BS EN 62056-7-6:2013

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Electricity metering data exchange — The DLMS/ COSEM suite

Part 7–6: The 3-layer, connection-oriented HDLC based communication profile

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National foreword

This British Standard is the UK implementation of EN 62056-7-6:2013. It is identical to IEC 62056-7-6:2013. It partially supersedes BS EN 62056-53:2007.

The UK participation in its preparation was entrusted to Technical Committee PEL/13, Electricity Meters.

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Electricity metering data exchange -
The DLMS/COSEM suite -
Part 7-6: The 3-layer, connection-oriented HDLC based communication profile
(IEC 62056-7-6:2013)

Echange des données de comptage de l'électricité -
La suite DLMS/COSEM -
Partie 7-6: Profil de communication à 3 couches, orienté connexion et basé sur HDLC
(CEI 62056-7-6:2013)

Datenkommunikation der elektrischen Energiemessung -
DLMS/COSEM -
Teil 7-6: HDLC basiertes 3-Schichten Kommunikations-Protokoll
(IEC 62056-7-6:2013)

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Foreword

The text of document 13/1527/FDIS, future edition 1 of IEC 62056-7-6, prepared by IEC/TC 13 "Electrical energy measurement, tariff- and load control" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62056-7-6:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-03-20
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-06-20

EN 62056-7-6:2013 supersedes partially EN 62056-53:2007.

It is based on EN 62056-53:2007, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM application layer*, Annex B.2 *The 3-layer, connection-oriented, HDLC based communication profile* and introduces the following significant technical changes:

NOTE EN 62056-53:2007 contains the specification of the DMS/COSEM communication profiles whereas the new edition, EN 62056-5-3:2013, which replaces it, does not.

• The title of the standard has been aligned with the title of other parts of the revised EN 62056 series;

• A Figure showing the protocol stack has been added to Clause 5.

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

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The text of the International Standard IEC 62056-7-6:2013 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 62056-5-3	2013	Electricity metering data exchange - The DLMS/COSEM suite - Part 5-3: DLMS/COSEM application layer	EN 62056-5-3	2013
IEC 62056-21	2002	Electricity metering - Data exchange for meter reading, tariff and load control - Part 21: Direct local data exchange	EN 62056-21	2002
IEC 62056-42	2002	Electricity metering - Data exchange for meter reading, tariff and load control - Part 42: Physical layer services and procedures for connection-oriented asynchronous data exchange	EN 62056-42	2002
IEC 62056-46 + A1	2002 2006	Electricity metering - Data exchange for meter reading, tariff and load control - Part 46: Data link layer using HDLC protocol	EN 62056-46 + A1	2002 2007

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ELECTRICITY METERING DATA EXCHANGE – THE DLMS/COSEM SUITE –

Part 7-6: The 3-layer, connection-oriented HDLC based communication profile

1 Scope

This part of IEC 62056 specifies the DLMS/COSEM 3-layer, connection-oriented HDLC based communication profile.

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.

IEC 62056-21:2002, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 21: Direct local data exchange*

IEC 62056-42:2002, *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 62056-46:2002, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 46: Data link layer using HDLC protocol*
Amendment 1:2006

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

NOTE See also the Bibliography.

3 Terms, definitions and abbreviations

AA	Application Association
AARQ	A-Associate Request – an APDU of the ACSE
ACSE	Association Control Service Element
AL	Application Layer
APDU	Application Layer Protocol Data Unit
ASO	Application Service Object
Client	A station, asking for services. In the case of the 3-layer, CO HDLC based profile it is the master station
.cnf	confirm service primitive
CO	Connection-oriented
COSEM	Companion Specification for Energy Metering
DLMS	Device Language Message Specification
DLMS UA	DLMS User Association

GSM	Global System for Mobile Communications
HDLC	High-level Data Link Control
HHU	Hand Held Unit
I	Information frame (a HDLC frame type)
.ind	.indication service primitive
LLC	Logical Link Control (Sublayer)
MAC	Medium Access Control (sublayer)
MAC	Message Authentication Code (cryptography)
master	Central station – station which takes the initiative and controls the data flow
NRM	Normal Response Mode
OSI	Open System Interconnection
PDU	Protocol Data Unit
P/F	Poll/Final
PhL	Physical Layer
PSTN	Public Switched Telephone Network
.req	.request service primitive
.res	.response service primitive
RNR	Receive Not Ready (a HDLC frame type)
RR	Receive Ready (a HDLC frame type)
SAP	Service Access Point
SNRM	Set Normal Response Mode (a HDLC frame type)
Server	A station, delivering services. The tariff device (meter) is normally the server, delivering the requested values or executing the requested tasks.
Slave	Station responding to requests of a master station. The tariff device (meter) is normally a slave station.
UA	Unnumbered Acknowledge (a HDLC frame type)
UI	Unnumbered Information (a HDLC frame type)

4 Targeted communication environments

The 3-layer, CO, HDLC-based profile is suitable for local data exchange with metering equipment via direct connection, or remote data exchange via the PSTN or GSM networks with appropriate modems.

5 Structure of the profile

This profile is based on a three-layer (collapsed) OSI protocol architecture:

- the DLMS/COSEM AL, specified in IEC 62056-5-3;
- the data link layer based on the HDLC standard, specified in IEC 62056-46;
- the physical layer; specified in IEC 62056-42.

This three-layer architecture is shown in Figure 1.

The use of the PhL for the purposes of direct local data exchange using an optical port or a current loop physical interface is specified in IEC 62056-21:2002, Annex E.

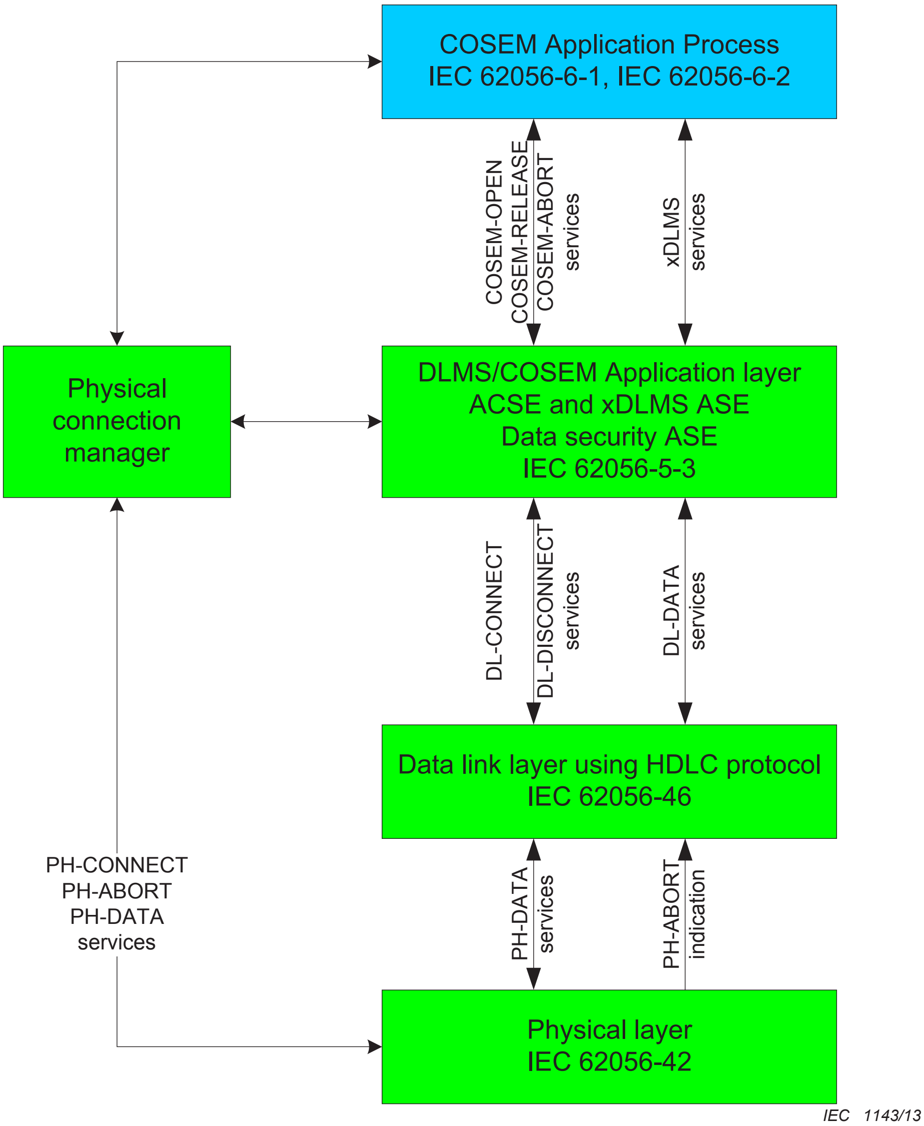

Figure 1 – The DLMS/COSEM 3-layer, connection oriented, HDLC based communication profile

6 Identification and addressing scheme

The HDLC-based data link layer provides services to the DLMS/COSEM AL at Data Link SAP-s, also called as the Data Link- or HDLC addresses.

On the client side, only the client AP needs to be identified. The addressing of the physical device hosting the client APs is done by the PhL (for example by using phone numbers).

On the server side, several physical devices may share a common physical line (multidrop configuration). In the case of direct connection this may be a current loop as specified in IEC 62056-21. In the case of remote connection several physical devices may share a single telephone line. Therefore both the physical devices and the logical devices hosted by the physical devices need to be identified. This is done using the HDLC addressing mechanism as described in 6.4.2 of IEC 62056-46:2002, Amendment 1:2006.

- physical devices are identified by their lower HDLC address;
- logical devices within a physical device are identified by their upper HDLC address;
- a COSEM AA is identified by a doublet, containing the identifiers of the two APs participating in the AA.

For example, an AA between Client_01 (HDLC address = 16) and Server 2 in Host Device 02 (HDLC address = 2392) is identified by the doublet {16, 2392}. Here, "23" is the upper HDLC address and "92" is the lower HDLC address. All values are hexadecimal. This scheme ensures that a particular COSEM AP (client or server) may support more than one AA simultaneously without ambiguity. See Figure 2.

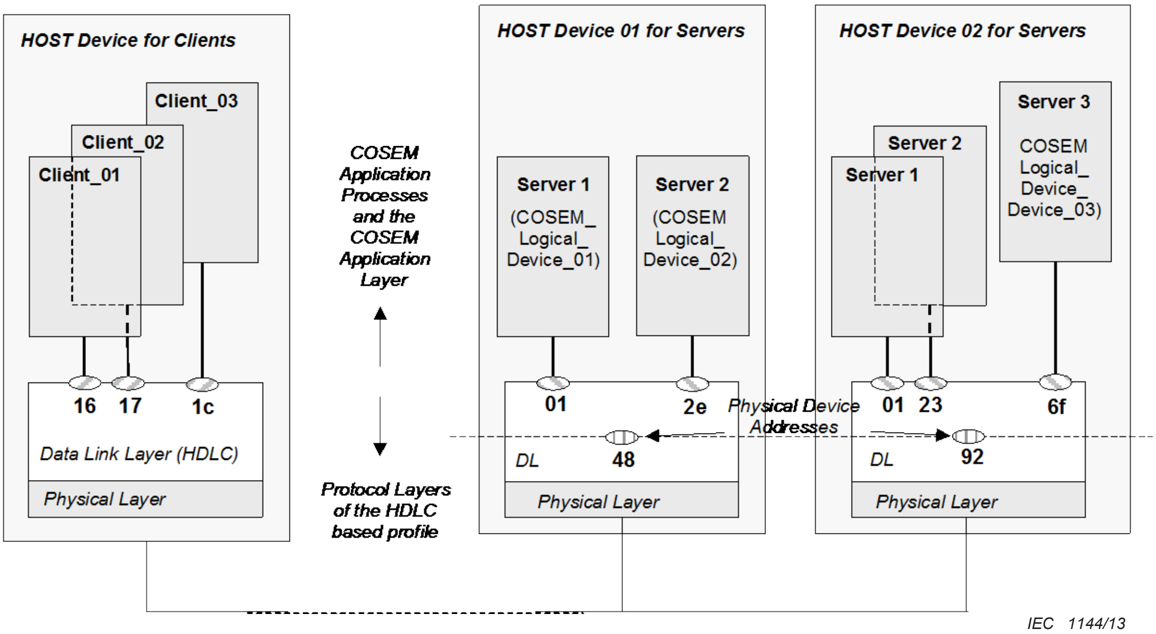

Figure 2 – Identification/addressing scheme in the 3-layer, CO, HDLC-based communication profile

7 Supporting layer services and service mapping

In this profile, the supporting layer of the DLMS/COSEM AL is the HDLC based data link layer. It provides services for:

- data link layer connection management;
- connection-oriented data transfer;
- connection-less data transfer.

Figure 3 summarizes the data link layer services provided for and used by the DLMS/COSEM AL.

The DL-DATA.confirm primitive on the server side is available to support transporting long messages from the server to the client in a transparent manner to the AL. See 9.5.

In some cases, the correspondence between an AL (ASO) service invocation and the supporting data link layer service invocation is straightforward. For example, invocation of a GET.request primitive directly implies the invocation of a DL-DATA.request primitive.

In some other cases, a direct service mapping cannot be established. For example, the invocation of a COSEM-OPEN.request primitive with Service_Class == Confirmed involves a series of actions, starting with the establishment of the lower layer connection with the help of the DL-CONNECT service, and then sending out the AARQ APDU via this newly established connection using a DL-DATA.request service. Examples for service mapping are given in IEC 62056-5-3:—, Clause 7.

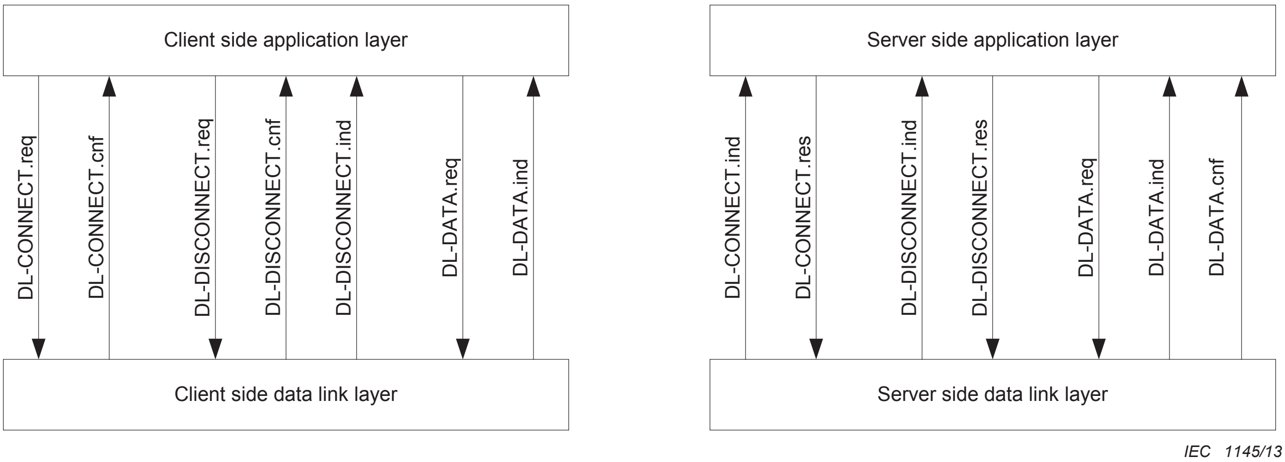

Figure 3 – Summary of data link layer services

8 Communication profile specific service parameters of the DLMS/COSEM AL services

Only the COSEM-OPEN service has communication profile specific parameters, the Protocol_Connection_Parameters parameter. This contains the following data:

- Protocol (Profile) Identifier 3-Layer, connection-oriented, HDLC-based;
- Server_Lower_MAC_Address (COSEM Physical Device Address);
- Server_Upper_MAC_Address (COSEM Logical Device Address);
- Client_MAC_Address;
- Server_LLC_Address;
- Client_LLC_Address

Any server (destination) address parameter may contain special addresses (All-station, No-station, etc.). For more information, see IEC 62056-46.

9 Specific considerations / constraints

9.1 Confirmed and unconfirmed AAs and data transfer service invocations, frame types used

Table 1 summarizes the rules for establishing confirmed and unconfirmed AAs, the type of data transfer services available in such AAs and the HDLC frame types that carry the APDUs. This table clearly shows one of the specific features of this profile: the Service_Class parameter of service invocations is linked to the frame type of the supporting layer:

- If the COSEM-OPEN service – see 6.2 of IEC 62056-5-3:—, – is invoked with Service_Class == Confirmed, then the AARQ APDU is carried by an “I” frame. On the other hand, if it is invoked with Service_Class == Unconfirmed, it is carried by a “UI” frame. Therefore, in this profile, the response-allowed parameter of the xDLMS InitiateRequest APDU has no significance. See also 7.2.4.1 of IEC 62056-5-3:—;
- Similarly, if a data transfer service .request primitive is invoked with Service_Class == Confirmed, then the corresponding APDU is transported by an “I” frame. If it is invoked with Service_class == Unconfirmed, then the corresponding APDU is carried by a “UI” frame. Consequently, Service_Class bit of the Invoke-Id-And-Priority field – see IEC 62056-5-3:—, Clause 8 – is not relevant in this profile.

Table 1 – Application associations and data exchange in the 3-layer, CO, HDLC-based profile

<table>
<tr><th colspan="4">Application association establishment</th><th colspan="2">Data exchange</th></tr>
<tr><th>Protocol connection parameters</th><th>COSEM-OPEN service class</th><th>Use</th><th>Type of established AA</th><th>Service class</th><th>Use</th></tr>
<tr><td rowspan="4">Id: HDLC
LLC and MAC addresses</td><td rowspan="2">Confirmed</td><td rowspan="2">1/ Connect data link layer
2/ Exchange AARQ/AARE APDUs transported in “I” frames</td><td rowspan="2">Confirmed</td><td>Confirmed</td><td>“I” frame</td></tr>
<tr><td>Unconfirmed</td><td>“UI” frame</td></tr>
<tr><td rowspan="2">Unconfirmed</td><td rowspan="2">Send AARQ in a “UI” frame</td><td rowspan="2">Unconfirmed</td><td>Confirmed (not allowed)</td><td>-</td></tr>
<tr><td>Unconfirmed</td><td>“UI” frame</td></tr>
</table>

9.2 Correspondence between AAs and data link layer connections, releasing AAs

In this profile, a confirmed AA is bound to a supporting data link layer connection, in a one-to-one basis. Consequently:

- establishing a confirmed AA implies the establishment of a connection between the client and server data link layers;
- a confirmed AA in this profile can be non-ambiguously released by disconnecting the corresponding data link layer connection.

On the other hand, in this profile, establishing an unconfirmed AA does not need any lower layer connection: consequently, once established, unconfirmed AAs with servers not supporting the ACSE A-RELEASE service (see 6.3 and 7.2.5 of IEC 62056-5-3:—) cannot be released.

9.3 Service parameters of the COSEM-OPEN / -RELEASE / -ABORT services

Thanks to the possibility to transparently transport higher layer related information within the SNRM and DISC HDLC frames, this profile allows the use of the optional “User_Information” parameter of the COSEM-OPEN – see 6.2 of IEC 62056-5-3:— – and COSEM-RELEASE – see 6.3 of IEC 62056-5-3:— – services:

- the User_Information parameter of a COSEM-OPEN.request primitive, if present, is inserted into the "User data subfield" of the SNRM frame, sent during the data link connection establishment;
- if the SNRM frame received by the server contains a "User data subfield", its contents is passed to the server AP via the User_Information parameter of the COSEM-OPEN.indication primitive;
- the User_Information parameter of a COSEM-RELEASE.request primitive, if present, is inserted into the "User data subfield" of the DISC frame, sent during disconnecting the data link connection;
- if the DISC frame received by the server contains a "User data subfield", its contents is passed to the server AP via the User_Information parameter of the COSEM-RELEASE.indication primitive;
- the User_Information parameter of the COSEM-RELEASE.response primitive, if present, is inserted into the "User data subfield" of the UA or HDLC frame, sent in response to the DISC frame;

- if the UA or DM frame received by the client contains "User data subfield", its contents is passed to the client AP via the User_Information parameter of the COSEM-RELEASE.confirm primitive.

In addition, for the COSEM-ABORT.indication service, the following rule applies:

- the Diagnostics parameter of the COSEM-ABORT.indication primitive – see 6.4 of IEC 62056-5-3:— – may contain an unnumbered send status parameter. This parameter indicates whether, at the moment of the physical abort indication, the data link layer has or does not have a pending Unnumbered Information message (UI). The type and the value of this parameter is a local issue, thus it is not within the scope of this companion specification. See also 5.2.2.3 and 6.2.2.3 of IEC 62056-46:2002, Amendment 1:2006.

9.4 EventNotification service and protocol

This subclause describes the communication profile specific elements of the protocol of the EventNotification service, see 6.9 of IEC 62056-5-3:—.

In this profile, an event is reported always by the server management logical device (mandatory, reserved upper HDLC address 0x01) to the client management AP (mandatory, reserved HDLC address 0x01).

The EventNotificationRequest APDU is sent using connectionless data services, using an UI frame, at the first opportunity, i.e. when the server side data link layer receives the right to talk. The APDU shall fit into a single HDLC frame. To be able to send out the APDU, a physical connection between the physical device hosting the server and a client device must exist, and the server side data link layer needs to receive the token from the client side data link layer.

If there is a data link connection between the client and the server when the event occurs, the server side data link layer may send out the PDU – carrying the EventNotificationRequest APDU – following the reception of an I, a UI or an RR frame from the client. See 6.4.4.7 of IEC 62056-46:2002.

Figure 4 shows the procedure in the case, when there is no physical connection when the event occurs (but this connection to a client device can be established).

NOTE Physical connection cannot be established when the server has only a local interface (for example an optical port as defined in IEC 62056-21) and the HHU, running the client application is not connected, or the server has a PSTN interface, but the telephone line is not available. Handling such cases is implementation specific.

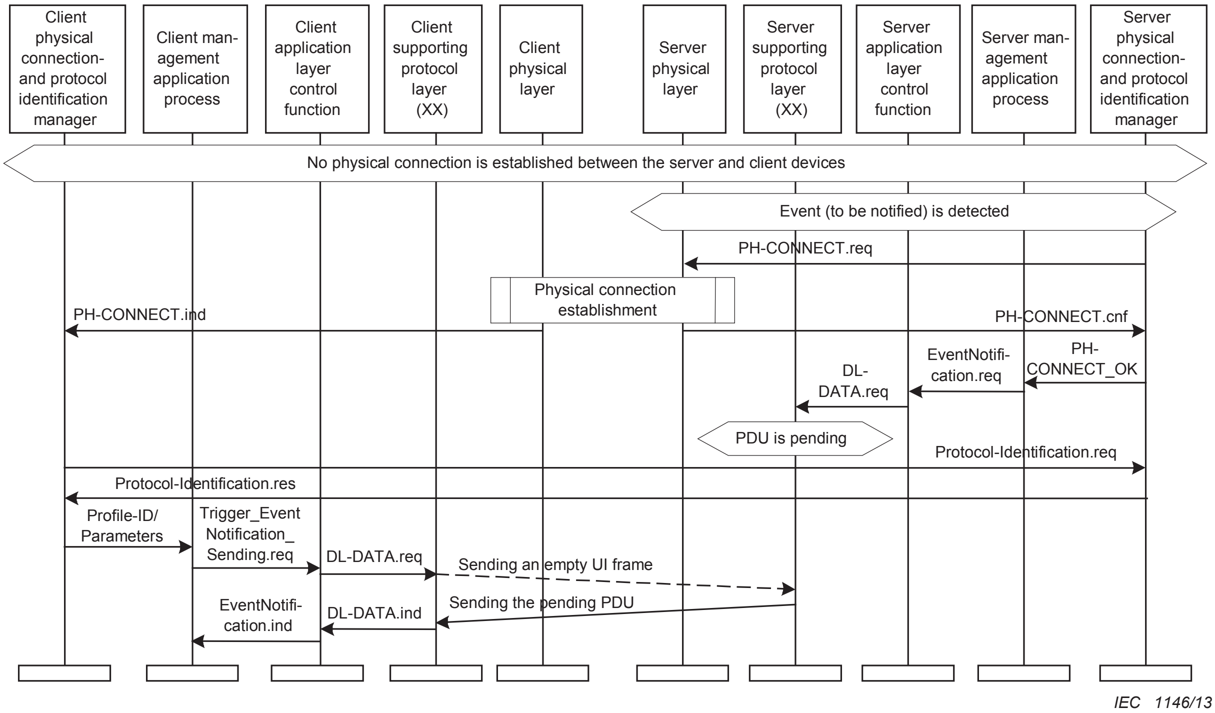

Figure 4 – Example: EventNotificaton triggered by the client

The first step is to establish this physical connection [3]. If successful, this is reported at both sides to the physical connection manager process. At the server side, this indicates to the AP that the EventNotification.request service can be invoked now. When it is done, the server AL builds an EventNotificationRequest APDU and invokes the connectionless DL-DATA.request primitive of the data link layer with the data parameter carrying the APDU. However, the data link layer may not be able to send this APDU, thus it is stored in the data link layer, waiting to be sent (pending).

When the client detects a successful physical connection establishment – and as there is no other reason to receive an incoming call – it supposes that this call is originated by a server intending to send the EventNotificationRequest APDU.

At this moment, the client may not know the protocol stack used by the calling server. Therefore, it has to identify it first using the optional protocol identification service described in IEC 62056-42. This is shown as a "Protocol-Identification.request" – "Protocol-Identification.response" message exchange in Figure 4. Following this, the client is able to instantiate the right protocol stack.

The client AP then invokes the TriggerEventNotificationSending.request primitive (see 6.10 of IEC 62056-5-3:—). Upon invocation of this primitive, the AL invokes the connectionless DL-DATA.request primitive of the data link layer with empty data, and the data link layer sends out an empty UI frame with the P/F bit set to TRUE, giving the permission to the server side data link layer to send the pending PDU.

When the client AL receives an EventNotificationRequest APDU, it generates the EventNotification.indication primitive. The client is notified now about the event, the sequence is completed.

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3 This physical connection establishment is done outside of the protocol stack.

9.5 Transporting long messages

In this profile, the data link layer provides a method for transporting long messages in a transparent manner for the AL. This is described in 6.4.4.5 of IEC 62056-46:2002. See also 4.2.3.12 of IEC 62056-5-3:—.

As transparent long data transfer is specified only for the direction from the server to the client, the server side supporting protocol layer provides special services for this purpose to the server AL. As these services are specific to the supporting protocol layer, no specific AL services and protocols are specified for this purpose. When the supporting protocol layer supports transparent long data transfer, the server side AL implementation may be able to manage these services.

9.6 Supporting multi-drop configurations

A multi-drop arrangement is often used allowing a data collection system to exchange data with multiple physical metering equipment, using a shared communication resource like a telephone modem. Various physical arrangements are available, like a star, daisy chain or a bus topology. These arrangements can be modelled with a logical bus, to which the metering equipment and the shared resource are connected, see Figure 5.

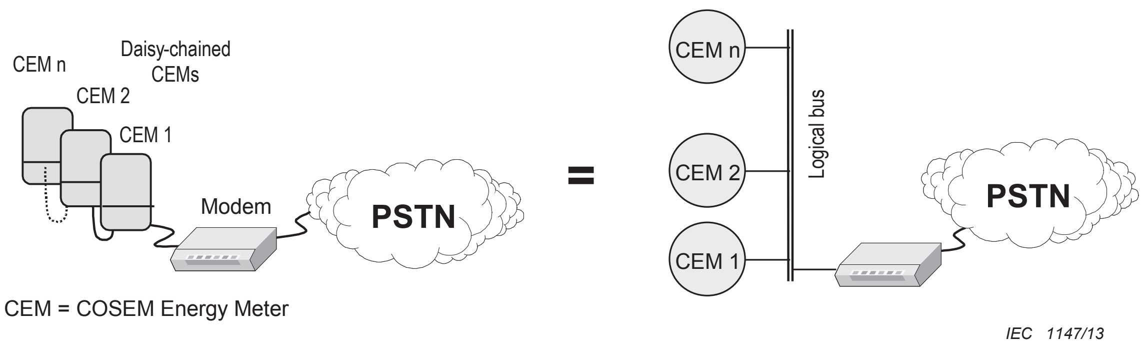

Figure 5 – Multi-drop configuration and its model

As collision on the bus must be avoided, but a protocol controlling access to the shared resource is not available, access to the bus must be controlled by external rules. In most cases, a Master-Slave arrangement is used, where the metering equipment are the Slaves (see Figure 6). Slave devices have no right to send messages without first receiving an explicit permission from the Master.

In DLMS/COSEM, data exchange takes place based on the Client/Server model. Physical devices are modelled as a set of logical devices, acting as servers, providing responses to requests. Obviously, the Master Station of a multi-drop configuration is located at the other end of the communication channel and it acts as the client, sending requests and expecting responses.

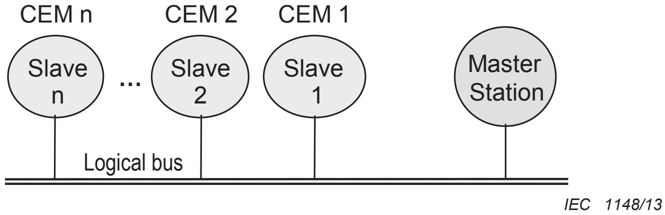

Figure 6 – Master/ Slave operation on the multi-drop bus

The client may send requests at the same time to multiple servers, if no response is expected (multi-cast or broadcast). If the client expects a response, the request shall be sent to a single server, giving also the right to talk to the server. It has to wait then for the response before it may send a request to another server and with this, giving the right to talk. Arbitration of access to the common bus is thus controlled in a time-multiplexing fashion.

Messages from the client to the servers shall contain addressing information. In this profile, it is ensured by using HDLC addresses. If a multi-drop arrangement is used, the HDLC address is split to two parts: the lower HDLC address to address physical devices and the upper HDLC address to address logical devices within the physical device. Both the lower and the upper address may contain a broadcast address. For details, see 6.4.2 of IEC 62056-46:2002, Amendment 1:2006.

To be able to report events, a server may initiate a connection to the client, using the non-client/server type EventNotification / InformationReport services. As events in several or all meters connected to a multidrop may occur simultaneously – for example in the case of a power failure – they may initiate a call to the client simultaneously. For such cases, two problems have to be handled:

- collision on the logical bus: For the reasons explained above, several physical devices may try to access the shared resource (for example sending AT commands to the modem) simultaneously. Handling such situations is left to the manufacturers;
- identification of the originator of the event report: this is possible by using the CALLING Physical Device Address, as described in 6.4.4.8 of IEC 62056-46:2002, Amendment 1:2006.

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