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Wireless Broadband Alliance

WBA INDUSTRY REPORT

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About the Wireless Broadband Alliance

Wireless Broadband Alliance (WBA) is the global organization that connects people with the latest Wi-Fi initiatives. Founded in 2003, the vision of the WBA is to drive seamless, interoperable Wi-Fi services experiences within the global wireless ecosystem. The WBA's mission is to bring together global industry leaders, collaborating to accelerate the development, integration and adoption of next-generation Wi-Fi and wireless technologies to deliver business growth, through innovation, technical and standards development, and real-world deployment programs.

Its key programs include NextGen Wi-Fi, OpenRoaming, 5G, 6G, IoT, Smart Cities, Testing & Interoperability and Policy & Regulatory Affairs.

Membership in the WBA includes major operators, service providers, enterprises, hardware and software vendors, and other prominent companies that support the ecosystems from around the world. The WBA Board comprises influential organizations such as Airties, AT&T, Boingo Wireless, Boldyn Networks, BT, Charter Communications, Cisco Systems, Comcast, CommScope, HFCL, HPE, Intel, Reliance Jio, Telecom Deutschland and Turk Telekom.

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Table of Contents

Table of Figures

1. Executive Summary

- Wi-Fi 7 is experiencing robust demand from both enterprises and consumers, with the technology's high throughputs, low latencies, and spectrum efficiency capabilities helping to enhance reliability, enable new innovative use cases, and deliver an overall improved user Quality of Experience (QoE). Across 2025, the WBA has partnered with a range of companies across the Wi-Fi ecosystem to conduct trials of Wi-Fi 7, demonstrating the potential of the new standard.
- Enterprises rapidly adopted Wi-Fi 7 following the standard's introduction to the market, with 3.3 million shipments of enterprise Wi-Fi 7 Access Points (APs) in 2024 alone. Shipments of Wi-Fi 7 APs are projected to surge going forward, hitting 20.1 million in 2027, surpassing Wi-Fi 6 for the first time, and continuing to rise to 38.8 million in 2030.
- Wi-Fi 7 device shipments are rising fast too. Notably, shipments of Wi-Fi smartphone chipsets jumped from 70.1 million in 2023 to 196.2 million in 2024, and are projected to hit 466.0 million in 2025.
- The new 6 GHz spectrum band is essential towards alleviating congestion on the legacy unlicensed spectrum bands, expanding capacity on consumer and enterprise networks, and providing the bandwidth for new innovative applications.
- These benefits are driving rapid adoption of 6 GHz across the industry. Reflecting this, shipments of 6 GHz-enabled Wi-Fi chipsets increased from 213.8 million in 2022 to 684.2 million in 2024, and shipments are forecast to accelerate further to 1.1 billion shipments in 2025, reaching 2.6 billion in 2030.
- In July 2025, the first Working Group (WG) letter ballot on the Task Group 802.11bn (TGbn) draft 1.0 (D1.0) was initiated. This will be the technical foundation of Wi-Fi 8.
- Wi-Fi 8 will introduce into Wi-Fi standardization Multi-AP Coordination (MAPC) capabilities for the first time. MAPC encompasses a range of features, which together are designed to maximize spectrum efficiency and improve performance by optimizing channel selection for all client/APs and balancing the load evenly and intelligently between APs in the network.
- Wi-Fi 8's advanced new capabilities are expected to drive strong demand for the new standard from both enterprises and consumers, resulting in swift adoption for Wi-Fi 8. By 2030, Wi-Fi 8 will be supported by 26% of shipped enterprise Wi-Fi APs, and by 30% of all shipped smartphones.
- Wi-Fi utilization for a range of IoT sensing and automation tasks is expanding, spurred by recent innovations in the technology, including Wi-Fi 6, Wi-Fi 7, and Wi-Fi HaLow. This is driving an expansion in shipments for Wi-Fi chipset for IoT applications from 215.9 million in 2025 to 524.9 million in 2030.
- The development of Wi-Fi HaLow (802.11ah), a nascent IoT-orientated Wi-Fi technology operating on the sub-1 GHz unlicensed band, is central to Wi-Fi expanded role within IoT. 2025 saw the Wi-Fi HaLow ecosySupport Wi-Fi 6E/7 and 6 GHz APs that require a new level of power to operate (PoE++) stem continue to expand and diversify with numerous new products, and in 2024 the effectiveness of Wi-Fi HaLow was validated in numerous environments in the WBA's ***Wi-Fi HaLow for IoT Field Trials Report***.
- In 2025 there were many major developments within the Wi-Fi Sensing ecosystem, with new strategic partnerships and product releases. The three main applications for Wi-Fi Sensing today are elderly healthcare monitoring, home security, and smart home automation, with the technology leveraged for tasks such as presence detection and motion alerts.

- Residential connectivity is expanding rapidly, facilitated by the emergence of new technologies like 5G Fixed Wireless Access (FWA) and satellite which can connect the underserved and the previously unconnected. This expanded access will spur the growth in the number of annual Wi-Fi CPE shipments from 233.1 million in 2024 to 394.1 million in 2030.
- Wi-Fi in the enterprise is expanding too, driven by a shift to wireless-first policies and the emergence of new potential applications for the technology. The number of annual enterprise Wi-Fi AP shipments forecast to increase at a Compound Annual Growth Rate (CAGR) of 11.1% between 2024 and 2030. This represents an increase from 22.2 million shipments annually in 2024 to 41.7 million in 2030.
- Momentum behind OpenRoaming continued to gather pace in 2025. In September the Tokyo Metropolitan Government ***committed to expanding*** its network of OpenRoaming-compatible Wi-Fi APs to around 1,500 additional locations throughout the city to help handle increased tourism numbers and ensuring reliable communications during environmental disasters. Earlier in the year, OpenRoaming was also ***deployed in the City of Westminster*** in London, with further plans to expand OpenRoaming across more of London in the future.
- The WBA has continually supported OpenRoaming with updates and revisions to improve user experience, increase security, and facilitate adoption. The most recent update, Release 5, delivered a range of enhancements centered on strengthening privacy, security, network reliability, and operator tooling. This involved the advancement of supporting tools including the ***Provisioning Portal*** and Hybrid Connectors to simplify the integration for Access Network Providers (ANPs) and Identity Providers (IDPs).
- AI has the potential to fundamentally transform Wi-Fi networking, with its ability to both improve the performance and reliability of existing experiences, streamline processes and raise efficiency, as well as facilitate the delivery of new, novel experiences.
- AI's efficacy is dependent on the data that underpins it, and so the improved performance and capacity of 6 GHz and Wi-Fi 7 are becoming increasingly important toward enabling the collection of data from the ever-growing number of network nodes, IoT assets, and connected devices throughout the network
- Wi-Fi and 5G have different and complementary areas of strength, and therefore there are many instances where it makes sense for both Wi-Fi and 5G to be deployed within the same network, so the benefits of both technologies can be harnessed for the delivery of optimal performance.
- To assist the industry in realizing converged networks, in December 2024, the WBA released its ***Private 5G and Wi-Fi Convergence – Technical Considerations*** report, which explored advanced architectural strategies and technical solutions for the achievement of converged Wi-Fi and 5G. In March 2025, the WBA also concluded its work on the defining requirements for OpenRoaming concepts within 3GPP, supported by the OpenRoaming co-chairs Intel and Cisco.
- In early 2025 the WBA published its ***report on 6G's potential transformative role***. The WBA's vision for 6G is that standardization should be aligned with other wireless technologies to avoid fragmentation and ensure interoperability, and that it's capabilities must focus on addressing industry pain points, leveraging other wireless technologies to this end.
- The results of the WBA's annual industry survey highlight a positive outlook in the industry and strong momentum behind the latest Wi-Fi technologies. Reflecting this, 62.0% of participants shared that their confidence in investing in Wi-Fi had changed over the last 12 months.
- Adoption of Wi-Fi 6E was shown to be strikingly robust, with 47.4% of respondents reporting that they had already deployed the technology within their organization. This indicates the high value the industry places on access to the 6 GHz band.

- Indeed, 24.6% of respondents believed that the availability of the 6 GHz spectrum band to be 'critical' towards the future of their Wi-Fi business and rollout, 40.0% saw it as 'Important', and 21.8% as 'somewhat important'.
- Wi-Fi 7 was identified as the technology likely to be deployed by the greatest number of respondents over the coming years, with 37.5% of all respondents reporting they plan to deploy it in the 2025/2026 timeframe. AI/Cognitive access networks was the second most likely to be deployed technology, with 32.0% of respondents selecting the technology.
- Highlighting industry concerns around improving Quality of Service (QoS) and spectrum efficiency, Wi-Fi 7's Multi-Link Operation (MLO) was considered to be the most important feature of innovative new Wi-Fi standards by respondents.
- The survey revealed growing industry confidence in OpenRoaming, with 46% of respondents sharing that they had already or planned to invest into OpenRoaming. The main factors stimulating their investments into OpenRoaming was the enablement of seamless access between Wi-Fi and 5G/LTE, and the enablement of seamless access across different networks.
- 75.5% of all respondents identified network security and privacy as the most important area for their businesses today, with end user experiences (Quality of Experience and Quality of Service), and seamless authentication to Wi-Fi being the second and third most important areas. Each of these aspects are all addressed by OpenRoaming, reinforcing why the technology was so well received by the participants.
- The aspect of Wi-Fi which organizations believed would be most important for their operations going forward was the solving of MAC randomization. Thankfully, this is being addressed by OpenRoaming, which uses alternative identity-based authentication profiles for device authentication, and IEEE 802.11bh, an amendment published in June 2025 which enables two alternative secure methods for device identification in MAC randomization environments.
- Smart home IoT and Artificial Intelligence (AI) were the most cited factors by respondents driving traffic growth, whereas stadiums/event venues and shopping malls/retail outlets were highlighted as the verticals with the greatest levels of traffic growth.
- Issues with business models was identified by just under half of respondents (49.5%) as a top challenge when developing and deploying new wireless services, the most of any challenge. OpenRoaming has a key role to play in helping to address this challenge, considering that in another question offload and roaming were identified by participants as the top 2 Wi-Fi monetization strategies over the next 12 months in an earlier question.
- Wi-Fi/5G convergence is clearly highly valued by the surveys participants, with 60.44% of them answering that converged Wi-Fi and 5G offers greater enterprise flexibility, and the same amount also believing that Wi-Fi and 5G will be in coexistence going forward.
- Finally, when asked the top 3 services for public Wi-Fi deployments, the most common responses were support for city services (70.3% of respondents), the provision of seamless, affordable, and secure internet access to users (64.9%), and to provide offload to carriers (48.7%). City governments around the world, such as the Tokyo Metropolitan Government (TMG), are already utilizing OpenRoaming to deliver all of these services.

2. Interview with WBA Chair—DR. Derek Peterson, Boingo Wireless

Congratulations on your appointment as the new Chair of the WBA? Could you share what most excites you about your new role?

First of all, I'm honored that the WBA leadership selected me to step into this role. During my time as Co-Chair, I've worked closely with our members, and I look forward to deepening those relationships as Chair. Our membership includes global carriers such as AT&T, Deutsche Telekom, Turk Telekom and BT, a growing number of enterprises, infrastructure vendors like Cisco to niche suppliers, and government agencies.

What excites me most is the immense amount of work underway at the WBA, from the convergence of cellular and Wi-Fi to advancements in satellite and roaming. I'm also encouraged by the expanding ecosystem of players that make up the WBA. The work aligns closely with my experience as Chief Technology Officer at Boingo Wireless, where my focus has always been on collaboration across organizations and technologies. Rather than working in silos, we're driving convergence so that technologies complement one another to deliver better connectivity.

As Chair, my goal is to accelerate that convergence and collaboration, ensuring networks work seamlessly—whether public, carrier, enterprise or rural. I'm excited to help guide the WBA through its next chapter.

Do you have any key priorities for 2026 which you can reveal to us?

We'll be focused on new technological advancements that keep us ahead and competitive. Wi-Fi 7 is a major one. Boingo is helping lead Wi-Fi 7 deployments for our venue partners, and adoption is accelerating. With global specs now available, we're entering the stage of mass adoption, which brings big opportunities to improve seamless and secure connectivity.

Another priority is the OpenRoaming federation, created by the WBA. OpenRoaming allows networks at stadiums, military bases, hospitals and other venues to connect seamlessly so users can automatically join and stay connected. OpenRoaming reduces security risks with unique, individualized encryption—a key part of its value.

We'll also continue advancing work around 6G. 6G is about building converged infrastructure, and our focus is understanding how it will integrate with other technologies. The WBA CTO group has been leading efforts in this area, and I'm eager to help realize that collaborative future.

AI and security will remain core areas of focus for the WBA.

As CTO of Boingo Wireless you work firsthand with the latest Wi-Fi technologies daily. What are the key use cases you are witnessing for Wi-Fi 7 and the 6 GHz spectrum?

Built to perform in high-density environments and dynamic spectrum conditions, next-generation Wi-Fi technologies like Wi-Fi 7 and the 6 GHz band deliver new levels of resilience for mission-critical connectivity.

One of Wi-Fi's ongoing challenges is that devices connect to a node, but power limitations can disrupt connectivity. Because of Wi-Fi's lower power, transitions between nodes happen more frequently, which can impact performance. With each generation, we've introduced technologies such as 802.11k, 802.11v and 802.11r to improve roaming and make those transitions seamless as users move. With Wi-Fi 7, and looking ahead to Wi-Fi 8, those transitions will become even faster and more resilient.

The enhanced resilience and security of Wi-Fi 7 are opening new use cases across airports, military bases, stadiums, hospitals and other large venues and enterprises.

In your day-to-day interactions with your customers at Boingo, what do you see as their top wireless networking priorities?

In the past, networks were installed in places like stadiums, and once the job was done, the installers moved on. There wasn't much discussion about what the venue actually needed the network to power. Over the past decade, that's changed. Now we start by asking customers what they want to achieve with connectivity.

Take stadiums, for example. Physical tickets are rare—mobile tickets and even facial recognition are the norm. All of that depends on stable, resilient connections. When 100,000 people are in a venue, the network must be fast, seamless and secure. That's where design matters. We build dynamic networks that can adjust in real time to deliver consistent performance.

Today, the network isn't static—it's part of the solution. Our systems are engineered to deliver the best possible customer experience while maintaining strong network security.

AI is one of the most revolutionary technologies in history, but the industry is still unclear on how it will transform Wi-Fi networking. What do you consider to be the most promising applications for AI within Wi-Fi networking?

The rise of AI is intersecting with next generation 5G and Wi-Fi buildouts, and that's no coincidence. AI depends on robust networks to move data efficiently. The reality is that businesses can't fully leverage AI without a strong digital backbone.

When most people think about AI, they think about large language models. That's an important piece, but there's more to it when it comes to networking. At Boingo, we're using AI models to detect network anomalies and support self-healing actions that fix issues like radio frequency interference and network congestion. These models can predict and assign corrective strategies on their own to keep the network running within key performance thresholds.

One of the most interesting parts of AI is the automation it can bring to venues like airports, stadiums, hospitals and enterprises. In a stadium, for example, you could run a live quiz with prizes that enhance the fan experience. Automation makes it possible to collect responses, identify the winning seat and have a staff member deliver the prize within minutes. The network is what ties all that together, sending and receiving the data in real time to make the experience work.

OpenRoaming is gradually gaining momentum, but what steps do you believe the industry can take to accelerate its adoption?

OpenRoaming is built on Passpoint, a technology Boingo has deployed since 2014 to enable the seamless connectivity we all want. Deployments are ramping up across the globe, and the next step is building broader awareness.

We need vendors to recognize the benefit of simple, automatic connections so enterprises can have office networks that just work. With OpenRoaming, devices connect securely and effortlessly. Our focus is on expanding partnerships and growing the footprint of OpenRoaming, making sure more organizations understand its advantages.

What do you think 2026 has in store for the Wi-Fi industry?

Wi-Fi 7 will see major growth in 2026. Adoption will accelerate as more people recognize the spectrum available and the technology's resilience. The latest iPhone includes Wi-Fi 7 with multi-link operation, which allows devices to connect and transmit across 2.4 GHz, 5 GHz and 6 GHz simultaneously. That capability will help drive rapid adoption.

We'll also see AI continue to evolve, with growing use of AI-driven traffic management to keep networks optimized.

Another trend to watch in 2026 is how the industry begins to talk about Wi-Fi 8, 6G, satellite integration and the role of private networks.

The Wi-Fi industry will continue to lead the way, and we're looking forward to the innovation ahead.

3. Interview with WBA Chief Executive Officer—Tiago Rodrigues

Firstly, could you provide an overview of the WBA for those who aren't familiar with the organization? How does it differ from the other industry bodies active in the industry?

We are a global trade association which was established in 2003 with a very diverse membership covering the entire value chain. This includes chipset vendors such as Qualcomm and Broadcom, device manufacturers like Apple and Dell, infrastructure vendors such as Cisco, HPE Aruba, Nokia, Ruckus and Huawei, as well as 7 out of 10 biggest carriers. We are now also starting to have good representation from many enterprise sectors, like in retail, automotive, aerospace, hotels, and others. Combined these members represent our very diverse ecosystem.

Wi-Fi is at the core of our work, but we also deal with other technologies like cellular, 5G, fiber, and satellite. Instead of operating in a silo, we try to work across technologies, creating convergence between them. For enterprises which need to deploy many technologies, we try to address gaps and challenges, solving real business challenges. This is how I believe we differentiate from other industry bodies.

Reflecting on the past year, what do you consider to be the main achievements of the WBA in 2025?

I would divide our achievements into several big components. The first of these are technical components. OpenRoaming has of course been a major program for us, and I am proud to see cities like London and Tokyo invest into OpenRoaming and investing into marketing to promote the technology. I also have a lot of expectations for our work on 6G. A group of operators have recently pushed for 6G work in WBA, and we published a vision paper. For us, we are excited for 6G not just as a new radio technology, but as a platform to integrate multiple technologies, to optimize convergence for a cellular carrier, and to optimize assets.

Another key achievement of the WBA is delivering reliable Quality of Service (QoS) over Wi-Fi, which is one of the biggest gaps currently in Wi-Fi. This has always been a big barrier and a big question mark, because we never know how Wi-Fi networks at home, in cafes, or in businesses will perform, or how we can ensure that we have the level of performance we need. WBA members have put in a lot of effort into this area, and we have some exciting releases for technologies helping to achieve QoS coming next year.

The WBA technical trials have been a further big achievement for us over the past year. Over the last year we conducted and published many Wi-Fi 7 trials, which were well received. We also carried out Wi-Fi HaLow trials, and we have a community of members who have now deployed Wi-Fi HaLow. The technology is proving to be hugely successful, which is helping drive forward enhanced use cases and deployments.

A final point I want to make, and to highlight, is the achievements of the WBA as an organization. We have seen our events grow, our membership expand, our overall revenues for the organization reach a new record, and for the first time we now also have a full board of directors.

Could you share some insight into the key priorities for the WBA in 2026 and beyond?

I will summarize our priorities into threekey areas, starting with convergence. Convergence is a very important program for the organization, and we believe that it is very important to advocate for convergence across the industry. We encourage convergence across all different technologies, including fiber, cellular, and IoT. Non-Terrestrial Networks (NTN) is another emerging technology which we think adds another tool to the toolbox, and for which there are great use cases that other technologies cannot address, and so we are going to be launching programs in that area soon.

A second key priority for the WBA will be continuing our work on QoS. I am excited to be continuing our work on the QoS agenda, and in fact QoS also involves the overlap of many technologies. For example, Wi-Fi supported by fiber, Wi-Fi converging with 5G, and now also satellite too. With so many different players active in connectivity, it is super important to understand which technology or combination of technologies is best suited for a particular application.

A further major achievement I want to highlight is OpenRoaming. A big milestone I am anticipating for the technology in 2026 is for an OpenRoaming identity to be used on a cellular network. This would enable a convergence of identities, so that it doesn't matter if it's a cellular identity or a Wi-Fi identity. This will be a huge benefit especially for an enterprise network, as it means IT managers managing multiple networks have the ability to use a Wi-Fi or a cellular identity flexibly. From my perspective that is a big milestone, and I am looking forward to seeing the technology come out and start to see adoption.

In your day-to-day interactions with your members, what topics do you feel are the most important issues for them?

I will say that there are two big topics. One is the convergence of Wi-Fi and 5G - how to do Wi-Fi offload, how to integrate Wi-Fi with a private cellular network, etc. The major concern our members have for convergence is one of the reasons that it has been at the core of the WBA's work. The other topic is device behavior. We have two of the biggest device vendors, Apple and Google, as members of the WBA, and we all use so many devices day-to-day, so it is a major concern. There remains a lot of work to be done in helping to optimize use of devices, in improving connection managers, in device decision making, in setting the metrics to be measured when we connect to Wi-Fi, connect to cellular, and much more. And if satellite becomes a mainstream technology, then that is one more technology to manage. This is so important because device behavior can have a huge impact on the Quality of Experience (QoE).

What do you believe are the most important technological developments underway in the Wi-Fi industry at the moment?

First of all, there are a handful of technologies which are already gaining traction, and in the next 12 months I foresee a gigantic boost in adoption of them. One of these is Wi-Fi 7, with Standard Power and 6 GHz. We have many Wi-Fi 7 deployments, and there are new ones happening every week. But we still need to work to get broader access to Standard Power by installing all the procedures to safeguard incumbents, and the mechanisms to manage spectrum. The second of these is OpenRoaming. We expect OpenRoaming will continue to grow, with a robust expansion of deployments. Every week we have multiplerequests from players, from enterprises to operators, enquiring about different OpenRoaming use cases. A third technology is AI. AI has already been used within Wi-Fi, but there is still room for further improvement, particularly in the areas of traffic management. All of these technologies are currently available but need to mature further.

The other important technological development is Wi-Fi 8, it is currently in the beginning. Throughout 2026 the core features of Wi-Fi 8 will be defined, exposed to the industry, and different companies can then begin planning on the news standard, helping them prepare for the next wave of Wi-Fi.

4. Key market segments update and the impact of Wi-Fi

4.1 Residential Wi-Fi

4.1.1 Consumer Premises

Wi-Fi is almost exclusively relied upon for home connectivity by consumers the world over, and consequently the market for residential Wi-Fi Customer Premises Equipment (CPE) is gigantic, with 233.1 million Wi-Fi CPE shipping to consumers in 2024 alone. What's more, this number is projected to continuously expand year-on-year, reaching a projected 394.1 million annual Wi-Fi CPE shipments in 2030, a 9.1% Compound Annual Growth Rate (CAGR) between 2024 and 2030.

This shipments expansion is being driven by several key trends. Firstly, growth will be stimulated by newly connected subscribers, particularly in Southeast Asia, Latin America, the Middle East, and Africa. Illustrating this, the developing Asia-Pacific region has a forecast shipment CAGR between 2024 and 2030 of 19.0%, well over double the 6.6% of the North American region. Another growth factor is the accelerating Wi-Fi CPE replacement cycles by ISPs in mature markets, spurred by their need to remain competitive, justify rising subscription costs, transfer broadband access improvements on to the end consumer, and to keep pace with accelerated Wi-Fi generations. A final major factor is the increasing number of consumers which are deploying additional CPE in order to improve Wi-Fi performance and coverage. Accordingly, Wi-Fi Mesh CPE is the fastest growing Wi-Fi CPE product type, with shipments forecast to more than double between 2024 and 2030, from 41.7 million to 86.9 million.

Alongside shipment expansion, the Wi-Fi CPE market is also undergoing a rapid transition to the latest Wi-Fi technologies. Wi-Fi 6 is now in the mainstream, with 145.6 million shipments of Wi-Fi CPE supporting the standard in 2024. 2025 also saw the ramping up of Wi-Fi 7 deployments by a wide range of ISPs, including AT&T and Spectrum (Charter Communications) in the US, Orange and Bouygues Telecom in France, alongside EE and Sky in the UK. This demand helped to deliver a large boost to Wi-Fi 7 CPE shipments across the last 12 months, with total shipments increasing from 23.0 million at the close of 2024 to a projected 59.0 million at the end of 2025. Towards the end of the decade robust demand for Wi-Fi 8 is anticipated, with 70.5 million shipments of Wi-Fi 8 CPE in the year 2030.

4.1.2 Multi-Dwelling Units

Multi-Dwelling Units (MDUs) is a term used throughout the connectivity industry for buildings that consist of multiple individual residences, apartment complexes, university dormitories, or assisted living facilities. The 2021 U.S. Census recorded that just under 25% of the population lived in MDUs with ≥4 units, and the percentage continues to increase alongside the growth of Real Estate Investment Trusts (REITs) in the United States, which buy, sell, manage, and develop MDUs. With the centrality of connectivity to everyday life continuing to grow, residents of MDUs now view Wi-Fi as a utility, similar to water or electricity, and expect it to be as reliable and as readily available as all other modern amenities. The key requirements of MDU networks are that they offer reliable high-performance Wi-Fi, secure personal networks, the simple onboarding of devices, seamless roaming throughout the wider network (hallway, outdoors, etc.), and finally, cost-efficiency.

Enabling high-performance Wi-Fi networks within MDUs can significantly increase their value, especially for rental properties. It is increasingly common for Managed Service Providers (MSPs) to provide Wi-Fi as-a-Service in MDUs, and Wi-Fi has now become a central component of the MDU value proposition. A plethora of MSPs are serving the MDU vertical, many of which specialize in a particular segment of the market, such as student dormitories, high-end properties, senior living properties, or even prisons. There are also MSPs that differentiate themselves via the technologies they employ. Examples include using equipment supporting OpenWiFi (an open-source, vendor-neutral, easy-to-manage, and low-cost alternative to the traditional proprietary enterprise Wireless Local Area Network (WLAN) solutions) or extending network management down to the Internet of Things (IoT) level, enabling home automation across the properties.

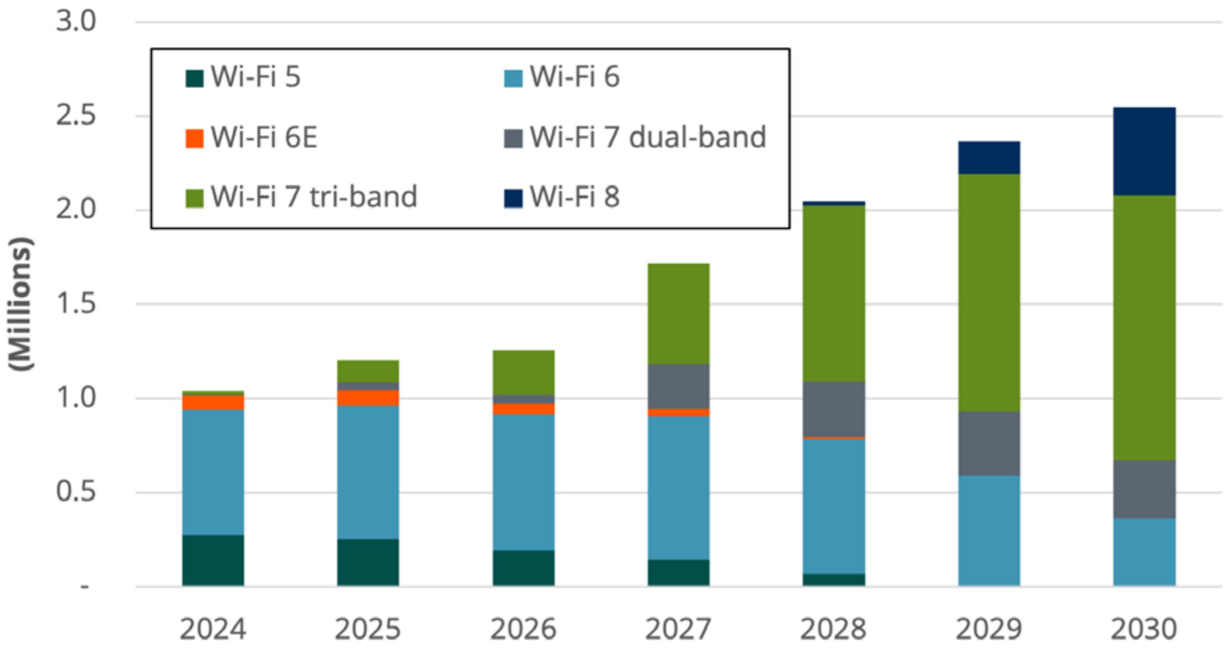


Chart 1: Wi-Fi Access Point Shipments to the MDU Vertical World Markets, Forecast: 2024 to 2030
(Source: ABI Research)

The continual expansion of MDUs, increase in the number of MSPs serving the vertical, and growing demands of residents are all acting to drive a rapid growth in the Total Addressable Market (TAM) for MDUs. Over the next 5 years, shipments of Wi-Fi Access Points (APs) to the MDU vertical are projected to more than double, from an expected 1.2 million shipments in 2025 to a forecast 2.6 million in 2030. As illustrated in Chart 1, at present, the majority of shipments to the MDU vertical are of Wi-Fi 6 equipment (64.2% in 2024), followed by Wi-Fi 5 (26.4% in 2024). But this is forecast to change rapidly, with Wi-Fi 7 supplanting Wi-Fi 6 in 2027 with 45.2% of shipments. The strong growth prospects for the MDU vertical are, in turn, leading Wi-Fi equipment vendors to expand their investments into developing equipment optimized for the needs of MDUs and creating new sales channels in the vertical.

MDUs have historically faced high levels of spectrum congestion and interference, making tri-band Wi-Fi 7, which offers both the additional capacity of the 6 Gigahertz (GHz) band and the enhanced spectrum efficiency capabilities of Multi-Link Operation (MLO), which are highly attractive to the vertical. In 2027, when Wi-Fi 7 becomes the most shipped protocol within the MDU vertical, 69.5% of all Wi-Fi 7 AP shipments will support the 6 GHz band. Yet, the remaining 30.5% of Wi-Fi 7 AP shipments in that year are forecast to not have 6 GHz compatibility, having access to the legacy 2.4 GHz and 5 GHz bands only. These dual-band-only Wi-Fi 7 shipments will be destined for markets without or with limited 6 GHz access, or more cost-sensitive markets.

The lucrative opportunities within MDUs have encouraged many Wi-Fi equipment vendors to devise targeted solutions for the vertical. CommScope RUCKUS, for example, maintains a division focused on MDUs, with a unique management platform tailored to the needs of MDU owners. In 2025, Airties also unveiled its new MDU-targeted connectivity experience platform "***Airties Multi***." Designed for Internet Service Providers (ISPs) and MSPs managing MDU environments, the dashboard provides real-time monitoring and management of network assets and users and implements Artificial Intelligence (AI) to optimize network performance for improved customer satisfaction.

4.2 Enterprise Wi-Fi

Without Wi-Fi, modern enterprises would be unable to function. The technology has become firmly entrenched in all aspects of business operations, facilitating communications both internally within an organization and externally with customers, prospects, stakeholders, and the wider market. Enterprises' reliance on Wi-Fi is steadily growing as more and more business operations become digitalized. As Wi-Fi continues to evolve, so do the applications for the technology. The improved performance and expanded capacity that innovations such as Wi-Fi 7 and the 6 GHz spectrum offer are enabling the technology to handle more devices, underpin new use cases, and offer superior reliability.

The expansion in both enterprise demand for Wi-Fi and the potential applications for the technology is driving robust growth in enterprise Wi-Fi AP shipments, with the number of annual shipments forecast to increase at a Compound Annual Growth Rate (CAGR) of 11.1% between 2024 and 2030. This represents an increase from 22.2 million shipments annually in 2024 to 41.7 million in 2030. Revenue derived from enterprise Wi-Fi AP equipment sales is forecast to expand at an even faster rate, jumping from US$12.8 billion in 2024 to US$24.9 billion in 2030.

Across the enterprise, standard Wi-Fi 6 is currently the predominant protocol, representing 57.9% of all enterprise Wi-Fi AP shipments in 2024. Wi-Fi 6E, the tri-band variant of 802.11ax, was still significant at 8.1% of shipments, but this is a decline from the standard's peak of 11.2% of shipments in 2023, and going forward, Wi-Fi 6E will decline further until it is gradually phased out. Following the commencement of official Wi-Fi 7 device certifications from the Wi-Fi Alliance in January 2024, shipments of the latest Wi-Fi standard surged to reach 3.3 million shipments in 2024, the equivalent of 14.7% of all enterprise Wi-Fi AP shipments for the year. Wi-Fi 7 AP shipments have continued to increase in 2025, and with a forecast of 7.7 million shipments for the entire year, and as illustrated in Chart 2, the enterprise Wi-Fi 7 AP shipment volume will surpass that of Wi-Fi 6 in the year 2027.

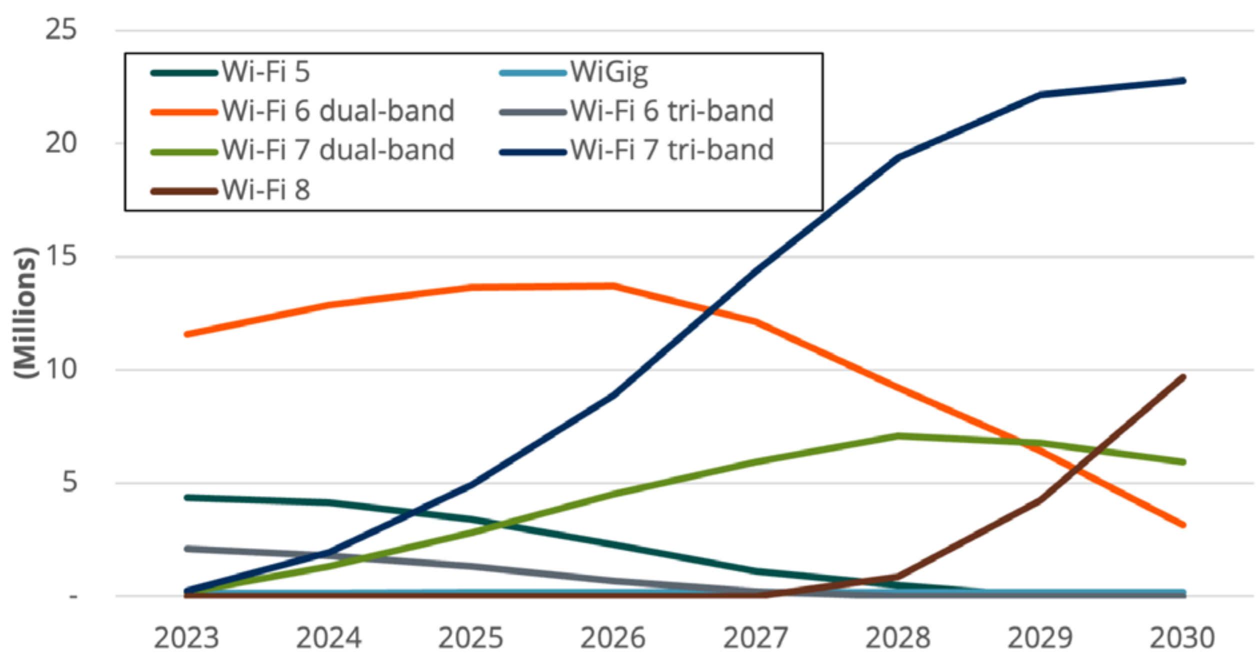


Chart 2: Enterprise Wi-Fi AP Shipments World Markets, Forecast: 2023 to 2030
(Source: ABI Research)

Carpeted enterprise is the largest vertical by scale, scooping up 26.0% of enterprise AP shipments in 2024, which amounted to 5.8 million APs. This reflects the well-established role Wi-Fi has in standard office environments. Yet, while enterprise Wi-Fi AP shipments to carpeted enterprise environments will continue to expand steadily throughout the decade, the vertical will not be the main engine of growth for enterprise Wi-Fi over the coming half decade, with other verticals growing, in some cases, over 200% faster. The following sections examine all the main enterprise Wi-Fi verticals, analyzing the market dynamics and drivers of growth for each.

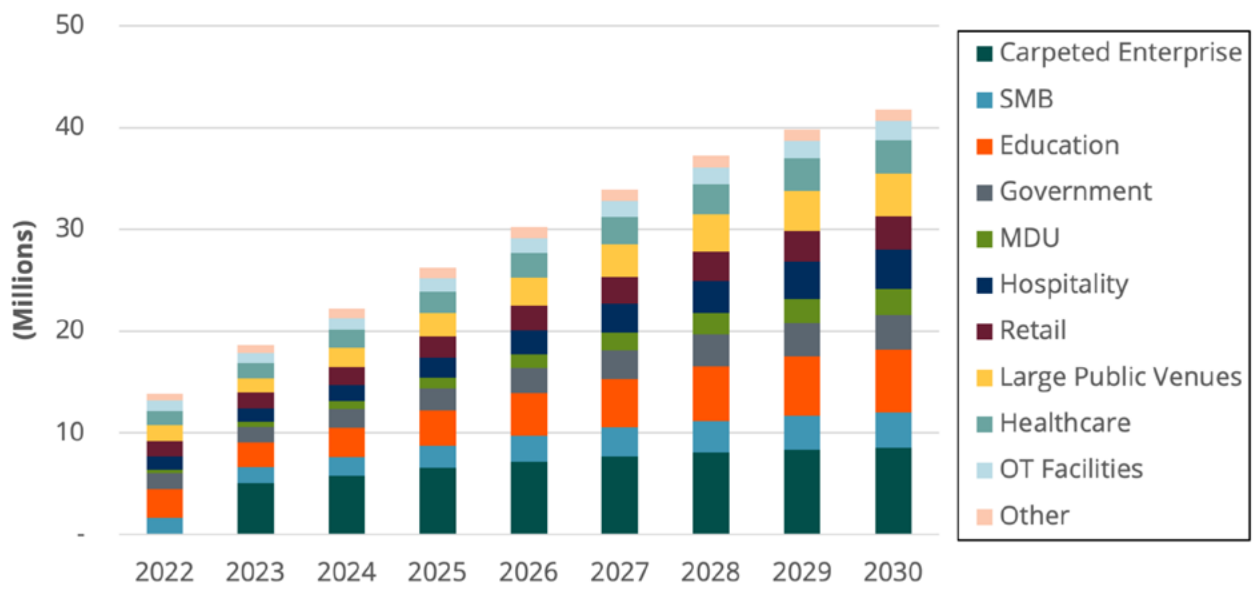


Chart 3: Enterprise Wi-Fi AP Shipments by Vertical World Markets, Forecast: 2022 to 2030
(Source: ABI Research)

4.2.1 Hospitality

Hospitality is a broad vertical encompassing numerous different sectors, including Food & Beverage (F&B) (e.g., cafés, restaurants, etc.), accommodation (e.g., hotels, resorts, etc.), and other services-related establishments. The diversity across the vertical gives rise to a high variation in requirements, with the needs of a small independent café being completely different from those of an international hotel chain. The café for example may only require a handful of APs, whereas the hotel chain will likely need to manage thousands of APs across a multi-tenant network, with numerous Service Set Identifiers (SSIDs), dedicated capture portals, monetization capabilities, advanced cybersecurity, and more.

Hotels have come to the realization that poor Wi-Fi can do greater harm to a guest's experience than they previously appreciated, particularly if the hotel is frequented by business travelers or there are business conferences held at the venue. F&B establishments are likewise deploying Wi-Fi to improve customer satisfaction, in the process of facilitating customer engagement with their social media while they are in the store. Moreover, Wi-Fi is enabling both hotels and F&B establishments to collect more granular data on traffic and customer behavior, which can be harnessed as feedback to refine their own service offerings and help introduce targeted new products and services.

With greater Wi-Fi adoption in hospitality being driven by growing customer expectations, on the one hand, and the greater use of the data collected via Wi-Fi on the other, it is unsurprising that shipments of Wi-Fi APs to the hospitality vertical are projected to more than double between 2024 and 2030, increasing from 1.6 million annual shipments to 3.9 million. Once installed, these Wi-Fi APs can enable a range of other services that support hospitality operations, such as location-based services, digital keys, or asset tracking.

4.2.2 Stadia

Stadia are extremely complex and demanding environments that require advanced Wi-Fi networks offering high performance, capacity, and resilience. Both the visitors and the staff within the stadia have their own unique requirements of the network, so there are specific features being introduced to address their individual needs.

Visitors have now come to expect a seamless and always-on connectivity experience when they visit stadia, and this begins with how they join the network. To make connecting to the network as smooth as possible, leading stadia, such as the London Stadium, have introduced OpenRoaming, which allows visitors to seamlessly transition from their cellular connection onto the local Wi-Fi network when they enter the premises. While on the network, it is now a widespread habit for visitors to remain constantly online throughout the event, sharing content, accessing real-time replays, and live-streaming footage with growing frequency. The event organizers are also increasingly leveraging this connectivity to facilitate a range of services, such as the ordering of food, and to engage deeper with visitors, perhaps by running quizzes or special promotions. These requirements, alongside high client device density and dynamically moving client device demand, lead to strained bandwidth and a high degree of spectrum congestion. This has also led to high demand for the 6 GHz spectrum from this vertical, and stadia were one of the first verticals to begin deploying Wi-Fi 6E back in 2022, and one of the earliest to begin adopting Wi-Fi 7 today. By the same token, these demands, alongside the need to cover wide and open spaces, have led to strong interest in Standard Power (SP) 6 GHz from the vertical.

On the other hand, the Wi-Fi network takes on a completely different role for the staff and vendors of the stadia. For them, the Wi-Fi network is crucial for supporting myriad tasks, including ticketing, sales of merchandise and food and drinks, internal communications, visitor traffic analytics, and more. Stadia management also must leverage advanced Wi-Fi analytics tools to gather data on visitor movements and network usage in order to continually optimize both their network and the provision of services.

Network refreshes and the trend toward greater AP density in stadia are helping to drive the 15.0% CAGR in Wi-Fi AP shipments into the vertical between 2024 and 2030. Many of the large enterprise Wi-Fi equipment vendors have solutions optimized for the specific needs of the vertical, including the ability to handle high-density environments, and the provision of advanced visitor analytics. Extreme Networks is a major equipment vendor within the vertical, supplying major sports stadiums worldwide, such as the stadiums of Manchester United and Liverpool football clubs in the United Kingdom. In 2025 the United Soccer League (USL) in the United States, representing over 200 clubs across the country, selected Extreme Networks as its official Wi-Fi solutions and analytics supplier.

4.2.3 Conference Venues

Conference venues can be unexpectedly complex environments. They are typically spread over several floors and contain a striking variety of different spaces, spanning expansive open areas, discrete meeting rooms, and tight winding corridors. Depending on the age of the venue, the structure itself may also pose a challenge, with thick brick walls or steel beams likely to block signals. Visitor dynamics further complicate matters, as large numbers of guests must be seamlessly onboarded, and the network needs to handle a high density of mobile client devices. These visitors also expect both failsafe-security and their privacy to be upheld.

Mobile World Congress (MWC), the technology industry's premier annual trade show held at the Fira de Barcelona center, has a long-term partnership with Wi-Fi equipment vendor Cisco. To supply connectivity to the over 100,000 attendees of MWC 2025, Cisco has deployed Wi-Fi 6E with 6 GHz to greatly expand the available capacity, and enabled OpenRoaming so visitors can seamlessly connect to the network. To deliver continual network optimization, Cisco's ThousandEyes dashboard provides a live view of all connected devices, with analysis of network performance and recommendations for how to improve it. Cisco's technology also allows the Fira de Barcelona to act as a service provider itself and lease access to the network to exhibitors.

4.2.4 Retail

Brick-and-mortar stores are being driven to digitalize rapidly in the face of intensifying competition from online retail platforms, due to the need to generate new sources of revenue, and in response to increasing customer expectations for digital experiences. Wi-Fi is front-and-center of this transformation, ensuring customers are connected throughout their journey, powering new in-store technologies such as automation, analytics, and cashier-less checkouts, collecting valuable footfall analytics that can be applied for Wi-Fi-powered targeted marketing, and increasingly acting as an offload for cellular, facilitated by OpenRoaming. Indicative of Wi-Fi's pivotal role in retail digitalization, Wi-Fi AP shipments to the retail vertical are projected to increase steadily from 1.8 million in 2024 to 3.3 million in 2030, at a CAGR of 10.2%.

In recent years, we have witnessed the rapid growth of innovative software platforms that harness guest Wi-Fi networks to collect actionable footfall analytics for retail, alongside creating further targeted marketing channels for brands. For example, Adentro tracks the anonymized Wi-Fi signals of customers to record the timing, frequency, and duration of their store visits, and then leverages these data to create valuable customer insights and targeted marketing opportunities. To ascertain the effectiveness of ad campaigns, Adentro's platform can also link advertisement views with physical store visits. Cloud4Wi is another solution that also gathers Global Positioning System (GPS) data from a consumer's smartphone for greater accuracy, and retail companies can even establish custom alerts for when a customer visits a competitor's location. Both of these solutions utilize Passpoint to establish long-term relationships with customers, helping to streamline network connections.

4.2.5 Aviation

Today, the most widespread technology leveraged by airlines for in-flight Wi-Fi connectivity is Air-To-Ground (ATG) solutions. These rely on antennas installed on the body of an aircraft transmitting with terrestrial cell towers, with on-board Wi-Fi APs then connecting with the passengers. Because existing ATG solutions are based on 3G/4G technology, speeds are restricted to no more than 10 Megabits per Second (Mbps), which is then shared among the passengers of the aircraft. To overcome this limitation, leading ATG supplier Gogo developed a 5G-based solution that promises to be capable of delivering peak throughputs of 80 Mbps. In June 2025, Gogo completed the ***first end-to-end 5G ATG call***, in partnership with 5G chipset designer GCT Semiconductor

Holding and Radio Access Network (RAN) developer Airspan. Gogo aims to bring its 5G ATG solution to market by the end of 2025.

Even with these advancements, ATG solutions still suffer from lost connectivity in areas where terrestrial cell towers are absent, such as oceans or sparsely inhabited locations like deserts. This, alongside the demand for increased bandwidths, has driven the emergence of new satellite-based solutions. There are two broad types of service within this category, those based on Geostationary Earth Orbit (GEO) constellations (altitudes of 35,786 Kilometers (km)), and those relying on Low Earth Orbit (LEO) constellations (altitudes under 2,000 km). GEO satellite constellations have a longer history of being utilized for in-flight Wi-Fi than LEO constellations, and therefore, they are the more established of the two types. Viasat, leveraging its constellation of GEO satellites, is a leading supplier of GEO-based in-flight connectivity solutions, and the company currently supplies airlines, including American Airlines, Southwest Airlines, United Airlines, and from 2025, ***Japanese airline ANA***.

Yet, thanks to their orbital altitudes, LEO constellations are able to offer wider coverage, faster speeds (of up to 250 Mbps), and lower latencies (less than 99 ms) than GEO constellations. This has spurred a rapid increase in the adoption of in-flight Wi-Fi solutions leveraging LEO constellations operating in the Ku-band (12-18 GHz) in 2025. In February 2024, Hawaiian Airlines became the ***first major U.S. airline*** to introduce a free Wi-Fi service underpinned by satellite connectivity, in this case, selecting SpaceX's Starlink as the provider. By September 2024, the airline had expanded free Wi-Fi access to ***all flights leaving the Hawaii islands***, and in ***1Q 2025, Ookla speed tests*** of in-flight Wi-Fi, Hawaiian Airlines recorded the highest speed and latency performance of every airline tested.

With the technology's potential proven, 2025 saw adoption of in-flight Wi-Fi solutions leveraging LEO constellations skyrocket. In Europe, February 2025 saw Latvian airline airBaltic became the ***first to launch free Wi-Fi*** on a commercial service, again using Starlink infrastructure. In fact, Starlink was the provider of choice for numerous other airlines throughout the year. United Airlines installed its first terminal in March, and subsequently retrofitted roughly 40 planes a month in order to ***upgrade its entire fleet*** by the end of the year. Air France also ***commenced installations in 2025***, whereas ***Scandinavian Airlines Systems (SAS)*** and ***Canadian airline WestJet*** both plan to complete retrofits across their entire fleets and bring their Wi-Fi services online by the end of 2025. In July 2025, ***Virgin Atlantic also announced*** its partnership with Starlink, with the goal of equipping its entire fleet by 2027.

Gogo also recently entered the LEO constellation for in-flight connectivity market, launching in 1Q 2025 a service based on Eutelstat's OneWeb, called Gogo Galileo. The service uses two modified variants of Electronically Steerable Antennas (ESAs) developed by Hughes Network Systems (a subsidiary of EchoStar), a Half-Duplex (HDX) ESA, and a Full-Duplex (FDX) ESA. The former is designed for small and mid-sized aircraft, with speeds of 60 Mbps download and 11 Mbps upload, while the latter is optimized for larger aircraft, with download speeds up to 195 Mbps, and upload speeds of 32 Mbps. Separately, Delta Airlines is gradually introducing a commercial model of Hughes' FDX ESA paired with ThinKom Ka2517 and Ka1717 VICTS antennas into its fleet of Airbus A321 and A350s.

4.2.6 Ground Transportation

In our increasingly interconnected world, passengers of public transport do not wish to be passive during the journey, but rather desire to use their time to communicate with friends or family, engage with social media content, and even work. Indeed, a ***recent survey*** by the video conferencing platform Zoom finding that 11% of people use Zoom on public transport. Therefore, enabling Wi-Fi aboard public transport is important in not only increasing customer satisfaction, but potentially also boosting passenger numbers and increasing revenue. Yet, enabling passenger connectivity while the train is in transit is an exceedingly complex task due to the speed of travel, the shifting exterior environment, and unpredictable demands of the passengers themselves.

Train-to-Ground (T2G) communications are typically handled by cellular 4G/5G networks, with transmissions converted into Wi-Fi signals for passengers by APs aboard the train. These APs are often equipped with advanced proprietary protocols that optimize the AP's performance for the needs of passengers aboard trains. For example, Wi-Fi AP vendor Moxa has developed a range of technologies for train connectivity. Moxa's Turbo Roaming greatly enhances Wi-Fi's mobility by seamlessly (less than 50 Milliseconds (ms)) reconnecting to different APs during motion. The handover time is less than 150 ms for client-based Turbo Roaming, and 50 ms for controller-based Turbo Roaming. AeroLink Protection, on the other hand, provides a backup node to activate and restore the communications link within 300 ms should the main active node fail. Alongside proprietary technologies, the expanded capacity and improved spectrum efficiency of Wi-Fi 7 and 6 GHz are well suited to the needs of passenger Wi-Fi, with adoption of these technologies on trains in the early stages.

While cellular is a well-established backhaul solution on trains, 2025 saw expanded interest in using satellite. The advantages of satellite over cellular are better coverage, improved throughputs, and lower latencies. This was ***demonstrated by a trial*** Icomera ran across a 970 km train route in Northern Sweden, in which Starlink terminals were consistently able to deliver between 200–400 Mbps speeds and under 40 ms latencies. In early 2025, ScotRail trains in Scotland equipped six of its trains with Starlink equipment for a ***6-month trial***. Across the United Kingdom, more broadly, the Department of Transport is ***running a tender*** to retro-fit the approximately 1,425 trains of Great British Railway with satellite. There are also hybrid solutions that leverage both cellular and Wi-Fi. Notably, Icomera's SureWAN can dynamically switch between cellular networks and Starlink to deliver uninterrupted passenger Wi-Fi.

4.2.7 Smart Transportation & Connected Vehicles

The proliferation of driver-assistance and self-driving features within vehicles, as well as the gradual transition to Electric Vehicles (EVs), has greatly expanded the volume of sensors and cameras within modern vehicles. This in turn has led to vehicles becoming ever larger procurers and consumers of data. A Light Detection and Ranging (LiDAR) sensor, for example, can generate 20 Mbps to 100 Mbps, whereas a high-resolution camera might generate 500 Mbps to over 1 Gigabits per Second (Gbps). Collectively, the hundreds of sensors and cameras within a vehicle can, by some estimations, lead to data generation of up to 25 Gigabytes (GB) per hour. A growing number of use cases, including many automative infotainment applications, depend on the time-sensitive transfer of large amounts of this data between the vehicle and the cloud. Existing solutions for this depend solely on cellular technologies, but cost concerns and network capacity limitations impact the scalability of the technology. Therefore, the industry is now beginning to explore the role that Wi-Fi could play in complementing cellular, helping to mitigate the data load on overburdened cellular networks, and potentially even providing a more cost-efficient and faster solution for certain applications.

There are many existing 802.11 capabilities that would support Wi-Fi data offload for automotive. For example, the Fast Basic Service Set (BSS) transition feature of 802.11r supports seamless client roaming between Wi-Fi APs, while the Fast Link Initial Setup (FILS) feature of 802.11ai enables 802.11 networks to minimize the time necessary to establish links. Yet, gaps remain that need to be addressed, such as mobile roaming and portable credentials for improved handover. The IEEE 802.11 Automotive Topic Interest Group (TIG) is currently exploring how Wi-Fi can develop these necessary capabilities, with the goal of creating and approving a final report on recommendations for early 2026.

The growing convergence between Wi-Fi and 5G (and in the future, 6G) may also help underpin the operation of Vehicle-to-Everything (V2X), in which the vehicle communicates information with local infrastructure and other vehicles for improving road safety and efficiency. The 802.11p standard and the more recent 802.11bd standards provide the framework facilitating V2V and Vehicle-to-Infrastructure (V2I) communications over Wi-Fi. Another notable recent development is the introduction of the 802.11bc standard, which provides cross-technology signaling between 5G and Wi-Fi that could be used for purposes such as remote software patching.

Wi-Fi for in-vehicle connectivity is also rapidly expanding, as the technology is increasingly leveraged for applications ranging from media to navigation. We are also seeing a rise in Wi-Fi integration into domestic EV chargers, keeping the charger connected to the home network to inform consumers of electricity fee fluctuations and electricity load, and also potentially to deliver firmware updates. Reflecting this rise, in 2024 there were 48.2

million Wi-Fi chipsets which were shipped to the automotive market, with the number projected to rise almost 30 million to 77.7 million by 2030.

4.2.8 Industrial Manufacturing

Historically, manufacturers have prioritized wired over Wi-Fi due to its perceived superior reliability, security, and performance. The 20+ year refresh cycles typical in industrial networks, alongside a tendency to stick with tried and tested technologies, have further delayed migrations to wireless. Reflecting this, the results from ***HMS Networks' 2025 industrial network market shares report*** reveal that wireless represented only 7% of newly installed nodes in factory automation in 2024, whereas Ethernet accounted for 76% and Fieldbus 17%.

Yet, this dynamic is set to be upended as the release of the 6 GHz spectrum, the authorization of Standard Power (SP) 6 GHz, and the latest advancements from Wi-Fi 7 and Wi-Fi 8 will enable Wi-Fi to finally satisfy the low-latency, high-throughput requirements that mission-critical applications demand. This will not only power mobile use cases like Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs), but will also allow machines that have traditionally relied on Ethernet to transition to 802.11, helping to reduce installation costs, operational complexity, maintenance requirements, and the physical footprint. Yet, it is not technical pull factors alone that are driving the migration to Wi-Fi. Industrial manufacturers are also struggling with labor shortages, and this is necessitating the introduction of mobile robots, which can only be connected reliably with wireless. The need to connect the increasing number of IoT devices throughout industrial environments is another factor.

The unleashing of Wi-Fi's potential in industrial environments will help stimulate a 7.6% CAGR of ruggedized Wi-Fi AP shipments to industrial environments 2024 and 2030. While Wi-Fi 4 is still the most shipped protocol to industrial networks, at 45.9% of shipments in 2024, the expansion of Wi-Fi 6 is accelerating fast. In 2026, shipments of the Wi-Fi 6 standard to industrial manufacturers are forecast to be 159.7% of Wi-Fi 4. Strong adoption is also expected for 6 GHz. Whie in 2024, only 6.8% of shipped ruggedized WLAN APs supported 6 GHz, this is projected to increase to 51.0% in 2027, and 70.8% in 2030.

To guarantee operational resilience in complex manufacturing environments, many Wi-Fi equipment suppliers serving the vertical have developed proprietary features that optimize Wi-Fi equipment for a specific task. For example, Hirschmann developed Clear Space Technology, which achieves reliable, uninterrupted Wi-Fi transmissions by eliminating all concurrent Radio Frequencies (RFs). Another example is industrial Point Coordination Function with Management Channel (iPCF-MC) from Siemens, which was designed specifically to support the resilient operation of AGVs. With iPCF-MC, Wi-Fi APs use two radio interfaces concurrently—one for transmitting a cyclic signal and another for data transfer. At the same time, clients will continuously scan for APs and will switch to an alternative should the transmission quality lag. This high degree of specialization, and the long deployment cycles, explains why Wi-Fi 4 is still the most shipped protocol within industrial manufacturing.

It is worth noting that the nascent Wi-Fi HaLow standard has a lot to offer Industrial IoT (IIoT) connectivity, thanks to its robustness, low power, extended range, and inherent scalability. Competing low-power, wide-area technologies like LoRa are often unable to provide sufficient throughput, whereas low-power, short-range technologies relying on the 2.4 GHz spectrum, such as Bluetooth®, do not perform well in harsh industrial environments. This is particularly evident for vibration monitoring and video streaming applications, and the technology will likely play an expanded role in data collection for AI related applications going forward. 60 GHz Wi-Fi also has a role to play in providing Point-to-Point (PTP) 60 GHz backhaul to remote sites or those requiring rapid network setup. Many such deployments have taken place in the mining and oil & gas verticals.

4.2.9 Education

With 2.9 million Wi-Fi AP shipments in 2024, education is the second largest campus vertical, after carpeted enterprise. Going forward, educations dependance on reliable, high-capacity Wi-Fi is only expected to grow, with the vertical forecast to undergo a Wi-Fi AP shipment expansion of 13.5% CAGR between 2024 and

2030. This will be driven by several factors. Firstly, there is the need for additional spectrum and improved networking performance to handle the growing volume, density, and demands of Wi-Fi devices in the education environments. Then there is the emergence of new learning tools, including Extended Reality (XR) applications, and the enablement of improved security measures, such as security cameras. Finally, there is the need to support flexible learning arrangements, including remote learning setups.

It was desperation for additional spectrum that resulted in the education vertical being among the earliest and keenest adopters of Wi-Fi 6E. In 2023, 10.9% of all WLAN APs shipped into the vertical supported Wi-Fi 6E. Reflecting the initial strong demand for Wi-Fi 6E within education, in July 2022, the University of Michigan completed its installation of 15,500 HPE Aruba Networking Wi-Fi 6E APs, at the time the largest Wi-Fi 6E deployment. Wi-Fi 7 is already beginning to gain traction in education, with Huawei announcing the deployment of its "All-Scenario Wi-Fi 7 Smart Campus" solution at the Shenzhen Welkin School in Mainland China in September 2024.

4.2.10 Healthcare

The healthcare industry is grappling with numerous challenges, spanning strained budgets and resources, staff shortages, an aging population, increasing patient expectations, and even cybersecurity threats. Wi-Fi has a central role to play in overcoming these challenges, helping with the smooth delivery of telehealth services, connecting the Internet of Medical Things (IoMT), supporting real-time patient monitoring, underpinning the secure transfer and management of patient data, enabling the reliable operation of mission-critical medical devices, and providing both patient and visitor connectivity. Reflecting the central role of Wi-Fi within healthcare, shipments of Wi-Fi APs to the vertical are forecast to grow from 1.8 million in 2024 to 3.3 million in 2030.

The expanded capacity that the 6 GHz spectrum band offers is particularly useful for healthcare environments, leading to high levels of adoption of the band across the vertical. In the case of the University of Massachusetts Chan Medical School, Wi-Fi 6E was introduced to better support the Medical School's dense population of personal, academic, and medical research devices. The Novant Health group, on the other hand, upgraded to Wi-Fi 6E so that it could dedicate the 6 GHz band for mission-critical healthcare applications and medical devices. In both cases, Extreme Networks was the infrastructure supplier.

The lower latencies and faster throughputs of Wi-Fi 7 are particularly valuable for mission-critical devices and equipment in hospitals, such as for Intensive Care Units (ICUs) and AGVs. We are also witnessing an expanded role of AGVs within healthcare, being applied in hospitals to reduce manual labor and improve logistical efficiency through the transporting items such as medicines, medical utensils, meals, and even hazardous waste. AGVs are also increasingly being implemented by pharmaceutical manufacturers to improve logistics processes and guarantee compliance with Good Manufacturing Practice (GMP) regulations, which mandate that every component used in manufacturing pharmaceutical products must be documented and traceable at all times.

Wi-Fi APs in the healthcare sector also can serve as IoT hubs, enabling other wireless IoT technologies which in turn enable tasks such as asset tracking, access control, indoor navigation, and staff safety applications. Bluetooth® Low Energy (LE) is a widely adopted IoT technology within healthcare, although others are also gaining traction, including Ultra-Wideband (UWB) and 802.15.4-based technologies.

4.3 Connected Communities and Public Spaces

4.3.1 Smart Cities

Smart cities harness advanced digital technologies to enhance the efficiency of service delivery, improve sustainability practices, ensure social inclusion, and increase the overall quality of life for residents. The provision of public Wi-Fi is a core component of the concept of smart cities, as it makes connectivity more accessible and affordable for residents and visitors alike. OpenRoaming, discussed in ***depth in section 5.4.1***., is a technology developed by the Wireless Broadband Alliance (WBA) that greatly simplifies the process of connecting to these networks. When within an OpenRoaming-compatible network, devices can automatically, securely, and seamlessly connect via a unique trusted identity provider, which can be reused every time by the same device entering an OpenRoaming environment. OpenRoaming is experiencing rapid adoption worldwide, and has been deployed in cities such as London and Tokyo.

Another crucial element of smart cities are IoT sensors, with the environmental, utility, and traffic data they collect being leveraged for numerous automation and optimization tasks. Wi-Fi often serves as the backhaul for connected IoT infrastructure. For traffic and parking management IoT sensors can track road and parking space utilization, monitor the condition of infrastructure, and conduct long-term analysis of traffic patterns, helping city planners to better identify any bottlenecks or risks, and understand where to prioritize investments. IoT sensors deployed within smart energy grids can support automating load balancing, and with demand forecasting, can enable the optimization of consumption and distribution. Utility management is another area where IoT Sensors are valuable, as they enable the authorities to optimize utilization and to swiftly detect any damage or leaks, aiding the quick resolution of the issue.

An assortment of different connectivity technologies are leveraged by IoT sensors today, including LoRaWAN, 802.15.4, and 5G. A fast-emerging alternative is Wi-Fi HaLow, which expands Wi-Fi into the IoT domain. The standard's balance between range and throughput positions it in the Goldilocks zone between competing low-power, short-range technologies like Bluetooth® LE and Zigbee, and low-power, WAN solutions such as Narrowband (NB)-IoT, Sigfox, and LoRa. This ability to maintain relatively fast data rates over vast distances (up to 150 Kilobits per Second (Kbps) when 1 km from the AP) makes it ideal for battery-operated IoT devices that require high bandwidths, such as cameras and certain sensors.

Safety and security within smart cities are greatly enhanced by a network of connected cameras that observe and identify issues in the city. To ensure that these cameras can promptly detect instances of crime or other challenges such as traffic jams, data from them needs to be analyzed in real time. This demands the high-throughput, low-latency connectivity that advanced Wi-Fi technologies, including Wi-Fi 7, can deliver.

4.3.2 Underserved Communities in Cities and Rural Communities

The modern digital world is founded upon connectivity, thus the economic prospects of entire communities' hinge on the availability of high-quality, affordable Internet access. Numerous studies have proven the direct link between connectivity and economic development, with the ITU's ICT Development Index (IDI) being one of the most widely cited. The IDI score is well respected because it does not just measure physical access (i.e., are homes connected by fixed broadband or is cellular coverage available), but also "meaningful connectivity," which considers affordability, connection quality, and the digital skills of citizens. Chart 4 displays the results of the ***ITU's 2025 update*** to the IDI, which assessed 164 economies. The distribution of IDI country scores by income group, with the red line indicating the group averages. Chart 4 highlights the stark disparity in connectivity between income groups, with low-income economies, in particular, lagging far behind the other groups.

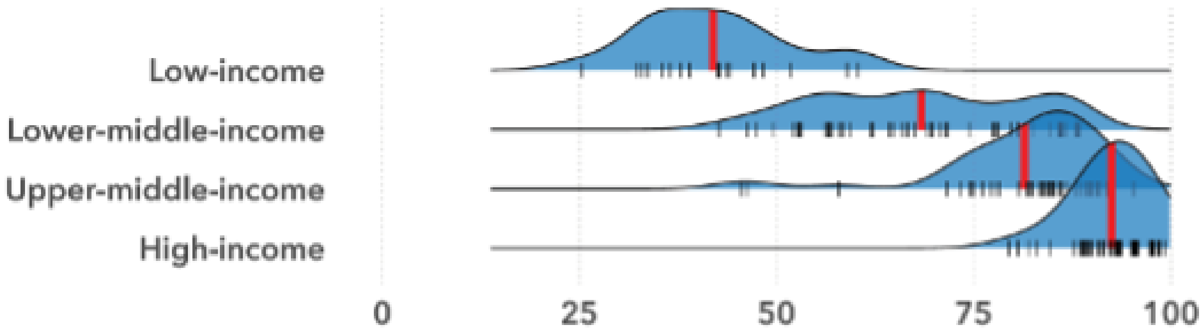


Chart 4: Distribution of IDI 2025 Scores by Income Group
(Source: ITU Measuring Digital Development – ICT Development Index 2025)

The chasm in connectivity access is not just present between nations, but also within them, with a persistent divide between urban and rural areas witnessed around the world. The Organization for Economic Co-operation and Development's (OECD) recent publication, ***Closing Broadband Connectivity Divides for All: From Evidence to Practice***, provides insight into this dynamic from across the organization, with the report revealing that the gap between the fixed broadband speeds of urban and rural areas in the OECD expanded from 22 Mbps to 58 Mbps between 2019 and 2024. The report also pointed out that, in 2024, the fixed broadband speeds of urban areas were, on average, 44% above that of rural regions. It is often the case that rural areas do not merely suffer from inferior connectivity, but that they lack connectivity altogether. For example, a ***2023 study*** of connectivity in Brazil uncovered that 94% of urban households were connected, while only 81% of rural households were.

Recognizing the importance of connectivity for socioeconomic development, in recent years, governments worldwide have poured significant resources into addressing digital inequality by closing the digital divide between the connected and the unconnected or underserved. This has taken the form of investments in broadband infrastructure, directly subsidizing or mandating affordable connectivity packages, and even offering digital literacy programs.

Perhaps the most high-profile infrastructure investment initiative is the Broadband Equity, Access, and Development (BEAD) program in the United States, which set aside US$42.45 billion for improving U.S. broadband infrastructure. The program, which was first introduced in November 2021 and is administered by the National Telecommunications and Information Administration (NTIA), initially prioritized the deployment of fiber-optic networks in locations identified as unserved (classed as those lacking Internet speeds of 25 Mbps downlink and 3 Mbps uplink) or underserved (those without 100 Mbps downlink and 20 Mbps uplink). Recent revisions to BEAD have now introduced a more tech-agnostic approach to the program, in which the most cost-effective solution will be favored. This potentially opens the doors to alternative connectivity technologies aside from fiber, such as satellite.

Other similar initiatives include the ***£800 million investment*** by the U.K. government to install gigabit-capable broadband for around 312,000 rural households and businesses across the country, which forms part of a broader strategy of realizing full gigabit broadband coverage throughout the United Kingdom by 2030. The United Kingdom's ***2025 Digital Inclusion Action Plan*** also includes numerous measures to make connectivity more affordable for the underserved, including low-cost "social tariffs" for broadband packages. As ambitious as this and similar plans are, affordability initiatives often face many hurdles to successful execution. Notably, it is often challenging to ensure that funds are distributed in a fair and equitable manner, and those who are eligible for the programs are, in many cases, unaware that it exists or unclear of how they can claim their entitlements.

As for digital literacy initiatives, the Indian State of Kerala serves as a shining example of what can be achieved which such programs. The campaign began in 2022 to increase the digital literacy of its population, and after 3 years of state-wide effort, the Chief Minister of Kerala, Pinarayi Vijayan, announced that, in August 2025, 100% digital literacy had finally been achieved.

There are numerous ways in which Wi-Fi can play a pivotal role in connecting the unconnected or underserved communities. For example, P2P and Point to Multi-Point (P2MP) Wi-Fi can serve as a low-cost, simple to deploy backhaul solution for rural communities. The latest Wi-Fi technologies are also vital for ensuring that the improved network performance unlocked by the significant investments that governments and the private sector make into upgraded broadband access infrastructure are passed on to the end consumer.

4.4 Non-Terrestrial Networks

4.4.1 Satellite Connectivity and Direct-to-Device Offerings

Market-enabling features for Non-Terrestrial Networks (NTNs) were first introduced in The 3rd Generation Partnership Project (3GPP) Release 17, consisting of two new 5G communications standards for satellite networks, IoT NTN and New Radio (NR) NTN. Subsequently, Release 18 in September 2023 saw the introduction of new NTN standards enhancements, and Release 19, expected for final completion in December 2025, will bring further NTN standards enhancements, including a standard for using Ku-band satellite frequencies for 5G NTN. An overview of NTN architecture is displayed in Chart 5.

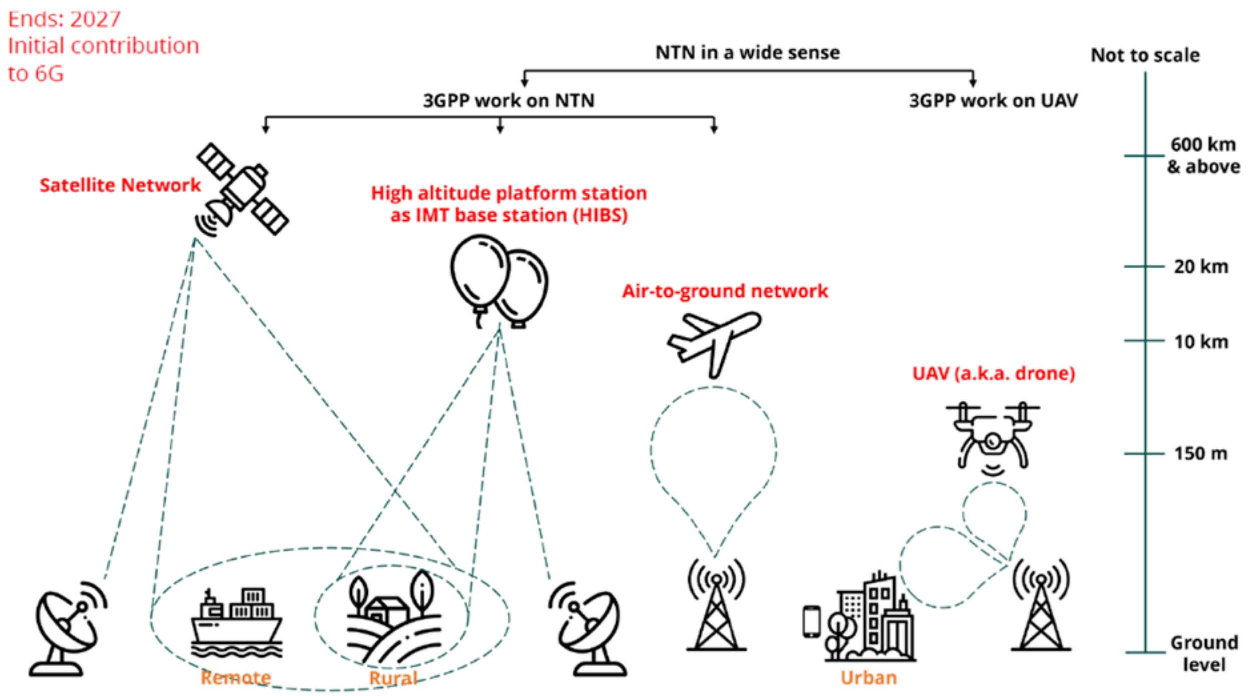


Chart 5: Overview of Non-Terrestrial Network Architecture
(Source: ABI Research)

With the foundation now firmly established, NTN technologies are beginning to scale fast. There are now over 10 Direct-to-Cellular (D2C) smartphones on the market, with Android 15 supporting satellite connectivity, and iOS 18 enabling iMessage and Short Message Service (SMS) over satellite. The total number of satellite-enabled D2C users—individuals or devices that have access to satellite connectivity through a consumer smartphone, including both free and paid access types—reached 585 million in 2024. This number is projected to continue growing rapidly. Yet it is becoming apparent from existing operational services that link budget limitations and current network capacity will limit D2C's potential to move beyond text messaging. For improvements to service performance and the enablement of more use cases, and by extension, to unlock more revenue opportunities, the industry will need to embrace standards that leverage globally harmonized spectrum, enabling superior link budget and spectrum planning.

There are more than 70 publicly announced partnerships between operators and Satellite Communications (SatCom) providers, spanning 42 countries and territories. North American satellite networks are projected to lead the satellite D2C market throughout most of this period, driven by the proliferation of SatCom networks, a supportive regulatory framework, and an increasing number of devices supporting NTNs. At present, the largest satellite D2C operators (Starlink, Skylo, Globalstar, Iridium, and EchoStar) are all also based in the United States. That said, the Asia-Pacific region is anticipated to be the largest market for satellite D2C. This is because many parts of that region lack adequate terrestrial coverage and face a high volume of natural disasters (which may disable terrestrial infrastructure). At the same time, the region enjoys relatively high smartphone penetration, and the falling costs of satellite connectivity will help make D2C services more affordable.

Satellite is also quickly emerging as a new broadband backhaul technology for home Wi-Fi connectivity. At the close of 2024 there were 6.76 million satellite broadband subscriptions worldwide, and this number is projected to almost double to 12.67 million by the end of 2026. The proliferation of satellite broadband will help deliver connectivity to previously unconnected or underserved regions, expanding connectivity access and acting to close the digital divide.

4.5 Operators (Mobile Carrier Offload, Neutral Host, and Other)

Operators are grappling with the growing burden of the continually expanding data traffic on their mobile networks. ***Recent analysis from Ericsson*** has reported that global mobile data traffic grew 19% between 2Q 2024 and 2Q 2025, 74% of which was driven by video content. If unaddressed, this mounting traffic will increase network congestion, reducing service quality, and, in turn, potentially revenue. While an enlargement and further densification of the cellular network could help alleviate the issue, in many cases, this is prohibitively expensive, and often simply impractical. The preferred solution for a growing number of operators is carrier offload, in which data are transferred from cellular networks onto local Wi-Fi networks. Seamless offloading is also beneficial for the consumer, as it enables them to enjoy an improved, more reliable Quality of Service (QoS). The increasing prevalence of offload is highlighted by OpenSignal reporting that U.S. consumers spend 77% to 88% of their screentime connected to Wi-Fi, not cellular, when outside the home.

Operator strategies toward carrier offload vary. In the United States AT&T has invested heavily into carrier offload. Not only has AT&T built its own network of over 20,000 Wi-Fi hotspots in dense urban areas across the country, in 2025, it also entered into a partnership with Helium, so that AT&T subscribers can access Helium's more than 105,000 U.S. hotspots. In 2025, Helium also entered into a ***partnership*** with Mexican operator Movistar, so its 2.3 million subscribers can connect with Helium's network in the country. In contrast to AT&T's enthusiasm for Wi-Fi offload, T-Mobile is doubling down on cellular, boosting coverage by enlarging its network and launching the nation's first 5G Standalone (SA) network in April 2025. On the other hand, Mobile Virtual Network Operator (MVNO) Xfinity Mobile has placed Wi-Fi Offloading, marketed as its PowerBoost technology, as a central component of its value proposition to consumers. PowerBoost allows Xfinity's mobile customers to offload onto dedicated hotspots, as well as Xfinity residential broadband gateways, which can also double-up as hotspots for mobile customers.

Numerous System Integrators (SIs) within the industry develop and maintain Wi-Fi hotspot networks onto which operators can offload traffic. Boingo Wireless is one of the largest, with more than 1 million hotspots worldwide, covering over 130 airports. The SI has over 100 operator partners, including AT&T and Telmex in the Americas, Orange and T-Mobile in Europe, the Middle East, and Africa (EMEA), and Tata alongside NTT DOCOMO in Asia-Pacific. Reflecting Boingo's leading-edge innovation, in 2025, Boingo was ***selected to deploy*** a converged Wi-Fi 7 and 5G network at the Hollywood Burbank Airport, located in a region that will be host to the 2028 Summer Olympic & Paralympic Games.

Another emerging model that is redefining the role of operator networks is that of neutral hosts. Neutral hosts are not a new concept, but the maturing of 5G networks, growing demand for dense cellular connectivity, and increasing interest in 5G private networks from enterprises have all driven a resurgence in the relevance of the model. A neutral host is a third-party provider that builds, owns, and operates the physical infrastructure required to support mobile networks, such as cell towers and fiber-optic cables, and then rents access to multiple Service Providers (SPs) on a shared-tenant basis. Within an enterprise environment, this allows neutral hosts to use the same infrastructure and rent out dedicated connectivity in the form of network management and operation to multiple enterprises simultaneously.

Neutral hosts offer providers lucrative new business and service models, enabling SPs to lower their Capital Expenditure (CAPEX), minimize their operational costs, reduce complexity, and accelerate the time to deployment in a given area. Environments where it is not economically viable for each individual operator to deploy their own infrastructure, such as densely populated areas or indoor environments, are where neutral hosts are gaining the most traction.

As neutral hosts have proliferated, so have the variety of different business models that leverage the technology. There are broadly two distinct approaches to delivering neutral host services. The first is where a provider rents access to its own spectrum resources and network infrastructure to other SPs. Because these rely on either shared or licensed spectrum, they are often referred to as spectrum-based neutral host networks. In the second model, the provider relies on unlicensed spectrum (such as the Citizens Broadband Radio Service (CBRS) in the United States), and operates by clustering multiple small cells together and sharing backhaul, or by using one small cell with virtualization capabilities to enable the radios to support different SP channels. Companies following this model, which is referred to as the Small Cell-as-a-Service (SCaaS) or tower company model, include TowerCo, ClearSky, Virgin Media, and Colt Technology Service.

The year 2025 has seen a significant advancement in the deployment and operation of neutral host networks around the world. In the United States, access to Celona's neutral host service was extended to millions of AT&T customers, allowing AT&T devices to seamlessly connect to the Celona 5G Local Area network (LAN) over CBRS spectrum. At the Stadium of Light in Sunderland, Boldyn Networks deployed what it described as the "UK's first full neutral host RAN managed service in a high-density demand venue." Operator Virgin Media O2 (VMO2) was a partner in the initiative, and is using the service to deliver tailored 5G connectivity to its customers in the stadium. In Sri Lanka, after a major policy shift, the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) awarded the EDOTCO Group with the country's first neutral host license. Finally, in Saudia Arabia, the Communications, Space & Technology Commission (CST), alongside Nokia, neutral host vendor ACES-NH, and SPs Mobily and Zain KSA, launched a neutral host network on the shareable 4.0 GHz spectrum.

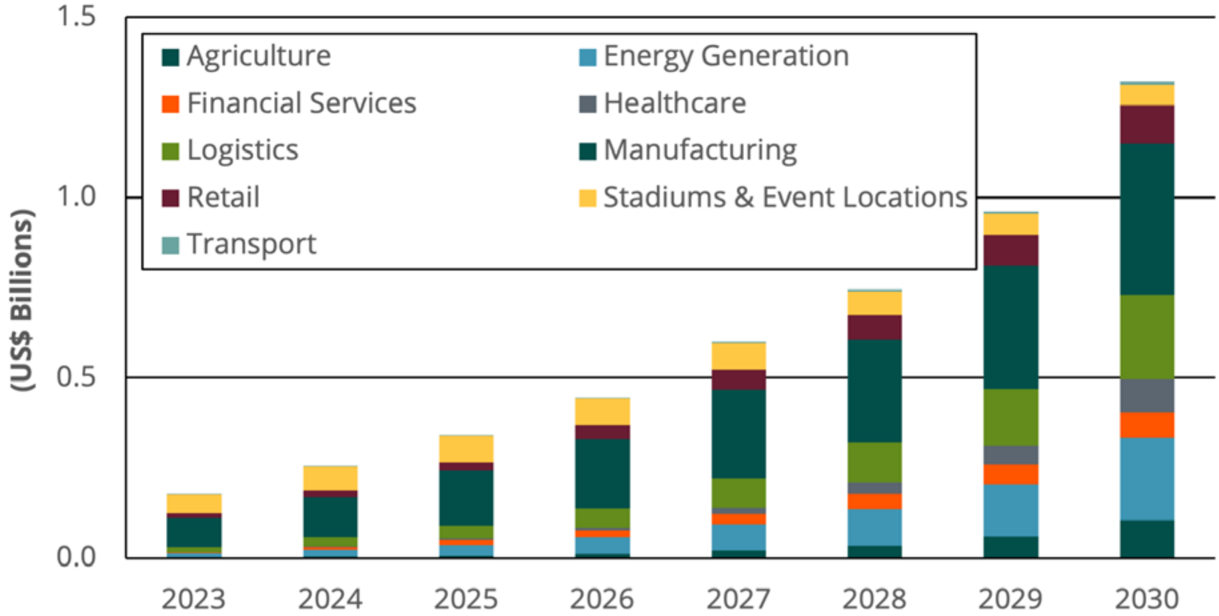


Chart 6: Neutral Host in Enterprise Cellular Revenue by Enterprise Segment World Markets, Forecast: 2023 to 2030 (Source: ABI Research)

ABI Research forecasts that revenue from neutral hosts in the enterprise sector will increase from 0.18 billion in 2023 to 1.32 billion in 2030, representing a 33.4% CAGR over the period. The vertical breakdown for this revenue is displayed in Chart 6. As seen in the chart, the largest vertical currently and throughout the forecast period will be manufacturing, although the fastest growth will be witnessed in healthcare, which is projected to undergo a 107.3% CAGR between 2023 and 2030.

5. Wi-Fi Technology Evolution

5.1 Key Updates on Wi-Fi Standards (Wi-Fi 7, Wi-Fi 8, 6 GHz/AFC, and overall adoption)

Wi-Fi 7, the latest Wi-Fi standard currently on the market, is experiencing robust demand from both enterprises and consumers. Reflecting this, shipments of devices and equipment supporting the standard have rapidly expanded over the past several years. For example, shipments of smartphone chipsets equipped with Wi-Fi 7 jumped from 70.1 million in 2023 to 196.2 million in 2024, and are projected to hit 466.0 million in 2025. This represents 37.0% of all forecast smartphone chipset shipments in 2025, and the percentage of Wi-Fi 7 smartphone chipsets is forecast to increase to 68.0% in 2027 and 75.0% in 2028. Wi-Fi 7 has also witnessed strong traction within enterprise Wi-Fi APs, and support for the protocol is forecast to expand from 14.1% of all shipped Wi-Fi APs in 2024 to 60.6% in 2027.

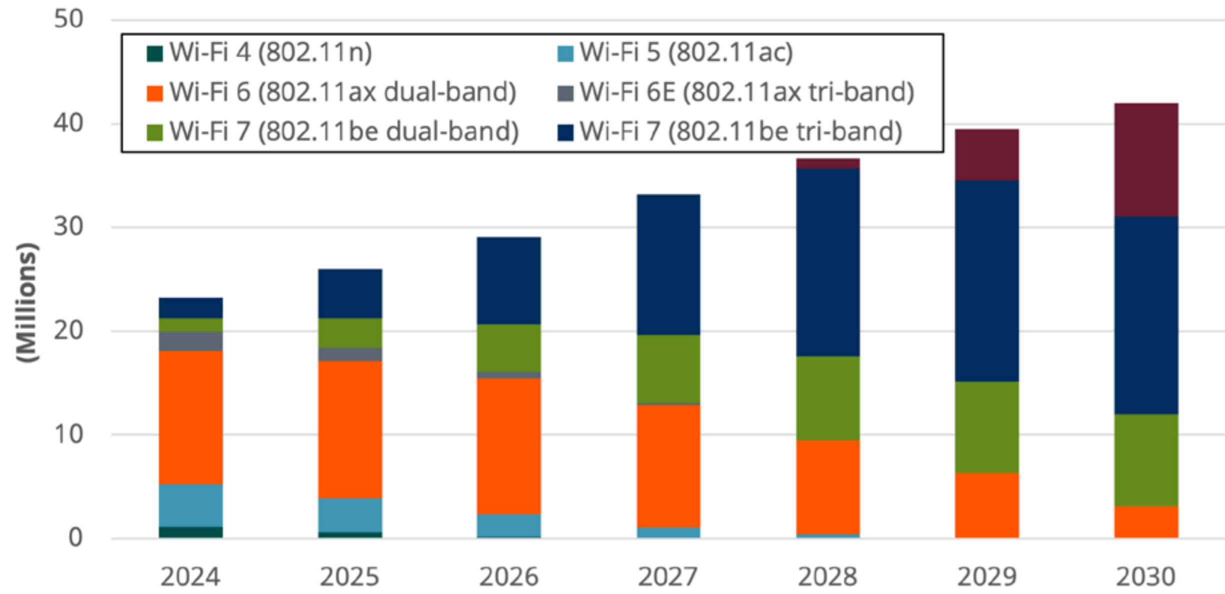


Chart 7: Enterprise Wi-Fi AP Shipments by Protocol World Markets, Forecast: 2024 to 2030
(Source: ABI Research)

Across 2025, the WBA has partnered with a range of companies across the Wi-Fi ecosystem to conduct trials of Wi-Fi 7, demonstrating the potential of the new standard. In February, CableLabs and Intel completed a test ***comparing Wi-Fi 6E and Wi-Fi 7*** performance in a 4,500 square foot residential building, with the results showing that Wi-Fi 7 significantly outperformed Wi-Fi 6E. A second trial in March by LG U+ and Intel showed that with MLO, peak throughputs of ***up to 9 Gbps*** were possible in real-world environments. In May, a ***Wi-Fi 7 mesh performance trial*** conducted by Türk Telekom and TP-Link saw throughputs exceed 10 Gbps. In September 2025 a ***report was published*** on Wi-FI 7 trials conducted in residential environments by Türk Telekom, HPE Aruba Networking, and Intel, revealing peak throughputs in excess of 4.2 Gbps, consistent coverage throughout multiple rooms of over 3 Gbps, and latencies under 1 ms.

It should be noted that not all device types will require the advanced capabilities of the latest Wi-Fi protocols, and for cost considerations, legacy Wi-Fi technologies will remain dominant in many device types throughout this decade. For example, in 2030, Wi-Fi 6 will be the most advanced Wi-Fi protocol supported in 94.3% of shipped smart home devices, and in 87.1% of shipped wearables.

As discussed in depth in ***Section 7***, the new 6 GHz spectrum band has been keenly adopted by the industry, driving shipments of 6 GHz-enabled Wi-Fi chipsets to increase from 213.8 million in 2022 to 684.2 million in 2024. Going forward, shipments are forecast to accelerate, with an expected 1.1 billion shipments in 2025, increasing to 2.6 billion in 2030. Further adoption of 6 GHz is stymied by the lack of full unlicensed 6 GHz access in many markets around the world. Regulatory hurdles are also hindering Standard Power (SP) 6 GHz deployments, as the Automated Frequency Coordination (AFC) systems necessary for its operation are not yet widely available. ABI Research forecasts just 0.7 million shipments of SP 6 GHz-enabled APs in 2025.

In July 2025, the first Working Group (WG) letter ballot on the TGbn draft 1.0 (D1.0), which is expected to become the foundation for Wi-Fi 8, was initiated. One of the most hotly anticipated features of the upcoming Wi-Fi 8 protocol are its multi-AP coordination capabilities, which are set to deliver significant improvements in reliability and spectrum efficiency. These multi-AP coordination abilities will support far superior user Quality of Experiences (QoE) and will be particularly valuable for mission critical applications, such as the operation of AGVs. Alongside this, Wi-Fi 8 is set to provide enhanced coexistence with other wireless technologies like Bluetooth and Ultra-Wide Band (UWB) via In-Device Coexistence (IDC), a feature that will prove especially useful in networks in which multiple radios of different technologies are operational simultaneously.

The advanced new capabilities of Wi-Fi 8 are expected to drive strong demand for the new standard from both enterprises and consumers, resulting in swift adoption for Wi-Fi 8. By 2030, Wi-Fi 8 will be supported by 26% of shipped enterprise Wi-Fi APs, and by 30% of all shipped smartphones. Consumers which adopt Wi-Fi 8 will be able to benefit from more reliable and consistent connectivity, alongside extended ranges and improved roaming.

Another development to keep an eye on is the Integrated Millimeter Wave (mmWave) Wi-Fi (802.11bq) WG, which is exploring applying Wi-Fi technology to the 60 GHz spectrum band. Harnessing the 60 GHz band will enable the high-gigabit, low-latency wireless transfer of large amounts of data, although the band typically requires Line of Sight (LoS) due to its poor penetration abilities. Another advantage of Wi-Fi in the 60 GHz band is that it operates on a clean, unlicensed spectrum that faces minimal interference with a very high degree of security. The Project Authorization Request for 802.11bq was initiated in December 2024, with a projected completion of the standard in 2029.

5.2 Key Technology Innovation—Evolution to Deterministic Wi-Fi

Historically, a lack of determinism has limited the application of Wi-Fi technologies for mission-critical applications that prioritize predictability and reliability over sheer performance. This has been particularly apparent in industrial facilities, which have tended to stick with physical cables or explore 5G solutions instead of considering Wi-Fi. The demand for deterministic Wi-Fi is set to increase further alongside the growth of new use cases, such as Augmented Reality (AR) and Virtual Reality (VR) applications.

A major industry development facilitating the realization of deterministic Wi-Fi is L4S networking, which stands for Low Latency, Low Loss, and Scalable throughput (L4S). In 2025, the WBA released its ***implementation guidelines for L4S***, which covered aspects such as reducing media access delays in Wi-Fi networks, enhancing network configurations, complementing QoS Management Stream Classification Services (SCS), and optimizing Enhanced Distributed Channel Access (EDCA) parameters.

At the 802.11 standard level, Wi-Fi's determinism handicap is finally set to be addressed by the upcoming Wi-Fi 8 standard, which in contrast to previous Wi-Fi generations that have typically focused on features that deliver faster throughputs, is centering its value proposition on reliability. This shift in focus is reflected in the names of the protocols. Whereas Wi-Fi 7 was engineered to achieve "Extremely High Throughput," Wi-Fi 8 is being designed to deliver "Ultra High Reliability." This transition in focus represents a major milestone in Wi-Fi, and highlights how Wi-Fi 8 will build upon the solid foundation of Wi-Fi 7 to ensure that the faster throughputs and lower latencies of the standard are more reliable and dependable in real-world environments.

Key to Wi-Fi 8's ability to achieve deterministic networking is its Multi-AP Coordination (MAPC) capabilities. MAPC encompasses a range of features, which together are designed to maximize spectrum efficiency and improve performance by optimizing channel selection for all client/APs and balancing the load evenly and intelligently between APs in the network. Features include Coordinated Spatial Reuse (Co-SR), Coordinated Beamforming (Co-BF), Coordinated OFDMA (Co-OFDMA), and Coordinated Time Division Multiple Access (Co-TDMA), Coordinated UL MU MIMO (Co-UL-MU-MIMO), and Joint Transmission (JT). Although aspects of MAPC were first proposed for Wi-Fi 7, they were never introduced, with the community leaving implementation until Wi-Fi 8.The main challenge MAPC aims to address is the interference and sub-optimal communications caused when multiple Wi-Fi APs work in isolation without knowledge of their counterparts. For example, the Co-SR feature is targeted at addressing the interference caused when multiple devices and APs leverage the same channels to communicate, called Overlapping Basic Service Sets (OBBS). Co-SR will resolve this issue with a framework via which multiple APs can coordinate collectively and simultaneously to dynamically adjust their respective power levels. This feature will be performed in three steps. In the first step, the "Cross-BSS Measurement Phase," all APs in the environment will be assembled into Co-SR groups, and they will share among themselves their measurements of OBSS interference on their network. This will be followed by a "Multi-AP Coordination Phase," during which one AP in the group will initiate a Co-SR Announce frame that details the transmission power limitations for each specific AP. In the final "Concurrent Transmission Phase," each AP will transmit data simultaneously at their mandated power level. The idea is that MAPC will finally deliver levels of determinism acceptable for mission-critical enterprise applications.

Just as Wi-Fi's occasionally unstable nature has led some enterprises to avoid using the technology for mission-critical assets or applications, many enterprises today see AI's lack of determinism as a major barrier to adoption, as they are unwilling to accept the unpredictable nature of AI. For advanced AI features to be successfully incorporated into Wi-Fi networking, it will also be necessary to improve AI's predictability.

5.3 ID Management

ID management is an essential component of Wi-Fi networking, enabling the identification and authentication of users, which is key to security and privacy. Yet, in recent years, industry developments have strained the ability for smooth ID management to function. One major issue is Medium Access Control (MAC) randomization, which periodically alters MAC addresses to make devices harder to track based on their MAC address. This feature was first introduced in the Apple ecosystem in iOS 14, and has been standard since Android 10. While MAC randomization was devised as a measure to enhance privacy and security on user devices, the feature also disrupts the smooth functioning of Wi-Fi communications, because unique MAC addresses-to-client mapping has traditionally been vital for device identification and authentication. With MAC randomization, session continuity and tasks such as the collecting of security credentials, billing, and troubleshooting are all impaired.

The IEEE has addressed this with the 802.11bh amendment, which was published in June 2025. By introducing modifications to the 802.11 MAC sublayer mechanisms, 802.11bh enables two alternative secure methods for device identification in MAC randomization environments. The first is Identifiable Random MAC (IRM) address, in which the client informs the AP which MAC address it will use the next time it engages. The second is Device ID, in which the AP gives the client an identifier to be used the next time the two engage. In both of these mechanisms, the information to be used when the devices next encounter each other is shared after each association between them, preserving client and user privacy.

The issues of MAC randomization can also be averted through several other methods. OpenRoaming, discussed in greater detail in ***Section 4.5.1***., avoids the challenge posed by MAC randomization by utilizing alternative identity-based authentication profiles for device authentication. Private Pre-Shared Keys (PSSK), which are unique profiles assigned to individual users, is another approach.

There have also been high-profile cases of ID management systems being exposed to serious cybersecurity attacks. In July 2024, a critical vulnerability was exposed in the commonly used client-server networking protocol RADIUS, an anacronym for Remote Authentication Dial-In User Service. This flaw, referred to as "BlastRadius," made it possible for malicious actors to perform a Man-In-The-Middle (MITM) attack and intercept traffic between a client (for example, an AP) and the RADIUS server. While swift updates to the RADIUS servers addressed the vulnerability, its existence in the first place highlights the scale of the challenge.

5.4 Wi-Fi Enablers

5.4.1 OpenRoaming

OpenRoaming is a Wi-Fi roaming framework managed and developed by the WBA that enables the automatic and secure onboarding of Wi-Fi devices onto OpenRoaming-compatible networks. The federation of OpenRoaming companies consists of OpenRoaming Access Network Providers (ANPs), which include locations such as airports, hospitality and retail sites, hotels, and large enterprises, and OpenRoaming Identity Providers (IDPs), which provide a verifiable identity for authentication. The IDPs serve as the unique and reusable profile allowing devices to be authenticated and connected to the OpenRoaming networks. The OpenRoaming onboarding mechanism is based on Wi-Fi-Certified Passpoint, but the WBA has overcome the hurdles Passpoint faced by simplifying and streamlining onboarding, advocating for the technology, outlining a commercial framework for the technology, and building a federation of supporting partners. Current OpenRoaming coverage is visible on this ***crowdsourced map***, developed in collaboration between the WBA and Wigle.

The WBA has continually supported OpenRoaming with updates and revisions to improve user experience, increase security, and facilitate adoption. The most recent update, Release 5, delivered a range of enhancements centered on strengthening privacy, security, network reliability, and operator tooling. This involved the advancement of supporting tools including the ***Provisioning Portal*** and Hybrid Connectors to simplify the integration for Access Network Providers (ANPs) and Identity Providers (IDPs).

A previous major update, Release 4, brought enhancements for OpenRoaming operation on moving platforms (trains, airplanes, ships, etc.). This involved enabling OpenRoaming networks to signal identity providers operating onboard moving platforms and to indicate the supported service levels in the environment. Early in 2025, OpenRoaming's certificate policy was updated for improved simplicity and security. Further advancements to OpenRoaming are currently being developed by the WBA. For example, the WBA's Access Network Metrics project team is working on creating a Network Application Programming Interface (API) Transmission framework. This would support the communicating of Wi-Fi Quality of Experience (QoE) requirements and insights between OpenRoaming ANPs and IDPs, aiming to facilitate the improvement of OpenRoaming in complex and demanding environments.

The year 2025 saw the momentum behind OpenRoaming continue to gather pace. In September 2025, the Tokyo Metropolitan Government ***committed to expanding*** its network of OpenRoaming-compatible Wi-Fi APs to around 1,500 additional locations throughout the city over the next 3 years, bringing the total number of locations up to roughly 3,600. The city views the enlargement of the OpenRoaming network as key to handling increased tourism numbers and ensuring reliable communications during environmental disasters. Earlier in the year, OpenRoaming was also ***deployed in the City of Westminster*** in London, with further plans to expand OpenRoaming across more of London in the future.

Monetization opportunities for OpenRoaming continue to drive adoption, with a comprehensive legal and commercial foundation for the technology supporting multiple business and service models. Targeted advertising is one such opportunity, and Adentro is one software vendor offering solutions that support this, via the collection of granular customer analytics, over OpenRoaming. Carrier offload is another key monetization strategy, where ANPs can guarantee tiered Service-Level Agreements (SLAs) for operators to offload their customers onto. One example is LongFi Solutions, which works with real estate owners, municipalities, and hospitality operators to design OpenRoaming-equipped Wi-Fi networks that can be monetized through carrier offload. In 2025, LongFi Solutions ***acquired*** the Relay Dashboard Platform, which will augment its offering with features such as Wi-Fi offload analytics for OpenRoaming networks, analytics on the revenue gained through carrier-grade monetization workflows, and enhanced network monitoring tools.

5.4.2 New Possibilities with Wi-Fi Sensing and Wi-Fi HaLow

Wi-Fi Sensing is an emerging Integrated Sensing and Communication (ISAC) technology that allows for the leveraging of pre-existing Wi-Fi infrastructure for additional positioning tasks. The technology's ability to leverage existing equipment and unlicensed spectrum makes it low-cost and simple to deploy, and its unobtrusive, passive nature enables it to operate without causing disruption or invading privacy. After almost 5 years of standardization work, the 802.11 WG and IEEE 802.11 Executive Committee (EC) approved the Wi-Fi Sensing standard, 802.11bf, in March 2025. This was followed by approval from the Standards Review Committee (RevCom) and the Standards Association Standards Body (SASB) in May 2025.

The three main applications for Wi-Fi Sensing today are elderly healthcare monitoring, home security, and smart home automation, with the technology leveraged for tasks such as presence detection and motion alerts. There is also currently a marked uptick in the development of standalone Wi-Fi's Sensing solutions that have been created through the partnerships of Wi-Fi Sensing vendors and security system firms. Examples include the Origin Wireless partnership with Verisure and Arlo Technologies, and Aerial.ai x nami with Alarm.com. Further enhancements to Wi-Fi Sensing in the future, by leveraging the 6 GHz spectrum, 60 GHz spectrum, and advanced AI models, are set to enable applications including people ID, gait analytics, sleep analytics, and gesture recognition.

The year 2025 saw many major developments within the Wi-Fi Sensing ecosystem. Wi-Fi Sensing developer Origin AI entered into strategic partnerships with the security system firms ***Verisure*** and ***arlo***, with both companies now aiming to incorporate Origin's Wi-Fi Sensing technology into its alarms. December 2024 also saw Origin AI's launch of its TruShield™ Security offering, which ISPs can leverage to introduce advanced security capabilities into consumer homes without any additional hardware. June 2025 saw Aerial.ai and nami announce a strategic partnership, in which the two companies will merge their capabilities and be managed by a shared Chief Executive Officer (CEO), Jean-Eudes Leroy. The first confirmed project for Aerial x nami will be an aging-in-place solution and pilots will be launched in 3Q 2025 across the United States, Japan, Singapore, Spain, and the Benelux countries.

Wi-Fi HaLow, otherwise known as 802.11ah, operates in the sub-1 GHz unlicensed band, with NB Orthogonal Frequency-Division Multiple Access (OFDMA) channels spanning 1, 2, 4, 8, and 16 Megahertz (MHz). The possible range of Wi-Fi HaLow is 10X that of standard Wi-Fi equipment, with data rates spanning a maximum of 86.7 Mbps at short distances to 150 Kbps when 1 km from the source. This range, combined with high energy efficiency, superior building penetration, ability to support more than 8,000 devices connected to a single access point, and avoidance of the heavily congested 2.4 GHz band have resulted in many proclaiming that Wi-Fi HaLow will become the solution of choice for long-range battery-operated IoT devices, such as cameras and sensors. An additional advantage of Wi-Fi HaLow is that it has interoperability with other Wi-Fi protocols and support for Wi-Fi-grade security (WPA3).

Wi-Fi HaLow's attributes make it ideal for IoT deployments across a range of verticals, and in July 2024, the WBA published its first ***Wi-Fi HaLow for IoT Field Trials Report***, which validated this effectiveness in environments including smart homes, smart offices, smart industrial complexes, smart farms, smart schools, and smart cities. For example, it was shown that a single Wi-Fi HaLow AP was able to provide coverage for an entire warehouse facility, and in smart city tests, that it could support ranges greater than 1 km. There are numerous other trials of the technology that have further demonstrated its capabilities. Notably, in September 2024, Morse Micro achieved the delivery of 2 Mbps video connectivity over an ***almost 16 km distance*** at the Joshua Tree National Park in California, and in a separate test from Newracom and Teledatics, a ***106 km*** Wi-Fi HaLow connection was achieved.

The year 2025 saw the Wi-Fi HaLow ecosystem continue to expand and diversify with numerous new products. In February, Morse Micro revealed the general availability of the industry's first Wi-Fi 4 and Wi-Fi HaLow IoT gateway, the ***HaLowLink 1***. March 2025 saw the unveiling of the industry's first Wi-Fi HaLow dongle, the ***VT-UBS-AH-8108*** from Vantron, powered by the company's compact VT-MOB-AH-8108 Wi-Fi HaLow module.

This was followed by ***another Wi-Fi HaLow USB dongle*** from AsiaRF in August. Other notable releases include the Gateworks' new ***GW16159*** Wi-Fi HaLow M.2 radio card in June, and Airfide's Wi-Fi HaLow-based occupancy sensor, the ***AFN6843***, in July. Finally, in 2025, the Wi-Fi Alliance also announced a ***new co-marketing program*** for the technology, to assist vendors in raising awareness and educating the market on their Wi-Fi HaLow solutions.

5.4.3 Operator Managed Wi-Fi—Architecture and Performance

Standardization guidelines that ISPs can follow to support the deployment and management of their Wi-Fi Customer Premises Equipment (CPE) network is provided in the WBA's Operator Managed Wi-Fi (OMWi) framework. This framework outlines mechanisms for streamlined deployment, unified and interoperable management, self-healing network architectures, remote management and diagnostics, coordinated firmware systems, and advanced security systems. In December 2024, the WBA released ***Phase 2*** of the OMWi program, which saw the addition of support for new network topologies, automatic configurations, and optimized channel management, among other features. Release 2 also inferred practical examples from the real-world deployments of RDK-B and prpl Foundation networks.

While in the past, many operators used proprietary middleware for CPE management, the industry is currently in the process of migrating toward the widespread adoption of open-source code, with developers using this as their base, and then adding additional differentiating features on top. The benefits of this open-source approach for operators include a faster time to market, lower resource requirements, improved scalability, smoother third-party integrations, a more intense testing of the code, and the ability to engage with an expanded number of equipment vendors. One fast-growing open-source middleware platform is Reference Design Kit – Broadband (RDK-B), which is backed by many large Tier One ISPs, including Comcast and Charter. Another is prplOS, with the first CPE supporting the platform being rolled out in 2025.

The Broadband Forum's TR-069 and TR-369 protocols, which standardize communications between the CPE and Auto Configuration Server (ACS), are almost universally relied upon by operators worldwide to manage their sprawling network of CPE. TR-069 was first introduced in 2004, and in response to the growing complexity of operator's CPE networks, in 2018, TR-369 was released, also referred to as the User Services Platform (USP). The new advancements that TR-369 introduces for operator-managed Wi-Fi include multi-controller compatibility, IoT support, real-time data collection, more efficient operation, and improved security. July 2025 saw the publication of the ***Technical Report TR-369 Issue 1 Amendment 4 Corrigendum 2***, which added new features to TR,-369 including advanced software modularization and management capabilities.

Within the TR-069 or TR-369 environments, the TR-181 standard allows for remote testing and diagnostics of CPE. TR-181 supports approximately 130 tests, allowing operators to perform various tasks, including understanding real-world performance of Wi-Fi infrastructure, identifying existing or potential performance issues, and validating the successful deployment of new hardware or software.

5.4.4 Extended Reality—Applications and Drivers

The Extended Reality (XR) market has undergone significant ebbs and flows over the past decade, although some new life was injected into the industry in 2025 with new product releases and the integration of AI. Notably, 2025 saw a marked uptick in interest in no-display AI smart glasses that integrate XR components like cameras and audio functions alongside AI agents, but lack a Heads-Up Display (HUD). The growing popularity of No-display AI smart glasses is driven by a combination of their lower cost, reduced complexity and intrusiveness, and the larger number of use cases they can support (compared to VR and Mixed Reality (MR) headsets). Following the introduction of Ray-Ban no-display AI smart glasses from Meta and Amazon's Echo Frames, 2025 saw the revealing of the Xiaomi AI Glasses, and the AirGo A5 and AirGo V2 smart from Solos.

No-display smart glasses are the fastest growing XR product type on the market, with a CAGR between 2024 and 2030 of 70.1%. This represents an expansion of annual shipments of no-display smart glasses from 0.8 million in 2024 to 19.9 million in 2030. The broader smart glasses market, also including monocular and binocular smart glasses, had an aggregate total shipment number of 3.0 million in 2024, which is forecast to climb to 53.0 million in 2030. Throughout this period, roughly two-thirds of all shipments will be destined for enterprises, with the remaining third set for the consumer market. VR hardware is also projected to undergo significant growth throughout this decade, with annual shipments of VR Head-Mounted Displays (HMDs) increasing from 8.6 million in 2024 to 28.6 million in 2030, representing a 22.2% CAGR over the period.

Supporting the performance demands of XR presents a new challenge for wireless networks, as XR applications, particularly VR headsets with HUDs, need reliable high-throughput, low-latency connectivity for their operation. This makes XR one of the key emerging use cases that requires the advancements of Wi-Fi 7 and Wi-Fi 8 to function.

5.4.5 Wi-Fi & IoT

Wi-Fi is widely utilized within IoT for a range of sensing and automation tasks, and recent innovations in the technology, including Wi-Fi 6, Wi-Fi 7, and Wi-Fi HaLow (discussed in greater detail in ***Section 5.4.2.),*** are spurring further adoption. This growing demand is driving a shipment expansion of IoT application Wi-Fi chipsets from a projected 215.9 million in 2025 to 524.9 million in 2030, representing a CAGR of 19%.

Today and throughout the rest of the decade, Wi-Fi 6 will remain the predominant Wi-Fi technology relied upon in the IoT, thanks to its many features that are beneficial to IoT applications. This includes Target Wake Time (TWT), which brings energy-saving capabilities that are particularly valuable for battery-powered IoT devices, such as sensors, and has helped expand the addressable market for Wi-Fi in the IoT. The introduction of the unlicensed 6 GHz band is another factor supporting further Wi-Fi adoption for the IoT. This is because migration of devices onto the new spectrum helps mitigate congestion on the 2.4 GHz spectrum. Wi-Fi 7 also helps alleviate congestion with features such as MLO and OFDMA.

Within many homes and enterprises, Wi-Fi serves as a key enabler for other IoT technologies, with Wi-Fi gateways and APs acting as hubs that bridge various IoT devices. Increasingly, Wi-Fi is also being used as the medium over which the new Matter standard is transmitted. Matter is an open-source, vendor-neutral protocol that aims to finally enable interoperability between smart home devices from different vendors, and is backed by major smart home vendors, including Apple, Samsung, Amazon, LG, and Google. A slew of new Matter products were announced in 2025, and the latest update to the standard, the Matter 1.4.1 update in May 2025, focused on bringing greater simplicity to setup and ease-of-use for devices.

The secure and seamless onboarding of IoT Wi-Fi devices using OpenRoaming received a major advancement in late 2024 when the WBA introduced a ***new framework*** integrating FIDO Device Onboard (FDO) and OpenRoaming.

5.4.6 Multi-Access Edge Computing

Multi-Access Edge Computing (MEC) brings computing power closer to the customer by moving data processing from a centralized cloud to the network edge. This brings significant reductions to latency, enabling real-time performance for high-bandwidth applications, while also introducing improved privacy and security. MEC is being driven by the exponential growth of traffic and rapid increase in the number of connected devices across networks, alongside the explosion of AI applications, which demand ultra-low latency for their efficacy. The range of key enterprise use cases for MEC is broad, spanning from smart city IoT networking and AR applications, to data and video analytics, alongside location tracking services.

The expanded capacity of 6 GHz, the improved throughput and latencies of Wi-Fi 7, and going forward, the advanced reliability of Wi-Fi 8, are all intimately tied to the realization of the benefits of MEC. This is because, put simply, the ultra-low latency of MEC will be ineffective if the wireless APs in the network are unable to also reliably deliver sufficiently low latencies at the access layer. The needs of MEC in large enterprises and campus environments are also another driver for adopting converged 5G/Wi-Fi private networks, as these solutions are uniquely able to offer low-latency and high-throughput coverage over wide areas and for mobile applications.

5.4.7 Wi-Fi Security and Privacy—Issues and How to Address Them

Security and privacy are two of the most pressing concerns for consumers and enterprises alike, but the needs of each often clash, with improvements to convenience acting to undermine security, and security enhancements coming at the expense of convenience. Getting the balance right between the two is challenging, but necessary to foster greater consumer trust in Wi-Fi and to improve the overall QoE.

Core components of Wi-Fi security are the Wi-Fi Protected Access (WPA) security protocols. While the latest WPA protocol, WPA3, was originally released back in 2018, only Wi-Fi devices operating in the 6 GHz spectrum (i.e., supporting Wi-Fi 6E and Wi-Fi 7) are required to be equipped with the latest WPA3 security. WPA3's advanced security includes 256-bit Broadcast/Multicast Integrity Protocol Galois Message Authentication Code (BIP-GMAC-256), 256-bit Galois/Counter Mode Protocol (GCMP-256), and 384-bit Hashed-based Message Authentication Code (HMAC). Another significant WPA3 security measure is Perfect Forward Secrecy (PFS), which generates a temporary private key exchange between clients and servers. Aside from enhancing security, WPA3 also introduced Wi-Fi Easy Connect, which enables the quick connection of devices, something particularly useful for IoT devices.

Another major industry initiative addressing privacy and security is 802.11bi. 802.11bi plans to introduce modifications to the 802.11 MAC specifications to enhance privacy, helping to prevent spoofing attacks and stop device tracking and fingerprinting, which have developed into a major concern due to the spread of randomized MAC addresses.

The WBA has played an important role in facilitating the development and promotion of security and privacy initiatives within the industry. For example, the WBA's IMSI Privacy Protection for Wi-Fi provides a standardization framework for seamless, private and secure access for SIM-based devices onto Wi-Fi. This automatic and secure onboarding onto Wi-Fi is a foundational component of OpenRoaming's cyber security. Current WBA project groups focused on security include the ***Wi-Fi Security Guidelines*** Roaming Work Group and the ***Enterprise Security for Private 5G Networks*** IoT Work Group. Security is also a foundational component of OpenRoaming.

Outside of official industry standardization, an increasingly common method to improve Wi-Fi security is through the use of Virtual Private Networks (VPNs), which route Internet traffic through a remote server to conceal a user's Internet Protocol (IP) address. Encryption is also widespread, with a growing number of Wi-Fi APs coming equipped with built-in wireless-security encryption protocols. Furthermore, the implementation of Zero-Trust Architectures (ZTAs) in enterprise networks, which require strict authentication for each device, user, and connection, are now standard in enterprises.

5.4.8 Artificial Intelligence

AI has the potential to fundamentally transform Wi-Fi networking, with its ability to both improve the performance and reliability of existing experiences, as well as facilitate the delivery of new, novel experiences. Traditional AI, which is primarily orientated around analyzing data and providing a response, is not new to Wi-Fi networking, and has already been successfully implemented in a variety of different ways. Examples include optimizing Radio Resource Management (RRM) based on user/client movements throughout the network, and enhancing power-efficiency by dynamically powering off radios or the entire CPE when the user leaves the home. Yet, in just a short few years, AI has undergone tremendous advancement, and at the tail end of 2025, Traditional AI was augmented with the emergence of Generative AI (Gen AI), which can conduct deep learning to create original content. The vast potential of the technology spurred rapid implementation, and Gen AI is widespread in enterprise networking today in the form of Large Language Models (LLMs) that allow chatbots to engage in natural language conversations with humans.

The year 2024 saw further progress with the arrival of Agentic AI, characterized by its proactive autonomous nature and its ability to work across multiple platforms, essentially acting as an "agent" for the user. It is also possible for multiple distributed agents to collaborate in tackling complex tasks, a concept that some enterprise networking vendors have termed as Agentic Mesh. This is not the final stage of AI though, as the industry anticipates that, in the future, we will reach the era of Autonomous AI, where numerous fully autonomous Agentic AI agents will independently address issues, optimize performance, and potentially even build applications, constrained only by user-defined rules governing its behavior.

Within enterprise networks today, AI typically serves as a tool facilitating the streamlining of processes and efficient stewarding of resources. This enables users to complete tasks with the maximum efficiency, boosting the overall productivity of an organization. Yet, there are a plethora of potential applications aside from increasing organizational efficiency, such as enabling personalized management dashboards, facilitating the dynamic reconfiguration of wireless networks, delivering significant cost savings, using AI assistants to complete staff training, conducting inventory checks, undertaking design validations, improving the user experience, increasing energy efficiency, automating network maintenance, tracking SLAs, and reinforcing security. At present, all vendors of AI-enhanced networking solutions have placed importance on keeping the "human in the loop" with AI decisions, ensuring that the user understands the reasoning behind AI automations or changes, and offering them the opportunity to conduct validation checks if necessary.

AI's efficacy is dependent on the data that underpins it, and so end-to-end network visibility with continuous monitoring is necessary to ensure that AI insights are actionable and personalized. This, in turn, is heightening demand for the additional capacity and improved performance of 6 GHz and Wi-Fi 7, which are becoming increasingly important toward enabling the collection of data from the ever-growing number of network nodes, IoT assets, and connected devices. This exponential growth in both data generation and its consumption, driven by AI, is also necessitating a transition from the traditional model of having data stored and managed in a centralized data center to a model of placing computing resources at the edge, closer to where the data are created and utilized.

AI is also playing a revolutionary role within operator networks. For example, AI has the ability to analyze vast amounts of network data in order to better optimize network operations and allocate resources. In practice, this could mean predicting potential congestion and proactively rerouting traffic to prevent congestion, or continuously observing the network to preemptively address faults before they occur. The rise of agentic AI will help to supercharge AI's role in operator networks, enabling autonomous AI to work across throughout the entire network. AI will also feed into the WBA's Operator Managed Wi-Fi (OMWi) framework, ***discussed in section 5.4.3***.

At the standardization level, the IEEE Artificial Intelligence / Machine Learning Standing Committee (AIML SC) is currently exploring how AI can be applied to IEEE 802.11 systems and devices.

5.4.9 TIP Open Wi-Fi

The open-source OpenWiFi platform aims to disrupt the status quo in the Wi-Fi market by offering organizations a low-cost, vendor-neutral, easy to manage alternative to the traditional proprietary solutions. The initiative has made significant progress since its introduction by the Telecom Infra Project (TIP) in 2021, with a range of Original Equipment Manufacturers (OEMs)/Original Design Manufacturers (ODMs) onboard, and real-world deployments across the hospitality and retail industry from MSPs such as Boingo and Pavlov Media. In 2024, Actiontec and Edgecore introduced Wi-Fi 7 APs supporting OpenWiFi, and a partner initiative, OpenLAN, was also launched to extend the open-source project to the fixed switching side of the network.

The disaggregated architecture of the OpenWiFi software stack consists of two core elements—enterprise-grade WLAN AP firmware, and an open-source cloud controller Software Development Kit (SDK). ODMs relying on the widely used OpenWrt Operating System (OS) can leverage the community-developed features of OpenWiFi to produce vendor neutral white-box enterprise APs. ODMs that choose OpenWiFi over proprietary approaches benefit from reduced Research & Development (R&D) costs, a lower barrier of market entry, an ability to focus on innovation over fundamentals, and full interoperability across the ecosystem. Enterprises adopting OpenWiFi, on the other hand, benefit from reduced CAPEX and Operational Expenditure (OPEX), management simplicity, and the avoidance of vendor lock-in.

5.4.10 Open RAN

Open RAN is an emerging trend within cellular RANs in which network infrastructure is disaggregated, vendor-neutral, and managed by open interfaces. Similar to OpenWiFi, Open-RAN promises to lower deployment costs and complexity, and introduce multi-vendor interoperability across the ecosystem. The most significant Open RAN deal, to date, is the US$14 billion multi-year joint commitment between AT&T and Ericsson, announced in December 2023, which aimed to transmit 70% of AT&T's mobile wireless traffic going through these newly deployed Open RAN sites by 2026. AT&T subsequently signed additional agreements with Fujitsu and Mavenir to develop radios specifically for crowded urban areas.

Open RAN has not enjoyed the levels of adoption previously anticipated, as the technology suffers from interoperability challenges and incredibly low investment for new infrastructure by Mobile Network Operators (MNOs). Although Nokia and Ericsson continue to advocate for the technology, others have exited the market, with Airspan Networks filing for bankruptcy and repositioning its Open RAN solutions for the private network domain. Further dampening excitement for Open RAN is the fact that attention in the industry has also shifted to AI, with the industry now placing greater emphasis on developing AI technology for the RAN over creating a more open ecosystem. This is reflected by the rapid growth of the ***AI-RAN Alliance***.

5.4.11 APIs and Network Connectivity

In recent years, API frameworks have opened up 5G network capabilities to developers, unlocking greater programmability and adaptability, and therefore, enabling the development of innovative applications and new business models. The Wi-Fi industry is now also moving to an API-first approach, with the hope that this will unleash a wave of new applications such as improved QoS tools, advanced network automations, and location-based services. An API-first model also facilitates seamless integration across multi-vendor environments, and assists scalability by allowing developers to introduce new technologies without overhauling the entire existing system.

Several converging trends are driving the movement toward API-first Wi-Fi. These include the rise of cloud-based architectures, the emergence of open standards, the growing convergence between Wi-Fi and 4G/5G, the needs for simplified device onboarding, and new AI-driven tools. Operators are also increasingly pushing for API access, as it allows them to escape proprietary vendor ecosystems. Developers and MSPs that make use of APIs will be able to attain a faster time to market, take advantage of reduced R&D costs, enjoy flexible customization, and achieve vendor interoperability.

6. 2026 Updates on Convergence of Wi-Fi and Other Radio Access Technologies

6.1 Wi-Fi 7 & 5G—Convergence & Key Milestones

Wi-Fi is a technology that is familiar to Information Technology (IT) departments worldwide, and is favored for its performance and reliability, cost-effectiveness, simplicity of management and maintenance, broad ecosystem with countless vendors and solutions, cross-generational interoperability, and ability to harness license free spectrum. These attributes guarantee that Wi-Fi will never be dislodged as the enterprise wireless connectivity solution of choice. That said, there are certain applications and use cases for which 5G does offer some performance advantages over Wi-Fi. These include a greater range and superior roaming capabilities, support for up to 1 million devices per km^2 with Massive Machine-Type Communication (mMTC), advanced security with the requirement for authorized Subscriber Identity Module (SIM) credentials, and reduced interference thanks to the use of licensed spectrum. At the same time, 5G does have many drawbacks, notably higher hardware and operational costs compared to Wi-Fi, greater management complexity, no cross-generational compatibility, and a lack of familiarity among enterprises. Given that Wi-Fi and 5G clearly have different and complementary areas of strength, there are naturally some applications for which Wi-Fi is best suited, and others for which 5G is better suited. There are also some instances where it makes sense for both Wi-Fi and 5G to be deployed within the same network, so the benefits of both technologies can be harnessed for the delivery of optimal performance.

A successful convergence between Wi-Fi and 5G hinges on several factors. Access must be agnostic at the service layer, so that management of both technologies will be unified and seamless. Both the Wi-Fi and 5G networks must have a common authentication and policy enforcement framework, with each connected device having a single, unified identity, allowing for the delivery of a consistent user experience regardless of the technology. Additionally, the converged network must also be deployed in a way that effectively harnesses the advantages of both technologies and that maximizes the value generated from their synergies.

To assist the industry in realizing converged networks, in December 2024, the WBA released its ***Private 5G and Wi-Fi Convergence – Technical Considerations*** report, which explored advanced architectural strategies and technical solutions for the achievement of converged Wi-Fi and 5G. In March 2025, the WBA also concluded its work on the defining requirements for OpenRoaming concepts within 3GPP, supported by the OpenRoaming co-chairs Intel and Cisco. This introduced requirements for Standalone Non-Public Network (SNPN) cellular hotspots within 3GPP TS 22.261, enabling connectivity similar to Wi-Fi hotspots using 5G network technology. Work has now progressed to defining the implementation of these use cases in the stage 3 protocol specification.

5G New Radio-Unlicensed (5G NR-U) is an emerging extension of 5G into unlicensed spectrum bands. Gradually, we are seeing these 5G NR-U deployments begin to emerge. For example, in China's Gansu province, the State Grid Corporation of China (SGCC) has deployed a 5G NR-U network operating in the unlicensed 5.8 GHz bands to support 5G applications such as video surveillance and mobile inspection robots. In many markets, the 6 GHz spectrum is a key target band for 5G NR-U operation, yet, as explored further in ***Section 7.2***, to ensure that 5G NR-U operation does not interfere with other unlicensed users (i.e., Wi-Fi), Listen-Before-Talk (LBT) procedures are required. The current LBT procedures are defined by 3GPP in TS 37.213, but widely recognized drawbacks remain to this approach. To address these issues, the industry is currently exploring new scheduling techniques, including the Scheduled Type 1 Channel Access Procedure (CAP).

Another significant development in the uniting of 5G and Wi-Fi was enabling cross-technology signaling between 5G and Wi-Fi with the publication of the 802.11bc standard in 2024. This introduced modifications to the 802.11 MAC for enhanced cross-technology wireless transmission and reception of broadcast content between fixed, portable, and moving Stations (STAs). In practice, this could be a 5G Next Generation Node B (gNB) or associated 5G user equipment signaling via 802.11bc to one or multiple Wi-Fi APs. 802.11bc is a low-cost way to enable communications between both technologies and is highly secure, as only licensed operators can configure its gNBs and associated User Equipment (UE) for these transmissions. Potential use cases for 802.11bc include connected vehicle applications, in which content is broadcast between 5G infrastructure and Wi-Fi APs within a moving vehicle, or for identifying interference challenges between Wi-Fi and the International Mobile Telecommunications (IMT).

6.2 Role of Wi-Fi in 6G

Development on the next cellular standard is underway by 3GPP, with the commencement of technical studies on 6G's RAN and system architecture in August 2025. These studies, which are occurring during the Release 20 timelines of 3GPP, are scheduled to conclude sometime in early 2027. Thereafter, Release 21 will start, which will signify the official beginning of normative work on 6G. 3GPP's specifications for 6G are expected to be completed before March 2029, ahead of the IMT-2030 submission window. Alongside existing spectrum bands, 6G also plans to access new bands to expand capacity and power innovative new applications, such as holographic transmissions and real-time synchronous digital twins. These news bands are in the 7,125 – 8,500 MHz, 10,700 – 13,250, and 14,000 – 15,350 ranges.

In early 2025, the WBA published its ***report on 6G's potential transformative role***. In it, the organization outlined its vision for 6G, and its recommendations for how the industry should approach the development and standardization of the technology. These included:

- Wireless technologies should collaborate instead of competing, delivering seamless experiences for all, irrespective of the environment.
- 6G should focus on addressing industry pain points, and should leverage other wireless technologies to this end.
- Wi-Fi should be implemented alongside 6G to help operators achieve greater cost-effectiveness and operational efficiency.
- 6G should be targeted at sectors that have the most to benefit from 6G's attributes, such as healthcare, smart cities, and industrial automation.
- 6G standardization should be aligned with other wireless technologies to avoid fragmentation and ensure interoperability.

To achieve these goals, the WBA suggested the following steps:

- Advocate for simplified, cross-network policies that focus on user experience.
- Develop frameworks for seamless identity management and access steering.
- Promote affordable and scalable solutions like OpenRoaming and neutral host models for network densification.
- Leverage AI to optimize network selection and reduce operational overhead.
- Establish innovation labs for real-world testing and vendor collaboration.

6.3 The Role of Wi-Fi in IoT

As explored in depth in ***Section 5.4.5.***, Wi-Fi is a key enabler for the IoT. Wi-Fi is the main wireless technology that enterprises worldwide rely upon for their connectivity, and as the IoT gains traction within the enterprise sector, we are seeing Wi-Fi APs increasingly being used as a bridge to connect and manage IoT assets across organizations. Similarly, in residential networks, the Wi-Fi gateway is uniquely positioned to serve as the hub connecting the various IoT devices throughout the home. Reflecting the central role that Wi-Fi plays in enabling the IoT, we are seeing an increase in integrating Wi-Fi with other IoT technologies at the chipset level. For example, Broadcom's Wi-Fi 7 BCM47722 for enterprise APs is equipped with dual-IoT radios for the simultaneous operation of IoT protocols such as Bluetooth® LE, 802.15.4, Thread, Zigbee, or Matter. The secure and standardized operation of the IoT within home networks is further supported by the WBA's OMWi framework, discussed further in ***Section 4.4.3***.

6.4 Private Cellular Aligned with Wi-Fi

Although upon its arrival on the market, Private 5G networks were initially presented as a challenger to Wi-Fi, the major vendors of the disruptive technology quickly realized that greater value could be created through collaboration and convergence between the technologies. Thus, as explored in ***Section 5.1***, the industry began working on converging the technologies and their respective operating spectrums so that the final solution would become greater than the sum of its parts. Key deployment verticals for converged 5G/Wi-Fi private networks include manufacturing, warehousing and logistics, mining, education, large public venues, and utilities.

Converged 5G/Wi-Fi private network solutions have been introduced by a range of vendors. The leading enterprise Wi-Fi vendors Cisco and HPE have seen the former partnering with NTT to develop its offering, and the latter acquiring the private cellular technology provider Athonet for the capabilities. For each solution, there are typically multiple methods via which Wi-Fi and 5G work together. For example, Nokia's MX Boost technology uses the Wi-Fi and 5G streams in three different ways—by aggregating both streams for capacity, using the additional stream for extra redundancy, or by enabling seamless handover between each stream for mobility. Yet despite Private 5G's capabilities, 2025 also saw interest in them wane somewhat, with several major suppliers exiting the market. In May 2025, Amazon Web Services (AWS) announced the retirement of its Private 5G service, and Microsoft discontinued its Azure Private 5G Core at the end of September. AWS highlighted a lack of spectrum availability and a reliance on third-party hardware as major hurdles which prevented them from achieving their original vision for private 5G, whereas Microsoft stressed that they scaled back their private 5G offering so they could focus on other growth areas instead.

6.5 Role of VoWi-Fi/Wi-Fi Calling in Asia

Voice-Over-Wi-Fi (VoWiFi), also referred to as Wi-Fi calling, is a Voice over Internet Protocol (VoIP) technology that allows smartphones to conduct voice calls over the Internet via a Wi-Fi connection instead of using the cellular network. Wi-Fi calling helps to support voice calls in locations that lack cellular coverage (such as remote regions) or where the signal is inadequate (such as indoors), and it is significantly more cost-effective than traditional cellular calls. Numerous Asian MNOs have enabled Wi-Fi calling for their customers over the past decade. Most recently, in September 2025, Asiacell launched the ***first Wi-Fi calling service*** in Iraq. The expansion of OpenRoaming in Asia, such as in Tokyo in 2025, also facilitates Wi-Fi calling within Asian cities.

The rollout of 5G has given rise to new requirements and complexities for Wi-Fi Calling. In 5G Non-Standalone (NSA) deployments, which are commonplace in Asia outside of Mainland China, voice services are connected with the 4G core using Voice over LTE (VoLTE). On the other hand, within 5G SA deployments, which have been mandatory for all new 5G infrastructure since 2020 in Mainland China, Voice over 5G Standalone (Vo5GSA) operates over the 5G SA core. The industry is also ***exploring using satellite backhaul for Wi-Fi calling***. This capability would be extremely valuable for remote regions in Asia, such as sparsely populated islands.

6.6 Other Wireless Technology considerations (Bluetooth®, Zigbee, others)

The number of chipsets integrating Wi-Fi with multiple other IoT technologies is increasing rapidly. A recent addition was the SYN461x family of chipsets from Synaptics, introduced in March 2025. Designed for embedded edge IoT applications, these chipsets include the combination of Ultra-Low-Power Wi-Fi, Bluetooth® 6.0 and Bluetooth® LE, and 802.15.4 (Zigbee/Thread). This reflects the fact that, as detailed in ***Section 5.4.5.***, Wi-Fi is a key enabler for IoT connectivity.

The growth of the new IP-based Matter standard is also significant for Wi-Fi, because it can run over Wi-Fi, or alternatively Thread. This will help further drive the development and release of all-in-one multi-protocol solutions for smart home applications.

7. Spectrum & Regulation

7.1 6 GHz Extension for Wi-Fi—Global Update

In the 5 years since the United States became the first country to allocate the 6 GHz spectrum for unlicensed use, the world has fractured into three blocs—those that have released the entire 1200 MHz of the spectrum (5925 – 7125 MHz) for unlicensed use, those that allocated only the lower portion (5925 – 6425 MHz), and those that have either reserved the entire band for licensed use, or are still on the fence. The Wi-Fi Alliance maintains an ***up to date map*** tracking 6 GHz unlicensed regulations globally, and Chart 8 below captures the current 6 GHz regulatory landscape as of November 2025.

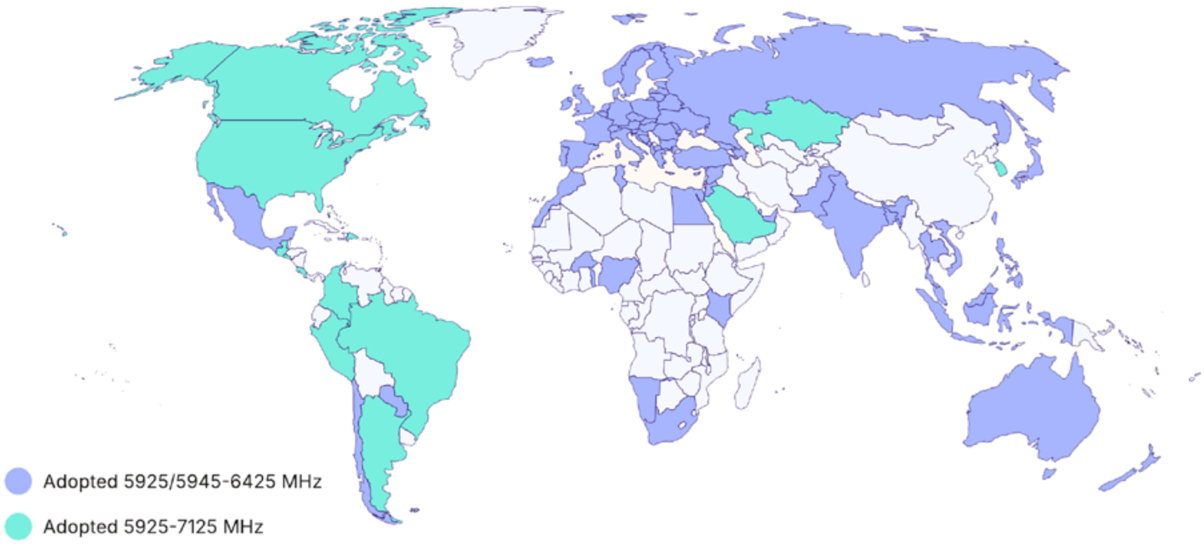


Chart 8: Current Unlicensed 6 GHz Availability
(Source: Wi-Fi Alliance)

At present, this division appears entrenched, with no signs of convergence on the immediate horizon. Below are the main unlicensed 6 GHz trends and developments in the major regions around the world.

- **North America:** The United States was the first country to open up the 6 GHz spectrum for unlicensed use, releasing the full band in 2020, and Canada soon followed suit. Both countries are also notable for being the only ones to have authorized SP 6 GHz operations. While there are advocates in the United States for a reevaluation of current allocations and for potentially licensing sections of the upper 6 GHz spectrum, the rapid adoption of unlicensed 6 GHz across the country makes this unfeasible, and ***studies have reported*** that should Wi-Fi's access to the upper 6 GHz be restricted, the U.S. economy would forfeit US$2.11 trillion in the next 2 years alone.
- **Europe:** The European continent has taken a unified approach to 6 GHz, assigning the lower portion for unlicensed use, and the upper portion for licensed IMT. This stance was reaffirmed at the 2023 World Radiocommunication Conference (WRC-23).

- **Asia-Pacific:** South Korea is the only country in the region to have assigned the entire 6 GHz band (5925 – 7125 MHz) for unlicensed use, and Mainland China is the only country in the world to have explicitly committed to releasing the entire 6 GHz band for IMT. Recent allocations of the lower 6 GHz (5925 – 6425 MHz) band for unlicensed use in the region include The Philippines and Bangladesh in 3Q 2024, Indonesia in 1Q 2025, and India in 2Q 2025. Other notable developments in the region include Australia's unique decision in 4Q 2024 to release an additional 160 MHz for Wi-Fi (6425 – 6585 MHz), and the world's first auction of upper 6 GHz spectrum in Hong Kong during the same quarter.
- **Latin America:** In the early 2020s, the continent witnessed a wave of successive countries allocating the entire 6 GHz band for unlicensed use, including Argentina, Colombia, Costa Rica, Dominican Republic, El Salvadore, Guatemala, Honduras, and Peru. Mexico bucked this trend in 1Q 2023, instead assigning only the lower 6 GHz for unlicensed use. Several Latin American nations have also opted to reverse course on 6 GHz and downgraded their unlicensed access to 6 GHz from the full band to only the lower portion. This includes Chile in 3Q 2022, and Brazil in 1Q 2025.
- **Middle East, North Africa, and Central Asia:** Saudi Arabia has been a leading advocate of unlicensed 6 GHz, being one of the first nations to follow the United States in releasing the entire 6 GHz band for unlicensed use in August 2021, and the country was also the home of the world's first demonstration of SP 6 GHz using the AFC database lookup in August 2022. Recent 6 GHz allocations in the region include the decision by Pakistan in 2Q 2024 and Egypt in 4Q 2024 to assign the lower 6 GHz band for unlicensed use, and Kazakhstan's announcement in 4Q 2024 that it would make the entire 6 GHz band available for unlicensed use.

While many countries and territories have reserved the upper 6 GHz spectrum for licensed IMT use, to date, only Hong Kong has actually conducted an auction of the spectrum. This auction, completed by Hong Kong's Office of the Communications Authority (OFCA) in November 2024, made available 15-year licenses for 20 separate frequency blocks of 20 MHz (with blocks A1 to A10 spanning 6570 – 6770 MHz, and A11 to A20 ranging from 6925 - 7125 MHz). The outcome of the auction saw that Blocks A16 to A20 were left unsold, and the final sale price for Blocks A1 to A15 was just HK$42 million, a mere 5% above the reserve price. Considering that bidders were able to benefit from a full tax deduction for spectrum fees payable on the acquired spectrum, suffice it to say that the outcome of the auction was somewhat underwhelming.

This auction, and the fact that auctions have not been repeated in other territories as of yet, reflects the lack of significant IMT demand for the 6 GHz band at present or in the near future, and the sluggish development of the 6 GHz IMT ecosystem. In contrast, Wi-Fi has been quick to harness the new opportunities offered by the 6 GHz spectrum. Highlighting this, shipments of 6 GHz-enabled Wi-Fi chipsets leapt from 213.8 million in 2022 to 684.2 million in 2024. Going forward, shipments are projected to accelerate further, with an expected 1.1 billion shipments in 2025, increasing to 2.6 billion in 2030.

7.2 Coordinated Shared Spectrum Models

Spectrum allocations should not inherently be viewed as zero-sum games between different communications technologies, as it is also possible for multiple technologies to have access to the same spectrum resources simultaneously. With a fully unlicensed approach, sharing is built-in, as the spectrum is not limited for use by any single user or technology. With a licensed approach, spectrum sharing can also be achieved through the application of coexistence technologies. These techniques have enabled unlicensed Wi-Fi to operate alongside existing incumbents in the same band in the past. For example, within the 5 GHz spectrum, this was accomplished via Dynamic Frequency Selection (DFS), which first scans for radar signals in the 5250 MHz and 5730 MHz frequency range before authorizing Wi-Fi transmissions. Similarly, within the 6 GHz spectrum, new AFC systems authorize SP 36 Decibel-Milliwatts (dBm) 6 GHz transmissions following scanning for incumbents. These will be explored in greater detail in the next section.

One of the pioneers for spectrum sharing in the upper 6 GHz spectrum is the U.K. telecommunications regulator Ofcom. Between February and May 2025, Ofcom ran a consultation with the industry on its proposal that Wi-Fi & IMT share the upper portion of 6 GHz (6425 – 7125 MHZ), with Wi-Fi allowed at low power indoor levels (250 Megawatts (MW)) only. Under this scheme, SP 6 GHz would also be permitted in the lower portion of 6 GHz via AFC. The mechanism would be introduced in a phased approach, although the sharing mechanism to facilitate coexistence between the two technologies has not yet been finalized. This model is viewed by many as a potential framework that other European nations could emulate.

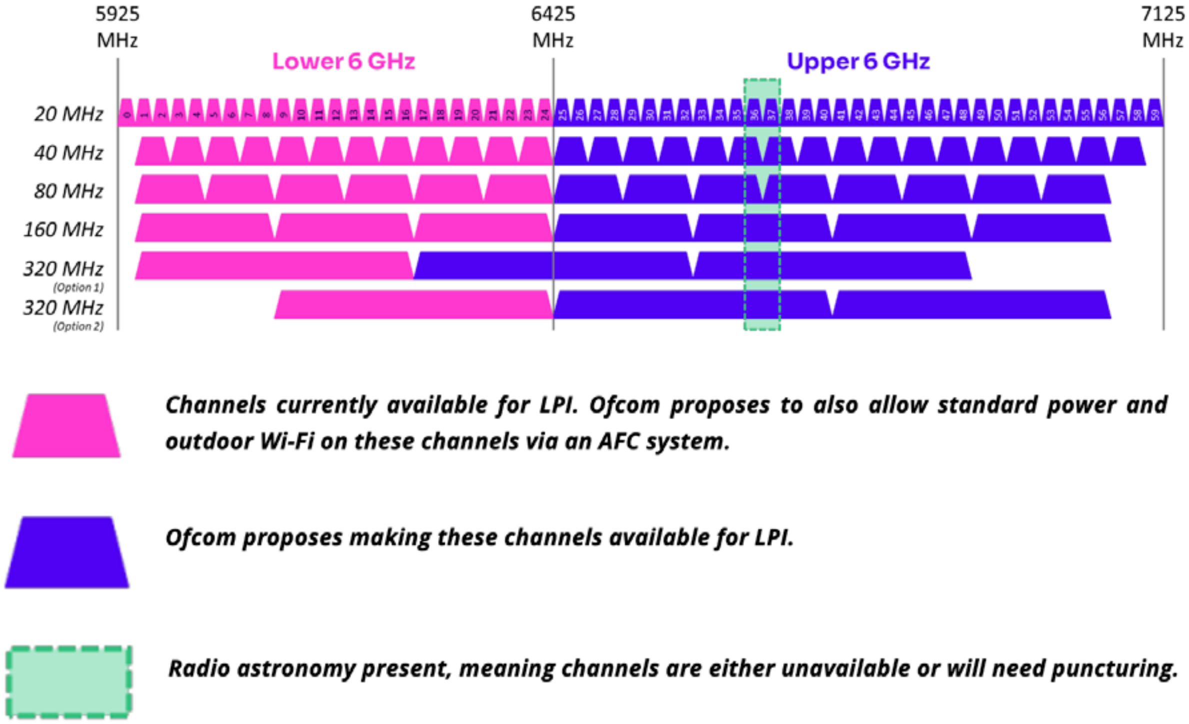


Chart 9: Ofcom's 6 GHz Band Wi-Fi Channel Plan
(Source: Ofcom)

One potential approach to coordinating spectrum sharing in the 6 GHz band between Wi-Fi and IMT is to leverage the 802.11bc standard to identify locations of potential interference between Wi-Fi and IMT transmissions utilizing the same time-frequency resources. This would allow operators to proactively reassign or restrict Wi-Fi transmissions to prevent this interference. In February 2025, wireless advisory firm Real Wireless conducted a ***Proof of Concept (PoC)*** of such an application of 802.11bc in the United Kingdom, validating the effectiveness of 802.11bc for this application.

7.3 Automated Frequency Coordination

Transmissions in 6 GHz are highly regulated to avert interference with the many incumbents in the band, which range from emergency services to public utilities. To ensure the uninterrupted operation of incumbents, higher power 6 GHz transmissions are only permitted with the use of AFC Systems. These are essentially database lookup schemes that first certify the absence of incumbents in the band in any given locality before permitting transmissions at SP levels. Alongside capped power levels, there are additional restrictions on the design of non-SP-certified equipment. For example, in the United States, SP certification is also required for external antennas, ruggedization, or if the AP is battery powered. However, this varies regionally—in the European Union (EU), the ruggedization of the equipment is not considered. The spectrum available for SP 6 GHz also varies between countries. In the United States there are two authorized U-NII bands, U-NII-5 (5925 – 6425 MHz) and U-NII-7 (6525 – 6875 MHz), for a total of 850 MHz of spectrum. Canada has released the U-NII-5, U-NII-6 (6425 – 6525 MHz), and U-NII-7 bands for SP 6 GHz operation. At 950 MHz of total spectrum, this is 100 MHz more than the United States has allocated.

Operating Class	Device Class	Environment	Maximum Power Level	AFC Required
Low Power Indoor (LPI)	Fixed Access Point	Indoor Only	30 dBm	No
	Client	Indoor Only	24 dBm	No
Very Low Power (VLP)	Fixed/Mobile Access Point	Indoor/Outdoor	14 dBm	No
	Client	Indoor/Outdoor	14 dBm	No
Standard Power (SP)	Fixed Access Point	Indoor/Outdoor	36 dBm	Yes
	Client	Indoor/Outdoor	30 dBm	Yes

Table 1: Operating Classes for 6 GHz 802.11 Devices in the United States
(Source: ABI Research)

To date, the United States and Canada are the only nations to have authorized SP 6 GHz. In the United States, approved AFC system operators include AXON Networks, Broadcom, Comsearch, C3Spectra, Federated Wireless, Sony, Qualcomm, the Wi-Fi Alliance Services, and the Wireless Broadband Alliance Services. Canada, on the other hand, was actually responsible for the approval of the world's first commercial AFC operator, Qualcomm, in August 2023. Following this, Comsearch was approved in October 2024, and the Wi-Fi Alliance Services in January 2025.

7.4 Regulatory & Spectrum Framework for 5G with Unlicensed Bands

In recent years, there has been a marked expansion in the accessibility of unlicensed spectrum for independent Long-Term Evolution (LTE) or 5G networks. These have been used for a range of applications, including private cellular networks for enterprises, for Fixed Wireless Access (FWA) in rural communities, and for MVNO offload to neutral host infrastructure. One of the most prominent examples of unlicensed spectrum used by LTE/5G networks is the General Authorized Access (GAA) tier of the U.S. CBRS spectrum, which provides access to a 150 MHz portion of the 3.5 GHz spectrum license-free. The only caveat is that license-free users only have access to GAA when it is not being utilized by incumbents or those with Priority Access Licenses (PALs). While CBRS adoption is strong, several carriers continue to advocate strongly for an auctioning of the spectrum, and the lack of protections for CBRS in the recently passed One Big Beautiful Bill Act have led some in the industry to become concerned about the future of the band.

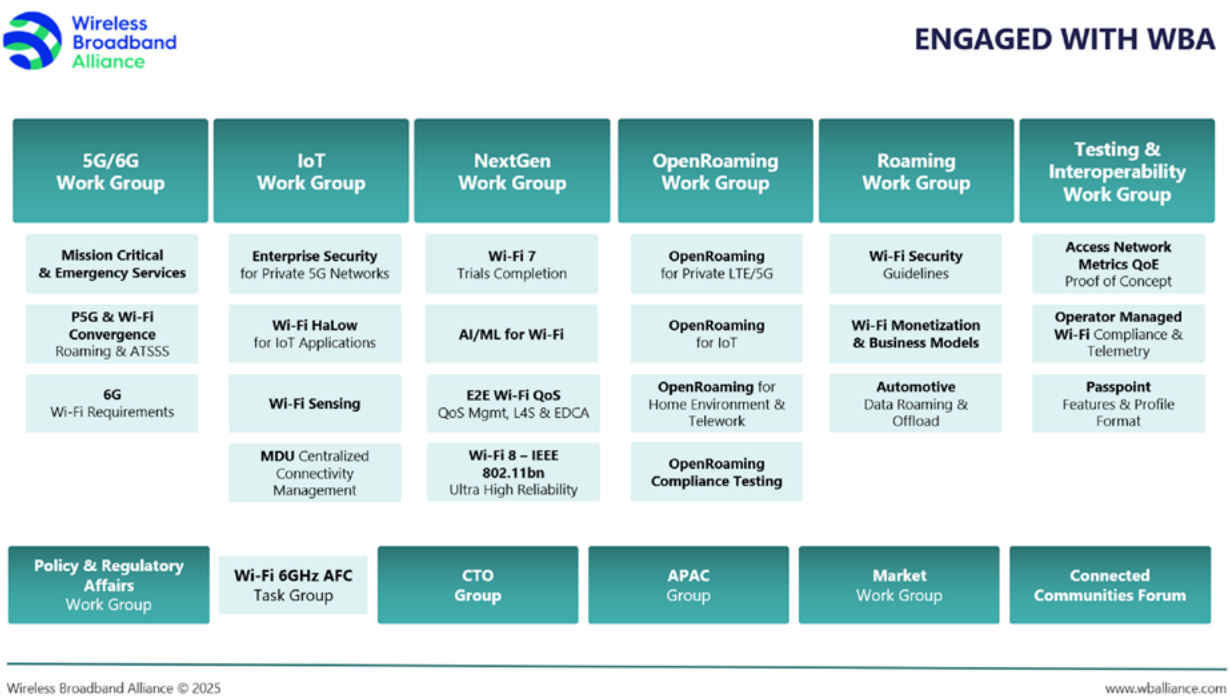
Due to their open nature, unlicensed bands can be subject to high levels of interference from their multiple users and different technologies operating in the band simultaneously. Several organizations are working on specifications to mitigate this interference within GAA. One such organization is the OnGo Alliance, which has developed Coexistence Managers (CxM) that can assign spectrum to compatible users in coexistence groups. Yet, these techniques are not mandated by Federal Communications Commission (FCC) rules, meaning there is no requirement for other users, including PAL users, to collaborate. The need to recertify Spectrum Allocation Service (SAS) equipment and a lack of interoperability testing has further limited the impact of the technology. The Wireless Innovation Forum (WinnForum) is another major industry organization working to solve GAA interference. Other proposals for efficient coexistence algorithms include *leveraging an Open RAN*-based solution with both Non-Real-Time (Non-RT) RAN Intelligent Controller (RIC) and Real-Time (RT) Distributed Unit (DU) O-DU to deliver a final scheduling solution.

Another low-cost and easily accessible alternative to unlicensed spectrum for LTE/5G network operators is spectrum available under a shared license agreement. These are also witnessing robust growth. This is highlighted by the United Kingdom's Shared Access Licenses (SAL) Framework. This was introduced in 2019, and offers licenses for shared access to specific spectrum bands, with Ofcom coordinating the users to ensure coexistence. These shared spectrum bands are 1800 MHz, 2300 MHz, 3.8 – 4.2 GHz, and the 26 GHz band. The *December 2024 review* of the SAL Framework reported that there were 988 active licenses in November 2024, up from 875 in July 2024. Emboldened by the success that shared spectrum is witnessing, many regulators globally are exploring making more spectrum available. For example, there is an ongoing review of the potential for spectrum sharing of the U.S. military's 3100 – 3450 MHz frequencies, due out in late 2026.

8. WBA Programs and Projects 2025/2026

8.1 Driving Seamless, Secure, and Interoperable Connectivity Worldwide

In 2025, the WBA is driving a major evolution towards the future of connectivity. Key initiatives span Wi-Fi and 5G convergence, IoT, next-generation Wi-Fi capabilities, OpenRoaming™, and interoperability testing. In parallel, WBA continues to drive global policy and regulatory advocacy, with a strong focus on 6GHz spectrum and the requirements defining the path to 6G.



8.2 The Rise of WBA OpenRoaming™: Scaling to a Global Standard

OpenRoaming an Alliance's flagship initiative, 2025 marked another year of accelerated growth. Adoption has doubled once again, with more than 3,000 server certificates issued and over 800 entities worldwide now participating. Deployments now span airports, stadiums, universities, enterprise campuses, and national-scale rollouts in Japan, France, Belgium, India, Luxembourg, United Kingdom, the United States, and beyond.

The publication of OpenRoaming Release 5 in 2025 delivers a comprehensive set of enhancements focused on strengthening privacy, security, network reliability, and operator tooling. Supporting tools such as the ***Provisioning Portal*** and Hybrid Connectors have simplified integration for Access Network Providers (ANPs) and Identity Providers (IDPs), while the ***OpenRoaming Map*** now tracks active hotspots across the globe.

OpenRoaming is also a proven driver of digital inclusion. Notable examples include ***Westminster City Council*** with support from the Mayor of London, and large-scale rollouts for Osaka World Expo 2025 in Japan, both demonstrating how OpenRoaming can provide free, secure Wi-Fi that breaks down connectivity barriers for residents, businesses, and visitors., demonstrate how OpenRoaming can provide free, secure Wi-Fi that breaks down connectivity barriers for residents, businesses, and visitors.

As Wi-Fi 6, 6E, and 7 gain momentum—and as more organizations integrate Wi-Fi with private 5G and IoT services—OpenRoaming is becoming an essential foundation for connectivity. Early adopters such as Canary Wharf, Adentro, and HFCL showcase the versatility of the framework across diverse regions and verticals.

OpenRoaming is also proving its marketing and business value. New case studies highlight how venue Wi-Fi usage data can be combined with digital advertising tactics to deliver measurable ROI. For example, ***Adentro*** partnered with the WBA to demonstrate how OpenRoaming enhances guest Wi-Fi in retail and hospitality, while HFCL became the first enterprise in India to adopt the standard across its io Wi-Fi product suite. These use cases confirm OpenRoaming's dual role as both a connectivity enabler and a commercial accelerator.

Explore the latest case studies in the ***OpenRoaming Resource Hub***.

8.3 Wi-Fi 7: From Trials to Commercial Reality

Wi-Fi 7 has transitioned from field trials to commercial deployment in 2025. Particularly, five multi-vendor trials completed over the past year have validated significant performance gains in throughput, latency, reliability, and Multi-Link Operation (MLO). These trials confirmed Wi-Fi 7's suitability for bandwidth-intensive and latency-sensitive applications such as cloud gaming, AR/VR, AI workloads, industrial IoT, and 8K streaming.

Recent ***trial reports*** confirm that Wi-Fi 7 delivers substantial performance enhancements over Wi-Fi 6E, particularly in throughput, coverage, and spectrum efficiency. These results demonstrate its value for remote work, immersive entertainment, and smart home automation.

- vAT&T, CommScope (RUCKUS Networks), and Intel – Demonstrated Wi-Fi 7's ability to support mission-critical enterprise applications including XR, AI, and cloud computing.
- LG U+ and Intel – Achieved 4.9 Gbps speeds in live trials, with improved reliability and lower latency for applications such as 8K streaming and high-performance gaming.
- CableLabs® and Intel – Confirmed residential performance gains, with TCP throughput reaching 3.5 Gbps in a 4,500-square-foot home, underscoring whole-home coverage and efficiency improvements.
- Türk Telekom, HPE Aruba Networking, and Intel – Validated real-world improvements in latency, reliability, and user experience for residential broadband customers.
- Türk Telekom and TP-Link – Achieved a world-first Wi-Fi 7 throughput exceeding 10 Gbps, setting a new benchmark for next-generation wireless networking.

- These results demonstrate that Wi-Fi 7 is now a key enabler for digital transformation, supporting businesses, service providers, and consumers with the high-performance, low-latency connectivity required for modern applications. ***Explore the latest trial results here***.

8.4 AI/ML for Wi-Fi

Artificial Intelligence (AI) and Machine Learning (ML) are reshaping how networks operate. Wi-Fi systems generate massive volumes of data from devices, access points, and network elements across diverse applications, deployments, frequency bands, and parameters. These complex, non-linear relationships directly affect device, application, and overall network performance.

WBA members began collaborative work on AIML in Wi-Fi in 2024 have advanced through multiple stages, including building a data lake and developing synthetic data.

This initiative encompasses a broad scope of activities, including assessing business investments and growth prospects, identifying critical use cases for end-to-end Wi-Fi deployments and examining technical and business challenges. It also involves analyzing market needs and available solutions and tools, and addresses gap areas such as defining standard interfaces, dataset, testing, and validation of ML-based solutions in real-world dynamic scenarios to show that these solutions can adapt and scale effectively under different conditions. In addition, the initiative explores standardization and certification efforts, by collaboration with partner organizations and key players in the ecosystem, and assesses the future work.

8.5 Wireless Security & Trust Framework

The WBA leads the industry on Wi-Fi security and enterprise Private 5G (P5G) security, setting the benchmark for consistent, standards-based practices. Its work empowers service providers, operators, and enterprises worldwide to deliver secure, reliable wireless experiences that foster innovation while protecting users and business-critical data.

Wi-Fi Security Guidelines

Security and privacy are critical foundations of any wireless network. To address these challenges, the WBA has developed Guidelines to ensure robust Wi-Fi security – covering devices, network infrastructure, and backend systems. The WBA's OpenRoaming framework, built on Wi-Fi Alliance's Passpoint® specification, is at the forefront of deploying state-of-the-art protocols for authentication, encryption, and privacy. These safeguards are particularly important for public and enterprise Wi-Fi, protecting users against the inherent risks of over-the-air communications and roaming credential exchange. By defining best practices for operators, Access Network Providers, and Identity Providers, the WBA ensures Wi-Fi ecosystems worldwide achieve the highest levels of resilience and protection against evolving threats.

Enterprise Security for P5G Networks

As enterprises accelerate digital transformation, wireless connectivity becomes mission-critical for efficiency, intelligence, and competitiveness. Private 5G networks are a key enabler of this shift, offering ultra-reliable, secure, and high-capacity infrastructure to support smart factories, predictive maintenance, supply chain visibility, and data-driven customer engagement. The WBA is leading global work on enterprise security frameworks that guarantee secure deployment and interworking of P5G with existing Wi-Fi environments. By shaping guidelines and standards in this space, the WBA ensures that enterprises can confidently embrace digitalization with networks that are secure by design. Phase 2 of work is moving forward with the development of a Technical Blueprint, getting hands-down in terms of technical enablement of best security practices.

8.6 Access Network Metrics (QoS/QoE)

Wi-Fi is the world's most widely used wireless technology, but ensuring consistent quality and visibility across networks is vital to meet rising demand. Limited performance insight has long challenged operators and identity providers (IDPs), especially in Wi-Fi roaming scenarios where users were "offloaded" to partner Wi-Fi networks. Without access to reliable performance data, operators had little control over the quality of experience (QoE), limiting business growth and eroding user trust in Wi-Fi roaming.

The WBA and its members are leading a groundbreaking effort to address this challenge through Access Network Metrics (ANM). Using RADIUS technology and the Connect-Info attribute, and with standardization underway at the IETF, ANM enables the collection of performance metrics directly from Wi-Fi networks. In its initial phase, the focus is on Wi-Fi, but the roadmap includes expanding to additional metrics, introducing aggregation models, and even generating grading scores as examples of how data can be interpreted. For the first time, operators can base policy decisions on measurable Wi-Fi performance.

The impact extends well beyond roaming. Access to real-time Wi-Fi performance data will support spectrum policy, Quality of Service (QoS) enforcement, and dynamic decision-making. ANM also lays the foundation for deeper convergence with 5G and future 6G, positioning Wi-Fi as a reliable and integral part of the global connectivity ecosystem. By driving this initiative, the WBA is equipping the industry with transformative tools that redefine how Wi-Fi networks are measured, trusted, and monetized.

8.7 Mission Critical & Emergency Services

Mission Critical and Emergency Services are a growing strategic focus for WBA. Wi-Fi is increasingly used in public safety, disaster recovery, and first responder communications, with requirements for high availability, deterministic latency, and seamless mobility.

In 2025, WBA published three strategic reports under its ***Mission Critical and Emergency Services Program***, offering frameworks for using Wi-Fi 6/7, OpenRoaming™, and Passpoint® in life-critical scenarios:

- Emergency Calling over Wi-Fi Networks Industry Framework – Defines an end-to-end framework for credential-free emergency calling over Wi-Fi using Emergency Passpoint Profiles, OpenRoaming, SIP, and IMS technologies.
- Cellular Emergency Calling over OpenRoaming Wi-Fi – Demonstrates how operators can extend IMS-based Voice over Wi-Fi (VoWi-Fi) and emergency calling over OpenRoaming to improve indoor and public-space coverage.
- National Security & Emergency Preparedness (NS/EP) over Wi-Fi – Outlines how Wi-Fi 7 and Emergency Preparedness Communication Services (EPCS) can provide priority access and resilient communications during critical events.

The program is now entering Phase 2 with Emergency Warning Systems as the next focus. Work is underway to develop a technical framework and standard for enabling communication between the networks and the end-devices, with the likely incorporation of new IEEE standards such as Enhanced Broadcast Services (P802.11bc).

8.8 Smart Home, IoT & Multi-Dwelling Units (MDU)

In parallel, WBA is expanding its Smart Home, IoT, and MDU programs. Building on the Matter protocol and the Operator Managed Wi-Fi (OMWi) specification, WBA has developed ***frameworks*** that emphasize interoperability, secure onboarding, and device orchestration across multi-vendor environments.

In 2025, the Alliance launched the first-ever MDU Centralized Connectivity Management program, which will help operators manage connectivity across complex multi-unit environments at scale. These efforts not only advance consumer-focused smart living environments but also provide the foundation for enterprise IoT and industrial automation use cases.

8.9 Testing & Interoperability

Building on a strong legacy in next-generation hotspot trials, the WBA Testing & Interoperability Work Group continues to lead the industry in advancing Passpoint usability, security, testing, and adoption. The group defines technical requirements, collaborates with peer organizations, and conducts interoperability testing of Passpoint features to raise awareness and engage key stakeholders on the most pressing technological gaps across the ecosystem.

In 2025, WBA launched the Passpoint Features & Profile Format group to accelerate the evolution of Passpoint technology. This initiative focuses on two core areas: enhancing the existing nodes within the current PPS Management Object (PPS MO) and defining a unified Passpoint profile (credential) format. This landmark initiative consolidates industry efforts, drives broad adoption and brings together cornerstone players to shape the future of Passpoint technology.

8.10 WBA Vision Statement for 6G

WBA has published its "***6G – WBA Vision Statement***", outlining how 6G can deliver value beyond the technical community by engaging policymakers, businesses, and end users. The statement calls for stronger collaboration across the ecosystem to achieve truly ubiquitous connectivity and identifies five core vision priorities:

- Ubiquitous connectivity for all – Seamless collaboration between Wi-Fi, cellular, non-terrestrial networks, IoT, and LPWAN technologies.
- Practical industry solutions – Tackling fragmented user experiences, high implementation costs, and inconsistent coverage.
- Cost and operational efficiency – Leveraging Wi-Fi's cost-effectiveness to reduce CAPEX and OPEX while improving sustainability.
- Targeted verticals – Focusing on sectors such as healthcare, smart cities, and industrial automation where reliable connectivity creates the greatest impact.
- Global collaboration and standardization – Driving alignment across standards bodies including 3GPP, GSMA, IEEE, IETF, WBA, and the Wi-Fi Alliance.

A new work group was formed and is already well underway – the team has begun by looking at the historical convergence challenges, why technology standards haven't been adopted and what work was already done in WBA to address this topic, aiming at building a solid future-proof framework.

8.11 Wi-Fi 8: Preparing for Ultra-High Reliability

WBA has launched its first exploratory efforts around Wi-Fi 8 (IEEE 802.11bn – Ultra-High Reliability, UHR). In 2025, WBA working groups are focused on defining the technical and business requirements for ultra-reliable wireless networks, particularly for deterministic latency, industrial automation, and 6G convergence.

A Wi-Fi 8 readiness paper mapping use cases, timelines, and adoption expectations is scheduled for release later in 2026.

8.12 Looking Ahead to 2026

WBA will continue to drive seamless, secure, and interoperable connectivity into 2026 and beyond. Priorities include scaling OpenRoaming into new verticals such as automotive and home broadband, implementing the OMWi compliance certification program, conducting mission-critical Wi-Fi guidelines & studies, bringing Security work to a new level through a WRIX-S vertical and addressing Quantum Computing, preparing the ecosystem for Wi-Fi 8 and 6G convergence, while reviving flagship thematics such as RADIUS, roaming & offload compliance testing.

Key Themes

- Standardization & Guidelines – Strong focus on channel management, provisioning, RF design, and APIs.
- Security & Trust – Advancing quantum resilience, RADIUS certification, WRIX-S, and enterprise-grade security blueprints.
- New Technology Exploration – Pilots for Li-Fi, ambient power solutions, spatial computing, and satellite IoT.
- Vertical Expansion – Growth across trains, in-flight connectivity, AR/VR, and residential IoT ecosystems.
- Roaming & User Experience – Enhancements in OpenRoaming mapping, seamless onboarding, and location-aware services.

Key Priorities

- **Wi-Fi 7 at Scale & Wi-Fi 8 Incubation** – Ensure global deployability of Wi-Fi 7 across global markets, with guidelines, certification, and interoperability testing. Kick-start Wi-Fi 8 "decoded" program.
- **Scaling OpenRoaming™** – Expand adoption into diverse verticals across automotive, in-flight connectivity, and residential broadband, while enhancing mapping, onboarding, and location-aware services.
- **Roaming, Offload, RADIUS** – Renew compliance testing for roaming and offload and strengthen core foundational infrastructure like RADIUS.
- **Operator-Managed Wi-Fi (OMWi)** – Launch the compliance certification program to provide consistency, interoperability, and stronger alignment with operator and enterprise service models.
- **Security & Trust** – Advance enterprise-grade security through WRIX-S, quantum resilience research, and certification for RADIUS, roaming, and offload.
- **Mission-Critical Wi-Fi** – Publish guidelines and conducting studies on reliability, QoS, and performance for industrial, healthcare, and emergency use cases.
- **Global Policy & Standards** – Drive consensus on channel management, RF design, provisioning frameworks, and APIs, while continuing strong advocacy on 6 GHz spectrum and emerging 6G requirements.

As WBA advances into 2026, the roadmap is anchored on three pillars: scaling proven technologies like Wi-Fi 7 and OpenRoaming, securing the next generation of networks with enterprise-grade trust frameworks, and exploring frontier innovations that will define Wi-Fi 8 and beyond. By combining global standardization, vertical expansion, and user-centric design, WBA aims to shape a future where Wi-Fi remains the foundation of seamless connectivity across every device, service, and industry.

9. Sustainability and World Wi-Fi Day—Charter and Progress

Whilst the energy consumption of individual Wi-Fi CPE and APs may appear relatively insignificant when viewed in isolation, the sheer volume of Wi-Fi CPE and APs which are active globally makes their aggregate consumption a major concern for sustainability initiatives. The challenge is compounded by the fact that many trends in the industry are driving a rise in the energy demands of Wi-Fi equipment. Notably, the fact that additional radios will be required in routers to accommodate the new 6 GHz spectrum band is a major challenge, as radios are typically responsible for ~80% of the total energy usage of a standard Wi-Fi router. Other energy-efficiency related challenges the industry faces includes that there is currently only a marginal difference between idle- and active-state energy consumption of Wi-Fi equipment, and that energy-efficiency varies considerably between vendors. The industry will need to address these challenges if they are to fulfill their climate obligations.

There are several notable energy-saving initiatives for Wi-Fi equipment within the industry. The European Commission's (EC) ***Code of Conduct on Energy Consumption of Broadband Equipment*** is a voluntary agreement within the European Union (EU) which sets maximum on-state and idle-state energy consumption limits for Wi-Fi equipment. Signatories must ensure that at least 90% of new equipment meets these targets, which are frequently updated to stimulate continual improvements in energy efficiency (the latest update is ***version 9.0*** from 2024). The EU has also enacted successive acts of legally binding legislation aimed at tightening the sustainability requirements on the industry. This included the ***implementation of climate targets*** covering all key sectors of the economy in 2023, which compels European ISPs to implement circular economy models and boost the energy efficiency and eco-design of their products.

Within the US on the other hand, there is no federal government legislation regulating the energy efficiency of Wi-Fi equipment, but there is the "***Voluntary Agreement For Ongoing Improvement To The Energy Efficiency of Small Network Equipment***." The agreement is non-binding, but sets out a range of guidelines for improving the energy efficiency of broadband CPE that member ISPs will deploy. Some of the largest US ISPs are members, including AT&T, Verizon, Charter, and Cox. Many of the Wi-Fi CPE vendors that supply these ISPs are also signatories.

Research & Development initiatives throughout the industry are also working to improve the energy efficiency of Wi-Fi equipment. Methods include more energy-efficient designs through the tighter integration of components, improvements to Wi-Fi radio performance by reducing interference, enhancing antenna power conversion efficiency, and dynamic adjustment of antenna power levels, as well as the application of AI for more intelligent and dynamic sleep modes.

Celebrated every year on the 20th of June, World Wi-Fi Day is an initiative dedicated to recognizing the role of Wi-Fi in improving education prospects, fostering economic growth, and enabling social mobility in cities and communities worldwide. The initiative is organized by the WBA under the leadership of the Connected Community Forum (CCF), and calls on cities, governments, and the broader technology industry to pledge support to the 'HOPE' charter. Specifically, the anacronym HOPE represents:

- **Help**: By supporting and funding Wi-Fi deployments in underserved and unconnected communities.
- **Offer**: Freely available public Wi-Fi networks to make the internet more accessible and affordable.
- **Promote:** Promote government and industry Wi-Fi initiatives to connect the underserved and unconnected.
- **Engage:** Recognize the central role of Wi-Fi in closing the digital divide.

There are currently around 100 supporting organizations spanning operators and carriers, technology vendors, industry forums, and city governments.

10. 2026/2027 Wi-Fi Predictions

- **Wi-Fi 7 adoption to accelerate**: 2025 saw industry adoption of Wi-Fi 7 begin to gather pace, with consumers and enterprises eager to harness the 6 GHz spectrum band and the advanced new features of the standard. Reflecting this strong interest in Wi-Fi 7, shipments of APs supporting the standard rose from 26.3 million in 2024 to a projected total of 66.5 million in 2025. ABI Research anticipates that this transition to Wi-Fi 7 will accelerate further in 2026, with a forecast annual shipment number of Wi-Fi 7 APs at 117.9 million.

- **Standard Power 6 GHz to gain further traction**: Standard Power (SP) 6 GHz got off to a rocky start, with protracted regulator certifications and limited infrastructure options. Now that there is greater clarity on the regulatory landscape of SP 6 GHz, and that a wider selection of SP 6 GHz enabled equipment has emerged, we expect that 2026 will see SP 6 GHz deployments accelerate. Large public venues, education, and the industrial manufacturing verticals will be the keenest adopters of the technology. We also anticipate that additional regulators will make moves on authorizing SP 6 GHz in 2026.

- **Early prototypes of Wi-Fi 8 to emerge**: Although the official Wi-Fi 8 (802.11bn) standard won't be finalized for several years, we saw the first wave Wi-Fi 8 chipsets being unveiled at the tail-end of 2025. We expect this to be followed in 2026 with a broader array of Wi-Fi 8 chipset announcements, and the revealing of many early prototype Wi-Fi 8 APs. A handful of these prototype Wi-Fi 8 APs will be seen early in the year at MWC 2026.

- **Wi-Fi offload gains in prominence**: A plethora of trends will act to spur investments into Wi-Fi offloading in 2026. For mobile carriers, the challenge of grappling with ever-increasing traffic on their cellular networks, alongside the need to improve connectivity experiences for their customers, will drive them to expand their Wi-Fi offloading capabilities. Many smart cities on the other hand will look to leverage Wi-Fi offloading to provide both residents and tourists with continuous free connectivity, as well as enabling a range of new applications, from smart traffic to disaster prevention. Additional advancements in OpenRoaming in 2026 will help to drive this trend further.

- **Wi-Fi HaLow momentum accelerates**: Following many successful trials from the WBA, 2025 was the year that Wi-Fi HaLow truly found its feet and commercialization of the technology began to scale up. Throughout the year we saw numerous new chipset and infrastructure announcements, alongside the successful running of the first Wi-Fi HaLow Global Summit and the launch of a new marketing program for Wi-Fi HaLow from the Wi-Fi Alliance. We expect the momentum behind Wi-Fi HaLow to continue in 2026. This will include additional product announcements, and exciting deployments which demonstrate the real-world applications of the technology.

- **Greater clarity on how Wi-Fi and 6G will converge**: The WBA's vision statement for 6G highlights how the upcoming 3GPP standard will be built around a collaboration with Wi-Fi and on harnessing both technologies for the achievement of the greatest cost-effectiveness and operational efficiency. As the cellular industry gradually begins to gear up for 6G throughout 2026, we expect that we will get further clarification on the exact nature of the 6G/Wi-Fi collaboration.

- **Wi-Fi on airplanes witnesses a major advancement**: The Quality of Experience (QoE) for in-flight Wi-Fi is set to undergo a major enhancement with the emergence of connectivity underpinned by Low Earth Orbit (LEO) satellite constellations, which have the potential to enable significantly faster speeds, lower latencies, and uninterrupted connectivity. 2026 will see a multitude of airlines, including British Airways (BA), adopt in-flight Wi-Fi solutions supported by LEO satellite constellations for the first time. BA, alongside many others, will at the same time make Wi-Fi access available for free to all passengers, irrespective of their travelling class, greatly expanding in-flight Wi-Fi access.

- **Advances in broadband access improve and expand connectivity**: Fiber penetration will continue to rise across 2026, with the number of fiber broadband subscriptions reaching a new record of 808.7 million at the end of 2026, up from an estimated 776.3 million at the close of 2025, which itself was a major leap from the 745.5 million at the end of 2024. At the same time, the continued expansion of satellite broadband will help to enable reliable, high-performance connectivity to the unconnected and underserved. Accordingly, the total number of worldwide satellite broadband subscriptions will increase from 6.76 million at the close of 2024 to 12.67 million by the end of 2026.
- **Mesh adoption continues to rise**: Consumers are increasingly turning to Wi-Fi Mesh to extend coverage and eliminate blind spots throughout the home, as well as to enable the delivery of additional services. In the early 2020s much of the demand came through the retail channel, but Internet Service Providers (ISPs) are now beginning to scale up their Wi-Fi Mesh deployments in an effort to raise ARPUs (Average Revenues Per User) and to improve customer Quality of Service (QoS). Reflecting this growing demand, annual shipments of Wi-Fi Mesh equipment are projected to rise from 41.7 million in 2024 to a total of 63.6 million in 2026.
- **Important progress on Integrated Millimeter Wave (mmWave) Wi-Fi (802.11bq)**: With the Project Authorization Request for 802.11bq initiated back in December 2024, the 802.11bq working group has now begun exploring how Wi-Fi can best utilize the 60 GHz spectrum band. Whilst project completion is not expected until 2029, 2026 should provide us some insight into the direction which the 802.11bq standard will take, and how the industry plans to leverage the band for the delivery of the high-gigabit, low-latency wireless transfer of data.

11. Industry Survey—Findings, Summary, and Implications

The WBA industry survey is an annual survey which canvasses representatives from across industry to provide a comprehensive insight into the state of the wireless ecosystem. This year's iteration collected input from 185 participants worldwide, with diverse job roles ranging from the C-suite and Business Strategy to those in Research & Development (R&D) and Product Management. To ensure the survey is an accurate reflection of sentiment from across the industry, over a dozen industries were consulted, spanning from wireless network operators, chipset vendors, device vendors, IT vendors, test labs, city and government officials, and enterprises themselves.

In response to the question of whether their confidence in investing in Wi-Fi had changed over the last 12 months, 62.0% of participants felt more confident, whereas 19.6% believed their confidence levels remained unchanged. There was a relatively minor 10.4% of participants which responded that they were now less confident about investing in Wi-Fi, whilst the remainder had no immediate plans to invest. Of those who were cautious towards investing, one participant noted that whilst new standards were exciting, at a practical level, they wished to first wait and see how client devices would respond to the new Wi-Fi technologies and standards before committing to investing. This highlights the importance of work groups focusing on client device performance and Quality of Experience (QoE) at the WBA.

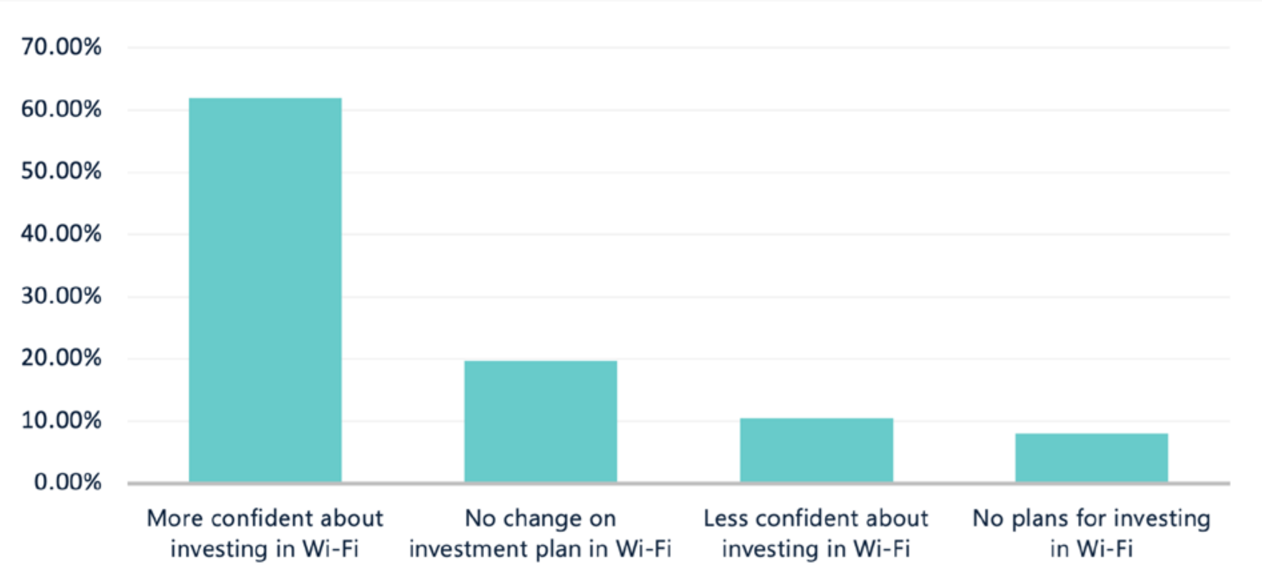


Chart 10: Responses to question ***"How has your confidence towards investing in Wi-Fi changed over the last 12 months?"***
(Source: WBA 2026 Annual Industry Survey)

There were 4 separate questions within this year's survey which dealt with OpenRoaming. In response to the first question, of whether an organization had already or planned to deploy a Passpoint and/or OpenRoaming network, 46.0% said they had/did, and 24.5% said that they did not have plans to (for the remaining 29.5%, the question was not applicable). The second question inquired as to when the organization would deploy an OpenRoaming/Passpoint compliant network. Of the responses, 37.5% reported that they had already deployed the compatible network, 31.9% wished to deploy one in 2026, 18.1% in 2027, 4.2% after 2028, and there was 8.3% which had no plans at all.

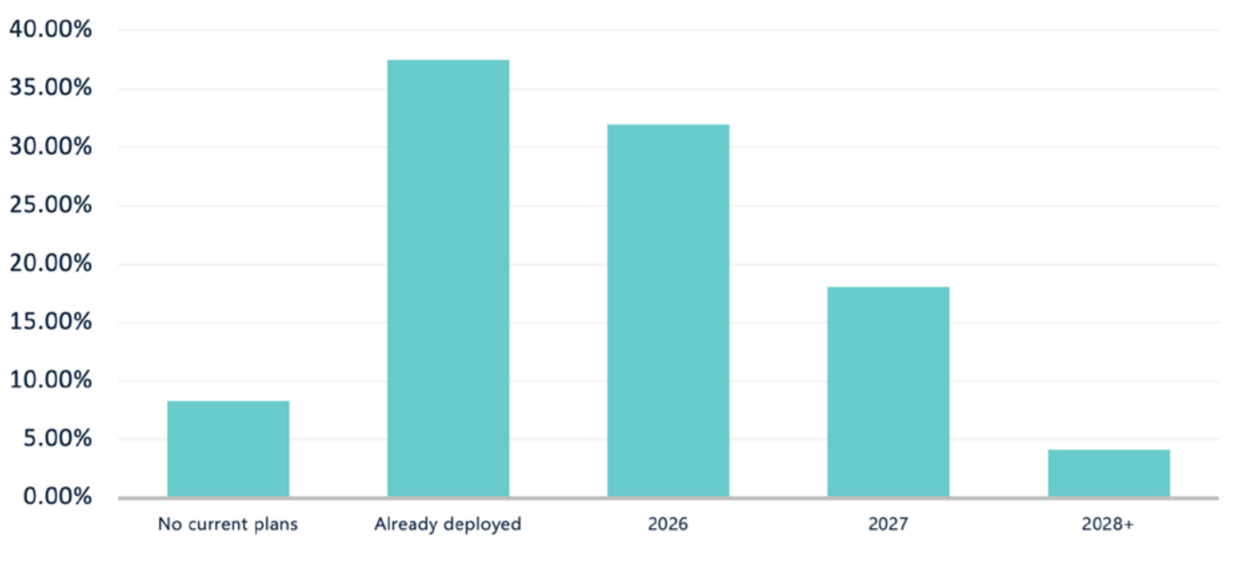


Chart 11: Responses to question ***"When do you plan to deploy an OpenRoaming/Passpoint compliant network?"***
(Source: WBA 2026 Annual Industry Survey)

The following two questions examined the drivers for and against investing in an OpenRoaming/Passpoint network. Amongst the factors stimulating OpenRoaming/Passpoint investments, the enablement of frictionless Wi-Fi, the enablement of seamless access between Wi-Fi and 5G/LTE, and the enablement of seamless access across different networks were the top 3 responses, with 62.5%, 59.7%, and 40.3% of responses respectively. Each of these responses relates to network access, highlighting that this element is the most important factor for the industry. Given the criticality that respondents placed on network access and roaming, it is perhaps not surprising that in response to the question of what were the top Wi-Fi monetization strategies over the next 12 months, offload and roaming were identified as the top 2 (with 42.9% and 40.0% of respondents respectively).

The 4th most cited reason for investing into OpenRoaming/Passpoint, with 33.3% of respondents, was to improve Wi-Fi security, whilst the 5th was to improve customer Quality of Experience (QoE) and reduce churn. As to the factors against investing, a lack of urgency for cellular offload was identified by 57.1% of respondents, by far the most common reason. The second most referenced reason was a lack of urgency for seamless access networks, although this was highlighted by only 31.4% of respondents, far below that of the first reason. The third most cited reason, with 20.0% of respondents, was a lack of need to improve customer QoE or to reduce churn.

The responses to the questions on OpenRoaming/Passpoint provide valuable insight into current attitudes towards the technology within the industry. Firstly, almost half of all participants have already or plan to deploy an OpenRoaming/Passpoint compatible network in the near future, highlighting the strong faith and keen interest the industry has in the technology. Secondly, all three of the top factors driving investments into OpenRoaming/Passpoint relate to the desire for seamless network access, implying that connecting to networks and frictionless roaming remains a major challenge that organizations wish to address. Finally, no urgency for cellular offload was by far the most cited reason for not investing in the technology, with 57.1% of respondents compared to 31.4% for the next most cited factor. This suggests that a significant portion of the industry does still not see the demand for nor the benefit of seamless handover between cellular and Wi-Fi.

Wireless connectivity is now so central to business operations that it has come to be considered as a necessary utility, just like water and electricity. Given this criticality, this year's survey asked participants what aspects of Wi-Fi they viewed as the most important to their business at present, and what they expected to be the most important in the future. Network security and privacy was identified as the most important area for businesses today, with 75.5% of all responses. Tied second position for the current most important aspect of Wi-Fi, both with 70.0% of responses, were end user experiences (Quality of Experience and Quality of Service), and seamless authentication to Wi-Fi. Each of these aspects are all addressed by OpenRoaming, reinforcing why the technology was so well received by the participants.

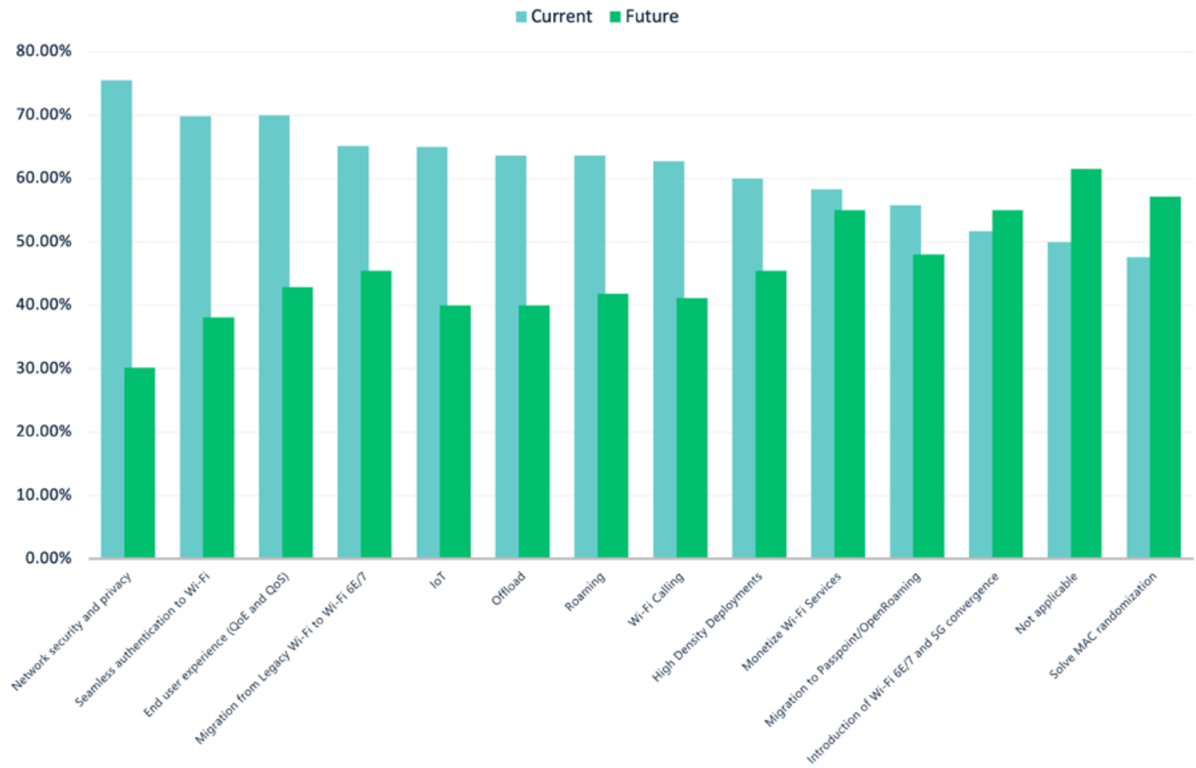


*Chart 12: Responses to question **"In relation to Wi-Fi which TOP 3 areas are most important to your business?"***
(Source: WBA 2026 Annual Industry Survey)

Looking forward, the aspect of Wi-Fi which organizations believed would be most important for their operations going forward was the solving of MAC randomization. MAC randomization, which was originally conceived as a method of enhancing privacy and security, has evolved into a major challenge for organizations, as negatively impacts tasks ranging from the collecting of security credentials, billing, and troubleshooting. The issue of MAC randomization and steps the industry is taking to tackle the problem are explored at length in ***section 5.3***. The second most important aspect according to the participants of the survey was the introduction of Wi-Fi 7 and the 5G convergence. The importance placed on this point reiterates how important the latest Wi-Fi technologies are to the smooth operations of organizations.

There was a series of questions which dealt with traffic growth in this year's report. When asked to identify the top 3 applications driving traffic growth, smart home IoT and Artificial Intelligence (AI) were the most cited factors by a considerable margin, with 35.5% and 32.7% of respondents respectively. The growth of IoT traffic is widely expected given the ever-expanding role of IoT in the home alongside the expansion in the number of IoT devices homes are deploying, with shipments of Wi-Fi chipsets for IoT applications projected to increase from 214.7 million in 2025 to 495.1 million in 2030. Again, as AI applications proliferate the amount of data needed to underpin their function will only grow accordingly.

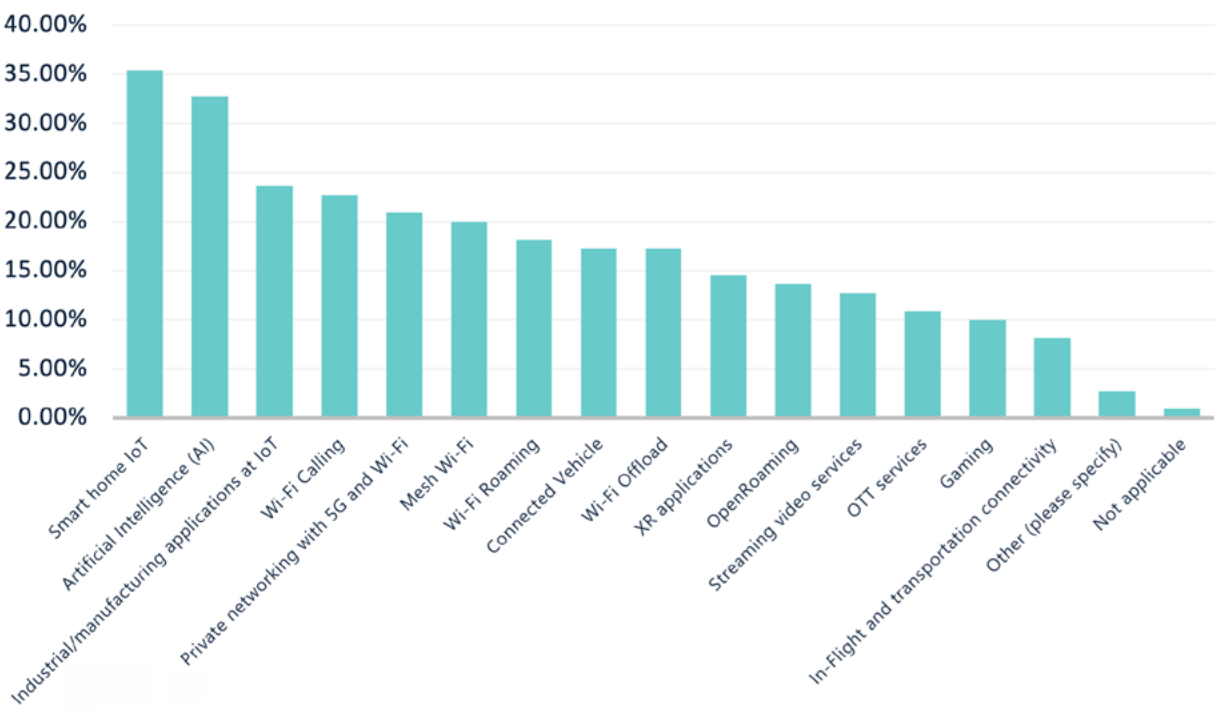


Chart 13: Responses to question ***"Please select the TOP 3 future applications and services most likely to drive overall network and traffic growth?"***
(Source: WBA 2026 Annual Industry Survey)

As to the verticals with the greatest levels of traffic growth, stadiums/event venues was identified by the highest number of respondents, at 40.66% of the total. This is understandable given the growing tendency for the thousands of visitors to stadiums to remain constantly online during events, sharing content, accessing real-time replays, and live-streaming footage. Event organizers are also increasingly leveraging stadium connectivity to facilitate a range of services and engage deeper with visitors, perhaps by running quizzes or special promotions. The expanding data demands of stadiums, alongside the naturally high client density in the environment, has resulted in stadiums emerging as one of the keenest adopters of the 6 GHz band in order to alleviate congestion. This additional capacity will, in turn, facilitate further data traffic growth in the vertical. Second to stadiums was shopping malls/retail outlets, which 34.0% of respondents identified as having high levels of traffic growth. This is being spurred by the growing number of visitors which are offloading from the cellular onto the Wi-Fi network when they enter the premises.

The survey results provide useful insight into what features the industry values most from the latest Wi-Fi technologies on the market, Wi-Fi 6E and Wi-Fi 7. Multi-Link Operation (MLO) was considered to be the most important feature of the new standards by 46.4% of respondents, the largest number of any feature. MLO is targeted at deriving greater efficiency from the available spectrum resources, a feature which ideal for tackling increasingly congested spectrum environments. This will prove to be especially valuable in regions without 6 GHz access, as the lack of the additional spectrum resources of the new band will place additional strain on the legacy 2.4 GHz and 5 GHz bands. There are two features tied in second position both with 32.7% of respondents highlighting them as important. The first is OFDMA Uplink & Downlink, a feature introduced in Wi-Fi 6 which brings significant boosts to latency performance. The second is WPA3. This identification of these two features reflects two of the major concerns that the industry, latency and security.

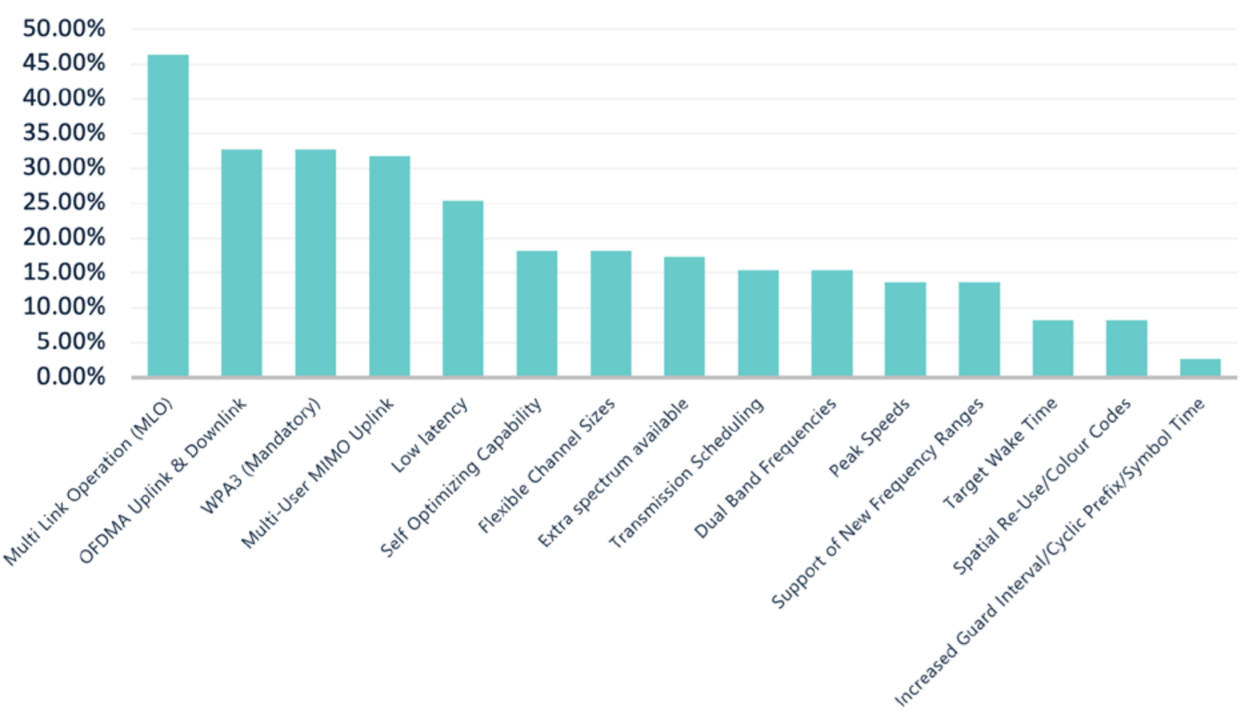


Chart 14: Responses to question ***"For Wi-Fi 6E or Wi-Fi 7, what do you consider to be the 3 most important new and improved features?"***
(Source: WBA 2026 Annual Industry Survey)

When asked which technologies they have already deployed within their organization, Wi-Fi 6E secured the lead by a long margin, with 47.4% of respondents choosing this technology. The second most selected technology was Distributed Antenna Systems (DAS) with 22.9%, followed closely by OpenRoaming with 21.3%. The high level of interest in Wi-Fi 6E reflects the fact that an overwhelming majority of the industry highly values the new band. Indeed, when asked how important they considered availability of the 6 GHz spectrum band to be towards the future of their Wi-Fi business and rollout, with 24.6% of respondents viewed it as 'critical', 40.0% as 'Important', and 21.8% as 'somewhat important'.

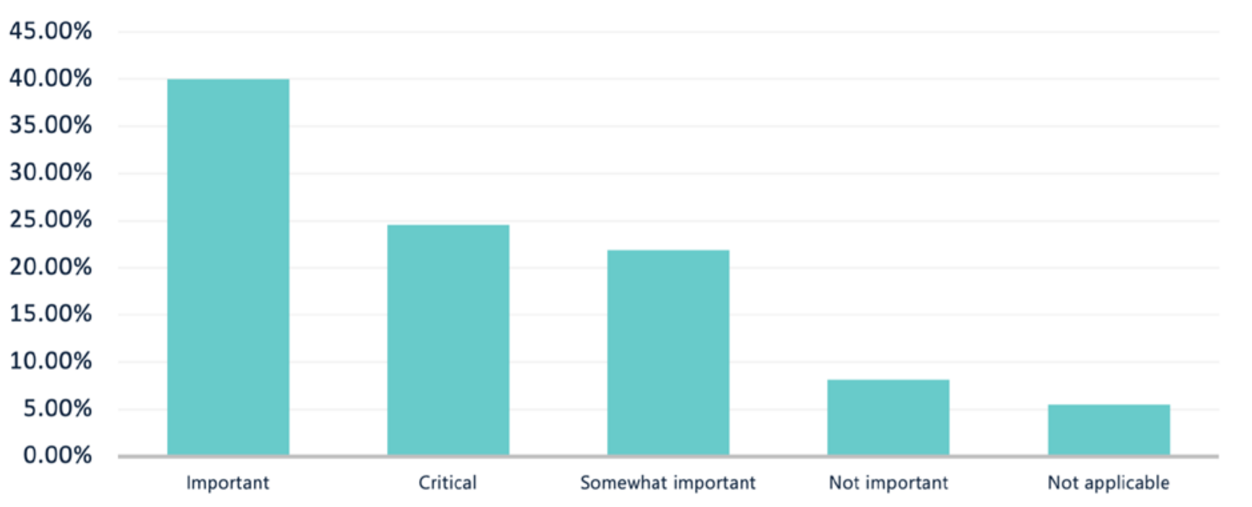


Chart 15: Responses to question ***"How important is availability of 6 GHz spectrum to your Wi-Fi business & rollout"***
(Source: WBA 2026 Annual Industry Survey)

When asked which technologies they were most likely to deploy over the coming years, Wi-Fi 7 received the most support across the 2025/2026 timeframe, with 37.5% of all respondents selecting the technology. This reflects the industry's strong interest in the new features of Wi-Fi 7, particularly the MLO feature which, as discussed above, was considered to be the most important feature of the new standard by 46.4% of respondents. AI/ Cognitive access networks was the technology second most likely to be deployed, with 32.0% of respondents identifying the technology. The huge potential of AI, discussed at length in **section 5.4.8.**, explains the high response rate for this technology. Looking out to 2027 and beyond, Wi-Fi Sensing has risen to secure the spot of the technology most likely to be deployed by organizations. This indicates that the industry generally is excited for what Wi-Fi Sensing can offer, but at the same time appreciate that it will take several years before the technology is mature enough to be deployed at scale.

Survey participants involved in the business of providing Wi-Fi in the home (42.7% of the total participants) were asked to identify their major gaps for delivering In-Home Wi-Fi services in line with customer expectations. Achieving Quality of Service (QoS) was noted by 37.1% of participants, the any of any gap, followed by the delivery of services over Wi-Fi Easy Mesh / Multi-AP architectures (34.3%) and the coordination of radio usage (30.0%). All three of these are intimately interconnected, as seamless service delivery across a multi-AP network and efficient Radio Resource Management (RRM) are both integral to the fulfillment of high levels of QoS.

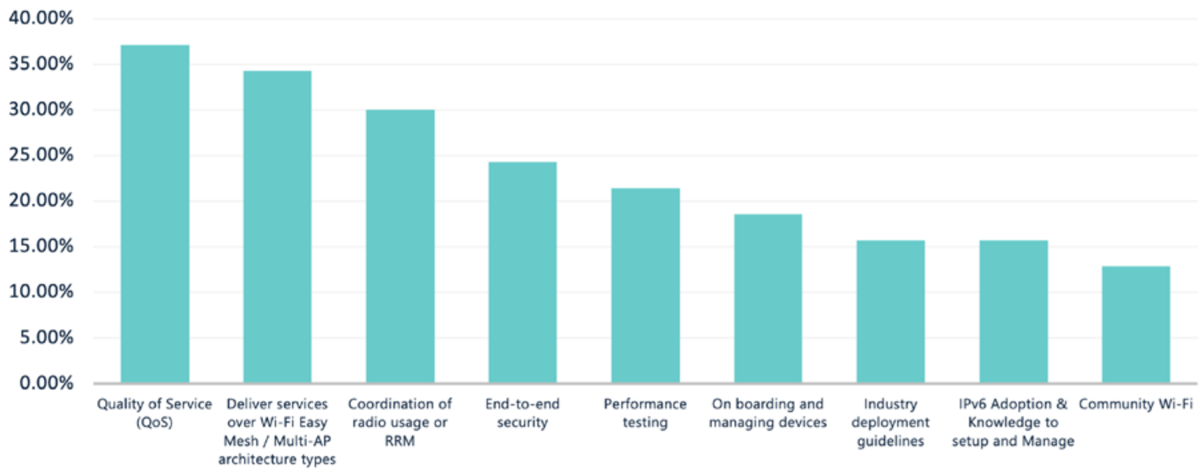


Chart 16: Responses to question ***"What are your major gaps for delivering In-Home Wi-Fi services in line with customer expectations?"*** *(Source: WBA 2026 Annual Industry Survey)*

Issues with business models was identified by just under half of respondents (49.5%) as a top challenge when developing and deploying new wireless services, the most of any challenge. OpenRoaming has a key role to play in helping to address this challenge, considering that offload and roaming were identified by participants as the top 2 Wi-Fi monetization strategies over the next 12 months in an earlier question. It is also notable that whilst ensuring Quality of Service (QoS) was the most referenced issue facing providers of home Wi-Fi solutions, it received the second largest number of responses, at 45.1%, in the question posed to those developing and deploying new wireless services. This likely reflects the fact that monetization models in residential settings are relatively more mature and established, but delivering on them with reliable QoS poses greater difficulty. The third most responses to the question of key challenges in developing and deploying new wireless services, at 41.8%, went to licensed / unlicensed interoperability and integration. The high response rate for this answer highlights the value of the WBA's work on driving interoperability and convergence between Wi-Fi and different wireless technologies, particularly 5G and 6G.

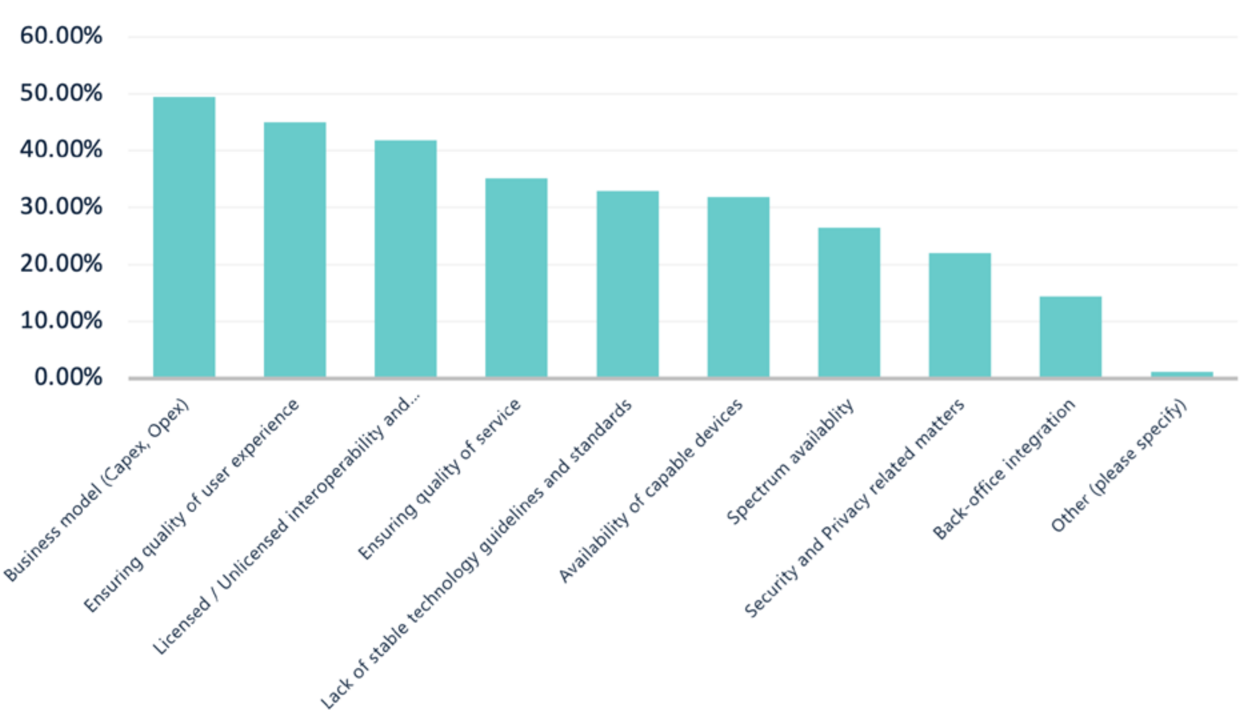


*Chart 17: Responses to question "**Please select the TOP 3 key challenges when developing and deploying new wireless services?**" (Source: WBA 2026 Annual Industry Survey)*

On the topic of 5G, a particularly revealing question in this year's survey asked participants what they thought Wi-Fi's role in converged networks with 5G and private enterprise implementations was? The two most common responses, with 60.4% of respondents selecting each of them, were that convergence of Wi-Fi and 5G offers greater enterprise flexibility, and that Wi-Fi and 5G will be in coexistence. The prominence of these feelings reflects the widespread belief that Wi-Fi and 5G will be complementary technologies, and that by having both technologies available organizations will have the flexibility to utilize the advantages of both depending on the needs of the specific use case.

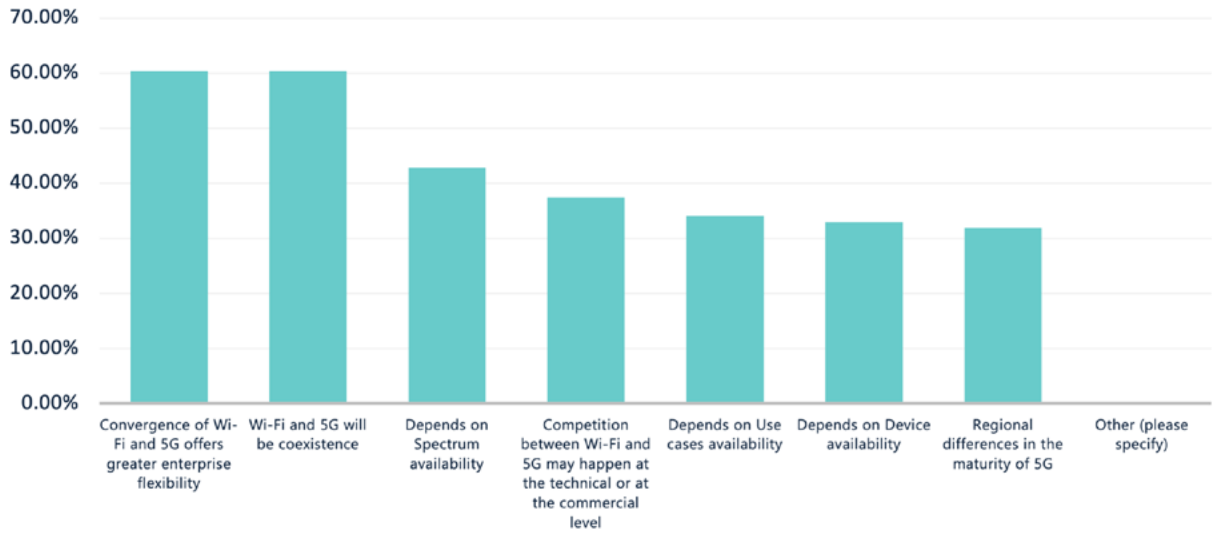


*Chart 18: Responses to question "**What do you think is Wi-Fi's role in converged networks with 5G and private enterprise implementations?**" (Source: WBA 2026 Annual Industry Survey)*

Finally, a series of questions on attitudes and experiences with city-wide public Wi-Fi helped to provide valuable insight into this fast-growing Wi-Fi application. For those which it was applicable, 33.3% said that they had already deployed city Wi-Fi roaming services, like Passpoint and/or OpenRoaming. A further 38.9% said they planned to in 2026/2027, 8.3% in 2028, and 11.1% in 2029 and beyond. These responses indicate the high level of interest that organizations have in the benefits of OpenRoaming, and their strong desire to leverage them. As to the specific opportunities available, when asked what they believed to be the top 3 services that are most relevant for public Wi-Fi deployments, the most common responses were support for city services (70.3% of respondents), the provision of seamless, affordable, and secure internet access to users (64.9%), and to provide offload to carriers (48.7%). City governments around the world, such as the Tokyo Metropolitan Government (TMG), are already utilizing OpenRoaming to deliver all of these services.

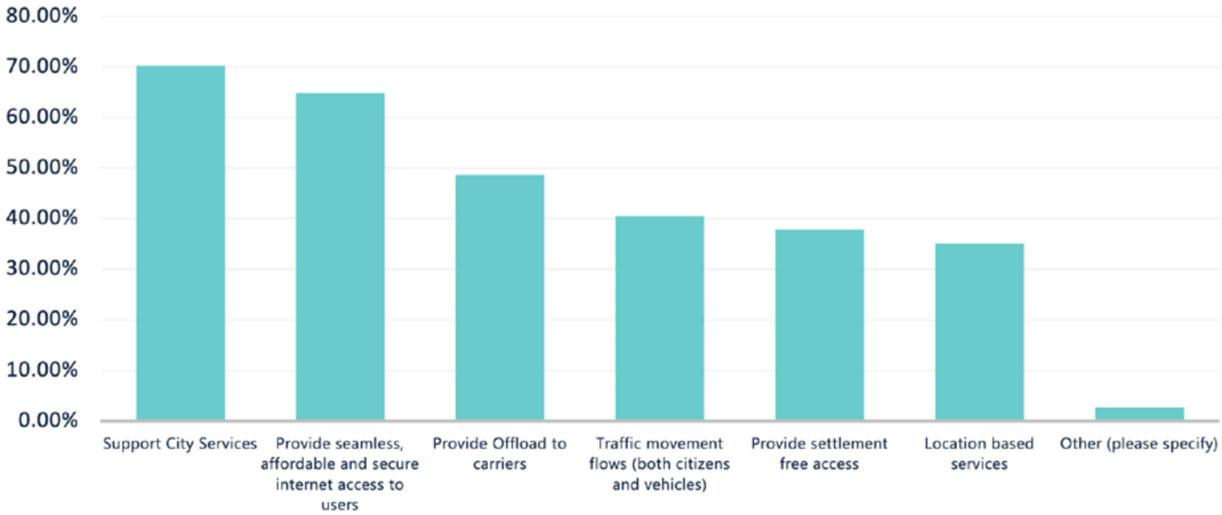


Chart 19: Responses to question ***"Please select the TOP 3 services that are most relevant for Public Wi-Fi deployments?"***
(Source: WBA 2026 Annual Industry Survey)

Alongside the many benefits, there are numerous challenges that city governments face when deploying public Wi-Fi networks. When asked what the top challenges were, the top 3 responses were the cost of operations and maintenance (OPEX), with 67.6% of respondents, alongside the cost of deployment (CAPEX) and business model and monetization strategies, both with 64.9% of respondents. The fact that all of the top 3 were related to budgeting and monetization, and that issues such as limited internal expertise and a lack of technologies to use all received far fewer responses, points to the fact that monetization remains the main thorn in the side of public Wi-Fi deployments. That said, city governments are adamant that public Wi-Fi should be accessible free-of-charge to all. When asked as to their preferred business model for city Wi-Fi roaming services, free to users and free to users but with third party sponsors were both selected by 32.4% of respondents, far more than users to pay (8.8%) or wholesale to operators (2.9%).

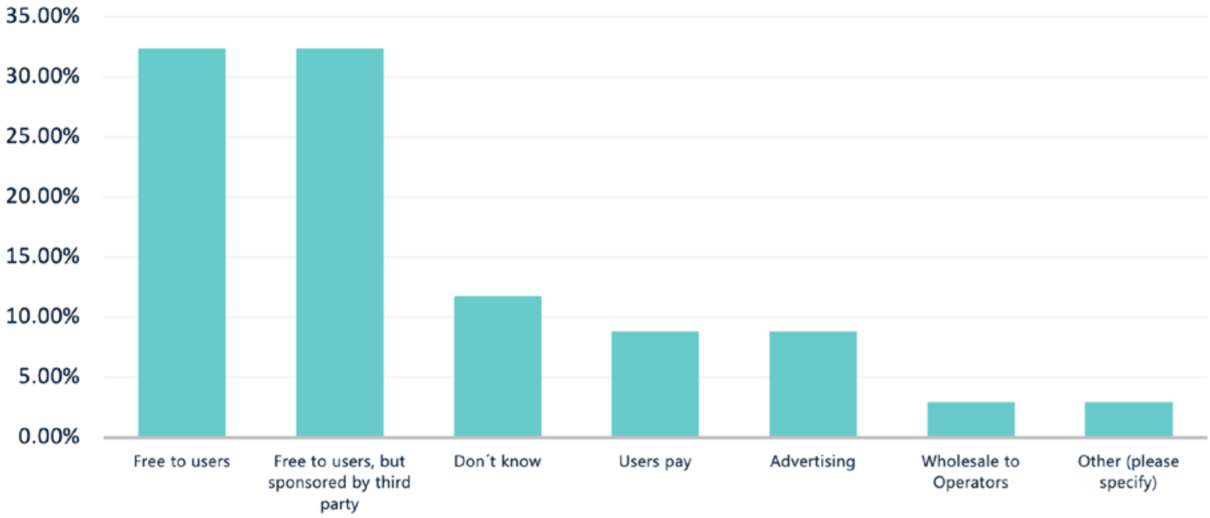


Chart 20: Responses to question ***"What would be your preferred business model for City Wi-Fi Roaming services?"***
(Source: WBA 2026 Annual Industry Survey)

12. Case Studies of Wi-Fi Innovation

Ahold Delhaize

Ahold Delhaize is an international supermarket and convenience store chain which handles 72 million customers each week across its 9,400 stores in 9 countries. In its home market of Belgium, local retail brand Delhaize wished to enable reliable in-store connectivity for its customers, a move which would vastly improve customer experiences and underpin a variety of innovative smartphone-based tasks. To achieve this, in 2022 Delhaize made the decision to integrate the Cisco Spaces SDK with its proprietary loyalty app, allowing customers to seamlessly onboard onto the local Wi-Fi network within any of their 850 Belgian stores via OpenRoaming. OpenRoaming was the chosen solution for the following reasons:

- Seamless onboarding: OpenRoaming allows authenticated devices to automatically and seamlessly connect to the network with an OpenRoaming profile. This removes the challenges traditional guest Wi-Fi networks face from numerous policies, IDs, and MAC address changes.
- Cost-Efficiency: Delhaize was able to leverage the existing Wi-Fi infrastructure within their stores, significantly reducing installation costs. Even if they didn't have this pre-existing Wi-Fi infrastructure, cellular would still not make economic sense because it is significantly more expensive than Wi-Fi hardware, and separate infrastructure would be required for each of Belgum's 4 operators.
- Visitor analytics: OpenRoaming allows Delhaize to directly collect rich customer analytics, including when customers visit the store, the frequency of their visits, and how long they remain inside. If a cellular approach was taken, it would be the operators which would be gathering, and ultimately owning, this valuable customer data.
- Customer engagement: The integration of Cisco Spaces into their loyalty app provides Ahold Delhaize with the means to directly engage with their customers, with data anonymization ensuring compliance with GDPR.

Following the successful rollout of OpenRoaming at Delhaize in Belgium, Ahold Delhaize is now planning to rollout the technology in Romania over the coming months. Because the same Wi-Fi infrastructure and white label loyalty app have been implemented across all Ahold Delhaize stores in Europe, the introduction of OpenRoaming in Romania, and potentially in other European markets in the future, will be smooth.

Ahold Delhaize has ambitious plans for the future of its OpenRoaming network. In phase 2 of their project, they intend to link the OpenRoaming data with customer purchasing behavior. This will allow stores to send targeted, personalized product promotions precisely when the customer arrives at the premises. AI could be harnessed to further customize these interactions, perhaps generating messages specific to the customer's age group or sex. Another potential future plan is to leverage the positioning capabilities of their Cisco infrastructure, possibly with Ultra-Wide Band (UWB) or BLE, to enable wayfinding within the store or send targeted promotions the exact moment the customer is in front of a specific isle.

Tokyo Metropolitan Government

The Tokyo Metropolitan Government (TMG) is the government for the Tokyo Prefecture of Japan, which covers 23 special wards, 26 cities, 5 towns, and 8 villages, with a total population close to 14 million. Alongside providing seamless connectivity for the prefecture's residents, the TMG also had a series of critical goals which they wished to address with their wireless connectivity solutions. Firstly, so Tokyo can better accommodate the approximately 504 million tourists which visit the city in 2024 (of which 25 million are international travelers), the TMG was seeking a seamless and secure way for visitors to access vital tourism information during their stay. Secondly, because the city is vulnerable to natural disasters, including earthquakes, tsunamis, typhoons, and floods, they required an effective communication redundancy solution which they could activate during any potential disasters. The TMG decided to adopt OpenRoaming and began implementing it as their solution to these challenges. OpenRoaming was chosen because it is an international standard that offers tight security through encryption and the convenience of automatic connection after one-time registration. To deploy the technology across the city, in 2023 the TMG formulated the "Connected Tokyo" Deployment Policy with three-year action plan. This was to be achieved via three targeted initiatives specifically related to the deployment of OpenRoaming.

- The first is the development of OpenRoaming infrastructure at approximately 1,100 Tokyo Metropolitan Government locations.
- The second is the provision of increased assistance for municipalities, inclusive of technical assistance such as Wi-Fi deployment plans and financial support for installation.
- Thirdly, additional support is to be available for private facilities (introduction at universities, awareness programs at metropolitan events, etc.).

The TMG also planned to leverage Wi-Fi log data to enable a range of new applications, including to assist with disaster prevention by supporting efficient evacuation, and to address overtourism. The TMG had several key partners which supported them throughout the initiative. For building authentication relay servers and Identity Provider (IdP), the TMG collaborated with Cityroam and Wi2, the contracted operator. In addition, as an initiative implemented alongside the action plan, the TMG worked with NTT EAST for Wi-Fi deployment using public phone booths and related awareness activities. Another key partner was the WBA, which provided continuous support to the TMG as they began deploying OpenRoaming.

The TMG was also given opportunities to present its progress on the TMG's initiatives internationally through presentations at the Connected Community Forum in April 2025 and at WGC 2025 EMEA held in Paris in October.

During the installation of the Wi-Fi hardware there were some unexpected interruptions which threatened to delay the schedule. Thankfully, the TMG was able to overcome this through close coordination with facility managers and contractors, and the revising of construction methods to ensure that Wi-Fi installation at the metropolitan facilities completed to date under the project was carried out within the planned timeframe. After implementing OpenRoaming, the TMG found that people generally appreciate that Wi-Fi is now available for them in places like metropolitan hospitals with long waiting times and museums and parks visited by many tourists. The automatic handover of OpenRoaming makes the whole connectivity experience smooth and convenient for them once registered, and furthermore they feel secure because the Wi-Fi is provided by the Tokyo Metropolitan Government.