

Electricity metering — Data exchange for meter reading, tariff and load control —

Part 46: Data link layer using HDLC protocol

The European Standard EN 62056-46:2002, incorporating amendment A1:2007, has the status of a British Standard

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National foreword

This British Standard is the UK implementation of EN 62056-46:2002, incorporating amendment A1:2007. It is identical with IEC 62056-46:2002, incorporating amendment 1:2006.

The start and finish of text introduced or altered by IEC amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

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

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

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

Equipements de mesure
de l'énergie électrique -
Echange des données pour la lecture
des compteurs, le contrôle des tarifs
et de la charge
Partie 46: Couche liaison utilisant
le protocole HDLC
(CEI 62056-46:2002)

Messung der elektrischen Energie -
Zählerstandsübertragung,
Tarif- und Laststeuerung
Teil 46: Anwendung des HDLC-Protokolls
in der Verbindungsschicht
(IEC 62056-46:2002)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 13/1267/FDIS, future edition 1 of IEC 62056-46, prepared by IEC TC 13, Equipment for electrical energy measurement and load control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62056-46 on 2002-03-01.

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with the EN have to be withdrawn (dow) 2005-05-01

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Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annex ZA is normative and annexes A, B and C are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62056-46:2002 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of document 13/1376/FDIS, future amendment 1 to IEC 62056-46:2002, prepared by IEC TC 13, Electrical energy measurement, tariff- and load control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 62056-46:2002 on 2007-02-01.

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implemented at national level by publication of
an identical national standard or by endorsement (dop) 2007-11-01
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with the amendment have to be withdrawn (dow) 2010-02-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of amendment 1:2006 to the International Standard IEC 62056-46:2002 was approved by CENELEC as an amendment to the European Standard without any modification.

¹⁾ Device Language Message Specification

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ELECTRICITY METERING – DATA EXCHANGE FOR METER READING, TARIFF AND LOAD CONTROL –

Part 46: Data link layer using HDLC protocol

1 Scope

This part of IEC 62056 specifies the data link layer for 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.

Annex B gives an explanation of the role of data models and protocols in electricity meter data exchange.

2 Normative references

The following referenced documents are indispensable for the application 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 60050-300:2001, *International Electrotechnical Vocabulary –Electrical and electronic measurements and measuring instruments* – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313: Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument

IEC/TR 62051:1999, *Electricity metering –Glossary of terms*

IEC 62051-1:2004, *Electricity metering – Data exchange for meter reading, tariff and load control – Glossary of Terms – Part 1, Terms related to data exchange with metering equipment using DLMS/COSEM*

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

¹⁾ To be published.

Ⓐ IEC 62056-53:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 53: COSEM Application layer*

IEC 62056-61:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 61: OBIS Object identification system*

IEC 62056-62:2006, *Electricity metering – Data exchange for meter reading, tariff and load control – Part 62: Interface classes* Ⓐ

ISO/IEC 8802-2:1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*

Ⓐ ISO/IEC 13239:2002, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures* Ⓐ

3 Terms, definitions and abbreviations

3.1 Terms and definitions

Ⓐ For the purposes of this document, the definitions given in IEC 60050-300, IEC 62051 and IEC 62051-1 apply. Ⓐ

3.2 Abbreviations

APDU	Application layer Protocol Data Unit
COSEM	Companion Specification for Energy Metering
DISC	DISConnect (an HDLC frame type)
DL	Data Link
DM	Disconnected Mode (an HDLC frame type)
DPDU	Data link Protocol Data Unit
DSAP	Data link Service Access Point
DSDU	Data link Service Data Unit
FCS	Frame Check Sequence
FRMR	FRaMe Reject (an HDLC frame type)
HCS	Header Check Sequence
HDLC	High-level Data Link Control
I	Information (an HDLC frame type)
LLC	Logical Link Control (Sub-layer)
LSAP	LLC sub-layer Service Access Point
LPDU	LLC Protocol Data Unit
LSB	Least Significant Bit
LSDU	LLC Service Data Unit
MAC	Medium Access Control (sub-layer)
MSAP	MAC sub-layer Service Access Point (here it is equal to the HDLC address)
MSB	Most Significant Bit
MSDU	MAC Service Data Unit
NDM	Normal Disconnected Mode

NRM	Normal Response Mode
N(R)	Receive sequence Number
N(S)	Send sequence Number
P/F	Poll/Final bit
PDU	Protocol Data Unit
PH	Physical layer
PSDU	Physical layer Service Data Unit
RNR	Receive Not Ready (an HDLC frame type)
RR	Receive Ready (an HDLC frame type)
SAP	Service Access Point
SDU	Service Data Unit
SNRM	Set Normal Response Mode (an HDLC frame type)
TWA	Two Way Alternate
UA	Unnumbered Acknowledgement (an HDLC frame type)
UI	Unnumbered Information (an HDLC frame type)
UNC	Unbalanced operation Normal response mode Class
USS	Unnumbered Send Status
V(R)	Receive state Variable
V(S)	Send state Variable

4 Overview

4.1 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 clause 5.

4.2 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.

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.

The MAC sub-layer is specified in clause 6.

4.3 Specification method

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 co-ordinates 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, for example addresses, control information;
- parameters which have only local $\boxed{A_1}$ significance $\langle A_1 \rangle$.
- parameters which are transmitted transparently across the data link layer to the user of the data link.

NOTE

Data link layer management services are explained in Annex C.

$\boxed{A_1}$ This standard specifies values for parameters of the first category only.

The **protocol** specification for a protocol layer includes: $\langle A_1 \rangle$

- the specification of the procedures for the transmission of the set of messages exchanged between peer-layers;
- 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 $\boxed{A_1}$ (Information field, User data subfield) $\langle A_1 \rangle$;
- 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.

5 The LLC sub-layer

5.1 The role of the LLC sub-layer

The LLC sub-layer used in this profile is based on ISO/IEC 8802-2. The presence of this sub-layer in the connection-oriented profile is somewhat artificial: the LLC sub-layer is used as a kind of protocol selector, and the 'real' data link layer connection is ensured by the MAC sub-layer. It can be considered that the standard LLC sub-layer is used in an extended class I operation, where the LLC sub-layer provides the standard data-link-connectionless services via a connection-oriented MAC sub-layer. In order to be able to establish the data link connection, the LLC sub-layer provides transparent MAC connection/disconnection services to the service user protocol layer.

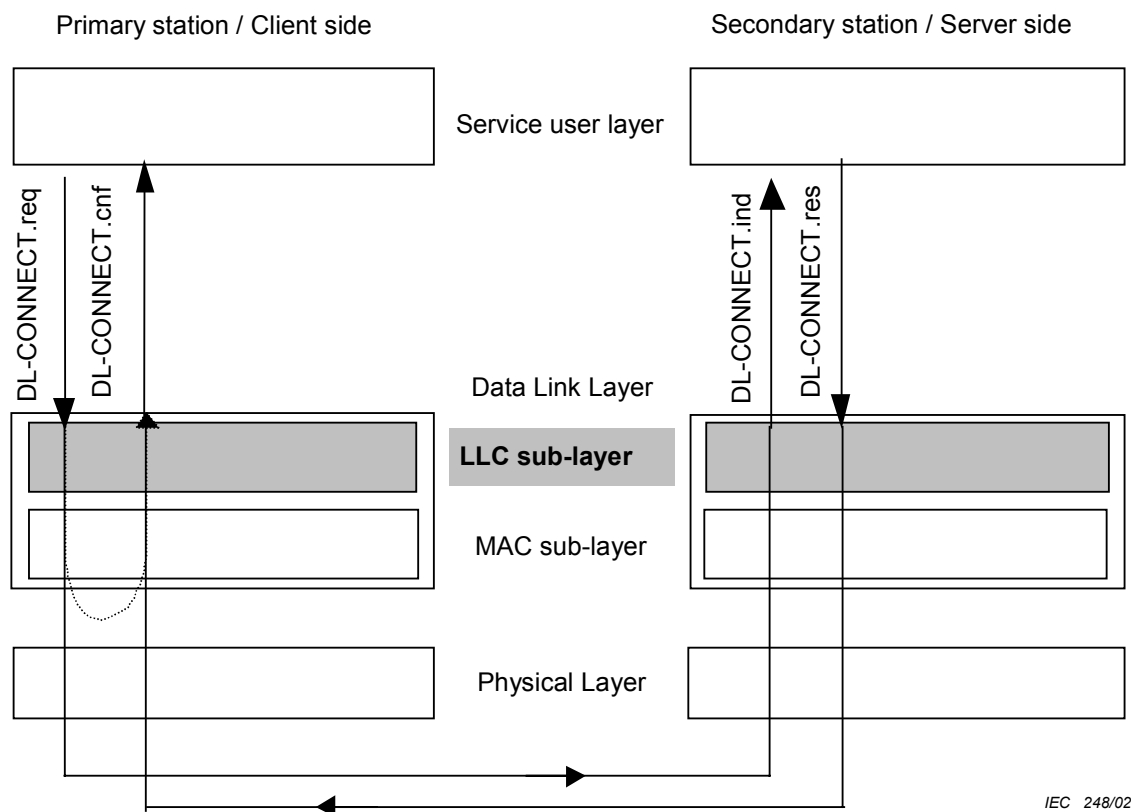
5.2 Service specification for the LLC sub-layer

This subclause specifies the services required of, or by, the LLC sub-layer at the logical interfaces with the Service User layer and the MAC sub-layer, using connection-oriented procedures. As the Service User layer 'sees' the services of the LLC sub-layer as the services of the data link layer, in this standard these services are called data link layer services and the prefix "DL" to designate these services is used.

5.2.1 Setting up the Data Link Connection

Overview

Figure 1 shows the services provided by the primary station (client side) and secondary station (server side) data link layers to the service user layer for data link connection establishment.



IEC 248/02

Figure 1 – Data Link (LLC) services for setting up the Data Link Connection

Data link connection establishment can only be requested by the primary station, so the DL-CONNECT.request and .confirm services are provided only at the client (primary station) side. On the other hand, the DL-CONNECT.indication and .response services are provided only at the server (secondary station) side.

The DL-CONNECT.request service primitive – in case of a locally detected error – can be also locally confirmed.

All these services are in fact, provided by the MAC sub-layer: the LLC sub-layer shall transparently transmit these services to/from the “real” service provider MAC sub-layer as the appropriate MA-CONNECT.xxx service primitive.

5.2.1.1 DL-CONNECT.request

Function

This service primitive is provided only at the client side. The Service User layer invokes this primitive to request set-up of a data link connection.

Service parameters

The semantics of the primitive is as follows:

```
DL-CONNECT.request
(
    Destination_MSAP1,
    Source_MSAP,
    User_Information
)
```

The Destination_MSAP and Source_MSAP parameters identify the referenced data link layer connection. The addressing scheme for the MAC layer is discussed in 6.4.2. The specification of the contents of the optional User_information parameter is not within the scope of this standard.

Use

The client side Service User layer entity invokes the DL-CONNECT.request primitive, when it wants to set up a connection with a peer data link layer.

5.2.1.2 DL-CONNECT.indication

Function

This service primitive is provided only at the server side. The LLC sub-layer uses this primitive to indicate to the Service User layer that the peer data link layer requested a Data Link connection.

Service parameters

The semantics of the primitive is as follows:

```
DL-CONNECT.indication
(
    Destination_MSAP,
    Source_MSAP,
    User_Information
)
```

The Destination_MSAP and Source_MSAP identify the referenced data link layer connection. The addressing scheme for the MAC layer is discussed in 6.4.2. The specification of the contents of the optional User_information parameter is not within the scope of this standard.

Use

The server side LLC sub-layer generates this primitive following the reception of an MA-CONNECT.indication primitive from the MAC sub-layer.

5.2.1.3 DL-CONNECT.response

Function

This service primitive is provided only at the server side. The Service User layer invokes this service primitive in order to indicate to the local data link layer whether the previously proposed data link connection can be accepted by the service user layer or not.

Service parameters

The semantics of the primitive is as follows:

```
DL-CONNECT.response
(
    Destination_MSAP,
    Source_MSAP,
    Result,
    User_Information
)
```

¹) MSAP in this environment is equal to the HDLC address.

The Destination_MSAP and Source_MSAP parameters identify the referenced data link layer connection. The Result parameter (OK, NOK, NO_RESPONSE) indicates whether the proposed connection could be accepted or not, and whether a response frame should be sent or not.

- Result == OK. This means that the received connect request can be accepted by the service user layer.
- Result == NOK. This means that the received connect request cannot be accepted by the service user layer.
- RESULT == NO_RESPONSE: This means that no response to the DL-CONNECT.indication shall be sent.

The User_Information parameter may be present only when the Result is NOK. The specification of its content is not within the scope of this standard.

NOTE The Result parameter indicates only whether the Data Link Connection can or cannot be accepted by the service user higher layers. The data link layer itself may refuse a proposed connection, (e.g. because it supports only one connection at a given moment, thus it is not able to support a second one) even if the higher layers could accept it (Result==OK).

Use

The server side Service User layer entity invokes the DL-CONNECT.response primitive to indicate the result of a previously received request for connection.

5.2.1.4 DL-CONNECT.confirm

Function

This service primitive is provided only at the client side and it can be originated remotely or locally. The data link layer generates this primitive to indicate to the Service User layer the result of a previously received DL-CONNECT.request service.

Service parameters

The semantics of the primitive is as follows:

```
DL-CONNECT.confirm
(
    Destination_MSAP,
    Source_MSAP,
    Result,
    User_Information
)
```

The Destination_MSAP and Source_MSAP parameters reference data link layer connection, which is confirmed by the service. The Result parameter (OK, NOK-REMOTE, NOK-LOCAL, NO_RESPONSE) indicates the result of the previously invoked DL-CONNECT.request service.

- Result == OK. This means that the connect request was accepted by the remote station.
- Result == NOK-REMOTE. This means that the connect request was not accepted by the remote station.
- Result == NOK-LOCAL. This means that a local error has occurred, for example the service user layer tried to establish an already existing data link connection.
- RESULT == NO_RESPONSE. This means that there was no response from the remote station to the connect request.

The User_Information parameter is present only when the Result is NOK-REMOTE. The specification of its content is not within the scope of this standard.

Use

The LLC sub-layer indicates the reception of an MA-CONNECT.confirm primitive to the Service User layer by using this primitive.

5.2.2 Disconnecting the Data Link Connection

5.2.2.1 Overview

Figure 2 shows the services provided by the client and server side data link layers to the Service User layer for disconnecting a Data Link connection.

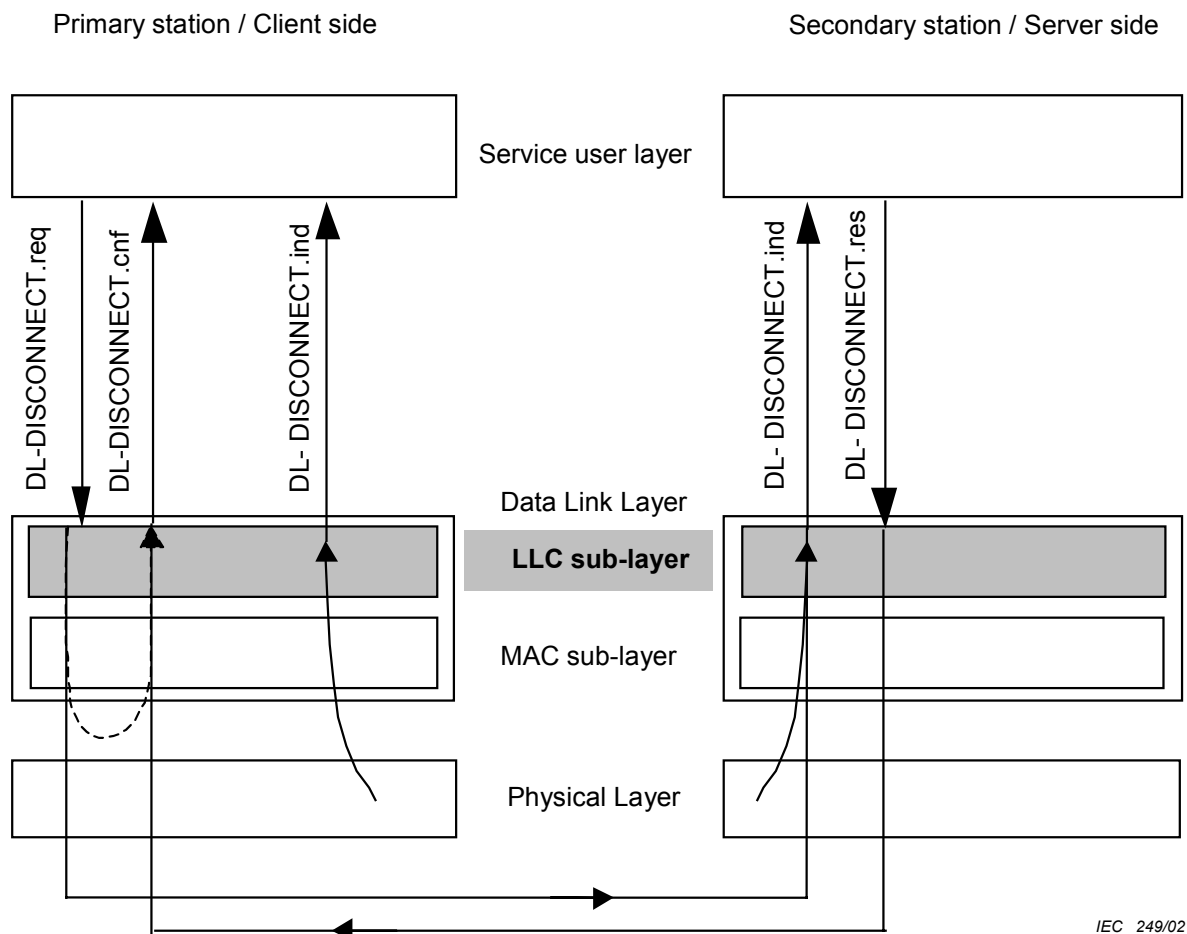


Figure 2 – Data Link (LLC) services for disconnecting the Data Link Connection

Data link disconnection can only be requested by the client device, so the DL-DISCONNECT.request and .confirm services are provided only at the client side. On the other hand, the remotely initiated (by the client) DL-DISCONNECT.indication and .response services are provided only at the server side.

NOTE When this data link layer is used together with the COSEM application layer as defined in IEC 62056-53, DL-DISCONNECT services are used to release existing Application Associations.

Both the client and server side LLC sub-layers provide a locally initiated DL-DISCONNECT.indication service, to signal a non-solicited disconnection, due to an unexpected loss of the data link and/or physical connection.

The DL-DISCONNECT.request service primitive – in case of a locally detected error – can be also locally confirmed.

These services are in fact provided by the MAC sub-layer: the LLC sub-layer shall transparently transmit these services to/from the MAC sub-layer as the appropriate MA-DISCONNECT.xxx service primitive.

5.2.2.2 DL-DISCONNECT.request

Function

This service primitive is provided only at the client side. It is invoked by the Service User layer to request disconnecting of an existing Data Link connection.

Service parameters

The semantics of the primitive is as follows:

```
DL-DISCONNECT.request
(
    Destination_MSAP,
    Source_MSAP,
    [A1] User_Information [A1]
)
```

The Destination_MSAP and Source_MSAP parameters specify the data link connection to be disconnected. The specification of the contents of the optional [A1]User_Information[A1] parameter is not within the scope of this standard.

Use

The client side Service User layer entity invokes this primitive to request a disconnection of a data link connection to peer data link layer(s).

5.2.2.3 DL-DISCONNECT.indication

Function

This service primitive is provided at the client side and at the server side.

- The server side data link layer generates this primitive to indicate to the Service User layer that the peer data link layer requests the disconnection of a data link connection.
- On both the server and client sides, this primitive is used to indicate that the data link and/or physical connection abort occurred in a non-solicited manner (e.g. the physical line has been disconnected).

Service parameters

The semantics of the primitive is as follows:

```
DL-DISCONNECT.indication
(
    Destination_MSAP,
    Source_MSAP,
    Reason,
    Unnumbered Send Status,
    [A1] User_Information [A1]
)
```

The Destination_MSAP and Source_MSAP parameters specify the local and remote MSAPs of the terminated connection.

The Reason parameter (REMOTE, LOCAL_PHY, LOCAL_DL) indicates the reason for the DL-DISCONNECT.indication invocation.

- Reason == REMOTE. This means that the data link layer received a disconnection request from the client side. This case may happen only at the server side.
- Reason == LOCAL_DL. This means that there was a fatal data link connection failure.
- Reason == LOCAL_PHY. This means that there was a fatal physical connection failure.

The value of the USS parameter indicates whether at the moment of the DL-DISCONNECT.indication service invocation the data link layer has (USS==TRUE) or does not have (USS==FALSE) pending UI message(s).

The **[A1]** User_Information **[A1]** field may be present only when Reason == REMOTE. The specification of the contents of this parameter is not within the scope of this standard.

Use

The LLC sub-layer generates this primitive following the reception of an MA-DISCONNECT.indication primitive.

5.2.2.4 DL-DISCONNECT.response

Function

This service primitive is provided only at the server side. The Service User layer invokes this service primitive in order to indicate to the data link layer whether the previously proposed data link disconnection can be accepted by the Service User layer or not. As in this environment the server has no right to refuse the disconnection, the response depends only whether the referenced Data Link connection is existing or not.

Service parameters

The semantics of the primitive is as follows:

```
DL-DISCONNECT.response
(
    Destination_MSAP,
    Source_MSAP,
    Result
)
```

[A1] The Destination_MSAP and Source_MSAP parameters specify the remote and local **[A1]** MSAPs involved in the connection being disconnected. The Result parameter can have values OK, NOK and NO_RESPONSE.

- Result == OK. This means that the received disconnect request refers to an existing higher layer connection.
- Result == NOK. This means that the received disconnect request refers to a non-existing higher layer connection.
- RESULT == NO_RESPONSE: This means that no response to the DL-DISCONNECT.indication shall be sent.

Use

The server side Service User layer invokes the DL-DISCONNECT.response primitive to indicate the result of a previously received request for disconnecting the data link connection.

5.2.2.5 DL-DISCONNECT.confirm

Function

This service primitive is provided only at the client side. The data link layer generates this primitive to indicate to the Service User layer the result of a previously received DL-DISCONNECT.request service. This service can be originated remotely or locally.

Service parameters

The semantics of the primitive is as follows:

```
DL-DISCONNECT.confirm
(
    Destination_MSAP,
    Source_MSAP,
    Result
)
```

The Destination_MSAP and Source_MSAP parameters specify the local and remote MSAPs of the terminated connection. The Result parameter (OK, NOK, NO_RESPONSE) indicates the result of the attempt to close the data link connection.

- Result == OK. This means that the disconnect request was accepted by the remote station.
- Result == NOK. This means that the disconnect request was not accepted by the remote station.
- Result == NO_RESPONSE. This means that there was no response from the remote station to the disconnect request.

Use

The client side LLC sub-layer indicates the reception of an MA-DISCONNECT.confirm primitive to the Service User layer using this primitive.

5.2.3 Data communication

5.2.3.1 Overview

Figure 3 shows the data communication services provided by the data link layer to the Service User layer to exchange data.

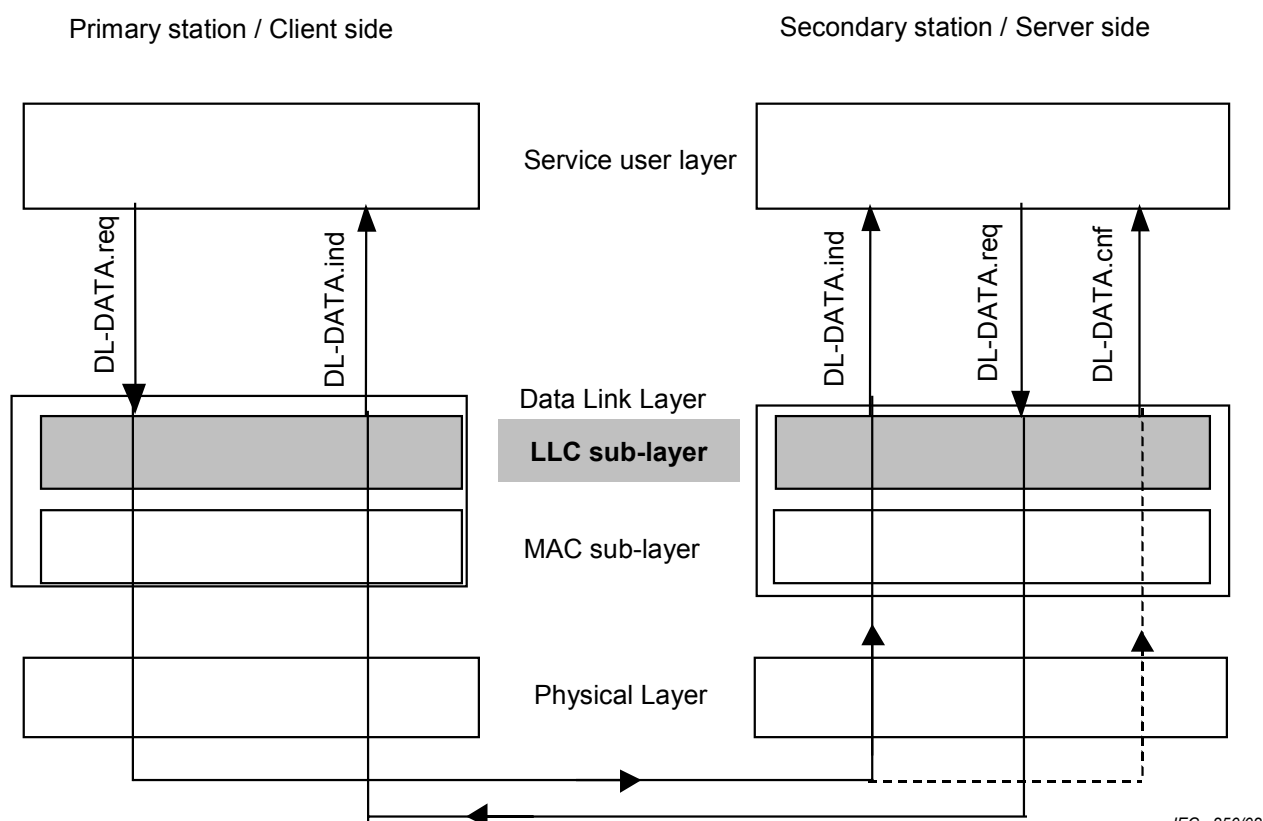


Figure 3 – Data link layer data communication services

In addition to the two standard .request and .indication services, a DL-DATA.confirm service is also provided at the server side. This service is necessary for transparent long message transfers, specified in 6.4.4.5.

5.2.3.2 DL-DATA.request

Function

The Service User layer invokes this primitive when data need to be transmitted to the peer layer entity(ies).

Service parameters

The semantics of the primitive is as follows:

```
DL-DATA.request
(
    Destination_LSAP,
    Source_LSAP,
    LLC_Quality,
    Destination_MSAP,
    Source_MSAP,
    Frame_type,
    Data
)
```

^[A1] The Destination_LSAP and Source_LSAP parameters specify the referenced data link ^[A1] layer connection ¹⁾. The value of the LLC_Quality parameter is used as the Control field of the PDU²⁾. See also 5.3.2.

^[A1] The Destination_MSAP and Source_MSAP parameters specify the remote and local ^[A1] MSAPs involved in the data unit transmission. The Destination_MSAP can be an individual address, a group address, or a special HDLC address (ALL_STATION, NO_STATION, etc.). Please refer to 6.4.2.4.

The Frame_Type parameter indicates for the data link layer which type of frame shall be sent. Valid frame types are different for the client and server sides. Client side valid frame types are I_COMPLETE and UI. On the server side valid frame types are I_COMPLETE, I_FIRST_FRAGMENT, I_FRAGMENT, I_LAST_FRAGMENT, and UI. See also 6.4.3.

The Data parameter contains the Service User LSDU to be transferred to the peer layer. This parameter may be empty (e.g. when Frame_type == UI, but the UI frame contains no data).

Use

The DL-DATA.request primitive is invoked by the Service User layer entity to request sending of a protocol data unit to a single peer application entity or, in the case of multicasting and broadcasting, to multiple peer application entities.

The receipt of this primitive shall cause the LLC sub-layer to append the LLC specific fields (the two LLC addresses and the LLC_Quality parameter)³⁾ to the received LSDU, and to pass the properly formed LPDU to the MAC sub-layer (by invoking the MA-DATA.request primitive) for transferring it to the peer LLC sub-layer.

5.2.3.3 DL-DATA.indication*Function*

This primitive is used to transfer the received data from the data link layer to its Service User layer.

Service parameters

The semantics of the primitive is as follows:

1) For COSEM purposes, the value of the Destination_LSAP parameter is constant and equal to E6H. The value of the Source_LSAP parameter is E6H or E7H depending on whether the Data field corresponds to a command or to a response.

2) For COSEM purposes, the value of the LLC_Quality parameter is set to 0, and reserved for future use.

3) When Frame_type == I_FRAGMENT or I_LAST_FRAGMENT, no LLC specific field is appended to the LSDU.

```
DL-DATA.indication
(
    Destination_LSAP,
    Source_LSAP,
    LLC_Quality,
    Destination_MSAP,
    Source_MSAP,
    Frame_type,
    Data
)
```

ⓘ The Destination_LSAP and Source_LSAP parameters specify the referenced data link ⓐ layer connection. The value of the LLC_Quality parameter is used as the Control field of the PDU. See also 5.3.2.

ⓘ The Destination_MSAP and Source_MSAP parameters specify the local and remote ⓐ MSAPs involved in the data unit transmission. The Destination_MSAP can be an individual address, a group address, or a special HDLC address (ALL_STATION, NO_STATION, etc.). Please refer to 6.4.2.4.

The Frame_Type parameter indicates for the Service User layer which type of frame has been received. Valid frame types are I_COMPLETE and UI. See also 6.4.3.

The Data parameter contains the Service User layer protocol data unit sent by the peer.

Use

The DL-DATA.indication primitive is used to indicate to the Service User layer entity the receipt of a protocol data unit from a peer layer entity.

This primitive is generated following the reception of an MA-DATA.indication service issued by the local MAC sub-layer. First, the LLC sub-layer shall check the LLC addresses. If these are correct, it shall remove the LLC specific fields (the two LLC addresses and the LLC_Quality parameter) from the received LPDU, and shall pass the remaining, properly formatted LSDU to the service user protocol layer with the help of the DL-DATA.indication service primitive. Otherwise the received LPDU shall be discarded.

5.2.3.4 DL-DATA.confirm

Function

This service primitive is provided only at the server side. The data link layer generates this primitive to indicate to the Service User layer the result of a previously received DL-DATA.request service, when this .request service has been invoked with Frame_type = I_FIRST_FRAGMENT, I_FRAGMENT or I_LAST_FRAGMENT. The DL-DATA.confirm service primitive is generated when the previously requested LSDU has been successfully sent to the peer data link layer.

Service parameters

The semantics of the primitive is as follows:

```
DL-DATA.confirm
(
    Destination_LSAP,
    Source_LSAP,
    Destination_MSAP,
    Source_MSAP,
    Frame_type,
    Result
)
```

The Destination_LSAP and Source_LSAP parameters identify the referenced data link layer connection.

ⓘ The Destination_MSAP and Source_MSAP parameters specify the local and remote ⓐ MSAP-s involved in the data unit transmission.

The Frame_Type parameter indicates the type of the frame which is confirmed. Valid frame types are I_FIRST_FRAGMENT, I_FRAGMENT and I_LAST_FRAGMENT.

The value of the Result parameter indicates the result of the transmission of the received LSDU. Possible values are OK and NOK.
Use

The server side LLC sub-layer indicates the reception of an MA-DATA.confirm primitive to the Service User layer by using this primitive.

5.3 Protocol specification for the LLC sub-layer

5.3.1 Overview

The LLC sub-layer specification is based on LLC type 1, specified in ISO/IEC 8802-2, which provides a data-link-connectionless-mode service across a data link with minimum protocol complexity. The presence of this sub-layer in this connection-oriented profile is somewhat artificial: the LLC sub-layer is used as a kind of a protocol selector, and the ‘real’ data link layer functionality is ensured by the MAC sub-layer.
The standard LLC frame format is shown in Figure 4. The LLC frame format for this standard is specified in 5.3.2.

Destination (remote) LSAP	Source (local) LSAP	Control	Information
8 bits	8 bits	8 or 16 bits	n*8 bits

IEC 251/02

Figure 4 – The ISO/IEC 8802-2 LLC protocol data unit format

The LLC sub-layer shall transparently transmit the Information Field between the Service User layer and the MAC sub-layer.
When a DATA.request service invocation is received from the service user protocol layer, the LLC sub-layer, if required, shall append the LLC specific fields (the two LLC addresses and the LLC_Quality parameter) to the LSDU. When an MA-DATA.indication service invocation is received from the MAC sub-layer, it shall check and remove these LLC specific fields from the received LPDU.

5.3.2 LLC protocol data unit (LPDU) structure

The only role of the LLC sub-layer is to select the Service User layer protocol; the selection is done based on the Destination_LSAP and the Source-LSAP addresses. The Control byte is referred to the LLC_Quality parameter in the LLC service primitives.
The LLC protocol data unit is as follows¹⁾:

8 bit	8 bit	8 bit	n * 8 bit
Destination (remote) LSAP	Source (local) LSAP	Quality	LLC+1 Layer PDU
			octets of LLC+1 Layer PDU

Figure 5 – The used LLC protocol data unit format

The destination LSAP 0xFF is used for broadcasting purposes. Devices in this environment shall never send messages with this broadcast address, but they shall accept messages containing this broadcast destination address as if it would be addressed to them.

5.3.3 State transition tables for the LLC sub-layer

As the role of the LLC sub-layer is limited to protocol selection, its state-transition diagram is quite simple: after being initialized, the LLC sub-layer enters into its only stable state, the IDLE state, and shall return into this state after any possible events. The state transitions of the client side LLC sub-layer is shown in Table 1:

¹⁾ In COSEM, the value of the Destination_LSAP is 0xE6. The value of the Source_LSAP is 0xE6 or 0xE7. The last bit is used as a flag: z=0 means ‘command’ and z=1 means “response”. The Control byte (LLC_Quality) is reserved for future use and its value must always be 0x00.

Table 1 – State transition table of the client side LLC sub-layer

Current state	Event	Action	Next state
IDLE	DL-CONNECT.request	Invoke MA-CONNECT.request	IDLE
IDLE	Receive MA-CONNECT.confirm	Generate DL-CONNECT.confirm	IDLE
IDLE	DL-DISCONNECT.request	Invoke MA-DISCONNECT.request	IDLE
IDLE	Receive MA-DISCONNECT.indication	Generate DL-DISCONNECT.indication	IDLE
IDLE	Receive MA-DISCONNECT.confirm	Generate DL-DISCONNECT.confirm	IDLE
IDLE	DL-DATA.request	Add LLC addresses and control byte (3 bytes) to the received LSDU; Invoke MA-DATA.request; ¹⁾	IDLE
IDLE	Receive MA-DATA.indication	Check LLC addresses (3 bytes); ²⁾ If address==O.K { remove LLC addresses; generate DL-DATA.indication; } else { discard the received packet; }	IDLE

The state transitions of the server side LLC sub-layer are shown in Table 2.

Table 2 – State transition table of the server side LLC sub-layer

Current state	Event	Action	Next state
IDLE	Receive MA-CONNECT.indication	Generate DL-CONNECT.indication	IDLE
IDLE	DL-CONNECT.response	Invoke MA-CONNECT.response	IDLE
IDLE	Receive MA-DISCONNECT.indication	Generate DL-DISCONNECT.indication	IDLE
IDLE	DL-DISCONNECT.response	Invoke MA-DISCONNECT.response	IDLE
IDLE	DL-DATA.request and Frame_type is I_COMPLETE, UI or I_FIRST_FRAGMENT	Add LLC addresses and control byte to the received LSDU; Invoke MA-DATA.request;	IDLE
IDLE	DL-DATA.request and Frame_type is I_FRAGMENT or I_LAST_FRAGMENT	Invoke MA-DATA.request	IDLE
IDLE	Receive MA-DATA.indication	Check LLC addresses; If address==OK { remove LLC addresses; generate DL-DATA.indication; } else { discard the received packet; }	IDLE
IDLE	Receive MA-DATA.confirm	Generate DL-DATA.confirm	IDLE

6 The MAC sub-layer

The MAC sub-layer is based on ISO/IEC 13239.

The MAC sub-layer – similarly to the LLC sub-layer – is specified in terms of **services** and **protocols**. As the MAC sub-layer behaviour is quite complex, some aspects of the service invocation handling are discussed in the service specification part, although these are normally part of the protocol specification.

¹ : LLC specific fields are not present, when Frame_type == I_FRAGMENT or I_LAST FRAGMENT. See Footnote 3 in 5.2.3.2.