CASE STUDY

of the first large AMI project in Poland

Abstract

Energa Operator was the first utility in Poland that implemented a massive rollout (Stage One) of Smart Meters, thus confirming its position as a leading investor in Polish Distribution System. This deployment took place in 2012, when Energa Operator installed 109 thousand Smart Meters delivered by ADD GRUP as a first stage of rolling out Advanced Metering Infrastructure.

On 30th of October 2013 Energa Operator officially released final results of Stage One as a success story, where collection rate for 15 minute interval data was more than 99%, and overall system performance exceeded the expectations.

This case study describes main challenges for Stage One implementation and illustrates organizational efforts needed to make an AMI project successful. It is especially relevant for other Distribution System Operators in Poland, to help them manage the implementation of AMI into their grids from defining specifications to organizing technical dialogues, selection, managing the installation, commissioning and day-to-day operation of AMI system.

Factors leading to AMI implementation

Implementation of Advanced Metering Infrastructure has been advocated by European Union Directives translated into Polish national strategy and action plans pertaining to energy sector.[i]

The Polish Energy Regulatory Office (ERO) has taken a leading role in steering AMI implementation. ERO has described the desired outcomes of AMI implementations, thus rewarding DSOs for achieving results based on clearly defined criteria. Each AMI project has to be positively assessed by ERO in order for the utility to be rewarded for its investments.[ii]

In addition to National priorities, Energa Operator has put forward its own goals to be achieved through AMI deployment[iii]:

- Remote metering data acquisition
- Remote control of metering devices
- Increase in operational efficiency
- Optimization of grid management and development processes
- Increase of customer awareness in the areas of energy efficiency and distributed generation
- Accordance with regulatory requirements for meter reading

Case presentation: General

Following a series of AMI pilot projects conducted during 2007-2011, involving about 23 000 smart meters from 12 vendors, Energa Operator has made a decision for AMI rollout. The first stage of rollout would involve implementation of 109 000 smart meters based on S-FSK IEC 61334-5-1 communication technology.

The project has been divided into three parts:

Zone A – Head End System (HES)

Zone B – 3GPP/CDMA modems for ensuring connection between Zone A and Zone C

Zone C – Data Concentrators and Balance Meters and residential meters manufactured and supplied by ADD GRUP.

The goal of such division, where different segments of AMI system are provided by independent suppliers, was to secure the utility from vendor lock-in and to have a better negotiating position. All solutions are interoperable and have well-defined interfaces to ensure easy integration.

Actual Implementation

The implementation of AMI project has begun with physical installation of various components of the system followed by their logical integration.

The physical activities of the project included the installation of the following network components:

- Residential Meters
- Data Concentrators
- Balance Meters
- 3GPP/CDMA modems

The initial milestone was integrating in the system first 50 000 meters that were installed in Kalisz and Koszalin. It was crucial to identify the exact quantity of installed meters and data concentrators together with CDMA modems. When we compared the number of installed equipment with the one registered in the AMI system, we've found out that not all installed Data Concentrators were online, as it was required for system start-up. After a detailed analysis it was agreed that:

1. Problematic CDMA links need to be rechecked (installation of more powerful antenna, equipment check etc)

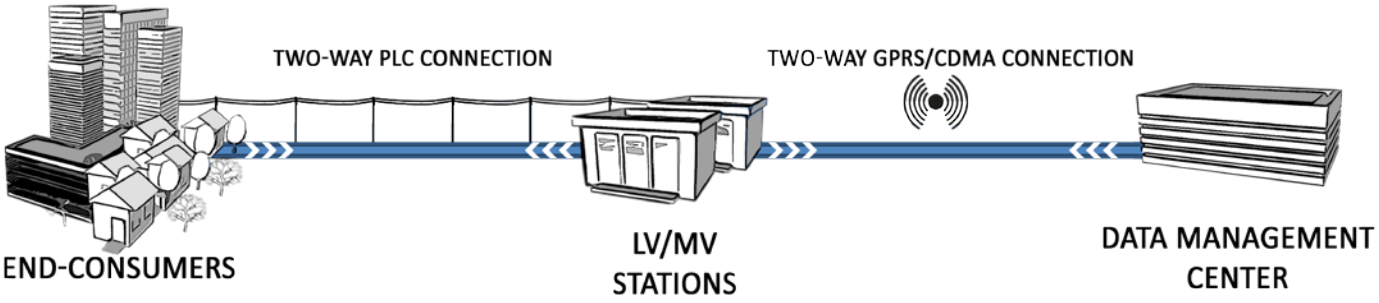
2. Missing Data Concentrators, needed to be installed, and inaccurate data provided by field personnel had to be corrected.

3. The correct connection of Data Concentrator to LV grid needed to be verified.

Successful execution of the above mentioned stages allowed us to proceed to the next phase – meter registration process as follows:

1. Time synchronization between HES and DCU
2. Right and synchronous process of meters registration (Automatic discovery sessions)
3. Necessary setting for the Repetition levels on the DC side
4. Configuration of the Meters Load profiles.
5. Load Profiles Acquisition.

One of the most difficult issues we had to



deal with in Kalisz was cross-talk.

Cross-Talk in Power Lines is a situation when the same meter is available to several Data Concentrators. Main areas where cross-talk appears are Two-Transformer Distribution Stations, or stations with closely placed feeders. Cross-talk significantly influences on equipment performance in power lines, i.e. creates domain collisions, information redundancy from the same meter for different masters, thus increasing traffic both in PLC and in WAN networks.

In our situation the "cross-talk" issue, that allowed meters to register with multiple Data Concentrators, was a consequence of the specific network topology in Kalisz: any given Distribution Transformer can be powered from several Substations to assure continuity of power supply in the case of failure.

ADD GRUP has found different methods for tackling cross-talks by applying special configuration to communication channel:

1. Division by MAC-Addresses. Each Data Concentrator has a unique MAC-address based on its ID. Meters in a specific Distribution Transformer are locked to this specific MAC-address and ignore requests from other Data Concentrators.

2. Repetition level tuning. Choice of optimal number of repetition levels based on network conditions to avoid negative effects of chorus repetition mechanism in S-FSK modulation.

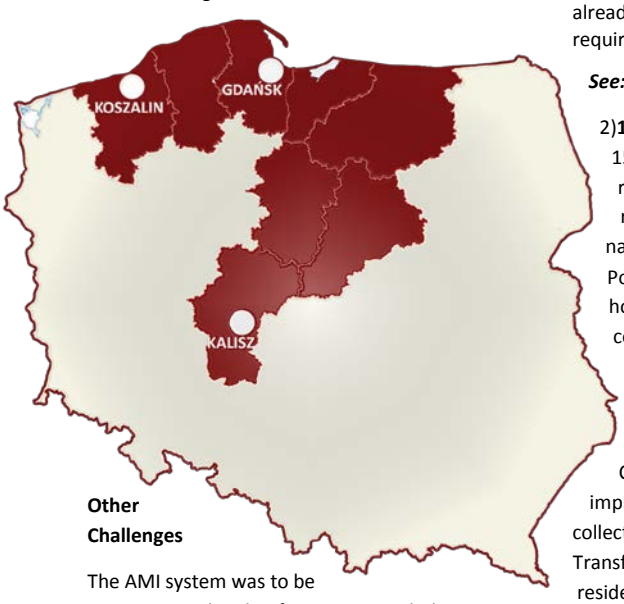
3. Creation of list of revoked meters. Meters from other substations can be added to revoke list thus making Data Concentrator ignore them. As a result meter will be assigned to the correct Master.

4. Field works. In case when none of the above mentioned solutions works, presence of qualified personnel might be required for troubleshooting in the field. For instance, such personnel would need to make investigation about accuracy of network topology, verify proper connections of meters and data concentrators, S-FSK settings of communications modules etc.

The application of these methods tremendously increased meter data collection rate, by eliminating cross-talk interference. The rest of the projects in Koszalin and Gdansk have been successfully completed, using methodology proved in the first run of 50 000 meters in Kalisz.

ADD GRUP continues development of new methods to deal with cross-talks (intelligent search initiator, auto sync reject and other).

Besides cross-talk issues, we had to face other challenges, as well.



Other Challenges

The AMI system was to be commissioned and to function as a whole. As a result, the implementation strategy focused on ensuring the interoperability of different components and system reliable operation. The following challenges were identified and addressed:

1) **Interoperability and integration.** ADD GRUP has collaborated with other participants to ensure a seamless integration of the following components, each provided by different vendors:

a. Data Concentrator (DCU) – HES. In this level we have used communication protocol P3.2 based on Dutch Smart Metering Requirements.

The document "Dutch Smart Meter Requirements" is an elaboration of the NTA8130 and the AMvB, commissioned by the Dutch grid companies, and aimed at meter interoperability. Also requirements have been added, mainly with respect to installation & maintenance, privacy & security, and performance.

This protocol has allowed us to implement synchronized work between HES and Data Concentrators/Meters, thus fully meeting functionality and performance demanded by Energa Operator.

b. Data Concentrator – 3GPP/CDMA modules were connected via Ethernet channel to assure transparent connection between HES and DCU and vice versa. Modules support both GPRS and CDMA technologies, allowing switching between them upon necessity and available network coverage thus minimizing risks of communication loss.

c. USB Host Interface. Energa Operator required all meters to be equipped with USB interface for potential HAN or WAN. Such a universal interface allows Energa Operator to choose between vendors of HAN or WAN equipment. Currently USB interface is used to connect with GPRS modems. USB interface has a very promising future and is already included in the most recent requirements of Polish Energy Regulator.

See: Solution Architecture

2)**15 minute load profiles.** Collection of 15 minute interval data from all residential meters via PLC is highly relevant for the DSO and for the national load dispatcher. Given that Power line carrier creates a rather hostile communication environment, collection of such data requires a vendor to fine-tune PLC technology in respective manner to address this challenge.

Current benchmark when implementing AMI project, had been to collect 15 minute data at Distribution Transformer level, and daily profiles at residential level. That was considered by many providers and utilities to be the most PLC could offer. ADD GRUP took the challenge, and proved that narrowband ADDAX PLC Technology breaks the limits by bringing 15 minute data from residential meter thus setting the new benchmark.

3**) Stable and robust AMI system performance** in heterogeneous environments in Kalisz, Koszalin, Gdansk, each presenting some issue for the normal functioning of PLC:

a. High density Urban Electricity grid in Kalisz
b. Large distances in Koszalin
c. Touristic area of Gdansk Region (Wladyslawowo, Hel, Puck, etc.)

See: AMI Project Locations, Poland

Those environments tested PLC technology at its limits. Still, ADD GRUP proved that even in such diverse and harsh conditions ADDAX PLC achieves high performance, maintains stable operation and successfully delivers 15 minute interval data.

Stage One AMI project provided challenges to integrate all system components and ensure robust communication. Close cooperation and coordination between vendors made it possible to ensure successful integration and commissioning.

Conclusions

Results: 15 minutes interval data are gathered from all meters in the project. This is an unprecedented result for a quantity of more than 100 000 meters.To date we could say that this is an important milestone for AMI systems.

The impacts of the project and the acceptance by clients:

• Consumers now pay for actual consumption, not for estimated one. This is the most important benefit as perceived by Polish consumers. According to a research realized by *GfK Polonia*[iv], 82% of Poles pointed out that paying for the actual electricity consumption is important, as it allows a better planning of family budget and gives a feeling of control in relation to the DSO.

• Web Interface allows each to check their own consumption. Information flow enables households to rationalize consumption and lower electricity bills.

• Remote reading is important to 36% of consumers, who prefer not to be visited by data collector.

• 65% of consumers are willing to change their habits to reduce their electricity bill.

Due to ADDAX Technology's high performance, proper project management, close cooperation and coordination among all project participants, Energa Operator has one of the most successful AMI projects in Europe. Based on the results of Stage One of Energa Operator project, ADD GRUP has established a new benchmark for global smart metering market.

Authors:

Maxim Granatiri, MS. Currently Head of Innovative Technology Implementation Section, holder a mastery degree in standardization. Joined ADD GRUP in 2008 and showed remarkable results and commitment to successful commissioning of ADDAX IMS projects in different regions of Europe, Asia, Africa and South America. Has an unparalleled experience in PLC deployment, AMI technology and project management.

Nicolae Tarlapan. Nicolae joined the ADD GRUP team in December 2010. Since then he has been responsible for monitoring tender applications, Market Research and Establishing long term relationship with clients and partners.

[i] European Smart Metering Landscape Report 2012–update May 2013

[ii] Position of the President of Energy Regulatory Office on necessary requirements with respect to smart metering systems implemented by DSO E taking into consideration the function of the objective and proposed support mechanism [...]. (2011).

[iii] Energa. (26.06.2013). AMI Project summary. *Smart Metering implementation in Europe: are we on track?*

[iv] Energy Regulatory Office. (13 May 2013 r.). *Elimination of energy bills projections the main advantage of smart meters*.