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Are you ready to build the digital factory of the future?
Nokia Industrial-grade Private Wireless for Manufacturing

In this guide we look at how industrial-grade private wireless can help manufacturing companies do extraordinary things, building smart, flexible, connected production lines that bring new levels of efficiency, productivity and profitability to their processes.
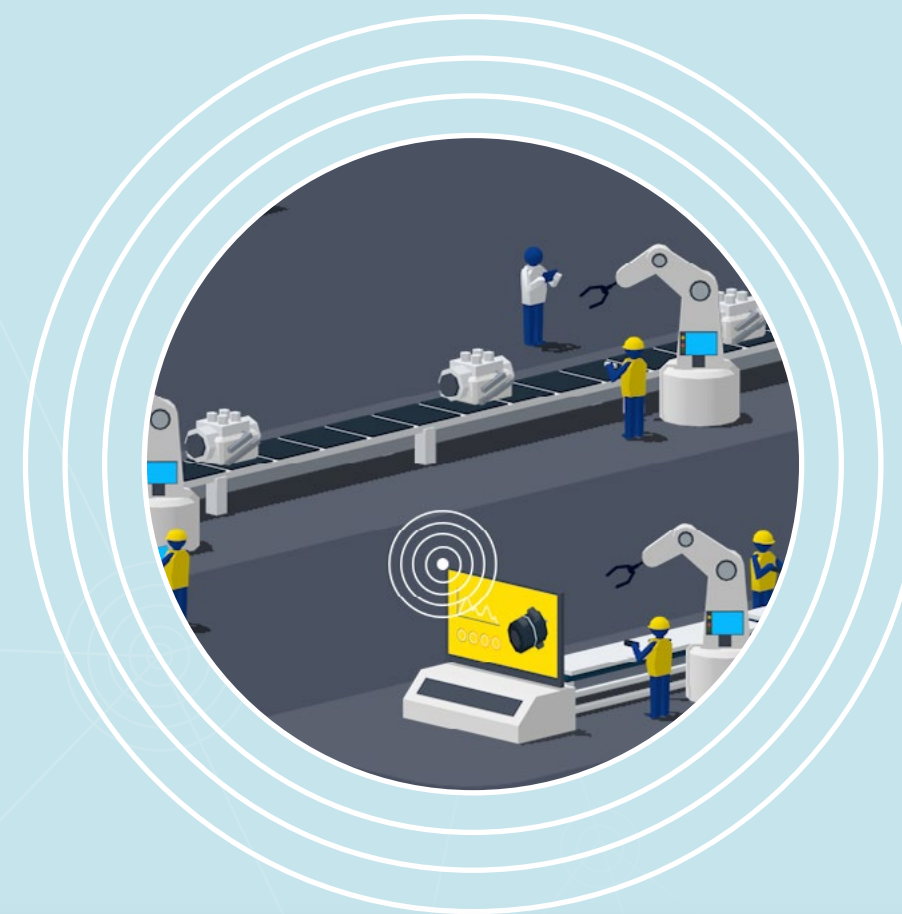
> ## Industry 4.0
Connect everyone and everything throughout your factory

> ## Intelligent Operations
Get reliable wireless connectivity to see, understand and control your entire factory

> ## Flexible Production Lines
Improve the flexibility and productivity of your production lines with automation, AI and robotics.

> ## Case Studies
Nokia Industrial-grade Private Wireless in Action

Make Industry 4.0 a reality in your factories

The fourth industrial revolution is well underway – but how are manufacturers able to turn the possibilities of Industry 4.0 into operational realities and build the digital factories of tomorrow?

In industrial IoT, AI, machine learning and more, the technologies are available to help you sharpen your competitive edge, bringing automation-powered efficiency, turn-on-a-dime agility, and increased safety, security and compliance to your processes.

And there's a huge cost benefit, too. It's expected that by the end of 2020 the entire industrial manufacturing industry will have saved $52 billion dollars through industry 4.0 technologies.[1]

But successfully adopting these technologies and gaining those advantages hinges on one thing: connectivity.

The trouble is, the wireless networks that most campuses rely on simply weren't built for business-critical industrial use cases. They were designed for office tasks such as web browsing and email communications, and they're characterized by unpredictable performance, patchy coverage and poor security.

To make Industry 4.0 work for your organization, you need industrial-grade, pervasive wireless connectivity. With a private LTE/4.9G network, you can deliver real competitive advantage right now using your existing ecosystem of machines, sensors and systems. And you can prepare your organization for what's next – a seamless transition to 5G.
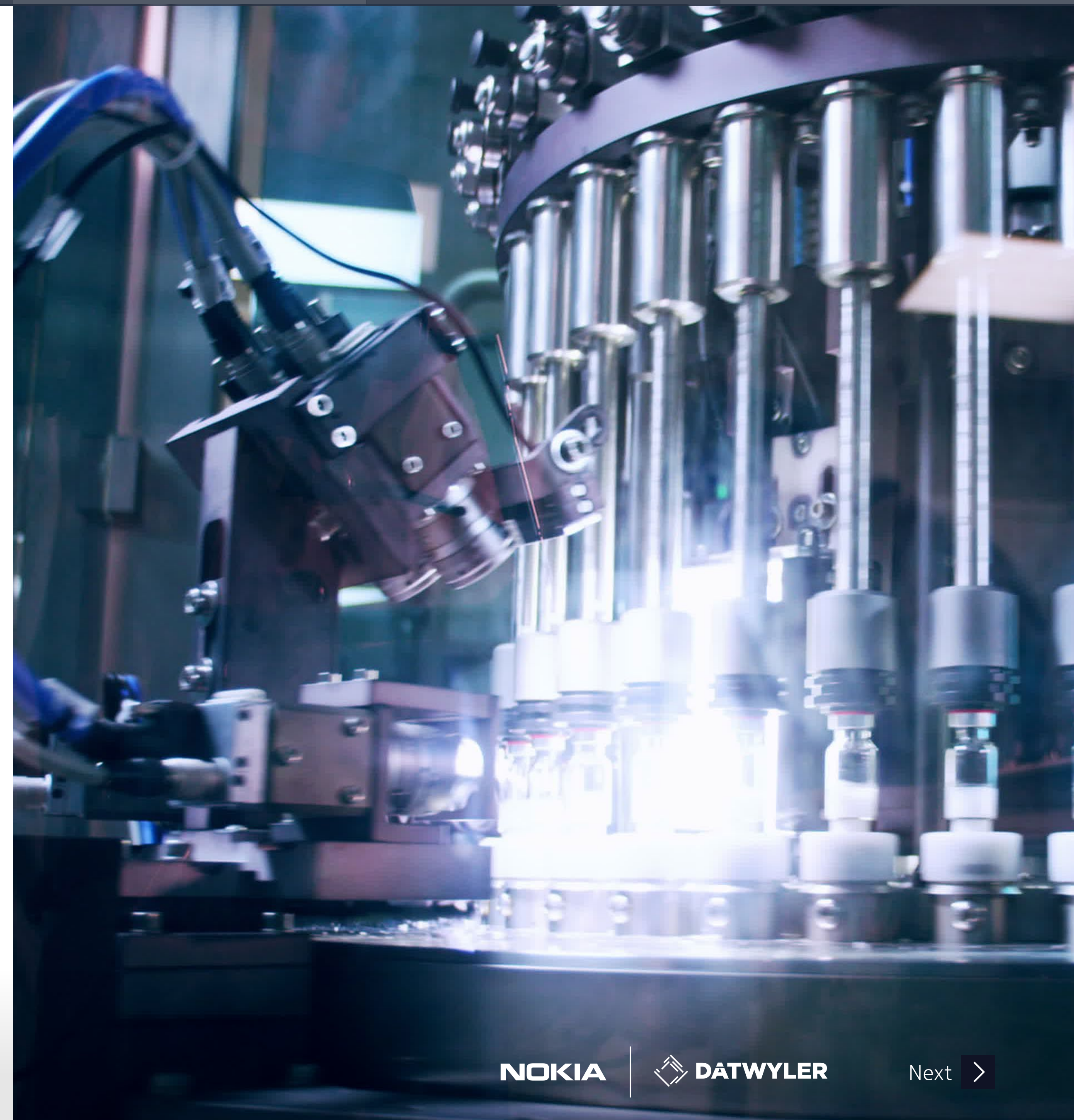
Nokia Industrial-grade Private Wireless is here

The 4G/LTE networks that were once only the domain of telcos are now becoming available to manufacturers

Governments around the world are designating more spectrum for manufacturing, and Nokia is pioneering small cell technology that's ideal for private manufacturing networks. That means you can deploy a private wireless network with 4.9G capabilities to meet your application and operational needs today, with a clear roadmap for a simple evolution to 5G tomorrow.

Meet business-critical connectivity requirements with a dedicated 4.9G network built to handle the demands of digital factory applications, offering you:

- **Intrinsic security**
  robust authentication procedures and security protocols

- **Mission-critical reliability**
  for continuous operations

- **Deep, wide coverage**
  to connect everyone and everything

- **Predictable performance**
  for industrial automation and real-time asset coordination

- **High capacity**
  to easily handle the rapid growth of devices, sensors and data

- **Greater operational control and flexibility**
  to respond and adapt quickly to changing business needs

- **Effortless mobility**
  built on trusted 3GPP mobile standards

- **Enhance safety with fewer accidents**
  through improved monitoring and situational awareness

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Nokia Industrial-grade Private Wireless for
Manufacturing

Create intelligent, agile factories with flexible, industrial-grade connectivity

In the manufacturing sector – the crucible of Industry 4.0 – operations have already been transformed by IIoT technologies and higher levels of automation. But now there's increasing pressure on manufacturers to ramp up their agility, flexibility and responsiveness even further to meet fast-changing consumer demands and remain competitive.

That means deploying reliable, resilient, wireless connectivity to support intelligent automation and rapid reconfiguration of production processes. And it means enabling seamless collaboration between humans, machines, robots and AMRs, helping to increase productivity and improve efficiency.

The trouble is, an Ethernet infrastructure is expensive and will limit the possible applications of Industry 4.0. And while Wi-Fi is more adaptable, it's limited in reliability, security and predictable performance – and it will fail to meet future requirements.
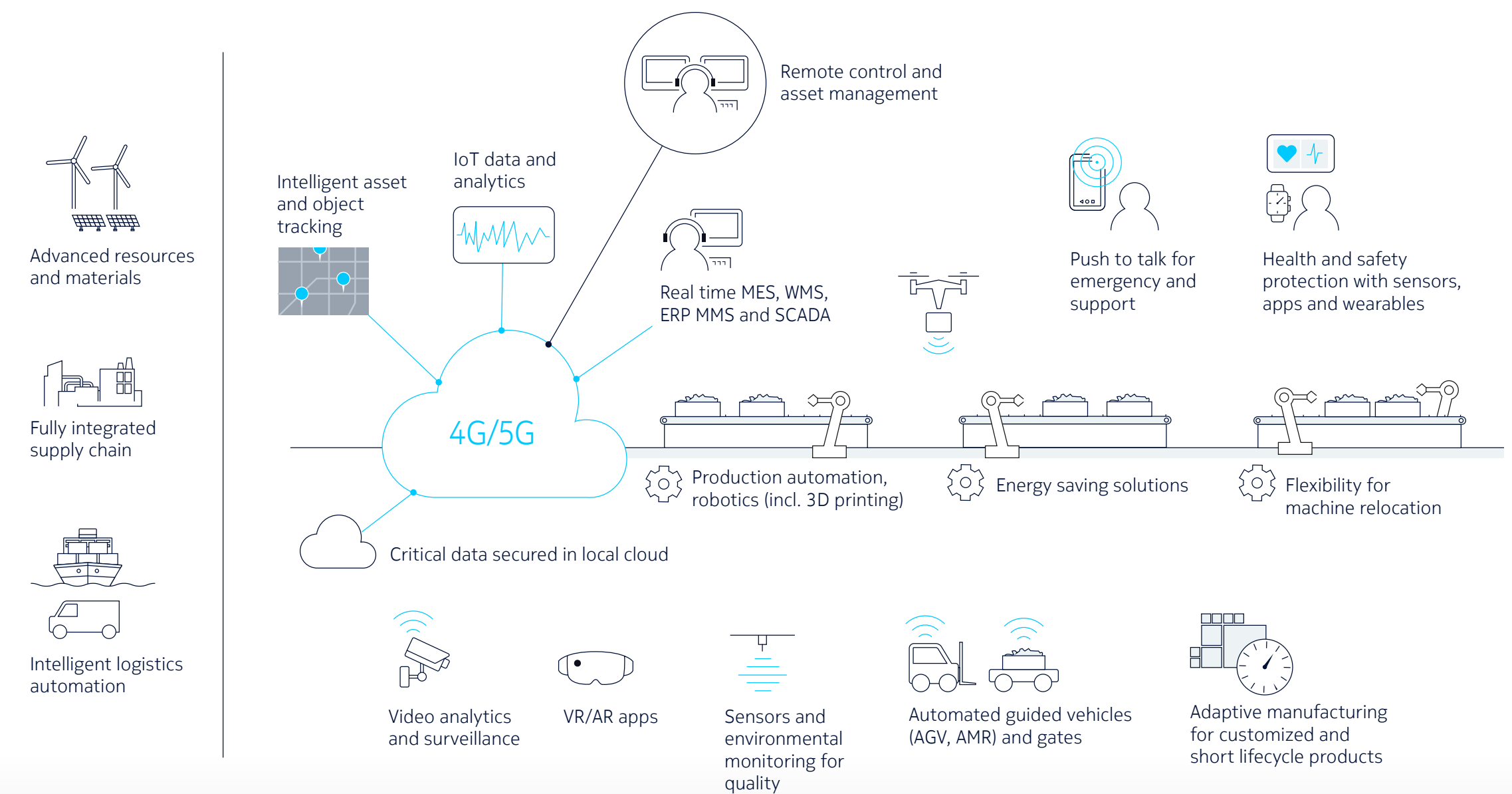
Unleash the full potential of Industry 4.0

Nokia private wireless provides a dedicated, industrial-grade mobile network built to deliver the flexibility to rapidly reconfigure and retool production lines for quickly responding to changing demands.

A low-latency, high-reliability network supports remote control and context-aware collaborative robots and AMRs. High-performance, resilient and secure connectivity helps realize the productivity increases and cost reductions promised by Industry 4.0 technologies. And with LTE/4.9G technology that seamlessly evolves to 5G, manufacturers can prepare today for tomorrow's 5G applications with minimal capital investment.

From now to next

- **Predictive maintenance:**
  Real-time data and advanced analytics to minimize downtime

- **Digital twin:**
  Increased insight and mobility to support dynamic, flexible production lines

- **Machine connectivity:**
  Secure, resilient LTE/4.9G to connect machines, robots, devices and people

- **Intelligent AMRs:**
  High performance and low latency to support AI and fleet management, increase their speed and avoid congestion points

Advanced resources and materials

Fully integrated supply chain

Intelligent logistics automation

Intelligent asset and object tracking

IoT data and analytics

Remote control and asset management

Real time MES, WMS, ERP MMS and SCADA

Push to talk for emergency and support

Health and safety protection with sensors, apps and wearables

4G/5G

Critical data secured in local cloud

Production automation, robotics (incl. 3D printing)

Energy saving solutions

Flexibility for machine relocation

Video analytics and surveillance

VR/AR apps

Sensors and environmental monitoring for quality

Automated guided vehicles (AGV, AMR) and gates

Adaptive manufacturing for customized and short lifecycle products

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Digital twin

Get reliable wireless connectivity to see, understand and control your entire factory for greater agility and productivity.

Gain deeper insights through increased data collection to develop virtualized models of both machines and production lines, and understand how changes will impact equipment performance and reconfiguration to meet on-demand manufacturing. Monitor every aspect of the factory environment to keep production quality high – and enable predictive maintenance to keep downtime low. Use private wireless and digital twin technology to improve the reliability and operational efficiency of equipment and production lines.

- Increased reliability of equipment and production lines
- Improved OEE and greater productivity through reduced downtime, enhanced performance and better quality
- Reduced risk exposure in various areas including product availability, marketplace reputation, and more

"For factory employees, the automation of our Oulu manufacturing environment increases flexibility and adaptability. The 'conscious factory' has evolved the working ecosystem - increasing motivation and the wellbeing of employees by automating the traditionally repetitive tasks, making work more diversified and productive."

Heikki Romppainen, Head of Oulu Factory, Nokia

Intelligent AMRs

Create a resilient, low-latency network to support smarter, safer, more collaborative AMRs.

Get secure, high-performance connectivity to empower intelligent AMRs with context-awareness and open-path navigation for obstacle and collision avoidance. Connect data and systems across the plant to keep AMRs up to date on changes in flexible production lines. And use real-time data from onboard cameras and sensors to enable smarter collaboration between your human and autonomous workforce.

- Intelligent, open-path navigation
- Increased interactivity with workers, AMRs, and unexpected changes
- Self-positioning using Edge cloud stored plans, factory digital twins and sensor data
- Context adaptable
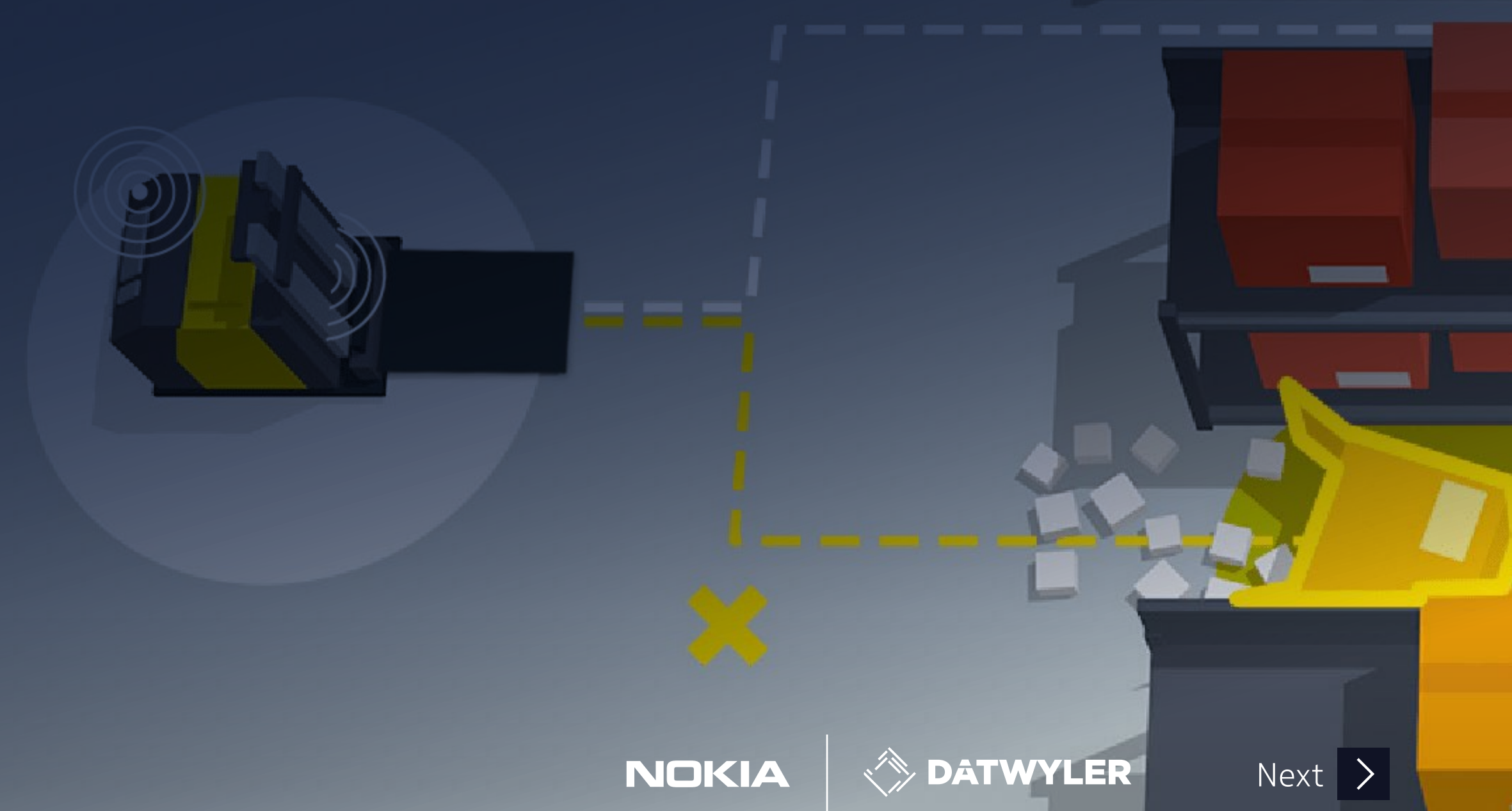
Efficient workers

Enable your people to work intelligently and wirelessly, using the latest AR and smart technologies.

Use real-time data in conjunction with the latest AR and VR technologies to optimize the efficiency of your production line. Support the latest headsets, tablets and tools and feed information directly to your workforce through a wireless 4.9G network. And deliver data to production line workers through AR so they can quickly change set-ups and re-tool for new requirements, or learn to operate machines more quickly and with fewer mistakes – both of which can have a profound impact on productivity.

- **Job-specific data delivered in real time**
- **Instant support for production line workers**
- **Hands-on training, fewer mistakes and greater productivity**
- **Faster working with wireless goggles, workstation tablets and smart tools**

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Flexible production lines

Improve the flexibility and productivity of your production lines with automation, AI and robotics.

Eliminate repetitive tasks and streamline efficiency with a network that supports autonomous machines, wireless robots and the rapid retooling of production lines to meet changing demand.

Combine real-time data with historical profiles to automatically adjust systems for peak performance, while ensuring your machines can predict maintenance and prevent faults.

Use Mobile Edge Computing (MEC) to replace manual operations – like pick-and-place, screw insertion and soldering – with wireless robots, and repurpose them as needed to gain the flexibility and high-level productivity that provide genuine competitive advantage.

- Multiple product variants from a single production line
- Fewer high-volume, repetitive tasks
- Self-predicting and self-healing technology
- Improved product assembly and employee health
- Efficiency gains of up to 20%

The Nokia Oulu factory used its private wireless network to implement wireless asset tracking, zero-touch logistics and lean manufacturing concepts on the factory floor, resulting in up to 90% reductions in lead times for layout changes.

Source: Making the Digital Factory a Reality

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Leading by example:
Making the digital factory a modern reality

Nokia's factory of the future uses a 4.9G private wireless network and the latest digital technologies to increase productivity, reduce time-to-market and improve product quality.

To remain competitive, today's factories need to be flexible, versatile, productive and smart – and our factories are no exception. The Nokia factory in Oulu, Finland, uses Nokia Industrial-grade Private Wireless to provide the bandwidth, scalability and performance needed to support the latest digital technologies and IoT applications.

Today, the Oulu factory can provide seamless connectivity across 100 percent of the production area. With no risk of service issues, plant managers can bring wireless asset tracking and lean manufacturing concepts to the factory floor, resulting in:

• Seamlessly connected stationary and mobile production machines
• Up to 90% faster lead times
• 90% faster floor layout changes

Improving productivity with AMRs

In Oulu, our private, 4.9G network is also used to connect wireless AMRs that autonomously navigate around obstacles and deliver materials to the workstation. As a result, logistics productivity at the factory has increased by 100 percent.

Overall, Nokia's digital factory of the future has seen productivity gains of 30 percent, a significant reduction in time-to-market, and annual cost savings of millions of euros.

> "The bottom line is that the Oulu factory has leveraged connectivity to become one of the most flexible, versatile, and productive factories anywhere in the world."
>
> **The World Economic Forum**

From now to next with
Nokia Industrial-grade Private Wireless

To compete today, you need to transform your operations now. But it's difficult to get the most out of the Industry 4.0 technologies that will support your digital transformation goals when you're relying on existing wireless networks that just aren't up to the task.

You need industrial-grade private wireless: a dedicated LTE/4.9G network that offers the predictable performance, mobility, massive coverage and capacity, and built-in security of 4.9G right now – and a simple evolution into 5G next.

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Go Allwhere with Nokia Industrial-grade Private Wireless

We deliver networks that solve unique, manufacturing challenges, giving you:

- **Flexibility:**
  Improve your ability to adjust and adapt to changing requirements and volumes

- **Increase automation:**
  Add IIoT and AI with data analytics and digital twins to gain a competitive advantage, increase productivity and improve OEE

- **Reliability:**
  Reduce downtime with up to five-nines availability to support synchronous industrial applications

- **Security:**
  Maintain control of all your critical IP data that's protected on-premises

- **Capacity:**
  Provide the speed and coverage you need to support your business-critical operations

- **Performance:**
  Meet diverse operational requirements with network predictability and assurance

- **Choice:**
  Deploy on-premises or in the cloud in a fully-owned or as-a-service model

- **Connectivity:**
  Connect every site, device, asset and person for greater visibility, control and collaboration

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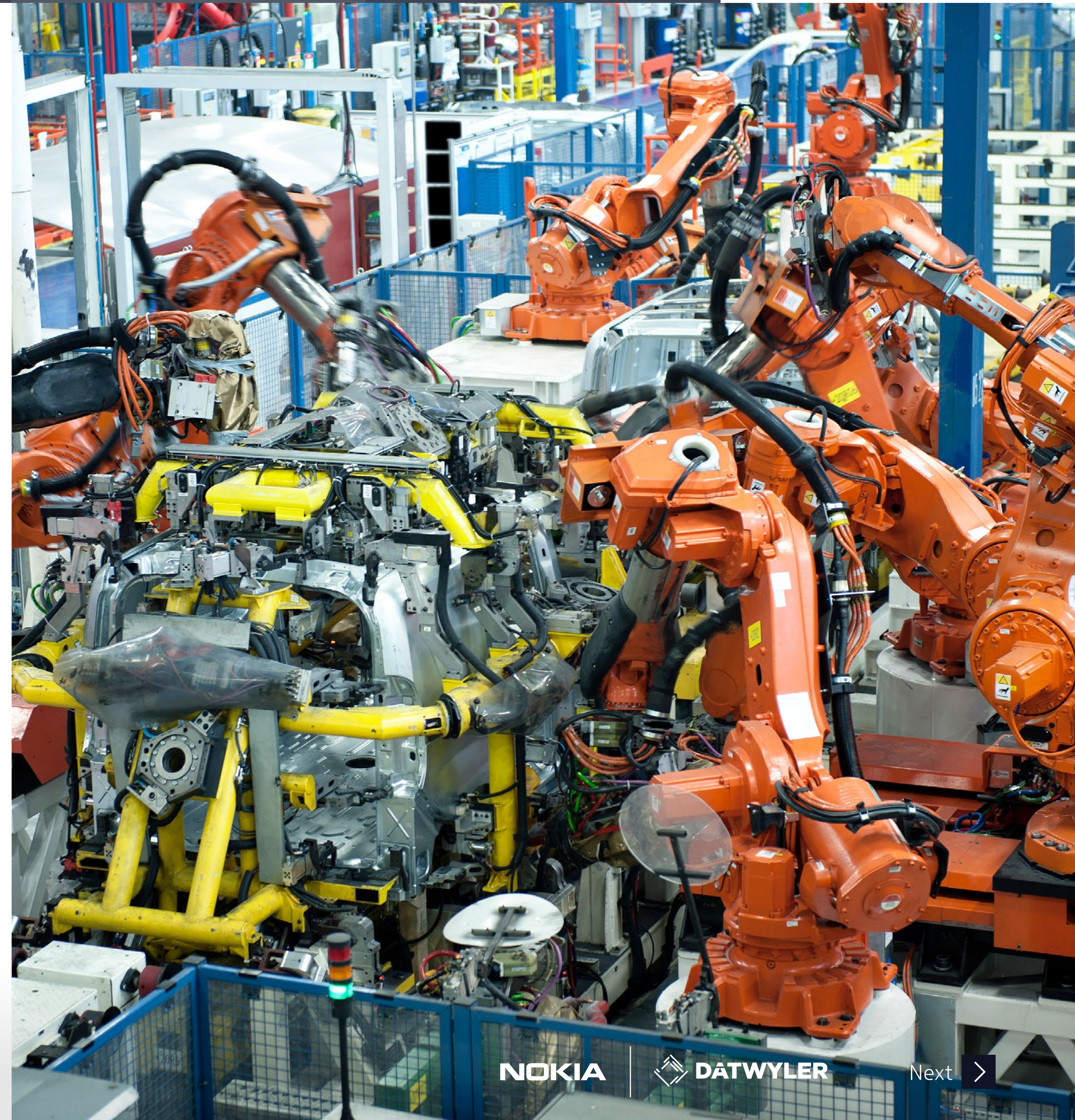
Why Nokia?

They might not know it, but more than a billion cellphone users worldwide rely on Nokia networking technology and expertise every day. And they're not the only ones.

With more than 1,300 mission-critical networks and more than 130 private wireless deployments around the world, our industrial customers trust us to provide the connectivity they need.

- Extensive real-world experience in key industrial sectors
- Industry-leading 4G and 5G wireless technologies end to end: small cells, cloud packet core, IP and optical transport, with common management and orchestration
- A rich analytics and application suite
- A powerful ecosystem of industrial partners
- Professional services to help build the business case and plan for the future
- End-to-end management and orchestration
- Engineering services to assist with design, deployment and maintenance
- Nokia Bell Labs innovations feeding market-leading solutions

Let's get started

To learn more about what you could achieve now with Nokia Industrial-grade Private Wireless – and where it could take you next – get in touch with one of our experts: **nokia.ly/private-wireless**

INTRO

INDUSTRY 4.0

INTELLIGENT OPERATIONS

FLEXIBLE PRODUCTION LINES

CASE STUDIES

CONCLUSION

Nokia private wireless gives you a dedicated, industrial-grade network that solves the unique connectivity challenges your factories face now – and the ones they'll face next. Want to learn what reliable, secure, high-performance wireless connectivity could do for your organization? Get in touch with one of our experts today:

nokia.ly/private-wireless-manufacturing
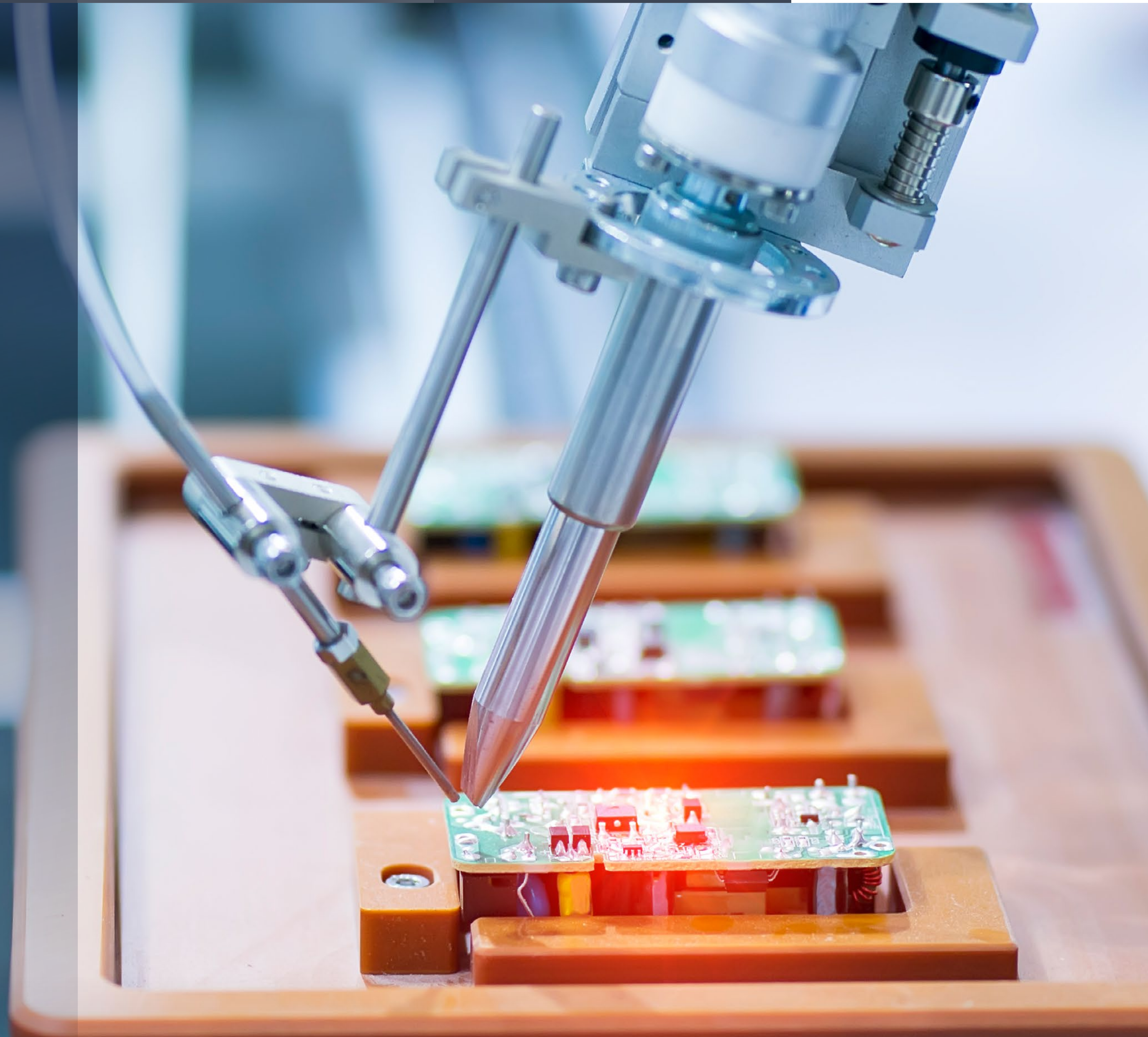
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About Nokia
Nokia is a global leader in the technologies that connect people and things. Powered by the innovation of Nokia Bell Labs and Nokia Technologies, the company is at the forefront of creating and licensing the technologies that are increasingly at the heart of our connected lives.

With state-of-the-art software, hardware and services for any type of network, Nokia is uniquely positioned to help communication service providers, governments, and large enterprises deliver on the promise of 5G, the Cloud and the Internet of Things. **http://nokia.com**

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