IEC 62056-7-3

Edition 1.0 2017-03

INTERNATIONAL STANDARD

colour inside

Electricity metering data exchange – The DLMS/COSEM suite – Part 7-3: Wired and wireless M-Bus communication profiles for local and neighbourhood networks

IEC 62056-7-3:2017-03(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 62056-7-3

Edition 1.0 2017-03

INTERNATIONAL STANDARD

colour inside

Electricity metering data exchange – The DLMS/COSEM suite – Part 7-3: Wired and wireless M-Bus communication profiles for local and neighbourhood networks

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 17.220.20; 35.100.01; 91.140.50

ISBN 978-2-8322-4012-0

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

ELECTRICITY METERING DATA EXCHANGE – THE DLMS/COSEM SUITE –

Part 7-3: Wired and wireless M-Bus communication profiles for local and neighbourhood networks

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this International Standard may involve the use of a maintenance service concerning the stack of protocols on which the present standard IEC 62056-5-3 is based.

The IEC takes no position concerning the evidence, validity and scope of this maintenance service.

The provider of the maintenance service has assured the IEC that he is willing to provide services under reasonable and non-discriminatory terms and conditions for applicants throughout the world. In this respect, the statement of the provider of the maintenance service is registered with the IEC. Information may be obtained from:

DLMS[1] User Association
Zug/Switzerland
www.dlms.com

International Standard IEC 62056-7-3 has been prepared by IEC technical committee 13: Electrical energy measurement and control.

The text of this standard is based on the following documents:

FDIS	Report on voting
13/1729/FDIS	13/1731/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

1 Device Language Message Specification.

INTRODUCTION

As defined in IEC 62056-1-0, the IEC 62056 DLMS/COSEM suite provides specific communication profile standards for communication media relevant for smart metering.

Such communication profile standards specify how the COSEM data model and the DLMS/COSEM application layer can be used on the lower, communication media-specific protocol layers.

Communication profile standards refer to communication standards that are part of the IEC 62056 DLMS/COSEM suite or to any other open communication standard.

This International Standard specifies DLMS/COSEM communication profiles for wired and wireless M-Bus networks using the lower layers specified in the EN 13757 series.

It follows the rules defined in IEC 62056-5-3, Annex A.

The DLMS/COSEM wired and wireless M-Bus communication profiles for local and neighbourhood networks may be used for smart energy data exchange with meters as well as with simple consumer displays and home automation systems.

ELECTRICITY METERING DATA EXCHANGE – THE DLMS/COSEM SUITE –

Part 7-3: Wired and wireless M-Bus communication profiles for local and neighbourhood networks

1 Scope

This International Standard specifies DLMS/COSEM wired and wireless M-Bus communication profiles for local and neighbourhood networks.

Setting up and managing the M-Bus communication channels of M-Bus devices, the M-Bus network, registering slave devices and – when required – repeaters is out of the scope of this International Standard.

The scope of this communication profile standard is restricted to aspects concerning the use of communication protocols in conjunction with the COSEM data model and the DLMS/COSEM application layer. Data structures specific to a communication protocol are out of the scope of this standard. Any project-specific definitions of data structures and data contents may be provided in project-specific companion specifications.

Annex A (informative) provides information on M-Bus frame structures, addressing schemes and an encoding example.

Annex B (normative) points to COSEM interface classes to set up and manage the wired and wireless M-Bus communication channel.

Annex C (informative) provides MSCs for representative instances of communication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62056-5-3:2016, *Electricity metering data exchange – The DLMS/COSEM suite – Part 5-3: DLMS/COSEM application layer*

IEC 62056-6-1:2015, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-1: Object identification system (OBIS)*

IEC 62056-6-2:2016, *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-2: COSEM interface classes*

IEC 62056-6-2:—[2] , *Electricity metering data exchange – The DLMS/COSEM suite – Part 6-2: COSEM interface classes*

2 Under preparation. Stage at the time of publication: IEC/CDV 62056-6-2:2016.

EN 13757-1, *Communication system for meters – Part 1: Data exchange*

EN 13757-2:2004, *Communication system 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)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62056-5-3, IEC 62056-6-1, IEC 62056-6-2 and in the EN 13757 series apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

The following M-Bus specific abbreviated terms are used in this standard.

Abbrev.	Term	Standard domain
ACC	Access number field	M-Bus
ALA	Application Layer Address	M-Bus
CFG	Configuration byte	M-Bus
CI_{ELL}	CI field introducing the extended link layer (wireless M-Bus)	M-Bus
CI Field	Control Information field	M-Bus
CI_{TL}	CI field introducing the transport layer	M-Bus
DTSAP	Destination Transport Service Access Point	Telecontrol
ELL	Extended Link Layer	M-Bus
ELLA	Extended Link Layer Address	M-Bus
FIN (bit)	Final bit	Telecontrol
FT1.2	Data integrity format class FT1.2	Telecontrol
FT3	Data integrity format class FT3	Telecontrol
LLA	Link Layer Address	M-Bus
MSC	Message Sequence Chart	General
STS	Status byte	M-Bus
STSAP	Source Transport Service Access Point	Telecontrol
TL	Transport layer	M-Bus
wM-Bus	Wireless M-Bus	M-Bus

4 Targeted communication environments

In the context of the smart metering architecture introduced in IEC 62056-1-0 and shown in Figure 1, the wired and wireless M-Bus communication profiles for local and neighbourhood networks cover the following interfaces:

- the C interface between an NNAP and metering devices;
- the M interface between an LNAP and metering devices;
- the H1 interface between a metering device and a simple consumer display;
- the H2 interface between an LNAP and a home automation system.

In all cases, metering devices act as DLMS/COSEM servers.

On the C and M interface, metering devices act as M-Bus slaves. The M-Bus master is the NNAP or the LNAP.

On the H1 and H2 interfaces the metering device acts as a DLMS/COSEM server. It may operate in pull mode or push mode, as M-Bus master or M-Bus slave, depending on the selection of wired or wireless M-Bus and the operating mode for wireless M-Bus.

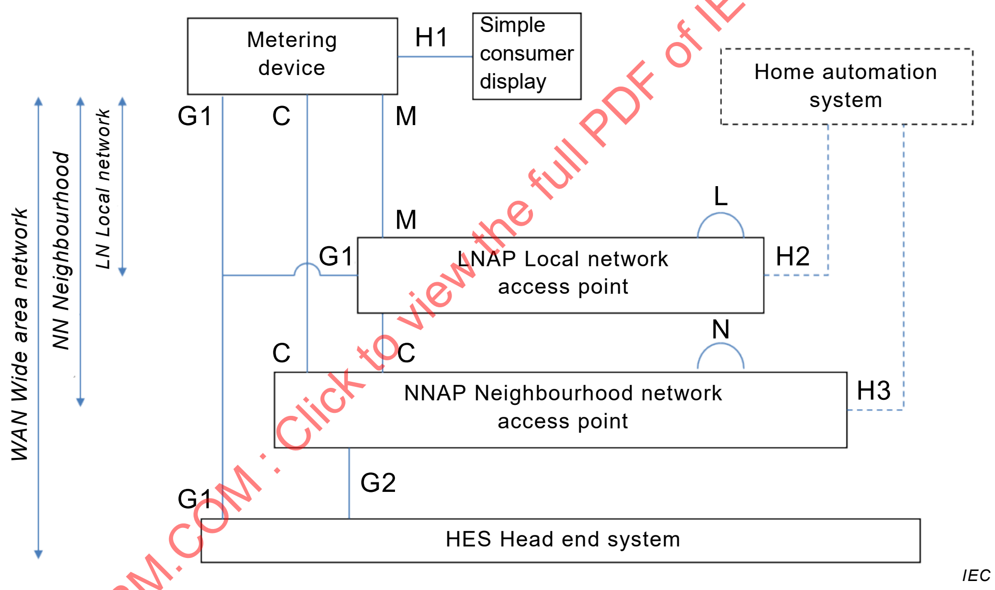

Figure 1 – Entities and interfaces of a smart metering system using the terminology of IEC 62056-1-0

5 Use of the communication layers for this profile

5.1 Information related to the use of the standard specifying the lower layers

The DLMS/COSEM wired and wireless M-Bus communication profiles for local and neighbourhood networks use the lower-layer protocols specified in the EN 13757 series.

Subclause 5.3.3 provides additional information on the use of the M-Bus transport layer in this communication profile.

5.2 Structure of the communication profiles

The structure of the DLMS/COSEM M-Bus wired and wireless M-Bus communication profiles is shown in Figure 2.

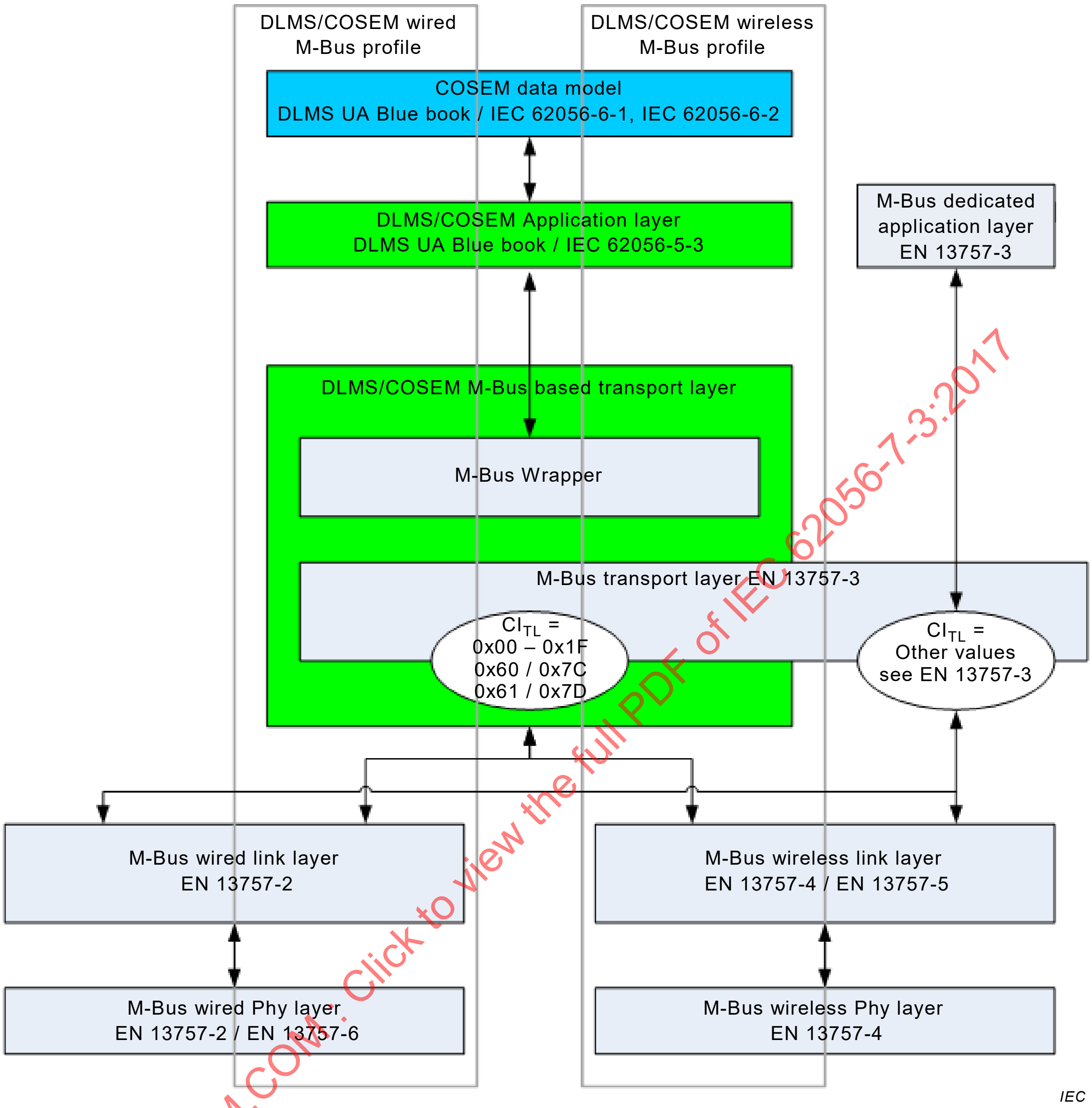

Figure 2 – The DLMS/COSEM wired and wireless M-Bus communication profiles

5.3 Lower protocol layers and their use

5.3.1 Physical layer

The physical layer is as specified in EN 13757-2:2004 (wired, twisted pair based) and in EN 13757-4:2013 (wireless).

For battery-operated masters and/or a small number of connected meters, a wired M-Bus physical layer is specified in EN 13757-6 (twisted pair based for short distances).

5.3.2 Link layer

The M-Bus link layer is as specified in EN 13757-2:2004 (wired) and in EN 13757-4:2013 (wireless).

NOTE For wireless meter readout EN 13757-5:2015 supports simple retransmission (single-hop repeating) as well as routed wireless networks that allow extending the range of transmission.

5.3.3 Transport layer

The M-Bus transport layer is as specified in EN 13757-3:2013.

Together with an M-Bus wrapper specified in 6.6, it constitutes the DLMS/COSEM M-Bus-based transport layer (TL) that acts as an adaptation layer between the link layer and the DLMS/COSEM AL.

The M-Bus TL allows several application layers to co-exist over the M-Bus lower layers. These can be:

- the M-Bus dedicated AL;
- the DLMS/COSEM AL; or
- some other AL that may be specified in the future.

The AL used is selected by the Control Information (CI) field of the M-Bus frame.

In the communication profiles specified in this document, only the DLMS/COSEM AL is used.

There are also CI field values for network management purposes. M-Bus frames carrying such CI field values do not necessarily carry application data.

5.4 Service mapping and adaptation layers

5.4.1 Overview

As already mentioned in 5.3.3, in the wired and wireless M-Bus communication profiles for local and neighbourhood networks the DLMS/COSEM M-Bus-based TL acts as an adaptation layer between the M-Bus link layer and the DLMS/COSEM AL.

It comprises the transport layer specified in EN 13757-3:2013 and a wrapper layer.

It provides OSI-style connectionless data services with optional segmentation and reassembly to the service user DLMS/COSEM AL.

The M-Bus wrapper – specified in 6.6 – provides the addressing capability required to address client and server DLMS/COSEM APs.

The service primitives are shown in Figure 3 and they are the same on the client and server side.

The .request service primitive is used to send a COSEM APDU to the peer TL.

The .indication service primitive indicates the reception of a COSEM APDU from the peer TL.

The .confirm service primitive is locally generated. It provides information to the AL about the status of sending the COSEM APDU.

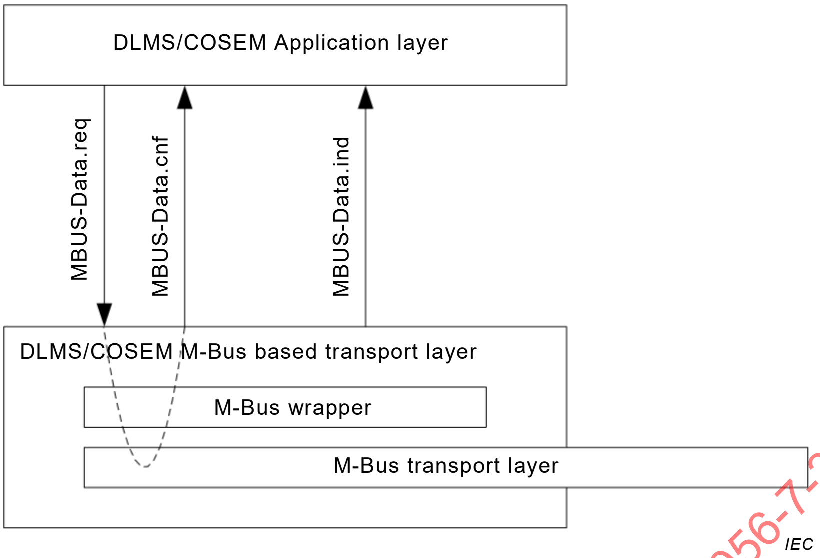

Figure 3 – Summary of DLMS/COSEM M-Bus-based TL services

5.4.2 MBUS-DATA service primitives

5.4.2.1 MBUS-DATA.request

Function

The MBUS-DATA.request primitive is used by the DLMS/COSEM AL to request the DLMS/COSEM M-Bus-based TL to send a COSEM APDU to (a) peer DLMS/COSEM M-Bus-based transport layer(s).

NOTE Multicast or broadcasting is available only in the direction client to server.

Semantics

The primitive shall provide the service parameters as follows:

MBUS-DATA.request (
M-Bus_Data_Header_Type,
STSAP,
DTSAP,
Data
)

The M-Bus_Data_Header_Type parameter indicates the M-Bus data header type to be used in the M-Bus frame to be sent. Its value can be *None_M-Bus_Data_Header*, *Short_M-Bus_Data_Header* or *Long_M-Bus_Data_Header*, see Figure 6.

The STSAP parameter indicates the TL service access point (SAP) belonging to the device / AP requesting to send the Data.

The DTSAP parameter indicates the TL SAP belonging to the device(s) / AP(s) to which the Data is to be transmitted.

The Data parameter contains the COSEM APDU to be transferred to the peer AL.

Use

The MBUS-DATA.request service primitive is invoked by either the client or the server DLMS/COSEM AL to request sending a COSEM APDU to a single peer AL or – in the case of multicast or broadcasting (by the client only) – to multiple peer ALs.

The reception of this primitive shall cause the DLMS/COSEM M-Bus-based TL to build the appropriate M-Bus data header accordingly and to construct the TPDU data unit to be passed to the M-Bus data link layer.

When the APDU to be sent is too long to fit in a single M-BUS frame, then segmentation may be used, see 5.4.3.

5.4.2.2 MBUS-DATA.indication

Function

The MBUS-DATA.indication primitive is used by the DLMS/COSEM M-Bus-based TL to pass a COSEM APDU received from the peer DLMS/COSEM M-Bus-based TL to the service user DLMS/COSEM AL.

Semantics

The primitive shall provide the service parameters as follows:

```
MBUS-DATA.indication    (
                        M-Bus_Data_Header_Type,
                        STSAP,
                        DTSAP,
                        Data
                        )
```

The M-Bus_Data_Header_Type parameter indicates M-Bus data header type used in the M-Bus frame received. Its value can be *None_M-Bus_Data_Header*, *Short_M-Bus_Data_Header* or *Long_M-Bus_Data_Header*, see Figure 6.

The STSAP parameter indicates the TL SAP belonging to the device / AP that has sent the Data.

The DTSAP parameter indicates the TL SAP belonging to the device / AP that has received the Data.

The Data parameter contains the COSEM APDU received from the peer AL.

Use

The MBUS-DATA.indication service primitive is generated by the DLMS/COSEM M-Bus-based TL to indicate to the service user DLMS/COSEM AL that a COSEM APDU from the peer layer entity has been received.

According to the received M-Bus data header, the TL allocates and passes only the M-Bus_Data_Header_Type to the DLMS/COSEM AL, but not the values of the received M-Bus data header.

If the STSAP or DTSAP are not valid – meaning that there is no AA bound to the given SAPs – the message received shall be simply discarded.

NOTE If the CI_{TL} field and the elements of the short or long M-Bus data header do not match, the TPDU is discarded by the EN 13757 M-Bus TL.

5.4.2.3 MBUS-DATA.confirm

Function

The MBUS-DATA.confirm service primitive allows the DLMS/COSEM M-Bus-based TL to inform the DLMS/COSEM AL about the status of transmitting the data following a .request.

Semantics

The primitive shall provide the service parameters as follows:

MBUS-DATA.confirm (
M-Bus_Data_Header_Type
STSAP,
DTSAP,
Transmission_Status
)

The value of the M-Bus_Data_Header_Type, STSAP and DTSAP parameters shall be the same as in the .request service primitive being confirmed.

The Transmission_Status parameter indicates the status of sending the data requested by the previous MBUS-DATA.request service. Its value can be SUCCESS, PENDING or FAILED.

Use

The MBUS-Data.confirm service primitive is generated locally by the DLMS/COSEM M-Bus-based TL to inform the service user DLMS/COSEM AL on the status of sending the Data in the .request primitive:

- Transmission_Status == SUCCESS means that the Data has been sent. It does not mean that the Data has been (or will be) successfully delivered to the destination;
- Transmission_Status == PENDING means that sending the Data has been prepared or is in progress;
- Transmission_Status == FAILED, means that the Data could not be sent by M-Bus lower layers.

5.4.3 MBUS-DATA protocol specification

5.4.3.1 Sending COSEM APDUs

When the DLMS/COSEM AL has to send a COSEM APDU to (a) peer AL(s), it invokes the MBUS-DATA.request primitive.

Upon the reception of this request, the DLMS/COSEM M-Bus-based TL builds the appropriate TPDU. The fields of the TPDU are the following, see also Figure 6:

- the CI_{TL} field, that indicates the kind of M-Bus data header used;
- the M-Bus data header, according to the value of the CI_{TL} field;
- the STSAP;
- the DTSAP; and the
- Data field i.e. the COSEM APDU or – when segmentation is used – a part of it.

The value of the CI_{TL} field depends on the M-Bus_Data_Header_Type parameter:

- when M-Bus_Data_Header_Type == None_M-Bus_Data_Header, the value of the CI_{TL} field shall be 0x10 when segmentation is not used, and shall be 0x00...0x1F when segmentation is used (with the FIN bit set to 0 in all segments except in the last segment);
- when M-Bus_Data_Header_Type == Short_M-Bus_Data_Header, the value of the CI_{TL} field shall be 0x61 in a M-Bus frame sent by a master and 0x7D in a M-Bus frame sent by a slave;
- when M-Bus_Data_Header_Type == Long_M-Bus_Data_Header, the value of the CI_{TL} field shall be 0x60 in an M-Bus frame sent by a master and 0x7C in an M-Bus frame sent by a slave.

In the case of a pull operation, the kind of M-Bus data header in M-Bus frames sent by the slave shall be the same as in the frames received from the master unless when segmentation needs to be used.

The client shall choose the M-Bus data header type according to the M-Bus media used – wired or wireless – and the capabilities of the server.

In the case of a push operation – using the xDLMS DataNotification service, see IEC 62056-5-3:2016, 6.10 – the M-Bus data header type is determined by the M-Bus slave.

The APDU can be sent without segmentation or, when it does not fit to a single M-Bus frame, with segmentation. Segmentation is available only when no M-Bus data header is used.

Sending COSEM APDUs without segmentation

When the M-Bus-based TL has successfully built the TPDU, it invokes the .request service primitive.

The .conf service primitive is invoked by the M-Bus-based TL with the value == SUCCESS once the lower layers confirm that the TPDU has been successfully sent.

If the lower layers cannot immediately send the M-Bus frame for whatever reason, then the .conf service primitive may be invoked by the M-Bus-based TL with the value == PENDING. When the lower layers indicate that the M-Bus frame could not be sent for whatever reason, then the .conf service primitive shall be invoked by the M-Bus-based TL with the value == FAILED.

When no M-Bus data header is used and the value of CI_{TL} = 0x10 (indicating that the payload is a complete COSEM APDU) or when the short M-Bus data header (CI_{TL} = 0x61) or the long M-Bus data header (CI_{TL} = 0x60) is used, the TPDU has to fit in a single M-Bus frame. If the TPDU does not fit in a single M-Bus frame, then the MBUS-Data.conf service primitive shall be invoked by the M-Bus-based TL with the value == FAILED.

Sending COSEM APDUs with segmentation

When the M-Bus_Data_Header_Type indicates None_M-Bus_Data_Header and the APDU to be sent does not fit in a single M-Bus frame, the transport layer shall use segmentation. The APDU is divided by the TL into as many parts as necessary so that each segment fits in a single M-Bus frame. Each TPDU shall contain a CI_{TL} field with the appropriate value – see Figure 7 – and one segment of the COSEM APDU. The TPDU containing the next segment can be sent once the confirmation of sending the previous segment from the lower layers is received.

The .conf service primitive is invoked by the M-Bus-based TL with the value == SUCCESS when the lower layers confirm that the last segment has been successfully sent.

The MBUS-Data.conf service primitive can be invoked by the M-Bus-based TL with the value == PENDING multiple times while the segments are being sent.

5.4.3.2 Receiving COSEM APDUs

The DLMS/COSEM M-Bus-based TL uses the MBUS-DATA.indication primitive to pass the APDU received from a peer TL to the AL.

When the TL receives an M-Bus frame, it checks the value of the CI_{TL} and the STSAP/DTSAP fields. When the values are not valid, the frame shall be discarded.

A STSAP and DTSAP pair is valid if there is an AA bound to these SAPs.

Receiving COSEM APDUs without segmentation

If the CI_{TL} field indicates that the M-Bus frame contains a complete APDU, then the TL invokes the .ind service primitive.

Receiving COSEM APDUs with segmentation

If the CI_{TL} field indicates that the M-Bus frame contains a part of the complete APDU, then the TL assembles the Data fields received in the segments and invokes the .ind service primitive when the final segment has been received.

However, if a segment is missing, all segments shall be discarded and the .confirm service primitive shall not be invoked.

NOTE The M-Bus-based TL does not provide a mechanism to recover lost segments.

5.5 Registration and connection management

Devices hosting DLMS/COSEM servers and implementing these profiles act as M-Bus slaves.

Their installation by the M-Bus master – that may be an LNAP or an NNAP – is out of the scope of this document.

NOTE The LNAP / NNAP may provide additional services like protocol conversion, security services and other services for entities outside the local / neighbourhood network as described in CEN / CLC / ETSI TR 50572.

The management of M-Bus entities is described in a general way in EN 13757-3:2013. Specific aspects for wired M-Bus networks are specified in EN 13757-2:2004 and for wireless M-Bus networks in EN 13757-4:2013 and EN 13757-5:2015.

The primary_address of the device – see 6.2 and 6.3 – is held by the “DLMS/COSEM server M-Bus port setup” object *primary_address* attribute. See Clause 8

6 Identification and addressing scheme

6.1 Overview

The wired and wireless M-Bus communication profiles for local and neighbourhood networks provide three levels of addressing:

- the Link Layer Address LLA identifies the physical device entity on the M-Bus. See 6.2, 6.3 and 6.4;
- the TL address CI_{TL} acts as a protocol selector and provides information on the structure of the TPDU and the options and capabilities available. In this profile, it selects the DLMS/COSEM M-Bus-based TL. See 6.5;

- the M-Bus wrapper, contained in the TL, provides addressing for COSEM client and server APs. See 6.6.

NOTE 1 In some cases – e.g. in the case when wireless M-Bus is used and repeaters are present – additional addressing may be needed, but this is out of the scope of this communication profile specification.

Together, these addresses allow messages to be transported non-ambiguously between a specific client AP and a specific server AP.

All addresses are provided by a protocol layer and they are present in a layer-specific M-Bus frame header. An example is shown in Figure 4.

The triplet {LLA, CI_{TL}, SAP} unambiguously identifies an AP:

- when the client AP#1 (Public Client) wants to send a xDLMS APDU to server AP#1 (Management LD) in server host device #1, the M-Bus frame shall carry the following addresses:
  – LLA = 0x45, CI_{TL} = 0x61, STSAP = 0x10, DTSAP = 0x01.
- in the response, the M-Bus frame shall carry the following addresses:
  – LLA = 0x45, CI_{TL} = 0x7D, STSAP = 0x01, DTSAP = 0x10.

NOTE 2 For the use of the LLA in the wired M-Bus profile, please see 6.2.

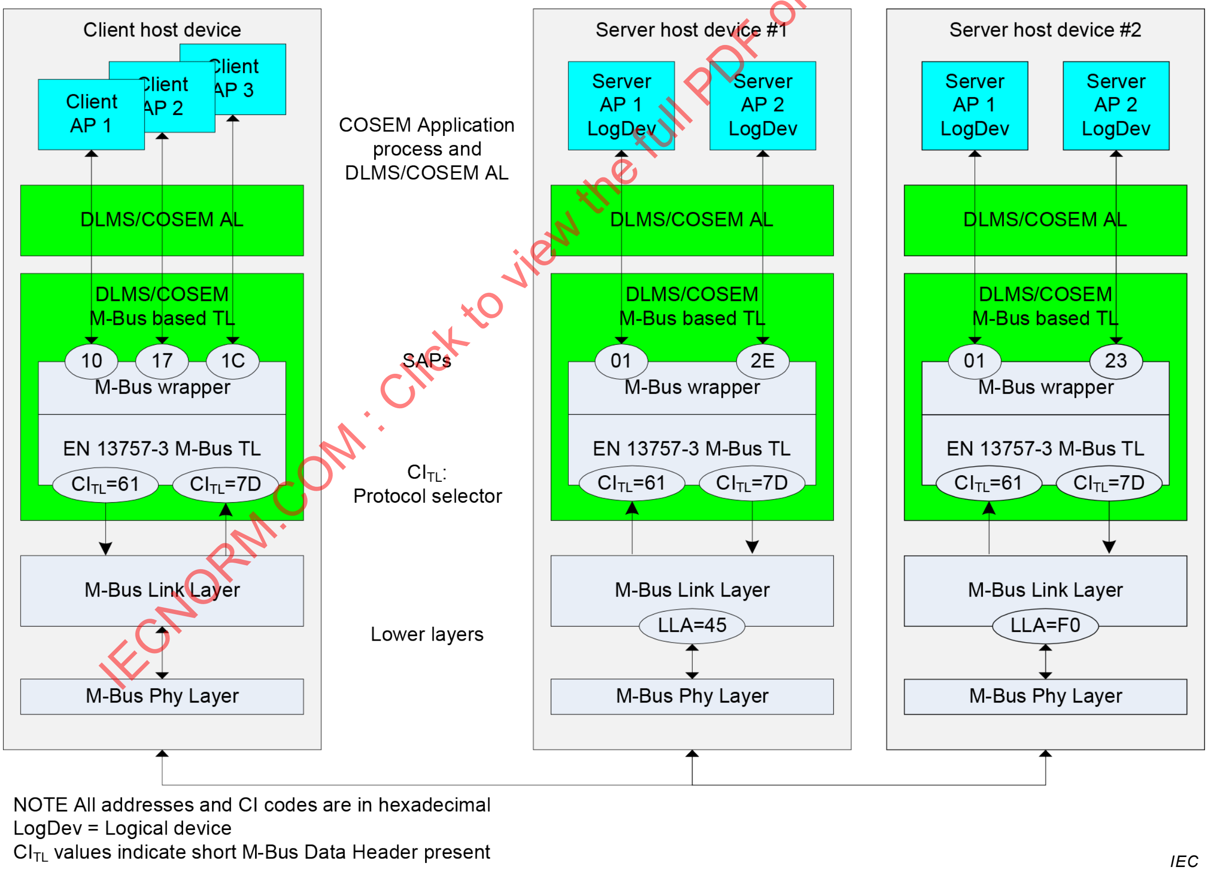

Figure 4 – Identification and addressing scheme in the wired M-Bus profile

6.2 Link Layer Address for wired M-Bus

The Link Layer Address (LLA) carries, in both communication directions, the secondary station (M-Bus slave) address of the physical device entity on the M-Bus which is connected with the single address-less M-Bus master. The addressing range is as specified in Table 1.

Table 1 – Wired M-Bus Link Layer Addresses

Value	Description
0x00	Un-configured slaves
0x01-0xFA	Primary address [a] range for slaves
0xFB	Reserved for management communication with the primary master repeater
0xFC	Reserved
0xFD	Reserved for secondary addressing [b]
0xFE	Test and diagnostic address
0xFF	Broadcast address

NOTE Most recent EN13757 standards apply the following terms:

[a] Link Layer Address (LLA) instead of primary address

[b] (M-Bus) Application Layer Address (ALA) instead of secondary address

Devices connected to a wired M-Bus can support both addressing via LLA and ALA. Details of the addressing scheme for the Link Layer Address of the wired M-Bus are provided in EN 13757-2:2004, 5.7.5.

6.3 Link Layer Address for wireless M-Bus

EN 13757-4:2013 specifies two data link layer frame formats:

- frame format A specified in EN 13757-4:2013, 11.3; and
- frame format B specified in EN 13757-4:2013, 11.4.

In both cases, the frames are divided into blocks, which are separated by CRC codes.

The LLA carries always the address of the sender (transmitter) wherever the frame comes from (the master or the slave). It is located in the first block.

The LLA consists of the sequence of the elements shown in Figure 5.

Manufacturer identification (M-ID)	Device identification No. (serial No.)	Device version (VER)	Device type (DT)

IEC

Figure 5 – Link Layer Address for wireless M-Bus

If the CI_{ELL} is present and indicates that the long Extended Link Layer Address (ELLA) is present, then the fields that follow contain the address of the receiver. It is located in the second block.

NOTE CI field CI_{ELL} indicates usage of the Extended Link Layer with additional control service capabilities.

6.4 Link Layer Address for M-Bus broadcast

In wired M-Bus networks the device capability according to the addressing via LLA and ALA determines the broadcast or multicast addressing:

- in the case of selective LLA usage, broadcast is identified by LLA = 0xFF;
- in the case of ALA usage (LLA value 0xFD), broadcast and multicast addressing is applicable.

In wireless M-Bus networks, broadcast and multicast addressing is applicable.

The addresses in ALA and in the wireless LLA are composed of the following 4 elements:

- manufacturer identification;
- device identification number;
- device version; and
- device type.

For broadcast or multicast addressing, the following rules apply (see EN 13757-3:2013, 11.5):

- in the device identification number element, each individual digit can be wild-carded by a wildcard nibble 0xF;
- the manufacturer, version and device type elements can be wild-carded by a wildcard byte 0xFF.

6.5 Transport layer address

An M-Bus frame may have several fields depending on the protocol layers present. Each field carries a protocol layer header and the payload is introduced by a Control Information (CI) field indicating the kind of the layer and the capabilities provided.

The CI_{TL} field values introducing the DLMS/COSEM M-Bus-based TL are specified in Table 2.

Table 2 – DLMS/COSEM M-Bus-based TL CI_{TL} values

CI_{TL}	Description
0x00-0x1F	No M-Bus data header is present [1]
0x60	Long M-Bus data header present, direction master to slave
0x61	Short M-Bus data header present, direction master to slave
0x7C	Long M-Bus data header present, direction slave to master
0x7D	Short M-Bus data header present, direction slave to master
[1] In this case, segmentation and reassembly is possible with restrictions.	

It is mandatory for the server and the client to support all three CI field address structure options.

The structure of TPDU corresponding to the various CI_{TL} values is shown in Figure 6.

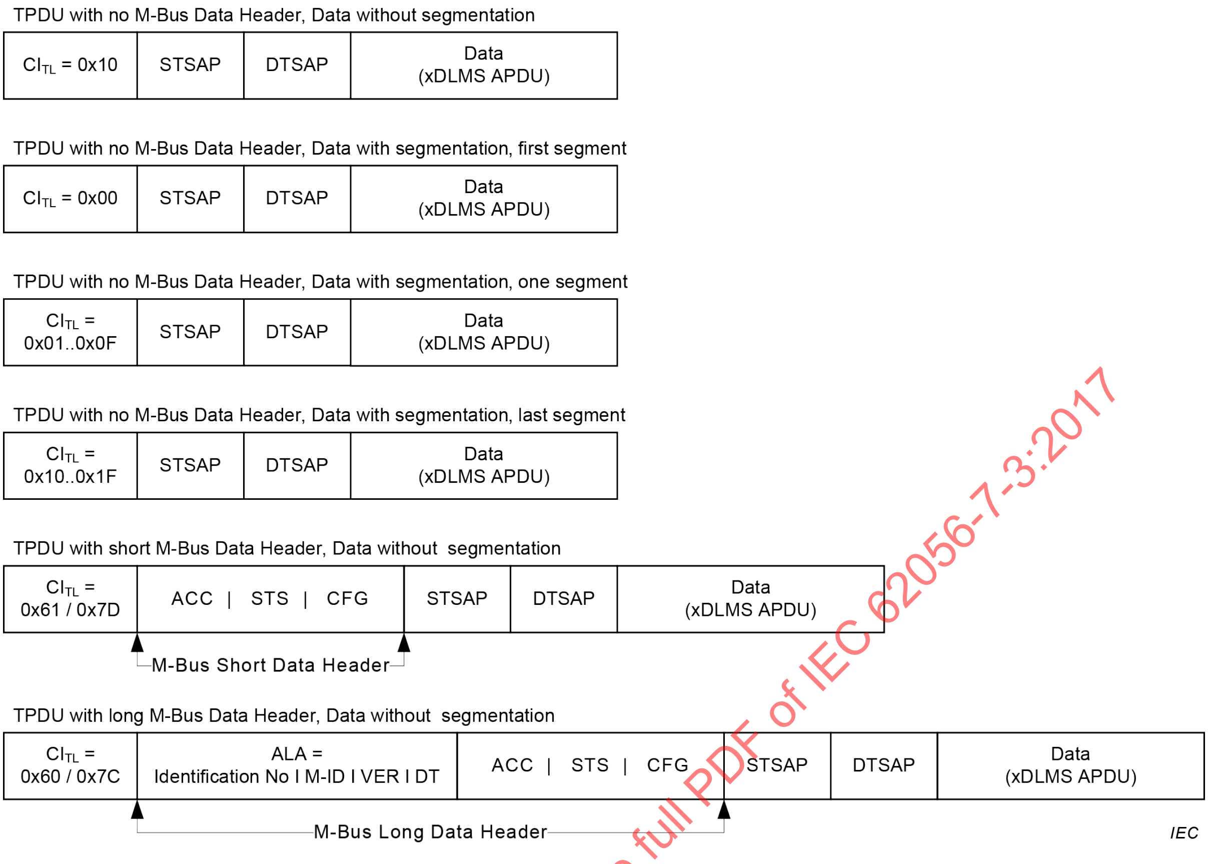

Figure 6 – M-Bus TPDU formats

The values CI_{TL} = 0x00…0x1F indicate that no M-Bus data header is present. In this case, the TL can provide segmentation and reassembly (see 5.4.3).

NOTE Segmentation adds less overhead than block transfer provided by the AL.

The structure of the CI_{TL} field in this case is shown in Figure 7:

b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	FIN	Sequence number			

IEC

Figure 7 – CI_{TL} without M-Bus data header

Bits 7, 6 and 5 set to 0 indicate that no M-Bus data header is present.

Bit 4 (FIN) indicates that the data field of the TPDU carries either one part of an xDLMS APDU or the complete APDU.

Bits 3 to 0 are used for sequence numbering. The rollover of the sequence numbers is permitted, meaning that when the sequence number reaches the value 1111 and there are segments remaining to be sent, the next segment sequence number will take the value 0000.

The segmentation protocol is specified in 5.4.3.

The values CI_{TL} = 0x61 / 0x7D indicate that the short M-Bus data header is present, as well as the direction of the message. Segmentation and reassembly is not available.

The values CI_{TL} = 0x60 / 0x7C indicate that the long M-Bus data header is present, as well as the direction of the message. Segmentation and reassembly is not available.

The use of the different M-Bus TPDU structures depends on the network environment as well as on the structure and capabilities of the M-Bus slave device. Therefore, their use is determined by the M-Bus slave.

The format of the TPDU in the request and the response shall be the same, except when segmentation needs to be used.

Table 3 shows values of CI fields for M-Bus link management purposes. These values are not relevant for the DLMS/COSEM M-Bus profiles, therefore they are provided for information only.

Table 3 – CI fields used for link management purposes

CI field	Upper layers	Description
0x80	Pure TL[a]	Long M-Bus data header present, to meter
0x8A	Pure TL[a]	Short M-Bus data header present, from meter
0x8B	Pure TL[a]	Long M-Bus data header present, from meter
0x8C	ELL[b]	Short M-Bus ELL without ELLA
0x8E	ELL[b]	Long M-Bus ELL with ELLA

[a] This CI field values indicate that the message is not intended to an application layer; no APDU is present.

[b] The Extended Link Layer (ELL) is used only with wireless M-Bus.

6.6 Application addressing extension – M-Bus wrapper

The DLMS/COSEM AL needs to identify the partners involved in the AA: each AA is bound to a pair of client and server SAPs. See also Figure 4 and Figure 6.

The M-Bus wrapper that constitutes a part of the DLMS/COSEM M-Bus-based TL provides the required addressing of the DLMS/COSEM client and server APs. The values of the SAPs as one-byte addresses on the client and the server side are specified in Table 4.

Table 4 – Client and server SAPs

Client SAPs	
No-station	0x00
Client Management Process	0x01
Public Client	0x10
Open for client SAP assignment	0x02…0x0F
	0x11… 0xFF
Server SAPs	
No-station	0x00
Management Logical Device	0x01
Reserved for future use	0x02…0x0F
Open for server SAP assignment	0x10…0x7E
All-station (Broadcast)	0xFF

7 Specific considerations and constraints for using certain services within profile

7.1 Overview

In general, there is no differentiation between wired and wireless M-Bus media for the usage of DLMS/COSEM AL services.

When using the features provided by DLMS/COSEM, the constraints set by the M-Bus medium, the use of a battery supply and the device type and configuration shall be considered by the implementer. See also 7.6.

With respect to efficiency in messaging, the following mechanism is applied to perform AA establishment and subsequent message exchange between the client and the server on the data link layer of M-Bus:

- M-Bus messages with application data in each message shall follow the scheme according to EN 13757-4:2013 where, in combination with the SND-UD2 message, the control byte code C = 0x43 allows data to be obtained instead of ACK (refer to EN 13757-4:2013, Table 24 – Function codes of the C-field in messages sent from primary stations);
- after establishment of an AA, all subsequent data exchanges follow the direct REQUEST – RESPONSE mechanism applying SND-UD2.

NOTE This mechanism is not applicable in combination with fragmented messages in wireless M-Bus (refer to EN 13757-4:2013 Table 24, note c).

7.2 Application association establishment and release: ACSE services

Table 5 summarizes the rules for establishing confirmed and unconfirmed AAs and exchanging COSEM APDUs.

Table 5 – Application associations and data exchange in the M-Bus-based profiles

Application association establishment				Data exchange	
Protocol connection parameters	COSEM-OPEN service class	Use	Type of established application association	Service class	Use
See below	Confirmed	Exchange AARQ/AARE APDU-s transported in M-Bus frames	Confirmed	Confirmed	M-Bus frame
				Unconfirmed	M-Bus frame
	Unconfirmed	Send AARQ-APDU-s in M-Bus frames	Unconfirmed	Confirmed (not allowed)	-
				Unconfirmed	M-Bus frame

The service parameters of the COSEM-OPEN service – see IEC 62056-5-3:2016, 6.2 – shall be used as described below.

The Protocol_Connection_Parameters parameter shall be: the protocol (profile) identifier: wired or wireless M-Bus;

- the Link Layer Address (LLA);

  NOTE In the case of wired M-Bus, this is the LLA of the slave for both communication directions, and in the case of wireless M-Bus, this is the LLA of the sender / transmitter.

- in the case of wireless M-Bus, and when required, the Extended Link Layer Address ELLA;
- the M-Bus data header type, and when present, the short or long M-Bus data header;

- server logical device address: COSEM logical device SAP;
- client_Id: COSEM client SAP.

Any server (destination) address parameter may contain special addresses (All-station, No-station, etc.).

The User_Information service parameter is not used.

The Service_Class parameter shall be used as follows:

- in the M-Bus-based profiles, the Service_Class parameter of the COSEM-OPEN service is linked to the response-allowed parameter of the xDLMS InitiateRequest APDU:
  - if the COSEM-OPEN service is invoked with Service_Class == Confirmed, the response-allowed parameter shall be set to TRUE. The server is expected to respond;
  - if it is invoked with Service_Class == Unconfirmed, the response-allowed parameter shall be set to FALSE. The server shall not send back a response.
- unconfirmed AAs between a client and a group of logical devices are established using a COSEM-OPEN service with Service_Class == Unconfirmed and a group of logical device addresses (for example broadcast address).

As the lower layers are connectionless, the Use_RLRQ_RLRE service parameter of the COSEM-RELEASE service – see IEC 62056-5-3:2016, 6.3 – shall be set to TRUE.

7.3 xDLMS services

7.3.1 Request – response type services

The Service_Class parameter of the GET, SET, ACTION and ACCESS services is linked to the service class bit of the Invoke-Id-And-Priority / Long-Invoke_Id-And-Priority field. If the service is invoked with Service_Class = Confirmed, the corresponding service class bit shall be set to 1, otherwise it shall be set to 0.

It is forbidden to request an xDLMS service in a confirmed way (Service_Class = Confirmed) within an unconfirmed AA established on the top of the DLMS/COSEM M-Bus-based transport layer. This is also prevented by the Client AL. Servers receiving such APDUs shall simply discard them, or shall send back a ConfirmedServiceError APDU or, if the feature is implemented, send back the optional ExceptionResponse APDU.

7.3.2 Unsolicited services

Application of the DLMS/COSEM unsolicited services (EventNotification, DataNotification, and InformationReport) in M-Bus networks depends on capability and configuration of M-Bus entities and should therefore be specified in project-specific companion specifications.

7.3.3 Broadcast messages

For wired M-Bus the use of broadcast messages by addressing with primary address (= link layer address, equal to 255) is supported. Due to the fact that broadcast messages cannot be acknowledged on the link layer level, a subsequent verification on the application level may need to be performed.

In general also broadcast and multicast for secondary addresses are available using the wildcard mechanism in the address parts (EN 13757-3:2013, referenced from EN 13757-4:2013).

Therefore, in wireless M-Bus networks broadcast / multicast messages are applicable, taking into account the fact that from a DLMS viewpoint, broadcast of COSEM APDUs via wireless M-Bus is available if supporting M-Bus lower layers will offer corresponding functionality.

7.4 Security mechanisms

The security mechanism specified in IEC 62056-5-3:2016 and IEC 62056-6-2:2016 may be used without specific constraints.

7.5 Transporting long application messages

There are two mechanisms available to transport long messages that do not fit directly in a single M-Bus frame:

- segmentation provided by the TL, see 5.4.3 and 6.5. This mechanism is available only when no M-Bus data header is present in the TPDU (refer to EN 13757-1);
- DLMS/COSEM application layer block transfer. This mechanism can be used with all TPDU structures.

7.6 Media access, bandwidth and timing considerations

For DLMS/COSEM unsolicited services – see 7.3.2 – the M-Bus alarm messaging in wired and wireless M-Bus installations could get certain delays due to:

- out of transmission credits[3] for battery-operated devices;

  NOTE Credits as information depends on project-specific companion specifications: these are not free parameters due to complex embedding and therefore accessible in application.
- waiting time for access until next transmission (wireless M-Bus only);
- disturbance on radio channel (wireless M-Bus only);
- handling message priority is not supported by M-Bus.

For broadcast in wireless M-Bus networks, some further aspects are important:

- energy consumption depends on various parameters, device and system design which, in general, does not prevent using broadcast;
- accessibility is essential for broadcast and multicast, where EN 13757-4:2013 Table 27 indicates different accessibility (no, temporary, limited, unlimited) with device examples;
- mains-powered meters and communication modules are accessible without limitations (with respect to duty cycles!). On the other hand, battery-powered meters pose some restrictions (see transmission credits), but may operate with dedicated time windows to receive messages.

8 Communication configuration and management

The COSEM interface classes that apply to the communication profiles specified in this document are the following:

- DLMS/COSEM server M-Bus port setup (class_id = 76), see IEC 62056-6-2:— , 5.7.6,
- M-Bus slave port setup (class_id = 25), see IEC 62056-6-2:2016, 5.6.1;
- wireless mode Q channel (class_id = 73), see IEC 62056-6-2:2016, 5.6.2;
- M-Bus diagnostic (class_id = 77, version = 0), see IEC 62056-6-2:— , 5.7.7.

[3] The battery-operated meter has to protect itself from frequent periodical readout in context with available communication budget. For this constraint, such a type of meter limits the number of transactions by credits. If the credit is used up, the communication (access) will stop until the device receives the next credit.

Annex A
(informative)

M-Bus frame structures, addressing schemes and examples

A.1 General

This annex gives an overview and examples of M-Bus frame structures and related addressing schemes for wired and wireless M-Bus.

For transporting xDLMS APDUs – the Data – only the source and destination SAPs providing DLMS/COSEM application process addressing are relevant. All other fields of the M-Bus frame are processed by the transport layer and the lower layers. For this reason, this Annex A is informative.

Further details and related usage context are to be found in the appropriate standards referenced.

In M-Bus frames there may be one or more Control Information (CI) fields present that provide information about the protocol layers and the related M-Bus frame fields present as well as the usage of those fields. All CI-Fields[4] relevant for the DLMS/COSEM M-Bus communication profiles are specified in clause 6.5.

In general, the M-Bus frame structure is determined by the master in the case of wired M-Bus and by the slave in the case of wireless M-Bus. The selection of the appropriate M-Bus frame structure depends also on a number of other factors:

- the communication path: direct or cascaded (e.g. with conversion unit between wired and wireless M-Bus), see Figure A.1;
- the physical structure of the M-Bus slave (e.g. with integrated or with external radio unit), see Figure A.1;
- the operation phase: installation or normal operation;
- the installation process, e.g. manual or automatic address assignment.

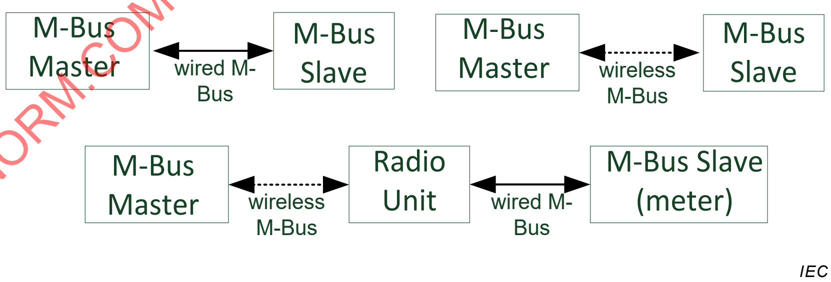

Figure A.1 – M-Bus communication paths direct or cascaded

In the following sections, M-Bus frame structures and addressing-related information are described and examples are shown for:

- wired M-Bus:

  Figure A.2 – Wired M-Bus frame structure, none M-Bus data header;

  Figure A.3 – Wired M-Bus frame structure with long M-Bus data header;

[4] Further CI-Fields are specified for management purposes, see EN 13757-3:2013 and EN 13757-4:2013.

- wireless M-Bus:

  Figure A.4 – Wireless M-Bus frame structure with short ELL, no M-Bus data header;

  Figure A.5 – Wireless M-Bus frame structure with long ELL, no M-Bus data header;

  Figure A.6 – Wireless M-Bus frame structure with long ELL and long M-Bus data header.

A.2 None, short or long M-Bus data header

A.2.1 Wired M-Bus

The wired M-Bus is a master/slave bus, which connects a single master with several slaves.

The master may address the slave either by the Link Layer Address, LLA (which is applied in the link layer of master message) or by the Application Layer Address, ALA. Due to the limited range of Link Layer Addresses – see Table 1 – the LLA shall be assigned during the installation of the slave. This can be done manually by a service technician or automatically from the master.

The ALA shall be assigned by the manufacturer and it shall be unique worldwide (however, an operator may change it within a system).

For addressing via the ALA, the master has to send a special Select-Command which contains the ALA of the slave. Such Select-Commands may apply wildcards. In this case no, one or several slaves will be selected. Wildcards can be used to search (test) for slaves connected to the M-Bus (refer to Wild Card Search in EN 13757-3:2013). Once a slave is detected, the master can assign a unique LLA to it.

This justifies why the slave shall apply the ALA in the long transport layer in the slave response for an automatic assignment by the master.

For a manually performed assignment, a frame with a simple wrapper in the slave response will be sufficient. The master should in general apply frames with simple wrappers.

NOTE 1 There will be the option to disable the long TL after the address assignment process.

Figure A.2 and Figure A.3 show wired M-Bus frame structures according to EN 13757-2:2004 / IEC 60870-5-1:1990.

Legend to the Figures:

L	L-Field, length field, number of user data octets
C	C-field, control field
A	Primary address (assigned during installation process), 1 octet
Identification No	Device identification number (serial number, Serial-nr), 4 octets
M-ID	Manufacturer ID, 2 octets
VER	Version, 1 octet
DT	Device Type, 1 octet
CI_{TL}	CI-Field for TL
ACC	Access number
STS	Status
CFG	Configuration field
CS	Check sum
STSAP	Source Transport Service Access Point

DTSAP	Destination Transport Service Access Point

Address elements (ALA)

M-ID	Manufacturer ID, 2 octets
Identification No	Device identification number (serial number, serial-nr), 4 octets
VER	Version, 1 octet
DT	Device Type, 1 octet

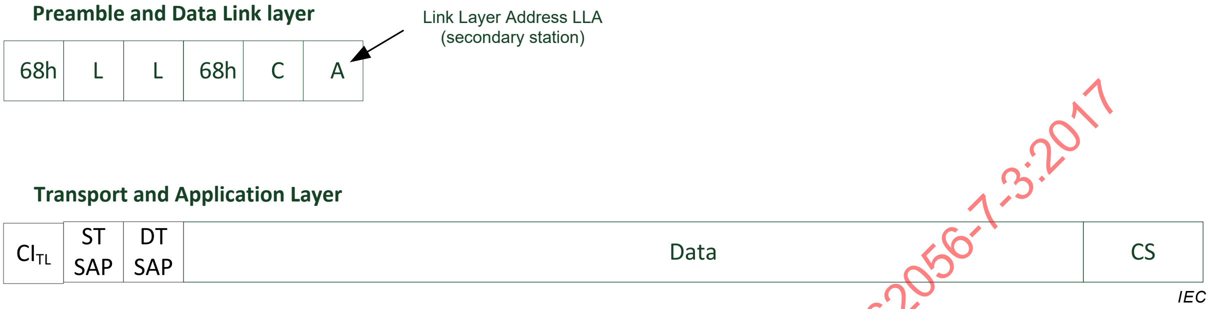

Figure A.2 – Wired M-Bus frame structure, none M-Bus data header

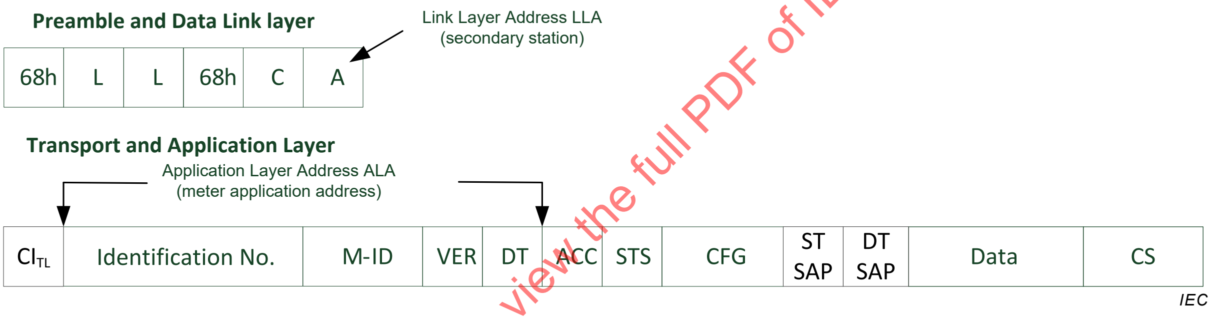

Figure A.3 – Wired M-Bus frame structure with long M-Bus data header

NOTE 2 The Link Layer Address (LLA) contains always the secondary station address (slave). The Application Layer Address (ALA) contains always the meter application address (M-Bus address of server entity address) and is available only in frames with long M-Bus data header.

A.2.2 Wireless M-Bus

A.2.2.1 Extended Link Layer

For the communication via wireless M-Bus the short or long Extended Link Layer shall be used in each message transmitted.

The wireless M-Bus uses the access Number (ACC) for the identification of an old or new M-Bus frame types, see EN 13757-3:2013, 5.9. Therefore, the wireless M-Bus protocol shall provide an access number for both the master and the slave. Additional link control bits are required which, for example, signal the availability of the server. Different services are provided by the Extended Link Layer type; see EN 13757-4:2013, 12.2.

Battery-operated slaves cannot provide unlimited availability for the master. That's why the access time is controlled by the slave itself. For that reason, the slave transmits periodically unrequested messages. The master may access the slave after such a transmission. For all frames transmitted between the master and the server, the LLA and the ELLA shall be applied. For the unrequested transmission by the slave, only the LLA is required.Figure A.4, Figure A.5 and Figure A.6 show wireless M-Bus frame structures according to EN 13757-4:2013 and apply frame format A as specified in EN 13757-4:2013, 11.3.

Legend to the Figures:

L	L-Field, length field, number of user data octets
C	C-field, control field
CRC	Cyclic redundancy check
CI	CI-Field for Extended Link Layer CI_{ELL} or TL CI_{TL}
ACC	Access number
CC	Communication Control Field
STS	Status
CFG	Configuration field
STSAP	Source Transport Service Access Point
DTSAP	Destination Transport Service Access Point

Address elements (LLA, ELLA, ALA)

HS	Selector for hard-coded (by manufacturing process) or soft-coded (by installation process) address
M-ID	Manufacturer ID, 2 octets
Identification No	Device identification number (serial number, Serial-nr), 4 octets
VER	Version, 1 octet
DT	Device Type, 1 octet

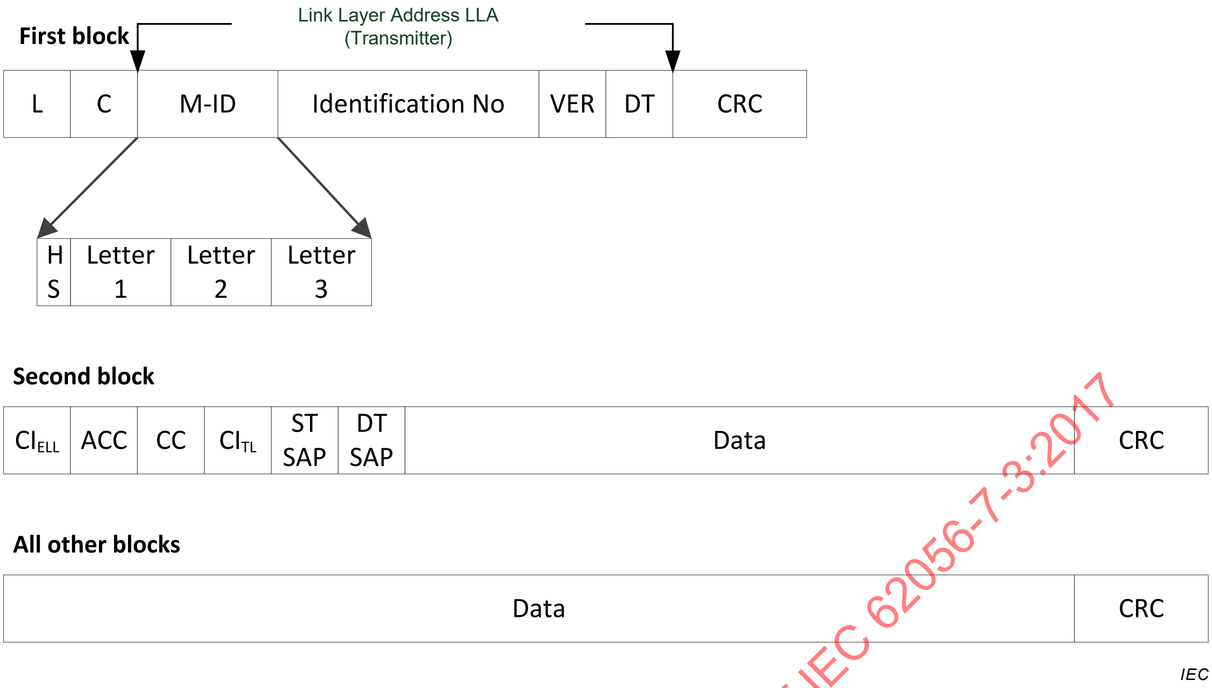

Figure A.4 – Wireless M-Bus frame structure with short ELL, no M-Bus data header

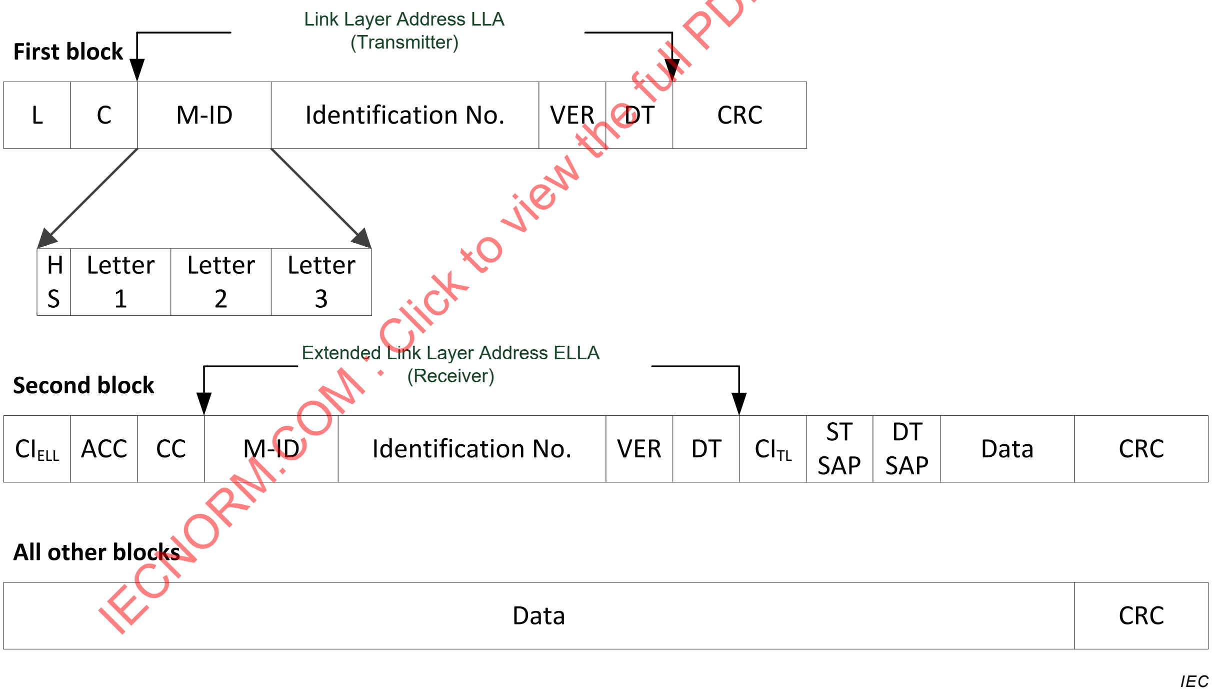

Figure A.5 – Wireless M-Bus frame structure with long ELL, no M-Bus data header

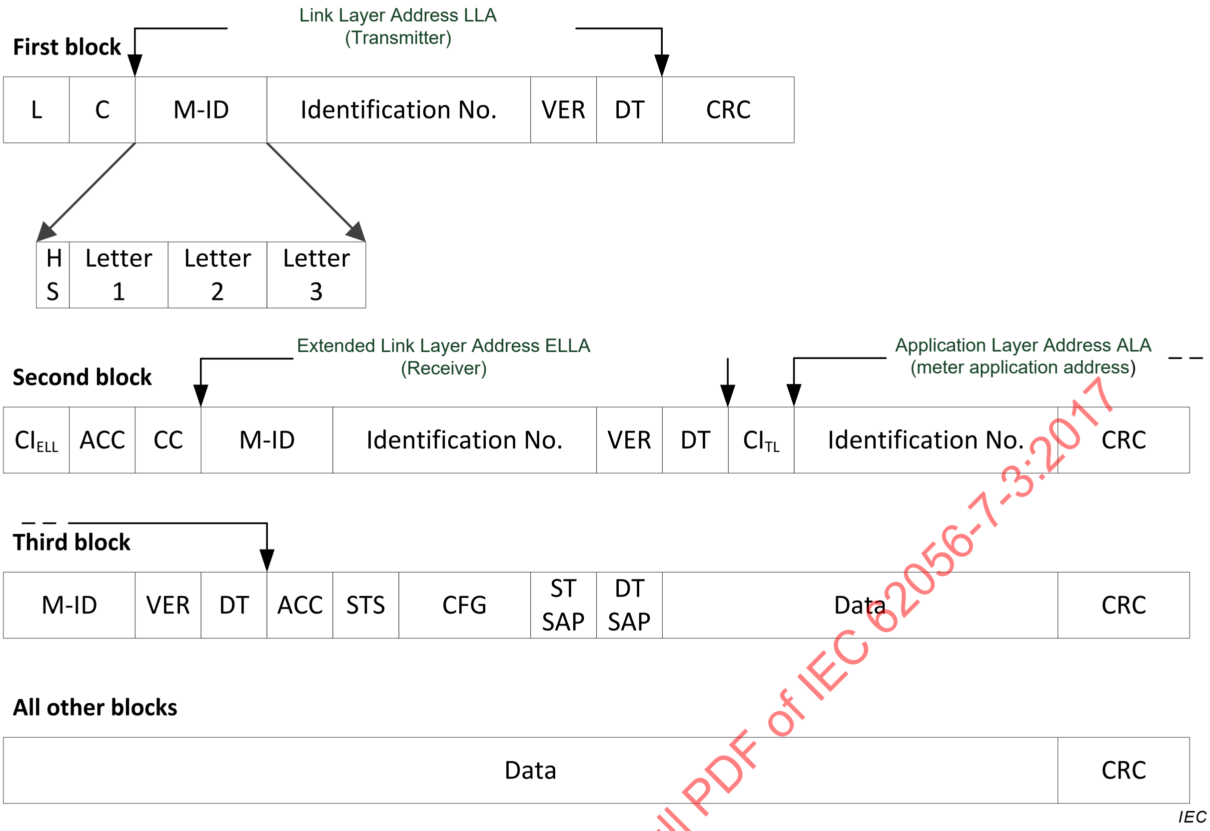

Figure A.6 – Wireless M-Bus frame structure with long ELL and long M-Bus data header

NOTE The Link Layer Address (LLA) always contains the transmitter address (radio unit). The Extended Link Layer Address (ELLA) always contains the receiver address.

The ELLA is available only in frames with a long Extended Link Layer.

The Application Layer Address (ALA) always contains the meter application address (M-Bus address of the slave entity). The ALA is available only in frames with CI-Fields indicating an M-Bus long data header.

Frames without or with short transport layers are applied only when the LLA is sufficient.

The link layer address (LLA + ELLA) is a hard-coded address assigned by the manufacturer and shall not be changeable by the operator. In the event that an external communication adapter is used, the ALA needs to be assigned to this adapter.

A.2.2.2 Transport layer

When several slaves share one radio unit, the ELLA is not sufficient for an unambiguous addressing of the dedicated slave. In this case, the long transport layer should be used. The ALA contains the intended slave address.

Otherwise, the wrapper with the CI-Field value 0x10 may be used (but no segmentation).

A.3 Encoding example: Data-Notification carrying daily billing data

A.3.1 Overview

This subclause of the Annex shows an encoding example for sending daily billing data by the server using the "Compact data" interface class. The data are pushed using the DataNotification service – see IEC 62056-5-3:2016 via wireless M-Bus using frame format A.

The "Compact data" interface class – see IEC 62056-6-2:2016 – allows the separation of the metadata from the data. This drastically reduces the overhead which is essential for battery-operated devices and for restrained communication media, such as wireless M-Bus.

The example also shows the encoding of the information related to the lower layers.

A.3.2 Example: Daily billing data

Figure A.1 shows the daily billing data that are captured – together with the *template_id* – to the *compact_buffer* attribute of a "Compact data" object.

Table A.1 – Example: Daily billing data

Data	class _id	Logical name	attribute_ id	Size (bytes)	Type
Template_id	62	0-0:66.0.0.255	4	1	unsigned
Unix time	1	0-0:1.1.0.255	2	4	double-long-unsigned
Operating status	1	0-0:96.5.0.255	2	1	unsigned
Error register	1	0-0:97.97.0.255	2	1	unsigned
Total index	3	7-0:13.83.1.255	2	4	double-long-unsigned
Index F1	3	7-0:13.83.1.255	2	4	double-long-unsigned
Index F2	3	7-0:13.83.1.255	2	4	double-long-unsigned
Index F3	3	7-0:13.83.1.255	2	4	double-long-unsigned
Activity calendar name	20	0-0:13.0.0.255	2	6	octet-string
Event counter	1	0-0:96.15.1.255	2	2	long-unsigned

Here, the overhead is only 1 byte, identifying the template.

Figure A.7 shows the example of transporting the Data-Notification APDU without ciphering and with authenticated encryption.