# PERVASIVE. INDUSTRIAL. WIRELESS.

## EVOLVING TERMINAL OPERATIONS

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Private cellular wireless services are the key to unlocking the digital transformation of terminal operations. Today, the full-scale automation of berth and yard operations, including the deployment of automated stacking cranes (ASC) and automated horizontal transport, such as straddle carriers, as well as the use of drones, is being held back by the inadequacies of existing wireless systems. With the availability of new radio spectrum, there are now 4G/LTE solutions and soon-to-arrive 5G solutions that are designed for private wireless networks. With their arrival, full digital transformation is now possible.

Terminal operators worldwide are challenged to meet the growing volume of container traffic, which is threatening to double by 2050, yet many terminals are already running 24/7. Container vessels grow ever larger, while just-in-time supply chains demand even faster turnaround times. Facing competition from new, smaller ports, shifting sea routes and loss of traffic, operators need to increase productivity, add new services and reduce costs to compete.

Digital transformation of their operations is one of the key ways to address these challenges. It allows operators to combine the strengths of IT, including computing, data storage and analytics, with operational control and monitoring systems and container handling equipment. The real advantages of linking all these systems digitally is best realized, however, when they have an end-to-end digitally connected operation, which is only possible with pervasive and robust wireless connectivity.

This kind of real-time connectivity is difficult to achieve with existing wireless technologies such as Wi-Fi or other proprietary wireless solutions. They suffer from critical inadequacies around reliability, predictability, security, capacity and coverage. Some of these problems can be worked around using wired technologies, but given the high degree of mobility inherent in port operations, especially for horizontal transport, wired communications has its limits.

### CELLULAR IS A GAME CHANGER

With the never-ending hype over the latest technological breakthroughs, it is rare when something we carry around in our pockets and use every day can grab headlines. Yet, the standards developed for mobile operators, such as Long-Term Evolution (LTE) and 5G, are some of the most stringent for any industry in the world. Today's cellular technologies are designed for high availability, high bandwidth, high numbers of devices per cell and the rapid movement of devices between cells. Wi-Fi, although fine for our home networks and checking our email at the coffee shop, is in a different league. Even industrial Wi-Fi systems cannot compete with cellular technologies because, at their foundation, they were never intended for business-critical applications. Until recently, cellular technologies were simply too expensive and too complicated to use in private networks. The radio spectrum was also licensed and consequently monopolized by the public carriers.

Both of these limitations for the private use of LTE have now been removed and 5G, which represents the next generation of cellular technology, is even more available for industrial usages. Governments worldwide are releasing new spectrum bands that

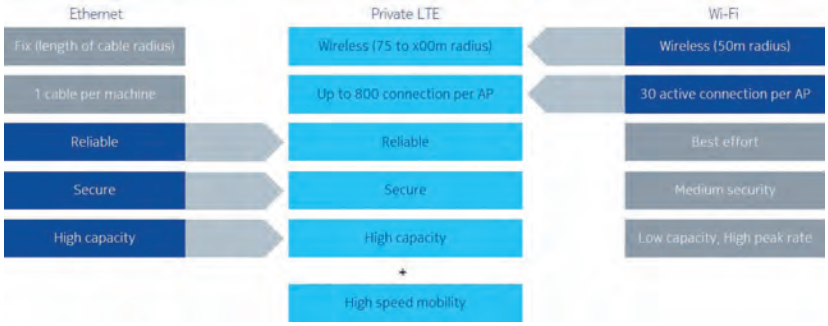


Figure 1: Private 4G/LTE combines the best of Wi-Fi and Ethernet and adds high-speed mobility

Figure 2: Private 4G/LTE network from Nokia deployed in a Finish terminal

are specifically designated for private networks, and cellular radios can now use unlicensed spectrum as well. Cellular radio equipment is available at price points and in configurations that are easily deployed by any IT team capable of running an Ethernet or Wi-Fi network.

The table in figure 1 illustrates the inherent advantages of private cellular networks over either Ethernet or Wi-Fi. One way to think of LTE is as a kind of wireless Ethernet, with the advantage of also supporting high-speed mobility of devices between cells or access points. With 5G even greater benefits can be expected. What this means in practice is that private LTE/ 5G networks can actually replace and converge all the other wireless networks that are currently in use in the port, including Wi-Fi and even private mobile radio solutions, such as TETRA (Terrestrial Trunked Radio) voice communications. To use TETRA as an example, cellular networks support dynamic group communications, including mobile radio features, such as push-to-talk and push-to-video, as well as call dispatch control and management.

## 5G EVOLUTION

As we evolve into 5G, private cellular networks will be reliable and fast enough that they could be used for remote operations. The remote control of equipment, such as straddle carriers, requires very low latency communications and 5G systems will support these low latency requirements, including support for layer-2 transport of PROFINET. 5G is a broadband, high-capacity wireless system that also supports the video uplink requirements of multiple cameras that would be required for remote command and control of the unit.

Other applications supported by private cellular include unmanned aerial vehicle (UAV) or drone inspection. Drones provide instant situational awareness in emergency situations but can also be used for remote visual asset inspection and monitoring of dangerous goods. LTE/5G can be used for end-to-end drone solutions that includes command and control of the drones and transport of the HDTV signal. Both these use cases showcase the inherent advantages of using a mobile cellular technology. Drones and remotely controlled straddle carriers need to remain in constant contact as they move through the terminal. Line of sight communications cannot be relied upon given the number of steel structures that can interfere with radio signals. LTE/5G, unlike other wireless technologies, are specifically designed for dense urban areas to provide coverage between very high buildings. They can easily provide ubiquitous coverage in the terminal yard, providing high reliability and QoS, as well as robust security and high-speed mobility.

As vessels grow in size, the volume of container traffic is becoming almost overwhelming. However, artificial intelligence and machine-learning analytics, supported by pervasive industrial connectivity made possible by LTE/5G, can dramatically improve terminal operations systems (TOS). By optimizing systems such as the coordination of container handling equipment and personnel, the flow of goods end-to-end, and the availability of equipment, such as straddle carriers and cranes, terminals can create a 7–10% increase in throughput.

## REAL WORLD DEPLOYMENT

A terminal operator in Finland recently installed a private LTE network illustrating some of the uses for this technology and how it can provide a platform for future growth. The operator installed a private LTE network from Nokia to support video cameras installed on ship-to-shore cranes. The application was primarily intended to record the status of containers before and after crane handling to provide early status to customers of damage and establish clear responsibility for insurance claims.

Their Wi-Fi/Wi-MAX network was not meeting their needs because it did not provide full terminal coverage and had insufficient capacity to support the video traffic. Digging fiber to the cranes was not an option, and as they looked towards future expansion plans, LTE provided a more inexpensive way to fully cover the terminal for other possible applications. Once the private LTE system was in place, the operator expanded the number of applications using LTE to include video surveillance for perimeter security and asset monitoring, connectivity to all cargo handling equipment in the terminal and warehouses, as well as connectivity for outside workers and machines. They now consider themselves ready for further automation to take them to Port 4.0.

## CONCLUSION

There are numerous use cases for private cellular networks (LTE or 5G) in terminal operations, any one of which can drive the business case for adoption. Once in place, they have all the features and capabilities to layer on future upgrades to port operations as they evolve towards full digital transformation. Private cellular wireless is the rare case of a disruptive technology that, due to recent government regulatory changes, comes to the market already mature and with a well-developed ecosystem. The risks from adoption are small and the benefits will be transformative.


## ABOUT THE AUTHOR

Matthias Jablonowski is global practice lead of the Ports program at Nokia. Being intrigued by the opportunities of connected technologies and digital transformation, he works with port authorities and terminal operators on Port 4.0 and terminal automation projects as they embark on their smart ports journeys. Matthias has been instrumental in the expansion of Nokia into the Transportation industry.


## ABOUT THE ORGANIZATION

Nokia has deployed over 1,000 mission-critical networks with leading customers in the transport, energy, large enterprise, manufacturing, web-scale and public sector segments around the globe. Leading enterprises across industries are leveraging our decades of experience building some of the biggest and most advanced IP, optical, and wireless networks on the planet. The Nokia Bell Labs Future X for industries architecture provides a framework for enterprises to accelerate their digitalization and automation journey to Industry 4.0

## ENQUIRIES

https://networks.nokia.com/5g