

Grid Reliability and Feeder Automation through Wireless Innovation

The Challenge of Achieving Grid-Wide Actionable Intelligence

Utilities' Transmission & Distribution and IT organizations are faced with numerous challenges in today's environment. Current grid assets are aging, and new demands are being placed on the existing grid's automation systems, such as challenging environmental conditions, higher plug loads, distributed generation, and electric vehicle integration. End customers and regulators want a more efficient and reliable grid. Utilities must pursue grid reliability and automation solutions that meet these growing demands and, at the same time, prolong the life of existing grid assets with little to no increase in operating budgets. This is no small task.

Many utilities have started a search for technologies that can help improve low voltage distribution grid operations which, from a pervasive communications perspective, have largely been "dark." These solutions must be able to connect to and provide reliable, cost-effective communications for disparate grid assets.

The challenge, and the opportunity, can best be described in terms of number of assets that need to be connected to generate positive returns on investment in terms of operating costs, power delivery efficiency, and grid reliability. To highlight this, we took a typical U.S. utility and normalized their grid assets to a service area of 1000 square miles to create an illustrative scenario. The distribution asset portfolio is summarized in Table 1.

Table 1: Distribution Automation Devices

DA End Point	Assets/1000 mi²	% of total
Distribution Transformer Monitors	37,805	92.16%
Fault Indicators	1,254	3.06%
Switches	1,137	2.77%
SF6 Monitoring	405	0.99%
Capacitor Banks	337	0.82%
Reclosers	51	0.12%
Regulator	31	0.08%
Total Number of Assets	41020	100%

“On-Ramp Wireless is a Top Ten Smart Grid Company to Watch in 2012” - GreenTech Media

The table explains the view of the world today, but what about a year from now or decades from now as requirements evolve? As these sensors are connected and the value of the information flow is assessed, utilities are expanding their sensor networks. Fortunately for the utility, the individual data requirements of these sensors are manageable. The vast majority (greater than 90%) of low voltage devices do not require high frequency data reporting in order to collect and distribute actionable information within acceptable operational time frames.

Actual Deployment Example

Utilities must find the right communications solutions to meet these challenges and pair the operational use cases to the appropriate wireless technology. The On-Ramp Total Reach Network provides utilities with the capability to meet grid demands for decades to come. The On-Ramp network technology provides the unique ability to connect disparate grid assets at a fraction of the cost of prior solutions, with the scalability to connect tens of thousands of devices simultaneously.

An example of how On-Ramp Wireless helped a major investor-owned utility improve grid automation and save money in the process, is detailed in Table 2.

Table 2: Distribution Automation Business Case for Wireless Grid Sensor and Fault Circuit Indicators

1000 mi ²	Service Area
1,254	Total number of Fault Circuit Indicators (FCIs) in the service area
\$540,000	Cost savings per year from automated monitoring of grid sensors by reducing crew time and improving SAIDI metrics (estimate by utility); it was also found that the sensor helped identify phase imbalances in the grid
\$1,000,000	Cost of 1,000 square mile area On-Ramp Total Reach Network, deployed within 4 weeks from project start
23 months	Time to recover network cost by implementing the new solution
\$1,000,000	Additional cost savings per year from just one additional application on the same network infrastructure (e.g., aviation light monitoring)

Additional Benefits of the On-Ramp Wireless Solution for Distribution Automation

01 Reaching All DA Assets: The On-Ramp Total Reach Network network provides coverage of the entire service area and ample capacity to support all of the distribution automation devices on a distribution network. These additional applications have not been considered in the business case analysis above and would further improve the investment scenario, if considered. Additional applications would be supported with the existing network or with minimal system upgrades, significantly accelerating the time to recover network investment. It is worth noting that the On-Ramp Total Reach Network can run entirely on batteries—the devices as well as network infrastructure. This means that grid devices will continue to perform in the event of a catastrophic power outage event and do not require powered repeaters.

02 Growing Value of the Operational Data: Another advantage of the On-Ramp Total Reach Network not considered above, is the additional real-time information provided from grid assets like the fault indicators.

Before the FCIs were wirelessly connected, they were used purely to identify faults for workers searching for the source of an outage.

After installing wireless Grid Sensors, not only is information about a fault communicated immediately with geo-location, but information about the grid is also transmitted daily and collected for data analytics, such as phase mismatch. This results in a fact basis for better capital planning with changing grid loads and more effective condition-based maintenance.

03 Additional Value of the Maintenance Indicators: Transformer monitoring represents one of the biggest opportunities for cost savings, efficiencies, and data collection/analytics in the grid today. On-Ramp Wireless is working with a leading vendor to provide a Smart Transformer device, which retrofits onto existing residential transformers as illustrated in Figure 1. At a very low cost per Smart Transformer sensor, this solution enables numerous benefits including:

- Predictive maintenance of the transformers, which leads to significant cost avoidance
- Collection of a wealth of data used in grid analytics and planning such as top and bottom oil temperature, ambient temperature, load current, voltage and PF monitoring, and more, as illustrated in Figure 2 below
- Alarms for thresholds such as temperature, oil temperature, and timeouts

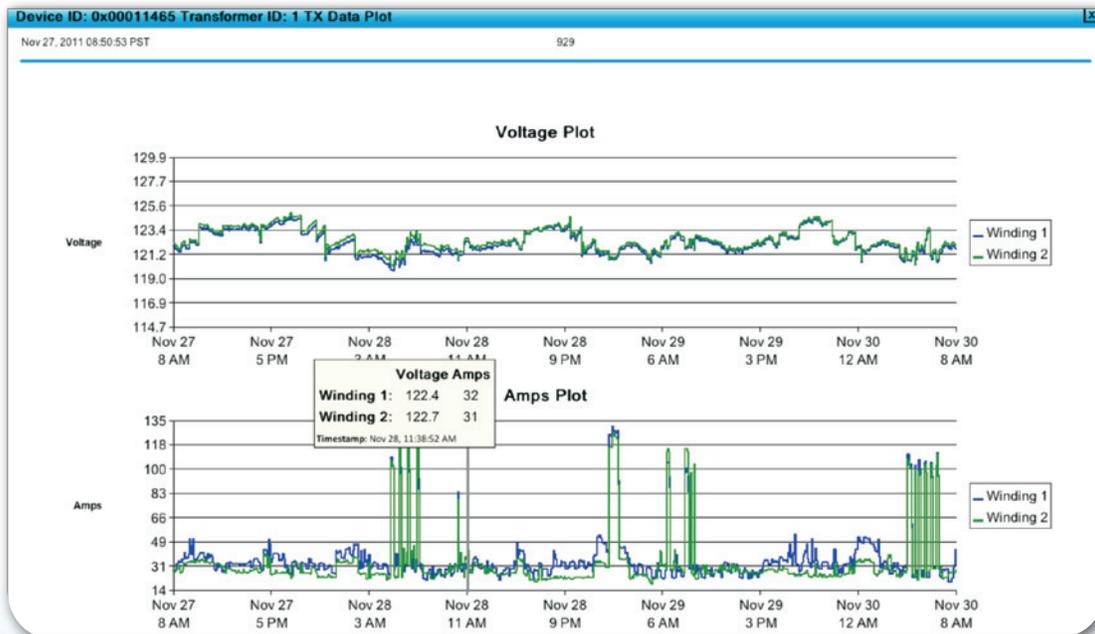


Figure 2: Transformer Monitoring via an On-Ramp Wireless Total Reach Network with TransformerIQ-P

04 Deployment Flexibility: Contrary to other solutions on the market for grid automation, the On-Ramp Total Reach Network solution is quick to deploy, and benefits are immediate. With a deployment “speed” of up to 300 square miles of coverage installed per day, an On-Ramp Total Reach Network is typically live in a matter of a few weeks. Because an On-Ramp Total Reach Network deploys as a simple star topology, devices can be activated on the network with deployment of the first On-Ramp Wireless Access Point.

05 Broad DA Ecosystem: The On-Ramp Wireless partner ecosystem continues to expand with industry leading solutions for grid automation. Table 3 lists a few of the grid automation solutions Powered by On-Ramp that are launching with On-Ramp customers.

06 Multi-Application Network: Finally, the On-Ramp Total Reach Network supports both Distribution Automation (DA) and Automated Metering Infrastructure (AMI) on the same network. For more information on On-Ramp Wireless AMI solutions, see the related solution brief.

Table 3: Distribution Automation Solution Examples

Grid Device	Vendor	Benefits
WSO-11 Wireless Sensor for Overhead Lines and 8301A Wireless Sensor for Underground Feeder Lines	Schweitzer Engineering Labs.	<ul style="list-style-type: none"> • Detects load imbalances • Fixes phase imbalance • Predictive maintenance • Faster restoration • Improved capacity planning • 10-year battery life
TransformerIQ-P	GridSense	<ul style="list-style-type: none"> • Condition monitoring • Grid performance metrics • Preparation for DG and EV • Extends the life of the transformer • Cost avoidance by preventing blowouts
On-Ramp Remote Monitoring Unit (Aviation Light Monitoring)	On-Ramp Wireless	<ul style="list-style-type: none"> • FAA automation compliance • Ultra quick payback compared with manual monitoring
KONRMO Remote IQ	KonDar	<ul style="list-style-type: none"> • Multi IO sensing device • Simple monitoring of low data rate DNP3 and Modbus devices • Protocol aware

Ultimately, a fully automated distribution grid will lead to better capital planning and prioritization of asset maintenance and replacement cycles.

SUMMARY

An On-Ramp Total Reach Network delivers a cost-effective DA solution that meets the present and future demands of the electrical grid. With rapid deployment, extremely low total cost of ownership, and flexible support for a multi-use network, On-Ramp Wireless delivers where other market leaders have fallen short.

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TOTAL REACH.

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