

# The Future

of Wi-Fi

By Andrew Zignani, ABI Research.

## What does 6GHz spectrum mean for connectivity, key industries and technology implementers?

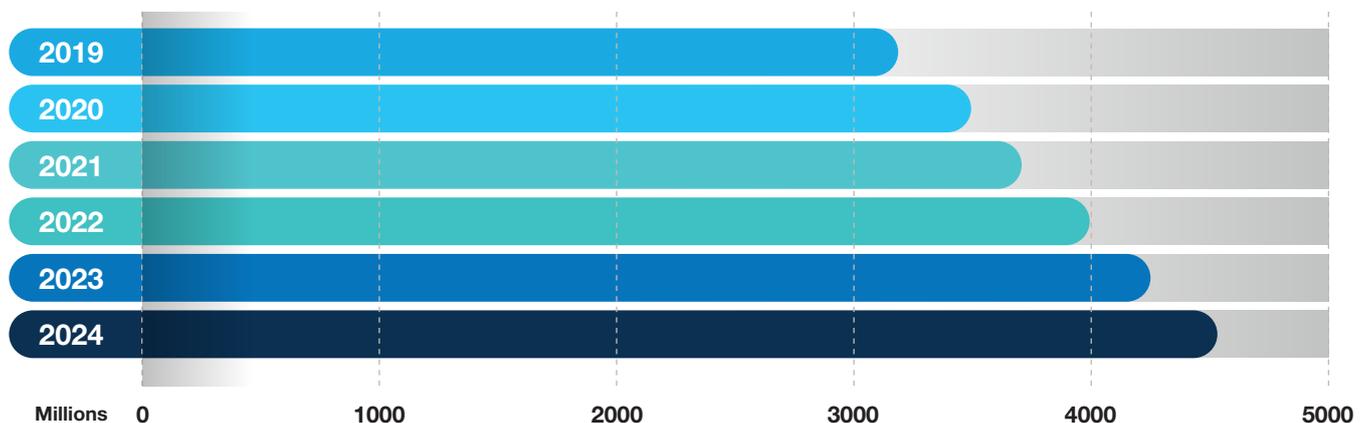
### Wi-Fi: two decades in the making

The year 2019 marked the 20th anniversary of Wi-Fi, and its adoption and evolution shows no signs of slowing down. The need for faster, more reliable, more efficient and more widespread Wi-Fi coverage is becoming increasingly vital in a world filled with more Wi-Fi devices at both ends of the performance spectrum, from high-throughput and low-latency applications to battery-constrained Internet of Things (IoT) devices.

As the chart below shows, ABI Research forecasts that Wi-Fi-enabled devices are set to increase from 3.3 billion annual unit shipments in 2019 to more than 4.5 billion by 2024.

Although the growing reach of Wi-Fi will be driven by a number of advancements, such as Wi-Fi 6 and Wi-Fi's expansion into the 60 Gigahertz (GHz) and sub-1GHz bands through WiGig and HaLow, the most exciting and potentially transformative change to the Wi-Fi landscape is the anticipated availability of 6GHz spectrum over the next few years. On 23 April 2020, the FCC voted to approve 1.2GHz of unlicensed spectrum in 6GHz available for Wi-Fi, with other regions anticipated to follow.

This article provides insight into what is driving 6GHz adoption, the significant benefits that 6GHz will provide and the expected timeline surrounding its launch. Finally, ABI Research provides strategic recommendations for technology implementers.



“ **New Wi-Fi standards, such as Wi-Fi 6 (also known as 802.11ax), are helping to address some of these challenges.** ”

### Why is 6GHz so important?

Over the next decade, Wi-Fi faces a number of difficult challenges. Key among them are the growing demands being placed 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, digital downloads, social networking, data-heavy web content and online gaming, among others. The tremendous surge in active Wi-Fi devices at home in recent months and resulting increase in traffic as a result of COVID-19 have reaffirmed Wi-Fi as a vital utility, acutely demonstrating both its importance and limitations.

Demands will only increase over time as the resolutions increase to 4K and 8K in the future, and greater performance is demanded. The growth of cloud services and uploading of content to social media and sharing websites also results in more uplink traffic. A report commissioned by the Wi-Fi Alliance indicated that, by 2020, Wi-Fi networks will need significantly more spectrum to satisfy increased traffic demands. The report also indicated that, by 2025, between 500 Megahertz (MHz) and 1GHz of additional spectrum at the very least would be needed to satisfy peak usage, with upper estimates placing this between 1.3GHz and 1.8GHz.

Cisco anticipates that Wi-Fi devices will account for almost half of all IP traffic by 2020, up from 42% in 2016.

As a result of this traffic explosion, cellular operators are increasingly looking to offload traffic onto Wi-Fi. Similarly, consumers with limited data plans are deciding to connect to Wi-Fi when at home or in public areas to circumvent these limitations. However, the user experience must be comparable to that of the existing cellular network, and the Wi-Fi network must be able to accommodate this extra traffic. Cisco anticipates that mobile offload is set to increase from 60% (10.7 exabytes/month) to 63% (83.6 exabytes/month) by 2021, with 64% of traffic from smartphones and 72% from tablets forecasted to be offloaded onto Wi-Fi by 2021, placing additional burdens on the 5GHz band.

### Current technologies falling short

Most deployments today are also now characterised by several overlapping Wi-Fi networks. Real-world performance is already beginning to suffer in these dense deployment areas and this will continue the transition to high-density environments. Furthermore, with the 2.4GHz band already congested and the growing transition to the 5GHz band, interference from neighbouring devices is significantly impacting performance and reducing overall throughput; increasing latency and errors; and ultimately reducing power consumption and reliability.

Performance can no longer be improved by adding more hotspots, which only increases the possibility of interference and collisions. With many new potential applications and 5G class services demanding high throughput, low latency, robust, reliable and efficient networks, there is a strong need for Wi-Fi to address these challenges to play a fundamental and complementary role to 5G cellular connectivity within indoor environments.

New Wi-Fi standards such as Wi-Fi 6 (also known as 802.11ax) are helping to address some of these challenges. However, there is an increasing acknowledgment that the existing unlicensed spectrum available for Wi-Fi will be insufficient to address the future needs of the Wi-Fi ecosystem. In 2017, leading companies that are invested in the Wi-Fi ecosystem (including Broadcom; Cypress; Intel; Qualcomm; MediaTek; Cisco; HPE; Google; Apple; Microsoft and Facebook) came together to press the U.S. Federal Communications Commission (FCC) on the need for unlicensed spectrum in the 6GHz band (i.e. 5925MHz to 7125MHz) to be opened and used by Wi-Fi technologies. In October 2018, the FCC voted in favour of opening up 1200MHz of spectrum for unlicensed devices in the 6GHz band, with final approval granted in April 2020.

### Greatest benefits of 6GHz

While the global regulatory landscape for 6GHz outside the U.S. is still being finalised, it is hard to overstate the potential that 6GHz can bring to Wi-Fi networks. The technology could bring about much higher throughput, much more capacity,



“ It is hard to overstate the potential that 6GHz can bring to Wi-Fi networks. ”

greater reliability, lower latency and better QoS than ever before, solving many of the key challenges that Wi-Fi is facing today.

**More than double the existing available spectrum:** Up to 1.2GHz of additional spectrum will be allocated for Wi-Fi, effectively doubling the existing spectrum available to Wi-Fi today. High-density deployments, such as stadiums, airports, conference halls and other venues suffering from congestion, will benefit greatly from this additional capacity, while the greater availability of 160MHz channels in the GHz band will enable low-latency multi-gigabit connectivity to better support a number of advanced use cases.

**A clean band:** 6GHz Wi-Fi will only support Wi-Fi 6 and beyond devices. In essence, a 6GHz Access Point (AP) will only be able to talk with Wi-Fi 6 and beyond clients, and will not be sharing airtime and bandwidth with legacy generations of Wi-Fi such as Wi-Fi 5. This keeps the band clean and ensures that slower devices do not congest the network.

**Improved legacy networks:** Without the availability of the 6GHz band, 5GHz could become extremely congested over time. The availability of 6GHz could therefore bring definite benefits for Wi-Fi 6 clients and legacy clients operating in that spectrum by freeing some of the 5GHz spectrum to help boost performance, particularly as Wi-Fi 6E will be absorbing much of the high-performance use cases currently on 5GHz.

**Improved backhaul and multi-AP systems:** 6GHz could enable guaranteed multi-gigabit throughput throughout the entire home by leveraging the band as the backhaul technology for multi-AP mesh deployments. While it may take some time for 6GHz clients to become mainstream, existing Wi-Fi devices could potentially take advantage of 6GHz backhaul throughout the home once 6GHz networking equipment arrives. This could lead to better user experiences across a wide range of high-performance applications from video streaming to gaming and Augmented Reality (AR).

**Reliability:** Wi-Fi 6E, unpolluted with legacy Wi-Fi devices, could provide much more reliable and consistent performance than Wi-Fi 5 has been able to achieve. Some enterprise deployments have held back on transitioning to wireless technologies due to latency and bandwidth requirements. Now, enterprises can move to Internet Protocol (IP) phones and support low-latency collaborative applications or other key services over Wi-Fi, rather than costlier and less flexible wired Ethernet solutions.

**Application-specific deployments:** The clean 6GHz band could allow specific applications to be leveraged on the 6GHz band. AR and Virtual Reality (VR) applications could be transferred to 6GHz Wi-Fi 6E to ensure reliability and performance. Likewise, backhaul could shift to 6GHz for higher throughput. For industrial applications, mission-critical machinery and equipment could leverage this band for guaranteed performance and low-latency services.

Chipset vendors, like Broadcom, have already unveiled client Wi-Fi 6E chipsets capable of supporting over 2Gbps, leveraging the 6GHz band.

**Low-latency, high-throughput non-line-of-sight performance:** Applications, such as VR/AR headsets, require increasing amounts of throughput, while maintaining extremely low latency. 6GHz could potentially enable non-line-of-sight AR/VR applications. It could also provide better casting performance than 5GHz Wi-Fi, potentially allowing low-latency display sharing or screen mirroring from mobile devices or game consoles with greater flexibility than 60GHz.

### The 6GHz timeline

In December 2018, the FCC released its Notice of Proposed Rulemaking (NPRM) which provided a set of guidelines for 6GHz Wi-Fi. In this notice, the FCC proposed that because the 5.925 GHz to 6.425GHz and 6.525GHz to 6.875GHz sub-bands of the 6GHz band (totaling 850MHz) are currently heavily used by point-to-point microwave links (including critical links

“ On 23 April 2020, the FCC voted to make 1.2GHz of additional spectrum in the 6GHz band available for Wi-Fi. ”



that must maintain a high level of availability in these parts of the band) only “standard-power APs” using power levels permitted for unlicensed use in the U-NII-1 and U-NII-3 bands will be able to operate only on frequencies determined by an Automated Frequency Control (AFC) system. As setting up a 6GHz link today requires coordination with existing license-holders, this AFC system is designed to automate this coordination by leveraging the FCC’s Universal Licensing System (ULS) to scale this effectively to the Wi-Fi ecosystem and determine if access can be granted.

Alongside this, other portions of the 6GHz band, specifically the 6.425GHz to 6.525GHz and 6.875GHz to 7.125GHz sub-bands (totaling 350MHz), are to be used by mobile stations where locations of the incumbent receivers are not necessarily known or cannot be easily determined from existing databases. Because the lack of location information on mobile stations makes an AFC approach impractical, the FCC has proposed allowing only indoor “low-power access point” operation in these sub-bands to protect incumbents.

In February 2019, the Wi-Fi industry sent its comments on the FCC’s NPRM and argued that low-power indoor operations should be enabled across the entire 6GHz band without the need for AFC. The Wi-Fi industry views band-wide authorisation of Low-Power Indoor (LPI) operations to be of special importance to ensure the rapid availability of spectrum to consumers while permitting the use of larger channel sizes. Without doing so, the Wi-Fi industry believes that investment in the 6GHz band would be hindered, and that LPI devices will be prevented from accessing wider 160MHz channel sizes, resulting in lower throughput. The industry also believes that

requiring AFC registration for all unlicensed devices or the need for professional installation would make the process too complex and result in a considerable delay to 6GHz rollout. In contrast, LPI unlicensed equipment without AFC could be available to consumers within 12 to 18 months, following FCC approval of the spectrum.

On 23 April 2020, the FCC voted to make 1.2GHz of additional spectrum in the 6GHz band available for Wi-Fi, and proposed that AFC will only apply to the standard power access points (APs), meaning that indoor, low-power APs and client devices will be able to take advantage of the full 1.2GHz of additional spectrum. The Wi-Fi industry is therefore extremely optimistic on much more rapid deployment of Wi-Fi 6E-enabled devices throughout the next few years, thanks to less stringent regulations. ABI Research anticipates significant uptake of 6GHz-capable Wi-Fi products from 2021 onwards.

Ahead of CES 2020, the Wi-Fi Alliance introduced Wi-Fi 6E as the terminology that will be leveraged to distinguish Wi-Fi 6-capable devices that can operate in the 6GHz band. At CES 2020, a number of vendors introduced 6E-capable chipsets. Broadcom introduced a comprehensive enterprise and residential portfolio of Wi-Fi 6E chipsets and showcased them at the show. These include a combination of dual and tri-band 4x4, 3x3 and 2x2 solutions with a combination of 80MHz and 160MHz support. Alongside this, Celeno announced that it was adding Wi-Fi 6E support to its CL8000 series of chips, with the entire family capable of supporting the entire 6GHz spectrum under regulatory evaluation (5925-7125MHz) with 160MHz support. In February 2020, Broadcom announced its BCM4389 Wi-Fi 6E client chipset, with support for more than



2Gbps throughput in devices like smartphones. Qualcomm is also developing its Wi-Fi 6E portfolio, while ON Semiconductor has also unveiled its QCS-AX2 series for Wi-Fi 6E infrastructure applications.

While much still needs to be done from a global regulatory perspective, the year 2020 will be a hugely important one in bringing 6E technology to the forefront. Following the show, Ofcom in the United Kingdom announced that it is proposing that 500MHz of the 6GHz spectrum should be made available for Wi-Fi. To date, the FCC has led the charge on 6GHz Wi-Fi by making 1.2GHz available for Wi-Fi in the United States.

### Regional variations in 6GHz

While the United States is leading the charge, Europe is also anticipated to have around 500MHz between the 5925MHz and 6725MHz bands and some initial technical studies are currently responding to a mandate from the European technical commission. In Asia-Pacific and other regions, there is still limited visibility on the availability or timeline. However, these are likely to follow suit given the likelihood of availability and traction in the United States and Europe. The industry is confident that these two regions will help drive wider adoption and interest, and ABI Research believes that 6GHz has the potential to become so important to Wi-Fi over the next decade that it will be virtually impossible for any region to ignore.

### 6GHz Wi-Fi challenges and strategic recommendations

**Regulatory challenges:** Perhaps the largest current barrier to 6GHz adoption is the need to iron out various regulatory challenges and obstacles across different regions. A number of other key stakeholders, other than the Wi-Fi industry, have responded to the FCC's NPRM, many of which are calling for more stringent requirements to protect incumbents and for more evidence that 6GHz Wi-Fi will not interfere with other essential services. Some have gone further and opposed any sharing of the band at all. Others are arguing that AFC must be strictly adopted, while others have argued that AFC does not go far enough. The UWB Alliance has also raised concerns about interference and suggested some amendments to avoid this. Several stakeholders have also proposed leveraging a portion of the 6GHz band for licensed operations. While the FCC is pressing ahead, other regions may find these challenges harder to solve. Staggered availability of spectrum across the globe may also slow down incentives for adoption in the near term.

**Lack of awareness and education:** Some chipset vendors have commented that the wider industry is still very much in the early learning cycle of 6GHz and most requests do not include a 6GHz requirement. It may therefore take more time for awareness to grow and devices to come to market. However, with recent momentum, FCC approval and the

“ 2020 will be a hugely important one in bringing 6E technology to the forefront. ”



“ Perhaps the largest current barrier to 6GHz adoption is the need to iron out various regulatory challenges and obstacles across different regions. ”

6E announcement, ABI Research anticipates that service providers, Original Equipment Manufacturers (OEMs) and the wireless industry more broadly will quickly digest the benefits of Wi-Fi 6E.

**Cost:** There will be a cost increase to supporting Wi-Fi 6E and the 6GHz band. Vendors will have to think carefully about how soon they will support the technology and it may not always be a simple upgrade. While 6GHz may gain some initial support in the ultra-high end, it will probably take some time to transition down as other components become more widely available on both the infrastructure and client sides. However, this is expected to diminish over time.

**Transition to new band:** Historically, moving to a new band takes time; 5GHz Wi-Fi took time to go mainstream and 60GHz WiGig and sub-1GHz Wi-Fi HaLow are still trying to find success. On a more positive note, some in the industry believe it could take a similar time frame as 802.11ac, which was ratified at the end of 2013 and by 2016, the technology had already reached one billion chipset shipments. If 6GHz does indeed ratify by the end of 2020, some expect similar volumes during the 2023 to 2024 time frame due to the huge advantages it can offer. However, much will depend on regional availability of spectrum, infrastructure rollout and mainstream device support to build a comprehensive 6GHz ecosystem.

**Chipset availability:** While several vendors are committed to bringing 6GHz chipsets to the market early on, as with any new standard, it will take time before these are well established with numerous vendors, helping to drive down costs and build scale.

**Proximity to ax rollout and deployment:** Although Wi-Fi-6 is still in its relative infancy, over the next 12 to 18 months upgrades are likely to gain considerable traction. Those who

have just invested in Wi-Fi 6 infrastructure may not immediately be able to afford the expense of upgrading once more to the 6GHz band. This could also apply to OEMs and the wider ecosystem. However, some vendors (such as ON Semiconductor) are future-proofing their Wi-Fi infrastructure chipsets to accommodate this, enabling flexible deployments that allow the network to operate in 5GHz or 6GHz depending on the available client devices, maximising performance and utilisation of each band.

However, ABI Research anticipates that most of these challenges will be overcome and that opening up the 6GHz band for Wi-Fi will help the technology address many of the challenges it is facing today. In today's environments, even when leveraging 80MHz or 160MHz channels, it is very challenging to guarantee QoS in the 5GHz band. 6GHz not only brings about additional spectrum and higher throughputs, but essentially guarantees access to channels with no legacy, resulting in a corresponding improvement in latency and simplifying channel access. Wi-Fi 6E can therefore open up new opportunities for Wi-Fi to better support 5G-class services reliant on high multi-gigabit throughput, low latency, high efficiency, broader coverage and better mobility .



**Contact**  
For further details, see [www.abiresearch.com](http://www.abiresearch.com)

“ Wi-Fi 6E can therefore open up new opportunities for Wi-Fi to better support 5G-class services reliant on high multi-gigabit throughput, low latency, high efficiency, broader coverage and better mobility. ”