

# The Importance of Being Interoperable

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## 1 Introduction

In the liberalised energy market metering is no longer what it used to be in the monopolistic environment. Geographically dispersed meters from different manufacturers communicate via different channels. Data is collected by different parties using different data acquisition systems and transferred to different billing systems. Moreover, information on the customer's consumption behaviour becomes a strategic issue. Access to consumption data must therefore be protected by appropriate security measures. In addition, data must be guaranteed to be authentic even after it has been handled by several parties.

In order to do business in this heterogeneous environment efficiently, the market players must concentrate on their clients and cannot spend their resources to solve technical incompatibility problems. Interoperable systems and components become more and more a strategic issue.

The paper shows how *dlms* (device language specification) and its companion specification for energy metering (COSEM) solves the interoperability problem. Different levels of interoperability are considered: from the recognition of the communication protocol, the identification of data, to the standardised building blocks of the meter functionality. The meter is not re-invented but metering experience is put into a modern concept. A concept that can be used for simple residential meters as well as for complex meters for industrial customers. A concept that can be used for a variety of different communication channels: from two-wire buses, PLC, telephone, to GSM. And finally, a concept which is able to adapt to the new requirements of the future.

The economic value of interoperability is demonstrated by considering several relevant "real world" scenarios.

## 2 The key elements supporting interoperability

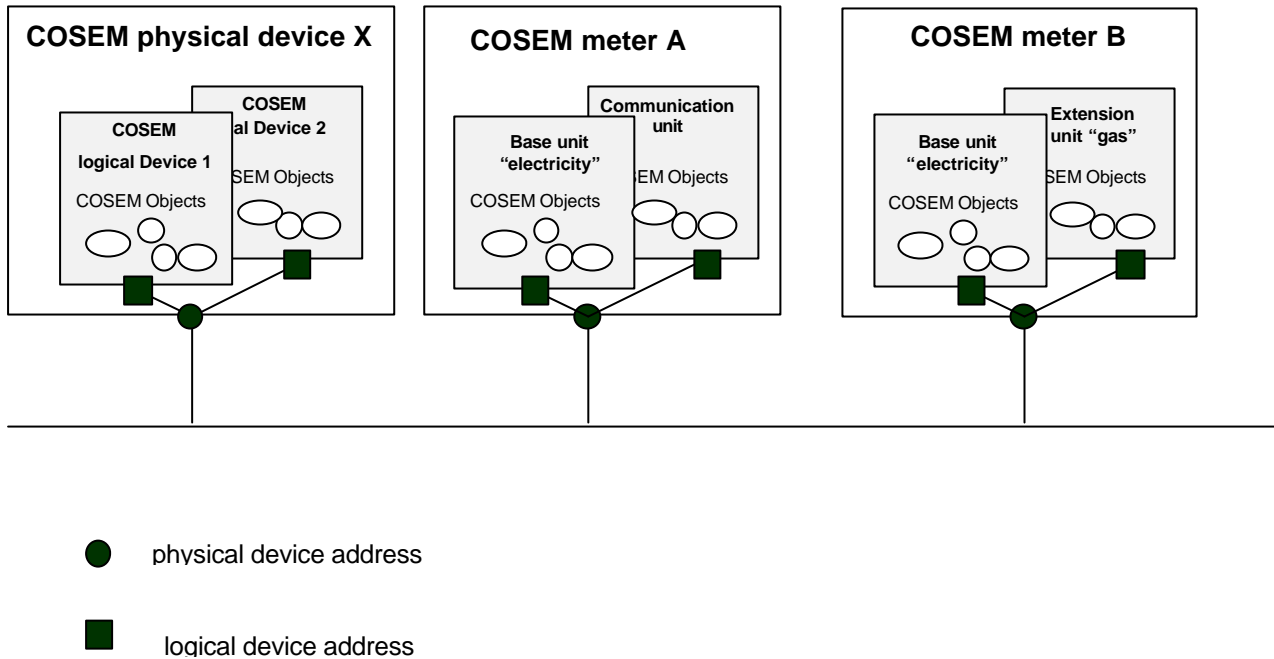
### 2.1 The *dlms*/COSEM device architecture

The COSEM device is hierarchically structured into three levels as shown in Figure 1:

- The **physical device**. It is typically represented by a physical box – e.g. a meter.
- The **logical device**. It consists of a functional unit such as: an electricity-metering unit, a gas-metering unit, a communication unit, control command receiver, etc.
- The **interface objects**. They are the functional blocks of which a logical device can be built. Objects are the basis for metering units (e.g.: Register, Demand Register, Profile, Clock, ...) and of communication units (e.g.: PSTN Modem Configuration, PSTN Auto Answer, PSTN Auto Dial, IEC Optical port Setup, ...)

The COSEM architecture offers addressed access on all three levels. Physical devices and logical devices can be addressed individually or by multi-casting, objects can be addressed via their identifiers or via short-names. The addressing scheme for the objects is negotiated when the device is integrated into the system.

The described architecture supports the design of a wide variety of interoperable products from different manufacturers. From a very simple meter (e.g a few register objects in one logical device as part of one physical device) to a complex network of measuring units and control devices connected to a bus. The simple devices are not burdened with unnecessary protocol overhead, nevertheless even a complex network can be efficiently operated.



**Figure 1: The COSEM architecture**

## 2.2 The COSEM interface objects

The heart of the *d/lms*/COSEM standards are the interface objects as defined in IEC 62056-62. Together with the object identification system (IEC 62056-61) the standard defines the building blocks of a metering device in an object oriented way. The standardised interface objects represent a revolutionary step forward towards truly interoperable system components.

It is the first time that a metering standard does not only define how to transport the metering data (by defining communication protocols) but uniquely specifies the metering functions and its access methods (objects consisting of attributes and methods to access the attributes). Meters can now be operated in a standardised way, independent of the manufacturer.

Optimal flexibility is achieved by defining the basic building blocks of a meter and not defining the functionality of a complete meter. With that approach a large range of products can be covered - from very simple residential meters to complex I&C meters. In addition, the concept considers extension for the future market needs.

Today the library of interface objects defined in IEC 62056-62 supports the following functionality:

<b>Interface objects supporting metering functionality</b>	
<b>Object</b>	<b>Functionality</b>
Data	Simple data points.
Register	Registers consisting of values, units and scalars.
Extended Register	Registers with extended functionality.
Demand Register	Registers measuring the energy demand.
Register Activation	Supports tariffication and definition of rates.
Profile Generic	Supports loadprofiles, historical values, event logs, etc.
Clock	Covers time related issues (setting , adjusting , daylight saving, etc.)
Script Table	Stores a set of scripts which define sequences of actions.
Schedule	Defines the trigger times of certain events.
Special Days Table	A list of days that need special treatment.
Activity Calendar	Defines the time instances when certain objects change their status.
Association LN	Table of contents of the logical device when the objects are addressed by their identifiers.
Association SN	Table of contents of the logical device when the objects are addressed by their short names.
SAP Assignment	Overview on the logical devices available in a physical device.
Register Monitor	Registers that are monitored and which can trigger certain actions.
Utility Tables	Tables containing metering data according to ANSI standards.
Single Action Schedule	Simple trigger for events (e.g. maximum demand reset)
<b>Interface objects supporting communication functionality</b>	
IEC Optical Port Setup	Setup parameters for an optical interface according to IEC 62056-21.
PSTN Modem Configuration	Supports PSTN modem configuration.
PSTN Auto Answer	Supports the operation of a PSTN modem in the automatic answering mode.
PSTN Auto Dial	Supports the operation of a PSTN modem in the automatic dialling mode.
IEC HDLC Setup	Setup parameters for an interface supporting the HDLC protocol
IEC Twisted Pair Setup	Setup parameters for an interface according to IEC 62056-31

**Table 1: COSEM object library**

### 2.3 The interoperable identification and formatting

In the past a lot of communication difficulties arose from the fact that different manufacturers used different naming rules within their products. Due to this incompatibility the data collection engines had to run complex translation tools in order to interpret the data coming from different devices. Even worse, each time a new device was added to the system a new translation tool had to be developed as well.

Today it is possible to use unique identifiers, which are manufacturer independent and which are only based on the information they reference. One part of the COSEM standard suite, IEC 62056-61, is giving an exhaustive list of these identifiers. The system is called OBIS, Object identification system. The OBIS system includes a concept for extensions considering the future needs for new identifiers.

To complete the whole picture, even in the non electrical energy world the OBIS concept is accepted now and it will be used to create compatible standards.

The second main problem of data interpretation was very often the format in which data was transmitted from a metering device to a data collection engine. Again, the translation tool had to be configured to correctly interpret the received data. Sometimes even the meter had to be re-configured to achieve compatibility.

In COSEM, a standard formatting system is used where each data item, which is not fully defined by the protocol itself carries sufficient information to be interpreted without any outside help.

## 2.4 The Door Keeper

A meter consists of a set of objects. However not all objects are available for all “users”. The relationship between “user” and the available objects is defined in the “Application Association” (AA). The AA depends on the “user” (e.g. meter reader, service client, parametrisation tool, ...). It specifies the “view” the client (user) has to the meter; i.e. it defines which of the objects built into the meter are actually accessible for the specific user. Access rights are assigned on attribute level; i.e. depending on the AA an attribute may be readable and/or writeable by the client.

Whenever access to the meter is established the *door keeper* checks the identity of the user and opens the corresponding view to the objects and attributes. In Figure 2 a meter with its objects is shown. Different users are accessing the meter: the electricity utility A, the heat utility B, the customer, and probably also a “hacker”. It is the task of the door keeper to identify the users and grant the appropriate access by assigning the correct application association.

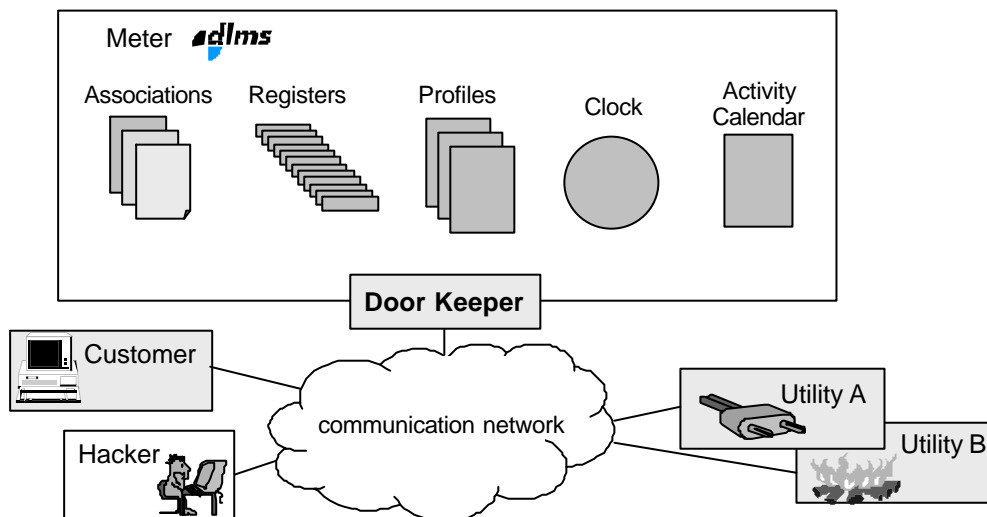


Figure 2: The different users and the “door keeper”

In two different associations are shown. For utility A the meter consists of: 2 registers, 2 profiles, a clock and an activity calendar. For utility B the same meter consists of 7 registers and an event log (profile object). In the object “association” the user finds a list of the objects available under the current association.

The identity of the user is checked by means of an authentication procedure. The security depends on the authentication procedure applied. The *dlms*/COSEM concept offers scalable security; i.e. the meter sets the level of security it requests from the user. With this concept it is possible to design simple meters requiring no user authentication at all or, to specify a meter for a high security environment in which a user is authenticated with a multi-pass security protocol. The “classical” authentication by password is also considered.

In addition to the door keeper function, the *dlms*/COSEM concept also supports encryption of data for secrecy purposes and the possibility to authenticate the originality of the data.

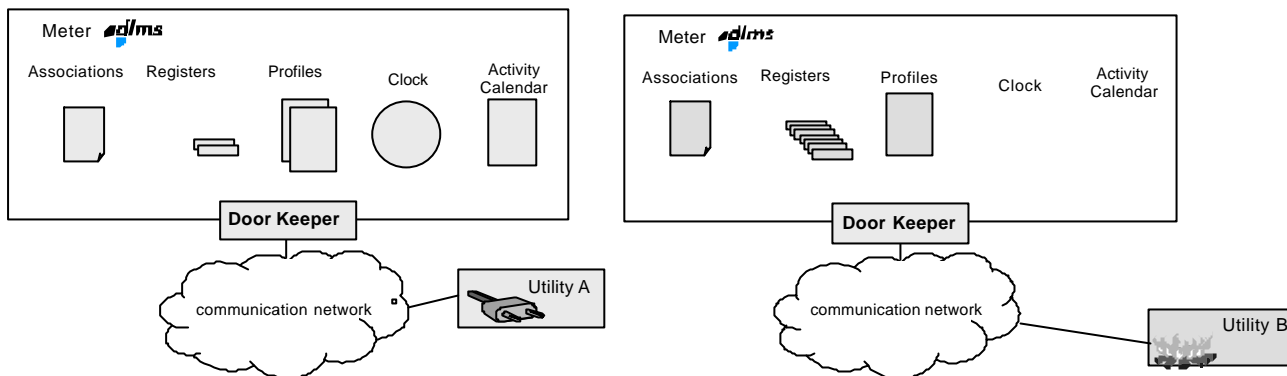


Figure 4: Two user dependent “application associations” for the same meter

### 3 Use Cases

#### 3.1 The installation of a new meter

Installing “traditional” meters and integrating them into a metering system can become a tedious process; especially if meters from different manufacturers are involved. A *dlms*/COSEM meter however, substantially facilitates the installation process by providing the following support functions in a manufacturer independent, interoperable way.

During the preparatory phase:

- Configuration of the communication modem by the standardised object “Modem Configuration”.
- Setting up of the auto calling features (e.g. calling time windows, calling numbers, ...) by the standardised object “Auto Dial”.
- Setting up of the auto answering features (e.g. answering time windows, number of rings before connection, ...) by the standardised object “Auto Answer”.

During installation “in the field”:

After the meter has contacted “its” master station (or vice versa, depending if the auto-dial mode or if the auto-answer mode is selected) the master station has to authenticate itself. Further, the “table of contents” of the meter is uploaded into the master station. The “table of contents” (attribute “object-list” of object “association”) contains all necessary information on the available metering functionality and on the access rights. The master station can then program the meter’s TOU<sup>1</sup> tables (object “activity calendar”) – if available - , and assemble a “shopping list” of the metering data to be collected.

The entire installation process can be automated covering the *dlms*/COSEM meters of all manufactures. In addition to the efficiency improvement, the major source of errors – human interference - can be reduced to a minimum.

#### 3.2 Upgrading an existing meter to a new communication medium

When installing a communicating meter today one must consider that the communication channel will be exchanged once or several times during the meter’s lifetime. This is due to the mismatch between the lifetime of the meter and the development cycles of communication technology.

The strict separation between metering functionality and the communication protocols simplifies the adaptation to new communication media drastically. This means that when exchanging the

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<sup>1</sup> Time Of Use

communication medium only those parameters that are channel dependent must be modified. Moreover, the same modelling methods that are used to model metering functionality can also be used to model the channel interfaces. Up to now interfaces to the following communication channels are supported by the dlms/COSEM models: PSTN, GSM, optical port, two-wire bus.

The dlms/COSEM meter supports ISO communication standards according to the OSI model.

### **3.3 Accessing a multi-media meter by competing utilities**

The Application Association concept described in 2.4 opens the door for a multi-utility meter – a meter that measures not only electricity but also water and heat/gas. Measuring and rate processing can be combined into one device for all media. Nevertheless, the multi-media meter can be accessed independently by the parties involved. The handling of access rights and the authentication processes provided by dlms/COSEM prevent any interference between the different users.

The COSEM objects described in 2.2 support electricity metering. An extension to gas-, heat and water metering is currently in preparation under the auspices of CEN TC294.

### **3.4 Synchronising the meter's clock**

The advantage of the object oriented design becomes particularly obvious in conjunction with the "Clock" object. This object combines the "attributes" time, date, status, etc. with the different "methods" to adjust the time. Therefore, whenever a manufacturer provides a clock object, it is clearly defined how time and date is represented, how daylight-saving is handled and how the time is adjusted.

For the master-station provider this means: with one single module all time related aspects of all devices can be handled, independent of the meter manufacturer.

### **3.5 Programming the tariff engine**

If tariffication is done locally in the meter (TOU), the object "activity calendar" provides the necessary means to program the rate switching times in a standardised way. The downloading of the TOU program may be done via the optical port. However, due to the security mechanisms provided by dlms/COSEM remote programming may be considered.

The interoperability of the TOU management, together with an interoperable time management leads to truly manufacturer independent meter management tools.

## **4 On the economical value of interoperability**

As shown in the previous sections interoperability substantially simplifies the utility's business processes. The processes that particularly profit from this simplification are:

- meter data collection,
- meter park management
- contract management.

Considering the fact that today the management of an I&C client costs the utility about DM 3000 per year and assuming that the processes listed above contribute to 10% of these costs, then the yearly costs affected by the interoperable meter is 300 DM. If interoperability can contribute to lower these costs by 50% then over the lifetime of the meter the potential savings are considerably higher than the actual costs of the meter.

## Company Background Information

**Siemens Metering** is the largest producer of high-quality electricity meters world-wide, with a strong position also in gas meters and heat meters. As a partner for systems and services Siemens Metering supports the utilities to control and to optimise their business processes from the meter to the bill. With nearly 5700 employees Siemens Metering achieved a turnover of 571 million Euro in business year 1998/99.

**Schlumberger Resource Management Services (RMS)** provides professional business services for utilities, energy service providers and industry world-wide. Through consulting, meter deployment and management, data collection and processing, and information analysis, RMS helps clients achieve network optimisation, greater operating efficiency and increased customer loyalty. Active in all utility sectors - water, gas, electricity and heat - the RMS group is present in more than 30 countries. Schlumberger RMS posted revenues of \$1.38 billion in 1999.

**DZG Consulting GmbH** has been founded in 1999 and has started to work in April of the year 2000. The company was built up by the former development department of Deutsche Zählergesellschaft (DZG) at Hamburg. Beside the main activity in development of electronic and computer based products for the DZG group, DZG Consulting offers non DZG companies the existing know-how on behalf of various projects.

**Enermet** is a company specializing in energy metering and data management systems and in load management. Enermet designs, manufactures and markets electricity and heat energy meters as well as metering and control systems. Enermet Group has companies in ten countries and has over 700 employees.

## Biographical Information

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**Speaker:** **Dr. Thomas Schaub**  
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Thomas Schaub is responsible for the evaluation and introduction of new technologies in the segment "Metering Systems" of Siemens Metering. Prior to this position he was responsible for the development and for the market introduction of the AMDES distribution line carrier system of Landis & Gyr. He is active in several national and international standardisation committees and he was one of the founding members of the DLMS User Association. Thomas Schaub received the Diploma in electrical engineering in 1976 and the Ph.D. degree in 1988, both from the Swiss Federal Institute of Technology (ETH) in Zürich.

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**Speaker:** **Dipl.Ing. Helmut Ratzenhofer**  
Position: Project manager for C&I meter development  
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Country: Austria

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Helmut Ratzenhofer is managing an international project to develop a new generation of Commercial and Industrial electricity meters. He is member in several national and international standardisation committees mainly related to the communication aspect. After graduating from Vienna Technical University he joined Schlumberger in the R&D department. He was involved in the development of several generations of electronic devices for the measurement of electrical power and energy. After 8 years in different positions within the R&D department he was in charge of world-wide sales and marketing for Schlumberger in Austria. After this period he joined the international project management team of Schlumberger first for marketing tasks, later on with full responsibility for the project.

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Martin Wisy is Managing Director of DZG Consulting GmbH, Hamburg, Germany. As member of national and international committees his work points to define modern protocols within the communication of computer based electronic devices, mainly for energy metering. Mr. Wisy joined the development department of "Deutsche Zählergesellschaft" (DZG) in winter 1996 as an electronic engineer. He was head of this department since winter 1998 to march 2000. Mr. Wisy finished his Diploma in electrical engineering end of 1988 and the Ph.D. degree in 1994 at the department of computer science, Ruhr-Universität of Bochum, Germany. From 1994 until the end of 1996 he stayed with scientific working at the university of Bochum.

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Mr Touko Salo is Managing Director of Enermet B.V. in the Netherlands and Marketing Manager, special interest groups, of Enermet Oy. Earlier he has worked as R&D Manager and Marketing Manager of metering automation systems and meters at Enermet Oy in Finland. Mr Salo has given lectures in several international conferences. He has also written articles about metering automation systems.