IEC 61158-4-7

Edition 1.0 2007-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications –
Part 4-7: Data-link layer protocol specification – Type 7 elements

Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 4-7: Spécification de protocole de la couche de liaison de données –
Éléments de Type 7

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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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 from their respective intellectual-property-right holders.

International Standard IEC 61158-4-7 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 61158-4 subseries cancel and replace IEC 61158-4:2003. This edition of this part constitutes an editorial revision.

This edition of IEC 61158-4 includes the following significant changes from 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 -4-1, -4-2, …, -4-19.

This bilingual version (2013-09) 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/474/FDIS	65C/485/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.

The contents of the corrigendum of January 2014 have been included in this copy.

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.

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

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

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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 standard 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 data-link service provider;

b) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, 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 capabilities, and thus its applicability to various time-critical communications needs.

1.5 Conformance

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

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.

IEC 61158-2 (Ed.4.0), *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-7, *Industrial communication networks – Fieldbus specifications – Part 3-7: Data link service definition – Type 7 elements*

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 and abbreviations

For the purposes of this document, the following terms, definitions, symbols and abbreviations 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 correspondent (N)-entities [7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

3.1.2 DL-address [7498-3]

3.1.3 DL-connection [7498-1]

3.1.4 DL-connection-end-point [7498-1]

3.1.5 DL-connection-end-point-identifier [7498-1]

3.1.6 DL-name [7498-3]

3.1.7 DL-protocol [7498-1]

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

3.1.9 DL-protocol-control-information [7498-1]

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

3.1.11 DL-relay [7498-1]

3.1.12 DL-service-connection-identifier [7498-1]

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

3.1.14 DL-user-data [7498-1]

3.1.15 flow control [7498-1]

3.1.16 (N)-entity [7498-1]
DL-entity
Ph-entity

3.1.17 (N)-interface-data-unit [7498-1]
DL-service-data-unit (N=2)
Ph-interface-data-unit (N=1)

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

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

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

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

3.1.22 peer-entities [7498-1]

3.1.23 Ph-interface-control-information [7498-1]

3.1.24 Ph-interface-data [7498-1]

3.1.25 primitive name [7498-3]

3.1.26 reset [7498-1]

3.1.27 responding-DL-address [7498-3]

3.1.28 routing [7498-1]

3.1.29 segmenting [7498-1]

3.1.30 sequencing [7498-1]

3.1.31 system management [7498-1]
systems-management

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 confirm (primitive);
requestor.deliver (primitive)

3.2.2 deliver (primitive)

3.2.3 DL-service-primitive;
primitive

3.2.4 DL-service-provider

3.2.5 DL-service-user

3.2.6 DL-user-optional-facility

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 Other terms and definitions

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

For the purpose of this part of IEC 61158, the following definitions also apply:

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 the window provided for aperiodic exchanges,

c) plus the window provided for message services,

d) plus the 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
consumed identified variable
identified variable that corresponds to a DLCEP-identifier for which the entity in question receives data

3.3.6
control field
portion of an emitted or received DLPDU that gives the nature of the data exchanged and the type of exchange

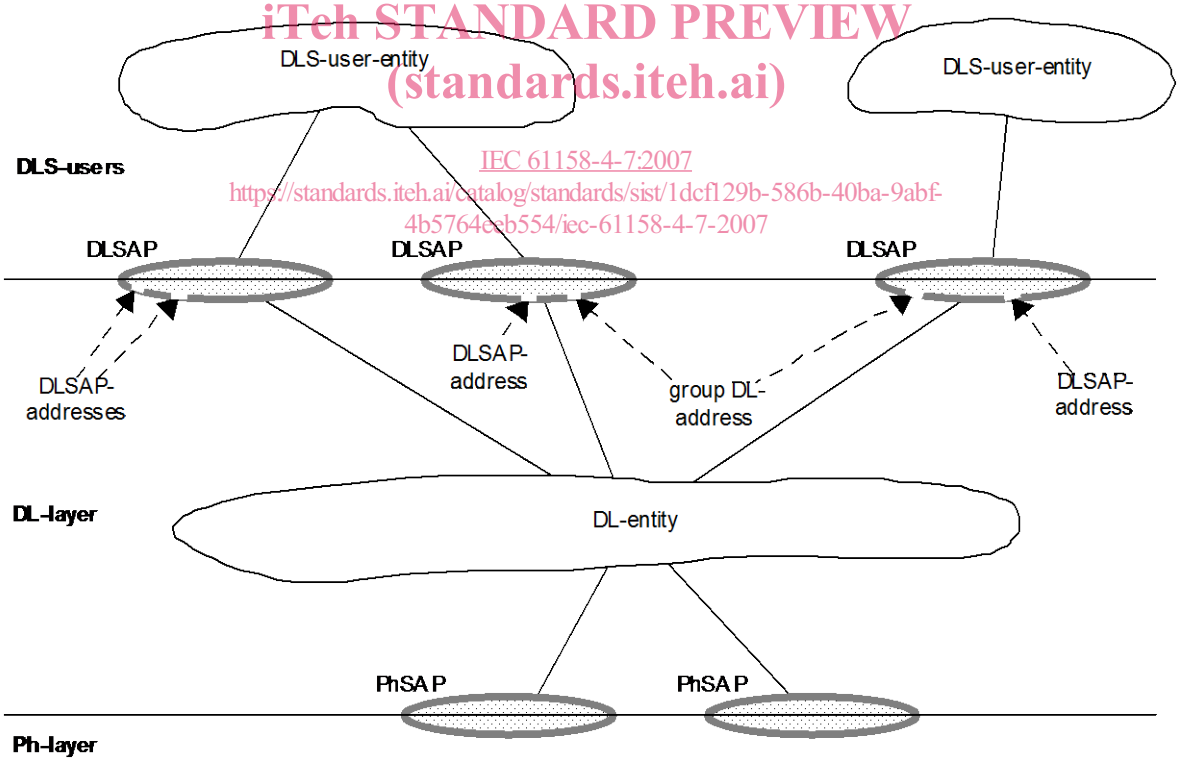
3.3.7
destination address
three octets specifying the DL-segment of the DLE to whom the message is sent, and the destination DLSAP's sub-address within the local link DL-segment

3.3.8
DLCEP-address
information that the bus-arbitrator emits to allocate the medium to a data producer for the purpose of exchanging a variable

3.3.9
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

3.3.10
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. (See Figure 1.)



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

3.3.11
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.