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Industrial communication networks – Fieldbus specifications – Part 3-4: Data-link layer service definition – Type 4 elements

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

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

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NOTE Combinations of protocol Types are specified in the IEC 61784-1 series and the IEC 61784-2 series.

IEC 61158-3-4 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition:

a) Use of extended data size for DLS-user data. This extension is restricted to nodes operating on a P-NET IP network.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1201/FDIS	65C/1242/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all the parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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- withdrawn,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.

INTRODUCTION

This document is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the "three-layer" fieldbus reference model described in IEC 61158-1.

Throughout the set of fieldbus standards, the term "service" refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the data-link layer service defined in this document is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-4: Data-link layer service definition – Type 4 elements

1 Scope

1.1 General

This part of IEC 61158 provides common elements for basic time-critical messaging communications between devices in an automation environment. The term "time-critical" is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This document defines in an abstract way the externally visible services provided by the Type 4 fieldbus data-link layer in terms of

a) the primitive actions and events of the services;

b) the parameters associated with each primitive action and event, and the form which they take; and

c) the interrelationship between these actions and events, and their valid sequences.

The purpose of this document is to define the services provided to

- the Type 4 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model;
- systems management at the boundary between the data-link layer and systems management of the fieldbus reference model.

1.2 Specifications

The principal objective of this document is to specify the characteristics of conceptual data-link layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of data-link protocols for time-critical communications. A secondary objective is to provide migration paths from previously-existing industrial communications protocols.

This document can be used as the basis for formal DL-Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

a) the sizes and octet ordering of various multi-octet service parameters;

b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of data-link entities within industrial automation systems.

There is no conformance of equipment to this data-link layer service definition standard. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfills the Type 4 data-link layer services defined in this document.

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.

NOTE All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

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

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model: Naming and addressing*

ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

3 Terms, definitions, symbols, abbreviated terms and conventions

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

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

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

3.1 Reference model terms and definitions

This document is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3, and makes use of the following terms defined therein.

3.1.1 DL-address [7498-3]

3.1.2 DL-address-mapping [7498-1]

3.1.3 called-DL-address [7498-3]

3.1.4 calling-DL-address [7498-3]

3.1.5 centralized multi-end-point-connection [7498-1]

3.1.6 correspondent (N)-entities [7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

3.1.7 DL-connection [7498-1]

3.1.8 DL-connection-end-point [7498-1]

3.1.9 DL-connection-end-point-identifier [7498-1]

3.1.10 DL-connection-mode transmission [7498-1]

3.1.11 DL-connectionless-mode transmission [7498-1]

3.1.12 DL-duplex-transmission [7498-1]

3.1.13 (N)-entity [7498-1]
DL-entity (N=2)
Ph-entity (N=1)

3.1.14 DL-facility [7498-1]

3.1.15 flow control [7498-1]

3.1.16 (N)-layer [7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.17 layer-management [7498-1]

3.1.18 DL-local-view [7498-3]

3.1.19 DL-name [7498-3]

3.1.20 naming-(addressing)-domain [7498-3]

3.1.21 primitive name [7498-3]

3.1.22 DL-protocol [7498-1]

3.1.23 DL-protocol-connection-identifier [7498-1]

3.1.24 DL-protocol-data-unit [7498-1]

3.1.25 DL-relay [7498-1]

3.1.26 Reset [7498-1]

3.1.27 responding-DL-address [7498-3]

3.1.28 routing [7498-1]

3.1.29 segmenting [7498-1]

3.1.30 (N)-service [7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.31 (N)-service-access-point [7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.1.32 DL-service-access-point-address [7498-3]

3.1.33 DL-service-connection-identifier [7498-1]

3.1.34 DL-service-data-unit [7498-1]

3.1.35 DL-simplex-transmission [7498-1]

3.1.36 DL-subsystem [7498-1]

3.1.37 systems-management [7498-1]

3.1.38 DLS-user-data [7498-1]

3.2 Service convention terms and definitions

This document also makes use of the following terms defined in ISO/IEC 10731 as they apply to the data-link layer:

3.2.1 acceptor

**3.2.2 confirm (primitive);
requestor.deliver (primitive)**

3.2.3 deliver (primitive)

3.2.4 DL-confirmed-facility

3.2.5 DL-facility

3.2.6 DL-local-view

3.2.7 DL-mandatory-facility

3.2.8 DL-non-confirmed-facility

**3.2.9 DL-service-primitive;
primitive**

3.2.10 DL-service-provider

3.2.11 DL-service-user

3.2.12 DLS-user-optional-facility

**3.2.13 indication (primitive);
acceptor.deliver (primitive)**

**3.2.14 request (primitive);
requestor.submit (primitive)**

3.2.15 requestor

**3.2.16 response (primitive);
acceptor.submit (primitive)**

3.2.17 submit (primitive)

3.3 Data-link service terms and definitions

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

3.3.1
broadcast-node-address
address used to designate all DLEs on a link

Note 1 to entry: All DLEs on a link receive all DLPDUs where the first node-address is equal to the broadcast-node-address. Such DLPDUs are always unconfirmed, and their receipt is never acknowledged. The value of the broadcast-node-address is 126.

3.3.2
destination-DL-route
sequence of DL-route-elements, describing the complete route to the destination

Note 1 to entry: This includes both the destination DLSAP and a local component meaningful to the destination DLS-user.

3.3.3
DL-route-element
octet holding a node DL-address or an address used by the DLS-user

3.3.4
DLSAP
distinctive point at which DL-services are provided by a single DL-entity to a single higher-layer entity

3.3.5
DL(SAP)-address
individual DLSAP-address, designating a single DLSAP of a single DLS-user

3.3.6
DLS-user address
uniquely identifies a DLS-user locally

3.3.7
frame
denigrated synonym for DLPDU

3.3.8
full DL-route
combination of a destination-DL-route and a source-DL-route

3.3.9
local link
single DL-subnetwork in which any of the connected DLEs may communicate directly, without any intervening DL-relaying, whenever all of those DLEs that are participating in an instance of communication are simultaneously attentive to the DL-subnetwork during the period(s) of attempted communication

3.3.10
maximum-indication-delay
time value that indicates to the DLS-user the maximum time interval for the DLS-user to prepare a response after receiving an indication requiring a response

Note 1 to entry: If the DLS-user is unable to prepare a response within maximum-indication-delay, the DLS-user is required to issue a DL-UNITDATA request with a DLSDU type indicating ACKNOWLEDGE. As a result the DLE will transmit an acknowledging DLPDU on the link.

3.3.11
maximum-retry-time
time value that indicates to the DLE for how long time retransmission of the request can be performed, as a result of Wait acknowledges from the remote DLE or DLS-user

3.3.12
no-confirm-node-address
node address which indicates that a request or response is unconfirmed

Note 1 to entry: The value of the no-confirm-node-address is 0.

3.3.13
node
single DL-entity as it appears on one local link

3.3.14
node-address
value that uniquely identifies a DLE on a link

Note 1 to entry: The value of a Node-address is in the range of 0-127. The values 0, 126 and 127 are reserved for special purposes.

3.3.15
normal class device
device which replies to requests from other normal class devices, and initiates transmissions

Note 1 to entry: Such a device can act as a server (responder) and as a client (requestor) – this is also called a peer.

3.3.16
receiving DLS-user
DL-service user that acts as a recipient of DLS-user-data

Note 1 to entry: A DL-service user can be concurrently both a sending and receiving DLS-user.

3.3.17
sending DLS-user
DL-service user that acts as a source of DLS-user-data

3.3.18
service-node-address
address reserved for service purposes only

Note 1 to entry: All DLEs on a link receive all DLPDUs where the first Node-address is equal to the service-node-address. Such DLPDUs can be Confirmed or Unconfirmed, and it is possible that their receipt can be acknowledged, or not. The service-node-address can be used on links with only two DLEs – the requesting Normal class DLE and the responding simple-class or normal-class DLE. The value of the service-node-address is 127.

3.3.19
simple-class device
device which replies to requests from normal class devices

Note 1 to entry: Such a device can act as a server or responder only.

3.3.20
source-DL-route
holds a sequence of DL-route-elements, describing the complete route back to the source

3.4 Symbols and abbreviations

NOTE Many symbols and abbreviations are common to more than one protocol Type; they are not necessarily used by all protocol Types.

DL-	Data-link layer (as a prefix)
DLC	DL-connection
DLCEP	DL-connection-end-point
DLE	DL-entity (the local active instance of the data-link layer)
DLL	DL-layer
DLPCI	DL-protocol-control-information
DLPDU	DL-protocol-data-unit
DLM	DL-management
DLME	DL-management Entity (the local active instance of DL-management)
DLMS	DL-management Service
DLS	DL-service
DLSAP	DL-service-access-point
DLSDU	DL-service-data-unit
FIFO	First-in first-out (queuing method)
OSI	Open systems interconnection

Ph-	Physical layer (as a prefix)
PhE	Ph-entity (the local active instance of the physical layer)
PhL	Ph-layer
QoS	Quality of service

3.5 Conventions

This document uses the descriptive conventions given in ISO/IEC 10731.

The service model, service primitives, and time-sequence diagrams used are entirely abstract descriptions; they do not represent a specification for implementation.

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction.

This document uses a tabular format to describe the component parameters of the DLS primitives. The parameters that apply to each group of DLS primitives are set out in tables throughout the remainder of this document. Each table consists of up to six columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the DLS:

– the request primitive's input parameters;
– the request primitive's output parameters;
– the indication primitive's output parameters;
– the response primitive's input parameters; and
– the confirm primitive's output parameters.

NOTE The request, indication, response and confirm primitives are also known as requestor.submit, acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

M	parameter is mandatory for the primitive.
U	parameter is a User option, and can be provided or not depending on the dynamic usage of the DLS-user. When not provided, a default value for the parameter is assumed.
C	parameter is conditional upon other parameters or upon the environment of the DLS-user.
(blank)	parameter is never present.

Items in brackets further qualify some entries. These may be

a) a parameter-specific constraint

   (=) indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.

b) an indication that some note applies to the entry

   (n) indicates that the following note n contains additional information pertaining to the parameter and its use.

In any particular interface, not all parameters need be explicitly stated. Some may be implicitly associated with the DLSAP at which the primitive is issued.

In the diagrams that illustrate these interfaces, dashed lines indicate cause-and-effect or time-sequence relationships, and wavy lines indicate that events are roughly contemporaneous.

4 Data-link service and concepts

4.1 Overview

4.1.1 General

The DLS provides for the transparent transfer of data between DLS-users. It makes the way that supporting communications resources are utilized invisible to these DLS-users.

In particular, the DLS provides for the following:

a) Transparency of transferred information. The DLS provides for the transparent transfer of DLS-user-data. It does not restrict the content, format or coding of the DLSDUs, nor does it interpret the structure or meaning of that information. It can, however, restrict the amount of information that can be transferred as an indivisible unit.

   NOTE It is possible for a DLS-user to segment arbitrary-length data into limited-length DLSDUs before making DLS requests, and afterwards reassemble received DLSDUs into these larger data units.

b) Reliable transfer of data. The DLS relieves the DLS-user from concerns regarding insertion, corruption, loss or duplication of data.

c) Prioritized data transfer. The DLS provides DLS-users with a means to prioritize requests.

d) Queue. The DLS provides the requesting DLS-user with a prioritized FIFO queue, where each queue item can hold a single DLSDU.

4.1.2 Overview of DL-naming (addressing)

A DLE is implicitly connected to a single PhE, and (separately) to a single DLSAP and associated DLS-user. A DLE always delivers received DLSDUs at the same DLSAP, and hence to the same DLS-user. This concept is illustrated in Figure 1.

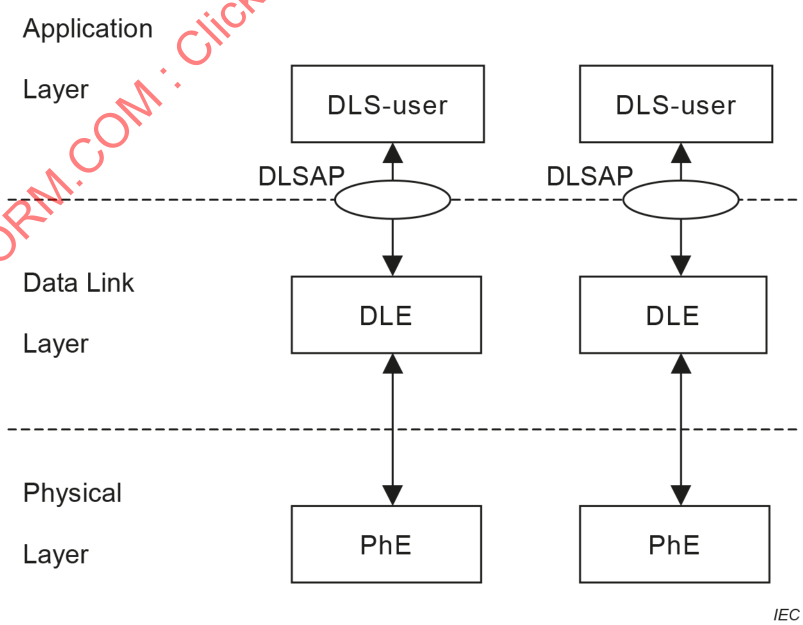

Figure 1 – Relationship of PhE, DLE and DLS-users

Each DLE has a node DL-address. Node DL-addresses uniquely identify DLEs within the local Link.

A DL-route-element is an octet, which can hold either a node DL-address or a higher-layer address used by the DLS-user.

A destination-DL-route holds a sequence of DL-route-elements, describing the complete route to the destination DLSAP plus a local component meaningful to the destination DLS-user.

A source-DL-route holds a sequence of DL-route-elements, describing the complete route back to the source DLSAP plus a local component meaningful to the source DLS-user.

A full DL-route is defined as a destination-DL-route and a source-DL-route.

4.2 Types and classes of data-link service

There are two types of DLS as follows:

– a connectionless-mode data transfer service, providing confirmed and unconfirmed data transfer (defined in 4.5.2 and 4.5.3);
– a management service. The Type 4 management service provides services for reading and writing managed objects (DLM-SET and DLM-GET requests), as defined in Clause 5.

4.3 Functional classes

The functional class of a DLE determines its capabilities, and thus the complexity of conforming implementations. Two functional classes are defined as follows:

a) simple-class, including only responder functionality (server);
b) normal-class, including initiator and responder functionality (client and server, also called peer).

4.4 Facilities of the connectionless-mode data-link service

The DLS provides a means of transferring DLSDUs of limited length from one source DLS-user to one or more destination DLS-users. The transfer of DLSDUs is transparent, in that the boundaries of DLSDUs and the contents of DLSDUs are preserved unchanged by the DLS, and there are no constraints on the DLSDU (other than limited length) imposed by the DLS.

4.5 Model of the connectionless-mode data-link service

4.5.1 General

A defining characteristic of data-link connectionless-mode unitdata transmission is the independent nature of each invocation of the DLS.

Only one type of object, the unitdata object, can be submitted to the DLS-provider for transmission.

The DLS-user issuing a request primitive specifies whether the request is to be confirmed by the remote DLS-user, or not. This is specified in the destination-DL-route and source-DL-route parameters of the DL-UNITDATA request primitive. If the remote DLS-user confirms a request, it does this by issuing a new, independent DL-UNITDATA request primitive.

4.5.2 Unconfirmed request

The DLE of the requesting DLS-user forms a DLPDU, which includes the submitted DLSDU and sends the DLPDU to the receiving DLE. The receiving DLE delivers the received DLSDU to the DLS-user by a DL-UNITDATA indication primitive. The value of the confirmation-expected parameter of this indication is FALSE.

4.5.3 Confirmed request

The DLE of the requesting DLS-user forms a DLPDU, which includes the submitted DLSDU and sends the DLPDU to the receiving DLE. The receiving DLE delivers the received DLSDU to the DLS-user by a DL-UNITDATA indication primitive. The value of the confirmation-expected parameter of this indication is TRUE.

If the receiving DLS-user is unable to handle the indication immediately, the receiving DLS-user should issue a DL-UNITDATA response primitive within the time specified by maximum-indication-delay.

If the receiving DLS-user either

a) does not reply with a DL-UNITDATA response primitive or a DL-UNITDATA request primitive within the interval maximum-indication-delay from receipt of the triggering DL-UNITDATA indication primitive, or

b) does reply with a DL-UNITDATA response primitive within the interval maximum-indication-delay from receipt of the triggering DL-UNITDATA indication primitive,

then the receiving DLE transmits an acknowledging DLPDU to the original requesting DLE. The following actions depend on whether the replying DLE is of simple-class or normal-class.

1) If the replying DLE is of simple-class, the acknowledge DLPDU from the replying DLE specifies "WAIT". In this case, the original requesting DLE requeues the original request DLPDU at the lowest possible priority for retransmission at the next opportunity. When the replying DLS-user has prepared the response, it should await the repeated request from the original requesting DLE, and this time reply by issuing a DL-UNITDATA request primitive within the time interval maximum-indication-delay.

   The action in the original requesting DLE of requeuing the original request for retransmission is repeated as long as the replying DLE keeps responding with "WAIT" acknowledges, or until retransmission has been attempted for the time interval specified in the maximum-retry-time configuration parameter.

2) If the replying DLE is of Normal class, the acknowledge DLPDU from the replying DLE specifies "RESPONSE COMES LATER / ACKNOWLEDGE". In this case, the original requesting DLE does nothing further. When the DLS-user at the replying DLE has prepared the response, it should reply by issuing a DL-UNITDATA request primitive. The replying DLE forms an appropriate DLPDU and queues it for transmission at the first opportunity.

4.6 Sequence of primitives

4.6.1 Constraints on sequence of primitives

Subclause 4.6.1 defines the constraints on the sequence in which the primitives defined in 4.6.2 and Table 1 can occur. The constraints determine the order in which primitives occur, but do not fully specify when they can occur.

Table 1 – Summary of DL-connectionless-mode primitives and parameters

Service	Service subtype	Primitive	Parameter
Data Transfer	Unitdata	DL-UNITDATA request	(*in* Destination-DL-route, Source-DL-route, Priority, Maximum-retry-time, Control status, Data field format, DLSDU)
		DL-UNITDATA indication	(*out* Destination-DL-route, Source-DL-route, Confirmation-expected, Control status, Data field format, DLSDU)
		DL-UNITDATA response	(*in* Destination-DL-route, Source-DL-route)

4.6.2 Relation of primitives at the end-points of connectionless service

4.6.2.1 General

A request primitive issued at one DLSAP will have consequences at one or more other DLSAPs. These relations are summarized in Figure 2 and Figure 3.

4.6.2.2 Confirmed and unconfirmed UNITDATA request

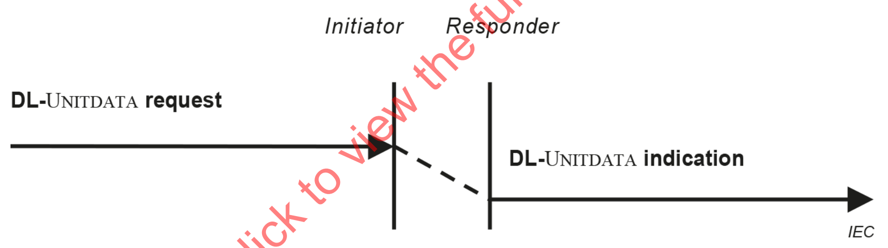

Figure 2 – Confirmed and unconfirmed UNITDATA request time-sequence diagram

4.6.2.3 Repeated confirmed UNITDATA request

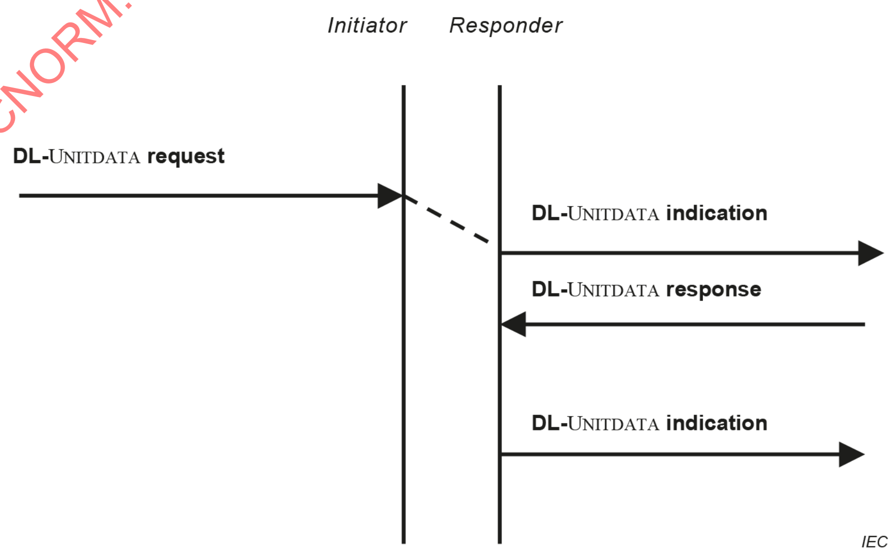

Figure 3 – Repeated confirmed request time-sequence diagram

4.6.3 Sequence of primitives at one DLSAP

The possible overall sequences of primitives at one DLSAP are defined in the state transition diagram of Figure 4.

NOTE Since there is no conformance to this document, the use of a state transition diagram to describe the allowable sequences of service primitives does not impose any requirements or constraints on the internal organization of any implementation of the service.

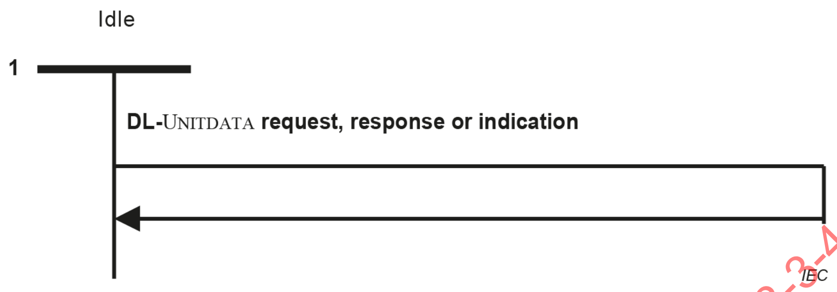

Figure 4 – State transition diagram for sequences of primitives at one DLSAP

4.7 Connectionless-mode data transfer functions

4.7.1 General

DL-connectionless-mode unitdata service primitives are used to transmit independent DLSDUs from one DLS-user to one or more other DLS-users. Each DLSDU is transmitted in a single DLPDU. The DLSDU is independent in the sense that it bears no relationship to any other DLSDU transmitted through another invocation of the DL-service by the same DLS-user. The DLSDU is self-contained in that all the information required to deliver the DLSDU is presented to the DL-provider, together with the user data to be transmitted, in a single service access.

4.7.2 Types of primitives and parameters

4.7.2.1 General

Table 2 indicates the types of primitives and the parameters needed for the DL-connectionless-mode unitdata service.

Table 2 – Unitdata transfer primitives and parameters

DL-UNITDATA Parameter name	Request input	Indication output	Response input
Destination-DL-route	M	M	M
Source-DL-route	M	M	M
Priority	U		
Maximum-retry-time	U		
Confirmation-expected		M	
Control-status	M	M(=)	
Data-field-format	M	M(=)	
Data unit (DLSDU)	M	M(=)	

4.7.2.2 Request primitive

This primitive causes the DLE to create a DLPDU and append it to the transmit queue for transmission at the first opportunity, after all preceding higher-priority DLPDUs in the queue.

If the transmission fails, the DLE delivers error information to the requesting DLS-user by a DL-UNITDATA indication primitive, provided that the requesting DLS-user expects a confirmation. The control-status parameter of this indication specifies the reason for failure. The DLSDU parameter of this indication is null.

4.7.2.3 Indication primitive

This primitive is used by a receiving DLE to deliver a received DLSDU to the addressed DLS-user.

4.7.2.4 Response primitive

This primitive is used by a receiving DLS-user which

a) is not able to generate an expected confirmation within an appropriate time interval; and
b) wishes to indicate that it has received the requesting DLSDU and is preparing a response.

4.7.2.5 Destination-DL-route

This parameter is a sequence of DL-route-elements defining the route to the responder (request) or to the requestor (response) (see 3.3.10).

This parameter of a request can also indicate that the requesting DLS-user does not expect a confirmation from the receiving DLS-user. If the value of one or more node DL-addresses in the destination-DL-route is equal to the broadcast-Node DL-address, the requesting DLS-user does not expect a confirmation.

NOTE DL-route elements holding Node DL-addresses can hold the value of the broadcast-node DL-address. This means that a broadcast DLPDU can be transmitted to all DLEs on a local link.

4.7.2.6 Source-DL-route

This parameter is a sequence of DL-route-elements, defining the reverse route to the requestor (request) or responder (response) (see 3.3.20).

This parameter can also indicate that the requesting DLS-user does not expect a confirmation from the receiving DLS-user. If the value of the last element of the source-DL-route is equal to the no-confirm-node DL-address, the service is unconfirmed.

4.7.2.7 Priority

This user-optional parameter specifies the initial priority of the request. The DLPDU resulting from the request is appended to the queue in the DLE at a position based on the value of this parameter. This value can be any integral number between 0 and 255. The DLPDU is placed in front of all DLPDUs already in the queue having a lower priority, where 255 indicate the highest possible priority.

4.7.2.8 Maximum-retry-time

This user-optional parameter specifies how long the local DLE should retry the transmission of the request as a result of WAIT acknowledge DLPDUs received from the remote DLE. Wait acknowledge DLPDUs are a result of the DL-UNITDATA response primitive described in 4.7.2.4. A DLE retries a transmission by re-appending the DLPDU to the transmit queue, but with a priority of 0 (the lowest possible).

4.7.2.9 Confirmation-expected

This parameter indicates to the receiving DLS-user whether the requesting DLS-user expects a confirmation or not. If the requesting DLS-user expects a confirmation, the receiving DLS-user should issue a new, independent DL-UNITDATA request primitive.

Confirmation-expected can hold the following values:

- TRUE, indicating the requesting DLS-user expects a confirmation.
- FALSE, indicating the requesting DLS-user does not expect a confirmation.

4.7.2.10 Control-status

This parameter is one octet. If the accompanying DLSDU is conveyed successfully to the addressed DLS-user, then this parameter will be delivered unchanged in the corresponding parameter of the indication to the receiving DLS-user.

If the transmission of a request fails and the requesting DLS-user expects a reply DLSDU, the DLE delivers error information to the requesting DLS-user by a DL-UNITDATA indication primitive. The value conveyed in this corresponding parameter of an indication is specified in Table 3:

Table 3 – Control-status error codes

Value (hexadecimal)	Meaning
00	failure – no response
18	failure – wait too long
38	failure – route error
80	failure – frame check error
88	failure – overrun/framing error
90	failure – link short circuit
98	failure – DLE is simple-class
A0	failure – out of synchronization
*X*1 – *X*7	success (where *X* = any digit value)

4.7.2.11 Data-field-format

This parameter holds information for the DLS-user on the interpretation of the DLSDU contents. The parameter of a request will be delivered unchanged in the corresponding parameter of the indication to the receiving DLS-user.

If the full-DL-route, i.e. both the source-DL-route and the destination_DL-route, describes nodes on an IP-network and the DLS-user data size is more than 56 octets, this parameter holds two octets of information. In all other cases this parameter holds one octet of information.

4.7.2.12 DLSDU

This parameter conveys DLS-user data.

If the full-DL-route, i.e. both the source-DL-route and the destination_DL-route, describes nodes on an IP-network and the DLS-user data size is more than 56 octets, the DLS-user data size can be an integral number of octets between 63 and 1280. In all other cases the DLS-user data size can be an integral number of octets between 0 and 63.

5 DL-management service

5.1 Scope and inheritance

Clause 5 defines the form of DL-management services for protocols which implement the DLS specified in 4.5. Only the form is specified, as the specifics of permitted parameters are dependent on the protocol, which implements these services.

This noteworthy difference of Clause 5 from the prior Clause 4 is the intended class of users; Clause 5 is intended for use by a management client, while the prior Clause 4provide services to any client.

5.2 Facilities of the DL-management service

DL-management facilities provide a means for

a) writing DLE configuration parameters;
b) reading DLE configuration parameters, operational parameters and statistics;
c) commanding major DLE actions; and
d) receiving notification of significant DLE events.

Together these facilities constitute the DL-management-service (DLMS).

5.3 Model of the DL-management service

Clause 5 uses the abstract model for a layer service defined in ISO/IEC 10731, Clause 5. The model defines local interactions between the DLMS-user and the DLMS-provider. DLMS primitives that convey parameters pass information between the DLMS-user and the DLMS-provider.

5.4 Constraints on sequence of primitives

Subclause 5.4 defines the constraints on the sequence in which the primitives defined in 5.5 through 5.8 can occur. The constraints determine the order in which primitives occur, but do not fully specify when they can occur.

The DL-management primitives and their parameters are summarized in Table 4. The only primitives with a time-sequence relationship are shown in Figure 5.

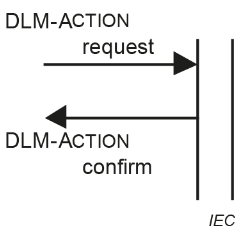

Figure 5 – Sequence of primitives for the DLM action service

Table 4 – Summary of DL-management primitives and parameters

Service	Primitive	Parameter
Writing managed objects	DLM-SET request	(*in* DLM-object-identifier, Desired-value, *out* Status)
Reading managed objects	DLM-GET request	(*in* DLM-object-identifier, *out* Status, Current-value)
Commanding actions	DLM-ACTION request	(*in* Desired-action, Action-qualifiers)
	DLM-ACTION confirm	(*out* Status, Additional-information)
Notifying of events	DLM-EVENT indication	(*out* DLM-event-identifier, Additional-information)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

5.5 Set

5.5.1 Function

This primitive can be used to set (write) the value of a DLE configuration parameter.

5.5.2 Types of parameters

5.5.2.1 Primitive and parameters

Table 5 indicates the primitive and parameters of the set DLMS.

Table 5 – DLM-Set primitive and parameters

Parameter name — DLM-SET	Request input	Request output
DLM-object-identifier	M	
Desired-value	M	
Status		M

5.5.2.2 DLM-object-identifier

This parameter specifies the primitive or composite object within the DLE whose value is to be altered. The naming-domain of the DLM-object-identifier is the DLM-local-view.

5.5.2.3 Desired-value

This parameter specifies the desired value for the DLM-object specified by the associated DLM-object-identifier. Its type is identical to that of the specified DLM-object.

5.5.2.4 Status

This parameter allows the DLMS-user to determine whether the requested DLMS was provided successfully, or failed for the reason specified. The value conveyed in this parameter is as follows:

a) "success";