Open Metering System Specification

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General Part

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RELEASE

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2.2.2	2021-12	Comments incorporated [BSI TR-02102] and [NIST 800-133] added 5.1 updated Release	A. Bolder A. Reissinger, AG1

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1 Introduction

The OMS-Group is a community of interest of associations, presently figawa[1]and KNX[2], with enterprises in the area of metering relevant to accounting. With the ‘OMS metering system specification’ the OMS-Group has developed an open, vendor independent standard for communications interfaces and basic requirements.

The Open Metering System (OMS) is the only system definition across Europe which integrates all media (electricity, gas, heat and water incl. submetering) into one system. It is developed by the industry in order to guarantee a future-proof communication standard and interoperability between all the meter and sensor products.

Working Groups have been established consisting of members from different companies[3]. The Working Group experts come from meter manufacturers, manufacturers for communication devices, energy suppliers, communication companies and scientific institutions. The Open Metering Working Groups specify communication interfaces for the gateway and different communication endpoints. The vendor associations, figawa and KNX together with the Board of the OMS Group and the General Assembly of the OMS members guide this process of specification creation.

This specification focuses on an automatic meter readout system. Part of this system is the functional separation between the end devices and the communication device i.e. the gateway (GW).

End devices are meters, actuators, and sensors which are defined in clause 3 Terms and Definitions. End devices and AMM Systems have to follow certain protocols which are described within this document for Open Metering conformity.

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

- The primary communication handles multi-discipline metering devices for electricity, gas and thermal energy as well as water meter or HCA reading. Its goals are the definition of the transmission media, of the transmission techniques and of the protocols between the end devices on one side and the gateway on the other side.
- 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. This routing protocol requires an additional Network Layer which is not supported by the primary communication. 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 OMS meter are provided as defined in the Open Metering System Specification.
  A simple manufacturer independent extension of the radio range, based on repeater technologies (without the additional Network Layer), is described in the part primary communication [OMS-S2].

[1] Bundesvereinigung der Firmen im Gas- und Wasserfach e.V. – German association of the companies in the gas and water industry, Cologne, GERMANY

[2] KNX Association, Brussels, BELGIUM

[3] The current members of the OMS-Group are listed under https://oms-group.org/oms-group/oms-mitglieder

- The tertiary communication is the interface between a gateway and the head-end systems for automated meter management (AMM). It specifies the data flow for defined pull and push procedures between the gateway and the AMMHES. The main topics in tertiary communication are data acquisition and data providing for presentation, event handling, configuration, control and clock synchronization.
  NOTE: Tertiary communication is no longer in the focus of OMS.

The OMS Group has published the following parts of the Open Metering System Specification (OMS-S):

- Volume 1 General Part [OMS-S1] – this document
- Volume 2 Primary Communication [OMS-S2]
- Volume 3 Tertiary Communication and MUC [OMS-TC]
  This Volume is no longer applicable

Conformance with the OMS-S can be obtained by having the devices tested against the Open Metering System Conformance Test (OMS-CT). The [OMS-CT] is also available on the website of the OMS Group, see clause 2 References.

2 References

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3 Terms and Definitions

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

More detailed definitions are given in a separate glossary document, see Annex A: Glossary of Terms.

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.

Table 1 – Market roles

Term	Description
Meter Site Operator (MSO)	The MSO is generally the owner of the metering devices and responsible for the legal and operational functionality of the meter site
Metering Service Provider (MSP)	The MSP is an organizational entity that is authorized by the connected party (consumer) to read the meter and/or status data. He is the operator of an AMM head-end and distributor of meter data to authorized parties
Distribution System Operator (DSO)	The DSO is a company assigned to operate and manage one or more distribution networks, also known as grid operator
Supplier	Company that delivers (sells) energy (electricity, gas, thermal energy etc.) or water to consumers
Consumer (CSR)	The end user of energy and supplied media (i.e. electricity, gas, thermal energy, water), also known as customer

3.2 Functional Units

3.2.1 Introduction

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 gateway is defined as a functional unit in order to leave open the position or physical outline. The gateway may be a unique device or a distributed system as well as an integrated functional unit e.g. within an electricity meter.

3.2.2 Devices using Primary Communication

3.2.2.1 General

In this specification different device types are defined, which are commonly referred to as OMS devices. These devices can communicate to or with a gateway via one of the primary communication interfaces. Such devices are meters, actuators, heat cost allocators, or other types of sensors usually related to metering.

Metering devices cover meters for all kinds of grid-bound fluids and energies which at least provide meter index data (current meter reading value).

Actuators are breakers, valves or load delimiters.

Sensors may include humidity, temperature, smoke detectors.

For authentication during communication different security profiles may be used. The security profiles supported by OMS and recommended for specific actions are listed in [OMS-S2].

Unidirectional wireless OMS devices will always operate in push mode.

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

Wired M-Bus OMS 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.

3.2.2.2 OMS Meter

OMS meters are meters compliant with [OMS-S2] with a minimal functionality. Current metering data is given by request or sent at regular intervals.

NOTE: Regular intervals are not precisely regular. A small deviation should be applied to minimize collisions on the radio interface.

Communication data flow can be unidirectional or bidirectional. Sent Metering data is identical with data displayed on an integrated display. The minimum security profile requested for an OMS meter is listed in [OMS-S2].

3.2.2.3 OMS Meter with Additional Functionalities

OMS meters with additional functionalities are OMS meters which support one or more of the use cases defined in Annex M of [OMS-S2].

With the support of one or more of the use-cases the meters may be used for a wider range of applications, as shown below.

- OMS meters with additional functionalities may have an internal real-time clock which can be adjusted or set to enable data logging of load profiles at regular metering periods (e.g. 60 min.) and other time related functions.
- A feature to limit or cut-off the feed-in[4] may be used in OMS meters with additional functionalities.

Communication data flow is always bidirectional. However, OMS meters with additional functionalities sent their data initially in push mode. They deliver additional data after being requested in pull mode. The minimum security profile requested for an OMS meter with additional functionalities is listed in [OMS-S2].

3.2.2.4 Actuator

Throughout this specification the term ‘actuator’ is used to describe appliances which can limit consumption or cut-off the supply of electricity or gas. 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 security profile requested for an actuator is listed in [OMS-S2].

NOTE: The functional unit gateway as described by OMS does not contain the switching or delimiting functionality. Only data transfer of commands and status information is done by the OMS gateway.

NOTE: The widespread or mandatory installation of actuators may be subject to national regulation.

[4] Compare: Actuator

3.2.2.5 Sensor

The communication of sensors used to provide metering services was integrated into the OMS specifications in 2021 in order to achieve interoperability in the communication of sensor data. The detailed requirements are specified in Annex C of [OMS-S2].

3.2.3 Repeater

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

On unidirectional end devices a ’unidirectional’ repeater is defined which must not repeat any datagrams from a gateway assigned to a meter.

The bidirectional repeater is repeating datagrams in both directions from an end device as well as from a gateway.

3.2.4 Gateway

The gateway is a meter data communication device which collects data from measuring instruments for electricity, gas and thermal energy as well as water consumption. Metering values will be transferred to the gateway and will be processed there to be transmitted to AMM head-end systems as well as to present energy usage information to the consumer.

As a special implementation the Smart-Meter-Gateway (SMGW) is a GW which also processes meter data and may therefore be liable to metrological certification depending on national legislation.

3.2.5 AMM Head-End System

In this specification the endpoint where all gateways connect to is referred to as AMM head-end system (AMMHES). AMM stands for Automated Meter Management and refers to systems which collect data. AMM head-end 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 head-end systems themselves process the metering data so it may be transferred as billing and balancing information to ERP-Systems of resource providers or other suppliers.

3.3 Interfaces and Protocols

3.3.1 Introduction

Hardware interfaces exist in many components such as various bus systems, other I/O devices etc. A hardware interface is described by the mechanical, electrical and logical signals at the interface and the protocol for sequencing them.

Communication systems use well-defined formats or protocols for exchanging messages. Each message sent has an exact meaning intended to provoke a particular response in or from the receiver. Thus, a protocol has to define the syntax, semantics and synchronization of communication. The specified behaviour should be independent of how it is to be implemented. Communication protocols have to be agreed upon by the parties involved. To reach agreement a protocol may be developed into a technical standard.

In the following sections the interfaces and protocols are described which are supported by the OMS and which are part of the OMS-S.

3.3.2 M-Bus

3.3.2.1 General

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

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 describing communication via a two-wire M-Bus line [EN13757-2].
- Wireless M-Bus (wM-Bus) is used for M-Bus radio transmission [EN13757-4].
- If the application protocol is referenced, this is done by the term M-Bus protocol [EN13757-3].
- The usage of M-Bus as a generic system is referenced to as M-Bus system.
- M-Bus communication via power line (M-Bus-PLC) is considered as a future option and is not in focus of this document.

With regard to the limited available energy of battery driven metering devices the shorter DIF/VIF coded data in a standard M-Bus-Application is transported more energy efficient than an OBIS based application protocol.

3.3.2.2 Wired M-Bus

Starting point for the design of the M-Bus are measuring instruments which provide their service in buildings and similar facilities. The underlying technical requirements are as follows:

- Limited amount of data – most of the meter values of a measuring instrument can be packed into datagrams with a maximum of 256 bytes.
- Relatively large reaction times – for many applications it is sufficient if the request from the master is answered by the measuring instrument within minutes.
- Variable data transfer speed – depending on environmental conditions, cable length of the M-Bus and number of the connected devices the data transfer rate can be adjusted.
- Cost-effective wiring – as standard two-wire cables (telephone cables) may be used.
- Noise immunity – a high voltage level on the line (> 12 V) reduces the influence by external interference.
- Short circuit and overvoltage protection – due to appropriate arrangements for the bus measuring devices are not adversely affected by a short circuit in the cable or by short-time overvoltage.
- Error detection – due to provisions in the datagram structure like parity and checksums most data transmission errors can be recognized.
- Power supply via the communication line – in addition to the transmission of information via the two-wire cable the measuring instruments or the communication device of the measuring instruments on the same line can be supplied with voltage.
- Simple organization of information transmission – with a master-slave principle and dispensation of elaborate organization rules for data transmission, the slave only requires low computing power.

- Large expansion and flexible topology of the communication infrastructure – up to 1.000 m length in a cable segment in a bus, tree or star structure, thus allowing large facilities with a very flexible wiring.
- Large number of measuring instruments in a system – up to 250 meters can be connected in one line segment; this can be expanded with repeaters to several thousand units.
- Simple installation guidelines – the reverse polarity protected connection of the measuring instruments avoids installation errors.
- Future orientation of the protocol definitions – the possibility to determine the content of the messages allow for expansion of potential meter readings.

The open approach of the M-Bus also includes weaknesses. E.g. the protocol layers are not fully specified. Prior to the use of new slaves, compatibility with the master has to be ensured. Wired M-Bus installations are therefore not easy to extend and appropriate tests have to be carried out in advance when replacing individual components against other brands. Nevertheless, large M-Bus installations in the utility and industry environment have been established over the years which are safe and cost effective. The OMS-S aim at the weak spots of the M-Bus. By delimiting allowed variations and by specifying somewhat blurred descriptions an easy configurable interoperability is achieved. Mitigating or even solving these weaknesses was the main motivation for the foundation of OMS and is currently the scope of the Working Groups of OMS. The OMS volumes serve this purpose since the beginning of the OMS activities.

The extension of the M-Bus standard to wireless communication in the early 2000s has given a huge boost to the distribution of the M-Bus protocol.

3.3.2.3 Wireless M-Bus (wM-Bus)

The wireless M-Bus is the consequent enhancement of the successful wired M-Bus idea. It was first described in EN 13757-4 in the year 2003. This standard added an alternative definition for the Physical Layer and Link Layer to the M-Bus layer model (see Figure 7). The radio communication enables the possibility of plug-and-play installations of meters. Neither more wire installation nor configuration in the field is necessary anymore. Especially in the sub metering market the new radio technology has been very successful.

In the latest release of the standard there are several modes of radio communication described (see subclause 5.2.5). This gives a high flexibility to cover the requirements of the known installation scenarios. It starts with mobile solutions optimized for Walk-By and Drive-By reading and proceeds with several kinds of fixed network solutions which are optimized for high density or wide area networks. The modes have sub-modes for unidirectional and bidirectional communication.

OMS decided to cover a subset of the modes in their specification. These are S1, S2, T1, T2[5] and since 2014 also C1 and C2, all operating in the frequency band 868 MHz to 870 MHz. The modes S1, T1 and C1 are defined for unidirectional communication from meter to gateway. The modes S2, T2 and C2 provide a backwards channel for bidirectional communication.

- Mode S (Stationary mode) provides a data rate of 16.384 bit/s at a greater communication distance than Mode T. Modes S1 and S2 are compatible with the wireless KNX-system of ISO/IEC enabling combined systems for home automation and open metering.

[5] Refer to [EN 13757-4:2013] and [OMS-S2]

- Mode T (Transmit frequently) provides a data rate of 66.667 bit/s. This is approximately four times higher than Mode S and for a given battery size allows more frequent transmissions without decreasing battery lifetime or increasing collision rate. This enables a faster user feedback regarding his consumption. Due to this higher transmission frequency, drive-by or walk-by meter readout is also feasible.
  The backwards channel of T2 uses the same frequency and data rate as S2 to allow economic receiver design.
- Mode C (data rate 50.000 resp. 100.000 bit/s) combines the advantages of Mode S and Mode T. It has a more compact data format and therefore allows transmission of more data within the same energy budget and with the same duty cycle. With Issue 4.0.2 of [OMS-S2] Mode C is incorporated into the OMS-S.

The wireless M-Bus has several advantages in comparison to other short-range radio devices.

- Minimal effort for implementation in embedded devices (compared to ZigBee, Z -Wave or Bluetooth).
- No meshed network, therefore a lean protocol implementation.
- Optimized for battery-operated meters, more than 12 years lifetime possible.
- As already mentioned above, various special modes allow precise and optimized selection of the physical transmission parameters through selection of the modes.
- Independent of the Application Layer (e.g. DLMS also possible).
- Adapter solutions are possible due to clean layer separation.
- Short datagrams (several-millisecond range) provide good performance in crowded radio channels.
- Quote by Prof. Ziegler (inventor of the M-Bus) “We are the woodlice of radio technology” i.e. there are lots of small or short messages, some of which will always come through.
- Global uniqueness of the radio address.
- Fail-Safe by appropriate checksums and data encoding methods.
- As already mentioned, plug-and-play installation, easy expansion, no network administration costs – therefore a simple system.

In summary the cost per metering point is very low due to the points above.

3.3.3 DLMS/COSEM

DLMS/COSEM is an additional application protocol which will be applied in both primary and tertiary communication as an alternative software solution. This protocol transports the related OBIS code together with each data point.

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

3.3.4 SML

SML is an additional application protocol which may be applied in primary communication as an alternative software solution. This protocol transports the related OBIS code together with each data point.

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

With the new DLMS/COSEM framework finally adopted into the European Standard [EN62056-1-0] the current SML specification [VDE0418-63-9] remains a national industry standard, with implementations in electricity meters according to the German EDL or SyM² specifications. SML is the basis for wired communication between meters and an SMGW over LMN in Germany [VDEV0418-63-7].

3.4 Security

3.4.1 General

Security items are recognized as absolutely essential in order to achieve legal and social acceptance within innovative residential metering systems.

There are three occurrences which need 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 change of a meter index has occurred,
  - 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.

3.4.2 Encryption

To provide confidentiality of meter data and therefore the privacy of the consumer, these metering data should be encrypted. Encryption should be applied to primary communication, secondary communication as well as to tertiary communication.

Encryption is mandatory for wireless and PLC communication.

To provide confidentiality of transmitted data in primary communication, encryption methods are described in [OMS-S2].

Figure 1 shows an example for symmetric encryption on primary communication and asymmetric encryption on tertiary communication. The private keys necessary for asymmetric encryption should be held in a security module in the specific device. Keys should be generated individually for every device.

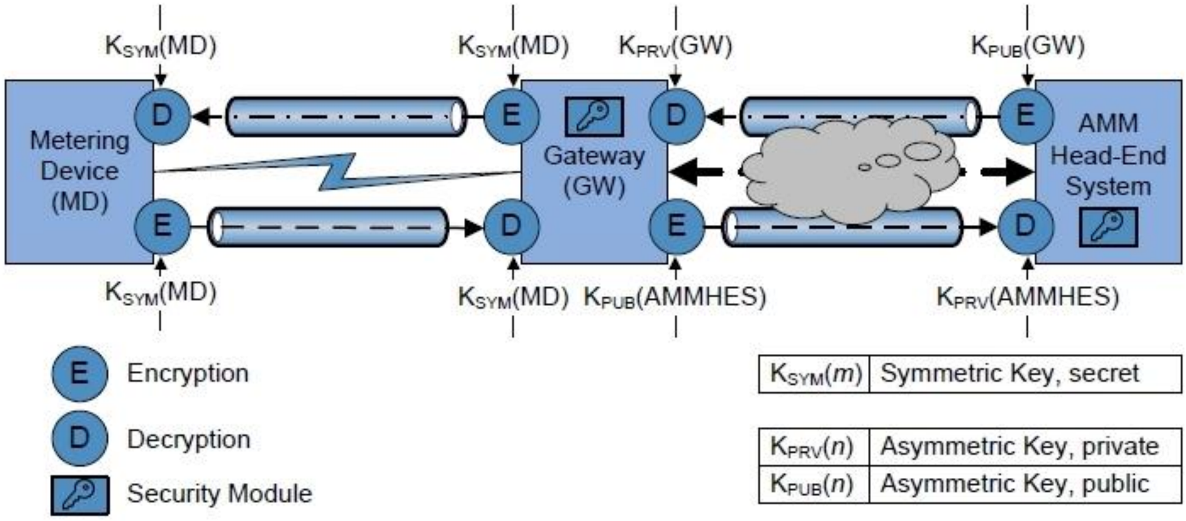

Figure 1 – Example for encryption – decryption

3.4.3 Authentication

Authentication should be considered in secondary and tertiary communication, where applicable. To provide authenticity and integrity of transmitted data in primary communication, authentication methods are described in [OMS-S2].

Authentication can be provided by a MAC for symmetric solutions (devices using unidirectional primary communication) or by a signature for asymmetric solutions (OMS meter with additional functionalities or tertiary communication – see subclause 3.4.4 Signature).

For the symmetric solution both communication partners must hold the same key. For transmitting a message over a public channel, the sender is using the key to compute a MAC, which is attached to the message and can be verified by the recipient using his key.

The current OMS-S supports an authentication method for the primary communication to provide authenticity and integrity of transmitted data.

NOTE: Standardized IP-Transport protocols also support authentication methods for tertiary communication with adequate security strength.

3.4.4 Signature

To provide authenticity, integrity and non-repudiation of data, a digital signature has to be used. This cryptographic more secure technology (compared to a MAC) can be provided only for two-way means of communication for bidirectional devices in primary communication and for tertiary communication.

NOTE: The current version of the OMS-S does not support a digital signature.

There may be a meter signature used to sign metered data and a command signature to sign (and authorize) commands in the AMM head-end.

As stated above, a meter signature is not required at the current specification, which focuses on OMS meters. As a future option the meter may sign the metered values to enable validation of the data source, if requested.

Also command signature is not required at the current state, but may be mandatory in the future for the following cases:

- Meter setting commands which influence the metering behaviour (e.g. tariff, due date);

- Delimiting or shut-off commands which affect the feed-in of the metered media.

Specifications of a signature may be subject to National legislation. The gateway may additionally sign pass-through data.

NOTE: In data messages the signature is an additional data point which has no effect on other data.

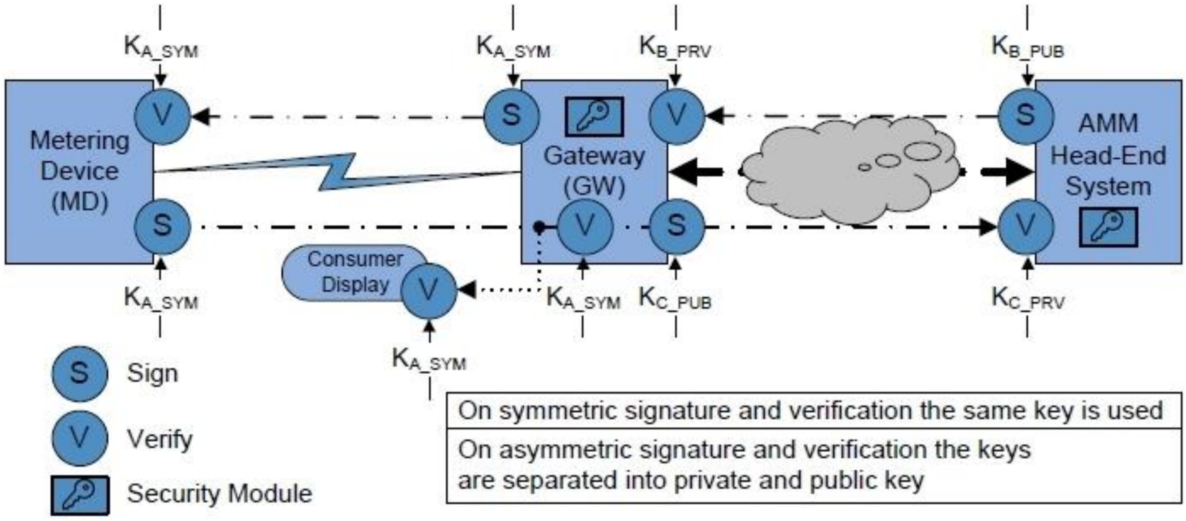

Figure 2 – Example for signature and verification

4 System Overview and Topology

4.1 System Overview

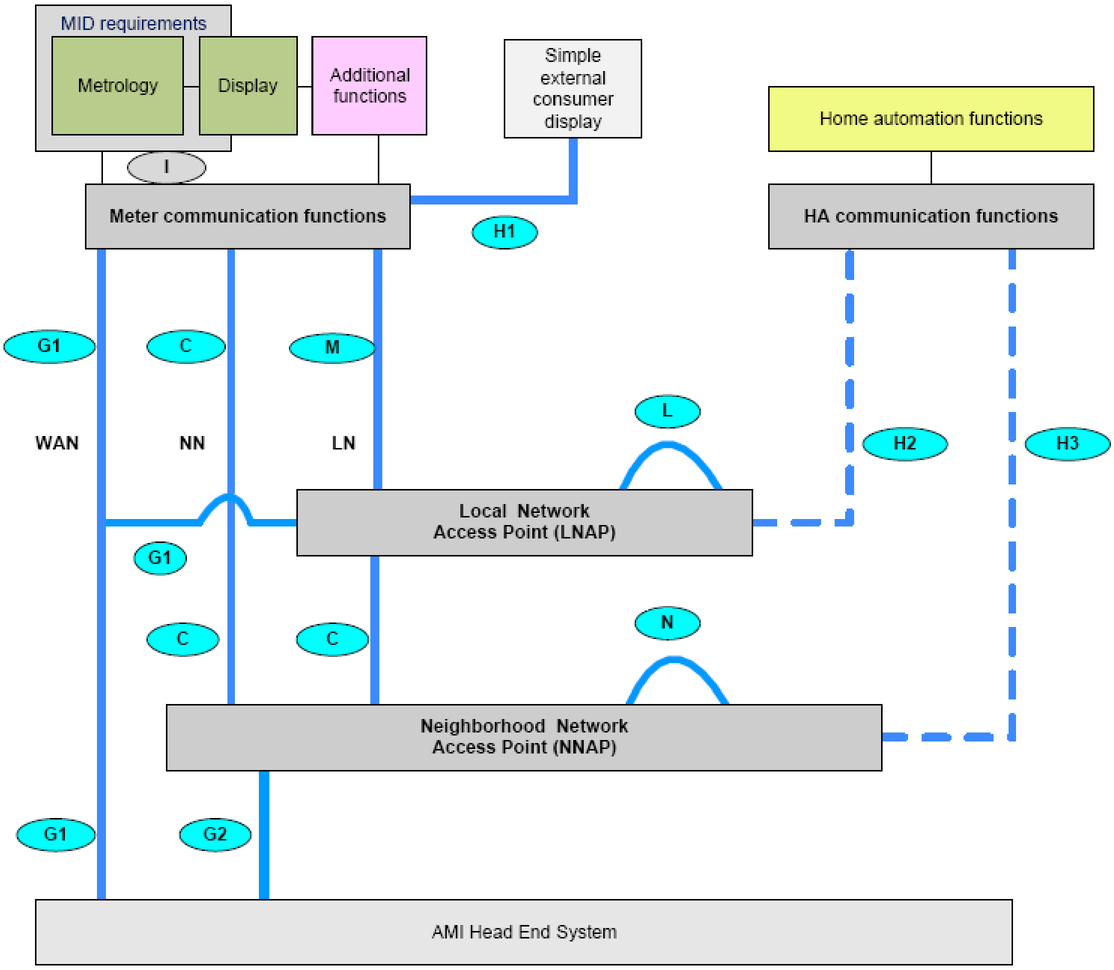

Figure 3 – Reference architecture diagram for smart metering communications[7]

Figure 3 gives an abstract overview of the functional entities and the interfaces, as defined by the mandate M/441 of The European Commission. The OMS-S provide solutions which may be used at the following interfaces:

- Metering end device interface (M interface)
- Local connection to consumer display (H1 interface)
- LNAP Peer Interface (L interface)
- NNAP interface (C interface)

Table 2 shows the relationship between the interfaces according to mandate M/441 and the OMS Group.

[7] Source: [TR50572]

Table 2 – Communication interfaces

OMS Interfaces	Interface in reference architecture
Primary communication	M, C, H1
Secondary communication	L, N, C
Tertiary communication	G1, G2

NOTE: The mandate M/441 does not see the two interfaces L and H1 within the scope of meter communication protocols but within the scope of home and building systems. Consequently CLC/TC 205 “Home and Building Electronic Systems (HBES)” has worked on the European Standard [EN50491-11]. In this standard the existing communication protocols from e.g. EN 13757 are mapped to a data model allowing the implementation of simple in-home displays (read-only). Thus OMS-S may be applicable to IHDs.

4.2 System Topology

Figure 4 to Figure 6 show different scenarios of the system topologies. The AMM head-end system maintains a connection to several gateways. The gateways 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.

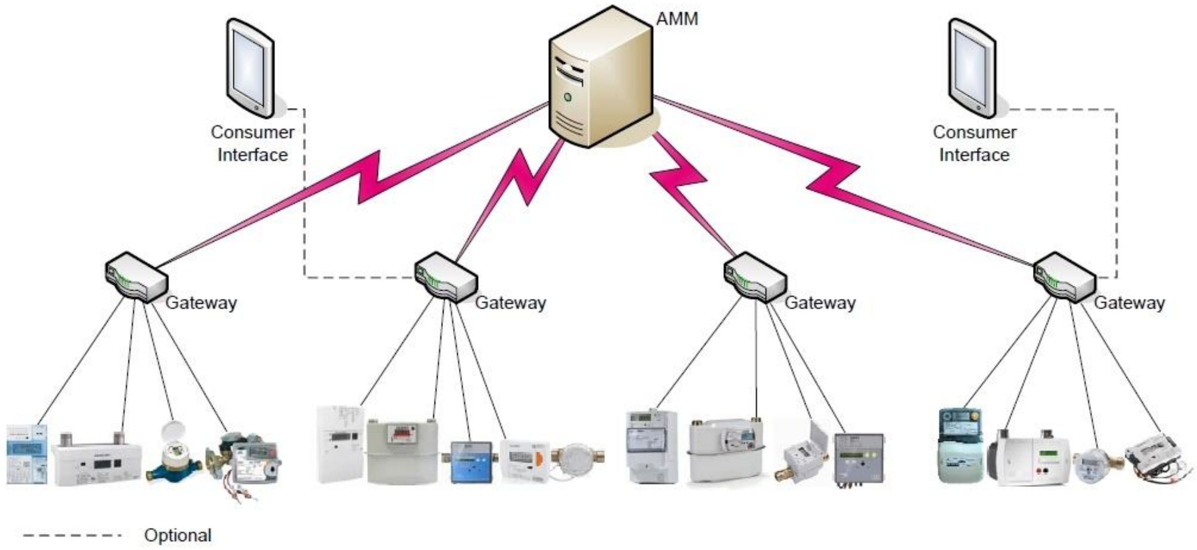

Figure 4 – System topology, scenario 1

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

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

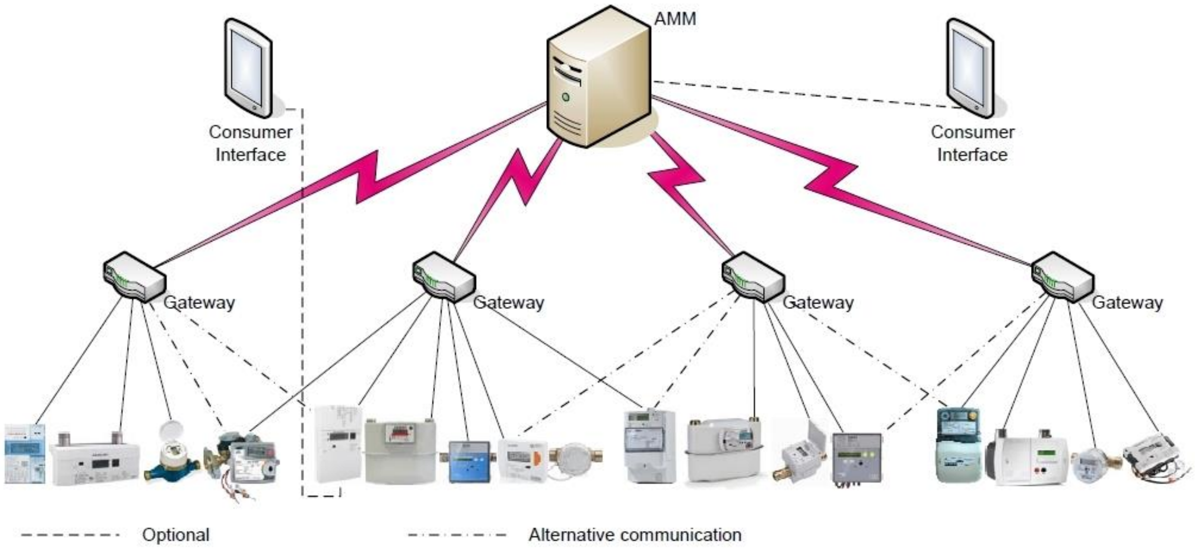

Figure 5 – System topology, scenario 2

In scenario 2 displays receive data from the AMM head-end, provided by an internet portal system, or they read meter data directly from the meter.

Meters may be shared among gateways to avoid out of range problems. Scenario 2 has the advantage, that redundant transmission from a meter via several gateways is possible. Scenario 2 has the disadvantage, that the different routing has to be tracked and that an occasional exchange of keys and/or certificates is more complex.

The scenario 2 topology may also be used during the installation phase to set up installations for scenario 1.

NOTE: Legal restrictions may prohibit the use of Scenario 2.

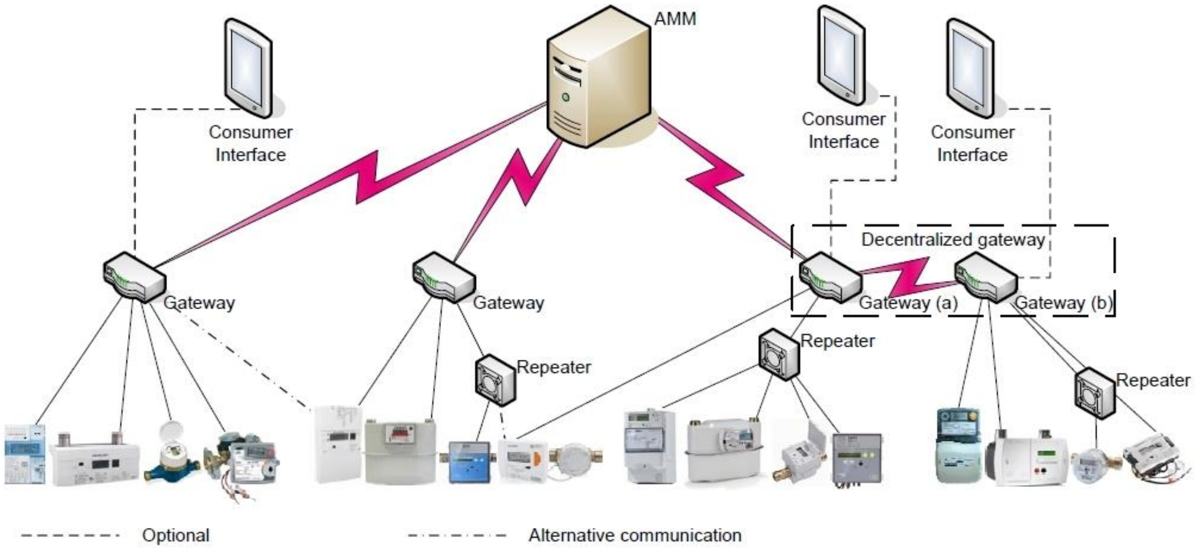

Figure 6 – System topology, scenario 3

Scenario 3 shows the clustering[8] of some gateways and primary communication with additional repeaters.

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

Here meters may also be shared among gateways to avoid out of range problems. Scenario 3 has the advantage, that redundant transmission from a meter via several gateways is possible. Scenario 3 has the disadvantage, that the different routing has to be tracked and that an occasional exchange of keys and/or certificates is more complex.

NOTE: Legal restrictions may prohibit the use of scenario 3.

5 Position towards CEN

5.1 General

The intention of OMS has always been to use existing standards and not to create a new standard. Conformance to standards assures coexistence and interconnection but not necessarily interoperability or interchangeability. With M-Bus as the preferred primary communication the OMS-S is fully in line with the scope of CEN/TC 294[9], which reads as follows:

"Standardization of communications interfaces for metering and submetering systems for Water, Fuel Gases, Heat and similar energies and fluids where the protocols are applied to the meters, sensors and actuators and systems used to provide metering services. Security features like Confidentiality, Authenticity and Integrity are provided at the application and lower layers. Cooperation with CENELEC and ETSI, in relation to consistent protocol and use of spectrum, is an essential condition for achieving interoperability between entities in systems. Excluded from this scope are areas, which are under the responsibility of CLC/TC 205 and CEN/TC 247.[10]"

The OMS-S state more precisely where the existing European Standard series EN 13757 leaves room for interpretations or allows alternative realizations.

Especially the parts -3, -4 and -7 of the European Standard series serve as basis for the OMS-S. The specifications made in earlier versions of the OMS-S have made their way into the Standard.

5.2 EN 13757 Communication Systems for Meters

5.2.1 Introduction

After the standardization of the M-Bus for heat meters in EN 1434 there were increasing requests for also using this communication standard for other measuring devices, especially gas and water meters. This is made possible by the open structure of the M-Bus, which allows the definition of an almost arbitrary number of device types. At the suggestion of some national standardization organizations, particularly the French AFNOR, CEN BT[11] has approved the transfer of the communication part of the standard from CEN/TC 176 into its own Technical Committee. Although the initiators of the M-Bus standard were initially reluctant to this decision, it is now generally seen as a consensus way forward. The foundation and establishment of the Technical Committee CEN/TC 294 was a successful step to describe meter communication independent of the measured medium. Only because the world of standards is divided into an electrical and non-electrical part (DKE, CENELEC, IEC and DIN, CEN, ISO), the standard series EN 13757 covers – in its origin – not all media.

However, with the mandate M/441 Smart Metering[12] of the European Commission, the executive Smart Metering Co-ordination Group has achieved a mutual recognition of appropriate standards among the participating Technical Committees of CEN and

[9] CEN/TC 294: Communication systems for meters

[10] CEN Technical Bodies - CEN/TC 294 (cencenelec.eu)

[11] BT: Bureau Technique

[12] Doc. 83/2008 EN of 22 January 2009: Draft Standardisation mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability

CENELEC. I.e. electricity meters with a communication in accordance with EN 13757 are considered to be in compliance with CENELEC.

Thus, the standard series EN 13757 is the only communication standard for meters and related equipment, which places the user into a position to cover measuring instruments of all media economically with one communication system.

In the following sections the individual parts of the standard series EN 13757 Communication systems for meters and remote reading of meters are presented. The standard series is a modular kit. Various physical interface characteristics as well as various protocol applications are described. These may be combined with one another in each case, so that a very flexible protocol stack is created, see Figure 7. Layers 5 and 6 according to OSI are not filled[13]. Layer 3 is optional and is only needed when using the standard part 5 Wireless relaying.

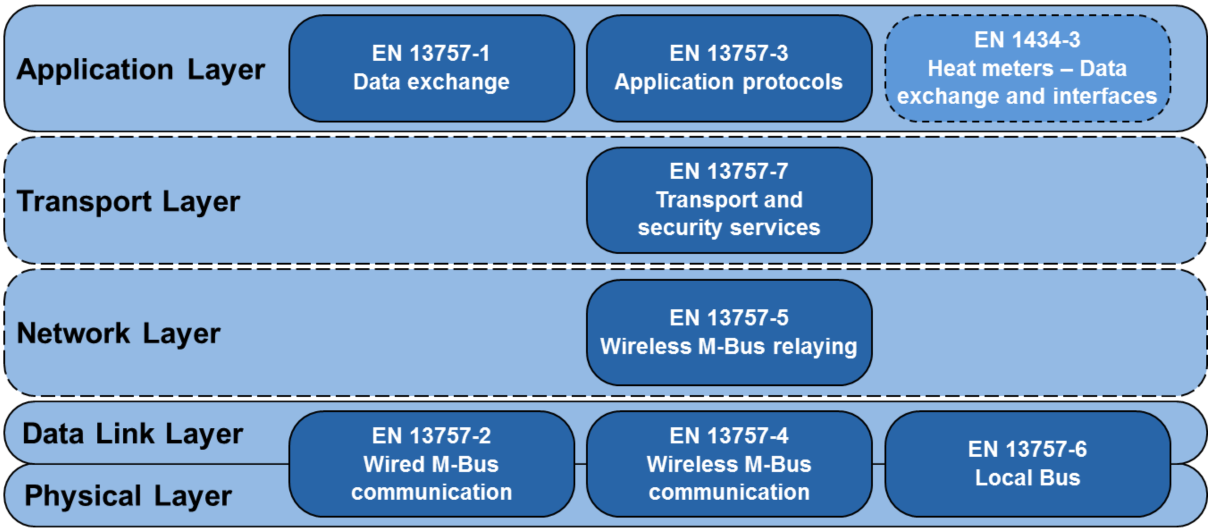

Figure 7 – Protocol stack EN 13757

5.2.2 EN 13757 Part 1: Data Exchange

This part of the standard describes the general data exchange and communication for meters and remote reading of meters. In particular; it specifies the COSEM Application Layer for meters with DLMS. EN 13757-1 is one of the basic documents to which the functional reference architecture from [TR50572] of mandate M/441 relates.

The currently valid version of [EN13757-1] was published by CEN in October 2014.

It has been revised from EN 13757-1:2002 to reflect the 7-layer OSI model, significant updates of security methods and updates of the OBIS model to the state of the art.

This part of the standard describes the data exchange and communication for meters and remote reading of meters in a generic way. Its main use is to provide an overview of the protocols at the different levels and to provide a specification for the DLMS/COSEM Application Layer for meters. EN 13757-1 is one of the basic documents to which the functional reference architecture from [TR50572] of mandate M/441 relates.

The next version of [EN13757-1] will be published by CEN in 2022.

It has been revised from EN 13757-1:2014 to reflect significant updates in Security practices, and updates to the OBIS model to reflect the state of the art. COSEM Classes have been

[13] The description of the Transport Layer in EN 13757-3:2013 is assigned to the Application Layer in the older version of the standard

removed from this document, as they are published in [EN62056-6-2] and there is a risk of contradiction.

5.2.3 EN 13757 Part 2: Wired M-Bus Communication

This part of the standard specifies the physical M-Bus via two-wire line. It is a compatible extension of the heat meter standard EN 1434-3:1997 and also covers the use of gas and water meters and heat cost allocators. The M-Bus master is also described. Reference is made to proven telecontrol protocols. The Physical Layer is partially based on [EN60870-5-1] and the Data Link Layer almost completely on [EN60870-5-2].

The two-wire M-Bus may be combined with the different Application Layers as shown in Figure 7.

The version valid until 2018 of EN 13757-2 was published by CEN in November 2004. It was still entitled "Physical and Link Layer". Revision and renaming of Part 2 of the standard represents a further important step in the direction of a functional set of standards.

The new publication of [EN13757-2] from April 2018 newly specifies or updates technical specifications compared to the 2004 version.

5.2.4 EN 13757 Part 3: Application Protocols

This part of the standard specifies the M-bus Application Layer. It is a compatible extension of the M-bus Application Layer originally described in the M-bus heat meter standard EN 1434-3:1997. The Application Layer described in this standard can be combined with the Physical, Data Link and Network Layers shown in Figure 7.

This standard allows many degrees of freedom, which means:

- It supports coexistence and a general communication ability of hierarchical communication devices;
- It does not guarantee any functional or communicational applied interchangeability of meters that follow this standard.

This interchangeability is achieved by the use of the OMS-S.

The version valid until 2018 of EN 13757-3 was published by CEN in May 2013. It was still entitled "Dedicated application layer". Revision and renaming of Part 3 of the standard also is another important step in the direction of a functional set of standards.

Due to the extensive expansion of Part 3 throughout the years, it became very large and sometimes confusing to handle. In addition to the application layer, the 2013 version also contains specifications for other OSI layers. The Working Group responsible in CEN TC/294 therefore decided to revise Part 3 again. Compared to EN 13757-3:2013, the following significant changes have been made:

- Dividing the previous Part 3 into three parts,
    - Adaptation of the title of EN 13757-3;
    - Relocation of transport and security services to new document [EN13757-7] (see section 5.2.8 in this document);
    - Moving the Informative Annexes to a technical report [CEN/TR17167] (see section 5.2.9 in this document);
- Extension of the application error protocol for improved error handling, especially with encryption or authentication problems;
- Software update, in particular updating of the safety algorithms for long-life meters;
- Extension of the application selection.

The new [EN13757-3] was published by CEN in April 2018.

5.2.5 EN 13757 Part 4: Wireless M-Bus Communication

This part of the standard specifies the requirements for the Physical Layer and the Link Layer for wireless applications for the remote reading of meters. In principle it is open for the application of different Application Layers. Mainly considered is radio equipment for short range devices (SRD) in frequency bands free for such applications. While the 2005 version specified only the frequency band from 868 MHz to 870 MHz, additional frequencies (169 MHz, 433 MHz) and other operating modes were included in the standard at the request of some European countries. In addition to the previously known operating modes (Mode S, Mode T, Mode R), the new operating modes (Mode C, Mode F, Mode N) with different duty cycles (0,1 % and 1 %) are defined, each with its preferred application.

- Walk-By
- Drive-By
- Stationary

With the possible alternatives of low data rate or high data rate the different use cases of high radio range or a high density of meters can be covered. One-way and two-way radio operation is defined. All parameters are optimised for use in battery-powered meters. The typical life span of usage without battery replacement is more than ten years. The carrier frequency in the Sub-Gigahertz range together with the extremely short transmission intervals guarantee a good penetration and low probability of collision in spite of the maximum transmission power in the European harmonised radio bands being limited to 25 mW.

This standard has been extremely successful, especially in Submetering. In Europe there are at least 100 million measuring instruments in use, based on this standard.

From 2009 onwards, work has been done on a significantly expanded version of EN 13757-4. This is evident with the new title of this part of the standard. In the past the wireless meter readout was limited to operation in the 868 MHz to 870 MHz SRD band only, now it is open to other SRD bands. New modes have been added (Mode C, Mode N and Mode F), some new frequencies (169 MHz and 434 MHz) as well as a new duty cycle (10 %). Thus, future applications can be covered where the previous modes could not achieve optimum results. Also, the used Link Layer for all modes was unified and its functionality extended.

The version valid until 2019 of EN 13757-4 was published by CEN in August 2013. It was still entitled "Wireless meter readout (Radio meter reading for operation in SRD bands)". The revision and renaming of Part 4 of the standard steps in the same direction as described for parts 2 and 3. The main changes since EN 13757-4:2013 are as follows:

- Referenced standards have been updated to the most recent versions;
- Mode N in the 169 MHz band has been extended to cover more frequencies;
- Extended timing tolerances for synchronous transmission;
- Optional Forward Error Correction in the Link Layer added;
- Management functions for link control added.

The new [EN13757-4] was published by CEN in April 2019.

5.2.6 EN 13757 Part 5: Wireless M-Bus Relaying

This part of the standard is an extension of [EN13757-4]. It is not always possible to position the radio master so that all meters of a wireless network can be reached directly. The main purpose of EN 13757-5 is to support simple transmission repetition and routed radio networks for meter reading. This part of the standard defines the protocols to be used for relaying in radio networks for meter reading. It supports routing of modes P and Q and simple single-hop transmission repetition of modes S, T, C, F and N.

Based on the general need for types of relaying, this part defines three different protocols with the following features.

Protocol using Routers

This protocol, referred to as operating mode P, extends the addressing to a two-address or symmetric protocol. It uses the physical layer specified in [EN60870-5-1] and the Data Link/Network Layer specified in [EN60870-5-2]. This protocol is useful if you want to use a true fully routed network. This approach is not compatible with the with the simple Link Layer approach of [EN13757-4].

All network nodes behave the same, are known to each other and are not hierarchical. The same protocol is used upstream and downstream. The way from the meter (data source) to the master (data sink) is specified before the first data transmission. Thus, the network cannot respond dynamically to changes, but the data overhead and the required computing power in each node is low. The individual nodes have knowledge about the final data sink.

Protocol using Gateways

The update of the connection layer protocol in [EN13757-4] means that operating mode R2 is no longer compatible with the gateway protocol defined in previous versions of part 5 of this standard series. Therefore, operating mode R2 is no longer covered by [EN13757-5].

Protocol supporting Precision Timing

This protocol, referred to as operating mode Q, supports a precise time regime and is intended in case it is not necessary to use the EN 60870-5 series of standards. The standards of the EN 60870-5 series were developed about 15 years ago and no longer meet all the requirements of a modern protocol.

Possibilities are used in operating mode Q

- to save energy by taking the clocking of the nodes into account,
- for the transmission of precise time regime information,
- for use of NRZ coding, based on digital signal processors.

The protocol can be used as a transport service for modern object-oriented high-level application layer services such as the DLMS protocol defined in EN 13757-1.

Single-hop-repeaters

A Physical Layer and Link Layer protocol for unidirectional or bidirectional single-hop repeaters. This is the most generic method as it is applicable to almost all radio modes specified in [EN13757-4]. The choice of operating mode of the repeater depends on whether

- the repeater is battery operated or
- the repeater will send messages to the meter.

The currently valid version of [EN13757-5] was published by CEN in November 2015.

The revision and renaming (formerly just known as “Wireless relaying”) of Part 5 of the standard follows the same common understanding as stated earlier.

5.2.7 EN 13757 Part 6: Local Bus

The insensitivity of the wired M-Bus to interference because of its high voltage level has advantages and disadvantages. The energy and material expenses for the operation of small installations is relatively high. Battery-powered masters are virtually impossible to achieve.

For this reason, this part of the standard series defines a Physical Layer with low power levels and for a maximum of 6 meters connected to the bus.

The readout frequency is limited by the connected meters. A permanent power supply of the meters through the bus is not provided. Therefore, the Local bus can be switched off completely if required. Both the M-Bus Application Layer of EN 13757-3 and the DLMS-based Application Layer of EN 13757-1 apply.

It is important to ensure that meters with an interface for the Local Bus are not operated on an M-Bus Master. The Local Bus is mainly used for water meters.

An interesting feature is that the physical quantities of the Local Bus are basically suitable for an Ex protection zone. If security features were to be applied it would be possible to have a secure wired communication protocol to gas meters and conversion devices in hazardous areas.

The currently valid version of [EN13757-6] was published by CEN in December 2015.

5.2.8 EN 13757 Part 7: Transport and Security Services

This part of the standard is derived from parts of the Standard EN 13757-3:2013 and describes the transport mechanism and the safety procedures for data. It offers a set of security services to design a secure system that is highly likely to withstand attacks during the normal lifetime of the meters used. The described security services are limited to symmetric encryption methods for data transmission. This enables energy- and storage-efficient solutions, which is advantageous for permanently battery-powered meters. With these boundary conditions, safe unidirectional meter communication is also possible. The procedures for key derivation and key distribution described in the standard section solve the conflict between the short key service life and the long meter service life.

The following technical changes have been included in the current document:

- Added new security modes (formerly "Encryption Mode") 7, 8, 9 and 10, which support encrypted and authenticated messages;
- Support of the key derivation function for generating volatile keys;
- Introduction of a new authentication and fragmentation layer that allows message authentication of all higher layers;
- The addition of a new protocol for exchanging security-relevant information, such as keys.

The new [EN13757-7] was published by CEN in April 2018. Together with [EN13757-3] it replaces EN 13757-3:2013.

5.2.9 prEN 13757 Part 8: Adaptation Layer

This new part of the EN 13757 series is currently worked upon. It will describe the functionalities and will specify the requirements of an Adaptation Layer to be applied when transporting M-Bus upper layers using a wireless communication protocol other than wM-Bus.

As described in [EN13757-1], the M-Bus protocol upper layers (Transport and Application) can be used with various lower layers (Network, Data Link and Physical). Systems based on the M-Bus protocol stack are well established in the metering market in Europe. Other wireless communication networks – called LPWAN (Low Power Wide Area Networks) – have been deployed during the last years and are targeting metering applications as well. These alternative radio technologies developed outside CEN/TC 294 could be based on Internet Protocol or not and operate either in licensed or unlicensed frequency bands.

The OSI reference model enables the transport of M-Bus upper layers on top of LPWAN's lower layers. An M-Bus Adaptation Layer (MBAL) shall provide the necessary services and information. Possible LPWAN technologies to be addressed by the MBAL are:

- LoRaWAN;
- LTE Cat-M1 (LTE-M);
- LTE Cat-NB1 (NB-IoT);
- mioty/TS-UNB;
- Sigfox;
- Wi-SUN;
- Wize.

The publication of this new part of the EN 13757 series by CEN is expected in the course of the year 2023.

5.3 CEN/TR 17167: Communication System for Meters – Accompanying TR to EN 13757-2, -3 and -7, Examples and Supplementary Information

CEN/TC 294 has decided to split the current standard EN 13757-3:2013 into the two standard parts [EN13757-3] and [EN13757-7] and with the revision of [EN13757-2] to group the illustrative informative annexes from these parts of the standard into one CEN/TR (Technical Report). The report contains e.g. telegram examples or descriptions for the application in smart metering systems.

This streamlines the individual parts of the standard series to the parts required for implementation in conformity with the norm, because the normative annexes remain in the respective part of the standard. At the same time, there will be a compendium of all explanatory and descriptive examples in the future. This also facilitates working with the standard.

The publication of [CEN/TR17167] by CEN was also in April 2018.

Annex A: Glossary of Terms

The Glossary of Terms is a separate document.

The actual version (RELEASE D 2021-12 or later) may be downloaded from the OMS website (https://oms-group.org/open-metering-system/oms-spezifikation).