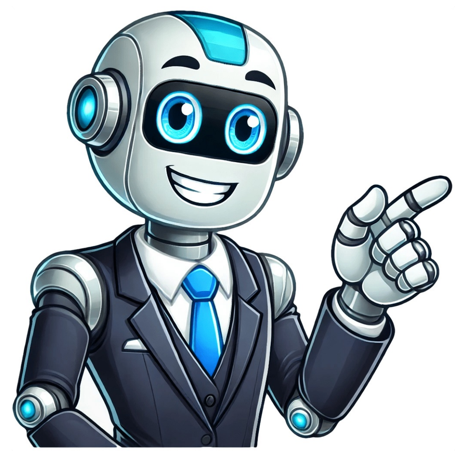

wireless lan wifi 802.11ax 802.11ac network standard IEEE 802.11ac (WiFi 5) and 802.11ax (WiFi 6) are both wireless networking standards developed by the IEEE. 802.11ac came after 802.11n (WiFi 4) and before 802.11ax. 802.11ac was introduced to provide faster and more reliable wireless communication, specifically focusing on the 5 GHz frequency band. IEEE 802.11ax was designed to offer significant improvements in wireless network performance, capacity, and efficiency, aiming to meet the ever-growing demands of modern wireless communication. WiFi 802.11ac (WiFi 5) This WLAN standard is the successor to IEEE 802.11n. It achieves high throughput by utilizing wider bandwidths, multi-user MIMO (MU-MIMO), a higher number of spatial streams, and advanced modulation schemes like 256 QAM. Its primary goal was to provide faster and more reliable wireless communication within the 5GHz band. It's often referred to as Wi-Fi 5 because 802.11ac is the fifth generation of the 802.11 standard. Key features and characteristics include: Wider Channel Bandwidths: Supports up to 80 MHz and 160 MHz, enabling high data throughput. MU-MIMO Support: Enables multiple devices to be served simultaneously on the same channel. Beamforming: Allows the Access Point (AP) to focus signal energy directly towards connected devices, improving signal strength and reliability. Backward Compatibility: Works with older standards like 802.11a/b/g/n. Enhanced Security: Supports WPA2 for improved wireless security. Improved Range and Coverage: Offers better range and coverage compared to its predecessors. It's commonly used as a high-speed Wi-Fi solution in both home and enterprise environments. Its enhanced data rates and performance make it suitable for bandwidth-intensive applications like streaming HD video, online gaming, and large file transfers. WLAN 802.11ax WiFi (WiFi 6) This WLAN standard is the successor to IEEE 802.11ac and is known as Wi-Fi 6 because 802.11ax is the sixth generation of the 802.11 standard. It boasts advanced features like downlink and uplink OFDMA, uplink resource scheduling (without contention, unlike 802.11ac), MU-MIMO (both downlink and uplink), longer OFDM symbols, a higher modulation scheme (1024-QAM), more spatial streams (up to 8), support for both 2.4 GHz and 5 GHz bands, and BSS coloring. Key features and characteristics of IEEE 802.11ax include: Higher Data Rates: Offers maximum data rates of up to 9.6 Gbps under ideal conditions, achieved through advanced modulation schemes like 1024-QAM. OFDMA Support: Allows for more efficient sharing of channel resources. Enhanced MU-MIMO: Supports MU-MIMO and extends the number of simultaneous streams up to 8, enhancing its ability to serve multiple devices concurrently. Target Wake Time (TWT): Allows devices to schedule when they wake up and communicate with the AP, conserving power, which is ideal for IoT devices. Improved Security: Supports WPA3 to enhance security for wireless networks. Flexible Channel Widths: Supports channel widths of up to 160 MHz and 80+80 MHz. Comparable Range: Doesn't significantly increase maximum range compared to 802.11ac. Backward Compatibility: Works with older Wi-Fi standards. Difference between 802.11ac and 802.11ax Let's break down the differences between the 802.11ac and 802.11ax Wi-Fi standards, focusing on features like speed/data rate, capacity, range, and network efficiency. Specifications802.11ac802.11axFrequency Bands5 GHz (2.4 GHz not supported)2.4 GHz, 5 GHzChannel Bandwidths20 MHz, 40 MHz, 80+80 MHz, 160 MHz20 MHz, 40 MHz, 80 MHz, 80+80MHz, 160 MHzFFT sizes64, 128, 256, 512256, 512, 1024, 2048Subcarrier spacing312.5 KHz78.125 KHzOFDM symbol duration3.2µs + 0.8/0.4 µs CP12.8µs + 0.8/1.6/3.2µs CPModulation scheme (highest)256 QAM1024 QAMData rates433 Mbits/sec(with 80 MHz and 1 SS)600.4 Mbits/sec (with 80 MHz, 1 SS)6.933 Gbits/sec (with 160MHz, 8 SS)9.6078 Gbits/sec (with 160 MHz, 8 SS)OFDMANot supportedSupportedTarget Wake Time (TWT)Not supportedSupportedSecurityWPA2WPA3Concurrent UsersUp to 100Up to 300Spatial reuse (BSS coloring)Not supportedSupportedPower efficiencyLess efficientImproved efficiencyQoS (Quality of Service)LimitedSignificant improvements Conclusion While they share some similarities, 802.11ax (Wi-Fi 6) introduces several enhancements and features that are absent in 802.11ac (Wi-Fi 5). As a result, 11ax delivers higher data rates, improved efficiency, and better support for dense deployments and IoT devices. Therefore, 802.11ax is considered a more advanced and capable Wi-Fi standard for addressing modern networking needs. 802.11ac (more commonly known as Wi-Fi 5) is the fifth generation of wireless standard released in 2014 by the Wi-Fi Alliance. While it was a much-needed upgrade to the previous Wi-Fi 4 standard, it still had a number of issues. 802.11ax (more commonly known as Wi-Fi 6) was developed as a response to the growing number of connected devices on a network, namely Internet of Things (IoT) devices like smart lights or even appliances like a fridge or washing machine. It's important to note that Wi-Fi 6 didn't re-imagine wireless routers. Instead, it introduced a series of incremental improvements to existing Wi-Fi standards that add up to a substantial upgrade over the older generation of Wi-Fi. Let's go through these changes one by one and address the primary question: What are the differences between 802.11ac (Wi-Fi 5) and 802.11ax (Wi-Fi 6)? I will also discuss whether upgrading to Wi-Fi 6 is necessary and explain why using Wi-Fi 6 access points/routers may not necessarily make your internet faster. First, let's examine the issues associated with Wi-Fi 5 that Wi-Fi 6 aimed to address and improve upon. Wi-Fi 5 access points often face congestion in crowded public areas where numerous devices are connected to a single router. The more devices competing for the same wireless signal in a small area – the worse the speeds and connectivity became. However, the same issue can also occur in your home network. Think about it – if you have 10-15 devices connected to your Wi-Fi network, and so do all your neighbors to their Wi-Fi network, that adds up to a lot of wireless devices and Wi-Fi networks all fighting for the same bandwidth. Wi-Fi 5 access points using the 5GHz band had limited wireless signal coverage, with signals unable to penetrate obstacles (such as thick walls) and travel long distances. Backwards compatibility can be an issue because some devices that operate within the 2.4GHz band may not work well (or at all) on a 5GHz network. You may experience this issue for yourself when connecting a smart home device like a smart plug. Most of these devices will only be compatible with a 2.4GHz band network. Wi-Fi 5 only offers two security protocols known to have several serious vulnerabilities – WPA and WPA2. Now, let's get into what makes Wi-Fi 6 a better choice compared to Wi-Fi 5. These two wireless protocols may sound similar, but when you take a closer look, they have some important differences. Wi-Fi 5 promises a maximum data transfer speed of 6.9Gbps, but due to hardware limitations – you won't actually see these speeds on individual devices. In most cases, 802.11ac (Wi-Fi 5) has an average data speed of about 200 Mbps. Source: Venturebeat.com The speed of a wireless standard relies on something called Quadrature Amplitude Modulation (QAM), and the number of devices using the router. Wi-Fi 5 utilizes 256-QAM modulation, which is lower than the one used by Wi-Fi 6. In comparison, Wi-Fi 6 is a better choice in terms of speed, especially for congested wireless networks. It uses 1024-QAM modulation and a theoretical maximum speed of up to 9.6 Gbps. The real speed improvements are noticeable when numerous devices are connected to a single Wi-Fi access point. Wi-Fi 6 ensures that even with a substantial number of connected devices, there will be minimal impact on the speed, which is one of the main improvements over Wi-Fi 5. One noticeable distinction between Wi-Fi 5 and Wi-Fi 6 is in the frequencies used by each standard. Wi-Fi 5 only operates on the 5Ghz band, which allows the Wi-Fi signal to be sent with less interference, meaning better speeds. However, it comes with a drawback: signals transmitted at this frequency have a shorter range and can't easily go through walls or other physical obstacles. Wi-Fi 6 uses two different band frequencies – 2.4Ghz and 5Ghz. Using both frequency bands allows connected devices to automatically scan and use the frequency band with minimal interference. As a result of this improvement, users will experience faster speeds when in close proximity to the router (using the 5GHz band), but also see a broader range but slower speed when devices are located further away (using the 2.4Ghz band). There are also Tri-Band routers that provide one 2.4GHz and two 5Ghz Wi-Fi network bands. Usually, Wi-Fi Routers communicate with each device one by one. Consequently, if several devices are connected to a single access point, it might create a queue, which slows down the speed for every device on that network. MU-MIMO stands for "Multi-user, multiple-input, multiple-output". This technology allows the router to "talk" to several devices on the same network simultaneously by assigning spatial streams to each antenna. It eliminates the queue and makes it possible for the router to respond to more connected devices faster. For each device, it reduces wait time, allowing the router to receive more data from more connected devices. Here's a different way to look at it. Instead of sending data to devices in "bursts" (also known as "packets"), MU-MIMO enabled routers send a steady stream of data to multiple devices on your network, without delay or pause. You will also see the benefit of MU-MIMO technology during Wi-Fi-intensive activities that require high bandwidth such as gaming and 4K video streaming. This is because MU-MIMO uses separate channels to send and receive even more data. Source: Qualcomm The second piece of technology making Wi-Fi 6 faster is OFDMA. It stands for Orthogonal Frequency Division Multiple Access. OFDMA is ideal for low-bandwidth applications because it can dedicate a single channel to one user at a time, or it can subdivide the same channel for multiple users – ideal for low bandwidth applications. As you can see, these technologies complement each other to make the connection feel faster for both high-bandwidth and low-bandwidth applications. Another feature of Wi-Fi 6 is Target Wake Time (TWT). TWT allows devices to schedule specific times to wake up and communicate with the router. As a result, this feature allows devices to conserve more battery power when not actively sending or receiving traffic. By optimizing the scheduling of network activity, Wi-Fi 6 can reduce the time devices need to stay awake and listen for signals, resulting in improved battery life. It's important to note that the impact of Wi-Fi 6 on the battery life is not significant for all devices on a network. For example, your computer needs to stay connected to Wi-Fi constantly, therefore, this device won't make heavy use of this feature. But other battery-operated devices can save a significant amount of energy, like smart blinds or wireless sensors. TWT is mainly used by low-powered Wi-Fi devices that need to send infrequent updates now and then. This includes smart-home and IoT devices and small sensors placed around your home. Target Wake Time (TWT) is missing in Wi-Fi 5. As a result, power consumption is higher. Another technology that was improved in Wi-Fi 6 is called Beamforming. Instead of broadcasting wireless signals in all directions, Wi-Fi 6 uses a data transmission technique that makes the router detect where the device that requests the data is located and sends independent data streams in that direction. As a result, Beamforming improves Wi-Fi range and performance for devices connected to the router. Source: Wi-Fi 5 ensures a secure connection by offering two security protocols WPA (Wi-Fi Protected Access) and WPA2. Today, these protocols are known to have several vulnerabilities. One of them is dictionary attacks, where cyber criminals try a large number of passwords from a pre-existing list to attempt to gain unauthorized access to a network. Wi-Fi 6 fixes this vulnerability by using WPA3, which is essentially a more complex and secure version of WPA2. Wi-Fi routers supporting WPA3 implement a different handshake technology for wireless networks using Dragonfly Key Exchange, also referred to as SAE (Simultaneous Authentication of Equals). Keep in mind that the connection between your device to your router and the router to your Internet Service Provider (ISP) are two different things. Your Wi-Fi network may be capable of super-fast speeds of up to 1000Mbps for example, but if the internet plan you have with your ISP is only 100Mbps, you won't notice much of a difference in everyday download/upload speeds (e.g. downloading a large file from the internet). This is also known as a "bottleneck", where your internet plan is the one limiting your speed potential. Instead, Wi-Fi 6 brings the most improvement to the local connection between your router and your devices, rather than the speed at which you can access the internet as a whole, which your ISP determines (e.g. your download and upload speeds). The goal of Wi-Fi 6 is not necessarily higher download and upload speeds, but to maintain faster speeds for each device connected to the network, especially when numerous devices are connected. It introduces technologies that allow routers to communicate with more devices simultaneously, send traffic to multiple devices at once, and schedule check-ins with devices. These features help maintain strong connections even as the number of devices demanding data increases. As a result, you'll see the most significant speed improvements when connecting a large number of devices to your router, or sending a large amount of data wirelessly between devices (e.g. from a media server to a TV, or a computer to a Network Attached Storage device (known as a NAS). To upgrade to Wi-Fi 6, you will need devices that support the Wi-Fi 6 wireless protocol. However, rushing out and buying new laptops and new phones is unnecessary, as improvements in Wi-Fi 6 are not considered groundbreaking. Over the next few years, new phones, laptops, and other devices will be Wi-Fi 6 compatible, thus, making the transition seamless and easier. The speed upgrade provided by Wi-Fi 6 will depend on the number of devices on your network and their data demands. While individual device speeds may not change dramatically, the overall performance and reliability of the network are expected to improve in everyday usage scenarios, especially in networks with multiple devices. Note that you will need a Wi-Fi 6 router to create a Wi-Fi 6 network in the first place. Overall, while Wi-Fi 6 does bring several significant improvements over it's Wi-Fi 5 predecessor, it's unlikely to make a significant difference compared to your existing Wi-Fi network. You'll need to ensure your ISP speeds are fast, and both your router and wireless devices can support Wi-Fi 6 to take advantage of most of the improvements. For most people, this could cost a fair amount of money. It's often better to simply wait until you own a number of Wi-Fi 6 devices (like a laptop) before upgrading your router to a Wi-Fi 6 compatible one. In addition, Wi-Fi 6 has already been superseded by Wi-Fi 6E. If you want to learn more, you can read about the differences between Wi-Fi 6 vs Wi-Fi 6E. Wi-Fi 6 is certainly a good choice for gaming due to several improvements over Wi-Fi 5. Wi-Fi 6 reduces latency, which is the time it takes for data to travel between the original source and the destination. Thanks to MU-MIMO, Wi-Fi 6 allows the router to "talk" to several devices on the same network simultaneously. It's perfect for Wi-Fi-intensive activities such as gaming. Wi-Fi 6 (802.11ax) introduces several advancements and improvements over Wi-Fi 5 (802.11ac) that contribute to increased speeds. Wi-Fi 6 has a higher theoretical maximum speed of 9.6Gbps compared to 6.9Gbps in Wi-Fi 5. Wi-Fi 6 introduces new technologies like OFDMA and MU-MIMO to improve speed and efficiency. Wi-Fi 6 is generally faster for crowded environments, and has enhanced range and coverage. Remember that you need to have Wi-Fi 6 compatible devices to enjoy these improvements. Wi-Fi 6 has a better range than Wi-Fi 5 because it employs two different band frequencies – 2.4Ghz and 5Ghz. Using both frequency bands allows connected devices to automatically scan and use the frequency band with minimal interference. As a result, you get faster speed when in close proximity to the router and a broader range when your devices are located far away. In addition, improved beamforming technology in Wifi-6 improves Wi-Fi range and performance. Wi-Fi 6 routers are fully compatible with Wi-Fi 5 and previous-generation Wi-Fi devices. While wireless networking standards IEEE 802.11ac and IEEE 802.11ax are related, there are some major differences. Both standards fall under IEEE 802.11, which is the set of standards that define communication for wireless local area networks (WLANs). The 802.11ac standard is 802.11ax's predecessor. Also known as WiFi 5, 802.11ac delivers high-throughput WLANs on the 5 GHz band. "Each new Wi-Fi standard has brought significant improvements in performance, with the most recent, 802.11ac, offering an impressive theoretical maximum rate of 1.3Gbps," Neal Weinberg wrote in Network World in 2018. "Unfortunately, these gains have not been enough to keep pace with demand, leading to that exasperated cry heard across airports, malls, hotels, stadiums, homes and offices: 'Why is the wireless so slow?'" With a fourfold increase in average throughput per user, IEEE 802.11ax, also known as WiFi 6, solves many of these issues. Arising in 2013 as a new amendment to the IEEE 802.11 WLAN standard, 802.11ax delivers high efficiency Wi-Fi in dense environments. Why is this? As Lee Badman reports in TechTarget, some of the key differences between the two standards include: Whereas 802.11ac works only in the 5 GHz band, 802.11ax operates in both the 2.4 GHz and 5 GHz bands. While the 802.11ac standard allowed up to eight spatial streams, it cannot deliver more than 6.9 Gbps due to hardware limitations. 802.11ax, however, may be able to achieve up to 9.6 Gbps, though Badman explains this is likely only under "ideal conditions" most probably have difficulty reaching. At its zenith, 802.11ax uses 1024 quadrature amplitude modulation compared to 802.11ac's 256 QAM, meaning that 802.11ax "lets more data pass through in a given operational time slot," according to Badman. 802.11ax has an almost 4x reduction in spacing between the modulated sub-carriers, so that more spectrum is used for data transfer with less spent on management. The use of orthogonal frequency-division multiple access in 802.11ax allows an AP support various wireless clients at different bandwidth requirements at the same time. 802.11ax comes with bidirectional enhancements in multiuser multiple input, multiple output radio processes. 802.11ax contains a feature known as basic service set (BSS) coloring that handles co-channel interference. "As good as 802.11ac is, it has no effective way to deal with interference from neighboring cells on the same channel, which can translate into reduced performance," Badman concludes. "BSS coloring in 802.11ax adds a field to the wireless frame that overcomes issues associated with same-frequency cell coexistence, leading to increased overall capacity." Overall, both of these standards have greatly enhanced wireless technology. However, 802.11ax contains features that deliver superior service, particularly in dense environments. Improving Quality of Experience with IEEE Std 802.11ax™ The work on High Efficiency Wireless Local Area Networks (WLANs) in IEEE Std 802.11ax™ started in 2013 as a new amendment to the IEEE 802.11 WLAN standard. A goal of the new amendment is to address dense deployments characterized by a large number of access points and stations placed in close proximity in a limited geographical area. Such usage scenarios impact the quality of experience (QoE) for latency-sensitive applications such as voice-over-Wi-Fi™ and video conferencing. Interested in Learning More About This Standard? Enroll in our upcoming live two-course program, IEEE 802.11ax: An Overview of High Efficiency Wi-Fi (Wi-Fi 6), which will provide an overview of the features and optimizations introduced by IEEE 802.11ax to the physical (PHY) and medium access control (MAC) layers, which lead to the improvements in Wi-Fi. Purchase this course program by 17 February for the opportunity to ask questions and interact with the instructors. Part One will take place on 21 Feb from 12-3pm ET, and Part Two will take place at the same time on the following day. Plus, check out this on-demand virtual event from IEEE Educational Activities and IEEE Standards Association that describes new IEEE 802.11ax features such as Orthogonal Frequency Division Multiple Access and Uplink multi-user transmissions together with Physical (PHY) and Medium Access Control (MAC) enhancements specific to IEEE 802.11ax to improve QoE. Watch now! Resources Badman, Lee. (July 2021). What's the difference between 802.11ac vs. 802.11ax? TechTarget. Weinberg, Neal. (27 February 2018). What is 802.11ax (Wi-Fi 6), and what will it mean for 802.11ac. NetworkWorld. 802.11ac and 802.11ax are different wireless (WiFi) technology standards that are present in WiFi routers or gateways. WiFi and Internet capabilities are constantly evolving. Up until 2019, the most common wireless standard called for 802.11ac, also referred to as WiFi 5. However, in late 2019, 802.11ax (also known as WiFi 6) was launched, providing enhanced capabilities over its predecessor. These two WiFi standards are important to understand because they determine what devices you will need for your home network, which features they support, and the overall performance of your WiFi. What is 802.11ac (WiFi 5)? 802.11ac is the 5th generation in WiFi standards and was introduced around 2013. 802.11ac is commonly referred to as WiFi 5 and was developed by the Wi-Fi Alliance to achieve gigabit speeds, meaning WiFi 5 could provide speeds up to 3.5 Gbps under optimal conditions. In addition to faster speeds, WiFi 5 offered wider WiFi frequency channels that allowed wireless devices to send and receive more data, resulting in faster overall performance. WiFi 5 (802.11ac) also introduced MU-MIMO technology that facilitated data to be sent to multiple devices simultaneously. Most notably, WiFi 5 was developed to only use the 5GHz wireless frequency, rather than both 2.4 GHz and 5 GHz frequencies. What is 802.11ax (WiFi 6)? 802.11ax, or WiFi 6, is the latest WiFi standard and is the highest performing. WiFi 6 is capable of speeds up to 9.6 Gbps which means its faster than WiFi 5, making it better for video streaming, online gaming and more high-bandwidth applications. WiFi 6 offers more efficient data management for faster speeds and supports both the 2.4 GHz and 5 GHz frequencies for faster Internet across both frequency channels. A new feature called "Targeted Wake Time (TWT)" allows your router to put the WiFi connection to "sleep" when not in use, saving the battery life of your smartphones, laptops and other connected devices until they are needed. WiFi 6 has the power to higher number of connected devices and deliver more data to those devices, meaning you will have a much faster and more efficient Internet connection to all devices. So, is WiFi 6 better than WiFi 5? Yes, but with that yes comes an explanation as to WiFi 6's key benefits and what ultimately makes it better than WiFi 5. WiFi 6's key benefits include: Next-generation WiFi technology Faster speeds and performance Can handle more connected devices without additional latency or lag Better 2.4 GHz and 5 GHz spectrum performance Increased MU-MIMO capacity from 4×4 (WiFi 5) to 8×8 (WiFi 6) More capacity to deliver more data simultaneously to many connected devices With any latest and greatest technology (wireless protocol included), increased capabilities are a given. WiFi 6 is no different. WiFi 6 offers multiple access channels, meaning one wireless channel can be divided into several different sub-channels, allowing more devices to be connected with the same fast speeds. WiFi 6 is especially useful for areas with a large number of people who are connected to WiFi and/or Internet, such as at hotels, airports, and stadiums. Additionally, WiFi 6 promises faster speeds and increased range across compatible devices, so lag-times and disrupted connectivity are things of the past. While WiFi 6 still uses 2.4 GHz and 5 GHz bands, the dual-band capacity helps more devices stream faster than they could on WiFi 5. Overall, WiFi 6 is faster, but it also is more efficient with its signal. Are WiFi 5 devices compatible with WiFi 6 devices? Even though WiFi 6 (802.11ax) has been around for over a year, it is still important to transition your WiFi 5 hardware to hardware that is compatible with WiFi 6. You will need a WiFi 6 router and modem to truly reap all the benefits of WiFi 6, regardless of how many WiFi 6 devices in your home – the router is key. If you are experiencing a slow Internet connection, consider a WiFi 6 router since it is the newest and highest performing WiFi standard on the market. Interested in learning more about WiFi 6 and Home Networking? Check out Hitron's Learn page or Blog. We live in the internet age, and almost everyone has a wireless router in their homes, helping families stay connected at all times. While Wi-Fi is a frequent term in our vocabulary, the names of the different wireless networking standards are challenging to understand and even pronounce. That is because they have complicated names invented by network engineers and corporations. Do you know what 802.11ax is? What about 802.11ac or 802.11n? To help you, I explain these terms and share the basics you need to know about each Wi-Fi standard, how they differ, and the real-life performance each of them delivers. Read this article to find the information you need: 802.11n, under its full name IEEE 802.11n-2009, is an old wireless networking standard, announced in its draft format in 2007, and finalized and published in 2009. 802.11n is also referred to as Wi-Fi 4, and it's the first standard to allow the use of two radio frequency bands: 2.4 GHz and 5 GHz. The 5 GHz band is an optional component of Wi-Fi 4, and manufacturers ignored it on many of their routers to keep costs down. However, 5 GHz was available as a differentiating feature on the more premium routers of the 802.11n era, like the ASUS RT-N56U. ASUS RT-N56U is one of the most popular 802.11n routers 802.11n is also the first wireless standard to support MIMO (multiple-input-multiple-output) - a technology that uses multiple antennas to transmit more data by combining independent data streams. MIMO was a revolutionary step in the evolution of wireless networking standards. It allowed major improvements in how data was transmitted between routers or access points and network clients in the standards that followed 802.11n. On modern Wi-Fi 6 routers, 802.11n is used for backward compatibility. Therefore, it's no longer turned on by default as the main standard for the 2.4 GHz band. However, you can use this standard by choosing 802.11b/g/n mixed as the operation mode of your router for the 2.4 GHz band. You can also set the channel width to 20 or 40 MHz (I recommend the latter for higher speed). Wi-Fi 6 routers still use 802.11n for the 2.4 GHz band 802.11ac, IEEE 802.11ac, or Wi-Fi 5 is a wireless standard developed between 2008 and 2013 and finalized in late 2013. It aimed to provide high-throughput connectivity across the 5GHZ band. Wi-Fi 5 improves the earlier 802.11n wireless standard and the MIMO technology introduced by Wi-Fi 4 with a major enhancement named MU-MIMO. MU-MIMO gives multiple devices the ability to transmit to several clients simultaneously instead of just one or to transfer data to a network client using multiple data streams at once, thus increasing the speed of the transfer. Synology RT2600ac is one of the best 802.11ac routers 802.11ac devices were split into two categories, called 802.11ac Wave 1 and Wave 2. The products sold as part of the 802.11ac Wave 1 were introduced in 2013, while the ones in Wave 2 were introduced in 2016. Wave 2 was an improved version of the 802.11ac standard and allowed routers to have higher throughput and add support for MU-MIMO: while Wave 1 routers could provide bandwidth of up to 1.3 Gbps, the ones in Wave 2 delivered bandwidth of up to 2.3 Gbps. Wi-Fi 5 allows the use of 20 MHz, 40 MHz, 80 MHz, and 160 MHz channels. However, 160 MHz became commonplace in consumer routers only with the launch of Wi-Fi 6, and most 802.11ac offered channels of up to 80 MHz. While you can still buy 802.11ac routers, they are dated for today's consumer expectations and needs. Such routers tend to have older hardware and can handle networks with fewer connected devices than modern Wi-Fi 6 routers. Wi-Fi 5 is available on all modern routers for backward compatibility purposes. If you want to set 802.11ac as the main standard for the 5 GHz band on your new Wi-Fi 6 router, choose 802.11a/n/ac mixed as the default operating mode. Wi-Fi 6 routers also use the 802.11ac standard on the 5 GHz band 802.11ax or IEEE 802.11ax, officially marketed by the Wi-Fi Alliance as Wi-Fi 6 and Wi-Fi 6E, is a standard for wireless networks that helps improve network operation in dense environments. This standard was designed to operate using the 2.4 GHz, 5 GHz, and 6 GHz bands. Wi-Fi 6 is the first standard to add a 6 GHz band, which aims to enhance the throughput per area in environments with a high density of connected devices. The most important feature of 802.11ax is orthogonal frequency-division multiple access or OFDMA, which is equivalent to cellular technology applied to Wi-Fi networks. It can operate using 20, 40, 80, and 160 MHz channels, with the key difference being that 160 MHz channels are widely adopted on Wi-Fi 6 routers for the consumer market, unlike on Wi-Fi 5 routers. Only lower-end Wi-Fi 6 routers lack 160 MHz channels. Wi-Fi 6 routers finally unlocked the 160 MHz channel bandwidth Another key feature introduced by Wi-Fi 6 is Target Wake Time. It allows network clients like smartphones and other mobile devices to wake up only when they have data to transmit to the router or access point instead of being active permanently, leading to important energy savings across the network. Lastly, security improved in 802.11ax by supporting the much more secure WPA3 encryption standard for password security. Target Wake Time optimizes energy consumption on your mobile devices The initial version of the Wi-Fi 6 standard was released in late 2019. Then, in January 2021, Wi-Fi 6 was further extended by the Wi-Fi 6E standard, which added a new 6 GHz band. More details in this article: What is Wi-Fi 6E? How does it compare to Wi-Fi 6? While Wi-Fi 6E allows routers to manage more devices and offer more bandwidth than ever with less interference, Wi-Fi 6E routers and mesh Wi-Fi systems tend to be expensive. Because of that, and the fact that you need Wi-Fi 6E compatible devices for the 6 GHz band, this standard's adoption is likely to be limited, at least in the consumer space. NETGEAR Nighthawk AXE7800 WiFi Router (RAXE300) To make things even more confusing, a Wi-Fi Certified 6 Release 2 is available as of January 2022, bringing new features that support increasing device and traffic density to deliver greater performance. One way this is achieved is by fine-tuning the MU-MIMO technology to work in an uplink direction. This means that it can be used by a router or access point to receive data from multiple clients simultaneously, not just to send data to them. Release 2 also improves the power management features of the initial release of Wi-Fi 6 to allow for extended sleep times, specific "wake up" times for transmitting data across the network, and other technical improvements. Wi-Fi Certified 6 Release 2 - Wi-Fi power saving features Ever since I started testing wireless routers in 2012, I disliked the naming conventions used by the Wi-Fi Alliance for their networking standards. They are very technical and impossible to understand by normal people with no technical knowledge. Years later, the organization understood the problem, and on October 3rd, 2018, it announced a new naming convention to make it easier for people to identify what's what. Their thinking is that Wi-Fi, followed by a number, is easy to remember, and that's true. Also, the higher the number, the newer and better the standard. Here's how the naming of wireless standards has changed as of 2018: 802.11n was turned into Wi-Fi 4 802.11ac was renamed to Wi-Fi 5 802.11ax has been named Wi-Fi 6 since its launch How wireless standards were renamed Wi-Fi 1, Wi-Fi 2, and Wi-Fi 3 do not exist as brands because they would have represented the old 802.11a, 802.11b, and 802.11g wireless standards (released in 1999 and 2003), which are no longer used by modern networks and devices. As of 2024, we will also have a new Wi-Fi 7 standard, or 802.11be, which will bring interesting developments and features. If you're curious how it will compare to the existing standards, check the table below, which presents a technical summary, courtesy of TP-Link. The future brings Wi-Fi 7 I will return with a detailed article about Wi-Fi 7 when it becomes available more widely, and I get access to routers and laptops with Wi-Fi 7, to test and understand this standard more thoroughly through personal experience, not just dry theory. If you read the specifications of each Wi-Fi standard and the maximum theoretical speed that each can achieve, you might believe you'll get some outstanding speeds for your Wi-Fi. However, the real-life experience differs greatly from what the maximum theoretical data rates tell us. To better understand what to expect and see just how fast Wi-Fi 6 is versus Wi-Fi 5 and Wi-Fi 4, I took two TP-Link routers and made a detailed performance comparison: Wi-Fi 6 vs. Wi-Fi 5 vs. Wi-Fi 4 on TP-Link routers. Wi-Fi 6 vs. Wi-Fi 5 vs. Wi-Fi 4 on TP-Link routers While routers from other brands will give you a slightly different experience, this analysis is representative of the actual speed differences people are likely to get in their homes and offices. All modern wireless routers emit their signal using multiple Wi-Fi standards simultaneously. For example, Wi-Fi 6 routers emit their signal on the 2.4 GHz frequency band using both 802.11ax and 802.11n simultaneously for compatibility purposes. This way, they ensure that older devices in your home can connect, even though they are incompatible with Wi-Fi 6. The same is true for the 5 GHz band; most routers emit their wireless signal using 802.11ac and 802.11ax simultaneously to provide maximum compatibility with the devices in your home. Wi-Fi 6 routers use both 802.11ax and 802.11n on the 2.4 GHz band You can set most routers to use only one standard on each of their bands. For example, I can disable 802.11ax on the 2.4 GHz band on just about any ASUS Wi-Fi 6 router and use only 802.11n to emit their signal. If you have a quad-band router like the ASUS ROG Rapture GT-AXE16000 or a tri-band router, you can set each band to use a completely different standard: Wi-Fi 4 on the 2.4 GHz band for maximum compatibility with old devices that don't work with Wi-Fi 6; Wi-Fi 5 on the first 5 GHz that this router provides. Again, the reason is to maximize compatibility for older devices working with the 802.1ac standard but not 802.11ax. Wi-Fi 6 on the second 5 GHz band, so that newer devices can take advantage of this standard's speed and bandwidth improvements. Wi-Fi 6E on the 6 GHz band for devices that work with this standard. ASUS ROG Rapture GT-AXE16000 - a powerful quad-band Wi-Fi 6E router Now you know all the basics about the different wireless standards used today, how they were named and subsequently renamed, and what they offer compared to the previous versions. Before closing this article, let me know if you have any questions left unanswered. I'm also curious about the router you're using in your home: is it an older Wi-Fi 5 router? Or is it a newer Wi-Fi 6 or Wi-Fi 6E router? Comment using the options below, and let's discuss. Wireless standards documents can be hundreds of pages long and fraught with technical minutiae. But the important highlights generally boil down to a short list of talking points that differentiate one standard from its predecessor. With the buzz about the latest Wi-Fi standard — 802.11ax, also known as Wi-Fi 6 — it's worth examining the new standard versus its predecessor, 802.11ac, also known as Wi-Fi 5. As we compare 802.11ac vs. 802.11ax, some important differences emerge between the two specifications. Where 802.11ac was considered evolutionary, 802.11ax has sometimes been labeled revolutionary. Even if that sounds grandiose, the new .11ax magic is different enough in several technical constructs to warrant scrutiny and to appreciate the real changes under the hood versus past standards. Some of the key differences between 802.11ac and 802.11ax include the following: frequency bands; spatial streams; maximum data rates; modulation; and overall performance at the same power levels. Let's start with the spectrum in play for 802.11ac vs. 802.11ax. Many people don't realize, when they buy a dual-band .11ac access point (AP), that the 2.4 GHz band reflects a much older standard — namely 802.11n. Why? 802.11ac operates only in the 5 GHz band, while 802.11ax works in both the 2.4 GHz and 5 GHz bands. Additionally, while the .11ac standard allowed up to eight spatial streams, the hardware market stagnated at four. For 802.11ax, eight spatial stream APs are theoretically possible. The significance here is that 802.11ac never got close to delivering its maximum potential of 6.9 Gbps because of hardware limitations. By contrast, .11ax is better positioned to deliver its own maximum of 9.6 Gbps, albeit under ideal conditions that most of us still may never achieve. One factor that prevailed in the earliest versions of the 802.11 standard also holds true in 802.11ax. In a well-designed Wi-Fi network, you can generally expect to see better data rates at the same ranges and power levels as the technology you are replacing. Simply put, you can expect better cell quality. Now to the nitty-gritty of what makes performance gains possible when considering 802.11ax vs. 802.11ac: You'll see the 4x multiplier used fairly frequently when comparing the specifics of the two standards. For example, .11ax, at its best, uses 1024 quadrature amplitude modulation, as opposed to .11ac's 256 QAM scheme. This means the symbol duration for .11ax is four times wider than .11ac, which lets more data pass through in a given operational time slot. Then, there is nearly a 4x reduction in spacing between the modulated sub-carriers in .11ax, meaning that more spectrum is actually used for data transfer and less for management. When comparing 802.11ac vs. 802.11ax, other significant developments include the following: the use of orthogonal frequency-division multiple access, which lets an AP service multiple wireless clients at different bandwidth requirements simultaneously; a new battery-preserving power-save methodology aimed at IoT devices; bidirectional improvements in multiuser multiple input, multiple output radio processes; and a feature called basic service set (BSS) coloring, which deals with co-channel interference. As good as 802.11ac is, it has no effective way to deal with interference from neighboring cells on the same channel, which can translate into reduced performance. BSS coloring in 802.11ax adds a field to the wireless frame that overcomes issues associated with same-frequency cell coexistence, leading to increased overall capacity. As you can see, 802.11ax has some powerful features, which is impressive when you consider that 802.11ac, as a standard, is no slouch. 802.11ac and 802.11ax are both Wi-Fi standards, with 802.11ax being the newer and more advanced version. 802.11ac operates on the 5GHz frequency band and can provide speeds of up to 3.5 Gbps, while 802.11ax operates on both the 2.4GHz and 5GHz bands and can provide speeds of up to 10 Gbps. 802.11ax also offers improved efficiency and performance in high-density environments, making it ideal for crowded areas like airports or stadiums. Overall, 802.11ax is the more advanced and faster option compared to 802.11ac. When it comes to wireless networking standards, 802.11ac and 802.11ax are two of the most popular options available today. Both standards offer significant improvements over their predecessors, but they also have some key differences that set them apart. In this article, we will compare the attributes of 802.11ac and 802.11ax to help you understand which one may be the best choice for your networking needs.SpeedOne of the most important factors to consider when comparing wireless networking standards is speed. 802.11ac, also known as Wi-Fi 5, offers maximum theoretical speeds of up to 1.3 Gbps on the 5 GHz band. This makes it a great choice for applications that require high bandwidth, such as streaming video or online gaming. In comparison, 802.11ax, or Wi-Fi 6, offers even faster speeds, with maximum theoretical speeds of up to 9.6 Gbps. This makes it ideal for environments with a high density of connected devices, such as busy offices or public spaces.EfficiencyAnother important factor to consider when comparing wireless networking standards is efficiency. 802.11ac uses a technology called MU-MIMO (Multi-User, Multiple Input, Multiple Output) to allow multiple devices to communicate with the router simultaneously, reducing latency and improving overall network performance. However, 802.11ax takes this a step further with the introduction of OFDMA (Orthogonal Frequency Division Multiple Access), which divides each channel into smaller sub-channels to allow more devices to communicate at the same time. This makes 802.11ax more efficient than 802.11ac, especially in crowded environments.RangeWhen it comes to range, both 802.11ac and 802.11ax offer improvements over previous wireless networking standards. 802.11ac uses beamforming technology to focus the signal towards connected devices, improving range and reliability. This makes it a great choice for larger homes or offices where coverage can be an issue. 802.11ax also supports beamforming, but it takes things a step further with the introduction of BSS Coloring, which helps reduce interference from neighboring networks. This can further improve range and reliability, especially in areas with a high density of wireless networks.CompatibilityCompatibility is another important factor to consider when choosing a wireless networking standard. 802.11ac is widely supported by most modern devices, including smartphones, laptops, and tablets. This makes it a great choice for users who want to take advantage of the latest wireless technology without having to upgrade all of their devices. On the other hand, 802.11ax is a newer standard that is still being adopted by device manufacturers. While support for 802.11ax is growing, it may not be compatible with all of your existing devices, so it's important to consider this when making your decision.SecuritySecurity is always a top priority when it comes to wireless networking, and both 802.11ac and 802.11ax offer strong security features to help protect your network. 802.11ac supports WPA2 encryption, which is considered to be highly secure and difficult to crack. In comparison, 802.11ax supports WPA3 encryption, which offers even stronger security features, such as individualized data encryption and protection against brute force attacks. This makes 802.11ax a great choice for users who prioritize security and want to ensure that their network is protected from potential threats.ConclusionIn conclusion, both 802.11ac and 802.11ax offer significant improvements over previous wireless networking standards, but they also have some key differences that set them apart. 802.11ac is a great choice for users who prioritize speed and compatibility, while 802.11ax is ideal for users who need faster speeds and improved efficiency in crowded environments. Ultimately, the best choice for you will depend on your specific networking needs and the devices you plan to connect to your network. We hope this article has helped you understand the attributes of 802.11ac and 802.11ax so you can make an informed decision when choosing a wireless networking standard. Comparisons may contain inaccurate information about people, places, or facts. Please report any issues. Wi-Fi technology has transformed the way of internet communication and it's been evolving over the years. All major updates are based on the IEEE 802.11 standards and the Wi-Fi 6 is the new sensation in the market. However, the previous generation i.e. Wifi 5 has not moved out from the market and is still in use and performing well. In this article, we will see what are the major differences between Wi-Fi 5 (802.11ac) and Wi-Fi 6 (802.11ax). What is Wi-Fi 5 (802.11ac)?Wi-Fi 5, also known as 802.11ac is the 5th generation of IEEE 802.11 standards. Wi-Fi 5 provides faster data transfer compared to it's previous generation 802.11n. It mainly operates on a 5GHz band and has support for older Wi-Fi standards. What is Wi-Fi 6 (802.11ax)?Wi-Fi 6 or 802.11ax is the next generation of Wi-Fi 5 with several improvements. It operates on 5GHz and 2.4GHz bands and provides better speed and connectivity than previous generations. Wi-Fi 6 also supports advance technologies like OFDMA and TWT with support for MU-MIMO. MU-MIMO: MU-MIMO stands for Muti-User, Multiple Input, Multiple Output. This technology allows Wi-Fi routers to communicate with multiple devices at the same time and not compromise in terms of efficiency and latency.OFDMA: OFDMA stands for Orthogonal Frequency Division Multiple Access. This enables more efficient data transmission by dividing the wireless channels into multiple smaller sub-channels which allows multiple devices to transmit data simultaneously.Differences Between Wi-Fi 5 and Wi-Fi 6Aspect Wi-Fi 5 (802.11ac) Wi-Fi (802.ax) Wi-Fi standards Based on IEEE 802.11, named as 802.11ac Based on IEEE 802.11, named as 802.11ax Frequency Bands Supports 5GHz and 2.4 GHz bands Supports 5GHz, 2.4GHz and 6GHz band Power efficiency Better power efficiency than previous generations. Better efficiency than Wi-Fi 5 with support for Target Wake Time Network Security Supports WPA2 and WPA3 protocol Supports enhanced WPA3 standards Multi-user Support Supports MU-MIMO for multi-user connectivity Supports MU-MIMO and OFDMA for better connectivity Compatibility Compatible with older internet technologies like 802.11a Supports old standards but both router and device need to be Wi-Fi 6 compatible for a better experience. ConclusionWi-Fi 6 is a new technology compared to Wi-Fi 5 and has significant advancements in wireless connectivity, networking experience, and reduced latency. This makes Wi-Fi 6 to be better compatible with modern internet devices. However, Wi-Fi 5 will remain in the picture for quite some time. We are always here to help! Contact us