EAC: Delivering Proven Reliability

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Imagine all the challenges you face modernizing your electricity grid. Now, imagine the same task, but across the largest country in the world where temperatures can dip to -55°C. This was the challenge faced by Russian Railways. With their electrical grid stretching across the forest tundra in Siberia, mountain ranges in the south, and rolling hills and plains in between, Russian Railway's deployment promised to be one of the most challenging efforts to date.

Geography was the main obstacle Russian Rail-ways faced five years ago as they considered efforts to modernize their electricity grid. Russia, the third largest energy producer in the world, covers more than one eighth of the Earth's in-habited land area (17 million km2), and is nearly twice the size of the United States. Extending across the whole of northern Asia and most of Eastern Europe, Russia spans nine time zones and incorporates a range of environments and landforms. It is the ninth most populous nation with 25% of its 143 million people still living in rural areas. Over the years, Russian Railways has installed more than 400,000 NES smart meters across its sprawling network through their systems integrator ENERGOAUDITCONTROL (EAC) to modernize the energy grid. This case study investigates the deployment challenges faced and how they were solved in a joint solution delivered by EAC and NES.

Never Visit the Meter Again

The key challenge EAC faced in their deployment for Russian Railways was geography. It was the largest distance spanned for a smart meter deployment we've seen. The new meters EAC installed had to work. They had to prove they could withstand the test of time and that they could be remotely controlled with software to eliminate field visits," said VP of Business Development at NES. "With the distance involved, it was simply too expensive to visit meters. Instead, we had to demonstrate we had a solution where EAC would almost never need to visit the meter again."

To meet the challenge, the solution needed to meet three main requirements:

- Deliver unquestioned reliability. The solution needed to provide a communications and controls network that worked flawlessly in an extremely harsh environment. It had to be performance driven and built for reliable data transport. Without reliable communications, nothing else mattered, so this was by far the most important proof point.

- Provide vital grid health data with the ability to pinpoint problems. Because of the distances involved in servicing the grid, EAC was looking for more than a billing solution; they wanted a meter that could also provide grid sensing, where information about grid health could be available through the meter.

- Be completely software driven. The solution needed to provide upgrades and reconfiguration changes through software. Remote service calls are expensive and EAC wouldn't always have the luxury of a field visit to update or change meters. The only remedy would be to provide control of the meters through software where changes could be made remotely. Features like remote connect/disconnect and firmware upgrades were "must have" items.
  After evaluating many different smart metering solutions, NES was chosen to partner with EAC and provide their energy control networking platform - the Networked Energy Services (NES) smart metering solution for the deployment. "Technically, given the large number of meters we anticipated operating in our system over time and the vast distances covered by our project - literally spanning the entire country - we required a system that can both scale in size and over distance," said Sylvian Seu, EAC's chief executive officer at the time of deployment. "The NES system has the proven capability for both. From a business perspective we were looking to implement a next generation set of features that goes far beyond automated meter reading. And, we were looking to deploy the system and deliver value quickly. Because the NES system exposes its functionality to our IT staff as industry standard web services, we could quickly and cost effectively integrate and develop application and meet our aggressive deployment schedule."

Deliver Unquestionable Reliability

Delivering unquestioned reliability starts with system architecture. NES's energy control networking platform consists of three tiers: a device tier (e.g. smart meters), a control node tier (e.g. data concentrators), and an enterprise tier (e.g. system software at the head end).

The system is able to deliver a high level of performance because each smart meter acts as a repeater and builds a highly reliable power line based meshed network with an algorithm that supports repeating on up to eight hops.

Provide Vital Grid Health Data with the Ability to Pinpoint Problems

With over 271 grid health measurements available in their residential smart meter family, NES delivers vital health statistics from the low voltage grid, allowing utilities to move rapidly beyond billing and into grid optimization applications to achieve a more proactive, self-healing grid.

Smart meters work with NES's control nodes and data concentrators to provide the reliable communication infrastructure between grid devices and the head-end by efficiently coordinating the bi-directional delivery of device and grid health data. This data is made available to software running at the head-end. By collecting a wide variety of mission critical grid health data such as voltage, power quality, load at peak and idle times, and transformer temperature, utilities can better maximize the life of grid assets, have better outage detection, find trouble conditions such as line breaks or device failures and protect consumer safety.

Be Completely Software Driven

It's easy to see why smart meters are often the focal point of the deployment, but the real unsung hero is the software working behind the scenes. Software automates functions and eliminates many field visits. As a result, it is often responsible for delivering most of the business case benefits and return on investment. In this deployment, software was provided both by NES and EAC.

NES's system software forms the foundation of a smart grid system and supports everything a utility needs to deploy, provision, configure, audit, diagnose and retrieve data from their smart meters and grid devices. Designed with interoperability in mind, the software communicates using standard web services interfaces (e.g. XML and SOAP) to the utility's applications such as billing, CRM, customer service, operations, workforce management. It also provides some of the key remote management features EAC was looking to reduce their number of field visits including remote configuration of meters, remote connect/disconnect and firmware upgrades.

Once deployed, EAC was able to develop their Resource Data Manager (RDM) software to run on top of NES system software. EAC's RDM collects and processes the data delivered by the system software for the end customer and is the end application Russian Railways sees.

It is responsible for:

- Implementing measurement, registration schemes and the state of measuring devices
- Ensuring the unity of time measurement and registration processes
- Collecting and organizing data storage of measurement results

- Calculating technical losses, the discovery of commercial losses, loss analysis, calculation of unbalances
- Organizing user access and managing their access rights
- Managing power consumption mode (limitation of electricity supply).

Delivering on the promise of providing grid health data, the RDM system collects profiles for individual points or groups with a specified interval for any measurement value including pressure, frequency, voltage, phase angles, currents, and more. The user simply scans the diagnostic data to analyze the parameters, including power quality parameters. The system displays logged events, including direct or indirect evidence of unauthorized access and possible loss or theft. RDM can then send group commands to any number of meters to monitor their performance in real time, on demand.

Key Takeaways

To date, the project has been a complete success and remains the largest distance covered by a single, unified smart meter rollout. Only a year after the deployment, EAC stated "We believe the project we are working on is unprecedented in the Russian market in terms of its scope and capabilities. Our engineers have implemented a powerful and unique solution."

The key lessons from this case study are not to underestimate the need for a reliable communications infrastructure or the power of software. By delivering high levels of reliability and an open software platform, EAC was able to develop customized applications that eliminated unnecessary field visits and delivered real value and cost savings to Russian Railways.

410,000 NES smart meters

Outcomes / Benefits:

• Provides measurement, registration schemes and the state of measuring devices.

• Collects and organizes data storage of measurement results.

• Calculates technical losses, the discovery of commercial losses, loss analysis, and calculation of unbalances.

• Manages power consumption mode (limitation of electricity supply).

• Uses power quality data and alarm events to better manage and operate the grid.

• Uses measurement data, alarms and analytics to identify and reduce network theft and losses.

Time frame 2007 - ongoing