IEC 61158-3-22

Edition 2.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 3-22: Data-link layer service definition – Type 22 elements

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Réseaux de communication industriels – Spécifications des bus de terrain – Partie 3-22: Définition des services de la couche liaison de données – Éléments de type 22

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-22: Data-link layer service definition – Type 22 elements

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

International Standard IEC 61158-3-22 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision. This edition includes the following technical changes with respect to the previous edition.

- Introduction of two new topology scan services.
- Marking old topology scan services as to be discontinued.

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

FDIS	Report on voting
65C/759/FDIS	65C/769/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

A list of all 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:

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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 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.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning Type 22 elements and possibly other types:

WO-2006/069691 A1	[PI]	Control system with a plurality of spatially distributed stations and method for transmitting data in said control system
DE-10 2004 063 213 B4	[PI]	Steuerungssystem mit einer Vielzahl von räumlich verteilten Stationen sowie Verfahren zum Übertragen von Daten in einem solchen Steuerungssystem
EP-1 828 858 A1	[PI]	Control system with a plurality of spatially distributed stations and method for transmitting data in said control system
JP-4 848 469 B2	[PI]	Control system with a plurality of spatially distributed stations and method for transmitting data in said control system
CN-101 111 807	[PI]	Control system with a plurality of spatially distributed stations and method for transmitting data in said control system
US-8 144 718 B2	[PI]	Control system having a plurality of spatially distributed stations, and method for transmitting data in such a control system

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-22: Data-link layer service definition – Type 22 elements

1 Scope

1.1 General

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 22 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.

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

- the Type 22 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 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 fulfils the Type 22 data-link layer services defined in this standard.

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.

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 8802-3:2000, *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*

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IEEE 802.1D-2004, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges,* available at http://www.ieee.org

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

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:

DL-address	[ISO/IEC 7498-3]
called-DL-address	[ISO/IEC 7498-3]
calling-DL-address	[ISO/IEC 7498-3]
DL-connection	[ISO/IEC 7498-1]
DL-connection-end-point	[ISO/IEC 7498-1]
DL-connection-end-point-identifier	[ISO/IEC 7498-1]
DL-connection-mode transmission	[ISO/IEC 7498-1]
DL-connectionless-mode transmission	[ISO/IEC 7498-1]

correspondent (N)-entities [ISO/IEC 7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)
decentralized multi-end-point-connection [ISO/IEC 7498-1]

DL-duplex-transmission [ISO/IEC 7498-1]

(N)-entity [ISO/IEC 7498-1]
DL-entity (N=2)
Ph-entity (N=1)
DL-facility [ISO/IEC 7498-1]

flow control [ISO/IEC 7498-1]

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

DL-local-view [ISO/IEC 7498-3]

multi-endpoint-connection [ISO/IEC 7498-1]

DL-name [ISO/IEC 7498-3]

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

peer-entities [ISO/IEC 7498-1]

primitive name [ISO/IEC 7498-3]

DL-protocol [ISO/IEC 7498-1]

DL-protocol-connection-identifier [ISO/IEC 7498-1]

DL-protocol-data-unit [ISO/IEC 7498-1]

DL-relay [ISO/IEC 7498-1]

reassembling [ISO/IEC 7498-1]

reset [ISO/IEC 7498-1]

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

routing [ISO/IEC 7498-1]

segmenting [ISO/IEC 7498-1]

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

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Ph-service (N=1)

(N)-service-access-point [ISO/IEC 7498-1]

DL-service-access-point (N=2)

Ph-service-access-point (N=1)

DL-service-access-point-address [ISO/IEC 7498-3]

DL-service-connection-identifier [ISO/IEC 7498-1]

DL-service-data-unit [ISO/IEC 7498-1]

DL-simplex-transmission [ISO/IEC 7498-1]

DL-subsystem [ISO/IEC 7498-1]

systems-management [ISO/IEC 7498-1]

DL-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:

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acceptor

asymmetrical service

confirm (primitive);

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requestor.deliver (primitive)

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deliver (primitive)

DL-confirmed-facility

DL-facility

DL-local-view

DL-mandatory-facility

DL-non-confirmed-facility

DL-provider-initiated-facility

DL-provider-optional-facility

DL-service-primitive;

primitive

DL-service-provider

DL-service-user

DL-user-optional-facility

indication (primitive);

acceptor.deliver (primitive)

multi-peer

request (primitive);

requestor.submit (primitive)

requestor

response (primitive);

acceptor.submit (primitive)

submit (primitive)

symmetrical service

3.3 Data-link service terms and definitions

3.3.1
acyclic data
data which is transferred from time to time for dedicated purposes

3.3.2
cell
synonym for a single DL-segment which uses RTFL communication model

3.3.3
communication cycle
fixed time period between which the root device issues empty frames for cyclic communication initiation in which data is transmitted utilizing CDC and MSC

3.3.4
cycle time
duration of a communication cycle

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3.3.5
cyclic
events which repeat in a regular and repetitive manner

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3.3.6
cyclic communication
periodic exchange of frames

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3.3.7
cyclic data
data which is transferred in a regular and repetitive manner for dedicated purposes

3.3.8
cyclic data channel
CDC
one or more frames, which are reserved for cyclic data

3.3.9
data
generic term used to refer to any information carried over a fieldbus

3.3.10
device
physical entity connected to the fieldbus

3.3.11
DL-segment
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

3.3.12
error
discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

3.3.13
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.

3.3.14
frame
denigrated synonym for DLPDU

3.3.15
gateway
device acting as a linking element between different protocols

3.3.16
interface
shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

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3.3.17
link
synonym for DL-segment

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3.3.18
logical double line
sequence of root device and all ordinary devices processing the communication frame in forward and backward direction

3.3.19
master clock
global time base for the PCS mechanism

3.3.20
message
ordered sequence of octets intended to convey data

3.3.21
message channel
MSC
one or more DPUs (frames), which are reserved for acyclic data

3.3.22
network
set of devices connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

3.3.23
open network
any network based on IEC 8802-3 with no further restrictions

3.3.24
ordinary device
OD
slave in the communication system, which utilizes RTFL for cyclic and acyclic data interchange with other ODs in the same logical double line

3.3.25
precise clock synchronization
PCS
mechanism to synchronize clocks of RTFL devices and maintain a global time base

3.3.26
process data
data designated to be transferred cyclically or acyclically for the purpose of processing

3.3.27
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.3.28
root device
RD
master in the communication system, which organises, initiates and controls the RTFL cyclic and acyclic data interchange for one logical double line

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3.3.29
real time frame line
RTFL
communication model communicating in a logical double line

IEC 61158-3-22:2014
https://standards.iteh.ai/catalog/standards/sist/8b3890d0-752e-4629-a1d0-125cd371b9e5/iec-61158-3-22-2014

3.3.30
real time frame network
RTFN
communication model communicating in a switched network

3.3.31
switch
MAC bridge as defined in IEEE 802.1D

3.3.32
timing signal
time-based indication of the occurrence of an event, commonly as an interrupt signal, used for DL-user synchronization

3.3.33
topology
physical network architecture with respect to the connection between the stations of the communication system

3.4 Symbols and abbreviations

CDC	Cyclic data channel
CDCS	Cyclic data channel send
DA	Device address