



Modernizing Energy Production and Automating Processes

WHEN IT MATTERS, IT RUNS ON WIND RIVER

EXECUTIVE SUMMARY

In an era of rising energy demand, multiple challenges confront electricity utilities, energy producers, system architects, and automation equipment OEMs. In response, a slate of interoperable technologies from Wind River® helps resolve many of these energy sector challenges, combining 5G networking, virtualization, and containerization. These technologies are complemented and enabled by the Industrial Internet of Things (IIoT), data insights from AI systems, and a growing ecosystem of distributed computing solutions.

“Wind River has for decades provided a backbone for global telecom infrastructure and is a leader in the 5G landscape. Combining our telecom expertise with our long-standing efforts as an open source champion, we are committed to delivering technology to advance the network, especially as the industry looks toward 5G and cloud infrastructures.”

—Michel Genard, Vice President of Product at Wind River

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TRANSFORMING ENERGY CAPTURE AND DISTRIBUTION

At the forefront of emerging technologies, 5G is accelerating wireless communication to levels that enable formerly difficult or impossible industrial operations. The need for improved energy efficiency and more granular process control has been a motivating force in establishing IIoT solutions, which, in turn, require advanced networking capabilities and higher performance to handle the massive volumes of data being exchanged and analyzed.

5G technology is well suited to these requirements, providing higher bandwidth (up to 20 gigabits/second), lower latency (typically less than 1 millisecond), an available spectrum of 30 gigahertz, and potential connection density up to 1 million connected devices per square kilometer (0.38 square miles).

For industrial and energy sector applications, early adopters of 5G and IoT solutions have defined eight requirements that address practical, real-world use cases, as shown in Figure 1.

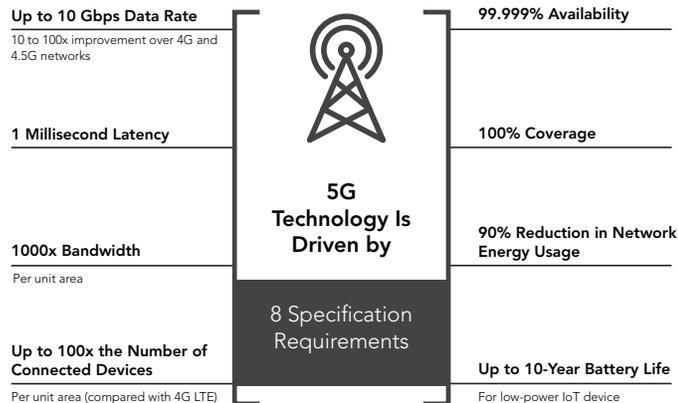


Figure 1. Requirements of 5G technology for IoT solutions
 Source: Gemalto, “Introducing 5G Networks—Characteristics and Usages”

Digital transformation taking place within the energy sector and the new technologies and business models that are emerging—such as distributed energy resources (DERs) and large-scale renewables—call for innovative approaches to intelligently handle processes and communication. Traditional producers of fossil-based energy can also benefit from IIoT, AI, and virtualization solutions that increase reliability, reduce the chance of mishaps, and boost efficiency across complex production lifecycles.

VIRTUALIZATION AND CONTAINERIZATION EXPAND THE POSSIBILITIES

Making effective use of available compute, storage, and network resources is a primary goal of utilities and energy production companies. Virtualization and containerization provide two different ways of accomplishing this. Wind River has deep experience developing agile, dynamically scalable solutions that maximize resource use and adapt to demand fluctuations and varying traffic loads in the network infrastructure—key factors to effectively cope with rapidly changing requirements in energy sector systems.

Virtualization

By abstracting the hardware in a system, creating one or more virtual machines, workloads can be run using a shared collection of resources. For example, Wind River Helix™ Virtualization Platform reflects 30 years of experience in meeting the stringent requirements of worldwide energy producers, enabling them to fully virtualize their industrial control systems. Based on a Type 1 hypervisor, Helix Platform supports a diverse range of operating systems to cover both mission-critical applications and legacy programs. Strict partitioning separates and isolates safety applications from other functions on the system, to such a degree that formal regulatory safety certification can be achieved.

Containerization

Container technology takes a different approach to maximizing server use, creating self-contained packages of applications that can be run while sharing a common operating system kernel. These flexible, portable containers streamline application deployment and simplify repairs and maintenance.

Wind River Cloud Platform is an open source, production-grade distributed Kubernetes solution for managing edge cloud infrastructure. Based on the OpenStack StarlingX project, Cloud Platform represents a compilation of best-in-class open source technology that delivers the features—such as low latency, high availability, and small footprint—needed to effectively deploy and manage distributed networks. With its broad support for containers, Cloud Platform is well suited for automation and control services where continuous operation is essential and reliability is paramount.

ENABLING TECHNOLOGIES FROM WIND RIVER AND INTEL

VxWorks – Developed for system-critical, embedded deployments, this RTOS is a favored choice for the rigorous, real-time demands of industrial IoT and production environments.

Wind River Linux – Well suited to container solutions in industrial applications, this open source operating system also securely runs IIoT systems and virtualized network environments.

Wind River Helix Virtualization Platform – Maximizes workload consolidation with diverse operating system support across multiple virtual machines. Supports container technology, too.

Wind River Cloud Platform – Enables the creation of a virtualized, standards-based environment on a production-grade distributed Kubernetes solution managed cloud infrastructure platform.

Intel processor technology – For IIoT deployments and edge-computing applications in energy system infrastructures where security, efficient power use, and fast media processing are key requirements, the Intel Atom processor provides industry-leading performance per watt in a compact, system-on-chip package. For building 5G-capable hybrid cloud infrastructures and meeting demanding IIoT use cases, the Intel Xeon Scalable processor includes built-in acceleration for critical workloads and also features robust, hardware-based security.

USE CASE EXAMPLES FOR 5G, IIOT, AND VIRTUALIZED INFRASTRUCTURES

The range of use cases for these enabling technologies spans many industries, but the potential uses in energy management and production—as well as automated process controls in the energy sector—are particularly compelling:

Grid modernization: The hub-and-spoke structure that defines most decades-old electrical grid infrastructures in use is proving fragile and inadequate to rapidly changing needs in the 21st century. Although 5G network deployments are only beginning, current available virtualization technologies, AI-enabled automation, IoT solutions, and simulation software can be applied immediately to increase the safety, security, and reliability of the grid. Community-scale or business-scale microgrids offer an option that is more resilient and less susceptible to outages and downtime, and uniquely well suited to integration with renewable forms of energy, such as solar and wind power. As 5G networks proliferate, delivering increased communication speeds and additional options for innovation, these technologies can already be in place and ready for a major restructuring and modernization of legacy grid infrastructures. According to the ARC Advisory Group, the [microgrid market](#) will increase by 12 percent from 2019 to 2025, because of a rising demand for microgrid connectivity in combination with affordable, clean energy storage. By harnessing energy resources from wind systems, hybrid systems, and microturbines using integrated IoT solutions, savings of \$8 million per year can be realized.

Electric power substation monitoring and control: As an essential component of the electrical power grid, power substations require continuous, real-time monitoring; failures can gravely impact the operation of the entire power infrastructure. The vital functions performed at the substation level include:

- Handling the interconnection of electrical power lines from different components of the system
- Monitoring and control of overall system operation
- Safeguarding the power system equipment

As a proven real-time operating system, VxWorks® can be used in a system to oversee monitoring and control, checking and responding to information from sensors relayed to a central control point. As 5G networking becomes widely available, the capabilities will increase the responsiveness of the monitoring system. Features such as high-speed throughput, low-latency operations, expanded spectrum coverage, integrated security features, and 99.999% availability will improve operation and protection of substations.

These capabilities can be further enhanced by interconnection with IoT infrastructures and AI-driven decision-making across points in the electrical power grid.

Robotic inspection of pipelines with 5G: Inspection and maintenance of gas and oil pipelines presents a time-consuming and difficult process for energy companies. New technologies, including robotics and drones, streamline these operations and reduce the costs of these essential tasks. With the advent of 5G networks, the capabilities of robots and drones can be amplified with artificial intelligence, machine learning, computer vision, and real-time interactivity

to perform safety inspections and ensure safe conditions across many miles of pipelines. The broadband capabilities of 5G could also swiftly relay video feeds from robots or drones to control centers, identifying sections of pipeline that require maintenance.

MAKING INROADS TO INDUSTRY 4.0 ADVANCES

The fourth industrial revolution is underway, powered by a convergence of the technologies discussed in this paper. This includes VxWorks, Wind River Linux, Cloud Platform, and Helix Platform running on Intel® architecture-based systems communicating wirelessly over 5G networks. Energy sector firms now have ready access to the tools and technologies to modernize their operations, automate control functions efficiently, and innovate with new products and services. To minimize disruption while the digital transformation process is proceeding, virtualization and/or container technology can maintain and run legacy system applications until modernization efforts are fully completed.

The vision of Industry 4.0 design, manufacturing, and distribution aligns well with the objectives of the energy sector. Infrastructure demands will necessarily escalate to accommodate the nature of 5G networks. Faster response times and lower latency will be needed to expedite the transfer and processing of data. Dynamic scaling at the network edge will also be required to handle the peaks and valleys of on-premise data traffic activity. These are areas in which Wind River and Intel technologies can address the challenges and collaborate with energy industry OEM leaders to take advantage of the arising opportunities.

ADDING INTELLIGENCE TO ELECTRICAL GRIDS

5G technology can link communication with homes, factories, power stations, IoT sensors, and other structures within a unified network environment. By applying AI techniques to extract intelligence from data harvested across the grid by IoT sensors and devices, energy use can be made more efficient and responsive to dynamic changes in demand from homes and businesses. Clean energy initiatives increasingly are incorporating AI techniques, including applications of machine learning and deep learning, to distribute energy intelligently at scale and to build a thriving market for renewable forms of energy. [AI technology](#) can:

- Build accurate models for predicting energy supply and demand patterns
- Enhance energy storage capabilities
- Help integrate renewable energy sources into the grid
- Facilitate trading markets for energy with pricing that corresponds to appropriate market rates
- Create virtual power plants that incorporate the full range of sources, integrating battery storage, microgrids, solar panels, small-scale turbines, and other sources into a single distribution system.

These types of tasks can be further advanced and improved by using IoT-powered infrastructures and virtualization to enhance the operations and use resources efficiently.

BUILDING SOLUTIONS THROUGH THE INTEL IOT SOLUTIONS PARTNER ALLIANCE PROGRAM

The Intel IoT Solutions Partner Alliance Program focuses on creating an ecosystem in which members can connect with other partners; access hardware and components to build innovative solutions using the latest technologies; and help provide the expertise needed to design, develop, and deploy market-leading products, including training and development tools.

As a member of the Intel IoT Solutions Partner Alliance Program, Wind River partakes of the benefits of being an active partner in a thriving ecosystem, with well-defined roadmaps for building solutions that meld intelligent devices, analytics engines, and IoT connectivity with software-defined infrastructures.

CONCLUSION

As demands for energy increase, electricity utilities, energy producers, system architects, and automation equipment OEMs face a multitude of new and complex challenges. Wind River has responded with an array of technologies that combine 5G networking, virtualization, and containerization. Supported by the Industrial Internet of Things (IIoT), AI data, and an ecosystem of distributed computing solutions, Wind River is at the forefront in providing solutions to emerging energy sector challenges.

For more information, contact [Wind River](#).

