



OnGo Private Cellular

CBRS for Private LTE and 5G



March 2024

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1 Executive Summary

Cellular mobile networks provide advanced wireless access capabilities that can solve many networking challenges existing today with alternative connectivity solutions. Until recently, cellular networks were only deployed on licensed spectrum, which is cost prohibitive to all but a few mobile network operator companies. The Citizens Broadband Radio Service (CBRS) band makes it possible to deploy private cellular networks without acquiring dedicated licensed spectrum. OnGo facilitates the use of the CBRS shared spectrum to allow enterprises to deploy their own LTE or 5G networks and take advantage of the capabilities of cellular networks when public cellular networks and Wi-Fi cannot meet the necessary access requirements. For many deployments, the already ubiquitous LTE cellular technology will be sufficient, but for some, the newer 5G New Radio (NR) technology may be a better option.

This whitepaper describes the benefits of private cellular networks from the perspective of enterprises and how enterprises can take advantage of them. We provide a brief overview of the benefits and capabilities of private cellular, briefly discuss how private cellular networks function, look at the performance of LTE and 5G NR networks, and examine some use cases across a range of industries and market segments.

OnGo Private Cellular gives access to the capabilities of LTE and 5G networks in a private deployment:

- Superior performance under load
- Large coverage areas (indoor and outdoor)
- Support for physically mobile devices
- Support for large numbers of devices
- Integrated, carrier-grade security
- Robust traffic monitoring and prioritization

We look at how these capabilities translate into real-world use cases showing how they can deploy new services, faster, at lower cost, and with an improved user experience, across a range of verticals:

- Commercial Real Estate
- Industrial and Warehouse
- Transportation
- Fixed Wireless Access
- Education
- Entertainment and Sports Venues
- Healthcare
- Retail

5G Market Survey Information

Technalysis Research recently performed an extensive survey of ~400 US organizations using and interested in private networks. The focus of the survey was in relation to private 5G networks. Some of the results are provided in this whitepaper. Summary results can be found at the following link: [https://www.technalysisresearch.com/downloads/TECHnalysis Research Private 5G Networks Study Highlights.pdf](https://www.technalysisresearch.com/downloads/TECHnalysis%20Research%20Private%205G%20Networks%20Study%20Highlights.pdf). The full report can be purchased from Technalysis.

2 Why Private Cellular?

A private cellular network is a network that provides coverage to a defined set of users in a specific area. Private cellular networks allow you to take advantage of the capabilities of public cellular networks, tailored to your specific needs. Cellular technologies provide several key advantages vs. other wireless technologies.

- Superior performance under load
- Support for large coverage areas
- Support for mobile devices
- Support for large numbers of devices
- Carrier-grade security
- Robust quality of service and quality of engagement systems and mechanisms

Below, we look at each of these in more detail.

2.1 Superior Performance Under Load

Cellular networks are designed to operate under load, sharing available resources efficiently across users of the network. Even when stressed with large numbers of connected devices and lots of network communications traffic, devices are able to connect to the network. The network is able to allocate network resources to each device, and ensure that they can maintain their connections.

2.2 Large Coverage Areas

The CBRS band (3.55 to 3.7 GHz) also has better propagation characteristics than the 5 and 6 GHz bands used by many Wi-Fi systems. The CBRS spectrum rules also allow for higher power levels when operating outdoors than unlicensed systems such as Wi-Fi. Combine that with the superior performance of LTE and 5G systems at the edge of their coverage areas, an OnGo private cellular access point will typically cover a larger area and connect over longer distances than other technologies.

2.3 Support for Mobile Devices

Support for mobile devices is built into cellular networks at a foundational level and is core to their operation. This allows LTE and 5G networks to provide reliable and seamless connectivity for devices as they move around the coverage area of the network, with reliable hand-offs between access points with no interruption of connectivity.

What's in a Word?

People don't always agree on terminology and definitions. Even a term as basic as "wireless" may be used differently by different people. Because this update focuses on the business impact of OnGo, we decided to simplify some technology descriptions.

3GPP: An international standards organization that develops globally used protocols for mobile telecommunications, notably the 4th generation LTE and 5th Generation 5G NR. OnGo technology is based on 3GPP standards.

Cellular Network: This term refers to networks designed to support mobile wireless devices over a large area. These networks are typically divided into multiple smaller cells, with base stations providing connectivity within that cell, and coordinating handoffs to other cells as devices move around the network.

CBRS: A dynamically licensed spectrum (band) that provides a combination (compared to other wireless technologies) of 1) affordability, 2) carrier-class performance, and 3) a foundation for innovative services.

Citizens Band Radio Service Device (CBSD): The fixed base station in a CBRS network, roughly equivalent to a Wi-Fi access point, or the eNodeB and gNodeB of LTE and 5G.

End User Device (EUD): The mobile device in a CBRS network, and is the equivalent of the User Equipment (UE) of an LTE and 5G.

OnGo network: An LTE or 5G network deployed in the CBRS band.

OnGo technology: This is a general term that describes any products or services offered by members of the OnGo Alliance based on innovations that are possible with the CBRS band.

Operators: We use "operators" as an umbrella term to encompass any organization that operates a wireless network, regardless of whether it is a public or private network and regardless of whether it provides wireless services for revenue or not. This includes such organizations as carriers, service providers, cable operators and could include others such as automotive manufacturing plants, seaports, real estate property owners, and so on.

2.4 Support for Large Numbers of Devices

Cellular networks also include support for a large number of devices, dynamically adjusting connection intervals and access so that all devices can connect when they need to, with minimal power consumption. Enterprises are deploying more and more devices, so being able to reliably provide services to lots of devices is only going to be more and more important. Additionally, because most LTE and 5G smartphones (including most leading manufacturers) support OnGo private cellular networks. Device makers are also adding additional features to support advanced 5G capabilities, all of which can be used in your OnGo private cellular network.

Apple Announces 5G SA Support in iOS 17

Apple recently announced that they will be adding support for 5G Standalone support in iOS 17, allowing their devices to be used in an OnGo 5G network taking advantage of the 5G NR's most advanced capabilities. Read more at the following link:

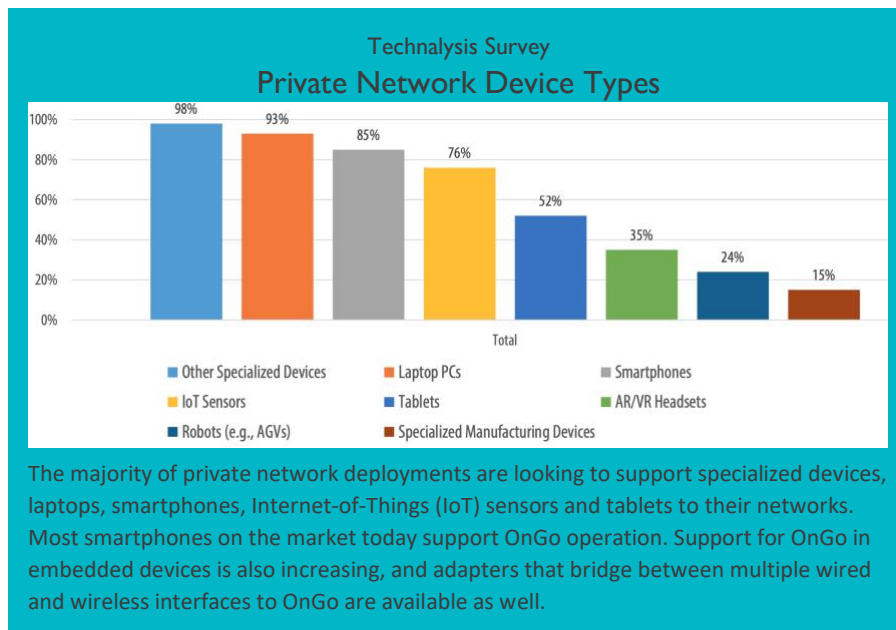
<https://support.apple.com/guide/deployment/support-for-private-5g-and-lte-networks-depac6747317/web>.

2.5 Integrated Carrier-Grade Security

Mobile carrier cellular networks have long been known for their extremely high levels of security for the information transmitted across their networks. Encryption is deployed throughout, and the use of hardware and software-based security mechanisms provide this carrier-grade security. This same carrier-grade security is a native part of private cellular networks as they use the same 3GPP, standards based, cellular technologies.

2.6 Robust Quality of Service and Quality of Engagement

Private cellular networks also incorporate advanced quality of service mechanisms, allowing the network to prioritize traffic for specific users, devices, and applications. This allows you to ensure that your mission critical systems have the coverage and bandwidth they need, even under heavy traffic loads.



3 How Does Cellular Work?

OnGo networks are cellular networks operating in the CBRS band, and cellular networks work a bit differently from other networks you may be familiar with, such as Wi-Fi. Just as Wi-Fi devices are connected wirelessly to Wi-Fi Access Points (WAPs / APs), mobile devices are connected to the base stations over an air interface. The base stations of a private cellular network are managed by a core network, which work together to provide services to the mobile devices. The core network routes data to the appropriate base station, handles authentication and encryption, and monitors devices as they move around the network. The mobile devices constantly monitor the signals they receive and report measurements back to the base stations and the core network. The network uses that information to tune itself to optimize performance and reduce interference. If a mobile device detects a better signal from another base station while physically moving around the network’s coverage area, it will be seamlessly handed off to the new base station.

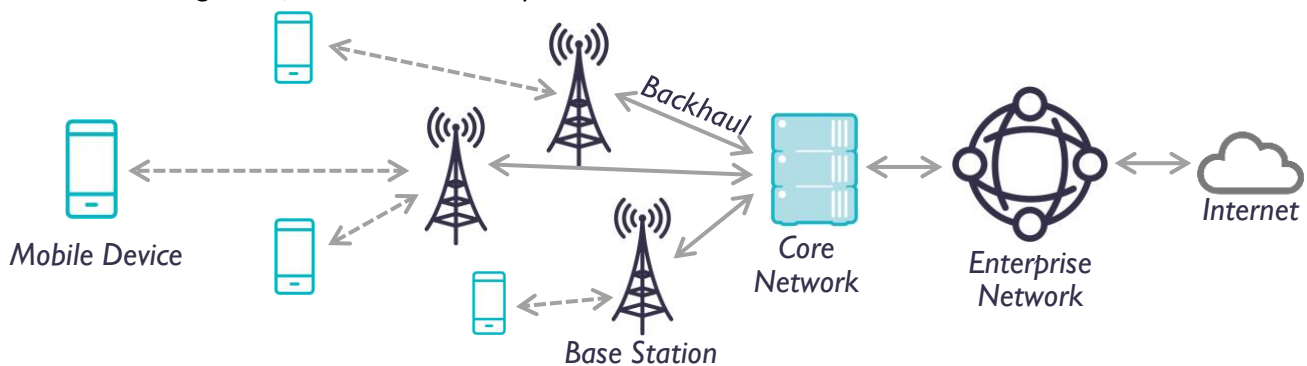


Figure 1: Basic cellular network architecture.

The technology of modern cellular networks is defined primarily by the 3GPP, an international industry standards organization. The 3GPP is constantly updating and revising the standards to add new capabilities and services, and to take advantage of the latest developments. The 3GPP defined the 4th generation Long Term Evolution (LTE) technology, which has been widely deployed around the world. The 3GPP’s successor to LTE is its 5th generation 5G NR, which is in the early stages of deployment. LTE isn’t going anywhere, with further deployments expected for a decade or longer.

While support for operating in unlicensed spectrum has been added in recent releases of the 3GPP specifications, LTE and 5G NR networks have typically operated in radio spectrum that is licensed by various national regulatory agencies. Auctions for these licenses typically run into the billions of dollars, which has meant that only the major network operators have been able to obtain them. The creation of the CBRS band makes it possible to deploy a private cellular network in licensed and coordinated radio spectrum at much lower cost.

5G, 5GS, and 5G NR

Technically, the formal name for the 3GPP’s 5th generation system is the 5G System (5GS), with New Radio (NR) just being the air interface, but as a practical matter, when people talk about the 5GS they often refer to it as 5G, NR, or 5G NR.

4 The CBRS Band and the OnGo Solution

CBRS reallocates spectrum for use by private cellular networks and pioneers a new method for managing access to wireless spectrum. Established by the Federal Communications Commission (FCC) in April of 2015, 150 MHz of spectrum from 3.55 to 3.7 GHz was allocated to the CBRS band for use by private organizations when not in active use by incumbent users. This spectrum had been previously reserved solely for military and other government-approved users. The FCC partitioned the band into 15 x 10 MHz channels, with channel allocation being dynamically controlled by dedicated spectrum-management services known as Spectrum Access Systems (SAS).

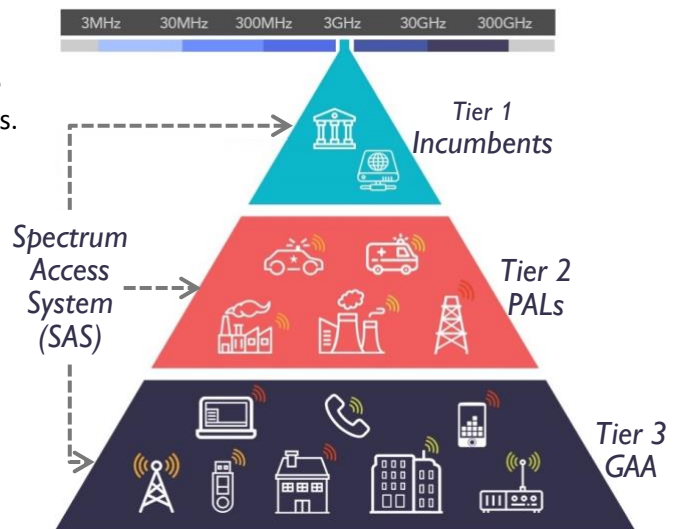
The OnGo Alliance created OnGo to promote the use of private cellular networks using LTE and 5G cellular technologies in the 3.5 GHz CBRS band, though other technologies can also make use of the band. This is a high-level summary of some of the basics of CBRS and OnGo. For more information, we have multiple guides and whitepaper that give additional information on our website: www.ongoalliance.org.

The upshot of CBRS is that it provides spectrum for use by private networks, without the huge licensing fees typically required. Instead, you just work with a SAS to gain access to the spectrum, either as a General Authorized Access (GAA) user, or by sublicensing a Priority Access License (PAL) from someone that has purchased priority access at auction.

4.1 Spectrum Access System (SAS)

At the heart of dynamic spectrum sharing is the SAS. The SAS manages access to the CBRS band on a dynamic basis. Users of the band request access from the SAS, which grants access to specific channels, based on their tier.

- Tier 1 – Incumbents. Top priority is given to defense radars and other grandfathered systems. When they need to use frequencies in the CBRS band, the SASs tell lower tier users to clear the channels in that area.
- Tier 2 – PALs. The FCC auctioned Priority Access Licenses (PALs) to commercial users on a per county basis. Less than half (70 MHz) of the CBRS band was auctioned this way, with any single PAL user able to purchase priority access for up to 40 MHz of the band in a given county. Work is in progress to allow PAL sublicensing.
- Tier 3 – GAA. General Authorized Access (GAA) users are granted unprotected access to any spectrum that isn't being used by higher-tier networks.



There are multiple SASs, each administered by private companies. They coordinate between each other when granting access to the band. Users that want to deploy a network in the CBRS band must contract with one of the SASs to be granted access.

4.2 OnGo Device Support

The good news with OnGo is that there are no changes needed on mobile devices to support OnGo. All they need to support is the CBRS band (band 48) – and most smartphones on the market today support band 48 and OnGo. Support for 5G NR is also available (band n48), both in non-standalone and stand-alone modes.

5 OnGo Private Cellular Value Proposition

Until now, there have been two primary wireless technology options available to enterprises for providing wireless coverage and capacity: Wi-Fi and public cellular networks.

- **Wi-Fi:** Most Wi-Fi technology struggles in large venues, high-density environments, or properties that present a lot of interference challenges. Channel conflicts and handoffs are frequent problems as well, especially for devices that are physically moving around the network's coverage area. And it's almost impossible to resolve the problem of channel conflicts when Wi-Fi signals from different networks penetrate walls and floors. Once deployed, Wi-Fi can also be difficult to manage and scale.
- **Public Cellular Networks:** The public cellular networks provide nationwide coverage, but aren't always available. Indoor coverage is a real challenge, and getting worse as energy-efficient glass attenuates cellular radio signals, leaving indoor areas with coverage gaps. Remote locations may not have any coverage at all. In locations with lots of devices and users in close proximity, there may just not be enough capacity. Operators can set up either small cells or Distributed Antenna Systems (DAS), but both options are usually cost-prohibitive for small and medium-sized venues.

The opening of the CBRS band makes it possible to deploy your own private cellular network, without having to pay for expensive licensed spectrum.

5.1 New Services Deployed Faster

An OnGo Private Cellular Network can be deployed in a fraction of the time of a DAS network because CBRS is not burdened by time-consuming spectrum access, approval, and certification. It requires minimal effort to expand/scale the network, such as integrating additional private networks, or even adding Neutral Host Network capabilities. This translates to faster-time-to-value (new services, revenue streams, etc.) for venue owners.

One big area of interest to enterprises is connecting an ever-increasing range of Internet-of-Things (IoT) devices: security cameras, connected smart door locks, motion sensors, access controls, energy management, building maintenance systems, and more. An OnGo private cellular network allows you to rapidly add support for these devices, in locations where Wi-Fi cannot reach, and where the cost of pulling cable is prohibitive.

5.2 Lower Costs

Dedicated OnGo networks cost less than DAS networks¹ and are competitive with other wireless network technologies. Examples of lower costs include:

- Deployment in a fraction of the time translates to lower deployment costs.
- Smaller footprint and energy costs reduce the total cost of ownership.

With fewer access points needed to provide the same area of coverage, OnGo private cellular deployments can be surprisingly competitive with Wi-Fi. Infrastructure such as cabling and backhaul can also be shared across Wi-Fi and OnGo networks. This reduces the cost of deploying an OnGo network, and increases the return on your existing data infrastructure investments.

5.3 Improve the User Experience

There are several reasons why OnGo private cellular networks enable a giant leap forward in meeting user expectations, even while demand keeps growing, including support for:

- High-bandwidth applications, including streaming video and virtual/augmented reality.

¹ Up to 68% less, per an analysis by Mobile Experts [<https://ongoalliance.org/wp-content/uploads/2018/04/Mobile-Experts-OnGo.pdf>]

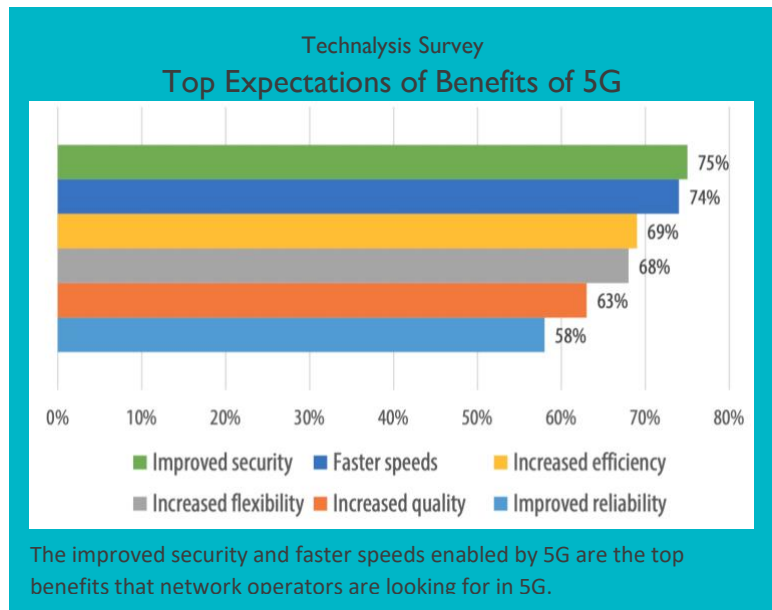
- High-density areas, so that users can connect and use applications in crowded and high-traffic environments.
- Low latency communications. Private cellular provides a consistent, controllable latency under load, reducing lag and jitter for gaming and conferencing.
- Providing a seamless experience, as mobile users can move throughout the coverage area without interrupting data flows.

New features are also being added to 5G and OnGo, which will further improve the user experience – geofencing support allows for faster connections, reduced power consumption, and reliable switching between private and public networks. And the coexistence management system will allow the SASs to coordinate adjacent networks to reduce interference.

5.4 Easier Network Management

OnGo private cellular simplifies management overhead for venue owners, including:

- Operators can support bring-your-own-device (BYOD) for subscribers without deploying special authentication systems (regardless of the operator)
- Information Technology (IT) friendly infrastructure options including cloud-based management, and network-as-a-service.



5.5 Carrier-Grade Security

An OnGo private cellular network uses the same hardware-based security (SIM cards) used by the carriers, which means an OnGo network has carrier-grade security at a minimum. Dual SIM devices can add support for your private network, while maintaining their existing service from their public network operator. Embedded SIMs or eSIMs allow for granting access to your private network using QR codes for easy, rapid, deployment.

5.6 Broad User Device Support

Because OnGo uses open standards and does not modify the interface between the end-user devices and the base stations, adding OnGo to end-user devices (handsets, smartphones, and other devices) is simply a matter of enabling the CBRS band. Most devices on the market today already support OnGo, and many older devices support it as well. Visit the OnGo Alliance’s webpage for a constantly updated list:

<https://ongoalliance.org/certification/fcc-authorized-end-user/>

5.7 Wi-Fi Network Coexistence

Another advantage of an OnGo private cellular network is that you can deploy it in parallel to and as an overlay of your existing Wi-Fi and Ethernet networks. The networks operate in separate frequency bands and do not interfere with each other. This doesn’t just increase your overall bandwidth from adding more available spectrum, it also allows you to optimize all your networks by allocating devices to the network that can best support them. As an example, a device that can barely connect to your Wi-Fi network because of low signal strength consumes an outsized proportion of your Wi-Fi network’s capacity. By moving that device to your

OnGo private cellular network, those resources become available to the devices that can use your Wi-Fi network more efficiently.

The 3GPP has baked-in coexistence and interoperability with Wi-Fi and other networks into their specifications, allowing individual devices to use whichever network is providing the best capability at the time. Network services provided over the cellular network can be passed over to the Wi-Fi network seamlessly, and vice-versa.

Just as with 5G, Wi-Fi is always adding additional capabilities and improving performance. Wi-Fi 6E is adding support for 6 GHz operation, increasing the bandwidth available for Wi-Fi. While improvements to latency and range are also being made in Wi-Fi 7, OnGo networks still have superior performance with those metrics.

OnGo Neutral Host Networks

An option when deploying an OnGo Network is to have it function as a Neutral Host Network (NHN). An NHN provides coverage to subscribers of the participating public networks, allowing the NHN to be seen as a seamless extension of those public networks. It's like roaming, but the subscribers don't even have to know that they aren't on their home network

Supporting NHN requires close coordination with the public networks to get them to participate. Fortunately, there are solutions providers that can help you deploy an NHN and take care of the interfacing with the public networks, including offering Neutral Host as-a-Service (NHaaS) models.

You can even deploy a hybrid private/neutral-host network, with your private network taking the place of one of the public networks.

6 Private Cellular Use Cases

Within the OnGo Alliance, we divide the enterprise market into eight verticals. Below, we discuss some of the key advantages and use cases for an OnGo private cellular network for enterprises in those verticals.

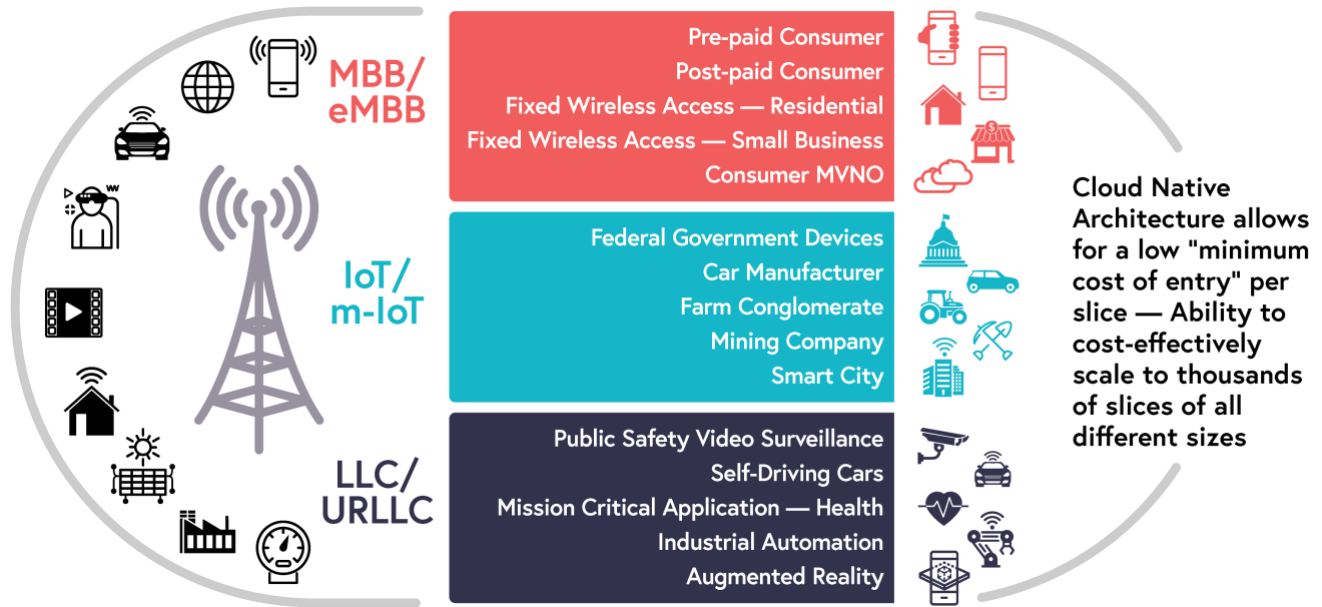


Figure 2: Private cellular applications across multiple verticals.

Verticals	Quick Description	Key Applications for Private Cellular
Entertainment and Sports Venues	Sports arenas, and concert halls, with large numbers of attendees.	<ul style="list-style-type: none"> • Mobile point of sale systems • Attendee services • Facility operations • Digital signage
Commercial Real Estate	Office buildings and multiple-dwelling units.	<ul style="list-style-type: none"> • Indoor mobile coverage • Building operations • Security
Industrial and Warehouse	Smart factories and warehouses.	<ul style="list-style-type: none"> • Reliable autonomous vehicle data links • Reliable wide-area coverage
Transportation	Planes, trains, and automobiles, and the hubs that they operate from.	<ul style="list-style-type: none"> • Hub operations • Passenger services • Sensors and tracking (IoT)
Fixed Wireless Access	Providing internet services to non-mobile devices.	<ul style="list-style-type: none"> • Reliable, last-mile connections
Education	Providing services to students, faculty, and on multiple campuses.	<ul style="list-style-type: none"> • Crossing the digital divide. • Security and access control • Faculty support
Retail	Supporting the shopper in stores ranging from big box to boutique.	<ul style="list-style-type: none"> • Mobile point of sale. • Employee communications and services • Customer services • Digital signage


6.1 Entertainment and Sports Venues

For entertainment and sports venues, wireless services are vital both to support operations, provide services to attendees, and deliver enhanced fan experiences. OnGo private cellular allows venues to deploy significant capacity without having to deal with the licensing and configuration headaches of DAS solutions. Some use cases include:

- **Mobile video streaming.** Multiple high-definition video feeds can be streamed over the network, using smartphone cameras or dedicated devices. Using OnGo private cellular ensures that the feeds won't be crowded out by other devices or network users,
- **Points of Sale and Smart Signs.** A private cellular network provides a reliable and secure connection for (PCI-DSS compliant) mobile point-of-sale systems. Digital signage can be programmed and controlled over the cellular network, allowing for signs to display rich media content and to be deployed in more areas, without having to worry about connectivity.
- **Attendee services.** By providing a reliable cellular connection, attendees can use their smart phones to access services, purchase concessions, and get additional digital perks. Access can be granted via QR code, and use of quality-of-service prioritization allows you to make sure that all attendees get the needed level of service.

**OnGo Sports Venue Deployment
Wells Fargo Center**

The Wells Fargo Center in Philadelphia has deployed an OnGo network to support operations at the indoor arena. In addition to supporting digital signage and real-time parking information, the OnGo network allows for streaming four simultaneous HD video feeds from mobile smartphones to the jumbotron.



More information about the deployment can be found here: <https://tiaonline.org/a-private-wireless-network-solution-for-wells-fargo-center/>.

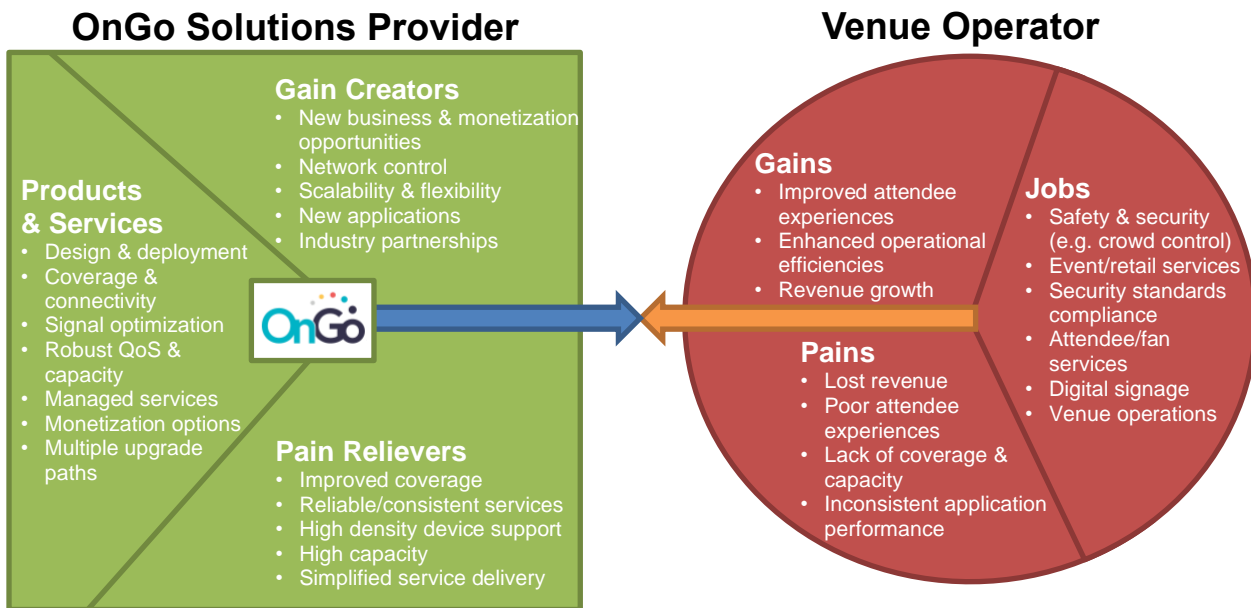


Figure 3: Private cellular provider value proposition to the Entertainment and Sports venues vertical.²

² Value Proposition Canvas framework developed by Alexander Osterwalder.

6.2 Commercial Real Estate (CRE)

CRE includes commercial properties of various sizes, with the property leased or rented to tenants of various types – typically offices or corporate tenants. OnGo allows deployment of private cellular networks for use by the owners of the property, and by their tenants. Modern construction techniques and use of high-efficiency glass can block the signals of the public mobile networks, limiting coverage and performance within the property. Wi-Fi networks provide a fallback and offload capability, but often does not provide sufficient performance. This lack of coverage prevents rolling out new services tenants, hinders tenant activities, and impairs property operation.

Some use cases where private cellular provides key capabilities include:

- **Mobile phone coverage.** A private cellular network provides indoor coverage to tenants and building staff, using their existing devices. A Neutral Host Network allows for seamless coverage for subscribers to the major networks. Dual-SIM devices (most now on the market) can use the second SIM to access a private OnGo network.
- **Physical security and access control.** Security and access control systems can be deployed reliably over a private cellular network, allowing for rapid deployment without having to pull data cables. This includes security cameras, which can stream data over the private cellular network.
- **Digital signage.** With private cellular connectivity, digital and smart signs can be deployed in more locations at lower cost, with fiber-like speeds, and with carrier-grade security.

6.3 Industrial and Warehouse

The industrial and warehouse vertical covers a wide range of deployments: manufacturing; extraction of natural resources such as agriculture and mining; processing facilities such as refineries, chemical and food processing plants; and assembly and distribution facilities. These deployments typically have complex RF environments, require large coverage areas, and can have many connected devices.

Some of the key use cases where private cellular provide key advantages include:

- **Extended Reality – Augmented and mixed reality systems** require consistent latency with low jitter and high bandwidths.
- **Automated Guided Vehicles (AGV) – Coordination and monitoring of AGVs** requires a network that can reliably support mobile devices, something private cellular excels at.

OnGo CRE Deployment Cabana Happy Valley Multi-Dwelling Unit Property

With new real estate construction popping up across the United States, it is often difficult to get new fiber or dedicated circuits directly connected to each apartment (or re-wire the apartments). To fill these new apartments, property owners must portray their property as the most compelling offering in the market. To do so, many property owners have created smart apartments. Without direct connectivity to each apartment, real estate property owners have turned to private LTE to create the smart apartment giving each tenant the ability to control the property's gate control, video chat and intercom, thermostats, energy management, etc. The private LTE network gives real estate owners the ability to deploy fast and reliable wireless solutions for developers and tenants without having to wait for fixed fiber/broadband facilities. The wireless model offers a faster and more cost-effective approach, with the opportunity to layer on new uses in the future, i.e., public Wi-Fi in common areas. With the performance private LTE offers, combined with the service coverage reach needed across MDU communities, the speed and cost to deploy private LTE vs. fixed facilities has made it a very compelling approach. And with costs at less than 75% of using fixed facilities vs. the time/budget required to deploy fiber, the costs could easily be covered via the tenants' monthly rents.

For more information on this deployment, go: <https://newswire.telecomramblings.com/2023/05/baicells-partner-group-delivers-award-winning-private-lte-solution-to-residential-multiple-dwelling-unit-type-properties/>.

- **Reliable, Wide-Area Coverage** – Private cellular networks operating in the mid-band (like OnGo) can provide significant improvement over other wireless networks, requiring fewer access points (base stations) to provide superior coverage.

Industrial and warehouse facilities often have multiple networks that they have already deployed to support their operation – Wi-Fi, Bluetooth, LoRa, Zigbee, and others. As noted above, OnGo private cellular plays well with these other networks, and can be deployed in parallel to them. With the ability to transmit over longer ranges (other than LoRa), private cellular can be deployed as a backhaul network, providing connectivity to locations where running data cables may not be practical or cost-effective.

6.4 Transportation

This vertical covers major transportation and logistics network hubs – seaports, bus stations, airports, railyards, etc. It also includes mobile systems on vehicles within that network such as buses, trains, aircraft and more. The primary challenge facing these systems is providing reliable connectivity over large areas with lots of devices and users.

- **Hub operations.** Transport hubs such as airports need ever-increasing amounts of data connectivity. Private cellular networks provide reliable connectivity to support multiple types of operations – from voice communications, asset tracking, and monitoring systems.
- **Passenger services.** Passengers passing through a transportation hub like a bus station or airport terminal put significant strain on wireless networks. Existing solutions, such as airport WiFi and the public networks, are often unable to provide wireless connectivity. Private cellular networks can provide additional capacity, and improve the overall passenger experience.
- **Internet of things.** Transportation hubs are at the leading edge of device density, and the number of devices that can take advantage of wireless connectivity is only increasing. 5G is designed to reliably support device densities on the order of a million per square kilometer, and the transportation vertical is one of the domains most likely to push up against that limit soon.

The transportation vertical is one of the cases where the OnGo band can be exploited to maximum benefit. Since these locations typically cover large areas, the spectrum does not have to be shared with other operators at that location. This means that the location can often use the full 150 MHz of the band and deploy higher-power base stations without as much risk of interfering with other CBRS band operators.

6.5 Fixed Wireless Access

Private cellular provides an ideal solution for Fixed Wireless Access systems and wireless internet service providers (WISPs) that use wireless to solve the “last mile” problem, as well as for “middle mile” backhaul links. OnGo private cellular allows for services to be deployed rapidly in response to changing needs,

**OnGo Logistics Deployment
OnGo for Wide Area Coverage**

The complex RF environment and large coverage areas can make providing wireless data coverage to support warehouse and logistics operations a major challenge with WiFi. RippleLink™ has demonstrated deployments that can cover 18 acres with just 3 OnGo outdoor access points. In indoor applications, they have been able to provide better performance with just 8 OnGo base stations compared to 30 Wi-Fi access points.

More information can be found on RippleLink’s website: <https://www.ripplelink.io/>.

**OnGo Transportation Deployment
OnGo for Airports**

Multiple airports have deployed CBRS networks at their locations to support gate and terminal operations, including Minneapolis-Saint Paul (MSP), O’Hare (ORD), Newark (EWR), and Dallas-Fort Worth (DFW). Deployments have shown that having OnGo at a gate providing consistent and low-latency connections for ground support staff and equipment can improve aircraft cycle times by several minutes.

bypassing the delay and complexity of traditional licensing. This allows for deployment in scenarios where wired connections are not practical, even on a temporary basis. While the total capacity is lower than wired broadband, private cellular can provide reliable connectivity in cases where wired solutions cannot be practically deployed.

6.6 Education

The education vertical, which includes both higher education institutions as well as primary and secondary education, faces a variety of challenges when it comes to data services. Private cellular can address several use cases:

- **Crossing the digital divide.** For students without broadband access, providing wireless internet services via private cellular networks provides a cost-effective solution when using Wi-Fi isn't practical. Access points can be setup and moved quickly as needed.
- **Security and access control.** Security cameras and access control systems can use a private cellular network in locations where running data cables is cost-prohibitive.
- **Instructor support.** For educators in the classroom or the lecture hall, being able to reliably access data services is becoming increasingly critical. Private cellular allows you to deploy dedicated services to instructors, supporting both in-person and remote learning.

OnGo Education Deployment
Utah Education and Telehealth Network

The UETN has deployed OnGo Private LTE networks in multiple locations across the state to address a variety of needs. Their primary objectives are to provide connectivity to students learning at home or on the go, collaborating over video, and accessing cloud-hosted educational tools. Using private LTE can help ensure equitable school network access for students. Using OnGo provided a cost-effective way to connect students, teachers, and administrators to each other and school technology resources. Private LTE extends access across a wide area without high data usage or infrastructure investment costs.

The UETN's CBRS (OnGo) project page can be found at the following link: <https://uetn.org/network/cbrs/>.

6.7 Healthcare

The healthcare vertical faces similar challenges to several other verticals: providing reliable and secure connectivity to an ever-increasing number of mobile devices in a challenging RF environment. The healthcare vertical also has regulatory and privacy considerations (HIPAA) that put additional constraints on how services can be deployed.

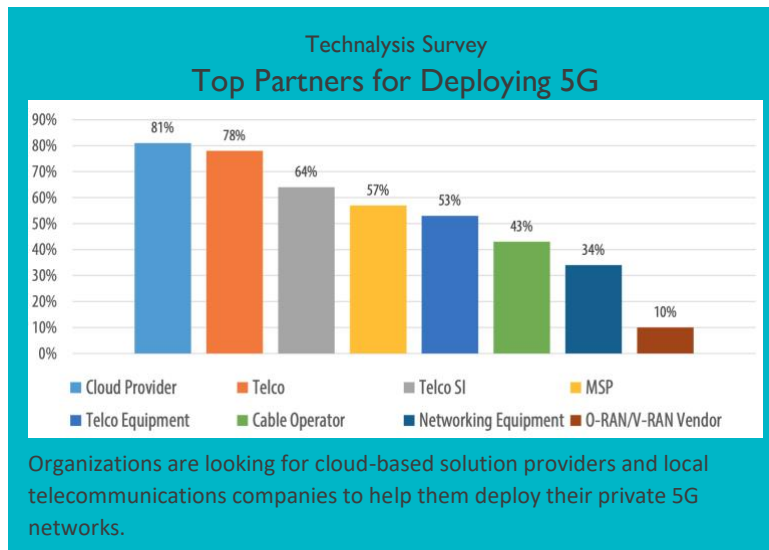
A private cellular network can augment existing networks in the healthcare environment, adding support for demanding use cases:

- **Mobility Support.** Private cellular networks support seamless connectivity to devices as they move around facilities. Location services provided over the private cellular network also allow devices to be quickly located, ensuring that expensive equipment can be tracked, and if it is available to be used.
- **High device density.** As devices proliferate, the ability to support high device densities ensures that the network is available to all devices and won't become unavailable because too many devices need it.
- **Consistent performance.** Network availability is also ensured under high traffic conditions. Specific traffic can be prioritized as well, ensuring that critical applications are granted the bandwidth they need.
- **MEC Support.** 5G adds robust support to deploying services at the edge of the network, ensuring that patient data stays under compliance control and on premises.

6.8 Retail

Retail locations also require reliable wireless data services. Large coverage areas and inconsistent connectivity can hobble mobile point-of-sale systems, resulting in lost sales. Having reliable wireless network supports several key activities:

- Point of sale. Mobile point-of-sale systems can be reliably deployed over a private cellular network. Fixed registers can take advantage of wireless connectivity as well, allowing for rapid reconfiguration.
- Employee communications and data services. Voice deployed over the private cellular network ensures your employees are always in communication, even in a BYOD environment. Efficiency is increased by ensuring their tools and applications have low-latency connectivity for faster scanning and inventory.
- Digital signage. With private cellular connectivity, digital and smart signs can be deployed in more locations at lower cost and with carrier-grade security and remote management.
- Customer services. Services provided by retailer-specific applications are often hobbled by poor connectivity in the store. A reliable connection, with the retailer-specific application’s data traffic having priority, ensures that the customer can take advantage of the application and increase the return on investment.



7 The OnGo Alliance Helps Enterprises Build a Trusted Partner Ecosystem

OnGo private cellular networks change the value proposition for enterprises that need wireless network coverage for locations and enterprises of all sizes. But there's yet another layer to this value proposition: the OnGo Alliance.

Our purpose: The OnGo Alliance, formerly the CBRS Alliance, created OnGo to commercialize the use of 3GPP technologies using the CBRS band. Alliance members are also developing specifications, devices, and services for deploying and supporting OnGo networks.

Today, the OnGo Alliance is an ecosystem of 140+ companies. It's a diverse group of experts that includes Managed Service Providers, Mobile Network Operators, product and services companies, and Systems Integrators. Here are some of the ways that the OnGo Alliance supports enterprises deploying and operating OnGo private cellular networks.

7.1 Choices in Products and Services

A large ecosystem of OnGo network providers means that enterprises have more choices in vendor selection. OnGo makes multi-operator and multi-vendor integration less complex, which translates to lower costs and fewer headaches for venue owners and their staff. Our members include integrated solutions providers and support service providers. Go to our member's page (<https://ongoalliance.org/members/>) and check out the Ecosystem Support Services and Service Providers categories.

7.2 Trusted Products and Services

The OnGo Alliance defines the technical requirements for deploying OnGo networks and certifies devices for compliance. We run a certification program for CBSDs (base stations), and monitor FCC authorizations to identify devices that support operation in the CBRS band.

- OnGo Certified CBSD Devices – <https://ongoalliance.org/certification/ongo-certified-devices/>
- FCC-Authorized End User Devices – <https://ongoalliance.org/certification/fcc-authorized-end-user/>

7.3 Guides and Whitepapers

We've put together several deployment guides that go into much greater detail on what is involved in deploying a network. Even if you are using a solutions provider, these are a great way to understand the kinds of questions that they are going to be asking you, and help you provide useful answers.

- Private LTE Deployment Guide: <https://ongoalliance.org/resource/ongo-private-lte-deployment-guide/>
- Neutral Host Deployment Guide: <https://ongoalliance.org/resource/ongo-nhn-deployment-guide/>
- Private 5G Deployment Guide: <https://ongoalliance.org/resource/private-5g-deployment-guide/>

We also have a range of resources addressing specific aspects of OnGo networks:

- OnGo Security Whitepaper: <https://ongoalliance.org/resource/ongo-security-whitepaper/>
- OnGo Managed Identifiers: <https://ongoalliance.org/resource/ongo-identifiers-flyer/>

We also have webinars, flyers, TCO calculators and other resources, and are adding new ones all the time. Check out our resources page to see the latest: <https://ongoalliance.org/resource/>

8 Private LTE or Private 5G?

There are two primary private cellular technologies available today, both based on 3GPP technology – 4G LTE and 5G. 4G LTE is a mature technology and well established in the marketplace. 5G (also called 5G NR, or just NR) is a newer technology and is being actively deployed now. 5G builds on 4G LTE, providing improved performance and capabilities, though at a price premium (for now). OnGo 4G LTE and OnGo 5G are 3GPP networks operating in the CBRS band, modified at the back end to comply with the FCC’s rules for the CBRS band – the mobile devices (UEs in 3GPP terms) do not require modification to work with OnGo – as long as they support band 48, they will work in an OnGo network.

8.1 5G Advantages Over LTE

The primary advantages of 5G over LTE are:

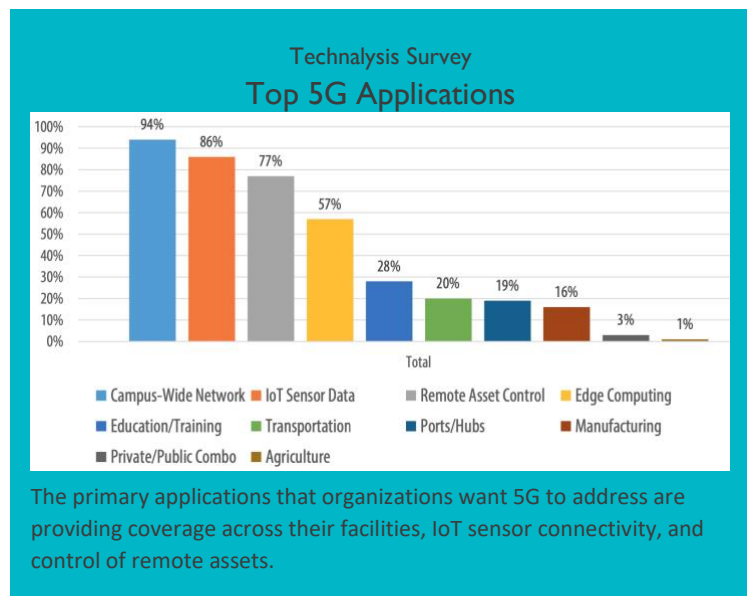
- Reduced latency. 5G has added support for latencies as low 1ms. When combined with MEC, this allows for high-performance applications that previously required physical cabling.
- Multi-Access Edge Computing (MEC). 5G adds increased support for deploying services at-the-edge, reducing latency, and allowing for data to be kept locally in your network.
- Advanced network virtualization and slicing. 5G adds increased capability to deploy multiple virtual networks over a shared physical network. This allows for deploying multiple private networks on the same hardware or even deploying private and public networks simultaneously.
- Improved spectral efficiency. 5G can push more data over the same amount of spectrum. Compared to 4G, the improvement is typically in the 10-15% range.
- Increased device density. A 5G network can support many more devices per square kilometer than a 4G network, with support for one million devices per kilometer targeted.

5G can be deployed in one of two modes:

- Non-standalone (NSA) – In this mode (and the one first deployed by the public networks), 5G uses an existing LTE network for command and control, with the 5G network providing additional high-performance channel for devices that support it. In NSA mode, you don’t get all the advantages of 5G, like MEC or reduced latency, but it can be deployed in parallel to an existing network and has more widespread device support.
- Standalone (SA) – This mode can operate completely independently of a 4G LTE network and uses a dedicated 5G core network. SA networks can take full advantage of the capabilities of 5G’s network services and don’t need an anchoring LTE network, but device support is currently limited.

8.2 When to Use 5G?

Since there is a price premium generally associated with 5G, the natural question to ask is when should I pay for 5G versus using 4G LTE? The short answer is: if you need a capability that 5G offers that 4G LTE doesn’t. This is typically the case when one of the following is true:



- You have an application where low latency is critical. This can be things like autonomous vehicles, telepresence, or similar applications.
- For security or regulatory reasons, you need to deploy MEC services, with local control and processing of data.
- You have lots of devices. If you have device densities over 2,000 per square kilometer, or will soon, 5G SA is for you.
- You have long deployment timelines. If you are planning for your network to be active 20 years or more, going with the 5G option can ensure device availability and support for several decades.

8.3 When to Use LTE?

With a mature device ecosystem, and lots of device availability – both mobile devices (UEs, or EUDs in CBRs terms), and access points (eNodeBs, or CBSDs in CBRs terms) – LTE is generally lower cost to deploy versus 5G. So LTE is generally the right choice when you don’t have a compelling reason to go with 5G. Migrating an LTE network to a 5G network as 5G becomes more prevalent is also an option.

8.4 Migrating from LTE to 5G

The 3GPP has designed into LTE and 5G the capability to migrate a deployment from LTE to 5G in stages, providing multiple upgrade paths. Most commonly, the 5G network is deployed in parallel to the LTE network, individual network components are migrated to 5G (sometimes by software update), and then the LTE components are shut down and removed when no longer needed. This allows you to deploy an LTE network today, migrate to 5G when you need to, and do it on your own terms. Even if you don’t see an immediate need for 5G, you should probably keep the option open to migrate to 5G at a future date.

If you think this is the path for you, make sure you:

- Select network devices that can be easily upgraded to 5G. Some base stations can be updated from LTE to 5G via a software update, while others may require components to be swapped.
- Make sure your network infrastructure supports the added capabilities and bandwidth requirements of 5G.
- Migrate user devices to 5G capable ones as they become available or when it comes time to refresh.

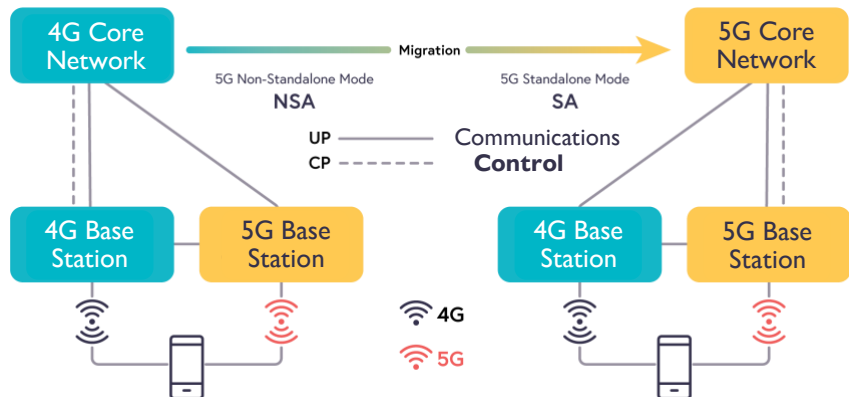


Figure 4: Migration Path from LTE to 5G.

9 Deploying an OnGo Network

It is entirely possible to deploy an OnGo Private Cellular Network entirely on your own. It's not a lot more complicated than deploying a Wi-Fi solution. There are four additional wrinkles, and the OnGo Alliance is here to help you navigate them:

- **The Core Network.** Cellular networks include a core network that routes data, controls access, and manages mobility functions. While they differ in the details, the EPC and 5GC of LTE and 5G, respectively, are pretty much the same thing – a bunch of software systems running on servers connected to your access points. You can deploy one yourself using open-source solutions, purchase commercial core networks, or even use a core-network-as-a-service cloud-based solutions.
- **Spectrum Access System (SAS) contract.** You must arrange with a SAS to be granted access and to coordinate your access to the CBRS band. The different SAS administrators have different commercial terms and support services. The list of SAS administrators can be found here: <https://cbrs.wirelessinnovation.org/sas-administrators>.
- **Certified Professional Installer (CPI) registration.** The FCC requires that information about the CBSDs (access points) be registered by CPIs. You can find a list of CPIs on our website (<https://ongoalliance.org/deploy-ongo/certified-professional-installers/>) or you can have someone in your organization become a CPI by taking training from one of the approved training program administrators (<https://cbrs.wirelessinnovation.org/cpi-program-administrator>).
- **Managed Identifiers.** For various technical reasons, you may need to obtain globally unique network identifiers that are used by the various components of the network to identify themselves and help ensure that your network works properly. Managed identifiers can be obtained from the OnGo Alliance on our website (<https://ongoalliance.org/ongo-identifiers/>).

The basic outline of the process for deploying an OnGo network is:



1. **Gather Requirements** – Figure out what you want the network to do and what the key use cases are.
2. **Survey and Planning** – Scope out the coverage area, look for where you can put access points, and determine what kinds of devices you will be connecting. A proof of concept may be called for at this stage to prove out the basic concept.
3. **Design** – Start selecting vendors, modeling, measuring signal propagation, and figuring out what is going to go where.
4. **Deploy** – Pull the cables, screw the bolts, configure everything, test coverage areas, and turn it on.
5. **Maintain** – Monitor the network to make sure everything is working, add capabilities as needed, and discover a dozen new applications you hadn't thought of initially.

Just because you can do it yourself doesn't mean that you should. There are lots of system integrators and integrated solutions providers that can take care of this for you, and many of them are members of the OnGo Alliance. Our Find an OnGo Vendor tool can help you find the right vendors and partners:

<https://ongoalliance.org/members/>.

10 Conclusion and Next Steps

If you think an OnGo network can help solve your wireless networking challenges, the OnGo Alliance is to help you deploy an OnGo private cellular network. The OnGo Alliance has multiple resources to help you decide if an OnGo Private Cellular Network is right for you and how to get started deploying an OnGo network.

For more information, [contact the OnGo Alliance](#), or visit <https://ongoalliance.org>.

Glossary

Term	Definition
5GC	5 th Generation Core; the core network component of the 5GS.
5GS	5 th Generation System, the formal name for the 3GPP's 5 th generation wireless cellular technology developed by the 3GPP
Air Interface	The system used to transmit wireless data between a base station and a mobile device; in LTE it is Evolved-UMTS Terrestrial Radio Access (E-UTRA), in 5G it is New Radio (NR)
Band 48/n48	The band ID assigned by the 3GPP for the CBRS band; LTE 48, 5GS n48
Base Station	The fixed radio element of a wireless cellular network; in LTE they are an eNodeB, in 5G they are a gNodeB.
BYOD	Bring Your Own Device
CBRS	Citizens Broadband Radio Service
CBSD	CBRS Device; generally equivalent to a base station (eNB or gNB).
Core Network	Back-end system of a wireless cellular network that coordinates and controls the base stations, routes traffic through the network, and provides network services; in LTE it is the EPC, in 5GS it is the 5GC
Coverage	The physical area over which wireless network provides connectivity
CRE	Commercial Real Estate
DAS	Distributed Antenna System
eNB	eNodeB; the base station in an LTE network
EPC	Evolved Packet Core provides network services to mobile devices in LTE
FCC	Federal Communications Commission
GAA	General Authorized Access; lowest access priority tier in the CBRS band
GHz	Gigahertz
gNB	gNodeB; the base station in an 5GS network
IT	Information Technology
IoT	Internet of Things
LTE	Long Term Evolution, the 4th generation wireless cellular technology developed by the 3GPP; used in OnGo
MEC	Multi-Access Edge Computing: deploying services close to the edge of the network for increased performance
MHz	Megahertz
NHN	A Neutral Host Network (NHN) is an LTE or 5GS network that provides coverage to multiple operators in a single network
NR	New Radio, the 3GPP's 5 th generation cellular technology, technically just the air interface, but commonly used for the entire 5GS
NSA	Non-Stand Alone; a 5G network that uses an LTE network for command and control
OnGo	3GPP technologies such as LTE and 5GS deployed in the CBRS band
Operator	An operator of a public wireless network; a Mobile Network Operator, Multiple System Operator, Mobile Virtual Network Operator, etc.
PAL	Priority Access License
PCI-DSS	Payment Card Industry Data Security Standard
SA	Stand Alone; a 5GS that does not need an LTE network to operate
SAS	Spectrum Access System, manages and assigns CBRS spectrum use on a dynamic basis, prioritizing incumbents and PAL holders
SIM	Subscriber Identifier Module
TCO	Total Cost of Ownership

About the OnGo Alliance

The OnGo Alliance believes that 3GPP-based solutions in the 3.5 GHz band, utilizing shared spectrum, can enable both in-building and outdoor coverage and capacity expansion at massive scale. In order to maximize the full potential of spectrum sharing, the OnGo Alliance enables a robust ecosystem through the management of the OnGo brand, and the OnGo Certification Program. For more information, please visit www.ongoalliance.org and learn more about the expanded business opportunities OnGo is enabling.