

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 4-25: Data-link layer protocol specification – Type 25 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 4-25: Spécification du protocole de la couche liaison de données –
Éléments de type 25**



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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
1.1 General.....	8
1.2 Specifications	8
1.3 Procedures	8
1.4 Applicability	9
1.5 Conformance	9
2 Normative references	9
3 Terms, definitions, symbols, abbreviations and conventions	9
3.1 Reference model terms and definitions	10
3.2 Service convention terms and definitions	11
3.3 Terms and definitions.....	11
3.4 Symbols and abbreviations	13
3.5 Common conventions.....	14
3.6 Additional Type 25 conventions	16
3.6.1 Primitive conventions.....	16
3.6.2 State machine conventions.....	16
4 Overview of the DL-protocol	17
4.1 General.....	17
4.2 Overview of the medium access control	17
4.2.1 General	17
4.2.2 Network topology	18
4.2.3 Priority control with VLAN	19
4.2.4 The maximum delivery delay in Type 25 network	20
4.2.5 Traffic control for real-time communication	21
4.3 Service assumed from PhL	21
4.4 DL Layer architecture.....	22
4.5 Local parameters and variables	23
4.5.1 Overview	23
4.5.2 Variables, parameter, counter and timer	23
5 General structure and encoding of PhPDUs and DLPDU and related elements of procedure	24
5.1 Overview	24
5.2 Common MAC frame structure, encoding and elements of procedure.....	24
5.2.1 MAC frame structure.....	24
5.2.2 Elements of the MAC frame	25
6 DLPDU-specific structure, encoding and elements of procedure	27
6.1 General.....	27
6.2 Structure of the RCL DLPDU.....	27
6.2.1 RCL header	27
7 DLE elements of procedure	29
7.1 Overview	29
7.2 RCL communication control (RCLC).....	29
7.2.1 General	29
7.2.2 Primitive definitions	29

7.2.3	RCLC state machine	32
7.2.4	Function of RCLC	48
7.3	Real-time communication control (RTC)	48
7.3.1	General	48
7.3.2	Primitive definitions	48
7.3.3	RTC state machine	50
7.3.4	Function of RTC	51
7.4	Transmit/Receive control (TRC)	52
7.4.1	General	52
7.4.2	Primitive definitions	52
7.4.3	TRC state machine	52
7.4.4	Function of TRC	57
7.5	DLL management protocol (DLM)	58
7.5.1	Overview	58
7.5.2	Primitive definitions	58
7.5.3	DLM state machine (DLM_SM)	59
	Bibliography	61
	Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses	16
	Figure 2 – Ring control in Type 25 network	18
	Figure 3 – Communication ranges of Type 25 frames	19
	Figure 4 – Priority control with VLAN of Type 25 network	20
	Figure 5 – The mechanism of transmission delay in a node	20
	Figure 6 – The maximum delay in Type 25 network	21
	Figure 7 – Data-Link layer internal architecture	22
	Figure 8 – Type 25 fieldbus DLPDU frame format	25
	Figure 9 – RCL frame format	26
	Figure 10 – State transition diagram of RHE_SM-A	33
	Figure 11 – State transition diagram of RHE_SM-B	36
	Figure 12 – The state diagram of RCLNode_SM	39
	Figure 13 – The state diagram of RCLTR_SM	46
	Figure 14 – The state diagram of RTTR_SM	51
	Figure 15 – The state diagram of TRC_SM	52
	Figure 16 – The state diagram of DLM_SM	59
	Table 1 – State transition descriptions	16
	Table 2 – Descriptions of state machine elements	17
	Table 3 – Conventions used in state machine	17
	Table 4 – Characteristics of the node states	18
	Table 5 – Characteristic of the frame classes	19
	Table 6 – VLAN priority mapping of Type 25 network	19
	Table 7 – Data-link layer components	22
	Table 8 – Destination address format	25
	Table 9 – VLAN tag format	26
	Table 10 – Types and classes of RCL frames	27

Table 11 – Structure of RCL header	28
Table 12 – Class field format	28
Table 13 – Destination address field format	28
Table 14 – Source address field format.....	29
Table 15 – CMD field format	29
Table 16 – The primitives and parameters for DLS-user interface	30
Table 17 – Parameters used with primitives exchanged between RCLC and DLS-user	30
Table 18 – The primitives and parameters for TRC interface.....	31
Table 19 – Parameters used with primitives exchanged between RCLC and TRC	31
Table 20 – The primitives and parameters for DLM interface.....	32
Table 21 – Parameters used with primitives exchanged between RCLC and DLM.....	32
Table 22 – Transitions of RHE_SM-A at RCL communication.....	33
Table 23 – Transitions of RHE_SM-B at RCL communication.....	36
Table 24 – Transitions of RCLNode_SM at RCL communication	39
Table 25 – Transitions of RCLTR_SM at RCL communication	47
Table 26 – RCLC function table	48
Table 27 – The primitives and parameters for DLS-user interface	49
Table 28 – Parameters used with primitives exchanged between RTC and DLS-user.....	49
Table 29 – The primitives and parameters for TRC interface.....	49
Table 30 – Parameters used with primitives exchanged between RTC and TRC	50
Table 31 – The primitives and parameters for DLM interface.....	50
Table 32 – Parameters used with primitives exchanged between RTC and DLM	50
Table 33 – Transitions of RTTR_SM at RT communication.....	51
Table 34 – RTC function table.....	51
Table 35 – The primitives and parameters for DLM interface.....	52
Table 36 – Parameters used with primitives exchanged between TRC and DLM	52
Table 37 – Transitions of TRC_SM	53
Table 38 – TRC function table.....	57
Table 39 – Primitives exchanged between DLM and DLS-user.....	58
Table 40 – Parameters used with primitives exchanged between DLM and DLS-user.....	59
Table 41 – Transitions of DLM_SM	60

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FIELDBUS SPECIFICATIONS –****Part 4-25: Data-link layer protocol specification –
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65C/946/FDIS	65C/955/RVD

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

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

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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.

The data-link protocol provides the data-link service by making use of the services available from the physical layer. The primary aim of this document is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer data-link entities (DLEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- a) as a guide for implementers and designers;
- b) for use in the testing and procurement of equipment;
- c) as part of an agreement for the admittance of systems into the open systems environment;
- d) as a refinement to the understanding of time-critical communications within OSI.

This document is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this document together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

NOTE Use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in Type combinations as specified explicitly in the profile parts. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning Type 25 elements and possibly other types given in this document as follows:

JP4074631 [HI]	Transmission line system, frame transmitter therein, and transmission line switching method
JP4653800 [HI]	Transmission line system, frame transmission apparatus, method and program for switching transmission line in transmission line system
JP4944986 [HI]	Transmission line system and transmission line construction method
CN1964307 [HI]	Transfer path system and frame transfer device in same system, transfer path handover method and system
CN101515887 [HI]	Transmission line system, frame transmitter therein, transmission line switching method and program

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-25: Data-link layer protocol specification – Type 25 elements

1 Scope

1.1 General

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides communication opportunities to all participating data-link entities

- a) in a synchronously-starting cyclic manner, according to a pre-established schedule, and
- b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This document specifies

- a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed datalink service provider;
- b) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals up to one millisecond;
- c) procedures for giving communication opportunities available for time-critical data transmission together with non-time-critical data transmission without prejudice to the time-critical data transmission;
- d) procedures for giving cyclic and acyclic communication opportunities for time-critical data transmission with prioritized access;
- e) procedures for giving communication opportunities based on ISO/IEC/IEEE 8802-3 medium access control, with provisions for nodes to be added or removed during normal operation;
- f) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this document, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

- a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;
- b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;
- c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation's capability, and thus its applicability to various time-critical communications needs.

1.5 Conformance

This document also specifies conformance requirements for systems implementing these procedures. This document does not contain tests to demonstrate compliance with such requirements.

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*

[IEC 61158-4-25:2019](https://standards.iteh.ai/catalog/standards/sist/b115a7e5-9734-4ef8-8220-a8d09b3b0ca/iec-61158-4-25-2019)

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

ISO/IEC/IEEE 8802-3:2017, *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*

IEEE Std 802.1D, *IEEE Standard for Local and metropolitan area networks – Media access Control (MAC) Bridges*, available at <http://www.ieee.org> [viewed 2018-09-17]

IEEE Std 802.1Q, *IEEE Standard for Local and metropolitan area networks – Bridges and Bridged Networks*, available at <http://www.ieee.org> [viewed 2018-09-17]

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]
3.1.32	(N)-service-access-point DL-service-access-point (N=2) Ph-service-access-point (N=1)	[ISO/IEC 7498-1]

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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	
3.2.6 DL-facility	
3.2.7 DL-local-view	
3.2.8 DL-mandatory-facility	
3.2.9 DL-non-confirmed-facility	
3.2.10 DL-provider-initiated-facility	
3.2.11 DL-provider-optional-facility	
3.2.12 DL-service-primitive; primitive	
3.2.13 DL-service-provider	
3.2.14 DL-service-user	
3.2.15 DLS-user-optional-facility	
3.2.16 indication (primitive); acceptor.deliver (primitive)	
3.2.17 multi-peer	
3.2.18 request (primitive); requestor.submit (primitive)	
3.2.19 requestor	
3.2.20 response (primitive); acceptor.submit (primitive)	
3.2.21 submit (primitive)	
3.2.22 symmetrical service	
3.3 Terms and definitions	

3.3.1

blocking

port state which does not participate in frame communication

3.3.2

class

identifiers that designate communication range of the RCL frame and the other frames

3.3.3

control communication

non-real-time acyclic data communication for higher priority applications and node control communication

3.3.4

cyclic communication

periodic data communication for real-time communication

3.3.5

DLCEP-address

DL-address which designates either

- a) one peer DL-connection-end-point, or
- 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.

3.3.6

DLSAP

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

3.3.7

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 1 to entry: 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.

<https://standards.iteh.ai/catalog/standards/sist/b115a7e5-9734-4ef8-8220-a8d69b55b0ca/iec-61158-4-25-2019>

3.3.8

(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.

3.3.9

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

3.3.10

frame

denigrated synonym for DLPDU

3.3.11

group DL-address

DL-address that potentially designates more than one DLSAP within the extended link

Note 1 to entry: A single DL-entity may have multiple group DL-addresses associated with a single DLSAP. A single DL-entity also may have a single group DL-address associated with more than one DLSAP.

3.3.12

information communication

non-real-time acyclic data communication for low priority applications

3.3.13**logical link down**

link status at which the port is in a blocking state and does not communicate all kinds of frames except RCL frames

3.3.14**logical link up**

link status at which the port communicates all kinds of frames

3.3.15**node**

single DL-entity as it appears on one local link

3.3.16**physical link down**

link status at which the port does not communicate the frames due to link down status defined in ISO/IEC/IEEE 8802-3

3.3.17**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.

3.3.18**ring control (RCL) communication**

control communication of Type 25 DLL ring network using RCL frames and non-real-time

3.3.19**sending DLS-user**

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

3.3.20**station**

synonym for node

3.3.21**station address**

identifier address that designates the node of Type 25 network

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
DLM	DL-management
DLME	DL-management Entity (the local active instance of DL-management)
DLMS	DL-management service
DLPCI	DL-protocol-control-information
DLPDU	DL-protocol-data-unit
DLS	DL-service