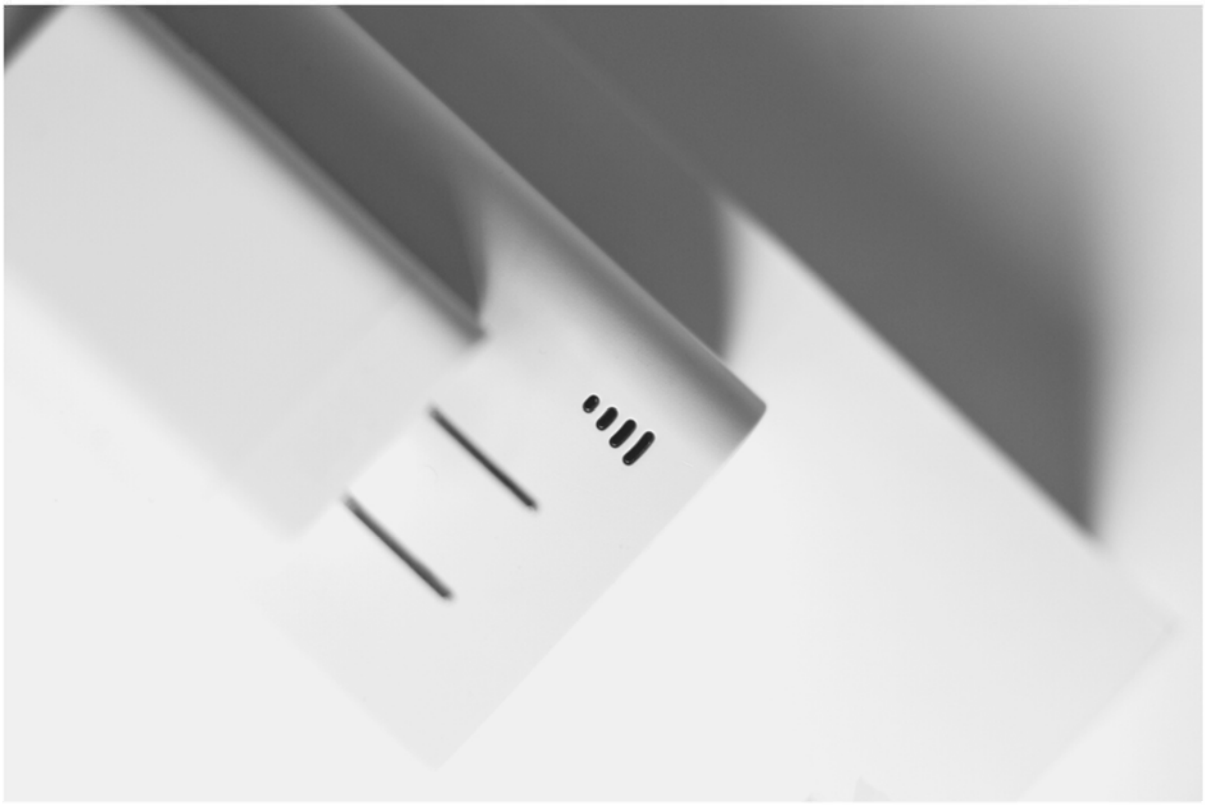
White Paper

Enterprise Private Wireless Guide

Kyung Mun - June 2023



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Enterprise Use Cases and Applications Driving Private Wireless

Before jumping into the enterprise private wireless guide, it is helpful to understand use cases and enterprise applications driving private wireless (here, meaning 5G and LTE networking) networking over well-established alternatives such as Wi-Fi. Private 5G/LTE provides a more extended range versus alternatives such as Wi-Fi. In addition to broader coverage per access point, private cellular networks provide seamless mobility across access points relative to Wi-Fi. Moreover, the robust SIM-based authentication foundation of cellular technology provides a strong security framework for businesses increasingly wary of cyber threats to their critical data.

These advantages, along with promises of advanced 5G features such as low latency and support for massive numbers of devices, drive a broad category of use cases and business applications toward private cellular networks, as highlighted below.

- *Video & Computer Vision* – connecting surveillance cameras, AR/VR-assisted diagnostics in industry 4.0 applications
- *Fixed Wireless Access* – broadband connectivity for distance learning, Wi-Fi backhaul in campus networking, cable replacement use cases such as digital signage
- *Mobility* – autonomous guided vehicles (AGVs) and robots in warehousing, remote operations of mobile vehicles in mining
- *Remote Control & Monitoring* – remote control of high-value assets (e.g., medical and industrial equipment), predictive maintenance of critical assets to avoid downtimes

Enterprises increasingly demand private networks that can support mission-critical services such as autonomous guided vehicles on factory floors. 5G is very secure and provides high reliability of speed and latency for this type of deterministic connectivity service. Meanwhile, Wi-Fi uses globally available unlicensed spectrum, broad and accessible device and networking ecosystems to support many IT applications today.

Five Steps in Private Wireless Projects

This is an exciting time for private wireless networking. According to Mobile Experts, the private cellular infrastructure and devices market will reach $1.9 billion this year, growing at a 20% CAGR over the next five years.[2] However, it also presents challenges for businesses as their IT and operational technology (OT) departments look to close the knowledge gap in private 5G and LTE networking. Besides the common challenge of limited in-house expertise, businesses face other challenges, such as new technology and vendor selection, network implementation and integration, and data and applications management, to name a few. Here, we highlight five key steps that an enterprise must consider as it embarks on private cellular network projects.

Figure 1. Step-by-Step Guide to Private Wireless Projects

1. Identify the business problem and clear use cases that an enterprise wants to achieve with a private cellular network

The first step is to clearly identify a business problem and use case(s) that an enterprise is looking to solve with a private cellular network. For example, deploying Wi-Fi would likely be a cost-effective solution if an enterprise is simply looking to extend wireless networking at a new building for general IT applications such as email or Internet browsing. However, suppose an enterprise is looking to extend robust wireless connectivity across wide-area coverage, for instance, for surveillance cameras or Wi-Fi backhaul. In that case, private LTE/5G may be an excellent solution. In addition to clearly understanding the business problem, the enterprise should identify the expected outcome from the private cellular network. For example, it is helpful to establish a service level assurance on wireless connectivity, e.g., latency, throughput, availability, etc., to ensure that specific business applications can be supported.

2. Determine the spectrum choice(s) for the private cellular network and the availability of infrastructure and devices to support the specific application or use case

Once a business problem and expected outcome have been identified, it is time for technology and vendor selection. Before that, however, a business, or a solution partner, must first decide on spectrum choice(s). While cellular technology has traditionally been associated with expensive licensed spectrum bands, private 5G and LTE networks can also run on shared and unlicensed spectrum bands, such as CBRS (USA), 3.7-3.8 GHz (Germany), 5 GHz (global), 6 GHz (global), and many other dedicated spectrum bands for industrial use. For a wide-area private cellular network for utility applications covering hundreds of square kilometers, 450MHz or 800/900 MHz licensed bands with higher regulated output power are appropriate. For a campus network covering a few tens of square kilometers, a shared mid-band spectrum (e.g., CBRS, 3.7-3.8 GHz) may be ideal. Lastly, for high throughput applications in smart factory environments, a dedicated millimeter wave spectrum (e.g., 28 GHz) may provide wide channel bandwidth to support high-speed, low-latency applications. It should be noted that multiple spectrum options are available, from licensed and unlicensed bands to shared/dedicated spectrum for the enterprise. A combination of these options is also possible, 3.7 GHz plus unlicensed, for example.

Once spectrum band choice(s) have been identified for specific business applications and environments, the next step is to select LTE/5G technology solutions across Core and RAN infrastructure and end devices. LTE EPC and RAN may be sufficient for basic connectivity applications, but 5G Standalone Core and RAN will be needed for low-latency and massive IoT applications. In choosing RAN and end devices, it is essential to consider that equipment supports specific spectrum bands for the private cellular network. If you want to provide service to employee devices (BYOD), you will also want to survey what bands they support.

3. Identify the right partners to design and implement the private cellular network

Depending on the scope and scale of a private cellular network, an enterprise can tap into a growing ecosystem of private cellular network partners, including network operators, system

integrators, integrated solution vendors, and managed service providers. They have the technical competency and industry know-how in vendor/solution selection, network design, implementation, and technical support. Choosing the right partner(s) with proven cellular technology experience will be critical to a successful private cellular network deployment. For example, for large-scale implementations covering large geographic areas, such as mining, utilities, or smart city applications requiring private and public network handoffs, a network operator may be an excellent partner to set up a local private network that seamlessly integrates with a public network. For private campus networks, a system integrator or an integrated Core and RAN solution vendor can help design (i.e., site survey, RF design, network planning, etc.) and implement (installation, integration, optimization, and provisioning) the private cellular network. 5G and efforts like RAN virtualization and Open RAN enable a great deal of flexibility in how elements of a private network can be deployed, allowing hosting elements of the network in-the-cloud, and via a variety of methods, including "network-as-a-service". For enterprises with limited in-house telco expertise, specialized managed service providers or hyperscale cloud providers offer private wireless service as an OPEX model.

4. Take into account the integration of the private cellular network to the rest of the enterprise LAN and possibly WAN to carrier networks and public and private clouds

The design of the private cellular network should take into account the IT situation and requirements. it is essential to integrate the private cellular network with the rest of the enterprise LAN to derive the full benefits of the network. An enterprise LAN integration facilitates seamless OT data flow to IT applications. Industry 4.0 applications require a tremendous amount of data processing in near real-time. This will require a continuum of edge computing and data processing in the central cloud. For these heavy computing applications found in many industries, a tight integration of private cellular networks to on-premises edge clouds will become necessary to handle a deluge of OT dataflows from industrial end devices such as autonomous robots, video cameras, etc., and user devices such as AR goggles and tablets.

5. Maintain and support the private cellular network for the duration of the project

Once the private cellular network is operational, it requires ongoing maintenance and support. If there is a problem, someone needs to diagnose and fix the problem so that the critical business applications running on the network are not negatively impacted. Some large enterprises may want to manage private network operations for data sovereignty. Other enterprises may opt to offload the management of the private cellular network to a trusted managed service provider who can provide network operations center support at a certain service level assurance.

Helpful MFA Resources

Tools:

- Available Spectrum Map - https://www.mfa-tech.org/
- Uni5G™ Technology Blueprints - https://www.mfa-tech.org/uni5g-technology-blueprints-download/

- MFA-defined MulteFire Specifications - https://www.mfa-tech.org/technology/specifications/
- Network Identifier Program (PLMN-ID) - https://www.mfa-tech.org/network-identifier-program/
- MFA Certification Program - https://www.mfa-tech.org/certification-program/

Education/Research:
- State of Private Networks - https://www.mfa-tech.org/state-of-private-networks/
- White Papers - https://www.mfa-tech.org/white-papers/
- Videos - https://www.mfa-tech.org/videos/

Social Media:
- Twitter - @MFA_Technology
- LinkedIn - https://www.linkedin.com/company/mfatech/

Frequently Asked Questions

Private wireless is a new technology for many businesses. Hence, concerns and misconceptions exist about what it is and how it can benefit. Below highlight some frequently asked questions from enterprises exploring private cellular networking:

1. Does a private cellular network replace Wi-Fi?

No, a private cellular network complements the Wi-Fi network by enabling additional enterprise applications which have been impossible or cost-prohibitive in the past. In general, private LTE and 5G technology are ideal for industrial applications that require wide area coverage, mobility, robust security, and deterministic throughput capacity. While Wi-Fi continues to provide improved performance, such as throughput speeds, it is generally unstable for business-critical OT applications, especially those that require high mobility. Wi-Fi will continue to play a vital role in enterprise campus networking. For advanced OT applications that require reliable low-latency connections with determinism, private 5G networks will become necessary. Wi-Fi and private cellular networks will co-exist to support myriad IT and OT applications. Deploying a private cellular network can improve the performance of the Wi-Fi network as well; by allocating devices and traffic to the network that can support them most efficiently, the performance of both networks can be improved, even when they are operating in the same spectrum.

2. What spectrum can I use for a private cellular network? Isn't private wireless only possible with licensed spectrum?

Private LTE and 5G technology are often associated with licensed spectrum use. And this has been one of the main barriers to deploying private cellular networks. However, the situation is changing. Regulators are opening shared spectrum dedicated for enterprise use for private 5G network deployments. For example, CBRS shared spectrum in the U.S. has allowed various enterprises to deploy private cellular networks. The 3.7-3.8 GHz is set aside in Germany for dedicated industrial use. Dedicated shared spectrum in mid-band (2-5 GHz) and millimeter wave bands (24-37 GHz) can be found in many other countries. For countries without

dedicated shared spectrum, MulteFire, based on 3GPP standards for the use of LTE and 5G in the unlicensed 5 GHz and 6 GHz bands. With the increasing availability of dedicated shared spectrum and MulteFire in the unlicensed bands, spectrum is no longer a high barrier to private wireless adoption.

3. Are there enough 5G devices available for me to invest in a private 5G network?

While it is true that enterprises can find more Wi-Fi devices ranging from Wi-Fi connected thermostats to video monitors, the global 5G network expansion is naturally driving device makers to introduce more 5G devices. According to GSA, the number of commercially available 5G devices will reach 1,350 by the end of 2022, almost doubling over the past year.[3] Moreover, almost 50% of the announced 5G devices were non-phone types, including FWA CPEs, industrial routers, modems, in-vehicle routers, laptops, tablets, etc. In addition to an increasing number of 5G non-phone devices, there are over 10,000 LTE non-phone devices in the market.[4] With the growing LTE and 5G device ecosystem, there is no need to delay private cellular network investments. What is important to realize, though, is that some of the key features that would match the requirements for industrial use cases are still to be implemented due to the fact that priorities of 5G features are influenced by the consumer 5G market in a major way. MFA has created the Uni5G blueprints in order to facilitate the healthy growth of the industrial 5G ecosystem and provide guidance on which features should be prioritized. The Uni5G blueprints can be used as a tool in the discussion with the system/equipment providers.

4. What is the business case for private wireless? Is it too expensive?

A higher cost of private wireless, relative to Wi-Fi, is often a barrier for businesses adopting private cellular networks. In challenging radio environments, a private cellular network using LTE or 5G can provide superior coverage with significantly fewer base stations/access points than Wi-Fi, reducing the overall system cost. In addition, private wireless can yield a return on investment (ROI) in many instances in less than a year. The quick ROI directly results from eliminating unplanned downtimes in business-critical operations by leveraging reliable private cellular networking. Moreover, with integrated solution providers and managed service providers offering OPEX models to lower the high CAPEX barrier, many businesses can use private wireless networking in critical business operations without heavy upfront CAPEX investments.

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[1] Based on bandwidth capacity and coverage per wireless access point or base station.

[2] Mobile Experts' 2022 *Enterprise Private Cellular* and *Industrial Private Cellular* market reports

[3] GSA, 5G Device Ecosystem, November 2022

[4] GSA, LTE Device Ecosystem, November 2022