IEC 61158-5-11

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications –
Part 5-11: Application layer service definition – Type 11 elements

Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 5-11: Définition des services de la couche application – Éléments de
Type 11

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International Standard IEC 61158-5-11 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This bilingual version (2014-07) corresponds to the English version, published in 2007-12.

This first edition and its companion parts of the IEC 61158-5 subseries cancel and replace IEC 61158-5:2003. This edition of this part constitutes a technical addition. This part and its Type 11 companion parts also cancel and replace IEC/PAS 62406, published in 2005.

This edition of IEC 61158-5 includes the following significant changes from the previous edition:

a) deletion of the former Type 6 fieldbus for lack of market relevance;

b) addition of new types of fieldbuses;

c) partition of part 5 of the third edition into multiple parts numbered -5-2, -5-3, …

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

FDIS	Report on voting
65C/475/FDIS	65C/486/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 of this standard has not been voted upon.

This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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• withdrawn;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.

The list of all the parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

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.

INDUSTRIAL COMMUNICATION NETWORKS –
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Part 5-11: Application layer service definition – Type 11 elements

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 11 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 part of IEC 61158 defines in an abstract way the externally visible service provided by the different Types of 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 part of IEC 61158 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 part of IEC 61158 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 part of IEC 61158 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 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 part of IEC 61158 do 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 fulfil any given Type of application layer services as defined in this part of IEC 61158.

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.

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

IEC 61131-1, *Programmable controllers – Part 1: General information*

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC/TR 61158-1 (Ed.2.0), *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-3-11, *Industrial communication networks – Fieldbus specifications - Part 3-11: Data-link layer service definition – Type 11 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 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model – Part 3: Naming and addressing*

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

ISO/IEC 8824, *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 10646-1, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Architecture and Basic Multilingual Plane*

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

3   Terms and definitions, 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

For the purposes of this document, the following terms as defined in ISO/IEC 8822 apply:

a) abstract syntax

b) presentation context

3.3   ISO/IEC 9545 terms

For the purposes of this document, the following terms as defined in ISO/IEC 9545 apply:

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

3.4   ISO/IEC 8824 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8824 apply:

a) object identifier

b) type

3.5   Fieldbus data-link layer terms

For the purposes of this document, the following terms as defined in IEC 61158-3-11 apply.

a) DLCEP

b) DLC

c) DLPDU

d) DLSDU

e) DLSAP

f) link

g) network address

h) node

i) scheduled

j) unscheduled

3.6   Fieldbus application layer type-specific definitions

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

3.6.1
access protection
limitation of the usage of an application object to one client

3.6.2
active connection control object
instance of a certain FAL class that abstracts the interconnection facility (as Consumer and Provider) of an automation device

3.6.3
address assignment table
mapping of the client's internal I/O-Data object storage to the decentralized input and output data objects

3.6.4
allocate
take a resource from a common area and assign that resource for the exclusive use of a specific entity

3.6.5
application
function or data structure for which data is consumed or produced

3.6.6
application layer interoperability
capability of application entities to perform coordinated and cooperative operations using the services of the FAL

3.6.7
application objects
multiple object classes that manage and provide a run time exchange of messages across the network and within the network device

3.6.8
application process
part of a distributed application on a network, which is located on one device and unambiguously addressed

3.6.9
application process identifier
distinguishes multiple application processes used in a device

3.6.10
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 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.

3.6.11
application process object class
a class of application process objects defined in terms of the set of their network-accessible attributes and services

3.6.12
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 preconfiguration activities

3.6.13
application relationship application service element
application-service-element that provides the exclusive means for establishing and terminating all application relationships

3.6.14
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.

3.6.15
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 behaviour of an object. Attributes are divided into class attributes and instance attributes.

3.6.16
behaviour
indication of how an object responds to particular events

3.6.17
bit-no
designates the number of a bit in a bitstring or an octet

3.6.18
channel
single physical or logical link of an input or output application object of a server to the process

3.6.19
channel related diagnosis
information concerning a specific element of an input or output application object, provided for maintenance purposes

EXAMPLE: validity of data

3.6.20
class
a set of objects, all of which represent the same kind of system component

NOTE   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 behaviour, but usually contain different data in their attributes.

3.6.21
class attributes
attribute that is shared by all objects within the same class

3.6.22
class code
unique identifier assigned to each object class

3.6.23
class specific service
service defined by a particular object class to perform a required function which is not performed by a common service

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

3.6.24
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

3.6.25
common memory
virtual common memory over the network for the Type 11 fieldbus, which is shared with the nodes participating in the Type 11 fieldbus and is primarily used for the real-time communications by the TCC data service

3.6.26
communication objects
components that manage and provide a run time exchange of messages across the network

EXAMPLES: Connection Manager object, Unconnected Message Manager (UCMM) object, and Message Router object.

3.6.27
configuration check
comparison of the expected I/O-Data object structuring of the client with the real I/O-Data object structuring to the server in the start-up phase

3.6.28
configuration data base
interconnection information maintained by the ACCO ASE

3.6.29
configuration fault
an unacceptable difference between the expected I/O-Data object structuring and the real I/O-Data object structuring, as detected by the server

3.6.30
configuration identifier
representation of a portion of I/O Data of a single input- and/or output-module of a server

3.6.31
connection
logical binding between application objects that may be within the same or different devices