eero

Why Wi-Fi 7 is critical for ISPs in the gigabit+ era

WHITE PAPER

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Executive summary

Today, customers are using an increasing amount of bandwidth-intensive and latency-sensitive applications, such as 4K and 8K streaming, online gaming, and AR/VR applications. As a result, internet service providers (ISPs) across North America are upgrading their broadband networks with the latest access technologies, such as DOCSIS 4.0, 5G FWA, and XGS-PON, in order to bring faster speeds to homes and businesses. With Wi-Fi 7 technology,[1] residential and SMB consumers have access to blanketed multi-gigabit connectivity—so ISPs must provide wifi that delivers on customers' expectations.

New high-performing devices that support Wi-Fi 7—such as Motorola Edge+ and OnePlus 11 5G (both powered by the Qualcomm® FastConnect™ 7800 system) and access points like eero's tri-band Wi-Fi 7 mesh wifi system, eero Max 7—are continuously coming to market.[2] By 2027, IDC and Gartner predict that Wi-Fi 6E and Wi-Fi 7 smartphones will reach 50% of all smartphone shipments.[3] Wi-Fi 7 technology provides two main enhancements: an increase in channel bandwidth from 160 MHz to 320 MHz, which doubles throughput, and 4K-QAM (4096-Quadrature Amplitude Modulation), which enables each symbol to carry 12 bits rather than 10 bits—resulting in two new modulation coding types (MCS 12 and 13) that can provide up to 20% higher transmission rates than Wi-Fi 6.

In this white paper, we discuss how customers' networking demands are evolving and how Wi-Fi 7 can help meet their needs. We also demonstrate how eero's patented TrueMesh technology—which has been the foundation of eero since the company's founding—ensures that customers have a fast, reliable internet experience. eero Max 7 brings TrueMesh together with Wi-Fi 7 technology to dramatically increase speeds when compared to previous generations of wifi technology (up to 60% for a single client and 100% for a multi-client not using TrueMesh). As a result, customers can enjoy consistent multi-gigabit experiences throughout their homes and businesses.

[1] Wi-Fi 7 is a trademark of the Wi-Fi Alliance.

[2] Smartphone Device Finder, Qualcomm Technologies

[3] IDC Worldwide Wi-Fi Technology Forecast 2023-2027, March 2023

1. A changing landscape

1.1 Usage trends

The number of connected devices and applications in the home requiring high bandwidth and low latency has been growing.[4] U.S. households using broadband internet now own an average of 20 connected devices, including smart home devices such as gaming consoles and connected consumer electronics like smart door locks. Extended reality (XR), online gaming, and 4K and 8K TVs need high-performing wifi networks to provide the level of quality that customers demand; new consumer habits have an increased reliance on collaborative workspace platforms, reliable video calls, high-quality gaming, and much more.

According to OpenVault, the average bandwidth usage across U.S. broadband households was a staggering 533.8 GB in Q2 2023, up from 513.8 GB in Q2 2022.[5] Video streaming represents the lion's share of traffic origination, generating 48% of internet traffic.[6] Gaming and immersive experiences have been on the rise as well, which leads to more users needing to access faster wifi speeds.

Bain & Company found that the gaming industry's growth has accelerated because of the unprecedented engagement from teenage gamers who spend about 40% more time in video game environments than in using other media.[7] The report also forecasts that global revenue for video gaming could increase by another 50% over the next five years. Because Wi-Fi 7 will be beneficial for speed and bring near-zero latency, we think the technology will allow game developers to break new barriers with immersive experiences.

Figure 1: 2022 internet traffic usage by category

App Category Total Volume

2022 Categories	Total Volume
Video	65.93%
Marketplace	5.83%
Gaming	5.58%
Social Networking	5.26%
Cloud	4.98%
Web Browsing	4.63%
File Sharing	3.39%
Messaging	2.30%
VPN	1.13%
Audio	0.95%

Source: Sandvine Global Internet Phenomena Report, January 2023

1.2 Device trends

There are a growing number of Wi-Fi 7 generation devices, with over 200 client devices launched or in development using the Qualcomm® FastConnect™ 7800, a wifi and Bluetooth connectivity system.[8] IDC predicts that Wi-Fi 6E- and Wi-Fi 7-enabled smartphone shipments will reach 50% of all smartphone shipments by 2027, up from 20% in 2023.[9]

Advancements in AI are also fueling the demand for fast, reliable connectivity—with technologies like virtual assistants and autonomous systems reliant on processing data in real time in order to work efficiently.[10] As digital immersion is expected to revolutionize the online experience for homes, wifi speeds and solutions supporting low, stable latency will be stretched to the limit. Remote rendering requires significant capacity and sub-5ms latency,[11] which will only be possible with the most efficient spectrum usage and scheduling techniques that Wi-Fi 7 technology provides.

[4]Deloitte's Connectivity & Mobile Trends Survey, 2021

[5]OpenVault Broadband Report, 2Q 2023

[6]Sandvine Global Internet Phenomena Report, January 2023

[7]Level Up: The Future of Video Games Is Bright, published by Bain & Company, October 12, 2022

[8]Qualcomm Technologies data, September 2023

[9]IDC Worldwide Wi-Fi Technology Forecast 2023-2027, March 2023

[10]FTTH Broadband and the Advancement of Artificial Intelligence AI, Utilities One, August 2023

[11]"Extended Reality in the Congested Enterprise" presentation from Global Congress Americas, June 2023

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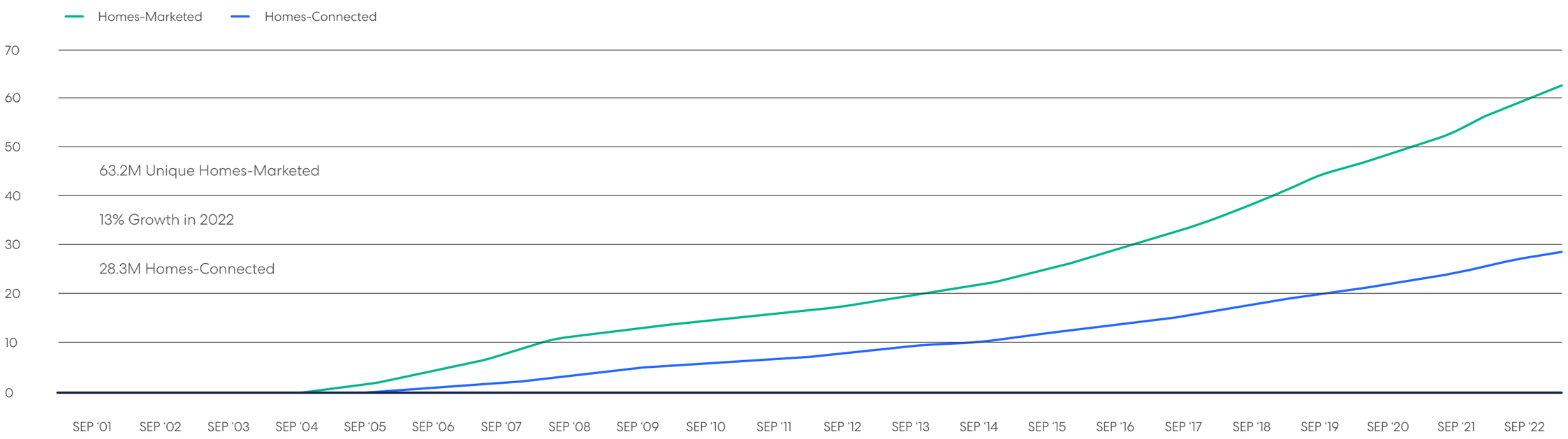
1.3 Emerging technologies for ISPs

The ISP business is being transformed to support multi-gigabit speeds with the latest access technologies, DOCSIS 4.0 and XGS-PON fiber. The Internet & Television Association (NCTA), citing the FCC, reports that gigabit broadband service will be available from cable providers to 97% of the locations they serve by the end of 2023.[12]

DOCSIS 4.0[13] will bring lower latency levels and higher security to cable's hybrid fiber-coaxial (HFC) networks so that operators can offer more advanced experiences (such as multiplayer online gaming, AR/VR, 8K video, and more) to their customers. Using coaxial cabling, DOCSIS 4.0 will enable up to 10 Gbps downstream rates and 5 Gbps upstream rates. XGS-PON takes broadband speeds to a whole new level by providing up to 10 Gbps transmission speeds.[14] The figure below shows the impressive growth of homes connected and those marketed with fiber to the home (FTTH).

As broadband infrastructure continues to be upgraded, more and more consumers are migrating to higher-speed plans; the gigabit tier now constitutes nearly 32% of all subscribers at the end of 2023, more than doubling in size year over year.[15] A Wireless Broadband Alliance report found that 41% of ISPs, network operators, and chipset vendors plan to deploy Wi-Fi 7 by the end of 2024.[16] As ISPs upgrade their networks to deliver multi-gigabit speeds, they must ensure that the wifi is capable of delivering these speeds to customers. Wifi performance and user experience are often compromised by radio frequency interference (RFI), such as noise and congestion. When faced with a poor connectivity experience, subscribers are more likely to churn to another provider[17] if their connectivity issues are recurring and/or met with poor customer service. Wi-Fi 7 technology can mitigate these risks and will become an integral part of multi-gigabit offerings from ISPs.

Figure 2: U.S. unique FTTH deployments



Source: RVA LLC Market Research

[12] New FCC Data Confirms Cable Gigabit Speeds Are Deployed Equitably, published by NCTA—The Internet & Television Association, 2023

[13] DOCSIS® 4.0 Technology, CableLabs

[14] 10 Gbps Symmetrical with XGS-PON, Broadband Library

[15] OpenVault Broadband Report, 2Q 2023

[16] Wi-Fi 7 on track to nearly 50% adoption by 2024-end, says WBA, RCR Wireless News, December 2023

[17] Managed Home Wi-Fi Networks for the Smart Home 2020-2025 Report, Maravedis, November 2019

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2. Wi-Fi 7 technology

Wi-Fi 6 technology brought new game-changing features, including access to 160 MHz channel bandwidth, OFDMA (Orthogonal Frequency-Division Multiple Access), and 1K-QAM (1024-Quadrature Amplitude Modulation) to improve spectral efficiency and boost speed and support for devices within a confined area. Wi-Fi 6E also introduced the use of the 6 GHz band (which has a 1.2 GHz spectrum, available in the U.S.)—a spectrum revolution in itself. Wi-Fi 7 technology builds on these contributions with several new benefits.

2.1 The benefits of Wi-Fi 7 technology explained

Double the throughput and speeds of Wi-Fi 6

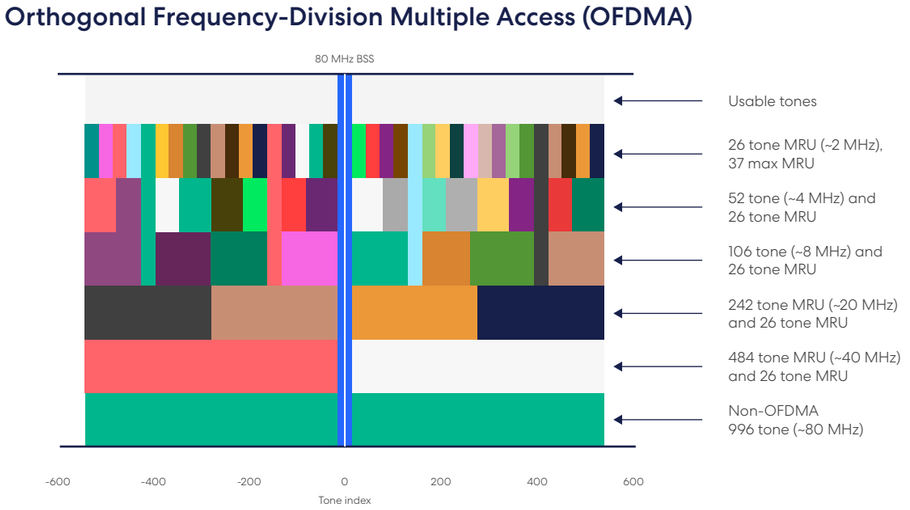
The Wi-Fi 7 protocol increases potential channel bandwidth to 320 MHz for the 6 GHz band. Doubling the channel bandwidth to 320 MHz translates into double the throughput, which results in double the speed for Wi-Fi 7-capable devices across the 6 GHz band. Spectrum puncturing—which prevents interference found in the channel from blocking the remainder of the channel—can be also used to dedicate up to 240 MHz in the 5 GHz band to support access and backhaul in a mesh topology.[18]

The Modulation Coding Scheme (MCS) index is the maximum throughput rate defined by modulation type and coding rate. With Wi-Fi 7 technology—which introduces 4K-QAM as a key enhancement—MCS values can theoretically reach 13, with a maximum throughput of 4.3 Gbps.[19] MCS 12 and 13 have the potential to deliver a 20% increase in throughput over Wi-Fi 6; however, in order to reach MCS 13, users must be three to five feet away from the access point in a clean radio frequency (RF) environment and adjust the orientation of their phone or laptop to a specific position.

Lower latency and greater efficiency

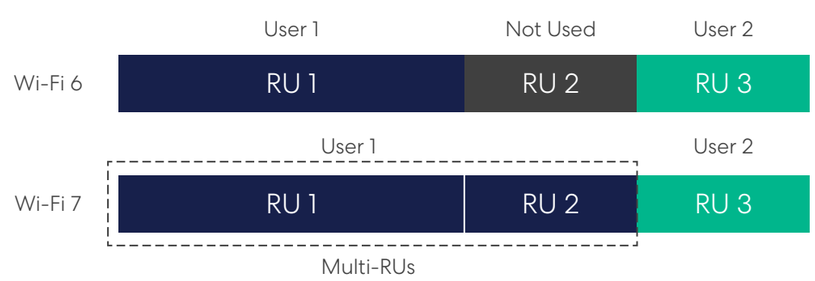
Another key benefit of Wi-Fi 7 is Multiple Resource Units (MRUs). This is a new feature that builds on OFDMA by allocating MRUs to the same client. MRUs ultimately help reduce wait times and lower latency, which ultimately increases efficiency.[20]

Figure 3: OFDMA



Source: eero

Figure 4: Example of Mutiple Resource Unit



Source: Qualcomm Technologies

Multi-Link Operation (MLO)

Wi-Fi 7 technology also provides MLO, a feature that enables access points and stations to transmit and receive data from the same traffic flow over multiple radio interfaces.[21] MLO can increase capacity, for instance, by bonding two radios and bands together: the 5 GHz and 6 GHz bands, the 2.4 GHz and 5 GHz bands, or the 2.4 GHz and 6 GHz bands. A two-stream client using the 5 GHz and 6 GHz bands could theoretically support throughputs of 6.4 Gbps to a single device: 4.3 Gbps in a 320 MHz channel within the 6 GHz band and 2.1 Gbps in a 160 MHz channel within the 5 GHz band.

[18] How Wi-Fi 7 adaptive puncturing in DFS channels can maximize mesh performance in the 5GHz band, Qualcomm OnQ Blog, March 2023

[19] Wi-Fi Unleashed: Wi-Fi 7, 6 GHz, and Beyond, Intel, June 2022

[20] Wi-Fi 7 (802.11be) Highlights, Wi-Fi Vitae

[21] Wi-Fi 7 — unlocking the next level of Wi-Fi performance, Qualcomm Technologies

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3. The eero difference

At eero, our vision is to deliver wifi the way it should be—for every home and business. eero Max 7, eero's first Wi-Fi 7-enabled mesh system, brings the company's patented TrueMesh networking technology together with Wi-Fi 7 to dramatically increase speeds, avoid interference from neighboring networks, and improve mesh latency. Built with Qualcomm Technologies' leading Qualcomm Networking Pro 1220 Platform, eero Max 7 sets a new bar for performance and can deliver the fastest speeds eero customers have ever experienced.

3.1 Fast, reliable speeds

eero Max 7 supports the 2.4, 5, and 6 GHz radio bands, and delivers wireless speeds up to 4.3 Gbps (throughput) and wired speeds up to 9.4 Gbps—to provide fast speeds in every corner of your space. With two 10 GbE ports and two 2.5 Gigabit Ethernet ports, it can support multiple wired devices and enable customers to take advantage of internet plans up to 10 Gbps. And with Wi-Fi 7 technology, eero users can expect, on average, 2.6 Gbps real throughput at MCS 6 in 90% of scenarios in a typical 2,500-square-foot home or business.[22] This is almost three times more than the average customer throughput of 1 Gbps experienced using Wi-Fi 6, according to eero's calculations.

Figure 4: Wireless max speeds for a 2x2 client

	Wi-Fi 5 11ac 2x2 80 MHz Client		**Wi-Fi 6** 11ax 2x2 80 MHz Client		**Wi-Fi 6/6E** 11ax 2x2 160 MHz Client		**Wi-Fi 7** 11be 2x2 80 MHz Client		**Wi-Fi 7** 11be 2x2 160 MHz Client		**Wi-Fi 7** 11be 2x2 320 MHz Client	
	On air	**User rate**	**On air**	**User rate**	**On air**	**User rate**	**On air**	**User rate**	**On air**	**User rate**	**On air**	**User rate**
MCS 0	65	49	72	54	144	108	72	54	144	108	288	216
MCS 1	130	98	144	108	288	216	144	108	288	216	576	432
MCS 2	195	146	216	162	432	324	216	162	432	324	864	648
MCS 3	260	195	288	216	576	432	288	216	576	432	1152	864
MCS 4	390	293	432	324	864	648	432	324	864	648	1728	1296
MCS 5	520	390	577	433	1154	866	577	433	1154	866	2308	1731
MCS 6	585	439	649	487	1298	974	649	487	1298	974	2596	1947
MCS 7	650	488	721	541	1442	1082	721	541	1442	1082	2884	2163
MCS 8	780	585	865	649	1730	1298	865	649	1730	1298	3460	2595
MCS 9	867	650	961	721	1922	1442	961	721	1922	1442	3844	2883
MCS 10			1081	811	2162	1622	1081	811	2162	1622	4324	3243
MCS 11			1201	901	2402	1802	1201	901	2402	1802	4804	3603
MCS 12							1297	973	2594	1946	5189	3892
MCS 13							1441	1081	2882	2162	5765	4324

Source: eero

[22]Provided that users follow eero's deployment guidelines

3.2 Optimization with TrueMesh

TrueMesh is eero's patented mesh technology, which intelligently routes traffic around congestion and continually optimizes network performance. With TrueMesh, eero devices connect wirelessly to every other eero device within range on the 2.4 GHz, 5 GHz, and 6 GHz bands. TrueMesh dynamically finds the ideal path for data to pass through a network, limiting interference and helping ensure customers have fast speeds, efficient coverage, and a reliable connection. TrueMesh does this by automatically choosing the fastest path for network traffic based on a variety of factors like a network's layout, connected devices, and overall network usage.

In addition—for eero Pro 6, eero Pro 6E, and eero Max 7—instead of using a single backhaul link (e.g., 6 GHz) for the traffic from all clients associated with a leaf node, the backhaul link is dynamically selected to optimize performance for each client after considering that client's association band. With TrueMesh on these three models, subject to client capacities, the client can use the available airtime in its connected band while the network uses another band for backhaul—rather than a single band being split for the client and backhaul traffic.

For example: If one client is connected on the 5 GHz radio of an eero Max 7 leaf node (given that eero products are backward compatible) and another client is on 6 GHz radio—instead of using one backhaul link (either 5 GHz or 6 GHz) for both clients at any time, eero can maximize performance by using a 6 GHz backhaul link for the 5 GHz client and a 5 GHz backhaul link for the 6 GHz client, optimizing mesh routing for a fast, reliable internet experience. When downloading a game online, either of these clients can utilize the full available airtime for blazing-fast download speeds. To learn more about TrueMesh, **click here**.

eero Max 7 makes it easy to enjoy applications that require little to no latency—such as augmented and virtual reality, 4K and 8K video streaming, and gaming. It improves connectivity overall for day-to-day activities by reducing congestion for devices on the network, and brings reliable connectivity to business networks with many connected devices and concurrent voice and video calls. It's the foundation for smart home connectivity, supporting over 200 connected devices and featuring Matter support, the ability to act as a Thread border router, and a built-in Zigbee smart home hub.

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Looking ahead

As we enter a new age of multi-gigabit connectivity and customers continue to lean into applications that require more bandwidth, ISPs will be faced with new opportunities and challenges. In the near future, we will see even more products coming to market that will enable faster wireless performance and a better experience in homes and businesses. Given customers' low tolerance for poor wifi connectivity, ISPs would do well to choose a solution that combines world-class hardware and software technologies from a trusted brand with the newest wifi technologies. With this latest generation of Wi-Fi 7 technology brought to bear on unique tools such as TrueMesh and superior customer service, ISPs can grow their customer base and average revenue per user with eero—while also reducing costs and churn.

About eero

eero was founded to make wifi and networking the way they should be—fast, reliable, secure, and built for the future. Since introducing the first home mesh wifi system, eero has become known for award-winning wifi—and continues to create connectivity solutions for individuals, businesses, communities, and service providers. eero is an Amazon company, headquartered and founded in San Francisco in 2014. For more information, visit **eero.com**

About Maravedis

Maravedis is a boutique wireless infrastructure analyst firm founded in 2002. Maravedis focuses on broadband wireless technologies with a particular focus on Wi-Fi and IoT as well as industry spectrum regulations and operator trends. Its mission is to research, analyze, and provide guidance on the role of unlicensed technologies in the overall connectivity space. For more information, visit **www.maravedis-bwa.com**

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