IMPROVED GRID OPERATIONS IN A DIGITAL GRID

Luis Molero Castro
Utilities Business Consultant, Region Mediterranean
Ericsson

APRIL 3RD, 2017
BIG CHANGES IN THE UTILITIES ARENA...

- Increase of renewable and distributed generation
- Deregulated markets, increased competition
- Energy Efficiency and Low Demand
- New business models, new markets, new revenues

...ARE TRANSFORMING THE INDUSTRY...

1. Customers – participating and active
2. Assets – connected and intelligent
3. Data – turned into value-add information
4. Capabilities – on-demand
5. Secure – resilient and trusted
MANAGING METER NETWORKS
FROM TECHNOLOGY THROUGH TO SKILLSETS
TO EXECUTION AND ROLLOUT

Challenges

- Added complexity
  (challenges to maintain efficiency)
- Increased data flows
  (values, events, control signals)
- Execution and roll out
  (workforce efficiency, vendor performance, logistics)
- New skillset
  (mixed technologies, troubleshooting and cleanup)
- Future-proof investment
  (right technology in a right place)
- Device network performance
  (data availability and network reliability)

- Challenges
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    (values, events, control signals)
  - Execution and roll out
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Building the smart grid comes down to

WHEN TO BUILD WHAT?

Gain maximum value from investments in IoT and Smart Metering
TWO TRACKS IN EXTRACTING VALUE FROM DATA

**Grow company value**
- Maintain existing asset efficiency
- Effective distribution services

**Data oriented asset management**
- Improving existing business efficiency by implementing new data capabilities

**Increase customer satisfaction**
- Cultivate new revenue streams
- Grow new business

**New business domains**
- Electric Mobility
- Demand Side Management
- Production Management

Source: Ericsson, Elektrilevi, GridMind
As an EU member, Estonia had committed itself to improving energy efficiency by 20% to 2020. The nationally owned electricity distributor Elektrilevi will play a key part in achieving the ambitious goal.

Ericsson helped Elektrilevi put together a roll-out of smart meters across the country between 2012 and 2017. Completing the set-up of supporting systems in record time, Ericsson has rolled out 625,000 smart meters in total.

As everyone in the industry knows, meters ‘talk’ a lot. Therefore, the challenge is to convert this huge data flow into useful and trustworthy information which can be put to proper operational use.”

Mait Rahi, Program manager

Using technology components that “just work”, in an flexible project framework will deliver results much faster and in a cost effective manner than current traditional approaches

Maintaining momentum and ultimately getting the most out of data will require parallel work in thinking of the organizational structure and processes – this will have a positive impact beyond just a single project”

Kaspar Kaarlep, Head of Digital Network Technology, Elektrilevi
ELEKTRILEVI
LARGEST NETWORK OPERATOR IN ESTONIA

- 90% of the marketshare
- Part of the Eesti Energia Group
- State-owned international energy company
- Operates in the Baltic countries and Poland, also in the international liquid fuels market
- Unique experience and technology in relation to processing oil share and energy production

### Asset Base

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement points</td>
<td>676 190</td>
</tr>
<tr>
<td>Primary substations</td>
<td>271</td>
</tr>
<tr>
<td>MV/LV substations</td>
<td>24 009</td>
</tr>
<tr>
<td>Secondary (switching) substations</td>
<td>219</td>
</tr>
<tr>
<td>35 (110) kV transformers</td>
<td>194</td>
</tr>
<tr>
<td>6-35kV lines</td>
<td>29 786</td>
</tr>
<tr>
<td>0.4kV lines</td>
<td>36 175</td>
</tr>
<tr>
<td>Total of lines</td>
<td>65 961</td>
</tr>
</tbody>
</table>

### Finance 2015

<table>
<thead>
<tr>
<th>Category</th>
<th>Value (mln €)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>249.2</td>
</tr>
<tr>
<td>EBITDA</td>
<td>106.8</td>
</tr>
<tr>
<td>Investments</td>
<td>93.3</td>
</tr>
<tr>
<td>ROIC (%)</td>
<td>8.80%</td>
</tr>
<tr>
<td>Sales GWh</td>
<td>6,521</td>
</tr>
<tr>
<td>Network losses GWh</td>
<td>326</td>
</tr>
<tr>
<td>Network losses (%)</td>
<td>4.8%</td>
</tr>
</tbody>
</table>
ENERGIZING ESTONIA (1/2)  
[Elektrilevi, Estonia]

THE CHALLENGE

› Replacement of 625k meters in 4y period to meet regulatory targets
› Turn-key project including technology and rollout planning, mass rollout, expiry rollout and maintenance of meter network until the end of the project.
› IT support infrastructure deployment

THE SOLUTION

› Ericsson as prime contractor responsible for project execution and rollout management, end-customer communication (on-site and call center), responsibility for all integrations and IT developments, SLA level and Meter warranty
› Subcontractors for AMI, installation and logistics

THE RESULT

› On time and right scope delivery
› Homogenous modern metering asset base
› Above target reduction of losses
› Meter network operational costs reduction
› Metering data for power grid operations optimization and investment planning

TURN-KEY ROLLOUT

EFFICIENT MANAGEMENT

EXCEEDING TARGETS
Energizing Estonia (2/2)

[Elektrilevi, Estonia]

**The Driver**
- Electricity market is opened for all customers since Jan 2013
- Estonia’s legislation in accordance with 2020 goal: all electricity meters replaced with smart meters by Jan 2017
- Last meter was installed on 7th of Nov 2016.

**Regulation as Key Driver**

**Project Scope**
- Prime Contractor for turn-key Project execution (625,000 MP’s)
- Rollout Management
  - Priority setting and follow-up on installation progress
  - End-customer communication (on-site and call center)
- Integration of AMR system into Elektrilevi IT landscape

**Technology**
- Communications Technology
  - Protocol based on DLMS/COSEM
  - PLC Communication: PLAN+, SFSK
  - Wireless communication: GPRS/UMTS
- Technology highlights
  - Interoperability and security (IDIS HLS)
  - Push messages from Meters to System
- 10,500 PLC Concentrators (44%)
› PLAN(+) S-FSK (Spread Frequency Shift Keying)

- 1 carrier using 2 frequencies at 63.3 kHz and 74 kHz for robustness
- Baud rate: PLAN 1200 b/s and PLAN+ 2400 b/s
- Signal Levels within the limits of Cenelec A Band, EN50065-1
Fault Location System
- Locating multi-phase short circuit faults in the distribution network. Most useful for faults on remote lines
- Measurements sent by an IED are collected by a SCADA system and transferred to a DMS system which then automatically displays the location of the short-circuit fault on the screen of the operator

RNA (Reliability based Network Analysis)
- Module of Trimble NIS
- Network Reliability modelling and analysis on the basis of its elements, condition, environment and topology
- Location of critical parts of the network
- Evaluation and comparison of planned network models in accordance to reliability parameters

Main grid operation processes:
- Grid monitoring
- Fault location
- Grid state restoration

Main challenges:
- Extreme weather
- Legacy overhead lines
- Lots of forests and trees
IT SUPPORT SOLUTION
ELEKTRILEVI SMART METER PROGRAM

Elektrilevi systems

Oracle MDM
Oracle CIS
Trimble NIS
ABB Asset

L+G
HES

Elektrilevi support systems

Smart Meter Mgr (SMM)
Work Order Mgmt (WOM)
Field Work Mgmt (FWM)
Field Toolset (FT)

Change request #30
Preventive maintenance based on smart meter data

Preventive maintenance
Performance metrics
LV grid visualization
Analytics platform

2G/3G cellular connectivity

PLC SFSK PLAN+

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KEY BENEFITS

› Always know the state, configuration and location of field assets
› Strictly controlled performance of the network
› Efficient network troubleshooting
› Back office automation through maths and machine learning
› Modern architecture and massive scalability
› Open and meter vendor agnostic
Client SAIDI in 2016
Voltage quality
 MAIN BENEFITS

- Quality assurance for newly built substations
  › Preventable faults and quality issues

- Planned outages instead of unplanned outages
  › 4x shorter outages for same fault

- Proactive approach in preventing power quality penalties
  › Reduction in compensation claims and quality penalties

- Investment based on actual detected problems
  › Estimated 5,1M€ could be saved annually

- Accurate SAIDI data for solving customer calls
  › Known SAIDI: 218,7 min
  › Actual SAIDI from smart meters: 391 min
ERICSSON, a global leader in communications technologies, is implementing a Network Management System for IBERDROLA’s PLC PRIME communications network, combining the ERICSSON know-how in communications networks and OSS, with the IBERDROLA expertise in electricity business. This platform will help extend the benefits of smart metering to any country where the market-proven PRIME standard is the selected low voltage communications technology.

Smart Metering is the first step towards smart grids, improving grid visibility and operations, and facilitating consumers to evolve into active participants in the energy market. This collaboration with Ericsson, as a global ICT player, will help us improve our smart metering operations and unleash the business benefits of smart metering.”

Miguel Angel Sanchez Fornie, Head of Smart Grids, Iberdrola
PLC PRIME MANAGEMENT SYSTEM
[IBERDROLA, SPAIN]

THE CHALLENGE

› Smart Metering deployment mandate: 100% (11M meters) by end of 2018
› Limited visibility on low voltage PLC (PowerLine Communications) issues
› Scalability of solutions for nationwide deployment

FROM SMART METERING TO SMART GRIDS

THE SOLUTION

› Fully scalable near-real time management system to monitor PLC PRIME networks through data concentrator (base node)
› Alarm generation towards external fault management systems
› Meter and data concentrator firmware upgrade

IMPROVED VISIBILITY ON PLC ISSUES

THE RESULT

› Intermittent PLC noise has been detected in some low voltage lines
› Previously undetected meter errors (such as faulty configuration or firmware) have been detected and solved

IMPROVED SMART METERING OPERATIONS
PLC PRIME is an open & market proven PLC technology for smart metering (over 12 million PRIME meters deployed in more than 10 countries)

The proposed system will be used, as part of Iberdrola’s NOC, by the communications department

Using SNMP, the system will access data concentrators in near real time to monitor PLC PRIME networks, extract topology information, trigger alarms, etc.

Initially connecting up to 200,000 points, its design is scalable enough to manage 11 million service nodes (meters) in the future
SNMP MANAGEMENT CAPABILITIES

› SNMP = Simple Network Management Protocol
  - Communications protocol used for network monitoring and management.
  - SNMP exposes management data in the form of a management information base (MIB) which describe the system status and configuration. These variables can then be remotely queried (and, in some circumstances, manipulated) by managing applications.

› MIB supported by Iberdrola’s base nodes normally cover:
  - Instantaneous PLC connectivity values: network uptime, number of active connections, number of terminal/switch nodes, number of switching levels, number of nodes per level, etc.
  - Interval values: topology changes, average availability, etc.
  - Advanced values: topology view with detailed information of all registered nodes (MAC, state, LNID, LSID, availability, coverage, etc.), PLC channel occupation, and MAC values (beacon slots occupation, number of RX/TX control packets, number of RX/TX data packets, etc.)
Near-Real Time (NRT) SNMP visibility allows to monitor PLC status and detect spurious communications issues even if they do not impact readability KPIs.
BUSINESS BENEFITS (2/3)

IMPROVED VISIBILITY AT LOWER PROTOCOL LAYERS

› Detection of registered meters with problems to communicate at DLMS level
› Identification of problematic data concentrators, which suffer from frequent resets (due to internal error in some DC models).

BUSINESS BENEFITS (3/3)
REAL TIME VISIBILITY TO MONITOR DC ISSUES
Israel is starting its smart metering rollout. ERICSSON has been selected by IEC to deploy the “tariff” smart metering pilot for 120,000 customers.

The aim of the trial is to gain information about customer behavior in response to various tariffs, to understand better the potential for demand management and to provide the basis of a cost-benefit-analysis for full roll-out of ~2.7m smart meters.

This is a great opportunity for Ericsson to contribute to the digitalization of our country’s energy system, helping achieve not only metering benefits, but also important grid operational benefits, contributing to a safer and sustainable energy system, and facilitating active participation of the end customers.”

Ofir Ron, KAM I&S Ericsson Israel
E2E SMART METERING SYSTEM
[IEC, ISRAEL]

THE CHALLENGE
› IEC is determined to implement a smart metering system as part of their vision to become a smart energy utility
› After a technology pilot, where PRIME and S-FSK was tested, IEC now wants to test customer behavior in response to various tariffs

CBA FOR FULL ROLLOUT

THE SOLUTION
› E2E Smart Metering architecture: MDC/MDM, NOC, MOC, & WFM
› Strong cybersecurity
› All system integration towards IT (CRM, billing, ERP) and OT (OMS, NIS, FMS…) systems
› 120,000 1-ph and 3-ph meters and 1,270 data concentrators

END TO END SOLUTION

THE RESULT
› High level of meter readability (>97%)
› Advanced tariffs, including ToU
› Meter data used to improve fraud and outage management

IMPROVED READING & GRID OPERATIONS
END TO END SOLUTION IT/OT INTEGRATION

» Improved grid operations

» Filter & forward events towards OMS:
  - Finished / non-finished power failure
  - Finished / non-finished over / under limit voltage
  - Meter neutral loss
  - DC power down events

» Filter & forward events towards FMS:
  - Dc and Meter / terminal cover opened / closed
  - Strong DC detected begin / end
  - Communications fraud detection
  - Current / voltage / impedance detection