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Industrial communication networks – Fieldbus specifications –
Part 5-17: Application layer service definition – Type 17 elements

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IEC 61158-5-17

Edition 1.0 2007-12

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XA**

ICS 35.100.70; 25.040.40

ISBN 2-8318-9469-7

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FIELDBUS SPECIFICATIONS –****Part 5-17: Application layer service definition – Type 17 elements**

FOREWORD

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NOTE Use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in type combinations as specified explicitly in the IEC 61784 series. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

International Standard IEC 61158-5-17 has been prepared by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

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 17 companion parts also cancel and replace IEC/PAS 62405.

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.

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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/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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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-17: Application layer service definition – Type 17 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 17 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

- 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 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 17 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 all other undated references, the latest edition of the referenced document (including any amendments) applies.

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*

ISO/IEC 7498 (all parts), *Information technology – Open Systems Interconnection – Basic Reference Model*

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 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1 ISO/IEC 7498-1 terms

For the purposes of this document, the following terms as defined in ISO/IEC 7498-1 apply:

- a) application entity
- b) application protocol data unit

c) application service element

3.1.2 ISO/IEC 10731 terms

- a) (N)-connection
- b) (N)-entity
- c) (N)-layer
- d) (N)-service
- e) (N)-service-access-point

3.1.3 Other terms and definitions

3.1.3.1

application

function or data structure for which data is consumed or produced

3.1.3.2

application process

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

3.1.3.3

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

3.1.3.4

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.

3.1.3.5

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.

3.1.3.6

behaviour

indication of how an object responds to particular events

3.1.3.7

bridge

intermediate equipment that connects two or more segments using a data-link layer relay function

3.1.3.8

channel

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

3.1.3.9

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.

3.1.3.10

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

3.1.3.11

connection

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

NOTE 1 Connections may be either point-to-point or multipoint.

NOTE 2 The logical link between sink and source of attributes and services at different custom interfaces of RT-Auto ASEs is referred to as interconnection. There is a distinction between data and event interconnections. The logical link and the data flow between sink and source of automation data items is referred to as data interconnection. The logical link and the data flow between sink (method) and source (event) of operational services is referred to as event interconnection.

3.1.3.12

connection point

buffer which is represented as a subinstance of an Assembly object

3.1.3.13

conveyance path

unidirectional flow of APDUs across an application relationship

3.1.3.14

dedicated AR

AR used directly by the FAL User

NOTE On Dedicated ARs, only the FAL Header and the user data are transferred.

3.1.3.15

device

physical hardware connected to the link

NOTE A device may contain more than one node.

3.1.3.16

domain

part of the RTE network consisting of one or two subnetwork(s)

NOTE Two subnetworks are required to compose a dual-redundant RTE network, and each end node in the domain is connected to both of the subnetworks.

3.1.3.17

domain master

station which performs diagnosis of routes to all other domains, distribution of network time to nodes inside the domain, acquisition of absolute time from the network time master and notification of status of the domain

3.1.3.18

domain number

numeric identifier which indicates a domain

3.1.3.19

end node

producing or consuming node

3.1.3.20

endpoint

one of the communicating entities involved in a connection

3.1.3.21**error**

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

3.1.3.22**external bridge**

bridge to which neither internal bridges nor RTE stations are connected directly

3.1.3.23**event**

an instance of a change of conditions

3.1.3.24**group**

a) <general> a general term for a collection of objects. Specific uses:

b) <addressing> when describing an address, an address that identifies more than one entity

3.1.3.25**interface**

a) shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

b) collection of FAL class attributes and services that represents a specific view on the FAL class

3.1.3.26**interface port**

physical connection point of an end node, which has an independent DL-address

3.1.3.27**internal bridge**

bridge to which no routers, external bridges or nodes non-compliant with this specification are connected directly

3.1.3.28**invocation**

act of using a service or other resource of an application process

NOTE Each invocation represents a separate thread of control that may be described by its context. Once the service completes, or use of the resource is released, the invocation ceases to exist. For service invocations, a service that has been initiated but not yet completed is referred to as an outstanding service invocation.

3.1.3.29**junction bridge**

bridge to which at least one router, external bridge or node non-compliant with this specification, and to which at least one internal bridge or RTE station is connected

3.1.3.30**link**

physical communication channel between two nodes

3.1.3.31**method**

<object> a synonym for an operational service which is provided by the server ASE and invoked by a client

3.1.3.32

network

a set of nodes connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

3.1.3.33

network time master

station which distributes network time to domain masters

3.1.3.34

node

single DL-entity as it appears on one local link

3.1.3.35

non-redundant interface node

node which has a single interface port

3.1.3.36

non-redundant station

station that consists of a single end node

NOTE “non-redundant station” is synonymous with “end node”.

3.1.3.37

object

abstract representation of a particular component within a device, usually a collection of related data (in the form of variables) and methods (procedures) for operating on that data that have clearly defined interface and behaviour

3.1.3.38

originator

client responsible for establishing a connection path to the target

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3.1.3.39

path

logical communication channel between two nodes, which consists of one or two link(s)

3.1.3.40

peer

role of an AR endpoint in which it is capable of acting as both client and server

3.1.3.41

producer

node that is responsible for sending data

3.1.3.42

provider

source of a data connection

3.1.3.43

publisher

role of an AR endpoint that transmits APDUs onto the fieldbus for consumption by one or more subscribers

NOTE A publisher may not be aware of the identity or the number of subscribers and it may publish its APDUs using a dedicated AR.