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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 3-7: Data-link layer service definition – Type 7 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 3-7: Définition du service de la couche de liaison de données – Éléments de Type 7

IEC 61158-3-7:2007

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FOREWORD

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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 61158-3-7 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.

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.

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 3-7: Data-link layer service definition – Type 7 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 7 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 7 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 7 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 [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 correspondent (N)-entities [7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

3.1.6 (N)-entity [7498-1]
DL-entity (N=2)
Ph-entity (N=1)

3.1.7 flow control [7498-1]

3.1.8 (N)-layer [7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.9 DL-name [7498-3]

3.1.10 peer-entities [7498-1]

3.1.11 primitive name [7498-3]

3.1.12 DL-protocol [7498-1]

3.1.13 DL-protocol-connection-identifier [7498-1]

3.1.14 DL-protocol-data-unit [7498-1]

3.1.15 DL-relay [7498-1]

3.1.16 (N)-service [7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.17 (N)-service-access-point [7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.1.18 DL-service-data-unit [7498-1]

3.1.19 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 acceptor

3.2.2 confirm (primitive);
requestor.deliver (primitive)

3.2.3 deliver (primitive)

3.2.4 DL-service-primitive;
primitive

3.2.5 DL-service-provider

3.2.6 DL-service-user

3.2.7 indication (primitive);
acceptor.deliver (primitive)

3.2.8 multi-peer

3.2.9 request (primitive);
requestor.submit (primitive)

3.2.10 requestor

3.2.11 response (primitive);
acceptor.submit (primitive)

3.2.12 submit (primitive)

3.3 Data-link service terms and definitions

3.3.1
acknowledgement response DLPDU
information that the recipient of an acknowledged message emits in order to signal either the proper reception of the message or the lack of available resources to store the message, received by the DLE on the local link that emitted the message which requested the acknowledgement

3.3.2
basic cycle
sequence of scanning by the bus-arbitrator of

a) a set of DLCEP-identifiers for variables, requests, and cyclical application messages;

b) plus a window provided for aperiodic exchanges;

c) plus a window provided for message services;

d) plus a window provided for synchronization

3.3.3
basic transaction
succession of DLPDUs related to a single DL-service instance

3.3.4
bus-arbitrator (BA)
DLE that controls each data producer's right to access the medium

NOTE At any given instant one and only one bus-arbitrator is active in each DL-segment of a DL-subnetwork.

3.3.5
control field
portion of an emitted or received DLPDU that gives the nature of the data exchanged and the type of exchange

3.3.6
destination address
three octets specifying the DL-segment of the DLE to whom the message is sent, and the destination DLSAP's sub-address within the local link

3.3.7
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

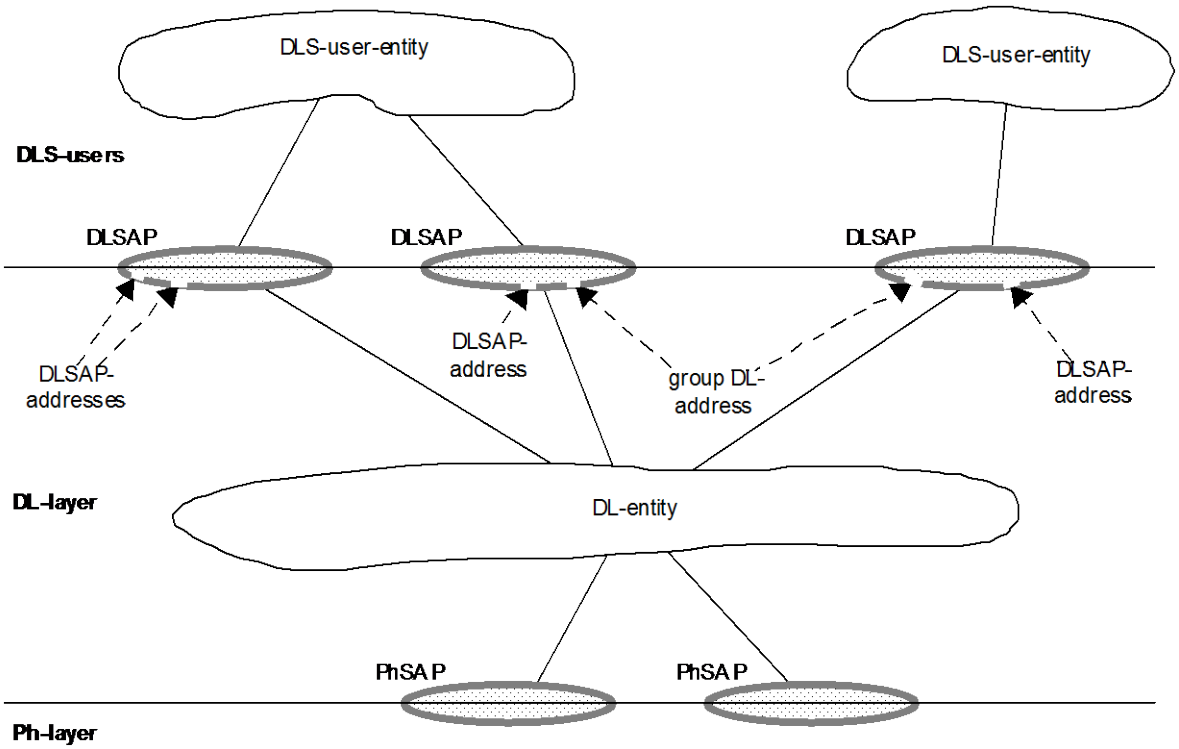
3.3.8
DL-segment, local link
set of devices that respect the DL-protocol and that are interconnected through a PhL. Only one bus-arbitrator is active on a single DL-segment

3.3.9
DLCEP-identifier
two octets specifying a link-local DLCEP-identifier associated with a system variable. A DLCEP-identifier uniquely designates a single DL-accessible variable within the local link

3.3.10
DLCEP-identifier DLPDU
information that a bus-arbitrator emits to allocate the local link to a data publisher for the purpose of exchanging a variable

3.3.11
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

3.3.12
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.

3.3.13
(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.

3.3.14
end of message transaction indication DLPDU
information that the source entity of a message emits in order to return link access control to the bus-arbitrator at the end of a message transaction

3.3.15
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.

3.3.16
frame
denigrated synonym for DLPDU

3.3.17
group DL-address
DL-address that potentially designates more than one DLSAP within the extended link. 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

3.3.18
identified variable (or simply "variable")
DLL system variable for which an associated DLCEP-identifier has been defined

3.3.19
invalid DLCEP-identifier
DLCEP-identifier not recognized locally

3.3.20
macrocycle
set of basic cycles needed for all cyclical DLCEP-identifiers to be scanned

3.3.21
message DLPDU identifier
information that a bus-arbitrator emits to allocate the medium to a source DLE for a message transfer

3.3.22
message response DLPDU
information that a data publisher emits in response to a message identifier DLPDU. This information is received and retained by the desired destination entity or entities

3.3.23
node
single DL-entity as it appears on one local link

3.3.24
periodic scanning of variables
action by the bus-arbitrator that guarantees the cyclical exchange of variables

NOTE This is the basic principle of the Type 7 DL-service and protocol.

3.3.25
published identified variable
variable that corresponds to a DLCEP-identifier for which the DLE emits data

3.3.26
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.

3.3.27
request DLPDU identifier
the information that a bus-arbitrator emits to allocate the medium to the initiator of an explicit request for a buffer transfer

3.3.28
request response DLPDU
the information that the initiator of an explicit request for a buffer transfer emits in response to a request identifier DLPDU. This information is received by the bus-arbitrator

3.3.29
sending DLS-user
DL-service user that acts as a source of DLS-user-data

3.3.30
source address
three octets specifying the local link-id of the entity sending the message, and the source DLSAP's sub-address within the local link

3.3.31
subscribed identified variable
variable that corresponds to a DLCEP-identifier for which the DLE receives data

3.3.32
triggered message scanning
function of a bus-arbitrator that makes it possible to transfer messages

3.3.33
triggered periodic scanning of messages
function of a bus-arbitrator that makes it possible to request triggered message exchanges cyclically

3.3.34
triggered periodic scanning of variables
function of a bus-arbitrator that makes it possible to request triggered variable transfers cyclically

3.3.35
triggered scanning of variables
function of a bus-arbitrator that makes possible the non-cyclical exchange of variables

3.3.36
turnaround time
time interval between reception or emission of the last MAC symbol of a DLPDU, signaled by a SILENCE indication from the PhL, and the reception or emission of the first MAC symbol of the subsequent DLPDU, signaled by an ACTIVITY indication from the PhL, both as measured in a given station

3.3.37
variable response DLPDU
information that a data producer emits in response to a DLCEP-identifier DLPDU, which also alerts data consumers to the relevance of the immediately time-proximate DLPDU.

3.4 Symbols and abbreviations

3.4.1 BA Bus-arbitrator

3.4.2 B_Dat_Cons Buffer which contains the value of the subscribed data

3.4.3 B_Dat_Prod Buffer which contains the value of the published data