

## **What advice would you offer a novice shooter who wants to photograph people?**

The relationship with your subject is crucial, because even if you could create a fantastic portrait or photo, if the subject doesn't feel fully immersed in his or her own headspace, it's not going to be a good image. Oftentimes, you'll either have a very comfortable and emotionally open subject or a fantastic composition. If you can get those two to blend, that's obviously the sweet spot we're all looking for. Another piece of advice is to keep things very simple. Look for lighting that creates a kind of tension and mood you find compelling in your subjects.

## **Is there a tech tip you have for those who want to create similar types of images to yours?**

Keep things simple, and master whatever you have in front of you. I shot both the "Beckon us from Home" and "Russia" projects using one lens the entire time. I never changed it. I have more lenses I can use for commercial work, but for my personal work, I keep it really simple. I use a 35mm prime lens, and it's my absolute favorite. I think it's just such a good translation of what I see in front of me without any kind of distortion. It feels the most natural to me.

## **Jessica Pettway**

Pettway is an editorial and commercial still-life photographer based in New York City whose work has appeared in *Bloomberg Businessweek*, *Time* magazine, and *New York Magazine*, among others. Describing herself as "a visual artist and grilled-cheese enthusiast," Pettway shoots humorous, cleverly composed still lifes that are provocative and visually stunning.

## **PCMag: What projects are you currently working on?**

**JESSICA PETTWAY:** I'm in between projects, so I'm just playing around and sourcing materials that I like or that I've been wanting to work with and seeing what can come from that. I've been eating a lot of junk food, too. [laughs] So that will probably come into play. But that also leads me back into thinking about childhood, junk food, and things like that. But I'm really just playing around with materials right now.



**“This photo shows one of my favorite vegetables, spaghetti squash, pretending to be a pineapple, one of my favorite fruits. I love shooting my favorite foods and eating them after the shoot.” [photo: Jessica Pettway]**

### **What draws you or attracts you to creating humorous still-life photos?**

I think it goes back to what I’ve always been interested in: different types of antics and humor I saw in cartoons growing up, like Looney Tunes or “Tom and Jerry.” These cartoons are basically set in a home, but there were so many random, unexpected, and crazy things that went down. So I’m thinking back to these memories and figuring out how to make everyday items fun.



**Where do ideas for your photos come from? How do you develop and turn them into photos? Do you improvise if an idea doesn't seem to translate to a still life?**

I'll think of different materials and shapes that I want to work with, and then, while I'm shooting, I'll give myself time to just play. Maybe I'll just take a few photos and think on it and see how it looks. Often, I'll keep moving things around. But I always have to see it and then decide. If I like the setup, great. If I don't like it, I'll try to attack it in different ways. But it's always easier for me to instinctively experiment in setting up my still lifes.

**What is the biggest challenge when you're working on a setup for a photo shoot?**

Physics. [Laughs] Sometimes, I just have these ideas that are not physically possible. No matter how much rigging or planning, it's just not feasible. But it's fun to try it.

**What is it about color that you find important in your images?**

For me, color is really fun and relaxing. Bright colors also bring me back to my childhood. My work relaxes me and takes me to a different place, which is what I want other viewers to experience.

**What kind of gear do you use?**

For lighting, I like using strobes. For the type of lighting I tend to use, I like either soft light or harsh light that emulates a bright, sunny day. In the studio, I mostly shoot with Canon EOS 5D Mark IV or Canon EOS 5DS D-SLRs. For lenses in the studio, I like to switch between a 50mm and 85mm. Outside the studio, I'll usually use a 50mm prime lens or maybe a 24-70mm, if I need some flexibility. I'll also bring along a speedlight.

**Do you do a lot of retouching on your images?**

I don't like to spend a lot of time in Photoshop or retouching. I would rather spend an extra 10 minutes to rig something up the right way, rather than spend more time in Photoshop.

# FEATURES



## HEAD TO HEAD:

**Apple iPhone 8 Plus**

**VS.**

**Olympus PEN E-PL9**

Can a phone camera rival a mirrorless camera in photo quality? We pitted these two devices against each other to find out.

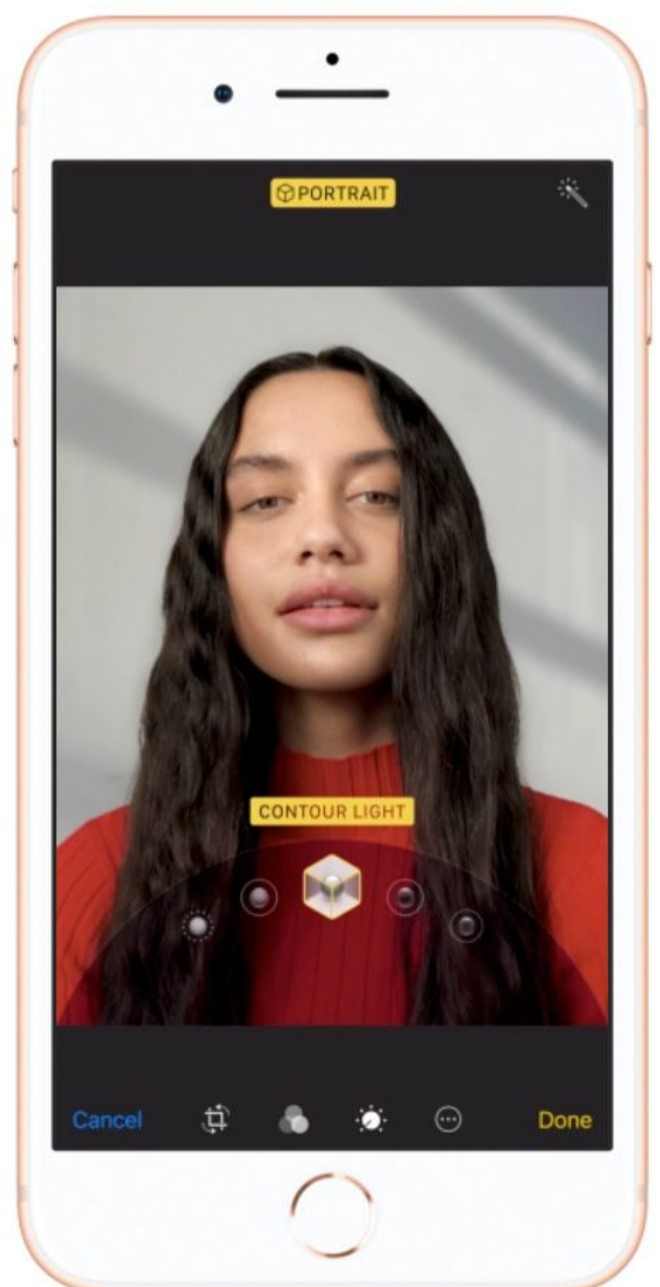
BY TERRY SULLIVAN

**C**ameras on mobile devices have come a long way in the past eleven years. And the makers of smartphones, including Apple, Samsung, LG, and Google, keep rolling out new improvements. Despite these enhancements, experienced photographers and pros still consider phone cameras to be inferior to advanced standalone cameras—particularly D-SLR (digital single-lens reflex) and mirrorless cameras, which yield high image quality and versatility. But in recent years, smartphone makers have attempted to compete in the rarefied world of advanced cameras.

In the fall of 2016, Apple announced the introduction of a new portrait mode that would soon be available on upcoming iPhones. This ushered in a new level of excitement (or hype, depending on your point of view) about just how advanced the cameras on a mobile device could be. During that product launch, Apple said its new Portrait mode would produce images that had a particular characteristic—shallow depth of field (DOF): “This effect, also known as ‘bokeh’ and previously only capable on D-SLR cameras, turns the camera you carry around with you every day into an even more powerful photography tool.”

Actually, not only D-SLRs can produce this effect. You can get shallow depth of field with newer mirrorless models, too. Both types of standalone cameras work with a wide array of high-quality (and pricey) interchangeable lenses that you can swap out, and both include large sensors in the camera body. Matching a wide aperture on a D-SLR or mirrorless lens with a large sensor is essential to capturing an image with a shallow depth of field, which displays your subject in sharp focus but renders the background in beautiful blur.

So how do Apple and other phone makers create this particular optical effect, considering the tiny lenses and sensors on smartphones? By manipulating data. On the iPhone, Apple uses computational photography to empower its Portrait mode. (For more, see our story “Computational Photography Is Ready for Its Closeup” in this issue.)





With this in mind, I wanted to get a sense of how well a mobile device captures a particular type of shot—an informal portrait—and compare it to what you can capture on an interchangeable-lens camera.

For my test, I set up a photo shoot with my son as a model and used two devices to capture two different informal portraits: one in an indoor setting and the other outdoors. I used a 12-megapixel Apple iPhone 8 Plus (I set the phone to Portrait mode for the indoor photo and used the ProCam app to capture a RAW file) and a 16-megapixel Olympus PEN E-PL9 mirrorless camera (shot in aperture priority mode and set up to capture both a fine-quality JPEG and a RAW file) equipped with an Olympus M.Zuiko Pro ED f/1.2 25mm prime lens. For each device, I turned off the onboard flash and used only available light.

It's important to note that to compare the two devices, I used the mirrorless camera in a very limited way. The PEN E-PL9 provides a vast array of settings and features. And because it's a system camera, you can buy a variety of accessories to further expand your creativity.

For this matchup, I focused on just a couple of important features on each device: In one photo I set each device to have a blurred background (using the iPhone's Portrait mode, and a wide aperture on the PEN mirrorless camera, using aperture priority mode); in the other photo, I captured both images in RAW file format.

But there are many other features I could have used, particularly on the Olympus. For instance, if I was shooting a more casual candid photo in low light without a flash, any action or movement would be a challenge for a mobile device, but certainly not for a mirrorless camera like the Olympus. Also, mirrorless and D-SLR cameras often come with capable on-board flash features and accept even more versatile external flash accessories, which can't be matched on a mobile device.

But for this comparison, I wanted a fair test of how well the photos shot on the iPhone compared with what we captured with the Olympus mirrorless camera. So I kept things simple. Here's what I found.

## **OVERALL RESULTS**

In my setups, the iPhone 8 Plus and the Olympus PEN E-PL9 both did a very good job of taking a casual portrait. Each captured the subject's skin tones as well as other colors. The Olympus may have blown out the bright highlights in a bit of the outdoor shot, but I like the crisp, sharp details in both the outdoor and indoor images taken with the PEN E-PL9. The iPhone captured my subject's skin tone pretty accurately, although it gave him slightly more color in the outdoor shot than he actually has. I also like that in both of the indoor shots, each device was able to provide a shallow depth of field, blurring the background and allowing for the subject to stand out.



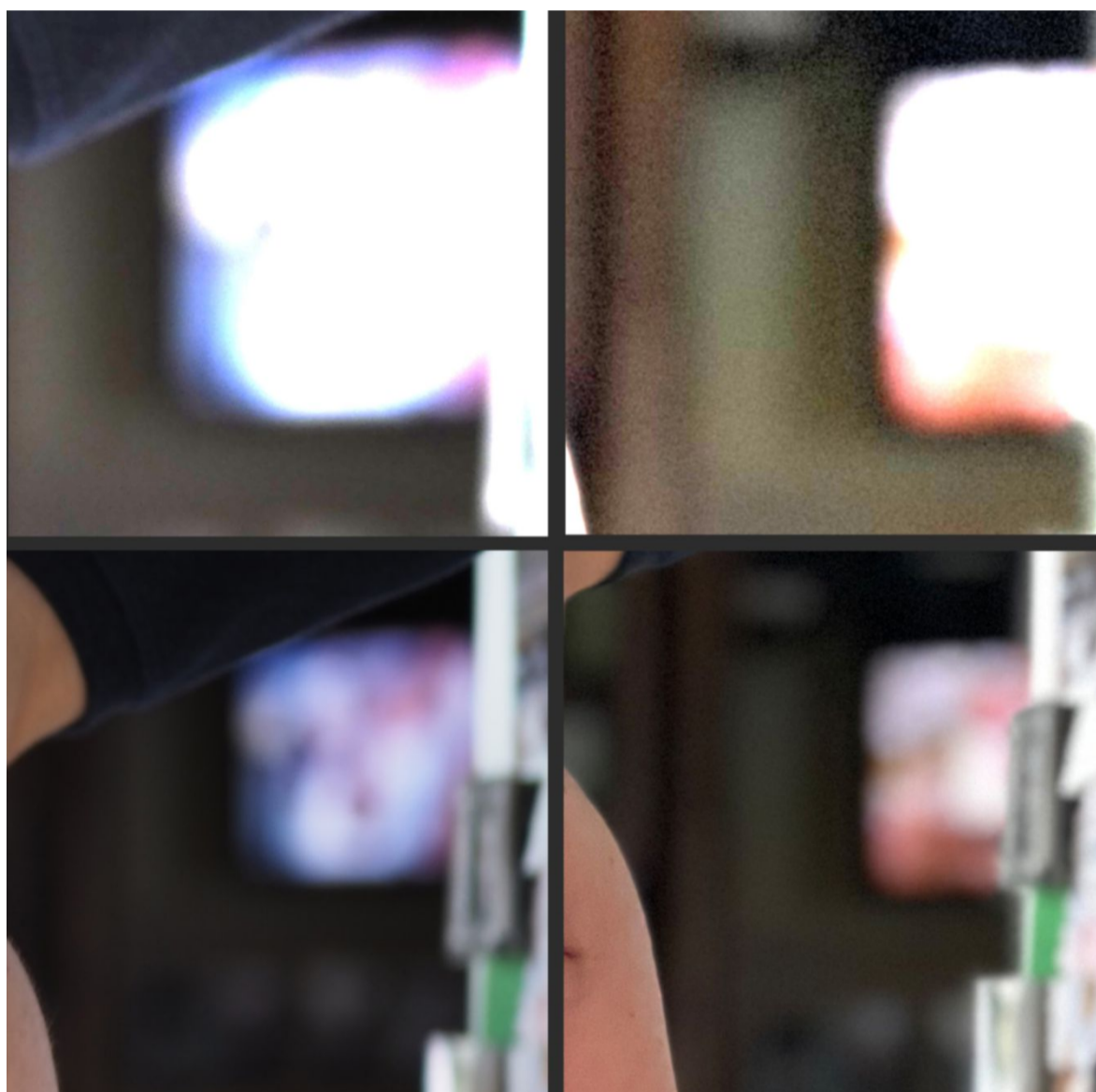
**Indoor photo taken  
with the iPhone 8  
Plus**



**Indoor portrait taken  
with the Olympus Pen  
E-PL9**

## INDOOR PORTRAIT

On the iPhone 8 Plus, I shot the images using Portrait mode, which artificially blurs the background and simulates the type of bokeh you'd get on an interchangeable-lens camera such as the PEN E-PL9. I then exported it and did some minor adjustments to the JPEG in Photoshop. For the Olympus image, I captured both a RAW image file and a fine-quality JPEG, but for this test, I used only the JPEG.



Composite image:  
details of both indoor  
portraits

The tones in both indoor portraits look good. But when you get closer, you can see some problems with the iPhone image. This composite image above shows details of both indoor portraits, in which I cropped in on the section just above my son's left shoulder—the television set and entertainment center. In the top two photos, the Olympus detail (left) looks clean, but you might notice a bit of noise in the image taken on the iPhone (right). However, the tones are dark and disguise the amount of noise. In the two lower images, in which I dramatically increased the exposure in Photoshop, you can see a noticeable amount of noise in the iPhone image (right). In contrast, the Olympus image is still quite clear and noise-free (left).



## **OUTDOOR PORTRAIT**

Another way advanced cameras such as mirrorless and D-SLRs have stood apart is that they can shoot RAW files. These have been called “digital negatives,” since they let you capture an image that isn’t processed inside the camera—unlike a JPEG, which is a compressed file format. You can manipulate a RAW file in Photoshop to truly maximize the photo’s dynamic range and minimize image noise and other artifacts that degrade image quality.

In the past few years, though, many phones, including a number of new iPhones let you capture RAW files. (Strangely, you need to download a third-party app such as ProCam or Manual to shoot RAW files on any iPhone.)



**Outdoor portrait  
taken with the iPhone  
8 Plus**



**Outdoor portrait  
taken with the  
Olympus PEN E-PL9**



Composite image:  
outdoor portrait  
details in shadow

For my outside portraits, I shot my subject with his back to the open front door to my house. I placed a vase with yellow tulips in the dark interior of my living room, about 6 feet from the front door. When I took the photos, the interior was underexposed—not surprisingly, the shadows swallowed up all the details. In the composite image above, the left-bottom photo was taken with the Olympus PEN E-PL9 and the right-bottom photo with the iPhone 8 Plus. Each top image has cropped-in details of the image below it. In both cases, I adjusted the exposure and other settings to reveal details in the doorway section. The iPhone did a decent job in recovering the detail in the shadows, but the Olympus does a better job of restoring some of the color of the tulips.

## DO WE HAVE A WINNER?

What my test reveals is that although the iPhone's on-board software does an exceptional job of mimicking features such as shallow DOF, it can't completely compensate for it in low-light settings, and it will inevitably introduce noise. And a large lens paired with a large sensor captures more visual information than a small lens and tiny phone sensor can.

But for the most part, the iPhone 8 Plus did a good job of keeping up with the Olympus PEN in tonal quality, color, and dynamic range. And of course, it's the kind of camera most people are likely to have with them when unexpected photo ops present themselves. That fact alone brings this contest closer to a tie.



# How to Sell Your Photos Online

BY ERIC GRIFFITH



**S**martphones have convinced us all that we're photographers. So it's only natural to wonder whether your phone photos—or those you shoot on a digital camera, of course—could put a little money in your pocket.

I'm not talking about active photography jobs, like shooting weddings, sports, food, fashion, babies, or tech products; leave that to the pros. I'm talking about passive income, where you monetarily benefit from pictures that would otherwise just be languishing in digital storage. The best way to earn that kind of cash is to sell your images as stock photography.



## WHAT IS STOCK PHOTOGRAPHY?

Stock photography has been around since the 1920s, providing photos for all sorts of media: print publications, newsletters, websites, you name it. Generally, customers pay a fee for a license to use a stock image, from a few cents to several hundred dollars. Back in the day, this was a lot cheaper than having photographers on staff, with all the overhead they'd need for developing photos—unlike today, when you take a shot and can edit it in seconds. Nowadays, all the stock photography providers are online.

While there are several major stock-photography suppliers—Getty Images is the 800-pound gorilla in this space—there are also plenty of what are called microstock outlets. The latter are hungry for new content, and that's where you come in. When a microstock agency accepts your images, it then markets those images. And when someone wants to use one of your photos, they pay the agency. You get a share of that—sometimes a hefty share, when the terms are right.

It takes some work to upload images to sites; you have to send one image at a time along with all the pertinent metadata. And the more images you offer (that are accepted), the more success you can realize.

Are you going to make millions? Unlikely, unless you're the best of the best, in which case you'd already be doing gallery openings and shooting magazine covers. You probably won't make enough even for coffee once a month. On sometimes people do get lucky with a single shot. The cofounder of Photerloo (a web service for uploading your images to multiple sites at once) offered some stock pics a few years ago and started making \$100 a month—one photo in particular garnered \$4,000. But it took 6,000 licenses of the image across five different microstock sites to reach that amount, because licensers spend only around 20 cents to \$5 to use the shot.



**Customers pay a fee for a license to use a stock image, from a few cents to several hundred dollars.**



You won't know whether you'll have similar luck until you do the work and upload some shots.

## TIPS FOR TAKING STOCK PHOTOS

**1. Don't take stock photos.** In other words, treat every shot like you're a pro trying to make the image of a lifetime—that is, take it seriously. You can't prognosticate what the microstock sites or their clients will want except that it's generally going to be commercial in nature.

**2. Keep it generic.** Stock shots can't contain brands and logos—owners of copyrights or trademarks may also want to get paid.

**3. Get model releases.** Written consent from living people in your photos is a must. No one wants their photo to become a worldwide commercial phenom and then have someone in the photo—even if it's Cousin Gertrude—sue for a cut. (You don't necessarily need this if you're shooting in public, but it can't hurt. Some microstock services will ask not only for photo releases but also for property releases.)

**4. Stick to microstock sites you like.** If you have success with one image, chances are the people using it will look at the rest of your photos on that site.

**5. Keep keywords simple.** Enough said.

**6. Shoot at full size.** Stock sites prefer to offer multiple size options to customers—they can charge more for larger, high-resolution images. Make sure your device is shooting at the largest size possible. With digital cameras, that's usually an uncompressed RAW image.





**7. Don't filter.** People want professional-quality images. If they need any Photoshoppery, they're paying for a license to do that themselves.

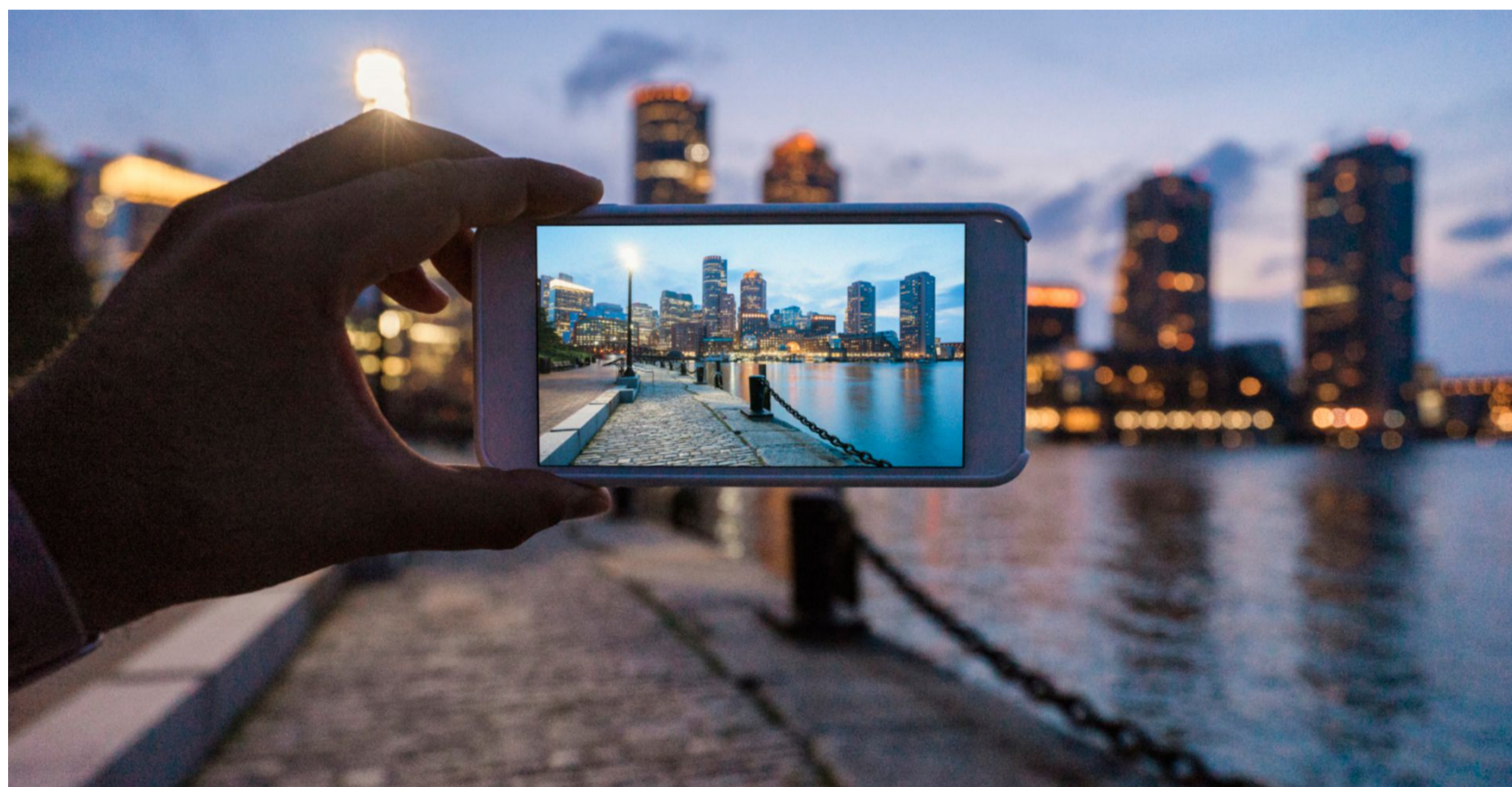
**8. Get used to rejection.** The sites are not likely to accept every photo you offer. But check out a microstock site's offerings before you upload your photos so you can cater to what they sell.

**9. Consider an equipment upgrade.** While some microstock sites are happy to accept iPhone or Galaxy shots and even provide apps to help make that happen, not all will—especially big-name services such as iStock. They prefer pro-quality shots taken with pro-level cameras.

## WHERE TO SELL YOUR PHOTOS

**Foap:** Sweden-based Foap wants your smartphone photos. While it'll sell to anyone, even big enterprises, the goal is to use the Foap apps for iOS and Android to get you to become a contributor earning some of that passive cash. The commission is 50 percent for each photo licensed.

**Adobe Stock:** Naturally, Adobe has a home for stock photos. In fact, using your Adobe ID, you can upload images to Adobe Stock directly from Adobe products including Lightroom, Bridge, and Premiere, as well as via the website. It's also open to vector images, illustrations, and even video. You get a 33 percent commission on each sale, 35 percent for videos, and can request a payout via PayPal when your account hits \$50; but your fee is substantially smaller when the customer buying the image has a subscription. Anything you contribute to Adobe Stock is also found at Fotolia.





**Alamy:** This site offers over 122 million images, videos, and vector art, with prices starting at \$19.99 for a license. It also offers great terms to stock photographers: You get 50 percent of sales even for non-exclusive images. Alamy says it has paid out \$180 million to contributors around the globe. It also says it “want(s) everything you’ve got” as it tries to keep the catalog very broad for customers—but it does claim to prefer D-SLR camera images or the “equivalent.” That equivalent has become at least an iPhone; it does accept iPhone image via its Stockimo app. It won’t reject your images based on content (within reason). Once an image is sent to Alamy and processed, you put in captions and keywords, and people can start buying.

**Can Stock Photo:** Another site with a nice commission, Can Stock Photo pays you 50 percent on licenses sold, with lots of other payment options for different-size images (and different video resolutions) and depending whether the buyer has a subscription. You have to sign up and apply to be approved as a contributor first—that means sending your three best images as an audition. Once your account hits \$50, you can request a payout to PayPal. All images also show up on Fotosearch; a sale there shows up in your Can Stock Photo account.

**EyeEm:** An international photo community, EyeEm (pronounced “I am”) uses artificial intelligence to pick imagery to sell—it has about 70 million images. Since its launch, EyeEm has embraced smartphone photography, and it has apps for iOS and Android to be used for inspiration and uploads. Submissions have to be reviewed, which reportedly could take as long as a few weeks; the AI looks for the shots with the most commercial potential to grab first. You always get 50 percent of the revenue on a photo, which sells for anywhere from \$20 to \$250 depending on the license needed. Payouts come to you via PayPal.

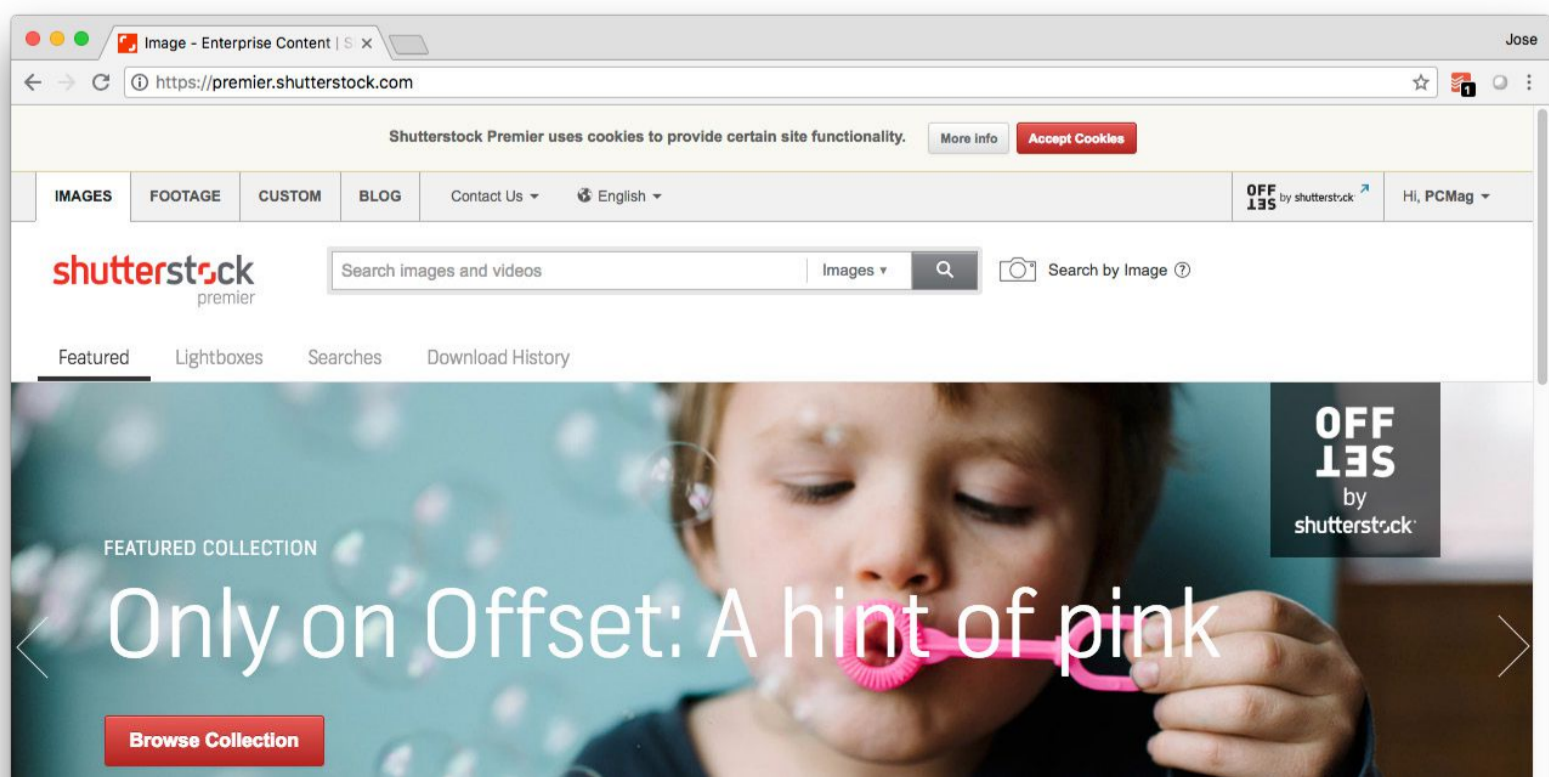
**Dreamstime:** This is another site that’s actively pushing to increase its stock catalog, now at 71 million images, with smartphone shots. Dreamstime offers apps for iOS and Android for both uploading (Companion) and for licensing photos as well as videos for use. You can earn up to \$12 per photo license—that’s with a royalty that can vary from 25 to 50 percent. For Dreamstime exclusives, you get 60 percent plus 20 cents for the first 100 submissions accepted. Payouts are made when your account accrues \$100. Dreamstime is also the provider of images for Google Ads; if your art is used by it, you get \$2 per non-exclusive image and \$2.20 for exclusive photos.

**Crestock:** The little-known Crestock couldn't make it any easier. Create an account, upload your images via the web or FTP, and await approval to become part of the market. The royalty rate varies depending on how many downloads you've achieved. When you're under 249 downloads, you get 20 percent for a single image license, or 25 cents if sold to a Crestock subscriber. It can go as high as 40 percent and 40 cents, respectively, if you manage to get over 10,000 downloads. You're paid via PayPal once your account goes over \$50, pretty much the standard.

**Shutterstock:** Shutterstock is big: It's paid out \$500 million to contributors since it opened, with about 180 million images, clips, vectors, and even musical tracks that licensees can use royalty-free. But it's hard to get in—supposedly only about 20 percent who try get past the reviewers. Those who do can upload via a browser (for images under 50 megapixels) or FTP, tag the image with metadata and keywords, attach release forms (definitely required for nudity/R-rated content, which is allowed), then wait for approval of each image, and sales. Earnings are a little complicated, but the more you earn for lifetime earnings on the service, the more your royalty payment is.

**123RF:** This stock photo/vector/video/sound site makes it pretty easy to start earning 30 to 60 percent commissions (it depends on your level, from 1 to 10, with 1 being the newbies), without being exclusive. The more images you add, the higher your level can get. Payment comes via PayPal and some other services.

**Stocksy:** Stocksy wasn't always open to submissions of pictures and video, and it takes only a few new contributors a year. But for those who get in, Stocksy offers what might be the highest royalty for photographers, 50 to 75 percent—



but that does require exclusivity. And Stocksy is pushing to get more art from Asia, the Middle East, and Europe, but not so much from the Americas. Apply with a minimum of 25 images or 10 videos with all keywords and model releases in place to get started.

**Pond5:** You get a pretty fair shake at Pond5, with a 50 percent commission. And you'll have a good chance at sales, since it's available in 150 countries. The site offers more than just stock photos; it also offers stock sound effects, music, video, templates, and even 3D objects. Uploads happen over the browser or via FTP; or when you have a lot of media, you can mail them a hard drive. All media has to be accepted and curated, even after you add descriptions and keywords/metadata. The payout happens only when you hit at least \$25 via sites including PayPal and Payoneer, or \$100 if you want a mailed check.

**Visual Society:** If you'd prefer to sell your photos yourself, you can build a personalized stock-photo site using Visual Society; plans start at \$5 per month. You keep a full 90 percent of those sales, minus the credit card processing and so on.



**Stocksy is pushing to get more art from Asia, the Middle East, and Europe, but not so much from the Americas.**





# How to Transfer Photos From Your PC to Your Mobile Phone

BY LANCE WHITNEY



**Y**ou may already have a method for sending photos from your mobile phone to your computer, but what about the reverse trip? Perhaps there are photos on your computer that you want to use as phone wallpaper, or maybe you want to copy certain personal photos from your PC to your phone.

On the iPhone, you can set up a specific folder for photos and use iTunes to make the transfer. For Android devices, you can copy the photos directly to your phone or via an SD card through File Explorer or Windows Explorer. You can also sync the photos using an online photo storage site such as Google Photos, which also works on iPad and Android tablets.



## USING AN IPHONE

With an iPhone, you can tap into iTunes to copy photos from a specific folder on your computer to your phone. Each time you run a sync, the photos from that folder are placed on your phone, where you can access them from within the Photos app.

First, open File Explorer or Windows Explorer. Create a new folder to store the photos you want synced from your computer to your iPhone. In my case, I created a folder called Photos for iPhone in my Pictures folder.

Then copy the photos you want to sync to your phone to your new folder.

Open iTunes and connect your phone to your PC. In iTunes, click on the icon for your phone.

In the Settings section for your phone, click on the entry for Photos. At the Photos screen, check the box to Sync Photos. By default, the location will point to your entire Pictures folder. Click on the drop-down box that says Pictures and select Choose Folder.

At the File Explorer or Windows Explorer window, browse to and click on the folder that contains the photos you want to sync and then click on the Select Folder button.

When you're ready to sync, click on the Apply or Sync button at the bottom of the screen. Wait for the sync to complete.



Open the Photos app on your iPhone. If you're in Albums view, tap on the icon at the bottom for Photos. Swipe through your photos from earliest to latest, and you should see the photos you synced.

The dates of the synced photos are based on the dates on which you saved or downloaded them on your computer, so you may have to scour your entire Photos library to see all the synced photos. That's why I created a special album on my iPhone to organize my synced photos.

To do this, click on the Albums icon and then click on the + button at the upper left. Type a name for the album and then tap Save. Now browse through your photos and tap on the ones you want to store in this album. Tap Done. Open your new album, and you'll see all the synced photos. You can then set up one of the photos as your wallpaper.

## **USING AN ANDROID PHONE**

To transfer photos from your PC to any Android phone, plug your phone into your computer. You may need to connect your phone as a media device so that Windows can access its files.

To do this, swipe down from the top of the screen and tap on the notification for USB connection or USB options. At the USB connection screen, select the option to connect as a media device. Swipe down from the top again, and the same notification should now let you know that your phone is connected as a media device.





Open File Explorer or Windows Explorer and segue to PC view to see all your drives and devices. Double-click on the icon for your Android phone.

Keep drilling down through the folders on your phone until you open the one for Pictures. Now open a second Explorer window and navigate to the folder that contains the photos you want to copy to your phone. Select the photos you want to transfer. Then copy and paste them or drag and drop them into the Pictures folder on your phone.

Segue back to your Android phone. Let's say you want to set up one of the photos as your new wallpaper. Press down on any empty area of the screen until you see the icon for Wallpapers. Tap on that icon. At the wallpaper setup screen, tap on the entry for My photos or From Gallery. Swipe through your photos, and you should see the ones you copied. Tap on the one you want to use as your wallpaper and then tap on the option to Set as Wallpaper.

### **USING A MICRO-SD CARD**

If your phone has a micro-SD card slot, you can use an SD card to transfer photos from your PC to your phone. Plug your micro-SD card into your computer using the SD card adapter. Open File Explorer or Windows Explorer and copy the files to your SD card.



**If your phone has a micro-SD card slot, you can use an SD card to transfer photos from your PC to your phone.**



Remove the SD card and insert it back into your phone. Hard tap on the screen, and tap the Wallpapers icon. Tap the entry for My photos or From Gallery. Tap on the Hamburger icon to access the Open from menu. Tap on the entry for your SD card. You should now see the photos you copied. Tap on the photo you want to use as your wallpaper.

Finally, you can also transfer photos from your PC to your iPhone or Android phone using an online storage site. I'll use Google Photos for this example, but any site accessible from your PC and your mobile phone should do the trick. Upload the photos you want to use on your phone from your PC to Google Photos.

Add the new photos to an album.

Open the Google Photos app on your phone and navigate to the album with the photos you uploaded. Tap on a specific photo. You can then download that photo to your phone to use it as wallpaper or just add it to your mobile photo library.



**You can also transfer photos from your PC to your iPhone or Android phone using an online storage site.**



# 10 Quick Tips to Fix Your Bad Photos

BY JIM FISHER



**D**igital photography has democratized the medium. More people are taking more photos than ever before, and they're sharing their shots online with friends and family. It's easy to place the blame on the camera (or your smartphone) when your images aren't as nice you'd like. But by following a few guidelines, you can improve the quality of your snapshots without having to shell out big bucks for a new camera. Keep these easy tips in mind next time you head out to capture the world around you.





## 1. GET BASIC COMPOSITION DOWN

The heart of a photograph is its composition—the position of different elements in a frame. The easiest rule of thumb to learn and remember is the “rule of thirds.” Basically, you break your frame into nine squares of roughly equal size. Try to align the subject of your photo along these lines and their intersections, and imagine the main image divided over these nine boxes. This gives you a more dramatic and visually interesting shot than one where your subject is dead-center. Many cameras and smartphones have a rule-of-thirds grid overlay that you can activate when shooting.

## 2. ADJUST EXPOSURE COMPENSATION

When you aren’t shooting in full manual mode, your digital camera is making decisions that determine the exposure of a photo—in English, how light or dark the shot appears. Generally, a camera looks at a scene and tries to determine the appropriate exposure based on the correct lighting of a gray card, which is why there are special scene modes for snow—without them, the camera would try to make the white snow gray.

If a photo is too light or dark, you can either delve through the dozens of scene modes that are available in modern point-and-shoot cameras or simply add some exposure compensation. Many cameras have a physical button or dial for this, identified by a +/- symbol. If your photo is too dark, move the scale up above zero; if too light, move it down a bit.





### 3. CHOOSE THE RIGHT MODE

Your camera is likely to have scores of shooting modes, ranging from fully automatic operation to modes for very specific scenes. When you're shooting fast action, you can put the camera into Shutter Priority ("S") mode and increase the speed at which a photo is taken. Setting it to 1/125 second or faster will help to freeze action, and for really quick subjects (such as the hummingbird, above), use as short a speed as possible to freeze motion or a slower speed to add motion blur to the flapping wings.

In lower light, you can use Aperture Priority ("A") mode to make sure as much light is entering the lens as possible—or when you're shooting landscapes on a tripod, you can close the lens's iris to increase depth of field, keeping everything in sharp focus from the foreground to the horizon. D-SLR shooters are more likely to use A or S modes; whereas users of point-and-shoot cameras will often find more specific modes that cater to activities such as sports, low-light use, and landscape shooting.

### 4. THINK ABOUT LIGHTING

Pay attention to how much light you have and where it's coming from when taking photos. When you're shooting outdoors, be careful not to take photos of a person when the sun is at their back, unless you want to make a portrait with some dramatic flare (make sure to dial in positive EV adjustment if you do). When you're grabbing a photo in front of a monument or landmark and you want to make sure it's not overexposed, use fill flash to make your backlit subject as bright as the background. You may have to manually activate the flash, as there's a good chance that the camera will think that it's unnecessary on a bright day.

## 5. USE YOUR FLASH WISELY

Many a photo has been foiled by a flash firing too close to a subject. If your friends and family look like Casper the Friendly Ghost when you photograph them, chances are that you're too close when snapping your photos. To activate the flash, back up a bit and zoom in to get the proper framing. If things are still too bright—or too dark—check whether flash compensation is an option. Many cameras allow you to adjust the power of the flash, which can help to add better balance to your flash-assisted photos. Adding just a little bit of light makes it possible to fill in shadows, resulting in a more natural-looking photo.

## 6. CHANGE YOUR PERSPECTIVE

Most snapshotters and beginners will take all their photos from eye level. While this is fine for many images, it's not always ideal. A camera with a tilting screen lets you more easily shoot from a low or high angle to get a different perspective on your subject.

If you don't have a tilting LCD, think about getting down low to the ground to get the best shots of pets and toddlers—you'll want the camera at their eye level to get an image that stands out. Play around with different angles and camera positions until you've found one that captures a moment and stands out from the crowd.



**Many cameras let you adjust the power of the flash, which can help to add better balance to your photos.**







## 7. WATCH YOUR WHITE BALANCE

Your camera will try to set white balance automatically, based on the type of light in which you're shooting. Different light casts different types of color—sunlight is very blue, tungsten lighting is yellow, and fluorescent is a bit green. In many cases, the camera automatically detects what type of lighting you're under and adjusts the color in photos so that they look natural.

But when the white balance isn't right, you can get results like you see above—the image on the left is correctly balanced, and the one on the right is way off. When you're shooting under mixed lighting, or when the camera is having a hard time figuring things out, you can set the white balance manually. On most point-and-shoots, you'll have to dive into the shooting menu to adjust this, but many D-SLRs have a dedicated white-balance button, often labeled "WB." You can correct color in the Mac or Windows photo-editing apps later on, but you'll get better-looking photos when you get the white balance right in the first place.

## 8. USE A TRIPOD OR MONOPOD

Sometimes, the best way to get a perfect shot is to take some extra time. Using a tripod lets you set up framing and can come in handy—along with your camera's self-timer—for getting that photo of you and the kids in front of Mount Rushmore. You can get away with an inexpensive tripod when you're a point-and-shoot user, although spending a bit more on a brand such as Manfrotto or MeFoto results in much less frustration than you'll encounter with bargain brands. D-SLR users should definitely put care into selecting a tripod, as a set of legs and a head that are sturdy enough to hold the camera are paramount.

When you're more of a run-and-gun shooter, a monopod—which is just what it sounds like, a tripod with two of its legs missing—will help you stabilize your shots. Great for use at zoos and sporting events, a monopod plus your two legs add stability to your camera without the sometimes cumbersome setup and breakdown required by a good tripod.

## 9. BE SELECTIVE

It's easy to take hundreds of photos in a few hours. But don't just dump your memory card's contents and upload all the images to Facebook. You should spend some time going through your photos so you can eliminate redundant shots and discard photos that may be out of focus or poorly composed. It's better to post just a few dozen great photos than to display them among hundreds of not-so-good ones.

## 10. DON'T FORGET TO POST-PROCESS

Consider using software to organize and edit your photos. Apple Photos and Microsoft Photos support basic organization and offer a number of editing tools. If you're more of a phone editor, check out the VSCO or Snapseed apps.

Performing some very basic editing on a photo can help improve its quality dramatically. Cropping can help with composition, and you can also rotate a photo so that horizon lines are straight. Getting perfect photos in-camera is a lofty goal; there's no harm in a bit of retouching.



## 3 Tech Ideas That Need to Be Shelved (for Now)

**T**here are three bad tech concepts trying to take hold in society, and the single culprit that will bring them all down is obvious to anyone in tech: hackers. Until the problem of wayward individuals penetrating and disrupting these systems is solved, there is no reason to release them. Can they be made hacker-proof? Yes, but not anytime soon.

### THE CASHLESS SOCIETY

The rationale for going cashless is obvious—it can reduce contraband and the illicit drug business. More important, taxation authorities have more control over collection. But a cashless society is a laughable expectation; we saw hints of its destruction in the European Union when Visa's network went down for hours.

You'll realize that the cashless society is a problem when you remember that during the Soviet era, there was a rigid monetary system that required you use rubles for everything. All the while, a second, illegal monetary system that used US currency flourished. That system was supposedly in place for non-Russians but became a black market for Russians. If a parallel system can appear within a ruthless structure, think of what is possible elsewhere.

Then there's the hacker who can make fake smart cards full of money. No system has been shown to be perfectly secure. Combine that with the never-ending problem of hackers bringing down the internet, and you have chaos. People would be



unwise to encourage this. Look what happened recently when an airline computer went down.

### **VOTING OVER THE INTERNET**

Discussions about voting over the internet emerge each election cycle and then are beaten back by reality. Internet voting would supposedly benefit society by making voting easier. Unfortunately, it also invites fraud. Despite all the advances in technology over the years, a good old paper trail is probably still the easiest way to keep tabs on votes.

### **THE DRIVERLESS CAR**

There's a laundry list of good reasons for this technology to take off. It will save lives, minimize congestion, and change society in many positive ways. But the technology has roadblocks, not the least of which are sabotage and hackers.

We've already received reports that most modern cars can have their driving systems hacked in murderous ways. The driverless car has to be even more susceptible to onerous hacks that could easily take control of a car, lock the doors, and drive you off a cliff. That sounds paranoid, but remember that in the US alone, there are about 43 murders a day. Done right, this looks like an easy way to get away with it.

But beyond using the driverless car as a tool to commit the perfect crime, hackers should have a field day with the subsystems that control navigation. The problem with the driverless car has never been with the car's ability to turn left and right and stop and go, it's been with its inability to perfectly determine what the signage says and whether it is in the right lane or not.



**The driverless car has to be even more susceptible to onerous hacks that could easily take control of a car.**



Studies have shown far too many instances of misinterpretation of simple signs—when someone has put a sticker on a stop sign, for example. And there are too many instances in pothole-riddled California of confusing lane markers. Too often, the self-driving mechanisms fail in these situations. And I can imagine some vandal at night painting misleading strips on a highway to see what happens to a driverless era.

There are all sorts of other reasons I do not like these technologies and ideas, but the one common denominator—hackers and vandals—leads the concerns you should have. And these disruptive folks are not going away.

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