OMS

Open Metering System
Specification

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Release

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1.1.3	2009-07-04	Editorial corrections	H. Baden
1.1.3	2009-07-05	Reference ETSI2006 changed to ETSI-ERM	H. Baden as submitted by Mr. Evjen
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1.1.3	2009-07-05	Reference REC7003 corrected to ERC7003 New references added: EN 60870-5-2 and NTPv4	H. Baden in adaption to OMSS Vol.2 V.1.0.8
1.1.3	2009-07-06	Version closed for release as V.1.2.0	H. Baden
1.1.3	2009-07-17	Final corrections (only formal)	H. Baden
1.2.0	2009-07-17	Release for publication	H. Baden

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1 Introduction

This specification focuses on an automatic meter readout system, called Open Metering System (OMS). Part of this system is the *Multi Utility Communication* (MUC). It is a hardware system which is used to readout different metering devices and to transfer subsets of this data to 'AMM back office systems' for billing, servicing or other purposes. Metering devices are sensors and actuators which are defined in "Chapter 3 Definitions and Terms". Metering devices and AMM Systems have to follow certain protocols which are described within this document for Open Metering conformity.

Working groups have been established consisting of members from different companies who are working in the energy supply and metering areas to work out this specification. The Open Metering Working Groups specifies communication interfaces for the MUC and different communication endpoints. The vendor associations Figawa[1] and ZVEI[2] are chairs in this specification creation process.

Communication with the MUC splits up into primary, secondary and tertiary communication:

- The primary communication handles multi-discipline metering devices for electricity and gas as well as heat and water meter reading. Its goals are the definition of the transmission media, of the transmission techniques and of the protocols between the metering devices on the one hand and the MUC on the other hand.
- The secondary communication focuses on an extension of the covered range (wired, PLC or wireless) using networking and multi hopping based on a routing protocol. A unified secondary communication is not defined yet. If necessary proprietary solutions for secondary communication may be used to transport data via a meshed network. In this case it has to be ensured that data send out by an open metering meter are provided as defined in the Open Metering System Specification.
  A simple manufacturer independent extension of the radio range, based on repeater technologies, is described in the part primary communication (OMSPC).
- The tertiary communication is the interface between a MUC and the back office systems for *automated meter management* (AMM). It specifies the data flow for defined pull and push procedures between the MUC and the *AMM back office system*. The main topics in tertiary communication are data acquisition and data providing for presentation, event handling, configuration, control and clock synchronization.

The relating documents are:

Open Metering System Specification …

- Volume 1, General Part (OMSGP) – this document.
- Volume 2, Primary Communication (OMSPC).
- Volume 3, Tertiary Communication and MUC (OMSTC).

They define minimal requirements on communication and functionality between given endpoints. Manufacturers and suppliers should be encouraged to develop their hardware and software in a common direction. The transport of data is specified only up to the TCP/IP layer of the Ethernet interface.

[1] Bundesvereinigung der Firmen im Gas- und Wasserfach e.V., Cologne

[2] Zentralverband Elektrotechnik- und Elektronikindustrie e.V., Frankfurt/Main

1.1 Text mark up

Text mark up is defined throughout all Open Metering System documents as follows:

- *Italic text* is used if new terms are invented.
- References to documents are given in square brackets: [ ]
- Parentheses mark up abbreviations or options, defined at Appendix B: Abbreviation Index
- Work items are marked up by the word [WORKITEM] in square brackets with a yellow background.

2 General Definitions and System Description

This chapter presents a total system overview including all term definitions and references to used standards.

2.1 Total System Overview

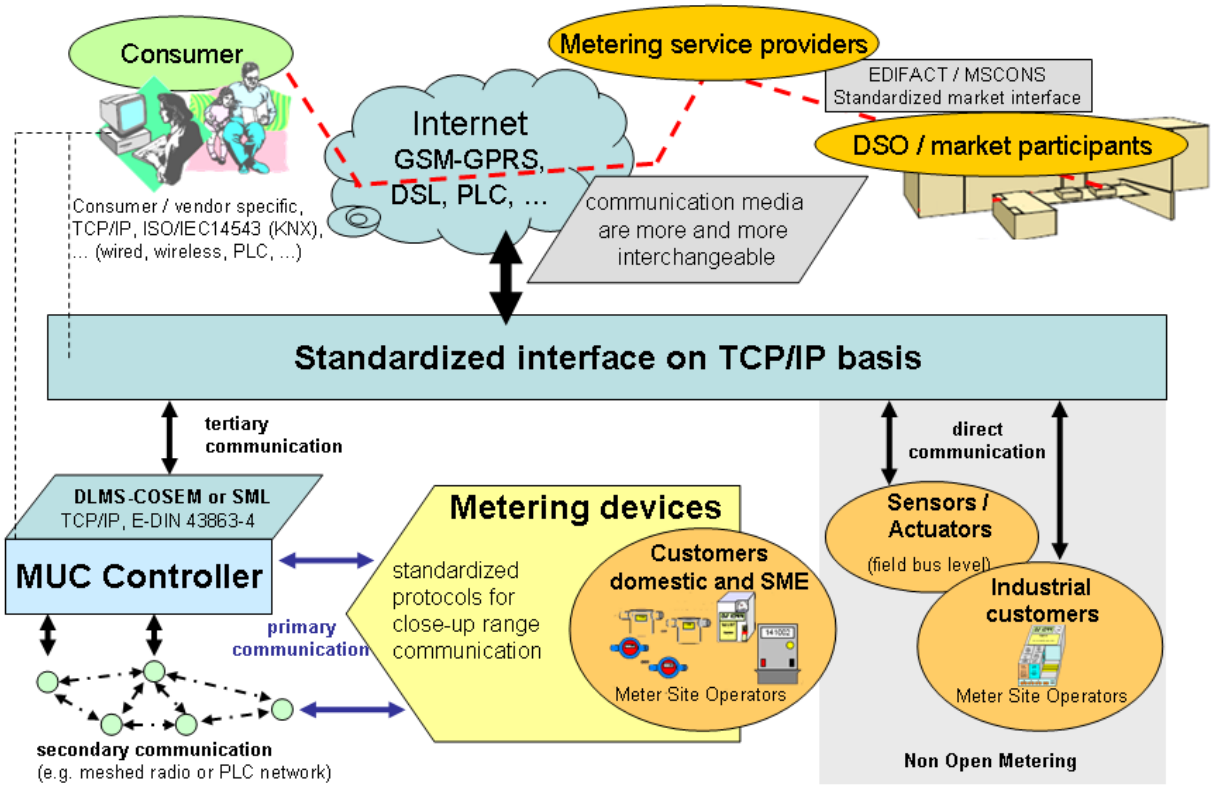


Figure 1: System Environment

Figure 1 illustrates the total system overview. The upper half shows the user's view: the system which has been installed at the consumer locations connects to a *Distribution System Operator* (DSO) or other market participants via internet communication technologies provided by GSM, Telephone Systems (PSTN), Power Line Communication or broad-band networks. The interface for this communication is standardized on a TCP/IP basis.

The lower half (technical view) shows the MUC which is installed at the consumer's location. Primary communication is used for close-up range communication with meters; tertiary communication is mainly used by the MUC to communicate with *Metering service providers* (MSP) which may be but does not have to be the MSO[3] or the DSO[4].

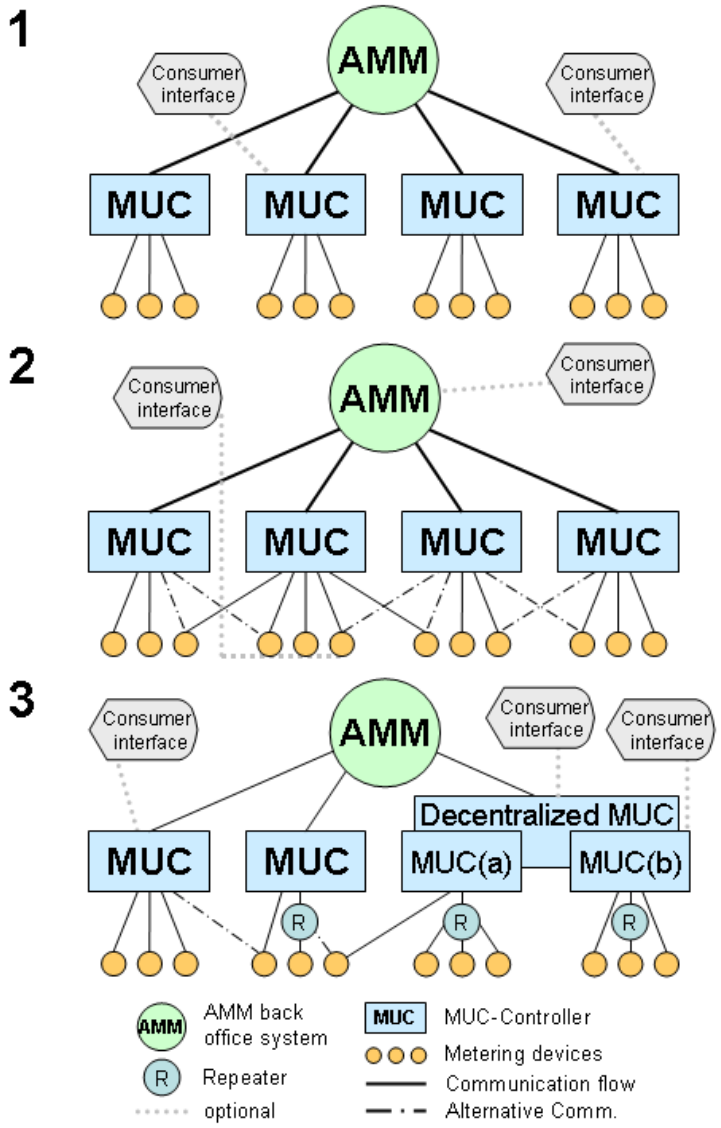
[3] MSO – Meter Site Operator

[4] DSO – Distribution Service Provider (distribution network operator)

2.2 System Topology

Figure 2 shows different scenarios of the system topologies. The AMM back office system maintains a connection to several MUCs. The MUCs themselves keep the connection to several meters.

In practice **all shown scenario options may appear as a hybrid topology** if supported by the particular product.



Scenario 1 will be used if each apartment has its own MUC Controller. Each metering device of an apartment is assigned to its one specific MUC.

Each consumer may have his own display unit (dedicated display, web browser application, PDA …) connected to his specific MUC, to receive energy consumption information and e.g. tariff data. Habitations or facilities are independent.

In Scenario 2 displays are getting data from the AMM back office, provided by an internet portal system or read meter data directly from the meter.

Meters can be shared among MUCs to avoid out of range problems.

Scenario 2 topology may also be used at installation phase to set up installations of scenario 1.

Scenario 3 shows clustering[5] of some MUCs and primary communication with additional repeaters.

Figure 2: Different System Topologies

[5] This is not subject of the OMS specification but may be realized as a proprietary solution as long as defined requirements of this specification are fulfilled.

3 Definitions and Terms

This chapter contains the major definitions and terms used in this specification.

More detailed definitions will be given at a separate glossary document.

3.1 Market Roles

According to the European legislation for the internal energy markets a set of market roles were established to fulfil the requirements on legal and functional unbundling of consolidated companies.

Meter Site Operator (MSO)

The MSO is owner of metering devices. He is reliable on legal and operational functionality of the meter site.

Metering Service Provider (MSP)

A MSP is an organizational entity that is authorized by the connected party (consumer) to read the data and/or status of metering devices. Operator of an AMM back office and distributor of meter data to authorized parties.

Distribution System Operator (DSO)

This is a Company that is assigned to operate and manage one or more distribution networks, also known as grid operator.

Energy Supplier (ESU)

Company that delivers (sells) energy like electricity, gas, heat etc. to consumers.

Consumer (CSR)

This is the end user of energy, also known as customer.

3.2 Functional Units

A functional unit is an entity of hardware, software or both, capable of accomplishing a specified purpose separated by task or impact. At OMS the MUC is defined as a functional unit to leave open the position or physical outline. The MUC may be a unique device or a distributed system as well as an integrated functional unit of e.g. an electricity meter.

MUC Controller

The *Multi Utility Communication* (MUC) is in focus of the OMS specification. It is a meter data communication system which collects data from metering devices for electricity and gas as well as heat and water consumption. Metering values will be transferred to the MUC Controller and will be processed there to transmit them to AMM back office systems as well as to offer energy usage information to the consumer.

The short form MUC is also used for the MUC-Controller. As plural form *MUCs* is used.

AMM Back Office

In this specification the endpoint where all MUCs connect to is referred to as AMM back office (AMMBO). AMM stands for Automated Meter Management and refers to systems which collect data. AMM back office systems can be found at *Metering Service Providers* (MSP) who may be identical with *Meter Site Operators* (MSO) or *Distribution System Operators* (DSO).

In literature the term “management” is sometimes replaced by “infrastructure”, which results in *Automated Metering Infrastructure* (AMI).

AMM back office systems themselves are processing metering data to be transferred as billing and balancing information to ERP systems of resource providers or other suppliers.

3.3 Interfaces and Protocols

M-Bus

M-Bus is defined as standard for primary communication particularly with regard to battery driven metering devices. Different physical media can be used here.

In order to distinguish between different M-Bus transport mechanism and application protocols, the following terms are introduced:

- *Wired M-Bus* (M.Bus)
  is the term for communicating via two-wire M-Bus lines [EN13757-2].
- *Wireless M-Bus* (wM-Bus) is used for M-Bus RF [EN13757-4].
  The M-Bus modes S1, S2, T1 and T2[6] may be used as meter interfaces for the MUC Controller. Modes S1 and T1 are defined for unidirectional communication from meter to MUC. Modes S2 and T2 provide a back channel for bidirectional communication. Modes S and T are operating at different frequency ranges in the frequency band 868 to 870 MHz. They have different data rates:
  - S-Modes (Stationary mode) provide a data rate of 16,384 baud at a longer communication distance than T-Mode. Modes S1 and S2 are compatible with the wireless KNX-system of ISO/IEC enabling combined systems for home automation and open metering.
  - T-Mode (Transmit frequently) provides a data rate of 66,667 baud. This is approximately four times higher than the S-modes and allows for a given battery size more frequent transmissions without decreasing battery lifetime or increasing collision rate. This enables a faster user feedback on his consumption.
    Due to this higher transmission frequency, drive-by or walk-in meter readout is also feasible.
    The back channel of T2 uses the same frequency and data rate as S2 to allow economic receiver design.
  - R-mode (Receive frequently) is not in the scope of open metering.
- If the application protocol is referenced, this is done by the term *M-Bus protocol* [EN13757-3].
- Usage of M-Bus as a generic system is referenced as *M-Bus system*.

[6] Refer to EN13757-4 and OMSS Vol.2 Primary Communication

- M-Bus communication via power line (*M-Bus-PLC*) is considered as a future option and is not focus of this document.
- According to energy efficiency of battery driven metering devices the standard M-Bus-Application transports shorter data DIF/VIF coded more efficient than OBIS.[7]

DLMS/COSEM, SML

DLMS/COSEM and SML are additional application protocols which will be applied in both Primary and Tertiary communication as alternative software solutions. These protocols transport the related OBIS-number together with each data point.

OBIS coded COSEM or SML data may also be carried via M-Bus.

3.4 Metering Devices

In this specification different device types are defined, which are commonly referred to as metering devices. These devices can communicate to or with a MUC via one of the primary communication interfaces. Metering devices in this specification are *sensors* and *actuators*.

Sensors are metering devices which at least provide meter index data (current metering counter value).

Actuators are breakers or load delimiters.

An authentication procedure is required for controlling devices by commands.

Unidirectional wireless M-Bus metering devices will always operate in *push mode*.

Pull mode may be possible with bidirectional data flow, if the metering device is supplied with external power or after communication was established in push mode.

Wired M-Bus metering devices will always communicate in pull mode. Even alarm messages are pulled via frequent polling.

With other wired meter interfaces like RS232, RS485 or PLC push and pull may be possible.

Basic Meter

Basic meter are meters with minimal functionality. Current metering data are given by request or sent in regular intervals. Note that regular intervals are not precisely regular. A small deviation should be applied to minimize collisions on the air interface.

Communication data flow can be unidirectional or bidirectional. Sent Metering data are identical with data displayed on an integrated display. Authentication is not needed to access the metering index.

Sophisticated Meter

Sophisticated meters are basic metering devices with additional features such as data logging. The metering data given by these devices could include timestamps and metering profiles of the recorded consumption data.

Sophisticated metering devices have an internal clock to enable data logging of load profiles at regular metering periods (e.g. 60 Min.) and other time related functions.

[7] Not specified in actual Version of Vol.2

Communication data flow is always bidirectional. For functions beyond meter readout authentication using a signature is needed. Metering data are always signed. ECC is used as technology for the creation of an authentication signature.

A feature to limit or cut-off the feed in[8] might be used in sophisticated metering devices.

Actuator

Throughout this specification the term ‘actuator’ is used to describe appliances which can limit consumption or cut-off the supply[9]. Terms which are included in the term ‘actuator’ are breaker, limiter, shut-off-valve, gas valve or switch. Bidirectional communication is mandatory for these devices.

The functional unit MUC as described by Open Metering (OMS-MUC) does not contain the switching or delimiting functionality. Only data transfer of commands and status information is done by the MUC.

Repeater

To extend the range of wireless primary communication (e.g. on the wM-Bus) repeaters may be used.

On unidirectional metering devices a *“unidirectional” repeater* is defined which must not repeat any telegrams from a MUC assigned to a unidirectional meter.

The *bidirectional repeater* is repeating telegrams in both directions from a metering device as well as from a MUC.

3.5 Offline Tariffing

In *normal* Tariffing, a tariff has a fixed period. Resource consumption costs a fixed rate per period. In offline Tariffing this is different: metering devices have to record the consumption per time unit (period) in a table as a *metering profile. A*lternatively the meter indexes are sent to the AMM back office system immediately. Tariffing can be dynamic, depending on the consumption volumes or is based on supply and demand principles. Other models are imaginable. The current tariff could be displayed on the consumer display or the consumer could choose a tariff which is most suitable for a period.

An alternative term for offline Tariffing is downstream Tariffing.

[8] Compare: Breaker

[9] Of electricity or gas

3.6 Security

Security items were recognized as essential to achieve legal and social acceptance of an innovative residential metering.

There are three occurrences to be handled by security procedures:

- Loss of availability
- Loss of confidentiality (to prevent unauthorized reading of data) – to be achieved by
    - encryption of the data telegrams,
      especially on wireless and power line communication
    - change of telegram content even if no index feed happened
    - a sophisticated user and access rights management
- Loss of integrity and authenticity – to be protected by signature of data records

Security techniques are used in different contexts regarding authentication or secure transmission using different encryption techniques.

Encryption

To provide confidentiality of meter data these should be encrypted. Encryption should be done at primary communication as well as on tertiary communication.

Encryption is mandatory for wireless and PLC communication.

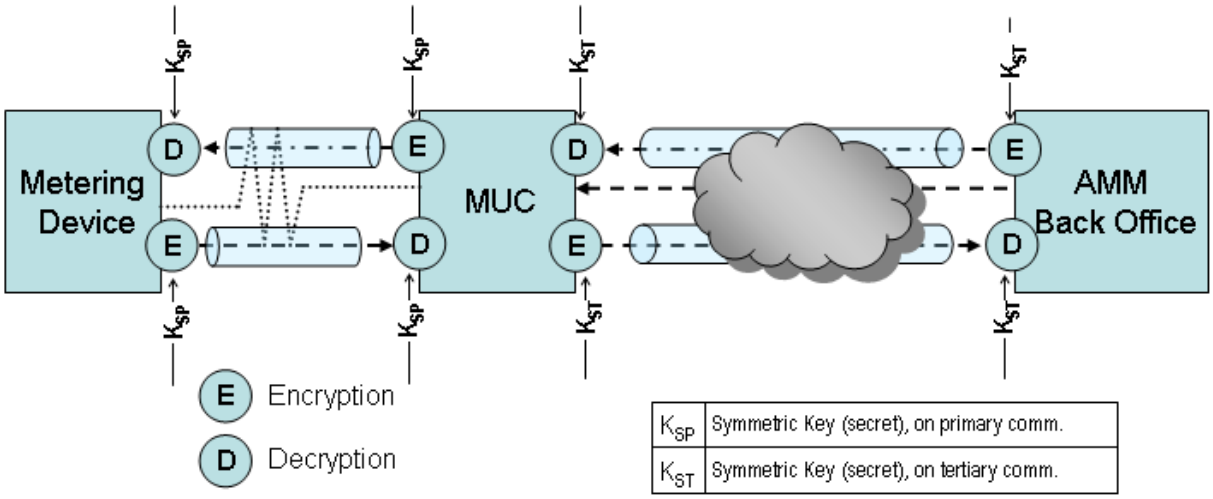


Figure 3: Encryption - Decryption

Specification of encryption and decryption methods and procedures in detail are described in OMSS Vol. 2 and 3.

Meter Signatures

Meter signature is not required at the current specification.

As a future option – if requested – the meter can sign the metered values to enable validation of the data source.

Command Signatures

[WORKITEM: to decide symmetric or asymmetric signature]

On AMM back office to meter (via MUC) communication authentication by signature of command data records is mandatory if meter setting commands were sent

- with influence to the metering behaviour (e.g. tariff register, due date)

as well as

- delimiting or switching commands were sent to affect feed in of the metered media.

The MUC itself does not sign pass-through data or commands anyway.
Specifications of signature in detail are given in OMSPC and OMSTC[10].

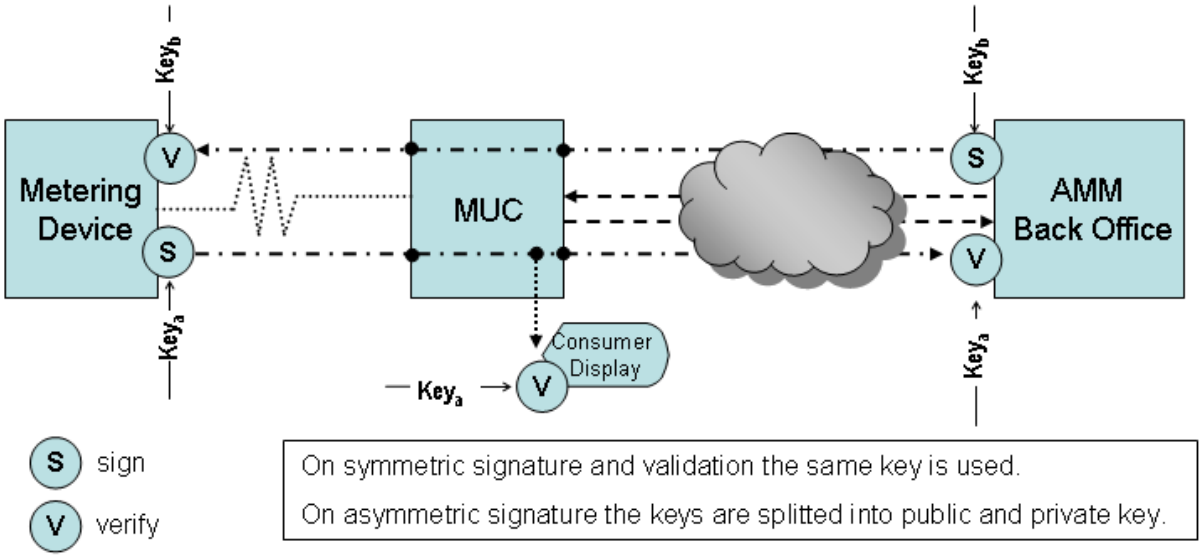


Figure 4: Signature and Validation

[10] Not done yet, planned for further versions.

4 References to Standards

M-Bus (*Meter-Bus*) is an European standard for remote reading of all types of consumption meters as well as for various sensors and actuators [MBUS2008]. References in detail:

EN 13757-2 Communication systems for and remote reading of meters – Part 2: Physical and link layer

EN 13757-3 Communication systems for and remote reading of meters – Part 3: Dedicated application layer

EN 13757-4 Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)

OBIS (*Object Identification System*) is specified in DIN EN 62056-61:2002 and EN 13757-1. It uses classification numbers to identify data types. These numbers are specified both for measuring equipment and data transmission.

SML *(Smart Message Language)* is a communication basis for applications in the parameterisation and data acquisition environment of metering devices. Data acquisition and exchange is the primary goal of the underlying protocol language, firmware upgrades of embedded systems should also be possible via SML. Communication is encoded using XML *(SML XML)* or in a binary form *(SML Binary Encoding)*. Both encodings are equivalent to each other. The specification is given in [SML2008].

DLMS/COSEM (*Device Language Message Specification / Companion Specification for Energy*) is specified in IEC 62056 / EN13737-1. Main focus of this language specification is the interoperability of utility meter data exchange [DLM2008]. An introduction to this language is given in [Wis1999].

NTP (*Network Time Protocol*) is a protocol for synchronizing the clocks of computer systems over packet-switched, variable-latency data networks. NTPv4 is the minimal requirement for the Open Metering System. It is specified in [RFC1305-1992].

Appendix A: Referenced Documents

DLMS-UA	DLMS User Association, in internet: *http://www.dlms.com* . *(*defined before as DLM2008)
ETSI-ERM	EN 300220-1 V.2.1.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods; 2006.
EN13757-1	Communication system for meters and remote reading of meters - Part 1: Data Exchange.
EN13757-2	Communication system for meters and remote reading of meters - Part 2: Physical and Link Layer.
EN13757-3	Communication system for meters and remote reading of meters - Part 3: Dedicated Application Layer.
EN13757-4	Communication system for meters and remote reading of meters - Part 4: Wireless Meter Readout.
EN13757-5	Communication system for meters and remote reading of meters - Part 5: Repeater Functionality.
EN13757-6	Communication systems for meters and remote reading of meters - Part 6: Local Bus
EN60870-5-2	Telecontrol equipment and systems - Part 5: Transmission protocols - Section 2: Link transmission procedures.
EN62056-61:2002	Object Identification System
ERC7003	ERC RECOMMENDATION 70-03 (Tromsø 1997 and subsequent amendments) relating to the use of short range devices (srd) Recommendation adopted by the Frequency Management, Regulatory Affairs and Spectrum Engineering Working (*July 2008)* *http://www.erodocdb.dk/Docs/doc98/official/pdf/REC7003E.PDF*
FIPS197	Specification for the ADVANCED ENCRYPTION STANDARD (AES) *http://www.csrc.nist.gov/publications/fips/fips197/fips-197.pdf* Nov 2001
ISO/IEC 14543-x-x	Architecture for Home Electronic Systems
MBUS-UG	Homepage of the M-BUS usergroup, in internet: *http://www.m-bus.com,* (defined before as MBUS2008).
NTPv4	no released public specification available, you may refer to http://tools.ietf.org/html/draft-ietf-ntp-ntpv4-proto-11
OBIS-ConvTab	Conversion table for metering media, *OBIS Basiszähler.xls by* Open Metering Group, always check for the latestet issue please (defined before as OBK2008).
SML-spec	Smart Message Language Specification *(defined before as* SML2008), please check for the latestet issue: http://www.m-u-c.org/download.htm or *http://www.vde.de/de/fnn/arbeitsgebiete/messwesen/seiten/messwesen.aspx*

PTB50-2002 Software-Anforderungen an Messgeräte und Zusatzeinrichtungen gemäß PTB-A 50.7 (in German) (*in internet April 2002)* *http://www.ptb.de/de/org/2/23/234/download_info-center/ptb-a50_7-2.pdf*

RFC1305-1992 Request for comments 1305, in internet *http://www.ietf.org/rfc/rfc1305.txt*

RFC2553 IPv6

WELM2004 WELMEC-European cooperation in legal metrology – Software Guide (Measuring Instruments Directive 2004/22/EC) , 7.2, Issue 2, In Internet http://www.welmec.org/publications/7-2.asp, visited Feb 2008.

Wis1999 The migration process to DLMS-COSEM: a short discussion beside the German way to interoperability [in automatic meter reading] Wisy M., Metering and Tariffs for Energy Supply, 1999. Ninth International Conference on (Conf. Publ. No. 462), Aug 1999 Page(s):119 – 123

Appendix B: Abbreviation Index

AES	Advanced Encryption Standard
AMI	Automated Metering Infrastructure
AMM	Automated Metering Management
AMMBO	AMM Back Office – a meter reading and meter management system
APL	Application Layer
COSEM	Companion Specification for Energy
DES	DES and Triple DES (3DES) are outdated Data Encryption Standards
DIF	Data information field (Control field in variable data point of M-Bus-Protocol)
DLMS	Device Language Message Specification
DSO	Distribution System Operator
ECC	Elliptic Curve Cryptography
ERP	Enterprise Resource Planning
GSM	Global System for Mobile Communication
Lo-Bus	Local Bus, an M-Bus extension as defined in EN13757-6
M-Bus	physical 2-wire M-Bus as defined in EN13757-2
M-Bus-AL	M-Bus application layer or M-Bus application protocol as defined in EN13757-3
MSO	Meter Site Operator
MSP	Metering Service Provider
MUC	Multi Utility Controller, Multi Utility Communication
NTP	Network Time Protocol
OBIS	Object Identification System
ODC	Operating Data Channel (in tertiary communication)
OMS	Open Metering System
OMSGP	Open Metering System specification, Vol. 1 – General Part
OMSPC	Open Metering System Specification, Vol. 2 – Primary Communication
OMSTC	Open Metering System Specification, Vol. 3 –Tertiary Communication
PTB	Physikalisch-Technische Bundesanstalt (the German metrology institute providing scientific and technical services)
RTC	Real Time Clock
SDC	Service Data Channel (in tertiary communication)
SML	Smart Message Language
PLC	Power line Communication
PSTN	Public Switched Telephone Network
RFC	Request for Comments
VIF	Value information field (Control field in variable data point of M-Bus-Protocol)
wM-Bus	wireless M-Bus as defined in EN13757-4

Appendix C: Members

Thanks are to be given to the companies[11] and their employees for all their efforts of time, work and financial support being involved in the consortium to develop this specification:

- Amber Wireless GmbH
- Aquametro AG, CH
- Brunata GmbH & Co. KG
- ELSTER Messtechnik GmbH
- EMH Elektrizitätszähler GmbH & Co KG
- Dr. Neuhaus Telekommunikation GmbH
- Görlitz AG
- GWF MessSysteme AG
- Hager Elektro GmbH
- HYDROMETER GmbH
- iAd GmbH
- ISKRAEMECO d. d.
- Itron GmbH
- Lackmann Zähler Gesellschaft mbH & Co. KG
- Landis + Gyr GmbH
- QUNDIS GmbH
- Radiocrafts AS, Norway
- Robert Bosch GmbH
- ScatterWeb GmbH
- Sensus Metering Systems GmbH
- SSV Software Systeme GmbH
- Swiss Gas Metering AG / MEMS AG, CH
- Techem Energy Services GmbH
- Tixi.Com GmbH
- T-Systems Enterprise Services GmbH
- WIKON Kommunikationstechnik GmbH

[11] listed in alphabetical order

Institutional Members are:

- EMSYCON for FNN
- Figawa, Cologne
- Fraunhofer ISE, Freiburg
- HBM management services, Hartmut Baden, Consultant
  (chairman of Figawa/ZVEI/KNX project group smart metering)
- KNX Association, Bruxelles
- Prof. Dr. Horst Ziegler, Paderborn, Chairman of CEN TC294 WG4
- Steinbeis-Innovationszentrum Embedded Design und Networking (sizedn), Lörrach
- ZVEI, Frankfurt am Main