

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 3-12: Data-link layer service definition – Type 12 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 3-12: Définition des services de couche liaison de données – Éléments
de Type 12**



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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
1.1 Overview.....	7
1.2 Specifications.....	7
1.3 Conformance.....	7
2 Normative references.....	8
3 Terms, definitions, symbols, abbreviations and conventions.....	8
3.1 Reference model terms and definitions.....	8
3.2 Service convention terms and definitions.....	9
3.3 Data-link service terms and definitions.....	10
3.4 Symbols and abbreviations.....	13
3.5 Common conventions.....	14
4 Data-link layer services and concepts.....	15
4.1 Operating principle.....	15
4.2 Topology.....	16
4.3 Data-link layer overview.....	16
4.4 Error detection overview.....	17
4.5 Parameter and process data handling introduction.....	17
4.6 Node reference model.....	17
4.7 Operation overview.....	18
4.8 Addressing.....	20
4.9 Slave classification.....	22
4.10 Structure of the communication layer in the slave.....	22
5 Communication services.....	23
5.1 Overview.....	23
5.2 Read services.....	24
5.3 Write services.....	27
5.4 Combined read/write services.....	29
5.5 Network services.....	33
5.6 Mailbox.....	34
6 Local interactions.....	39
6.1 Read local.....	39
6.2 Write local.....	39
6.3 Event local.....	40
Figure 1 – Mapping of logical data in an Ethernet frame consisting of a single Type 12 DLPDU.....	16
Figure 2 – Type 12 data-link reference model.....	18
Figure 3 – Type 12 segments in open mode.....	19
Figure 4 – Type 12 segment in direct mode.....	19
Figure 5 – Addressing mode overview.....	20
Figure 6 – Fieldbus memory management unit overview.....	21
Figure 7 – Layering of communication.....	23
Figure 8 – Flow of Type 12 service primitives.....	24

Figure 9 – Successful mailbox write sequence.....	35
Figure 10 – Successful mailbox read sequence	35
Table 1 – Auto-increment physical read (APRD)	24
Table 2 – Configured-address physical read (FPRD).....	25
Table 3 – Broadcast read (BRD).....	26
Table 4 – Logical read (LRD).....	26
Table 5 – Auto-increment physical write (APWR).....	27
Table 6 – Configured-address physical write (FPWR)	27
Table 7 – Broadcast write (BWR)	28
Table 8 – Logical write (LWR)	29
Table 9 – Auto-increment physical read/write (APRW)	29
Table 10 – Configured-address physical read/write (FPRW).....	30
Table 11 – Broadcast read/write (BRW).....	31
Table 12 – Logical read/write (LRW).....	31
Table 13 – Auto-increment physical read / multiple write (ARMW).....	32
Table 14 – Configured-address physical read / multiple write (FRMW)	32
Table 15 – Provide network variable (PNV).....	33
Table 16 – Mailbox write.....	36
Table 17 – Mailbox read update.....	37
Table 18 – Mailbox read	38
Table 19 – Read local	39
Table 20 – Write local	39
Table 21 – Event local.....	40

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 3-12: Data-link layer service definition –
Type 12 elements**

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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 the profile parts. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

International Standard IEC 61158-3-12 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 2007. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- editorial improvements.

This bilingual version published in 2011-11, corresponds to the English version published in 2010-07.

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 of this standard 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.

[IEC 61158-3-12:2010](https://standards.iteh.ai/catalog/standards/sist/457990e-de3f-4b52-85c4-e192dd78a15f/iec-61158-3-12-2010)

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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/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.



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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-12: Data-link layer service definition – Type 12 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 12 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;
- 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 12 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model;
- 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 12 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 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*

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

3.1.1 DL-address	[7498-3]
3.1.2 DL-connectionless-mode transmission	[7498-1]
3.1.3 correspondent (N)-entities correspondent DL-entities (N=2) correspondent Ph-entities (N=1)	[7498-1]
3.1.4 DL-duplex-transmission	[7498-1]
3.1.5 (N)-entity DL-entity (N=2) Ph-entity (N=1)	[7498-1]
3.1.6 (N)-layer DL-layer (N=2) Ph-layer (N=1)	[7498-1]
3.1.7 layer-management	[7498-1]
3.1.8 peer-entities	[7498-1]
3.1.9 primitive name	[7498-3]
3.1.10 DL-protocol	[7498-1]
3.1.11 DL-protocol-data-unit	[7498-1]

3.1.12 DL-relay	[7498-1]
3.1.13 reset	[7498-1]
3.1.14 responding-DL-address	[7498-3]
3.1.15 routing	[7498-1]
3.1.16 segmenting	[7498-1]
3.1.17 (N)-service	[7498-1]
DL-service (N=2)	
Ph-service (N=1)	
3.1.18 (N)-service-access-point	[7498-1]
DL-service-access-point (N=2)	
Ph-service-access-point (N=1)	
3.1.19 DL-service-data-unit	[7498-1]
3.1.20 DL-simplex-transmission	[7498-1]
3.1.21 DL-subsystem	[7498-1]
3.1.22 systems-management	[7498-1]
3.1.23 DLS-user	[7498-1]
3.1.24 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 asymmetrical service**
- 3.2.3 confirm (primitive);
requestor.deliver (primitive)**
- 3.2.4 deliver (primitive)**
- 3.2.5 DL-service-primitive;
primitive**
- 3.2.6 DL-service-provider**
- 3.2.7 DL-service-user**
- 3.2.8 DL-user-optional-facility**
- 3.2.9 indication (primitive);
acceptor.deliver (primitive)**
- 3.2.10 request (primitive);
requestor.submit (primitive)**
- 3.2.11 requestor**
- 3.2.12 response (primitive);
acceptor.submit (primitive)**
- 3.2.13 submit (primitive)**
- 3.2.14 symmetrical service**

3.3 Data-link service terms and definitions

3.3.1

application

function or data structure for which data is consumed or produced

3.3.2

application objects

multiple object classes that manage and provide a run time exchange of messages across the network and within the network device

3.3.3

basic slave

slave device that supports only physical addressing of data

3.3.4

bit

unit of information consisting of a 1 or a 0. This is the smallest data unit that can be transmitted

3.3.5

client

1) object which uses the services of another (server) object to perform a task

2) initiator of a message to which a server reacts

3.3.6

connection

logical binding between two application objects within the same or different devices

3.3.7

cyclic

events which repeat in a regular and repetitive manner

3.3.8

cyclic redundancy check (CRC)

residual value computed from an array of data and used as a representative signature for the array

3.3.9

data

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

3.3.10

data consistency

means for coherent transmission and access of the input- or output-data object between and within client and server

3.3.11

device

physical entity connected to the fieldbus composed of at least one communication element (the network element) and which may have a control element and/or a final element (transducer, actuator, etc.)

3.3.12

distributed clocks

method to synchronize slaves and maintain a global time base

3.3.13**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

3.3.14**error**

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

3.3.15**event**

instance of a change of conditions

3.3.16**fieldbus memory management unit**

function that establishes one or several correspondences between logical addresses and physical memory

3.3.17**fieldbus memory management unit entity**

single element of the fieldbus memory management unit: one correspondence between a coherent logical address space and a coherent physical memory location

3.3.18**frame**

denigrated synonym for DLPDU

3.3.19**full slave**

slave device that supports both physical and logical addressing of data

3.3.20**interface**

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

3.3.21**master**

device that controls the data transfer on the network and initiates the media access of the slaves by sending messages and that constitutes the interface to the control system

3.3.22**mapping**

correspondence between two objects in that way that one object is part of the other object

3.3.23**medium**

cable, optical fibre, or other means by which communication signals are transmitted between two or more points

NOTE "media" is used as the plural of medium.

3.3.24**message**

ordered series of octets intended to convey information

NOTE Normally used to convey information between peers at the application layer.

3.3.25

network

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

3.3.26

node

- a) single DL-entity as it appears on one local link
- b) end-point of a link in a network or a point at which two or more links meet [derived from IEC 61158-2]

3.3.27

object

abstract representation of a particular component within a device

NOTE An object can be

- a) an abstract representation of the capabilities of a device, composed of any or all of the following components:
 - 1) data (information which changes with time);
 - 2) configuration (parameters for behavior);
 - 3) methods (things that can be done using data and configuration); or
- b) a collection of related data (in the form of variables) and methods (procedures) for operating on that data that have a clearly defined interface and behavior.

3.3.28

process data

data object containing application objects designated to be transferred cyclically or acyclically for the purpose of processing

3.3.29

receiving DLS-user

DL-service user that acts as a recipient of DL-user-data

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

3.3.30

sending DLS-user

DL-service user that acts as a source of DL-user-data

3.3.31

server

object which provides services to another (client) object

3.3.32

service

operation or function that an object and/or object class performs upon request from another object and/or object class

3.3.33

slave

DL-entity accessing the medium only after being initiated by the preceding slave or the master

3.3.34

Sync manager

collection of control elements to coordinate access to concurrently used objects.

3.3.35**Sync manager channel**

single control elements to coordinate access to concurrently used objects.

3.3.36**switch**

MAC bridge as defined in IEEE 802.1D

3.4 Symbols and abbreviations

APRD	Auto-increment physical read
APRW	Auto-increment physical read/write
APWR	Auto-increment physical write
ARMW	Auto-increment physical read / multiple write
BRD	Broadcast read
BRW	Broadcast read/write
BWR	Broadcast write
CAN	Controller area network
CoE	CAN application protocol over Type 12 services
CSMA/CD	Carrier sense multiple access with collision detection
DC	Distributed clocks
DL-	Data-link layer (as a prefix)
DLC	DL-connection
DLCEP	DL-connection-end-point
DLE	DL-entity (the local active instance of the data-link layer)
DLL	DL-layer
DLPCI	DL-protocol-control-information
DLPDU	DL-protocol-data-unit
DLM	DL-management
DLME	DL-management entity (the local active instance of DL-management)
DLMS	DL-management service
DLS	DL-service
DLSAP	DL-service-access-point
DLSDU	DL-service-data-unit
E²PROM	Electrically erasable programmable read only memory
EoE	Ethernet tunneled over Type 12 services
ESC	Type 12 slave controller
FCS	Frame check sequence
FIFO	First-in first-out (queuing method)
FMMU	Fieldbus memory management unit
FoE	File access with Type 12 services
FPRD	Configured address physical read
FPRW	Configured address physical read/write
FPWR	Configured address physical write
FRMW	Configured address physical read/multiple write
HDR	Header
ID	Identifier