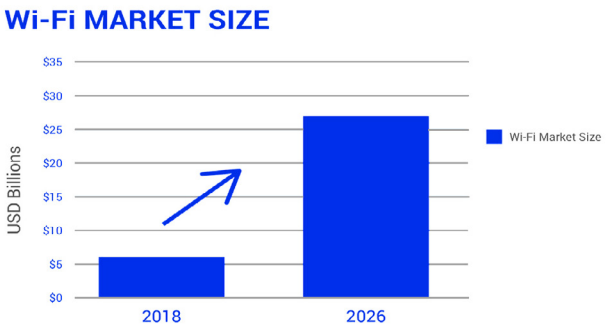
Improving Wi-Fi Capacity and Efficiency in the Connected Home with Wi-Fi 6

Wi-Fi continues to grow in popularity around the globe.[1]

For in-home networks, Wi-Fi has become virtually indispensable. Nearly 89 percent of U.S. broadband households rely exclusively on wireless connectivity versus wired connections.[2] And the Wi-Fi market is projected to reach $31 billion in the next four years.[3]

With an estimated 549 million Wi-Fi hotspots worldwide and a 75% increase in mobile device traffic from just eight years ago, today Wi-Fi delivers nearly 55% of all internet traffic.



Source: Wi-Fi Market by Component (Solutions and Services), 2017-2026, Reports & Data, February 2019; https://www.reportsanddata.com/report-detail/wi-fi-market

Wi-Fi Usage Is Evolving Rapidly

It's not just that more of us are using Wi-Fi; the way we are using it is also undergoing major changes. For one thing, we're buying more connected devices than ever before, and that number is growing rapidly. Today, approximately 15 billion IoT devices are connected to the internet—a number expected to double in less than a decade.[4] And over 86 percent of the world's population owns a smartphone, which equals nearly 7 billion users.[5] From phones and tablets to wearables, gaming systems, smart TVs, security systems, light bulbs, locks, thermostats, and more, the need for Wi-Fi connectivity increases year over year.

In addition to more devices, the applications that are being used in these increasingly connected homes are evolving, too, and having a major impact on how Wi-Fi is used. With the growing popularity of bandwidth-intensive applications like 4K and 8K video, video conferencing, and even virtual and augmented reality, requirements for Wi-Fi speed, performance and coverage (not to mention user expectations) have never been higher.

Yet Wi-Fi Is Not Without Its Challenges

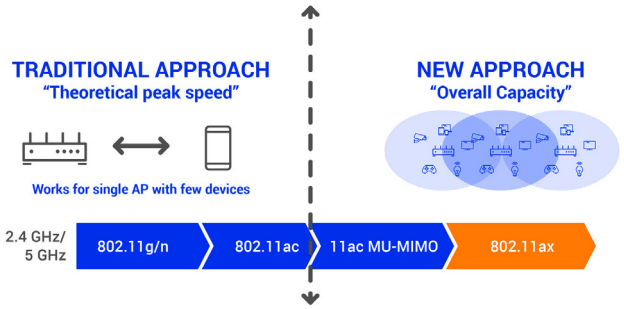
While Wi-Fi continues to grow in popularity, users are also facing numerous challenges. With the sheer number of Wi-Fi hotspots in operation, especially in densely populated urban areas, interference from nearby access points is a key challenge. As users connect more and more devices, congestion is another factor affecting quality of experience in Wi-Fi networks, whether in the home, the enterprise or outdoor public spaces like university campuses or sports stadiums.

And those bandwidth-hungry applications? They depend on higher speeds and reliability. For users, this combination of interference, congestion, and the increased load on the network from applications is having a detrimental effect on the Wi-Fi experience.

Fortunately, Wi-Fi continues to evolve with Wi-Fi 6.

What Is Wi-Fi 6?

Wi-Fi 6 (IEEE 802.11ax), known as High Efficiency Wireless, is a recent evolution in wireless connectivity. Compared to its predecessors, Wi-Fi 6 takes a different approach to Wi-Fi performance. While previous releases of the standard focused on achieving theoretical peak speeds under good conditions, Wi-Fi 6 targets improved performance and capacity in real-world conditions. Part of this improvement involves a fourfold increase in peak speeds, as well as Wi-Fi 6 support for both the 2.4 GHz and 5 GHz bands. But the primary purpose of this release is to increase the capacity of Wi-Fi networks and improve their efficiency, particularly in dense environments where devices with different usage profiles are connecting at varying distances.



Key Benefits

- Supports both 2.4 GHz and 5 GHz bands
- Better performance in dense environments
- Increased network efficiency
- Extended battery life for connected devices
- Backwards compatibility with 802.11a/b/g/n/ac
- Faster throughput

Key Wi-Fi 6 Features

While Wi-Fi 6 offers more advanced features than previous iterations, the following features make the biggest impact by improving connectivity efficiency and quality as Wi-Fi density continues to grow.

MU-MIMO

The Multi-user, Multiple-Input, Multiple-Output (MU-MIMO) feature was first introduced in 802.11ac to enable simultaneous transmission of data streams from an access point to multiple clients. In 802.11ac, the maximum number of data streams supported by MU-MIMO was four. In Wi-Fi 6, the maximum is increased to eight simultaneous data streams. By serving up to eight users simultaneously, MU-MIMO in Wi-Fi 6 boosts capacity and enables more efficient spectrum use.

MU-MIMO UPLINK SUPPORT

In addition to doubling the number of simultaneous transmissions, the new standard adds support for full-duplex MU-MIMO transmissions. While the 802.11ac standard supports MU-MIMO on the downlink, Wi-Fi 6 adds support for this feature on the uplink as well. This means an access point can transmit to multiple clients simultaneously and also receive from multiple clients simultaneously.

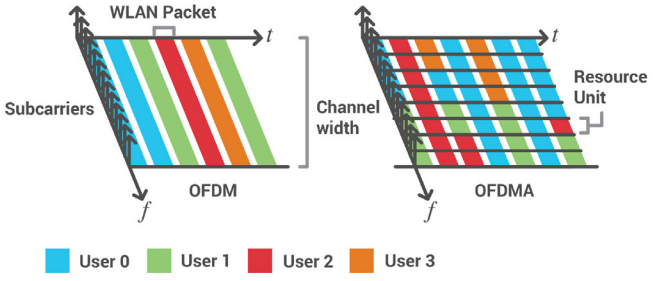
Given the growth of bandwidth-intensive uplink activities—such as video uploads to YouTube, cloud storage, video conferencing and live streaming on social media apps like Facebook and Periscope—MU-MIMO uplink support promises to substantially improve performance.

DOWNLINK AND UPLINK OFDMA

Wi-Fi 6 introduces an important new feature called orthogonal frequency-division multiple access (OFDMA). OFDMA allows multiple users with varying bandwidth needs, including Internet of Things (IoT) devices, to be served by the access point simultaneously on both the downlink and the uplink.

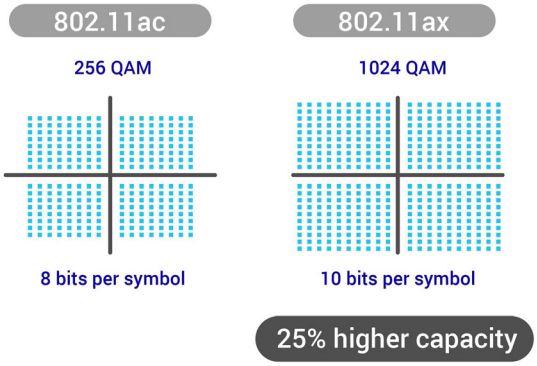
OFDMA accomplishes this by breaking a Wi-Fi channel into subcarriers called resource units (RU). Each RU carries data from different devices connected to the access point. Users no longer have to compete with one another to send data because the access point now manages this process using OFDMA.

OFDMA is particularly beneficial for clients transmitting short packets and for lowbandwidth IoT devices. Overall, it results in better frequency reuse, reduced latency, and increased efficiency.



HIGHER-ORDER MODULATION (1024 QAM)

The Wi-Fi 6 standard increases quadrature amplitude modulation (QAM) to a maximum of 1024 QAM, up from 256 QAM in 802.11ac. This represents an increase from 8 bits per OFDM symbol to 10 bits per symbol, which overall translates into a 25 percent boost in peak rates and spectral efficiency when the signal level is high and noise low.



BSS COLORING

Basic Service Set (BSS) coloring is a Wi-Fi 6 feature that optimizes air-time transmission in high interference environments. By inserting a 6-bit BSS identifier in the preamble, the access point and its clients can see packets from their own BSS and ignore packets from any overlapping BSS (OBSS). In a typical environment, the signal strength of an access point's own BSS is better than that of the OBSS. As a result, the access point and clients will continue their communication on top of the OBSS traffic. Similarly, the signal from the OBSS network will likely be stronger among its own access point and clients. As such, the BSS coloring feature provides an improvement over the conventional listen before talk (LBT) method, by enabling the BSS and OBSS to continue communicating with their clients without losing airtime.

IMPROVED OUTDOOR PERFORMANCE

Wi-Fi 6 also has several features that improve Wi-Fi performance and efficiency in outdoor environments. Subcarrier spacing, for example, is four times narrower.

This enables transmission of more data within the same channel bandwidth for higher spectral efficiency. Wi-Fi 6 also increases the guard interval, which allows for transmission over larger distances by improving the management of fading and inter symbol interference and collision.

The standard also adds support for a new packet type specifically for use in outdoor environments. This packet, the High Efficiency Extended Range Single User PPDU (HE ER SU), is used for extended range single-user transmission only (to a single STA or the access point).

REDUCED POWER CONSUMPTION

One of the goals of Wi-Fi 6 is to reduce the power consumption of connected devices. This applies to devices that are connected to the network for long periods of time, such as laptops and smart phones, but is especially relevant for smart IoT devices, which typically have limited coin cell battery with lower data rates than other connected devices and also transmit data less frequently than other connected devices.

To address the unique requirements of these devices, Wi-Fi 6's target wait time (TWT) feature makes it possible for devices to remain powered off when they are not transmitting data. TWT allows devices to negotiate with the access point to determine how often they will wake up to send or receive data.

Depending on the frequency with which they transmit data, these devices could potentially sleep for hours or days at a time to conserve battery life. With TWT, their wake time is greatly reduced, cutting power consumption and substantially extending battery life.

NARROW CHANNELS

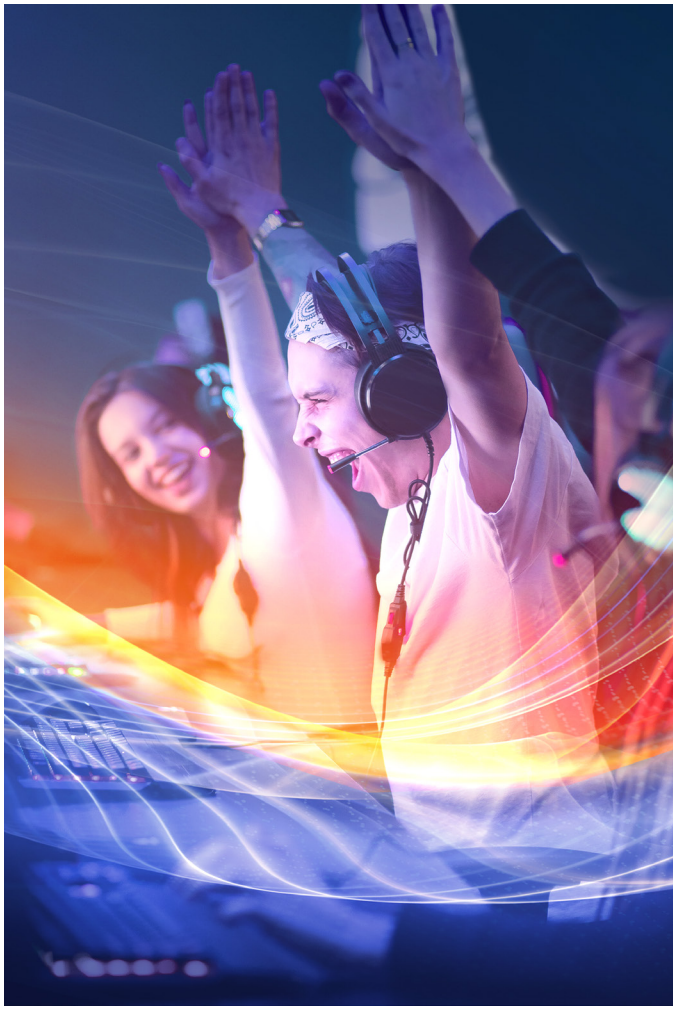
The Wi-Fi 6 standard also adds support for narrow 2 MHz and 5 MHz channels. These channels are particularly useful for low power mobile devices and for devices that typically transmit small amounts of data, such as IoT sensors or actuators.

The use of 2 MHz or 5 MHz channels increases transmission range by 9 dB or 6 dB (respectively) over the use of 20 MHz channels. This substantial increase in transmission range allows communication into hard-to-reach locations where IoT devices may need to operate.

What Are the Benefits Of Wi-Fi 6 for Service Providers?

For service providers, Wi-Fi 6 promises several important business benefits:

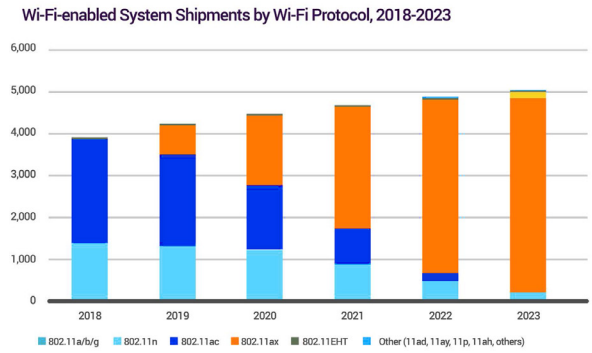
- A Wi-Fi 6 router offers on average 30 percent better rate and reach compared to earlier generation Wi-Fi 5 (11ac) technology. This substantially increases user experience.
- Stay on the cutting edge. Providing subscribers with the latest Wi-Fi hardware enables service providers to stay ahead of the competition, whether from traditional competitors or manufacturers of consumer Wi-Fi solutions.
- Provide a superior user experience. Not all Wi-Fi solutions are created equal, and service providers who offer carrier-grade, Wi-Fi 6-compatible hardware, especially as part of a Managed Wi-Fi package, will differentiate themselves with a Wi-Fi experience that is second to none.
- Drive demand for bandwidth. New technologies like Wi-Fi 6, which improve Wi-Fi performance, also drive higher bandwidth consumption among subscribers. This in turn drives increased demand for premium high-speed Internet and Managed Wi-Fi packages.
- Increase revenue. Providing the latest Wi-Fi technology to subscribers enables service providers to recover the money subscribers would otherwise spend on consumer Wi-Fi solutions that support Wi-Fi 6.



The Time to Deploy Wi-Fi 6 Is Now

Even as Wi-Fi 7 is starting to be incorporated in new technology, Wi-Fi 6 is still the standard in numerous device categories, including smartphones, tablets, PCs, networking products, and home entertainment devices. Nearly 4 billion Wi-Fi enabled devices are estimated to ship this year, and two-thirds of those devices will be Wi-Fi 6 or 6E. [6]

The sooner service providers can put a firm plan in place to roll out carrier-grade Wi-Fi 6 hardware to their subscribers, the better they will be prepared to combat competition from other service providers and Wi-Fi 6-compatible consumer devices.[7]



In conclusion...

With subscriber demand for bandwidth showing no signs of letting up, and the connected home continuing to grow in popularity and sophistication, service providers need to focus on providing the best possible Wi-Fi experience for their subscribers. While there are many components of a successful residential Wi-Fi offer, providing carrier-class Wi-Fi premises equipment that leverages the latest standards is critical. With its exciting new features focused on efficiency and performance in dense realworld Wi-Fi environments, Wi-Fi 6 gives service providers the ability to combat intense competition in the market, provide a superior Wi-Fi experience and increase high-speed Internet service revenues.

WI-FI 6 SUPPORT IN CALIX PRODUCTS

Calix GigaSpire BLAST u6.1, u6.2 and u4 systems are not typical residential gateways; they are premium smart home systems that support the latest and greatest Wi-Fi 6 technology (802.11ax).

Featuring comprehensive Wi-Fi 6 features—such as beamforming, enhanced security, and faster throughput—the Calix GigaSpire BLAST systems provide the ultimate user experience. “ to “Featuring comprehensive Wi-Fi 6 features—such as beamforming, enhanced security, and faster throughput—the Calix GigaSpire BLAST systems are Wi-Fi 6 certified, providing the ultimate user experience.

Calix stays on the cutting edge of technology and incorporates the latest standards into our solutions. You can trust Calix to serve your needs today and in the future.

For more information, visit Calix.com

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