Innovate and lead

Enhancing defense operations and situational awareness with 5G
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Why Nokia?
The defense and government security sectors have long depended on proprietary communications systems developed specifically for their use. In this way, they have been able to leverage the best technology available to create purpose-built systems that meet their exacting standards. With LTE/4.9G network technology and the need for defense organizations to further digitalize their operations, this situation started to change; the advent of 5G technology will accelerate this evolution. Outside of combat operations and augmented by specific security features such as mesh networking, many of the communications needs of the defense sector can now be met with private wireless networks based on 4.9G or 5G technologies. While they may need to be hardened for more demanding applications, they offer state-of-the-art communications capabilities more affordably.

5G is a game-changing technology in many fields because it is the first wireless technology that is able to replace wired systems in terms of capacity, reliability, control and security. It has also been designed to meet the needs of industry for time-sensitive automated processes and massive numbers of low-powered industrial IoT sensors and devices, which are key technologies applicable to logistics and base operations. It has the capacity to support video communications and data-intense applications in the field for improved situational awareness and better coordination of personnel.

For the defense sector, there are a number of use cases for 5G and Advanced LTE or 4.9G private networks. In this e-book we present a survey of some of the most promising applications of these exciting new technologies for the defense sector.
Command and control
C2 operations and 5G

With the digital transformation of defense operations, data now plays a strategic role in operational command and control (C2). C2 centers now consolidate multiple layers of information coming from many different domains, sending back rich information to personnel, including video, for enhanced situational awareness and real-time operations monitoring.

5G offers the kind of secure bandwidth needed to make this possible for a wide range of applications. For example, ship-to-ship data transfers when traveling in convoy can be facilitated by setting up a private 5G network between the ships. Mobile “deployable” 5G networks can similarly be set up for temporary camps where a C2 is also located to keep in touch with field operations.

One of the chief advantages of 5G for C2 operations is that it can consolidate a number of communications systems, often running in silos, onto a single 5G private network. Beyond improving C2 efficiency, this reduces costs and the overhead of operating, managing, securing, and evolving multiple systems.
Base operations, logistics and maintenance
The connected intelligent base has many use cases for 5G private networks. 5G communications systems can connect sensors and cameras to help manage traffic, and provide real-time information on base assets preventive maintenance and optimized logistic operations.

On naval bases, 5G can provide video and haptic feedback to remote operators of cranes and gantries when loading and unloading ships. Ships can begin downloading data before they have docked or while at anchor using 5G for ship-to-shore data connectivity.

On air force bases, 5G can provide rapid download of aircraft data while still on the runway. It can provide real-time data to air field operations staff or connect with asset subsystems to monitor for maintenance and performance issues.
Optimizing the supply chain

5G connectivity is of great interest to the logistics industry for its ability to automate operations with its seamless, low-latency indoor and outdoor coverage. It is expected to help with automated storage and retrieval systems, industrial IoT sensors, robotic processes, autonomous vehicles and drone inspections. It is being considered as an essential technology across the industrial supply chain, from ports and rail to warehousing, processing and delivery of goods.

Given the extensiveness of the military supply chain, almost all of the same use cases hold. 5G can also meet the mission-critical standards required and is extremely secure. It can be deployed by autonomous convoys to co-ordinate and monitor individual vehicles and the surrounding territory. It can be used in concert with secure slices provided by public mobile operators to manage the inter-base logistics fleet and do real-time tracking of goods, equipment and vehicles. It can be used in warehouse and processing facilities to automate sorting and handling systems and guide autonomous vehicles.

The benefits of the digital systems that 5G makes possible are many. It allows for the modeling of the entire supply chain, which helps to identify areas for improvement, manage risk and anticipate maintenance. These systemic efficiencies speed port turnaround times and generally create higher availability while lowering operating costs.

- **4.9G 5G** Autonomous convoy and convoy surveillance
- **4.9G 5G** Inter-base logistics: fleet management
- **4.9G 5G** Real-time equipment positioning and tracking
- **5G** Remote maintenance with VR/AR
- **4.9G 5G** Ship-to-shore data exchange
Base security
Securing the base

The way in which private wireless can enhance the security of military bases deserves a special section. Sensor networks connected by 4.9/5G can include CCTV, audio sensors, movement sensors and a variety of environmental and hazardous chemical sensors. Advanced analytics solutions, like the Nokia Scene Analytics solution, can be paired with 4.9G- or 5G-connected cameras and sensor networks to reduce the workload associated with monitoring the overwhelming amount of data that can be produced.

Once a threat has been identified and if further investigation is needed, personnel can launch a drone that can be controlled and automated in flight using 4.9/5G, which also serves to stream infrared, audio and video data or embarked sensor data (e.g., gas) to the base security center. The drone can also be used to communicate warnings to potential intruders to leave the area or give other instructions. Security personnel can be dispatched and get full situational awareness by using push-to-talk and push-to-video radio over 4.9/5G while monitoring video streams sent by the drone on their devices.

Nokia Scene Analytics uses machine learning to construct a model based on historic sensor data to establish what constitutes normal patterns of behavior and alert personnel when anomalies appear. Unlike other analytic systems, it does not require pre-programming of known threats. For instance, for perimeter surveillance of a base, an individual camera’s “scene” rarely changes significantly. The program learns to treat this as a “normal” pattern. When an intruder enters the scene the system alerts security personnel to look at the footage, not because it recognized “intruder” but simply because the normal scene has changed. It also learns from how personnel react and becomes more accurate over time.
Training
Immersive training

The improved bandwidth performance of 5G enables the broader deployment of virtual and augmented reality (VR/AR) both indoors and outdoors around facilities and in the field. This capability has multiple use cases, including training of personnel and real-time information sharing for improved situational awareness.

Training with immersive VR/AR covers a broad range of activities from leading technicians through the maintenance process for complex technical equipment to running exercises on battlefield tactics. With 5G, AR can be adapted to a wide range of activities where the trainee has access to helpful, visually relevant information to help them master the activity even in the field.

It will contribute to the overall improvement of forces training level, while keeping their costs under control.
Base utilities
The typical military base is functionally not very different from a small city, and it can profit from many of the same use cases as smart cities do today. Most smart cities start their programs by installing broadband. For a military base, it may not be worth installing the fixed infrastructure needed for residential broadband. In these cases, 4.9/5G networks can provide broadband connectivity to residential users at home or on the move.

5G is also ideal for smart city services and can be used to provide broadband connectivity for everything from smart lighting to waste and water quality management. The key to most smart city services is advanced data and analytics collected from IoT sensors and cameras. Smart bases can also use this approach to understand and enhance services such as mobility and transportation, energy, environment, buildings and equipment.

Bases can also use 5G to enhance base safety and provide first responders with improved situational awareness and assistance from remote experts using data and video communications over 5G. Ubiquitous connectivity is also important for schools, hospitals and other community services provided on base.
Personnel recovery
Managing disasters and emergencies with 5G

There are many non-battlefield situations that require forces to respond, such as personnel recovery. Just as 4.9G is an important communications technology for public first responders, both 4.9G and 5G have a key role to play in military safety applications. 5G’s mobile broadband capabilities make video possible for real-time group video communications. Body cams can supplement existing CCTV cameras and vehicle-mounted cameras to provide feedback to the operations center during a recovery mission.

With 5G’s IoT capabilities, bio-vital health signs and chemical exposure can also be monitored, and geo-positioning can ensure that the whereabouts of responders and equipment is known at all times. It can also be used to geo-fence no-go zones to ground personnel in areas where, for instance, chemical spills or other hazards have been detected.

Micro-drones can be controlled over 4.9/5G and can be used to stream infrared and video images, as well as capturing sound, detecting safety hazards and giving directions to people remotely. 5G has more than enough bandwidth for these applications and can also augment visualizations during times of poor visibility using AR.
Why Nokia?
Why Nokia?

5G technologies will provide unprecedented opportunities to improve safety, productivity and efficiency across all levels of defense, from warehouses to maintenance and forward operating bases. With its very high bandwidth, low latency and reliability and massive IoT support, 5G is ideal for remote tele-operation of machines, drones and robots, thereby keeping skilled operators out of harm's way while improving overall efficiency. A hyperscale optical and IP/MPLS backbone will connect 5G base stations to edge and core clouds that will provide flexible compute resources to support AI and machine learning analytics for advanced automation.
Nokia calls this the Future X Network for defense: a secure, end-to-end architecture that will provide the reliability and scale that governments need. It relies on Nokia’s unique end-to-end mission-critical private wireless portfolio, which covers all the configurations needed by a defense organization. Based on best-of-breed products for each segment of the network, it allows end-to-end optimization of the 5G network to realize its full value.

**Portfolio tailored to mission-critical services**

<table>
<thead>
<tr>
<th>Devices</th>
<th>Radio</th>
<th>Backhaul/Transport</th>
<th>5G ready Core</th>
<th>Services &amp; Edge Apps</th>
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<tr>
<td>MulteFire &amp; unlicensed LTE modems</td>
<td>Airscale Macro BTS</td>
<td>Transport</td>
<td>Core Appliances &amp; Cloud core</td>
<td>Services &amp; Edge Apps</td>
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<tr>
<td>Ruggedized IP/MPLS LTE routers</td>
<td>Small cells BTS</td>
<td>Backhaul</td>
<td>Core Appliances &amp; Cloud core</td>
<td>Services &amp; Edge Apps</td>
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<tr>
<td>Ruggedized devices from partners</td>
<td>• LTE/4.9G &amp; 5G</td>
<td>• Mission-critical IP</td>
<td>DAC turnkey private wireless with integrated edge cloud &amp; applications</td>
<td>Services &amp; Edge Apps</td>
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<td>• Indoor &amp; outdoor</td>
<td>• Optical</td>
<td>• e.g. Drones, high-accuracy indoor positioning, group comms, …</td>
<td>Services &amp; Edge Apps</td>
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<td>• LTE-M, NB-IoT support</td>
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<td>Services &amp; Edge Apps</td>
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<td>250mW, 5W &amp; 20W</td>
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<td>Services &amp; Edge Apps</td>
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<td>Up to 840 users per BTS</td>
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**End-to-end management and orchestration**

**End-to-end security management and orchestration**
Nokia takes a holistic approach to securing mission-critical networks using a SOAR (security, orchestration, analytics and response) model that leverages AI and machine learning capabilities to predict, prevent, detect and respond to attacks. With its defense-in-depth security, automated security management, precision access controls, and intelligent end-to-end approach, Nokia can help governments gear up for 5G and enable many exciting new applications and use cases.

As chipsets and devices for 5G take the next several years to roll out, defense departments can get a jump by implementing Nokia private wireless solutions using LTE/4.9G technology today. Already incorporating many of the features of 5G, LTE/4.9G systems will enable teams to develop the skills and experience operating these advanced wireless networks and prepare for the seamless transition to 5G as it rolls out.

Nokia is a leader in mission-critical networks with more than 1,300 global customers and over 180 for private wireless networks. We serve the defense sector worldwide with over 30 deployed networks. Nokia Bell Labs has played a key role in the US defense sector for close to a century with key developments from radar to satellite communications. We continue to partner with the government on key initiatives and projects. A recipient of 12 US National Medal of Science awards and 11 US National Medal of Technology and Innovation awards, Nokia Bell Labs has a strong heritage of innovation and recognition from the federal government.
About Nokia
We create the technology to connect the world. Only Nokia offers a comprehensive portfolio of network equipment, software, services and licensing opportunities across the globe. With our commitment to innovation, driven by the award-winning Nokia Bell Labs, we are a leader in the development and deployment of 5G networks.

Our communications service provider customers support more than 6.4 billion subscriptions with our radio networks, and our enterprise customers have deployed over 1,300 industrial networks worldwide. Adhering to the highest ethical standards, we transform how people live, work and communicate. For our latest updates, please visit us online www.nokia.com and follow us on Twitter @nokia.

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