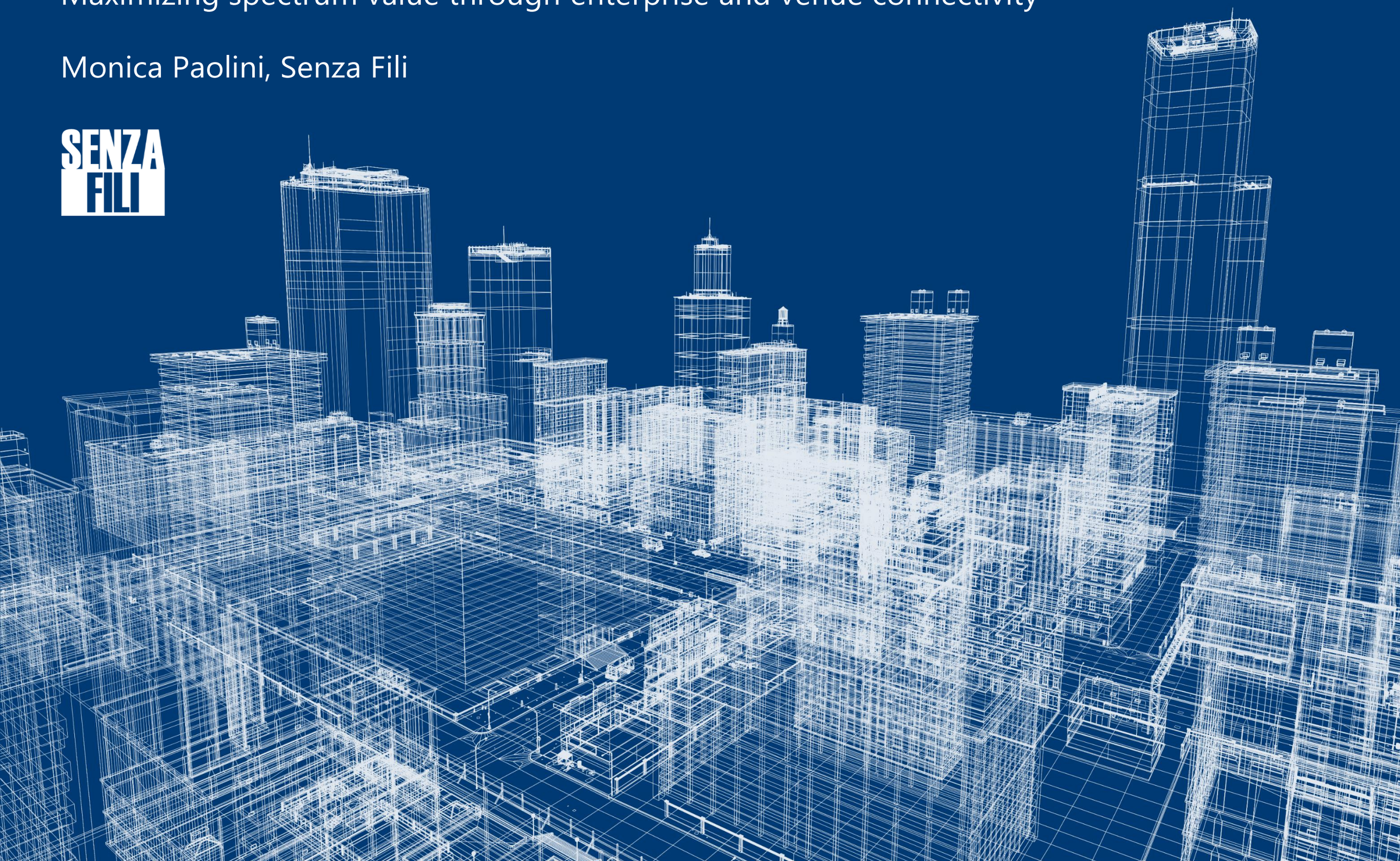
Sharing access to the upper 6 GHz band

Maximizing spectrum value through enterprise and venue connectivity

Monica Paolini, Senza Fili



Deciding how to allocate spectrum is always a complex decision that inevitably generates controversy on what is the most effective way to meet our connectivity needs and who is best positioned to do so. The choice of a regulatory framework – licensed, lightly-licensed, unlicensed or a mix – depends on who needs and can benefit from the spectrum the most, on the spectrum characteristics, and on the incumbent users, if any.

For the 6 GHz band, the debate has been spirited because of the large amount of spectrum available (1,200 GHz, 5.925-7.125 GHz). Thanks to the limited propagation in the band and technological advancements in spectrum sharing, access can be safely and fairly shared with incumbent users if transmission power is low. 6 GHz is well suited to provide high-capacity coverage in areas with a high concentration of demand – which are often, but not exclusively, indoors, where congestion and degraded performance are most common, and also where low power enables higher frequency reuse.

The EU and other countries have allocated the lower 6 GHz band (500 MHz, 5.925-6.425 GHz) to unlicensed RLAN use, including Wi-Fi, subject to power limitations to ensure coexistence with incumbent users. Countries like the US, Canada, Brazil and Saudi Arabia have allocated the entire 6 GHz band to unlicensed access, with different power restrictions for indoor and outdoor usage. WRC-23 will consider recommendations for the allocation of the upper 6 GHz band (700 MHz, 6.425-7.125 MHz) in ITU Region 1 (EMEA) and of the upper 100 MHz (7025-7125 MHz) globally. Ahead of WRC-23, the EU, the UK and other countries are considering a variety of regulatory frameworks for opening access to the upper 6 GHz band.

In this paper, we look at how regulation of the upper 6 GHz band can best meet the connectivity needs of users in dense, mostly indoor locations, and of enterprise, IoT and IIoT applications using low transmission power. Our working assumption is that these are the use cases best served by the 6 GHz band and most in need of additional spectrum.

While licensed and unlicensed regimes are the main contenders, multi-tier or lightly-licensed models are also being considered. However, it is still unclear how effective they could be in the 6 GHz band because of the limited experience with such models. The initial learnings from the US with Citizens Band Radio System (CBRS) – which uses multi-tier access sharing in the 3.5 GHz band – can give us insights into how effective shared access could be in promoting enterprise and venue-based low-power connectivity in the upper 6 GHz band, and into how it compares to licensed and unlicensed regimes.

Terminology: Enterprises and venue defined

In this paper, we refer to enterprise and venue-based networks as networks that are controlled and owned by entities that are not primarily telecommunication service providers (i.e., enterprises, educational institutions, hospitals, cities, transportation hubs, entertainment locations, and commercial and multiunit residential buildings), and that are limited to locations where the entity operates. These networks can be deployed and operated by the entity itself, a system integrator, or a service provider.

While most enterprise and venue networks are indoor, some cover outdoor environments (e.g., stadiums, outdoor retail centers, and enterprise campuses). Some networks only support enterprise or venue-specific applications and services. Others also provide access to tenants, guests, staff, or the public.

A common element is that the enterprise or venue can operate the network because it controls the real estate where it is located. Control over real estate gives enterprises and venues the choice of the wireless infrastructure to be installed, and the ability to manage contention and interference. Enterprises and venues can decide whether to allow other parties to install networks, and retain control over what is installed and where. They can also benefit from easier and cheaper installation and operations because they can share backhaul with their wireline networks and have easy access to the equipment.

CBRS: Multi-tiered shared access in the 3.5 GHz band in the US

CBRS has been an innovative and ambitious initiative to make the 3.5 GHz band – licensed for 5G use in most countries – available to service providers, enterprises, and other users on a shared basis (see table on the right) while preserving incumbent access. There are multiple benefits:

- Increased spectrum utilization and efficiency by allowing more users to use the spectrum based on demand and availability.
- Support for both public and private wireless networks with technology neutrality.
- Simultaneously encourage wide-area mobile access, FWA, and indoor access, by a combination of PAL users (mostly service providers) and GAA users (mostly operating indoors or in circumscribed locations).

CBRS deployments have demonstrated that spectrum-sharing mechanisms effectively protect incumbent access and allocate spectrum resources fairly across PAL and GAA users.

However, the need to enable multi-tier access and get the incumbent's consent in sharing the spectrum exacted a price: a complex regulatory framework that is slowing down adoption across most users and use cases. WISPs are a good example: they were already using the 3.5 GHz band, and they had to upgrade to CBRS to continue using the spectrum.

Nevertheless, initial worries that exclusion zones where incumbent users operate would limit the attractiveness of CBRS don't seem to have had a major impact on adoption.

Mobile operators and other service providers (e.g., cable operators) are the largest PAL owners, but in many cases, they recently got midband licenses, and they prefer to deploy in licensed spectrum and use 5G. Today's CBRS networks use 4G, although CBRS is technology neutral, and 5G will soon be an option.

Most enterprises and venues use GAA for multiple reasons:

- They do not have a PAL. While some enterprises (mostly utilities) acquired PALs, a country-wide license is too big and expensive for most of them.
- GAA spectrum is sufficient to meet their needs. GAA users have at least 80 MHz available. If there are no PAL users at a location, GAA users can use the entire 150 MHz band.

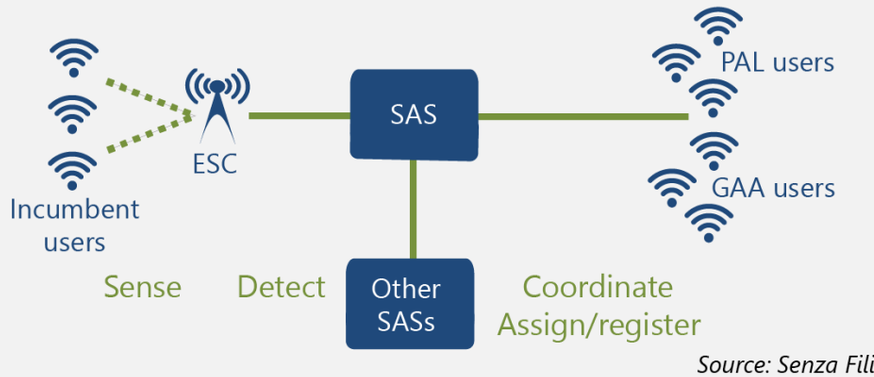
How does CBRS work?

With CBRS, the FCC has opened access to 150 MHz of spectrum in the 3.5 GHz band to service providers, enterprises and other users, using a three-tier system:

- Incumbents (i.e., military, WISPs, and satellite operators) have priority access over all other users.
- Priority Access License (PAL) holders have priority access over non-incumbent users. PALs were allocated on a county basis for seven 10 MHz channels (i.e., 70 MHz), with each license holder allowed a maximum of four channels.
- General Authorized Access (GAA) users have access to at least 80 MHz of spectrum, shared among all the users at a location. They do not need a license, but they need to register their equipment. The FCC does not mandate a mechanism (e.g., LBT) to manage coexistence among GAA users. The WInnForum is currently working on a coexistence solution.

PAL and GAA users have to register with and pay fees to a Spectrum Access System (SAS), which dynamically grants access according to priority level and demand. The SAS is connected to an Environmental Sensing Capability (ESC) that detects incumbent use to determine spectrum availability.

Spectrum sensing and coordination in CBRS



Source: Senza Fili

- Real estate control protects CBRS access. Some PAL owners offer licensed access on the secondary market or as system integrators, but most enterprises and venues do not see a need for PAL access, especially if they control the real estate where they operate. They can prevent PAL owners from installing equipment within their premises, giving them control of the entire band. PAL owners can install CBRS equipment in adjacent areas, but because of the power limitations of CBRS, their coverage within the enterprise or venue location is limited. For instance, an airport that does not allow PAL owners to install their equipment within its premises can get access to the entire CBRS band – provided tenants do not install GAA equipment.

Enterprises and venues have compelling use cases for CBRS, and many are running trials. While many are committed to deploying CBRS, it is taking them longer than expected to move to large commercial deployments. There are several reasons for this:

- Enterprises and venues familiar with Wi-Fi find CBRS more complex to operate (e.g., it requires SIM cards on the terminal devices and core functionality). Solutions that simplify CBRS deployments and system integrators that manage CBRS on behalf of enterprises and venues will accelerate the deployment pace. Still, deploying CBRS takes longer than upgrading Wi-Fi networks.
- SAS connectivity typically comes with the RAN equipment, so enterprises and venue managers do not have to sign up or register, but they have to pay a monthly fee for each CBRS access point. Although the fees are low, they can create a barrier to adoption for some users.
- The requirement for an ESC network to sense incumbent activity increases the complexity and cost of managing CBRS access that SASs incur and have to pass on to CBRS users. ESCs were created to get incumbents to trust spectrum sharing, but they are an unnecessarily complex and expensive solution. There is work underway at the NTIA to find an alternative mechanism.
- GAA users must also continuously receive grants to use CBRS channels. This is unlikely to be an issue if the user has control over who installs equipment within the premises and if there is no CBRS equipment in the immediately surrounding area. However, the novelty of an approach that makes users dependent on an external entity – the SAS – to operate may lengthen the decision process.
- Device, equipment and network management costs are still higher than Wi-Fi, but we expect them to go down and see access equipment that combines CBRS and Wi-Fi gain ground. Joint CBRS and Wi-Fi deployments may encourage uptake, as enterprise and venue owners may include CBRS as a part of their Wi-Fi network refresh.

Lessons learned from CBRS

The three-layer access system is working well, keeping both incumbents and CBRS users on good terms. By April 2022 – less than two years after the commercial launch for GAA access – there were over 200,000 CBRS cells installed, according to the OnGo Alliance. Most CBRS deployments are in FWA networks because the transition to CBRS is straightforward for WISPs already using the 3.5 GHz band.

Commercial deployments in enterprises and venues will take a longer time to scale because private 4G or 5G networks require substantial planning to support use cases and applications that are mostly new to enterprises and venues.

The CBRS spectrum sharing framework is not (and never was) a model to be exported to other markets. It was created to make the best out of a complex situation, with multiple incumbents and pressure from different parties to access highly valuable and, at the time, scarce midband spectrum.

However, there is much to learn from it that can be valuable in developing new spectrum sharing models to encourage enterprise and venue-based networks in the upper 6 GHz:

- Complexity can be a deterrent to adoption: it may lengthen the decision and deployment process, it may increase costs, and eventually, it may divert potential users to alternative technologies.
- Cost may create a burden for some users, even if it is much lower than the cost of acquiring cellular licenses.
- Opening access to spectrum to multiple types of users may not increase spectrum utilization if users are uncertain about their ability to consistently use the spectrum. For instance, some potential CBRS users may be more comfortable using Wi-Fi than CBRS, because with Wi-Fi they have to manage contention, but can operate the network as they choose, without depending on the decisions of a SAS.

CBRS and 6 GHz Wi-Fi shipments in the US

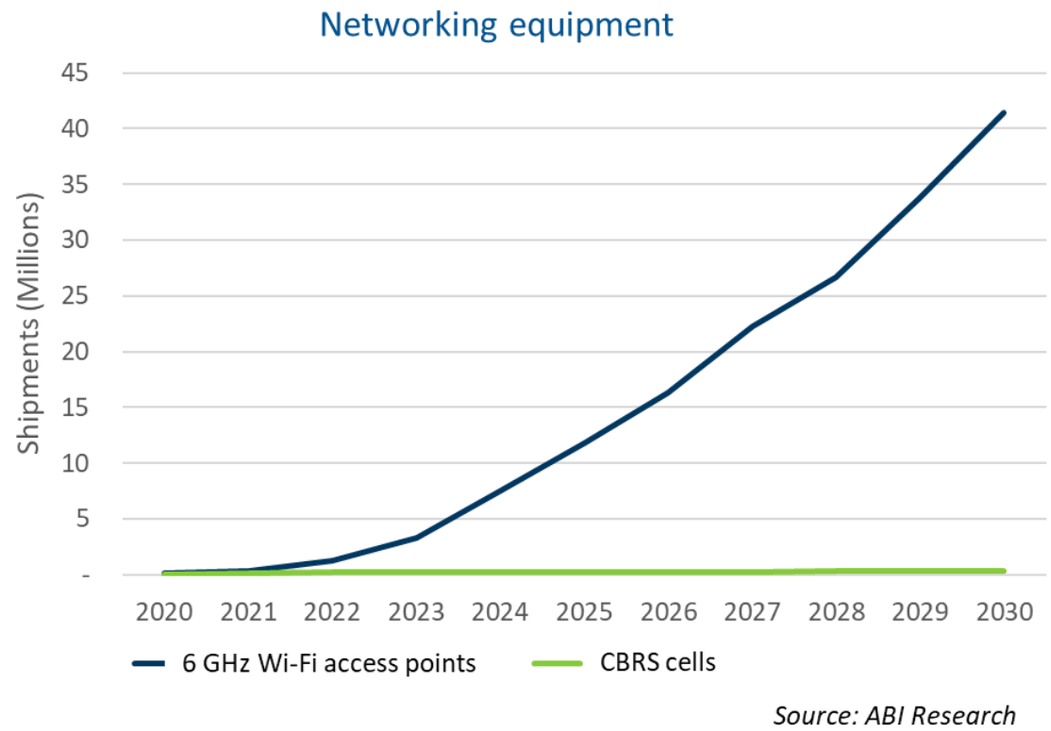
Another way to assess the impact of shared versus unlicensed access in the 6 GHz band is to compare the market size for infrastructure equipment for CBRS and Wi-Fi in the 6 GHz band. Both technologies became available in 2020 when the FCC opened the 6 GHz band to unlicensed use and conducted the CBRS PAL auction.

ABI Research expects Wi-Fi AP shipments to exceed 40 million by 2030 (see the graph on the right). CBRS will grow more slowly and reach 300,000 shipments by 2030. Small cells will account for 70% of CBRS shipments, reflecting a higher adoption rate of CBRS among enterprises and venue owners, which are more likely to use small cells in private networks, than mobile operators in public networks or WISPs in FWA networks.

We should expect Wi-Fi shipments to be higher than CBRS shipments because the deployment models are different. Wi-Fi in the 6 GHz will be ubiquitously deployed across residential, enterprise and public locations. CBRS will be deployed in restricted areas in public, FWA and enterprise networks, with no widespread residential adoption. In addition, because of the longer range, CBRS cells can be deployed less densely than Wi-Fi APs to ensure good coverage.

However, the massive difference in shipment volumes suggests that unlicensed access in the upper 6 GHz band will promote higher adoption in enterprises and venues than shared access. Wi-Fi in the 6 GHz addresses a wider set of adoption use cases than CBRS – or other cellular licensed bands. The simplicity of Wi-Fi – no need to register or pay a SAS, no worries about continuous access, no contention with PAL owners, no SIM to manage devices, and no core network – will facilitate adoption, especially among medium and small enterprises and venues.

As a result, we should expect higher spectrum reuse and utilization in the 6 GHz band than in the 3.5 GHz band, even though the CBRS sharing regime accommodates both licensed and license-free access. Wi-Fi carrying 60-80% of the traffic over the 2.4 GHz and 5 GHz bands alone demonstrates a higher utilization in unlicensed bands.



Source: ABI Research

At the same time, CBRS adoption shows that shared access can accelerate the deployment of private networks and densification of the wireless infrastructure since most CBRS network equipment is small cells. For comparison, there were over 200,000 CBRS cells in 2022, but only 100,000 5G cells in 2011, and 417,000 cellular sites in 2020.

However, the spectrum utilization in CBRS may be lower than in licensed bands because most CBRS sites use small cells and most cellular sites, including 5G, use macro cells, which support more devices and carry more traffic.

Sharing spectrum in the 6 GHz to expand enterprise and venue connectivity

If we want to maximize spectrum utilization in the 6 GHz band, unlicensed access is the best bet because the short range compared to midband frequencies makes densification, frequency reuse and spectrum sharing easier. On the other hand, licensing the spectrum maximizes revenues from spectrum licenses.

However, if we want to maximize enterprise and venue access to provide connectivity in a delimited area to meet specific needs, we need to consider a broader range of factors. As Wi-Fi in the 2.4 GHz and 5 GHz bands show, unlicensed access drives use in enterprise and other venue settings. Unlicensed access in the 6 GHz band will be even more attractive because of the large amount of spectrum available and the low contention.

Is the unlicensed allocation of the entire 6 GHz band more effective than licensed or lightly-licensed regimes in promoting the growth of enterprise digitalization, smart cities, IIoT, XR and other new use cases? We need to answer this question in the context of the overall spectrum strategy, as these innovative use cases require a balanced mix of licensed and unlicensed bands and multiple wireless technologies. Enterprises and venues need 5G as much as they need Wi-Fi to get the connectivity they need. But what is best in the 6 GHz band to balance the overall licensed/unlicensed mix? And could a lightly-licensed model with some of CBRS's features be a good compromise to provide better access and performance to enterprise and venue networks?

The table on the next page compares the impact of different regulatory regimes on the enterprise and venue connectivity within their premises. Multiple models have been proposed for the 6 GHz band. Here we compare those that have been adopted in other bands for enterprise/venue connectivity.

Contention or interference?

One of the most common complaints raised against Wi-Fi performance is interference. While Wi-Fi is subject to interference (e.g., from microwave ovens in the 2.4 GHz band), what we most commonly see (and complain about) is high contention. Demand on Wi-Fi networks is higher than their capacity, and performance suffers as a result because Wi-Fi has to fairly accommodate the best it can all the traffic. Wi-Fi becomes the victim of its success – high demand – rather than of interference from other networks or other bands.

High contention is not limited to Wi-Fi, of course. Cellular networks also suffer from congestion, but operators can more aggressively reduce its impact by selectively throttling or blocking traffic because they have exclusive control over the licensed spectrum they use. This is crucial to support critical communications and prioritize traffic, but it also impacts service availability when network resources are limited.

Capacity limits the ability of any network to provide services to its users regardless of whether it uses licensed or unlicensed spectrum. The mechanisms used to manage contention are different, but in both cases, it is contention, rather than interference, that creates performance and service availability issues.

Managing contention is necessary to optimize the use of available network resources but is insufficient to address the cause of contention: more demand than networks can handle – i.e., insufficient capacity.

Better spectrum reuse and more spectrum are essential to increase capacity and reduce contention. In the 6 GHz band, the combination of low power and unlicensed access enables an increase in capacity to support new use cases and, at the same time, relieves contention in legacy Wi-Fi in enterprise and venue networks.

Comparison among regulatory regimes for enterprise/venue networks (excluding WAN)

	Licensed public	Licensed private	CBRS PAL	CBRS GAA	Local license	Unlicensed	
Spectrum sharing, utilization and reuse	○	◔	◑	◕	◕	●	The ability to share spectrum among all infrastructure users across the national footprint increases as the limitations on spectrum access are reduced.
Spectrum cost	○	○	◕	◑	◑	●	Enterprises/venues indirectly bear the licensed spectrum costs even though they do not own a license in the licensed public/private cases.
Indoor coverage	◕	◑	●	●	●	●	Licensed networks have cost/capacity limitations for indoor coverage.
Deterministic performance	◕	●	●	◑	●	◑	Deterministic performance, latency and reliability are limited for public networks because of contention with public traffic. Network slicing and real-estate control may address this limitation.
Latency	◕	●	●	◕	●	◕	
Reliability	◕	●	●	◑	●	◑	
URLLC	◑	●	●	◑	●	◑	URLLC and enterprise security require both exclusive spectrum access and private infrastructure. Network slicing and real-estate control may address this limitation.
Mobility support	●	●	●	◕	●	○	CBRS GAA may limit support for mobility if there is contention.
Enterprise security	◕	●	●	◕	●	◕	Isolation in private networks provides additional security.
Spectrum access for enterprises and venues	○	○	◔	◕	◕	●	CBRS PAL and local licenses give enterprises protected spectrum access, but unlicensed access provides wider access, even though it is unprotected.
Complexity	●	◑	◑	◕	◕	●	Using the existing public network has the lowest complexity and time-to-deployment for enterprises because they do not have to deploy or host an on-premises network.
Time to commercial deployment	●	◑	◑	◕	◑	●	
Attractiveness to small and medium enterprises	◑	○	◔	◕	◕	●	Small and medium enterprises may not need a private network, but if they do, unlicensed is the best option if they don't have strict performance requirements.

Good ● ◕ ◑ ◔ ○ Bad

Licensed public: Enterprise/venue uses the public mobile network available on premises. Licensed private: Mobile operator uses its licensed spectrum to deploy a private network on behalf of the enterprise. CBRS PAL: Enterprise/venue has PAL or full control of the premises. CBRS GAA: Enterprise/venue has limited control over real estate.
Local license: Enterprise/venue has exclusive control of spectrum within its premises (e.g., 3.8-4.2 GHz band). Unlicensed: RLAN.

Licensed regimes

Licensed spectrum is the least friendly to enterprises and venues. Licenses are typically issued nationwide or for areas too large for local networks. As a result, enterprises and venues do not have direct access to licensed bands.

Enterprises and venues may choose to use the existing public networks. This approach may work for small or medium enterprises with limited connectivity needs, but it can be expensive and it does not support new use cases, especially for IoT and IIoT.

If they choose private networks that use licensed spectrum, venues and enterprises need to work with mobile operators or other licensed holders to lease the spectrum or access a network that uses that spectrum. This increases the cost, complexity and deployment time, and reduces flexibility and control over network deployment and operation.

This model is already available for any licensed band, and the limited adoption of licensed spectrum in private networks (except in markets such as China, where mobile operators have a stronger role in enterprise connectivity) demonstrates that a licensed model in the 6 GHz band will not meet the needs of the enterprise.

Shared-access and locally-licensed regimes

Lightly-licensed models combine some of the advantages of unlicensed and licensed spectrum for enterprises and venues: they give them protected access to spectrum without the high cost of licensing.

In addition to CBRS in the US, local licensing models have been introduced in the UK and Germany to enable innovation in IIoT, IoT and other enterprise and venue-based applications. Local licensing gives enterprises, venues and other users protected spectrum access in their locations at a low cost. The EU is considering adopting a local licensing harmonized framework across Europe to create a broad market for 5G IoT and IIoT ecosystem in the 3.8-4.2 GHz band. While the implementation differs, these allocations use sub-6 GHz bands with wider coverage, better mobility support and a larger 3GPP ecosystem than the 6 GHz band, but have narrower bandwidths.

Multi-tier sharing models provide varying degrees of protection. With CBRS, for instance, PAL users have priority but only within their licensed channels. As a result, the bandwidth available may fluctuate as they may or may not get grants to use the additional GAA spectrum. GAA users have to share the available bandwidth with other colocated networks if they cannot prevent other users from installing their infrastructure within their premises. However, if an enterprise or venue has control over the real estate, GAA performance is likely to be the same as PAL performance, as there will be only one CBRS network at that location.

Shared-access and locally-licensed bands are the most effective way to support new cases and applications that require the deterministic performance, guaranteed URLLC, and reliability that only licensed or protected spectrum can provide. Critical communications, public safety, AGV and drones are some of the applications that require licensed spectrum. Unlicensed technologies can strengthen the support for these applications by providing redundancy or additional capacity but cannot guarantee the required KPIs because contention from colocated networks cannot be eliminated or controlled at each location.

Many enterprises and venues are not ready yet to deploy many of these applications, so we need to assess the value of shared-access and local-licensing models to support these applications in the medium to long term. Furthermore, we should expect lower utilization with shared-access and local-licensing regimes than in unlicensed bands because the complexity needed to protect enterprise and venue access raises the barriers to entry. An enterprise that does not require such protection, for instance, may opt to deploy only an unlicensed network.

Enterprises and venues need access to protected spectrum to support these applications, but the 6 GHz band is not the best candidate because of its limitations in range, power and mobility support. Sub-6 GHz bands such as CBRS's 3.5 GHz or the 3.8-4.2 GHz in Europe are better suited to support applications with stringent performance and reliability requirements.

Unlicensed regimes

An unlicensed model, with no spectrum costs and no requirement to register the equipment, maximizes spectrum sharing among a wide range of users.

These include mobile operators and other service providers who already use unlicensed spectrum opportunistically (e.g., LAA and Wi-Fi, with the addition of 5G NR-U in the future). They will be able to continue to do so in the 6 GHz band, even if it is unlicensed.

The increased spectrum sharing and reuse will be conducive to better indoor coverage because enterprises and venues have easier and lower-cost access to

their premises and a stronger incentive to provide local connectivity. As a result, enterprises and venues are more willing to invest in the on-premises wireless infrastructure than service providers. Increasingly they see this investment as a requirement for their operations or to attract tenants in new buildings.

The simplicity of unlicensed deployments will accelerate adoption. Virtually all enterprises and venues already operate a Wi-Fi network, and they can expand it to include 6 GHz (or to use 5G N-RU or other technologies, when available). This streamlines the decision and planning process, and reduces costs and deployment times. The mature and large Wi-Fi ecosystem will support the needs of any network in terms of size, environmental features, and performance requirements as the technology expands to include the 6 GHz band with Wi-Fi 6E.

Yet, performance and reliability concerns may limit unlicensed use of the 6 GHz band. These concerns stem from the experience many enterprises and venues have with congested Wi-Fi networks in the 2.4 GHz and 5 GHz bands. It is difficult to manage congestion in an unlicensed network where the enterprise has no control over the real estate because all users have the right to transmit and need to find a way to coexist (with LBT in Wi-Fi). In a licensed band, the network operator decides which traffic to allow in the network to control congestion. Congestion inevitably degrades performance, with lower throughput and reliability, and higher latency and jitter. These performance metrics are essential to many of the new use cases.

But this is precisely the reason why we need more unlicensed spectrum: it will reduce congestion and improve network performance. As a result, unlicensed technologies such as Wi-Fi can support demanding use cases more effectively. In the absence of congestion, Wi-Fi 6 and 5G have similar KPIs. Wi-Fi 6 also supports more advanced traffic management than previous versions of Wi-Fi to prioritize traffic for specific applications and use cases.

The 6 GHz band will foster uncongested unlicensed access. It is still mostly unused, and it has more bandwidth and better frequency reuse (because of the higher frequency and, in most countries, lower power) than 2.4 GHz and 5 GHz. With the entire 6 GHz band available for unlicensed use, enterprises and venues can use wider channels that allow for a more effective traffic and contention management, as well as for an increase in capacity.

The limited coverage range and transmission power in the 6 GHz band make it easier for enterprises and venues to manage congestion caused by colocated networks: they may control who installs APs within the premises and coordinate access with them. Control over real estate effectively establishes a framework to manage spectrum access that can be as effective as centrally managed systems such as the SAS in CBRS but much less complex.

The combination of lightly-licensed access in sub-6 GHz bands, such as the 3.8-4.2 GHz band in Europe, and unlicensed access in wider bands such as the 6 GHz band is crucial to support innovation, efficiency and reliability in enterprises and venues, with the right mix of openness and protection in spectrum access.

Takeaways: Five reasons unlicensed allocation of the full 6 GHz band is best for enterprises and venues

Simplicity

Unlicensed allocations maximize spectrum use because simplicity allows every type of user – residential, enterprise, venue or service provider – to deploy and operate a network.

Enterprises and venues will benefit the most from unlicensed access to the 6 GHz band because they are the most affected by congestion in the existing unlicensed bands, and their connectivity needs keep growing with digitalization, growth of IoT and IIoT, and adoption of demanding use cases, such as XR.

Lightly-licensing frameworks encourage enterprise and venue adoption but necessarily introduce a complexity and cost that reduces and slows down adoption, and limits spectrum utilization.

Sharing

Lightly-licensed models are designed to encourage sharing among specific user types – e.g., licensed and unlicensed users in CBRS – but may also create tension among different users because they are subject to different regulatory constraints.

The combination of unlicensed allocation, low power and limited range in the 6 GHz band gives equal access to all users and promotes more effective spectrum sharing than licensed or lightly-licensed allocations.

Higher frequencies enable better spectrum reuse in dense networks and facilitate spectrum sharing among multiple users in unlicensed regimes. The benefits of spectrum licenses for access decrease as frequency increases.

Location

At higher frequencies and lower transmission power, the need for a mechanism for centralized spectrum coordination decreases, as control over the premises can be used to coordinate access among users or limit deployments from other users.

Where and when necessary, enterprises and venues can manage contention with tenants or share their networks with them.

Real-estate control can become a substitute for database registration or dynamic spectrum allocations that reduces the cost and complexity of spectrum sharing.

Scale

While unlicensed RLAN allocations are technology neutral, Wi-Fi will most likely be the prevalent RLAN technology.

Because the entire 6 GHz band is already unlicensed in some countries, including the US, APs and devices are already commercially available within the wide Wi-Fi ecosystem.

Unlicensed access in the 6 GHz band will accelerate adoption, reduce costs for enterprises and venues, and create the economies of scale needed to support innovative use cases.

Synergy

Enterprises and venues need a combination of sub-6 GHz (e.g., CBRS or 3.8-4.2 GHz) and 6 GHz networks to roll out the multitude of use cases that collectively enable their digital transformation.

Deterministic performance and control over contention in sub-6 GHz bands are crucial to support applications with stringent mobility, latency, or reliability requirements.

The wider bandwidth in the 6 GHz band gives enterprises and venues the capacity other applications require.

Co-location and integration of these two networks enable enterprises and venues to support applications that require both the capacity of 6 GHz and the more deterministic performance of sub-6 GHz.

About Senza Fili

Senza Fili provides advisory support on wireless technologies and services. At Senza Fili, we have in-depth expertise in financial modeling, market forecasts and research, strategy, business plan support, and due diligence. Our client base is international and spans the entire value chain: clients include wireline, fixed wireless, and mobile operators, enterprises and other vertical players, vendors, system integrators, investors, regulators, and industry associations. We provide a bridge between technologies and services, helping our clients assess established and emerging technologies, use these technologies to support new or existing services, and build solid, profitable business models. Independent advice, a strong quantitative orientation, and an international perspective are the hallmarks of our work. For additional information, visit www.senzafili.com.

About Monica Paolini

Monica Paolini, PhD, founded Senza Fili in 2003. She is an expert in wireless technologies and has helped clients worldwide to understand technology and customer requirements, evaluate business plan opportunities, market their services and products, and estimate the market size and revenue opportunity of new and established wireless technologies. She frequently gives presentations at conferences, and she has written many reports and articles on wireless technologies and services. She has a PhD in cognitive science from the University of California, San Diego (US), an MBA from the University of Oxford (UK), and a BA/MA in philosophy from the University of Bologna (Italy).