Going Beyond Connectivity: Architecture for Enterprise use cases

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Nokia at a glance

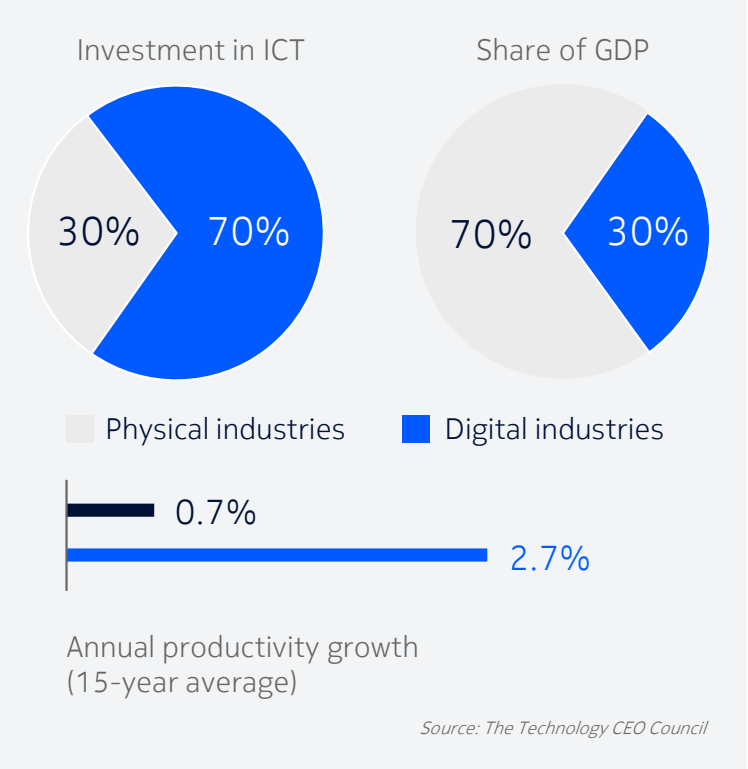
We are a B2B technology innovation leader pioneering the future where networks meet cloud, to realize the full potential of digital in every industry

Unlocking new opportunity for:

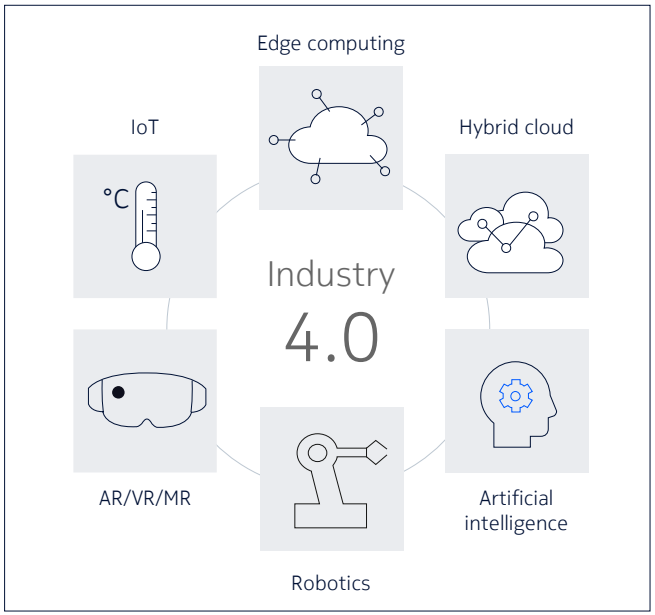
- Telecom service providers
- Enterprises and governments
- Webscalers
- Technology licensees

On the edge of the 4th industrial revolution

...and this is happening NOW



Confluence of key technologies enablers create the perfect environment for Industry 4.0



>70%

enterprise are investing in IoT today

https://www.pwc.pt/pt/temas-actuais/pwc-apresentacao-iot.pdf

49%

IT are reporting working closer with OT on IoT projects (32% in 2018)

451 research - Internet of Things, Organizational Dynamics 2019

Industry 4.0 transformation cycle

Understand

From information to knowledge
Real time data analysis for intelligence

Predict

From knowledge to wisdom
Prepare with predictive analysis

Critical

Networks

See

From physical to digital
Real time data generation of physical assets
Pre-requisite: Physical assets connectivity

Autonomous Action

From wisdom to intuitive action
Controlled fully autonomous, self-learning and organizing systems
Pre-requisite: Digital control of physical assets

Industry 4.0

Full operational transformation enabling new business models

Different application domains for the same enterprise

Different technologies for different requirements

WAN Employees mobile services

WAN Business applications

Employees' mobile subscription, Coverage at enterprise site offices, Non critical IoT sensors in the fields, Remote sites wireless connectivity, etc…

WAN Business critical apps

Vehicle fleet tracking, delivery scanner devices, drone operation, repair crew communications, etc…

WAN Mission critical apps

Oil well & wind turbine monitoring, public warning system sensors, emergency intervention teams

IT requirements
IT responsibility

Mobile operators nationwide networks (2G to 5G)

LAN and WiFi

OT requirements
Combined OT/IT responsibility

Private networks (5G & LTE/4G)

SLA based nationwide MO / IoT mobile networks sharing

What connectivity technology to use?

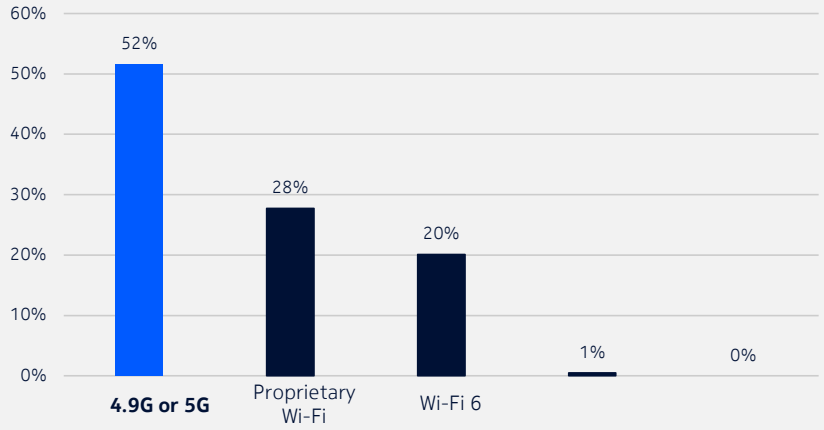
Private Wireless (5G/LTE) more suitable for mission and business critical applications

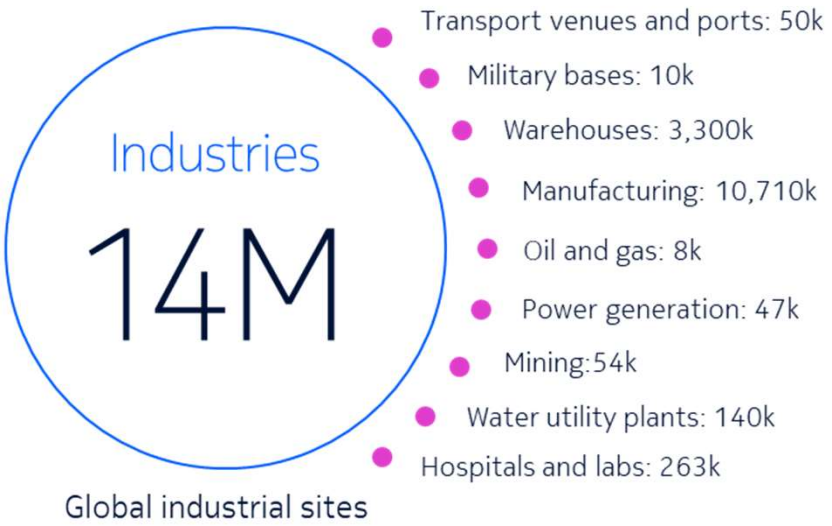
	Wi-Fi 5/6	TETRA P25	SCADA	LoRaWAN Sigfox	Bluetooth BLE	LTE & 5G
High data-rates, low-latency	✓	✗	✗	✗	✗	✓
Mission-critical	✗	✓	✓	✗	✗	✓
Cyber-secure	✗	✓	✗	✗	✗	✓
Predictable performance	✗	✗	✓	✗	✗	✓
Coverage	✗	✗	✗	✓	✗	✓
Fast mobility	✗	✓	✗	✗	✗	✓
LP-WAN (IoT)	✗	✗	✓	✓	✓	✓
MC Voice	✗	✓	✗	✗	✗	✓
Single tech. for all use cases	✗	✗	✗	✗	✗	✓

LTE/5G is becoming the main connectivity technology for industrial networks

"43% of European enterprises consider **network transformation to be a key challenge** [..] recognizing that **current networks cannot support the future growth** [...] in areas such as **IoT and digital transformation"***

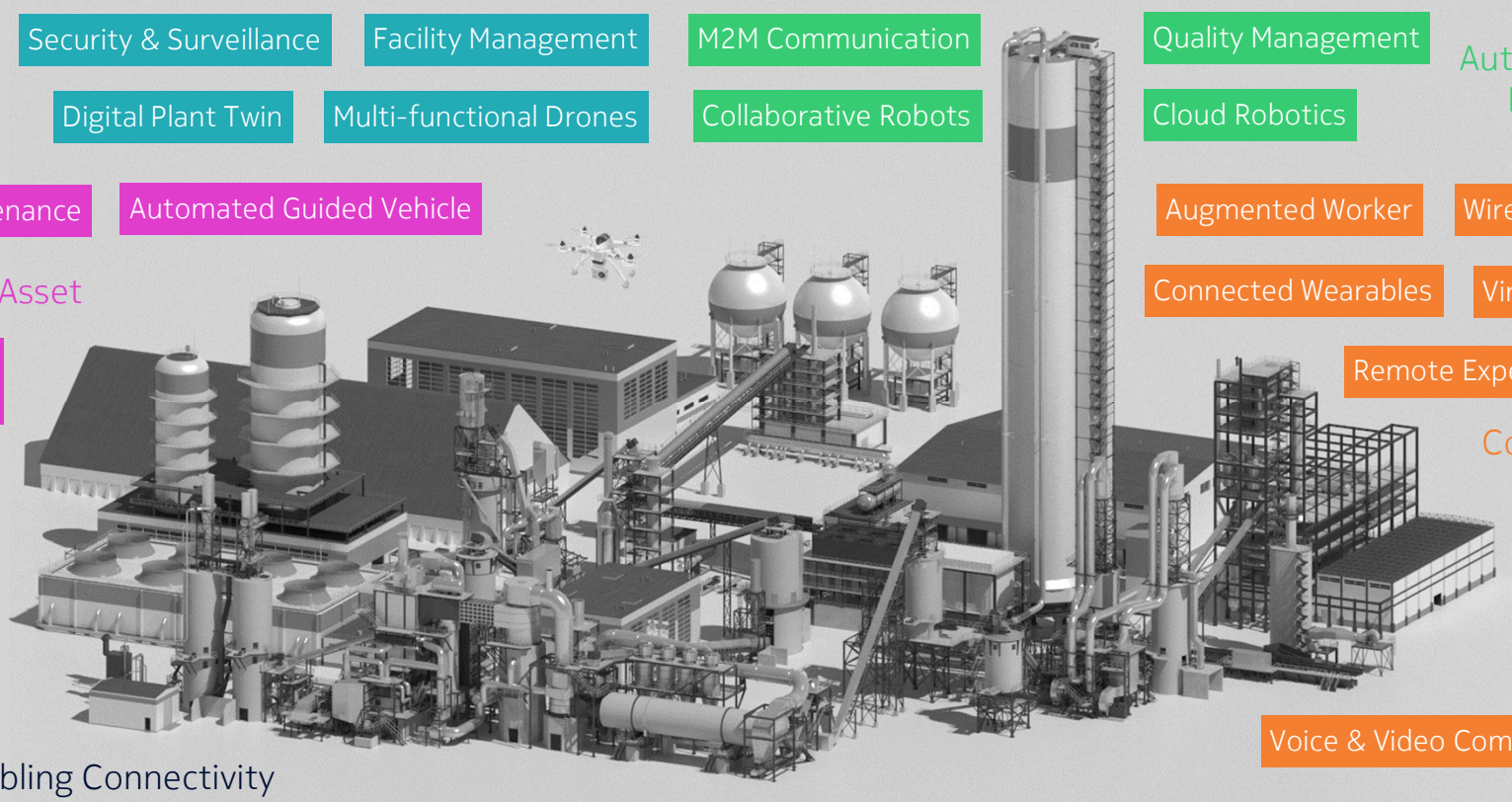
52% plan to leverage private LTE/5G for their future business/mission critical connectivity**





* IDC, European Enterprise Communications Survey, 2019
** 2021 Nokia-ABI research, 600+ manufacturers survey
*** Omdia 2021 - Global pWireless BTSes shipments. Results are not an endorsement of Nokia . Any reliance on these results is at the third-party's own risk.

Industry 4.0 use cases apply in a variety of producing plant contexts



Digital Industrial Campus

Security & Surveillance

Facility Management

M2M Communication

Digital Plant Twin

Multi-functional Drones

Collaborative Robots

Quality Management

Cloud Robotics

Automated Plant

Predictive Maintenance

Automated Guided Vehicle

Augmented Worker

Wireless Safety

Smart Asset

Connected Wearables

Virtual Reality

Asset Condition Monitoring

Remote Expert Support

Connected Worker

Remote Maintenance

Remote Configuration & Control

Wireless Human Machine Interface

Voice & Video Communication

Enabling Connectivity

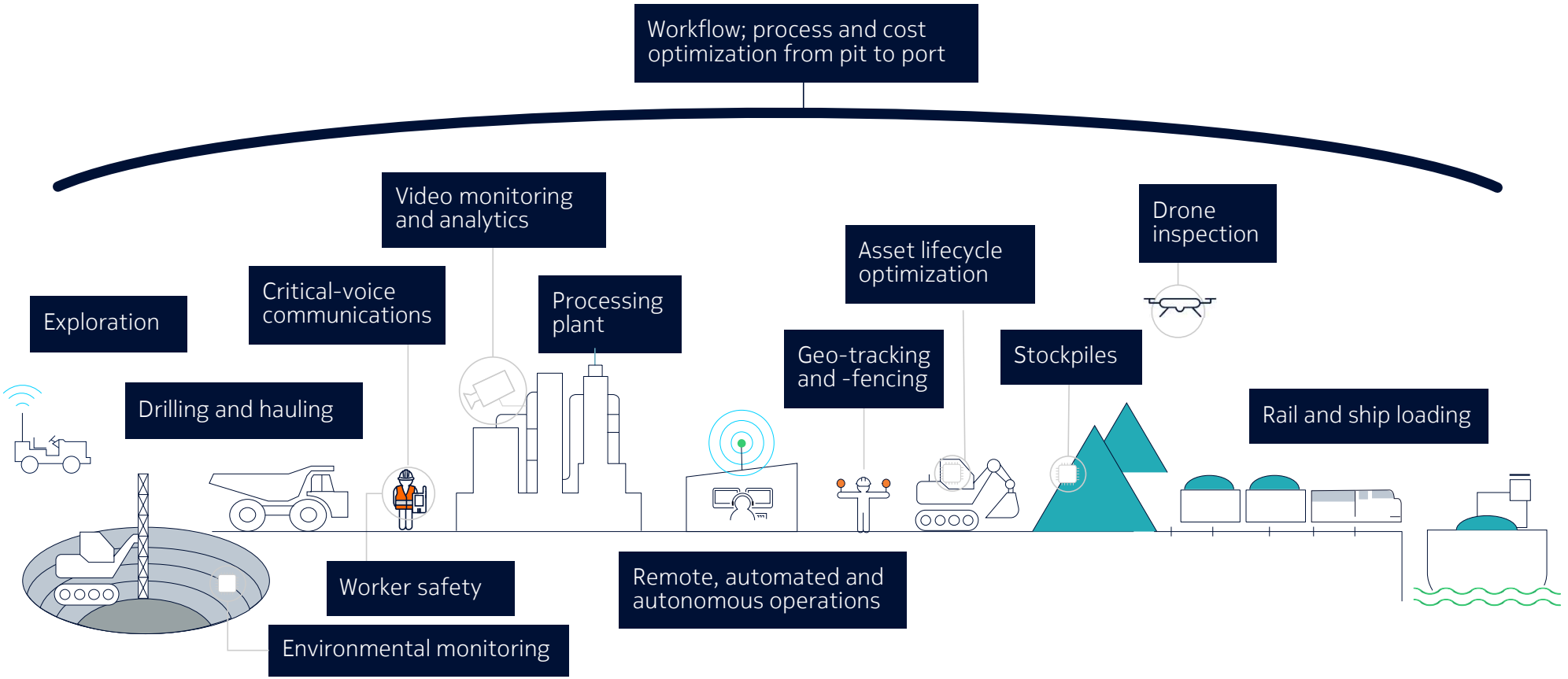
Industrial Private Wireless Network

Industrial Fixed Network

Multi-Site Inter-Connect

Seamless Global Connectivity

Mining - enabling digital transformation use cases from pit to port



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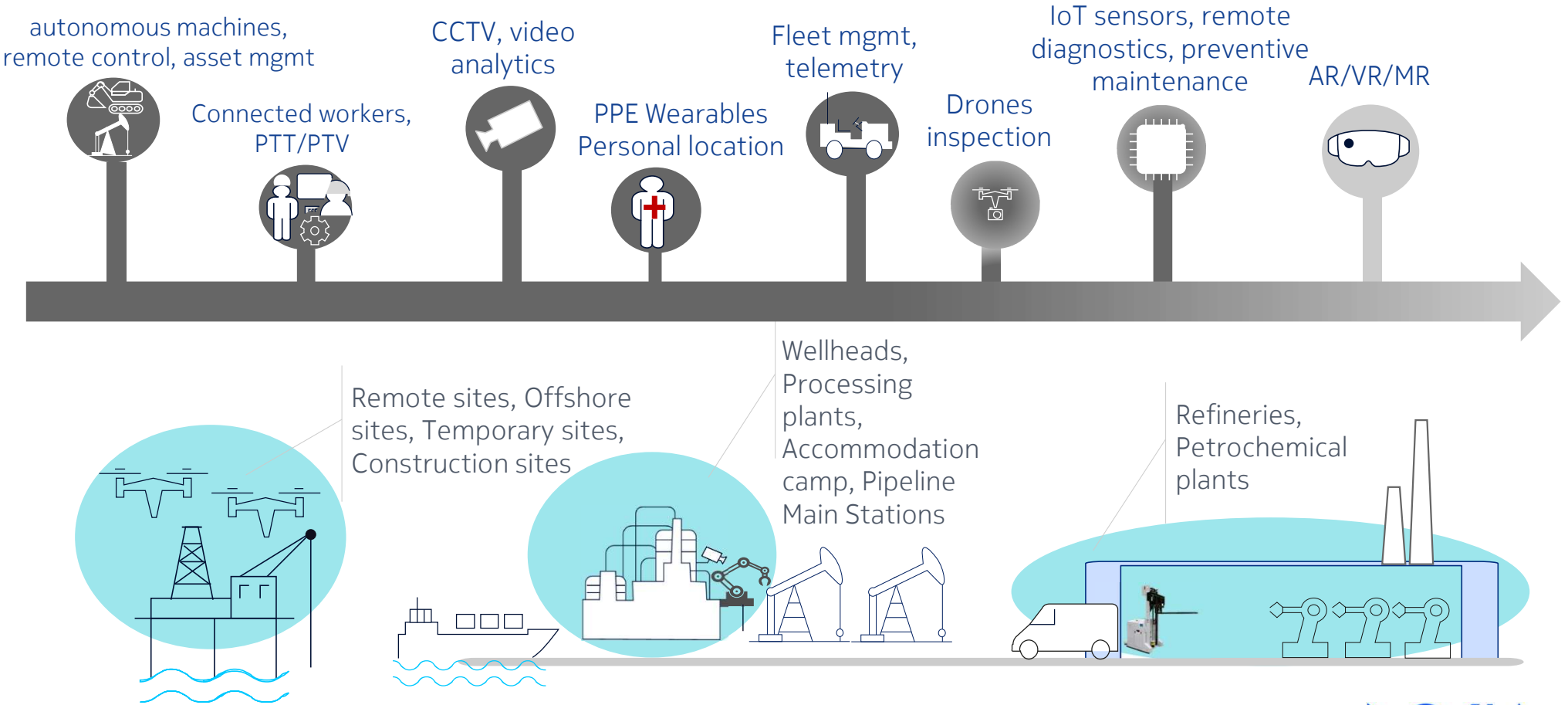
Oill&Gas use cases enabled by Nokia private wireless technology

Example of use cases that could be applied to Oil&Gas operations



Digitalizing everything that matters on energy segment

Connecting equipment, systems, processes…

Distributed Generation (DG)
- Energy resources
- Energy storage
- DG collectors

Distribution substations
- RTUs/IEDs
- CCTV cameras

Distribution automation
- Reclosers
- Capacitor banks
- Switches
- Distribution transformers
- …

Mobile Field Force enablement
- Mobile data terminals
- Video
- AR

Drones
- Remote operations
- Analytics

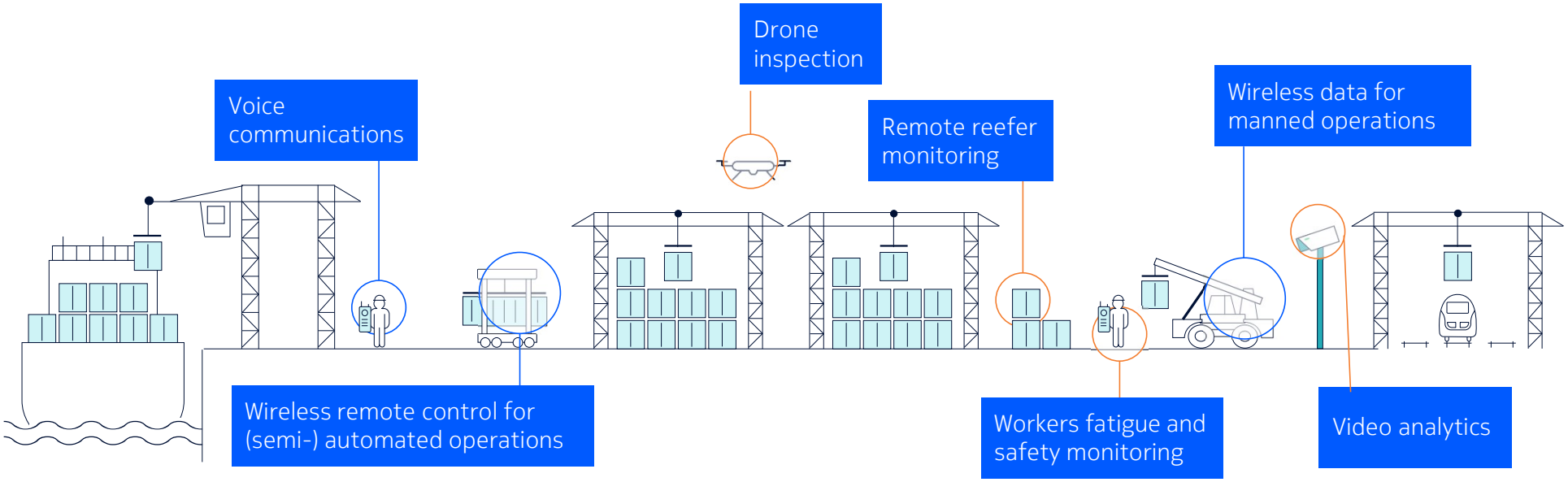
IoT devices (Pole-top)
- Sensors
- Sensor collectors

Metering
- Meters
- Meter collectors

Nokia Bell Labs “Future X study” → 20x more devices connected in the next 10 years

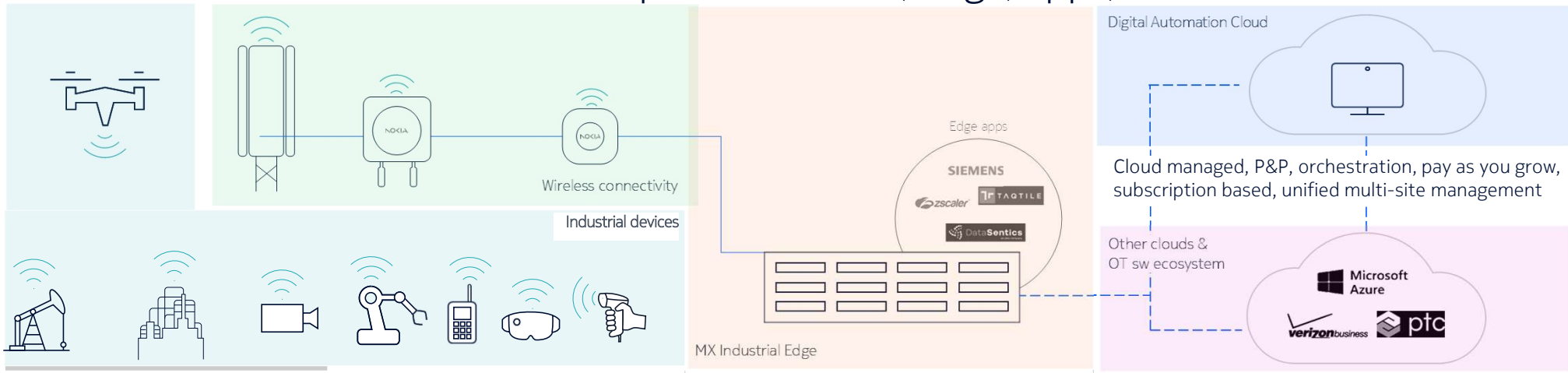
Digital transformation of port operations

A portfolio of end-to-end wireless systems and wireless enabling blocks



Nokia - One platform for mission-critical digitalization

Accelerate I4.0 transformation with private wireless, edge, apps, cloud and Solution-aaS



Reliable & deterministic performance wireless connectivity for digitalization of OT assets and workers, and future autonomous actions

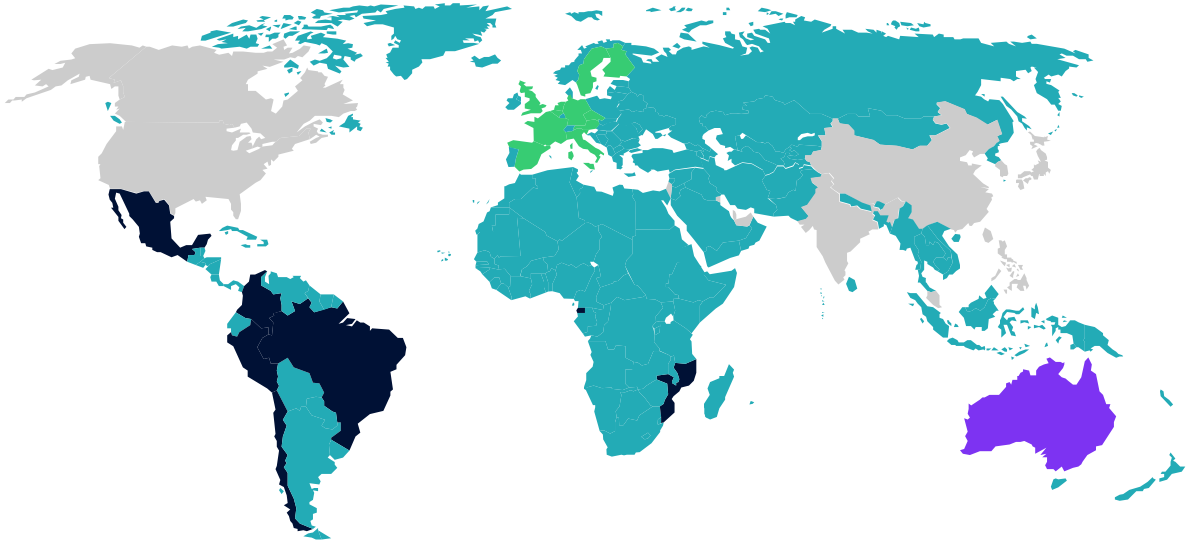
OT low latency edge OT app processing Application enablement (own/3rd P)

Expose APIs, edge data lake and integrate with worlds leading digital ecosystems and solution providers

++ | Industrial Devices & associated apps | Connectivity (LTE/5G) | OT Edge Compute AAS, Campus data lake | Own OT applications & Industrial connectors | 3rd party apps marketplace & cloud apps partners | Productivity platforms | Northbound & Webscale connectors | ++

800+ private wireless (LTE/5G) customers

Global leader on private wireless



- “Mapa das Redes Celulares Privativas” from Mobile Time (Sept/24): 401 private wireless deployments in Brazil (Nokia with 65% market share)

Public Logos

Brasil
30+ customers

VALE
PETROBRAS
itaipu parquetec
JACTO
Celesc
Brasil Terminal Portuário
Acreditar e Inovar
NEOENERGIA

NORCAT
Société du Grand Paris
NASA
BHP
LAS BAMBAS
RioTinto
Vienna International Airport
Ameren
Lufthansa Technik
CARGOTEC
KOKKOLAN SATAMA
beach
CITY OF TAMPERE
PORT OULU
KONECRANES
LUT University
ALTAN REDES
Etteplan
conectar4GRO
SANDVIK
KR network
STEVECO

NOKIA

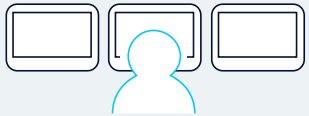
Value beyond connectivity:
Speed-up OT digitalizaiton by Edge Cloud

Nokia Industrial Application Catalog integrated to MX Industrial Edge (MXIE)

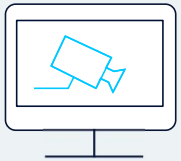
Industrial private wireless LTE/5G SA

Critical team comms – PTT/PTV, VoIP

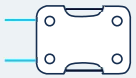
Integrated Operations Center (IOC)



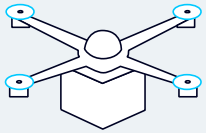
Video analytics



Tracking and positioning



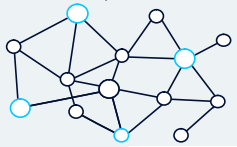
Drone networks



AR/VR for connected workers

Industrial connectors (Profinet, Modbus…)

Webscale connectors (MSFT Azure, AWS)



MXIE Edge Cloud installed on plant

Source : Gartner Edge Computing in support of the Internet of Things

75%

of all enterprise generated data will be processed at the Edge

The Edge Cloud:

- Places computing resources closer to the source of data
- Enables real-time collaboration between cyber-physical systems
- Drives actionable intelligence for industrial automation, situational awareness and worker safety

NOKIA

Brasil Terminal Portuario (APMT/Maersk, TIL/MSC), Brazil

Background, challenges and drivers

- Wireless connectivity was a challenge.
- Main goal is to enable the implementation of solutions to increase equipment connectivity and boost operational efficiency.
- BTP seeks to enhance communication among over 1,400 employees at the terminal, including with the use of its own tools and applications.

Solution

- Nokia DAC delivers a private 5G network in 3.5 GHz band with geo-redundant core on premises and ruggedized tablets for operators in yard connected to TOS with required speed, coverage, and latency.
- Nokia DAC is expected to enable remote and real-time monitoring of equipment, such as cranes, as well as operational activities, managed from a monitoring center.
- It is the first private 5G network in a port terminal in Latin-America and the Caribbean

“We believe technology has the power to make the port sector more efficient, safe and sustainable. We are continually investing in the development of new digital tools and technologies to offer our customers the best solutions."

Ricardo Arten, CEO at Brasil Terminal Portuario

AMBEV - Global Beverage producer deploys 4G private wireless to support Industry 4.0 plans

Global Beer producer

- World leading producer of beer with multiple named brands
- Operations in 100+ countries and 100K+ employees
- Looking for global/regional partners that can support their evolution plans across the globe
- Deployment of private wireless 4G/LTE network in multiple Latin American plants

Use Cases & Private Wireless

- Remote technical assistance/support with AR devices and applications
- MES data access to connected tablets/smartphones/laptops
- Telemetry data access
- Private LTE network backhaul for Wi-Fi connected employees to business/office applications

Business Benefits

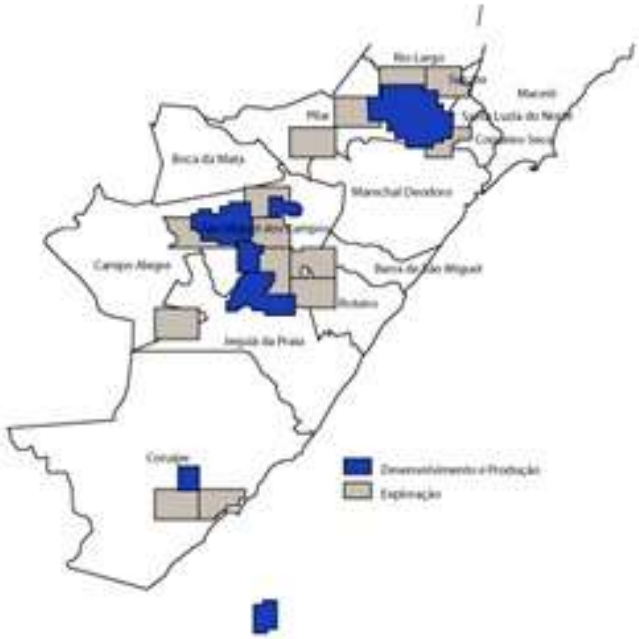
- Lower cost OPEX investment model
- Common LTE network supports connectivity to multiple end devices (glasses, smartphones, tablets, laptops and sensors) for both plant operations and business applications
- SPaaP provides system integration support to all the countries where plants are located

Origem pLTE deal and ecosystem move

ORIGEM

The venture considers:

- 14 Exploratory Blocks
- 7 Fields
- 600 Wells
- 1 Natural Gas Processing Unit (NGPU)
- 2 Production Plants (Pilar and Furado)
- 5 Collecting Plants (Anambé, Arapaçu, São M de São Miguel dos Campos and Paru)
- Offloading System: 156 km of gas pipeline ar
- Main fluid: oil e gas



Customer challenges:

- Connectivity solution for Alagoas Plant;
- PTT and PTV Communication;
- Asset Surveillance to the Gas Wells;
- Automation to the Gas Wells.
- Connectivity solution has to provide low latency, high trasmission power, high throughput

NOKIA

Elektro Neoenergia, Brazil

Complete Private LTE network using 3.5 GHz and 700MHz spectrum —with Nokia professional services

"Will deliver increased power efficiency to bring both increased quality and cost savings to our customers… enable the introduction of distributed power, … while providing the required communications for our transformation to new business models."

Case study: Building a more reliable power grid in Brazil with private LTE connectivity

Challenges

- An unreliable power grid made it difficult for customers to access the electricity they needed
- Limited availability of bandwidth frequency

Solution

- Private LTE deployment for grid automation to allow fast power restoration in the event of an outage, and enhanced grid visibility
- Link smart meters and other equipment to track power usage and enable more than 75,000 customers to shift consumption patterns to save money

Benefits

- This 'smart grid' project will streamline operations and reduce costs by:
  - increasing grid reliability by up to 50 percent
  - reducing commercial losses by up to 80 percent
- Enable consumers to track their usage and shift consumption to save

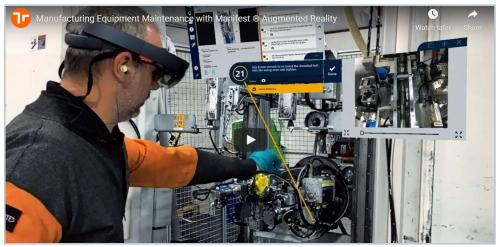
Connected worker for the Digital Substation

NDAC AR/VR, Group Communications use cases over private wireless in action

Machine operator training ROI with augmented reality

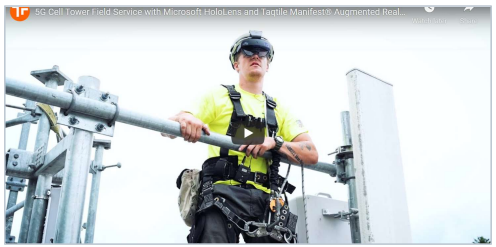
Augmented reality in hands-on learning environment

Manufacturing equipment maintenance with augmented reality



Field service management with augmented reality

Field service and remote assistance with augmented reality



2 hours to 40 minutes

Technicians at PGT Industries now complete a 2-hour machine maintenance procedure in 40 minutes using step-by-step, guided instruction created in Manifest.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