Utilising Smart Metering for Low-Voltage Network Management

Project Experiences of a medium-size Finnish utility

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18.4.2013
Founded 1921
A co-operative utility
28.300 Customers, of which ~15.000 are members of the co-op.
Member discount 1,2 c/kWh
About 3.300km network, 11 stations (110/20kV), 1400 substations (20/0.4kV)
450GWh/a energy transfer
28.200 Smart meters installed
Smart Metering Project Schedule, actual:

- **2009**: 03/2009 Measurement act
- **2010**: 04-12/2009 Tender phase, 01/2010 Contract, 04-05/2010 System integration, 06/2010 Pilot installations
- **2011**: 09/2010-12/2011 Mass installations, 01/2012 Project Ready, New Integrations
- **2012**: Low-voltage control and MV, 12/2012 End of Contract
Smart Metering System at Oulun Seudun Sähkö:

Customer Information System
CRM / Generis

Public IP Network

Customer

Extranet

Public IP
Network

APN/LAN

2G/3G
(900,1800,2100MHz)

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P2P

RS-485

30% of devices
Flats

RS-Master

RS-Slave1-60pcs (av. 9pcs)

Aidon Gateware

Reading System

60% of devices
Urban and semi-urban areas

10% of devices
Rural areas, single Customers

Mesh-Master

Mesh-Slave
1-90pcs (average 11pcs)

Mesh-radio network
(865MHz)

2G/3G
(900,1800,2100MHz)

10% of devices
Rural areas, single Customers

Aidon

Customer Reading System

Aidon Gateware

Smart Metering System at Oulun Seudun Sähkö:
Smart Meters are an integrated part of the system:

- **ABB MicroScada**
  - Alarms
  - Controls
  - Status info
  - Measurements
  - Residual current info

- **ABB DMS600WS / DMS600NE**
  - Remote disconnects and switches
  - Status, measurements
  - Network operation

- **Customer Information System**
  - CRM / Generis
  - Customer information

- **Reading System**
  - Aidon Gateware
  - Low-voltage control, alarms, measurements

- **Portable control room**
  - Operation outside office hours

- **Control room**
  - Outage Info to Customers (www and telephone)

- **Outage Info to Customers**
  - Alarms, Measurements
Improved Safety

”Electrical safety has been improved by replacing energy meters with smart ones”

Alarms:
- Neutral connection lost
- Reverse phase rotation

The operator can inform the customer, and switch off the power, if needed
More efficient way of working – Minimizing downtime in a network

“Smartness in the low-voltage network is the best ever tool for analyzing what is happening in the medium voltage network”
More efficient way of working – Minimizing downtime in a network

“If we are experiencing any kind of network issue, we can analyze it through the smart meter network”

The operator can immediately see:
- Problem type
- Problem location
- Number of customers affected
More efficient way of working – Minimizing downtime in a network

New legislation is putting pressure on minimizing downtime:
Smart meters inform us of a problem before we get the first customer call.

A problem has been analysed before a technician arrives to the outage area – we are saving tens of minutes, sometime hours, of fault finding time.
Distributed quality measurements

Smart meters are electricity quality sensors
  A number of different values can be used for analyzing the network behaviour, online or post-processed.
Any exceeding of set limits are stored in a log for
  - Further analysis
  - Capacity planning
Distributed quality measurements

Blown fuses or electricity quality problems?
- Hour by hour information on energy usage
- Advice to do changes in customer’s system
- Propose upgrading main fuses
Distributed quality measurements

Customers are sometimes complaining about broken devices due to low or high voltage

- Smart metering gives us a great tool logging all deviations in voltages, together with time stamps
- Customer compensation decision can be based on logs
Add-on Services using Smart Metering, Information

Energy consumption readings on the extranet.

- Available hour-by-hour for customers
- The information is also useful when a customer is complaining about the energy invoice
Add-on Services using Smart Metering, Relay Controls

Meters have relay outputs that can be controlled by the software.

- Traditionally night time (22-07) control of the load, e.g. normally the heating.
- Demand for controlling the load based on energy price variations instead of time.
Add-on Services using Smart Metering, Future Possibilities

Two approaches for the future control:

- Fixed amount of cheapest hours per day

OR

- Smart system with data fusion: building info, weather forecast, pricing
Add-on Services using Smart Metering, Future Possibilities

Calculation example:
- A house with 180W/K power loss, 12kW heating power
- Weather forecast for the next day: -21°C average
- Energy need: \((17+21) \times 180W = 6,84kW \text{ average} \)
  \(80\%\), \(131kWh\), covered with smart control heating,
  \(131kWh/12kW=10,9h\)
- System selects 11 cheapest hours of the day active, rest of the day based on thermostat control.
Add-on Services using Smart Metering, Future Possibilities

In the future, the second relay could be used for customer’s own controls, for example by sms or internet, or assisted system by the operator.

Applications: Electric Sauna, Car engine heater, Vacation Home temperature control etc.
Conclusion

Oulun Seudun Sähkö has been very satisfied with results of the Smart Meter project. Together with low-voltage control functionality, the concept has been better than expected. Meters help us serve our customers better and save money.

Thank You for Your Interest in the Topic.