



Advancing wind farm communications for the Industry 4.0 era

The new Industry 4.0 era, with greater digitalization and automation, offers the potential to optimize many facets of wind farm operations. This will require seamlessly interconnected systems that sense, analyze, optimize and control key attributes and actions. To accomplish this, communications networks must be able to connect everything simultaneously with guaranteed service and also connect onsite workers — all while the diversity and quantity of connected assets grows.

For wind farm operators to analyze information about the state of those assets and optimize their operations, communications networks must have the flexibility to connect applications, devices and workers in a way that meets stringent latency, capacity, reliability and security requirements. Communications networks will need to be able to dynamically adapt to transport massively varying amounts of data between multiple devices, sensors and systems. Analysis of the data will ultimately support more precise execution, maximize productivity and improve safety.





For many operators, an industrial-grade broadband wireless network will be a key part of the communications network for a 4.0 era wind farm. When planning this network solution, operators will need to consider the capacity, latency, reliability and security requirements of current and future key applications. This includes requirements for: operations optimization; remote inspection and maintenance; worker safety and improved productivity; and surveillance and security. Support for secure, reliable, critical voice communications will continue to be essential in the 4.0 era.

Typically, the broadband wireless network will require spectrum that the operator does not currently utilize or own. Possible available spectrum options in the remote onshore/offshore locations where wind farms are often located include licensed, unlicensed and shared spectrum.

Ownership options to consider for this dedicated private broadband wireless network range from a cloud-based solution that is predominantly a monthly fee, to a solution that is predominately a one-time purchase of all equipment. Operators need to consider the up-front investment, flexibility and risk of each option as well as future application needs that might benefit from the use of new wireless technologies such as 5G.

For more information about how your wind farm communications network can benefit from the Industry 4.0 era, visit our [Renewable Energy web page](#).



Operations optimization

Through the use of a combination of measures, such as static yaw correction, dynamic yaw control, control optimization, aerodynamic improvements and site optimization using data frequently collected on wind farm performance.

Remote inspection and maintenance

Through unmanned drones and inspection robotics, which are becoming more prevalent, and potentially robotic systems for maintenance, which are now being researched.

Worker safety and improved productivity

By providing workers with the ability to make emergency calls from remote work zones and to receive equipment information and environmental data in real time to enhance their situational awareness. Augmented reality is needed to provide access to documents, procedures and maintenance logs through a simple, hands-free visual interface and a helmet-mounted camera to guide novice workers remotely as they perform their work. Automated and optimized daily schedules will bundle primary and maintenance tasks to maximize the productivity of each trip to a tower.

Surveillance and security

By using a growing quantity and variety of thermal cameras to detect and alert. HD cameras will record incidents and provide details required to react to and follow up on incidents, thereby protecting a wind farm's perimeter, its entire area, and all the devices and workers.

About Nokia

We create the critical networks and technologies to bring together the world's intelligence, across businesses, cities, supply chains and societies.

With our commitment to innovation and technology leadership, driven by the award-winning Nokia Bell Labs, we deliver networks at the limits of science across mobile, infrastructure, cloud, and enabling technologies.

Adhering to the highest standards of integrity and security, we help build the capabilities we need for a more productive, sustainable and inclusive world.

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Nokia OYJ
Karakaari 7
02610 Espoo
Finland
Tel. +358 (0) 10 44 88 000

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