IEC 61158-5-21

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 5-21: Application layer service definition – Type 21 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 5-21: Définition des services de la couche application – Eléments
de Type 21**

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International Standard IEC 61158-5-21:2010 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This standard cancels and replaces IEC/PAS 62573 published in 2008. This first edition constitutes a technical revision.

This bilingual version published in 2012-01 corresponds to the English version published in 2010-08.

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.

The French version 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• withdrawn;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   The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

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.

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 considered a window between corresponding application programs.

This standard provides the common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment as well as material specific to the Type 21 protocol. 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 FAL in terms of:

a) an abstract model for defining application resources (objects) capable of being manipulated by users via 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 that they take;

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;

b) systems management at the boundary between the application layer and systems management of the fieldbus Reference Model.

This standard describes the structure and services of the IEC FAL, 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 (AEs) contained in 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 management of the instances of FAL classes.

Although these services specify how requests and responses are issued and delivered from the perspective of applications, they do not include a specification of what the requesting and responding applications are to do with them. That is, these services only define what requests and responses applications can send or receive, not the functions of the applications themselves. 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. This latter objective 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 standard may be used as the basis for formal application programming interfaces. Nevertheless, it is not a formal programming interface, and any such interface must address implementation issues not covered by this standard, including:

a) sizes and octet ordering of various multi-octet service parameters;

b) correlation of paired primitives for request and confirmation, or indication and response.

1.3 Conformance

This standard does not specify individual implementations or products, nor does it constrain the implementations of application layer entities in industrial automation systems.

There is no conformance of equipment to this application layer service definition standard. Instead, conformance is achieved through the 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 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,.

IEC 60559, *Binary floating-point arithmetic for microprocessor systems*

IEC 61158-2:2010[1], *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-21:2010[1], *Industrial communication networks – Fieldbus specifications – Part 3-21: Data-link layer service definition – Type 21 elements*

IEC 61158-4-21:2010[1], *Industrial communication networks – Fieldbus specifications – Part 4-21: Data-link layer protocol specification – Type 21 elements*

IEC 61158-6-21:2010[1], *Industrial communication networks – Fieldbus specifications – Part 6-21: Application layer protocol specification – Type 21 elements*

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

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[1] To be published.

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model: Naming and addressing*

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

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

ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

3 Terms, definitions, symbols, abbreviations, and conventions

3.1 Terms and definitions from other ISO/IEC standards

3.1.1 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

3.1.2 ISO/IEC 8822 terms

a) abstract syntax

b) presentation context

3.1.3 ISO/IEC 9545 terms

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

3.2 Fieldbus data link layer terms

For the purposes of this document, the following terms as defined in IEC 61158-3-21:2010 and IEC 61158-4-21:2010 apply.

a) DL-Time

b) DL-Scheduling-policy

c) DLCEP

d) DLC

e) DL-connection-oriented mode

f) DLPDU

g) DLSDU

h) DLSAP

k) link

l) ISO/IEC 8802-3:2000 MAC address

m) DL–entity identifier

3.3 Fieldbus application layer specific definitions

3.3.1
application
function or data structure for which data are consumed or produced

3.3.2
application objects
multiple object classes that manage and provide a runtime exchange of messages across the network and within the network device

3.3.3
application process
part of a distributed application on a network, which is located on one device and addressed unambiguously

3.3.4
application process identifier
distinguishes multiple application processes used in a device

3.3.5
application process object
component of an application process that is identifiable and accessible through an FAL application relationship

NOTE 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"). 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 create and delete application objects and their corresponding definitions dynamically.

3.3.6
application process object class
class of application process objects defined in terms of the set of their network-accessible attributes and services

3.3.7
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 This relationship is activated either by the exchange of application-protocol-data-units or as a result of preconfiguration activities.

3.3.8
application relationship application service element
application-service-element that provides the exclusive means for establishing and terminating all application relationships

3.3.9
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   Each application process involved in the application relationship maintains its own application relationship endpoint.

3.3.10
attribute
description of an externally visible characteristic or feature of an object

NOTE   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.

3.3.11
behavior
indication of how an object responds to particular events

3.3.12
channel
single physical or logical link of an input or output application object of a server to the process

3.3.13
class
set of objects, all of which represent the same type of system component

NOTE   A class is a generalization 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.

3.3.14
class attributes
attribute shared by all objects within the same class

3.3.15
class code
unique identifier assigned to each object class

3.3.16
class-specific service
service defined by a particular object class to perform a required function that is not performed by a common service

NOTE   A class-specific object is unique to the object class that defines it.

3.3.17
client
a) object that uses the services of another (server) object to perform a task

b) initiator of a message to which a server reacts

3.3.18
consume
act of receiving data from a producer

3.3.19
consumer
node or sink that receives data from a producer

3.3.20
consuming application
application that consumes data

3.3.21
conveyance path
unidirectional flow of APDUs across an application relationship

3.3.22
cyclic
repetitive in a regular manner

3.3.23
data consistency
means for coherent transmission and access of the input- or output-data object between and within client and server

3.3.24
device
physical hardware connected to the link

NOTE   A device may contain more than one node.

3.3.25
device profile
a collection of device-dependent information and functionality providing consistency between similar devices of the same device type

3.3.26
diagnostic information
all data available at the server for maintenance purposes

3.3.27
end node
producing or consuming node

3.3.28
endpoint
one of the communicating entities involved in a connection

3.3.29
error
discrepancy between a computed, observed, or measured value or condition and the specified or theoretically correct value or condition

3.3.30
error class
general grouping for related error definitions and corresponding error codes

3.3.31
error code
identification of a specific type of error within an error class

3.3.32
event
instance of a change of conditions