

BS EN 61158-5-13:2014



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Industrial communication networks — Fieldbus specifications

Part 5-13: Application layer service definition — Type 13 elements

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National foreword

This British Standard is the UK implementation of EN 61158-5-13:2014. It is identical to IEC 61158-5-13:2014. It supersedes BS EN 61158-5-13:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications: process measurement and control, including fieldbus.

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**Industrial communication networks - Fieldbus specifications -
Part 5-13: Application layer service definition - Type 13 elements
(IEC 61158-5-13:2014)**

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 5-13: Définition des services de la
couche application - Éléments de type 13
(CEI 61158-5-13:2014)

Industrielle Kommunikationsnetze - Feldbusse -
Teil 5-13: Dienstfestlegungen des Application Layer
(Anwendungsschicht) - Typ 13-Elemente
(IEC 61158-5-13:2014)

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Foreword

The text of document 65C/763/FDIS, future edition 2 of IEC 61158-5-13, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61158-5-13:2014.

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This document supersedes EN 61158-5-13:2008.

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 61158-5-13:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61784-1	NOTE	Harmonized as EN 61784-1.
IEC 61784-2	NOTE	Harmonized as EN 61784-2.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61158-1	2014	Industrial communication networks - Fieldbus specifications - Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	EN 61158-1	2014
IEC 61158-3-13	-	Industrial communication networks - Fieldbus specifications - Part 3-13: Data-link layer service definition - Type 13 elements	EN 61158-3-13	-
IEC 61158-4-13	-	Industrial communication networks - Fieldbus specifications - Part 4-13: Data-link layer protocol specification - Type 13 elements	EN 61158-4-13	-
IEC 61158-6	Series	Industrial communication networks - Fieldbus specifications - Part 6: Application layer protocol specification	EN 61158-6	Series
IEC 61158-6-13	-	Industrial communication networks - Fieldbus specifications - Part 6-13: Application layer protocol specification - Type 13 elements	EN 61158-6-13	-
ISO/IEC 646	-	Information technology - ISO 7-bit coded character set for information interchange	-	-
ISO/IEC 7498-1	-	Information technology - Open Systems Interconnection - Basic reference model: The basic model	-	-
ISO/IEC 8822	-	Information technology - Open Systems Interconnection - Presentation service definition	-	-
ISO/IEC 9545	-	Information technology - Open Systems Interconnection - Application layer structure	-	-
ISO/IEC 10731	-	Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services	-	-
IEEE 754	-	IEEE Standard for Floating-Point Arithmetic	-	-

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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.

The application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This standard defines the application service characteristics that fieldbus applications and/or system management may exploit.

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 application layer service defined in this standard is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-13: Application layer service definition – Type 13 elements

1 Scope

1.1 General

The fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a “window between corresponding application programs.”

This standard provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 13 fieldbus. 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 different Types of the fieldbus Application Layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form which they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

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

- 1) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- 2) Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This standard specifies the structure and services of the IEC fieldbus Application Layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application-entities (AE) contained within the application processes. The FAL AE is composed of a set of object-oriented Application Service Elements (ASEs) and a Layer Management Entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can

send/receive is specified. This permits greater flexibility to the FAL users in standardizing such object behavior. In addition to these services, some supporting services are also defined in this standard to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual application layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols for time-critical communications.

A secondary objective is to provide migration paths from previously-existing industrial communications protocols. It is this latter objective which gives rise to the diversity of services standardized as the various Types of IEC 61158, and the corresponding protocols standardized in subparts of IEC 61158-6.

This specification may be used as the basis for formal Application 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 application layer entities within industrial automation systems.

There is no conformance of equipment to this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill any given Type of application layer services as 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.

IEC 61158-1:2014, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-3-13, *Industrial communication networks – Fieldbus specifications – Part 3-13: Data-link layer service definition – Type 13 elements*

IEC 61158-4-13, *Industrial communication networks – Fieldbus specifications – Part 4-13: Data-link layer protocol specification – Type 13 elements*

IEC 61158-6 (all parts), *Industrial communication networks – Fieldbus specifications – Part 6: Application layer protocol specification*

IEC 61158-6-13, *Industrial communication networks – Fieldbus specifications – Part 6-13: Application layer protocol specification – Type 13 elements*

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information interchange*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model – Part 1: The Basic Model*

ISO/IEC 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

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

IEEE 754, *IEEE Standard for Floating-Point Arithmetic*

3 Terms, definitions, symbols, abbreviations and conventions

For the purposes of this document, the following terms, definitions, symbols, abbreviations and conventions apply

3.1 ISO/IEC 7498-1 terms

- 3.1.1 application entity**
- 3.1.2 application process**
- 3.1.3 application protocol data unit**
- 3.1.4 application service element**
- 3.1.5 application entity invocation**
- 3.1.6 application process invocation**
- 3.1.7 application transaction**
- 3.1.8 real open system**
- 3.1.9 transfer syntax**

3.2 ISO/IEC 8822 terms

- 3.2.1 abstract syntax**
- 3.2.2 presentation context**

3.3 ISO/IEC 9545 terms

- 3.3.1 application-association**
- 3.3.2 application-context**
- 3.3.3 application context name**
- 3.3.4 application-entity-invocation**
- 3.3.5 application-entity-type**
- 3.3.6 application-process-invocation**
- 3.3.7 application-process-type**
- 3.3.8 application-service-element**
- 3.3.9 application control service element**

3.4 Fieldbus application-layer specific definitions

For the purposes of this part of IEC 61158, the following terms and definitions apply.

3.4.1

application

function or data structure for which data is consumed or produced

3.4.2

application objects

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

3.4.3

application process

part of a distributed application on a network, which is located on one device and unambiguously addressed

3.4.4

application process identifier

distinguishes multiple application processes used in a device

3.4.5**application process object**

component of an application process that is identifiable and accessible through an FAL application relationship

Note 1 to entry: Application process object definitions are composed of a set of values for the attributes of their class (see the definition for Application Process Object Class Definition). Application process object definitions may be accessed remotely using the services of the FAL Object Management ASE. FAL Object Management services can be used to load or update object definitions, to read object definitions, and to dynamically create and delete application objects and their corresponding definitions.

3.4.6**application process object class**

class of application process objects defined in terms of the set of their network-accessible attributes and services

3.4.7**application relationship**

cooperative association between two or more application-entity-invocations for the purpose of exchange of information and coordination of their joint operation

Note 1 to entry: This relationship is activated either by the exchange of application-protocol-data-units or as a result of preconfiguration activities.

3.4.8**application relationship application service element**

application-service-element that provides the exclusive means for establishing and terminating all application relationships

3.4.9**application relationship endpoint**

context and behavior of an application relationship as seen and maintained by one of the application processes involved in the application relationship

Note 1 to entry: Each application process involved in the application relationship maintains its own application relationship endpoint.

3.4.10**attribute**

description of an externally visible characteristic or feature of an object

Note 1 to entry: The attributes of an object contain information about variable portions of an object. Typically, they provide status information or govern the operation of an object. Attributes may also affect the behavior of an object. Attributes are divided into class attributes and instance attributes.

3.4.11**behavior**

indication of how an object responds to particular events

3.4.12**channel**

single physical or logical link of an input or output application object of a server to the process

3.4.13**class**

set of objects, all of which represent the same kind of system component

Note 1 to entry: A class is a generalisation of an object; a template for defining variables and methods. All objects in a class are identical in form and behavior, but usually contain different data in their attributes.

3.4.14**class attributes**

attribute that is shared by all objects within the same class

3.4.15**class code**

unique identifier assigned to each object class

3.4.16**class specific service**

service defined by a particular object class to perform a required function which is not performed by a common service

Note 1 to entry: A class specific object is unique to the object class which defines it.

3.4.17**client**

- a) object which uses the services of another (server) object to perform a task
- b) initiator of a message to which a server reacts

3.4.18**controlled node**

All nodes except one (this is the Managing Node) in a Type 13 network are of this type

3.4.19**connection**

logical binding between application objects that may be within the same or different devices

Note 1 to entry: Connections may be either point-to-point or multipoint.

3.4.20**connection channel**

description of a connection between a sink and a source of data items

3.4.21**connection path**

an octet stream that defines the application object to which a connection instance applies

3.4.22**connection point**

buffer which is represented as a subinstance of an Assembly object

3.4.23**consume**

act of receiving data from a producer

3.4.24**consumer**

node or sink that is receiving data from a producer

3.4.25**consuming application**

application that consumes data

3.4.26**control commands**

action invocations transferred from client to server to clear outputs, freeze inputs and/or synchronise outputs

3.4.27**conveyance path**

unidirectional flow of APDUs across an application relationship

3.4.28**cyclic**

repetitive in a regular manner

3.4.29**data consistency**

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

3.4.30**device**

physical hardware connected to the link

Note 1 to entry: A device may contain more than one node.

3.4.31**device profile**

a collection of device dependent information and functionality providing consistency between similar devices of the same device type

3.4.32**diagnosis information**

all data available at the server for maintenance purposes

3.4.33**end node**

producing or consuming node

3.4.34**endpoint**

one of the communicating entities involved in a connection

3.4.35**error**

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

3.4.36**error class**

general grouping for related error definitions and corresponding error codes

3.4.37**error code**

identification of a specific type of error within an error class

3.4.38**event**

an instance of a change of conditions

3.4.39**FIFO variable**

a Variable Object class, composed of a set of homogeneously typed elements, where the first written element is the first element that can be read

Note 1 to entry: On the fieldbus only one, complete element can be transferred as a result of one service invocation.

3.4.40

frame

denigrated synonym for DLPDU

3.4.41

group

a) <general> general term for a collection of objects

Specific uses:

b) <addressing> when describing an address, an address that identifies more than one entity

3.4.42

invocation

act of using a service or other resource of an application process

Note 1 to entry: Each invocation represents a separate thread of control that may be described by its context. Once the service completes, or use of the resource is released, the invocation ceases to exist. For service invocations, a service that has been initiated but not yet completed is referred to as an outstanding service invocation. Also for service invocations, an Invoke ID may be used to unambiguously identify the service invocation and differentiate it from other outstanding service invocations.

3.4.43

index

address of an object within an application process

3.4.44

instance

the actual physical occurrence of an object within a class that identifies one of many objects within the same object class

EXAMPLE California is an instance of the object class US-state.

Note 1 to entry: The terms object, instance, and object instance are used to refer to a specific instance.

3.4.45

instance attributes

attribute that is unique to an object instance and not shared by the object class

3.4.46

instantiated

object that has been created in a device

3.4.47

logical device

a certain FAL class that abstracts a software component or a firmware component as an autonomous self-contained facility of an automation device

3.4.48

manufacturer ID

identification of each product manufacturer by a unique number

3.4.49

management information

network-accessible information that supports managing the operation of the fieldbus system, including the application layer

Note 1 to entry: Managing includes functions such as controlling, monitoring, and diagnosing.

3.4.50**message router**

object within a node that distributes messaging requests to appropriate application objects

3.4.51**managing node**

One node of a type 13 network must act as a managing node.

3.4.52**multi-point connection**

connection from one node to many

Note 1 to entry: Multipoint connections allow messages from a single producer to be received by many consumer nodes.

3.4.53**network**

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

3.4.54**node**

host of one AP, identified by a unique DLCEP-address

3.4.55**object**

abstract representation of a particular component within a device, usually a collection of related data (in the form of variables) and methods (procedures) for operating on that data that have clearly defined interface and behavior

3.4.56**object dictionary**

Collection of definitions. communication specific attributes and parameters, and application dependent data

3.4.57**object specific service**

service unique to the object class which defines it

3.4.58**originator**

client responsible for establishing a connection path to the target

3.4.59**physical device**

automation or other network device

3.4.60**point-to-point connection**

connection that exists between exactly two application objects

3.4.61**pre-established AR endpoint**

AR endpoint that is placed in an established state during configuration of the AEs that control its endpoints

3.4.62**process data**

object(s) which are already pre-processed and transferred cyclically for the purpose of information or further processing

3.4.63**produce**

act of sending data to be received by a consumer

3.4.64**producer**

node that is responsible for sending data

3.4.65**property**

general term for descriptive information about an object

3.4.66**provider**

source of a data connection

3.4.67**publisher**

role of an AR endpoint that transmits APDUs onto the fieldbus for consumption by one or more subscribers

Note 1 to entry: A publisher may not be aware of the identity or the number of subscribers.

3.4.68**publishing manager**

role of an AR endpoint in which it issues one or more confirmed service request APDUs to a publisher to request the publisher to publish a specified object

Note 1 to entry: Two types of publishing managers are defined by this standard, pull publishing managers and push publishing managers, each of which is defined separately.

3.4.69**push publisher**

type of publisher that publishes an object in an unconfirmed service request APDU

3.4.70**push publishing manager**

type of publishing manager that requests that a specified object be published using an unconfirmed service

3.4.71**push subscriber**

type of subscriber that recognizes received unconfirmed service request APDUs as published object data

3.4.72**server**

a) role of an AREP in which it returns a confirmed service response APDU to the client that initiated the request

b) object which provides services to another (client) object

3.4.73**service**

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

3.4.74**subscriber**

role of an AREP in which it receives APDUs produced by a publisher

3.4.75**target**

end-node to which a connection is established

3.5 Abbreviations and symbols

AE	Application entity
AL	Application layer
ALME	Application layer management entity
ALP	Application layer protocol
APO	Application object
AP	Application process
APDU	Application protocol data unit
AR	Application relationship
AREP	Application relationship end point
ASCII	American Standard Code for Information Interchange
ASE	Application service element
BNB-PEC	Buffered network-scheduled bi-directional pre-established connection
BNU-PEC	Buffered network-scheduled uni-directional pre-established connection
CID	Connection ID
CN	Controlled node
Cnf	Confirmation
DL-	(as a prefix) data-link-
DLCEP	Data-link connection end point
DLL	Data-link layer
DLM	Data-link-management
DLSAP	Data-link service access point
DLSDU	DL-service-data-unit
DNS	Domain name service
FAL	Fieldbus application layer
Ind	Indication
IP	Internet protocol (see RFC 791)
MN	Managing node
NMT	Network management
OD	Object dictionary
PDO	Process data object
PReq	PollRequest (Type 13 frame type)
Pres	PollRespons (Type 13 frame type)
QUB-CL	Queued user-triggered bi-directional connectionless
QUB-COS	Queued user-triggered bi-directional connection-oriented with segmentation
QUU	Queued user-triggered uni-directional

Req	Request
RPDO	Receive process data object
Rsp	Response
SDO	Service data object
TPDO	Transmit process data object

3.6 Conventions

3.6.1 Overview

The FAL is defined as a set of object-oriented ASEs. Each ASE is specified in a separate subclause. Each ASE specification is composed of two parts, its class specification, and its service specification.

The class specification defines the attributes of the class. The access to these attributes is beyond the scope of this document except where specified. The service specification defines the services that are provided by the ASE.

3.6.2 General conventions

This standard uses the descriptive conventions given in ISO/IEC 10731.

3.6.3 Conventions for class definitions

Class definitions are described using templates. Each template consists of a list of attributes for the class. The general form of the template is shown below:

FAL ASE:	ASE name
CLASS:	Class name
CLASS ID:	#
PARENT CLASS:	Parent class name
ATTRIBUTES:	
1 (o) Key Attribute:	numeric identifier
2 (o) Key Attribute:	name
3 (m) Attribute:	attribute name(values)
4 (m) Attribute:	attribute name(values)
4.1 (s) Attribute:	attribute name(values)
4.2 (s) Attribute:	attribute name(values)
4.3 (s) Attribute:	attribute name(values)
5. (c) Constraint:	constraint expression
5.1 (m) Attribute:	attribute name(values)
5.2 (o) Attribute:	attribute name(values)
6 (m) Attribute:	attribute name(values)
6.1 (s) Attribute:	attribute name(values)
6.2 (s) Attribute:	attribute name(values)
SERVICES:	
1 (o) OpService:	service name
2 (c) Constraint:	constraint expression
2.1 (o) OpService:	service name
3 (m) MgtService:	service name

(1) The "FAL ASE:" entry is the name of the FAL ASE that provides the services for the class being specified.