

NOKIA



2023

# Institute of Measurement and Control Webinar

14th February 2023

# The journey to Industry 4.0

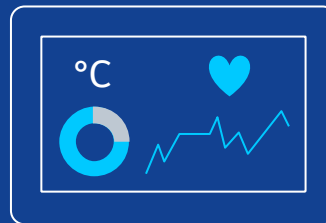
How digital technologies are transforming asset-intensive industries



Manual operation  
of physical assets

Real-time digital view  
of physical assets

Digitally controlled  
physical assets



# Industry KPIs and evolving needs are driving the adoption of digital technologies



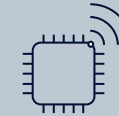
Fast, reliable, and secure mobile data connectivity



Mission-critical voice and video communications



Real-time video streaming



Sensor networks, IoT, analytics and AI



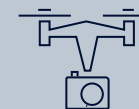
Low-latency for extreme autonomy and automation



Asset monitoring and predictive maintenance



Geo-location, geo-tracking and geo-fencing



Robots, drones and digital twins



Augmented/Virtual Reality



# Digital transformation is helping O&G to save time, money and lives

+6%

average total shareholder returns. (BCG)

+10% -8.5%

10% increase in revenue due to increased production and reduced time to project start-up, and an 8.5% decrease in cost from improved operational efficiency (PWC)

20-30%

Faster well delivery and more productive wells (BCG)

80%

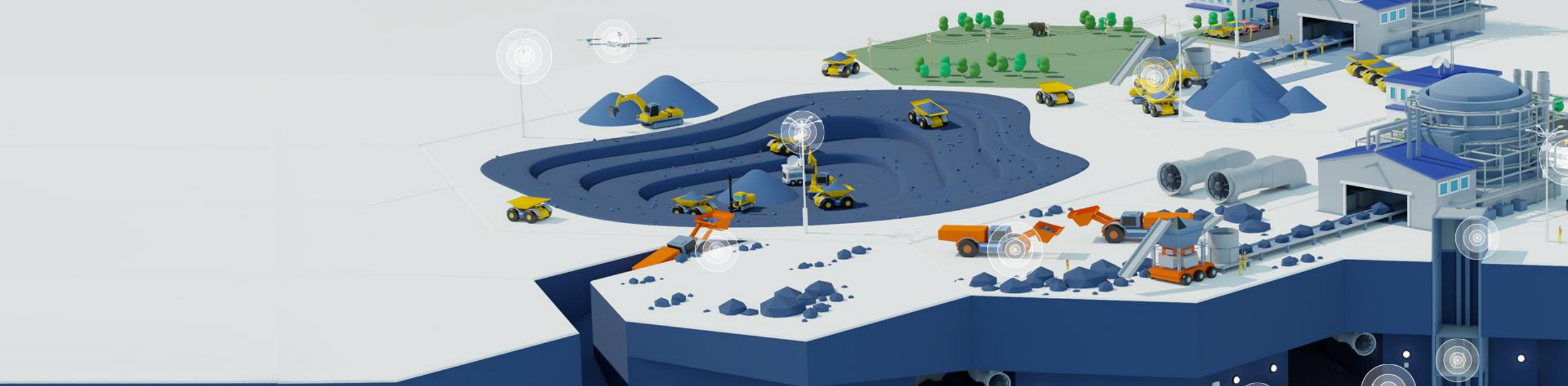
Robotic process automation can take on 80%, or even more, of the tasks executed today. (McKinsey)

11\$

Digital technologies could cut CAPEX by up to 20%. Cashflows improve \$11 per barrel across offshore value chain. (McKinsey)

3X

fewer safety recordables and process incidents (Emerson)



# What do we mean by Private Wireless

## What is a Private Network

# What do you know about a Wireless Connectivity?



**Bluetooth** is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances up to 100m. Typical applications are for connecting headsets to computers and speakers to phones.

Example: Music

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**Wi-Fi** is a technology that allows devices such as computers, smart phones, printers and video cameras to connect wirelessly with the Internet and other devices via a router. Typical bandwidth up to 200mbps, range up to 500m. Typical applications are for home and office networks and indoor public spaces.

Example: TV, gaming and office & plant networks.

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**Cellular Mobile** provides transmission over the air from a base station to a mobile phone or device fitted with a SIM card providing voice and data. Typical bandwidth up to 100mbps\* to 1Gbps\*\*, range up from 1km\*\* - 20km\*  
Typical applications are fixed and mobile hardware requiring high data rates, fast response over longer distances indoor and outdoor. **In most cases this uses Licensed Spectrum**

Example: Voice & data, high-definition video, augmented reality and control of autonomous vehicles\*\*

\*4G

\*\*5G

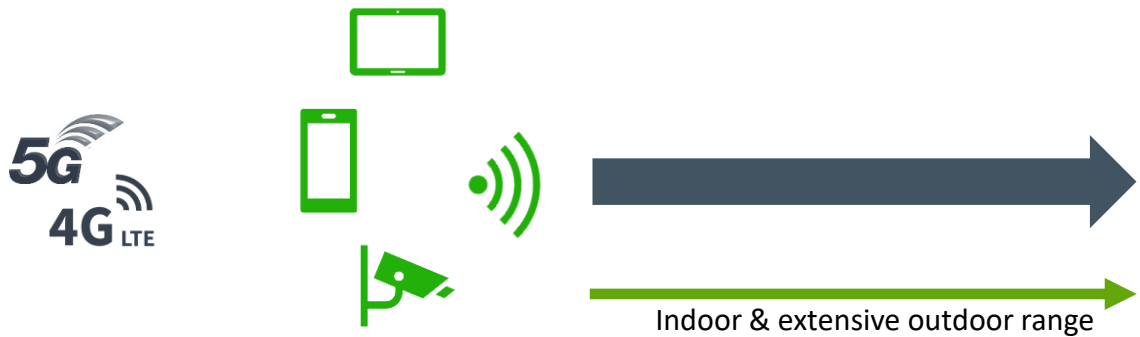
## What is a Private Network

# How does it work?



### Wifi

Your WiFi enabled device connects to a router which is connected to your IT network and the internet



### Public Mobile Network

Your mobile device connects to a tower which is part of a wider area network operated by a Mobile Network Operator (MNO).

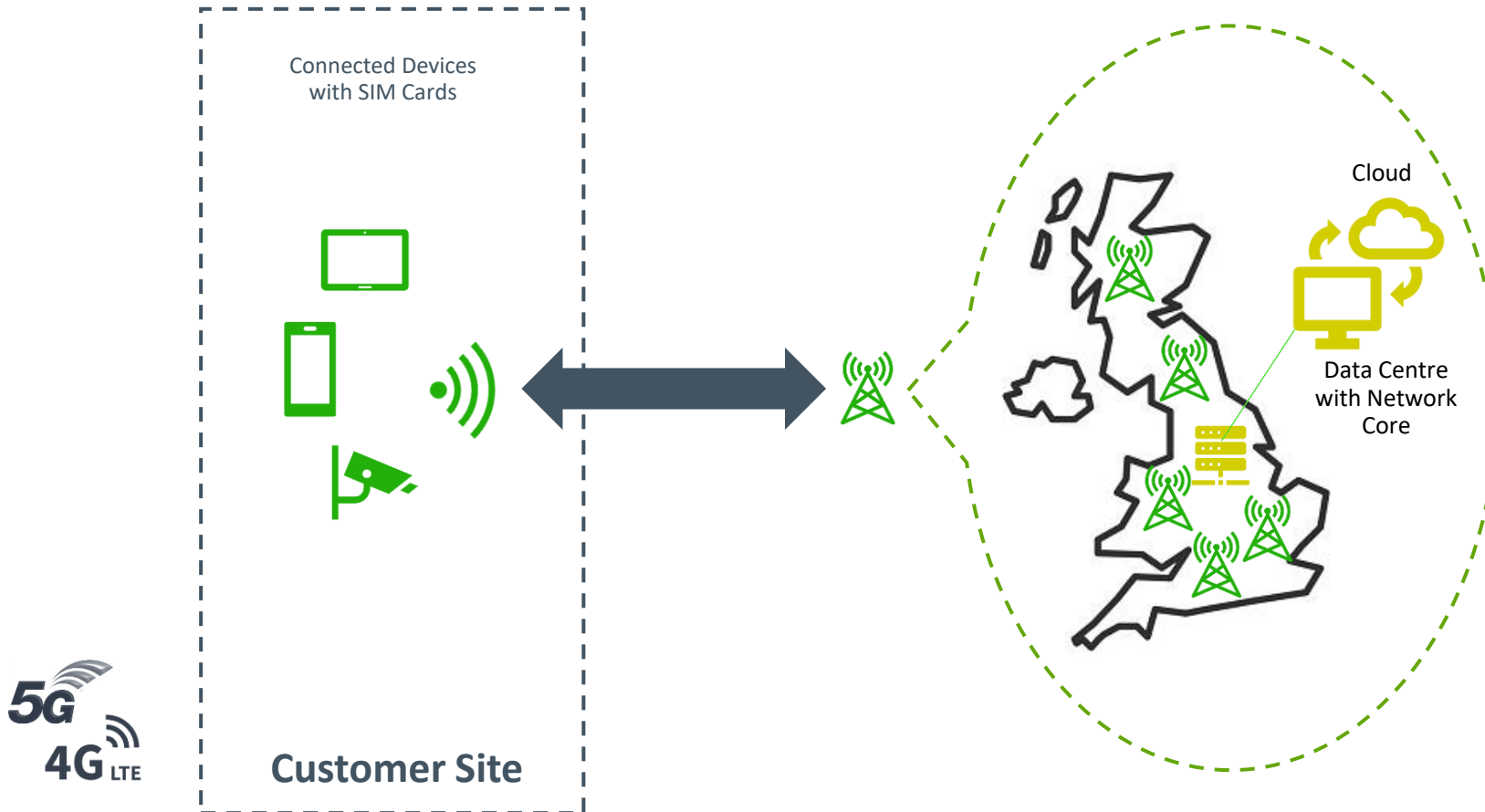
Your mobile device connects to other devices on the network and the internet





## What is a Private Network

# Should I use a Public Mobile Network for Industrial Applications?



## Public Mobile Network

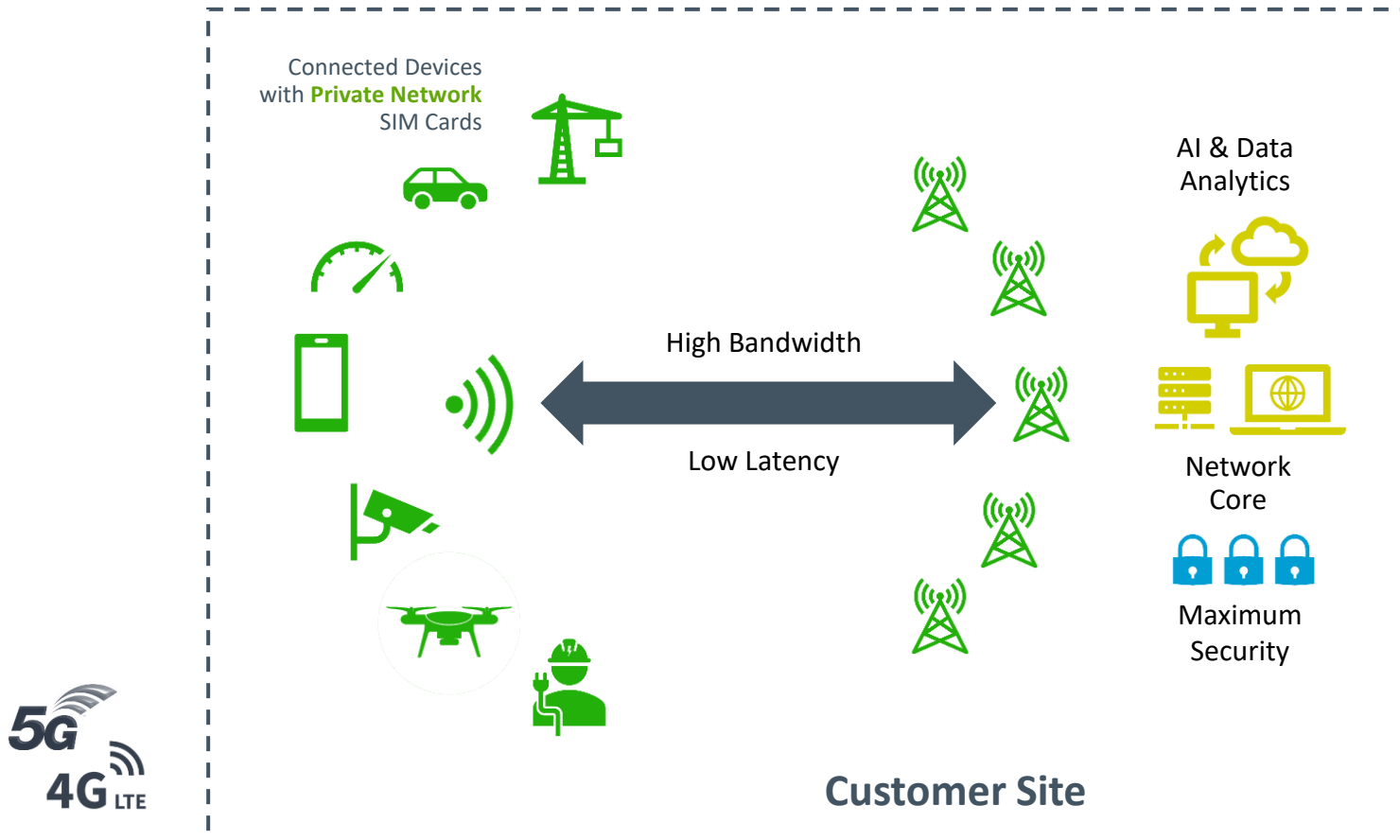
Infrastructure and services are shared with other users on a public network

- Variable bandwidth
- Medium-High Latency
- Variable Coverage
- Variable service levels
- Network Core Distant
- Licensed Spectrum



## What is a Private Network

# What does a Private Wireless Network offer?



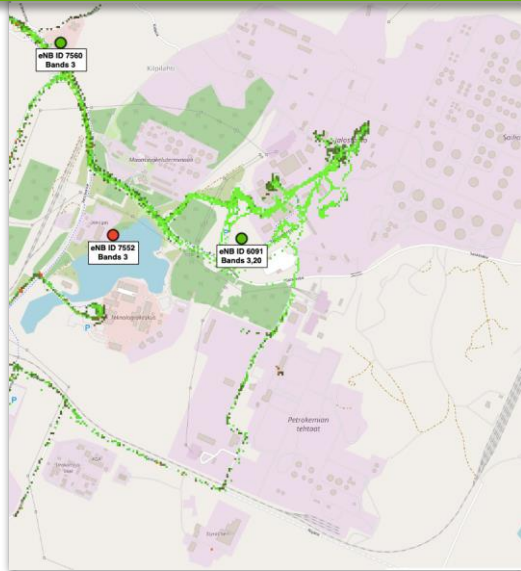
## Private Wireless Network

A Private Wireless Network uses dedicated 4G & 5G technology located on customer premises providing:

- High bandwidth
- Low Latency
- Maximum Security
- High Availability
- High Reliability
- Local High Performance Core
- Licensed Spectrum

# Advantages of Private vs. Public Network

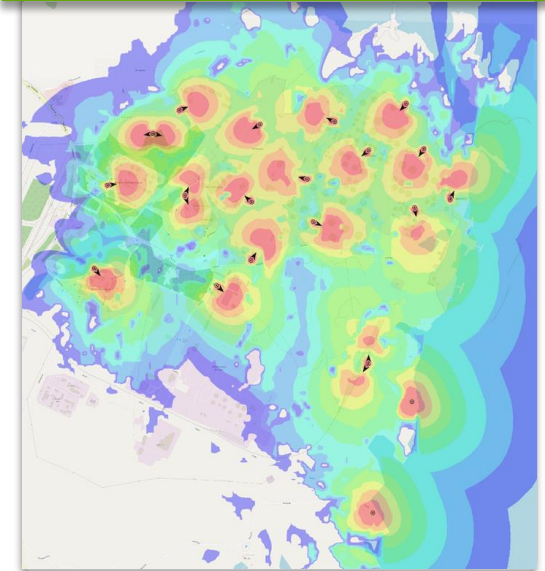
## Public Network by Mobile Operator



Before

Generic	<	<b>COVERAGE</b>	>	Tailored
Best-effort	<	<b>RELIABILITY</b>	>	Tailored
Shared	<	<b>SPECTRUM</b>	>	Dedicated
Uncontrolled (during Operator breaks)	<	<b>NETWORK MAINTENANCE</b>	>	Controlled

## Edge Connectivity with Private Network

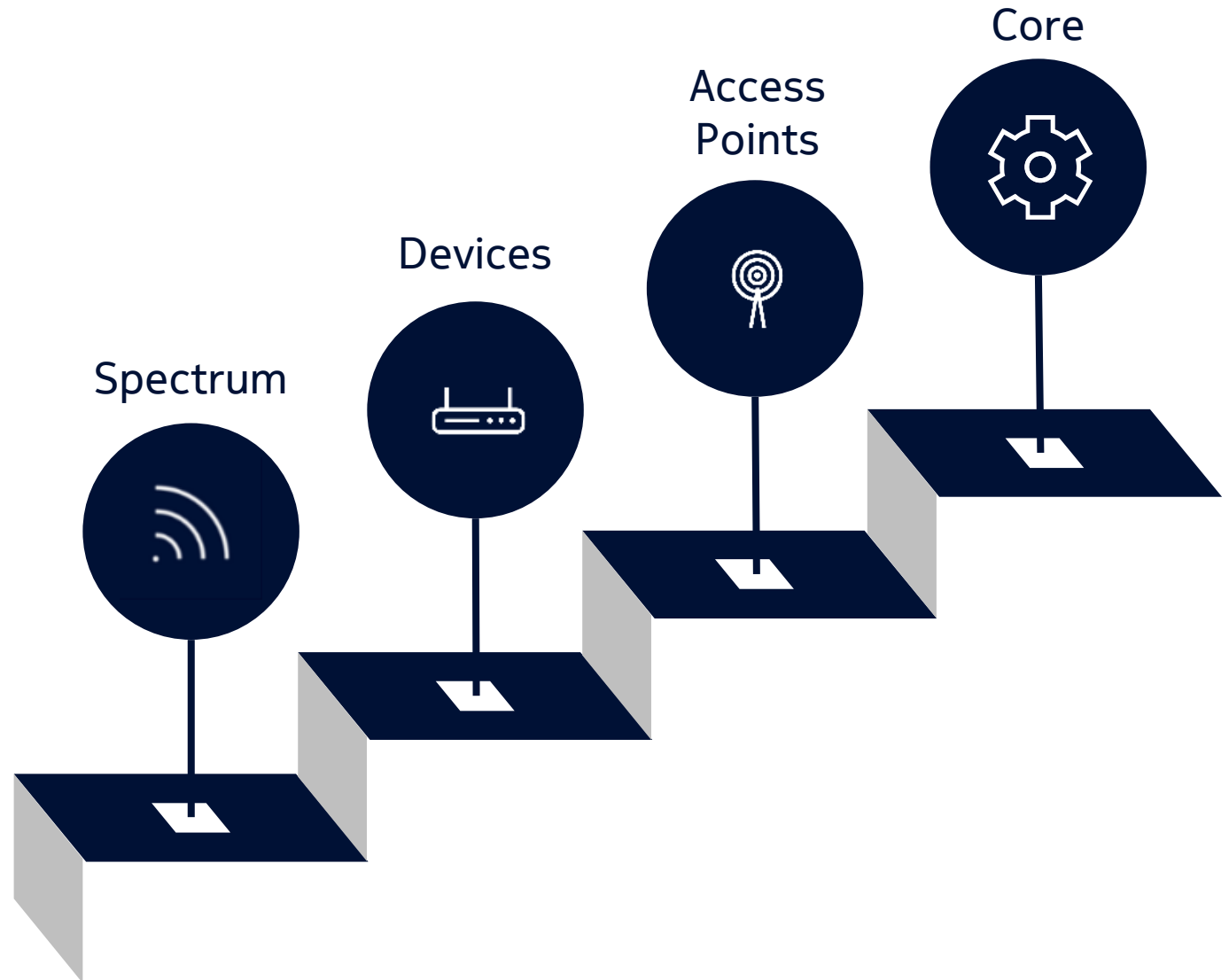


After

# The ingredients for private wireless

## It all starts with spectrum

- Spectrum is the critical resource. The choice of spectrum drives the design.
- Devices are then chosen to fit the use cases and solution
- Nokia make a vast array of access points; indoor & outdoor; coverage range from a few metres to tens of kilometres.
- Nokia has mobile cores that scale to all enterprise and Mobile Operator requirements.



# Most common triggers for Private Wireless

## Current wireless tech limitations

- Issues with existing use cases on existing wireless tech (e.g. AGV on Wi-Fi)
- Issue with existing wireless tech (e.g. aging PMR & PAMR network)



## Introduction of new use cases

- Specific new use cases that require reliable wireless (e.g. Mine autonomous haulage)
- Remote sites (e.g. Offshore sites)



## Incidents & External factors

- Worker safety (e.g. dangerous environments, ...)
- Site security breach
- Data privacy breach
- Major disasters



## Innovation & paradigm shift

- I4.0 “innovation” corporate projects
- Industry segment paradigm-shift (e.g. Distributed power generation)



## Wireless connectivity...

- Greenfield sites
- Brownfield sites with no existing wireless networks



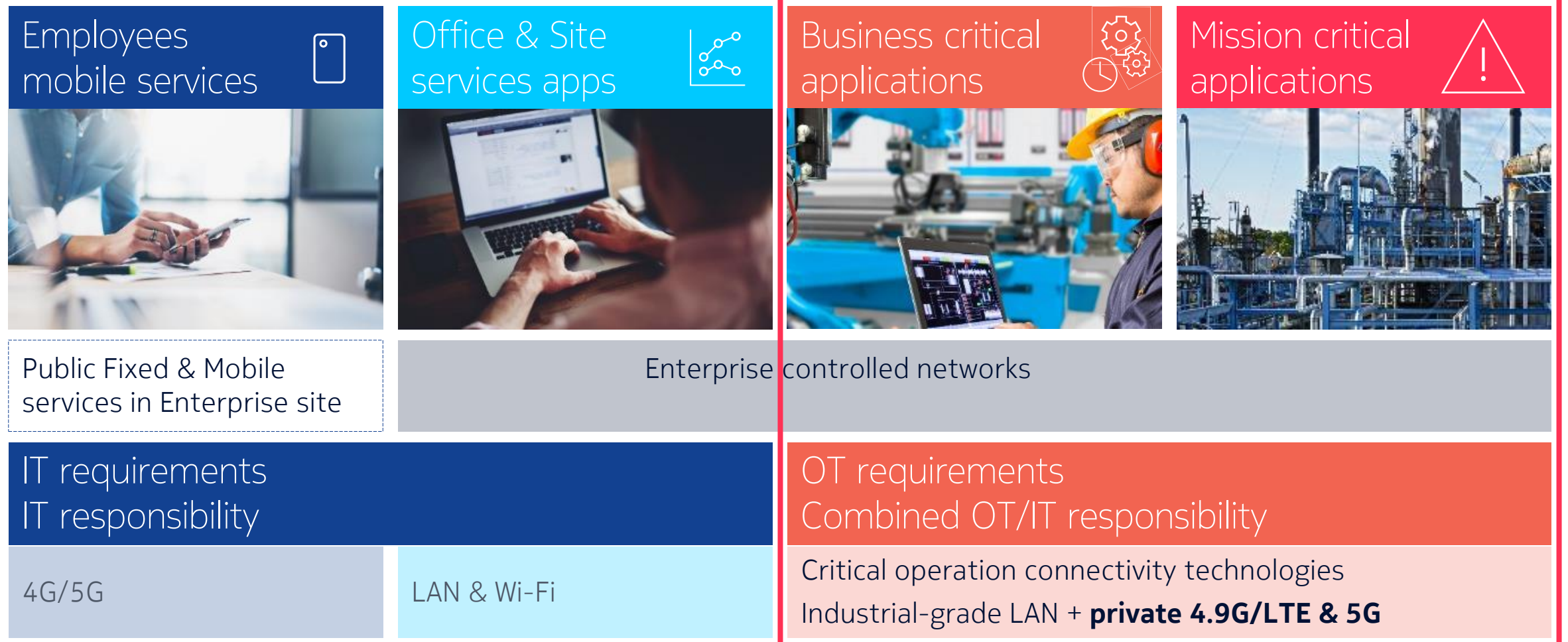




# Addressing different Business needs

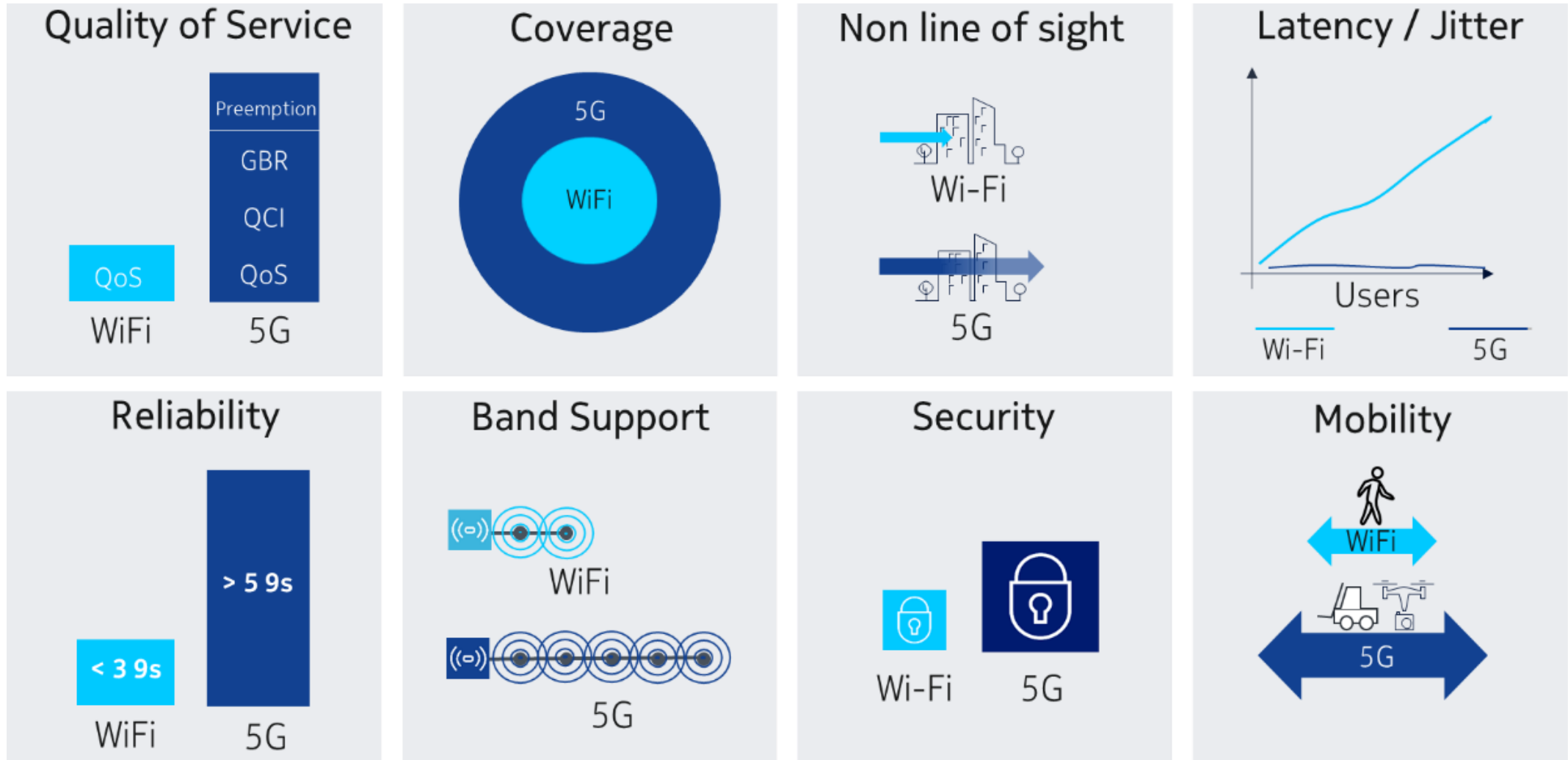
# Different application domains in the same industrial site

Different technologies for different requirements





# Private Wireless – Bringing best of Wi-Fi & Ethernet’s DNA for industry verticals’ “mass adoption” business-critical wireless connectivity



# The network can make or break your digital transformation

Wi-Fi networks haven't been designed for mission-critical environments

## Wi-Fi (5 and 6)



**Capacity:** ~30-100 active connections per AP



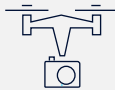
**Coverage:** access point radius of ~50-100 meters; truck mounted APs to cover the whole pit



**QoS:** best effort; lack of prioritization



**Performance:** high peak rates; unstable performance/capacity



**Mobility:** loss of connection up to 15 secs on handover between APs



**Latency:** fluctuating between 1 ms and 2 secs; reliability decreases with number of connections



**Security:** high risk for hacker attacks and intrusion



**Services:** co-existence with LMR/PMR radio, no IoT support; no handover to public network



**OpEx:** low cost perception (APs) but frequent reconfigurations needed, up to 15 hrs/week

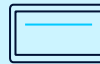
## Private Wireless (4.9G/LTE and 5G)



**Capacity:** up to 800 connections on a single (4.9G) small cell; tens of thousands on a macro antenna



**Coverage:** radius from 100 meter up to 30 km; 5-10 times less antennas needed



**QoS:** dependable QoS management with prioritization



**Performance:** predictable data rates; 99.9 – 99.999% reliability (99.9999% with 5G R17)



**Mobility:** 350 km/h (4G) to 500 km/h (5G)



**Latency:** 8-20 ms with 4G down to a few ms with 5G; remains stable with increasing number of connections



**Security:** security by design



**Services:** one network for PTT/PTV, broadband, video streaming, IoT; same technology as public 4G



**OpEx:** 4 times less configuration, management and maintenance cost; up to 5x less TCO\*.

\*Design, use case & spectrum dependent





# Nokia Private Network Portfolio



# Building technology leadership across the industry



## Mobile Networks

- Radio Access Networks
- Microwave Radio Links
- Related network management software and services



## Cloud and Network Services

- Business applications
- Core network solutions
- Cloud and cognitive services



## Network Infrastructure

- IP networks
- Optical networks
- Fixed networks
- Alcatel Submarine Networks



## Nokia Technologies

- Patent licensing
- Technology licensing
- Brand licensing

Enterprise Solutions derived from entire Nokia Portfolio

# Nokia Private Wireless – Providing choice to suit all requirements

A variety of business needs that generally breaks into two categories



## Focus on simplicity

### Digital Automation Cloud (NDAC)

- Integrated **Plug&Play as-a-service** solution
- **CI/CD Digitalization platform** with ready-to-run applications
- **Delivered Fully Integrated**



HPE DL 110



DELL XR11



Airframe OpenEdge

Common  
Industrial Edge  
(MXIE)

Growing industrial application eco-system:

Nokia:PTX, Team comms, Drone Control, Indoor Positioning, Scene analytics

3<sup>rd</sup> party; AR, industrial protocols, video orchestration, IoT

- **Latest generation Core: 4.9G and 5G (NSA & SA)**
- **Leading small cell portfolio & cloud core**
- Complete **IP and optical transport** solutions
- **End-to-end Management and orchestration**



## Need for full control

### Modular Private Wireless (MPW)

- **End-to-end customizable** solution for most **demanding enterprise requirements**
- **CMU core proven with 3rd party RAN**
- **Architectural flexibility**
- **Scales to business need**

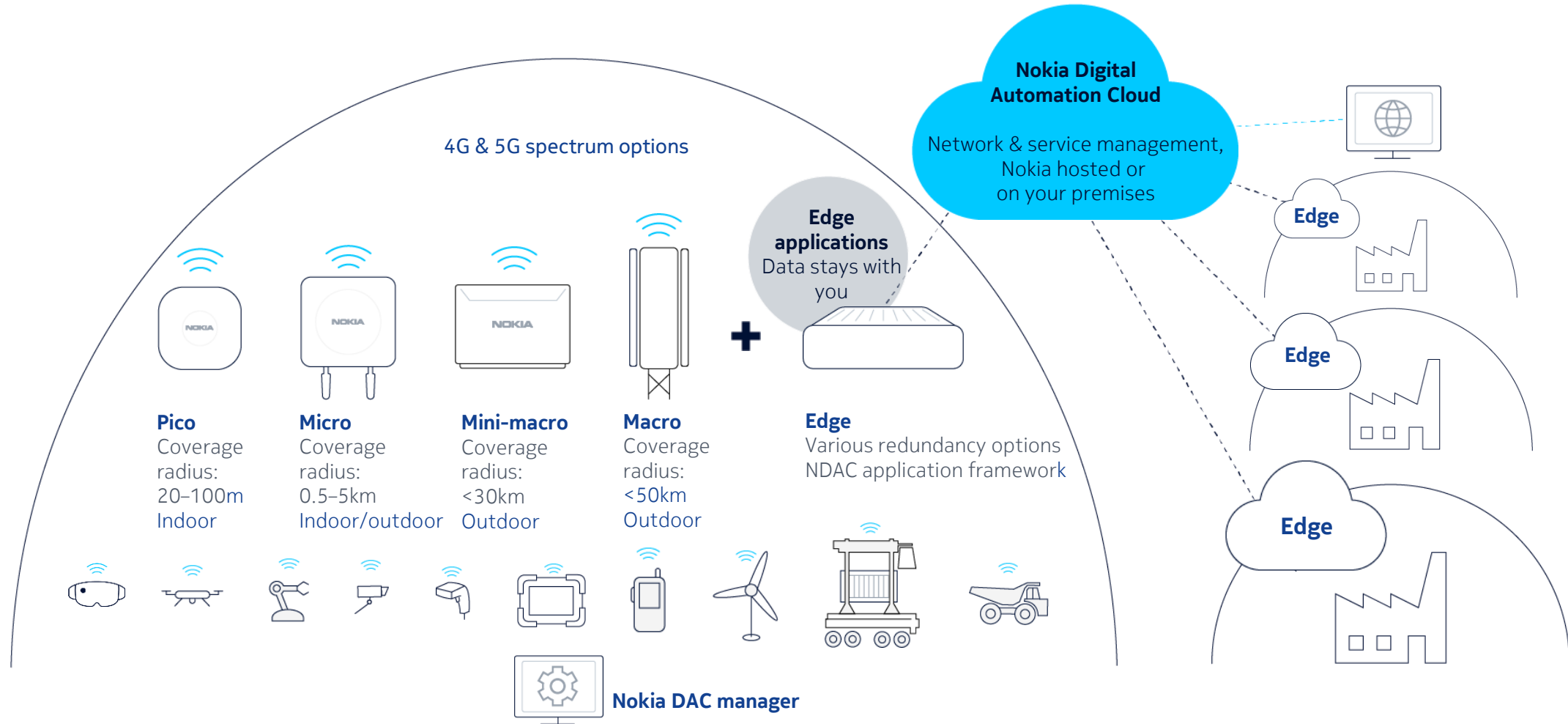


HPE DL325 Gen10+

# Nokia Digital Automation Cloud

E2E platform for private wireless connectivity and automation

Comes with; edge computing, access points, applications, user equipment and spectrum (in certain countries)





# Rich set of Digitalization Enablers

Nokia DAC Application Catalog running on MXIE

Industrial Private  
Wireless 4G/5G SA



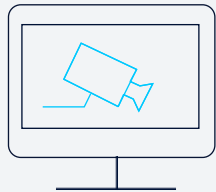
Critical Team  
Communications



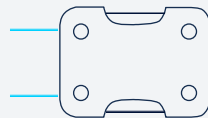
Unified Operations and  
Automation workflow engine



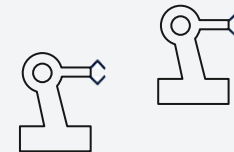
Video Analytics



Tracking and  
Positioning



Autonomous Mobile  
Robots



Mixed Reality

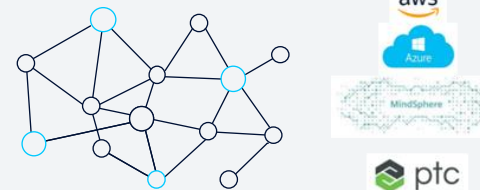


Industrial Connectors



- Profinet
- Sigfox
- Modbus
- BACnet
- ODBC
- OPC-UA
- CAN
- BLE

Webscale Connectors



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Click to deploy Industrial applications accessed from DAC application catalog

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Automated provisioning on MXIE edge from DAC

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Automated application lifecycle management

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Includes Nokia and 3rd party applications, offering growing

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# Nokia MXIE with 5G core

Small, Compact, Powerful



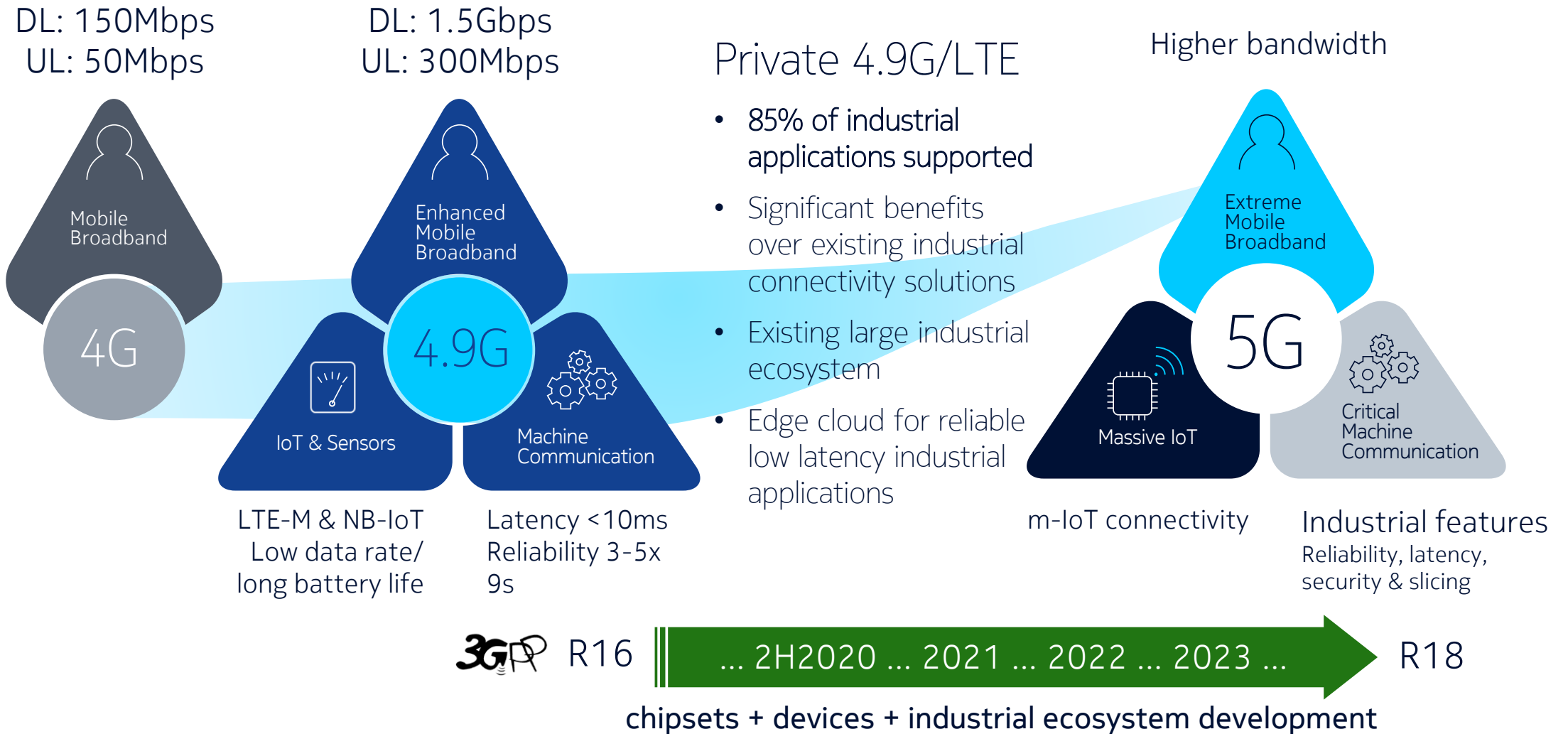




# Where are we on the 5G journey

# Industrial-grade Private Wireless networks

4.9G and 5G for mission-critical and business-critical communications







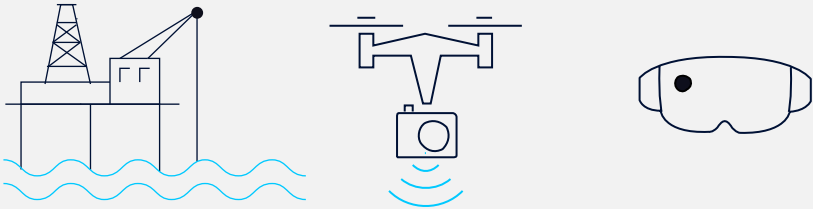

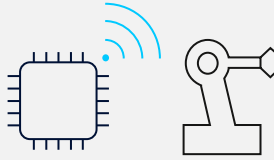
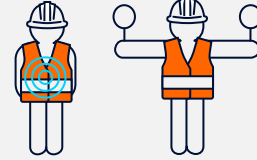

# Industrial Private Networks

Use Case Examples



# Typical Use Cases for Heavy Industry

One single network for connecting the assets that enable digitalisation

Real-time and near real-time broadband data			Mission-critical communications	Massive IoT & analytics	Worker health and safety	Optimized value chain
						
On-demand adaptive bit rate video from E&P platforms with potential for tele-operations.	Video monitoring and analytics on CCTV and drone camera streams for surveillance, inspections and repair.	Augmented reality (e.g. overlay of obstacle detection) on topographical maps, digital twin creation and synchronization.	Mission-critical Push-to-Talk (PTT) and Push-to-Video (PTV) services for worker safety and team communication applications (out-phasing TETRA/P25)	Communications from sensors for asset health and diagnostics, position reporting, environmental monitoring, process control and optimization.	Worker health and safety monitoring with digital Personal Protective Equipment (PPE) and wearables, geofencing for unauthorized or unsafe areas.	Leveraging extreme autonomy and near-real time equipment, load and people tracking for improved safety, productivity and efficiency.
High bit rate	High bit rate	Moderate bit rate	Low bit rate, low latency high priority	Low bit rate, moderate to high latency	Low to moderate bit rate and latency	Low to high bit rate, low to moderate latency
<p>Low to moderate latency</p>						

# Use cases: worker safety, situational awareness and critical communications

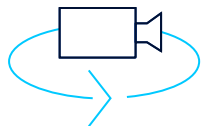
Monitor all O&G operations in real time to respond quickly to critical events



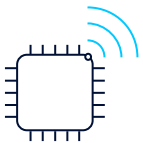
**Worker monitoring and critical communications:** use smart personal protective equipment (PPE) to monitor environmental conditions, worker biometrics and man-down situations, and to warn workers of hazards. Replace TETRA and P25 networks with LTE for mission-critical PTT/PTV services.



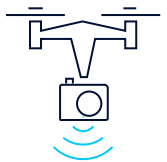
**Geo-location and geo-fencing:** use high-accuracy location services to track people and assets; onshore and offshore, indoor and outdoor. Combine smart PPE wearables and LTE geo-fencing to ensure workers aren't entering no-go zones.



**Video surveillance:** meet the extreme bandwidth demands of video cameras covering operational areas. And use video analytics capabilities to alert operators to anomalous behavior that requires their attention.



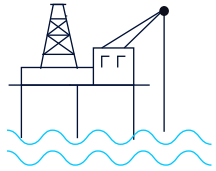
**Geological, meteorological and environmental monitoring:** connect remote operations centers to real-time sensor data for timely insights into mine conditions, so they can take action to prevent productivity losses or mitigate environmental risks.



**Drone inspection:** use drones to automatically survey and map platforms and wells, and to monitor pipelines, storage tanks and processing plants. And equip drones with gas/chemical sensors and HD cameras that stream data to monitor the environment for leaks.

# Use cases: offshore and onshore E&P communications

Get wireless coverage, capacity and reliability to support 24/7 operations



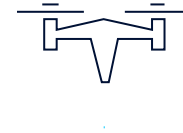
**Wireless communications between platforms and moving rigs/vessels:** reliable connectivity enabling fixed offshore facilities and surrounding/moving rigs and vessels to exchange data and connect people and things.



**Asset lifecycle management:** collect data from IoT sensors to understand the condition of every asset in real time; predict failure times and use condition-based maintenance to reduce costs, increase utilization and extend asset life.



**Unmanned /low manned remote operations:** reduce OpEx, reduce safety exposure due to less flying/driving to offshore/onshore; improve working conditions, wellness and productivity.



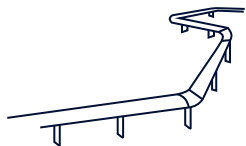
**Asset inspection and repair:** deploy drones and robots to inspect and repair assets in hazardous environments, isolated facilities and other places that are difficult or dangerous for personnel to access.



**Wellhead automation:** remote monitoring and control of wellheads, spread over large area, often in remote and harsh environments.



**Augmented Reality:** use AR/VR systems to train workers and give them real-time information. Enable maintenance staff to fix problems fast, with guidance on AR glasses to take them step by step to a rapid resolution of the issue.

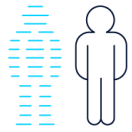


**Pipeline operations:** voice, data and video communication along pipelines, block valve stations and compressor/pump stations for field personnel and to the Main Control Center.



# Use cases: wireless communication in refineries and plants

Reliable wireless communications to automate and optimize operational processes



**Digital twin:** Monitor and visualize plant data as digital twin to optimize through advanced analytics, data mining, machine learning and IoT



**Facility Management & Security:** Fixed and mobile surveillance enhanced with IoT, virtual geofencing, video analytics and multi-functional drones.



**Smart connectivity:** Industrial private wireless and fixed networks, multi-site interconnect and seamless global connectivity to digitalize plant campuses.



**M2M Communication:** Machine-to-machine control, IoT, collaborative robots and edge/cloud-based coordination.



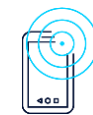
**Quality Management:** Condition, process and production (product) KPI monitoring with video analytics using anomaly detection, patterns and counting.



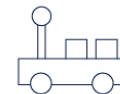
**Augmented Worker:** Digital, augmented or virtual content distribution to worker's device, incl. remote expert support and connected wearables.



**Wireless Human Machine Interface:** (Position-based) machine control via industrial protocols with or without safety functions using a human machine terminal.



**Voice & Video Communication:** Voice, video and enhanced group communication incl. external calls, prioritization and broadcasting features.



**Automated Guided Vehicles:** Motion control, video streaming, sensing, local edge computing and localization of autonomous guided vehicles.



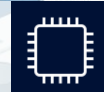
**Asset Management:** Control, locate, monitor condition, predict and remotely perform maintenance tasks of industrial assets across the digital plant

# Expanded Use cases for the entire value chain

Drone inspection of platforms, pipelines, plants and storage tanks



Monitoring of environmental conditions with IoT sensors



Communication along pipelines



Transport and distribution logistics



Enterprise LAN/WAN and data center networking



Geo-tracking and geo-fencing of people, vehicles and assets



Low-latency communications for autonomous vehicles and robots



Cyber security and defense

Undersea transmission networks



Wireless communications on offshore platforms and with vessels



Digitalization and automation of business-critical processes



Wireless connectivity to and remote management of offshore wind farms



MC PTT/PTV for person-to-person and group communications

Data analytics, AI-assisted decision making and digital twins



Main Control Center, telemetry and tele-remote operations

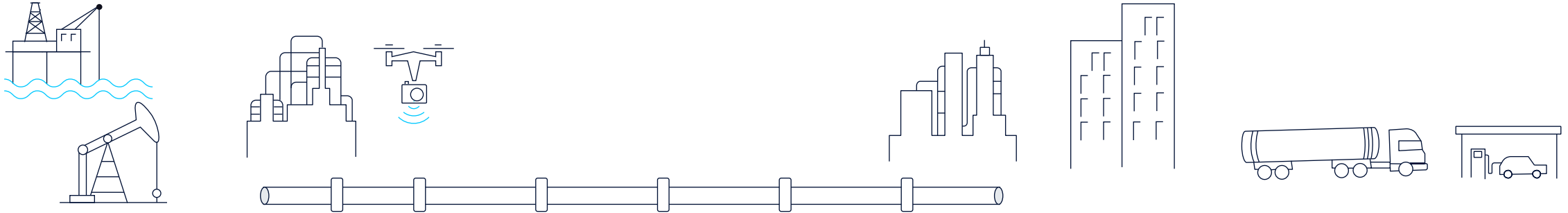


Digital PPE for worker health and safety



AR/VR for employee training and remote support assistance

# Leveraging Nokia's Wireless, IP and Optics leadership along the value chain

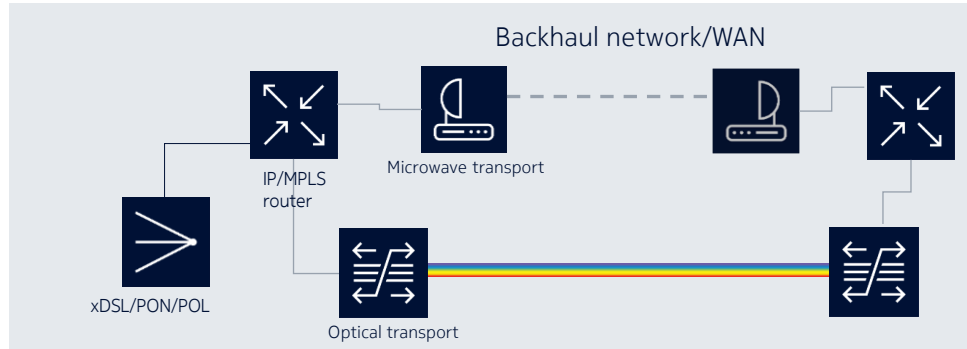


**Machines, people & sensors (UE)**

- Remote command and control
- MC-PTT/PTV
- IoT sensors and digital PPE

**Private wireless network**

- Radio
- Core
- Mngmnt



- Application servers
- Cloud/SDN
- Asset Intelligence
- Management
- IoT
- Scene Analytics

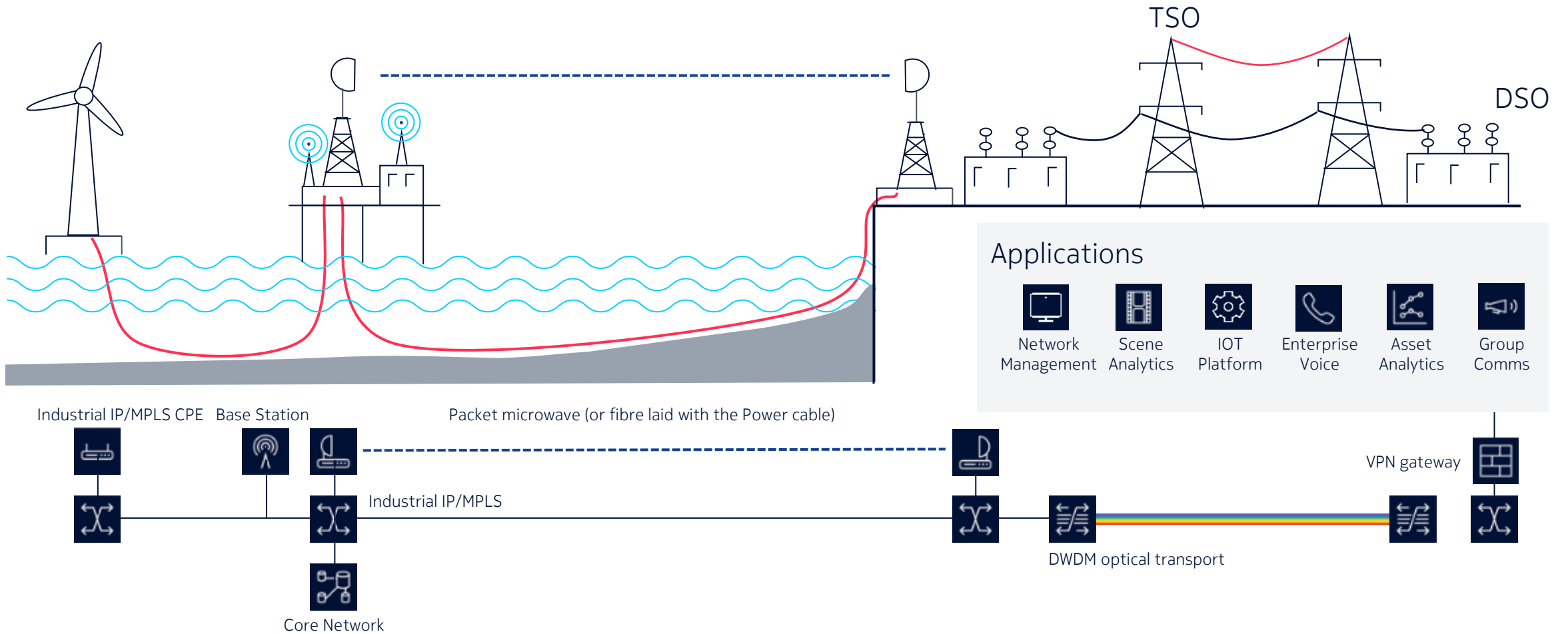


END-TO-END SERVICE ENABLEMENT & SECURITY

Design, Build & Operate Services



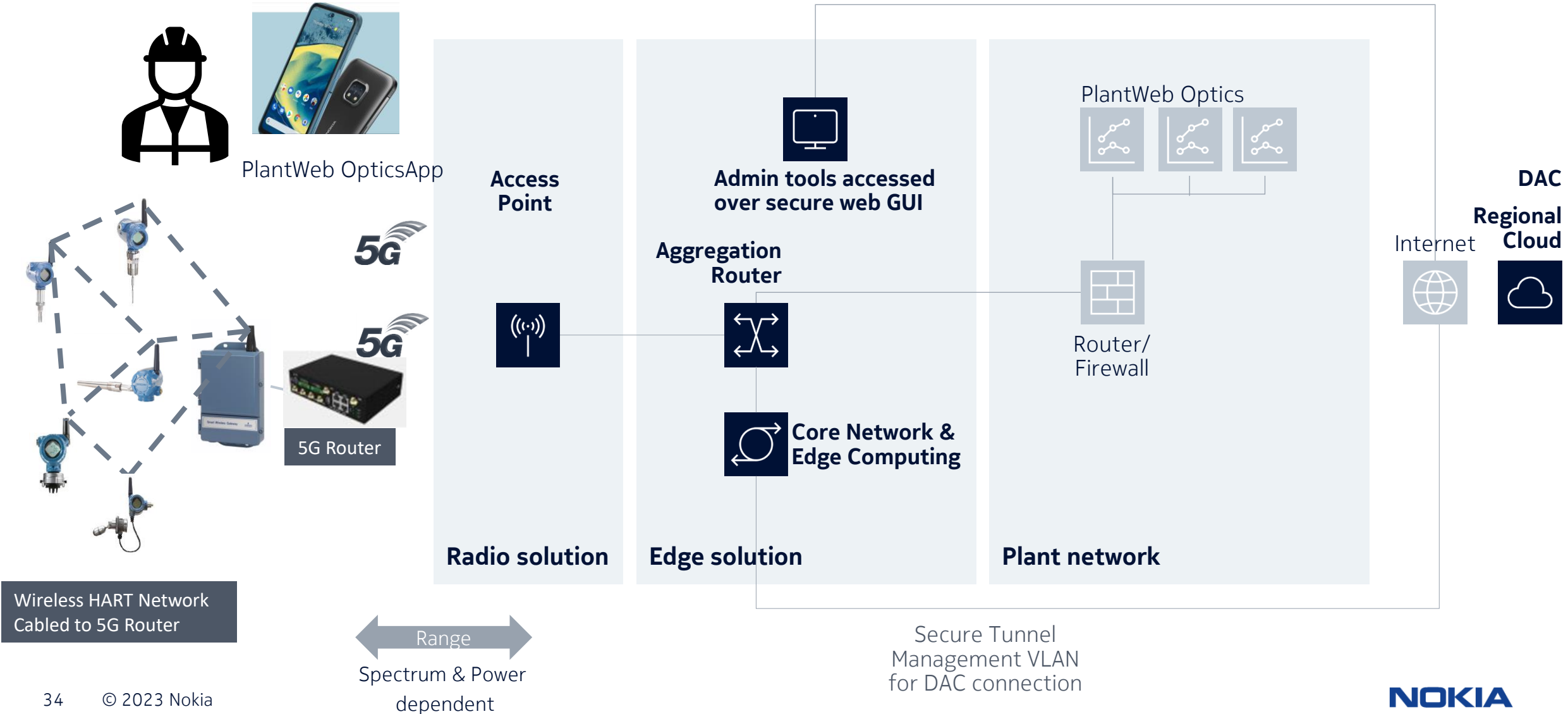
# Nokia's blueprint for wind farms (offshore solution)





# Wireless Hart™ integration – a potential use case

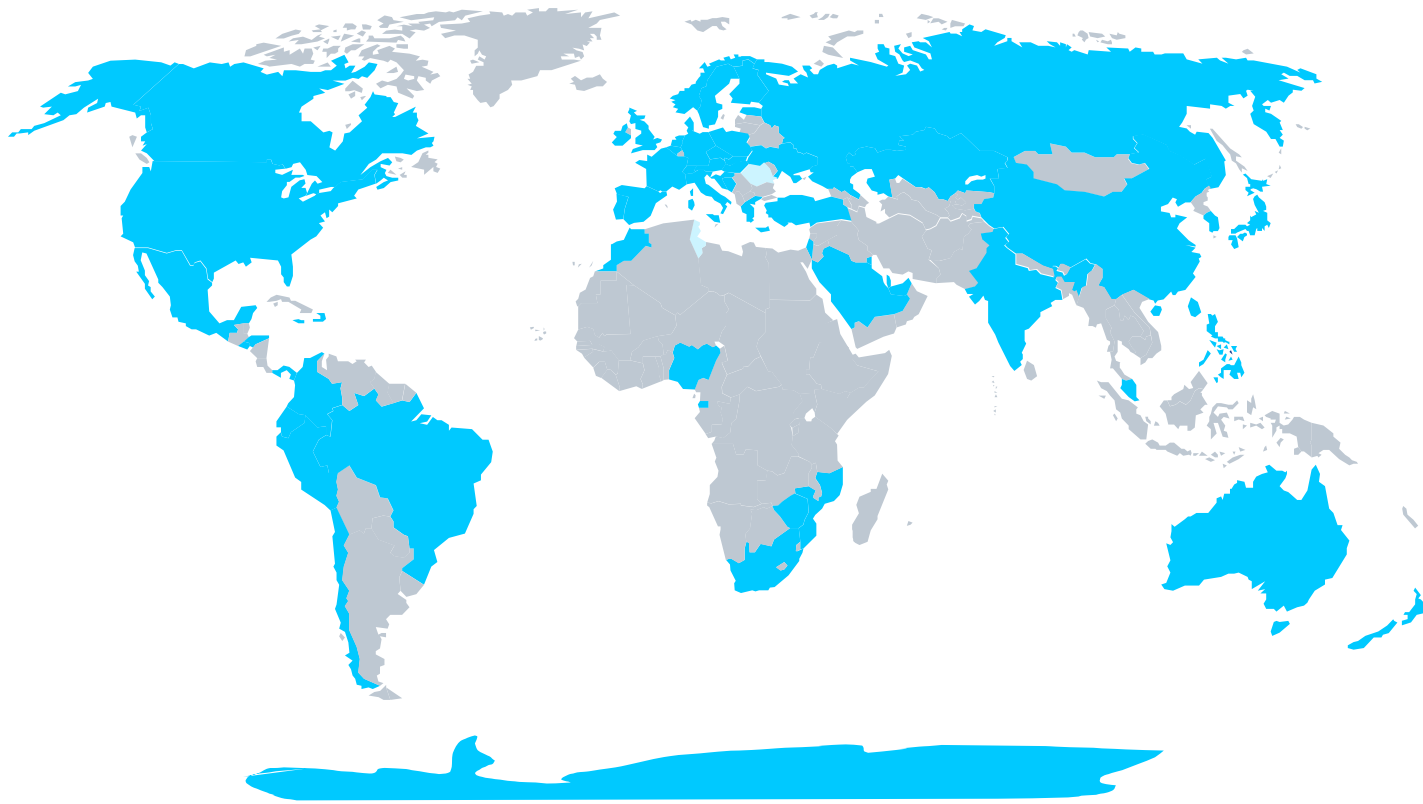
## Extending Wireless Hart reach without the need to run cables





# Some References

560+ private wireless customers  
 Uncontested market leader in private wireless\*



## Public references

Recent new logos



\*Supported by latest publicly released data from key analysts firms



# Collaborating with entire ecosystem to drive Industry 4.0



## Service provider partners

Expertise in building & operating mobile network or public clouds, spectrum partners



## Industrial bodies and ecosystem partners

Kick starting the industry with more LTE and future 5G industrial connected things



## System integrators & Consulting

Deeper industry expertise and specialised channel to market  
Broadening the sphere of influence





# Private 4G/5G LTE network coverage

Infrastructure Networks (INET), US service provider to Oil&Gas industry



## Background, challenges and drivers

- With 100+ customers INET holds/controls spectrum across the “Big 4” shale producing regions in USA
- INET is recognized as top 4G LTE spectrum and connectivity provider for the US energy industry, covering more than 110,000 square miles, including 80% of the US oil and gas producing assets in the lower 48 states
- Operators, drillers and oilfield service companies will embrace automation, analytics, AI and machine learning, only made accessible with next generation, high-bandwidth, low-latency connectivity.
- The robustness, reliability and sophistication of Nokia LTE platform brings accessibility at scale to IIoT applications, helping oil and gas operators embrace the digital revolution in the oilfield.

## Solution

- INET teamed with Nokia for network expansion and upgrade, utilizing in particular Nokia Airscale RAN (radio access network) and Wavence Microwave technologies

## Use cases and applications

- INET’s LTE network is positioned to meet the mission critical needs of the oil and gas industry across drilling, completions, production and midstream operations



# Private LTE for remote Oil operations

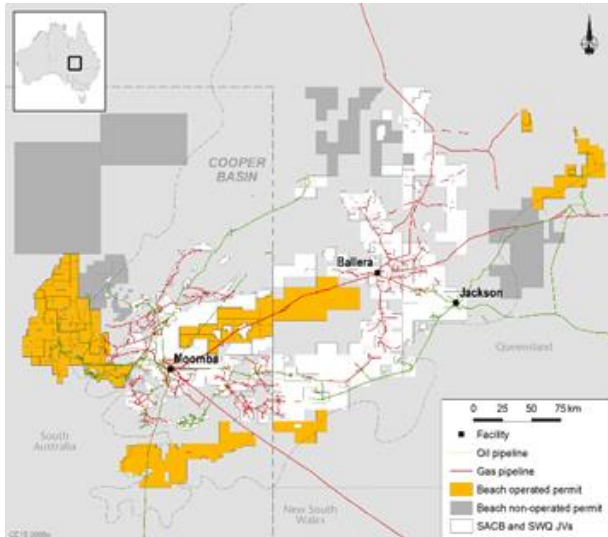
## Beach Energy, Australia's largest onshore oil producer

“The new LTE network allows our staff to access key systems, facilities and production information throughout our western Cooper Basin field area, reducing requirements for travel between sites, making operations more efficient, saving money and significantly enhancing safety”

– Neil Gibbins, Acting Chief Executive Officer at Beach Energy Limited

### Solution

- State-of-the-art voice and data network through local Partner
- Nokia LTE macro and micro base stations
- Significant productivity gains through lower OPEX using Nokia LTE base stations, each of which can typically replace multiple WiFi access points



### Use cases and applications

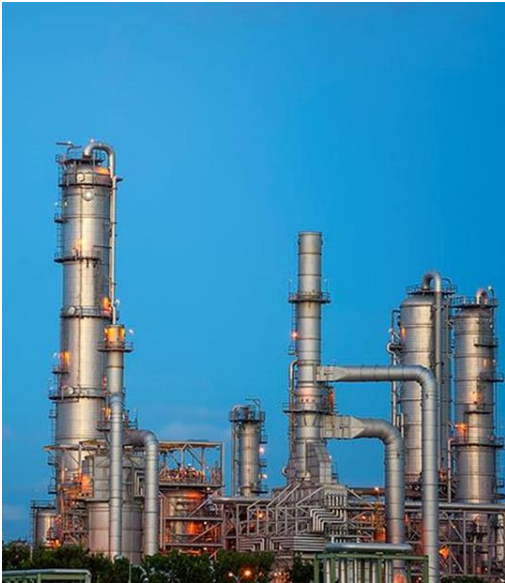
- Access to key systems, facilities and production information

# Nokia Digital Automation Cloud platform

## Oil refinery in Europe

### Background, challenges and drivers

- Needed to improve operational efficiency in the refinery
- Large outdoor area with limited cabling as it is costly
- Difficult environment to roll out Wi-Fi
- Limited public mobile network coverage and capacity.



### Solution

- Nokia private LTE improves operational efficiency and saves costs

### Use cases and applications (in phases)

- Connectivity to oil refinery vehicles
- Extension of office network to process area for company workers and subcontractors
- Facility checks, detection of oil leakages with dedicated cameras & drones reducing need for manpower
- Equipping local fire department with push-to-talk, meeting needs of oil refinery port operations



# 5G-ready private 4.9G/LTE network

Frame agreement with a leading producer of oil, gas and wind power

## Background and drivers

Equinor is well underway to deliver profitable growth in renewables and being a leading company in the energy transition. With five decades of ocean engineering and project management expertise, focus on safe and efficient operations, in depth knowledge of the energy markets, skilled personnel and a network of competent partners and suppliers, Equinor is uniquely positioned to take a leading role in this burgeoning industry.

## Solution

The eight-year frame agreement will include hardware, software, design, radio planning, implementation and support. Under the agreement, the private LTE network has been installed at Dudgeon and Sheringham Shoal windfarms, located in the UK and both operated by Equinor.

## Use cases and applications

The industrial-grade private wireless technology will deliver the reliability, capacity, security and low latency needed to support collaboration between teams across Equinor's installations.



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