Wi-Fi 6 or 5G for Enterprise?

White Paper

Abstract

Enterprise IT leaders, commercial property owners, and facilities managers need to develop strategies that will ensure wireless connectivity that meets the evolving needs of all their stakeholders. Wi-Fi 6 and 5G represent the latest emerging wireless standards in the unlicensed and licensed spectrum, respectively, with each offering impressive capabilities across multiple dimensions. Given the significant advances embodied in each of them, it's natural to ask whether both are still needed—or whether one will replace the other.

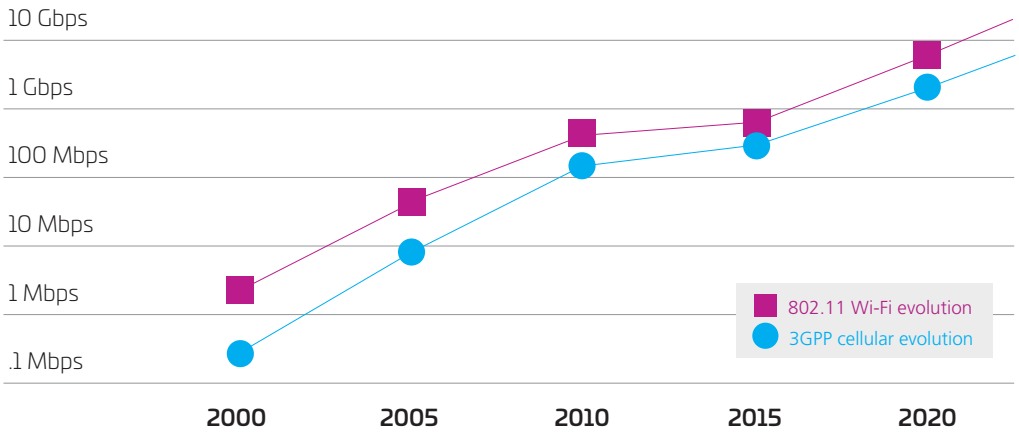
This paper explains the differences and similarities between these technologies and explores how enterprises and building owners are likely to use each of them moving forward.

Introduction and background

5G is the fifth-generation technology standard for cellular networks, developed under the auspices of the Third Generation Partnership Project (3GPP) as the successor to 4G/LTE (hereinafter LTE). Mobile network operators (MNOs) began deploying 5G worldwide in 2019. Wi-Fi 6 is based on the IEEE 802.11 family of standards, which is used for local area networking of devices and internet access. Wi-Fi 6 is the Wi-Fi Alliance's name for 802.11ax (hereinafter Wi-Fi 6).

The concurrent emergence of Wi-Fi 6 and 5G is the latest example of parallel advances in Wi-Fi and mobile cellular standards and technologies that has been going on for over two decades. The original 802.11 Wi-Fi standard released in 1997 supported maximum data rates of 1 or 2 megabits per second. The first 3G networks were introduced in 1998—initially supporting up to 384 kilobits per second. Initial 5G services being deployed in 2020-21 support 2-4 gigabits per second, and subsequent 5G releases promise to increase the rates by a factor of 5 to 10 over the next decade. Meanwhile, Wi-Fi 6 supports rates of more than 10 gigabits per second.

Wi-Fi and cellular technologies have followed parallel evolution paths.



Sources:
https://en.wikipedia.org/wiki/List_of_mobile_phone_generations
https://en.wikipedia.org/wiki/IEEE_802.11

All things being equal, Wi-Fi generally provides higher data rates than comparable generation cellular services due in part to the much shorter distance the signal must travel. The actual speed a user experiences depends on many other factors, including available channel bandwidth, number of users sharing the channel, and distance from the signal source. Also, data rate is only one measure of performance. Latency and reliability, for example, are also critical for many applications. Wi-Fi can suffer from congestion due to bandwidth that is inadequate for the number of users, which can in turn lead to both low speed and high latency. Wi-Fi 6E, which greatly expands the spectrum available to Wi-Fi 6, will mitigate these problems.

Many comparisons of Wi-Fi 6 and 5G focus almost exclusively on these performance differences. While these are meaningful for certain applications, excessive focus on these differences can obscure the larger point that today's Wi-Fi and cellular technologies *both* meet the requirements of many applications. Therefore, to understand why one might be preferred over another, it's important to examine other factors.

Licensed and unlicensed

The first important distinction is in the way spectrum is allocated for each of the technologies. We use the terms "licensed" and "unlicensed" to describe this. With licensed spectrum, a commercial entity (typically an MNO) acquires exclusive rights to use specified frequency bands within a geographical area. With unlicensed spectrum, the frequency band is open for anyone to use, subject to agreed practices that prevent users from interfering with one another. 5G (like all the Gs before it) operates in licensed spectrum while Wi-Fi 6 (and all Wi-Fi) operates in unlicensed spectrum.

Business models

This licensed/unlicensed distinction translates directly into different business models associated with the use of 5G and Wi-Fi. MNOs deploy 5G along with LTE and legacy technologies as a paid service offering that includes voice calling, text messaging, internet access and supporting services like voice mail. The user accesses the spectrum in the form of a service subscription with the MNO—hence the term "subscriber," which describes a mobile user.

Even when enterprise IT organizations or building owners deploy licensed spectrum systems (such as distributed antenna systems or small cells), they are only providing access to the operator's network and services, and the operator must approve the deployment.

By contrast, Wi-Fi networks are deployed by an enterprise or venue for use by their own employees accessing the enterprise network—and by customers accessing enterprise services such as hotel check-in or the internet. Thus, Wi-Fi is an intrinsic part of the business operation. Home users similarly deploy Wi-Fi networks (usually consisting of a single router or access point) for their own household members.

Use cases: The right tool for the job

For the cellular subscriber, the advantage of the licensed MNO model is that connection to the network is automatic, universal, and pervasive. The subscriber never needs to look for an SSID or enter a password. This seamless access makes cellular the universal voice technology because users can call and be called via the same process—no matter where they are. Wi-Fi is also used for voice, notably within applications like Zoom or Teams, but this assumes a shared application environment and application-specific calling procedures by all participants.

Cellular technology also has greater range to cover large spaces, and it is inherently mobile—meaning users' sessions are maintained as they move between serving radios even while driving at high speed. Mobility is another feature that makes cellular especially well suited to voice calling, since voice call user experience can be disrupted by session interruptions, whereas many data experiences (for example, email) are not. Cellular is also the technology on which emergency services organizations (fire, police, ambulances) have standardized for their communications, again due to its longer range, mobility, and universal access.

By contrast, with Wi-Fi, a private enterprise or homeowner can create a network without reliance on a service provider. As such, it is the default access method for *both* enterprise and home networks. Wi-Fi technology provides unmetered high-speed connectivity that can be implemented anywhere, anytime by the organization or homeowner.

Further, because Wi-Fi is deployed by the enterprise or venue owner, it enables end-user data collection by those entities. This has been a significant driver of Wi-Fi deployment—especially in public spaces such as shopping and entertainment venues. User data that is created when visitors attend an event or frequent a store enables enterprises to better understand, serve and engage with their patrons and customers. User data has become the "new oil" in its commercial value.

Despite the natural advantages of Wi-Fi for many forms of network and internet access, there are still cases in which cellular is more suitable. When users are somewhere other than their home or permanent office location, they may prefer to use their cellular connection (which is automatically on) rather than take the extra steps to log onto public Wi-Fi (assuming it is present). In fact, the very actions that organizations take to monetize Wi-Fi—collecting user data or showing ads, for example—can be incentives for the user to stay on cellular.

The differing deployment models and their implications for business models and use cases help explain why, to date, neither cellular nor Wi-Fi has replaced the other; on the contrary, both have flourished. The emergence of Wi-Fi 6 and 5G does little to alter this fundamental dynamic. To be sure, there are overlapping use cases such as internet access, but the persistent differences continue to make the technologies complementary rather than substitutes for one another.

	Wi-Fi	Cellular
Data/internet access	Yes	Yes
Where used for data	Sustained presence: home, office, hotel	Everywhere else
Voice telephony	Application-specific	Universal
Where used for voice	Specific settings, use cases	Everywhere
Enterprise network access	Universal	Application-specific

5G and Wi-Fi 6 have technical differences, but deployment and business model differences are equally significant

Blurring the distinction: private cellular and OpenRoaming

Recent developments have the potential to blur the licensed/unlicensed technology distinction—enabling each to cross into the other's domain.

Private cellular networks

On the cellular side, regulators are allocating spectrum for private use, either through site-specific allocations (common in Europe) or through a dynamic spectrum sharing arrangement such as Citizens Broadband Radio Service (CBRS) in the U.S. These are sometimes referred to as "lightly licensed."

Private cellular networks are initially being targeted for critical communications such as factory automation or operational communications across large venues like airports or distribution hubs. These applications benefit from cellular technology's range, mobility, security, and deterministic performance. While private cellular is akin to Wi-Fi in its spectrum ownership model, deployment model and business operation support function, it is not a wholesale alternative to Wi-Fi. For generalized network access and widespread use, Wi-Fi is already well established and has much greater capacity.

Private cellular networks and Wi-Fi both provide robust security, but in different ways. With Wi-Fi one creates logical network segments—for example, to separate enterprise users from guests from IoT devices. Each segment can have its own appropriate security policies such as access credentials, server privileges and encryption methods. CBRS achieves security in large part by being a separate (from Wi-Fi) physical network. Access devices require physical SIM cards, plus logon credentials if applied. Other user devices within the coverage area will not even be aware of the presence of the CBRS network. With both Wi-Fi and CBRS, user and application data can be kept within the organization.

OpenRoaming

On the Wi-Fi side, there are industry efforts to replicate the automatic pervasive access nature of cellular, starting with Hotspot 2.0 and Passpoint r1, and subsequent release updates of Passpoint r2 and r3. The Wireless Broadband Alliance's OpenRoaming program leverages Passpoint and a federation of identity and venue providers to support Wi-Fi network roaming.

With cellular-to-Wi-Fi roaming becoming invisible to the user, OpenRoaming has the potential to divert usage from cellular to Wi-Fi—especially indoors. This will require a critical mass of OpenRoaming adoption, notably by mobile operators and hotspot owners. Operators have historically been reluctant to deliver their services over networks they do not operate, due to their desire to control the quality of the subscriber experience, which is brand-affecting. OpenRoaming is addressing this concern by enabling Wi-Fi hotspots to provide tiered service (e.g., bronze silver, gold) to operators, with mechanisms to monetize the hotspot investments, thereby increasing the offload of cellular services to Wi-Fi in more places.

As of early 2021, device vendors, including Google and Samsung, are shipping OpenRoaming-capable devices. However, the degree to which MNOs will adopt this offload model is not known, nor whether it will be used for voice calling or only for data. It should also be noted that, to date, the focus of OpenRoaming has been on inter-Wi-Fi roaming rather than cellular-to-Wi-Fi.

CommScope in Wi-Fi 6 and 5G

CommScope provides Wi-Fi 6, 5G and CBRS infrastructure for enterprises, service providers and residential users. We see an ongoing need for both Wi-Fi and cellular technologies, so we continue to invest in a range of 5G and Wi-Fi 6 solutions. For further information, see the links below:

Wi-Fi for enterprise and service provider networks

In-building 5G and CBRS cellular systems

Home gateways

Cellular base station antennas

Conclusion

As Wi-Fi and cellular technologies evolve, it is natural for their respective domains to overlap. However, we believe that, despite such overlap, both technologies will continue to be complementary—serving the broad range of enterprise services and applications.

It can even be argued that cellular and Wi-Fi indirectly drive each other's growth. As apps and their users become more dependent on high-speed Wi-Fi connections at home or in the office, this in turn drives demand for the same connection quality over cellular when users are away from their Wi-Fi networks. Likewise, the ubiquitous nature of cellular connectivity begs a similar expectation of Wi-Fi; hence, the increased emphasis on public Wi-Fi and developments like OpenRoaming.

CommScope will continue to invest in both Wi-Fi and cellular technologies and solutions.

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