

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications –
Part 6-9: Application layer protocol specification – Type 9 elements

Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 6-9: Spécification du protocole de la couche application – Éléments
de type 9



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IEC 61158-6-9

Edition 3.0 2014-08

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INTERNATIONAL
ELECTROTECHNICAL
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COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XD**
CODE PRIX

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-1760-3

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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 6-9: Application layer protocol specification –
Type 9 elements**

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

International Standard IEC 61158-6-9 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:

- Correct Time-difference valid range
- Correct Table 3 state transition
- Include Transparent timeliness class in BNU AREP formal model

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

FDIS	Report on voting
65C/764/FDIS	65C/774/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:

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- replaced by a revised edition, or
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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 protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- as a guide for implementors and designers;
- for use in the testing and procurement of equipment;
- as part of an agreement for the admittance of systems into the open systems environment;
- as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-9: Application layer protocol specification – Type 9 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 9 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 behavior provided by the Type 9 fieldbus Application Layer in terms of

- a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
- b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
- c) the application context state machine defining the application service behavior visible between communicating application entities; and
- d) the application relationship state machines defining the communication behavior visible between communicating application entities; and.

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

- 1) define the wire-representation of the service primitives defined in IEC 61158-5-9, and
- 2) define the externally visible behavior associated with their transfer.

This standard specifies the protocol of the Type 9 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).

1.2 Specifications

The principal objective of this standard is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-9.

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 protocols standardized in IEC 61158-6.

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. Conformance is achieved through implementation of this application layer protocol specification.

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

IEC 61158-3-1, *Industrial communication networks – Fieldbus specifications – Part 3-1: Data-link layer service definition – Type 1 elements*

IEC 61158-4-1, *Industrial communication networks – Fieldbus specifications – Part 4-1: Data-link layer protocol specification – Type 1 elements*

IEC 61158-5-5, *Industrial communication networks – Fieldbus specifications – Part 5-5: Application layer service definition – Type 5 elements*

IEC 61158-5-9, *Industrial communication networks – Fieldbus specifications – Part 5-9: Application layer service definition – Type 9 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: The Basic Model*

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

ISO/IEC 8825-1, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

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*

ISO/IEC/IEEE 60559, *Information technology – Microprocessor Systems – 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 Terms and definitions from other ISO/IEC standards

3.1.1 Terms and definitions from ISO/IEC 7498-1

- a) abstract syntax
- b) application entity
- c) application process
- d) application protocol data unit
- e) application service element
- f) application entity invocation
- g) application process invocation
- h) application transaction
- i) presentation context
- j) real open system
- k) transfer syntax

3.1.2 Terms and definitions from ISO/IEC 9545

- a) application-association
- b) application-context
- c) application context name
- d) application-entity-invocation
- e) application-entity-type
- f) application-process-invocation
- g) application-process-type
- h) application-service-element
- i) application control service element

3.1.3 Terms and definitions from ISO/IEC 8824-1

- a) object identifier
- b) type
- c) value
- d) simple type
- e) structured type
- f) component type
- g) tag
- h) Boolean type
- i) true
- j) false
- k) integer type
- l) bitstring type
- m) octetstring type
- n) null type
- o) sequence type
- p) sequence of type
- q) choice type
- r) tagged type
- s) any type
- t) module
- u) production

3.1.4 Terms and definitions from ISO/IEC 8825-1

- a) encoding (of a data value)
- b) data value
- c) identifier octets (the singular form is used in this standard)
- d) length octet(s) (both singular and plural forms are used in this standard)
- e) contents octets

3.2 IEC 61158-1 terms

For the purposes of the present document, the following IEC 61158-1 terms apply.

3.2.1

application

function or data structure for which data is consumed or produced

3.2.2

application layer interoperability

capability of application entities to perform coordinated and cooperative operations using the services of the FAL

3.2.3

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.

3.2.4

application process

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

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3.2.5

application process identifier (standards.iteh.ai)

distinguishes multiple application processes used in a device

3.2.6

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.

3.2.7

application process object class

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

3.2.8

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.

3.2.9

application relationship application service element

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

3.2.10**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.

3.2.11**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.

3.2.12**behaviour**

indication of how the object responds to particular events

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

3.2.13**class**

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

Note 1 to entry: A class is a generalisation of 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.

3.2.14**class attributes**

attribute that is shared by all objects within the same class

3.2.15**class code**

unique identifier assigned to each object class

3.2.16**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.

3.2.17**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, 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

3.2.18**conveyance path**

unidirectional flow of APDUs across an application relationship

3.2.19**cyclic**

events which repeat in a regular and repetitive manner

3.2.20**dedicated AR**

AR used directly by the FAL User

Note 1 to entry: On Dedicated ARs, only the FAL Header and the user data are transferred

3.2.21**device**

physical hardware connection to the link

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

3.2.22**device profile**

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

3.2.23**dynamic AR**

AR that requires the use of the AR establishment procedures to place it into an established state

3.2.24**endpoint**

one of the communicating entities involved in a connection

3.2.25**error**

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

3.2.26**error class**

general grouping for error definitions

Note 1 to entry: Error codes for specific errors are defined within an error class.

3.2.27**error code**

identification of a specific type of error within an error class

3.2.28**FAL subnet**

networks composed of one or more data link segments

Note 1 to entry: They are permitted to contain bridges, but not routers FAL subnets are identified by a subset of the network address.

3.2.29**logical device**

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

3.2.30**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.