December 2020
Vol. XXXL, No 11

KEYSTONE MacCentral

printout

Keystone MacCentral Macintosh Users Group ❖ www.keystonemac.com

December Meeting

Eric Adams is inviting you to a scheduled Zoom meeting.

Keystone MacCentral December Program

Dec 15, 2020 06:30 PM Eastern Time (US and Canada)

Join Zoom Meeting

https://zoom.us/j/94163031133?pwd=UVg3NmUyeVQ5OXAvWlB4ZDhsQm5DUT09

Meeting ID: 941 6303 1133

Passcode: 959632

This is our December meeting: we have our annual Christmas party this month. That being said, it will be a virtual party with virtual chili this year. Dress up in festive clothes or hats. We will discuss podcasts, VPN (*Using a VPN to connect to the internet allows you to surf websites privately and securely as well as gain access to restricted websites and overcome censorship blocks*), and maybe even a video about Apple's new M1 chip.

Our meeting are virtual meetings via Zoom
on the third Tuesday of each month (except during summer).
Just click on the link at the designated date and time.
The invitation will be sent out prior to each meeting.

Contents

By Adam Engst & Josh Centers

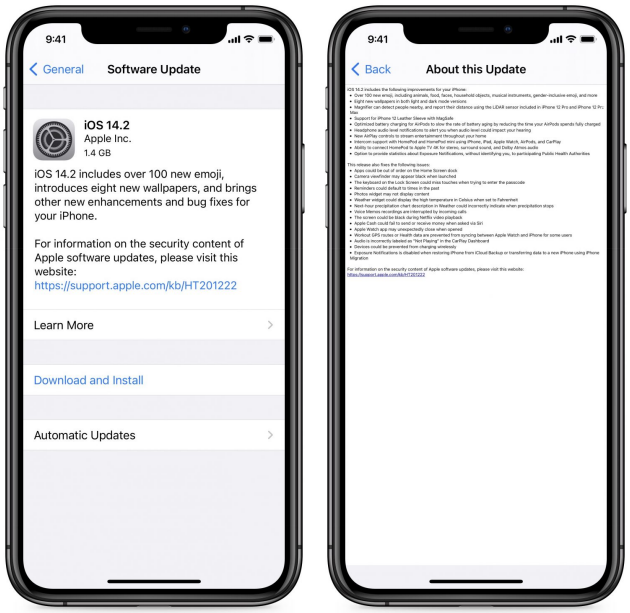
Apple Releases iOS 14.2, iPadOS 14.2, watchOS 7.1, HomePod Software 14.2, and tvOS 14.2

In what may be the final feature releases of Apple's non-Mac operating systems before the end of the year, the company today rolled out iOS 14.2, iPadOS 14.2, watchOS 7.1, HomePod Software 14.2, and tvOS 14.2. Although none of the new features are ground-breaking, many fill in small integration gaps in the overall Apple ecosystem.

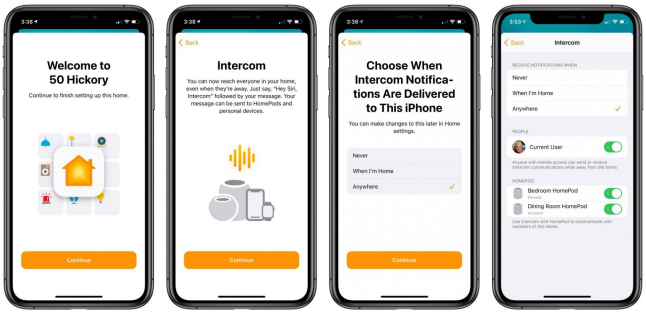
Although we generally encourage caution when it comes to installing updates, you should plan to install the iOS, iPadOS, and watchOS updates soon because they address three serious security vulnerabilities that are being exploited in the wild. The HomePod Software and tvOS updates will install on their own in a bit; the only reason to install them manually is if you want their new features right away.

iOS 14.2

With a release just ahead of the new iPhone 12 mini and iPhone 12 Pro Max, along with the HomePod mini, all of which became available to order on 6 November 2020, the new iOS 14.2 is packed with updated features. Most notable among them is the promised support for Intercom for the iPhone, iPad, Apple Watch, and CarPlay—at its launch in HomePod Software 14.1, Intercom worked only with HomePods (see "Apple Releases iOS 14.1, iPadOS 14.1, HomePod Software 14.1, and tvOS 14.0.2," 20 October 2020).



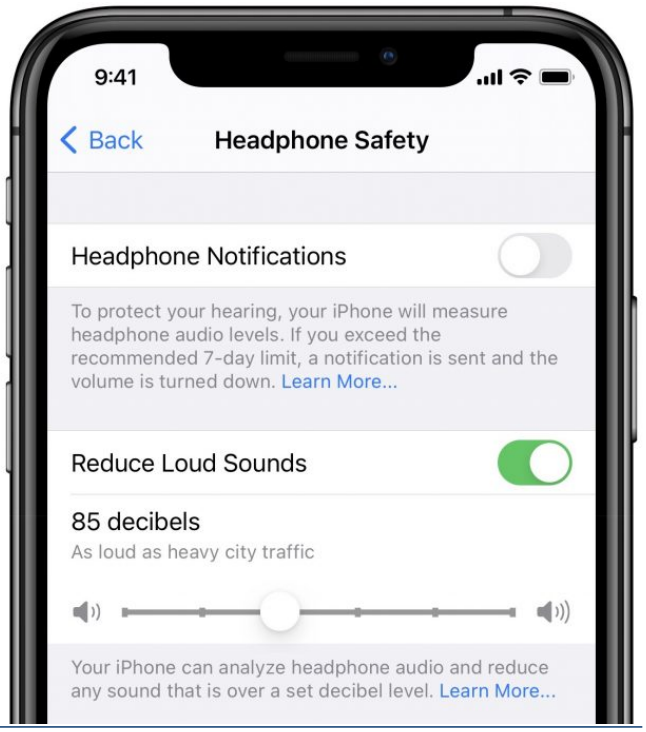
To use Intercom on an iPhone, you must first enable it in the Home app. The Home app will prompt you to set it up when you next launch it (the first three screenshots below), so you can learn the necessary Siri command and set when Intercom notifications are delivered to the device you're using. You can also adjust this setting (and avoid using certain HomePods) by tapping the Home icon in the upper-left corner, choosing Home Settings from the menu, and then tapping Intercom (the rightmost screenshot below).



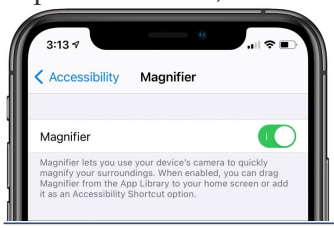
Once everything is set up, you can ask Siri to "tell" or "Intercom" along with your message. If you give Siri a destination HomePod or other device, only that device will get the message; otherwise, it will be broadcast to all devices in the "home." You can also tap the new Announce icon in the upper-right corner of the Home app. You'll be prompted to record your message. Tap Done when you're finished.

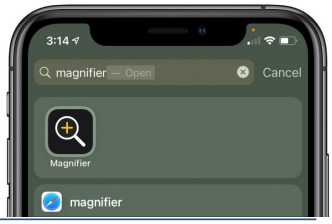
Other features in iOS 14.2 include:

- Window dressing: iOS 14.2 includes over 100 new emojis, including new animals, ninjas, food, and faces, and it adds eight new wallpapers in both Light and Dark Mode variants. You can find them in Settings > Wallpaper > Choose a New Wallpaper.
- Loud headphone alerts: iOS 14.2 alerts you if your headphones are too loud and might damage your hearing. You can find this setting in Settings > Sounds & Haptics > Headphone Safety. There are two settings: one for Headphone Notifications and another for Reduce Loud Sounds, which analyzes headphone output and reduces any sounds over a decibel level you specify.



- People recognition in Magnifier: The Magnifier feature can use the LiDAR sensor in the iPhone 12 Pro and 12 Pro Max to detect nearby people and report how far away they are. Steven Aquino explained the utility of the feature to blind and low-vision users in Forbes. To use Magnifier in iOS 14, you first need to enable it in Settings > Accessibility > Magnifier. Previously, you had to access it from an Accessibility Shortcut, but a Magnifier app now appears in the App Library. (See "iOS 14's App Library: The FAQ," 9 September 2020.)

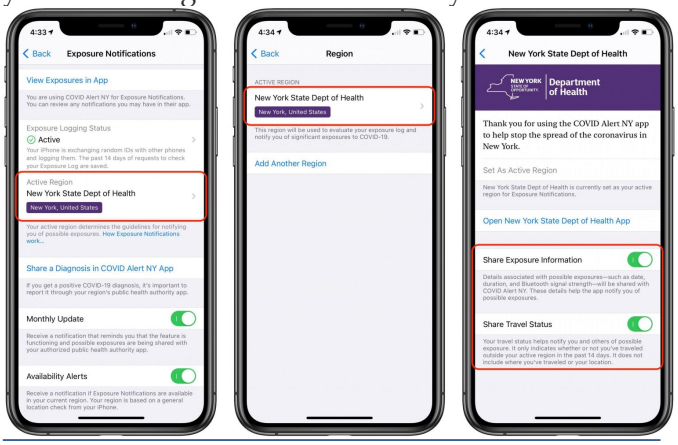




- Improved HomePod / Apple TV audio: We're not sure why this is in the iOS 14.2 notes, but if you connect a HomePod to an Apple TV, you can now get surround and Dolby Atmos audio output, which should be a substantial improvement.
- iPhone 12 Leather Sleeve with MagSafe support: The update adds support for this upcoming case

from Apple, though we're not entirely sure what it entails.

- Optimized AirPods charging: As it has done with the iPhone and Apple Watch, Apple has tweaked AirPods charging to lengthen the lifespan of the battery. (We presume iOS 14.2 includes a firmware update for the AirPods.)
- COVID exposure notifications statistics: You can elect to provide these exposure notifications to local public health authorities, without exposing your personal information, along with the fact (but not the location) that you've traveled outside your active region in the last 14 days.



The iOS 14.2 update also fixes a number of issues that could:

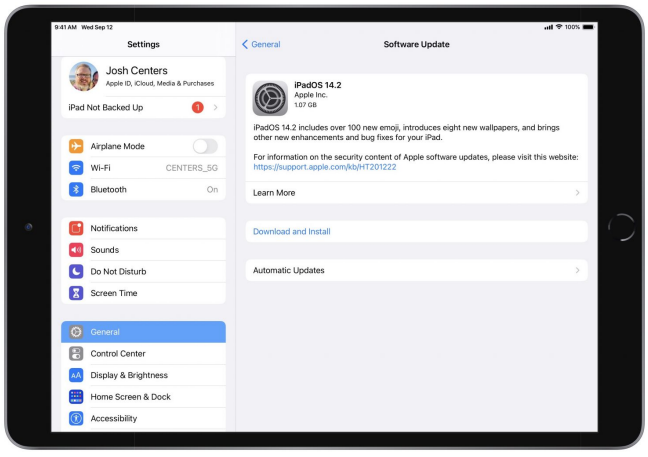
- Throw apps out of order on the Home screen dock
- Black out the Camera viewfinder when launched
- Make the Lock screen passcode keyboard miss touches
- Cause Reminders to default to past times
- Make the Photos widget fail to display content
- Have the Weather widget display Celsius even when set to Fahrenheit
- Cause the next-hour precipitation chart in Weather to be wrong
- Let Voice Memos recording be interrupted by incoming calls
- Black out the screen during Netflix video playback
- Cause Apple Cash payments to fail when invoked through Siri
- Crash the Watch app
- Prevent Workout GPS routes and Health data from syncing between iPhones and Apple Watches
- Show Not Playing in the CarPlay Dashboard even when audio is playing
- Keep devices from charging wirelessly
- Disable Exposure Notifications when restoring an iPhone from backup or using iPhone Migration to set up a new iPhone

The iOS 14.2 and iPadOS 14.2 updates share 24 CVE entries detailing security fixes, three of which are being exploited in the wild.

You can download the iOS update, which weighs in at 1.4 GB on an iPhone 11 Pro, in Settings > General > Software Update, through the Finder in macOS 10.15 Catalina, or using iTunes in earlier versions of macOS.

iPadOS 14.2

As usual, iPadOS 14.2 gets a subset of the changes in iOS 14.2, except for two camera-related improvements aimed solely at the recently released fourth-generation iPad Air.



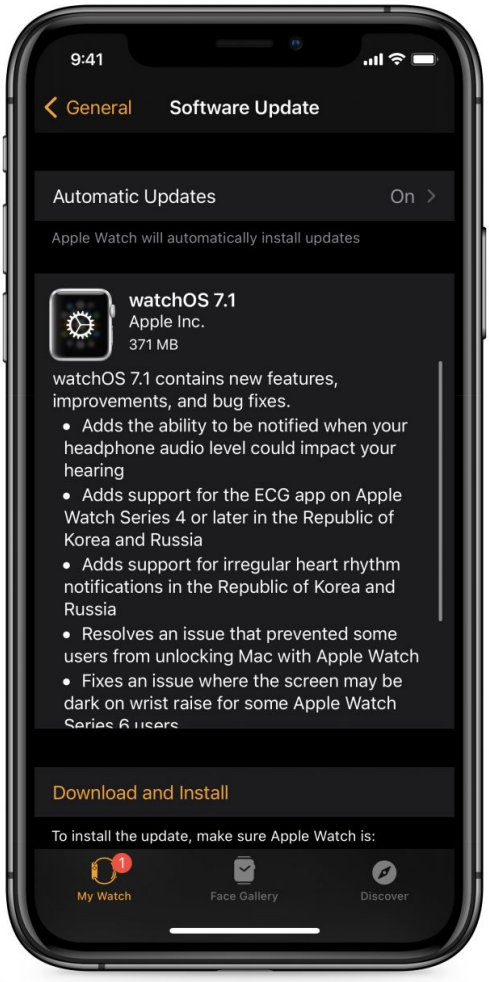
- Scene Detection in the Camera app uses intelligent image recognition to identify objects within a scene and automatically improves the photo.

- Auto FPS in the Camera app automatically reduces the frame rate when recording video to improve low light capture and optimize file size.

These improvements fall squarely into the "Huh, that's nice" category, although we suspect it will be impossible to know when they're in play—photos and videos should just be a little better.

watchOS 7.1

Although the change list for watchOS 7.1 is short, there are a couple of bug fixes that may be particularly welcome. In terms of features, there's only one that's available to everyone: the option to be notified when your headphone audio could impact your hearing. Sadly, it's not your mother yelling at you to "Turn that music down!" Plus, Apple Watch users in the Republic of Korea and Russia gain support for the ECG app and irregular heart rhythm notifications.



More interesting are the two bugs that Apple says it fixed. One resolves an issue that prevented some users from unlocking a Mac using the Apple Watch, something that's particularly frustrating once you've become used to your Mac unlocking automatically. The other addresses a problem that made the screen dark on a wrist raise for some Apple Watch Series 6 users.

watchOS 7.1 is a 371 MB download for an Apple Watch Series 4. To install the watchOS 7.1 update, open the Watch app on your iPhone and go to My Watch > General > Software Update. Remember that the watch must be on its charger and charged to at least 50%

tvOS 14.2

Unusually, a tvOS update has actual new features that merit a mention in release notes. tvOS 14.2 lists two: HomePod home theater and support for the Apple One bundle of services (see "Apple Subscriptions Expand with Apple Fitness+, Apple One Bundles," 15 September 2020).

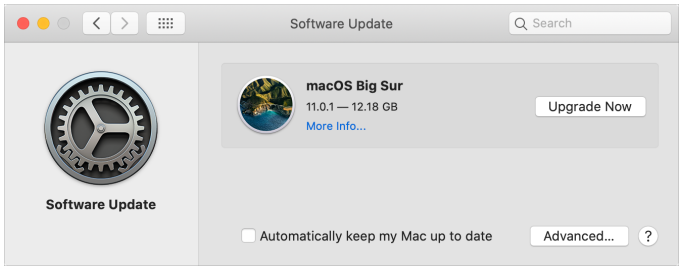
For those for whom an Apple TV 4K is a significant part of your home theater system, the HomePod home theater support will let you connect one or two HomePods to the Apple TV 4K to get stereo, surround sound, and Dolby Atmos audio. All you'll have to do is put your updated HomePod (or a HomePod stereo pair) in the same HomeKit room as your Apple TV using the Home app in iOS 14.2 or iPadOS 14.2. (The feature doesn't support the Apple TV HD or other AirPlay-2 enabled speakers.)

By Josh Centers

Big Sur Is Here, but We Suggest You Say "No Sir" for Now

As Apple promised, macOS 11 Big Sur launched on 12 November 2020. The actual release was version 11.0.1, skipping 11.0 entirely. We're curious to see if Apple's new M1-equipped Macs ship with 11.0 or 11.0.1.

The download weighs in at an eye-watering 12.18 GB. You can update directly from macOS 10.14 Mojave or macOS 10.15 Catalina from System Preferences > Software Update. You can also install Big Sur from the Mac App Store, which is the route you need to take if you want to put the installer on a USB thumb drive for a clean install or installation on multiple Macs without additional downloads.



Delay Upgrades to Production Macs

We advise everyone to delay upgrading production Macs for now. We always recommend delaying major macOS upgrades until Apple has had a chance to address early problems, and Big Sur has several big behind-the-scenes changes that are causing more headaches than usual.

Plus, there were numerous first-day reports of problems installing Big Sur, including failed installations and extremely slow downloads. Such issues aren't unusual with a new version of macOS, when Apple's servers are being hammered. With luck, Apple has already resolved the network problems that were likely at the heart of many of these issues.

The most concerning issue reported so far is that the Big Sur update is bricking many late-2013 and mid-2014 13-inch MacBook Pro models. Users are reporting black screens after the update, and none of the typical remedies—resetting SMC and NVRAM or booting in Safe mode or Recovery mode—are helping. Apple has escalated the issue to its engineering team, and the company is currently telling users to bring their MacBook Pros in for repair.

Also concerning, though not something that most people need to worry about, is a warning from Native Instruments, a manufacturer of professional audio devices, has warned that Big Sur could damage hardware.

Big Sur, Big Backup Problems

With 10.15 Catalina, Apple split the macOS boot drive into separate System and Data volumes, the former of which holds the operating system files and is typically read-only. Big Sur further secures the System volume by applying a cryptographic hash to every file on it, as Howard Oakley explains. That makes it incredibly difficult for an attacker to hijack your Big Sur install, but it has caused headaches for many apps, especially those that make (and restore) bootable backups.

The good news is that Mike Bombich, developer of Carbon Copy Cloner, has worked with Apple to resolve the issues. Carbon Copy Cloner 5.1.23-b1 includes full support for making bootable backups in Big Sur. However, we can't recommend upgrading to an operating system that requires a beta release to make bootable duplicates.

Similarly, Dave Nanian, the developer of the SuperDuper cloning utility, has said, "it's going to be a while" before SuperDuper works with Big Sur. He recommends waiting to upgrade or using Time

Machine, although Time Machine backups serve a different purpose than a bootable backup.

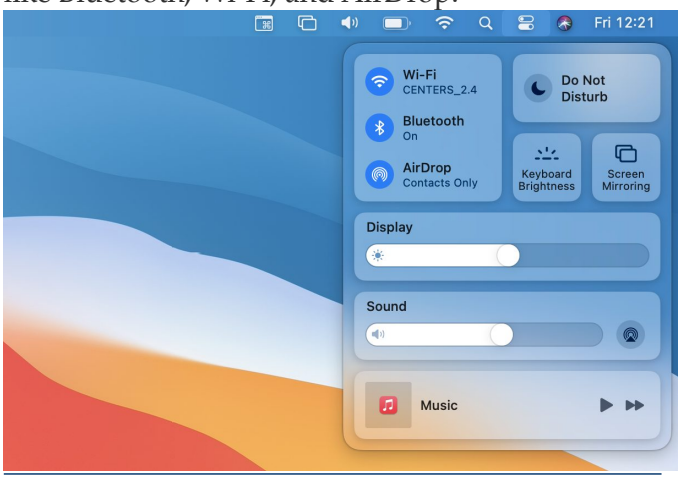
Econ Technologies has developed a technique for creating bootable backups with ChronoSync, but it's complicated. In short, you install Big Sur on the backup drive and then copy over the contents of the Data volume (see "ChronoSync 4.9.12," 13 November 2020).

What's New in Big Sur

We don't want to be all doom and gloom. Big Sur is the most significant change to macOS in years, most notably because it runs natively on (and is required for) Apple's new M1 chips. More obviously, Apple overhauled the entire user interface to more closely resemble the iPhone and iPad.

Here are some of the features that are new to Big Sur:

- Control Center: Big Sur features an iOS-style Control Center that lets you quickly control things like Bluetooth, Wi-Fi, and AirDrop.



- Notification Center: No longer split into separate columns for notifications and widgets, Notification Center now puts everything into a single column, with notifications at the top and widgets at the bottom. Widgets also now resemble those in iOS 14 and iPadOS 14.

- Messages and Maps overhaul: Apple rewrote the Messages app in Mac Catalyst, which gives it feature parity with the iOS and iPadOS versions. Messages now supports thread pinning, Memojis, animated GIF inserts, and message effects. Apple similarly re-implemented the Maps app in Mac Catalyst.

- Automatic AirPods switching: As with iOS 14 and iPadOS 14, your AirPods should connect to your Mac automatically when Big Sur detects that you've moved to your Mac from another device.

There are many more small features, and Apple provides a full list of what's new in Big Sur. As you prepare for an eventual upgrade, we recommend that you read Joe Kissell's *Take Control of Big Sur*.

For those interested in exploring Big Sur, I suggest these videos:

Top Features

Tips & Tricks

By Josh Centers

iOS 14.2.1 Fixes Three Bugs for iPhone 12 Users

Apple has released iOS 14.2.1 exclusively for the iPhone 12 lineup: the iPhone 12 mini, iPhone 12, iPhone 12 Pro, and iPhone 12 Pro Max. Don't bother checking Settings > Software Update if you're using an older iPhone. The update clocks in at 1.1 GB on an iPhone 12 Pro and can also be installed from your Mac in the Finder or through iTunes if you're using macOS 10.14 Mojave or earlier.

The iOS 14.2.1 update fixes a handful of iPhone 12-specific problems:

- MMS messages not being received
- Sound quality issues with Made for iPhone hearing aids
- An unresponsive Lock screen on the iPhone 12 mini

There are no published CVE entries for this update.

iOS 14.2.1 is so specific that it's probably fine to install immediately if you have one of the iPhone 12 models. If you don't use text messages or hearing aids, and you don't have an iPhone 12 mini, you could put off the update for a few days, just to be safe, but it's not something to avoid for long.

By Glenn Fleishman

Understanding 5G, and Why It's the Future (Not Present) for Mobile Communications

How much bandwidth do we need in day-to-day life? Do we need enough to stream 4K video at 60 frames per second while driving down the highway? How quickly do we need interactions to round-trip from our phones to provide a real-time feel and interact with new devices—like self-driving cars? In a world where billions have little access to high-speed data, why would a gigabits-per-second standard even matter?

Those are the questions that we should ask as cellular data networks continue to mature. Apple devoted a "Stan Sigman of Cingular at the iPhone introduction" level of time and attention to 5G at its recent iPhone 12 introduction, and many of us in the industry are still puzzling over why. Apple doesn't usually parrot marketing points or let speakers from other companies drone on about things that aren't immediately useful to Apple or its customers.

Fifth-generation (5G) cellular networks have already achieved a reasonable level of rollout across the US and a few other countries, and many more countries are aggressively pushing private companies to build out the infrastructure as a national goal. It will eventually allow phones, tablets, fixed devices, and other equipment to transfer data at speeds ranging from hundreds of

megabits per second to several gigabits per second. That's impressive, given that it's far faster than the vast majority of broadband Internet connections in the developed world.

5G is inevitable, and it would be a simple joke to say that it's "just one more" than 4G, but to some extent, that's true. 3G was the first Internet-focused flavor of cell networks, and 4G and 5G built on those principles. But 5G is being marketed as The Next Big Thing that will have some kind of transformative effect on everyday life and business.

Even the current generation of 5G-equipped devices that really have 5G tech—not the "5GE" label that is just fast 4G—have the potential to make data move zippier and with fewer delays. In practice, though, true 5G is hard to find in the field, where 4G LTE often outpaces 5G with current-generation devices. (Apple's 5G-enabled iPhones aren't yet widespread, so we can't compare their performance; it's unlikely to be much different.)

However, 5G won't be transformative for most people or purposes. Its advantages primarily accrue to cellular carriers, even more so than 3G or 4G, which offered significant boosts in throughput and allowed higher rates over broader areas. 5G will let carriers charge more for service in some cases, handle more customers simultaneously, break into new markets that require higher throughput or low latency, and equip more kinds of devices with ubiquitous high-speed cellular data connections.

For users, it will gradually feel like we have broadband no matter where we might be, which is not terribly exciting except when you want to stream a 4K movie in the backseat of a car on a highway or download a 5 GB file in a minute in a coffee shop. The level of excitement should be more akin to finding out your city has silently dug up the streets while you were sleeping, replaced 10-inch water mains with 20-inch ones, and then cleaned it all up without you knowing. 5G is better network plumbing that your "Internet utility" has to install to deal with the amount of data and new data connections it wants to move around a city.

(If you're concerned about health issues related to 5G, I wrote an extensive article about why the current debate is mostly manufactured. See "Worried about 5G and Cancer? Here's Why Wireless Networks Pose No Known Health Risk," 6 December 2019.)

Let's start with the 5G technology and move into its applications.

Five Gee Whiz

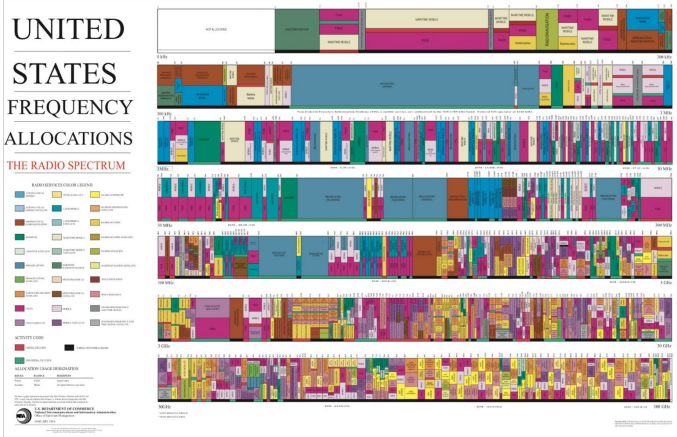
The cellular industry has advanced across five generations of standards, about one generation per decade, starting in the 1980s. The 1G standard was analog and entirely focused on voice, although slow data rates could be crammed through. (I once filed a newspaper column over 1G at 9600 bps.) 2G switched to digital, improved voice quality, and enabled throughput close to that of the 56 Kbps dial-up modems of the 1990s. Next, an interim 2.5G improvement called EDGE, a bridge to 3G, upped data rates to as fast as 200 Kbps in Apple's first iPhone. (That iPhone avoided 3G because the chips available in mid-2007 drained batteries like the dickens.)

It wasn't until 3G emerged that we saw glimmerings of modern, high-speed, ubiquitous Internet availability. While 3G came in many flavors, it started at roughly hundreds of Kbps upstream and just over 1 Mbps downstream in the best conditions. Over a few years, improved phone chips and base stations enabled 3G to reach over 7 Mbps downstream. Some versions allowed voice and data to flow simultaneously; others had to pause data while a call was active.

While the future of cellular was still in development as Long Term Evolution (LTE), which would be the underpinning of 4G networks, carriers in the US got antsy. They started labeling their faster 3G networks as "4G," presaging what's happening today with 5G. Early "4G" networks were only slightly faster. True 4G LTE boosted speeds into the current tens of Mbps range, although LTE's specification allowed for up to 1 Gbps for fixed usage and 100 Mbps for mobile purposes. (4G and LTE are sometimes used

together, as "4G LTE," and sometimes LTE is used preferentially to 4G.)

Along with the evolution of these generations came an increase in the number of electromagnetic frequency ranges that cellular carriers could use. Every country slices its spectrum up a little differently, though North America and much of Europe are aligned, as are many adjacent countries in other regions. While you may be accustomed to unlicensed spectrum used for Wi-Fi, cellular carriers must generally purchase licenses—often time-limited leases—for swaths of spectrum at auction or in carefully arranged government deals that in some countries reek of patronage, nepotism, or outright corruption.



This 2016 wall chart from the National Telecommunications and Information Administration shows the utter complexity of frequency bands in use.

As cellular standards advanced, radio-chip manufacturing became more sophisticated, processing power and bandwidth demands from phones grew ever heavier, and spectrum availability became more baroque. Early cell phones, even well into the 3G era, had chips that could handle only a handful of popular bands. Apple made several models of iPhones to cope with worldwide differences. Over just a few years, though, Apple, Samsung, HTC, and others generally gained the ability to produce as few as two worldwide models that could handle dozens of bands. While 3G moved a bit in this direction, 4G was more substantial, and 5G takes the cake. If you want to get a sense of how many different frequency bands are currently used, consult Apple's 5G and LTE iPhone bands page.

If you read down that list with a gimlet eye, you will note something intriguing: while most frequencies are listed as MHz (megahertz), just a few have GHz (gigahertz) following their names—and only on the newest iPhone models sold in the United States.

That's because the actual innovation in 5G isn't in better data rates in spectrum ranges used by 4G and earlier standards. Rather, it's about *millimeter-wave* (mmWave) transmissions that work at extraordinarily high rates over very short distances. Let's dig into that along with what else 5G offers.

Long and Slow or Short and Fast

When trying to increase data throughput in any communications system designed to pass information, wired or wireless, engineers are constrained by the Shannon-Hartley theorem, a proof developed by three brilliant people (Harry Nyquist was the third) and named for two of them. The theorem effectively explains the upper limit of information—in digital communications, the data rate—that can be carried by a system and how the presence of noise reduces that maximum rate.

There's always noise, which disorganizes information. Noise is why you might see a Wi-Fi device advertised as carrying a maximum of 3.2 Gbps but measure only 500 Mbps of actual throughput when you copy a large file: with any interference or signal degradation over distance, the maximum data rate quickly drops down. (Wireless networking also has a fair amount of overhead—from 20 to 40 percent of throughput—that's necessary for managing traffic and preventing competition among devices on the same and nearby networks.)

Throughput = Spectrum x Antennas

There are several methods to improve throughput within the constraints of Shannon-Hartley. One is to add spectrum: expand the frequency ranges to

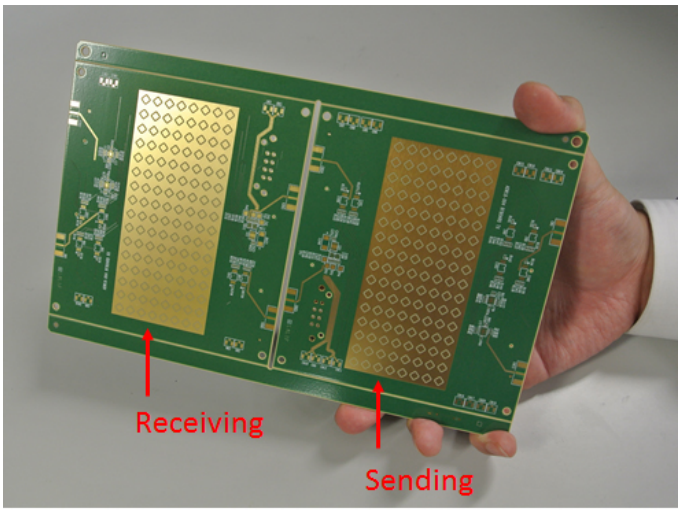
increase the amount of data that can flow. But adding frequencies requires the aforementioned government interaction. Countries are eager to spur innovation and investment, so they have regularly made more spectrum available to gain the ostensible future benefits of 5G.

Another method of improving throughput relies on adding antennas. That might sound like just improving reception or transmission, but for over 15 years, multiple-in, multiple-out (MIMO) radio systems have allowed devices to transmit simultaneous streams of data that a receiver can distinguish. By changing certain wireless characteristics and using different combinations of antennas, cellular and Wi-Fi base stations can even direct signals directly to specific devices, called *beamforming*.

MIMO allows frequency reuse in the same space, effectively multiplying throughput. It doesn't violate Shannon-Hartley because it leverages distinct paths across the same volume of space. Imagine a billiard table on which you send balls caroming around along unique paths. The difference is that as long as wireless signals are on different paths, they pass through each other, unlike billiard balls.

But MIMO has a physical constraint: antennas have to be a particular length that corresponds with the frequency wavelength. The 2.4 GHz wavelength used in Wi-Fi is about 5 inches (12.5 cm), and commonly used antennas are designed to be half a wavelength. You've probably seen Wi-Fi routers festooned with antennas—some have 8, 9, 12, or even more external ones! But there's a practical limit on adding more antennas, even for cellular towers, due to their size and the complexity of attaching them.

The millimeter-wave (mmWave) ranges available for 5G start at 24 GHz, which allows for extremely small antennas that can be packed together tightly. (A half-wavelength antenna at 24 GHz is 0.25 inch or 6.35 mm.) Cellular base stations might be equipped with several dozen antennas linked together into a phased array, which enables precise beamforming across a huge number of combinations of antennas. The industry calls this "massive MIMO." Many, many more devices can each receive essentially their own full-speed data stream, even in a crowded environment. (A famous Wi-Fi failure in the early 2000s was a phased-array antenna that was so far ahead of its time that, despite successful prototypes, the company couldn't take it into actual production. But the idea was sound—particularly at mmWave scale.)



Fujitsu's 2018 design for a 128 antenna 28 GHz phased-array panel.

The downside of mmWave hinges on the relationship between signal power and wavelength. Higher frequencies require more power than lower frequencies to achieve the same range at the same signal quality to noise ratio (the commonly seen SNR measurement). At the same power level, lower frequencies can't transmit as much information as higher frequencies, but they travel further and penetrate solid objects better.

Range and penetration were two reasons why 2.4 GHz was preferred originally for Wi-Fi because, with the original very narrow Wi-Fi bands, transmissions could pass through objects, walls, and ceilings while maintaining a passable data rate. Wi-Fi in 5 GHz (and in 6 GHz in the US soon) relies on rules that allow for greater power and the capability to use much larger swaths of frequencies.

With mmWave, because the frequencies used are so high (starting at 24 GHz), its estimated range is like Wi-Fi: about a 500-foot (150-meter) radius. In comparison, cellular frequencies at 2 GHz enjoy a roughly 3-mile radius, and when you drop down to the even lower-frequency 700 MHz range, signals can travel within a 6-mile radius. (In practical terms, cell towers have to overlap to ensure seamless handoff and are placed far more densely than those maximum ranges to handle large numbers of users in dense urban areas.)

There's one more parameter here, too, that can affect throughput. Network systems encode data through modulation, which (more or less) maps bits into an analog pattern. Quadrature amplitude modulation (QAM) is heavily used for wireless communications. You can think of it as a square containing a pattern of dots spread out across rows and columns, called a *constellation*. The dots as transmitted should be received exactly on the interstices where rows and columns cross, but QAM is designed to let a receiver nudge dots that don't line up back into the right place.

Each generation of digital cellular and Wi-Fi technology has increased the size of this constellation, making it possible to cram more data into each time-slice of wireless transmission. Larger constellations require cleaner signals, which typically means that a device has to be relatively close to a transmitter to achieve the higher throughputs.

Conveniently, the high frequencies of mmWave require base stations to be located close together to provide coverage at all. That fits nicely with large QAM constellations requiring clean signals.

Latency

Alongside all of these changes to increase throughput is the potential for 5G to reduce latency, a lagging factor in cellular that's a key attribute of responsive wired and Wi-Fi networks. Latency measures the amount of time it takes for a network transmission to pass from its origin to its destination, no matter how fast it goes. Think of the flow of water to a faucet: the water pressure and pipe width control the throughput—how much water can be delivered in a period of time— while latency measures how long it takes from turning the tap until water comes out.

4G networks have a latency of about 50 milliseconds. 5G should typically be closer to 10 ms, which is similar to modern Wi-Fi and roughly equivalent to the limits of human visual perception —the time between an image appearing and us processing it. However, 5G has the potential to drop even lower, down to 1 ms, which is the same latency that wired Ethernet can achieve.

For interactive purposes, high latency is a killer: it's what makes you see or hear a lag when using videoconferencing or VoIP calls, and it prevents things from happening in what feels like a real-time way. That's critical for gaming, but also for many industrial and business purposes, where the lag has to be as close to zero as possible.

Sub-Channels

There's one more trick up cellular's sleeve. Both 4G and 5G also employ a technique—used earlier in Wi-Fi standards—that breaks a wide swath of frequency set up as a channel into tiny sub-channels, each of which has its own modulation. If there's interference or a reflection problem in one sub-channel, it doesn't downgrade the throughput

of the entire transmission. It's like plowing a field and avoiding rocks.

For further reading, I suggest this highly understandable article about 5G at Waveform.

The Purported Potential Uses of 5G

The US is the first country in which 5G will rely on a triad of cellular frequencies: existing ones across a range of bands, new allocations up near the bands currently used for 5 GHz Wi-Fi and soon for 6 GHz Wi-Fi, and mmWave starting at 24 GHz. It's a grand experiment for delivering broad-scale higher-performance in lower bands and super-fast throughput as needed in the much higher bands.

The uses cited for 5G include all things we do now, though carriers actually don't mention video streaming all that often. Perhaps 4K-quality video streams just aren't that compelling, especially given that some carriers already downscale video automatically or require a higher-priced subscription to get higher fidelity than 480p, and more expensive plans top out at 1080p.

Carriers are excited about (and investing in) 5G because they anticipate new money-making opportunities, particularly in industries in which low-latency, high-bandwidth, high-coverage wireless enables new products or services, or allows shifting intelligence from edge devices to central processing.

Just as Web apps have benefitted from the massive improvements of speed in JavaScript running in a browser that allows a combination of locally downloaded code and seamless interaction with remote resources, 5G networks will ostensibly enable massively scaled systems that can feed data out in real time to edge points. This includes both relatively low-featured Internet of Things (IoT) devices that will benefit from storing their brains elsewhere—with all the security and privacy issues associated with that—and more sophisticated hardware, like autonomous or driver-assisting vehicles.

Some of the most compelling cases are:

- Augmented reality: In recent years, Apple has focused significant attention on AR, which can require a lot of constantly updated data that's processed centrally and streamed to a device, all while responding to movements in the physical environment.
- Gaming: Gamers often required wired Ethernet connections in their homes for the best results. 5G will make mobile gaming more responsive.
- Rural access: Every generation of cellular technology promises better coverage for rural residents. Every generation often disappoints them, too, because carriers prefer to deploy service where they can more easily make money. However, 5G's greater efficiency and variety of frequency options, particularly in some new frequency territory around 5 GHz and 6 GHz, should generally improve rural service.
- Urban/suburban access: In some cases, carriers and other parties might find it feasible to deliver high-speed urban and suburban residential broadband over 5G. It's more likely to happen outside the US because in this country there's sufficient inexpensive wired infrastructure (cable, phone wire, and fiber) in more densely populated areas. I pay $85 per month for unlimited gigabit Internet in Seattle; it's hard to imagine a wireless provider offering even 100 Mbps at that price for residential-scale video and other use in the US. However, in some developed and developing countries, even relatively populated or dense areas lack wired or fiber-optic infrastructure at the level demanded.
- Remote medical procedures: We've all become more familiar with telemedicine consultations in the last few months, but with sufficient bandwidth, remote medical procedures are here today. Diagnosis and even robot-assisted surgery can be performed through remote linkages, but setting up a stable, low-latency, high-bandwidth network where a wired, low-latency broadband connection is unavailable, or for facilities that aren't able to wire Ethernet into existing areas, would open up new possibilities. (That said,

would you want a wireless surgeon operating on you? Seems like a hard sell.)

- Autonomous cars: A car can't rely solely on a 5G network for robotic operations while it's zooming down the highway, but it could overlay its onboard capabilities with information gathered around and ahead of it to reduce accidents and improve safety.
- Expanded sensor networks: 5G will enable massively scaled sensor networks for monitoring infrastructure. A Deloitte report suggested, "Imagine a scenario where millions of such devices can be connected in a city center, measuring temperature, humidity, air quality, flood levels, pedestrian traffic, and more." I can imagine plenty of negative uses, too, but after suffering from weeks of bad air in Seattle recently, I can also acknowledge some of the more constructive purposes.
- Industrial robots: Robots used in factories have to be hard-wired for control to keep latency low. Wi-Fi relies on unlicensed frequencies, which makes depending on throughput sometimes iffy, as we've all seen. Licensed 5G inside manufacturing facilities could enable wireless robots and make it easy to move them or add new ones without rewiring the factory floor. These private 5G networks would be like Wi-Fi but with higher power, lower latency, and more stability thanks to running over restricted frequencies.

Additional use cases will surely arise as the networks are deployed, but you're excused if you don't find the list above compelling. That's a problem for carriers, who are largely eating the cost of network updates, except Verizon, which is charging customers more for it; see below. It also troubles phone makers who want the engineering effort of adding 5G support to be seen as a major reason to buy the next generation of phones that have only incremental improvements otherwise. Smartphones haven't reached the end of innovation in their features, but the camera, display, and processing improvements make less of a difference with each release.

In short, although 5G is inevitable and may become an important aspect of society's networking infrastructure, there's no reason for most people to upgrade to get it right now.

Carriers Plan Their Plans

When it comes to 5G rollouts, cellular carriers face a lot of competing problems and employ different marketing and pricing approaches, even as they have more or less adopted the same technology. It's a bit like Coke and Pepsi if Coke only let you buy its sugar water in 12-packs of cans and Pepsi could only be purchased in 2-liter bottles.

For now, we're seeing the major cellular firms roll out 5G networks in order to claim they have 5G networks in place—they want competitive bragging rights. Only a few limited areas have 1 Gbps or faster mmWave service available for customers. PCMag dug into maps for Verizon's mmWave service and found it was scarce so far and, as expected, clustered in places that likely also have high-speed free or paid Wi-Fi. AT&T and T-Mobile have not yet announced mmWave plans. Here's how it shakes out now:

- Verizon says its mmWave "5G Ultra Wideband" (UWB) can be found in 55 cities, while it has regular 5G across swaths of metropolitan areas nationwide. It charges $10 extra on its unlimited plans per line for 5G data rates.
- AT&T seemingly calls its current 4G network "5G," but says "5G+" (actual 5G) is "available in select innovation zones in over 15 states across the US." AT&T includes 5G throughput on its "Unlimited Starter, Extra, and Elite plans," which start at $35 per month and require at least four lines.
- T-Mobile claims it has the biggest deployment, with over 7500 cities and towns having 5G in place, but given that the company also promises that "our network will be 8x faster than current LTE in just a few years, and 15x faster in the next six years," it's unclear which part of the network is faster 4G and which is actually next-generation 5G. At least T-Mobile says it won't charge more for 5G service. (T-Mobile acquired Sprint earlier

this year and has developed a 5G plan that coordinates the two brands.)

Verizon's early mmWave deployments are promising, providing fiber-optic broadband and high-end Wi-Fi speeds in the extremely limited areas they cover, though I will ask again—to what end? I don't need 1 Gbps while strolling down Newbury Street in Boston. But I can imagine appreciating excellent throughput when we're once again surrounded by thousands of people in public.

More disappointing, however, is that the "normal" flavor of 5G, the generational upgrade to 4G, appears to be lagging behind 4G LTE performance in some areas where they overlap. That will change, but it seems odd that your fancy new iPhone with 5G capability could see worse performance than 4G in some places.

Are We Ready for 5G?

I hate to be a downer when it comes to improved technology that actually does what it says on the tin. 5G networks will provide substantial improvements in throughput and availability that we will notice—in a year or maybe two. Until then, not so much.

I'd almost rather the entire industry didn't talk about it for a while, but 5G-involved companies have to talk about something because that's how marketing works. Advertising that "we keep making things slightly faster" is not a winning campaign, particularly when your competitor is shooting off 5G fireworks.

5G is inevitable, in that all phones and cellular-capable devices will transition to supporting early flavors of it over the next year, including some relatively fast versions that use mmWave. The question is when we'll see use cases that impact our everyday lives.

Apple Updates

Security Update 2020-006 (Mojave)
Nov 12, 2020 – 1.23 GB

System Requirements
– macOS mojave 10.14

Security Update 2020-006 is recommended for all users and improves the security of macOS.

macOS 10.15.7 Supplemental Combo Update
Nov 11, 2020 – 2.86 GB

System Requirements
– macOS Catalina 10.15.7

macOS Catalina 10.15.7 provides important security updates and bug fixes for your Mac.

• Resolves an issue where macOS would not automatically connect to Wi-Fi networks

• Fixes an issue that could prevent files syncing through iCloud Drive

• Addresses a graphic issue that may occur on iMac (Retina 5K, 27-inch, 2020) with Radeon Pro 5700 XT

Some features may not be available for all regions, or on all Apple devices.

macOS 10.15.7 Supplemental Update (Delta)
Nov 11, 2020 – 1.22 GB

System Requirements
– macOS Catalina 10.15.7

macOS Catalina 10.15.7 Supplemental Update is recommended for all users and improves the security of macOS.

Some features may not be available for all regions, or on all Apple devices.

Security Update 2020-006 (High Sierra)
Nov 11, 2020 – 1.25 GB

System Requirements
– macOS High Sierra Security Update 2020-006

Security Update 2020-006 is recommended for all users and improves the security of macOS.

Pro Display XDR Calibrator 1.0.0
Nov 4, 2020 – 1.4 MB

System Requirements
– macOS 10.15.6 or later

Every Pro Display XDR undergoes state-of-the-art factory calibration with laboratory grade instrumentation. Pro Display XDR Calibrator enables in-field recalibration of Pro Display XDR for specific color workflows that may require custom calibration. Recalibration with this utility requires one of the following spectroradiometers:

- Photo Research SpectraScan PR-740, PR-745 or PR-788
- Colorimetry Research CR-300

Additional Requirements:

- Pro Display XDR with display firmware v.4.2.30

For more information on in-field recalibration, see Measuring and calibrating Apple Pro Display XDR