

The Nokia logo is displayed in the top left corner in a bold, white, sans-serif font. The background of the entire image is a landscape featuring a field of tall, golden grass in the foreground, a line of wind turbines in the middle ground, and several high-voltage power line towers with multiple cross-arms and power lines stretching across the sky. The sky is a clear, light blue, suggesting a bright day.

NOKIA

Prepare for the future of your smart grid
Nokia Industrial-grade Private Wireless for Utilities

In this guide we look at how industrial-grade private wireless can help utilities as they decarbonize, zooming in on practical use cases for operating the productive, efficient and safe smart grid of the future.



> Industry 4.0

Connect everyone and everything throughout your smart grid

> Grid Health Management

Get reliable wireless connectivity to understand, automate and maintain your productive smart grid

> Field Workforce Enablement

Keep workers connected and informed to ensure safe, efficient remote operations

Make Industry 4.0 a reality

The fourth industrial revolution is well underway – but how can utilities turn the possibilities of Industry 4.0 into operational realities?

The technologies – industrial IoT, AI, virtual reality, advanced analytics, cognitive cyber security and more – are available to help you sharpen your operations, bringing real-time grid control, automation-powered distribution, predictive maintenance, and heightened efficiency.

All while maintaining grid stability and power quality as distributed energy resources are integrated into the grid.

But gaining all those advantages hinges on one thing: connectivity.

The trouble is, the wireless networks that most utilities rely on weren't built to support these new business-critical utilities use cases. They don't have the latency, performance and connectivity capabilities to support the real-time management and optimization of smarter, more agile grids. Grids that will increasingly combine centralized generation resources with distributed renewables, micro-generation and large-scale storage facilities.

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 operational efficiency advantages right now. And you can prepare your organization for what's next – a seamless transition to 5G.

Nokia Industrial-grade Private Wireless is here

The LTE networks that were once only available to telcos are now within reach for utilities.

Governments in several countries have begun designating LTE spectrum for utilities and industry, and Nokia has been pioneering small cell technology ideal for private industrial networks. That means you can deploy a private wireless network with 4.9G capabilities that's ready to meet your needs today, with a seamless roadmap for a simple evolution to 5G tomorrow.

You can meet critical operational connectivity requirements with a dedicated LTE network built to handle the demands of industrial applications, offering you:

- **Intrinsic security**
to ensure truly compliant and reliable connection
- **Mission-critical reliability**
for continuous operations
- **Deep, wide coverage**
to connect everyone and everything
- **Predictable performance**
for 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 enhance safety and respond quickly to changing business needs
- **Effortless mobility**
built on trusted 3GPP mobile standards



Nokia Industrial-grade Private Wireless for Utilities

Control and optimize smart grids
with ultra-reliable pervasive connectivity.

The ground is shifting beneath the feet of power utilities. The industry is moving from fossil fuels to renewables, from centralized to distributed energy generation, and from cumbersome, manual processes to smart, automated systems. Renewable energy generation by consumers and advances in battery storage are also bringing enormous changes to the way the distribution grid works.

In this new landscape, utilities are striving to modernize power grids and optimize grid performance to dynamically balance supply with demand. And they're looking for new ways to reduce the expense and complexity of managing multiple field area networks (FANs) that connect the applications and devices that monitor, control and automate grid functions.

The old wireless networks are beginning to feel the strain, and utilities are realizing that the productivity benefits of digitalization and automation will require a new communications infrastructure. One that can also offer a platform for new business models and, as always, make sure safety and reliability remain a priority.

The answer? Nokia Industrial-grade Private Wireless.

Connect everything and everyone across your grid

Nokia Industrial-grade Private Wireless provides efficient, reliable mission-critical connectivity for all grid equipment, applications and personnel on a dedicated converged network.

A secure private network offers the capacity to cope with the growing volume and variety of data while utilizing Quality of Service (QoS) to prioritize performance for mission-critical traffic. Combinations of spectrum that include dedicated (licensed) and shared (unlicensed, CBRS, MulteFire) are transparently and efficiently supported to effectively address a range of use cases. Resilient, highly available connectivity enables more efficient ways of working in the field. And with LTE/4.9G technology today, and a seamless transition to 5G tomorrow, private wireless can empower your move to smart grids right now – and help you make them even smarter in the future.

From now to next

- **Grid automation:**
Resilient, secure wireless for holistic real-time grid management
- **Virtual reality:**
To help refresh field workers on procedures, tools and equipment before beginning a work assignment
- **Data and voice FAN convergence:**
Eliminate the cost of separate LMR/PMR network for field workers
- **Advanced collaboration features:**
Secure Push-to-Talk, Push-to-Video and advanced mobile applications to improve field worker safety and productivity
- **Predictive maintenance:**
Connectivity and analytics for insight to reduce costs while optimizing asset lifecycles and power quality

What use cases can your utility use with industrial-grade private wireless?

- SCADA – Traditional and IEC 61850
- Distributed generation and storage
- Distribution system protection
- Remote circuit breaker/recloser operation
- Advanced metering infrastructure
- Distribution automation
- Wind farms
- Field workforce data and video
- Microgrids, home area networks
- Demand response
- Synchrophasors in distribution networks
- Wide area situational awareness
- Flexible AC transmission systems
- Dynamic line rating
- Drone remote operation and analytics
- Field workforce AR/VR
- And more

Single communications platform for OT and IT, IoT and new businesses



Distribution automation

Get reliable, secure wireless connectivity to increase automation and manage growing distributed energy resources across your smart grid.

Appropriately connect all grid applications, sensors and equipment in real time to enable greater automation with a solution that includes edge computing for applications with very low latency requirements.

Combine LTE/5G and IP/MPLS to simplify operations and optimize performance. Use the proven mission-critical WAN IP/MPLS service, security and management environment to create a single, consistent communications network that extends to critical devices at the grid edge.

Empower the distribution grid applications that improve reliability and outage management, voltage management, equipment health monitoring and DER integration.

- Application-specific FAN convergence reduces cost and enhances flexibility
- Low latency connectivity enables digitalization, automation, and interconnected distributed generation and storage
- Extend proven mission-critical WAN IP/MPLS service, security and management environment to critical devices at grid edge to optimize their performance and simplify operations



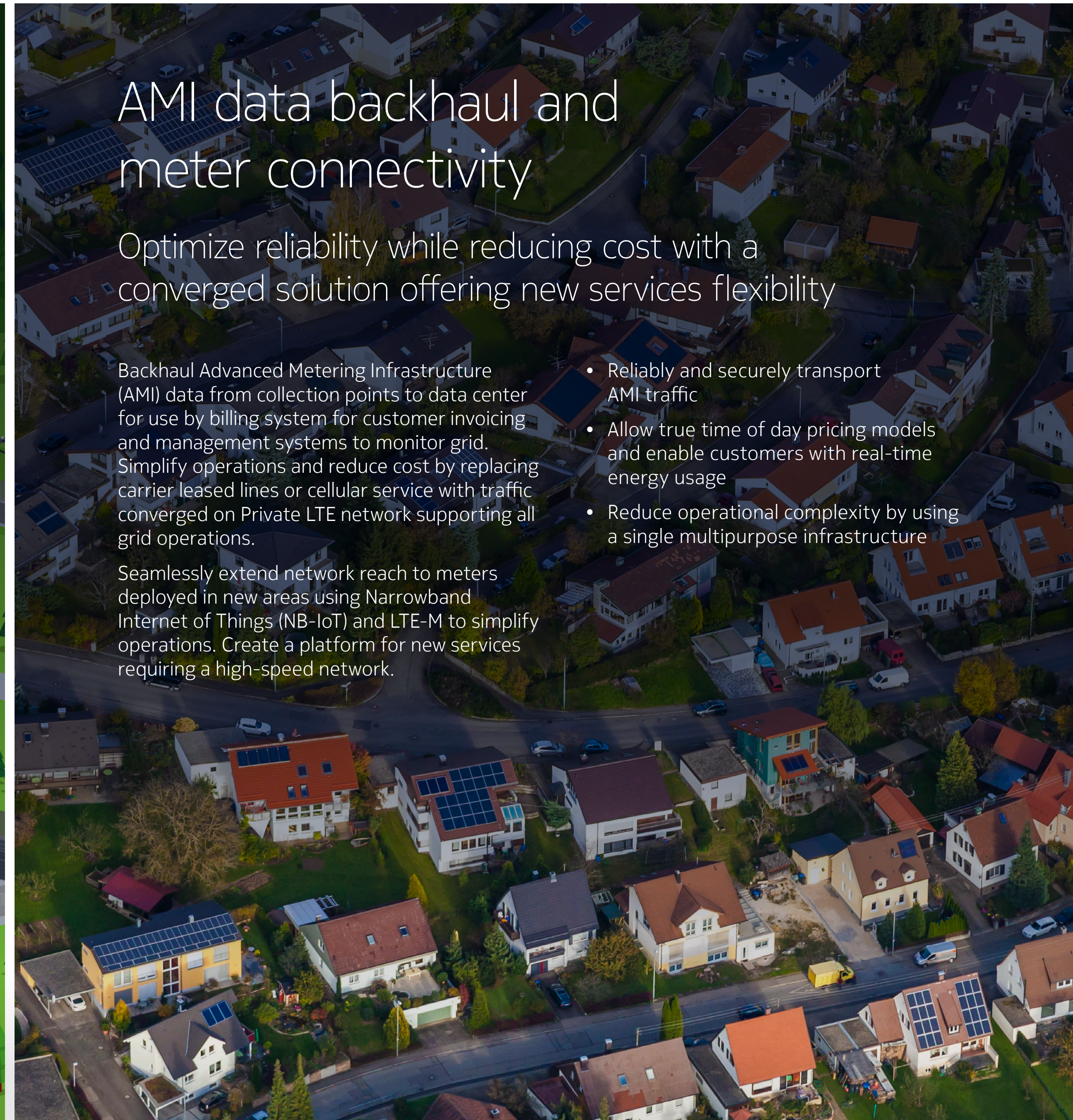
AMI data backhaul and meter connectivity

Optimize reliability while reducing cost with a converged solution offering new services flexibility

Backhaul Advanced Metering Infrastructure (AMI) data from collection points to data center for use by billing system for customer invoicing and management systems to monitor grid. Simplify operations and reduce cost by replacing carrier leased lines or cellular service with traffic converged on Private LTE network supporting all grid operations.

Seamlessly extend network reach to meters deployed in new areas using Narrowband Internet of Things (NB-IoT) and LTE-M to simplify operations. Create a platform for new services requiring a high-speed network.

- Reliably and securely transport AMI traffic
- Allow true time of day pricing models and enable customers with real-time energy usage
- Reduce operational complexity by using a single multipurpose infrastructure



Synchrophasors in distribution grid

Understand and respond to real-time grid conditions using synchrophasors data, analytics and pervasive broadband connectivity to enhance power quality and reliability.

Get high-performance connectivity to gain real-time insights into grid conditions. Monitor and control the stability of grids with intermittent distributed renewable energy resources and storage, enhancing quality and reliability. Use analytics to detect and respond to potential intermittent problems with preventative maintenance.

- Monitor real-time grid conditions across distributed generation and storage resources
- Detect and respond proactively to potential sporadic issues
- Maintain grid stability and enhance quality and reliability

Wind/solar farm predictive maintenance

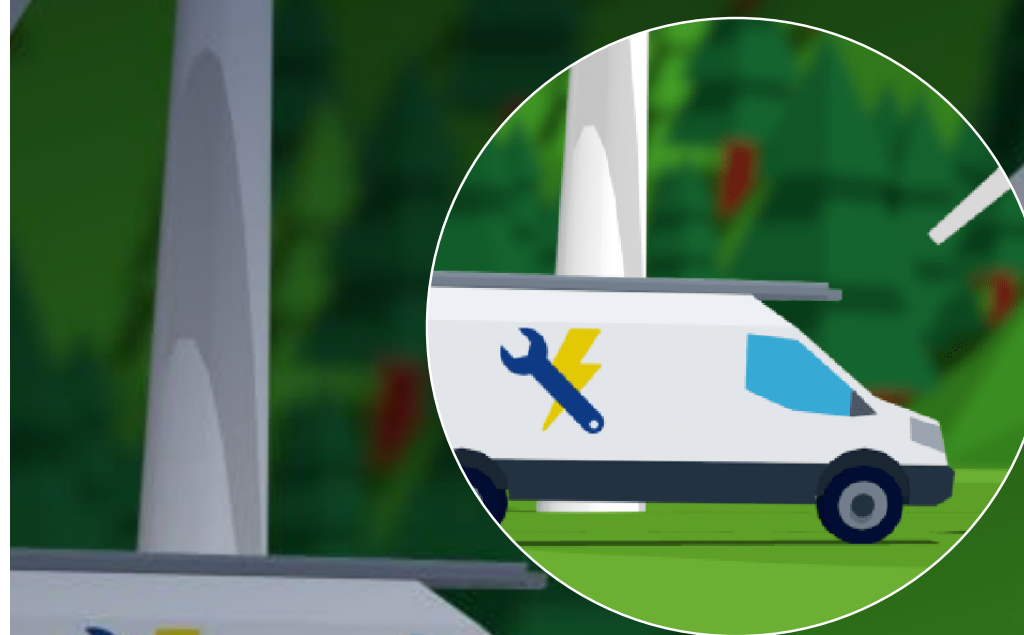
Connectivity and analytics for insight to reduce costs and lost productivity while optimizing asset lifecycles.

Get near real-time insight into the condition of remote assets – from wind turbines to solar panels and distribution grid assets. Use private wireless to collect IoT sensor data and analytics to enable preventative maintenance, reducing costly unexpected asset failures and lost energy productivity, while optimizing asset investment lifecycles.

Utilize this broadband network for remote drone operation for inspections, perimeter protection and vegetation management for solar farms. Perform data processing and analytics on site for low latency, time-sensitive applications, such as automated early shutdown of turbines to avoid cascading damage.

And keep onsite workers safe and productive with reliable coverage for Push-to-Talk and Push-to-Video communications.

- Private wireless, IoT and analytics for optimization of wind farm operations
- Predictive maintenance enabled by timely sensor data and analytics reduces costly and unexpected asset failures and lost energy
- Reliable coverage improves onsite worker safety and productivity



Field workforce enablement

Keep workers connected and informed to ensure safe, efficient remote operations.

Remote worker communications

Empower your field workforce with reliable access to business-critical applications and intelligence. Keep workers safe and connected, with Push-to-Talk, Push-to-Video and broadband data capabilities. And reduce costs and complexity while enhancing situational awareness with a single converged LTE network for voice, data and video that also supports grid operations.

- Get business-critical applications and intelligence to remote workers
- Continuously increase workforce safety and productivity
- Eliminate the operational headaches and cost of running separate networks



Field workforce enablement

Keep workers connected and informed to ensure safe, efficient remote operations.

Virtual reality (VR) and analytics

Enable field workers seated in their truck to use VR to refresh their understanding of processes, tools, equipment and grid devices before they begin a task. Use video analytics to assess worker preparedness to safely perform tasks and alert the operations center to 'man down' situations. Seamlessly evolve from LTE/4.9G to 5G to deliver the ultra-low latency required for VR to enhance worker safety and productivity.

- Refresh worker training immediately before commencing work
- View 3D replicas of grid equipment about to be worked on
- Automatically get alerts in the operations center when onsite personnel are not authorized or prepared for work, and for other issues requiring attention

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 transformation 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 network that offers the predictable performance, massive coverage and capacity, and built-in security and mobility of 4.9G right now – and a simple evolution into 5G next, where your applications require it.



Ready 4.0 anything with Nokia Industrial-grade Private Wireless

We deliver networks that solve unique, industrial-scale challenges, giving you:

- **Remote management of resources:**
Reliable connectivity to remote locations for greater visibility and control
- **Grid automation:**
Resilient, secure wireless for real-time holistic grid management
- **Reliability:**
Support efficient, round-the-clock operations and enhance worker safety
- **Security:**
Gain peace of mind with an intrinsically secure, private network that fully complies with regulatory requirements
- **Capacity:**
Handle millions of sensor feeds, multiple HD video streams and more, while providing priority to mission-critical traffic
- **Performance:**
Enable extreme automation, real-time coordination, and autonomous operations
- **Agility:**
Make rapid operational adjustments to meet changing demands
- **Choice:**
Deploy on-premises or in the cloud, owned or as-a-service
- **Connectivity:**
Connect every site, device, asset and person for greater visibility, control and collaboration



Why Nokia?

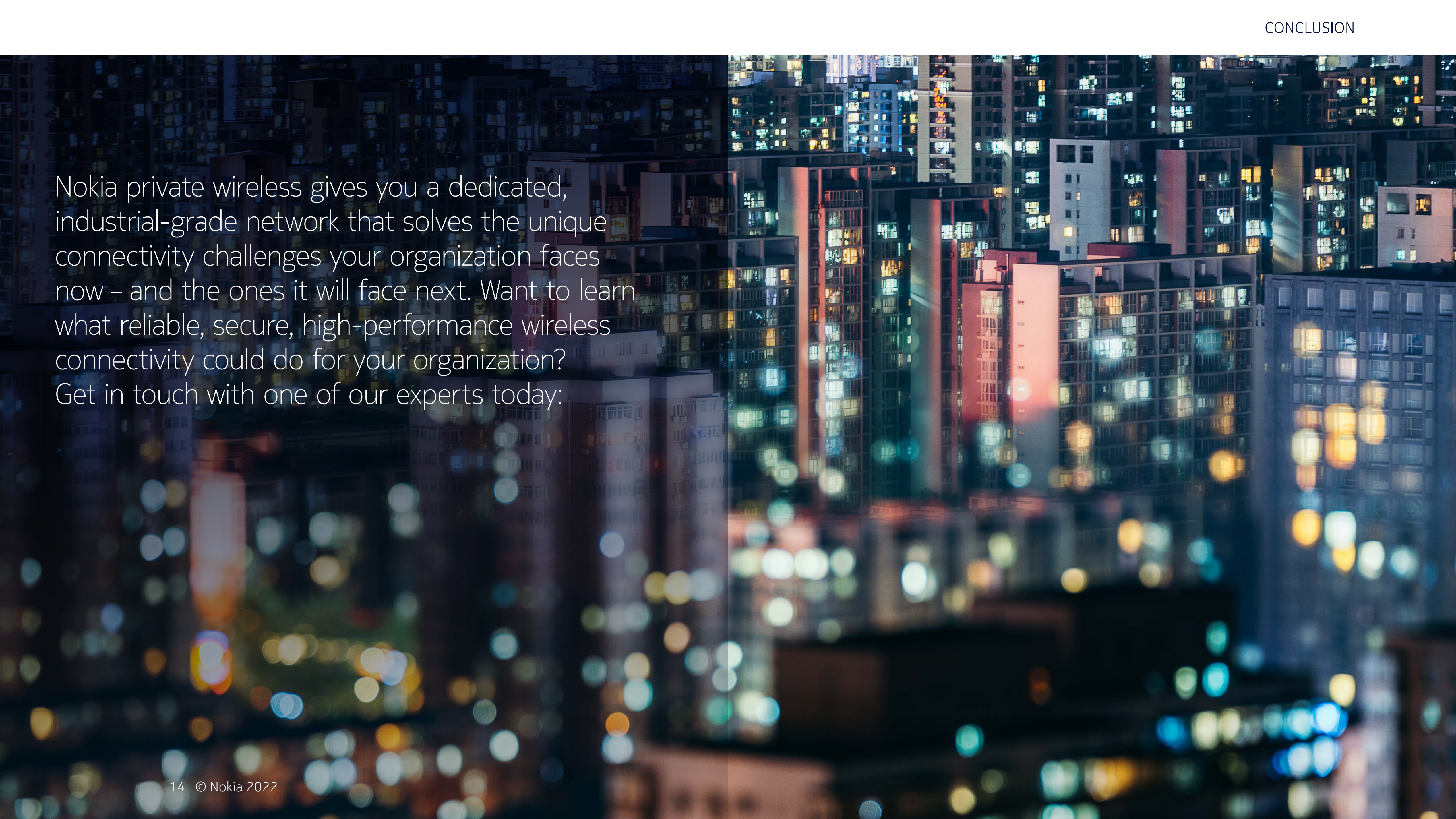
They might not know it, but more than a billion cellphone users worldwide rely on Nokia networking technology and expertise every day. And they're not the only ones.

With more than 1,300 mission-critical networks and more than 420 private wireless deployments, our industrial customers trust us because we have:

- Extensive real-world experience in 200+ power utility networks and in other critical 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
- End-to-end network solution leveraging Nokia's proven IP/MPLS WAN and DWDM and microwave transport networks
- 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 private wireless gives you a dedicated, industrial-grade network that solves the unique connectivity challenges your organization faces now – and the ones it will 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:

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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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