

BUILDING PORT 4.0 WITH LTE/5G PRIVATE WIRELESS



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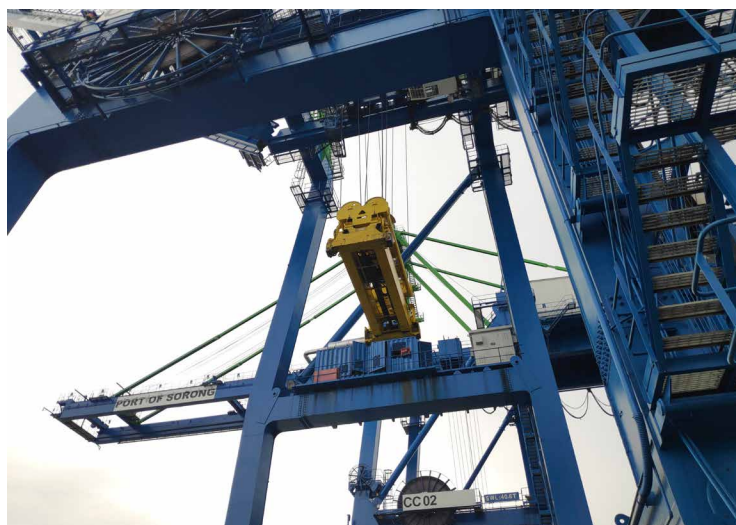
Venkatesh Ramakrishnan,
Head of Maritime & Supply Chain
Logistics Verticals, Nokia

Ports have been put on the front page of national newspapers as supply chain concerns have roiled global markets and disrupted the normal operations of many businesses. Hundreds of ships lining up to unload containers has become a familiar site from Shanghai to Rotterdam. Staff shortages during pandemic lockdowns, a lack of containers and fast-rising freight costs all spell trouble for smooth port operations, putting a renewed emphasis on port efficiency, digitalisation, and automation. One of the technologies playing an important role in port transformation is industrial-grade private wireless based on LTE and 5G, providing pervasive connectivity for the fully digital port.

THE TRANSPARENT PORT

As with many other areas of life, the pandemic accelerated trends that already existed. Over the last decade, the stresses on ports have included expanded loads, bigger ships, and larger call sizes, all of which have led to increasing idle times and yard congestion. As an important link in the global intermodal supply chain, port operations need to improve throughput and become more flexible and resilient to accommodate rapidly shifting requirements.

During the height of the pandemic, many downstream businesses began demanding greater data transparency from end to end; they needed to know where key goods were and whether to arrange for alternate suppliers. Many ports still work with paper forms, thus having real-time data on where shipments



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are not always feasible. This makes improving data transparency one of the key priorities for ports and their multimodal partners. There are several key digital technologies that will play a role in providing a solution.

The first step is to connect workers, cranes, trucks, trains, and vessels across the entire port system so that data can be made available. With this kind of ubiquitous

connectivity, a Terminal Operations Systems (TOS) can maintain real-time connections to all the key assets and stakeholders in the port system, including connecting mobile workers and machines to the TOS. This is where having an industrial-grade wireless connectivity platform such as private wireless based on LTE/5G is essential. Equipped with handheld terminals that support

push-to-talk radio as well as data and video, yard workers, ship crews, truck and train personnel can exchange any kind of information with central office systems.

Having seamless connectivity across the port also solves a long-standing issue with Port Community Systems (PCS), which tend to struggle with isolated data lakes and documentation backlogs. Private wireless can solve these issues by making it possible to connect gate automation and vehicle booking systems to traffic management and yard crane scheduling. Using edge cloud computing running AI and

machine learning software, the data generated by each transportation mode within the port can be captured, updated, and analysed. This enables better planning of resources and personnel, simplified documentation processing and real-time transparency to other intermodal supply chain partners on the status of their goods.

CLEARING YARD CONGESTION

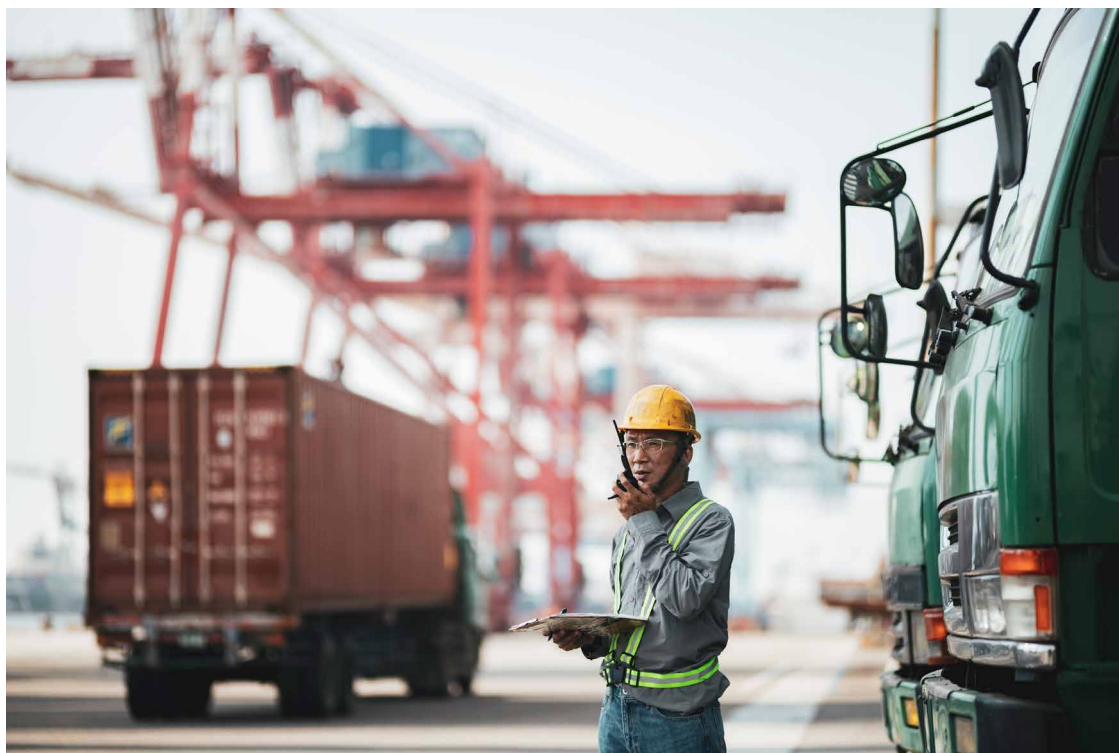
For several decades, research on yard automation has focused on container handling equipment such as RTGs and RMGs, the two most popular yard machines. The first

automated equipment included rail-mounted gantries (ARMGs) and automated electrified rubber-tyred gantry (AERTG) cranes, which appeared in the early 2000s. Unfortunately, they needed to be tethered to fiber optic links because no wireless technology at that time could provide the high bandwidth and reliable communications needed. With six to eight 4K video cameras, the streaming video needed to remotely operate an AERTG is beyond the ability of any wireless technologies prior to 5G.

The high-speed bandwidth provided by 5G is sufficient for these remote-controlled

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operations. This will untether RTGs and RMGs, thereby dramatically increasing their mobility and, thus, the flexibility and adaptability of container handling operations. 5G can also achieve latencies an order of magnitude faster than other wireless technologies. This means that machine-to-machine communications and remote-control interfaces can support much greater precision. Faster feedback means that remote operators have greater 'feel'. The equipment vendor Kalmar, for example, is incorporating both 4G and 5G into its systems for straddle carriers, rubber-tyred gantries, and automated stacking carriers.

SMART MAINTENANCE

One of the other benefits of ubiquitous connection is the ability to log sensor data from all the various pieces of equipment and machinery. Sensors can monitor variables such as temperature, vibrations and use cycles, feeding data into centralised analytics software. AI/ML software that has been trained on the historical data is able to spot anomalies in the data patterns that correlate with possible future equipment failure.

Besides identifying potential failures and reducing downtime due to unscheduled and expensive equipment malfunctions, the technology can also be used to optimise performance of engines and reduce fuel costs. This 'predictive' ability is also a more precise way to schedule maintenance, ensuring crews are focused on the highest priority maintenance. It also feeds important data for the scheduling of equipment replacement and capital planning.

YARD SAFETY

Providing wireless broadband coverage of the entire yard also promotes safer operations. Workers equipped with smart personal protection equipment (PPE) and connected wearables can be tracked so that central software always knows their locations. Smart PPE can monitor vitals, report man down situations and alert workers to hazardous gases using sensors. Coordinating the movement of workers and machines and using geo-fencing to ensure workers are alerted to high traffic areas are just some of the safety aspects provided by pervasive wireless coverage.

When events do occur that pose a safety risk, wireless directed drones can be used to quickly observe and understand the situation using infrared and normal video cameras. Central crisis control personnel can then use speaker-equipped drones to communicate with personnel in the area and direct them to where they are needed or, alternately, to where they will be safe.

CONSOLIDATING COMMUNICATIONS

Older wireless technologies can be supplemented or even replaced by LTE/5G, enabling IT to consolidate and simplify operations. Many ports currently run several different wireless communications systems such as wireless sensor networks using low-powered wide area networks (LPWA) and proprietary systems for machine-to-machine communications such as beacon networks for AGV guidance. Dock and yard workers typically rely on professional mobile radio, TETRA and P25, for push-to-talk services, while WiFi provides an outdoor extension of the central office LAN for general purpose data communications.



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LTE/5G private wireless can replace all these technologies with a single network solution, providing narrowband IoT communications, push-to-talk and, even better, push-to-video services for workers on the move, as well as data communications that are more reliable and deterministic than on WiFi. WiFi struggles with the many metal surfaces of container stacks, which cause radio interference that can create dead zones. A WiFi radio network can find these 'noisy' environments difficult to solve for on a regular basis, especially when the environment is so dynamic with containers being moved constantly. LTE/5G employs much more robust technologies for overcoming interference and can provide seamless coverage with less outdoor radio access points and no need to re-engineer coverage as the yard configurations change.

PORT-WIDE COMMUNICATIONS

In a complex multimodal port terminal, private wireless provides a

connectivity platform that all players can leverage for better coordination, productivity and safety. It has the speed and low latency to support the entire spectrum of application needs, from mission-critical voice to autonomous and remote-controlled operation of equipment. It can be a platform to support digitalisation and automation of operations from localised sensor networks to system-wide Port Operating Systems that use digital twin technology and edge computing to coordinate and optimise the entire workflow from ship to shore to rail and road.

LTE/5G private wireless has been specifically designed to meet the industrial needs of today's most advanced enterprise infrastructures. The pandemic has focused governments and enterprises on the importance of our supply chains and logistics, and ports and terminals are feeling the pressure to respond. LTE/5G can play a key role in the digital journey to reduce congestion, provide more transparency, and realise greater resilience, flexibility and safety with Port 4.0.

ABOUT THE AUTHOR:

Venky Ramakrishnan is the Head of Maritime & Supply Chain Logistics Verticals within Nokia. His work includes consulting and helping enterprises with their supply chain digitisation/automation vision, rolling out dedicated LTE/5G networks and deploying use cases with strong business benefits for end customers. He is based out of Munich, Germany and comes with experience in retail and supply-chain.

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