

Private Networks In Healthcare

Industry Whitepaper



Introduction

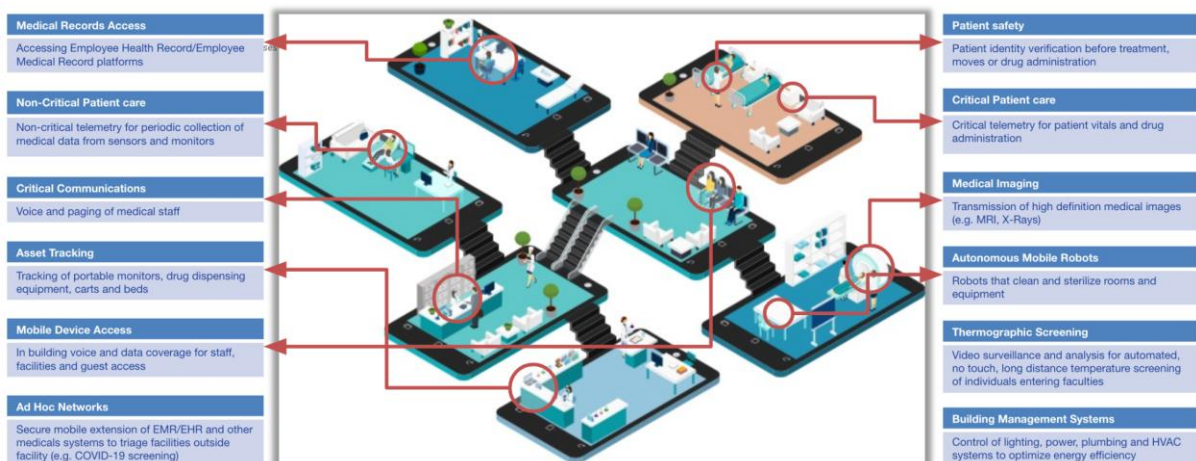
In the healthcare industry, having a reliable and secure means of communication is literally a matter of life or death. In such an environment, a private mobile network has many compelling advantages over alternative connectivity solutions such as Wi-Fi or public network coverage. In this paper we explore the unique benefits that a private mobile network brings to a healthcare provider and offer examples of how it can be applied to different use cases that exploit the bandwidth, quality of service, and reliability that it offers.

Modern Healthcare and the Need for Improved Communications

Quality patient care in the healthcare industry depends on a reliable communications network that ensures immediate access to the necessary personnel, data and applications required to deal with every incident. In the past, healthcare professionals relied on a mix of pagers, DECT (Digital Enhanced Cordless Telecommunications) phones¹, desk phones, paper charts on ring binders, and tablet computers to communicate, store and transfer information, resulting in delays and inefficient processes.

Faced with an ageing population, increased demand on their services, and a declining pool of trained doctors and nurses, healthcare providers are turning to modern communications technologies to improve their workflows, provide better care and reduce their operating costs. Modern healthcare campuses consisting of extensive buildings on many floors covering a large footprint regularly suffer from poor public mobile network coverage and are hard to service reliably with the limited range supported by Wi-Fi.

To overcome these challenges, they require a reliable, dedicated, high-quality communications network that will allow their staff to use modern smartphones to provide a solution to all their voice, messaging and data access requirements.



Use Cases for Private Mobile Networks in a Healthcare Setting

¹ DECT phones are legacy wireless communication devices once commonly used in professional settings for internal communications.

Why Private Mobile Networks are the Preferred Solution

A private mobile network using 4G and/or 5G technologies offers healthcare providers an ideal solution to all their communications needs. A private network removes any dependency on public mobile operators to provide adequate indoor service, and overcomes the limitations of Wi-Fi concerning coverage area, quality of service and handovers.

The benefits of a private mobile network solution for healthcare providers include:



Professionals can use a single, modern, smartphone device for all their communication requirements, eliminating the need to carry multiple devices.



Two-way messaging with confirmation via a smartphone application allowing nurses and doctors to accept or decline incoming notifications or requests, unlike outdated one-way communication in regular paging systems.



Dedicated healthcare solutions, such as Nurse Call applications, can be integrated with the private network environment to implement healthcare-specific use cases.



Use of standard 4G and 5G devices allows providers to save costs compared to relying on proprietary devices with a limited choice of vendors.



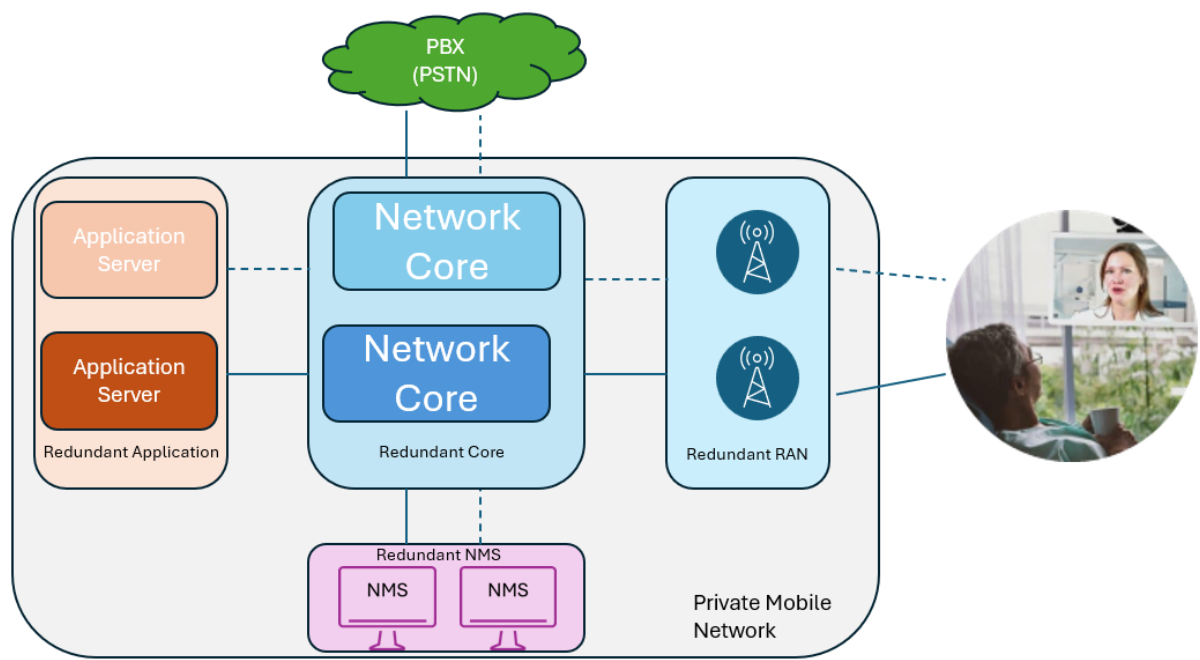
Native support for quality and reliable voice services, which is still the most important service used by healthcare professionals in their working lives.

Private Mobile Network Features Supporting High-Quality Healthcare Communications

High availability

One of the primary drivers for deploying a private mobile network in a healthcare environment is to ensure that the periodic outages which continue to plague public networks do not compromise patient care. In a private network scenario, these outages can be avoided by using a high availability implementation when building the network. High

availability can be achieved using redundant configurations for the network core and associated applications, and in the radio access network (RAN) using overlapping cells or coverage areas.



Highly Available Hospital Private Mobile Network

Autonomy from Public networks

Large healthcare facilities are key assets in any City/Region's disaster response plan. These healthcare assets need to be operating at their highest efficiency in times of public disaster/critical events. History has shown that during these critical events public network operation is commonly interrupted because of congestion and other security related reasons. Therefore, it is essential that any cellular communication service that is used by these facilities is autonomous and independent from public networks. A private LTE/5G network is the best and most secure way on ensuring continuity of service in such circumstances

Additionally, the network connections between all elements can be made resilient with tools deployed in place for end-to-end monitoring of the entire system from UE (User Equipment) to the Nurse call application server.

4G and 5G Technology

Private Mobile Network solutions exploit the capabilities of advanced 4G and 5G technologies to deliver high quality connectivity in a healthcare environment. Unlike Wi-Fi, native support is provided for voice services, and a dedicated bearer can be used to ensure highly reliable voice communication. Both 4G and 5G technologies offer high bandwidth in an extended coverage area, supporting mission-critical use-cases like accessing high resolution medical images on mobile devices. Advanced network security features like SIM-authentication and network slicing prevent unauthorized access to sensitive data. Compared to Wi-Fi, radio frequency planning on a large campus is easier, with more resources available for handling concurrent connections and calls.

Spectrum availability for private networks varies from country to country, but increasingly spectrum is being freed up for these networks, such as the Citizens Broadband Radio Service (CBRS) in the US.

Integrated Healthcare-Specific Applications

A private mobile network delivers a robust communications backbone that connects medical professionals with each other and with the applications and data they need to care for their patients. Typical applications used in a healthcare setting with a private network are illustrated below:

Medical Alerts (Nurse Call)

A private mobile network can be used to deliver broadcast, multicast or individual alerts to healthcare professionals in response to a variety of situations. APIs provided by the private network can be used to integrate with applications and devices that generate alarms and notifications requiring urgent responses.

In most countries there are regulations according to the evacuation plans in private and public spaces especially where there are people who require assistance during evacuation such as hospitals and care homes. In both cases it is crucial to avoid panic when an evacuation alarm is activated. Hence, it is not permitted to alert the individuals in the enclosed environment using a siren or bell. Instead, the professionals working in these settings must be informed in a 'silent' and 'discreet' manner using broadcast messages sent to their devices over the private network.

Medical alarms from infuse pumps, blood and heart rate monitors and other critical devices can also be delivered over the private network to the on-call doctors and nurses to provide immediate notifications of changing patient condition.

Access Control

Access control secure locking devices providing video and voice feeds to hospital staff via the private network can be used to secure sensitive areas from unauthorized access.

Hospital Automation Systems

Connected medical devices enable better clinical care with less human intervention. Modern hospitals are equipped with a large variety of such devices, including panic buttons, wearables, sensors, door contacts, smart bed mats and geo-fencing systems. Devices using short-range communication protocols in the RF 868/2.4 BLE bands can be integrated with the private network via wireless gateways. Advanced 5G features such as network slicing can be used to ensure that each device is connected to the network at the necessary bandwidth, quality and latency characteristics.



Healthcare Communications and the Impact of 5G

Although hospitals and other healthcare providers have used private mobile networks for a considerable time now, the global adoption of 5G technologies is expected to trigger an exponential growth of new deployments in the sector. As access to 5G spectrum becomes easier, healthcare environments are poised to take advantage of the growth in the device ecosystem, and the increased bandwidth and higher throughput rate that 5G offers compared to 4G and earlier technologies. With increased data throughput and therefore greater capacity, it will be possible to expand use cases by running more applications over the Private Network and supporting more users and devices (UE) simultaneously. This new capacity makes it easier to scale up without reaching the network's capacity limits.

Ultra Reliable Low Latency Connectivity

5G Networks offer a low latency data link which opens perspective for new real-time use case such as:

- **Remote Surgery:** 5G's ultra-low latency enables surgeons to perform real-time, remote surgeries using robotic systems, allowing patients in remote or underserved areas to access expert medical care without delay.
- **Telemedicine and Remote Monitoring:** Real-time, high-definition video consultations and continuous monitoring of patient vitals via wearable devices become more reliable, improving the quality of telehealth services and enabling quicker responses to medical emergencies.
- **Augmented Reality (AR) for Medical Training:** 5G networks allow for seamless AR applications, providing medical professionals with real-time, immersive training experiences and assisting during surgeries with precise, augmented overlays that enhance accuracy and outcomes.

Location Management Function

This 5G network function enables highly accurate location tracking of connected devices, support use-cases including:

- **Asset tracking:** infuse pumps, medical devices, beds, heart monitors etc.
- **People tracking:** Accurate, up-to-date, location details for nurses and doctors improves the efficiency of the nurse call alarming system by notifying the right persons in the right place.

Use of 5G RedCap devices for Fully Connected Healthcare

5G RedCap (Reduced Capability) is a technology intended to support connectivity for large numbers of low-cost devices to a 5G network where ultra-high bandwidth is not a requirement. It is the enabler for the mMTC (massive Machine Type Communications) variant of 5G, and in a healthcare environment, provides superior connectivity features to a private network compared to earlier narrow-band IoT technologies. Use cases for 5G RedCap devices on a private network in healthcare setting include:

- **Asset Management:** Monitoring existing medical / non-medical assets
- **Shorrange Radio Gateway:** Replacement of legacy gateways, permitting wearables and other healthcare devices to connect directly to the network
- **Optimised Resource Allocation:** 5G enables efficient use of network resources with tailored data rates and reduced power consumption, making it ideal for low-complexity RedCap devices in healthcare applications like wearables and remote monitoring.
- **Scalability and Massive Connectivity:** 5G supports a vast number of devices per cell, allowing for the scalable deployment of numerous RedCap devices in healthcare settings without compromising network performance.
- **Enhanced Coverage and Reliability:** 5G provides widespread, reliable connectivity, essential for ensuring continuous operation of mMTC healthcare devices, especially in critical environments like hospitals or remote areas.

E2E Ethernet connections (5GLAN)

Any legacy system based on Ethernet can be integrated into 5G network infrastructure with end-to-end Ethernet connectivity in 5G capability. This allows the healthcare and cure sectors to benefit from:

- **Seamless Integration of Legacy Systems:** 5G networks enable the integration of existing Ethernet-based medical equipment and systems with modern 5G infrastructure. This ensures that legacy devices, such as imaging systems or patient monitoring systems, can connect directly and efficiently to the 5G network, facilitating a smooth transition and interoperability within healthcare settings.
- **Enhanced Data Transfer and Real-Time Access:** With the high bandwidth and low latency of 5G technology, healthcare providers can achieve faster and more reliable data transfer. This is crucial for real-time access to patient data, remote

consultations, and telemedicine applications, ensuring that critical information is delivered promptly and accurately.

- **Improved Network Reliability and Security:** 5G networks offer advanced features such as network slicing and enhanced security protocols. Network slicing allows for dedicated, high-performance slices for healthcare applications, while robust security measures protect sensitive medical data. This ensures that healthcare data remains secure, and the network performs consistently, even with the high demands of critical healthcare services.

5G Multicast and Broadcast Messaging Services (5GMBS)

5G supports native multicast, broadcast and direct messaging services that can be applied in a healthcare environment to meet several use cases:

- **Secure, Rapid Information sharing:** Send files / pictures / voice messages to a large group of people in case of an alarm (instructions/situation awareness etc.) while using low radio resources.
- **Critical Communications:** In large hospitals it can be used in combination with mission-critical applications for security, fire-safety etc., while using low radio resources
- **Enhanced Patient Monitoring and Alerts:** 5GMBS can facilitate real-time distribution of critical health alerts, updates, and monitored data to many healthcare professionals and patients simultaneously, improving response times and coordination in emergency situations.
- **Efficient Distribution of Health Information:** This technology enables the widespread broadcast of health-related educational content, public health announcements, and urgent advisories, ensuring that vital information reaches a broad audience quickly and effectively.
- **Improved Coordination in Emergency Responses:** 5GMBS allows for synchronised communication among multiple healthcare facilities and first responders during crises, ensuring that everyone receives consistent and timely updates, which enhances overall emergency management and patient care.

Security Benefits of 5G Private Networks

A 5G-based private network offers some built-in security benefits that protect healthcare providers, their staff and their patients from network-based attacks:

- **You control the network:** A Private Cellular Network allows you to remain in full control of all your data, even if a Mobile Network Operator (MNO) delivers the network. With all the network components either on premise or your own managed cloud, you can optimize your network's reliability and availability levels
- **End-to-End Authentication:** The 3GPP technology behind 5G has been developed in such a way that end-to-end authentication always takes place when a user is on the network. Other technologies such as Wi-Fi are inherently less secure.
- **Network-controlled decision making:** On a 5G network decisions on how a user can behave are made by the network itself, ensuring that the performance is the same

for every user. This contrasts with technologies like DECT and Wi-Fi, where the handsets independently make network-related decisions.

Improved Network Coverage and Mobility

In comparison to Wi-Fi, a 5G network offers coverage and mobility benefits that enhance the wireless experience for users:

- **Optimised for mobile communication:** 5G networks are built using protocols developed for mobile communication, whereby the users are seamlessly handed-off between network elements as they move around the coverage area. This ensures continuous connectivity and prevents dropped calls. In comparison, other wireless technologies such as Wi-Fi are not designed for this level of mobility.
- **Wide coverage range:** 5G's superior wireless algorithms support a wider coverage range compared to Wi-Fi, allowing a healthcare campus to be fully covered with fewer radios. 5G also copes better with reflections of signals from buildings and other infrastructure, making it particularly suited to large healthcare campuses.

Benefits of 3GPP Compliance

Operating within a framework of standardized, certified network equipment and devices, and a regulated spectrum environment, also results in improved network performance and quality:

- **Independent of Device Software updates:** As all 3GPP compliant cellular technologies are controlled from the 3GPP, any modifications to the software of an end-point device will not impact the functioning of the communication between the network and the devices. This contrasts with Wi-Fi, where performance can vary significantly depending on the brand, type, and firmware, posing challenges when developing mission- or business-critical applications that depend on reliable wireless connectivity.
- **3GPP Frequency Spectrum use:** 3GPP networks operate in frequencies reserved for mobile operators, private mobile networks, and PPDR (Public Protection and Disaster Relief)² agencies, and are therefore free from interference generated by consumer products. This is a significant advantage compared to Wi-Fi networks, which always operate in an ISM band³.
- **Roadmap from 4G to 5G:** Core and RAN vendors adhering to 3GPP standards can support migration from 4G to 5G and allow healthcare providers to upgrade their networks in stages to exploit new 5G capabilities.

² One of the projects subsidised by European Commission to deploy an extensive 5G-based disaster-resilient network along the Hungarian-Ukrainian border to provide police, border guards and ambulance services with secure and reliable real-time voice, data, image and video communication, as well as enabling connected vehicles. More details, follow the link: <https://digital-strategy.ec.europa.eu/en/news/5g-based-public-protection-and-disaster-relief-ppdr-5g>

³ Additional information in regard to ISM band and its requirements can be found here: https://en.wikipedia.org/wiki/ISM_band

Conclusion

The advantages of a Private Mobile Network solution built to take advantage of 5G technologies are compelling for healthcare providers seeking a robust, secure and high-quality solution for all their connectivity needs. In contrast to Wi-Fi, 5G private networks offer higher performance, provide better coverage, and support a wider variety of health-care specific use cases. Private 5G networks allow healthcare providers and professionals to take advantage of a wide range of applications and devices delivered by a worldwide ecosystem of standard-compliant vendors. Most importantly, the improvements in efficiency and performance offered by these networks allow healthcare professionals to do their jobs more effectively, resulting in better outcomes for the patients under their care.

About the Author

Raymond Valk, CTO Office at Druid Software

Raymond started his career in Telecommunications in 1998 in mission critical communication networks for the public safety sector. Subsequent experience included many years working for mobile network operators and the private network industry. He is the author of the first documentation to get Private Networks certification according to the Dutch silent evacuation regulations (NEN 2575) and the deployment of these networks. He has extensive experience in the deployment of large hospital and care-home networks in the Netherlands and UK.

Currently, Raymond Valk serves as SME in the CTO Office of Druid Software providing assistance to the commercial team of the company and customers globally.

Druid

About Druid Software

Druid Software, founded in 2000 and headquartered in Ireland, is an industry-leader in private cellular network technology. Druid has a proven track record in meeting the requirements of defense, public safety, healthcare, industry and enterprise market segments for secure, high-quality mobile wireless connectivity. From a foundation 25 years ago delivering 2G platforms, Druid Software has evolved into the market leader for Enterprise 5G & 4G cellular core technology. Druid's mature Raemis platform is in use today by ISPs and Enterprises for business and mission-critical environments globally.

This technology enables solutions in different solution areas including Enterprise Communications, IoT, Mobile Edge Computing, NTN (non-terrestrial Networks), Neutral Host and Public Safety.

For more information, email enquiries@druidsoftware.com or visit www.druidsoftware.com.

