IEC 61158-4-14

Edition 3.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 4-14: Data-link layer protocol specification – Type 14 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 4-14: Spécification du protocole de la couche liaison de données –
Eléments de type 14**

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Part 4-14: Data-link layer protocol specification – Type 14 elements

FOREWORD

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Attention is drawn to the fact that the use of the associated protocol type is restricted by its 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 layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

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

International Standard IEC 61158-4-14 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision. The main changes with respect to the previous edition are listed below:

- provide stability date for the publication;

- update the Communication model;

- update the Encoding of DL-management Tag for FRT applications in Subclause 6.2.3;
- corrections the edit error;
- update of the requirements for all conformance classes;
- update of the requirements for all conformance services.

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/762/FDIS	65C/772/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.

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

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

The committee has decided that the contents of this publication will remain unchanged until the stability 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.

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 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.

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 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 14 elements and possibly other types given in Clause 5 as follows:

ZL 200410088676.7 [SPT]   Scheduling method with deterministic communication based on Ethernet

ZL 03142040.0 [SPT]   A scheduling method for deterministic communication based on Ethernet

ZL 200810171872.9 [SPG] [ZJU]   The communication method and equipment used in the Ethernet

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent rights have assured IEC that they are willing to negotiate licenses either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holders of these patent rights is registered with IEC. Information may be obtained from

[SPT] Zhejiang SUPCON Technology Co., Ltd.
Dongqin FENG Jian CHU
Liuhe Road 309, Bingjiang District,
Hangzhou, Zhejiang, 310053
China

[SPG] Zhejiang SUPCON Group Co., Ltd.
Dongqin FENG Jian CHU
Liuhe Road 309, Bingjiang District,
Hangzhou, Zhejiang, 310053
China

[ZJU] Zhejiang University
Dongqin FENG Jian CHU
Zheda Road 38,
Hangzhou, Zhejiang,310027
China

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-14: Data-link layer protocol specification – Type 14 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 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) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals;

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 standard ISO/ IEC 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 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 standard does not contain tests to demonstrate compliance with such requirements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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.

IEC 61158-1, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-5-14, *Industrial communication networks – Fieldbus specifications – Part 5-14: Application layer service definition – Type 14 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 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

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

RFC 768, *User Datagram Protocol (UDP),* available at <http://www.ietf.org>

RFC 791, *Internet protocol,* available at <http://www.ietf.org>

RFC 793, *Transmission Control Protocol*, available at <http://www.ietf.org>

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	**called-DL-address**	[ISO/IEC 7498-3]
3.1.2	**calling-DL-address**	[ISO/IEC 7498-3]
3.1.3	**centralized multi-end-point-connection**	[ISO/IEC 7498-1]
3.1.4	**correspondent (N)-entities** **correspondent DL-entities (N=2)** **correspondent Ph-entities (N=1)**	[ISO/IEC 7498-1]
3.1.5	**demultiplexing**	[ISO/IEC 7498-1]
3.1.6	**DL-address**	[ISO/IEC 7498-3]
3.1.7	**DL-address-mapping**	[ISO/IEC 7498-1]
3.1.8	**DL-connection**	[ISO/IEC 7498-1]
3.1.9	**DL-connection-end-point**	[ISO/IEC 7498-1]
3.1.10	**DL-connection-end-point-identifier**	[ISO/IEC 7498-1]
3.1.11	**DL-connection-mode transmission**	[ISO/IEC 7498-1]
3.1.12	**DL-connectionless-mode transmission**	[ISO/IEC 7498-1]
3.1.13	**DL-data-sink**	[ISO/IEC 7498-1]
3.1.14	**DL-data-source**	[ISO/IEC 7498-1]
3.1.15	**DL-duplex-transmission**	[ISO/IEC 7498-1]
3.1.16	**DL-facility**	[ISO/IEC 7498-1]
3.1.17	**DL-local-view**	[ISO/IEC 7498-3]
3.1.18	**DL-name**	[ISO/IEC 7498-3]
3.1.19	**DL-protocol**	[ISO/IEC 7498-1]
3.1.20	**DL-protocol-connection-identifier**	[ISO/IEC 7498-1]
3.1.21	**DL-protocol-control-information**	[ISO/IEC 7498-1]
3.1.22	**DL-protocol-data-unit**	[ISO/IEC 7498-1]
3.1.23	**DL-protocol-version-identifier**	[ISO/IEC 7498-1]
3.1.24	**DL-relay**	[ISO/IEC 7498-1]
3.1.25	**DL-service-connection-identifier**	[ISO/IEC 7498-1]
3.1.26	**DL-service-data-unit**	[ISO/IEC 7498-1]
3.1.27	**DL-simplex-transmission**	[ISO/IEC 7498-1]
3.1.28	**DL-subsystem**	[ISO/IEC 7498-1]
3.1.29	**DL-user-data**	[ISO/IEC 7498-1]

3.1.30 **flow control**   [ISO/IEC 7498-1]

3.1.31 **layer-management**   [ISO/IEC 7498-1]

3.1.32 **multiplexing**   [ISO/IEC 7498-3]

3.1.33 **naming-(addressing)-authority**   [ISO/IEC 7498-3]

3.1.34 **naming-(addressing)-domain**   [ISO/IEC 7498-3]

3.1.35 **naming-(addressing)-subdomain**   [ISO/IEC 7498-3]

3.1.36 **(N)-entity**   [ISO/IEC 7498-1]
          DL-entity
          Ph-entity

3.1.37 **(N)-interface-data-unit**   [ISO/IEC 7498-1]
          DL-service-data-unit   (N=2)
          Ph-interface-data-unit   (N=1)

3.1.38 **(N)-layer**   [ISO/IEC 7498-1]
          DL-layer   (N=2)
          Ph-layer   (N=1)

3.1.39 **(N)-service**   [ISO/IEC 7498-1]
          DL-service   (N=2)
          Ph-service   (N=1)

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

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

3.1.42 **peer-entities**   [ISO/IEC 7498-1]

3.1.43 **Ph-interface-control-information**   [ISO/IEC 7498-1]

3.1.44 **Ph-interface-data**   [ISO/IEC 7498-1]

3.1.45 **primitive name**   [ISO/IEC 7498-3]

3.1.46 **reassembling**   [ISO/IEC 7498-1]

3.1.47 **recombining**   [ISO/IEC 7498-1]

3.1.48 **reset**   [ISO/IEC 7498-1]

3.1.49 **responding-DL-address**   [ISO/IEC 7498-3]

3.1.50 **routing**   [ISO/IEC 7498-1]

3.1.51 **segmenting**   [ISO/IEC 7498-1]

3.1.52 **sequencing**   [ISO/IEC 7498-1]

3.1.53 **splitting**   [ISO/IEC 7498-1]

3.1.54 **synonymous name**   [ISO/IEC 7498-3]

3.1.55 **systems-management**   [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   DL-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   ISO/IEC 8802-3 terms

This standard also makes use of the following terms defined in ISO/IEC 8802-3 as they apply to the data-link layer:

3.3.1   destination address

3.3.2   frame check sequence

3.3.3   length/type

3.3.4   MAC frame

3.3.5   pad

3.3.6   source address

3.4   Common 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.

3.4.1
communication macrocycle
set of basic cycles needed for a configured communication activity in a macro network segment

3.4.2
communication phase
elapsed fraction of a cycle, measured from some fixed origin

3.4.3
communication scheduling
algorithms and operation for data transfers occurring in a deterministic and repeatable manner

3.4.4
cyclic
repetitive in a regular manner

3.4.5
data DLPDU
DLPDU that carries a DLSDU from a local DLS-user to a remote DLS-user

3.4.6
destination FB Instance
FB instance that receives the specified parameters

3.4.7
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

3.4.8
DLSAP
distinctive point at which DL-services are provided by a single DL-entity to a single higher-layer entity