

INTERNATIONAL STANDARD

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**Industrial communication networks – Fieldbus specifications –
Part 3-28: Data-link layer service definition – Type 28 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 3 28: Définition des services de la couche liaison de données – Éléments
de type 28**

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ELECTROTECHNICAL
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INTERNATIONALE

ICS 25.040

ISBN 978-2-8322-6573-4

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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 3-28: Data-link layer service definition –
Type 28 elements**

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

IEC 61158-3-28 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

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

Draft	Report on voting
65C/1206/FDIS	65C/1235/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.

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- amended.

IEC 61158-3-28:2023

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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 3-28: Data-link layer service definition – Type 28 elements

1 Scope

1.1 General

This part of IEC 61158 describes basic packet communication services and models in an automation control industrial field environment. The Type 28 data-link layer provides time-critical and non-time-critical communication services. Time-critical refers to the requirement to complete specified functions between devices in a defined time window in an industrial field environment. Failure to complete specified functions within the time window can lead to failure or harm in industrial production.

This document defines in an abstract way the externally visible service provided by the Type 28 fieldbus data-link layer in terms of

- a) function description;
- b) primitive actions and events with primitive sequence diagram;
- c) the form of externally service interface and related parameters.

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

- the Type 28 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.

Type 28 DL-service provides both a connected and a connectionless subset of those services provided by OSI data-link protocols as specified in ISO/IEC 8886.

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-sensitive communications. A secondary objective is to provide migration paths from previously-existing industrial communications protocols.

This specification 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; and
- 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 28 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.

IEC 61158-2:2023, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-4-28:2023, *Industrial communication networks – Fieldbus specifications – Part 4-28: Data-link layer protocol specification – Type 28 elements*

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: Naming and addressing*

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

ISO/IEC 8886, *Information technology – Open Systems Interconnection – Data link service definition*

ISO/IEC/IEEE 8802-3:2021, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

3 Terms, definitions, 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	[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) DL-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]
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 Common data-link service terms and definitions**

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

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

3.3.1

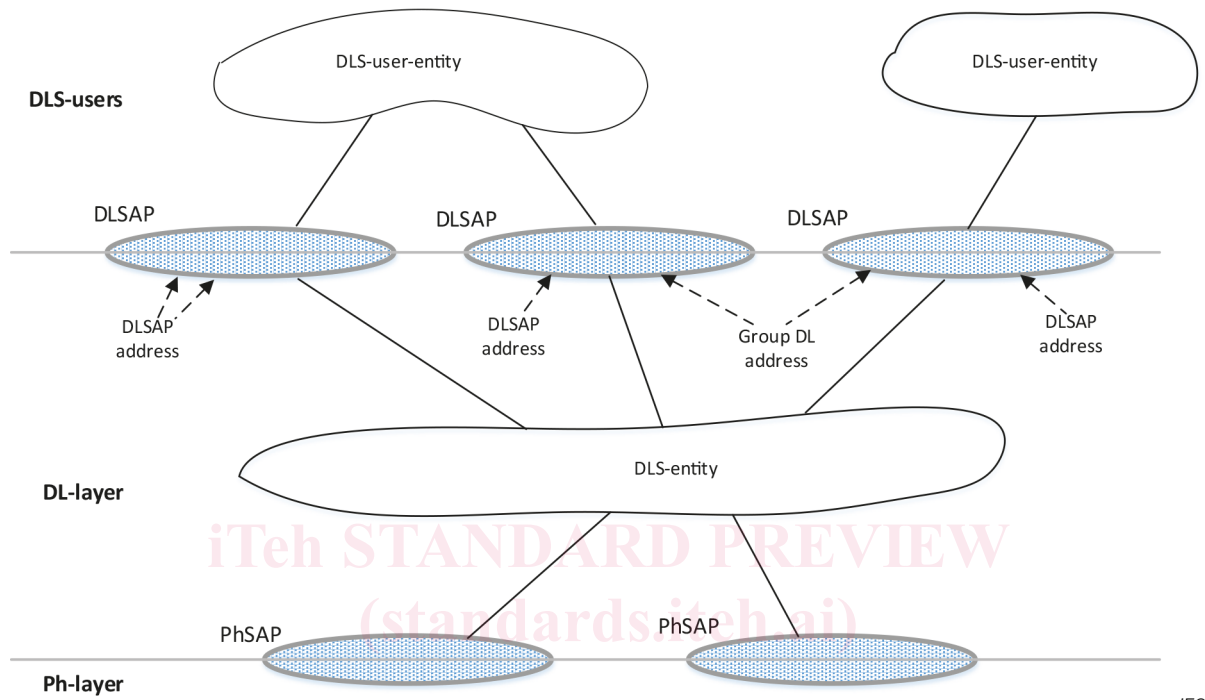
DL-segment, link, local link

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



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Note 2 to entry: DLSAPs and PhSAPs are depicted as ovals spanning the boundary between two adjacent layers.

Note 3 to entry: DL-addresses are depicted as designating small gaps (points of access) in the DLL portion of a DLSAP.

Note 4 to entry: 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 where each DLSAP is from 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.

**3.3.4
(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.

**3.3.5
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 1 to entry: An extended link may be composed of just a single link.

3.3.6

frame

denigrated synonym for DLPDU

3.3.7

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 may also have a single group DL-address associated with more than one DLSAP.

3.3.8

node

single DL-entity as it appears on one local link

3.3.9

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.

3.3.10

sending DLS-user

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

3.4 Additional Type 28 data-link specific definitions

3.4.1

control device

device that controls all field devices for logical operations, timing, calculations, etc.

3.4.2

management node

device for allocating and managing Type 28 network physical communication resources

3.4.3

terminal node

device in Type 28 network that communicates based on allocated physical communication resources

3.4.4

clock synchronization

clock calibration of the terminal node device

3.4.5

cyclic time

time of cyclic processing of a device or module

3.4.6

RT data

data sensitive to time deterministic requirements

3.4.7

non-RT data

data insensitive to time deterministic requirements