

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications –
Part 5-20: Application layer service definition – Type 20 elements

Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 5-20: Définition des services de la couche application – Éléments
de type 20





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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELD BUS SPECIFICATIONS –****Part 5-20: Application layer service definition –
Type 20 elements**

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

International Standard IEC 61158-5-20 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 change with respect to the previous edition is listed below:

- added Data types;
- added services;
- updated the Normative references, Terms, definitions, symbols, abbreviations;
- corrected the editorial errors and the text.

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

FDIS	Report on voting
65C/763/FDIS	65C/773/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 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;
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- replaced by a revised edition, or
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INTRODUCTION

This document is one of a series produced to facilitate the interconnection of automation system components. It is related to other documents 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 document 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 document is a conceptual architectural service, independent of administrative and implementation divisions.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-20: Application layer service definition –

1 Scope

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 International 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 20 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 International Standard defines in an abstract way the externally visible service provided by the Type 20 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 International Standard is to define the services provided to the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model.

This International 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).

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 International Standard to provide access to the FAL to control certain aspects of its operation.

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 62591:2010, *Industrial communication networks – Wireless communication network and communication profiles – WirelessHART™*

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

ISO/IEC 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8859-1, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

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*

ANSI/IEEE 754: *IEEE Standard for Floating-Point Arithmetic*

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3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 Terms and definitions from other ISO/IEC standards

3.1.1 ISO/IEC 7498-1 terms

- a) abstract syntax
- b) application entity
- c) application process
- d) application protocol data unit
- e) application service element

3.1.2 ISO/IEC 9545 terms

- a) application-entity-invocation
- b) application-service-element
- c) application-service-element

3.1.3 ISO/IEC 8824-1 terms

- a) object identifier
- b) type
- c) value
- d) simple type
- e) structured type
- f) component type

- g) tag
- h) true
- i) false
- j) integer type
- k) octet string type
- m) null type

3.2 IEC 61158-1 terms

For the purposes of this document, the following terms and definitions apply.

3.2.1

application

function or data structure for which data is consumed or produced

3.2.2

application object

object class that manages and provides the run time exchange of messages across the network and within the network device

Note 1 to entry: Multiple types of application object classes may be defined.

3.2.3

application process

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

3.2.4

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

3.2.5

application process object class

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

3.2.6

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 pre-configuration activities

3.2.7

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

3.2.8**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 behaviour of an object. Attributes are divided into class attributes and instance attributes

3.2.9**behaviour**

indication of how the object responds to particular events

Note 1 to entry: Its description includes the relationship between attribute values and services.

3.2.10**class**

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

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

3.2.11**class attributes**

attribute that is shared by all objects within the same class

3.2.12**class code**

unique identifier assigned to each object class

3.2.13**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.

3.2.14**client**

- a) an object which uses the services of another (server) object to perform a task
- b) an initiator of a message to which a server reacts, such as the role of an AR endpoint in which it issues confirmed service request APDUs to a single AR endpoint acting as a server

3.2.15**conveyance path**

unidirectional flow of APDUs across an application relationship

3.2.16**cyclic**

term used to describe events which repeat in a regular and repetitive manner

3.2.17**endpoint**

one of the communicating entities involved in a connection

3.2.18**error**

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

3.2.19

error code

identification of a specific type of error within an error class

3.2.20

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.

3.2.21

server

- a) role of an AREP in which it returns a confirmed service response APDU to the client that initiated the request
- b) an object which provides services to another (client) object

3.2.22

service

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

Note 1 to entry: A set of common services is defined and provisions for the definition of object-specific services are provided. Object-specific services are those which are defined by a particular object class to perform a required function which is not performed by a common service.

3.3 Type 20 fieldbus application-layer specific definitions

For the purposes of this document, the following terms and definitions apply.

[IEC 61158-5-20:2014](https://standards.iteh.ai/catalog/standards/sist/18f102dc-b74b-4e41-abed-ae47765d53c6/iec-61158-5-20-2014)

3.3.1

analog channel

continuously varying electrical signal connecting a field device to the remainder of the data acquisition or control system

Note 1 to entry: Some field devices support multiple analog channels (input or output). Each analog channel transmits a single dynamic variable to or from the field device.

3.3.2

broadcast

process of sending a PDU to all devices that are connected to the network and are able to receive the transmission

3.3.3

broadcast address

address used by a master to send a command to all devices

3.3.4

burst mode

initiation of communication activity by a slave device at cyclic interval without request from a master

3.3.5

comm error

detectable error in receiving a PhPDU or DLPDU, also 'Communication error code' octet of APDU

3.3.6**device**

any entity containing an implementation of Type 20 fieldbus

3.3.7**device ID**

serial number for a device that is unique among all instances of one type of device

Note 1 to entry: The manufacturer is required to assigned unique value for every device that has the identical values for Manufacturer ID and Device Type.

3.3.8**device type**

manufacturer's type of a device, e.g. its product name

Note 1 to entry: The value of this attribute is unique among all manufacturers and all type of devices. Its value specifies the set of commands and data objects supported by the device.

3.3.9**device variable**

uniquely defined data item within a Field Device that is always associated with the process-related information

Note 1 to entry: A device variable's value varies in response to changes and variations in the process to which the device is connected.

3.3.10**dynamic variable**

device variable that is assigned as the dynamic variable and possibly associated with an analog channel

Note 1 to entry: A device may contain up to four variables – primary, secondary, tertiary, and quaternary variables. These are collectively called the dynamic variables.

3.3.11**expanded device type**

manufacturer's type of the device

Note 1 to entry: The value of this attribute is unique among all manufacturers and all type of devices. Its value specifies the set of commands and data objects supported by the device.

3.3.12**field device**

physical entity that is connected to the process or to plant equipment and has at least one signalling element that communicates with other signalling element(s) via the network

Note 1 to entry: It directly connects to the sensor or actuator or performs process control function and it is directly connected to the physical layer specified in this standard. It may generate or receive an analog signal in addition to a digital signal.

3.3.13**long tag**

32 character restricted ISO Latin-1 string used to identify a field device

3.3.14**loop current**

value measured by a milli-ammeter in series with the field device

Note 1 to entry: The loop current is a near DC analog 4-20 mA signal used to communicate a single value between the control system and the field device. Voltage mode devices use "Volts DC" as their engineering units where "loop current" values are used.

3.3.15**manufacturer ID**

string identifying the manufacturer that produced the device

Note 1 to entry: A manufacturer is required to use the value assigned to it and is not permitted to use the value assigned to another manufacturer.

3.3.16**master**

device that initiates communication activity by sending request PDU to a another device and expecting a response frame from that device

3.3.17**network**

single pair of cable, connectors, associated signaling elements by which a given set of signaling devices are interconnected and non-signaling elements that are attached to the same pair of cable

Note 1 to entry: An installation using multiple-pair wire and a common network power supply is considered as multiple networks.

3.3.18**polling address**

identifier assigned to a device such that it is unique within the network to which the device is connected

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3.3.19**slave**

device that initiates communication activity only after it receives a request PDU from a master device and it is required to send a response to that request

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3.3.20**tag**

8 character ASCII string used to identify the field device

3.3.21**unique ID**

identifier assigned to a device which is unique among all instances of the devices compliant to this standard

3.4 Abbreviations and symbols

AE	Application Entity
AL	Application Layer
AP	Application Process
APDU	Application Protocol Data Unit
APO	Application Process Object
AR	Application Relationship
AREP	Application Relationship End Point
ASCII	American Standard Code for Information Interchange
ASE	Application Service Element
Cnf	Confirmation
DL-	(as a prefix) Data Link-
DLC	Data Link Connection
DLL	Data Link Layer

DLM	Data Link-management
DLSAP	Data Link Service Access Point
DLSDU	DL-service-data-unit
FAL	Fieldbus Application Layer
ID	Identifier
IEC	International Electrotechnical Commission
Ind	Indication
OSI	Open Systems Interconnect
Req	Request
Rsp	Response
VFD	Virtual Field Device

3.5 Conventions

3.5.1 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 service specification defines the services that are provided by the ASE.

3.5.2 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) OpsService:	service name
2. (c) Constraint:	constraint expression
2.1 (o) OpsService:	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.