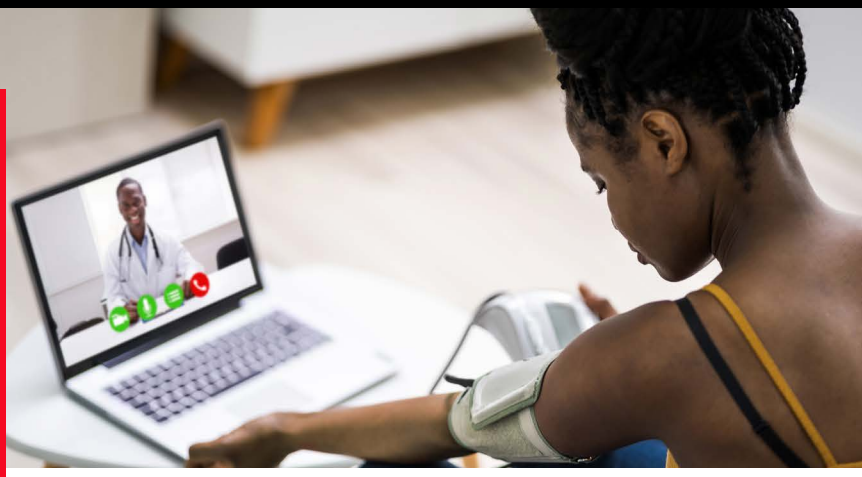
Private Wireless Networks for health care



Executive summary

With health care systems positioning themselves to offer digital first primary care by 2027[1], a reliable and robust mobile communications infrastructure is vital. A private wireless network in health care refers to a dedicated cellular network operated by a hospital or health care facility, providing high-speed, reliable connectivity for medical devices, staff communication and patient data transmission, all while offering more direct control over security when compared to public networks.

This document explores the benefits, use case and deployment strategies of private wireless networks tailored for the health care environment. It is designed to help Verizon's health care customers better understand the features and benefits of a Verizon private wireless network and how it can integrate into their ecosystem.

Private 5G networks offer the robust connectivity needed for a myriad of applications like wearable smart sensors that continuously monitor patient vital signs in real-time, monitor temperature and other environmental conditions for medicine storage, etc.

By deploying a private wireless network, health care organizations can help enhance data security, improve patient care and operational efficiency, and maintain a competitive edge in a digital-first world.

Private Wireless Networks, by Verizon

Introduction

Verizon is well known for the power and popularity of its consumer wireless network, but Verizon Business also offers a broad collection of enterprise network solutions and emerging technology offerings serving global enterprises, including many in the health care industry.

With the growing adoption of private 5G networks, the health care industry is poised for substantial improvements in care today, while setting the stage for revolutionary advancements in the future. It uses cellular technologies like LTE (4G) or 5G to enable seamless communication between devices, machines and systems within a health care facility.

Verizon understands the unique needs of health care organizations and provides solutions that accelerate the digital transformation of health care. Modular networks with data driven efficiencies are enabling innovation in the overall health care industry. Our Neutral Host Network (NHN) solution provides seamless multicarrier public network access within the hospital facility along with a high speed and low latency Private Wireless Network (PWN)/Multi-Access Edge Computing (MEC) solution tailored towards more critical hospital operations, offering more direct control over data security and supporting real-time decision making.

With the advancement of wireless technology, we see many organizations reevaluating their legacy Distributed Antenna Systems (DAS). Traditionally favored for their ability to enhance cellular coverage within large buildings and venues like stadiums, DAS is now seen as less viable for smaller, less complex environments due to high costs and inflexibility. Emerging technologies such as NHN and PWN are stepping up as the new champions of indoor connectivity.

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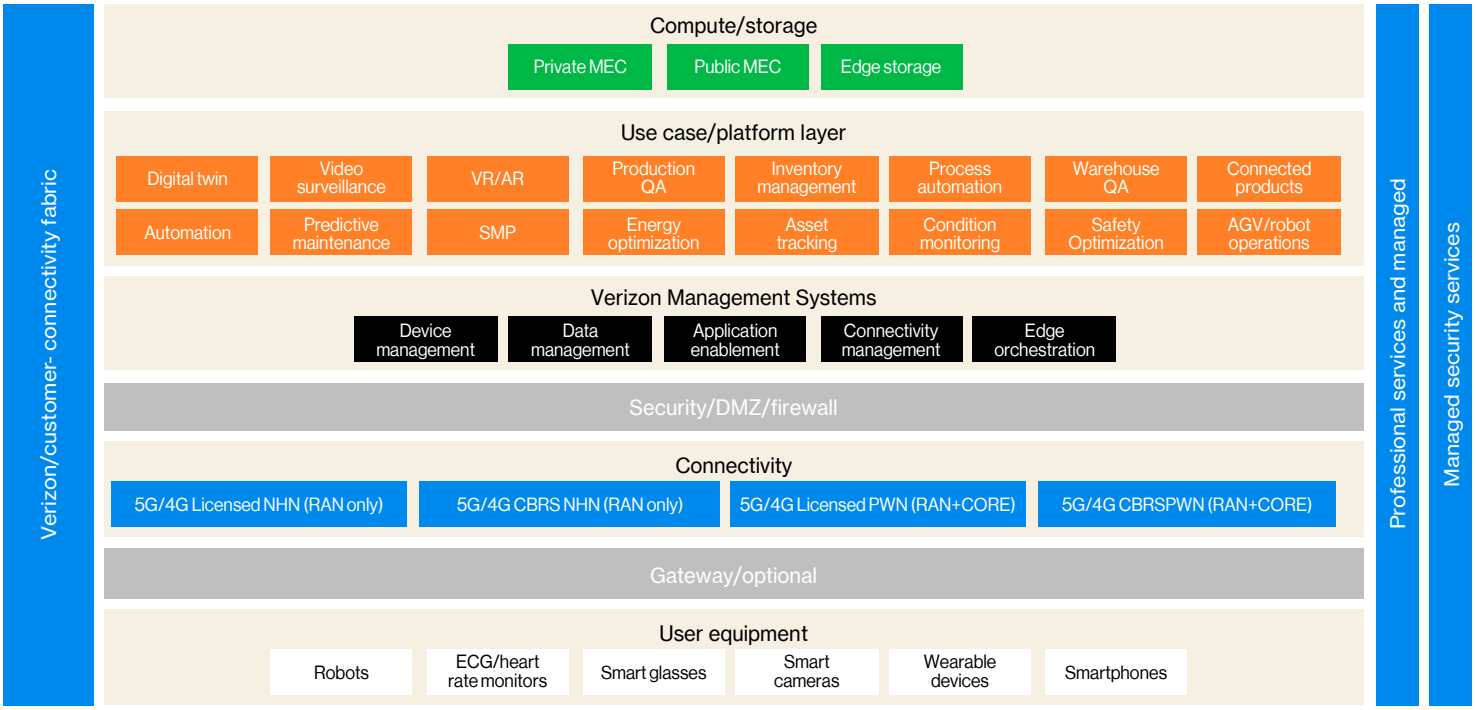
What follows is a comparison of DAS and Ericsson DOT solution used in an NHN or PWN deployment:[1]

Active DAS System	Radio Dot System
Complex deployment	2x faster to deploy
Higher order MIMO complex and costly	Leading 5G performance and native MIMO support
4x more components	Up to 80% less footprint
More elements demand higher power consumption	Up to 70% less power consumption
Higher cost per gigabyte	Up to 50% less total cost of ownership
Separate and limited O&M	Fully integrated macro O&M with antenna-level visibility

NHN/PWN is cost effective and is a fully integrated solution which is scalable and future proof. But how do these cellular networks integrate into the health care architecture? Here is a visually engaging architecture for a private wireless network tailored to the health care industry using the Purdue Model.[2] When applied to a health care network architecture, the Purdue Model acts as a framework for dividing a health care network into distinct security zones, effectively separating operational technology (OT) systems used for medical devices and patient monitoring from the broader information technology (IT) network.



Why Private Wireless Networks by Verizon

Private Wireless Networks by Verizon ensure minimal interference and consistent performance, which is crucial for time-sensitive health care applications such as robotic coordination and real-time sensor communication. Data transmitted over a private wireless network remains within the hospital boundaries, significantly reducing the risk of cyber threats and ensuring compliance with stringent industry regulations.

Health care organizations can design private wireless networks to meet their specific needs, such as prioritizing bandwidth for critical applications or expanding coverage in challenging environments. These networks can easily scale to accommodate new devices and use cases as the health care device ecosystem grows and evolves. Private wireless networks are designed and built to scale efficiently, with a robust infrastructure that can support a large number of devices in complex environments.

Verizon's private wireless network infrastructure provides connectivity for mobile devices with centralized control, real-time insights, analytics and visibility into the entire network through a rich, customer-facing web portal. As a company, we have made significant investments in 5G Edge technology to support businesses across multiple sectors by enhancing their digital transformation. This enables businesses to process data closer to where it is generated, offering faster insights, improved performance and reliability to deliver better customer outcomes through API Orchestration, platforms, connectivity, devices and ecosystem partnerships.

Overall, this architecture ensures seamless integration between operational and enterprise technologies while prioritizing security, reliability and scalability to meet the demands of modern health care environments.

Key characteristics of a private wireless network:

- **Dedicated infrastructure:** Owned or leased exclusively by the health care organization, and operates on licensed or unlicensed spectrum.
- **High performance:** Provides ultra-reliable low-latency communication and can handle massive device connectivity with high throughput and minimal interference.
- **Enhanced security:** Ensures data privacy as information remains within the facility. Offers better control over access and network policies compared to public networks or Wi-Fi.
- **Customizable network features:** Configurable to meet specific operational needs.

Private Wireless Networks reference architecture

Before we dive into the reference architecture, it is important to understand the components of a private wireless network:

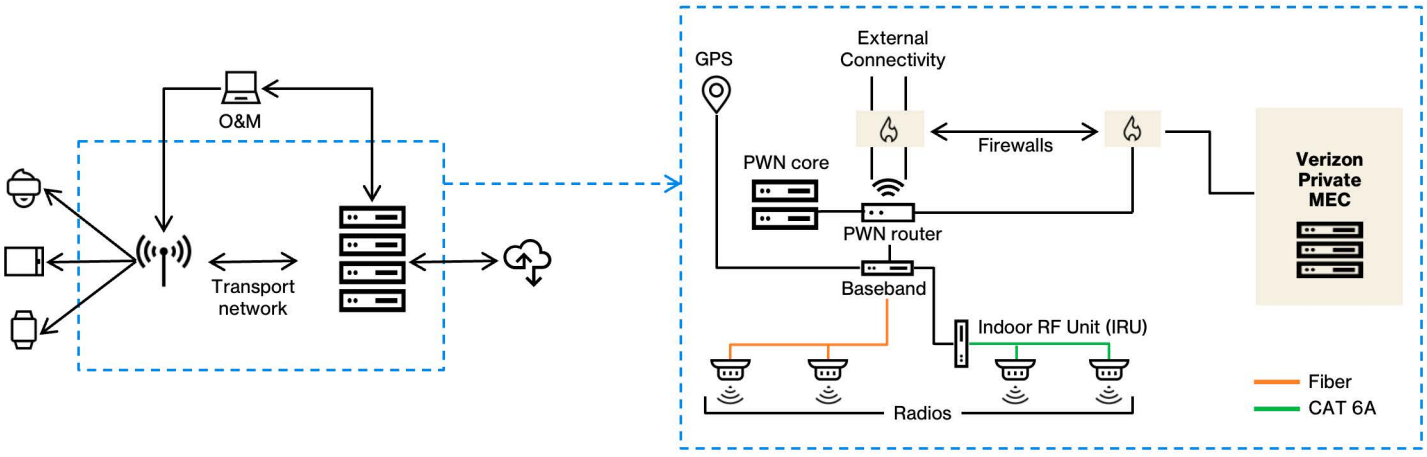
- **Core network:** The control system that manages devices, user authentication and data flow within the network
- **Radio Access Network (RAN):** The wireless infrastructure (base stations, small cells) that provides connectivity to devices
- **Edge computing integration:** Colocates local data processing with wireless connectivity for real-time applications
- **User Equipment (UE):** Devices like IoT sensors, remote surgical robots, augmented reality (AR) tools and handheld devices connected to the network

Network requirements analysis

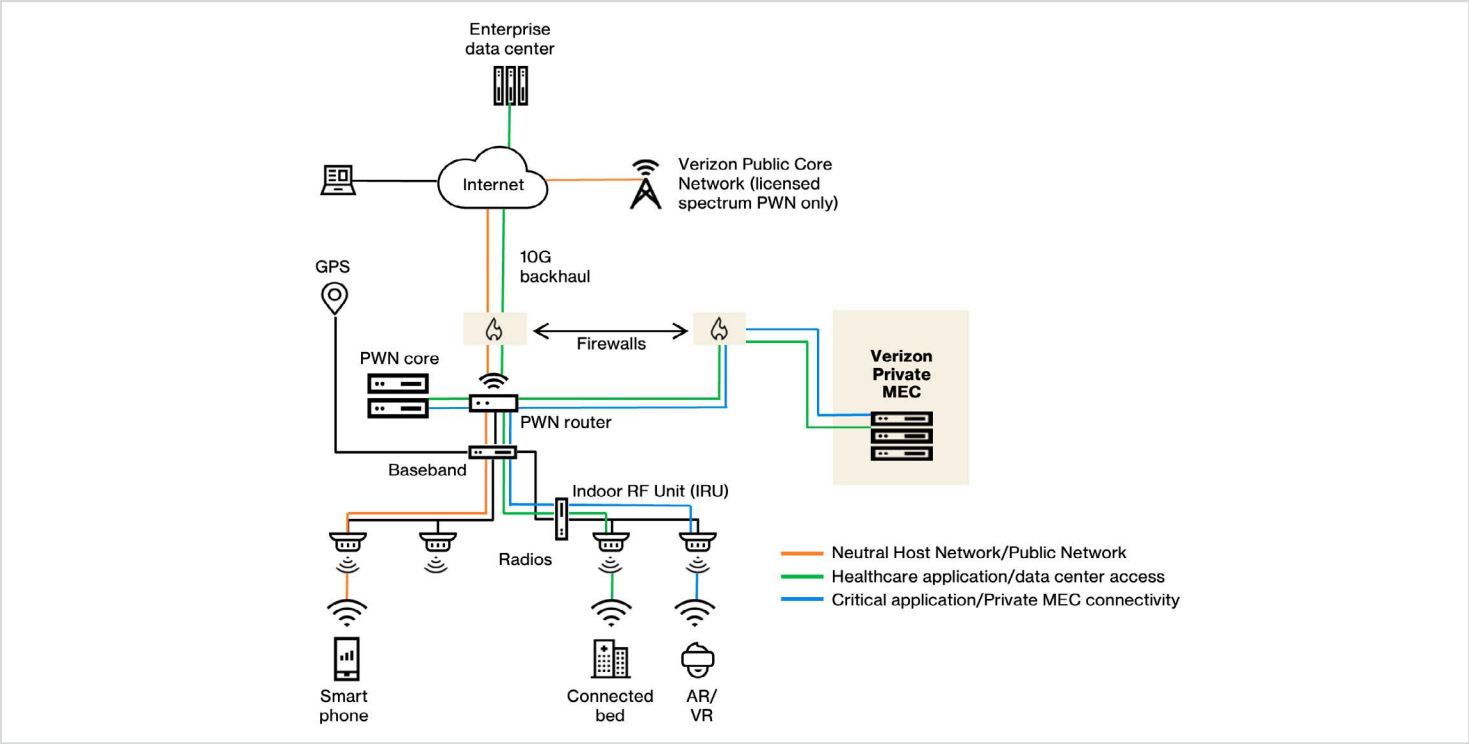
Designing and implementing private wireless networks for health care organizations requires careful consideration of various technical, operational and strategic factors to ensure reliable performance, scalability and security. The design is fully customized based on the needs of the enterprise:

- Connectivity needs: Number and types of devices (e.g., IoT sensors, robotics, AR/VR systems) as well as required bandwidth and throughput per device/application
- Performance criteria: Low latency for real-time applications, plus high availability and reliability for critical operations
- Coverage area: Size and layout of the facility (community clinics, trauma facilities, wellness centers etc.)
- Wireless standards: Choose between LTE or 5G based on performance needs
- Spectrum: licensed, unlicensed or shared spectrum
- Integration with existing networks: Ensure seamless interoperability with legacy systems
- Data protection: Encryption for data in transit and at rest
- Access control: Role-based access, multi-factor authentication (MFA), SIM-based verification and secure device onboarding
- Network segmentation: Isolate critical systems (e.g., production line controls) from less sensitive systems

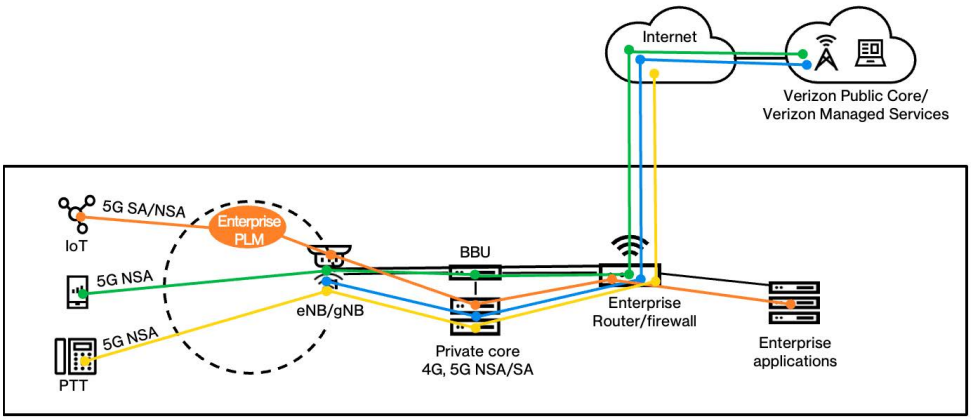
Typical health care facility PWN deployment



High-level Private Wireless Network reference architecture



High-level data flow



- **Enterprise user** – Enterprise specific SIM, No monthly plan, Coverage within enterprise facility, Data only service (OTT Voice / PTT capable)
- **Operations & Management** – Verizon Network Operations Center
- **PTT/Internet Apps**
- **Any Verizon user** – Verizon SI, Monthly Verizon plan, Coverage within enterprise facility and Verizon 4G/5G network, Voice support through Verizon IMS

- **Data generation:** IoT devices and machines generate data in the OT zone.
- **Processing**: Data is aggregated and analyzed at the Enterprise Level in Verizon Private MEC.
- **Storage and decision-making:** Processed data is sent to the IT zone for storage, enterprise analysis and actionable insights.
- **Feedback loop:** Commands from the IT zone are sent back to the OT zone to optimize operations.

Two Critical Private Wireless Network Use Cases for Health Care

Use case 1

Coverage/connectivity

Connectivity is critical for today's health care industry. There is a need for reliable access to a cellular network that allows medical devices, like wearables or remote patient monitoring systems, to transmit data consistently, regardless of location, and ensure seamless communication between patients, health care providers and medical equipment, particularly in scenarios where reliable Wi-Fi might not be available. Whether for delivering patient records, contact information, lab results or performing other wireless-dependent operations, health care professionals need a reliable wireless connection across all devices.

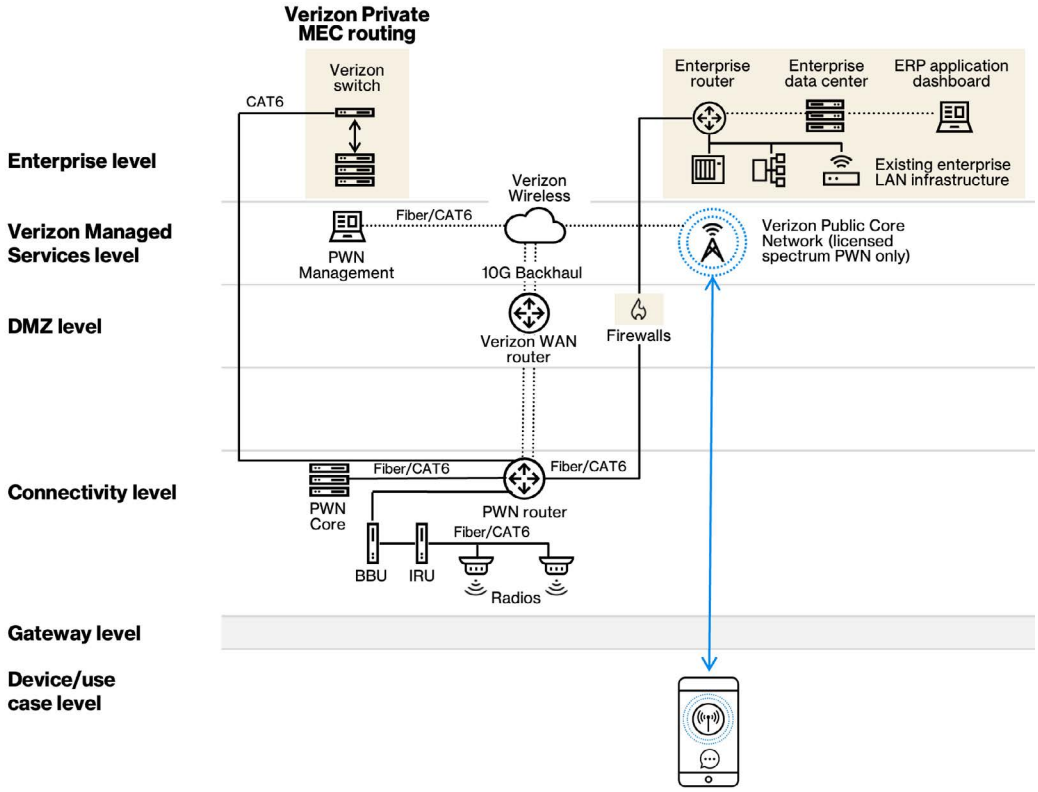
Additionally, connectivity makes a patients' stay easier and more comfortable. Patients can use their devices to navigate visitor hours, cafeteria hours and hospital communications. Cellular connectivity enables them the comfort of staying in contact with loved ones or access to their favorite apps during what is likely a difficult time. While selecting connectivity solutions may be simple for some industries, networks for health care must be designed to function optimally within an environment laden with interfering medical machinery and devices – making it no easy task.

Regardless of the technologies, apps and devices used, health care facilities can optimize operations, communications and patient care throughout the property by improving the in-building wireless infrastructure to support Wi-Fi and cellular frequencies.

Benefits of Neutral Host Networks

- **Telemedicine consultations:** Reliable connectivity enables high-quality video conferencing for remote patient consultations with specialists
- **Mobile nursing stations:** Nurses can access patient data and critical applications on mobile devices while moving around the hospital
- **Surgical suite integration:** Real-time data transmission from medical devices during complex surgeries
- **Emergency response systems:** Immediate communication during critical situations like code blues
- **Multi-carrier access:** Patients and staff can use their preferred mobile carrier on the hospital network without needing to switch providers

The neutral host network market is expected to grow to $8.7 billion by 2028.[3] This growth is driven by the increasing use of private networks and indoor data traffic.



Use case 2

Connected Beds- IoT

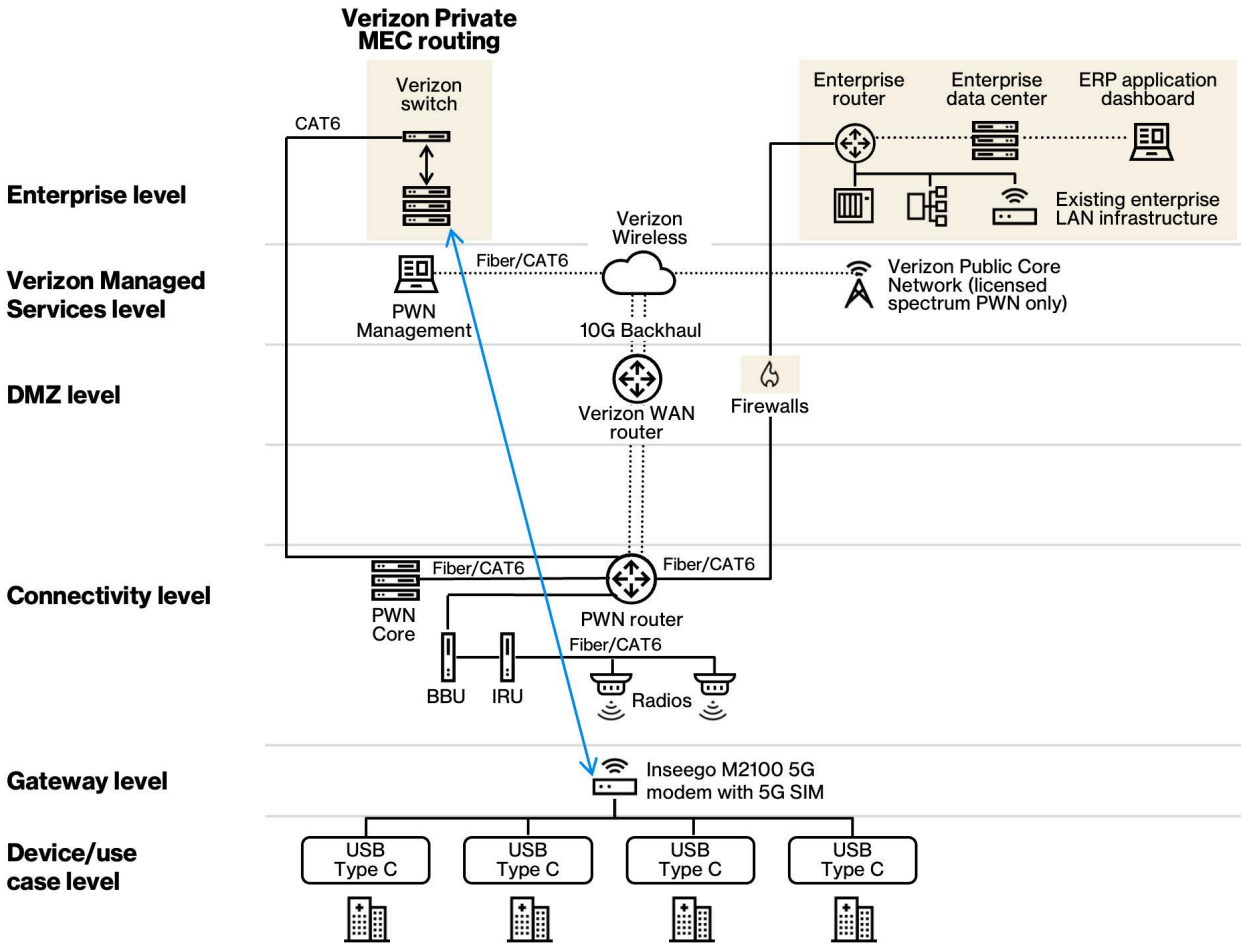
With innovation in IoT devices, the role of the hospital bed is being reimagined. There is a big demand for using the bed itself for temperature, blood pressure, oxygen and even weight monitoring. In acute care these smart beds help medical teams continuously monitor patients' health 24/7. This definitely increases patient safety by automatically transferring all data in real time over a secure 5G network, allowing medical teams to instantly review and respond.

Benefits of using PWN with Connected Bed in health care:

The ultra-fast, low latency wireless connectivity offered by 5G means that IoT devices can be utilized almost anywhere inside the facility. The top drivers for the adoption of Private 5G networks are integration of advanced telehealth solutions to expedite patient-centered remote consultations, accelerated adoption of robotics for real-time immersive and precise surgical procedures, as well as a growing impetus for wearable developments to gather continuous patient diagnostics.

Private networks not only add reliability of service and mobility but also help enable secure data transfer.

The connected Hospital market is expected to reach $808.4 billion by 2033 with a CAGR of 31.83%.[3]



Use case 3

Telemedicine

5G Private Wireless Network significantly enhances telemedicine by providing a dedicated, secure and high-bandwidth connection for remote patient consultations, enabling seamless real-time video calls, data transmission of medical images and remote patient monitoring, especially beneficial in rural areas where traditional internet access might be limited. Essentially, it allows for a more reliable and secure way to deliver telemedicine services compared to a Wi-Fi network. 5G Private Wireless Network improves operational efficiency, ensures accuracy and enables smarter, data-driven decision-making.

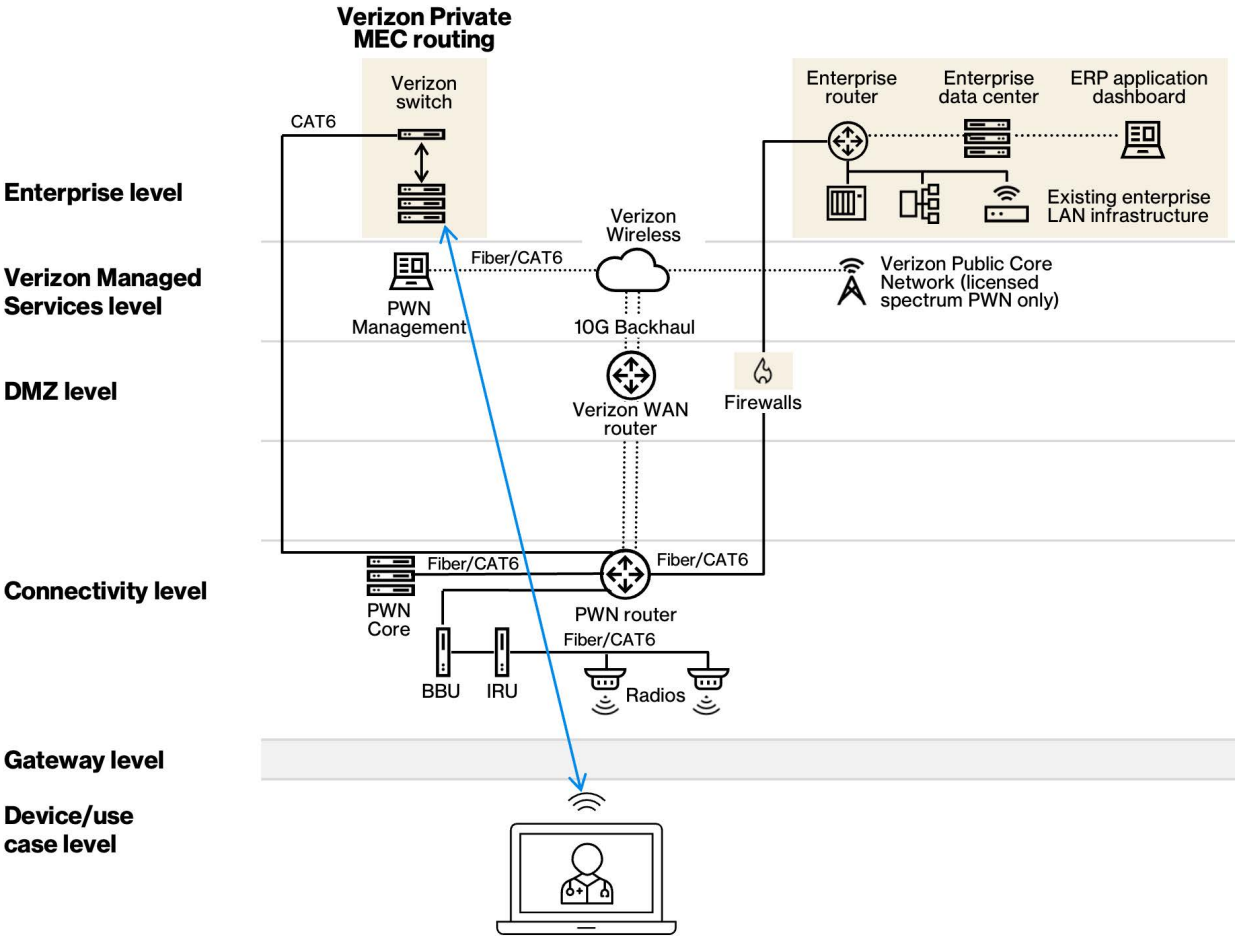
Below are key use cases of PWN with Telemedicine in health care:

Improved connectivity: 5G PWN offers dedicated bandwidth and low latency which is crucial for real time data transfer and video conferencing.

Enhanced security: Patient data is protected from unauthorized access, ensuring confidentiality during telemedicine interactions.

Remote patient monitoring: Reliable connectivity allows for continuous monitoring of vital signs and other patient data from remote locations, facilitating proactive health care management.

Medical applications: Private networks can support applications like remote surgery, real-time medical imaging and tele-ultrasound, due to their high bandwidth capabilities.



Verizon PWN/Edge partner ecosystem

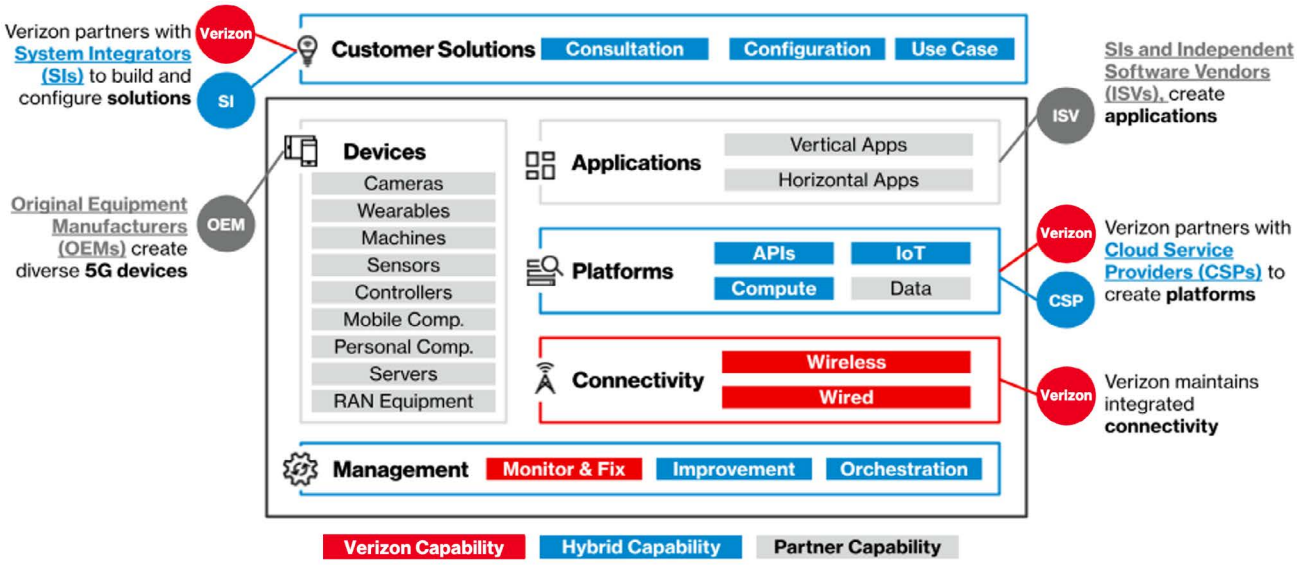
Verizon has established relationships with a range of technology partners and integration providers to incorporate 5G Edge technologies with existing infrastructure, creating a robust "Ecosystem" that accelerates digital transformation for businesses. It is through these initiatives that Verizon and our ecosystem partners can position 5G Edge technology as a catalyst for innovation, enhancing operational efficiencies, enabling new business models and supporting adoption across industries.

What does the PWN/Edge ecosystem consist of?

The Verizon Ecosystem consists of partners that provide consultation, application, device integration and end to end integration to enable use cases and outcomes for our health care customers. Exhibit 1 provides details of how these partners interact to provide the best application of our robust Private Network and Edge network:

1. **System Integrators:** Our list of SI partners leverage our 5G assets to provide an array of functions including ideation, consultation and creation of bespoke solutions for our health care customers
2. **Software vendors/ISVs:** Solutions are available for use in health care settings that integrate Verizon 5G edge assets on our partners' software or platforms
3. **Medical device Manufacturers:** We have many devices certified for use on our 'macro' and validated for private network deployments in the United States through multiple device OEMs
4. **Edge Cloud Service Providers (CSP):** Our partnerships with CSPs enable us to bring computing and application closer to the devices through on-prem servers

Exhibit 1: Block representation of how our Partners work across the tech stack to enable health care outcomes



Our partners can leverage our Private Network and Private Edge capabilities to enable use cases for our health care customers across the following domains and applications:

1. **Enhanced Communications/Push-to-X:** Operations Logistics, Connected health care Workers, Televisits
2. **Security:** Health care Data integrity (EHR), Safety Control & Compliance
3. **Location service:** Hospital Asset & Inventory Tracking & Management, Patient Tracking & Security, Wayfinding, Geofencing for Safety & Security
4. **IoT:** Smart Hospitals, Connected Devices, Connected Patient Rooms, Remote Patient Monitoring, Surgical Robotics, Condition-Based Monitoring
5. **Edge AI:** AI Diagnostics, AR/VR Assisted Surgery, Computer Vision (Virtual Care)

While our Private Network and Edge Networks are built to support multiple use cases for our health care customers, there are a few that we have activated through key ecosystem partnerships and exist in our portfolio today.

Exhibit 2: Key partners and solutions enabled for health care

Partner type	Partner name	Role(s)	Description
System integrator	KPMG	Consulting, Program Management, Use Case Validation	SIs provide advisory and use case consulting and design end to end solutions for health care application
	Tech Mahindra	Consulting, Use Case Development	
	IBM	Consulting, Use Case Development	
	SSR	Consulting	
OEMs	Baxter	Connected hospital beds	5G embedded hospital beds to track bed usage, location within hospitals, among other things, with the intent for it to work on macro network and PWN
Edge CSPs	AWS	Low latency applications on AWS Outpost & AWS Wavelength	Private Edge with AWS Outpost or Public Edge with AWS Wavelength zone enable health care applications

Example of how an ecosystem partner enables a specific outcome for our customers:

Connected beds

Verizon launched a pilot with Baxter on our macro network with a dongle in January 2025 to validate data collected on bed usage and maximize efficiency of bed use, with plans to natively enable future bed models.

Resources

Verizon can enable multiple solutions through our partners as well as the ability for developers to integrate our services into their products through our APIs. The following links detail our capabilities, use cases and case studies for health care focused customers:

A. Health Care Webpage

B. 5G Edge Webpage

C. 5G Edge Developer Portal

Conclusion

The deployment of private 5G in health care is gathering momentum. Private 5G networks have the potential to revolutionize health care by providing high-speed and reliable connectivity that enables faster and more efficient transmission of critical data. In health care, private 5G networks can be used to support a wide range of applications, including remote patient monitoring, telemedicine, virtual reality-based surgical training and mobile health care services.

Private 5G networks offer several advantages over traditional wired networks, including greater scalability, faster deployment and more robust security. With private 5G networks, health care providers can ensure the confidentiality and integrity of patient data, which is critical for complying with regulations and maintaining trust with patients.

Credits

Author

Taru Jain – Associate Director, 5GA Solution Architect

Contributors

Eric McClanahan – Sr. Director, 5GA Solution Architect

Ravi Annadanam – Distinguish Architect, 5GA Solution Architect

Preeti Singh – Associate Director, 5GA Business Development

Thomas Fuerst – Sr. Manager, Product Marketing

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