Brave New World: Leveraging the Private Networking Opportunity

In today's connected economy, private wireless networks are increasingly playing a critical role in organizations' mission and business-critical communications. As private wireless networks become more important, many organizations have begun using cellular technologies, like LTE and 5G, rather than other networking technologies, like Wi-Fi, for these networks.

For example, in a recent report, Deloitte observed that it expected more than "100 companies worldwide will have begun testing private 5G deployments by the end of 2020, collectively investing a few hundred million dollars in labor and equipment."

These and other optimistic predictions regarding the growth of private LTE and 5G networks raise many questions for professionals responsible for managing their organizations' wireless networks and the IoT and other applications that depend on these networks.

In this white paper, we will examine why private LTE and 5G networks have emerged as an option for many organizations, the basics of how they work, the differences between them, Wi-Fi networks, and public LTE and 5G networks, and some of the use cases they are well suited for – helping these professionals determine if a private LTE or 5G network might help their organization create more value for their customers, employees and other stakeholders

How the Private Networking Landscape is Changing

Since the first cellular network was launched by Nippon Telegraph and Telephone (NTT) in 1979, cellular network technologies have been primarily used for public wireless networks, not private ones.

The owners of these public cellular networks, Mobile Network Operators (MNOs), had exclusive rights to the wireless spectrum used to transmit data for the network. However, they offered any individual and organization that wanted to use these networks the opportunity to do so – for a price.

With a few exceptions, this state of affairs persisted even as cellular network technologies evolved, first with the introduction of 2G, then later with 3G, 4G, and 4G LTE. While you could pay MNOs to use their cellular networks to make calls (at first) or transmit data (later), you couldn't build and manage your own cellular network to support communications for your factory, office building, transit hub, campus, or utility service territory.

If you wanted to build, operate, and control your own private wireless network, you had to use other open standard network technologies, like Wi-Fi, or proprietary network technologies, like LoRa or Sigfox. Today, private networks built using these technologies connect billions of laptops, smart speakers, cameras, TVs, sensors, industrial equipment, automobiles, and other assets to the internet.

However, many organizations have found these technologies frustrating to use for Industrial IoT (IIoT) and similar applications. Some of these difficulties stem from the fact that these technologies do not provide the same broad coverage, fast upstream data transmission speeds, high device capacity, low latency, or strong security as cellular technologies like LTE or 5G. Other difficulties arise from these networks' incompatibility with public cellular networks, and the high ongoing costs associated with managing these networks.

In recent years, government initiatives and new technologies have made it much easier for organizations to deploy their own private LTE or 5G networks, allowing them to address the limitations of other private networking technologies.

First, governments have started to make wireless spectrum available to organizations for private LTE or 5G networks. In the United States, the FCC has made a 150 MHz wide band of 3.5 GHz wireless spectrum, called the Citizens Broadband Radio Service (CBRS), available for private LTE and 5G networks. Organizations can use this spectrum by buying a Priority Access License (PAL) to it at a government auction, or by paying to use someone else's PAL. If they do not want to obtain a license, they can still use CBRS spectrum because the FCC offers General Authorized Access (GAA) to this spectrum – though PAL owners have priority access to it.

In May 2020, the FCC also approved rules that will allow 900 MHz spectrum previously used for Land Mobile Radio (LMR) networks to be used for private LTE networks. The organization that owns this 900 MHz spectrum, Anterix, is currently working with electric utilities, like Ameren and Xcel Energy, to help them build out private LTE networks for their service areas.

In addition to new spectrum coming available for private networks, cellular technology advancements have made it easier for organizations to deploy private LTE and 5G networks. For example, with 5G, MNOs can carve out spectrum on their existing network infrastructure for organizations that want a private 5G network, but do not want to purchase spectrum or deploy infrastructure for the network themselves.

What Do Organizations Need In Order to Deploy a LTE or 5G Network

The general architecture of a private network is similar to that of a public network. At a high level, it can be broken down into the following:

- **Wireless spectrum,** either owned by the organization deploying the private network, leased from an MNO or someone else, or shared with others.

- **Edge devices,** the "things" at the edge of the network that extract, collect, or otherwise send and receive data from the cloud or private data centers using the internet. These edge devices can be practically anything that has integrated in it or is connected to an LTE or 5G embedded module, router, or gateway. This includes not just laptops and smartphones, but also industrial equipment, Automated Mobile Robots (AMRs), tools, and even shoes, hats and other wearables.
- **Radio Access Network (RAN) infrastructure,** including large cellular base stations and small wireless access points, that transmit data back and forth from edge devices to the cloud or private data centers.
- **A core network** that manages the RAN infrastructure and connects the private network to the internet or private data centers. These core networks consist of hardware and software, which organizations can either install and manage themselves on-premises, or outsource to cloud and managed service providers. One of the advantages of 5G is that the 5G Core Network (5GCN) architecture improves network performance and makes it easier to deploy and manage the core network in the cloud, compared to LTE's core network architecture, Evolved Packet Core (EPC).

  The difference between public and private LTE and 5G networks lies not in the technology used for the network, but who has a license or priority access to the wireless spectrum, and who owns and operates the network's base stations and other infrastructure.

MNOs own and operate the spectrum and the network infrastructure used for public wireless networks. These networks are public in the sense that all of the MNO's customers (outside of police departments, fire departments, and other public safety agencies) have the same level of access rights to the network.

What makes a private LTE and 5G network different from a public LTE or 5G network is that a private organization owns, operates, or at least has some level of priority access to the network's infrastructure or spectrum.

The Different Types of Private Networks

However, the amount of spectrum and network infrastructure owned and operated by a private organization can vary.

Some organizations choose to own the wireless spectrum they use for their network, as well as the cellular base stations and other network infrastructure. These Full Private LTE and 5G networks provide organizations with complete control over the network and allow them to fully isolate it from public networks.

Not all organizations need or want such full control over their private network. These organizations can deploy Private Shared or Hybrid Private LTE and 5G networks, in which the wireless spectrum, network infrastructure or both are either owned, shared, or operated by an MNO or another organization.

For example, an organization might purchase wireless spectrum, but then have an MNO set up and manage the network infrastructure for their private LTE or 5G network. Or the organization could outsource the spectrum ownership and network infrastructure to the MNO – with the MNO slicing off part of its spectrum for the exclusive, private use of the organization.

Benefits of Private LTE and 5G Networks

Today most organizations have deployed Wi-Fi or other private networks at their facilities. These networks allow them to connect their employees' laptops and smartphones, as well as other assets to the cloud and private data centers via the internet.

However, private LTE and 5G networks offer these organizations several advantages over Wi-Fi, advantages that are often particularly valuable to organizations deploying IoT applications. These benefits include:

- **Better Coverage:** Wi-Fi networks are very restricted in the amount of power they can use to send signals, limiting the ability of these signals to travel long distances or through walls and other obstacles. Cellular base stations can use more power, allowing them to send stronger signals that travel further and can more easily penetrate obstacles. This results in better wireless coverage, making it easier for organizations to connect to devices in a large facility or even across a large geographic area (such as a utility's service territory). These stronger signals also help eliminate "dead zones" where edge devices can't connect to the network.
- **Stronger Security:** To connect to any LTE or 5G network, an edge device needs to have a Subscriber Identify Module (SIM) card that has been set up to connect to that network. SIM cards make it more difficult for someone to connect to a private LTE or 5G network, as they can't connect unless they have the right SIM for the network. In addition, unlike Wi-Fi networks, both LTE and 5G networks encrypt data by default.

- **More Device Capacity:** LTE and 5G network technologies were designed to connect to hundreds to thousands of devices. However, Wi-Fi routers using the latest Wi-Fi technology – Wi-Fi 6 – can only connect to a limited number of devices at a time. With a LTE or 5G network in place, an organization can allow hundreds of people to connect their smart phones or laptops to the network, while still deploying IoT applications that connect to thousands of assets in their facility.

- **Faster Upstream Data Speeds:** New Wi-Fi 6 networks can deliver downstream data speeds comparable to LTE and 5G networks that use sub-6 GHz spectrum. However, LTE and 5G technologies provide faster upload speeds than Wi-Fi. As more video and other broadband data is being transmitted from edge devices to the cloud, these faster upload speeds become more important. In addition, while still in the early stages of deployment, 5G networks that use mmWave spectrum can offer both upstream and downstream speeds that are much faster than anything that Wi-Fi 6 can provide.

- **Lower Latency:** Both LTE and 5G networks have lower latencies (the time it takes between when a device sends a signal and when it receives a response) than Wi-Fi networks. For many IIoT process control and Virtual Reality (VR), Augmented Reality (AR) and other Extended Reality (XR) applications, such low latency is required.

- **Easier Management:** Though Wi-Fi networks are easy to set-up, the need to deploy more access points on a Wi-Fi network than a LTE or 5G network, along with Wi-Fi networks' weaker coverage and lower capacity, make them harder and more costly to manage than LTE or 5G networks – especially when organizations want to connect hundreds or thousands of edge devices to the network.

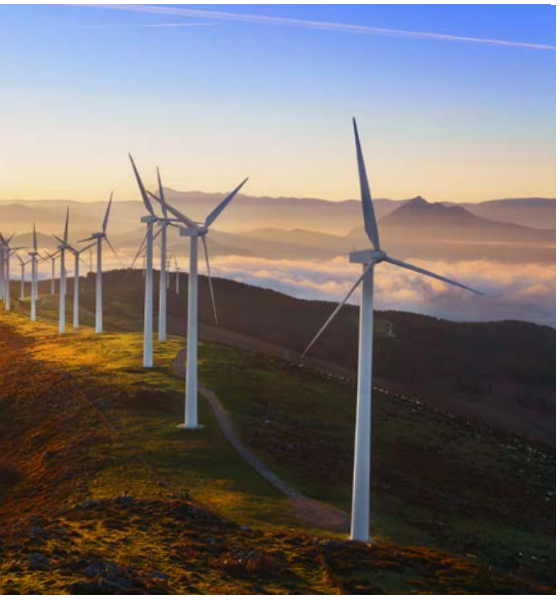
Private LTE and 5G networks derive additional benefits from the fact that they use the same technology as public LTE and 5G networks. This enables an organization's private network edge devices to be handed off to MNOs' public cellular networks if they leave their private network's coverage area, as long as they have the right SIM cards and agreements with MNOs in place.

For example, an automated forklift connected to a private 5G network can be handed off to an MNO's public 5G network, enabling the organization to continue to control the forklift even if it moves out of range of their private network. Compatibility with public LTE and 5G networks also allow organizations to use public networks as a "backup" for their own private network if it goes down.

There are also advantages to using a private LTE or 5G network rather than public LTE and 5G networks. Private networks can eliminate or reduce the payments an organization needs to make to MNOs for access to their public LTE or 5G networks, and help them better predict and control their networking costs. Private networks also enable companies to transform network operating expenses into capital expenses, which can yield financial benefits.

In addition, organizations can deploy private LTE and 5G networks that provide them with more capacity, better reliability and lower latency than public LTE and 5G networks. Moreover, with a private network organizations have complete control over the coverage of the network, allowing them to ensure all the locations in their facility or service area that need coverage have coverage. Finally, private networks free companies from having to depend on carriers for connectivity.

Private LTE and 5G Use Cases



Private LTE and 5G networks' strong performance capabilities, robust security, and low management costs make these networks well-suited for a wide range of use cases – particularly when these advantages are complemented by their compatibility with public LTE and 5G networks.

For example, private LTE and 5G networks meet the connectivity needs of organizations in the following sectors.

- **Manufacturing:** Private LTE and 5G networks enable manufactures to connect their Information Technology (IT) systems to many different types of manufacturing assets located throughout their factories. This allows them to deploy AGVs, remote machine, robotic control, manufacturing process monitoring, predictive maintenance, AR guided maintenance and other IIoT applications that require broad, reliable coverage, low latency, and the ability to connect to hundreds of devices. In a recent survey by Nokia and ABI Research, 90% of manufacturing decision makers are investigating the use of either 4G and/or 5G in their operations and 84% of these decision makers are considering a deployment of their own local private 4G/5G wireless network

- **Utilities:** Private LTE and 5G networks allow utilities to achieve secure, flexible, reliable connectivity across a wide geographic area. With this connectivity, they can more easily and affordably deploy IoT applications that connect to smart meters, transformers, battery-based energy storage systems, and other types of grid infrastructure. These networks also offer them the ability to gather video in real-time from security cameras monitoring expensive equipment, or from vehicles used by their mobile workforce.
- **Mining, Oil, and Gas:** Mining and energy extraction companies often need to connect their drilling machines, rugged handhelds, and other equipment to the cloud. Using private LTE and 5G networks, these companies can have the network coverage and reliability needed to make and maintain these connections, even in remote or underground areas.

- **Campuses:** Large numbers of people and IoT devices need connectivity at universities, hospitals, military bases, hotels, offices, apartment buildings, and other campuses, venues, and facilities. Private LTE and 5G networks offer the organizations managing these campuses the fast, reliable, and secure connectivity required to support thousands of edge devices.
- **Local Governments:** Broad, secure, reliable wireless connectivity is a prerequisite for any local government seeking to deploy IoT and other applications across a wide area. With private LTE and 5G networks, these local governments can control their street lighting, track ambulances, gather video from police in-car and body cameras, deliver remote learning to students, and support other applications that make their communities smarter.
    - For example, the City of Tucson has used COVID-19 stimulus funding to build out a private LTE network that uses CBRS spectrum to provide internet connectivity to around 1,000 kids in low-include households, making it easier for them to participate in remote learning programs. The city is also considering how it can use the private network for a variety of other services, including smart city IoT applications and a government-operated cell phone offering for residents.
- **Warehouses:** Online retailers and warehouse operators can use private LTE or 5G networks that support robotic product picking, product tracking, and other IIoT warehouse applications without having to deal with dead spots in their warehouse, or invest a lot in network management.
- **Airports, Train Stations, Ports, Stadiums, and other Large Public Facilities:** Large public facilities often need to not just address their own connectivity needs, but also those of hundreds to thousands of visitors. Private LTE and 5G networks offer these venues the strong coverage required to deliver this connectivity both inside their facilities and outdoors, along with the capacity needed to support thousands of different types of edge devices. For instance, by building their own private network instead of relying on public MNOs for connectivity, airport operators can overtime reduce their operating expenses while improving the passenger experience

Start with Sierra

As the world's leading provider of IoT solutions, Sierra Wireless can help organizations fully realize the benefits of private LTE and 5G networks thanks to its:

- **Deep IoT Expertise:** Sierra Wireless possesses more than two decades of experience in the IoT market, and actively participates in 3GPP meetings, making recommendations on LTE, 5G, and other wireless standards.
- **Broad Portfolio of IoT solutions:** Sierra Wireless also offers a range of robust, edge-to-cloud solutions, along with CBRS-certified routers and gateways for a range of use cases. For example, Sierra's AirLink® RV55 is a compact, rugged and low-power router that is CBRS-certified. In addition, Sierra Wireless' AirLink device management software provides organizations with a secure on-premises or cloud-based device management solution for over-the-air device registration, configuration and software updates.
- **Global Connectivity Services:** As a Mobile Virtual Network Operator (MVNO) offering customers LTE connectivity to customers around the world, Sierra Wireless can provide organizations with network connectivity in areas where it does not make sense to build out their private network. In addition, Sierra Wireless can serve as a backup network for customers as they build out or update their private network, or if their private network goes down.
- **Commitment to Quality and Security:** Sierra Wireless has implemented processes across its supply chain to ensure its solutions have advanced end-to-end security built-in, while also meeting the highest quality standards.

To learn more about how Sierra Wireless can help you use private LTE and 5G networks to create value in the connected economy, visit us at www.sierrawireless.com

About Sierra Wireless

Sierra Wireless is the leading IoT solutions provider that combines devices, network and software to unlock value in the connected economy. Companies globally are adopting IoT to improve operational efficiency, create better customer experiences, improve their business models and create new revenue streams. Whether it's a solution to help a business securely connect edge devices to the cloud, or a software/API solution to help manage processes associated with billions of connected assets, or a platform to extract real-time data to make the best business decisions, Sierra Wireless will work with you to create the right industry-specific solution for your next IoT endeavor. Sierra Wireless has more than 1,300 employees globally and operates R&D centers in North America, Europe and Asia.

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