COMMDEX

5G APPLICATIONS

Using Private 5G Networks for Enhanced Security and Efficiency

INTRODUCTION

Modern networks need to handle not only voice communications but also large and varied types of data, including still images, video, sensor data, maps, situational awareness data, and inventory information. Mission-critical information that flows from the field personnel to the command centers needs to preserve its integrity and accuracy so it can be turned into actionable information and returned to the field. In addition to transporting the raw data itself, the networks must redistribute the analysis of all this complex and multifaceted data from remote computing resources back to the field. However, the collective volume of data transmission is competing for limited network bandwidth on contested public cellular networks. As volume grows, factors such as latency become more important.

The deployment of 5G networks has emerged as a strategic imperative to enable faster and more reliable connectivity, reducing latency and improving response times. This can lead to increased operational efficiency, productivity gains, and improved overall organizational performance.

For mission-critical applications, customers have a choice between Private and Public 5G networks. Private 5G is a localized, private wireless network that offers the benefits of 5G technology but is dedicated to the users of a specific organization or entity. It differs from public 5G wireless networks, which are operated by telecom providers and serve a wide range of customers. Private 5G allows organizations to have exclusive control over their network, ensuring enhanced security, low latency, and customization to meet specific needs, such as in security, automation, or large-scale IoT applications. Public 5G networks, on the other hand, serve the general public and prioritize broader coverage and capacity.

WHY PRIVATE NETWORKS?

Private 5G networks offer unparalleled data speeds, ultra-low latency, and superior reliability compared to their predecessors. These attributes lay the foundation for seamless connectivity, supporting the Internet of Things (IoT) ecosystem and enabling real-time communication between devices. For mission-critical operations, where precision and responsiveness are critical, private 5G networks offer a transformative solution. The ability to connect and control a multitude of devices simultaneously with minimal delay opens avenues for process automation, remote monitoring, and predictive maintenance, all of which enhance operational efficiency and reduce costs.

From augmented reality (AR) and virtual reality (VR) experiences to autonomous vehicles and smart warehouses, private 5G networks can serve as the backbone for groundbreaking technologies that can redefine customer engagement and operational paradigms. Embracing an analytics-friendly, open structure, the private 5G paradigm unlocks the gateway to advanced AI and machine-learning techniques. These capabilities can optimize resource utilization, reduce manual labor, and minimize downtime, resulting in cost savings.

DEVICES IN THE ENTERPRISE

In a typical enterprise 5G use case, a diverse array of devices comes into play, each designed to fulfill specific tasks and have very specific network requirements. These devices can range from smartphones, tablets, and laptops used by employees for seamless connectivity to mission-critical machines and sensors that drive automation and data gathering. The traffic requirements need to be assessed from a bandwidth capacity, latency tolerance, mobility, and reliability perspective on a use case-by-use case basis. Each use case is highly tailored to the nature of the devices involved and their respective applications, so it is very important to understand the characteristics of the devices and translate them into network requirements for proper network planning and design.
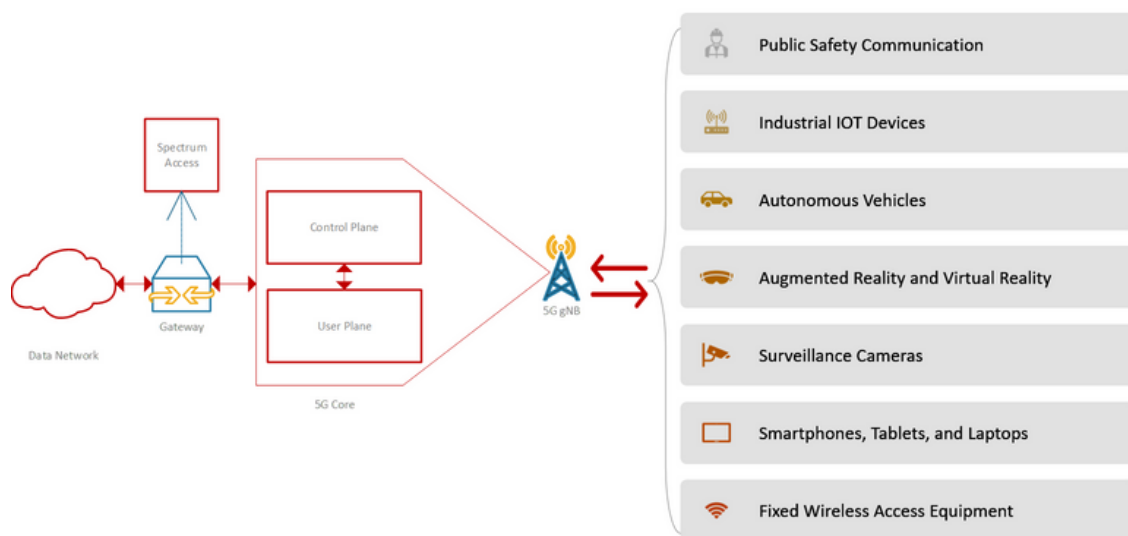

Figure 1 – Devices in the Enterprise

Public Safety Communication Devices

In public safety, 5G handsets play a key role in ensuring the effective operations of first responders and law enforcement agencies during emergencies and critical incidents. They require high-bandwidth capacity for voice and data communication, including video streaming. Low latency tolerance is essential to enable real-time decision-making, and the mobility requirement ensures seamless connectivity while on the move. Reliability is paramount, with redundancy and failover mechanisms ensuring that communication remains intact in the most challenging situations, such as natural disasters or public safety incidents. Body-worn cameras equipped with 5G connectivity allow law enforcement officers to record and transmit high-definition video and audio in real time.

These devices require both high bandwidth for video streaming and low latency to transmit critical footage instantaneously, ensuring transparency and accountability in public safety operations.

Industrial IoT Devices

In manufacturing and industrial settings, a multitude of IoT devices, such as sensors, actuators, and controllers, are employed. These devices typically generate a massive amount of data but do not necessarily require high bandwidth. However, they demand ultra-low latency for real-time monitoring and control, as well as high reliability to prevent downtime and ensure safety.

Augmented Reality (AR) and Virtual Reality (VR) Devices

In scenarios like remote training, maintenance, or even mission-critical scenarios, AR and VR devices may be used. They require substantial bandwidth to transmit high-quality video and 3D models, very low latency to provide an immersive experience without lag, and high reliability to prevent disruptions.

Surveillance Cameras

In security and surveillance applications, cameras transmit video feeds over 5G. These devices require moderate bandwidth, low latency to deliver real-time footage, and high reliability to ensure continuous monitoring.

Fixed Wireless Access Equipment

In rural or underserved areas, fixed wireless access equipment like home routers and CPEs (Customer Premises Equipment) are employed to deliver high-speed Internet. These devices need high bandwidth capacity to provide fast internet connections but no mobility requirements. Also, latency tolerance may be slightly more forgiving, depending on the application.

In general, the type of devices used in Enterprise 5G use cases varies widely, and their traffic requirements are intricately linked to their intended functions. While some demand high bandwidth for data-intensive tasks, others prioritize low latency and reliability for mission-critical operations, ultimately shaping the network design, QoS profile definitions, and deployment strategy of the private 5G network.

Autonomous Vehicles

In transportation and logistics, autonomous vehicles rely on 5G for communication with central systems and other vehicles. These applications demand extremely low latency to enable split-second decision-making and high reliability to ensure safe operations.

Smartphones, Tablets, and Laptops

These are common devices used by employees for tasks like remote work, video conferencing, and accessing cloud-based applications. They require moderate bandwidth capacity for data transfer, lower latency for real-time interactions, and reliable connections to ensure smooth communication.

PRIVATE VS. PUBLIC CELLULAR
5G NETWORKS

In a world where choices abound, organizations find themselves at a crossroads; collaborate with wireless operators, a route many tread for its own merits, or chart an independent course with a Private Network to experience unprecedented connectivity, innovation, and growth. The decision between private and public 5G networks has become a pivotal choice for organizations seeking to optimize their digital strategies. Each path holds distinct advantages and considerations, from tailored control and security to broader coverage and cost-effectiveness.

Why should organizations take the leap into private networks? The reasons are compelling. Traditional private networks are not new, yet the availability of the CBRS spectrum brings a fresh dawn. The 150 megahertz of CBRS shared spectrum can be used to address the ever-growing demand for bandwidth. Moreover, by interconnecting the private 5G networks to the public 5G networks, users of the private network can maintain a connection as they move away from the private network. By sharing the same network equipment, devices, and technology as public 5G networks, these networks present a golden opportunity for organizations to experience blazing-fast speeds, true mobility, robust security, and unparalleled quality of service – all delivered by a private network built on 5G technology. This isn't just incremental progress; it's game-changing potential. Here are some reasons why you might prefer a private 5G network:

This table highlights key characteristics between each technologies. As we can see, 5G offers higher peak data rates, lower latency, greater user density and bandwidth with enhanced security features described in 3GPP. It also performs better for mobile users and is the only technology that supports network slicing.

	5G	4G/LTE	WiFi6
Peak Data Rate	20 GBPS	10 GBPS	10 GBPS
Latency	1 millisecond	10 milliseconds	20 milliseconds
User Density	10^6 km^2	10^4 km^2	10^2 km^2
Bandwidth	10 - 400 MHz	10 - 80 MHz	20 - 160 MHz
Security	SIM/eSIM	SIM	WPA3
Mobility	Highest	High	Low
Network Slicing	Yes	No	No

Figure 2: Benefits of 5G over Wifi and previous cellular generations

1 Enhanced Control and Security: With a private 5G network, you have full control over the infrastructure, configuration, and security measures. This level of control allows you to tailor the network to your specific needs, implement stringent security protocols, and ensure that sensitive data and operations within your factory or warehouse are well-protected.

3 Dedicated Resources: With a private 5G network, you have dedicated resources that are not shared with other organizations or users. This ensures that your network performance remains stable and predictable, particularly in high-demand situations or environments with a dense device population. It also eliminates potential congestion issues that might occur in a public 5G network.

2 **Customization and Optimization:** A private 5G network enables you to customize and optimize the network architecture, coverage, and quality of service to suit the unique requirements of your facility. You can prioritize critical applications, allocate network resources efficiently, and fine-tune performance parameters to ensure reliable and consistent connectivity for your specific use cases.

4 **Mission-Critical Applications:** If your facility relies on mission-critical applications, processes, or systems that require ultra-reliable and low-latency connectivity, a private 5G network can provide the necessary performance guarantees. Private networks can be designed and optimized to meet strict service level agreements (SLAs) for latency, availability, and reliability, ensuring uninterrupted operations.

5 **Data Privacy and Compliance:** Depending on the nature of your business and industry, you might have strict data privacy and compliance requirements. By deploying a private 5G network, you have more control over data governance, ensuring compliance with relevant regulations and maintaining the privacy and integrity of sensitive data.

7 **Industrial IoT Integration:** Private 5G networks are well-suited for integrating industrial Internet of Things (IoT) devices and applications within your factory or warehouse. The dedicated and reliable connectivity provided by a private 5G network supports the seamless integration and communication of IoT devices, enabling real-time monitoring, control, and optimization of industrial processes.

8 **Seamless Mobility:** Private 5G users can experience Seamless mobility both intra-network and inter-network (if the network connects to a public 5G network). With dual SIM, dual standby, and eSIM, one cellular device can support both a private 5G network and a public 5G network. The private cellular network can, if necessary, be a neutral host, meaning that, like a neutral-host DAS, it can support multiple operators and still maintain the privacy and security of the various carriers/enterprises connected to the network.

9 **Industrial IoT Integration:** Private 5G networks are well-suited for integrating industrial Internet of Things (IoT) devices and applications within your factory or warehouse. The dedicated and reliable connectivity provided by a private 5G network supports the seamless integration and communication of IoT devices, enabling real-time monitoring, control, and optimization of industrial processes.

Deploying a private 5G network requires upfront investment and expertise in network infrastructure management. Public 5G networks, on the other hand, can offer convenience and broader coverage, especially if your facility is located in an area well-served by public 5G infrastructure. Ultimately, the decision between private and public 5G networks is based on specific organizational requirements, priorities, and available resources. Conducting a thorough assessment of your needs and consulting with network professionals can help determine the most suitable options.

CONTROL AND CUSTOMIZATION
WITH A PRIVATE 5G NETWORK

A private 5G network offers a high level of control and customization, allowing organizations to align the network with their specific requirements and objectives. Here are some aspects of control and customization that can be achieved with a private 5G network:

1

Network Architecture: With a private 5G network, you have the flexibility to design and implement a network architecture that suits your organizational needs. You can determine the coverage area, network topology, and infrastructure deployment based on your specific requirements.

3

Edge Computing: Private 5G networks enable the deployment of edge computing resources closer to the network edge, reducing latency and improving real-time processing capabilities. This allows you to run latency-sensitive applications and process data locally, aligning with organizational objectives that require fast decision-making and near-instantaneous responses.

2

Quality of Service (QoS): Private 5G networks enable you to prioritize network resources and allocate bandwidth, ensuring consistent and reliable connectivity for critical applications and services. You can define different service level agreements (SLAs) based on the application requirements, ensuring consistent and reliable performance for mission-critical processes. This improved QoS can lead to enhanced customer experiences, reduced service disruptions, and increased customer satisfaction.

4

Customized Applications and Services: Private 5G networks empower organizations to develop and deploy custom applications and services tailored to their specific needs. You can leverage the network's capabilities to support emerging technologies like IoT, augmented reality (AR), virtual reality (VR), and machine learning (ML) for innovative solutions that align with your business objectives.

5

Network Management and Monitoring: With a private 5G network, you have full control over network management and monitoring. You can implement advanced network management tools and analytics to monitor network performance, identify potential issues, and optimize network resources. This aligns with business objectives by ensuring network efficiency, proactive maintenance, and improved operational productivity.

By having control and customization over your private 5G network, you can align it precisely with your business objectives. Whether it's improving operational efficiency, enhancing security, enabling innovative applications, or meeting specific industry requirements, a private 5G network provides the flexibility and customization necessary to achieve your business goals.

SECURITY AND DATA PRIVACY

Privacy and security concerns have become paramount in today's digital age. Private 5G networks provide an inherent advantage by allowing organizations to retain complete control over their network infrastructure and data. This level of control ensures that sensitive information remains within the confines of the organization, mitigating the risks associated with data breaches and cyberattacks. For organizations dealing with proprietary information or compliance, the deployment of private 5G networks becomes not only a strategic choice but a necessity. You can implement robust security measures, such as end-to-end encryption, access control, and authentication mechanisms, to safeguard your network and data. This level of control helps align with business objectives by ensuring data privacy, compliance with industry regulations, and protection against potential cyber threats.

Here are some key aspects of security and data privacy with a private 5G network and their alignment with compliance requirements:

Enhanced Security Measures:

Encryption: Private 5G networks support end-to-end encryption, ensuring that data transmitted over the network remains secure and protected from unauthorized access.

Access Control: You can implement strict access control mechanisms, including user authentication and authorization, to ensure that only authorized devices and users can connect to the network.

Network Segmentation: Private 5G networks allow for network segmentation, enabling you to isolate critical assets, applications, and data from potential threats.

Security Monitoring: Private 5G networks facilitate advanced security monitoring capabilities, allowing for real-time threat detection, intrusion prevention, and incident response.

Data Privacy and Compliance:

Data Localization: Private 5G networks enable data to be processed and stored locally, within the boundaries of your organization's infrastructure, ensuring compliance with data sovereignty requirements in certain jurisdictions.

Compliance Frameworks: Private 5G networks can align with various compliance frameworks and regulations, such as GDPR (General Data Protection Regulation), HIPAA (Health Insurance Portability and Accountability Act), and industry-specific standards. You can enforce data protection practices, consent management, and privacy controls.

Control Over Data Processing: With a private 5G network, you have greater control over how data is collected, processed, and shared. This allows you to establish data governance policies that align with your compliance requirements.

Regulatory Compliance:

Spectrum Regulations: Private 5G networks need to comply with local spectrum regulations and licensing requirements to ensure legal and authorized usage of radio frequencies.

Industry-Specific Regulations: Depending on the industry you operate in, specific regulations may apply (e.g., healthcare, finance). Private 5G networks can be designed and operated to meet the unique compliance requirements of these industries.

By leveraging the security features of a private 5G network and implementing the necessary controls and measures, you can align your network infrastructure with compliance requirements and enhance the security and privacy of your data.
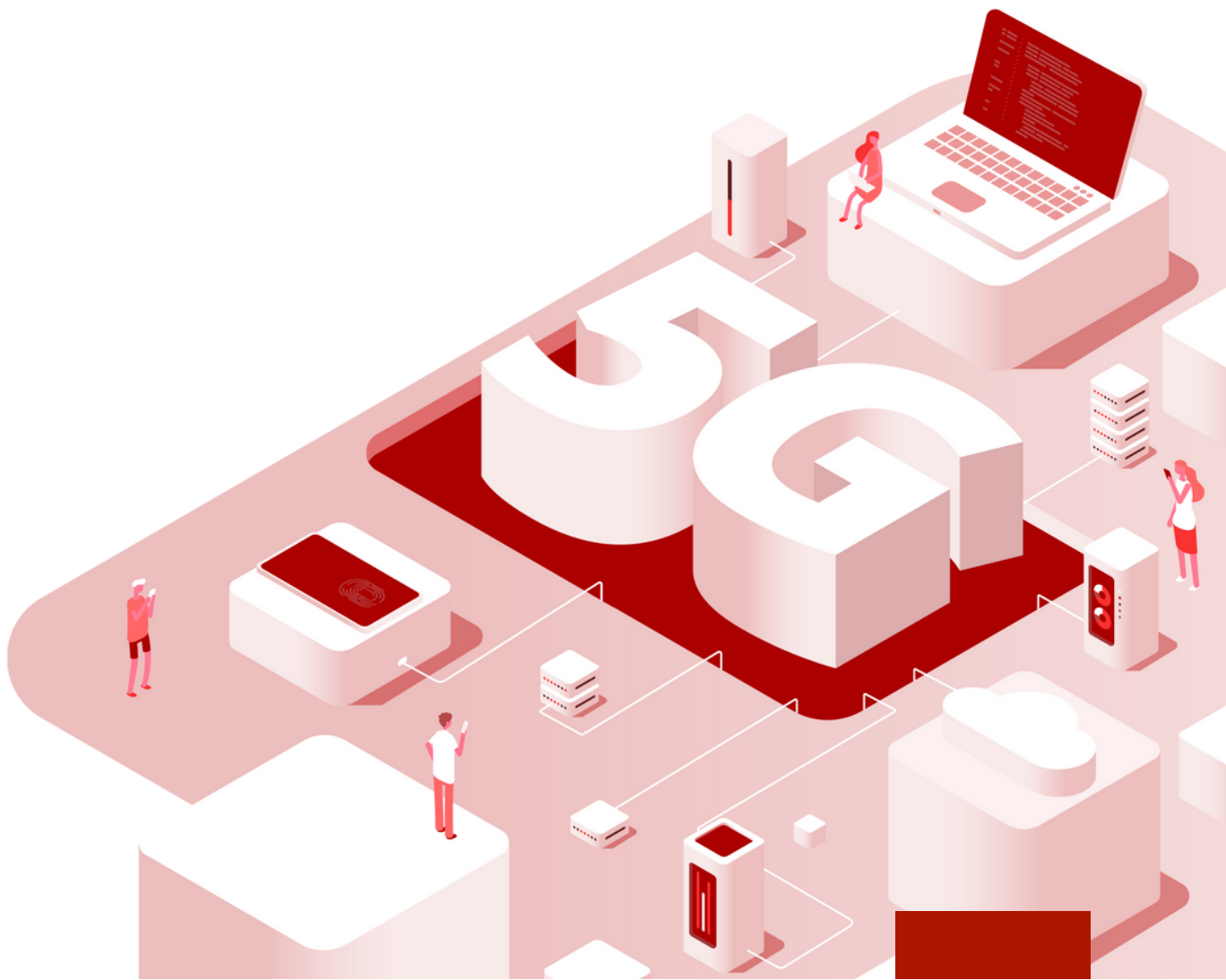
ENABLING INNOVATIVE USE CASES

A private 5G network can provide various benefits and address specific organizational requirements across different industries. Private 5G networks provide a foundation for implementing emerging technologies such as IoT, augmented reality (AR), and machine learning (ML). These technologies can enable new business models, revenue streams, and differentiated services, leading to potential growth opportunities and competitive advantages. Here are some specific business requirements and use cases that can benefit from a private 5G network:

Manufacturing and Industrial Automation:

- Low-latency and high-reliability connectivity for industrial automation and control systems.

- 5G-connected robots can be used to automate tasks, and 5G-enabled sensors can be used to collect data on the production process.

- Real-time monitoring and control of robotics and machinery.

- Efficient asset tracking and inventory management using IoT devices.

- Enhanced worker safety through wearable devices and real-time location tracking.

Logistics and Warehousing:

- Seamless and efficient inventory management with real-time tracking and tracing using IoT devices.

- Improved supply chain visibility and optimization. 5G-connected vehicles can be used to track shipments in real-time, and 5G-enabled robots can be used to automate warehouse operations.

- Autonomous guided vehicles (AGVs) for material handling and transportation within warehouses.

- Enhanced security and surveillance systems with high-definition video monitoring.

Healthcare:

- Remote patient monitoring and telemedicine applications. 5G-connected devices can be used to monitor patients remotely, and 5G-enabled robots can be used to perform surgery.

- High-resolution medical imaging and diagnostics transmitted in real-time.

- Reliable connectivity for Internet of Medical Things (IoMT) devices.

- Precision medicine and personalized patient care through real-time data analysis.

Smart Cities:

- Connected infrastructure for efficient traffic management and control.

- Smart lighting and energy management systems.

- Environmental monitoring and pollution control.

- Public safety and video surveillance for crime prevention.

Retail:

- Improved customer experience through personalized and location-based services.

- 5G-connected beacons can be used to provide personalized recommendations to customers, and 5G-enabled drones can be used to deliver products to customers in the store.

- Efficient inventory management using IoT sensors and RFID technology.

- Augmented reality (AR) and virtual reality (VR) applications for virtual shopping experiences.

- Enhanced security and surveillance systems to prevent theft and ensure safety.

Energy and Utilities:

- Remote monitoring and control of power grids, pipelines, and utility infrastructure. 5G-connected sensors can be used to monitor the performance of power lines, and 5G-enabled drones can be used to inspect solar panels.

- Smart metering and consumption monitoring for efficient energy management.

- Predictive maintenance of critical equipment and assets.

- Real-time monitoring of renewable energy generation and distribution.

Transportation and Fleet Management:

- Connected vehicle technology for real-time traffic updates, route optimization, and predictive maintenance.

- Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication for increased road safety.

- Fleet management and logistics optimization.

- Enhanced passenger experiences through in-vehicle connectivity and entertainment.

Government and Public Safety:

- Private 5G networks facilitate real-time video streaming and advanced analytics for enhanced situational awareness. Agencies can deploy high-resolution surveillance cameras and AI-driven analytics to detect anomalies and potential threats.

- Leveraging the Internet of Things (IoT), private 5G networks enable connected devices such as sensors, drones, and wearable devices. These devices can monitor environmental conditions, gather data, and provide critical insights for more effective incident management and resource allocation.

- Private 5G networks facilitate remote operations in disaster-stricken areas or remote locations. Public Safety teams can deploy autonomous robots, drones, and remotely operated vehicles to gather information, assess risks, and perform search and rescue operations.

CONCLUSION

Private 5G networks have emerged as a transformative force for enhanced operational efficiency, where seamless and low-latency connectivity propels faster decision-making and streamlined processes while ensuring reliable operations and seamless customer experiences. Moreover, it allows for cost optimization by allowing organizations to embrace automation, predictive maintenance, and efficient resource allocation, leading to substantial savings.

Beyond these advantages, Private 5G applications lay the groundwork for organizational Innovation, on which emerging technologies like IoT, AR, and AI can be layered. Lastly, Private 5G networks provide heightened data protection and the ability to retain control over the network infrastructure. As organizations embrace the power of private 5G, they unlock a new era of productivity, agility, and connectivity, positioning themselves at the forefront of technological advancement.

Nonetheless, the choice of architecture depends on the organization's specific organizational requirements, priorities, and available resources. The process of making such crucial decisions necessitates a thorough assessment of individual needs, goals, and operational landscape. Seeking guidance from seasoned Systems Integrators becomes paramount in this journey, as their insights and expertise can illuminate the most suitable options for the organization's unique circumstances. As organizations tread the path to embracing Private 5G applications, they are effectively propelling themselves into a future where connectivity isn't merely a utilitarian tool but a strategic asset that fuels enhanced productivity, greater security, and overall success in an ever-evolving digital landscape.

ABOUT COMMDEX

For over 20 years, Commdex has been providing a broad, rich portfolio of proven network solutions to Government and Enterprise customers for the deployment of telecom networks, facilities, and supporting systems. Commdex specializes in designing and implementing missioncritical voice and data networks over 5G, microwave, land mobile radio, DAS, SATCOM, and other technologies. Its solutions, services, and methodologies have been tested and proven in hundreds of customer environments nationwide. With its ability to design 5G Solutions coverage and our experience in regional and statewide systems, Commdex has not only the technical expertise to build the systems but also the management expertise to aid in the integration and operation.

Based on its years of experience in implementing large, complex systems, Commdex has perfected an integrated approach that maximizes the capability of any solution that a customer may require while minimizing the associated risks, schedule, and cost. This iComm360o approach ensures that the project is delivered with proven expertise through the capability of a proven integrator that understands the entire life cycle of Communications projects. This experience gives it the ability to confidently and quickly implement the 5G network. For more information, visit Commdex at http://www.commdex.com.