

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 3-21: Data-link layer service definition – Type 21 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 3-21: Définition des services de couche liaison de données – Éléments
de type 21**





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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
1.1 Overview.....	8
1.2 Specifications	8
1.3 Conformance	8
2 Normative references	9
3 Terms, definitions, symbols, abbreviations, and conventions	9
3.1 Reference model terms and definitions	9
3.2 Service convention terms and definitions	11
3.3 Common data-link service terms and definitions	12
3.4 Additional Type 21 data-link specific definitions	15
3.5 Common symbols and abbreviations	15
3.6 Additional Type 21 symbols and abbreviations	16
3.7 Common conventions.....	16
3.8 Additional Type 21 conventions.....	17
4 Data-link layer services and concepts.....	17
4.1 General.....	17
4.1.1 Overview.....	17
4.1.2 Overview of full duplex flow control.....	17
4.1.3 Types and classes of DL-layer service.....	18
4.2 Detailed description of the data service.....	21
4.2.1 General.....	21
4.2.2 Sequence of primitives.....	21
4.2.3 Transmit/receive data	22
4.3 Detailed description of the sporadic data service	23
4.3.1 General	23
4.3.2 Sequence of Primitive.....	24
4.3.3 Transmit/receive sporadic data	24
4.4 Detailed description of network control message service.....	25
4.4.1 General	25
4.4.2 Sequence of Primitives	25
4.4.3 Transmit/receive network control message	25
5 Data-link management services	28
5.1 General.....	28
5.2 Data link management service (DLMS) facilities.....	28
5.3 Data link management service (DLMS)	28
5.3.1 Overview	28
5.3.2 Reset.....	29
5.3.3 Set-value	29
5.3.4 Get-value.....	29
5.3.5 SAP-allocation	29
5.3.6 SAP-deallocation	29
5.3.7 Get-SAP information.....	29
5.3.8 Get-diagnostic-information.....	29
5.3.9 Event.....	29

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5.3.10	Get-path	29
5.4	Overview of interactions	29
5.5	Detailed specification of service and interactions	31
5.5.1	Reset	31
5.5.2	Set-value	31
5.5.3	Get-value	32
5.5.4	SAP-allocation	33
5.5.5	SAP-deallocation	34
5.5.6	Get-SAP-information	35
5.5.7	Get-diagnostic-information	36
5.5.8	Event	37
5.5.9	Get-path	38
6	MAC control service	39
6.1	General	39
6.2	MAC control service	39
6.2.1	Overview	39
6.2.2	MAC-reset	39
6.2.3	MAC-forward-control	39
6.3	Overview of interactions	39
6.4	Detailed specification of service and interactions	40
6.4.1	MAC-reset	40
6.4.2	MAC-forward-control	41
7	Ph-control service	42
7.1	General	42
7.2	Ph-control service	42
7.2.1	Overview	42
7.2.2	Ph-reset	42
7.2.3	Ph-get-link-status	42
7.2.4	Ph-link-status-change	42
7.3	Overview of interactions	42
7.4	Detailed specification of service and interactions	43
7.4.1	Ph-reset	43
7.4.2	Ph-get-link-status	44
7.4.3	Ph-link-status-change	45
	Bibliography	46
	Figure 1 – Full-duplex flow control	18
	Figure 2 – Sequence diagram of DL-DATA service	18
	Figure 3 – Sequence diagram of DL-SPDATA service	19
	Figure 4 – Sequence diagram of NCM service primitive	19
	Figure 5 – Relationships of DLSAPs, DLSAP-addresses, and group DL-addresses	20
	Figure 6 – DL-DATA service	21
	Figure 7 – Sequence diagram of Reset, Set-value, Get-value, SAP-allocation, SAP-deallocation, Get-SAP information and Get-diagnostic information service primitives	30
	Figure 8 – Sequence diagram of Event service primitive	31
	Figure 9 – Sequence diagram of MAC-reset and MAC-forward-control service primitive	40
	Figure 10 – Sequence diagram of Ph-reset and Ph-get-link-status service primitive	43

Figure 11 – Sequence diagram of Ph-link-status-change service primitive	43
Table 1 – Destination DL-address	20
Table 2 – Primitives and parameters used in DL-DATA service	22
Table 3 – DL-DATA Primitives and Parameters	22
Table 4 – Primitives and parameters used in DL-SPDATA service	24
Table 5 – DL-SPDATA Primitives and Parameters	24
Table 6 – Primitives and parameters used on DL-NCM_SND service	25
Table 7 – DL-NCM_SND Primitives and Parameters	26
Table 8 – Summary of Network Control Message Type	27
Table 9 – Summary of DL-management primitives and parameters	30
Table 10 – DLM-RESET primitives and parameters	31
Table 11 – DLM-SET_VALUE primitives and parameters	32
Table 12 – DLM-GET_VALUE primitives and parameters	33
Table 13 – DLM-SAP_ALLOC primitives and parameters	34
Table 14 – DLM-SAP_DEALLOC primitives and parameters	35
Table 15 – DLM-GET_SAP_INFO primitives and parameters	35
Table 16 – DLM-GET_DIAG primitives and parameters	36
Table 17 – DLM-EVENT primitives and parameters	37
Table 18 – DLM event identifier (standards.iteh.ai)	38
Table 19 – DLM-GET_PATH primitives and parameters	38
Table 20 – Summary of MAC control primitives and parameters	40
Table 21 – MAC-RESET primitives and parameters	40
Table 22 – MAC-FW_CTRL primitives and parameters	41
Table 23 – Summary of Ph-control primitives and parameters	42
Table 24 – Ph-RESET primitives and parameters	43
Table 25 – Ph-GET_LINK_STATUS primitives and parameters	44
Table 26 – Ph-LINK_STATUS_CHANGE primitives and parameters	45

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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELD BUS SPECIFICATIONS –****Part 3-21: Data-link layer service definition –
Type 21 elements**

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NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-3-21 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

- added Network Control Message Type;
- miscellaneous editorial corrections.

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

FDIS	Report on voting
65C/945/FDIS	65C/954/RVD

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

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

A list of all parts of the IEC 61158 series, published 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 publication will remain unchanged until the stability 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

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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.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-21: Data-link layer service definition – Type 21 elements

1 Scope

1.1 Overview

This part of IEC 61158 provides the common elements for basic time-critical messaging communications between devices in an automation environment. The term “time-critical” in this context means the prioritized full-duplex collision-free time-deterministic communication, of which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the required time risks the failure of the applications requesting the actions, with attendant risk to equipment, plant, and possibly human life.

This International Standard defines in an abstract way the externally visible service provided by the Type 21 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 that they take; and
- c) the interrelationships between these actions and events, and their valid sequences.

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

- The Type 21 application layer at the boundary between the application and DLLs of the fieldbus reference model;
- Systems management at the boundary between the DLL and the systems management of the fieldbus reference model.

1.2 Specifications

The principal objective of this document is to specify the characteristics of conceptual DLL services suitable for time-critical communications, and to 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 may be used as the basis for formal data link programming interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this document, including:

- a) The sizes and octet ordering of various multi-octet service parameters;
- b) The correlation of paired primitives for request and confirm, or indication and response.

1.3 Conformance

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

There is no conformance of equipment to this data-link layer service definition document. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfils the Type 21 DLL 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 IEC 61784-1 and IEC 61784-2 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/IEEE 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

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.

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

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

3.1 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	[ISO/IEC 7498-3]
3.1.2	DL-address-mapping	[ISO/IEC 7498-1]
3.1.3	called-DL-address	[ISO/IEC 7498-3]
3.1.4	calling-DL-address	[ISO/IEC 7498-3]
3.1.5	centralized multi-end-point-connection	[ISO/IEC 7498-1]
3.1.6	DL-connection	[ISO/IEC 7498-1]
3.1.7	DL-connection-end-point	[ISO/IEC 7498-1]
3.1.8	DL-connection-end-point-identifier	[ISO/IEC 7498-1]
3.1.9	DL-connection-mode transmission	[ISO/IEC 7498-1]
3.1.10	DL-connectionless-mode transmission	[ISO/IEC 7498-1]
3.1.11	correspondent (N)-entities correspondent DL-entities (N=2) correspondent Ph-entities (N=1)	[ISO/IEC 7498-1]
3.1.12	DL-duplex-transmission	[ISO/IEC 7498-1]
3.1.13	(N)-entity DL-entity (N=2) Ph-entity (N=1)	[ISO/IEC 7498-1]
3.1.14	DL-facility	[ISO/IEC 7498-1]
3.1.15	flow control	[ISO/IEC 7498-1]
3.1.16	(N)-layer DL-layer (N=2) Ph-layer (N=1)	[ISO/IEC 7498-1]
3.1.17	layer-management	[ISO/IEC 7498-1]
3.1.18	DL-local-view	[ISO/IEC 7498-3]
3.1.19	DL-name	[ISO/IEC 7498-3]
3.1.20	naming-(addressing)-domain	[ISO/IEC 7498-3]
3.1.21	peer-entities	[ISO/IEC 7498-1]
3.1.22	primitive name	[ISO/IEC 7498-3]
3.1.23	DL-protocol	[ISO/IEC 7498-1]
3.1.24	DL-protocol-connection-identifier	[ISO/IEC 7498-1]
3.1.25	DL-protocol-data-unit	[ISO/IEC 7498-1]
3.1.26	DL-relay	[ISO/IEC 7498-1]
3.1.27	Reset	[ISO/IEC 7498-1]
3.1.28	responding-DL-address	[ISO/IEC 7498-3]
3.1.29	Routing	[ISO/IEC 7498-1]
3.1.30	Segmenting	[ISO/IEC 7498-1]
3.1.31	(N)-service DL-service (N=2) Ph-service (N=1)	[ISO/IEC 7498-1]

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3.1.32	(N)-service-access-point DL-service-access-point (N=2) Ph-service-access-point (N=1)	[ISO/IEC 7498-1]
3.1.33	DL-service-access-point-address	[ISO/IEC 7498-3]
3.1.34	DL-service-connection-identifier	[ISO/IEC 7498-1]
3.1.35	DL-service-data-unit	[ISO/IEC 7498-1]
3.1.36	DL-simplex-transmission	[ISO/IEC 7498-1]
3.1.37	DL-subsystem	[ISO/IEC 7498-1]
3.1.38	systems-management	[ISO/IEC 7498-1]
3.1.39	DLS-user-data	[ISO/IEC 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	asymmetrical service	
3.2.3	confirm (primitive); requestor.deliver (primitive)	
3.2.4	deliver (primitive)	
3.2.5	DL-confirmed-facility	IEC 61158-3-21:2019
3.2.6	DL-facility	https://standards.iteh.ai/catalog/standards/sist/00ae9c25-bafd-4dd3-a273-4e61968faf9a/iec-61158-3-21-2019
3.2.7	DL-local-view	
3.2.8	DL-mandatory-facility	
3.2.9	DL-non-confirmed-facility	
3.2.10	DL-protocol-machine	
3.2.11	DL-provider-initiated-facility	
3.2.12	DL-provider-optional-facility	
3.2.13	DL-service-primitive; primitive	
3.2.14	DL-service-provider	
3.2.15	DL-service-user	
3.2.16	DLS-user-optional-facility	
3.2.17	indication (primitive); acceptor.deliver (primitive)	
3.2.18	multi-peer	
3.2.19	request (primitive); requestor.submit (primitive)	
3.2.20	requestor	

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

3.2.22 submit (primitive)

3.2.23 symmetrical service

3.3 Common data-link service terms and definitions

For the purpose of this document, the following definitions also apply.

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

3.3.1

active network

network in which data transmission between non-immediately-connected devices is dependent on active elements within those intervening devices that form the connection path

[SOURCE: IEC 61918, 3.1.3]

3.3.2

DL-segment

link

local link

single data link (DL) subnetwork in which any of the connected data link entities (DLEs) may communicate directly, without any intervening data link 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

3.3.3

data-link service access point

DLSAP

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

Note 1 to entry: Definition derived from ISO/IEC 7498-1:1994, Clause 5.

3.3.4

DL(SAP) -address

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

Note 1 to entry: This terminology was 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.

3.3.5

(individual) DLSAP-address

DL-address that designates only one DLSAP within the extended link

Note 1 to entry: A single DL-entity may have multiple DLSAP-addresses associated with a single DLSAP.

3.3.6

Data-link connection endpoint address

DLCEP-address

DL-address that designates either:

a) one peer DL-connection-end-point;

- b) one multi-peer publisher DL-connection-end-point, and implicitly the corresponding set of subscriber DL-connection-end-points, where each DL-connection-end-point exists within a distinct DLSAP and is associated with a corresponding distinct DLSAP-address.

3.3.7

DL-entity identifier

address that designates the (single) DLE associated with a single device on a specific local link

3.3.8

device

single DLE as it appears on one local link

3.3.9

end-station

system attached to a network that is an initial source or a final destination of MAC frames transmitted across that network

Note 1 to entry: A network layer router is, from the perspective of the network, an end-station. A switch, in its role of forwarding MAC frames from one link to another, is not an end-station.

[SOURCE: IEC 61784-2, 3.1.5]

3.3.10

frame

unit of data transmission on an ISO/IEC/IEEE 8802-3 MAC (Media Access Control) that conveys a protocol data unit (PDU) between MAC service users

[SOURCE: IEEE 802.1Q-2011]

3.3.11

Frame check sequence (FCS) error

error that occurs when the computed frame check sequence value after reception of all the octets in a data link protocol data unit (DLPDU) does not match the expected residual

3.3.12

linear topology

topology where the nodes are connected in series, with two nodes connected to only one other node and all others each connected to two other nodes (that is, connected in the shape of a line)

Note 1 to entry: This topology corresponds to that of an open ring.

[SOURCE: IEC 61918, 3.1.51]

3.3.13

link

transmission path between two adjacent nodes

[SOURCE: derived from ISO/IEC 11801]

3.3.14

network management

management functions and services that perform network initialization, configuration, and error handling

3.3.15

node

network entity connected to one or more links