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IoT Solutions Revolutionize Processes to Take Your Business to the Next Level

By Artemis Daphnis, Product Marketing Manager, Wind River



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EXECUTIVE SUMMARY

The drive for more efficient production, management, and distribution of energy, as well as for wider adoption of renewable energy sources, is crucial, not only to the future of the energy industry, but to the future of the planet. But hindering progress on both fronts are legacy systems that lack automation and centralized coordination, and the inability of power providers to effectively leverage the data generated by their energy assets.

The Internet of Things (IoT) has the potential to revolutionize and reshape the industry. By centralizing and automating control of power generation and distribution systems using intelligent, interconnected devices, energy providers and utility operators stand to realize enormous efficiency gains that could translate to billions in savings annually. Moreover, the ability to aggregate, synthesize, and analyze real-time data from these devices will empower operators to make smarter decisions and take action in a more timely manner.

This paper examines some of the key challenges confronting energy producers today and the potential to meet them with IoT solutions. It also explores how one company, Texas-based Group NIRE, is implementing IoT solutions to master today's challenges while creating new business opportunities—and, in doing so, leading the way for the future of the industry.

TABLE OF CONTENTS

Executive Summary	2
The Balancing Act: Matching Generation to Consumption	3
Taking Control	3
Predictive Maintenance	4
Powering New Markets and Business Concepts	4
Wind River Solutions	5
Gateway Solutions	5
Wind River Edge Management System	5
Conclusion	6

GROUP NIRE: AT THE FOREFRONT OF IOT IN ALTERNATIVE ENERGY

Spun out of Texas Tech University in 2010, Group NIRE was formed to create a real-world testing facility—one that could move more quickly than universities or national labs to develop energy projects on an actual electrical grid.

Group NIRE is engaged in the advancement of alternative energy on a number of fronts, including:

- Real-world testing of wind turbines using actual utility distribution systems
- Accelerated certification of turbines for commercialization
- Leading-edge research on energy storage batteries and power monitoring
- Weather and energy forecasting that supports the market bidding process

Group NIRE sees the Internet of Things as the future of energy management, and has partnered with Wind River® to implement innovative IoT solutions to address challenges faced by traditional and alternative energy providers alike.

THE BALANCING ACT: MATCHING GENERATION TO CONSUMPTION

Utility operators and energy providers across the U.S. face a wide range of large-scale challenges. Chief among them is having sufficient transmission access. Power generation must be matched to consumption in order to comply with utility laws intended to ensure that the electricity grid never collapses. That means providers have to constantly manage their generators to balance their loads in the communities that they supply with power. They need to gather and analyze multiple and often disparate datasets to help determine how to drive power into the transmission and distribution systems most effectively to comply with utility regulations.

Those datasets raise another issue: the difficulty of collecting and aggregating the large amounts of data energy assets create. Equipment such as generators, wind turbines, or power-monitoring units are frequently at remote locations, requiring extensive travel time to retrieve data, make any changes to it, and check up on equipment operations.

Power providers often need to gather datasets from multiple systems in order to have a good understanding of their field operations. Each of these systems likely uses a different mechanism for data storage and data delivery, with different data formats, interfaces, and communications protocols. Getting the data out of their remote management systems, aggregating it, and integrating it into a useable form is an extremely time-consuming, labor-intensive manual process.

Compounding the issue is the fact that by the time the data is aggregated, integrated, and ready to be analyzed, it is historical—operators can only analyze what happened in the past. Without the ability to see in real time what is happening across all energy assets and the distribution system, it is very difficult to make actionable, timely decisions on site operations and power generation levels.

TAKING CONTROL

The Internet of Things offers the opportunity to dramatically transform this state of affairs. IoT solutions will enable energy providers to automate the real-time aggregation of data from multiple energy assets and view it in an integrated format at a central location. Furthermore, IoT will allow centralized control of energy assets—as soon as decisions are made, they can be implemented from a central console by transmitting instructions to the edge devices monitoring and controlling the equipment, without having to dispatch engineers to the field.

The potential for IoT to drive efficiency gains along the entire energy supply chain is enormous. According to one analysis by *The Economist*, just a 1% efficiency improvement via connected machines, will save \$66 billion annually in the power industry over the next 15 years (“Industrial Internet: the Power of 1%,” GE Lookahead, March 31, 2013; <http://geloookahead.economist.com/infograph/industrial-internet-the-power-of-1-2/>).

THE CHALLENGE: MAKING SENSE OF DISPARATE DATA

Energy systems generate not only power, but also enormous amounts of data. Group NIRE faced the challenge of collecting data from a variety of assets, including its synchrophasor power-monitoring units, wind turbines, storage batteries, and weather forecasting systems. The data then had to be integrated manually in order to analyze system performance and make power generation decisions. The process took too much time, dragged down efficiency, and ran the risk of making decisions based on old or inaccurate data. Group NIRE knew that a more efficient solution lay in an IoT approach.

PREDICTIVE MAINTENANCE

Besides enabling more efficient monitoring and management of equipment in the field, IoT solutions can drive efficiencies and savings in another key area of operations: equipment maintenance. In addition to performing automated tasks as directed, intelligent connected devices can feed telemetry, sensor, and performance data into central control systems. Sensors report on the condition of equipment in the field through gateways and alert operators when a machine-related problem needs attention. By managing and analyzing large amounts of data, IoT solutions make predictive maintenance possible, which eliminates the time and labor costs associated with sending technicians to the field for scheduled inspections and scheduled maintenance.

Wind turbines, for example, have hundreds of sensors, making maintenance tasks very expensive. With predictive maintenance, energy providers can measure the system health of a wind turbine remotely with sensor readings and determine when parts need to be replaced in order to prevent downtime. Predictive maintenance allows users to predict when breakage is imminent and repair equipment proactively and efficiently beforehand instead of after the fact.

POWERING NEW MARKETS AND BUSINESS CONCEPTS

IoT holds the promise not only to transform existing industries through dramatic productivity gains, but also to create opportunities for new business concepts and revenue streams. One current market driver for IoT in the renewable energy sector is the development of smart wind farms. Making a wind farm “smart” means leveraging the enormous volumes of data that wind turbines generate but that has not been fully utilized up to now. This requires communication among all the individual wind turbines, as well as with operations centers, which may be located in different areas. With better data collection, operators can increase power performance by developing the smart wind farm concept. For instance, with edge intelligence, turbine sensors can detect wind shifts and operate more efficiently. In a smart wind farm, upwind turbines can detect changes in wind direction and then relay that information to downwind turbines, which can be rotated in anticipation of those wind shifts.

Another emerging new business opportunity is the concept of microgrids—modern, small-scale versions of the larger utility grid, localized to the areas they serve. With microgrids, operators have to control the balance of electrical power generation and consumption in real time or else run the risk of collapse. The most efficient and reliable way to achieve this is through an IoT approach, which enables operators to synthesize data from a variety of sources, including weather and energy forecast data, as well as data derived from each energy asset’s generation, distribution, and load transmission.

THE END-TO-END SOLUTION

Group NIRE is implementing the Intel IoT Gateway, based on Wind River Intelligent Device Platform XT, to securely aggregate, share, and filter data for analysis. The IoT solution will enable the firm to combine weather forecasting data, real-time wind turbine data, and battery data from its various sites, which in turn will enable engineers to get actionable analyses and make decisions in real time. Group NIRE is also using Wind River Edge Management System to remotely monitor and manage devices in the field. The Wind River Professional Services team helped integrate the Intel and Wind River solution with the SeeControl™ IoT interface for data visualization and analytics, creating a true end-to-end solution.

Among other benefits, the solution will help Group NIRE cut costs through predictive maintenance and reduced manual operations. Moreover, Group NIRE expects to leverage its IoT capabilities to develop new business and revenue opportunities, such as smart wind farms and microgrids.

WIND RIVER SOLUTIONS

Together with Intel®, and working closely with customers in the energy and industrial sectors, Wind River is bringing solutions to market that enable enterprises to reap the benefits and realize the opportunities afforded by IoT.

“Wind River and SeeControl together have provided Group NIRE an end-to-end solution that leverages best-in-class capabilities from each organization, including Wind River Professional Services to provide the expertise needed to successfully integrate everything into a custom-designed solution. Group NIRE had a critical business need for an advanced analytics tool incorporating real-time visualization, alarms, metadata creation, and rule sets for their vast amounts of data. This empowered them to make quick, actionable decisions to expand business and scale for the long-term.”

—Bryan Kester, CEO, SeeControl



Gateway Solutions

Wind River Intelligent Device Platform XT is a scalable, sustainable, and secure development environment that simplifies the development, integration, and deployment of IoT gateways. It is based on the Wind River industry-leading, standards-compliant operating systems, as well as Wind River development tools. The platform provides device security, smart connectivity, rich network options, and device management.

Intelligent Device Platform XT is part of Intel IoT Gateway, a family of platforms that enables companies to seamlessly interconnect devices and systems. The Intel IoT Gateway platform enables users to securely aggregate, share, and filter data for analysis. It helps ensure that data generated by devices and systems can travel securely and safely from the edge to the cloud and back—without replacing existing infrastructure.

Wind River Edge Management System

Wind River Edge Management System is a cloud-based IoT platform that enables IoT edge devices to connect securely to and be managed from a centralized console. As energy providers deploy more and more connected devices, the ability to get data off the edge and into a central system becomes vital. Edge Management System makes this possible, connecting machines and devices, collecting and managing data, and allowing users to aggregate that data for analysis and actionable decision-making.

Edge Management System is a pre-integrated technology stack from the device to the cloud that has been validated to work out-of-the-box with complementary components. It is integrated and validated with the Intel IoT Gateway.

Wind River provides energy producers with a single source for end-to-end IoT solutions, eliminating the worry as to whether all the components will work together, and avoiding the friction that often happens when trying to integrate pieces from multiple providers. Because the technology is pre-integrated and pre-validated, it enables users to accelerate development and focus on optimization of their solutions.

Leveraging more than three decades of embedded technology expertise and deep experience with intelligent, interconnected systems, Wind River is well prepared to help the energy industry realize the full potential of IoT.

“The Wind River Edge Management System enabled us to quickly build an IoT solution without having to invest development cycles into the underlying infrastructure. We were able to greatly accelerate our timeline because the gateway technology is integrated with the cloud technology out-of-the-box, so we could focus on what we know.”

—Mark Harral, CEO, Group NIRE



CONCLUSION

IoT has the potential to transform the way energy is produced and distributed. It enables power providers and utilities to deploy and centrally control automation across large-scale energy systems. And it enables them to aggregate and synthesize data more easily and efficiently from widely dispersed and disparate systems—all of which helps them be more productive and effective in the analysis and application of data for smart and timely energy decisions. Companies like Group NIRE are leading the way, showing the industry how an integrated IoT approach can help master today's challenges while opening up opportunities for the future.

