

Smart Technology Choices for Private Cellular Networks: Driven by Application Demands



Private Cellular Networks: Application Drives Technology Choices

Private cellular networks provide the foundational connectivity to enable business processes and productivity in factories, farms, warehouses, ports, and entertainment venues worldwide. Designed for business needs, private cellular is the only viable wireless solution to address the demands of delay-sensitive operations, to provide hardened data security and locally managed access, and to put performance and flexible control into the hands of the enterprise.

Private cellular is neither a replacement for, nor a competitor of, Wi-Fi. Private cellular networks are purpose-built to provide reliable, deterministic, and high-performance connectivity to digitalize enterprise operations. This technology has been deployed in Industry 4.0 and IoT operations globally, offering tremendous efficiencies and enabling connectivity that is not practical or achievable with Wi-Fi. At a high level, private cellular possesses similar radio characteristics to Wi-Fi technology. However, Wi-Fi operates in a frequency band that is easily disrupted by infrastructure—especially metal equipment and structures found in industrial settings—as well as radio interference from in-network access point (AP) signals and those from other networks and sources.

While private cellular is technically similar to the consumer-focused offerings from public carriers, it offers distinct cost, performance, and management advantages that better align with enterprise needs than public carrier services. For example, private cellular platforms such as GXC's ONYX offer users a range of technologies and features to cost-effectively deploy a network that addresses business demands while providing a path to additional services and capabilities through simple upgrade options.

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Key performance differences between GXC ONYX and Wi-Fi networks

	Wi-Fi	GXC
COVERAGE	3000-5000 sqft. per AP	16,000 sqft. per AP Indoor 500,000+ sqft. per AP Outdoor
ENVIRONMENT	Best suited for Indoor	Indoor + Outdoor
INTERFERENCE	Unlicensed / congested bands, only 3 non-overlapping channels available in 2.4GHz band	15 independent channel, managed network, cellular QoS
SECURITY	Vulnerable to intercept and impersonation attacks. Generally controlled by passwords	Employ carrier-grade, robust, protocols, end-to-end encryption. SIM-based authentication
LATENCY	Unpredictable latency	Consistent, lower latency
DEPLOYMENT	Designed for simpler radio environments, lower number of devices	Designed for complex environments, high (>200) number of devices supported per AP
HANDOVER	Best effort, proprietary solutions	Controlled handovers, decades of cellular development

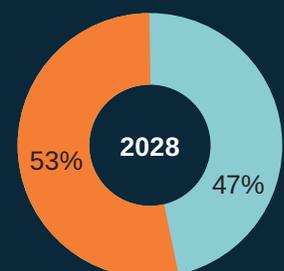
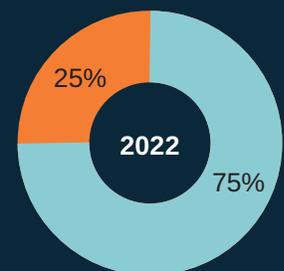
Private Cellular Technology Options

The two main operating system offerings of private cellular are 4G LTE or 5G. Both are highly reliable and secure.

Most current private cellular networks operate in the mid-band frequency range between 1 GHz and 6 GHz (commonly referred to as sub-6 GHz). Both 4G LTE and 5G services use the Citizen Band Radio Service (CBRS), Citizens Broadband Radio Service, Channel 48, Band 48/n48, 3.55GHz -> 3.70GHz. These frequency bands do not interfere with most public and private radio services. However, it is important to conform to transmission power regulations to avoid interference with nearby equipment and other wireless networks.

Choosing either 4G LTE or 5G private cellular is a business decision based on the required network bandwidth capacity and quantity of endpoint devices—including tablets, smartphones, handheld scanners and wands, edge servers, vehicles and robots, IoT sensors, and surveillance equipment and sensors. There are currently fewer 5G endpoint devices available in the marketplace, and unit prices are higher than those for 4G LTE devices.

Share of private networks by technology, 2022 and 2028



However, as reflected in the Dec. 2023 Analysys Mason report, [Private LTE/5G networks: worldwide trends and forecast](#), networks utilizing each option will reach parity by 2028, raising the likelihood that the 5G device costs will become more competitive before then. The differences between the two offerings are primarily in connection speed, latency, and operational channel bandwidth:

PRIVATE CELLULAR	4G LTE	5G
 Speed	Max 1Gbps	Max 10Gbps
 Latency	Ranges from 30-90ms	Under 10ms
 Channel Bandwidth	Up to 20MHz	Up to 100MHz

In addition to higher speeds and lower latency, 5G supports network slicing, a service which partitions available network capacity into discrete logical end-to-end network paths, each with unique parameters to support assigned applications. Network slices preserve quality of service (QoS) for priority functions such as delay-sensitive data or voice and/or emergency communications and alerts, regardless of the demands placed on the network by other applications such as email, video streaming, file transfers, OTA upgrades, or batch processes.

Multi-access Edge Computing (MEC) is also a new capability in 5G, which may offer greater efficiencies in private enterprise network applications. Through this feature, processing capacity can be placed closer to the enterprise network edge and near to data sources or controlled systems, thereby reducing network transmission loads, latency, and processing loads on core network servers. Moving processing to the network edge can deliver cost and performance efficiencies when there are processes and functions that do not rely on network-core services.

Choose the Right Fit

The decision to select and deploy 4G LTE or 5G in a private enterprise network should be made based on application demands, the availability and cost of endpoint devices, and future technology plans and requirements. In the case of Industry 4.0 applications, many sensors and control applications currently deployed do not place large bandwidth demands on the network. However, with the added speed and capacity of 5G, additional services, such as high-definition video streaming, low-latency remote control of vehicles and systems, and other advanced applications, become more practical across private 5G networks.

Other 5G advantages offered by the GXC ONYX platform include innovative methods to extend the reach of 5G private networks using a Fronthaul Multiplexer (FHM). This multiplexer replicates and aggregates two-way AP traffic, enabling aggregation at the edge server to create a single large cell. This reduces network infrastructure cost and complexity while enhancing AP scalability and optimizing throughput.



Shaping the Network

Private cellular APs have a broad scope of available transmission power options that enable precise management of network boundaries and coverage areas.

Through the use of directional antennas and power management, networks can be designed to cover difficult locations with strong, high-quality signals, regardless of topology. Spanning distances of up to two miles, private wireless networks can support numerous connected devices, with 4G LTE handling around 200 active connections per AP, and 5G supporting up to 10 times more connections per AP. The GXC ONYX platform further enhances the potential for coverage through its patented mesh technologies, including dynamic interference cancellation and micro-second scheduling of transmit and receive functions, which enhance network performance at the cell edge to extend coverage to areas with RF coverage gaps having minimal impact on the direct data handling capacity of the intervening upstream AP passing backhaul traffic to the network core.



Securing Networks and Facilities

Ensuring the security of data, intellectual property, and all digital network traffic is paramount for practically every application. Inherent cellular security and management functions help to reduce or eliminate common cyberattack vectors such as man-in-the-middle. In addition, unlike the open network architecture of IP-based Wi-Fi, if a device or endpoint are cloned or otherwise compromised to gain access to a network, the point-to-point network topology employed in private cellular will only allow the device to access the AP.

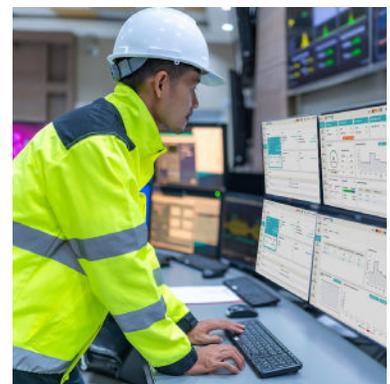
Perimeter security of facilities and sites can also be enhanced through private cellular. In many venues, campuses, ports, and large-footprint sites, monitoring of the perimeter for intrusions or security issues is usually performed with surveillance cameras and sensors which now offer high-resolution, high frame rates, and AI-driven facial and object recognition features. While most of these devices will work across a 4G LTE network, this is one use case in which the higher speed and lower latency of 5G will deliver more functionality.



Local Control, Data Security, and Performance Management

Within the private cellular infrastructure, different applications and traffic types can be prioritized to ensure that delay-sensitive or other important data streams are not disrupted by less critical or sensitive traffic across the network.

Through the GXC ONYX Portal's unified network view, administrators can efficiently manage and optimize network performance, set limits, groom traffic, control what data leaves the premises, and manage access and permissions through an intuitive GUI-based secure application. Control of data assets and storage within the enterprise can also offer substantial security advantages over some cloud-based data management platforms and processes.



GXC ONYX Delivers Flexibility Today and Tomorrow

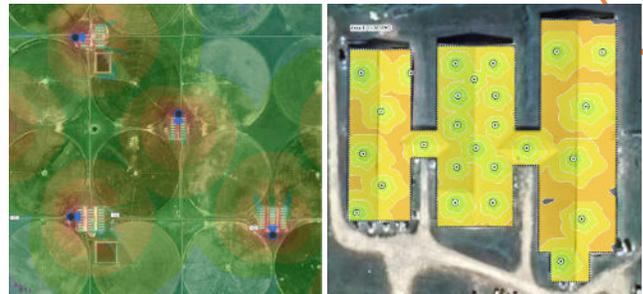
The GXC ONYX private cellular platform provides unmatched flexibility to support the networking needs of nearly any industrial IOT or Industry 4.0, indoor or outdoor deployment. The platform is compliant with 3GPP standards in offering an engineered in-situ migration process for simple upgrade of a 4G LTE network to 5G when business demands warrant



Application Use Cases

Livestock

Livestock are highly valued assets that are constantly monitored for health, feed consumption, and activity. For example, hog barns are often constructed with multiple rooms, each housing a small group of sows, an environment that challenges Wi-Fi transmission and limits data throughput—often requiring multiple Wi-Fi APs to cover the entire area. Private cellular APs can cover large areas and the radio signals more easily pass through walls. It is typical that GXC ONYX APs can reduce the number of APs required to cover the same space in ratios of up to 1 to 6 when compared to Wi-Fi. In addition, a private cellular AP installed inside a barn can often cover all rooms and allow personnel inside the barn seamless communication access.



^ Four GXC ONYX APs cover four barns. 26 Wi-Fi APs connected to the network via cabled ethernet cover one barn on the same animal production facility.

Manufacturing and Warehousing

Factory floors are typically not conducive to wireless signal propagation due to moving and stationary equipment, conveyors, and other metallic machinery and systems. In addition, many manufacturers require extensive indoor and outdoor storage facilities with equally challenging RF environments. GXC ONYX offers comprehensive coverage and extensibility through features such as Cellular Mesh to reduce or even eliminate cabling and deployment costs. 5G network slicing can also aid in managing bandwidth utilization to ensure time-sensitive traffic is always prioritized.



^ Four GXC ONYX APs provide coverage of extensive indoor and outdoor storage areas.

MANUFACTURING

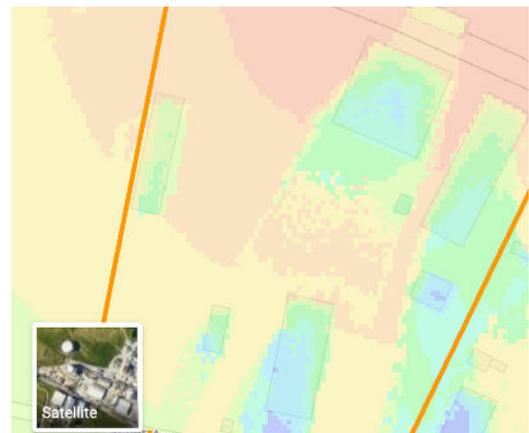
Businesses utilize private cellular connectivity to manage production, inventory placement, and tracking via private cellular scanners and tablets aboard forklifts. Providing continuous contact with the warehouse management system, the implementation offers significant advantages over the traditional practice of workers manually scanning locations and pallets, then driving back to upload data and process work orders.

Energy, Refineries, and Chemical Plants

Indoor and outdoor energy production, storage, and distribution facilities -such as refineries, chemical production plants, renewable energy production facilities, extraction wells, mines, and power distribution facilities –all require oversight. Challenges such as difficulty in adding network infrastructure through these facilities, complex wireless environments, limited public wireless coverage in the remote locations of many of these facilities, and the need for real-time monitoring, control, and maintenance, can be addressed through private cellular networks and GXC cellular mesh solutions. Deciding between 4G LTE or 5G service options is based on data volume, the importance of traffic segmentation through network slicing, or the density of sensor, control, or device endpoints.

CHEMICAL PRODUCTION PLANT

With large indoor and outdoor raw materials, mixing and storage tanks and systems, an industrial chemical manufacturing facility checks all the boxes for a difficult, yet critical, RF environment. Located away from population centers, these facilities often have limited access to public cellular, require constant monitoring of material properties such as temperature, pressure, and volume, and require real-time communications and alerting to ensure worker safety. These sites are impractical to cover with Wi-Fi technology, but are ideal candidates for private cellular networks. Consider that one 150,000 sq. ft. outdoor facility achieved complete and reliable private cellular coverage by deploying just two GXC ONYX APs.



^ Chemical production facility achieves complete private cellular coverage with two GXC ONYX APs.

Experience the Future of Connectivity With GXC

Contact us today to request a personalized demo or learn more about our solutions. Let's explore how our innovative technology can transform your business and drive your success. Don't miss out on the opportunity to elevate your operations—reach out to us now!

 www.gxc.io

 info@gxc.io

