

## THE INTERFACE BETWEEN THE UTILITY SECTOR AND HOME AUTOMATION

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### ABSTRACT

*In 2011, the Swedish energy sector and meter manufacturers initiated a work to develop a solution which would improve integration of high resolution energy data from electricity meters into the smart home. Initially aimed at producing a national recommendation for a standard port on all electricity meters; it ended up as an international standardization initiative. This document is a description of the drivers behind the need of DFI (Data Flow Interface), a new interface for direct data exchange with Smart Homes and other premises and some of the potential benefits for the customer.*

### INTRODUCTION

Since the initial unbundling of the Swedish electricity market in 1996, it has evolved into a marketplace with a wide variety of suppliers and products. However, an important goal of the reforms has been to improve the customer's means to take control over their electricity usage. This challenge remains although it has been addressed repeatedly since the unbundling by both legislators and different market initiatives.

The customers, in general, consider electricity a low interest product in which also includes the awareness of how and when the consumption actually occurs. This has resulted in less than expected customer movements on the market. It can also be noted that the kWh-price is the main driver rather than opportunities to increase efficiency in usage.

During 2011 the Swedish Government instructed the Energy Market Inspectorate to further investigate four major challenges that had been identified in the areas of Smart Grids and Smart Metering [ref 1]:

- Facilitate increased share of electricity from renewable energy sources.
- Mitigate peaks in electricity demand
- Improve incentives for energy efficiency
- Enable customers to be active

Three of these challenges will be met when the customer can act on a properly functioning market:

- Mitigate peaks
- Improve energy efficiency
- Active consumers

The market has not yet met the intention of the legislators. Products that promote more efficient use of energy are there, but not in any abundance. Nearly all electricity contracts are based on fixed rates with no incentives for the customer to adjust consumption patterns in relation to peaks or periods with high production costs.

The general assumption of the main driver for the reform, as it has come to evolve, was that the unbundling of the electricity market was supposed to lower the electricity bill for the individual customer. Increased taxes and subsidies for renewable energy has instead increased prices significantly since the reform. In the public debate it is however the utilities who has been held responsible for this development. It has quite naturally affected the confidence in the market as well as customer perception of the new products brought on by the utilities.

To measure is to know, but this assumes that the result of the measurement reaches the decision maker, e.g. the customer, in time to influence. Today, electricity is measured per hour, per day or per month with high accuracy. Unfortunately, the information does not normally reach the customer until the next bill. It's increasingly common with web-based customer portals, but these require log on procedures and will not provide the customer with all the necessary information. With an instantaneous product as electricity this is not sufficient to enable the customer the opportunity to exercising real time influence on their own usage. Empowerment of the customer by enabling real time access to the information is crucial.

### BACKGROUND AND DEFINITION

New legislation has, step by step, been implemented in order to create an end customer market similar in function with those of insurance and banking. The latest

addition, in October 2012, was legislation regarding hourly metering where the DSOs have to supply hourly metering, for all who request so, free of charge.

Although these reforms have increased the flow of information on the electricity market, the major problem is still there. Information always arrives too late to be of real use for the customer. To get a working business relationship to happen, both buyer and seller must understand the transaction and to assess its reasonableness. Customers perception of the product is that electricity is expensive and that information on the consumption arrives too late. Information regarding last month's usage will not allow the consumer to adapt the consumption pattern. Even if the data is retrieved daily and presented to the consumer with as little as 24 hours delay the consumer can't act upon the information. Consumption has already occurred.

*The information regarding the energy consumption is a perishable commodity that must be made available to the customer in real time.*

Proactive Forum was initiated 2009 as a collaboration between Svensk Energi (Swedenergy) and Elmaterielleverantörerna, EL, (Electrical equipment suppliers association, EL). The Forum's task is to develop an economically and technically sustainable meter solution that meets the requirements and needs of all parties, enabling their contribution to our joint climate goals (20-20-20).

One of the fundamental tasks for Proactive Forum is to develop a model to ensure sustainability investments in smart metering and smart grids. In the model, consumers must also be able to monitor and control their own consumption in real time and thus create incentives for energy savings, peak spreading and an active market for customers.

## LEGISLATIVE ENVIRONMENT

There is a political consensus regarding the importance to reach the 20-20-20 goals and several national- as well as international initiatives is ongoing. The European Commission is implementing a legislative framework for the internal electricity market. It will affect how electricity is measured and information presented in several aspects, to mention a few:

- The third Electricity Directive
- M441 appointing the industry to put standards in place
- The energy efficiency directive

The governments of the Nordic countries have decided to establish a Nordic supplier centric market model where the Nordic electricity market will become one market. Several changes to the current market legislative

framework have been investigated during 2012 to remove any obstacles for a common Nordic retail market.

- Deregulation of metering and billing
- Central hub
- EI functional demands on smart meters
- Net Billing Inquiry

## THE VISION OF THE PROACTIVE FORUM

Building the future measurement systems requires long-term thinking and a willingness to invest.

Communications systems are costly to procure, put in place, operate and maintain, (OPEX) and this is why DSOs in Sweden generally haven't dimensioned the systems to meet future requirements. This is why the current system structures commonly only meets the current legal requirements with limited possibility of extended functionality. Add upon this the fact that the legislations change almost every other year.

Early on in the work with Proactive Forum all aspects of metering were included. This included metering of small scale production, introduction of energy storages, smart metering as well as the future metering from a customer's point of view

The first step was to meet the need for real time values, i.e. a local port on the meter for the end users need.

It is important to understand that the DSO's have a very limited need for information regarding the consumption at the customer site (only billing and settlement) while the consumer and the energy service supplier are interested in several other types of information and having access to those in real time.

The DSO is interested in the energy consumption while the consumer might be interested in voltages, currents, power for all three phases as well as for each individual phase, all depending on the need at the moment.

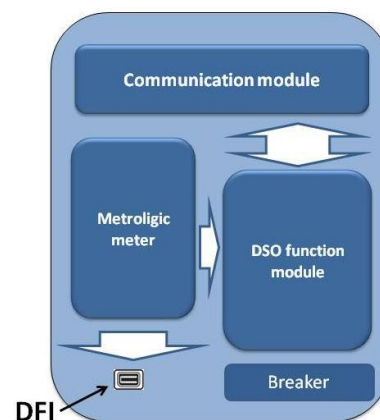


Figure: The smart meter consists of four main blocks; a measurement module, a communication module for the DSO and a physical port where the electricity consumer

always can obtain the data. The mini USB symbol shall be interpreted as an example.

The energy meter is often considered as one unit hosting all necessary functions. Proactive Forum noticed early on that it was easier to understand the main stakeholders needs if the meter was divided into a number of blocks, each describing a distinct function.

### **1. The metrological module**

The metrological module is a well-defined function that follows the measurement instrument directive MID004. Electricity meters (Mid meters) are all exchangeable and they all work the same and are not tied to national rules.

### **2. The DSO function module**

The DSO function module is a functional module that allows the unit to be configured in such a manner that it complies with national regulations; it can for example be functions like tariffs, peak powers, outage detection management and/or power quality.

### **3. The communication module**

The communication module is the main communication channel for the need of the DSO. It is a two-way channel that has a narrow bandwidth and a very long technical lifecycle. The channels main purpose will be data collection, tariff configuration and remote software upgrades.

### **4. The physical port**

The physical port shall be a standard interface where the customer extracts information about their own energy usage. The data is accessed in real time directly from the metrological module.

### **5. On the customer side**

The technical architecture on the customer side has not yet been a prioritized part of Proactive Forums work. We believe that the architecture will be solved and taken care of by home and building automation standardization.

Once this default port is available on the meter, it will enable service providers to develop smart products directly to the consumer without ever involving the grid operator.

It will be the customer who grants access to the information as well as the level of security to be applied. If security is of importance it can be achieved by a wired connection with high level of encryption, if security is not important a simple and inexpensive open frequency radio solution that broadcast the information might be sufficient.

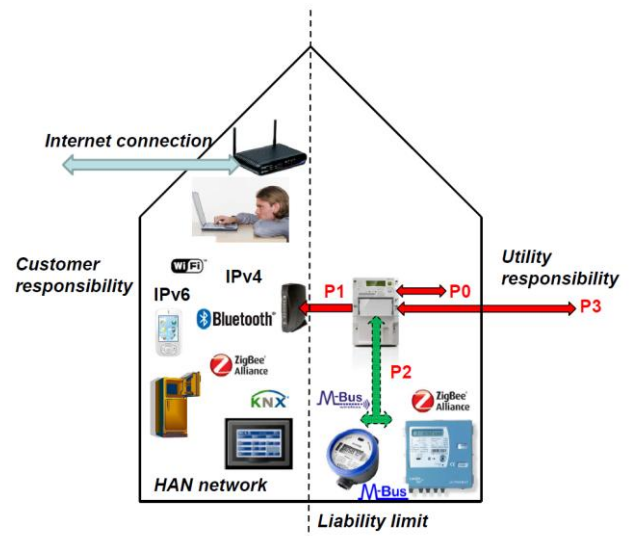


Figure: The DFI interface will allow complex services to be introduced on the future market as it matures without any need of exchanging the electricity meters.

For multisite customers like shopping malls a solution incorporating GPRS will allow a nationwide collection of data and important information. This will provide an opportunity for multisite consumers to utilize new solutions for cost effectiveness.

With the standard interface available on the meter the DSO is not involved when the customer makes a deal with the service supplier, nor is the DSO involved when the customer makes a deal with a energy supplier that incorporates functions that include energy monitoring. There are several stakeholders on the market that most likely will introduce and release electricity management devices that will give customers better control of their electricity expenses.

*A standard open interface for local readout will contribute to market development in a fundamental way.*

With the ability to integrate multi-utility measurement, i.e. measuring electricity as well as heat, gas and water, even more opportunities are created for energy consumers.

It is possible to draw parallels to the development boom of open source software for the Smart phone market. Smart phones have a large community of companies that develop and supply products to the platforms. The Proactive Forum is confident that functions and products will be developed in a similar way for smart meters as soon as one standardized open interface becomes available on the meter.



Figure: The DFI interface provides consumption data in real time. Price information is imported from the internet to a residential gateway owned by the electricity consumer.

## FUTURE ROLE OF THE DSO

The DSO will continue to read information from the meter in the same way as today via its own connection to the communication module. The limited bandwidth prevents the DSO from monitoring the unit in real time. This ensures the integrity of the customer.

The Proactive Forum vision is that it should be a long term solution where the meters should have an economic and functional lifespan exceeding 10 years. The vision has defined clear interfaces between stakeholders, between DSO and service suppliers and between end users and service suppliers as well as between energy suppliers and energy consumers.

*A clear limit of liability is very important from a legal and economic perspective.*

- The model for Smart Meters meets high legal standards of integrity and prevents unauthorized distribution of metering data information. The real time interface will be sufficient for providing the market with data under the foreseeable future.

- The model assumes that the actor that is benefiting from the use shall carry the cost. With this port the services will be placed on the market when market identifies that there is an actual business opportunity. It is reasonable to assume that small homes with electrical heating and commercial building owners will be the front runner segment. Monitoring- and control equipment for direct electrical heating as well as heat pumps will become a common application.

- Legally and economically, the DSO will be obligated to provide "raw data" (non-validated data, such as energy and power) to the energy consumer in real time. The validation of the measurement data will be carried by the

DSO at a later stage in the invoice function before billing and settlement is carried out.

A system equipped with this simple, inexpensive DFI port will allow smart services to be added. New features that meet the requirements of future political reforms can be implemented without extensive reinvestments. In essence, an open interface is essential to enhance the market efficiency and to create a greater level of understanding from the consumer point of perspective.

The European mandate M441 has identified a number of interfaces within smart metering. There is a gap in the current standardization between smart metering and home automation where DFI will act as gap filler, i.e. feed data to via H1-H3 interfaces to home automation systems. The current home automation standardization aims to put open web services solutions in place. DFI can act as a feeder into these solutions.

During 2012 the Swedish Energy Market Inspectorate has investigated if a deregulation of the metering would help the market for services to evolve [ref 2]. The report concludes that the findings of Proactive Forum will help the market to the greatest extent. The report suggests that the Swedish Government shall enforce legislation that gives the consumer the right to real time information regarding the energy consumption in a manner similar to that what has been suggested by Proactive Forum.

## CONCLUSIONS

We have initiated an international standardization project on the local port, DFI (Data Flow Interface) [ref 3] "Electricity metering - Data Exchange for meter reading, tariff and load control". During the course of the work Proactive Forum came to the conclusion that a Swedish recommendation wouldn't be sufficient without an international recognition.

## REFERENCES

- [1] Adapting Electricity Networks to a Sustainable Energy System – Smart metering and smart grids Ref: EI R2011:03
- [2] Vägval för en utvecklad marknad för mätning och rapportering av el (Crossway for a developed market for measurement and reporting of electricity) – Ref: Ei R2012:12, October 2012
- [3] NWIP, IEC 62056-21 Electricity metering - Data Exchange for meter reading, tariff and load control - Part 21: Direct local data exchange; Amendment A: Mode D DFI interface with OBIS codes, Ref: 13/1518/NP, 2012-10-26