BS EN 13757-1:2014

BSI Standards Publication

Communication systems for meters

Part 1: Data exchange

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National foreword

This British Standard is the UK implementation of EN 13757-1:2014. It supersedes BS EN 13757-1:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/894, Remote Meter Reading.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

Communication systems for meters - Part 1: Data exchange

Systèmes de communication et de télérelevé de compteurs - Partie 1 : Echange de données

Kommunikationssysteme für Zähler - Teil 1: Datenaustausch

This European Standard was approved by CEN on 30 August 2014.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 13757-1:2014) has been prepared by Technical Committee CEN/TC 294 “Communication systems for meters and remote reading of meters”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2015, and conflicting national standards shall be withdrawn at the latest by April 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13757-1:2002.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been revised in order to reflect the 7 – layer OSI model, significant updates in Security practices, and updates to the OBIS model to reflect the state of the art.

EN 13757 comprises the following parts:

— *Part 1: Data exchange* [the present document];

— *Part 2: Physical and link layer*;

— *Part 3: Dedicated application layer*;

— *Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)*;

— *Part 5: Wireless relaying*;

— *Part 6: Local Bus*.

This document is referred to in the CEN/CLC/ETSI TR 50572:2011, *Functional Reference Architecture for Communications in Smart Metering Systems*, as a standard for communications between elements in the Smart Metering Architecture. The M/441 Mandate, which led to the CEN/CLC/ETSI TR 50572, is driving significant development of standards in smart metering.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

There are a number of other activities taking place in the smart metering and smart grid environment. The reader's attention is drawn to M/490, the mandate for standardization for smart grid, available from http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/2011_03_01_mandate_m490_en.pdf, and C(2012) 1342, "Guidelines for conducting a cost-benefit analysis of Smart Grid projects", available from http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/20120427_smartgrids_guideline.pdf.

This document describes the data exchange and communications for meters and remote reading of meters in a generic way. It is Part 1 of EN 13757.

The main use of EN 13757-1 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.

Additional parts to the series of standard EN 13757 are:

— *Part 2: Physical and link layer*;

— *Part 3: Dedicated application layer*;

— *Part 4: Wireless meter readout (radio meter reading for operation in SRD bands)*;

— *Part 5: Wireless relaying*;

— *Part 6: Local Bus*.

The world of metering is going through a period of rapid change, and it is anticipated that this and other parts of the standard will require amendment in a short period of time.

NOTE 1 This document makes reference to EN 62056 standards repeatedly. An exercise is taking place to reissue and renumber these standards, and it is anticipated that CEN-listed versions of these standards will be confirmed shortly. References to older versions of these standards will be comprehensively updated as part of the response to comments to this draft.

NOTE 2 Some of the ISO/IEC documents listed under Clause 2 may be available only from ISO or IEC directly. If the document you require is not available from your national standards organization, it is recommended that you contact ISO or IEC to establish the status of the document and it is availability. ISO can be contacted via www.iso.org.

NOTE 3 Clause 3 contains the terms and definitions special to remote reading of meters. Annex B is used to explain terms related to the object oriented model used in COSEM, detailed in EN 62056–6-2 and OBIS, detailed in EN 62056–6-1.

1 Scope

This European Standard specifies data exchange and communications for meters and remote reading of meters in a generic way.

This European Standard establishes a protocol specification for the Application Layer for meters and establishes several protocols for meter communications which may be applied depending on the application being fulfilled.

NOTE Electricity meters are not covered by this standard, as the standardization of remote readout of electricity meters is a task for CENELEC.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 834, *Heat cost allocators for the determination of the consumption of room heating radiators — Appliances with electrical energy supply*

EN 1434-1, *Heat meters — Part 1: General requirements*

EN 1434-2, *Heat meters — Part 2: Constructional requirements*

EN 1434-3, *Heat Meters — Part 3: Data exchange and interfaces*

EN 13757-2:2004, *Communication systems for and remote reading of meters — Part 2: Physical and link layer*

EN 13757-3:2013, *Communication systems for and remote reading of meters — Part 3: Dedicated application layer*

EN 13757-4:2013, *Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)*

EN 13757-5:2008, *Communication systems for meters and remote reading of meters — Part 5: Wireless relaying*

EN 13757-6, *Communication systems for meters and remote reading of meters — Part 6: Local Bus*

CEN/CLC/ETSI TR 50572, *Functional Reference Architecture for Communications in Smart Metering Systems*

EN 60870-5-2, *Telecontrol equipment and systems — Part 5: Transmission protocols — Section 2: Link transmission procedures (IEC 60870-5-2)*

EN 61334-4-1, *Distribution automation using distribution line carrier systems — Part 4: Data communication protocols — Section 1: Reference model of the communication system (IEC 61334-4-1)*

EN 61334-4-41, *Distribution automation using distribution line carrier systems — Part 4: Data communication protocols — Section 41: Application protocols — Distribution line message specification (IEC 61334-4-41)*

EN 62056-3-1, *Electricity metering data exchange — The DLMS/COSEM suite — Part 3-1: Use of local area networks on twisted pair with carrier signalling (IEC 62056-3-1)*

EN 62056-5-3, *Electricity metering data exchange — The DLMS/COSEM suite — Part 5-3: DLMS/COSEM application layer (IEC 62056-5-3)*

EN 62056-6-1:2013[1)], *Electricity metering data exchange — The DLMS/COSEM suite — Part 6-1: Object Identification System (OBIS) (IEC 62056-6-1:2013)*

EN 62056-6-2:2013[1)], *Electricity metering data exchange —The DLMS/COSEM suite — Part 6-2: COSEM interface classes (IEC 62056-6-2:2013)*

EN 62056-21:2002[1)], *Electricity metering — Data exchange for meter reading, tariff and load control — Part 21: Direct local data exchange (IEC 62056-21:2002)*

EN 62056-42[1)], *Electricity metering - Data exchange for meter reading, tariff and load control — Part 42: Physical layer services and procedures for connection-oriented asynchronous data exchange (IEC 62056-42)*

EN 62056-46:2002[1)], *Electricity metering — Data exchange for meter reading, tariff and load control — Part 46: Data link layer using HDLC protocol (IEC 62056-46:2002)*

EN 62056-47[1)], *Electricity metering — Data exchange for meter reading, tariff and load control — Part 47: COSEM transport layers for IPv4 networks (IEC 62056-47)*

ISO 1155, *Information processing — Use of longitudinal parity to detect errors in information messages*

ISO 1177, *Information processing — Character structure for start/stop and synchronous character oriented transmission*

ISO 1745, *Information processing — Basic mode control procedures for data communication systems*

ISO 7498-2, *Information processing systems — Open Systems Interconnection — Basic Reference Model — Part 2: Security Architecture*

ISO 9506-1, *Industrial automation systems — Manufacturing Message Specification — Part 1: Service definition*

ISO/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO/IEC 8802-2, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control*

ISO/IEC 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*

ISO/IEC 15408 (all parts), *Information technology — Security techniques — Evaluation criteria for IT security*

ISO/IEC 15953, *Information technology — Open Systems Interconnection — Service definition for the Application Service Object Association Control Service Element*

ISO/IEC 15954, *Information technology — Open Systems Interconnection — Connection-mode protocol for the Application Service Object Association Control Service Element*

ISO/IEC 27033 (all parts), *Information technology — Security techniques — Network security*

IETF RFC 791, *Internet Protocol — Darpa Internet Program — Protocol Specification* [IPv4 Network Layer]

1) The EN 62056 series of standards are in the process of revision/renumbering.

IETF RFC 793, *Transmission Control Protocol — Darpa Internet Program — Protocol Specification*

IETF RFC 768, *User Datagram Protocol*

IETF RFC 2460, *Internet Protocol, Version 6 (IPv6) — Specification*

IETF RFC 4301, *Security Architecture for the Internet Protocol* [IPsec]

IETF RFC 5246, *The Transport Layer Security (TLS) Protocol — Version 1.2*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
authorized party
utility, energy retailer, network operator, meter operator or data collection company authorized to access the information stored in the meter that is accessible to them according to the application association they can use

3.2
base conditions
fixed conditions used to express the volume of gas independently of the measurement conditions (e.g. temperature of 273,15 K and absolute pressure of 1,013 25 bar or temperature of 288,15 K and absolute pressure of 1,013 25 bar)

3.3
billing period
period over which a consumer bill is calculated

Note 1 to entry: See also B.7.

3.4
calendar
mechanism to program changes to active registers for Time-of-Use Tariffs

Note 1 to entry: See Activity Calendar B.3.

3.5
concentrator
intelligent station in a hierarchical communications network where incoming data (generated by multiple meters) is processed as appropriate and then repackaged, relayed, retransmitted, discarded, responded to, consolidated, prioritized and / or increased to multiple messages

3.6
disturbances
influence quantity having a value within the limits specified, but outside the specified rated operating conditions of the measurement instrument

3.7
gas-volume conversion device
device that computes, integrates and indicates the volume increments measured by a gas meter as if it were operating at base conditions, using as inputs the volume at measurement conditions as measured by the gas meter, and other characteristics such as gas temperature and gas pressure

Note 1 to entry: The conversion device can also include the error curve of the gas meter and associated measuring transformers.

Note 2 to entry: The deviation from the ideal gas law can be compensated by the compressibility factor.

3.8
hand held terminal
portable device for reading and programming metering equipment at the customer's premises or at the access point

3.9
index
for gas and water metering, current reading of the total volume (mass) passed through the meter

3.10
index difference
for gas and water metering, difference between the index at the end of a measurement or billing period and the index at the start of the same measurement or billing period

Note 1 to entry: Index difference over a certain measurement or billing period is also known as consumption. For consumption, thresholds may be defined.

3.11
IPsec
end-to-end security scheme operating in the Internet Layer

Note 1 to entry: It works on IPv4 and IPv6 Networks.

Note 2 to entry: It is described in IETF RFC 4301.

3.12
measurement conditions
conditions of the gas whose volume is measured, at the point of measurement (e.g. the temperature and the pressure of the gas)

3.13
scaler
exponent (to the base of 10) of the multiplication factor

Note 1 to entry: If the value is not numerical, then the scaler will be set to 0.

Note 2 to entry: See also B.49.

3.14
specified measuring range
set of values of measurements (the pressure for the pressure transducer or temperature for the temperature transducer) for which the error of the conversion device is intended to lie within the limits specified in the standard

Note 1 to entry: The upper and lower limits of the specified measuring range are called maximum value and minimum value respectively.

3.15
specified field of measurement of a conversion device
set of values at measurement conditions for which the error of the conversion device is within specified limits

Note 1 to entry: A conversion device has a measuring range for every quantity that it processes.

Note 2 to entry: The specified field of measurement applies to the characteristic quantities of the gas that are used to determine the conversion factor.

3.16
unit
enumeration defining the physical unit

Note 1 to entry: See also B.69.

4 General description and security

4.1 Basic vocabulary

All communications involve two sets of equipment represented by the terms **Caller** system and **Called** system. The **Caller** is the system that decides to initiate a communication with a remote system known as the **Called** party; these denominations remain valid throughout the duration of the communication.

A communication is broken down into a certain number of transactions. Each transaction is represented by a transmission from the **Transmitter** to the **Receiver**. During the sequence of transactions, the **Caller** and **Called** systems take turns to act as **Transmitter** and **Receiver**.

The terms **Client** and **Server** have the same meanings as in the DLMS model EN 61334-4-41. The **Server** is the system (meter) that acts as a receiver for service requests. The **Client** is the system (usually a data collecting system) that uses the Server for a specific purpose by means of one or more service requests.

The situation involving a **Caller Client** and a **Called Server** is undoubtedly the most frequent case, but a communication based on a **Caller Server** and a **Called Client** is also possible, in particular to report the occurrence of an urgent alarm and may offer savings in terms of data volumes in mass metering applications.

While the terms **Caller** and **Called** may imply a session, sessionless communications using, for example UDP over IP are also a valid approach to communications for smart meters depending on the type of network.

4.2 Layered protocols

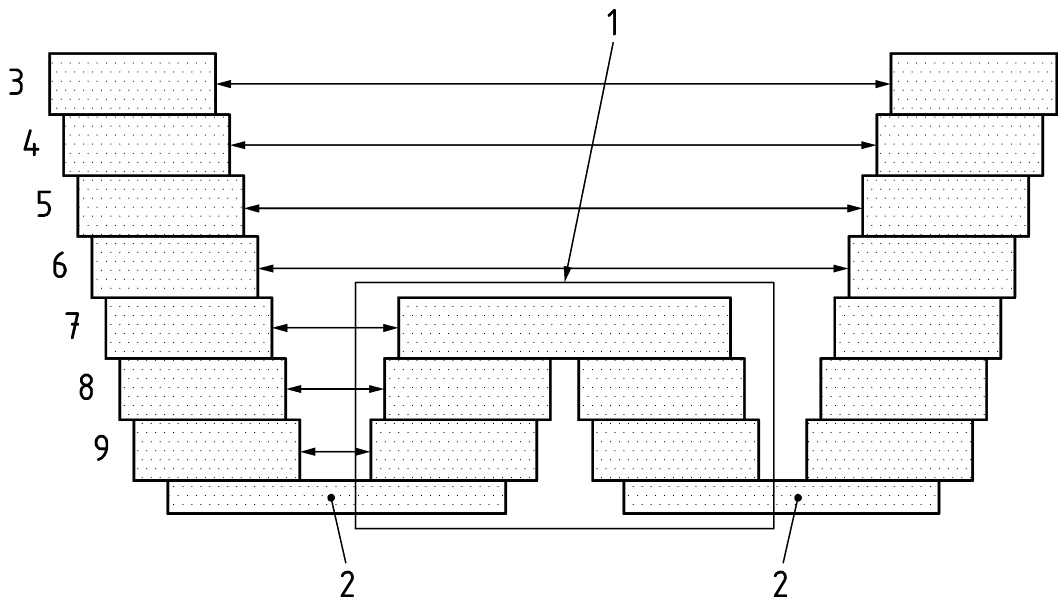
4.2.1 General

The purpose of this subclause is to explain, in a summarized way, the layered approaches and to explain the development since the initial issue of this standard.

In order to perform automatic reading of meters, this standard assumes a protocol stack approach. A protocol stack is divided into layers in order to reduce the complexity of the communicating system. Each layer provides services to the layer above on the basis of the layer below.

4.2.2 7 Layer Protocol

The architecture of data communication in this standard is modelled using the ISO – OSI 7- layer reference model ISO/IEC 7498-1. The model is shown in Figure 1.



Key

1	relay entity	6	transport
2	physical media	7	network
3	application	8	data link
4	presentation	9	physical
5	session		

Figure 1 — The OSI 7-layer model

All layers have a corresponding layer at the other end of the communications link. The three upper layers are application related. The three lower layers are communications related. The Transport Layer creates the link between them. There may be multiple instances of the three lower layers if a relay is inserted between the communicating partners.

It shall be kept in mind that this is a model and not an implementation guide, i.e. not all implementations follow this model. An example of this is the Internet series of standards. They follow the model for the four lower layers, but do not specify the application related part as independent layers. Layers not necessary and thus not implemented in a specific protocol may be handled as null layers.

4.2.3 IP Protocol

IPv4, and its successor IPv6 are becoming widely used protocols for transport of all kinds of data, including metering data. Its principal advantages are that it can be used to carry a wide variety of applications over a wide range of communications media.

<table>
<tr><td rowspan="2">Application Layer</td><td colspan="2">Common, method independent layer</td></tr>
<tr><td colspan="2">TCP/UDP IP Wrapper</td></tr>
<tr><td>Transport</td><td>UDP</td><td>TCP</td></tr>
<tr><td>Network</td><td colspan="2">IP</td></tr>
<tr><td>Data Link</td><td>Any</td><td>Any</td></tr>
<tr><td>Physical</td><td>Any</td><td>Any</td></tr>
</table>

Figure 2 — Connection method independent Application Layers

The architecture shown in Figure 2 allows for multiple different communications media, while at the same time keeping a common connection method independent Application Layer. This is important as different connection methods are suited for different operating environments. The use of common layers lowers the overall cost and complexity of a remote readout metering system.

Users of the TCP/IP or UDP/IP protocol shall follow the standard EN 62056-47.

4.2.4 3 Layer Protocol

A very common model for simple meter readout, without any relays is a collapsed three layer model as depicted in Figure 3.

This is the IEC 3-layer model EN 61334-4-1, which is derived from OSI 7-layer model documented in ISO/IEC 7498-1.

The three layers of the IEC model are shown on the figure below:

Layer 7	Application
Layer 2	Data link
Layer 1	Physical

Figure 3 — IEC 3-layer model

NOTE The layer numbers refers to the numbering in the ISO-OSI 7-layer model.

This model ensures that the original concept of a model where the Application Layer is independent of communication transport method used, is maintained.

This division makes it possible to achieve an Application Layer that is independent of the communication connection method used, and the possibility of using the same communication method transport mechanism for different Application Layers. An example of this is shown in Figure 4. The Physical Layer and in some cases the Data Link Layer are closely related and highly dependent on the Layers 1 and 2 depend on the connection method used (Optical interface, Power Line Carrier-Low Voltage (PLC - LV), Public Switched Telephone Network (PSTN), VHF/UHF radio, Twisted Pair cable (TP)). This standard requires Application Layers that are independent of the connection method used.

Application Layer	Common, method independent layer					
Link Layer	EN 62056–46		EN 13757–3		...	?
Physical Layer	EN 62056–21	EN 62056–42	EN 13757–2/ EN 13757–6	EN 13757–4/ EN 13757–5	...	?
Connection Method	Optical (Local) Port	PSTN	Wired M-Bus (twisted pair baseband)	Wireless M-Bus		Future methods (to be defined)

Figure 4 — Link and Physical layers in the 3 layer model

4.3 Security

4.3.1 General

The data transferred between meters and head end systems may, in many cases, be regarded as the private data of the energy user, and therefore is subject to EU and national rules for the protection of said data. If communications to the meter can influence demand, then the meter may form part of critical national infrastructure. If data transferred from the head end to the meter can control the meter, then the integrity of the data may be a safety issue as well.

A mandate for standardization for security, M/487, is in place, and this is driving further standardization efforts in this area. A copy of the mandate can be obtained at ftp://ftp.cencenelec.eu/CENELEC/EuropeanMandates/M_487.pdf.

Security, therefore, is a much higher priority than in the earlier version of this standard.

There are four key security aspects required for smart metering:

a) Ensuring that only those who should have access to information are granted access;

b) Ensuring that information is not changed accidentally or deliberately;

c) Ensuring that the source of the information cannot be falsified;

d) Ensuring that the source of information cannot be denied.

Item a) is normally named Privacy. This can be achieved by limiting the physical access, or by using cryptographic methods. Both methods shall be considered depending on the application and communications methods being used. It should be noted that data encrypted cannot be retrieved again if the ‘key’ is lost. The normal method for ensuring privacy is by encrypting information. With the cryptographic methods available this is very safe and reasonably easy to perform. The real issue is not the encryption and decryption, but the handling and distribution of the encryption/decryption key(s) – see 4.3.3.

Item b) is normally named Integrity. Integrity in communication is normally achieved by generating a compressed signature over the message, referred to as a message digest. If the message digest cannot be recalculated on the data received, then it is possible that the data may be damaged. A method that is falling out of favour is Cyclic Redundancy Check. CRC has been in use for a long time to generate message digests. The strength of CRC is that is very simple to implement efficiently in hardware and that it is reasonably good at detecting random / accidental errors. The weakness is that it is unable to detect deliberate changes to the information. Protection against deliberate changes to information can be achieved by using cryptographic methods in the generation of the message digest. A message digest is calculated using a secure hashing method or a key based method. The result of this is a 'signature' or Message Authentication Code added to the end of the message. The MAC is recalculated when data are received. The strength of the MAC is that it is impossible to modify the message in such a way that the MAC is correct unless the ’key’ is known.

Item c) is named Authentication. Authentication ensures that the source of the message is the one stated. It can be combined with Integrity. Authentication is not encryption but uses cryptographic methods. It is not possible to distinguish between sources of information if they use the same key, and therefore keys need to be dedicated to both ends of the data flow. Authentication will often ensure the integrity of the data as well.

Item d) is an extension to item c) and named Non-repudiation. This requires that unique keys are used, and that the sender and receives are using a cryptographic method with asymmetric keys. This ensures that the receiver cannot generate a message that appears as if it came from the sender. This is often achieved using a public key system.

4.3.2 Security Requirement Analysis/ Threat Analysis

There are a number of items that need to be considered with respect to security. It is clear that a simple AMR system that grabs meter index values infrequently is likely to require significantly lower levels of security than more sophisticated meter management systems, especially where the network is used to control devices in the home, or the meter is used for prepayment. Selection of key management and encryption strategies is driven by the threat analysis. Such a threat analysis shall as well take man-in-the middle and replay attacks into account.

An assessment of the risks and alternatives shall be carried out using a recognized method; for example ISO/IEC 27033 (all parts) or ISO/IEC 15408 (all parts).

The financial world has had a focus on cost efficient data security for many years, and processes, procedures and methods used there should be taken into account.

4.3.3 Key Management

4.3.3.1 General

Correct key management is essential to meet the security requirements of the smart metering system. Correct handling of secure information like encryption keys is not straightforward. The keys require a high level of protection. The principle of “need to know” shall be applied. In some situations there may be a need for dual control, i.e. that one person alone cannot handle the whole key. Part of the threat analysis should address the following concepts:

1) how many entities need access to the keys in order to be able to encrypt and decrypt data passed from/to the meter;

2) how often keys will need changing;

3) how often some of the entities will change;

4) how key information is going to be distributed.

A meter is expected to have a lifetime in the order of 10 years. Therefore it is expected that keys will need to be changed several times within that time span. Given the prohibitive cost of site visits it is necessary that there is a method to distribute key information through the network in a secure manner.

The general concept is that there should at least be three levels of keys:

a) there is a master key used for distribution of a key encryption key, KEK;

b) there is a key-encryption-key, KEK, used for the distribution or generation of the normal key;

c) there are ‘normal’ keys for encryption and signing the data.

Depending on the level of security required, there may be a need for at least two keys, one for encrypting the data and one for generating the message digest (secure hash), and these shall be different keys. Different clients for the meter data should necessitate different sets of keys. It should also be considered that meters with tariff functions, prepayment, and/or valves will need to be confident in the instructions being received them may need further keys to ensure non-repudiation of these instructions.

Where a meter is supplied with a master key, care shall be taken to ensure that the key cannot be derived from other data (for example serial number), and suitable methods shall be used to store and distribute such master keys.

When keys are being supplied or updated, consideration should be given to using the three pass protocol exchange method.

4.3.3.2 Symmetrical or Asymmetrical Encryption

The classical concept is the use of a secret key, used for encryption as well as decryption, and hence is known as symmetrical.

Asymmetric encryption dates back to around 1970. It uses two keys, a public and a private key. Messages encrypted with a private key can only be decrypted with the public key and vice versa. Public/private key are easier to handle as the public part can be distributed as plain text but they are much larger than symmetrical keys take much more computing power to use. Public/private keys are traditionally used for the distribution of secret keys and the generation of certificates with secret keys being used for the data transactions.

A strategy often used is a hybrid approach, where a secret symmetrical key is created and shared using asymmetrical encryption. This minimizes the risk of decryption of data, as long as the key is replaced in less time than the expected time to use an attack to identify the key. This is because the data that could be accessed is limited, and the key will have changed before simulated data can be effectively inserted into the network. In practice, the use of this approach will depend on a reliable threat analysis and monitoring, to ensure that keys are changed promptly. Asymmetrical encryption does not by itself provide authentication. Authentication is provided by letting trusted third party sign the public key / information from the sender. The receiver can then verify the authenticity of the sender by verifying the signature.

NOTE EN 62056–5-3 and EN 62056–6-2 supports symmetric key algorithms. Work continues to amend these standards to support public key algorithms.

4.3.4 COSEM Upper Layer Security

COSEM has a system of clients with access to data in the meter governed by application associations. The public client and management client shall be implemented. This requires that users create application associations when initiating a session with the meter. When this session is established, the Meter will limit data and configuration options to that permitted by configuration of the meter. The exception is the management client, which generally has complete access to all aspects of the meter. Establishment of this session can be done in an insecure way or a number of secure ways. Typical client associations are listed in Table 1.

Table 1 — Typical Client Access Levels

Name	**Description**
Public Client	This client is usually configured to provide very little access, except to prove that communications to the meter exist.
Data Collection Client	Allows reading of ID's, Alarm, Date/Time, Load Profile, TOU's, MD's, Blocks, Cumulative Registers, measurement parameters
Extended Data Collection Client	Correction of time and Date, Resetting of MD's
Management Client	Allows Programming of Displays, setting of measurement, setting of 'secret' for Data Collection and Extended Data Collection Clients
Manufacturer Client	Allows specialized access for manufacturing operations

Application associations can be associated with the properties and methods of OBIS objects directly, either as a configurable object accessed via the management client or manufacturer client or defined in a companion specification.

When an application association has been created using an appropriate level of security for the application, the client messages can be expected to be encrypted and/or signed depending on the level of privacy and authentication that are required.

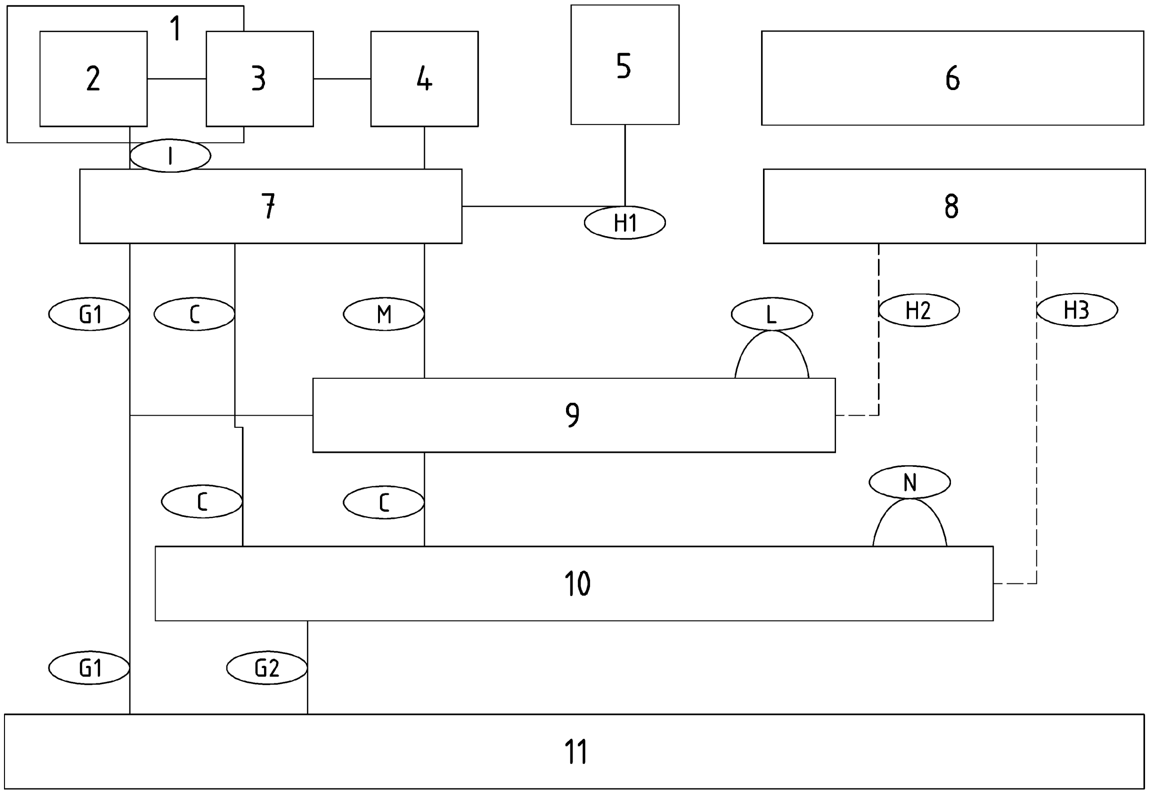
Both encryption and signature can be achieved by use of keys shared between the meter and the client.

4.3.5 Lower Layer Security

Lower layer security can be applied in addition to the upper layer security discussed above. The types of lower layer security that can be used depend on the lower layers being employed, and therefore these are discussed further within the relevant subclauses of Clause 7, Data Exchange. ISO 7498-2 recommends that encryption is performed end-to-end and not at the Data Link Layer.

5 Network Architecture

5.1 M/441 Mandate



Key

1	items required by MID	7	meter communication functions
2	metrology	8	HA communication functions
3	display	9	Local Network Access Point (LNAP)
4	additional functions	10	Neighbourhood Network Access Point (NNAP)
5	simple external consumer display	11	AMI Head End System
6	home automation functions		

Figure 5 — Network Architecture — The architecture diagram in CEN/CLC/ETSI TR 50572

This standard (in whole or part) is referred to in CEN/CLC/ETSI TR 50572 as a relevant standard for the interfaces noted as M, C, G1, and G2 in Figure 5.

The actual network architecture is dependent on the operating environment, meter functionality and the connection method used. It varies between basic readout networks to full Local Area Networks. The latter has turned applicable due to the low cost and high performance of such network components.

It is generally assumed that the communications interface is an integral part of the meter within this standard, but this may not be the case in the physical world. The communications interface may there be an add-on device to the meter.

5.2 General

This clause presents a simplified architecture for communicating with meters, concerning only the basic metering LAN.

This architecture should permit the quick introduction and installation of communicating meters, as well as the ability to extend the system afterwards. Therefore, some rules are given.

The principles of the metering network architecture are as follows:

— There shall be a single access point to the metering network.

— The single access point shall support multiple authorized parties accessing the metering network. It may be possible for the access point to support multiple concurrent accesses to one or multiple meters.

— The network should have a logical tree structure.

— The system shall be reasonably secure.

— The network should allow the use of a Hand Held Unit.

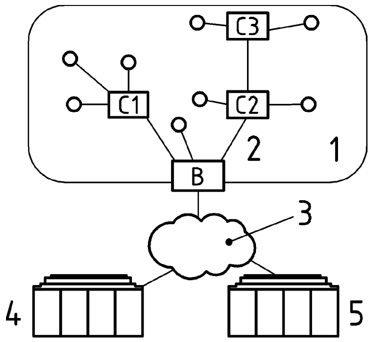
This architecture shall facilitate the fast installation and operation of meters and their associated communications onto a metering LAN. The potential for extending the architecture is a prime requirement.

The implementation of a physical architecture is determined by the media used.

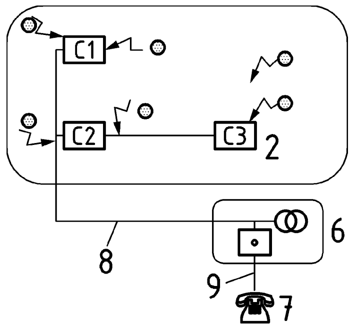
This document focuses on the system architecture, in order to accommodate a wide range of types of physical media.

5.3 Basic architecture

Figure 6 shows a typical basic architecture based on a tree topology and the corresponding physical architecture.



a) System Architecture



b) Physical Architecture

Key

1	meter LAN	6	MV/LV Station
2	access point	7	MODEM
3	WAN	8	PLC
4	authorized party 1 Central Station	9	PSTN or IP connection
5	authorized party 2 Central Station		
	TC 294 compliant meter		radio meter

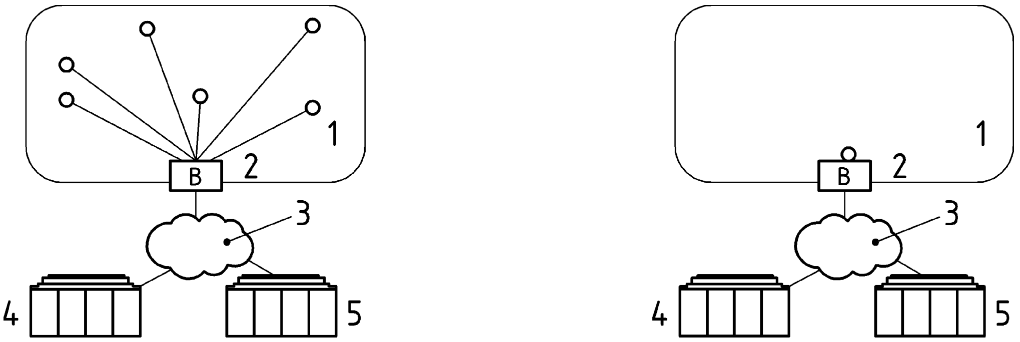
Figure 6 — System and physical architecture

C1, C2 and C3 are optional nodes (data concentrators) of the system that may be used to help access meters.

The access point B is the unique way to remotely access the system. Several authorized parties may access the system using access point B, providing they have access to the WAN connection.

5.4 Metering Architecture

The metering architecture may be analysed in terms of the systems architecture and physical architecture, as shown in Figure 6. The system architecture represents the key elements of the metering network, showing data flow, and providing the connectivity from the meter to the authorized party central station via a wide area network. The physical architecture represents the practical implementation of the system. In the example given in Figure 7, the meters are connected via radio to the concentrator, followed by the low voltage line to the MV/LV substation and finally via the telephone line to the central station. Although the figure shows that three different transmission media are used in this connection it may be more economical to use a single media throughout the system. The actual setup to use will have to be selected as part of the system design.



a) b)

Key

1	meter LAN	1	meter LAN
2	access point	2	access point
3	WAN	3	WAN
4	authorized party 1 Central Station	4	authorized party 1 Central Station
5	authorized party 2 Central Station	5	authorized party 2 Central Station
O	TC 294 compliant meter		

Figure 7 — Basic Metering architecture

A system architecture with a single master station and a number of meters connected to a physical bus as Figure 7 a) is an example of a basic network where the concentrators have been integrated into the access point.

A system with a single meter connected via the WAN to the integrated collection system as Figure 7 b) is an example of a system where the whole LAN has been integrated into the access point and combined with the meter.

The structure shall conform to the following rules:

— the architecture is a tree structure;

— there is only one access point per LAN;

— the unique access point (B) may have zero or more meters connected;

— the access point (B) may have zero or more 'concentrators' connected;

— a ‘concentrator’ may have zero or more meters attached;

— a ‘concentrator’ may have zero or more ‘concentrators’ attached;

— The logical meter may not communicate with another meter, but it may be appropriate to combine the concentrator with the meter in a single device;

— ‘concentrators’ have no external access point apart from zero or more data collection computers that may use the access point of (B).

NOTE Exact mapping of concentrators and access points to the architecture in 5.1 may depend on the implementation being carried out.

5.5 One unique access point at any time: a tree structure

An economic and easy to manage system may be achieved by having only one unique access point. A system with one unique access point is feasible with a tree structure. The actual physical structure depends on the actual physical layer used. Besides the line or star topology a loop or a ring would also be acceptable.

5.6 Self-configurable network

The proposed hierarchical architecture allows a level of self-configuration of a meter in a network. Self-configuration is managed, because each device needs to indicate to only one unique device that it is present and unassigned. This configuration is usually the responsibility of the Management Application in the meter.

The concentrator shall be resistant to unauthorized meters joining the network.

5.7 Hand Held Unit for local access

The requirement to be able to interrogate a device on the LAN using a Hand Held Unit (HHU) makes a temporary modification to the connectivity in order to maintain the network topology. The device may disconnect itself from its master, conducts the dialogue with the HHU as required and then reconnect to the system.

If a HHU is connected to a concentrator, the equipment itself and all the equipment under it may be made temporarily unavailable for the remote system (for the local operation duration), and be controlled by the HHU.

The Hand Held unit interfaces shall be treated as any other interfaces in the network with respect to their security requirements.

5.8 Network layers

There is no network layer required in a meter in a basic architecture. The meter will need some network layer functionality, as soon as it is possible to connect the meter to different destinations. This may be a part of more elaborate meters.

If one or more independent concentrators are in the Meter LAN, the protocol stack interconnecting the concentrators requires a network layer.

The collapsed models shown in Figure 7 b), does not require a network layer.

The consequential cost of a network layer is offset by the benefits of a concentrator. (e.g. to improve physical distance).

If a network uses IP, then the IP network layer is necessary.

5.9 Multiple access

The access point to the network is unique, but different communication channels may connect from the upper side. Several access networks are allowed, but not simultaneously, depending on the capabilities of the access point.

Network traffic priority will be handled by the access point.

6 Application Layers for Metering

6.1 General

There are at the present at least two Application Layers applicable to metering. This standard discusses the M-Bus based Application Layer and the DLMS COSEM Application Layer. The DLMS COSEM Application Layer is specified in EN 62056-5-3. It proves services to access COSEM interface object attributes and methods, modelling the functions of the meter. The COSEM interface classes are specified in EN 62056-6-2. The OBIS Object Identification System is specified in EN 62056-6-1 for abstract objects and electricity metering objects, and in this standard for other metering technologies. The M-Bus based Application Layer is specified in EN 13757-3. The M-Bus Application Layer has a simpler functionality and requires thus less electrical and processing power when implemented. This standard does not preclude alternative application layers as they are developed. Alternative Application layers are applicable only if they will co-exist with the existing M-Bus and DLMS COSEM application layers.

6.2 COSEM Application Layer for Metering

DLMS/COSEM is an application layer (AL) protocol specified in EN 62056-5-3. It covers the Application, Session and Presentation layer functionalities of the OSI model.

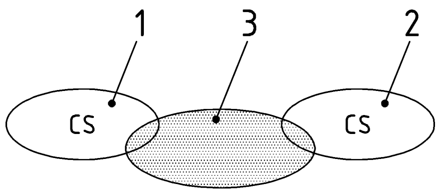
The DLMS COSEM AL provides services for establishing Application Associations (AAS) based on ISO/IEC 15953 and ISO/IEC 15954, the standards specifying the Association Control Service Element (ACSE) services and connection-oriented protocols.

It also provides services for accessing attributes and methods of COSEM interface objects that model the functions on the server. These services are provided by the xDLMS Application Service Element. xDLMS is an upper compatible extension of the DLMS standard specified in EN 61334-4-41. It can be considered as a companion specification to EN 61334-4-41.

The xDLMS ASE also provides cryptographic protection of the APDUs, the application layer level messages. To transport long messages, a block transfer mechanism is also available.

6.3 Companion Specification

A **Companion Specification** (CS) is an extension to a generic standard. It may contain extension to the existing standard, as well as operating rules within the scope of the existing standard, as shown in Figure 8.



Key

1 operating rules inside scope of the existing standard

2 extensions not compatible with the existing standard

3 messaging system kernel

Figure 8 — Scope of Companion Specifications

DLMS is a powerful messaging system, derived from MMS, ISO 9506-1 (Manufacturing Messaging System). In order to fully adapt DLMS to the metering application, the COSEM Application Layer is based on an extended version of DLMS. These extensions are made such that there is no conflict with the current version of DLMS. This can be viewed as a **Companion Specification** (CS). The CS can be seen as a set of additional rules to DLMS, which are semantically and syntactically compatible with the DLMS kernel.

Extensions can be found in EN 62056-5-3 (COSEM Application Layer).

A **Companion Specification** may go beyond pure data communication. It specifies the functionality of an application, as seen through the communication system as shown in Figure 9. In the current context, this is the functionality, of the meter or meters, defined in terms of the objects contained within them (e.g. Index, ID, meter type, manufacturer, date and time, rate and even communication entities such as a phone number). This standard bases its generic functional application requirements on the EN 62056-6-2, “Companion Specification for Energy Metering”, approach.

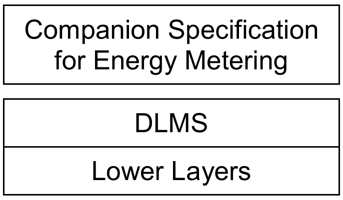


Figure 9 — Companion Specification in relation to lower layers (3 layer model)

6.4 COSEM Basic Principles

This Clause 4 describes the basic principles on which the COSEM interface classes (ICs) are built. It also gives a short overview on how interface objects – instantiations of the ICs – are used for communication purposes. Data collection systems and metering equipment from different vendors, following these specifications, can exchange data in an interoperable way.

For specification purposes, this standard uses the technique of object modelling.

An object is a collection of attributes and methods. Attributes represent the characteristics of an object. The value of an attribute may affect the behaviour of an object. The first attribute of any object is the “logical_name”. It is one part of the identification of the object. An object may offer a number of methods to either examine or modify the values of the attributes.

Objects that share common characteristics are generalized as an IC, identified with a class_id. Within a specific IC, the common characteristics (attributes and methods) are described once for all objects. Instantiations of ICs are called COSEM interface objects.

Manufacturers may add proprietary methods and attributes to any object. Figure 10 illustrates these terms by means of an example:

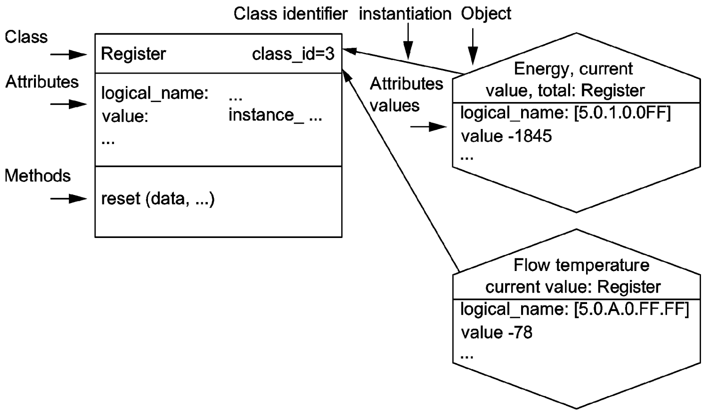


Figure 10 — An interface class and its instances

The IC "Register" is formed by combining the features necessary to model the behaviour of a generic register (containing measured or static information) as seen from the client (data collection system, hand-held terminal). The contents of the register are identified by the attribute "logical_name". The logical_name contains an OBIS identifier. The actual (dynamic) content of the register is carried by its "value" attribute.

Defining a specific meter means defining several specific objects. In the example of Figure 10, the meter contains two registers; i.e. two specific instances of the IC "Register" are instantiated. Through the instantiation, one COSEM object becomes a "total, positive, active energy register" whereas the other becomes a "total, positive, reactive energy register".

NOTE The COSEM interface objects (instances of COSEM ICs) represent the behaviour of the meter as seen always initiated from the outside. Internally initiated changes of the attributes – for example updating the value of a register – are not described in this model.

6.5 Management of a COSEM Device

One physical unit may contain or represent multiple metering units or logical devices. Such a physical unit will have one physical communications interface but multiple metering applications. This calls for a management application inside the unit that performs communications management. This is handled by COSEM as well.

The COSEM Logical Device is a set of COSEM objects. Each Physical Device shall contain a Management Logical Device. The mandatory contents of each Logical Device are:

— COSEM Logical Device Name;

— Current Association (LN or SN) object.

The Management Logical Device shall support an Application Association with lowest security level to a Public Client. The Management Logical Device shall support at least one further Application Association with security appropriate to the network structure and risk.

The addressing of the COSEM Logical Devices shall be provided by the addressing scheme of the lower layers of the protocols used.

6.6 Lower layers

The Lower layers shall include the Physical Layer and the Link Layer. If the seven layer OSI Model is used, the lower layers shall include network and transport layers. If the IP Model is used, the lower layers are managed by the IP system. The need for multiple communications methods causes the need for multiple different lower layers. All of the lower layers consist of a Physical Layer and a Link Layer. The requirements for the Link Layer are very often closely related to a specific Physical Layer.

In order to define full protocol stacks, which are needed for meter interchangeability, the lower layers shall be specified/ selected as well. Some lower layers have been selected/ adopted, and new lower layers will be added as amendments in the future when new technologies mature.

An overall diagram with all of the elements needed and their relationships is shown in Figure 11.

Application Functionality	Companion Specification for Energy Metering EN 62056–6-2, EN 62056–6-1 and EN 13757–1					
Application Layer	DLMS/COSEM application layer EN 62056–5-3					
Link Layer	EN 62056–46		EN 13757–3		...	?
Physical Layer	EN 62056–21	EN 62056–42	EN 13757–2/ EN 13757–6	EN 13757–4; EN 13757–5	...	?
Connection Method	Optical (Local) Port	PSTN	Wired M-Bus	Wireless M-Bus		Future methods (to be defined)

Figure 11 — Full protocol stack

As can be seen from the figure above, the Application Layer and the Application functionality remain unchanged, even if the connection method changes.

7 Data Exchange

7.1 General

This subclause describes a number of lower layers and stacks that are to be used in implementing smart metering. Because of the speed of evolution of communications media, and the use cases to which they will be put, this document does not promote any one of these. The document now also provides a secure interface to allow innovative communications media to be used with the EN 13757 series of standards, in accordance with the M/441 mandate.

7.2 Data exchange using direct local connection

7.2.1 General

This clause handles the reading of meters directly connected to a readout device. One interface of this type has been adopted, EN 62056-21. This standard specifies the physical connection adopted between meter and reading device:

— an optical interface;

— an electrical current loop interface;

— an electrical V.24/ V.28 interface.

All interfaces use the same protocol. Data are exchanged using a character oriented protocol (ASCII). Different communication modes are described in EN 62056-21. Modes A to D use ASCII transfer only, Mode E is able to switch over to a HDLC oriented binary data exchange. Provisions for battery operated devices are given in EN 62056-21:2002, B.1 and B.2.

NOTE This is for use with a hand-held terminal and is not intended as an H1 interface for in-home display.

7.2.2 Security

Physical access to this interface is governed by the location of the meter. The meter design should take account of the need for security of this interface, perhaps by means of a pre-shared key to ensure that the user of the terminal used to connect directly to the meter is suitably accredited.

7.2.3 Physical layer

7.2.3.1 Optical interface

This is a very common interface for Hand Held Units. It supports one meter at a time using half-duplex communication. It communicates with the meter using IR light via a standardized optical reading head, to be plugged magnetically to the meter. An interface of this type shall fulfil the requirements of EN 62056-21:2002, 4.3.

7.2.3.2 Electrical current loop interface

This interface is the ‘classical’ 20 mA current loop. Two- as well as four-wire configurations are available. One master unit may support up to eight meters. An interface of this type shall fulfil the requirements of EN 62056-21:2002, 4.1.

7.2.3.3 Electrical V.24/V.28 interface

This interface is the well-known “RS232 port” in a three-wire configuration (Rx, Tx, GND). An interface of this type shall fulfil the requirements of EN 62056-21:2002, 4.2.

7.2.4 Link Layer

The requirements of EN 62056-21 apply. Although no explicit layering is mentioned in this standard, the following relevant standards are referenced:

The character-oriented Link Layer uses:

— the ISO 7-bit coded character set as defined in ISO/IEC 646;

— the use of longitudinal parity (7E1) as defined in ISO 1155;

— the start/stop character-oriented transmission as defined in ISO 1177;

— the basic mode control procedures as defined in ISO 1745.

Binary data exchange (mode E) is based on:

— EN 62056-46 Data Link layer using HDLC protocol (see EN 62056-21:2002, Annex E).

7.3 Data exchange using wired local area network (LAN)

7.3.1 General

This is represented on the M/441 architecture, as interface M. See Figure 5.

This clause handles the reading of meters connected to a wired metering local area network. The network has a single master station, and one or more slave stations. Three types of interfaces have been adopted.

— EN 13757-2, the classical “M-Bus” for fixed installations,

— EN 13757-6, “Local bus” a limited subset of the M-Bus for non-fixed reading,

— EN 62056-3-1, the “Urídis” setup.

They are specified in the following subclauses.

7.3.2 Twisted pair, baseband signalling

7.3.2.1 General

This type of interface is standardized by EN 13757-2. It is a ‘multi-drop’ type connection with one master unit and one or more slave units. The master unit in the network can support energy to the interface part of the slave unit. A network may have up to 250 meters connected. The meter shall be a slave unit. This connection is applicable to COSEM as well as to M-Bus based Application Layers.

7.3.2.2 Physical layer

An interface of this type shall fulfil all the requirements of EN 13757-2:2004, Clause 4.

7.3.2.3 Link layer

An interface of this type shall fulfil all the requirements of EN 13757-2:2004, Clause 5.

7.3.3 Twisted pair, baseband limited systems

This type of interface is standardized by EN 13757-6. It is a limited version of EN 13757-2. It has a simple concentrator only able to support up to 5 meters. The standard only specifies the physical layers. The link layer is identical to the one used in EN 13757-2. This data exchange is only intended for M-Bus based Application Layer.

7.3.4 Twisted pair, carrier signalling

This interface shall comply with EN 62056-3-1. It is a multi-drop connection with one master unit and one or more slave units. A master unit is named a Primary Station. A slave unit is named a Secondary Station. The meter shall be a Secondary Station. The network is able to supply energy to the interface part of the slave unit. This data exchange is only intended for DLMS COSEM Application Layer.

7.4 Data exchange using wide area network (WAN)

7.4.1 General

This clause lists protocol stacks applicable for a direct connection from the meter to the processing centre using wide area networks, WAN, without intermediate processing. The public switched telephone network, PSTN is gradually being replaced by TCP/IP based data networks and Mobile telephone networks. Two standards have been identified for transfer across the wide area network. The one is based on the use of PSTN, the other is based on the use of a TCP/IP or UDP/IP based network. These connections are only applicable to DLMS/COSEM application Layers.

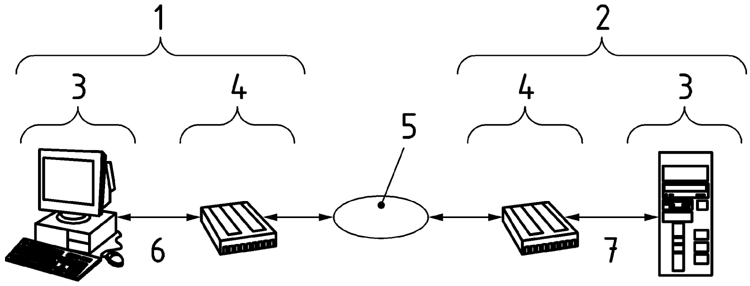
7.4.2 PSTN based connection

7.4.2.1 General

Meters using PSTN Connection shall comply with the relevant requirements of EN 62056-42 and EN 62056-46 for the lower layers. These are parts of the COSEM (Companion Specification for Energy Metering) three-layer connected oriented profile for asynchronous data communication. Normal asynchronous MODEM connection is used, based on intelligent Hayes modems.

7.4.2.2 Physical Layer EN 62056-42

From the external point of view, the physical layer provides the interface between the Data Terminal Equipment (DTE) and the Data Communication Equipment (DCE). Figure 12 shows a typical configuration for data exchange through a Wide Area Network, for example the PSTN.



Key

1	COSEM Client	5	transmission network
2	COSEM Server	6	DTE to DCE ITU-T V. Series EIA RS232, RS485 Hayes, etc
3	DTE	7	DCE to DTE ITU-T V. Series EIA RS232, RS485 Hayes, etc
4	DCE		

Figure 12 — Typical PSTN configuration

From the physical connection point of view, all communications involve two sets of equipment represented by the terms Caller system and Called system, as defined in 4.1.

From the data link point of view the central station normally acts as a master, taking the initiative and controlling the data flow. The tariff device is the slave, responding to the master station.

From the application point of view the central station normally acts as a client asking for services, and the tariff device acts as a server delivering the requested services.

For the purposes of local data exchange, two DTEs can be directly connected using appropriate connections.

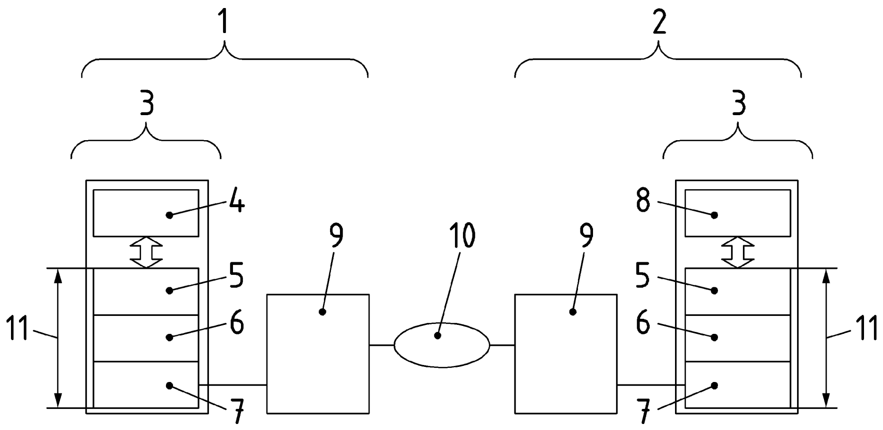
To allow using a wide variety of media, this standard does not specify the physical layer signals and their characteristics. However, the following assumptions are made:

— the communication is point to point or point to multipoint;

— both half-duplex and full-duplex connections are possible;

— asynchronous transmission with 1 start bit, 8 data bits, no parity and 1 stop bit (8N1);

— from the internal point of view, the physical layer is the lowest layer in the protocol stack – see Figure 13.



Key

1	COSEM Client	7	Physical Layer
2	COSEM Server	8	server application
3	DTE	9	Data Comm. Equipment (DCE)
4	client application	10	transmission network
5	Application Layer	11	protocol
6	Data Link Layer		

Figure 13 — The location of the Physical Layer

This standard defines the services of the physical layer towards its peer layer(s) and the upper layers, and the protocol of the physical layer.

7.4.2.3 Link Layer EN 62056-46

7.4.2.3.1 Introduction

This part of EN 62056 specifies the Data Link Layer for a connection-oriented, HDLC-based, asynchronous communication profile.

In order to ensure a coherent Data Link Layer service specification for both connection-oriented and connectionless operation modes, the Data Link Layer is divided into two sub-layers: the Logical Link Control (LLC) sub-layer and the Medium Access Control (MAC) sub-layer.

This specification supports the following communication environments:

— point-to-point and point-to-multipoint configurations;

— dedicated and switched data transmission facilities;

— half-duplex and full-duplex connections;

— asynchronous start/stop transmission, with 1 start bit, 8 data bits, no parity, 1 stop bit.

Two special procedures are also defined:

— transferring of separately received Service User layer PDU parts from the Server to the Client in a transparent manner. The Server side Service User layer can give its PDU to the Data Link layer in fragments and the Data Link Layer can hide this fragmentation from the Client;

— event reporting, by sending UI frames from the secondary station to the primary station.

7.4.2.3.2 The MAC sub-layer

The MAC sub-layer – the major part of this Data Link Layer specification – is based on ISO/IEC 13239 concerning high-level data link control (HDLC) procedures.

The MAC sub-layer is specified in EN 62056-46:2002, Clause 6. This standard includes a number of enhancements compared to the original HDLC, for example in the areas of addressing, error protection and segmentation. These enhancements have been incorporated in a new frame format, which meets the requirements of the environment found in telemetry applications for electricity metering and similar industries.

7.4.2.3.3 The LLC sub-layer

In the connection-oriented profile the only role of the LLC sub-layer is to ensure consistent Data Link Addressing. It can be considered that the LLC sub-layer, defined in ISO/IEC 8802-2, is used in an extended Class I operation, where the LLC sub-layer provides the standard connectionless data services via a connection-oriented MAC sub-layer.

The LLC sub-layer provides Data Link (DL) connection/disconnection services to the Service User layer, but it uses the services of the MAC sub-layer to execute these services.

The LLC sub-layer is specified in EN 62056-46:2002, Clause 5.

7.4.2.3.4 Specification method

Both sub-layers of the Data Link Layer are specified in terms of ***services*** and ***protocol***.

Service specifications cover the services required of, or by, the given sub-layer at the logical interfaces with the neighbouring other sub-layer or layer, using connection oriented procedures. Services are the standard way to specify communications between protocol layers. Through the use of four types of transactions, commonly known as service primitives (Request, Indication, Response and Confirm) the service provider coordinates and manages the communication between the users. Using service primitives is an abstract, implementation-independent way to specify the transactions between protocol layers. Given this abstract nature of the primitives, their use makes good sense for the following reasons:

— they permit a common convention to be used between layers, without regard to specific operating systems and specific languages;

— they give the implementers a choice of how to implement the service primitives on a specific machine.

Service primitives include service parameters. There are three classes of service parameters:

— parameters transmitted to the peer layer, becoming part of the transmitted frame, e.g. addresses, control information;

— parameters which have only local significance (e.g. Physical_Connection_Type);

— parameters which are transmitted transparently across the data link layer to the user of the data link layer.

This document specifies values for parameters of the first category only.

The ***protocol*** specification for a protocol layer includes:

— the specification of the procedures for the transmission of the set of messages exchanged between peer-layer;

— the procedures for the correct interpretation of protocol control information;

— the layer behaviour.

The protocol specification for a protocol layer does not include:

— the structure and the meaning of the information which is transmitted by means of the layer (Information Field);

— the identity of the Service User layer;

— the manner in which the Service User layer operation is accomplished as a result of exchanging Data Link messages;

— the interactions that are the result of using the protocol layer.

7.4.3 IP connection

7.4.3.1 General

The internet protocol is the principal communications protocol used to relay datagrams across a wide area network. It uses a slightly different structure to the OSI 7-layer model, in that it consists of application, transport, internet and link layers.

COSEM on IP is currently fully defined for IPv4, in that the standard data model has support for IPv4 addressing, using the COSEM Application Layer, with ACSE and xDLMS to communicate via UDP or TCP.

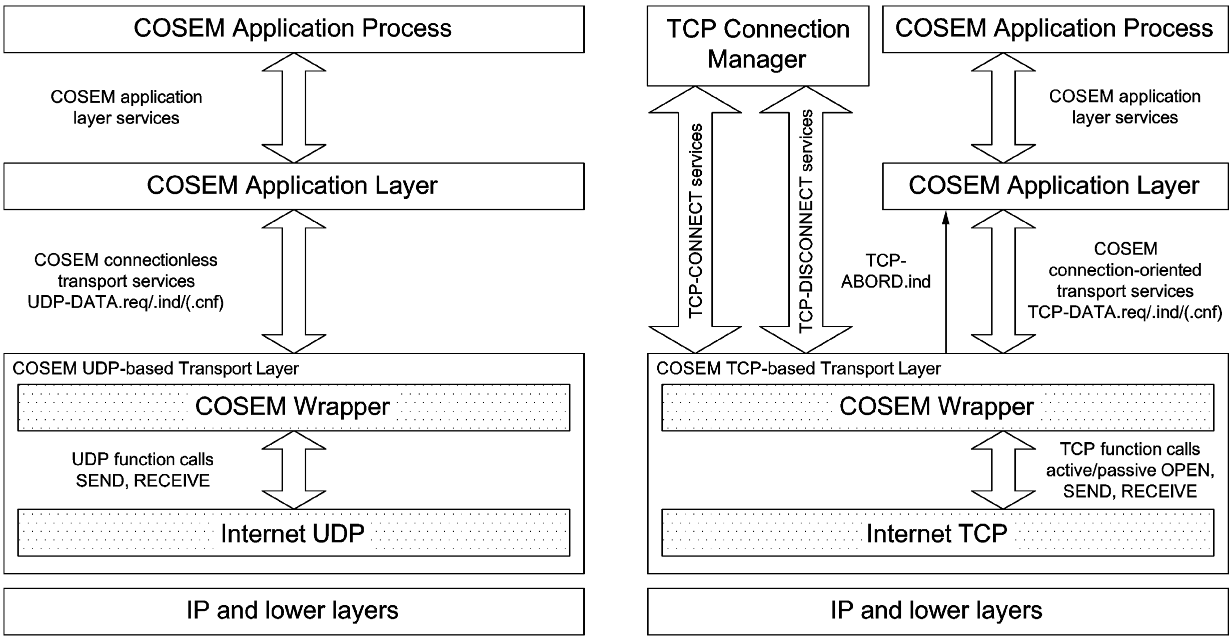


Figure 14 — COSEM over IP

Figure 14 shows the layers utilized in communication over IP networks. Where COSEM is to be transported over IP, the layers below the IP layer shall be capable of transporting the data between the client and the server. While this will often be on the internet, this could be over a private IP network. Technologies that can support this transport include PSTN, xDSL, PLC and a range of radio technologies including GPRS.

7.4.3.2 IPv4 based connection

The internet based connection is based on the “Internet” protocol suite. There are no limitations to the Physical Layer and Link Layer protocols, except that they shall provide the services needed by the “IPv4” network layer. Typical connection methods applicable are optical fibre, LAN cabling, ADSL and wireless services. The network layer is specified by IETF RFC 791. Two possible Transport Layer standards are available, IETF RFC 793, TCP and IETF RFC 768 UDP. The adaptation to the COSEM Application layer is specified in EN 62056-47. This standard is as well applicable as the connection method across a LAN to a concentrator. The biggest restriction in IPv4 is the lack of availability of static IP addresses, and this is leading a move to IPv6 technology for the future. The shortage of IPv4 addresses means that the vast majority of meters cannot be allocated individual IP addresses, and therefore the meter needs to initialize a communications session to gain a temporary IP address, either as result of a scheduled event, a response to an event within the meter, or by a communications stimulus (for example, a SMS message to a GPRS modem).

7.4.3.3 IPv6 based connection

This is the latest version of the Internet Protocol. There are no limitations to the Physical Layer and Link Layer protocols that may be applied, except that they shall provide the services needed by the “IPv6” network layer. Typical connection methods applicable are optical fibre, LAN cabling, ADSL, Power Line Carrier, and radio services. The IPsec security layer was designed to be used on IPv6. The core standard for IPv6 is IETF RFC 2460. The key difference between IPv6 and IPv4 is that IPv6 uses 128 bit addressing, which provides for ($3{,}4 \times 10^{38}$) possible addresses, where IPv4 was limited to just over 4 billion addresses.

7.4.3.4 IP security

7.4.3.4.1 General

There are a number of methods that can be used for IP security. While any or all of the methods described here can be used with or without the application layer client security requirements in 4.3.4, evaluation of the value of the data and costs of security is necessary to select the correct methods to ensure a secure solution. There is a temptation to simply insist on security at three levels, where this will be burdensome and costly to manage, and may provide little better protection than protection at one or two layers.

7.4.3.4.2 IPsec

IPsec is an end-to-end security scheme operating in the Internet layer. It can be used in protecting data flows between a pair of hosts (*host-to-host*) or between a security gateway and a host (*network-to-host).* IPSec is documented principally in IETF RFC 4301. IPSec provides both encryption and authentication.

If IPSec is used on IPv4 networks then Tunnelling Mode shall be applied, to avoid network address translation issues.

7.4.3.4.3 TLS

TLS is a secure transport/application layer security protocol that can be used alongside TCP or UDP. While one of its features is the ability to use a variety of encryption, hashing and key handling techniques, the additional handling required to negotiate the security is not optimal for networks where small data sets are moved over frequent sessions. TLS is documented fully in IETF RFC 5246.

7.5 Data exchange using M-Bus radio communication

7.5.1 General

This clause handles the reading of meters connected to a wireless metering network. There are networks with a basic architecture as well as networks with routing capabilities. The networks are specified in EN 13757-4 and EN 13757-5.

7.5.2 Basic M- Bus radio networks

EN 13757-4 specifies radio network with a number of different modes. It uses the basic architecture from Clause 5. It has a number of different modes, each applicable to a different operating environments. EN 13757-4 is updated periodically to ensure that new radio modes are standardized.

EN 13757-4 specifies physical and link layers based on EN 60870-5-2. This connection provided is applicable to COSEM as well as to M-Bus based Application Layers.

7.5.3 Routed M-Bus radio networks

EN 13757-5 specifies the forwarding of data from basic radio networks using gateways or routers. It contains three different modes all having Network Layer functionality:

— the forwarding of data from basic networks using gateways, based on Mode R from EN 13757-4;

— the forwarding of data using routers, using an adapted Mode R2 Link Layer protocol and a Network Layer;

— a mode optimized for the handling of precise timing.

All three modes are able to handle COSEM as well as M-Bus Application Layer data.

7.6 Data Exchange using HDLC for some innovative communications technologies and local interfaces

7.6.1 General

This subclause handles the reading of meters where there is as yet no formal stack, and is designed to allow innovation in communications media using a standardized approach to the upper layers.

Data should be exchanged using a character oriented protocol (ASCII). Mode E, as described in EN 62056-21:2002, 6.4.5, shall be used as it is able to switch over to a HDLC oriented binary data exchange. Provisions for battery operated devices are given in EN 62056-21:2002, B.1 and B.2.

7.6.2 Security

As a minimum, low level authentication security shall be applied. See 4.3.4 for more information.

If the electrical interface can be accessed by unauthorized persons without causing an error condition in the system, then:

1) high level application layer security shall be applied;

2) traffic over the interface shall be encrypted and signed.

7.6.3 Physical layer

7.6.3.1 General

The physical layers specified below may be used to provide local interfaces to the meter, but innovative communications media will be determined by the media specification.

7.6.3.2 Electrical current loop interface

This interface is the ‘classical’ 20 mA current loop. Two- as well as four-wire configurations are available. One master unit may support up to eight meters, however, this application of the interface shall restrict users to a single master and a single slave. An interface of this type shall fulfil the requirements of EN 62056-21:2002, 4.1.

7.6.3.3 Electrical V.24/V.28 interface

This interface is the well-known “RS232 port” in a three-wire configuration (Rx, Tx, GND). An interface of this type shall fulfil the requirements of EN 62056-21:2002, 4.2.

7.6.4 Link Layer

The requirements of EN 62056-21 apply. Although no explicit layering is mentioned in this standard, the following relevant standards are referenced:

The character-oriented Link Layer uses:

— the ISO 7-bit coded character set as defined in ISO/IEC 646;

— the use of longitudinal parity (7E1) as defined in ISO 1155;

— the start/stop character-oriented transmission as defined in ISO 1177;

— the basic mode control procedures as defined in ISO 1745.

Binary data exchange (mode E) is based on EN 62056-46 Data Link layer using HDLC protocol (see EN 62056-21:2002, Annex E).

8 Upper Layer Protocols

8.1 Introduction

This clause covers the upper layer protocols for COSEM based connections. The requirements are split into the following sub-layers:

— transport;

— application.

NOTE Upper layer protocols for M-Bus based connections are handled in EN 13757–3.

8.2 Transport sub-layer

8.2.1 Introduction

The Transport sub-layer is the first one to handle direct connections between the systems at the ends of the links. All the connections set up at this level and those at higher levels can be considered as end-to-end links. This end-to-end notion indicates that the transport entities offer services completely independent of the physical networks.

The most important properties of the Transport sub-layer are; end-to-end transport (mentioned above), transparency (any binary configuration shall be accepted by the transport protocol and delivered without modification, whatever its format or size, this may require segmenting/reassembling functionality in the sub-layer) and application layer addressing (multiplexing of multiple logical connections on one physical connection).

The Transport sub-layer accepts the messages from the Application sub-layer. As the size of these messages is dictated by the application, the Transport sub-layer shall be able to segment them into packets (called TPDUs, transport protocol data units) with a size supported by the lower layers and transmit them to the corresponding Transport sub-layer at the other end. Reciprocally, it shall be able to receive the packets from the corresponding Transport sub-layer and assemble them into coherent messages for the Application sub-layer.

The Transport sub-layer protocol shall be able to transmit data in full duplex or half duplex modes, Caller-Called and Called-Caller. Moreover, the multiplexing of transport connections on the same virtual circuit means that several application associations can coexist in a given communication.

Whatever their origin, the Transport Protocol Data Units, TPDUs are transmitted using the services of the Data Link Layer. Of course, the Data Link is not aware of the multiplexing implemented at the higher level.

8.2.2 EN 62056-46 related Transport sub-layer

For connection methods using the HDLC based link layers, the use of the EPA model has been foreseen. The transport layer services needed has been integrated into the link layer.

In COSEM, there are two mechanisms provided for segmentation:

— The data link layer provides segmentation for messages between the slave and the master station only. This is transparent for the application layer. It is supported by the segmentation feature of HDLC (I frames). See EN 62056-46:2002, 6.4.4.5;

— The application layer provides segmentation in both directions, using the xDLMS services GET, SET, ACTION (DataBlock-G, DataBlock-SA).

Multiple Application Associations are supported by the DLMS/COSEM application layer and the COSEM Association objects, provided that the HDLC layer supports multiple data link connections

NOTE For details of establishing and releasing application associations, see EN 62056–5-3. For details of transferring long data, see EN 62056–46 and EN 62056–5-3.

8.2.3 EN 62056-47 related Transport sub-layer.

For connections based on IP TCP provides the handling of segmentation. The TCP-UDP/IP transport layer is specified in EN 62056-47, EN 13757-2 and EN 13757-4.

8.2.4 Transport sub-layer

For connection methods based on the EN 60870-5-2, link layer, transport sub-layer services are not included. For these connection methods, the Transport Protocol Data Unit (TPDU) shall consist of the following fields:

— a Control Information, (CI) field of 1 byte;

— a Source Transport Service Access Point (Address), STSAP field of 2 bytes;

— a Destination Transport Service Access Point (Address), DTSAP field of 2 bytes;

— a data field, of up to 248 bytes in size.

The fields shall be in the sequence shown in Figure 15.

NOTE 1 The maximum size of the data field is determined by the size limitations of the EN 60870–5-2 link level packets.

CI	STSAP	DTSAP	Data Field

Figure 15 — EN 60870-5-2-related Transport PDU format

The CI field of the Transport PDU shall be as shown in Figure 16 and coded in the following way:

Bit 8, Bit 7, Bit 6		Always ‘000’
Bit 5	‘FIN’	Set to ‘1’ in the last ‘TPDU’ as a part of a ‘APDU’
Bit 4, Bit 3, Bit 2, Bit 1		Fragment count, set to ‘0000’ in the first ‘TPDU’ for a session and incremented for each ‘TPDU’ sent.

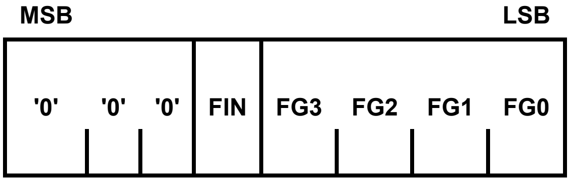


Figure 16 — CI field format

The coding of bit 8, bit 7 and bit 6 of the CI field ensures that DLMS oriented frames can coexist with existing meter communication from an EN 1434-3 or EN 13757-3 based bus system.

The FIN (finish) bit indicates the last segment of an APDU from the Application sub-layer. The FIN bit shall be set in the last TPDU of a APDU. This makes it possible to reassemble the data reliably at the receiving end.

In short messages, with only one segment, the FIN bit should be set as well in the first (and only) TPDU.

A fragment counter, FG3 - FG0 shall be available in the Transport sub-layer, as EN 60870-5-2 has no mechanism to identify double packet in responses from the meter to the central station. The fragment counter shall be ‘0000’ in the first TPDU of every APDU from the Application sub-Layer. The fragment counter shall be incremented for every TPDU.

NOTE 2 Usually there will be one fragment counter for each concurrent connection.

The STSAP field shall contain the Logical Device Address of the caller. Most significant byte is sent first.

The DTSAP field shall contain the Logical Device Address of the called. A DTSAP of FFFFh is a broadcast address, and the data shall be distributed to all logical devices in the called unit. Most significant byte is sent first.

The DTSAP of 0001h is in COSEM pre-assigned to the management application, and should always be present. In a simple meter, this can be the only DTSAP assigned. The Management Logical Device should support an Application Association with lowest security level to a Public Client with a STSAP of 0010h.

Detection of errors in the communication of the Transport sub-layer will cause the following actions:

— an abort indication will be sent to the Application sub-layer;

— a request to abort is sent to the Link Layer;

— a re-initialization of the Transport sub-layer.

Care should be taken to avoid confusing caller and called with DLMS-COSEM client and server.

8.3 Application sub-layer

8.3.1 Introduction

EN 62056-5-3 applies. This document specifies the COSEM Application Layer in terms of structure, services and protocols, for COSEM Clients and Servers.

8.3.2 Application layer structure

The main component of the Client and Server COSEM Application Layer is the COSEM Application Service Object (ASO), which provides services to the COSEM Application process and uses services provided by the supporting lower layer.

Both the Client and Server side COSEM ASO contains three mandatory components, as follows:

— Association Control Service Element (ACSE). The task of this element is to establish, maintain and release application associations. For the purpose of the connection-oriented profile, the connection-oriented ACSE, specified in ISO/IEC 15953 and ISO/IEC 15954 is used;

— the Extended DLMS Application Service Element (xDLMS_ASE). The task of this element is to provide data communication services to remote COSEM equipment;

— the Control Function (CF). This element specifies how the ASO services invoke the appropriate service primitives of the ACSE and the xDLMS ASE-s and the services of the supporting layer.

Both the Client and the Server COSEM ASO may contain other optional application protocol components. Figure 17 shows a 'minimal' COSEM ASO-s, containing only the three mandatory components.

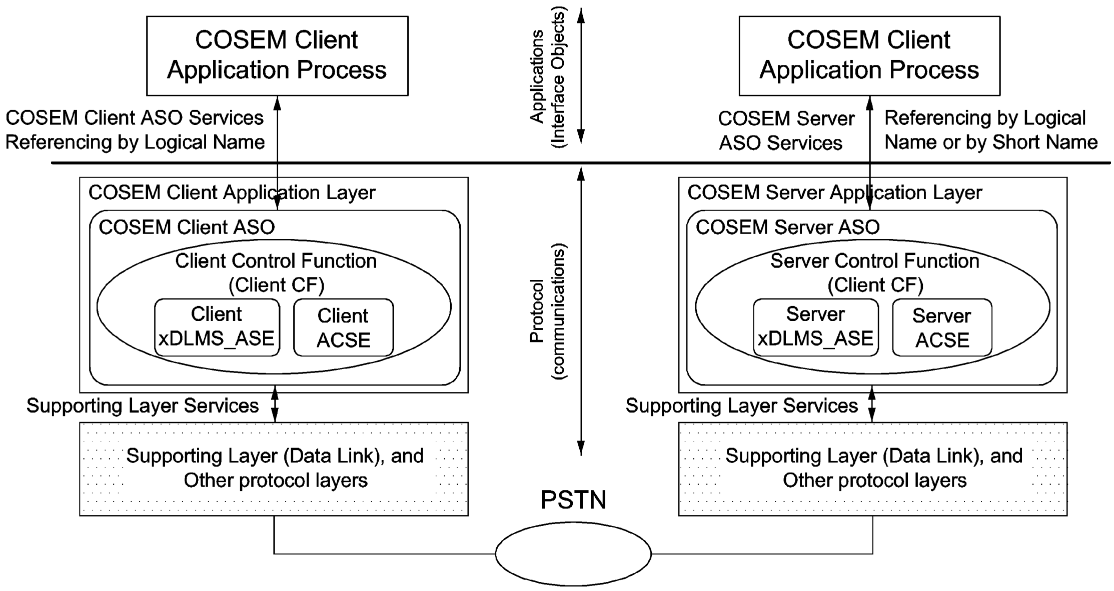


Figure 17 — The structure of the COSEM Application Layers

8.3.3 Service specification

Service specification covers the services required of or by, the Client and Server COSEM Application Processes at the logical interfaces with the respective COSEM Application Layer, using connection oriented procedures.

Services provided by the COSEM ASO fall in three categories:

— services provided for application establishment and release;

— services provided for data communication;

— services provided for layer management.

8.3.4 Protocol specification

The COSEM Application layer protocols specify the procedures for the transfer of information for application association control, authentication (ACSE procedures) and for data exchange of COSEM Servers (xDLMS procedures). These procedures are defined in terms of:

— the interactions between peer ACSE and xDLMS protocol machines through the use of services of the supporting protocol layer;

— the interactions between the ACSE and xDLMS protocol machines and their service user;

— the abstract syntax (ASN.1) representation of Application Protocol Data Units (APDU-s) is also specified with the Application protocols.

NOTE All COSEM Services are operating on an already established physical connection. Establishment of this physical connection is done outside the COSEM protocol, therefore it is out of the scope of this document.

9 Cross-application data handling

9.1 General

This subclause will explain the handling of different Application Layers used a one combined metering system. The described solutions will provide interoperability of such a metering system.

There are two different methods possible:

— Tunnelling:

One concept is called tunnelling. This will allow the complete transport of one telegram using the mechanism of a different transportation standard, controlled by the application layer. Using this concept will build up a transparent End to End communication. Therefore no telegram evaluation is done in the nodes of the communication line which will minimize the implementation and maintenance effort, and provide for better message security. Tunnelling may also be known as wrapping.

— Translation:

Translation will transform transmitted data points of the source telegram to the new application layer data format. This will create a complete new telegram that will be transmitted. Using this mechanism some data selection (reduction) can be done within the node. The conversion roles may have a 1:1 relation to achieve total interoperability.

This document covers Tunnelling methods.

9.2 Data tunnelling

9.2.1 General

Both M-Bus and DLMS Application Layer protocols can support the transfer of ‘foreign’ data. This is achieved by encapsulating the information as special data types. The COSEM Application Layer can transfer M-Bus information using an abstract object, as specified in 9.2.2.

The principles of Tunnelling the COSEM Application Layer via M-Bus are shown in Figure 18.

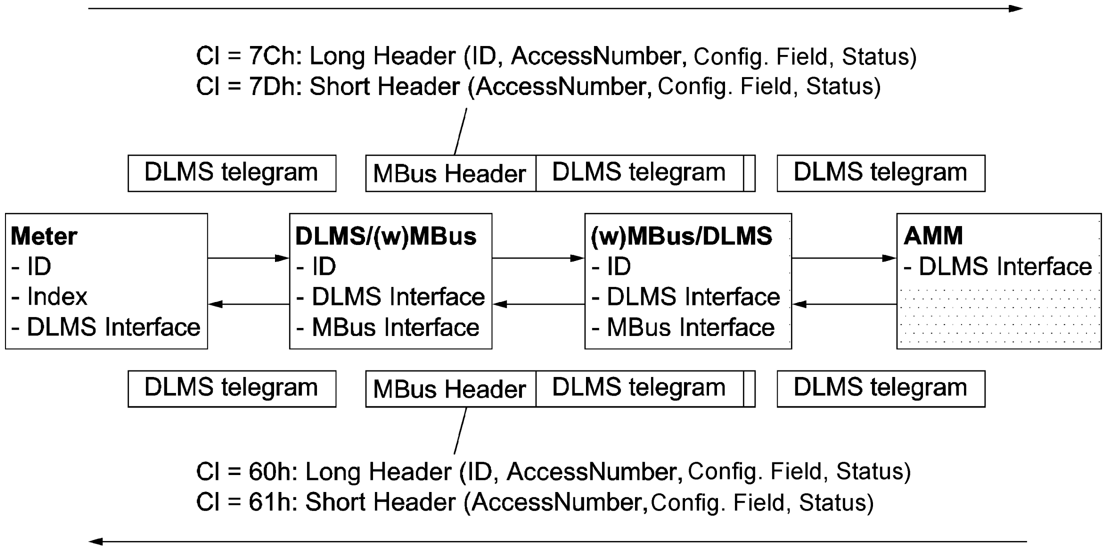


Figure 18 — Transporting DLMS/COSEM APDU's via M-Bus

The M-Bus Application layer allows encapsulating a DLMS/COSEM APDU into an M-Bus telegram, using special CI fields as specified in EN 13757-3:2013, Table 1. The frame structure shall conform with EN 13757-2:2004, 5.6 for wired connections, and with EN 13757-4:2013, Clause 11 respectively EN 13757-5:2008, 5.4. The higher layers shall conform with EN 13757-3:2013, 4.1.

9.2.2 M-Bus Application Layer transferred by DLMS

9.2.2.1 Setting up the interface

The interface setup for wired M-Bus (see EN 13757-2) is done by implementing one of the M-Bus interface classes in 10.2.

This COSEM object defines and controls the behaviour of the device regarding the communications parameters according to EN 13757-2. It is an instance of the interface class "M-Bus Port Setup".

Table 2 — M-Bus Port Setup Object

M-Bus Port Setup	OBIS identification						
	IC	A	B	C	D	E	F
M-Bus Port Setup Object	M-Bus Port setup	0	X	24	0	0	0xFF

If more than one object of the type is instantiated in the same physical device its value group B shall number the communications channel.

9.2.2.2 Simple Tunnelling

The details of any tunnelling should be described fully in a Companion Specification. A DLMS class interface type "Data" (class_id = 1) could be used to tunnel a M-Bus frame through DLMS. The OBIS code for this object could be defined as below.

Table 3 — Description of Class ID “Data”

Data	**0…n**	**class_id = 1, Version = 0**			
Attributes	**Data type**	**Min.**	**Max.**	**Def.**	**Short name**
1. logical_name (static)	octet-string				x
2. value	*CHOICE*				x + 0x08
Specific methods	**m/o**				
(none)					

The attribute “value” could be defined as:

Value provides access to the received data.

Value: = structure
{
rx_type,
rx_length,
rx_data
}

rx_type: defines the type of received data that is stored in rx_data.

Enum	(0)	(w)M-Bus standard frame
	(1)	(w)M-Bus Installation frame
	(2)…(9)	(w)M-Bus reserved
		…
	(10)…(31)	reserved for other applications
	(32)	Encrypted Generic Telegram, (Ack Expected)
	(33)	Encrypted Generic Telegram (No Ack Expected)
	(34)	Plaintext Generic Telegram (Ack Expected)
	(35)	Plaintext Generic Telegram (No Ack Expected)
	(36..255)	Reserved

Rx_length: defines the number of bytes stored in rx_data

Unsigned8, except
Unsigned16 for rx_type 32 to 35

Rx_data: This buffer stores the received data bytes for further actions.
Octet-string

NOTE “The first stored byte corresponds to the first CI-Field of the M-Bus frame where rx_type in the range 0..31”.

9.2.2.3 Tunnelling with better resilience to intermittent communications

9.2.2.3.1 General

The details of any tunnelling should be described fully in a Companion Specification. This is very similar to the description in 9.2.2.2, however, it has better provision for status of data in transit. To achieve this it uses an extended register object, class_id:4.

Extended Register Class id: 4.

logical_name	“Request” and “Response” OBIS codes to be determined in a companion specification.	
value	Octet -string This contains the targeted Object, wrapped, as necessary to ensure that it can be passed to or from the non-COSEM function. This is detailed below	
scaler_unit	{0,255} (not used)	
status	bit-string	Bit 0 – set true when the data received from source to the COSEM Server. Bit 1 – set true when the data sent to the target Bit 2 – set true when there is an ACK from the target.
capture_time	octet-string, Provides an “Extended register” specific date and time information showing when the value of the attribute “value” has been captured.	

“Request” describes a logical name that is associated with data from the COSEM Client to the COSEM Server, and “Response” describes a logical name that is associated with data from the Server to the Client. In some circumstances, for example an alarm condition, there will be a “response” without a “message”.

Value Field E.

It is anticipated that the simplest implementation would contain only one register pair, but the e value field may be used as enumerator if multiple pairs are to be used.

Table 4 — Tunnelling, Value group E

Value Field E	Description
255	If only a single register is used. Also: Used to send a Message immediately Also: Used when a “Response” is created without a “Request”
0..127	Used as a sequenced set of messages
128..254	Reserved

Where field e < > 0, it is assumed that there is a sequence of messages to be sent to the non-COSEM function. In this case it is anticipated that:

— the messages can be populated into the objects in any sequence, but populating the object where e = 0 will initiate the process of sending the messages; and

— the next message in the sequence will be sent (if status = 0x01) when the status of the previous message object has a status > 0x04: that is, an ACK of the previous message has been made by the non-COSEM function;

— the sequence will stop when an object is reached where the status has value 0; therefore good housekeeping – clearing used message objects – is essential housekeeping before starting to populate a command sequence;

— it is implicit in this approach that there will be a “Stop on Fail”.

The response, if any, to a message will be stored in the co-responding response object: that is, value e will be the same for both message and response.

Value (provides access to the received data).
Value: = structure

{
rx_type,
rx_length
rx_data
}

rx_type: defines the type of received data that is stored in rx_data.

Enum	(0,1)	Reserved for M-Bus
	(2)	SND_UD2 Standard Message (Ack and Response expected)
	(3)	SND_UD Standard Message (ACK expected)
	(4)	SND-NR Standard Message (No ACK expected)
	(5)	reserved for M-Bus
	(6)	SND_IR Installation Message (No ACK expected)
	(7)	ACC_DMD Access demand (Alert)
	(8)	RSP_UD Response to SND_UD
	(9)	Reserved for M-Bus[2)]
	(10)	REQ_UD1 Request of Class1 Data
	(11)	REQ_UD2 Request of Class2 Data
	(12..15)	reserved for M-Bus
	(16..31)	reserved for future M-Bus Version
	(32)	Encrypted Generic Telegram, (Ack Expected)
	(33)	Encrypted Generic Telegram (No Ack Expected)
	(34)	Plaintext Generic Telegram (Ack Expected)
	(35)	Plaintext Generic Telegram (No Ack Expected)
	(36..255)	Reserved

rx_length: defines the number of bytes stored in rx_data

Unsigned8 for rx_type 0–15
Unsigned16 for rx_type 32 to 35

rx_data: This buffer stores the received data bytes for further actions.

2) In this case, it is expected that requests for allocation of these reserved codes will be generated either by the M-Bus association or by CEN/TC 294.

Octet_String.

9.2.2.3.2 Multiple non-Cosem Functionalities

9.2.2.3.2.1 General

Subclause 9.2.2.3.2 has been prepared to be abstract in its wording. It is acknowledged that the non-Cosem functions could be devices on an M-Bus or other network.

In the situation where the message and response need to be targeted to a number of functions, there are two possible solutions:

9.2.2.3.2.2 Use of b Field

It is possible that the b field be used to identify multiple non-Cosem functions within a device. A method would need to be prepared to associate the b field value with specific non-Cosem functions, network addresses, etc.

9.2.2.3.2.3 Use of Logical Devices

Logical devices also offer a solution to this, with the benefit that security to non-Cosem functions can be individually assigned. It will be necessary to design and configure the behaviour of the logical device, including a set of configuration objects, depending on the network technology under discussion. As the context of this will depend on the architecture of the solution being proposed, it is anticipated that these will be consortium specific or client specific OBIS codes and possibly Classes.

9.2.2.3.2.4 Use of a Gateway Protocol

If a gateway protocol is incorporated in the architecture, for example, if there is a home concentrator or similar, then this function may be used. This would necessitate a significant COSEM structure to be incorporated in a device that is not natively COSEM, but may have benefits from security and network head end perspectives.

9.3 Data translation

The data models used for the M-Bus consist of data elements that can be read or written. This gives a simple model requiring limited processing capability.

The data model used in COSEM is an object oriented model that allows different operation (methods) on the data (objects). The object oriented model allows more complex operations. These complex operations are only needed for a subset of the meters. The object oriented model requires as well much larger amounts of data to be transferred and much more processing to be performed on the data.

The reading and writing of data from the M-Bus applications can be translated into get and set methods on COSEM objects. This makes it possible to translate data to a single common representation. The conversion of some core M-Bus data records to the corresponding OBIS Identifier is defined in EN 13757-3:2013, Annex O. These should form the basis of development of further conversion tables where the data records to be converted are led by the use cases to be applied to the meters and the network.

It is not feasible to translate arbitrary methods operating on an COSEM object into M-Bus data. It is however possible to specify the COSEM object to create to represent a specific M-Bus data element by performing reverse-lookup in the tables.

This method parses the received M-Bus telegram and converts single data points into OBIS notation. The result will be stored in a corresponding OBIS object and can be accessed using the standard communication methods.

10 Extensions to COSEM

10.1 Introduction

It has been recognized that there is a need for some dedicated Interface Classes when new lower layer and new functionalities are added.

In the event of a conflict between abstract objects below and the content of EN 62056-6-1 and EN 62056-6-2, then the EN 62056 document shall prevail.

10.2 Dedicated Interface classes

10.2.1 M-Bus interface class.

10.2.2 M-Bus slave port setup (class_id: 25, version: 0).

NOTE The name of this IC has been changed from “M-BUS port setup” to “M-Bus slave port setup”, to indicate that it serves to set up data exchange when a COSEM server communicates with a COSEM client using wired M-Bus.

This IC allows modelling and configuring communication channels according to EN 13757-2. Several communication channels can be configured.

Table 5 — M-Bus slave port setup

M-Bus slave port setup		**0...n**	**class_id = 25, Version = 0**			
Attributes		**Data type**	**Min.**	**Max.**	**Def.**	**Short name**
logical_name	(static)	octet-string				x
default_baud	(static)	enum	0	5	0	x + 0x08
avail_baud	(static)	enum	0	7		x + 0x10
addr_state	(static)	enum				x + 0x18
bus_address	(static)	unsigned				x + 0x20
Specific methods		**m/o**				
(none)						

Attribute description

logical_name Identifies the “M-Bus slave port setup” object instance.

default_baud Defines the baud rate for the opening sequence.

enum: (0) 300 baud,
(3) 2 400 baud,
(5) 9 600 baud

avail_baud Defines the baud rates that can be negotiated after startup.

enum: (0) 300 baud,
(1) 600 baud,
(2) 1 200 baud,
(3) 2 400 baud,
(4) 4 800 baud,

		(5)	9 600 baud,
		(6)	19 200 baud,
		(7)	38 400 baud
addr_state	Defines whether or not the device has been assigned an address since last power up of the device.		
	enum:	(0)	Not assigned an address yet,
		(1)	Assigned an address either by manual setting, or by automated method.
bus_address	The currently assigned address on the bus for the device. NOTE If no bus address is assigned, the value is 0.		

10.2.3 M-Bus client (class_id: 72, version: 1).

This interface class version 1 supersedes version 0.[3)]

Instances of this IC allow setting up M-Bus slave devices and exchanging data with them. Each M-Bus client object controls one M-Bus slave device. For details on the M-Bus dedicated application layer, see EN 13757-3:2013.

The M-Bus client device may have one or more physical M-Bus interfaces, which can be configured using instances of the M-Bus master port setup IC,

An M-Bus slave device is identified with its Primary Address, Identification Number, Manufacturer ID, etc. as defined in EN 13757-3:2013, Clause 5, *Variable Data Send and Variable Data Respond*. These parameters are carried by the respective attributes of the M-Bus client IC.

Values to be captured from an M-Bus slave device are identified by the capture_definition attribute, containing a list of data identifiers (DIB, VIB) for the M-Bus slave device. The data are captured periodically or on an appropriate trigger. Each data element is stored in an M-Bus value object, of IC “Extended register”. M-Bus value objects may be captured in M-Bus Profile generic objects, eventually along with other, not M-Bus specific objects.

Using the methods of M-Bus client objects, M-Bus slave devices can be installed and de-installed.

It is also possible to send data to M-Bus slave devices and to perform operations like resetting alarms, setting the clock, transferring an encryption key, etc.

Configuration field as defined in EN 13757-3:2013, 5.12 provides information about the encryption mode and number of encrypted bytes.

Encryption key status provides information if encryption key has been set, transferred to M-Bus slave device and is in use with M-Bus slave device.

3) Version 0 was covered by the earlier version of this standard, EN 13757-1:2002.

Table 6 — M-Bus client

M-Bus client		**0...n**	**class_id = 72, Version = 1**			
Attributes		**Data type**	**Min.**	**Max.**	**Def.**	**Short name**
1. logical_name	(static)	octet-string				x
2. M-Bus_port_reference	(static)	octet-string				x + 0x08
3. capture_definition	(static)	array				x + 0x10
4. capture_period	(static)	double-long-unsigned				x + 0x18
5. primary_address	(dyn.)	unsigned				x + 0x20
6. identification_number	(dyn.)	double-long-unsigned				x + 0x28
7. manufacturer_id	(dyn.)	long-unsigned				x + 0x30
8. version	(dyn.)	unsigned				x + 0x38
9. device_type	(dyn.)	unsigned				x + 0x40
10. access_number	(dyn.)	unsigned				x + 0x48
11. status	(dyn.)	unsigned				x + 0x50
12. alarm	(dyn.)	unsigned				x + 0x58
13. configuration	(dyn.)	long-unsigned				x + 0x60
14. encryption_key_status	(dyn.)	Enum				x + 0x68
Specific methods		**m/o**				
1. slave_install (data)		o				x + 0x70
2. slave_deinstall (data)		o				x + 0x78
3. capture (data)		o				x + 0x80
4. reset_alarm (data)		o				x + 0x88
5. synchronize_clock (data)		o				x + 0x90
6. data_send (data)		o				x + 0x98
7. set_encryption_key (data)		o				x + 0xA0
8. transfer_key (data)		o				x + 0xA8

Attribute description

logical_name Identifies the “M-Bus client” object instance.

M-Bus_port_reference Provides reference to an “M-Bus master port setup” object, used to configure an M-Bus port, each interface allowing to exchange data with one or more M-Bus slave devices.

capture_definition Provides the capture_definition for M-Bus slave devices.

NOTE This attribute can be pre-configured or written as part of the installation procedure.

array capture_definition_element

capture_definition_element:: = structure

{

data_information_block: octet-string,

value_information_block: octet-string

}

NOTE The elements data_information_block and value_information_block correspond to Data Information Block (DIB) and Value Information Block (VIB) described in EN 13757–3:2013, 6.2 and Clause 7, respectively.

capture_period > = 1: Automatic capturing assumed. Specifies the capture period in seconds.

0: No automatic capturing: capturing is triggered externally or capture events occur asynchronously.

primary_address Carries the primary address of the M-Bus slave device, in the range 0...250.

Each M-bus device is bound to a channel of the M-Bus master. However, there is no direct link between the primary address and the channel number.

NOTE 1 The specification of the B field of the OBIS codes limits the range to 1…64 within one logical device.

If the slave device is already configured and thus, its primary address is different from 0, then this value shall be written to the primary_address attribute. From this moment, the data exchange with the M-Bus slave device is possible.

Otherwise, the slave_install method shall be used; see below.

NOTE 2 The primary_address attribute cannot be used to store a desired primary address for an unconfigured slave device. If the primary address attribute is set, this means that the M-Bus client can immediately operate with this primary address, which is not the case with an unconfigured slave device.

identification_number Carries the Identification Number element of the data header as specified in EN 13757–3:2013, 5.5.

This attribute, together with attributes 7, 8 and 9 are filled with the values found in the first message received after installation.

If in subsequent messages these values are not the same, the message is discarded.

It is either a fixed fabrication number or a number changeable by the customer, coded with 8 BCD packed digits (4 Byte), and which thus runs from 00 000 000 to 99 999 999. It can be preset at fabrication time with a unique number, but could be changeable afterwards, especially if in addition a unique and not changeable fabrication number (DIF = 0Ch, VIF = 78h, see 7.2 is provided.

manufacturer_id Carries the Manufacturer Identification element of the data header as specified in EN 13757–3:2013, 5.6.

It is coded unsigned binary with 2 bytes. This manufacturer_id is calculated from the ASCII code of the EN 62056–21 manufacturer ID (three uppercase letters), using the formula specified in EN 13757–3:2013, 5.6.

version Carries the Version element of the data header as specified in EN 13757–3:2013, 5.7. It specifies the generation or version of the meter and depends on the manufacturer. It can be used to make sure, that within each version number the identification # is unique.

device_type Carries the Device type identification element of the data header as specified in EN 13757–3:2013 5.8, Table 6.

access_number	Carries the Access Number element of the data header as specified in EN 13757–3:2013, 5.9. It has unsigned binary coding, and it is incremented (modulo 256) by one before or after each RSP-UD from the slave. Since it can also be used to enable private end users to detect an unwanted over-frequently readout of their consumption meters, it should not be resettable by any bus communication.
status	Carries the Status byte element of the data header as specified in EN 13757–3:2013, Tables 7 and 8. It is updated with every readout of the M-Bus slave device.
alarm	Carries the Alarm state specified in EN 13757–3:2013, Annex D. It is coded with data type D (Boolean, in this case 8 bit). Set bits signal alarm bits or alarm codes. The meaning of these bits is manufacturer specific. It is updated with every readout of the M-Bus slave device.
configuration	Carries the Configuration field (previously: Signature field) as specified in EN 13757–3:2013, 5.12. It contains information about the encryption mode and the number of encrypted bytes. It is updated with every readout of the M-Bus slave device.
encryption_ key_status	Provides information on the status of the encryption key: Enum: (0) no encryption key, (1) encryption_key set (2) encryption_key transferred (3) encryption_key set and transferred (4) encryption_key in use

Method description

slave_install (data)	Installs a slave device, which is yet unconfigured (its primary address is 0). This method can be successfully invoked only if the value of the primary_address attribute is 0. The following actions are performed: the M-Bus address 0 is checked for presence of a new device. If no uninstalled M-Bus slave is found, the method invocation fails; if the slave_install method is invoked with no parameter, then the primary address is assigned automatically. This is done by checking the primary_address attribute of all M-Bus client objects in the DLMS/COSEM device and then selecting the first unused number. The primary_address attribute is set to this address and it is then transferred to the M-Bus slave device; if the slave_install method is invoked with a primary address as a parameter, then the primary_address attribute is set to this value and it is then transferred to the M-Bus slave device. data:: = unsigned (no data, or a valid primary address) NOTE Unconfigured slave devices are configured with primary address as specified in EN 13757–3:2013, E.5.

slave_deinstall (data)	De-installs the slave device. The main purpose of this service is to uninstall the M-Bus slave device and to prepare the master for the installation of a new device. The following actions are performed: the M-Bus address is set to 0 in the M-Bus slave device; the encryption key transferred previously to the M-Bus slave device is destroyed; the default key is not affected. the attribute primary_address is also set to 0. NOTE A new M-Bus slave can be installed only, once the value of the primary_address attribute is 0. data:: = integer (0)
capture	Capture values – as specified by the capture_definition attribute – from the M-Bus slave device. data:: = integer (0)
reset_alarm	Reset alarm state of the M-Bus slave device. data:: = integer (0)
synchronize_clock	Synchronize the clock of the M-Bus slave device with that of the M-Bus client device. data:: = integer (0)
data_send	Send data to the M-Bus slave device.

```
dataarray data_definition_element
data_definition_element:: = structure
{
    data_information_block:        octet-string,
    value_information_block   :    octet-string
    data:                    CHOICE
    {
        – simple data types
        null-data            [0],
        bit-string           [4],
        double-long              [5],
        double-long-unsigned         [6],
        octet-string             [9],
        visible-string           [10],
        UTF8-string              [12],
        integer                  [15],
        long                 [16],
        unsigned                 [17],
        long-unsigned                [18],
        long64                   [20],
        long64-unsigned          [21],
        float32                  [23],
        float64                  [24]
    }
}
```

set_encryption_key Sets encryption key to be used with the M-Bus slave device.

NOTE Changing the encryption requires two steps: First, the key is sent to the M-Bus slave, encrypted with the master key, using the transfer_key method. Second, the key is set in the M-Bus master using the set_encryption_key method.

data:: = octet-string (encryption_key)

After the installation of the M-Bus slave, the M-Bus client holds an empty encryption key. With this, encryption of M-Bus telegrams is disabled.

Encryption can be disabled by invoking the set_encryption_key method with null data as a parameter.

transfer_key Transfers an encryption key to the M-Bus slave.

data:: = octet-string (encrypted_key)

Each M-Bus slave device shall be delivered with a default encryption key.

Before encrypted M-Bus telegrams can be used, an operational encryption key shall be sent to the M-Bus slave, by invoking the transfer_key method. The method invocation parameter is the operational encryption key encrypted with the default key of the M-Bus slave device. The M-Bus telegram sent is not encrypted. After the execution, the encryption is enabled and all further telegrams are encrypted.

A new encryption key can be set in the client by invoking the set_encryption_key method with the new encryption key as a parameter.

With further invocations of the transfer_key method, new encryption keys can be sent to the M-Bus slave. The method invocation parameter is the new encryption key encrypted with the default key. The M-Bus telegram is encrypted.

When an M-Bus slave is de-installed, the encryption key is destroyed, but the default key is not affected. Encryption remains disabled until a new encryption is transferred.

10.2.4 Wireless Mode Q channel (class_id: 73, version: 1).

Instances of this IC define the operational parameters for communication using the mode Q interfaces.

Table 7 — Wireless Mode Q channel

Wireless Mode Q channel		**0...n**	**class_id = 73, Version = 1**			
Attributes		**Data type**	**Min.**	**Max.**	**Def.**	**Short name**
1. logical_name	(static)	octet-string				x
2. addr_state	(static)	enum				x + 0x08
3. device_address	(static)	octet-string				x + 0x10
4. address_mask	(static)	octet-string				x + 0x18
Specific methods		**m/o**				
(none)						

Attribute description

addr_state Defines whether or not the device has been assigned an address since last power up of the device

	enum: (0)	not assigned an address yet,
	(1)	assigned an address either by manual setting or by automated method
device_address	The currently assigned address of the device on the network	
address_mask	The group address the device will respond to when short form addressing is used	

10.2.5 M-Bus master port setup (class_id: 74, version: 0).

Instances of this IC define the operational parameters for communication using the EN 13757-2 interfaces if the device acts as an M-Bus master.

Table 8 — M-Bus master port setup

M-Bus master port setup		**0...n**	**class_id = 74, version = 0**			
Attributes		**Data type**	**Min.**	**Max.**	**Def.**	**Short name**
1. logical_name	(static)	octet-string				x
2. comm_speed	(static)	enum	0	7	3	x + 0x08
Specific methods		**m/o**				

Attribute description

logical_name Identifies the “M-Bus master port” setup object instance.

comm_speed The communication speed supported by the port

enum:
- (0) 300 baud,
- (1) 600 baud,
- (2) 1 200 baud,
- (3) 2 400 baud,
- (4) 4 800 baud,
- (5) 9 600 baud,
- (6) 19 200 baud,
- (7) 38 400 baud

10.2.6 M-Bus tunnelling.

The classes and objects used for tunnelling shall be implemented as in 9.2.2.2 and 9.2.2.3 depending upon the implementation.

10.3 Specific object types — Error reporting object

10.3.1 Introduction

Error reporting should be handled in a hierarchical way:

— the first level of error reporting is the general error object;

— the second level is media specific;

— the third level is manufacturer specific.

10.3.2 General error object

10.3.2.1 General

This level offers a short but important overview of the current device status.

The general error object for a meter should be of the interface class type ‘Data’. The attribute ‘value’ should be of the type unsigned16 with the following bit-allocation:

— Bit 15 (MSB) alert non-acknowledged;

— Bit 14 warning non-acknowledged;

— Bit 13 indication non-acknowledge;

…

— Bit 7 alert pending;

— Bit 6 warning pending;

— Bit 5 indication pending.

The outbreak of an error condition should set both the non-acknowledged and the pending bit. The non-acknowledge bit can be cleared by writing to the bit. The pending can only be cleared by removing the condition that caused it to be set.

The other bits in the data structure are reserved for future use. They should not be used. If used, they should follow the structure with a pair of non-acknowledged/ pending bits for each condition.

The conditions Alert, Warning and Indication are defined below:

10.3.2.2 Alert

The status “alert” is given when at least one quantity which is necessary for the determination of a billing quantity:

— exceeds one of the permissible limits (according to the metrological approval);

— achieves a value which is not plausible according to defined and accepted rules for plausibility checks.

In case of an alert the counters for billing volumes will be stopped, disturbance or alert counters can be activated. In addition to that an alert-status is given, if any dangerous situation occurs.

An alarm shall be cleared by an acknowledgement procedure.

10.3.2.3 Warning

The status “warning” is given when:

— a user defined limit acc. metrological quantities is exceeded

(those shall be within the permissible “metrological” limits acc. approval);

— a user defined limit outside metrological quantities is exceeded

(e.g. pulser output buffer overflow, pulser input supervision);

— a power failure has led to a temporary breakdown of the device

(possibly combined with a stop of the clock);

— internal supervision units for soft- and hardware detect an error.

A warning shall be cleared by an acknowledgement procedure.

10.3.2.4 Indication

An indication is a status which is shown on the display unit of the device but will disappear simultaneously with the disappearance of the reason for it. An indication does not have to be cleared.

Indications are status information which describes a condition of the device.

(E.g. calibration lock open, input not adjusted.)

These conditions do not disturb the device operation and they can be intentional.

10.3.3 Media specific error object

It offers further information according to the media and the device type. It will be one of the general purpose objects defined for the media type. These objects shall have an OBIS name of the format m x 97 97 x.

10.3.4 Manufacturer specific error object

It offers the possibility for further information to support service and maintenance. The definition of these objects is outside the scope of this standard.

11 Object Identification System (OBIS)

11.1 Object Identification System (Variable naming rules)

11.1.1 Introduction

EN 62056-6-1 defines a hierarchical structure to identify commonly used data items in metering equipment. This is known as the Object Identification System, or OBIS. It provides unique identifiers for the data within the metering equipment. It covers not only measurement values, but also abstract values used for configuration or obtaining information and simple control of some meter features, for example valves.

OBIS defines the identification codes, ID-codes, for abstract objects and metering related data. This standard defines ID-codes for non-electricity related data as an extension to OBIS. EN 62056-6-1 is a necessary base document when defining meters.

OBIS defines how to express the name of an object, if it is implemented in the meter. Each value group has a maximum range of 0 to 255, but it may be limited to a sub range.

The actual object codes for the different media can be found in 11.3.5.4.

11.1.2 Structure

The ID-code is a combination of six value groups, named A through F. Together they describe, in a hierarchical way the exact meaning of each data item. The main meaning of the individual value groups is shown in the table below.

Table 9 — OBIS code structure and use of value groups

Value group	Use of the value group
A	Identifies the media (energy type) to which the metering is related. Non-media related information is handled as abstract data.
B	Generally, identifies the measurement channel number, i.e. the number of the input of a metering equipment having several inputs for the measurement of energy of the same or different types (for example in data concentrators, registration units). Data from different sources can thus be identified. It may also identify the communication channel, and in some cases it may identify other elements. The definitions for this value group are independent from the value group A.
C	Identifies abstract or physical data items related to the information source concerned, for example current, voltage, power, volume, temperature. The definitions depend on the value in the value group A. Further processing, classification and storage methods are defined by value groups D, E and F. For abstract data, value groups D to F provide further classification of data identified by value groups A to C.
D	Identifies types, or the result of the processing of physical quantities identified by values in value groups A and C, according to various specific algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.
E	Identifies further processing or classification of quantities identified by values in value groups A to D.
F	Identifies historical values of data, identified by values in value groups A to E, according to different billing periods. Where this is not relevant, this value group can be used for further classification.

11.1.3 Manufacturer, utility, consortia and country specific codes

Specific codes may be allocated to meet the needs of a manufacturer or other party, except where data can be read out or methods followed using the standard codes. Specific codes shall be selected in accordance with the table below.

Table 10 — Reserved OBIS codes

Code type	Value group					
	A	B	C	D	E	F
Manufacturer specific[a]	0, 1, 4...9; F	128…199	*c*	*d*	*e*	*f*
		b	128… 199, 240	*d*	*e*	*f*
		b	*c*	128…254	*e*	*f*
		b	*c*	*d*	128…254	*f*
		b	*c*	*d*	*e*	128…254
Manufacturer specific abstract[b]	0	0…64	96	50…99	0…255	0…255
Manufacturer specific, media related general purpose[b]	1, 4…9; F	0…64	96	50…99	0…255	0…255
Utility specific[c]	1, 4…9; F	65…127	0..255	0..255	0..255	0..255
Consortia specific[d]	0, 1, 4...9; F	1…64	93			
Country specific[e]		1…64	94	[f]		

[a] "b", "c", "d", "e", "f" means any value in the relevant value group.

[b] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

[c] If the value in value group B is 65…127, the whole OBIS code should be considered as utility specific and the value of other groups does not necessarily carry a meaning defined neither in Clause 4, nor Clause 5.

[d] The usage of value group E and F are defined in consortia specific documents.

[e] The usage of value group E and F are defined in country specific documents.

[f] See Annex D for the list of country specific identifiers.

11.1.4 Common value groups

11.1.4.1 General

The definitions for value groups A, B, E and F are common to all non-electricity meters. Value group C for abstract objects (A = 0) is common to all meters. There is no common value group D. Common value groups are specified in the following subclauses.

11.1.4.2 Value group A

This value group defines the media that the metering is related to. Non-media related information is handled as abstract data. The range for value group A is limited to 0 to 15. The definition of value group A is common to all types of media.

Table 11 — Value group A

Value group A	Description
0	Abstract objects
1	Electricity related objects
4	Heat cost allocator related objects
5	Cooling related objects
6	Heat related objects
7	Gas related objects
8	Cold water related objects
9	Hot water related objects
F	Other media related objects
All other	Reserved

11.1.4.3 Value group B

This value group defines the channel number, i.e. the number of the input of a metering device having several inputs (e.g. concentrators, converters). Data from different sources can thus be distinguished.

The allowed range is of 0 to 255. If no channel information is essential the value 0 shall be assigned. Channel numbers from 65 to 127 are reserved for future applications.

Table 12 — Value group B

Value group B	Description
0	No channel specified
1…64	Channel 1..64
65…127	Utility specific codes
128…199	Manufacturer specific codes
200…255	Reserved

With devices having just one channel, the usage of channel no. One even for device specific non-metering related data items is allowed.

The range 65…127 is available for utility specific use. If the value of value group B is in this range, the whole OBIS code shall be considered as utility specific and the value of other groups does not necessarily carry a meaning defined elsewhere in this clause.

NOTE A physical metering device combining multiple logical metering devices could be modelled as a logical metering device having a number of channels, or a number of logical metering devices using different SAP's. The latter is the preferred solution for new development.

11.1.4.4 Value group C (abstract objects)

Value group C defines the abstract or physical data items related to the information source concerned. Abstract objects are data items, which are not related to a certain type of physical quantity. For abstract data the hierarchical structure of the 6 code fields is not applicable beyond value group C.

Table 13 — Value group C codes where A = 0 (abstract objects)

Value group C	Description
0…89	Context-specific identifiers
93	Consortia specific identifiers
94	Country specific identifiers
96	General and service entry objects
97	Error register objects - Abstract
98	List objects - Abstract
99	Data profile objects - Abstract
127	Inactive objects[a]
128...199, 240	Manufacturer specific COSEM related abstract objects
others	Reserved
[a] An inactive object is an object, which is defined and present in a meter, but which has no assigned functionality.	
NOTE Context specific identifiers identify objects specific to a certain protocol and/or application.	

11.1.4.5 Notes for value group C (abstract objects)

Where C = 94, a country specific value of group D is used, allowing groups E and F to be defined in national requirements. There are no ranges reserved in this occurrence. The country specific identifiers are listed in Annex D. Objects that are already identified in this standard shall not be re-identified by country specific identifiers.

11.1.4.6 Value group D

See 11.1.3 for clarity on the use of value group D.

11.1.4.7 Value group E

The range for value group E is 0 to 255. It can be used for identifying further classification or processing of values defined by values in value groups A to D, as specified in the relevant energy type specific clauses. The various classifications and processing methods are exclusive.

11.1.4.8 Value group F

11.1.4.8.1 General

The range for value group F is 0 to 255. In all cases, if value group F is not used, it is set to 255.

11.1.4.8.2 Identification of billing periods

Value group F specifies the allocation to different billing periods (sets of historical values) for the objects defined by value groups A to E, where storage of historical values is relevant. A billing period scheme is identified with its billing period counter, number of available billing periods, time stamp of the billing period and billing period length. Several billing period schemes may be possible:

— A value of a single historical billing period may be represented using the same IC as used for representing the value of the current billing period. With *F* = 0…99, the billing period is identified by the value of the billing period counter VZ. *F* = VZ identifies the youngest value, *F* = VZ-1 identifies the second youngest value, etc. *F* = 101…125 identifies the last, second last …25th last billing period. (*F* = 255 identifies the current billing period). Simple objects can only be used to represent values of historical billing periods, if “Profile generic” objects are not implemented.

— A value of a single historical billing period may also be represented by “Profile generic” objects, which are one entry deep, and contain the historical value itself and the time stamp of the storage. With *F* = 0…99, the billing period is identified by the value of the billing period counter VZ. *F* = VZ identifies the youngest value, *F* = VZ-1 identifies the second youngest value, etc. *F* = 101 identifies the most recent billing period.

— Values of multiple historical billing periods are represented with “Profile generic” objects, with suitable controlling attributes. With *F* = 102…125 the two last, …25 last values can be reached. *F* = 126 identifies an unspecified number of historical values.

— When values of historical billing periods are represented by “Profile generic” objects, more than one billing periods schemes may be used. The billing period scheme is identified by the billing period counter object captured in the profile.

11.2 Abstract Objects (A = 0)

11.2.1 Abstract objects, general service entries

The table below summarizes the codes that shall be used for abstract objects and general service entries.

Table 14 — Abstract objects, general service entries

Abstract objects, general service entries	OBIS code					
	A	B	C	D	E	F
Billing period values/reset counter entries (First billing period scheme if there are two)						
Billing period counter (1)	0	*b*	0	1	0	VZ or 255
Number of available billing periods (1)	0	*b*	0	1	1	
Time stamp of the most recent billing period (1)	0	*b*	0	1	2	
Time stamp of the billing period (1) VZ (last reset)	0	*b*	0	1	2	VZ
Time stamp of the billing period (1) VZ_{-1}	0	*b*	0	1	2	VZ_{-1}
…	…	…	…	…	…	...
Time stamp of the billing period (1) VZ_{-n}	0	*b*	0	1	2	VZ_{-n}
Billing period values/reset counter entries (Second billing period scheme)						
Billing period counter (2)	0	*b*	0	1	3	VZ or 255
Number of available billing periods (2)	0	*b*	0	1	4	
Time stamp of the most recent billing period (2)	0	*b*	0	1	5	
Time stamp of the billing period (2) VZ (last reset)	0	*b*	0	1	5	VZ
Time stamp of the billing period (2) VZ_{-1}	0	*b*	0	1	5	VZ_{-1}
...	…	…	…	…	…	...
Time stamp of the billing period (2) VZ_{-n}	0	*b*	0	1	5	VZ_{-n}
Program entries						
Active firmware identifier		b		2	0	
Active firmware version		b		2	1	
Active firmware signature		b		2	8	
Time entries						
Local time		b		9	1	
Local date		b		9	2	
Device ID numbers (non-energy/channel related)						
Complete device ID	0	0	96	1		

Abstract objects, general service entries	OBIS code					
	A	B	C	D	E	F
Device ID 1 (manufacturing number) … Device ID 10	0 0	0 0	96 … 96	1 … 1	0 … 9	
Metering point ID (abstract)	0	0	96	1	10	
Parameter changes, calibration and access						
Number of configuration program changes	0	*b*	96	2	0	
Date [a] of last configuration program change	0	*b*	96	2	1	
Date [a] of last time switch program change	0	*b*	96	2	2	
Date [a] of last ripple control receiver program change	0	*b*	96	2	3	
Status of security switches	0	*b*	96	2	4	
Date [a] of last calibration	0	*b*	96	2	5	
Date [a] of next configuration program change	0	*b*	96	2	6	
Date [a] of activation of the passive calendar	0	*b*	96	2	7	
Number of protected configuration program changes [b]	0	*b*	96	2	10	
Date [a] of last protected configuration program change [b]	0	*b*	96	2	11	
Date [a] (corrected) of last clock synchronization/setting	0	*b*	96	2	12	
Date of last firmware activation	0	*b*	96	2	13	
Input/output control signals						
State of input/output control signals, global [c]	0	*b*	96	3	0	
State of input control signals (status word 1)	0	*b*	96	3	1	
State of output control signals (status word 2)	0	*b*	96	3	2	
State of input/output control signals (status word 3)	0	*b*	96	3	3	
State of input/output control signals (status word 4)	0	*b*	96	3	4	
Disconnect control	0	*b*	96	3	10	
Internal control signals						
State of the internal control l signals, global [c]	0	*b*	96	4	0	
State of internal control signals (status word 1)	0	*b*	96	4	1	
State of internal control signals (status word 2)	0	*b*	96	4	2	
State of internal control signals (status word 3)	0	*b*	96	4	3	
State of internal control signals (status word 4)	0	*b*	96	4	4	
Internal operating status signals						
Internal operating status, global [c]	0	*b*	96	5	0	
Internal operating status (status word 1)	0	*b*	96	5	1	
Internal operating status (status word 2)	0	*b*	96	5	2	
Internal operating status (status word 3)	0	*b*	96	5	3	
Internal operating status (status word 4)	0	*b*	96	5	4	
Battery entries						
Battery use time counter	0	*b*	96	6	0	

Abstract objects, general service entries	OBIS code					
	A	B	C	D	E	F
Battery charge display	0	*b*	96	6	1	
Date of next change	0	*b*	96	6	2	
Battery voltage	0	*b*	96	6	3	
Battery initial capacity	0	*b*	96	6	4	
Battery installation date and time	0	*b*	96	6	5	
Battery estimated remaining use time	0	*b*	96	6	6	
Aux. supply use time counter	0	*b*	96	6	10	
Aux. voltage (measured)	0	*b*	96	6	11	
Reserved for Power failure monitoring	0	0	96	7		
Operating time						
Time of operation	0	b	96	8	0	
Time of operation rate 1…rate 63	0	b	96	8	1... 63	
Environmental related parameters						
Ambient temperature	0	*b*	96	9	0	
Ambient pressure	0	*b*	96	9	1	
Relative humidity	0	*b*	96	9	2	
Status register						
Status register (Status register 1 if several status registers are used)	0	*b*	96	10	1	
Status register 2	0	*b*	96	10	2	
…	0	*b*	96	10	…	
Status register 10	0	*b*	96	10	10	
Event code						
Event code objects # 1…#100	0	*b*	96	11	0… 99	
Communication port log parameters						
Reserved	0	*b*	96	12	0	
Number of connections	0	*b*	96	12	1	
Reserved	0	*b*	96	12	2	
Reserved	0	*b*	96	12	3	
Communication port parameter 1	0	*b*	96	12	4	
GSM field strength	0	*b*	96	12	5	
Consumer messages						
Consumer message via local consumer information port	0	*b*	96	13	0	
Consumer message via the meter dispay and/or via consumer information port	0	*b*	96	13	1	
Currently active tariff						
Currently active tariff objects # 1…#16	0	*b*	96	14	0… 15	

Abstract objects, general service entries	OBIS code					
	A	B	C	D	E	F
Event counter objects						
Event counter objects #1…#100	0	*b*	96	15	0… 99	
Meter tamper event related objects						
Meter open event counter	0	*b*	96	20	0	
Meter open event, time stamp of current event occurrence	0	*b*	96	20	1	
Meter open event, duration of current event	0	*b*	96	20	2	
Meter open event, cumulative duration	0	*b*	96	20	3	
Reserved	0	*b*	96	20	4	
Terminal cover open event counter	0	*b*	96	20	5	
Terminal cover open event, time stamp of current event occurrence	0	*b*	96	20	6	
Terminal cover open event, duration of current event	0	*b*	96	20	7	
Terminal cover open event, cumulative duration	0	*b*	96	20	8	
Reserved	0	*b*	96	20	9	
Tilt event counter	0	*b*	96	20	10	
Tilt event, time stamp of current event occurrence	0	*b*	96	20	11	
Tilt event, duration of current event	0	*b*	96	20	12	
Tilt event, cumulative duration	0	*b*	96	20	13	
Reserved	0	*b*	96	20	14	
Strong DC magnetic field event counter	0	*b*	96	20	15	
Strong DC magnetic field event, time stamp of current event occurrence	0	*b*	96	20	16	
Strong DC magnetic field event, duration of current event	0	*b*	96	20	17	
Strong DC magnetic field event, cumulative duration	0	*b*	96	20	18	
Reserved	0	*b*	96	20	19	
Supply control switch / valve tamper event counter	0	*b*	96	20	20	
Supply control switch / valve tamper event, time stamp of current event occurrence	0	*b*	96	20	21	
Supply control switch / valve tamper event, duration of current event	0	*b*	96	20	22	
Supply control switch / valve tamper event, cumulative duration	0	*b*	96	20	23	
Reserved	0	*b*	96	20	24	
Metrology tamper event counter	0	*b*	96	20	25	
Metrology tamper event, time stamp of current event occurrence	0	*b*	96	20	26	
Metrology tamper event, duration of current event	0	*b*	96	20	27	
Metrology tamper event, cumulative duration	0	*b*	96	20	28	
Reserved	0	*b*	96	20	29	
Communication tamper event counter	0	*b*	96	20	30	
Communication tamper event, time stamp of current event occurrence	0	*b*	96	20	31	
Communication tamper event, duration of current event	0	*b*	96	20	32	

Abstract objects, general service entries	OBIS code					
	A	B	C	D	E	F
Communication tamper event, cumulative duration	0	*b*	96	20	33	
Reserved	0	*b*	96	20	34	
Manufacturer specific [d] … Manufacturer specific	0 0	*b* *b*	96 96	50 99	*e* *e*	*f* *f*

[a] Date of the event may contain the date only, the time only or both.

[b] Protected configuration is characterized by the need to open the main meter cover to modify it, or to break a metrological seal.

[c] Global status words with E = 0 contain the individual status words E = 1…4. The contents of the status words are not defined in this standard.

[d] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

11.2.2 Error registers, alarm registers and alarm filters – Abstract

Table 15 — Codes for error registers, alarm registers and alarm filters – Abstract

Error registers, alarm registers and alarm filters – Abstract	OBIS code					
	A	B	C	D	E	F
Error register objects 1…10	0	*b*	97	97	0…9	
Alarm register objects 1…10	0	*b*	97	98	0…9	
Alarm filter objects 1…10	0	*b*	97	98	10…19	
Alarm descriptor 1…10	0	*b*	97	98	20…29	

NOTE The information to be included in the error objects is not defined in this document.

11.2.3 List objects – Abstract

Lists – identified with a single OBIS code – are defined as a series of any kind of data (for example measurement value, constants, status, events).

Table 16 — OBIS codes for list objects – Abstract

List objects – Abstract	OBIS code					
	A	B	C	D	E	F
Data of billing period (with billing period scheme 1 if there are more than one schemes available)	0	*b*	98	1	*e*	255 [a]
Data of billing period (with billing period scheme 2)	0	*b*	98	2	*e*	255 [a]

[a] *F* = 255 means a wildcard here.

11.2.4 Register table objects – Abstract

Register tables are defined to hold a number of values of the same type.

Table 17 — OBIS codes for register table objects – Abstract

Register table objects – Abstract	OBIS code					
	A	B	C	D	E	F
General use, abstract	0	*b*	98	10	*e*	

11.2.5 Data profile objects – Abstract

Abstract data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Table 18 — OBIS codes for data profile objects – Abstract

Data profile objects – Abstract	OBIS code					
	A	B	C	D	E	F
Load profile with recording period 1 [a]	0	*b*	99	1	*e*	
Load profile with recording period 2 [a]	0	*b*	99	2	*e*	
Load profile during test [a]	0	*b*	99	3	0	
Connection profile	0	*b*	99	12	*e*	
GSM diagnostic profile	0	*b*	99	13	*e*	
Parameter monitor log	0	*b*	99	16	*e*	
Event log [a]	0	*b*	99	98	*e*	
[a] These objects should be used if they (also) hold data not specific to the energy type.						

11.3 Media specific value groups

11.3.1 General

This following subclause covers the value groups that are media specific, i.e. value group C and D. They identify objects representing information that is media related. The value groups C and D are presented jointly for one media type at a time.

11.3.2 Value groups specific to Heat Cost Allocators

11.3.2.1 Introduction

HCA's are mounted on radiators in the area to be monitored. The HCA shall be mounted with in free air and radiators should not be enclosed. There will normally also be multiple HCA's, even for a single customer. This makes at, the present, direct connection to all HCA's using a two way connections an infeasible solution. It is nevertheless important, that data coming from a (number of) HCA's (via a concentrator) can be handled in the same way as data from other meters for remote reading.

The current subclause describes the naming of objects carrying HCA information in a COSEM environment. The words used in this clause are those used in EN 834 the corresponding media standard.

The output from an HCA's is “the temperature integral with respect to time”, and it is only a relative sum. The main parameter from a HCA is this integral. Time series of this integral may be stored in the HCA for later readout. Other media related information available from a HCA are temperature and rating factors.

11.3.2.2 Value group C for HCA

The name of the different objects in the table for HCA objects corresponds to the name used in the meter standard, EN 834.

Table 19 — Value group C codes where A = 4 (HCA objects)

Value group C	Description
0	General purpose objects [a]
1	Unrated integral [b]
2	Rated integral [c]
3	Radiator surface temperature [d]
4	Heating medium temperature, t_m
5	Flow (forward) temperature, t_V
6	Return temperature, t_R
7	Room temperature, t_L
93	Consortia specific identifiers, see 11.1.4.4
94	Country specific identifiers, see Appendix D
96	General and service entry objects– HCA.
97	Error register objects – HCA.
98	List objects – HCA
99	Data profile objects – HCA
128...199, 240	Manufacturer specific codes
All other	Reserved

The room temperature measurement (C = 7) should always be accompanied by either a radiator surface (C = 3) temperature, a heating media (C = 4) temperature or a pair of forward / return flow (C = 5 / C = 6) temperatures.

NOTE 1 The radiator surface (C = 3) temperature and the heating media (C = 4) temperature, are mutually exclusive.

NOTE 2 The forward flow (C = 5) and reverse flow (C = 6) temperatures are exclusive to the radiator surface (C = 3) temperature.

[a] Settings like time constant, thresholds, etc.

[b] Readout prior to compensation as specified in EN 834.

[c] Readout after compensation as specified in EN 834.

[d] Temperature measured prior to any rating.

11.3.2.3 Value group D for HCA

This value group specifies the result of processing a *Quantity* according to a specific algorithm for Heat Cost Allocator related values.

Table 20 — Value group D codes where A = 4, C < > 0, 96 .. 99 (HCA objects)

Value group D	Description
0	Current value
1	Periodical value [a]
2	Set date value
3	Billing date value
4	Minimum of value
5	Maximum of value
6	Test value [b]
Other	Reserved

[a] A set of values periodically stored (this may be once or twice a month).

[b] A value specially processed for test purpose. This may be due to an increased precision of the data, or to a faster (but less precise) processing of data.

11.3.2.4 General and service entry objects – HCA

Table 21 — OBIS codes for general and service entry objects – HCA

General and service entry objects – HCA	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined ID	4	*b*	0	0		
ID 1	4	*b*	0	0	0	
...			...	...	...	
ID 10	4	*b*	0	0	9	
Storage information						
Status (VZ) of the historical value counter	4	*b*	0	1	1	
Number of available historical values	4	*b*	0	1	2	
Target date	4	*b*	0	1	10	
Billing date	4	*b*	0	1	11	
Configuration						
Program version no.	4	*b*	0	2	0	
Firmware version no.	4	*b*	0	2	1	
Software version no.	4	*b*	0	2	2	
Device measuring principle [a]	4	*b*	0	2	3	
Conversion factors						
Resulting rating factor, K	4	*b*	0	4	0	

General and service entry objects – HCA	OBIS code					
	A	B	C	D	E	F
Thermal output rating factor, K_Q	4	*b*	0	4	1	
Thermal coupling rating factor overall, K_C	4	*b*	0	4	2	
Thermal coupling rating factor room side, K_{CR}	4	*b*	0	4	3	
Thermal coupling rating factor heater side, K_{CH}	4	*b*	0	4	4	
Low temperature rating factor, K_T	4	*b*	0	4	5	
Display output scaling factor	4	*b*	0	4	6	
Threshold values						
Start temperature threshold	4	*b*	0	5	10	
Difference temperature threshold	4	*b*	0	5	11	
Period information						
Measuring period for average value	4	*b*	0	8	0	
Recording interval for consumption profile	4	*b*	0	8	4	
Billing period	4	*b*	0	8	6	
Time entries						
Local time	4	*b*	0	9	1	
Local date	4	*b*	0	9	2	
General and service entry **objects – HCA**	**OBIS code**					
	A	**B**	**C**	**D**	**E**	**F**
Manufacturer specific[b]	4	*b*	96	50	*e*	*f*
....						
Manufacturer specific	4	*b*	96	99	*e*	*f*

[a] This is an object of the type 'Data' enumerated, (0) single sensor, (1) single sensor + start sensor, (2) dual sensor, (3) triple sensor.

[b] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

11.3.2.5 Error register objects – HCA

Table 22 — OBIS codes for error register objects – HCA

Error registers objects – HCA	OBIS code					
	A	B	C	D	E	F
Error registers	4	*b*	97	97	*e*	

11.3.2.6 Data profile objects – HCA

HCA related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Table 23 — OBIS codes for data profile objects – HCA

Data profile objects – HCA	OBIS code					
	A	B	C	D	E	F
Data profile objects	4	*b*	99	1	*e*	

11.3.2.7 OBIS codes for HCA related objects (examples)

Table 24 — OBIS codes for HCA related objects (examples)

HCA related objects	OBIS code					
	A	B	C	D	E	F
Consumption						
Current unrated integral	4	*b*	1	0	0	
Current rated integral	4	*b*	2	0	0	
Rated integral, last set date	4	*b*	2	2	0	V_Z
Unrated integral, previous billing date	4	*b*	1	3	0	V_{Z-1}
Rated integral, two most recent periodical values	4	*b*	2	1	0	102
Monitoring values						
Radiator temperature, current value	4	*b*	3	0		
Flow temperature, test value	4	*b*	5	6		
Room temperature, minimum value	4	*b*	7	4		

11.3.3 Value groups specific to Heat or Cooling Meters

11.3.3.1 Introduction

The current subclause describes the naming of objects carrying heat meter information in a COSEM environment. It covers the handling of heat, as well as the handling of cooling. The media specific words used in this clause are those used in EN 1434-1 and EN 1434-2 parts of the corresponding media standard. The output from a heat or cooling meter is “the integral of power, i.e. the enthalpy difference times the mass flow-rate, with respect to time”.

Value group A = 5 has been set aside for metering of cooling specific objects, and value group A = 6 for the metering of heat specific objects. The other value groups are identical for heating and cooling.

11.3.3.2 Value group C for Heating/Cooling meters

The name of the different objects in the table for heat metering and cooling metering objects corresponds to the name used in EN 1434-1.

Table 25 — Value group C codes where A = 5 or A = 6 (Heat/cooling objects)

Value group C	Description
0	General purpose objects[a]
1	Energy
2	Accounted volume
3	Accounted mass[b]
4	Flow volume
5	Flow mass
6	Return volume
7	Return mass
8	Power
9	Flow rate
10	Flow temperature
11	Return temperature
12	Differential temperature, Δθ [c]
13	Media pressure [d]
93	Consortia specific identifiers, see 11.1.4.4
94	Country specific identifiers, see Annex D
96	General and service entry objects – Heat / cooling
97	Error register objects – Heat / cooling
98	List objects – Heat / cooling
99	Data profile objects – Heat / cooling related
128...199, 240	Manufacturer specific codes
All other	Reserved

[a] Settings like time constant, thresholds, etc.
[b] Used when metering steam.
[c] Will often be available with a higher precision and accuracy than flow and return temperature.
[d] Pressure of the media, if measured. The backup value, to use if pressure cannot be measured, is a general purpose object (C = 0).

11.3.3.3 Value group D for Heat

This value group specifies the result of processing a *Quantity* according to a specific algorithm for heat or cooling related values.

Table 26 — Value group D codes where A = 5 or A = 6 and C < > 0, 96…99 (Heat/cooling objects)

Value group D	Description
0	Current value
1	Periodical value 1 [a]
2	Set date value
3	Billing date value
4	Minimum of value 1
5	Maximum of value 1
6	Test value [b]
7	Instantaneous value [c]
8	Time integral 1 [d]
9	Time integral 2 [e]
10	Current average [f]
11	Last average [g]
12	Periodical value 2 [a]
13	Periodical value 3 [a]
14	Minimum of value 2
15	Maximum of value 2
20	Under limit occurrence counter
21	Under limit duration
22	Over limit occurrence counter
23	Over limit duration
24	Missing data occurrence counter [h]
25	Missing data duration [h]
All other	Reserved

[a] A set of data that is collected periodically. Recording of data in this way is directly supported by 'profiles'.

[b] A value specially processed for test purpose. This may be due to a increased precision of the data, or to a faster (but less precise) processing of data.

[c] An immediate readout from the system, typically with a shorter measuring time than the current value.

[d] For a current billing period (F = 255): Time integral of the *quantity* calculated from the origin (first start of measurement) to the instantaneous time point.

For a historical billing period (F = 0…99): Time integral of the *quantity* calculated from the origin to the end of the billing period given by the billing period code.

[e] For a current billing period (F = 255): Time integral of the *quantity* calculated from the beginning of the current billing period to the instantaneous time point.

For a historical billing period (F = 0…99): Time integral of the *quantity* calculated over the billing period given by the billing period code.

[f] The value of a current demand register.

[g] The value of a demand register at the end of the last measurement period.

[h] Values considered as missing (for instance due to sensor failure).

11.3.3.4 General and service entry objects – Heat/ cooling

Table 27 — OBIS codes for general and service entry objects – Heat/cooling

General and service entry objects – Heat/ cooling	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined ID	5/6	*b*	0	0		
ID 1	5/6	*b*	0	0	0	
...			…	…	…	
ID 10	5/6	*b*	0	0	9	
Storage information						
Status (VZ) of the historical /periodical value counter	5/6	*b*	0	1	1	f
Status (VZ) of the periodical value counter, period 1	5/6	*b*	0	1	1	1 [f]
Number of available historical / periodical values	5/6	*b*	0	1	2	f
Number of available periodical values for period 2	5/6	*b*	0	1	2	2 [f]
Set date	5/6	*b*	0	1	10	
Billing date	5/6	*b*	0	1	11	
Configuration						
Program version	5/6	*b*	0	2	0	
Firmware version	5/6	*b*	0	2	1	
Software version	5/6	*b*	0	2	2	
Meter location (flow or return) [a]	5/6	*b*	0	2	3	
Device version	5/6	*b*	0	2	4	
Serial number of flow temperature transducer	5/6	*b*	0	2	10	
Serial number of return temperature transducer	5/6	*b*	0	2	11	
Serial number of forward flow transducer	5/6	*b*	0	2	12	
Serial number of return flow transducer	5/6	b	0	2	13	
Conversion factors						
Heat coefficient, k	5/6	*b*	0	4	1	
Media pressure (backup value) [b]	5/6	*b*	0	4	2	
Media enthalpy [c]	5/6	*b*	0	4	3	
Threshold values						
Threshold value limit for rate 1 [d]	5/6	*b*	0	5	1	
...			…	…	…	
Threshold value limit for rate 9 [d]	5/6	*b*	0	5	9	
Maximum contracted flow rate [e]	5/6	*b*	0	5	21	
Maximum contracted power [e]	5/6	*b*	0	5	22	
Maximum contracted Δθ [e]	5/6	*b*	0	5	23	
Minimum contracted return temperature [e]	5/6	*b*	0	5	24	
Timing information						

General and service entry objects – Heat/ cooling	OBIS code					
	A	**B**	**C**	**D**	**E**	**F**
Averaging period for measurements, generic	5/6	*b*	0	8	0	
Averaging period for instantaneous measurements	5/6	*b*	0	8	1	
Averaging period for volume / flow measurements	5/6	*b*	0	8	2	
Averaging period for temperature measurements	5/6	*b*	0	8	3	
Averaging period for pressure measurements	5/6	*b*	0	8	4	
Averaging period, power	5/6	*b*	0	8	5	
Averaging period, flow rate	5/6	*b*	0	8	6	
Averaging period, test values	5/6	*b*	0	8	7	
Measurement period, peak values, period 1(short) [g]	5/6	*b*	0	8	11	
Measurement period, peak values, period 2 [g]	5/6	*b*	0	8	12	
Measurement period, peak values, period 3 [g]	5/6	*b*	0	8	13	
Measurement period, peak values, period 4 [g]	5/6	*b*	0	8	14	
Measurement period, periodical values, period 1(short) [g]	5/6	*b*	0	8	21	
Measurement period, periodical values, period 2 [g]	5/6	*b*	0	8	22	
Measurement period, periodical values, period 3 [g]	5/6	*b*	0	8	23	
Measurement period, periodical values, period 4 [g]	5/6	*b*	0	8	24	
Measurement period, test values	5/6	*b*	0	8	25	
Recording interval 1 for profiles [h]	5/6	*b*	0	8	31	
Recording interval 2 for profiles [h]	5/6	*b*	0	8	32	
Recording interval 3 for profiles [h]	5/6	*b*	0	8	33	
Billing period	5/6	*b*	0	8	34	
Time entries						
Local time	5/6	*b*	0	9	1	
Local date	5/6	*b*	0	9	2	
Manufacturer specific [i]	5/6	*b*	96	50	*e*	*f*
....						
Manufacturer specific	5/6	*b*	96	99	*e*	*f*

[a] Information about where the (single) flow meter is inserted. A non-zero value is used when the flow meter is located in the flow path.

[b] Defines the pressure of the media, if not measured. The default value is 16 bar.

[c] The enthalpy of the thermal conveying liquid. This will be necessary when using media other than pure water. The enthalpy is a part of the calculations when converting from mass to power.

[d] Part of the contract between the customer and the supplier. The threshold defines when to switch rate, and can be used for diagnostic purposes, or to control limiting valves as well.

[e] Part of the contract between the customer and the supplier. The threshold may be used to set a 'flag', for diagnostic purposes, or to control limiting valves.

[f] Value group 'F' may be left unused, if there is only one set of historical / periodical values in the meter.

[g] The instantiation of periods in a meter shall always start at period 1.

[h] If only one recording interval is implemented, then it shall be recording interval 1. If multiple recording intervals are implemented, the recording interval 1 shall be the interval with the shorter period.

[i] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

11.3.3.5 Error register objects – Heat/ cooling

Table 28 — OBIS codes for error register objects – Heat/ cooling

Error register objects – Heat/ cooling	OBIS code					
	A	B	C	D	E	F
Error register	5/6	*b*	97	97	*e*	
NOTE The information to be included in the error objects is not defined in this document.						

11.3.3.6 Data profile objects – Heat/ cooling

Heat/ cooling related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Table 29 — OBIS codes for data profile objects – Heat/ cooling

Data profile objects – Heat/ cooling	OBIS code					
	A	B	C	D	E	F
Consumption/ load profile with recording interval 1	5/6	*b*	99	1	1	
Consumption/ load profile with recording interval 2	5/6	*b*	99	1	2	
Consumption/ load profile with recording interval 3	5/6	*b*	99	1	3	
Profile of maxima with recording interval 1	5/6	*b*	99	2	1	
Profile of maxima with recording interval 2	5/6	*b*	99	2	2	
Profile of maxima with recording interval 3	5/6	*b*	99	2	3	
Consumption/ load profile during test	5/6	*b*	99	3	1	
Certification data log	5/6	*b*	99	99	*e*	

11.3.3.7 OBIS codes for heat/ cooling related objects (examples)

Table 30 — OBIS codes for heat/ cooling related objects (examples)

Heat/ cooling related objects (examples)	OBIS code					
	A	B	C	D	E	F
Consumption						
Energy, current value, total	5/6	*b*	1	0	0	
Energy, current value, rate 1	5/6	*b*	1	0	1	
Energy, periodical, total, the two last storages	5/6	*b*	1	1	0	102
Energy, billing date value, total, last storage, rate 1	5/6	*b*	1	3	1	V_Z
Monitoring values						
Energy, maximum value (current period)	5/6	*b*	1	5		
Flow rate, Period value 2, previous storage	5/6	*b*	9	12		V_{Z-1}
Power, Max value, previous period	5/6	*b*	8	5		V_{Z-1}
Energy, Missing duration [c]	5/6	*b*	1	25		
Differential temperature, Test value	5/6	*b*	12	6		
Flow path, temperature transducers serial no.	5/6	*b*	0	2	10	
Collection of data with interval using a profile [a]	5/6	*b*	99	1	1	0
Error handling						
Overall error status [b]	5/6	*b*	97	97	0	
Subsystem where error has occurred [d]	5/6	*b*	97	97	1	
Duration of error condition [c]	5/6	*b*	97	97	2	

[a] This shows the use of the object type profile, designed to capture objects periodically. No profiles have been predefined for heat meters.

[b] This object is a 'mirror' of the object 0.x.97.97.0.

[c] This is the time during which the meter has not been able to calculate energy.

[d] A further subdivision of error information.

11.3.4 Value groups specific to Gas Meters

11.3.4.1 Introduction

The current subclause describes the naming of objects carrying gas metering information in a COSEM environment. It covers the handling of meters, volume converters as well as data loggers.

See Annex B for a detailed description of the data flow in gas metering.

11.3.4.2 Value group C for Gas

The allocations in the value group C take into account the different combinations of measuring and calculating devices located at a metering point, to allow identifying the source where the data are generated.

For the purposes of volume/mass/energy measurement, value group C identifies:

— the location of the device in the measurement chain: meter (encoder), converter, logger;

— the direction of the gas flow: forward or reverse;

— the qualifier of the measurement: undisturbed, disturbed, or absolute.

Value group C is also used for identifying process data.

For the purposes of gas analysis, a distinction is made between measured values generated by gas analysing systems (C = 70) and parameters used for calculation (C = 0, D = 12).

Table 31 — Value group C codes where A = 7 – Gas

Value group C	Description
0	General purpose objects
1	Forward undisturbed meter volume
2	Forward disturbed meter volume
3	Forward absolute meter volume
4	Reverse undisturbed meter volume
5	Reverse disturbed meter volume
6	Reverse absolute meter volume
7	Forward absolute meter volume (encoder)
8	Reverse absolute meter volume (encoder)
11	Forward undisturbed converter volume
12	Forward disturbed converter volume
13	Forward absolute converter volume
14	Reverse undisturbed converter volume
15	Reverse disturbed converter volume
16	Reverse absolute converter volume
21	Forward undisturbed logger volume
22	Forward disturbed logger volume
23	Forward absolute logger volume
24	Reverse undisturbed logger volume
25	Reverse disturbed logger volume
26	Reverse absolute logger volume
31	Forward undisturbed energy
32	Forward disturbed energy
33	Forward absolute energy
34	Reverse undisturbed energy
35	Reverse disturbed energy
36	Reverse absolute energy
41	Absolute temperature
42	Absolute pressure
43	Flow rate
44	Velocity of sound
45	Density (of gas)
46	Relative density

Value group C	Description
47	Gauge pressure
48	Differential pressure
49	Density of air
51	Correction factor
52	Conversion factor
53	Compressibility factor
54	Superior calorific value [a]
55	Gas law deviation coefficient (= compressibility factor ratio)
61	Forward undisturbed mass
62	Forward disturbed mass
63	Forward absolute mass
64	Reverse undisturbed mass
65	Reverse disturbed mass
66	Reverse absolute mass
70	Natural gas analysis
93	Consortia specific identifiers
94	Country specific identifiers
96	General and service entry objects – Gas
97	Error register objects – Gas
98	List objects – Gas
99	Data profiles – Gas
128...199, 240	Manufacturer specific codes
All other	Reserved
Notes	
[a] The superior (or gross) caloric value can be seen as a conversion factor for converting volume to energy although it is also used for the conversion algorithm.	

11.3.4.3 Value group D for Gas

11.3.4.3.1 Gas indexes and index differences

The allocations allow identifying the various volume, mass and energy quantities measured along the measuring chain and the gas volume conversion process, relative to various measurements and billing periods:

— indexes: current values and historical values relative to various billing periods;

— index differences: current and last values relative to measurement periods and billing periods;

Index difference over a certain measurement or billing period is also known as consumption. For consumption, thresholds may be defined, see Table 39.

— maximum of index differences over various measurement periods, relative to various billing periods.

A distinction is made between *value at metering conditions*, *corrected value* and *value at base conditions* (converted value). The applicability of these qualifiers depends on the location in the measuring chain and in the gas volume conversion process.

Three measurement periods are available:

— measurement period 1: default value 15 min;

— measurement period 2: default value 1 h;

— measurement period 3: no default value specified.

Four billing periods are available:

— billing period 1: default value 1 day;

— billing period 2: default value 1 month;

— billing period 3: default value 1 year;

— billing period 4: no default value specified.

The default values specified reflect the most common applications. If other values are used, they may be held by COSEM objects specified for this purpose.

In addition to the current values of the indexes, the following values are available:

For measurement periods 1 to 3:

— index differences for the current and the last measurement period (6 values each).

For billing periods 1, 3 and 4:

— historical indexes (3 values each);

— index differences for the current and the last billing period (6 values each);

— maximum of index differences over measurement periods 1, 2 and 3 (9 values each);

— in total, (18 values each).

For billing period 2:

— historical indexes (3 values);

— index differences for the current and the last billing period (6 values);

— maximum of index differences over measurement periods 1, 2 and 3, as well as over billing period 1 (12 values);

— in total, 21 values.

For all these values, tariffs may be applied.

Table 32 — Value group D codes for Gas – Indexes and index differences (A = 7, C = 1…8, 11…16, 21…26, 31…36, 61…66)

Value group D	Quantity	Qualifier	Period
0	Index	Value at metering conditions	Current [c]
1	Index	Corrected value [a]	Current [c]
2	Index	Value at base conditions / “Converted value”	Current [c]
3	Index	Current redundant value at metering conditions [b]	Current [c]
Values relative to measurement period 1 (default value = 15 min)			
6	Index difference	Value at metering conditions	Current
7	Index difference	Corrected value	Current
8	Index difference	Value at base conditions	Current
9	Index difference	Value at metering conditions	Last
10	Index difference	Corrected value	Last
11	Index difference	Value at base conditions	Last
Values relative to measurement period 2 (default value = 1 h)			
12	Index difference	Value at metering conditions	Current
13	Index difference	Corrected value	Current
14	Index difference	Value at base conditions	Current
15	Index difference	Value at metering conditions	Last
16	Index difference	Corrected value	Last
17	Index difference	Value at base conditions	Last
Values relative to measurement period 3 (no default value)			
18	Index difference	Value at metering conditions	Current
19	Index difference	Corrected value	Current
20	Index difference	Value at base conditions	Current
21	Index difference	Value at metering conditions	Last
22	Index difference	Corrected value	Last
23	Index difference	Value at base conditions	Last
Values relative to billing period 1 (default value = 1 d)			
24	Index	Value at metering conditions	Historical [c]
25	Index	Corrected value	Historical [c]
26	Index	Value at base conditions	Historical [c]
27	Index difference	Value at metering conditions	Current
28	Index difference	Corrected value	Current

Value group D	Quantity	Qualifier	Period
29	Index difference	Value at base conditions	Current
30	Index difference	Value at metering conditions	Last
31	Index difference	Corrected value	Last
32	Index difference	Value at base conditions	Last
33	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
34	Maximum of Index differences over measurement period 1 [c]	Corrected value	
35	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
36	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
37	Maximum of Index differences over measurement period 2 [c]	Corrected value	
38	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
39	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
40	Maximum of Index differences over measurement period 3 [c]	Corrected value	
41	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
Values relative to billing period 2 (default value = 1 m)			
42	Index	Value at metering conditions	Historical [c]
43	Index	Corrected value	Historical [c]
44	Index	Value at base conditions	Historical [c]
45	Index difference	Value at metering conditions	Current
46	Index difference	Corrected value	Current
47	Index difference	Value at base conditions	Current
48	Index difference	Value at metering conditions	Last
49	Index difference	Corrected value	Last
50	Index difference	Value at base conditions	Last
51	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
52	Maximum of Index differences over measurement period 1 [c]	Corrected value	
53	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
54	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
55	Maximum of Index differences over measurement period 2 [c]	Corrected value	
56	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
57	Maximum of Index differences over	Value at metering conditions	

Value group D	Quantity	Qualifier	Period
	measurement period 3 [c]		
58	Maximum of Index differences over measurement period 3 [c]	Corrected value	
59	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
60	Maximum of Index differences over billing period 1 [c]	Value at metering conditions	
61	Maximum of Index differences over billing period 1 [c]	Corrected value	
62	Maximum of Index differences over billing period 1 [c]	Value at base conditions	
Values relative to billing period 3 (default value = 1 year)			
63	Index	Value at metering conditions	Historical [c]
64	Index	Corrected value	Historical [c]
65	Index	Value at base conditions	Historical [c]
66	Index difference	Value at metering conditions	Current
67	Index difference	Corrected value	Current
68	Index difference	Value at base conditions	Current
69	Index difference	Value at metering conditions	Last
70	Index difference	Corrected value	Last
71	Index difference	Value at base conditions	Last
72	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
73	Maximum of Index differences over measurement period 1 [c]	Corrected value	
74	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
75	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
76	Maximum of Index differences over measurement period 2 [c]	Corrected value	
77	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
78	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
79	Maximum of Index differences over measurement period 3 [c]	Corrected value	
80	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
Values relative to billing period 4 (no default value)			
81	Index	Value at metering conditions	Historical [c]
82	Index	Corrected value	Historical [c]
83	Index	Value at base conditions	Historical [c]
84	Index difference	Value at metering conditions	Current

Value group D	Quantity	Qualifier	Period
85	Index difference	Corrected value	Current
86	Index difference	Value at base conditions	Current
87	Index difference	Value at metering conditions	Last
88	Index difference	Corrected value	Last
89	Index difference	Value at base conditions	Last
90	Maximum of Index differences over measurement period 1 [c]	Value at metering conditions	
91	Maximum of Index differences over measurement period 1 [c]	Corrected value	
92	Maximum of Index differences over measurement period 1 [c]	Value at base conditions	
93	Maximum of Index differences over measurement period 2 [c]	Value at metering conditions	
94	Maximum of Index differences over measurement period 2 [c]	Corrected value	
95	Maximum of Index differences over measurement period 2 [c]	Value at base conditions	
96	Maximum of Index differences over measurement period 3 [c]	Value at metering conditions	
97	Maximum of Index differences over measurement period 3 [c]	Corrected value	
98	Maximum of Index differences over measurement period 3 [c]	Value at base conditions	
All other	Reserved		
Notes			

[a] Error correction of meter curves can be allocated to meters (e.g. temperature compensation of a diaphragm gas meter) or subsequent connected devices (e.g. high pressure correction curve of a turbine meter implemented in an associated volume conversion device).

[b] From data logger (parallel recording) for use in case of a measurement device fails.

[c] Current value: $F = 255$

Historical values ($F \neq 255$):

With $F = 1…12, 0…99$ value(s) of (a) previous billing period, relative to the billing period counter.

With $F = 101…126$ value(s) of (a) previous billing period(s) relative to the current billing period.

11.3.4.3.2 Flow rate

The allocations allow identifying values associated with the flow rate of the gas. The flow rate is a process information. It is not linked to a physical device. No tariffication is applicable.

A distinction is made between:

— current average, last average, and maximum of last average values measured over various averaging periods, relative to various measurement and billing periods. Measurement period 2 and 3 shall be multiple of the averaging period of block demand/sliding demand measurement;

— values at metering conditions, corrected value, value at base conditions (converted value) and value at standard conditions.

NOTE Standard conditions refer to national regulations, which may differ from ISO standards reference values for base conditions.

EXAMPLE Gas reference temperature at standard conditions is 0 °C, gas reference temperature at base conditions is +15 °C.

For averaging period 2, block demand (default) or sliding demand is available. In the case of sliding demand, the averaging period is split to sub-periods. The number of sub-periods is carried by the object 7.b.0.8.35.255.

The last average values of the various flow rate quantities can be captured to load profiles, with self-explanatory OBIS codes.

Table 33 — Value group D codes – Gas – Flow rate: A = 7, C = 43

Value Group D	Quantity	Qualifier
0	Instantaneous	Current value at metering conditions
1	Instantaneous	Corrected value
2	Instantaneous	Value at base conditions/“Converted value”
13	Instantaneous	Value at standard conditions
Averaging period 1, default value = 5 min		
15	Current average for averaging period 1	Value at metering conditions
16		Corrected value
17		Value at base conditions
18		Value at standard conditions
19	Last average for averaging period 1	Value at metering conditions
20		Corrected value
21		Value at base conditions
22		Value at standard conditions
23	Maximum of last averages for averaging period 1 relative to measurement period 2 (default value = 1 h)	Value at metering conditions
24		Corrected value
25		Value at base conditions
26		Value at standard conditions
27	Maximum of last averages for averaging period 1 relative to measurement period 3 (no default value)	Value at metering conditions
28		Corrected value
29		Value at base conditions
30		Value at standard conditions
31	Maximum of last averages for averaging period 1 relative to billing period 1 (default value = 1 d)	Value at metering conditions
32		Corrected value
33		Value at base conditions
34		Value at standard conditions

Value Group D	Quantity	Qualifier
Averaging period 2, default value = 15 min (block demand or sliding demand)		
35	Current average for averaging period 2	Value at metering conditions
35		Corrected value
37		Value at base conditions
38		Value at standard conditions
39	Last average for averaging period 2	Value at metering conditions
40		Corrected value
41		Value at base conditions
42		Value at standard conditions
43	Maximum of last averages for averaging period 2 relative to measurement period 2 (default value = 1 h)	Value at metering conditions
44		Corrected value
45		Value at base conditions
46		Value at standard conditions
47	Maximum of last averages for averaging period 2 relative to measurement period 3 (no default value)	Value at metering conditions
48		Corrected value
49		Value at base conditions
50		Value at standard conditions
51	Maximum of last averages for averaging period 2 relative to billing period 1 (default value = 1 d)	Value at metering conditions
52		Corrected value
53		Value at base conditions
54		Value at standard conditions
Averaging period 3, default value = 1 h		
55	Current average for averaging period 3	Value at metering conditions
56		Corrected value
57		Value at base conditions
58		Value at standard conditions
59	Last average for averaging period 3	Value at metering conditions
60		Corrected value
61		Value at base conditions
62		Value at standard conditions
Averaging period 4, (no default value)		
63	Current average for averaging period 4	Value at metering conditions
64		Corrected value
65		Value at base conditions
66		Value at standard conditions
67	Last average for averaging period 4	Value at metering conditions
68		Corrected value

Value Group D	Quantity	Qualifier
69		Value at base conditions
70		Value at standard conditions
All other	Reserved	

11.3.4.3.3 Process values

For process values, a distinction is made between:

— instantaneous values;

— average, minimum and maximum values over various process intervals;

— value at metering conditions, value at base conditions; and value at standard conditions;

NOTE Standard conditions refer to national regulations, which may differ from ISO standards reference values for base conditions.

EXAMPLE Gas reference temperature at standard conditions is 0 °C, gas reference temperature at base conditions is +15 °C.

— for some quantities, backup, actual and preset values are available.

Table 34 — Value group D codes – Gas – Process values (A = 7, C = 41, 42, 44…49)

Value group D	Quantity	Qualifier
0	Instantaneous	Current value at metering conditions [a]
2	Instantaneous	Value at base conditions/“Converted value” [b]
3	Instantaneous	Backup value
10	Instantaneous	Actual value
11	Instantaneous	Preset value
13	Instantaneous	Value at standard conditions
Process interval 1 (default value = 15 min)		
15	Average, current interval, process interval 1	Value at metering conditions
16		Value at base conditions
17		Value at standard conditions
18	Minimum, current interval, process interval 1	Value at metering conditions
19		Value at base conditions
20		Value at standard conditions
21	Maximum, current interval, process interval 1	Value at metering conditions
22		Value at base conditions
23		Value at standard conditions
24	Average, last interval, process interval 1	Value at metering conditions
25		Value at base conditions

26		Value at standard conditions
27	Minimum, last interval, process interval 1	Value at metering conditions
28		Value at base conditions
29		Value at standard conditions
30	Maximum, last interval, process interval 1	Value at metering conditions
31		Value at base conditions
32		Value at standard conditions
Process interval 2 (default value = 1 h)		
33	Average, current interval, process interval 2	Value at metering conditions
34		Value at base conditions
35		Value at standard conditions
36	Minimum, current interval, process interval 2	Value at metering conditions
37		Value at base conditions
38		Value at standard conditions
39	Maximum, current interval, process interval 2	Value at metering conditions
40		Value at base conditions
41		Value at standard conditions
42	Average, last interval, process interval 2	Value at metering conditions
43		Value at base conditions
44		Value at standard conditions
45	Minimum, last interval, process interval 2	Value at metering conditions
46		Value at base conditions
47		Value at standard conditions
48	Maximum, last interval, process interval 2	Value at metering conditions
49		Value at base conditions
50		Value at standard conditions
Process interval 3 (default value = 1 d)		
51	Average, current interval, process interval 3	Value at metering conditions
52		Value at base conditions
53		Value at standard conditions
54	Minimum, current interval, process interval 3	Value at metering conditions
55		Value at base conditions
56		Value at standard conditions
57	Maximum, current interval, process interval 3	Value at metering conditions
58		Value at base conditions
59		Value at standard conditions
60	Average, last interval, process interval 3	Value at metering conditions
61		Value at base conditions

62		Value at standard conditions
63	Minimum, last interval, process interval 3	Value at metering conditions
64		Value at base conditions
65		Value at standard conditions
66	Maximum, last interval, process interval 3	Value at metering conditions
67		Value at base conditions
68		Value at standard conditions
Process interval 4 (default value = 1 m)		
69	Average, current interval, process interval 4	Value at metering conditions
70		Value at base conditions
71		Value at standard conditions
72	Minimum, current interval, process interval 4	Value at metering conditions
73		Value at base conditions
74		Value at standard conditions
75	Maximum, current interval, process interval 4	Value at metering conditions
76		Value at base conditions
77		Value at standard conditions
78	Average, last interval, process interval 4	Value at metering conditions
79		Value at base conditions
80		Value at standard conditions
81	Minimum, last interval, process interval 4	Value at metering conditions
82		Value at base conditions
83		Value at standard conditions
84	Maximum, last interval, process interval 4	Value at metering conditions
85		Value at base conditions
86		Value at standard conditions
Process interval 5, since last event		
87	Average, process interval 5, interval since last event	Value at metering conditions
88		Value at base conditions
89		Value at standard conditions
90	Average, process interval 6, interval between last two events	Value at metering conditions
91		Value at base conditions
92		Value at standard conditions
All other	Reserved	
Notes		
[a] To be used for e.g. velocity of sound.		
[b] Value of the base conditions is associated with reference values for volume conversion: C = 41, 42.		

11.3.4.3.4 Conversion related factors and coefficients

For correction, conversion, compressibility, superior calorific value and gas law deviation coefficient values, various OBIS code allocations are made taking into consideration the specifics of the measuring process. For these values, average values over various averaging periods are also defined.

Table 35 — Value group D codes – Gas – Correction, conversion and compressibility values (A = 7, C = 51…55)

Value group D	Description
0	Current value at metering conditions
2	Current value at base conditions/“Converted Value”
3	Backup
10	Actual
11	Preset
12	Method
All other	Reserved

11.3.4.3.5 Natural gas analysis values

For natural gas analysis, allocations in value group D identify the key parameters and the components of the natural gas.

For these values, average values over various averaging periods are also defined.

Table 36 — Value group D codes – Gas – Natural gas analysis values (A = 7, C = 70)

Value group D	Description
8	Reference pressure of gas analysis
9	Reference temperature of gas analysis
10	Superior [a] Wobbe index 0 °C
11	Inferior [b] Wobbe index 0 °C
12	Methane number
13	Total sulfur
14	Hydrogen sulphide H_2S
15	Mercaptans
16	Water dew point (DP H_2O)
17	Water (H_2O) dew point outlet/normalized
18	Hydrocarbon dew point (DP C_XH_Y)
19	Inferior [c] calorific value $H_{i,n}$
20	Water H_2O
60	Nitrogen N_2

61	Hydrogen H_2
62	Oxygen O_2
63	Helium He
64	Argon Ar
65	Carbon monoxide CO
66	Carbon dioxide CO_2
67	Methane CH_4
68	Ethene C_2H_4
69	Ethane C_2H_6
70	Propene C_3H_6
71	Propane C_3H_8
72	i-butane i-C_4H_{10}
73	n-butane n-C_4H_{10}
74	neo-pentane neo-C_5H_{12}
75	i-pentane i-C_5H_{12}
76	n-pentane n-C_5H_{12}
77	Hexane C_6H_{14}
78	Hexane share higher hydrocarbons C_6H_{14} %
79	Hexane+ C_6H_{14}+
80	Heptane C_7H_{16}
81	Octane C_8H_{18}
82	Nonane C_9H_{20}
83	Decane $C_{10}H_{22}$
84	Tetrahydrothiophene C_4H_8S
All other	Reserved
Notes	

[a] Superior (gross) Wobbe index.
[b] Inferior (net) Wobbe index.
[c] Inferior (net) calorific value.

11.3.4.4 Value group E codes

11.3.4.4.1 General

The following clauses define the use of value group E for identifying further classification or processing the measurement quantities defined by value groups A to D. The various classifications and processing methods are exclusive.

11.3.4.4.2 Indexes and index differences – Tariff rates

This table shows the use of value group E for identification of tariff rates typically used for indexes and index differences of volume, mass and energy.

Table 37 — Value group E codes – Gas – Indexes and index differences – Tariff rates for A = 7, C = 1...8, 11...16, 21...26, 31...36, 61...66, D = 0…3, 6…98

Value group E	Description
0	Total
1..63	Rates 1 to 63 inclusive
128…254	Manufacturer specific codes
All other	Reserved

11.3.4.4.3 Flow rate

No further classifications in value group E are made. Therefore, group E shall be 0.

11.3.4.4.4 Process values

No further classifications in value group E are made. Therefore, group E shall be 0.

11.3.4.4.5 Conversion related factors and coefficients – Averages

The table below shows the use of value group E for the identification of average values of correction, conversion and compressibility values over various averaging periods.

Table 38 — Value group E codes – Gas – Correction, conversion and compressibility values – Averages: A = 7, C = 51...55, D = 0, 2, 3, 10, 11

Value group E	Description
0	Process independent current value [a]
1	Weighted value (e.g. Superior calorific value) [b]
11	Average, current interval, averaging period 1 (default 5 minutes)
12	Average, last interval, averaging period 1 (default 5 minutes)
13	Average, current interval, averaging period 2 (default 15 minutes)
14	Average, last interval, averaging period 2 (default 15 minutes)

15	Average, current interval, averaging period 3 (default 1 h)
16	Average, last interval, averaging period 3 (default 1 h)
17	Average, current interval, averaging period 4 (no default value)
18	Average, last interval, averaging period 4 (no default value)
19	Average, current interval, averaging period 5 (default 1 d)
20	Average, last interval, averaging period 5 (default 1 d)
21	Average, current interval, averaging period 6 (default 1 month)
22	Average, last interval, averaging period 6 (default 1 month)
23	Average, current interval, averaging period 7 (default 1 year)
24	Average, last interval, averaging period 7 (default 1 year)
25	Average, current interval, averaging period 8 (no default value)
26	Average, last interval, averaging period 8 (no default value)
27	Average, averaging period 9, interval since last event
28	Average, averaging period 10, interval between last two events
All other	Reserved
Notes	

[a] Process independent current value is a gas analysis technology independent value, which is generated asynchronous to processing cycles, but used for further calculations.

[b] Weighted value is the result of specific algorithms taking into account different values by weighting their influence on the algorithm result.

11.3.4.4.6 Conversion related factors and coefficients – Averages

The table below shows the use of value group E for the identification of calculation methods.

Table 39 — Value group E codes – Gas – Calculation methods A = 7, C = 51...55, D = 12

Value group E	Description
0	Total
1..63	Rates 1 to 63 inclusive
128…254	Manufacturer specific codes
All other	Reserved

11.3.4.4.7 Natural gas analysis values – Averages

The table below shows the use of value group E for the identification of natural gas analysis values over various averaging periods.

Table 40 — Value group E codes – Gas – Natural gas analysis values – Averages: A = 7, C = 70, D = 8...20, 60...84

Value group E	Description
0	Process independent current value [a]
1	Weighted value (e.g. CO_2 in [GJ/t]) [b]
11	Average, current interval, averaging period 1 (default 5 minutes)
12	Average, last interval, averaging period 1 (default 5 minutes)
13	Average, current interval, averaging period 2 (default 15 minutes)
14	Average, last interval, averaging period 2 (default 15 minutes)
15	Average, current interval, averaging period 3 (default 1 hour)
16	Average, last interval, averaging period 3 (default 1 h)
17	Average, current interval, averaging period 4 (no default value)
18	Average, last interval, averaging period 4 (no default value)
19	Average, current interval, averaging period 5 (default 1 d)
20	Average, last interval, averaging period 5 (default 1 d)
21	Average, current interval, averaging period 6 (default 1 month)
22	Average, last interval, averaging period 6 (default 1 month)
23	Average, current interval, averaging period 7 (default 1 year)
24	Average, last interval, averaging period 7 (default 1 year)
25	Average, current interval, averaging period 8 (no default value)
26	Average, last interval, averaging period 8 (no default value)
27	Average, averaging period 9, interval since last event
28	Average, averaging period 10, interval between last two events
All other	Reserved
Notes	
[a] Process independent current value is a gas analysis technology independent value, which is generated asynchronous to processing cycles, but used for further calculations. [b] Weighted value is the result of specific algorithms taking into account different values by weighting their influence on the algorithm result.	

11.3.4.5 Value group F codes - Gas

Value group F identifies current (with *F* = 255) or historical values of quantities identified by value groups A to E, where appropriate.

There are four billing period schemes available (for example to store daily, monthly, yearly and weekly values). For each billing period scheme, the following general purpose objects are available:

— billing period counter;

— number of available billing periods;

— time stamp of most recent and historical billing periods;

— billing period length.

11.3.4.6 General and service entry objects – Gas

Table 41 — OBIS codes for general and service entry objects – Gas

General and service entry objects – Gas	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined gas ID	7	*b*	0	0		
Gas ID 1	7	*b*	0	0	0	
...	…	…	...	...	...	
Gas ID 10	7	*b*	0	0	9	
Billing period values/ reset counter entries (First billing period scheme if there are more than one)						
Billing period counter (1)	7	*b*	0	1	0	VZ or 255
Number of available billing periods (1)	7	*b*	0	1	1	
Time stamp of the most recent billing period (1)	7	*b*	0	1	2	
Time stamp of the billing period (1) VZ (last reset)	7	*b*	0	1	2	VZ
Time stamp of the billing period (1) VZ_{-1}	7	*b*	0	1	2	VZ_{-1}
...			...	...	...	
Time stamp of the billing period (1) VZ_{-n}	7	*b*	0	1	2	VZ_{-n}
Billing period values/ reset counter entries (Second billing period scheme)						
Billing period counter (2)	7	*b*	0	1	3	VZ or 255
Number of available billing periods (2)	7	*b*	0	1	4	
Time stamp of the most recent billing period (2)	7	*b*	0	1	5	
Time stamp of the billing period (2) VZ (last reset)	7	*b*	0	1	5	VZ
Time stamp of the billing period (2) VZ_{-1}	7	*b*	0	1	5	VZ_{-1}
...			...	...	...	
Time stamp of the billing period (2) VZ_{-n}	7	*b*	0	1	5	VZ_{-n}

Billing period values/ reset counter entries (Third billing period scheme)						
Billing period counter (3)	7	*b*	0	1	6	VZ or 255
Number of available billing periods (3)	7	*b*	0	1	7	
Time stamp of the most recent billing period (3)	7	*b*	0	1	8	
Time stamp of the billing period (3) VZ (last reset)	7	*b*	0	1	8	VZ
Time stamp of the billing period (3) VZ_{-1}	7	*b*	0	1	8	VZ_{-1}
...			...	...	...	
Time stamp of the billing period (3) VZ_{-n}	7	*b*	0	1	8	VZ_{-n}
Billing period values/ reset counter entries (Fourth billing period scheme)						
Billing period counter (4)	7	*b*	0	1	9	VZ or 255
Number of available billing periods (4)	7	*b*	0	1	10	
Time stamp of the most recent billing period (4)	7	*b*	0	1	11	
Time stamp of the billing period (4) VZ (last reset)	7	*b*	0	1	11	VZ
Time stamp of the billing period (4) VZ_{-1}	7	*b*	0	1	11	VZ_{-1}
...			...	...	...	
Time stamp of the billing period (4) VZ_{-n}	7	*b*	0	1	11	VZ_{-n}
Configuration						
Program version	7	*b*	0	2	0	
Firmware version	7	*b*	0	2	1	
Software version	7	*b*	0	2	2	
Device version	7	*b*	0	2	3	
Active firmware signature	7	*b*	0	2	8	
Number of device channels	7	*b*	0	2	10	
Pressure sensor, serial no.	7	*b*	0	2	11	
Temperature sensor, serial no.	7	*b*	0	2	12	
Calculator, serial no.	7	*b*	0	2	13	
Volume sensor [a], serial no.	7	*b*	0	2	14	
Density sensor, serial no.	7	b	0	2	15	
Sensor (medium irrespective), serial no.	7	*b*	0	2	16	
Digital output configuration	7	*b*	0	2	17	
Analogue output configuration	7	*b*	0	2	18	
Output pulse constants converted/unconverted						
Volume forward at metering conditions	7	*b*	0	3	0	
Volume reverse at metering conditions	7	*b*	0	3	1	
Volume absolute [b] at metering conditions	7	*b*	0	3	2	
Volume forward at base conditions	7	*b*	0	3	3	
Volume reverse at base conditions	7	*b*	0	3	4	
Volume absolute [b] at base conditions	7	*b*	0	3	5	

Conversion factors						
{This area is to be used for polynomials, constants for conversion, and similar} ... 	7 7 7 7 7	*b* *b* *b* *b* *b*	0 0 0 0 0	4 4 4 4 4	0 1 2 3 4	
Threshold values						
Threshold power for over-consumption relative to measurement period 2 for indexes and index differences						
limit 1 ... limit 4	7 7	*b* *b*	0 ... 0	5 ... 5	1 ... 1	1 ... 4
Threshold power for over-consumption relative to measurement period 3 for indexes and index differences						
limit 1 ... limit 4	7 7	*b* *b*	0 ... 0	5 ... 5	1 ... 1	11 ... 14
Threshold limit for rate 1 for over-consumption relative to measurement period 2 for indexes and index differences ... limit for rate 9	7 7	*b* *b*	0 ... 0	5 ... 5	2 ... 2	1 ... 9
Threshold limit for rate 1 for over-consumption relative to measurement period 3 for indexes and index differences ... limit for rate 9	7 7	*b* *b*	0 ... 0	5 ... 5	2 ... 2	11 ... 19
Maximum contracted consumption for rec. interval 1 Maximum contracted consumption for rec. interval 2 Absolute temperature, minimum limit setting [c] Absolute temperature, maximum limit setting [c] Absolute pressure, minimum limit setting [c] Absolute pressure, maximum limit setting [c]	7 7 7 7 7 7	*b* *b* *b* *b* *b* *b*	0 0 0 0 0 0	5 5 5 5 5 5	3 4 11 12 13 14	
Nominal values volume sensor						
Pressure Temperature Q_{min} Q_{max}	7 7 7 7	*b* *b* *b* *b*	0 0 0 0	6 6 6 6	1 2 3 4	
Input pulse constants						
Volume forward at metering conditions	7	*b*	0	7	0	

Volume reverse metering conditions	7	*b*	0	7	1	
Volume absolute [b] at metering conditions	7	*b*	0	7	2	
Volume forward at base conditions	7	*b*	0	7	3	
Volume reverse at base conditions	7	*b*	0	7	4	
Volume absolute [b] at base conditions	7	*b*	0	7	5	
Intervals and periods						
Recording interval 1, for profile [d]	7	*b*	0	8	1	
Recording interval 2, for profile [d]	7	*b*	0	8	2	
Measurement period 1, for average value 1	7	*b*	0	8	3	
Measurement period 2, for average value 2	7	*b*	0	8	4	
Measurement period 3, for instantaneous value	7	*b*	0	8	5	
Measurement period 4, for test value	7	*b*	0	8	6	
Billing period	7	*b*	0	8	10	
NOTE Codes 7.b.0.8.11...35 are newly defined in Blue Book Edition 9.						
Process interval 1, default value 15 min	7	*b*	0	8	11	
Process interval 2, default value 1 h	7	*b*	0	8	12	
Process interval 3, default value 1 d	7	*b*	0	8	13	
Process interval 4, default value 1 month	7	*b*	0	8	14	
Process interval 5, for process value, since last event	7	*b*	0	8	15	
Process interval 6, between last two events	7	*b*	0	8	16	
Measurement period 1, for indexes and index differences, default value 15 min	7	*b*	0	8	17	
Measurement period 2, for indexes and index differences, default value 1 h	7	*b*	0	8	18	
Measurement period 3, for indexes and index differences, no default value	7	*b*	0	8	19	
Billing period 1, for indexes and index differences, default value 1 d	7	*b*	0	8	20	
Billing period 2, for indexes and index differences, default value 1 month	7	*b*	0	8	21	
Billing period 3, for indexes and index differences, default value 1 year,	7	*b*	0	8	22	
Billing period 4, for indexes and index differences, no default value	7	*b*	0	8	23	
Averaging period 1, default value 5 min	7	*b*	0	8	25	
Averaging period 2, default value 15 min	7	*b*	0	8	26	
Averaging period 3, default value 1 h	7	*b*	0	8	27	
Averaging period 4, no default value	7	*b*	0	8	28	
Averaging period 5, default value 1 d	7	*b*	0	8	29	
Averaging period 6, default value 1 month	7	*b*	0	8	30	

Averaging period 7, default value 1 year	7	*b*	0	8	31	
Averaging period 8, no default value	7	*b*	0	8	32	
Averaging period 9, since last event	7	*b*	0	8	33	
Averaging period 10, between two last events	7	*b*	0	8	34	
Number of sub-periods for averaging period 2	7	*b*	0	8	35	
Time entries						
Number of days (time expired) since last reset (First billing period scheme if there are more than one)	7	*b*	0	9	0	
Local time	7	*b*	0	9	1	
Local date	7	*b*	0	9	2	
Start of conventional gas day	7	*b*	0	9	3	
Residual time shift [e]	7	*b*	0	9	4	
Time of last reset (First billing period scheme if there are more than one)	7	*b*	0	9	6	
Date of last reset (First billing period scheme if there are more than one)	7	*b*	0	9	7	
Clock time shift limit	7	*b*	0	9	11	
First billing period scheme						
Number of days (time expired) since last reset (end of billing period)			*See above.*			
Time of last reset			*See above.*			
Date of last reset			*See above.*			
Billing period reset lockout time (First billing period scheme if there are more than one)	7	*b*	0	9	12	
Second billing period scheme						
Number of days (time expired) since last end of billing period	7	*b*	0	9	13	
Time of last reset	7	*b*	0	9	14	
Date of last reset	7	*b*	0	9	15	
Billing period reset lockout	7	*b*	0	9	16	
Third billing period scheme						
Number of days (Time expired) since last end of billing period	7	*b*	0	9	17	
Time of last reset	7	*b*	0	9	18	
Date of last reset	7	*b*	0	9	19	
Billing period reset lockout time	7	*b*	0	9	20	
Fourth billing period scheme						
Number of days (time expired) since last end of billing period	7	*b*	0	9	21	
Time of last reset	7	*b*	0	9	22	
Date of last reset	7	*b*	0	9	23	
Billing period reset lockout	7	*b*	0	9	24	

Station management information objects						
Heating temperature [f], current value	7	*b*	0	10	0	
Heating temperature, average 15 min	7	*b*	0	10	1	
Heating temperature, average 60 min	7	*b*	0	10	11	
Heating temperature, average day	7	*b*	0	10	21	
Heating temperature, average month	7	*b*	0	10	31	
Ambient device temperature [g], current value	7	*b*	0	11	0	
Ambient device temperature, average 15 min	7	*b*	0	11	1	
Ambient device temperature, average 60 min	7	*b*	0	11	11	
Ambient device temperature, average day	7	*b*	0	11	21	
Ambient device temperature, average month	7	*b*	0	11	31	
Gas parameters for volume conversion, currently used in compressibility calculation						
Reference pressure of gas analysis	7	*b*	0	12	8	
Reference temperature of gas analysis	7	*b*	0	12	9	
Superior Wobbe number 0 °C	7	*b*	0	12	10	
Inferior Wobbe number 0 °C	7	*b*	0	12	11	
Methane number	7	*b*	0	12	12	
Total sulfur	7	*b*	0	12	13	
Hydrogen sulphide H_2S	7	*b*	0	12	14	
Mercaptans	7	*b*	0	12	15	
Water dew point (DP H_2O)	7	*b*	0	12	16	
Water (H_2O) dew point outlet / normalized	7	*b*	0	12	17	
Hydrocarbon dew point (DP C_XH_Y)	7	*b*	0	12	18	
Inferior calorific value $H_{i,n}$	7	*b*	0	12	19	
Water H_2O	7	*b*	0	12	20	
Density (of gas), base conditions	7	*b*	0	12	45	
Relative density	7	*b*	0	12	46	
Superior calorific value $H_{s,n}$	7	*b*	0	12	54	
Nitrogen N_2	7	*b*	0	12	60	
Hydrogen H_2	7	*b*	0	12	61	
Oxygen O_2	7	*b*	0	12	62	
Helium He	7	*b*	0	12	63	
Argon Ar	7	*b*	0	12	64	
Carbon monoxide CO	7	*b*	0	12	65	
Carbon dioxide CO_2	7	*b*	0	12	66	
Methane CH_4	7	*b*	0	12	67	
Ethane C_2H_4	7	*b*	0	12	68	

Ethane C_2H_6	7	*b*	0	12	69	
Propene C_3H_6	7	*b*	0	12	70	
Propane C_3H_8	7	*b*	0	12	71	
i-butane i-C_4H_{10}	7	*b*	0	12	72	
n-butane n-C_4H_{10}	7	*b*	0	12	73	
neo-pentane neo-C_5H_{12}	7	*b*	0	12	74	
i-pentane i-C_5H_{12}	7	*b*	0	12	75	
n-pentane n-C_5H_{12}	7	*b*	0	12	76	
Hexane C_6H_{14}	7	*b*	0	12	77	
Hexane share higher hydrocarbons C_6H_{14} %	7	*b*	0	12	78	
Hexane+ C_6H_{14}+	7	*b*	0	12	79	
Heptane C_7H_{16}	7	*b*	0	12	80	
Octane C_8H_{18}	7	*b*	0	12	81	
Nonane C_9H_{20}	7	*b*	0	12	82	
Decane $C_{10}H_{22}$	7	*b*	0	12	83	
Tetrahydrothiophene	7	*b*	0	12	84	
Gas parameters for Venturi measurement						
Internal pipe diameter	7	*b*	0	13	1	
Orifice diameter	7	*b*	0	13	2	
Pressure type (orifice fitting)	7	*b*	0	13	3	
Flow coefficient (alfa)	7	*b*	0	13	4	
Expansion coefficient (epsilon)	7	*b*	0	13	5	
Reflux coefficient	7	*b*	0	13	6	
Isoentropic coefficient	7	*b*	0	13	7	
Dynamic viscosity	7	*b*	0	13	8	
Differential pressure dp for cut off	7	*b*	0	13	9	
Reynold number	7	*b*	0	13	10	
Gas parameters for density measurement						
K0 Densimeter Coefficient	7	*b*	0	14	1	
K2 Densimeter Coefficient	7	*b*	0	14	2	
Densimeter period for instanteneous measurement	7	*b*	0	14	10	
Densimeter period for measurement period 15 min	7	*b*	0	14	11	
Sensor manager						
Sensor manager objects	7	*b*	0	15	*e*	
Internal operating status, gas related						
Internal operating status, global [h]	7	*b*	96	5	0	
Internal operating status (status word 1) [h]	7	*b*	96	5	1	
Internal operating status (status word 2) [h]	7	*b*	96	5	2	
Internal operating status (status word 3) [h]	7	*b*	96	5	3	

Internal operating status (status word 4) [h]	7	*b*	96	5	4	
Internal operating status (status word 5) [h]	7	*b*	96	5	5	
Internal operating status (status word 6) [h]	7	*b*	96	5	6	
Internal operating status (status word 7) [h]	7	*b*	96	5	7	
Internal operating status (status word 8) [h]	7	*b*	96	5	8	
Internal operating status (status word 9) [h]	7	*b*	96	5	9	
Manufacturer specific [i] .... Manufacturer specific	7 7	*b* *b*	96 96	50 99	e e	

[a] A volume sensor could be an external mechanical meter/encoder/electronic index.

[b] Absolute in the sense that this represents total volume regardless of direction of flow: for example 2 m^3 forward with one cubic meter reverse flow would combine to give 3 m^3.

[c] The limits represent the values at which a temperature or absolute pressure measured outside these limits may affect the error status of the device.

[d] If multiple recording intervals are implemented, then recording interval 1 shall be the shorter.

[e] This value indicates the remaining time interval for soft time setting, where the clock is corrected in small steps (equivalent to clock object method 6).

[f] Heating temperature refers to the heating system temperature where stations have gas heating systems.

[g] Application for control of battery environment or volume conversion device environmental control.

[h] Status words referring to a status table with fix status words or to any status table bits using mapped status (class_id = 63).

[i] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

11.3.4.7 Error register objects – Gas

Table 42 — OBIS codes for error register objects – Gas

Error register objects – Gas	**OBIS code**					
	A	**B**	**C**	**D**	**E**	**F**
Error register	7	*b*	97	97	*e*	

NOTE The information to be included in the error objects is not defined in this document.

11.3.4.8 List object – Gas

Table 43 — OBIS codes for list objects - Gas

List objects – Abstract	OBIS code					
	A	B	C	D	E	F
Gas related data of billing period (with billing period scheme 1 if there are more than one schemes available)	7	*b*	98	1	*e*	255 [a]
Gas related data of billing period (with billing period scheme 2)	7	*b*	98	2	*e*	255 [a]
Gas related data of billing period (with billing period scheme 3)	7	*b*	98	3	*e*	255 [a]
Gas related data of billing period (with billing period scheme 4)	7	*b*	98	4	*e*	255 [a]
Gas related data of event triggered billing profile [b]	7	*b*	98	11	*e*	255 [a]

[a] *F* = 255 means a wildcard here. See 11.5.3.

[b] Event triggered means the termination of a billing period by events, e.g. by commands. (Therefore, the profile entries are not equidistant in time.)

11.3.4.9 Data profile objects – Gas

Table 44 — OBIS codes for data profile objects – Gas

Data profile objects – Gas	OBIS code					
	A	B	C	D	E	F
Load profile with recording interval 1	7	*b*	99	1	4 [a]	
Load profile with recording interval 2	7	*b*	99	2	4 [a]	
Profile of maxima with recording interval 1	7	*b*	99	3	4 [a]	
Profile of maxima with recording interval 2	7	*b*	99	4	4 [a]	
Load profiles for indexes and index differences of volume, mass and energy [b]	7	*b*	99	*d* [c]	*e* [d]	
Load profiles for process values	7	*b*	99	*d* [e]	*e* [f]	
Load profiles for flow rate	7	*b*	99	43	*e* [g]	
Power failure event log	7	*b*	99	97	*e*	
Event log	7	*b*	99	98	e	
Certification data log	7	*b*	99	99	0	
Load profile with recording interval 15 min	7	*b*	99	99	1	
Load profile with recording interval 60 min	7	*b*	99	99	2	
Load profile with recording interval day	7	*b*	99	99	3	
Load profile with recording interval month	7	*b*	99	99	4	

[a] The value in value group E has been changed from 0 to 4 to avoid overlaps with the self-description profile OBIS codes. The use of the value 0 is deprecated.

[b] Value group D and E identify the value captured in these profiles. Value group D and E of the OBIS code of the load profile is mapped to value group C and D of the OBIS code identifying the value captured. The value captured in the buffer is always attribute 2 (value) of the respective Register / Extended register object.

[c] The possible values are 1…8, 11…16, 21...26, 31...36, 61...66.

[d] The possible values are 0…3, 6…98.

EXAMPLE Load profile OBIS code 7.b.99.11.17.255.

This load profile contains the logged values from a volume conversion device: Forward undisturbed converter volume, index difference, value at base conditions, relative to measurement period 2. The values are captured at the end of each measurement period (last values).

[e] The possible values are 41, 42, 44...49.

[f] The possible values are 0, 2, 13, 24…32, 42...50, 60...68, 78...86, 90...92.

EXAMPLE Load profile OBIS code 7.b.99.41.43.255.

This load profile contains the logged values of absolute gas temperature, average, last interval, (relative to) process interval 2.

[g] The possible values are 0, 1, 2, 13, 19…22, 39…42, 59...62, 67…70.

EXAMPLE Load profile OBIS code 7.b.99.43.19.255.

This load profile contains the logged values of the flow rate, last average for averaging period 1, value at metering conditions.

11.3.5 Value groups specific to Water Meters (A = 8 and A = 9)

11.3.5.1 Introduction

The current subclause describes the naming of objects carrying water meter information in a COSEM environment. It covers the handling of hot, as well as the handling of cold water.

11.3.5.2 Value group C for Water

Table 45 — Value group C codes where A = 8 or A = 9 (Water volume objects)

Value group C	Description
0	General purpose objects
1	Accumulated volume
2	Flow rate
3	Forward temperature
93	Consortia specific identifiers, see 11.1.4.4
94	Country specific identifiers, see Annex D
96	General and service entry objects – Water
97	Error register objects – Water
98	List objects – Water
99	Data profile objects – Water
128...199, 240	Manufacturer specific codes
All other	Reserved

NOTE All values not specified are reserved.

11.3.5.3 Value group D for Water

This value group specifies the result of processing a *Quantity* according to a specific algorithm for water related values.

Table 46 — Value group D codes where A = 8 or A = 9, C < > 0, 96…99 (Water volume objects)

Value group D	Description
0	Current value
1	Periodical value
2	Set date value
3	Billing date value
4	Minimum of value
5	Maximum of value
6	Test value
All other	Reserved

11.3.5.4 General and service entry objects – Water

Table 47 — OBIS codes for general and service entry objects – Water

General and service entry objects – Water	OBIS code					
	A	B	C	D	E	F
Free ID-numbers for utilities						
Complete combined ID	8/9	*b*	0	0		
ID 1	8/9	*b*	0	0	0	
...			...	...	...	
ID 10	8/9	*b*	0	0	9	
Storage information						
Status (VZ) of the historical value counter	8/9	*b*	0	1	1	
Number of available historical values	8/9	*b*	0	1	2	
Due date	8/9	*b*	0	1	10	
Billing date	8/9	*b*	0	1	11	
Billing date period	8/9	*b*	0	1	12	
Program Entries						
Program version no.	8/9	*b*	0	2	0	
Device version no.	8/9	*b*	0	2	3	
Threshold values						
Contracted maximum consumption	8/9	*b*	0	5	1	
Input pulse constants						
Volume forward	8/9	*b*	0	7	1	
Measurement-/registration-period duration						
Recording interval for load profile	8/9	*b*	0	8	1	
Time integral, averaging period for actual flow rate value	8/9	*b*	0	8	6	
Time entries						
Local time	8/9	*b*	0	9	1	
Local date	8/9	*b*	0	9	2	
Manufacturer specific[a] .... Manufacturer specific	8/9 8/9	b *b*	96 96	50 99	*e* *e*	*f* *f*

[a] The range D = 50…99 is available for identifying objects, which are not represented by another defined code, but need representation on the display as well. If this is not required, the range D = 128…254 should be used.

11.3.5.5 Error register objects – Water

Table 48 — OBIS codes for error register objects – Water

Error register objects – Water	OBIS code					
	A	B	C	D	E	F
Error register	8/9	*b*	97	97	*e*	
NOTE The information to be included in the error objects is not defined in this document.						

11.3.5.6 Data profile objects – Water

Water related data profiles – identified with one single OBIS code – are used to hold a series of measurement values of one or more similar quantities and/or to group various data.

Table 49 — OBIS codes for data profile objects – Water

Data profile objects – Water	OBIS code					
	A	B	C	D	E	F
Consumption/load profile	8/9	*b*	99	1	*e*	

11.3.5.7 OBIS codes for water related objects (examples)

Table 50 — OBIS codes for water related objects (examples)

Water related objects	OBIS code					
	A	B	C	D	E	F
Consumption						
Current index, total	8/9	*b*	1	0	0	
Current index, tariff 1	8/9	*b*	1	0	1	
Current index, periodical, total, the two last periods	8/9	*b*	1	1	0	102
Monitoring values						
Flow rate, maximum value, previous period	8/9	*b*	2	5	0	V_{Z-1}
Forward temperature, billing date value, last billing period	8/9	*b*	3	3	0	101

11.4 Other media (Value group A = F)

11.4.1 General

This Subclause 11.4 specifies naming of objects related to other media than defined with values A = 1, 4…9. Typical application is distributed energy generation using renewable energy sources.

NOTE The details of OBIS codes will be specified as application of DLMS/COSEM in this area grows.

11.4.2 Value group C codes – Other media

Table 51 specifies the use of value group C for other media.

Table 51 — Value group C codes – Other media

Value group C	Description
0	General purpose objects
1…10	Solar
11…20	Wind
128…254	Manufacturer specific codes
All other	Reserved
128...199, 240	Manufacturer specific codes
All other	Reserved

11.4.3 Value group D codes – Other media

To be specified later.

11.4.4 Value group E codes – Other media

To be specified later.

11.4.5 Value group F codes – Other media

To be specified later.

11.5 Code presentation

11.5.1 Reduced ID codes (e.g. for EN 62056-21)

To comply with the syntax defined for protocol modes A to D of EN 62056-21, the range of ID codes is reduced to fulfil the limitations which are usually apply to the number of digits and their ASCII representation. Values in all value groups are limited to a range of 0…99 and within that range, to the values specified in the clauses specifying the use of the value groups.

Some value groups may be suppressed, if they are not relevant to an application:

— optional value groups: A, B, E, F;

— mandatory value groups: C, D.

To allow the interpretation of shortened codes delimiters are inserted between all value groups, see Figure 19:

A	-	B	:	C	.	D	.	E	*	F

Figure 19 — Reduced ID code presentation

The delimiter between value groups E and F can be modified to carry some information about the source of a reset (& instead of * if the reset was performed manually).

The manufacturer shall ensure that the combination of the OBIS code and the class_id uniquely identifies each COSEM object.

11.5.2 Display

The usage of OBIS codes to display values is normally limited in a similar way as for data transfer.

Some codes may be replaced by letters to clearly indicate the differences from other data items[4]:

Table 52 — Example of display code replacement – Value group C

OBIS code	Display code
96	C
97	F
98	L
99	P

11.5.3 Special handling of value group F

Unless otherwise specified, the value group F is used for the identification of values of billing periods.

The billing periods can be identified relative to the status of the billing period counter or relative to the current billing period.

For gas, there are four billing period schemes available, see Table 38.

With $0 \leq F \leq 99$, a single billing period is identified relative to the value of the billing period counter, VZ. If the value of the value group of any OBIS code is equal to VZ, this identifies the most recent (youngest) billing period. VZ_{-1} identifies the second youngest, etc. The billing period counter may have different operating modes, for example modulo-12 or modulo-100. The value after reaching the limit of the billing period counter is 0 for the operating mode modulo-100 and 1 for other operating modes (for example modulo-12).

With $101 \leq F \leq 125$, a single billing period or a set of billing periods are identified relative to the current billing period. *F* = 101 identifies the last billing period, *F* = 102 the second last/ two last billing periods, etc., F = 125 identifies the 25th last/ 25 last billing periods.

F = 126 identifies an unspecified number of last billing periods, therefore it can be used as a wildcard.

F = 255 means that the value group F is not used, or identifies the current billing period value(s).

4) The letter codes may also be used in protocol modes A to D.

Table 53 — Value group F – Billing periods

Value group F	
VZ	Most recent value
VZ_{-1}	Second most recent value
VZ_{-2}	Third most recent value
VZ_{-3}	Fourth most recent value
VZ_{-4}	...
etc.	
101	Last value
102	Second / two last value(s)
….	
125	25th/25 last value(s)
126	Unspecified number of last values

Annex A
(normative)

Basic class meters

A.1 General

This annex defines the minimum requirements for basic meters for the different media types.

A.2 Basic requirements for Heat Cost Allocators

A basic HCA with remote reading shall include at least the following objects:

Table A.1 — Basic requirements for Heat Cost Allocators

Basic H.C.A object list	OBIS identification						
	IC	A	B	C	D	E	F
COSEM Logical Device Name	Data [a]	0	0	42	0	0	0xFF
General Error Object	Data [a]	0	0	97	97	0	0xFF
Current Association	Association LN/SN	0	0	40	0	0	0xFF
Unrated Integral [b]	Register	4	0	1	0	0	0xFF

[a] In case that the class “Data” is not available, the class “Register” (with scaler = 0, unit = 255) may be used.

[b] It may be replaced by “Rated Integral”, 4.0.2.0.0.0xFF.

NOTE Other objects would be required to build a practical device: but these would be dependent on the transport technology used.

A.3 Basic requirements for Heat/ Cooling meters

A basic Heat/ Cooling meter with remote reading shall include at least the following objects:

Table A.2 — Basic requirements for Heat/ Cooling meters

Basic Heat/ Cooling meter object list	OBIS identification						
	IC	A	B	C	D	E	F
COSEM Logical Device Name	Data [a]	0	0	42	0	0	0xFF
General Error Object	Data [a]	0	0	97	97	0	0xFF
Current Association	Association LN/SN	0	0	40	0	0	0xFF
Energy, Current value, total [b]	Register	5/6	0	1	0	0	0xFF

[a] In case that the class “Data” is not available, the class “Register” (with scaler = 0, unit = 255) may be used.

[b] As a basic Heat meter only has a single rate, only total is needed.

NOTE Other objects would be required to build a practical device: but these would be dependent on the transport technology used.

A.4 Basic requirements for Gas meters

A basic Gas meter with remote reading shall include at least the following objects:

Table A.3 — Basic requirements for Gas meters

Basic Gas meter object list	OBIS identification						
	IC	A	B	C	D	E	F
COSEM Logical Device Name	Data [a]	0	0	42	0	0	0xFF
General Error Object	Data [a]	0	0	97	97	0	0xFF
Current Association	Association LN/SN	0	0	40	0	0	0xFF
Forward absolute volume, Actual value, total [b]	Register	7	0	n3 [b]	0	0	0xFF
Meter Location Code (Utility specific)	Data [a]	7	0	0	0	0xFF	0xFF

[a] In case that the class “Data” is not available, the class “Register” (with scaler = 0, unit = 255) may be used.

[b] The value group 'C' may have the values n3; where the n represents a 0 in the case of an intelligent meter, 1 in the case of a volume conversion device, 2 in the case of an add-on logger to an existing meter with pulse output, and 3 in the case of a theoretical direct energy meter.

NOTE Other objects would be required to build a practical device: but these would be dependent on the transport technology used.

A.5 Basic requirements for Cold/ Hot water meters

A basic Cold/ Hot water meter with remote reading shall include at least the following objects:

Table A.4 — Basic requirements for Cold/ Hot water meters

Basic Cold/ Hot water meter object list	OBIS identification						
	IC	A	B	C	D	E	F
COSEM Logical Device Name	Data [a]	0	0	42	0	0	0xFF
General Error Object	Data [a]	0	0	97	97	0	0xFF
Current Association	Association LN/SN	0	0	40	0	0	0xFF
Accumulated volume	Register	8/9	0	1	0	0	0xFF

[a] In case that the class "Data" is not available, the class "Register" (with scaler = 0, unit = 255) may be used.

NOTE Other objects would be required to build a practical device: but these would be dependent on the transport technology used.

Annex B
(informative)

DLMS Glossary

B.1 Introduction

This annex contains relevant glossary items describing OBIS, COSEM and DLMS terms and phrases. It is based on the IEC/TR 60251-1, which should be regarded as the definitive reference in the case of ambiguity.

B.2 Activation mask

An instance of the Register Activation class is used to handle different tariff setting structures. It specifies which Register, Extended Register and Demand Register objects are enabled if a specific Activation Mask is active (active_mask). All other register objects defined in register_assignment not being part of the active_mask are disabled. All register objects not defined in any register_assignment are enabled by default.

B.3 Activity calendar

An instance of the Activity Calendar class is typically used to handle different tariff setting structures. It is a definition of scheduled actions inside the meter, which follow the classical way of calendar based schedules by defining seasons, weeks, etc. It can coexist with the more general object Schedule and can even overlap with it. If actions are scheduled for the same activation time in an object Schedule and in the object Activity Calendar, the actions triggered by Schedule are executed first.

B.4 Association LN

COSEM Logical Devices able to establish application associations within a COSEM context using Logical Name references, model the associations through instances of the “Association LN” (Association Logical Name) class. A COSEM Logical Device has one instance of this interface class for each association the device is able to support.

B.5 Association SN

COSEM Logical Devices able to establish application associations within a COSEM context using Short Name reference, model the associations through instances of the “Association SN” (Association Short Name) class. A COSEM Logical Device has one instance of this IC for each association the device is able to support.

The short_name of the Association SN object itself is fixed within the COSEM context as FA00h.

B.6 Automatic capturing

Used in relation with interface class Profile Generic.

B.7 Billing Period in COSEM

COSEM treats values or lists of values for several billing periods as profiles.

With value group F having a value between 0 and 99, and 101 direct access to data of previous billing periods is available. (See EN 62056-6-1:2013, 4.7 “Value group F”.) This is managed by COSEM objects of interface class “Profile Generic” which are 1 entry deep and contain the timestamp of the storage in addition to the historical value.

B.8 Capture

The Profile Generic class defines a generalized concept to store dynamic process values of capture objects. A capture object is either a register, a clock or a profile. The capture objects are collected periodically or occasionally. A profile has a buffer to store the captured data. To retrieve a part of the buffer, either a value range or an entry range may be specified, asking to retrieve all entries whose values or entry numbers fall within the given range.

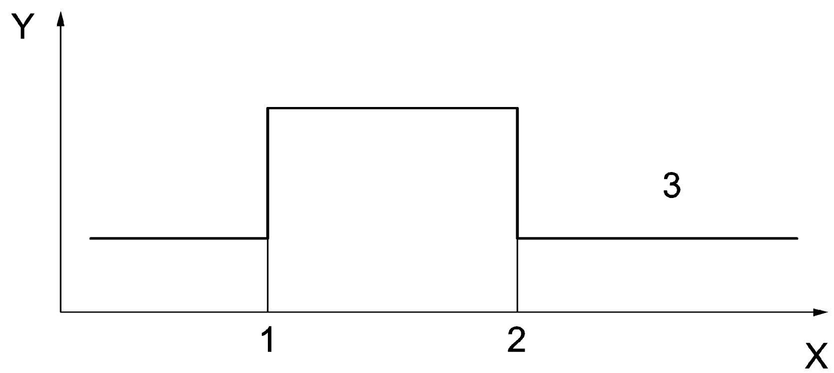
B.9 Channel

To cover metering equipment measuring other energy types than electricity, combined metering equipment measuring more than one type of energy or metering equipment with several physical measurement channels, the concept of channels and medium are introduced. This allows meter data originating from different sources to be identified.

B.10 Clock

An instance of the clock interface class handles all information that is related to date and time, including leap years and the deviation of the local time to a generalized time reference (Universal Coordinated Time, UTC). The deviation from the local time to the generalized time reference can change depending on the season (e.g. summer time vs. winter time). The interface to an external client is based on date information specified in day, month and year, time information given in hundredths of seconds, seconds, minutes and hours and the deviation from the local time to the generalized time reference.

It also handles the daylight savings function in that way; i.e. it modifies the deviation of local time to UTC depending on the attributes. The start and end point of that function is normally set once. An internal algorithm calculates the real switch point depending on these settings.



Key

Y deviation

X time

1 daylight_savings_begin

2 daylight_savings_end

3 local time

Figure B.1 — The generalized time concept

B.11 Current and last average value objects

Current and last average values are the respective attributes of COSEM objects which are instances of interface class “Demand Register”. These use the OBIS code of the current value as logical name, see B.22.

B.12 Date and time

Date and time notations normally use octet-string as the data type, but the formatting of the data are defined precisely.

B.13 Daylight saving

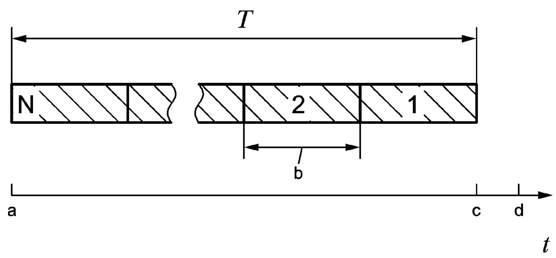
If the clock is forwarded then all scripts which fall into the forwarding interval (and would therefore get lost) are executed.

If the clock is reversed re-execution of the scripts which fall into the reverse interval is suppressed.

Used in relation with interface class Schedule.

B.14 Demand Register

Instances of a Demand Register class store a demand value with its associated status, unit, and time information. The demand register measures and computes its current_average_value periodically. The time interval T over which the demand is measured or computed is defined by specifying “number_of_periods” and “period”.



Key

T number_of_periods * period

T is the time interval used for calculation of the current_value of a sliding demand register.

a start_time_current

b period

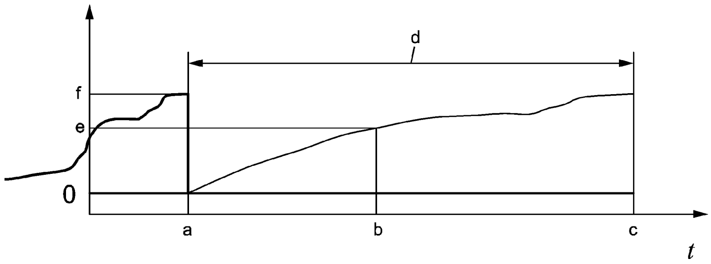
c capture_time

d now

Figure B.2 — The attributes when measuring sliding demand

The Demand Register delivers two types of demand: the current_average_value and the last_average_value (see Figure B.3 and Figure B.4).

The Demand Register knows its type of process value which is described in “logical name” using the OBIS identification system.



Key

a start_time_current

b now

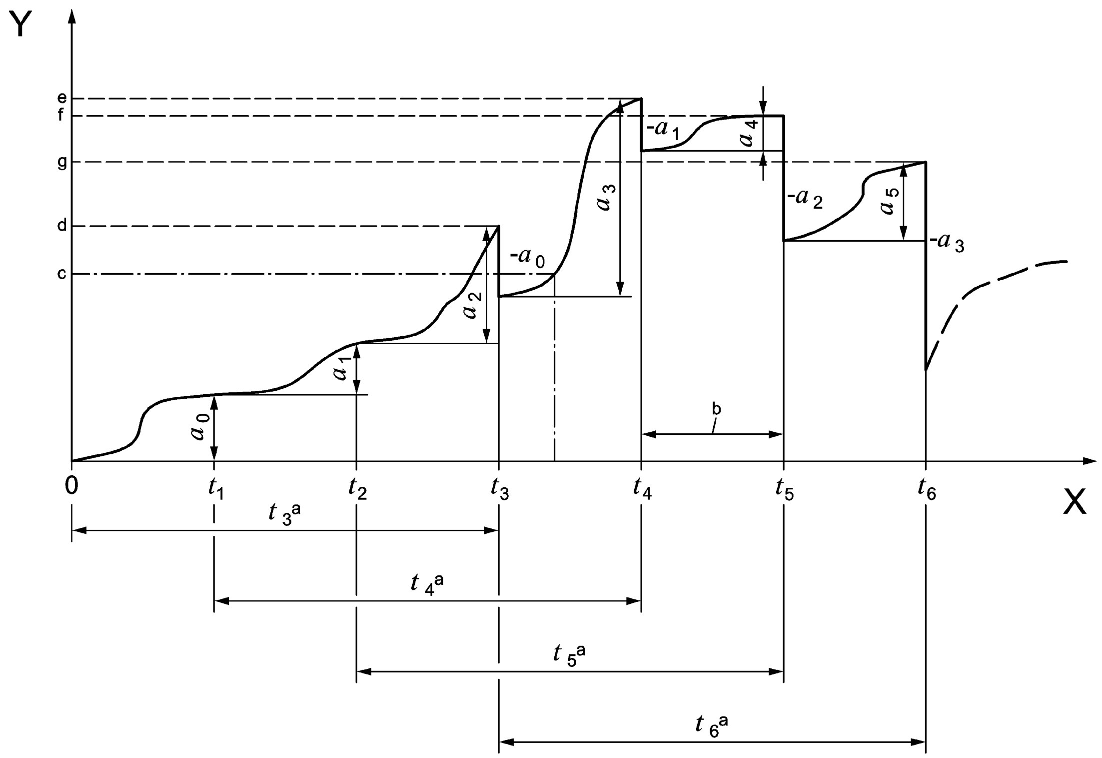
c start_time+period

d period

e current_average_value

f last_average_value

Figure B.3 — Attributes when measuring current_average_value if number of periods is 1



Key

Y	$\dfrac{\text{energy}}{3 * \text{period}}$	X	time
3	number_of_periods	c	current average value
d	last_average_value 3	e	last average value 4
a_k	energy accumulated during period k	f	last average value 5
a	sliding window	g	last average value 6
b	period		

Figure B.4 — The attributes if number of periods is 3

B.15 Device ID

A series of COSEM objects is used to communicate ID numbers of the device. These can be numbers defined by the manufacturer (manufacturing number) or defined by the user.

The different ID numbers are instances of the interface class “Data”, with data type octet-string.

If more than one of those is used it is also allowed to combine them into one instance of the interface class “Profile Generic”. In this case the captured objects are the device ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1.

B.16 Error values

A series of COSEM objects are used to communicate error indications of the device.

The different error values are instances of the interface class “Data”, with data type octet_string.

If more than one of those are used it is also allowed to combine them into one instance of the interface class “Profile Generic”. In this case the captured objects are the device ID data objects, the capture period is 1 to have just actual values, the sort method is FIFO, the profile entries are limited to 1.

Error code objects can also be related to an energy type and to a channel. (See EN 62056-6-1.)

Extended register interface class

Instances of an Extended Register class store a process value with its associated status, unit, and time information. The Extended Register object knows the nature of the process value. The nature of the value is described by the attribute “logical name” using the OBIS identification system.

B.17 High level security

As described in EN 62056-5-3 the ACSE provides part of the authentication services for high level security (HLS). High-level security authentication is typically used when the communication channel offers no intrinsic security and precautions shall be taken against eavesdroppers and against message (password) replay. In this case a 4-pass authentication protocol is foreseen.

NOTE 4 pass authentication is a peer to peer method for authentication of the communication partners.

B.18 Interface modelling

The interface class “Register” is formed by combining the features necessary to model the behaviour of a generic register (containing measured or static information) as seen from the client (central unit, hand-held terminal). The contents of the register are identified by the attribute “logical_name”. The logical_name contains an OBIS identifier (see EN 62056-6-1). The actual (dynamic) content of the register is carried by its “value” attribute.

B.19 I/O Control Signals

These COSEM objects define and control the status of I/O lines and the pulse duration of physical pulse outputs of the device.

Status is defined by an instance of the interface class “Data”.

B.20 Interoperability

Driven by the need of the utilities to optimize their business processes, the meter becomes more and more part of an integrated metering and billing system. Whereas in the past, the commercial value of a meter was mainly generated by its data acquisition and processing capabilities, nowadays the critical issues are system integration and interoperability.

The set of different interface classes form a standardized library from which the manufacturer can assemble (model) its individual products. The elements are designed such that with them the entire range of products (from residential to commercial and industrial applications) can be covered. The choice of the subset of interface classes used to build a meter, their instantiation and their implementation are part of the product design and therefore left to the manufacturer. The concept of the standardized metering interface class library provides the different users and manufacturers with a maximum of diversity without having to sacrifice interoperability.

B.21 Logical device

The COSEM Logical Device is a set of COSEM objects. Each physical device shall at least contain a “Management logical device”.

The addressing of COSEM Logical Devices shall be provided by the addressing scheme of the lower layers of the protocol used.

B.22 Logical name referencing

In this case the attributes and methods of a COSEM object are referenced via the identifier of the COSEM object instance to which they belong. The alternate method is described in B.57.

The reference for an attribute is:

— class_id, value of the 'logical_name' attribute, attribute_index.

The reference for a method is:

— class_id, value of the 'logical_name' attribute, method_index.

B.23 Low level security

As described in EN 62056-5-3, the ACSE provides the authentication services for low level security (LLS). Low level security authentication is typically used when the communication channel offers adequate security to avoid eavesdropping and message (password) replay.

For LLS all the authentication services are provided by the ACSE. The association objects provide only the method/attribute (see EN 62056-6-2:2013, 5.3) to change the "secret" (e.g. password).

For LLS authentication the client transmits a "secret" (e.g. a password) to the server, by using the "Calling_Authentication_Value" parameter of the COSEM-OPEN. Request service primitive of the client application layer. The server checks if the received "secret" corresponds to the client identification. If yes, the client is authenticated and the association can be established.

B.24 Manufacturer defined ID-s

A series of COSEM objects is used to communicate ID numbers of the device. These can be numbers defined by the manufacturer (manufacturing number) or defined by the user.

B.25 Manufacturer specific abstract objects

If a code is required that does not already exist, it may be defined as a manufacturer specific abstract object. If the quantity is not required to be displayed on the meter, then it shall use a value group greater than 127.

B.26 Manufacturer specific class id

Identification code of the class (range 0 to 65 535). The class_id can be obtained from an "Association" object. The class_id's from 0 to 8 191 are reserved to be specified by the DLMS UA. Class_id's from 8 192 to 32 767 are reserved for manufacturer specific interface classes. Class_id's from 32 768 to 65 535 are reserved for user group specific interface classes. DLMS UA reserves the right to assign ranges to individual manufacturers or user groups.

B.27 Manufacturer specific data and parameters

A Data object stores data related to internal meter object(s). The meaning of the value is identified by the logical_name. The data type of the value is instance specific. Data are typically used to store manufacturer specific configuration data and parameters having manufacturer specific logical names.

B.28 Manufacturer specific OBIS codes

An OBIS code, in which any of the value groups B to F has a value in the manufacturer specific range.

If one value in a group B to F is used in the manufacturer specific range then the whole code is characterized as manufacturer specific and the other value groups (with the exception of group A) are not necessarily bearing any meaning defined by this standard.

B.29 Maximum and minimum value objects

Interface objects representing minimum and/or maximum values of process values. They may be instances of the interface class “Extended register” or “Profile generic”.

B.30 Measurement of different media

To cover metering equipment measuring different energy types, combined metering equipment measuring more than one type of energy or metering equipment with several physical measurement channels, the concept of channels and medium are introduced. This allows meter data originating from different sources to be identified. While this standard fully defines the structure of the identification system for other media, the mapping of non-electrical energy related data items to ID codes needs to be completed separately.

The value group B defines the channel number, i.e. the number of the input of a metering equipment having several inputs for the measurement of energy of the same or different types (e.g. in data concentrators, registration units). Data from different sources can thus be identified. The definitions for this value group are independent from the value group A.

B.31 Measurement method and tariffs

The value group D defines types, or the result of the processing of physical quantities identified with the value groups A and C, according to various specific algorithms. The algorithms can deliver energy and demand quantities as well as other physical quantities.

The value group E defines the further processing of measurement results identified with value groups A to D to tariff registers, according to the tariff(s) in use. For abstract data or for measurement results for which tariffs are not relevant, this value group can be used for further classification.

The value group F defines the storage of data, identified by value groups A to E, according to different billing periods. Where this is not relevant, this value group can be used for further classification.

B.32 Measurement values series

Data profiles – identified with one single OBIS code – are defined as a series of measurement values of the same type or of groups of the same kind consisting of a number of different measurement values.

B.33 Missing measurement values

Values considered as missing (e.g. interruptions).

B.34 Node

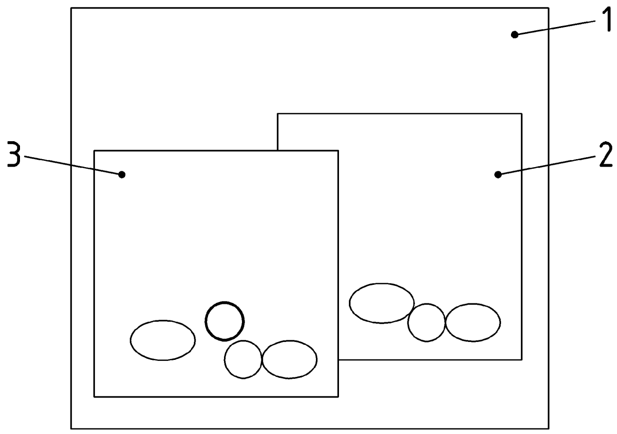
A node is a device that will convert used communication methods, it could be a standalone or integrated device.

B.35 Password

See Clauses B.18 and B.24.

B.36 Physical device

The Physical Device is the highest level element in the COSEM server. The COSEM server is structured into 3 hierarchical levels as shown in Figure B.5.



Key

1 COSEM physical device A

2 COSEM Logical device 2

COSEM Objects

3 COSEM Management logical device

COSEM Objects

Figure B.5 — The COSEM server model

B.37 Power failure handling

After a power failure the whole schedule is processed to execute all the necessary scripts that would get lost during a power failure. For this the entries that were not executed during the power failure shall be detected. Depending on the validity window attribute they are executed in the correct order (as they would have been executed in normal operation).

After a power failure only the “last action” missed from the object Activity Calendar is executed (delayed). This is to ensure proper tariff setting after power up. If a Schedule object is present, then the missed “last action” of the Activity Calendar shall be executed at the correct time within the sequence of actions requested by the Schedule.

B.38 Power failure monitoring

Different possibilities to represent values coming from power failure monitoring of the device are available. Simple counting of events is represented by COSEM objects of interface class “Data” with data type unsigned or long unsigned. If more sophisticated information is presented the COSEM object shall be of interface class “Profile Generic”.

B.39 Preferred readout-values

By setting profile_entries to 1, the profile object can be used to define a set of preferred readout-values. In the "capture_objects" attributes those objects and attributes are pre-defined which should be readable with one single command.

Setting capture_period to 1 ensures that the values are updated every second.

B.40 Profile objects

Data profiles – identified with one single OBIS code – are defined as a series of measurement values of the same type or of groups of the same kind consisting of a number of different measurement values.

B.41 Profile for billing periods

Values above 100 allow the identification of profiles which contain values of more than one billing period. The maximum allowed value for this is 125.

The value 126 identifies a profile with values of an unspecified number of billing periods.

B.42 Profile generic interface class

The Profile Generic class defines a generalized concept to store dynamic process values of capture objects. A capture object is either a register, a clock or a profile. The capture objects are collected periodically or occasionally. A profile has a buffer to store the captured data. To retrieve a part of the buffer, either a value range or an entry range may be specified, asking to retrieve all entries whose values or entry numbers fall within the given range.

B.43 Register interface class

The interface class "Register" is formed by combining the features necessary to model the behaviour of a generic register (containing measured or static information) as seen from the client (central unit, hand-held terminal). The contents of the register are identified by the attribute "logical_name". The logical_name contains an OBIS identifier (see EN 62056-6-1). The actual (dynamic) content of the register is carried by its "value" attribute.

Defining a specific meter means defining several specific registers. In the example of Figure 11, the meter contains 2 registers; i.e. two specific COSEM objects of the class "Register" are instantiated. This means that specific values are assigned to the different attributes. Through the instantiation one COSEM object becomes a "total, positive, active energy register" whereas the other becomes a "total, positive, reactive energy register".

The COSEM objects (instances of interface classes) represent the behaviour of the meter as seen from the "outside". Therefore modifying the value of an attribute shall always be initiated from the outside (e.g. resetting the value of a register). Internally initiated changes of the attributes are not described in this model (e.g. updating the value of a register).

A Register object stores a process value or a status value with its associated unit. The Register object knows the nature of the process value or of the status value. The nature of the value is described by the attribute "logical name" using the OBIS identification system (see EN 62056-6-2:2013, Clause 6).

B.44 Reset, IC Demand register

This method forces a reset of the object. Activating this method provokes the following actions:

— the current period is terminated;

— the current_average_value and the last_average_value are set to their default value;

— the capture_time and the start_time_current are set to the time of the execution of reset (data).

B.45 Reset, IC Extended register

This method forces a reset of the object. By invoking this method the attribute value is set to the default value. The default value is an instance specific constant. The attribute status is set such that it shows that a reset method has been invoked.

B.46 Reset, IC Profile generic

Clears the buffer. The buffer has no valid entries afterwards, entries_in_use is zero after this call. This call does not trigger any additional operations of the capture objects, specifically, it does not reset any captured buffers or registers.

B.47 Reset, IC Register

This method forces a reset of the object. By invoking this method the value is set to the default value. The default value is an instance specific constant.

B.48 Reset, indication of source

The delimiter between value groups E and F can be modified to carry some information about the source of a reset (& instead of * if the reset was performed manually).

B.49 Scaler

A component of Scaler-unit that is used to scale the unit, by being the exponent (to the base of 10) of the multiplication factor.

B.50 Scaler-unit

An attribute of the interface classes Register, Extended Register and Demand Register. It provides information on the unit and the scaler of the unit. If the value uses a complex data type, the scaler and unit apply to all elements.

B.51 Schedule

The IC Schedule together with an object of the IC Special Days Table handles time and date driven activities within a device.

After a power failure the whole schedule is processed to execute all the necessary scripts that would get lost during a power failure. For this the entries that were not executed during the power failure shall be detected. Depending on the validity window attribute they are executed in the correct order (as they would have been executed in normal operation).

B.52 Script

These COSEM objects control the behaviour of the device.

Several instances of the interface class “Script Table” are predefined and normally available as hidden scripts only with access to the execute() method.

B.53 Script table interface class

The IC Script table provides the possibility to trigger a series of actions by activating an execute method. For that purpose Script table contains a table of script entries. Each table entry (script) consists of a script_identifier and a series of action_specifications. An action_specification activates a method of a COSEM object or modifies attributes of a COSEM object within the logical device.

B.54 Season

This is an attribute of the interface class “Activity calendar”. It contains a list defining the starting date of a season. This list is sorted according to season_start. Each season activates a specific week_profile.

B.55 Selective access

The common methods READ/WRITE and GET/SET typically reference the entire attribute addressed. However, for certain attributes selective access to just part of the attribute may be provided. The part of the attribute is identified by specific selective access parameters. These selective access parameters are defined as part of the attribute specification.

B.56 Set date

A date value stored in the metering device. On the set data the cumulated consumption is stored in an internal register for later readout. A set day is common to all HCA's in a common installation to provide for cost allocation.

B.57 Short name referencing

This kind of referencing is intended for use in simple devices. In this case each attribute and method of a COSEM object is identified with a 13 bit integer. The syntax for the Short Name is the same as the syntax of the name of a DLMS Named Variable. The alternate referencing method is B.23.

B.58 Special days table interface class

The interface class allows defining dates, which will override normal switching behaviour for special days. The interface class works in conjunction with the class “Schedule” or “Activity Calendar” and the linking data item is day_id.

B.59 Standard readout definitions

A set of COSEM objects is defined to carry the standard readout as it would appear with EN 62056-21 (modes A to D). Standard readout objects can also be related to an energy type and to a channel. See EN 62056-6-1.

B.60 Tariff

The value group E defines the further processing of measurement results identified with value groups A to D to tariff registers, according to the tariff(s) in use. For abstract data or for measurement results for which tariffs are not relevant, this value group can be used for further classification. Additionally see B.32.

B.61 Tariffication

An instance of the Register Activation class is used to handle different tariff setting structures. It specifies which Register, Extended Register and Demand Register objects are enabled if a specific Activation Mask is active (active_mask). All other register objects defined in register_assignment not being part of the active_mask are disabled. All register objects not defined in any register_assignment are enabled by default.

An instance of the Activity Calendar class is typically used to handle different tariff setting structures. It is a definition of scheduled actions inside the meter, which follow the classical way of calendar based schedules by defining seasons, weeks… It can coexist with the more general object Schedule and can even overlap with it. If actions are scheduled for the same activation time in an object Schedule and in the object Activity Calendar, the actions triggered by Schedule are executed first.

After a power failure only the “last action” missed from the object Activity Calendar is executed (delayed). This is to ensure proper tariff setting after power up. If a Schedule object is present, then the missed “last action” of the Activity Calendar shall be executed at the correct time within the sequence of actions requested by the Schedule.

B.62 Threshold

This is an attribute of the interface class Register monitor. It provides the threshold values to which the attribute of the referenced register is compared. The threshold is of the same type as the monitored attribute of the referenced object.

These values are represented by instances of the interface class “Register Monitor” by defining the monitored register, the threshold itself and the actions to be performed, when a threshold is crossed.

B.63 Time integral value objects

Time integral values are represented by COSEM objects which are instances of interface class “Register” or “Extended Register”.

B.64 Time setting, in relation with IC Schedule

B.64.1 General

There are four different “actions” of time changes:

— time setting forward;

— time setting backwards;

— time synchronization;

— daylight saving action.

B.64.2 Time setting forward

This is handled the same way as a power failure. All entries missed are executed depending on the validity window attribute. A (manufacturer specific defined) short time setting can be handled like time synchronization.

B.64.3 Time setting backward

This results in a repetition of those entries that are activated during the repeated time. A (manufacturer specific defined) short time setting can be handled like time synchronization.

B.64.4 Time synchronization

Time synchronization is used to correct small deviations between a master clock and the local clock. The algorithm is manufacturer specific. It shall guarantee that no entry of the schedule gets lost or gets executed twice. The validity window attribute has no effect, because all entries shall be executed like in normal operation.

B.64.5 Daylight Saving

If the clock is forwarded then all scripts which fall into the forwarding interval (and would therefore get lost) are executed.

If the clock is reversed re-execution of the scripts which fall into the reversed interval is suppressed.

B.65 Time stamps (in relation with IC PSTN Auto dial)

Contains the start and end date/time stamp when the window becomes active (for the start instant), or inactive (for the end instant). The start_date defines implicitly the period. Example: when day of month is not specified (equal to 0 *x* FF) this means that we have a daily share line management. Daily, monthly… window management can be defined.

B.66 Time stamp (in relation with billing periods)

The time stamps of previous data values shall be part of the captured objects within the COSEM objects representing the data of previous billing periods. The values can also be related to a channel.

B.67 Time synchronization

Time synchronization is used to correct small deviations between a master clock and the local clock. The algorithm is manufacturer specific. It shall guarantee that no entry of the schedule gets lost or gets executed twice.

B.68 Unique identifier

The Object Identification System (OBIS) provides a unique identifier for all and every data within the metering equipment, including not only measurement values, but also abstract values used for configuration or obtaining information about the behaviour of the metering equipment. The ID codes defined in this standard are used for identification of:

— logical names of the various instances of the Interface Classes, or objects, as defined in EN 62056-6-2;

— data transmitted through communication lines (see EN 62056-6-1:2013, A.1);

— data displayed on the metering equipment (see EN 62056-6-1:2013, A.2).

This standard applies to all types of metering equipment, like fully integrated meters, modular meters, tariff attachments, data concentrators, etc.

B.69 Unit

This is an enumerator defining the physical unit. The enumeration is detailed in the table below.

Table B.1 — Enumerated values for physical units

unit: = enum	**Unit**	**Quantity**	**Unit name**	**SI definition (comment)**
(1)	a	time	year	
(2)	mo	time	month	
(3)	wk	time	week	7*24*60*60 s
(4)	d	time	day	24*60*60 s
(5)	h	time	hour	60*60 s
(6)	min.	time	min	60 s
(7)	s	time (t)	second	s
(8)	°	(phase) angle	degree	rad*180/π
(9)	°C	temperature (T)	degree Celsius	K-273.15
(10)	currency	(local) currency		
(11)	m	length (l)	metre	m
(12)	m/s	speed (v)	metre per second	m/s
(13)	m^3	volume (V) r_V, meter constant or pulse value (volume)	cubic metre	m^3
(14)	m^3	corrected volume	cubic metre	m^3
(15)	m^3/h	volume flux	cubic metre per hour	m^3/(60*60s)
(16)	m^3/h	corrected volume flux	cubic metre per hour	m^3/(60*60s)
(17)	m^3/d	volume flux		m^3/(24*60*60s)
(18)	m^3/d	corrected volume flux		m^3/(24*60*60s)
(19)	l	volume	litre	10^{-3} m^3
(20)	kg	mass (m)	kilogram	
(21)	N	force (F)	newton	
(22)	Nm	energy	newton meter	J = Nm = Ws
(23)	Pa	pressure (p)	pascal	N/m^2
(24)	bar	pressure (p)	bar	10^5 N/m^2
(25)	J	energy	joule	J = Nm = Ws
(26)	J/h	thermal power	joule per hour	J/(60*60s)
(27)	W	active power (P)	watt	W = J/s
(28)	VA	apparent power (S)	volt-ampere	
(29)	var	reactive power (Q)	var	
(30)	Wh	active energy r_W, active energy meter constant or pulse value	watt-hour	W*(60*60s)
(31)	VAh	apparent energy r_S, apparent energy meter constant or pulse value	volt-ampere-hour	VA*(60*60s)
(32)	varh	reactive energy r_B, reactive energy meter constant or pulse value	var-hour	var*(60*60s)
(33)	A	current (I)	ampere	A
(34)	C	electrical charge (Q)	coulomb	C = As

unit: = en um	**Unit**	**Quantity**	**Unit name**	**SI definition (comment)**
(35)	V	voltage (U)	volt	V
(36)	V/m	electric field strength (E)	volt per metre	V/m
(37)	F	capacitance (C)	farad	C/V = As/V
(38)	Ω	resistance (R)	ohm	Ω = V/A
(39)	Ωm^2/m	resistivity (ρ)		Ωm
(40)	Wb	magnetic flux (Φ)	weber	Wb = Vs
(41)	T	magnetic flux density (B)	tesla	Wb/m^2
(42)	A/m	magnetic field strength (H)	ampere per metre	A/m
(43)	H	inductance (L)	henry	H = Wb/A
(44)	Hz	frequency (f, ω)	hertz	1/s
(45)	1/(Wh)	R_W, active energy meter constant or pulse value		
(46)	1/(varh)	R_B, reactive energy meter constant or pulse value		
(47)	1/(VAh)	R_S, apparent energy meter constant or pulse value		
(48)	V^{2}h	volt-squared hour, r_{U2h}, volt-squared hour meter constant or pulse value	volt-squared-hours	V^2(60*60s)
(49)	A^{2}h	ampere-squared hour, r_{I2h}, ampere-squared hour meter constant or pulse value	ampere-squared-hours	A^2(60*60s)
(50)	kg/s	mass flux	kilogram per second	kg/s
(51)	S, mho	conductance	siemens	1/Ω
(52)	K	temperature (T)	kelvin	
(53)	1/(V^{2}h)	R_{U2h}, volt-squared hour meter constant or pulse value		
(54)	1/(A^{2}h)	R_{I2h}, ampere-squared hour meter constant or pulse value		
(55)	1/m^3	R_V, meter constant or pulse value (volume)		
(56)		percentage	%	
(57)	Ah	ampere-hours	Ampere-hour	
...				
(60)	Wh/m^3	energy per volume	3,6*10^3 J/m^3	
(61)	J/m^3	calorific value, wobbe		
(62)	Mol %	molar fraction of gas composition	mole percent	(Basic gas composition unit)
(63)	g/m^3	mass density, quantity of material		(Gas analysis, accompanying elements)
(64)	Pa s	dynamic viscosity	Pascal second	(Characteristic of gas stream)
(65)	J/kg	specific energy NOTE The amount of energy per unit of mass of a substance.	Joule / kilogram	m^2 · kg · s^{-2} / kg = m^2 · s^{-2}
….				
(70)	dBm	signal strength, dB milliwatt (e.g. of GSM radio systems)		
(71)	dbμV	signal strength, dB microvolt		

unit: = enum	**Unit**	**Quantity**	**Unit name**	**SI definition (comment)**
(72)	dB	logarithmic unit that expresses the ratio between two values of a physical quantity		
…				
(253)		reserved		
(254)	other	other unit		
(255)	count	no unit, unitless, count		

B.70 Utility tables

An instance of the Utility Tables class encapsulates ANSI C12.19:1997 table data.

With this interface class definition, each “Table” is represented as an instance. The specific instance is identified by its logical_name.

Annex C
(informative)

Gas Volume Conversion

C.1 Introduction

This document is a summary from CEN/TC 237 for gas–volume electronic conversion devices.

It shows the minimum set of data objects for such a device, as they shall be displayed at the device. This set is also defined as general data model for OBIS gas meter reading as abstract description of a volume converter.

The given model can be extended by various data objects, which are state-of-the-art and manufacturer-independent.

In addition to the volume conversion device an energy converter is defined, which is also included in the technical sketch of the corresponding data flow.

C.2 Foreword to abstract data model of gas volume converter

In addition to the functionality of gas volume conversion devices generally gas flow can have a forward and a reverse direction. The ability to operate bidirectional flow depends on physical method and device type. Mainly there is only one defined direction – forward. For each direction the same data objects in gas conversion algorithm exist.

If the device is equipped with so called "disturbance registers", they are used when detection exceeds permissible metrological limits or plausibility.

So the gas conversion process will switch to store results into disturbance registers, when an alert condition occurs, and switch back to normal operation registers, if this condition disappears.

The abstract model of the gas volume converter operates equivalent, if:

— electronic meter reading instead of pulse input indicates gas flow at metering conditions;

— ultrasonic technology measures gas flow at metering conditions.

Using volume conversion values from density meter technology, the relevant data objects according to density have been introduced.

C.3 Abstract data model of gas volume converter — Common objects in gas conversion and energy calculation

Table C.1 — OBIS-Value group A = 7, B = X, E = 0, *F* = FF

OBIS value C	OBIS value D	Gas formula symbol	Common Object Names and explanations
3	0	V_m	Unconverted Volume “Index” from meter
13	0		Unconverted Volume “Index” from converter
23	0		Unconverted Volume “Index” from logger
3	1	V_c	Error-Corrected Volume from meter
13	1		Error-Corrected Volume from converter
23	1		Error-Corrected Volume from logger
23 [a]	2	V_b	Converted Volume [a]
33	2	E	Energy “Index”
41	0	T	Current Temperature [c]
			Temperature of Gas, expressed in Kelvin. Volume conversion depends on Kelvin temperature measurement.
41	2	T_b	Base Temperature [c]
41	3	(none)	Backup Temperature (Used if temperature sensor fails) [c]
0	5: 11 [b]	T_{min}	Minimum absolute gas temperature in measuring range
			(lower limit) [c]
0	5: 12 [b]	T_{max}	Maximum absolute gas temperature in measuring range
			(upper limit) [c]
0	2: 12 [b]	(none)	Temperature Sensor serial number [b]
42	0	P	Current Pressure
			Pressure of Gas, expressed in a suitable unit, in absolute terms, for example bar (a). This means that the value is referenced to a perfect vacuum, as opposed to “Gauge” pressure, which is referenced to current atmospheric conditions.
42	2	P_b	Base Pressure
42	3	(none)	Backup pressure value (Used if pressure sensor fails)
0	5:13 [b]	P_{min}	Minimum abs. gas pressure in measuring range
			(lower limit)
0	5:14 [b]	P_{max}	Maximum abs. gas pressure in measuring range
			(upper limit)
42	11	(none)	Preset pressure value: used for conversion devices without a pressure sensor
0	2: 11 [b]	(none)	Pressure Sensor serial number [b]
43	0	(none)	Flow Rate. Flow rate is a measured/calculated instantaneous representation of the rate of flow: it is analogous to power in electrical terms. It is usually expressed in m^3/hour. It can represent unconverted or converted flow,

OBIS value C	OBIS value D	Gas formula symbol	Common Object Names and explanations
			governed by value group D.
44	0	(none)	Velocity of sound. Ultrasonic meters can almost always determine the velocity of sound of the gas, and it is a useful indication of the gas condition. It is worth noting that large changes of Velocity of sound in the gas may represent changes in gas composition, or condition.
45	0	(none)	Density: Density can be measured, and used to calculate energy with a variant of Calorific value.
51	0	C_f	Correction Factor: A fixed value used to correct a scalar error on a meter: for example, if a meter under-registers volume by 0,5 %, then a correction factor value of 1,005 will compensate for the error.
52	0	C	Conversion Factor: A factor that is used to convert “unconverted volume” to “converted volume”.
53	0	Z	Compressibility: *Z*: effectively, the “difference” in compressibility between the gas being measured and “noble” gas. SGERG-88 and EN 12405–1 give full information on this, though below 1,5 bar (a) this is usually set to 1.
53	2	Z_b	Base compressibility
53	11	(none)	Preset compressibility: used where a fixed value of *Z* is assumed
53	12	(none)	Compressibility method: Usually a text string, SGERG88, AGA8, AGANX19, etc.
54	0	(none)	Calorific Value (measured).
			CV is the energy that may be gained from the coM-Bustion of a standard volume of gas at base conditions, or at a pre-set density.

[a] The “C” field value is 23, because it is assumed that the most common arrangement of commercial/ industrial meter installation applies: that is Meter, connected to volume converter, connected to datalogger.

[b] Setting values like sensor serial numbers are stored as General Purpose objects (C = 0). The entry in the value group D column is < value group D > : < value group E >

[c] Temperatures used for gas are generally specified in Kelvin.

C.4 Principle of measurement for volume conversion and energy calculation

Assumption: The conversion device:

— is able to correct the error curve of the gas meter (Option);

— consists of a temperature transducer;

— consists of a pressure transducer (Option);

— is able to calculate compressibility factor (Option).

Step 1

The error curve of the gas meter will be corrected by a correction factor:

$$V_c = C_f \times V_m$$

where

C_f is the correction factor given by a formula $C_f = f(q)$,

there can be several methods used by the manufacturers for error correction.

Step 2

Volume at base conditions is calculated by:

$V_b = C \times V$ where V can be V_m or V_c

where

C is the conversion factor given by the relationship:

$$C = (P / P_b) \times (T_b / T) \times (Z_b / Z)$$

where

Z is the compressibility factor using an appropriate formula as a function of pressure and temperature to compensate the deviation from ideal gas law:

$$Z = f\ (p, T)$$

Presettable gas properties and components are used for the compressibility calculation, combined into one of several existing calculation methods.

If the pressure is not measured, it can be included as a fixed value in the processing of the conversion factor.

If the compressibility factor is not calculated, it may be included as a fixed value in the processing of the conversion factor.

“Energy converter”

In addition to “volume converter”, but outside the scope of EN 12405-1 an “energy converter” can be defined by the next calculation step.

Step 3

Energy is calculated by:

$$E = \text{Cal/Value} \times V_b$$

Cal/Value is the Calorific value, this term implies all the energy, which is contained in the fuel. This Calorific value is measured typically by calorimeter or gas chromatograph devices.

C.5 Data flow in volume conversion and energy calculation

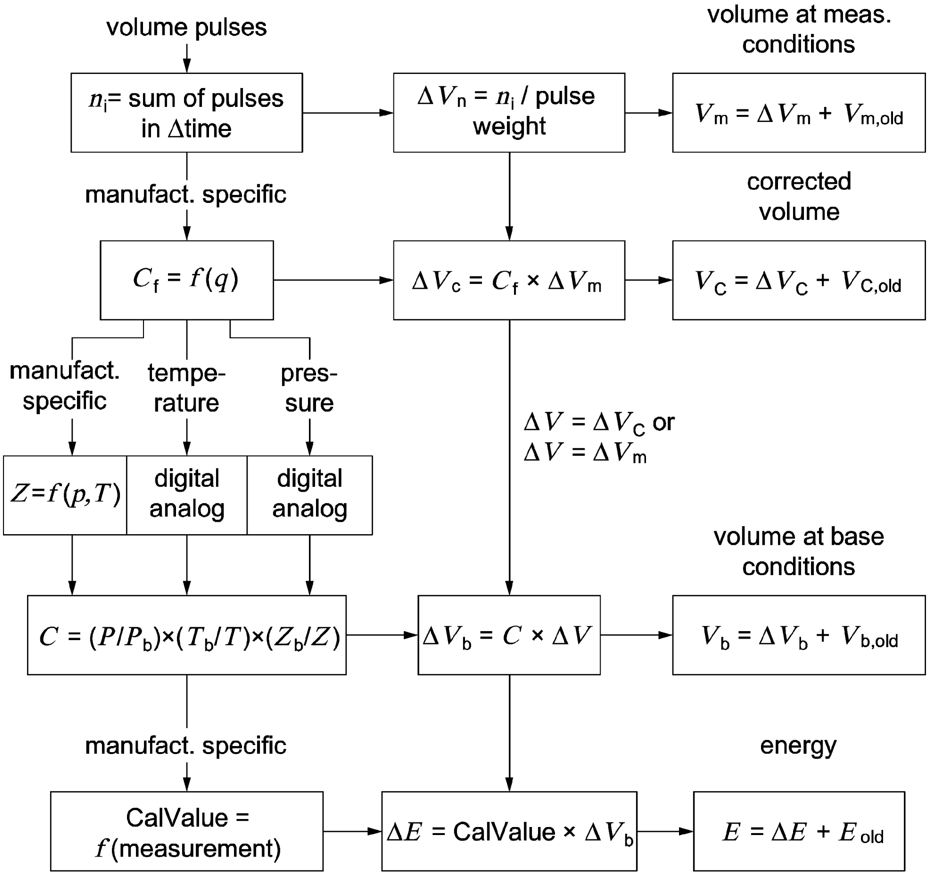


Figure C.1 — Energy Conversion Calculation flow chart

Annex D
(normative)

Country specific identifiers

Table D.1 — Value group D codes — Country specific identifiers C = 94

Value group D	Identifiers
00	Identifiers for Finland
01	Identifiers for the USA
02	Identifiers for Canada
03	Identifiers for Serbia
07	Identifiers for Russia
10	Identifiers for Czech Republic
11	Identifiers for Bulgaria
12	Identifiers for Croatia
13	Identifiers for Ireland
14	Identifiers for Israel
15	Identifiers for Ukraine
16	Identifiers for Yugoslavia [a]
20	Identifiers for Egypt
27	Identifiers for South Africa
30	Identifiers for Greece
31	Identifiers for the Netherlands
32	Identifiers for Belgium
33	Identifiers for France
34	Identifiers for Spain
35	Identifiers for Portugal
36	Identifiers for Hungary
37	Identifiers for Lithuania
38	Identifiers for Slovenia
39	Identifiers for Italy
40	Identifiers for Romania
41	Identifiers for Switzerland
42	Identifiers for Slovakia
43	Identifiers for Austria
44	Identifiers for the United Kingdom
45	Identifiers for Denmark
46	Identifiers for Sweden

47	Identifiers for Norway
48	Identifiers for Poland
49	Identifiers for Germany
51	Identifiers for Peru
52	Identifiers for South Korea
53	Identifiers for Cuba
54	Identifiers for Argentina
55	Identifiers for Brazil
56	Identifiers for Chile
57	Identifiers for Colombia
58	Identifiers for Venezuela
60	Identifiers for Malaysia
61	Identifiers for Australia
62	Identifiers for Indonesia
63	Identifiers for the Philippines
64	Identifiers for New Zealand
65	Identifiers for Singapore
66	Identifiers for Thailand
73	Identifiers for Moldova
75	Identifiers for Belarus
81	Identifiers for Japan
85	Identifiers for Hong Kong
86	Identifiers for China
87	Bosnia and Herzegovina
90	Identifiers for Turkey
91	Identifiers for India
92	Identifiers for Pakistan
96	Identifiers for Saudi Arabia
97	Identifiers for the United Arab Emirates
98	Identifiers for Iran
Others	Reserved

[a] With the dissolution of the former Yugoslavia into separate nations, country code 16 was decommissioned.

Objects that are already identified in this standard shall not be re-identified by country specific identifiers.

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