

INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications – Part 3-8: Data-link layer service definition – Type 8 elements





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**Industrial communication networks – Fieldbus specifications –
Part 3-8: Data-link layer service definition – Type 8 elements**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –**
Part 3-8: Data-link layer service definition – Type 8 elements

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International Standard IEC 61158-3-8 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition and its companion parts of the IEC 61158-3 subseries cancel and replace IEC 61158-3:2003. This edition of this part constitutes an editorial revision.

This edition includes the following significant changes with respect to the previous edition:

- a) deletion of the former Type 6 fieldbus, and the placeholder for a Type 5 fieldbus data-link layer, for lack of market relevance;
- b) addition of new types of fieldbuses;
- c) division of this part into multiple parts numbered 3-1, 3-2, ..., 3-19.

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

FDIS	Report on voting
65C/473/FDIS	65C/484/RVD

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

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under <http://webstore.iec.ch> in the data related to the specific publication. At this date, the publication will be:

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- withdrawn;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

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

The 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.

INTRODUCTION

This part of IEC 61158 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/TR 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 standard is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-8: Data-link layer service definition – Type 8 elements

1 Scope

1.1 Overview

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 standard defines in an abstract way the externally visible service provided by the Type 8 fieldbus data-link layer in terms of

- a) the primitive actions and events of the service;
- 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 standard is to define the services provided to

- the Type 8 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model, and
- 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 standard 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 specification may 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, and
- b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This standard 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 8 data-link layer services defined in this standard.

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.

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

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

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

3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 Reference model terms and definitions

This standard 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-connection	[7498-1]
3.1.3 DL-connection-end-point	[7498-1]
3.1.4 DL-connection-end-point-identifier	[7498-1]
3.1.5 DL-connection-mode transmission	[7498-1]
3.1.6 DL-connectionless-mode transmission	[7498-1]
3.1.7 correspondent (N)-entities	[7498-1]
correspondent DL-entities (N=2)	
correspondent Ph-entities (N=1)	
3.1.8 (N)-entity	[7498-1]
DL-entity (N=2)	
Ph-entity (N=1)	
3.1.9 (N)-layer	[7498-1]
DL-layer (N=2)	
Ph-layer (N=1)	
3.1.10 layer-management	[7498-1]
3.1.11 DL-local-view	[7498-3]
3.1.12 DL-name	[7498-3]
3.1.13 naming-(addressing)-domain	[7498-3]
3.1.14 peer-entities	[7498-1]

3.1.15 primitive name	[7498-3]
3.1.16 DL-protocol	[7498-1]
3.1.17 DL-protocol-connection-identifier	[7498-1]
3.1.18 DL-protocol-data-unit	[7498-1]
3.1.19 reset	[7498-1]
3.1.20 (N)-service	[7498-1]
DL-service (N=2)	
Ph-service (N=1)	
3.1.21 (N)-service-access-point	[7498-1]
DL-service-access-point (N=2)	
Ph-service-access-point (N=1)	
3.1.22 DL-service-access-point-address	[7498-3]
3.1.23 DL-service-connection-identifier	[7498-1]
3.1.24 DL-service-data-unit	[7498-1]
3.1.25 DL-simplex-transmission	[7498-1]
3.1.26 systems-management	[7498-1]
3.1.27 DLS-user-data	[7498-1]

3.2 Service convention terms and definitions

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

- 3.2.1 confirm (primitive)**
- 3.2.2 DL-service-primitive;
primitive**
- 3.2.3 DL-service-provider**
- 3.2.4 DL-service-user**
- 3.2.5 indication (primitive);
acceptor.deliver (primitive)**
- 3.2.6 request (primitive);
requestor.submit (primitive)**
- 3.2.7 response (primitive);
acceptor.submit (primitive)**

3.3 Common data-link service terms and definitions

NOTE This subclause contains the common terms and definitions used by Type 8.

3.3.1

link, local link

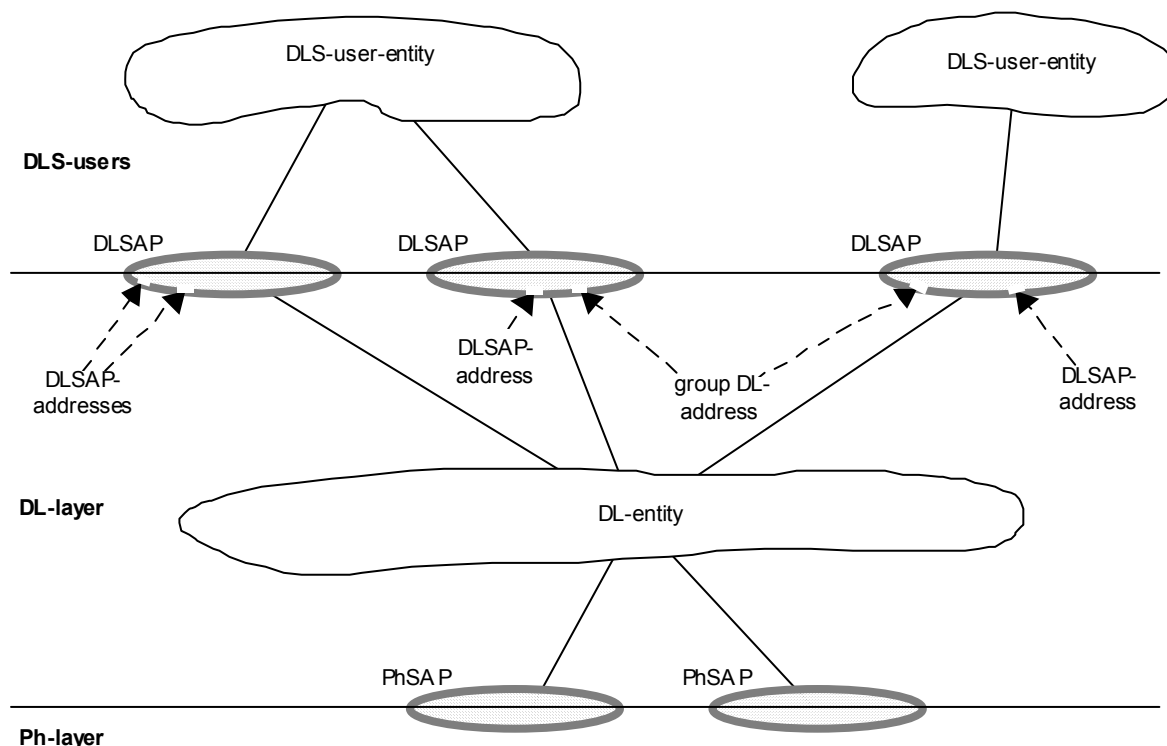
single DL-subnetwork in which any of the connected DLEs may communicate directly, without any intervening DL-relaying, whenever all of those DLEs that are participating in an instance of

communication are simultaneously attentive to the DL-subnetwork during the period(s) of attempted communication

**3.3.2
DLSAP**

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

NOTE This definition, derived from ISO/IEC 7498-1, is repeated here to facilitate understanding of the critical distinction between DLSAPs and their DL-addresses.



NOTE 1 DLSAPs and PhSAPs are depicted as ovals spanning the boundary between two adjacent layers.

NOTE 2 DL-addresses are depicted as designating small gaps (points of access) in the DLL portion of a DLSAP.

NOTE 3 A single DL-entity may have multiple DLSAP-addresses and group DL-addresses associated with a single DLSAP.

Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses

**3.3.3
DL(SAP)-address**

either an individual DLSAP-address, designating a single DLSAP of a single DLS-user, or a group DL-address potentially designating multiple DLSAPs, each of a single DLS-user

NOTE This terminology is chosen because ISO/IEC 7498-3 does not permit the use of the term DLSAP-address to designate more than a single DLSAP at a single DLS-user.

**3.3.4
extended link**

DL-subnetwork, consisting of the maximal set of links interconnected by DL-relays, sharing a single DL-name (DL-address) space, in which any of the connected DL-entities may communicate, one with another, either directly or with the assistance of one or more of those intervening DL-relay entities

NOTE An extended link may be composed of just a single link.

3.3.5**frame**

denigrated synonym for DLPDU

3.3.6**receiving DLS-user**

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

NOTE A DL-service user can be concurrently both a sending and receiving DLS-user.

3.3.7**sending DLS-user**

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

3.4 Additional Type 8 data-link specific definitions**3.4.1****device**

slave or master

3.4.2**device code**

two octets which characterize the properties of a slave

3.4.3**DL-segment**

group of slaves in consecutive order

3.4.4**DL-segment level**

nesting level number of a DL-segment

3.4.5**master**

DL-entity controlling the data transfer on the local link and initiating the medium access of the slaves by starting the DLPDU cycle

3.4.6**slave**

DL-entity accessing the medium only after being initiated by the preceding slave or master

3.5 Common symbols and abbreviations

NOTE This subclause contains the common symbols and abbreviations used by Type 8.

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
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

3.6 Common conventions

This standard 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 standard 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 standard. 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 may or may not be provided 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.

Some entries are further qualified by items in brackets. 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 which 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

Type 8 provides a connection-oriented subset of services, specified in ISO/IEC 8886, on pre-established DLCs. The DLS provides the sending or receiving DLS-user with either a FIFO queue or a retentive buffer, where each queue item or buffer can hold a single DLSDU.

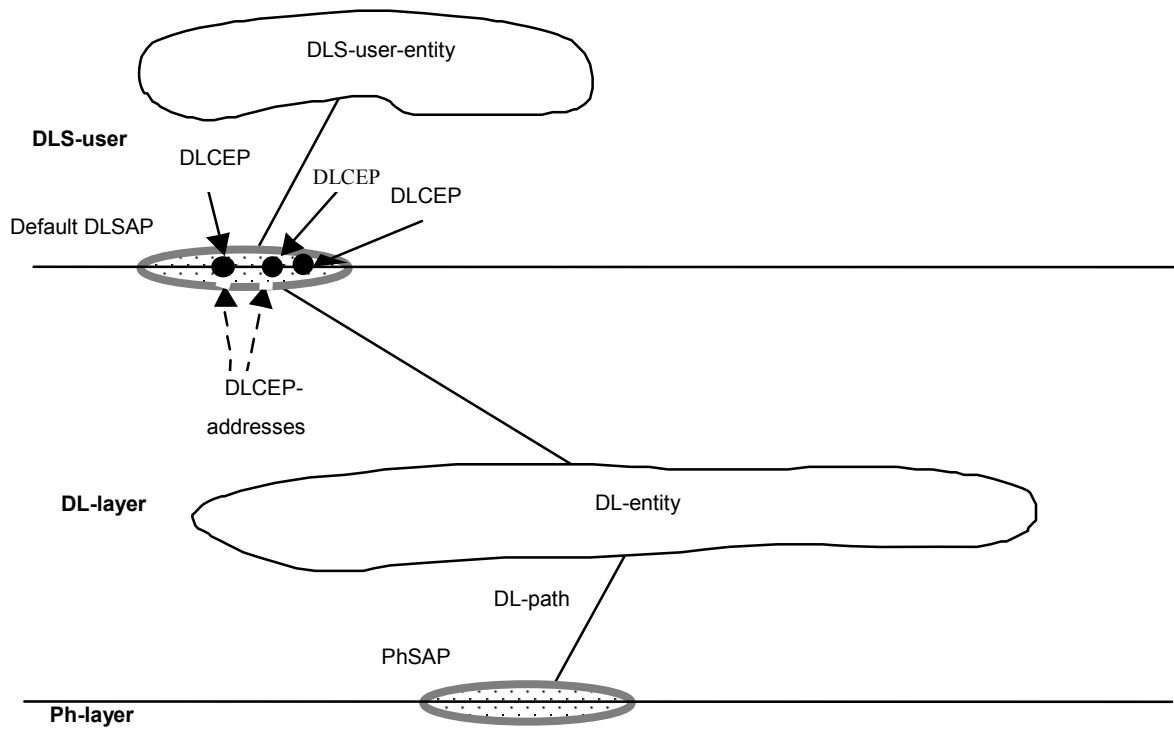
DL-names, known conventionally as DL-addresses, are identifiers from a defined identifier space — the DL-address-space — which serve to name objects within the scope of the data-link layer. The objects that need to be named within the DLL are data-link-connection-end-points (DLCEPs).

The DL-address-space from which DL-addresses are drawn may be partitioned into sub-spaces of DL-addresses due to the class of the device in which the DLS-entity resides, and the class of the addressed DLCEP.

Only two DLSAPs are supported by a DLE: a single default DLSAP for sending and receiving data, and a single default management DLSAP to invoke local DL-management services. As these DLSAPs are accessed locally, they have no DLSAP DL-address assigned to them. The DLSAP used is determined implicitly by the type of service primitive selected.

A DLS-user may need to distinguish among several DLCEPs at the same DLSAP for sending and receiving data; thus a local DLCEP-identification mechanism is also provided. All primitives issued at such a DLSAP within the context of a DLC use this mechanism to identify the local DLCEP. The naming-domain of this DLCEP-identification is the DL-local-view.

The relationship between DLSAPs, DLCEPs and DLCEP DL-addresses used for data transfer services is shown in Figure 2.



NOTE 1 DLSAPs and PhSAPs are depicted as ovals spanning the boundary between two adjacent layers.

NOTE 2 DL-addresses are depicted as designating small gaps (points of access) in the DLL portion of a DLSAP. A DLCEP-address also designates a specific point of information flow (its DLCEP) within the DLSAP.

NOTE 3 Only one DLS-user-entity can be associated with any given DL-entity.

NOTE 4 Only one default DLSAP is supported.

NOTE 5 Only connection oriented DL-services are supported. All DLCs are pre-configured and pre-established. No DLSAP addresses are assigned.

Figure 2 – Relationships of DLCEPs and DLCEP-addresses to default DLSAP

The DLS provides three classes of DLCEPs:

- a) **PEER** — the DLS-user can exchange DLSDUs with one other peer DLS-user;
- b) **PUBLISHER** — the DLS-user can send DLSDUs to a set of zero or more associated subscribing DLS-users;
- c) **SUBSCRIBER** — the DLS-user can receive DLSDUs from the associated publishing DLS-user.

NOTE The DLCEP Classes PUBLISHER and SUBSCRIBER only support one conveyance path from the publisher DLCEP to each subscriber DLCEP. No conveyance path from a subscriber DLCEP to the publisher DLCEP exists.

All buffers and queues are pre-created and bound to DLCEPs. The DLS-user cannot directly create, delete, bind or unbind buffers or queues.

DLCEPs of class PEER always use queues; DLCEPs of classes PUBLISHER and SUBSCRIBER always use buffers which are bound to them.

DLCEPs of class PEER are used only for confirmed data transfer; DLCEPs of classes PUBLISHER and SUBSCRIBER are used only for unconfirmed data transfers.

All DLCs are pre-defined and pre-established by local DL-management before any DLS-user is granted access to the DLS.

All information used during creation of buffers and queues and establishing of DLCs is stored by local DL-management. The means by which a DLS-user can obtain this information from local DL-management is a local issue, beyond the scope of this standard.

A buffer is referenced by a Buffer DL-identifier assigned by local DL-management during creation. As each buffer or queue is associated with (bound to) a single DLCEP, a DLCEP DL-identifier or DLCEP DL-address (if assigned to the DLCEP) can also be used to reference the buffer or queue bound to this DLCEP. Local DL-management can provide the DLS-user with the facility to inter-convert the reference types.

4.2 Sequence of primitives

4.2.1 Constraints on sequence of primitives

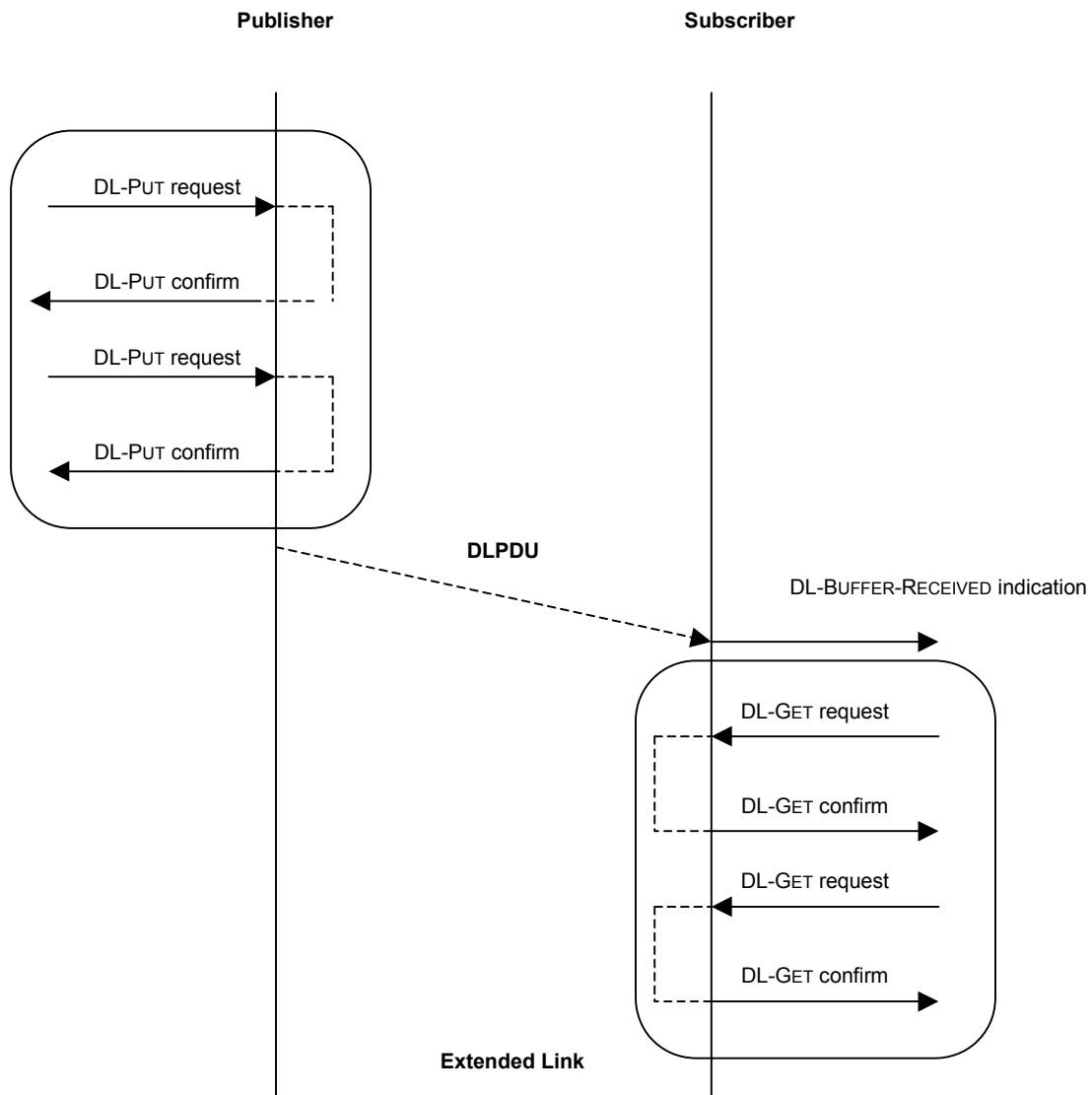
This subclause defines the constraints on the sequence in which the primitives defined in 4.3 may occur. The constraints determine the order in which primitives occur, but do not fully specify when they may occur.

In order to request a service, the DLS-user uses a request primitive. A confirmation primitive is returned to the DLS-user after the service has been completed. The arrival of a service request is indicated to the remote DLS-user by means of an indication primitive. The connection-mode primitives and their parameters are summarized in Table 1. The major relationships among the primitives at two DLC end-points are shown in Figure 3 through Figure 5.

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

Service	Primitive	Parameter
Put buffer	DL-PUT request	(<i>in</i> Buffer DL-identifier DLS-user-data)
	DL-PUT confirm	(<i>out</i> Status)
Get buffer	DL-GET request	(<i>in</i> Buffer DL-identifier)
	DL-GET confirm	(<i>out</i> Status, DLS-user-data)
Buffer received	DL-BUFFER-RECEIVED indication	(<i>out</i> Status)
Normal data transfer	DL-DATA request	(<i>in</i> DLCEP DL-identifier, DLS-user-data)
	DL-DATA indication	(<i>out</i> DLCEP DL—identifier, DLS-user-data)
	DL-DATA confirm	(<i>out</i> Status)
NOTE The method by which a DL-DATA confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

The sequence of primitives of a successful normal data transfer is defined in the time-sequence diagrams in Figure 4. The sequence of primitives in a failed normal data transfer is defined in the time-sequence diagram in Figure 5.



NOTE 1 Primitives within the outlined areas can be repeated many times between instances of the primitives in the enclosing areas.

NOTE 2 The request primitives within the outlined areas are locally confirmed.

Figure 3 – Sequence of primitives for the buffer data transfer

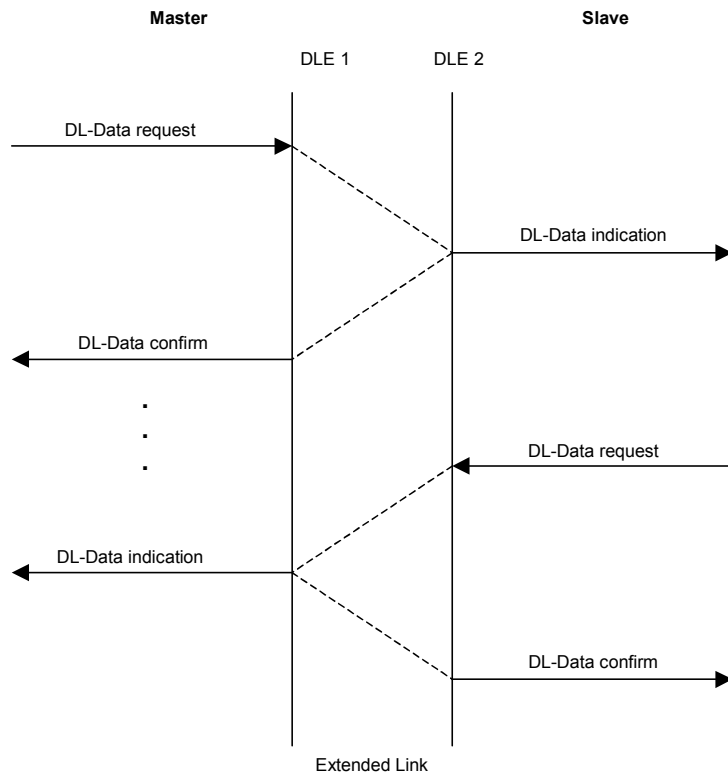


Figure 4 – Normal data transfer service between a master and a slave

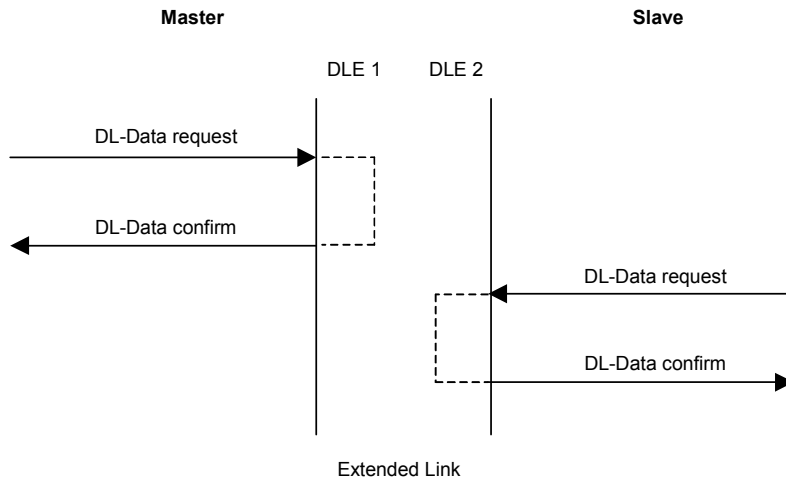


Figure 5 – Sequence of primitives for a failed normal data transfer

4.3 Connection-mode data-link services

4.3.1 Put buffer

4.3.1.1 Function

The DLS-user uses this service to write directly to the specified buffer. The service is locally processed after the DL-PUT request primitive has arrived. The DLE communicates the successful processing of the service to the DLS-user by means of a DL-PUT confirmation primitive (immediate confirmation).

4.3.1.2 Types of parameters

Table 2 indicates the primitive and parameters of the Put Buffer DLS.

Table 2 – Put buffer primitive and parameters

Parameter name	DL-PUT	Request	Confirm
		input	output
Buffer DL-identifier		M	
DLS-user-data		M	
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.			

4.3.1.2.1 Buffer DL-identifier

This parameter specifies the local DL-identifier of the buffer as assigned by local DL-management.

4.3.1.2.2 DLS-user-data

This parameter specifies the user-data which is to be written to the buffer.

4.3.1.2.3 Status

This parameter indicates the success or failure of the preceding request. The value conveyed in this parameter is as follows:

- a) "OK — success — service completed"
- b) "IV — failure — invalid parameters in the request".

4.3.2 Get buffer

4.3.2.1 Function

The DLS-user uses this service to directly read the specified buffer. The service is locally processed after the DL-GET request primitive has arrived. The DLE communicates the successful processing of the service to the DLS-user by means of a DL-GET confirmation primitive (immediate confirmation).

4.3.2.2 Types of primitives and parameters

4.3.2.2.1 General

Table 3 indicates the primitives and parameters of the Get Buffer DLS.

Table 3 – Get buffer primitive and parameters

Parameter name	DL-GET	Request	Confirm
		input	output
Buffer DL-identifier		M	
DLS-user-data			C
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.			

4.3.2.2.2 Buffer DL-identifier

This parameter specifies the local DL-identifier of the buffer as assigned by local DL-management.

4.3.2.2.3 DLS-user-data

This parameter is present when the preceding request primitive was successfully executed. This parameter specifies the data which was read from the buffer.

4.3.2.2.4 Status

This parameter indicates the success or failure of the preceding request. The value conveyed in this parameter is as specified in 4.3.1.2.3.

4.3.3 Buffer received

4.3.3.1 Function

The DLS-provider uses this service to inform the DLS-user about the successful update of all buffers.

NOTE If the DLS-provider detects an error, no DL-BUFFER-RECEIVED indication is generated.

4.3.3.2 Types of primitives and parameters

4.3.3.2.1 General

Table 4 indicates the primitive and parameters of the Buffer Received DLS.

Table 4 – Buffer received primitive and parameters

DL-BUFFER-RECEIVED Parameter name	Indication output
Status	M

4.3.3.2.2 Status

This parameter indicates the successful update of all buffers. The value conveyed in this parameter is as follows:

NOTE 1 In this protocol all buffers on all DLCs are updated at the same time.

a) “OK — success — buffer received without errors”

NOTE 2 If the DLE detects an error no DL-BUFFER-RECEIVED indication is generated.

4.3.4 Normal data transfer

4.3.4.1 Function

This service allows a DLS-user (called local user) to send DLS-user-data to a single remote DLE. If the remote DLE receives the data correctly, the data is reported to its DLS-user. The requesting DLS-user receives a confirmation indicating the receipt or non-receipt of the user data at the remote DLE.

4.3.4.2 Types of primitives and parameters

4.3.4.2.1 General

Table 5 indicates the types of primitives and the parameters needed for normal data transfer.

Table 5 – Normal data transfer primitive and parameters

Parameter name	DL-DATA	Request	Indication	Confirm
		input	output	output
DLCEP DL-identifier		M	M	
DLS-user-data		M	M(=)	
Status				M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.				

4.3.4.2.2 DLCEP DL-identifier

This parameter specifies the DLCEP for which the data transfer service is to occur. The identifier was assigned by local DL-management when the DLC was pre-established.

4.3.4.2.3 DLS-user-data

This parameter specifies the user data to be transmitted (request) or which was received (indication).

4.3.4.2.4 Status

The link status parameter indicates the success or failure of the preceding request. The value conveyed in this parameter is as follows:

- a) "OK — success — service completed"
- b) "RR — failure — resources of the remote DLCEP not available or insufficient"
- c) "LR — failure — resources of the local DLCEP not available or insufficient"
- d) "NA — failure — no response, or not a plausible response (acknowledge response), of the remote device"
- e) "DS — failure — DLE not synchronized at the moment"
- f) "IV — failure — invalid parameter in the request".

5 DL-management service

5.1 Scope

This clause defines the administrative DL-management services (DLMS) which are available to the DLMS user, together with their service primitives and the associated parameters. All DL-management services use the default management DLSAP.

5.2 Facilities of the DL-management service

The service interface between the DLMS-user and the DLE makes the following functions available:

- a) reset of the local DLE;
- b) request and change the current operating parameters of the local DLE;
- c) indication of unexpected events, errors, and status changes, either local or remote;
- d) read-out of the active DL-subnetwork configuration;
- e) read-out of the current DL-subnetwork configuration;
- f) setting of a DL-subnetwork configuration.

Together these facilities constitute the DLMS.

5.3 Overview of services

5.3.1 General

DL-management provides the following services to all DLMS-users:

- a) reset
- b) event.

DL-management may provide the following services to DLMS-users:

- c) set value
- d) get value.

DL-management provides the following additional services to DLMS-users of DLEs that are functioning as a DLL master:

- e) get current configuration
- f) get active configuration
- g) set active configuration.

5.3.2 Reset

The DLMS-user uses this required service to cause DL-management to reset the DLE. The DLMS-user receives a confirmation for this service.

5.3.3 Event

DL-management uses this required service to inform the DLMS-user of certain events or detected errors in the DLE.

5.3.4 Set value

The DLMS-user uses this service to set a new value to the variables of the DLE. It receives a confirmation on whether the specified variable(s) assumed the corresponding specified value(s).

5.3.5 Get value

The DLMS-user uses this service to read variables of the DLE.

5.3.6 Get current configuration (master only)

The DLMS-user of the master DLE uses this required service to read the current DL-subnetwork configuration.

5.3.7 Get active configuration (master only)

The DLMS-user of the master DLE uses this required service to read the active DL-subnetwork configuration.

5.3.8 Set active configuration (master only)

The DLMS-user of the master DLE uses this required service to set a DL-subnetwork configuration.

5.4 Overview of interactions

The DL-management primitives and their parameters are summarized in Table 6. The sequences of DL-management primitives are defined by the time-sequence diagrams in Figure 6 through Figure 12.

NOTE DL-management services which provide an immediate response use only a request primitive with output parameters; this provides correlation of the response with the request. Those services where the response can be much delayed and where the response information is independent of the number of, or time sequence of, the corresponding requests, use separate request and indication primitives.

Table 6 – Summary of DL-management primitives and parameters

Service	Primitive	Parameter
Reset	DLM-RESET request	<none>
	DLM-RESET confirm	(out Status)
Event	DLM-EVENT indication	(out Event-identifier, Additional-information)
Set value	DLM-SET-VALUE request	(in Variable-name, Desired-value)
	DLM-SET-VALUE confirm	(out Status)
Get value	DLM-GET-VALUE request	(in Variable-name)
	DLM-GET-VALUE confirm	(out Status, Current-value)
Get current configuration	DLM-GET-CURRENT-CONFIGURATION request	(in Desired configuration)
	DLM-GET-CURRENT-CONFIGURATION confirm	(out Status, Current configuration)
Get active configuration	DLM-GET-ACTIVE-CONFIGURATION request	<none>
	DLM-GET-ACTIVE-CONFIGURATION confirm	(out Status, Active configuration)
Set active configuration	DLM-SET-ACTIVE-CONFIGURATION request	(in Active configuration)
	DLM-SET-ACTIVE-CONFIGURATION confirm	(out Status, Additional-information)

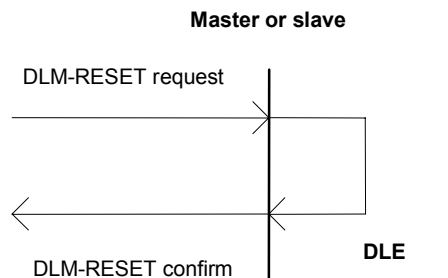


Figure 6 – Sequence of primitives for the reset service

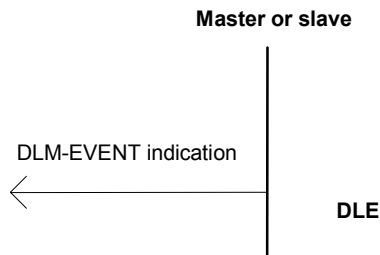


Figure 7 – Sequence of primitives for the event service

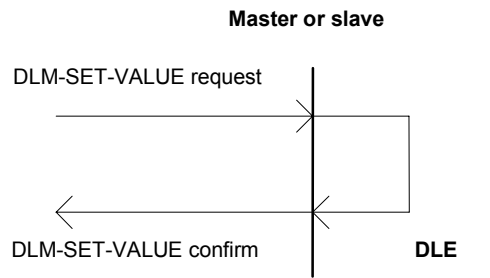


Figure 8 – Sequence of primitives for the set value service

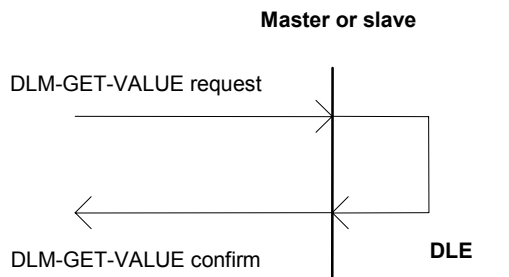


Figure 9 – Sequence of primitives for the get value service

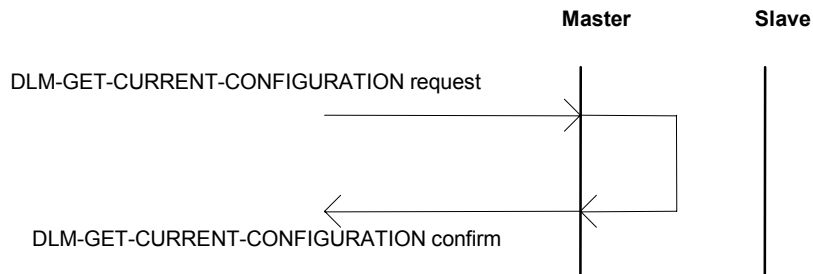


Figure 10 – Sequence of primitives for the get current configuration service

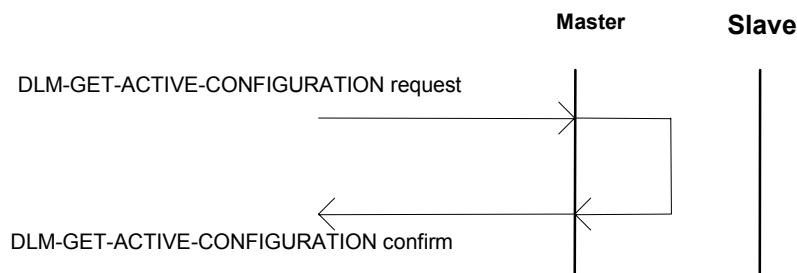


Figure 11 – Sequence of primitives for the get active configuration service

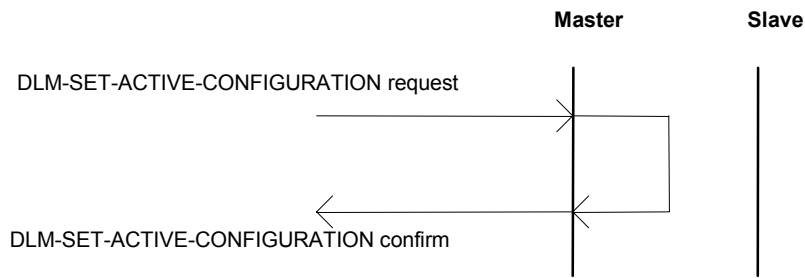


Figure 12 – Sequence of primitives for the set active configuration service

5.5 Detailed specification of services and interactions

5.5.1 Reset

5.5.1.1 Function

This required service is used to reset the DLE. The confirm primitive is issued immediately prior to the DLE reset action.

5.5.1.2 Types of parameters

5.5.1.2.1 General

Table 7 indicates the primitives and parameters of the DLM-RESET service.

Table 7 – Reset service primitives and parameters

Parameter name	DLM-RESET	Request	Confirm
		input	Output
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.			

5.5.1.2.2 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) "OK — success; reset completed"; or
- b) "NOK — failure".

5.5.2 Event

5.5.2.1 Function

This required service is used to report the occurrence of a DL-event which could be of significance to DL-management. After link-related errors have been reported, the DLMS-provider carries out a configuration check (determination of the current configuration by connection all outgoing interfaces). If the configuration differs from the configuration prior to the detection of the link-related error, the DLMS-provider automatically generates an event with information on the configuration change.

5.5.2.2 Types and parameters

5.5.2.2.1 General

Table 8 indicates the primitives and parameters of the DLM-EVENT service.

Table 8 – Event service primitive and parameters

Parameter name	DLM-Event	Indication
		output
Event-identifier		M
Additional-information		C

5.5.2.2.2 Event identifier

This parameter specifies the event within the DLE whose occurrence is being announced.

NOTE Possible event values are defined in the corresponding IEC 61158-4-8 protocol specification..

5.5.2.2.3 Additional-information

This optional parameter provides event-specific additional information.

5.5.3 Set value

5.5.3.1 Function

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

5.5.3.2 Types of parameters

5.5.3.2.1 General

Table 9 indicates the primitives and parameters of the DLM-SET-VALUE service

Table 9 – Set value service primitives and parameters

Parameter name	DLM-SET-VALUE	Request	Confirm
		input	Output
Variable-name		M	
Desired-value		M	
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.			

5.5.3.2.2 Variable-name

This parameter specifies the variable within the DLE whose value is to be altered. The selectable variables are defined in the corresponding part of IEC 61158-4.

5.5.3.2.3 Desired-value

This parameter specifies the desired value for the selected variable. The permitted values or value ranges are defined in IEC 61158-4, Type 8.

5.5.3.2.4 Status

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

- a) “OK — success — variable value updated”;
- b) “NOK — failure — variable does not exist or could not assume the new value”; or
- c) “IV — failure — invalid parameters in the request”.

5.5.4 Get Value

5.5.4.1 Function

This optional service can be used to get (read) the value of a DLE variable.

5.5.4.2 Types of parameters

5.5.4.2.1 General

Table 10 indicates the primitives and parameters of the DLM-GET-VALUE service.

Table 10 – Get value service primitives and parameters

DLM-GET-VALUE Parameter name	Request	Confirm
	Input	Output
Variable-name	M	
Status		M
Current-value		C
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

5.5.4.2.2 Variable-name

This parameter specifies the variable within the DLE whose value is being requested. The selectable variables are defined in the corresponding part of IEC 61158-4.

This parameter receives the current value for the selected variable.

5.5.4.2.3 Status

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

- a) “OK — success — the variable could be read”;
- b) “NOK — failure — the variable does not exists or could not be read”; or
- c) “IV — failure — invalid parameters in the request”.

5.5.4.2.4 Current-value

This parameter is present when the status parameter indicates that the requested service was performed successfully. This parameter specifies the current value of the selected variable.

5.5.5 Get current configuration

5.5.5.1 Function

This service is required for a master DLE; it is not available for a slave. The DLMS-user of the master DLE can use this service to get (read) the current DL-configuration of the extended link.

NOTE 1 The DLMS-provider is expected to use ID cycles to detect the currently connected slaves and transfer the detected configuration to the DLMS-user in the current configuration parameter.

NOTE 2 The DL-subnetwork configuration parameter specifies the configuration of the DL-subnetwork which is implied by successful completion of the service.

NOTE 3 The DLMS-provider employs a similar function at DLL start-up to open all outgoing interfaces of the slaves.

5.5.5.2 Types and parameters

5.5.5.2.1 General

Table 11 indicates the primitives and parameters of the Get Current Configuration DLMS.

Table 11 – Get current configuration service primitives and parameters

DLM-GET-CURRENT-CONFIGURATION Parameter name	Request	Confirm
	Input	Output
Desired Configuration	M	
Status		M
Current configuration		C
Additional-information		C
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

5.5.5.2.2 Desired configuration

This parameter specifies the desired configuration of the extended link after the service has completed.

- a) "CLOSED — the outgoing interfaces of all slaves are closed".
- b) "OPEN — the outgoing interfaces of all slaves are open".

5.5.5.2.3 Status

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

- a) "OK — success";
- b) "NOK — failure — an error was detected when a DL-segment was connected"; or
- c) "IV — failure — no ID cycles could be run (DL-subnetwork error)".

5.5.5.2.4 Current configuration

This compound parameter specifies the current configuration of the extended link. The parameter has the structure specified in Table 13.

5.5.5.2.5 Additional-information

This optional parameter provides status-specific additional information.

5.5.6 Get active configuration

5.5.6.1 Function

This service is required for a master DLE; it is not available for a slave. The DLMS-user of the master DLE can use this service to get (read) the active DL-configuration of the extended link.

NOTE This is a local service without implied activity on the local link.

5.5.6.2 Types and parameters

5.5.6.2.1 General

Table 12 indicates the primitives and parameters of the get active configuration service.

Table 12 – Get active configuration service primitives and parameters

DLM-GET-ACTIVE-CONFIGURATION Parameter name	Request	Confirm
	input	Output
Status		M
Active configuration		C
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

5.5.6.2.2 Active configuration

This compound parameter specifies the active configuration of the DL-subnetwork. It takes the form of a conceptual list whose entries are ordered according to the physical order of the slaves in the ring. The parameter has the structure specified in Table 13.

Table 13 – The active configuration parameter

Item Number	Type	Description
1	device code	first device code of slave
2	DL-segment level	first DL-segment level of slave
3	device code	second device code of slave
4	DL-segment level	second DL-segment level of slave
...
2N-1	device code	Nth device code of slave
2N	DL-segment level	Nth DL-segment level of slave

5.5.6.2.3 Status

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

- a) "OK — success"; or
- b) "NOK — failure".

5.5.7 Set active configuration

5.5.7.1 Function

This service is required for a master DLE; it is not available for a slave. The DLMS-user of the master can use this service to configure the extended link. If the new configuration cannot be accepted, the exact error cause is communicated to the DLMS-user and the old configuration is retained.

5.5.7.2 Types and parameters

5.5.7.2.1 General

Table 14 indicates the primitives and parameters of the set active configuration service.

Table 14 – Set active configuration service primitives and parameters

DLM-SET-ACTIVE-CONFIGURATION Parameter name	Request	Confirm
	input	Output
Active configuration list	M	
Status		M
Additional-information		C
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter.		

5.5.7.2.2 Active configuration list

This compound parameter specifies the new active configuration of the DL-subnetwork to be generated. The parameter has the structure specified in Table 13.

5.5.7.2.3 Status

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

- a) "OK — success";
- b) "NOK — failure — an error was detected when a DL-segment was connected to the ring. The new configuration could not be generated"; or
- c) "IV — failure — no ID cycles could be run; a fatal bus error".

5.5.7.2.4 Additional-information

This optional parameter provides status-specific additional information.

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