



NOKIA

From now to next.

Powering the 4th industrial revolution  
with Nokia Industrial-grade Private Wireless

## From now to next

For your business to be agile and responsive to shifting markets and demanding customers, you need to digitally connect all your critical operations in real time, across your business. You need wireless, low-latency connectivity that is utterly reliable, secure and covers every inch of your operations, no matter how fast the parts are moving. You need industrial-grade private wireless from Nokia.

The Nokia Industrial-grade Private Wireless solution is based on the latest evolution of LTE, 4.9G, used for nearly a decade in mobile networks and now available and affordable for private networks. It is as easy to install as a Wi-Fi network, as robust and capable as Ethernet and is also available in the industry's first 5G standalone version for trial networks. It will make your most ambitious Industry 4.0 dreams come true now and prepare your business for whatever comes next.



# Industrial-strength private wireless

Industrial-grade Private Wireless from Nokia provides robust connectivity to power your Industry 4.0 transformation.

- Remote control equipment and machines
- Deploy cameras for increased site security and operational overview
- Enable environmental data collection from low power sensors
- Implement remote controlled, autonomous and collaborative cranes, AGV and forklift trucks
- Compute the trajectories of vehicles, machinery and personnel for optimized workflows
- Implement smart wearables for increase safety of workers
- Run Push-to-talk and Push-to-video applications
- Connect machines wirelessly to allow production line flexible layout renewal
- Protect your data by storing and processing it in your own network, centrally or locally
- Track your assets with highly accurate indoor positioning
- Analyze anomalies in the production line with real-time video analytics.

Private wireless can support all mission- and business-critical vertical applications. It provides the pervasive and predictable connectivity to automate your operations, ensure safety and security, and push you to new levels of quality, efficiency and productivity.

## Private wireless capabilities

### One network for all applications

Very high  
reliability



Intrinsically  
secure



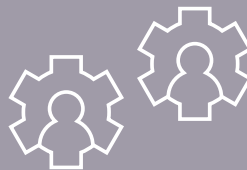
Large outdoor  
and pervasive  
indoor coverage



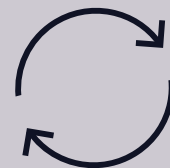
Predictable  
performance  
(data rate and latency)



High multi-user  
capacity



Full mobility



This is the vision of digital transformation that the Nokia Industrial-grade Private Wireless solution makes possible for any business.

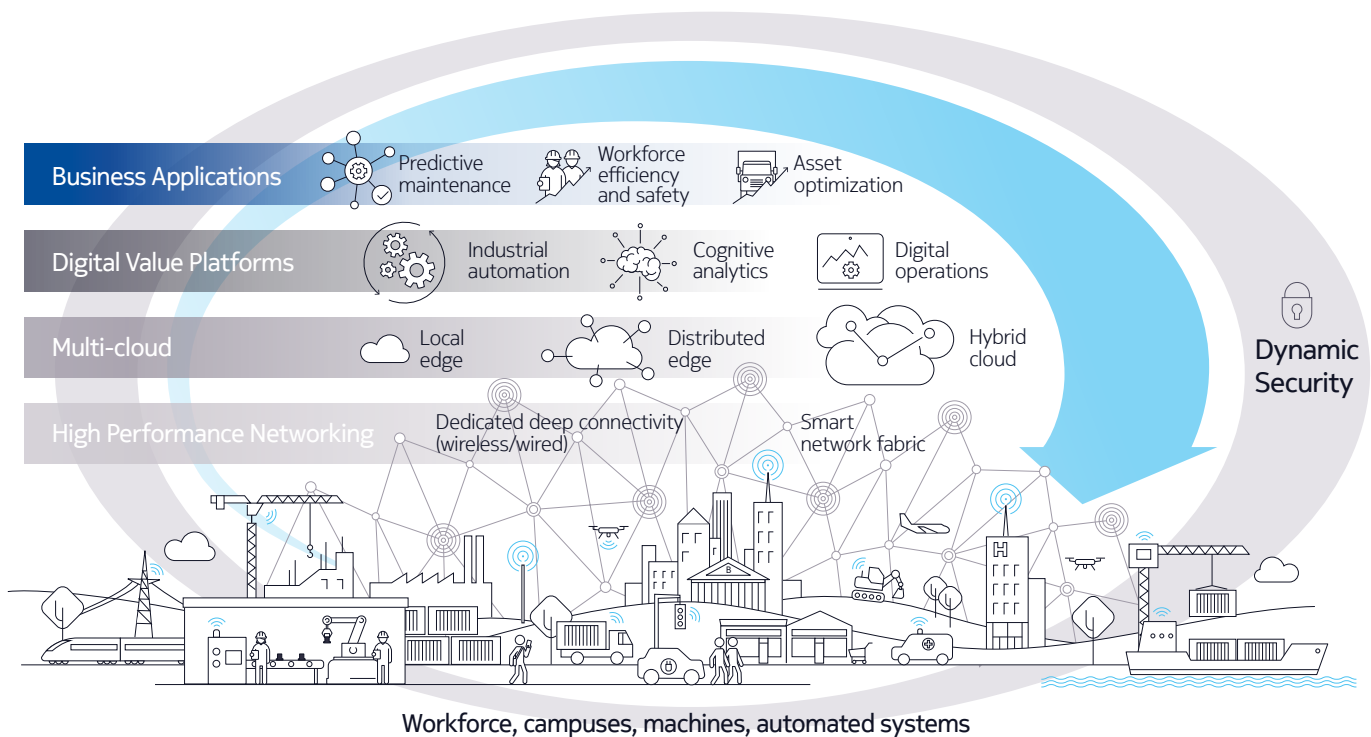
# Disruptive technology, one decade old

Until very recently, cellular technology was reserved for mobile operators due to their ownership of radio spectrum. Increasingly, governments around the world are releasing new spectrum specially designated for private networks. Mobile operators are also beginning to lease their spectrum to enterprise customers. Additionally, new versions of LTE/4.9G and future 5G-NR-U can operate in unlicensed or lightly licensed spectrum.

The Nokia Industrial-grade Private Wireless solution completely changes what you can do compared to any other kind of wireless technology. Imagine the capabilities of Ethernet in a wireless format. And, it already has a mature ecosystem of industrial devices and the LTE/4.9G version has proven its capabilities for a decade in the most demanding networks in the world.

## Future X for industries architecture

The Nokia Industrial-grade Private Wireless solution provides a ubiquitous connectivity platform for supporting enterprise clouds, dedicating slices for specific applications, such as IoT. Nokia's private wireless has digital connectivity to consolidate every kind of data, using AI and machine learning to optimize and automate your operations.






# Nokia Industrial-grade Private Wireless solution

The world's most complete industrial wireless solution, meeting industrial connectivity application requirements for Industry 4.0 today and tomorrow.

## Industrial-grade private wireless for secure, reliable and predictable performance

End-to-end solution from end-points to analytics and everything in between.

<h3>Reach</h3>  <h4>Deploy wherever you need it</h4> <ul style="list-style-type: none"><li>• Anywhere in the world</li><li>• Any site, any device</li><li>• On-premise and in the field</li></ul>	<h3>Flexibility</h3>  <h4>Use it and operate it as you see fit</h4> <ul style="list-style-type: none"><li>• Fit for purpose modular or turnkey</li><li>• On-premise or cloud-based operations</li><li>• Owned or As-a-Service</li></ul>	<h3>Ease of use</h3>  <h4>Industries' business is not networking but depends on it</h4> <ul style="list-style-type: none"><li>• Plug-and-Play</li><li>• Web management portal</li><li>• Blueprinted solutions</li><li>• Managed operation</li></ul>
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Nokia's private wireless is easy to deploy in combined indoor and outdoor areas of small to very large industrial sites and in field area networks. It can also be used by mobile operators to offer nationwide secure MVNO services.

### The key components are:

- An enterprise-grade, 4.9G and 5G core network — the heart of the system that orchestrates the network, authentication, mobility, etc.
- LTE/4.9G and 5G new radio base transceivers (BTS) — indoor or outdoor small or macro cells that provide the radio coverage

Enterprises get a dedicated wireless network that reserves its full capacity for business-critical machines, sensors and workers. The LTE/4.9G version is the latest evolution of the 4G standard and can support the majority of today's industrial applications. The Nokia Industrial-grade Private Wireless solution is also available as the world's first 5G standalone private network solution, ideal for early 5G trials and preparing your for full 5G deployment as industrial 5G devices become available.

Access to the network and priority/performance parameters are controlled by the enterprise. Defined machines, sensors and workers are granted access and guaranteed the right level of performance.

The Nokia Industrial-grade Private Wireless solution is complemented by Nokia's mission-critical IP/MPLS, optical, wireless backhaul, and passive optical LAN (POL) solutions. Nokia service capabilities provide enterprise a true end-to-end solution fitting their exact requirements.

# Two private wireless approaches to fit all requirements

Nokia's long experience has shown the need for extremely flexible solutions that adapt to the requirements of our customers. These needs generally break into two categories, and this is how we architected our offering:

## Focus on simplicity

### Digital Automation Cloud (DAC)

- Integrated **Plug & Play as-a-service** solution
- **Digitalization/automation platform** with ready-to-run applications
- **Enterprises and partners**

## Need for full control

### Modular Private Wireless (MPW)

- **End-to-end customizable** solution for most **demanding enterprise requirements**
- **Enterprises and partners**
- **CSP private wireless offering**

- **Latest generation LTE: 4.9G** and smooth **5G evolution**
- **Leading small cell portfolio and cloud core**
- Largest **range of spectrum options**
- Complete **IP and optical transport** solutions
- **End-to-end Management and orchestration**

With these two variations, Nokia is able to cater to all possible architecture and deployment scenarios, whether direct to enterprise or via mobile operators and system integrator partners:

- Fully autonomous, industrial site, local deployments
- Connected industrial sites with transparent roaming between the private wireless network and mobile operator networks
- Hybrid edge and centralized cloud deployments for both locally run applications and data processing as well as global management of multiple sites and release upgrades
- Centralized cloud deployments for enterprises wishing to leverage public clouds to run some of the private wireless network elements
- Mobile operator private wireless offerings
- Mobile operator secure MVNO services (e.g., public safety) or nationwide network slicing.

**The wireless access points**, called base transceiver stations (BTS), create the secure, low-latency and high-capacity wireless connections. They come in outdoor and indoor versions, with varying output power from 250mW to 20W. Each BTS can support up to 840 actively communicating users per cell.

Flexi Zone 4.9G all-in-one small cells can be connected by either CAT cables (existing or new), POL cabling or microwave links. Nokia small cells are renowned for their class-leading performance, high capacity and compact all-in-one form factor, easing deployment with a single box solution that integrates all the needed elements.

The Nokia AirScale range of BTS have 5G new radios covering both outdoor and indoor needs.



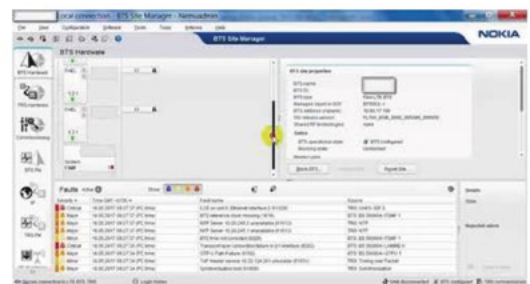
**The Enterprise core network** combines all the functions required to run a full-blown private LTE/4.9G and 5G networks. The Nokia Enterprise core runs on Nokia AirFrame servers. It supports up to 50,000 active users, 250 BTS as well as Geo-redundancy for increased availability and reliability. Additional blades can be added for increased capacity.

For DAC, the Enterprise core and management are operated in a hybrid edge-centralized architecture. Some parts of the core network and applications are operated in the edge-cloud server to ensure data stays within the enterprise LAN (local break-out), to lower latency and for the network to continue to operate in case of lost WAN connectivity.

An optional voice core module can be added for VoLTE support.



The Nokia Industrial-grade Private Wireless solution provides a software or web-based interface for operating and managing your system.



# Applications

Various applications, from Nokia or third parties, can be added to expand the system capabilities. For example:

- Nokia Group communications enables Push-to-Talk (PTT) applications on the same cellular network, saving the need to run a separate PMR network for critical-voice communications and also enabling Push-to-Video (PTV) applications.
- Nokia Space Time analytics applications can also be added to bring intelligent insights coming from captured sensors, machines or workers' data.
- High Accuracy Indoor Positioning (HAIP) provides indoor asset geo-positioning up to 30cm level precision using additional HAIP GW and low power tags.





# Where is Nokia Industrial-grade Private Wireless being used today?

The Nokia Industrial-grade Private Wireless solution is being used by many large enterprises worldwide to support business- and mission-critical enterprise applications for everything from utilities and mining to manufacturing, airports and port operations.



## Oil extraction

Reliable coverage for IoT sensors and remote plant monitoring and operation.



## Port operations

Video surveillance, video orchestration and remote operation and geo-positioning of vehicles (cranes/trucks).



## Manufacturing

Enhanced collaborative automated guided vehicles (AGVs), sensors, machine connectivity and group-critical communications.



## Mining

Autonomous ore trucks, video analytics and environmental sensors.



## Logistics

Operations center and hub optimization, global correlation, and video and IoT sensor analytics.



## Utilities

Distributed regional energy management, video analytics and asset monitoring and management.

## Critical wireless leadership

Nokia is a proven leader in digital transformation having spent decades building some of the world's biggest and most advanced mission- and business-critical IP, optical and wireless networks.

Nokia's 400+ LTE mobile operator customers today serve more than three of every four cellular subscribers worldwide. In addition, Nokia has deployed over 1,000 mission-critical networks with leading enterprise organizations such as utilities, railways, smart cities, mining companies, banks and healthcare systems worldwide.

Along with its strong heritage in networking, Nokia Bell Labs, one of the world's pre-eminent research organizations, has pursued cutting edge research in cloud, machine learning and analytics, developing the software platforms to support networking solutions for the new age of industry.



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## **About Nokia**

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing.

From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.

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