

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 3-18: Data-link layer service definition – Type 18 elements**

**Réseaux de communications industriels – Spécifications des bus de terrain –
Partie 3-18: Définition du service de la couche de liaison de données –
Éléments de Type 18**





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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –**
Part 3-18: Data-link layer service definition – Type 18 elements

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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 IEC 61784 series. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

International Standard IEC 61158-3-18 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 a technical addition.

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.

This bilingual version (2013-07) corresponds to the monolingual English version, published in 2007-12.

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.

The French version of this standard has not been voted upon.

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.

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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.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-18: Data-link layer service definition – Type 18 elements

1 Scope

1.1 Overview

This standard provides common elements for basic time-critical and non-time-critical messaging communications between devices in an automation environment and material specific to Type 18 fieldbus. 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 18 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.

This standard defines the services provided to

- the Type 18 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model, and
- system 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 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 standard. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfills the Type 18 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: The Basic Model*

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – 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 | [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] |
| 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 standard 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 Data-link service terms and definitions

3.3.1

DLE station identifier

network address assigned to a DLE

3.3.2

DLE station slot

unit (granularity of one) of position dependent mapping (for cyclic data field) of which a DLE may occupy one or more, delineated by the range beginning at the DLE station identifier with a length equal to the configured number of occupied slots

3.3.3

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

3.3.4 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.

3.3.5 DL(SAP)-address

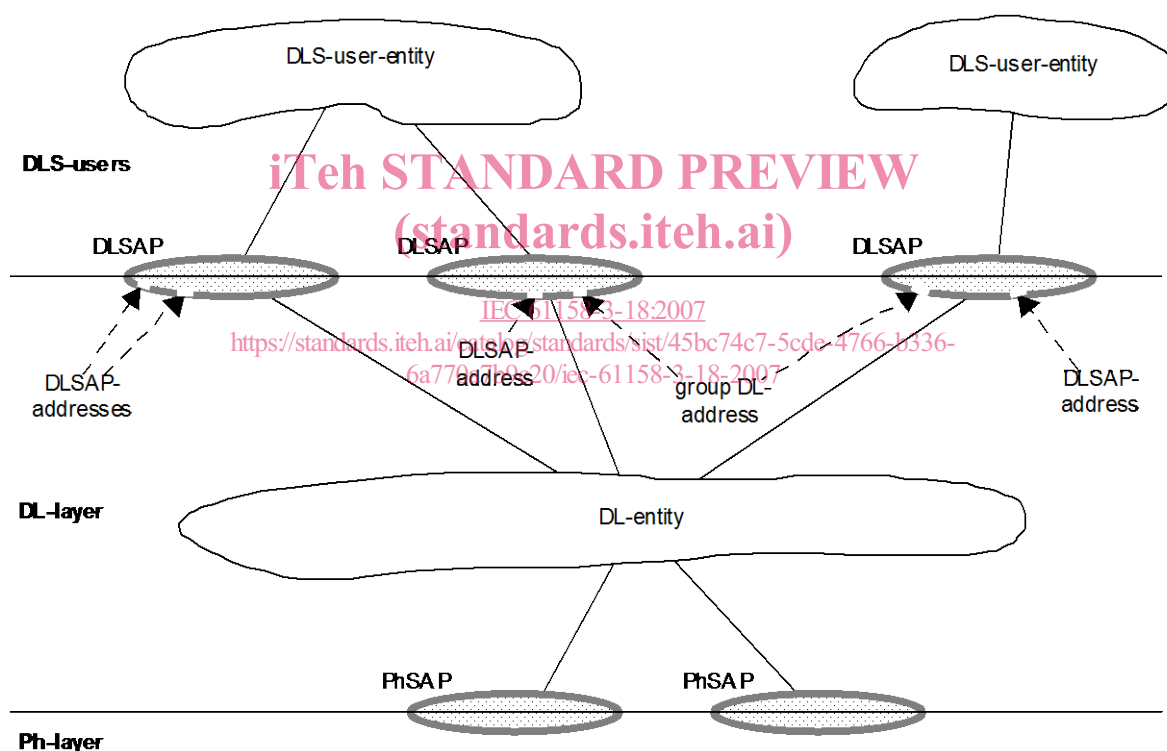
either an individual DLSAP-address, designating a single DLSAP of a single DLS-user, or a group DL-address potentially designating multiple DLSAPs, each of a single DLS-user

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.

3.3.6 (individual) DLSAP-address

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

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



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

3.3.7 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.

3.3.8

frame

denigrated synonym for DLPDU

3.3.9

group DL-address

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

NOTE 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.

3.3.10

master DLE

DLE that performs the functions of network master

3.3.11

master-packed DLE

master DLE that uses the packed response access protocol

3.3.12

master-polled DLE

master DLE that uses the polled response access protocol

3.3.13

node

single DL-entity as it appears on one local link

3.3.14

packed response

transmission of data managed by the process of a master broadcasting a trigger message whereupon each slave waits a time period unique to its DLE station identifier then transmits its response resulting in a time-sliced packing of all slave responses triggered by a single master request

3.3.15

polled response

transmission of data managed by the process of a master individually interrogating each slave in a request/response paradigm

3.3.16

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.

3.3.17

RWr

DLS-user visible register containing word-oriented cyclic data of type input data that is transmitted from a slave DLE to a master DLE

3.3.18

RWw

DLS-user visible register containing word-oriented cyclic data of type input data that is transmitted from a master DLE to a slave DLE

3.3.19

RX

DLS-user visible register containing bit-oriented cyclic data of type input data that is transmitted from a slave DLE to a master DLE

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3.3.20**RY**

DLS-user visible register containing bit-oriented cyclic data of type output data that is transmitted from a master DLE to a slave DLE

3.3.21**sending DLS-user**

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

3.3.22**slave DLE**

DLE that performs the functions of network slave

3.3.23**slave-packed DLE**

slave DLE that uses the packed response access protocol

3.3.24**slave-polled DLE**

slave DLE that uses the polled response access protocol

3.4 Common symbols and abbreviations

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

3.5 Conventions**3.5.1 Basic conventions**

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