element14
AN AVNET COMMUNITY

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Next Generation Wi-Fi 2021

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Next Generation Wi-Fi 2021

element14 is a Community of over 750,000 makers, professional engineers, electronics enthusiasts, and everyone in between. Since our beginnings in 2009, we have provided a place to discuss electronics, get help with your designs and projects, show off your skills by building a new prototype, and much more. We also offer online learning courses such as our Essentials series, video tutorials from element14 presents, and electronics competitions with our Design Challenges.

Wi-Fi has been a wildly successful technology since its introduction two decades ago, connecting billions of devices all over the world. In this eBook, we will discuss the upcoming market trends in Wi-Fi, how its standards are advancing and offering new features, and future applications that could expand Wi-Fi's importance and reach even further.

element14 Community Team

Introduction

Wi-Fi's fundamental strengths of interoperability, security, and ease of use have made it a spectacular success in technology. It is nearer to delivering its vision of connecting everyone and everything, everywhere. The technology is now 21 years old, and over the decades there have been continuous improvements to keep up the pace for both consumers and businesses.

Based on the Institute of Electrical and Electronics Engineers (IEEE) wireless communication standard 802.11, each generation of Wi-Fi brings better user experiences in a multitude of environments with various device types. The original technology used the 2.4 GHz frequency, but has since expanded to 5 GHz, 60 GHz, and now to 6 GHz frequency bands. Today, many devices connect to the Internet using Wi-Fi: computers, consoles, media players, home automation devices, smart TVs, smartphones, wearables, and tablets, to name a few. Wi-Fi has proven to be a game-changer across the consumer and enterprise sectors.

Scope

This eBook highlights the upcoming market trends in Wi-Fi technology, Wi-Fi's evolving standards and advancements, and its potentially influential future applications and use cases.

CHAPTER - 1 THE Wi-Fi MARKET

Wi-Fi is no longer just a convenience – it's a mission-critical networking standard, the primary wireless network connection. About 51 percent of all internet traffic by 2022 will derive from Wi-Fi connected devices, according to Cisco. Wi-Fi has grown thanks to the large and ever-expanding consumer base for Wi-Fi enabled devices.

Wi-Fi signal is ubiquitous, with around 18 billion Wi-Fi devices shipped, eight billion still in use, and three billion new ones added every year. Wi-Fi enabled devices may predictably increase from 3.3 billion annual unit shipments in 2019 to more than 4.5 billion by 2024, according to ABI Research.

Over the next decade, we anticipate a number of challenges for the Wi-Fi standard. Key among them is the growing demand on Wi-Fi networks, leading to increased congestion, performance limitations, and reduced Quality of Service (QoS). Most Wi-Fi devices use increasing amounts of data per device, including streaming high-resolution music and videos,

video calling, application and firmware updates, social networking, data-heavy web content, and online gaming.

The growing reach of Wi-Fi is benchmarked by several advancements, highlighted in the following sections of this eBook. Looking ahead to 2021 and beyond, the upcoming changes in Wi-Fi will try to satisfy the traffic load, import new proficiencies, enhance security, and keep up with recent application trends in the market. Here are the most exciting Wi-Fi trends expected in 2021 and beyond.

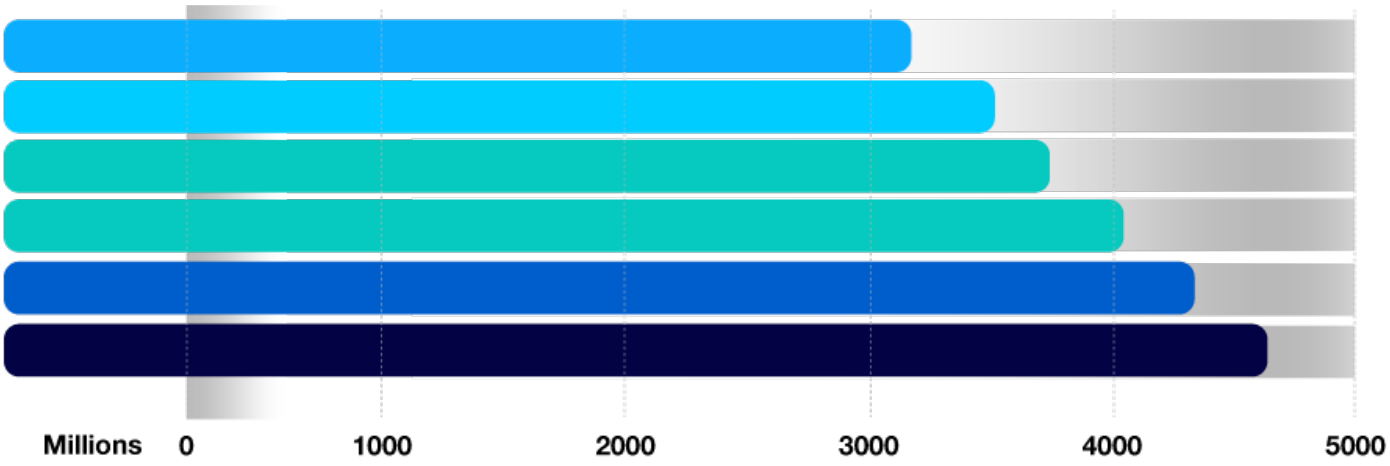

Figure 1. Wi-Fi Device Shipments Estimate. *Image Source: ABI Research*

CHAPTER - 2 Wi-Fi 6 DEVICE TECHNOLOGY

To accommodate the growing number of internet-enabled devices entering the market, the Wi-Fi Alliance has offered Wi-Fi 6 certification for 802.11ax devices. This standard assures users the needed efficiency, coverage, and performance in stringent Wi-Fi environments. Wi-Fi 6 benefits both the 5GHz and 2.4 GHz bands, incorporating significant fundamental enhancements like Multi-User MIMO, OFDMA, 1024-QAM, BSS coloring, and target wait time. This new version of Wi-Fi technology can support multi-user communications.

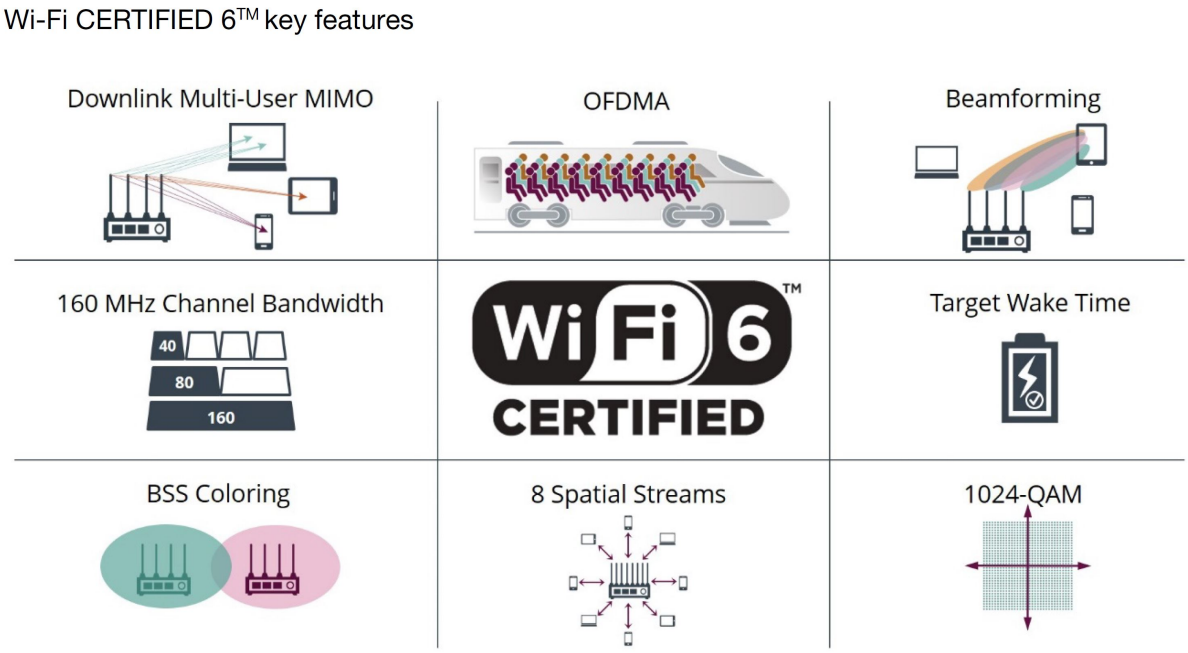

Figure 2. Wi-Fi Certified 6 Key Features. Proprietary: Wi-Fi Alliance. *Image Source: wifirst*

It enables multiple clients to speak simultaneously, is potentially four to 10 times faster than Wi-Fi 5, and also consumes less energy. It can efficiently connect as many as eight devices at the same time, compared to four in the previous generations.

Wi-Fi 6 brings lower latency, implying smoother data flow with fewer delays. It embraces "TWT" or target wake time, a new technology that helps connected devices customize when and how they "wake up" to receive data signals from Wi-Fi, boosting battery life.

Wi-Fi 6 officially debuted with the certification program's release in September 2019 from the Wi-Fi Alliance, with Wi-Fi 6 enabled hardware releasing in late 2019 and throughout 2020. With 802.11ax just beginning to roll out into the marketplace, there are currently few devices capable of using Wi-Fi 6 features. Nevertheless, the market predicts that the bulk of all new wireless access points will be Wi-Fi 6 compatible (Figure 3) by 2022. To date, around a dozen high-end smartphones and PCs are Wi-Fi 6 compatible. To reap the benefits of Wi-Fi 6, the router and the device in use need to be consistent with the standard. Wi-Fi 6 certified router versions have been issued by ASUS, Netgear, and TP-Link. In 2021, manufacturers will scramble to add Wi-Fi 6 enabled devices to everyone's shopping lists.

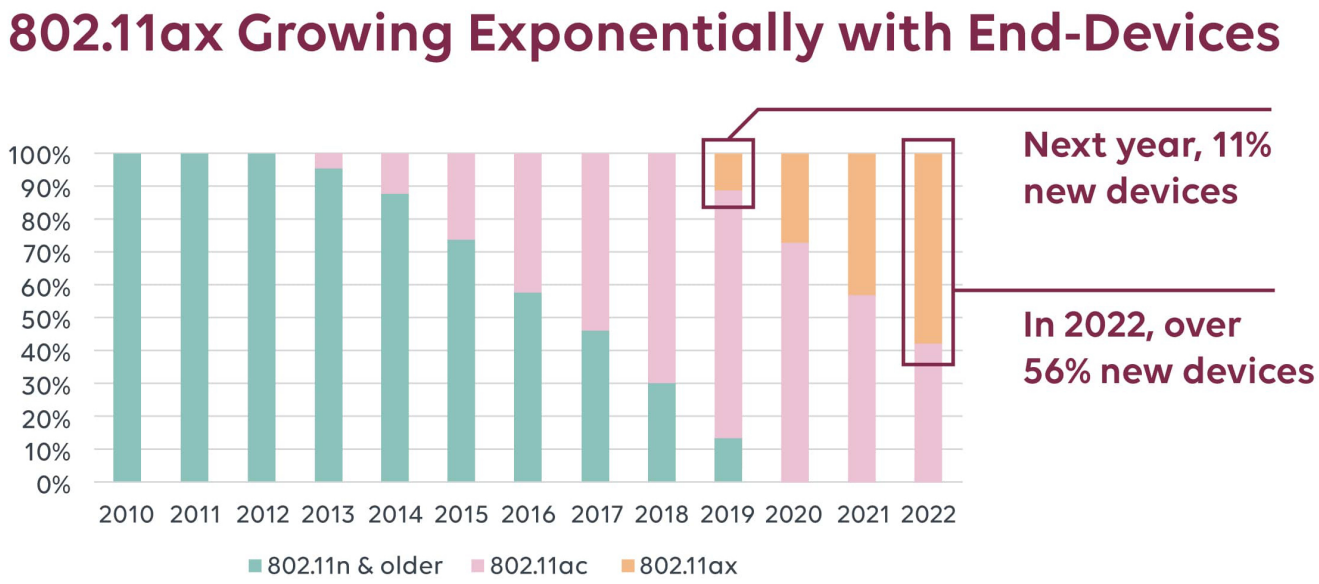

Figure 3: Wi-Fi 6 Growth Prediction. Source Cisco. *Image Source: wifirst*

CHAPTER - 3 EVOLVING WPA3 SECURITY

As Wi-Fi has grown in popularity, so too did hackers and other bad actors' ability to disrupt. Initially, most Wi-Fi networks were open, with unsecured data traveling over the air. The Wi-Fi Alliance solved this vulnerability by adding different security protocols to the standard, including the latest Wi-Fi Protected Access 3. WPA3 is a suite of protocols and technologies providing authentication and encryption for Wi-Fi; it is now mandatory for all new Wi-Fi CERTIFIED™ products, implemented from July 1st, 2020 onwards. This will help ensure that Wi-Fi devices keep pace with the security landscape.

WPA3 enables more robust authentication, provides greater cryptographic strength for sensitive data, and maintains networks' resilience. It is also more user-friendly, as you can choose easier passwords and still ensure robust authentication. Interoperability is another plus, as WPA3 devices are backwards compatible with WPA2 protocol usage devices.

CHAPTER - 4 Wi-Fi 6E IN 6 GHz

One of the more exciting developments in Wi-Fi in 2021 is its potential expansion into the 6 GHz unlicensed band. Wi-Fi 6E is the standard for Wi-Fi 6 extension with 6 GHz, in addition to the currently supported 2.4 GHz and 5 GHz bands. The introduction of Wi-Fi 6E solves Wi-Fi spectrum shortage issues by providing additional and contiguous channel bandwidth, supporting an ever-growing population of devices at unprecedented speeds.

On April 23rd, 2020, the U.S. FCC voted to make 1,200 megahertz of spectrum available in the 6 GHz band for Wi-Fi enterprises to deliver faster, more reliable enterprise Wi-Fi networks. These networks will be highly scalable and resilient, with simplified architectures, improving their ability to support more users at multi-gigabit speeds. This new frequency band will enable Wi-Fi 6E to operate using 14 additional 80 MHz channels and 7 additional 160 MHz channels.

Wi-Fi 6 certification will be available from early 2021 and onwards. The Wi-Fi Alliance anticipates over 300 million Wi-Fi 6E devices by the end of 2021. Europe is slated to release 500 megahertz of the 6 GHz spectrum to Wi-Fi, as well. Being on this brand new frequency space, Wi-Fi 6E will not have to support older, slower devices. Wi-Fi 6E will revamp the space.

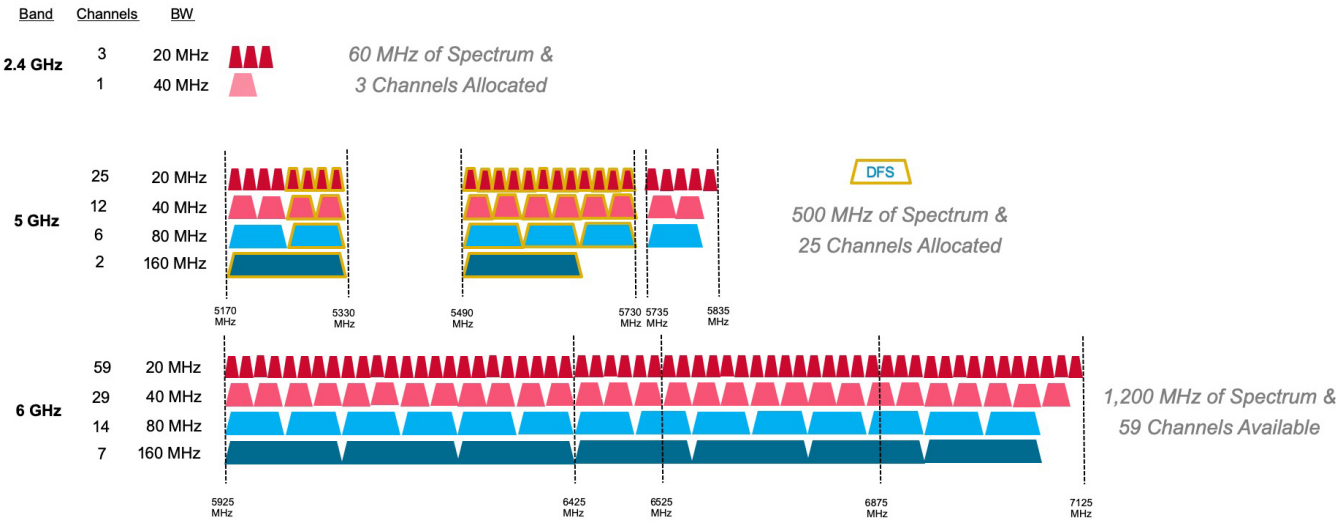

Figure 4: Wi-Fi 6E Frequency Band Spectrum. *Image Source:* [BROADCOM]

CHAPTER - 5 Wi-Fi AWARE

Beyond the additional spectrum growth in 2021, further Wi-Fi upgrades will focus on improving interoperability and new devices that offer networking connectivity to a local network or the Internet. Initiatives and concepts such as Wi-Fi Aware for proximity-based discovery will drive the technology in new directions. The proximity-based discovery feature enables applications to discover each other within a certain range without network infrastructure. This technology will follow its natural evolution into the Internet of things, allowing devices to interact to enhance the user experience

without the need for an access point or human oversight. As long as your device is compatible and within range, you can access the area applications and share information. As an example, in 2020 the DJI Company used Wi-Fi Aware in drones because of its capability of acting as a remote ID solution.

CHAPTER - 6 Wi-Fi HOTSPOTS

Public internet access points are thriving, and this trend will continue in the future. According to a Cisco VNI report, there will be nearly 628 million public Wi-Fi hotspots by 2023, sprinkled across the globe. Public Wi-Fi connectivity for citizens in public spaces includes parks, squares, buildings, libraries, hospitals, museums, and airports. The future of Wi-Fi hotspots concerns quick and secure delivery of personalized services via new-generation Wi-Fi. The Wi-Fi CERTIFIED Passpoint will play a significant role in these scenarios. It will streamline access to Wi-Fi hotspots in public places by excluding the users' need to locate and authenticate a network each time they connect.

CHAPTER - 7 FUTURE APPLICATIONS OF Wi-Fi

The past decade has witnessed Wi-Fi expanding from a handful of computers to many slim, rugged laptops, tablets, and, noticeably, smartphones. We have also seen other devices, like home assistants and smart machines, connect to Wi-Fi networks to improve their features. Wi-Fi will soon play an essential role in wireless connectivity. Here are a few ongoing and new application areas which will benefit from Wi-Fi technology advancement:

Internet of Things

Internet of Things (IoT) applications have diverse connectivity requirements in terms of data throughput, energy efficiency, security, and device cost. Wi-Fi will significantly improve with its latest iteration in terms of performance, providing faster speeds, lower latencies, and increased device connectivity. Wi-Fi 6 capable routers can support up to 1024 devices simultaneously, compared to the more common 250 devices currently.

Target Wake Time will enable IoT devices to use less power, since they won't constantly be working to maintain their network connections. Similarly, the upgrade with WPA3 will provide better security for IoT devices.

Wi-Fi for Home and Enterprise

With the continuous maturity of Wi-Fi technology and the expansion of smart homes, the use of Wi-Fi to control home systems will be essential to people's lives in the future. Building automation systems, communications systems, room automation systems, and computer-aided equipment management systems will rely on home Wi-Fi for real-time processing and managing requests locally at the edge.

Wi-Fi is the choice for networking technology in enterprise environments. The latest advancements and Wi-Fi certifications offer greater capacity, higher performance, and flexibility with improved security to support enterprise applications.

Wi-Fi in Automation

Automotive OEMs have swiftly adopted Wi-Fi for a growing number of use cases, both in and outside of the vehicle. Infotainment files are getting progressively bigger, with support for high-resolution video, and more people download data to their devices during drives. The sensors used for autonomous driving generate a significant amount of data, projected at upwards of 4TB per day, and this data needs to be uploaded for processing and analysis.

Wi-Fi in Mission-critical Applications

Wi-Fi will become a more stable and accepted infrastructure for mission and life-critical applications, as well. Expect to see Wi-Fi as the preferred technology to power essential business operations, electric power grid systems, and satellite communications systems. A notable event was registered in 2020 when the International Space Station received its first truss-mounted Wi-Fi access point, installed by NASA astronauts.

CHAPTER - 8 Wi-Fi: KEY TO DIGITAL RESILIENCE

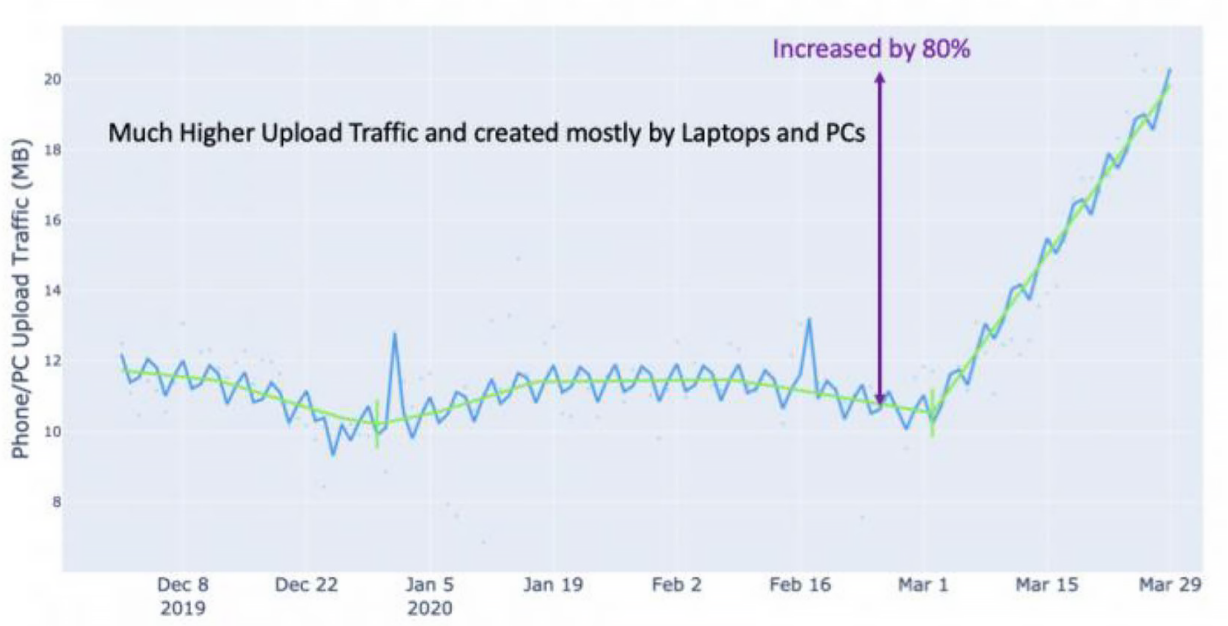

Figure 5: Global Wi-Fi Traffic Growth (December 2019 – April 2020). *Image Source: Gil, T. (2020)*

Wi-Fi networks were a significant contributor to national resilience in the face of the COVID-19 pandemic. According to ASSIA, Wi-Fi activity increased and stabilized at approximately 82 percent higher compared to pre-pandemic conditions.

Wi-Fi has delivered essential connectivity at the individual consumer level, allowing users to accomplish daily activities and carry out tasks that previously required physical contact—such as grocery shopping, buying essential goods, virtual learning, and telehealth appointments. It provided workers with virtual tools for supply-chain digitization and distribution channels to maintain productivity when face-to-face interactions with colleagues, customers, and suppliers must be avoided at the enterprise level. Additionally, free public Wi-Fi networks deployed outdoors offered essential connectivity for COVID-19 healthcare facilities, "Wi-Fi on wheels" for education, and coverage in rural or underserved areas.

Wi-Fi's role in critical use cases mitigates economic damage by keeping the economy up and running, allowing people and businesses to continue their tasks during the global pandemic.

Check out our dedicated **wireless web page** for more information about next generation Wi-Fi.

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