The object oriented, interoperable meter

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1. The drivers behind the object oriented meter

Driven by liberalisation the utilities need to optimise their business processes. The meter becomes more and more part of an integrated AMR system. Today's communication technology offers cost-effective solutions which support the integration process.

1.1 Communication technology

Traditionally telemetering systems are based on telephone and similar voice-grade channels. Today new channels such as radio or distribution line carrier (DLC) open new possibilities. The most discussed telecommunication channel is the data highway. It is formed by the combination of cable and of optical fibre networks. In many countries the utilities themselves are involved in the development of the data highway. Energy information and demand side management are offered as new services on the network.

Probably the strongest influence on the utility's business processes will come from the interconnection of existing and new communication networks. This leads to shorter access times for information and therefore becomes the basis for quick decisions.

For the user of the AMR system the actual choice of the communication medium must be a secondary issue. The system chooses the appropriate channel automatically according to the availability of the medium; e.g. the command to reduce the loads is transmitted to one part of the consumers via ripple control, an other part is reached using DLC and the rest via radio.

1.2 Liberalised markets - the European experience

Liberalisation is based on a simple principle but it can be difficult to implement. In the following we give a short summary on the metering principles used in the liberalised UK market. More details can be found in [1] and [2].

Figure 1 illustrates the concepts of the metering arrangements used in the British market. Energy flows are measured at the generator's side, in the grid and at the customer's side. The metering data is collected by different area collectors and by the central data collector. Final settlement of the energy prices is done through a national settlement agency considering charges for transport and distribution.

A consumer can make a contract directly with its local "Electricity Supplier" or via a "Second Tier" supplier. The settlement between generators, grid and suppliers is based on measured half-hourly consumption values which are collected daily. The described scheme is operating successfully for customer sites down to 100 kW.

In 1998 all customers can profit from full liberalisation. It is obvious that half-hourly measurements are not feasible for all 25 million British customers. Therefore for the "<100kW" customers profiling settlement is foreseen as the standard method (half-hourly measurement can be used as an option). For that purpose 8 profile classes are defined. Two (single rate, double rate) for domestic customers and six for business customers. The consumption profiles for the different classes are estimated based on statistical measurements.

There are three parties dealing with the meters; the meter owner who buys the meter, the meter operator who installs and maintains the meter; and the data collector who reads the meter. Today the meter owner and the meter operator are the same. After '98 the meter can be owned by the customer, by the supplier, by the distributor or by the meter operator.

The scheme presented above describes the British solution. In other countries the models are similar - but not the same. Finally it must be emphasised that things are on the move and it is very likely that new models of liberalised markets will appear and that the existing models will be modified as experience grows.

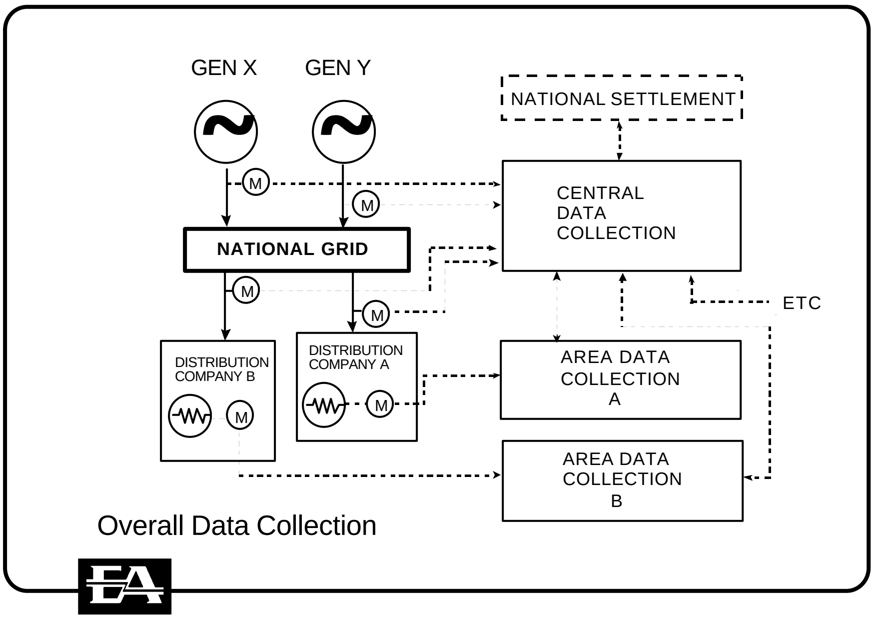

Figure 1: Data Collection in Britain (figure provided by Electricity Association)

1.3 Conclusions

Liberalisation of the electricity market leads to a completely new relationship between the utility and the customer. Several providers are competing by offering the same commodity - electricity. In order to become competitive the commodity has to be transformed to a product - energy supply. The different providers can be distinguished by the product offerings they provide to their customers; i.e. the tariff structures, the prices and the services. A successful product must be designed according to the needs of the customer. It will contain much more than just delivery of energy and a yearly bill. Additional services such as tariff-consulting, quality supervision, monthly billing, supervision of the client's installations, etc. must be offered. In order to provide these services in an efficient way a considerable amount of metered data must be processed.

For a energy supplier the data base of its clients changes now more dynamically. New clients are acquired, some clients are lost to other suppliers. This means that the utility has to deal with a growing variety of data. For the data collector things are not better. They have to collect their data from a heterogeneous set of meters from different manufacturers with different functionalities. Whereas in the past the commercial value of the meter was mainly generated by its data acquisition and processing capabilities in the new environment the critical issues are its system integratability and its interoperability.

In order to meet the needs all involved parties the future meter must provide the following features:

- modular functionality in order to cover the different needs of the different markets,
- interfaces to different communication channels,
- interoperability between the equipment of different manufacturers,
- support system integration.

The "interoperability" requirement can only be fulfilled if the meters conform to some standard. Such a standard must not be too restrictive in order to allow adaptations of the meter functionality to the changing environment.

2. The situation in standardisation

The International Electrotechnical Commission (IEC) has come up with a set of standards which support also the needs of the liberalised market. There is the technical report "User requirements for local and remote meter data exchange - Applications and performance" (IEC 1361) which covers a broad range of applications. On the other hand there are several communication standards; defining the lower layers of the OSI reference model (e.g. IEC 1334-5, HDLC, IEC 870-5-2, etc.).

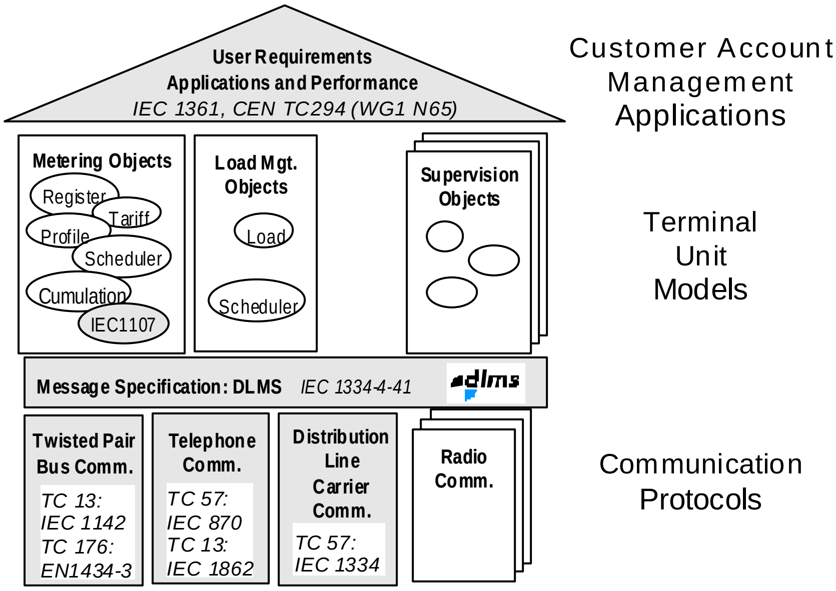

Figure 2: The house of standards

Figure 2 displays an overview on the current situation concerning standards applicable to metering systems. The grey building blocks represent the available standards, whereas the blank blocks mark the missing standards.

At the top of our "house of standards" we put the applications, they form the target of the entire system. It's in the applications where the value of the system is created. On the other end are, the communication channels. Different communication standards are available covering the most important communication media; i.e. "voice grade channels" (PSTN) and distribution line carrier (DLC) channels. Extensions to radio and other channels are currently under consideration. The Device Language Message Specification (DLMS) forms the common basis for the variety of channels and applications [3]. It defines how data is accessed and how data structures are defined, independently of the communication medium. The DLMS communication objects are described in ASN.1, the only standardised abstract syntax.

3. The "Objectives Initiative"

In order to provide truly compatible but also flexible meters and systems major meter manufacturers initiated the "Objectives" program. The initiative has now been taken over by the "DLMS User Association". The goal of this initiative is to specify an interoperable metering system which can be networked using different communication channels. The approach is based on the client server principle and on object technology. Figure 3 illustrates how the meter and the data collection system work together. Any meter (server) provides information about its capabilities. This information enables the data collecting client to easily integrate the meter into the system.

When defining the objects and the communication protocols the following rules are strictly followed:
- use existing standards,
- use standards which have been validated trough implementation,
- clearly specify all "open issues" of the standards that are revealed during implementation.

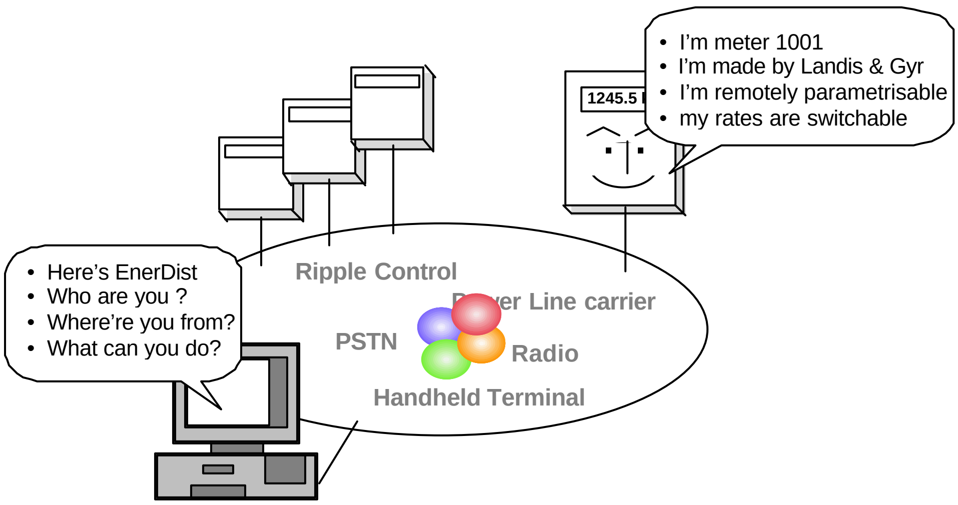

Figure 3: "Objectives" - towards the object oriented, interoperable metering system

The set of objects forms a standardised library from which the manufacturer can assemble its individual product. The objects are designed such that they cover the entire range of applications (from residential to commercial and industrial metering). The choice of the subset of objects, their instanciation and their implementation are part of the product design and therefore left to the manufacturer. The concept of standardised objects offers the different manufacturers a maximum amount of diversity without giving up on interoperability (comp. figure 4).

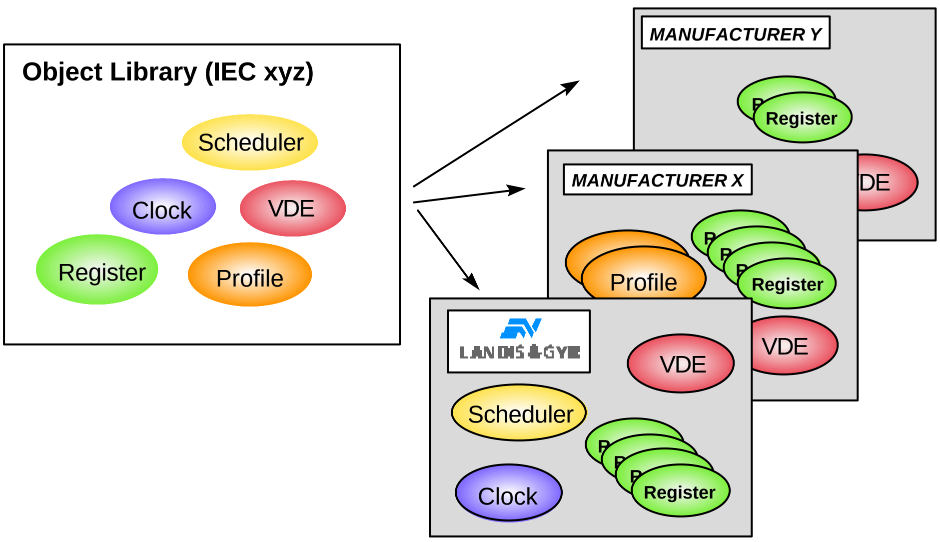

Figure 4: The Object Library

The objects must be mapped to a messaging system which is suited for communication purposes. DLMS [3] offers these means for the applications envisaged in metering. As shown in figure 5 the attributes and the methods of the objects are transformed to the respective ASN.1 structures and to the DLMS services. Finally the DLMS frames (DLMSpdu) form the "payload" of the underlying channel dependent communication protocol. From the huge set of possible communication channels PSTN (public switched telephone network), DLC (distribution line carrier) and radio is treated with first priority. This concept allows a clear separation between object design (specifying the functional blocks of the meter as seen from the client), messaging system (specifying the data structures and the communication services) and the actual communication protocol (defining the data transport mechanism). The 3 blocks are independent of each other and they can be exchanged separately.

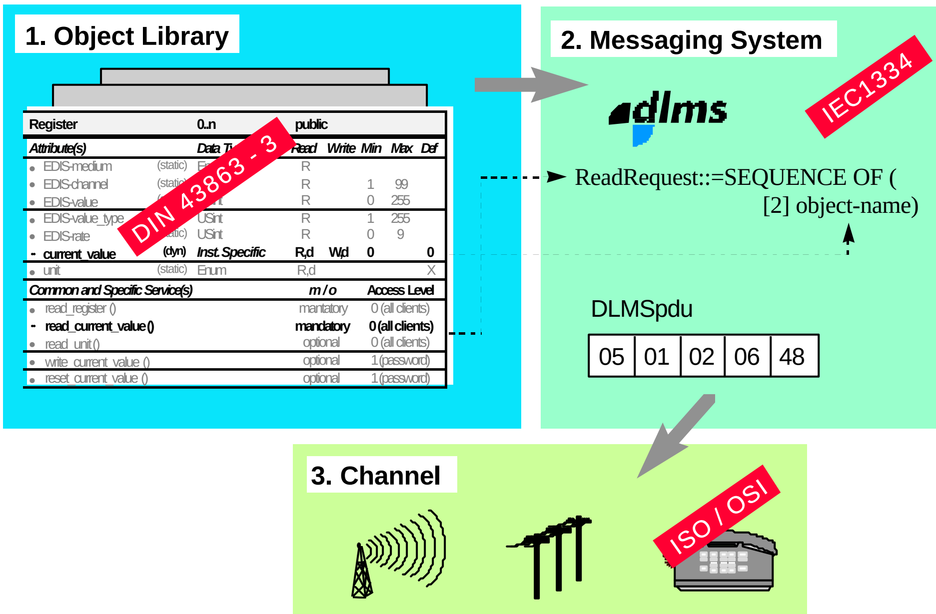

Figure 5: From the object library to the communicating meter

The labels in figure 5 indicate the standards which are involved in the metering objects (e.g. DIN 43863-3 is used as identifying concept). The goal of the "Objectives" initiative is not to invent new standards but to bundle existing standards to a system solution which can be validated though implementation.

4. Outlook

Landis & Gyr has a leading position in telemetering systems. Based on extensive experience in grid-metering and in energy management new integrated solutions for the commercial and residential customers are offered. These solutions include new applications such as billing, invoicing and meterpark management. They support the utility in a monopolised as well as in the liberalised market. The integration of Landis & Gyr's devices, subsystems and existing systems into an end-to-end solution is enabled by our Linkage concept.

Landis & Gyr is clearly committed to base their systems on existing and evolving standards. This commitment is underlined by the active role Landis & Gyr plays in several standardisation committees.

5. References

[1] Alan Dick, "Auswirkungen des Wettbewerbs in England auf die Zählertechnik", VDEW -Fachtagung ZMP '96, May 1996, Gosslar, Germany.

[2] R.R. Loe, "Metering Systems for Competitive Energy Supply to Residential Customers", Mates '96, July 96, Brighton, UK.

[3] IEC International Standard 1334-4-41, 1996.