IEC 61158-5-20

INTERNATIONAL
STANDARD

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

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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 second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

The main change with respect to the previous edition is listed below:

- Revised VFD ASE, see 6.2.1.

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

FDIS	Report on voting
65C/606/FDIS	65C/620/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;

• withdrawn;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 standard 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.

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.

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1 Scope

1.1 Overview

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 part of IEC 61158 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 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

a) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and

b) 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) 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.

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 do they 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 the Type 20 application layer services as 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 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

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*

3 Terms, definitions, symbols, abbreviations and conventions

For the purposes of this document, the following terms as defined in these publications apply:

3.1 ISO/IEC 7498-1 terms

a) application entity

b) application process

c) application protocol data unit

d) application service element

e) application entity invocation

f) application process invocation

g) application transaction

h) real open system

i) transfer syntax

3.2 ISO/IEC 8822 terms

a) abstract syntax

b) presentation context

3.3 ISO/IEC 9545 terms

a) application-entity-invocation

b) application-entity-type

c) application-process-invocation

d) application-process-type

e) application-service-elementt

3.4 ISO/IEC 8824 terms

a) object identifier

b) type

3.5 IEC/TR 61158-1 terms

The following IEC/TR 61158-1 terms apply.

3.5.1
application
function or data structure for which data is consumed or produced

3.5.2
application layer interoperability
capability of application entities to perform coordinated and cooperative operations using the services of the FAL

3.5.3
application object
object class that manages and provides the run time exchange of messages across the network and within the network device

NOTE Multiple types of application object classes may be defined.

3.5.4
application process
part of a distributed application on a network, which is located on one device and unambiguously addressed

3.5.5
application process identifier
distinguishes multiple application processes used in a device

3.5.6
application process object
component of an application process that is identifiable and accessible through an FAL application relationship. 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

3.5.7
application process object class
a class of application process objects defined in terms of the set of their network-accessible attributes and services

3.5.8
application relationship
cooperative association between two or more application-entity-invocations for the purpose of exchange of information and coordination of their joint operation. This relationship is activated either by the exchange of application-protocol-data-units or as a result of pre-configuration activities

3.5.9
application relationship application service element
application-service-element that provides the exclusive means for establishing and terminating all application relationships

3.5.10
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. Each application process involved in the application relationship maintains its own application relationship endpoint

3.5.11
attribute
description of an externally visible characteristic or feature of an object. 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

3.5.12
behaviour
indication of how the object responds to particular events. Its description includes the relationship between attribute values and services

**3.5.13
class**
a set of objects, all of which represent the same kind of system component. 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

**3.5.14
class attributes**
an attribute that is shared by all objects within the same class

**3.5.15
class code**
a unique identifier assigned to each object class

**3.5.16
class specific service**
a service defined by a particular object class to perform a required function which is not performed by a common service. A class specific object is unique to the object class which defines it

**3.5.17
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

**3.5.18
conveyance path**
unidirectional flow of APDUs across an application relationship

**3.5.19
cyclic**
term used to describe events which repeat in a regular and repetitive manner

**3.5.20
dedicated AR**
AR used directly by the FAL User. On Dedicated ARs, only the FAL Header and the user data are transferred

**3.5.21
device**
a physical hardware connection to the link. A device may contain more than one node

**3.5.22
device profile**
a collection of device dependent information and functionality providing consistency between similar devices of the same device type

**3.5.23
endpoint**
one of the communicating entities involved in a connection

**3.5.24
error**
a discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

3.5.25
error code
identification of a specific type of error within an error class

3.5.26
management information
network-accessible information that supports managing the operation of the fieldbus system, including the application layer. Managing includes functions such as controlling, monitoring, and diagnosing

3.5.27
network
a series of nodes connected by some type of communication medium. The connection paths between any pair of nodes can include repeaters, routers and gateways

3.5.28
pre-defined AR endpoint
AR endpoint that is defined locally within a device without use of the create service. Pre-defined ARs that are not pre-established are established before being used

3.5.29
pre-established AR endpoint
AR endpoint that is placed in an established state during configuration of the AEs that control its endpoints

3.5.30
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

3.5.31
service
operation or function than an object and/or object class performs upon request from another object and/or object class. 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

3.6 Fieldbus application-layer specific definitions

There are additional terms defined for this part.

3.6.1 analog channel

A continuously varying electrical signal connecting a field device to the remainder of the data acquisition or control system. Some field devices support multiple analog channels (input or output). Each analog channel transmits a single dynamic variable to or from the field device.

3.6.2 broadcast address

A broadcast address is used by a master to send a command to all devices. The broadcast address is five octet long and has all zeros as the value.