INDUSTRY 4.0 TO YOUR INDUSTRIAL CAMPUS

Pal Matits

Nokia, Espoo, Finland

ABSTRACT

The Fourth Industrial Revolution, 4IR, or Industry 4.0, conceptualizes rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart automation. A part of this phase of industrial change is the joining of technologies like artificial intelligence, gene editing, to advanced robotics that blur the lines between the physical, digital, and biological worlds. Throughout this, fundamental shifts are taking place in how the global production and supply network operates through ongoing automation of traditional manufacturing and industrial practices, using modern smart technology, large-scale machine-to-machine communication (M2M), and the internet of things (IoT). This integration results in increasing automation, improving communication and self-monitoring, and the use of smart machines that can analyze and diagnose issues without the need for human intervention. Amid the hype surrounding Industry 4.0, IIOT, and digital transformation, the introduction of Industry 4.0 has caused a bit of a culture shock for manufacturers. The benefits of data-driven manufacturing are far too significant to ignore and will enable many to deliver competitive advantages in an ever-competitive landscape. Digital transformation is about changing business models and about companies not just taking advantage of the huge opportunities created by these latest technologies but also preparing for their constant evolution. These new models for technology-enabled manufacturing have already moved into the implementation phase by many of the world's top manufacturers. However, a great deal of hesitancy exists for many manufacturers to embrace the technology and modernization that solves these new challenges.

KEYWORDS: Fourth Industrial Revolution, Industry 4.0, M2M, IoT, communication.

Information about author:

Pal Matits, *Pal is a Marketing Manager for Nokia's Enterprise So-lutions business. He focuses on private wireless solutions for industrial campuses. He is passionate about digital transformation and how Nokia can help enterprises on the journey to Industry 4.0 by providing One Digital Platform that includes Private Wireless connectivity, an Industrial Edge, digital applications and Industrial Devices. Pal is based in Budapest, Hungary. He holds an MBA and a Communications degree.*

The article is supplemented with materials "The right technology mix for Industry 4.0. Make your industrial campus work as one" (© Nokia)

INTRODUCTION

The fourth industrial revolution is under way. Enterprises in all industries are looking for ways to embrace data-driven operations, adopt zero-touch automation, and help people and machines work together more efficiently. The pressure to succeed is intense. But the goal is clear: a rapid digital transformation that makes industrial processes safer, more productive and more sustainable without disrupting critical operations along the way.

Let's explore the most important challenges and milestones you'll encounter on your transformation journey to Industry 4.0.

Today, 70% of industrial assets, machines and field workers are unconnected. This means they don't provide real-time data that can be used to gain insight into industrial operations. What's more, information technologies (IT) and operational technologies (OT) are often incompatible for reasons such as complex protocols and skills gaps within the workforce. All of this makes it more challenging for enterprises to embrace Industry 4.0 and adopt new applications and devices [1-3].

To bring Industry 4.0 to your industrial campus, you need a connectivity solution that can interface with your legacy environments and provide robust security, flawless 24/7 availability and deterministic performance for your mission-critical processes.

A secure, reliable, high-performance infrastructure that connects machines, people and processes can give you the basis for collecting deep insights, introducing more agile and proactive operations, and managing quality on any scale [4].

But while the need for new digital infrastructure may be clear, your path to implementing it could be complex. In particular, you will need to navigate a fragmented landscape of applications, industrial devices, connectivity and edge computing suppliers. This can lead to long integration times for legacy and new solutions, which can increase your costs and make it difficult to predict your return on investment [5].

ONE DIGITAL PLATFORM TO MAKE DIGITAL TRANSFORMATION SIMPLE

Nokia is helping industries address these needs by providing one digital platform that simplifies and accelerates Industry 4.0 transformation (Figure 1). The platform includes four essential components:

- Industrial-grade private wireless and Wi-Fi connectivity;
- Certified and ruggedized industrial devices;
- On-premises Edge compute capabilities for mission-critical communication;
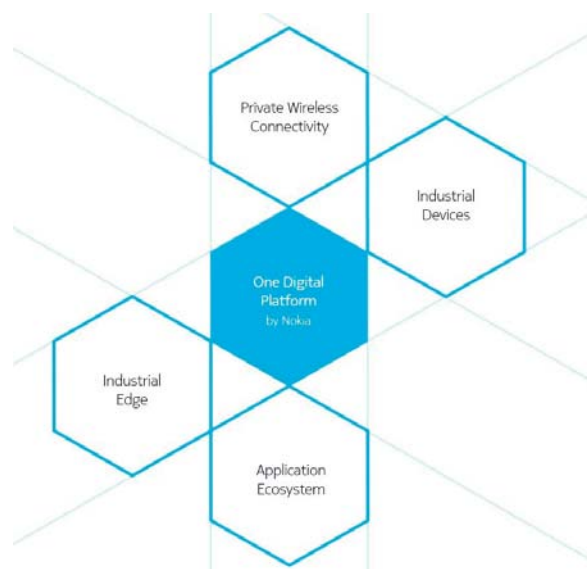- A digital application ecosystem that supports Industry 4.0 use cases.

Figure 1. One Digital Platform for operational transformation by Nokia

To implement autonomous actions, robust, reliable, mission-critical connectivity is a central element in our platform and the foundation of Industry 4.0 success for every industry. Take manufacturing, for example – a huge industry with more than 10 million facilities worldwide. An ABI Research study found that more than 90% of manufacturers are considering using 4G or 5G networks to support their operations with reliable, low latency connectivity.

This uptake in private cellular network technology reflects the fact that most manufacturers face connectivity challenges today. The Wi-Fi networks at their plants and campuses weren't designed to connect everyone and everything or turn data into meaningful insights. They often can't interface with legacy environments and enable mission-critical processes that demand high bandwidth coverage, low latency, strong security and 24/7 availability. But it takes more than connectivity for an enterprise to reap the full benefits of Industry 4.0 [6-8]. For example, manufacturers need to complement high-performance wireless networks with technologies such as edge computing, cloud-managed digital applications and industrial-grade ruggedized devices so they can meet the demands of sensors, machines, robots, mobile workers and more. With the right mix of technologies, they can transform production operations with exciting use cases such as digital twins, autonomous mobile robots (AMRs), remote maintenance and rich group communications.

GET AHEAD IN THE RACE TO IMPLEMENT INDUSTRY 4.0

Manufacturers aren't the only enterprises that can gain an edge by using digitalization to make their operations smarter.

No matter what vertical you're part of, Industry 4.0 promises to help make your operations more flexible and efficient, which will lead to increased productivity, faster time to market, reduced waste, improved safety and security, and higher employee satisfaction.

We're ready to help you turn these promises into operational realities with a unified digital platform that can:

- Connect your end-to-end production processes in real time
- Support edge computing applications while protecting your industrial data
- Provide high performance, reliability and security so you can digitalize your mission-control and communications applications
- Transform data into operational insight and support autonomous actions
- Ease your digital transformation and avoid disrupting operations

SIMPLIFYING INDUSTRY 4.0 DIGITALIZATION REQUIREMENTS

The fourth industrial revolution is under way. Enterprises across all industries are looking for ways to embrace data-driven operations, adopt zero-touch automation and transform the way people and machines work together. Their goal is to digitalize their operations to make production processes safer, more productive and more sustainable.

Connectivity is the key to achieving this goal. But the wireless networks at most industrial sites weren't designed to connect all industrial devices or transform data into insight. They also can't interface with legacy environments and enable mission-critical processes that demand pervasive broadband coverage, strong security, 24/7 availability and deterministic performance.

The path to transformation is complicated by the need to navigate a fragmented landscape of application, industrial device, connectivity and edge computing suppliers. This can lead to longer integration times, higher costs and an unpredictable return on investment. Nokia makes digital transformation simpler and faster with one digital platform that provides multi-technology connectivity, Industrial Edge, applications and devices. Our platform brings you:

- Industrial-grade private LTE/4.9G or 5G connectivity that can help you digitalize your operational technology (OT) systems to make them infinitely more agile and resilient;
- A complementary Wi-Fi layer that provides connectivity for IT systems and non-business-critical OT use cases;
- Certified industrial devices that help improve worker communication, productivity and safety;
- An on-premises edge that can support and unify your industrial OT use cases and processes;
- An application ecosystem that cuts through complexity and helps accelerate your digital transformation.

With this unified platform, you get a complete private wireless connectivity infrastructure that can meet the security, reliability and performance demands of your machines, people and processes. This infrastructure can provide the deep data insights you need to support more agile and proactive operations and achieve your Industry 4.0 ambitions today and tomorrow (Figure 2).
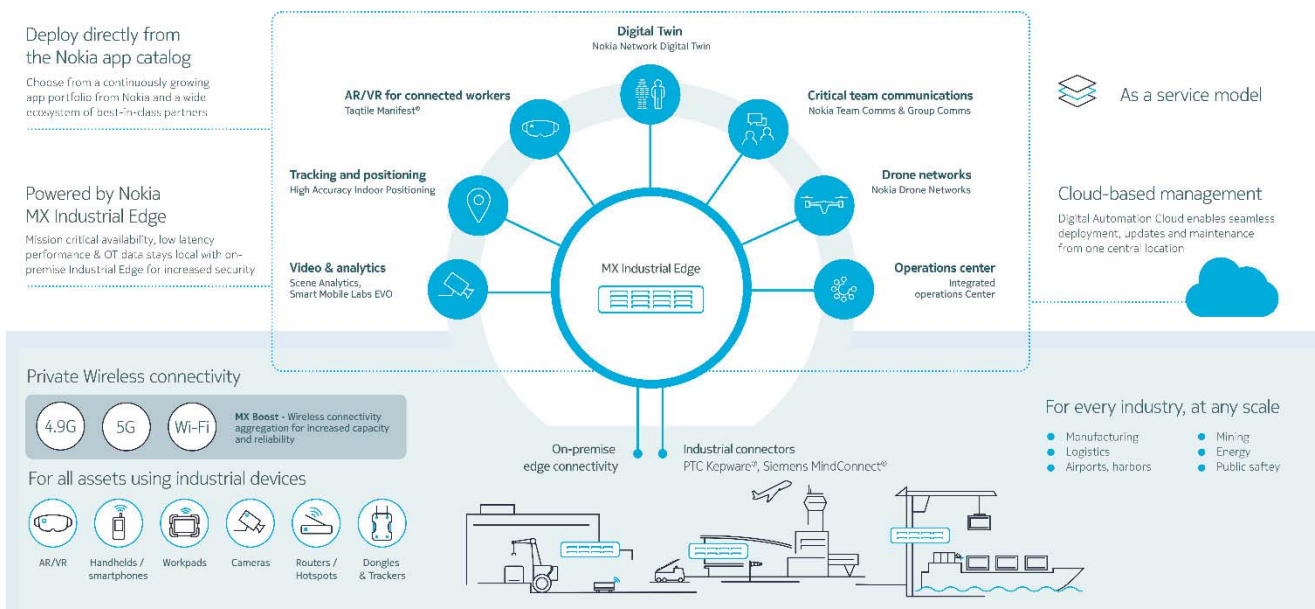

Figure 2. One digital platform for mission-critical Private Wireless and Industrial Edge

Nokia provides end-to-end industrial wireless campus solutions support essential use cases for hundreds of enterprises across a broad range of segments. These solutions help our customers connect all their assets, turn data into operational insight, maintain operational continuity and reap all the benefits of digitalization.

Manufacturing and logistics

Manufacturing and logistics companies want to use digitalization and automation to accelerate their Industry 4.1 initiatives. To transform their operational processes, they need to connect their assets and generate insights from data while supporting 24/7 operations.

The key to success is to combine pervasive, reliable connectivity with edge computing, digital applications and industrial devices to meet the demands of everything from sensors and machines to robots and connected workers.

Industry 4.0 presents a host of exciting possibilities to the manufacturing and logistics sector, from digital twins and autonomous mobile robots (AMRs) to remote maintenance and rich group communications. These use cases promise to reduce time to market, make production lines more flexible, optimize efficiency and bring the vision of zero safety issues within reach.

To turn these promises into operational realities, you need a platform that can:

– onnect your end-to-end production processes in real time;

– support edge computing applications while protecting your industrial data;

– provide high performance, reliability and security so you can digitalize your mission-critical control and communications applications;

– transform data into operational insight and support autonomous actions;

– eas your digital transformation and avoid disrupting your operations.

This platform needs to be easy to set up and integrate with your legacy networks and OT. It must also work seamlessly with the Wi-Fi networks you rely on for basic IT connectivity (Figure 3).

Inspecting airplane engines virtually, with help from 5G

Maintenance, repair, and overhaul (MRO) companies play a critical role in maintaining aircraft safety and flightworthiness. Their work requires constant, often face-to-face, collaboration between engineers on the shop floor and the aircraft owners they serve.

In the early days of the COVID-19 pandemic, lockdowns and travel restrictions made it difficult for Lufthansa Technik, one of the leading providers of aircraft MRO services, to perform in-person inspections of aircraft engines with its customers. Nokia helped Lufthansa Technik address this challenge by deploying a 5G private wireless network that enabled the company to conduct remote inspections from its facility in Hamburg, Germany.
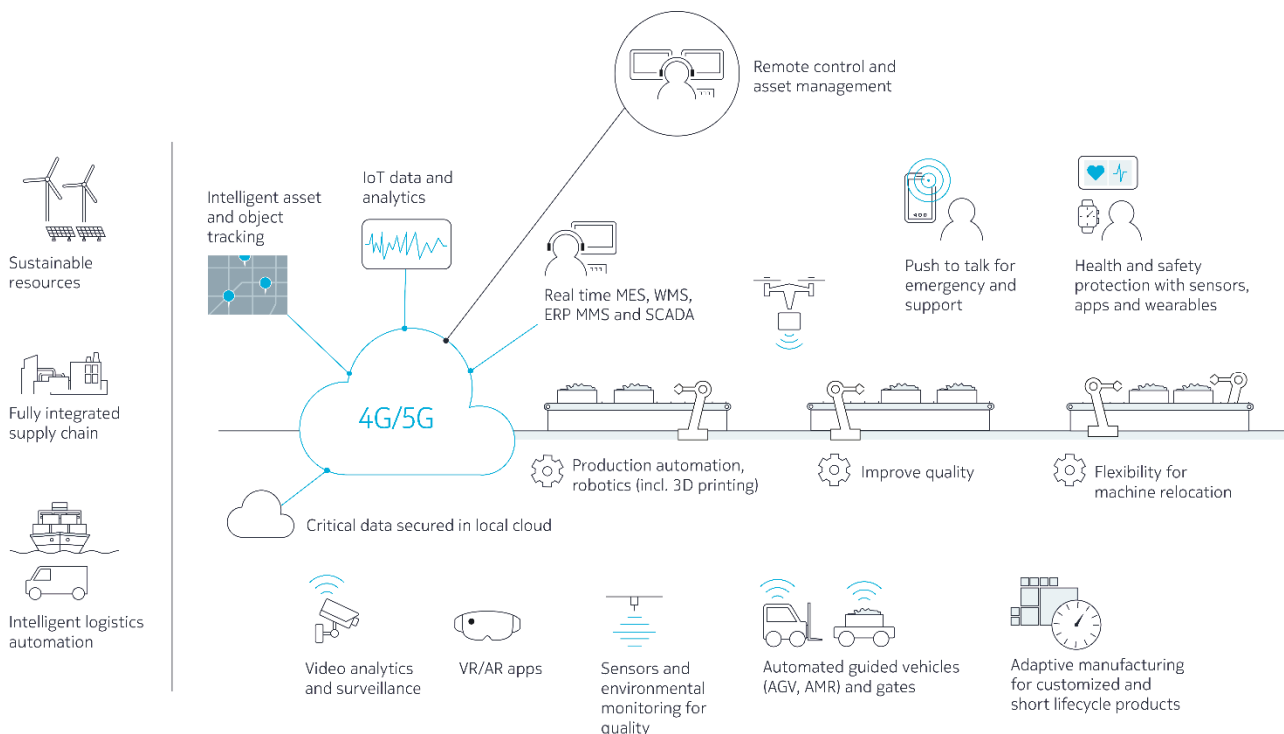

Figure 3. Digital platform transform factories and warehouses

These "virtual table inspections" use 4K wireless cameras and a hyper-fast video link to enable civil aviation customers to observe and approve work on aircraft engines without traveling to Hamburg. This saves time and money and improves operational efficiency on the shop floor. High-resolution video generates significant volumes of data, and requires the high bandwidth and super-low latency that only cellular technology can provide.

Although intended as a proof of concept, the virtual table inspection capability quickly proved its mission-critical value. After a yearlong trial, Lufthansa Technik confirmed that it would move to a permanent Nokia 5G Standalone private wireless network deployment. The company will also use the new network to support additional Industry 4.0 use cases.

Leading consumer durables and electronics manufacturer Arçelik Global is deploying Turkey's first commercial private 4.9G/LTE network in partnership with Nokia and Türk Telekom. This 5G-ready network will provide pervasive, reliable, low-latency connectivity for the company's washing machine manufacturing facility in the Çayırova district of Kocaeli Province. Nokia will provide Arçelik with industrial-grade private wireless infrastructure based on Nokia DAC. This digitalization platform provides reliable high-bandwidth, low-latency private networking. It also incorporates on-premises edge computing capabilities, voice and video services, and a catalog of digital applications and enablers.

Arçelik plans to use the new infrastructure to accelerate its digital transformation and implement Industry 4.0 use cases. For example, the company will take advantage of industrial-grade connectivity to enhance AGV performance, support high-accuracy indoor provisioning for real-time asset tracking, and improve safety and security with video analytics applications. Nokia and Arçelik aim to collaborate on other use cases, including augmented and virtual reality, digital twins, inventory control, safety and facility management, quality control, highresolution video for remote inspections, and facility-wide voice and video communication. This collaboration will allow Arçelik to advance its leadership in manufacturing digitalization.

ENERGY AND NATURAL RESOURCES

Energy and natural resources companies must digitalize and automate their operations to survive and thrive. To succeed, they need networks, devices and applications that can provide robust and reliable wireless connectivity for everything from mobile workers and substations to offshore platforms and wind turbines. Change is coming fast for the energy and resources industry. And while power utilities, wind farm operators and oil and gas companies face different operational challenges, they share many of the same big goals: Keep pace with shifting demand. Develop new business models. Reduce carbon emissions. Improve safety, security and productivity across the supply chain. Industry 4.0 technologies such as IIoT, machine learning and augmented reality can help your company use data-driven automation to achieve these goals and more.

But you can't take full advantage of these technologies by relying on Wi-Fi and legacy application-specific networks such as advanced metering infrastructure (AMI), two-way radio (TETRA, P25) and supervisory control and data acquisition (SCADA).
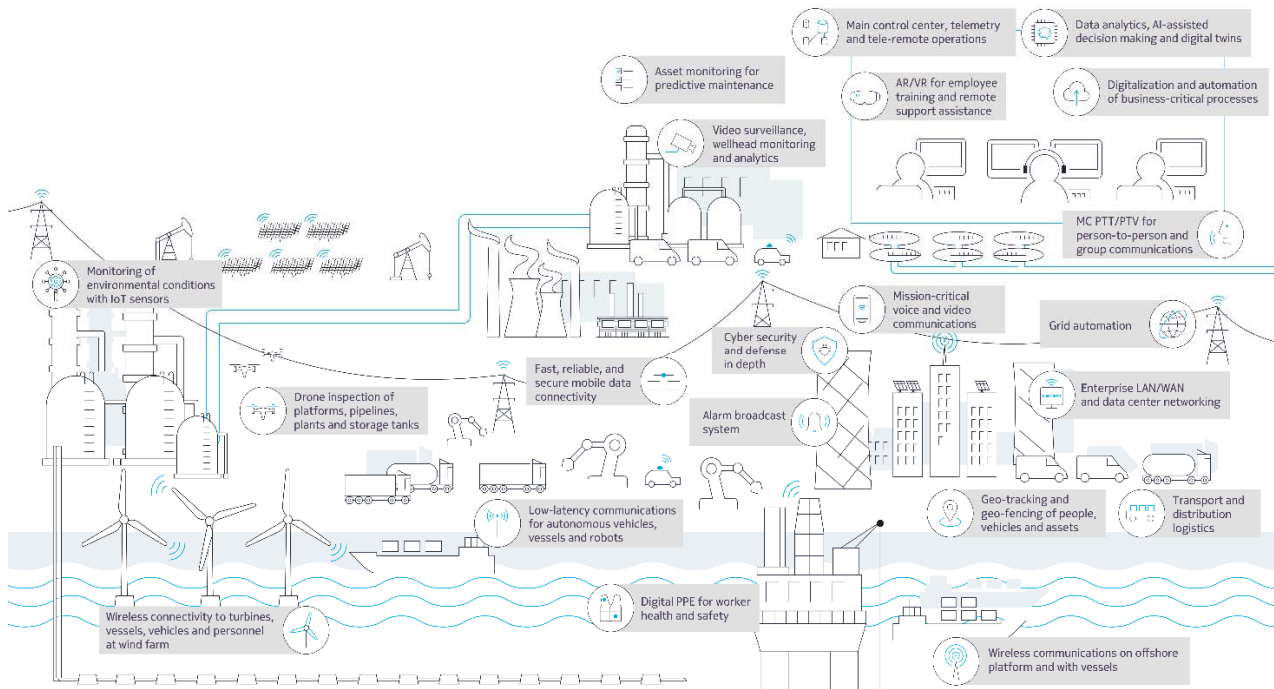

Figure 4. One platform transform the energy and resources value chain

To digitalize and automate your operations, you need a flexible platform that can:

– meet the high performance, reliability and security requirements of your mission-critical operational technology (OT);

– support high-bandwidth edge computing applications while protecting your industrial data;

– provide robust connectivity for all industrial devices, video cameras, IoT sensors, machines and vehicles;

– transform data into operational insight and support autonomous actions;

– eas your digital transformation and avoid disrupting your operations.

This platform must be easy to deploy, operate and integrate with your existing networks and assets. It also has to work seamlessly with the Wi-Fi networks you rely on for basic IT connectivity (Figure 4).

Wind farm operators are increasing their use of digitalization and automation to keep pace with growing demand for offshore wind power. These capabilities require wireless communication systems that can reliably deliver high speeds and low latency and transfer large amounts of data over long distances. Operators across the Belgian North Sea are addressing this need by using our private 4.9G/LTE networks to provide secure broadband connectivity for their workers, vessels, sensors and operation centers. The deployed networks make it easier to operate larger turbines in more remote areas where wind speeds are greater.

The private LTE solution uses wireless base stations installed on substations within the wind farm and connects them to the shore with fiber laid on the seabed. Vessels are equipped with LTE equipment. The deployment enables a host of digital applications, including push-to-talk and push-to-video communication, drone-based inspections, predictive maintenance, AR/VR remote assistance, high-volume data transfer and leisure connectivity for remote crews.

Thanks to these 5G-ready private wireless networks, the entire Belgian North Sea has secure, reliable broadband coverage that will enable operators to use digitalization and Industry 4.0 technologies to construct and maintain turbines in a more efficient and cost-effective way.

TRANSPORTATION

Modern transportation hubs run on wireless connectivity

The transportation industry relies on vast quantities of data to keep traffic flowing through busy and complex sites and ensure smooth journeys for passengers and freight. In airports, seaports and rail yards, more and more operational processes are being digitalized to support critical goals such as achieving operational excellence, improving safety and security, enhancing the passenger experience and reducing carbon emissions. But many transportation enterprises use a mix of siloed wireless technologies to support their operations. These technologies can be inflexible and may have coverage, interference or quality of service limitations that make it difficult to realize the benefits of digitalization.

This platform must be easy to deploy, operate and integrate with your existing networks and assets. It also has to work seamlessly with the Wi-Fi networks you rely on for basic IT connectivity (Figure 5).
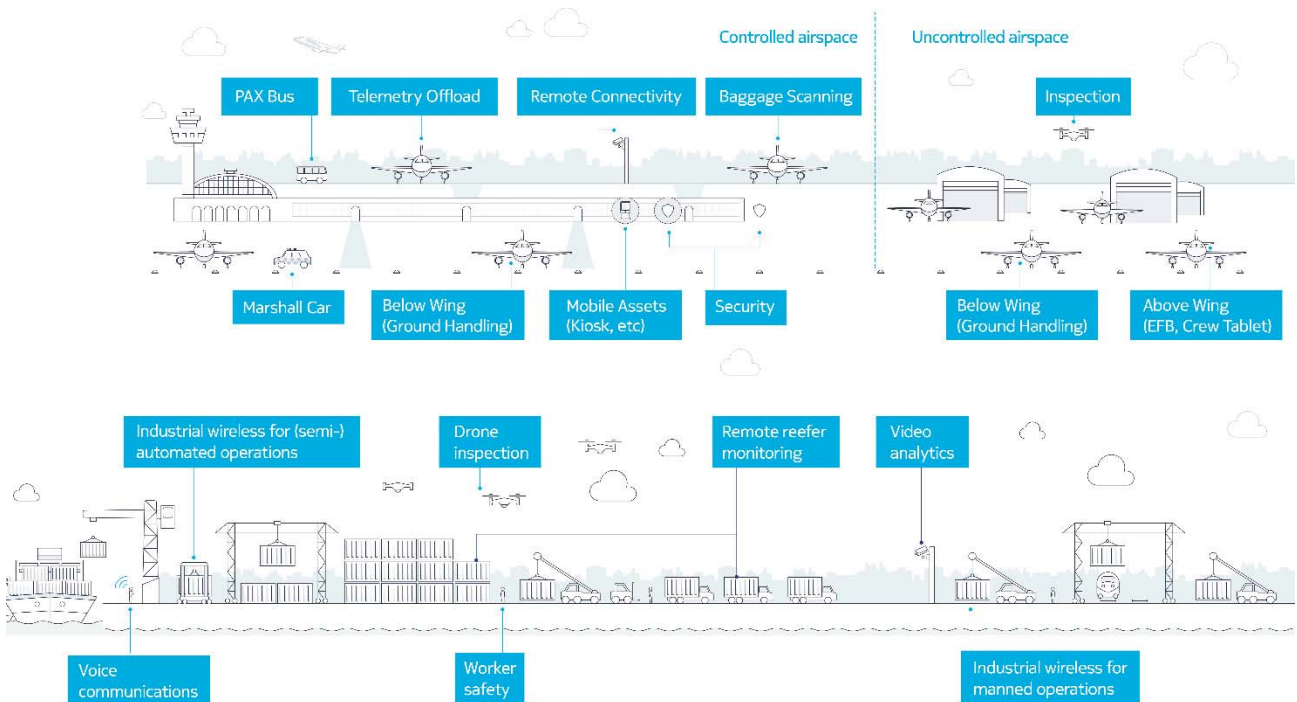

Figure 5. Digital platform transforms transportation

Private 5G network fuels innovation at Brussels Airport

Brussels Airport has deployed a 5G-ready private wireless network to increase efficiency and support innovative applications. The network will help the airport optimize its operations, accelerate its digital transformation and ease the integration of future technologies.

The new network is enabled by Nokia DAC. It delivers much faster and more reliable connectivity than Wi-Fi or public LTE networks. Combining high capacity with low latency and pervasive coverage, the network makes it possible for the airport to explore technologies such as IoT, automated vehicles, mobile safety systems, and track-and-trace applications.

In the project's initial phase, the airport will use 5G technology to provide industrial-grade connectivity outdoors. A subsequent phase will bring 5G to indoor environments. The airport will take advantage of the network's capabilities to test a variety of technologies and applications to determine what value they can provide.

By deploying a 5G-ready private wireless network – one of the first in Belgium and one of the first in a European airport – Brussels Airport has confirmed its position as a pioneer in digital innovation. The network gives the airport a foundation for using Industry 4.0 automation to make air travel safer and more convenient, enhance operational awareness and support new business models.

MINING

Mining operators are making significant investments in Industry 4.0 to optimize safety, sustainability and efficiency.

Mining companies are embracing automation to improve their ability to handle rapid shifts in supply and demand and comply with stringent environmental and safety regulations above and underground.

The automation of critical processes such as drilling, blasting, hauling and crushing can play a vital role in making your mines and pit-to-port operations safer, more efficient and more productive.

Broadband data and video communications are essential for increasingly mobile workforce. But extreme automation and enriched communications demand robust wireless connectivity that is beyond the capabilities of Wi-Fi, TETRA and P25-based radio networks.

This platform must be easy to deploy and integrate with the systems and assets you rely on today. It also has to work seamlessly with the Wi-Fi networks for basic IT connectivity (Figure 6).

Boliden strives to be the most climate-friendly and respected metal supplier in the world. At the Boliden Kevitsa multi-metal open pit mine in Northern Finland, the company is working to improve productivity and safety and reduce its environmental impact by investing in automation, electrification and remote control.

A purpose-designed private 4.9G/LTE network is the main enabler of automation at the mine. Designed, built and operated by Edzcom using Nokia Industrial-grade Private Wireless technology, the network uses four access points to provide missioncritical connectivity to the entire 14 km^2 pit area. It also provides seamlessly integrated coverage for all the buildings and facilities at the site, along with full connectivity for every employee.
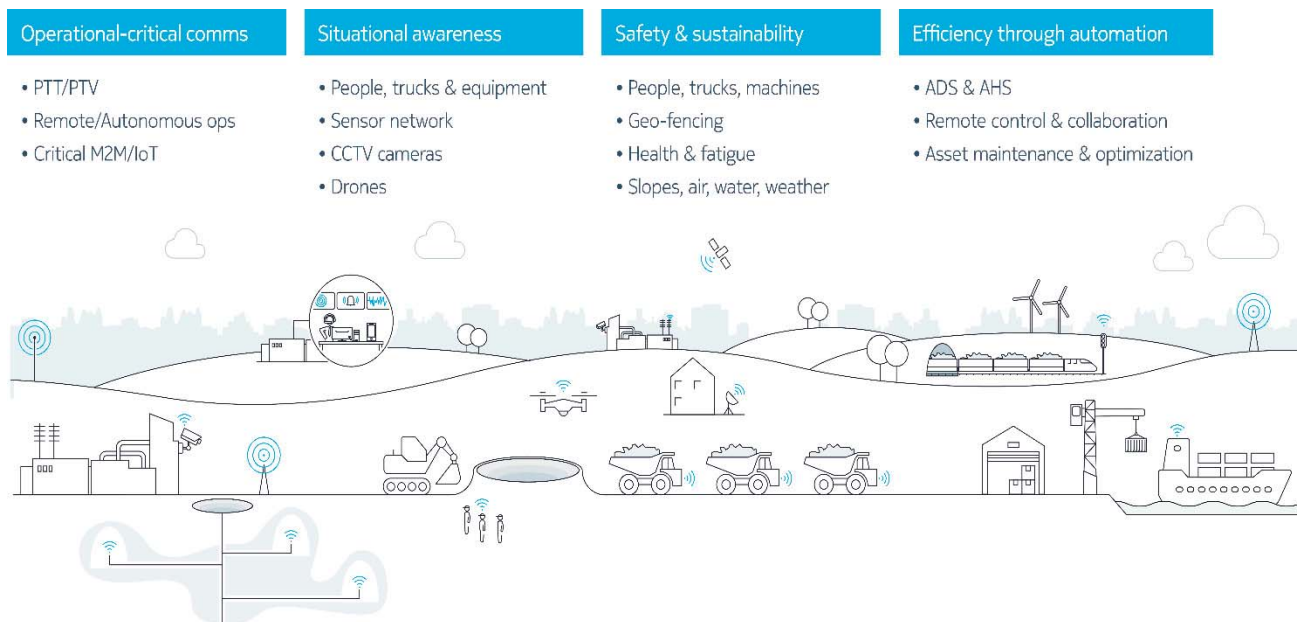

Figure 6. Digital platform transform mine operations

Boliden uses the network to enable several advanced Industry 4.0 use cases. These include tele-remote drilling, software that ensures that haul trucks dump their contents in the right places, and monitoring to enable preventative vehicle maintenance. The network also supports a host of other business-critical applications, including group communications, IoT analytics and low-latency edge computing for remote, automated and autonomous applications.

CONCLISION

Today, 70% of industrial assets, machines and field workers are unconnected, which means they don't provide real-time data that can be used for operational insights. What's more, IT and operational technologies (OT) are often incompatible because of complex protocols, certifications and skills gaps. All of this makes it more challenging for enterprises to embrace Industry 4.0 and adopt new applications and devices.

To succeed with digital transformation, you need the ability to capture and act on data, often in near-real time. Data from IIoT sensors must be processed by edge computing systems that can use artificial intelligence (AI) and machine learning (ML) to model and analyze it. The results must then used to make split-second decisions, reconfigure processes and achieve new efficiencies, especially around automation.

Nokia MX Industrial Edge (MXIE) is an on-premises edge solution that combines a simple as-a-service model with a high-performance, resilient and secure edge architecture. Designed to accelerate OT transformation, MXIE comes with a portfolio of ready-to-use industrial applications and connectors and supports an extensive range of industrial devices.

Choosing the right user equipment is as important to your Industry 4.0 strategy as choosing the right private wireless technology. Ruggedized 4G and 5G devices can play a big part in delivering business-critical communications for teams and machines in challenging industrial environments.

The Nokia Industrial device portfolio unleashes the power of private wireless for any use case or industry. It includes ruggedized equipment such as compact handhelds, workpads, field routers, dongles, hotspots and 5G video cameras. We also offer headsets, light earpieces, push-to-talk (PTT) microphones and wearable cameras.

All devices are pre-tested for industrial use and come with smart management tools and communication applications designed for our Industrial-grade Private Wireless solutions. Fully integrated approach helps to boost productivity by ensuring that workers and machines can always share information in a fast and simple way.

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