IEC 61158-5-14

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 5-14: Application layer service definition – Type 14 elements**

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

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FOREWORD

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International Standard IEC 61158-5-14 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

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 14 companion parts also cancel and replace IEC/PAS 62409, 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.

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• withdrawn;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 – FIELDBUS SPECIFICATIONS –

Part 5-14: Application layer service definition – Type 14 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 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 14 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 Type 14 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

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 standard specifies the structure and services of the Type 14 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 14 application layer services as defined in this standard.

2 Normative references

The following referenced standards 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 standard (including any amendments) applies.

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 61588, *Precision clock synchronization protocol for networked measurement and control systems*

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 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-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

a) object identifier

b) type

3.5   Fieldbus application-layer specific definitions

3.5.1
access control
control on the reading and writing of an object

3.5.2
access Path
association of a symbolic name with a variable for the purpose of open communication

3.5.3
communication macrocycle
set of basic cycles needed for a configured communication activity in a macro network segment

3.5.4
communication scheduling
algorithms and operation for data transfers occurring in a deterministic and repeatable manner

3.5.5
configuration (of a system or device)
step in system design: selecting functional units, assigning their locations and defining their interconnections

3.5.6
cyclic
repetitive in a regular manner

3.5.7
destination FB Instance
FB instance that receives the specified parameters

3.5.8
domain
part of memory used to store code or data

3.5.9
domain download
operation to write data in a domain

3.5.10
domain upload
operation to read data from a domain

3.5.11
entity
particular thing, such as a person, place, process, object, concept, association, or event

3.5.12
bridge
DL-relay entity which performs synchronization between links (buses) and may perform selective store-and-forward and routing functions to connect two micro network segments

3.5.13
identifier
16-bit word associated with a system variable

3.5.14
index
address of an object within an application process

3.5.15
instance
actual physical occurrence of an object within a class that identifies one of many objects within the same object class

3.5.16
instantiation
creation of an instance of a specified type

3.5.17
management information
network-visible information for the purpose of managing the field system

3.5.18
management information base
organized list of management information

3.5.19
mapping
set of values having defined correspondence with the quantities or values of another set

3.5.20
message filtering
decision on a message according to a special rule

3.5.21
micro segment
part of a network, where special scheduling is implemented

3.5.22
offset
number of octets from a specially designated position

3.5.23
phase
elapsed fraction of a cycle, measured from some fixed origin

3.5.24
process interface
data exchange and information mapping between physical process and application unit

3.5.25
real-time
ability of a system to provide a required result in a bounded time

3.5.26
real-time communication
transfer of data in real-time

3.5.27
real-time Ethernet (RTE)
ISO/IEC 8802-3-based network that includes real-time communication

NOTE 1   Other communication can be supported, providing the real-time communication is not compromised.

NOTE 2   This definition is dedicated, but not limited, to ISO/IEC 8802-3. It could be applicable to other IEEE 802 specifications, for example IEEE 802.11.

3.5.28
schedule
temporal arrangement of a number of related operations

3.5.29
scheduling macrocycle
time interval to implement a specific schedule

3.5.30
source FB Instance
FB instance that sends a specific parameter

3.5.31
time offset
time difference from a specially designated time

3.6   Abbreviations and symbols

AAE	Application Access Entity
AE	Application Entity
AL	Application Layer
ALME	Application Layer Management Entity
ALP	Application Layer Protocol
APO	Application Object
AP	Application Process
APDU	Application Protocol Data Unit
API	Application Process Identifier
AR	Application Relationship
ARP	Address Resolution Protocol
AREP	Application Relationship End Point
ASE	Application Service Element
Cnf	Confirmation
CR	Communication Relationship
CREP	Communication Relationship End Point
CSMA/CD	Carrier Sense Multiple Access Protocol with Collision Detection
DD	Device Description
DHCP	Dynamic Host Configuration Protocol
DL-	(as a prefix) Data Link-
DLCEP	Data Link Connection End Point
DLL	Data Link Layer
DLE	Data Link Entity
DLM	Data Link-management
DLS	Data Link Service
DLSAP	Data Link Service Access Point
DLSDU	DL-service-data-unit
ECSME	Type 14 communication scheduling management entity
Type 14	Ethernet for Plant Automation
EM_	(as a prefix) Type 14 Management
ESME	Type 14 Socket Mapping Entity
FB	Function Block