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STANDARDS: FROM COMMUNICATION TO APPLICATIONS AND SYSTEMS

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Abstract: **The availability of new communication channels between the utility and their customers will drastically affect the utilities business processes. In order to profit from these possibilities substantial investment in communication infrastructure, terminal units and central units will be necessary. Standards are the means to secure this investment by guaranteeing the interoperability of the equipment from different manufacturers. The more the utility equipment is interlinked through communication networks, the more the aspects of system management and data access becomes important. This affects also the standardisation activities where the emphasis will be shifted from the specification of the communication channels to the specification of abstract application and device models. These models must be suited for a multi-manufacturer and multi-media environment.**

1. COMMUNICATION - THE MULTIMEDIA ENVIRONMENT

Communication technology is evolving fast. Table 1 shows the major current trends and their consequences for the utilities.

Liberalisation in the PSTN (public switched telephone network) market leads to the situation where the utility can negotiate attractive contracts with the different competitors. Examples from the USA show, that today the reading of a household meter can be done for less than 1 cent of telephone charges. Independent companies already offer meter reading as a service to the utilities.

Besides the mobile telephone, mobile data communication networks are built up in Europe. The radio data terminals open the access to the world-wide public communication network without any installation effort.

Besides classical ripple control the energy distribution network is also used for two-way communication. The great advantage of DLC (distribution line carrier) is the avoidance of installation costs. With the connection to the power supply the DLC-terminal is also connected to the communication network. The existing European and international standards should guarantee the compatibility between systems of different manufacturers. The availability of in-house DLC systems opens new possibilities to control and supervise household equipment by the utility while considering the individual needs of their customers.

Low-power (< 10 mW) radio systems can be operated in most European countries free of charge. They are used to transmit metering data from the house to street. The data is collected in a wireless hand-held terminal which can be operated from a moving vehicle.

For direct data transmission from the meter to the utility low-power radio is not sufficient. For that purpose cellular or hierarchical radio systems are used. Today the costs for these systems does not justify their use for residential customers. They are mainly applied in conjunction with network supervision and automatisation.

Today, the most popular telecommunication channel is the data highway. In most cases it is formed by the combination of cable and of optical fibre networks. In many countries the utilities 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.

The list of communication media displayed in table 1 is by far not complete. New media will become attractive as technology evolves.

Conclusion 1:
A future-proof DSM (demand side management) system must be independent of the communication medium. For its efficient operation it must even support several communication media in parallel; i.e. it must offer multi-media communication capabilities.

Technology	Trend	Consequences for the utilities
Public switched telephone network (PSTN)	- Privatisation - Liberalisation	- Due to competition, better conditions can be negotiated.
Mobile data communication	- Mobile data communication networks are evolving in Europe.	- With a minimal installation effort, even remote locations can be integrated into the communication network.
Distribution line carrier (DLC)	- Reliable systems are available also for low cost applications.	- Two-way communication from the utility to the residential client. becomes technically and economically feasible. - DLC communication systems for in-house applications: household equipment can be integrated into a domestic energy management system.
Radio	- New frequency bands become available. - Low-cost, low-power communication systems are available.	- Radio networks can cover extensive medium voltage networks. - Even with low-power systems the utility can read the meters without entering the home.
Broadband cables and optical fibres	- Fibres and cables are combined to form “data highways”	- Utilities get involved in the build-up of the new networks. - DSM services are offered on the new networks.
Networking	- Existing and new channels are interlinked.	- Due to shorter information paths faster decisions become possible.

Table 1: The major trends in communication technology

2. APPLICATIONS - FROM DSM TO CAM (CUSTOMER ACCOUNT MANAGEMENT) SYSTEMS

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 tariff structures and the prices and by the services they provide to their customers. 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.

The new services and cost pressure will require new tools to support the utilities business processes:

- DSM tools for balancing the demand side with the supply side through tariff and load management.
- Tools for the optimal use of the existing distribution network. New investment should only be made where a bottleneck can be identified. To identify a bottleneck situation the quality of the delivery and the loading of the network has to be supervised permanently.
- Tools to support the “account management” of the customers, from contracting to billing.

The set of application tools, the customer/consumption database and the interfaces to the communication channels, form the Central Unit (CU) of a *Customer Account Management* (CAM) system as shown in figure 1.

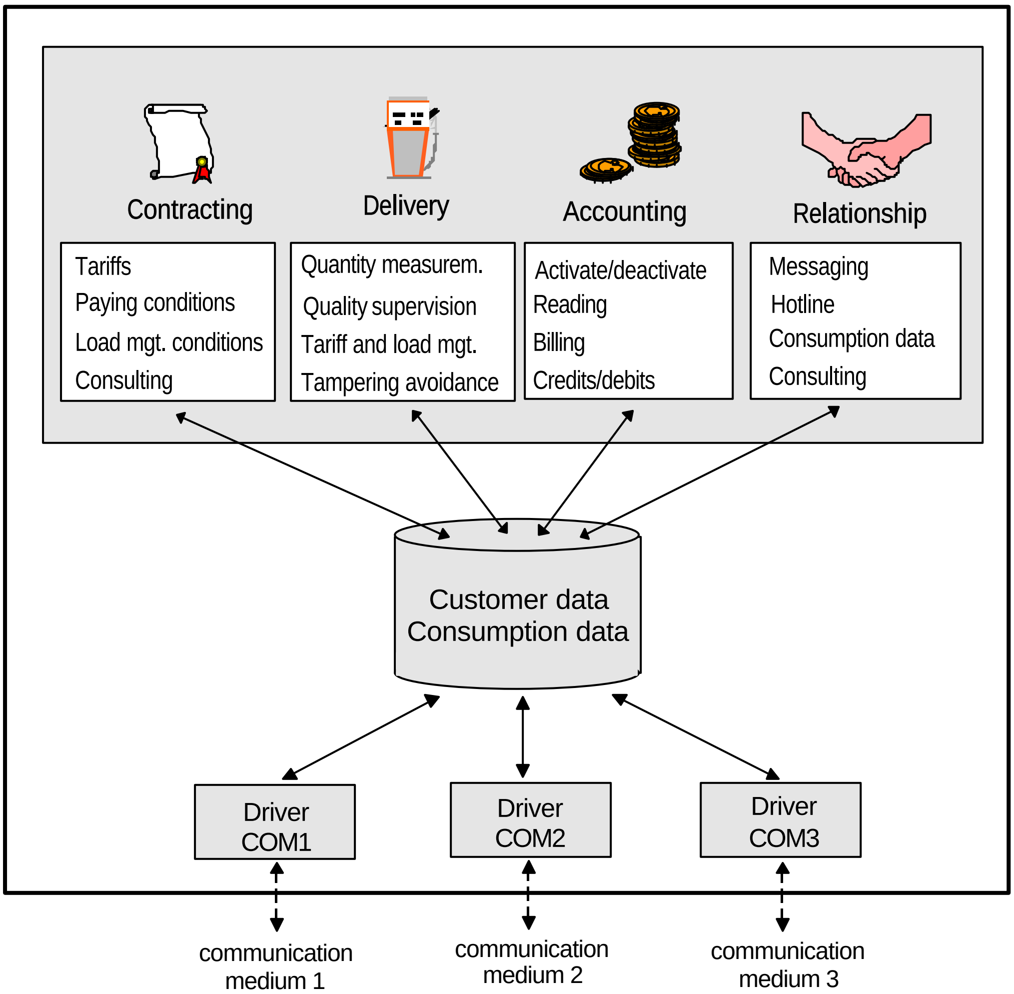

Figure 1: Customer Account Management system: Central Unit

The CU(s) is the central part of a system architecture as shown in figure 2. It is connected via channels and Node Units (NU) to the Terminal Units (TU). Node Units are necessary for communication purposes only, they do not create any additional "value" for the CAM system. The TUs (meters, load-switches, sensors, etc.) are located at the consumer's premises or at the critical points of the distribution network (e.g. substations).

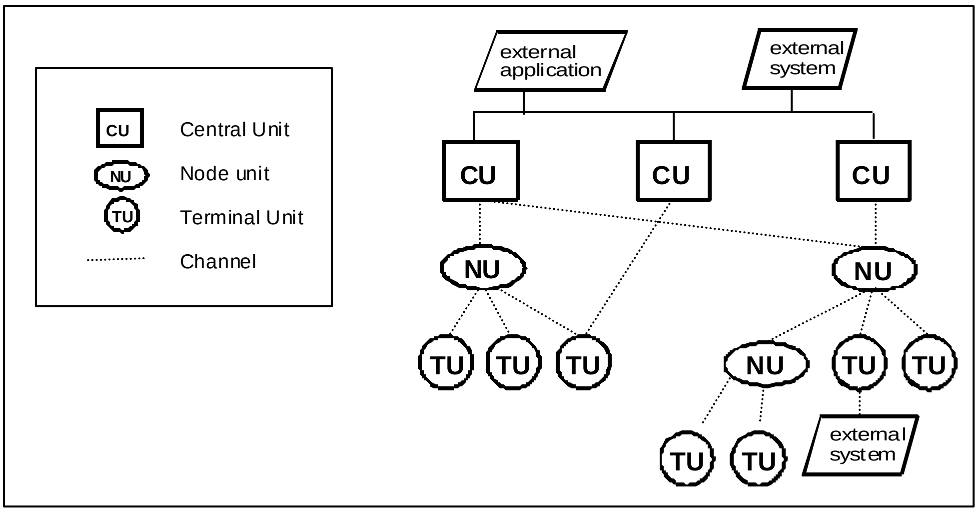

Figure 2: Customer Account Management system architecture

In the CAM system the TUs are always operated from the CU. It is the central unit which creates the “value” of the TU by integrating the “capabilities” of the TU into the business processes. Therefore not the physical design of the TU is critical but it’s behaviour as seen from the CU. Aspects such as the initialisation of new TUs, the handling of data and the access rights become more and more relevant.

During the evolution of the system new applications and new types of TUs will become available from different manufacturers. The CU must be able to identify the capabilities of the new TUs in order to integrate them into the system; i.e. the CU must have an abstract model which describes the behaviour of the TU. If the system is truly manufacturer independent then the abstract models must be described in a standard way.

Conclusion 2:
A future-proof CAM system must offer a broad range of applications. In order to do so, it must be capable to deal with different terminal units from different manufacturers. The capabilities of the terminal units and their behaviour - as seen from the operating central - must be defined as a standard.

3. STANDARDS

3.1. The situation

The market price of a TU for a CAM system can range from under $100 to more than $1000. For residential consumers the units will be certainly on the lower end of this range. In addition, most of the applications do not justify the use of costly, high performance communication channels. It is therefore necessary that implementation costs are considered as a critical issue when defining the standards for communication protocols and for the behaviour of the TUs. The International Electrotechnical Commission (IEC) has come up with a set of standards which consider the boundary conditions of a CAM system in an utility environment There is the draft standard “User requirements for local and remote meter data exchange - Applications and performance” (IEC 1361) which covers a broad range of CAM applications. On the other hand there are several communication standards; from the “classical” IEC870 series to the more recent IEC1334 series. However, up to now there is no standard describing the model of a terminal unit which is suited for the multi-media environment[1].

3.2. The vision

Figure 3 displays an overview on the current situation concerning standards necessary for a CAM system. The grey building blocks represent the available standards, whereas the blank blocks mark the missing standards.

At the top of our “house of standardisation” we put the applications, they form the target of the entire CAM 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: IEC870: which is suited for “voice grade channels” (channels with a transmission quality comparable to telephone) and IEC1334 which is designed for DLC (distribution line carrier) channels. In the future an extension to radio and other channels will be necessary.

The message specification DLMS is independent of the communication channel. It defines how data is accessed and how data structures are defined. The communication objects of DLMS are described in ASN.1, the only standardised abstract syntax.

In order to put the roof (the applications) on a sound basis considerable work on the TU models is now necessary. The models are defined in a two step approach.

Step 1: Starting from the user requirements, the application objects are defined. The major criterion for the design of the objects must be the integratability into the business processes.

Step 2: The application objects are mapped into DLMS objects and described in ASN.1. ASN.1 guarantees an unambiguous description in a standardised form which is not subject to interpretation of the different manufacturers.

The set of standardised objects forms a library from which the manufacturer can form its product. The choice of the subset of objects and its implementation is part of the product design and therefore left to the manufacturer.

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[1] IEC1107 describes a meter model but it is strongly optimised for hand-held terminal readout.

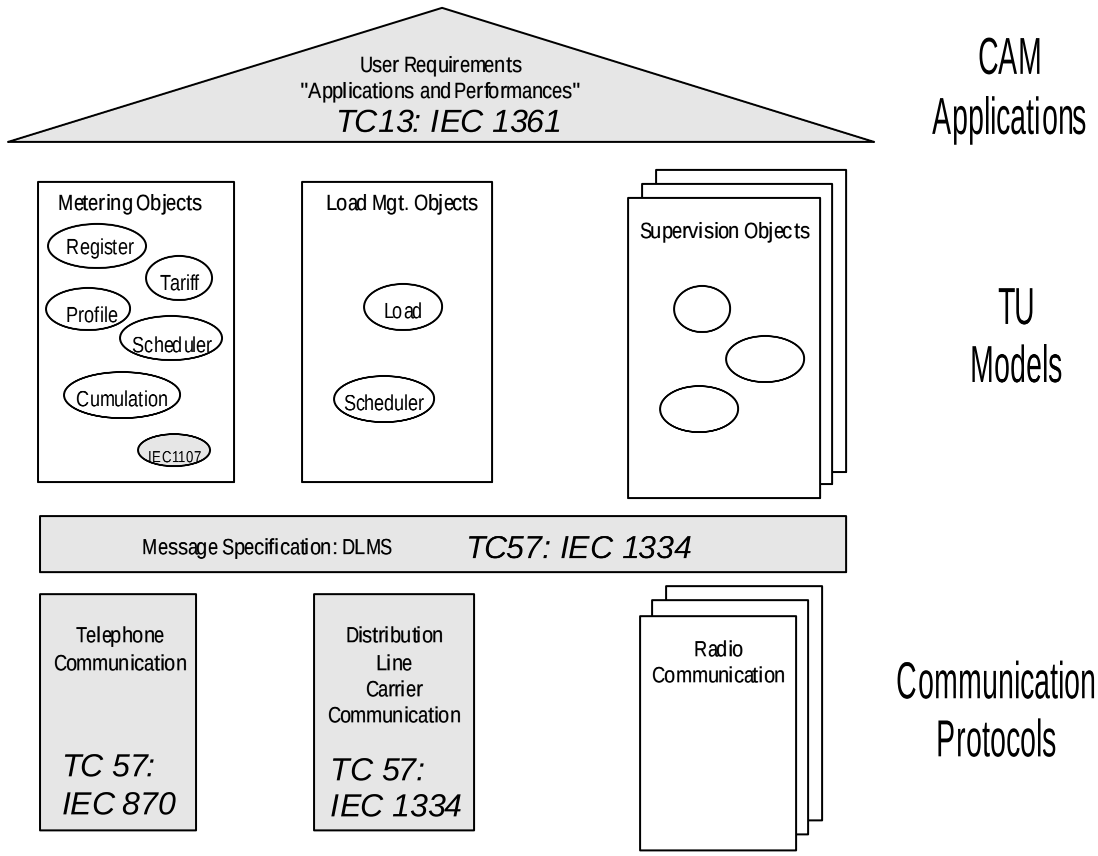

Figure 3: The house of standards

3.3. An example: the metering device

In figure 3 the major objects of a metering device are shown.

The *Register* object stores a dynamic process value (the current-value) and its associated unit. Each register is of a particular type according to the classification of the “media”, “channel”, “value”, “value-type” and “rate”. Different functions, such as read, reset and write can operate on the current-value.

The *Tariff* object contains a table defining which rate is active for which register when a particular tariff is activated. The table can be set or read. A specific tariff can be activated.

The *Profile* object is used to store register values periodically or aperiodically. The corresponding registers can be assigned. For simple devices this assignment is static, for more complex meters the assignment can be modified dynamically. Other major functions are: freeze, read-buffer and reset-buffer.

The *Cumulation* object supports the classical “cumulation” procedure.

The *Scheduler* object contains a clock. It can be programmed to trigger functions of the other objects (Tariff, Profile, Cumulation).

The *IEC1107* object guarantees upwards compatibility to the installed basis of meters which are read with hand-held terminals using the IEC 1107 specifications.