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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 3-21: Data-link layer service definition – Type 21 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 3-21: Définition des services de couche liaison de données – Eléments de Type 21

IEC 61158-3-21:2010

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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FOREWORD

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NOTE 1 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 of their respective intellectual-property-right holders.

International Standard IEC 61158-3-21:2010 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This standard cancels and replaces IEC/PAS 62573 published in 2008. This first edition constitutes a technical revision.

This bilingual version published in 2012-01 corresponds to the English version published in 2010-08.

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

FDIS	Report on voting
65C/604/FDIS	65C/618/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 has not been voted upon.

This publication has been drafted in accordance with 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE 2 The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

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 3-21: Data-link layer service definition – Type 21 elements

1 Scope

1.1 Overview

This part of IEC 61158 provides the common elements for basic time-critical messaging communications between devices in an automation environment. The term "time-critical" in this context means the prioritized full-duplex collision-free time-deterministic communication, of which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the required time risks the 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 21 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 that they take; and

c) the interrelationships between these actions and events, and their valid sequences.

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

- The Type 21 application layer at the boundary between the application and DLLs of the fieldbus reference model;
- Systems management at the boundary between the DLL and the systems management of the fieldbus reference model.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual DLL services suitable for time-critical communications, and to 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 standard may be used as the basis for formal data link programming interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this standard, including:

a) The sizes and octet ordering of various multi-octet service parameters;

b) The correlation of paired primitives for request and confirm, or indication and response.

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 21 DLL 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.

IEC 61158-2:2010[1], *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-4-21:2010[1], *Industrial communication networks – Fieldbus specifications – Part 4-21: Data-link layer protocol specification – Type 21 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 8802-3:2000, *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 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

3 Terms, definitions, symbols, abbreviations, and conventions

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]

[1] To be published.

3.1.11 correspondent (N)-entities [ISO/IEC 7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

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

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

3.1.14 DL-facility [ISO/IEC 7498-1]

3.1.15 flow control [ISO/IEC 7498-1]

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

3.1.32 (N)-service-access-point [ISO/IEC 7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=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-protocol-machine

3.2.11 DL-provider-initiated-facility

3.2.12 DL-provider-optional-facility

3.2.13 DL-service-primitive; primitive

3.2.14 DL-service-provider

3.2.15 DL-service-user

3.2.16 DLS-user-optional-facility

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

3.2.18 multi-peer

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

3.2.20 requestor

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

3.2.22 submit (primitive)

3.2.23 symmetrical service

3.3 Data link service terms and definitions

3.3.1
DL-segment, link, local link
single data link (DL) subnetwork in which any of the connected data link entities (DLEs) may communicate directly, without any intervening data link 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

3.3.2
Data link service access point (DLSAP)
distinctive point at which DL-services are provided by a single DLE 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.

3.3.3
DLSAP address
either an individual DLSAP address designating a single DLSAP of a single data link service (DLS) user (DLS-user), or a group DL-address potentially designating multiple DLSAPs, each of a single DLS-user

NOTE This terminology was 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.

3.3.4
(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.

3.3.5
Data link connection endpoint address (DLCEP-address)
DL-address that designates either:

a) one peer DL-connection-end-point;

b) one multi-peer publisher DL-connection-end-point, and implicitly the corresponding set of subscriber DL-connection-end-points, where each DL-connection-end-point exists within a distinct DLSAP and is associated with a corresponding distinct DLSAP-address.

3.3.6
Frame check sequence (FCS) error
error that occurs when the computed frame check sequence value after reception of all the octets in a data link protocol data unit (DLPDU) does not match the expected residual

3.3.7
frame
synonym for DLPDU

3.3.8
network management
management functions and services that perform network initialization, configuration, and error handling

3.3.9
protocol
convention on the data formats, time sequences, and error correction for data exchange in communication systems

3.3.10
receiving DLS-user
DL-service user that acts as a recipient of DLS-user data

NOTE A DL-service user can be both a sending and receiving DLS-user concurrently.

3.3.11
sending DLS-user
DL-service user that acts as a source of DLS-user data

3.3.12
device
single DLE as it appears on one local link

3.3.13
DL− entity identifier
address that designates the (single) DLE associated with a single device on a specific local link

3.3.14
device unique identification
unique 8 octet identification to identify a Type 21 device in a network. This ID is a combination of a 6 octet ISO/IEC 8802-3:2000 MAC address and 2 octet DL-address

3.3.15
ring
active network where each node is connected in series to two other devices

NOTE A ring may also be referred to as a loop.

3.3.16
linear topology
topology where the devices are connected in series, with two devices each connected to only one other device, and all others each connected to two other devices, for example, connected in a line

3.3.17
R-port
port in a communication device that is part of a ring structure

3.3.18
real-time
ability of a system to provide a required result in a bounded time

3.3.19
real-time communication
transfer of data in real-time

3.3.20
Real-time Ethernet (RTE)
ISO/IEC 8802-3:2000 based network that includes real-time communication

NOTE 1 Other communications can be supported, providing that the real-time communication is not compromised.

NOTE 2 This definition is base on, but not limited to, ISO/IEC 8802-3:2000. It could be applicable to other IEEE802 specifications, *e.g.*, IEEE802.11.

3.3.21
RTE end device
device with at least one active RTE port

3.3.22
RTE port
media access control (MAC) sublayer point where an RTE is attached to a local area network (LAN)

NOTE This definition is derived from that of bridge port in ISO/IEC 10038: 1993, as applied to local MAC bridges.

3.3.23
switched network
network also containing switches

NOTE Switched network means that the network is based on IEEE802.1D and IEEE802.1Q with MAC bridges and priority operations.