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Industrial communication networks – Fieldbus specifications –
Part 6-22: Application layer protocol specification – Type 22 elements

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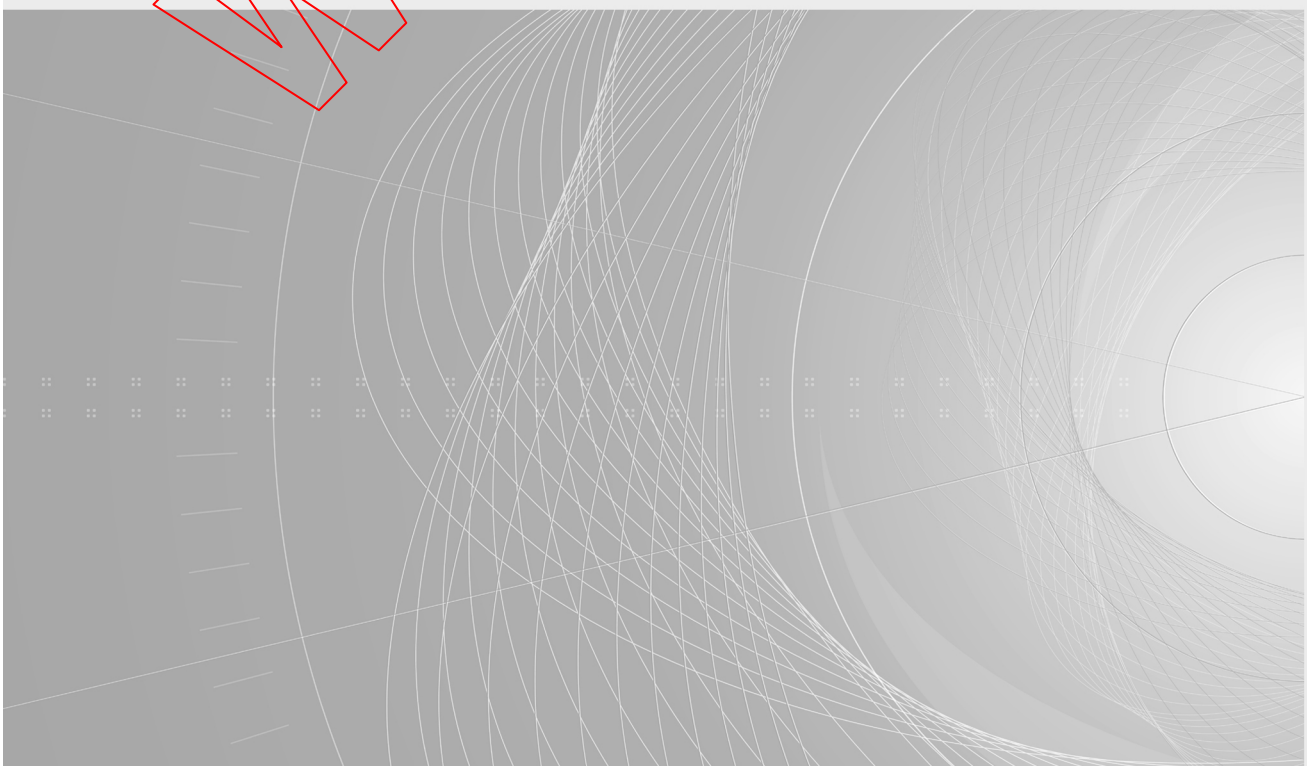

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-22: Application layer protocol specification – Type 22 elements

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International Standard IEC 61158-6-22 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 61158-6-22 published in 2009. This first edition constitutes a technical revision.

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

FDIS	Report on voting
65C/607/FDIS	65C/621/RVD

Full information on the voting for the approval of this International 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- withdrawn,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.

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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 protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

- as a guide for implementors and designers;
- for use in the testing and procurement of equipment;
- as part of an agreement for the admittance of systems into the open systems environment;
- as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-22: Application layer protocol specification – Type 22 elements

1 Scope

1.1 General

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 22 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 behavior provided by the different Types of the fieldbus Application Layer in terms of:

a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities;
b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities;
c) the application context state machine defining the application service behavior visible between communicating application entities; and
d) the application relationship state machines defining the communication behavior visible between communicating application entities.

The purpose of this standard is to define the protocol provided to:

a) define the wire-representation of the service primitives defined in IEC 61158-5-22:2010; and
b) define the externally visible behavior associated with their transfer.

This standard specifies the protocol 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

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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 syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-22:2010.

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 protocols standardized in subparts of IEC 61158-6.

1.3 Conformance

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

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

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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 61158-3-22:2010[1], *Industrial communication networks – Fieldbus specifications – Part 3-22: Data-link layer service definition – Type 22 elements*

IEC 61158-4-22:2010[1], *Industrial communication networks – Fieldbus specifications – Part 4-22: Data-link layer protocol specification – Type 22 elements*

IEC 61158-5-22:2010[1], *Industrial communication networks – Fieldbus specifications – Part 5–22: Application layer service definition - Type 22 elements*

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

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

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*

1 To be published.

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, abbreviations, symbols and conventions

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

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

3.1.4 ISO/IEC 8824-1 terms

a) object identifier
b) type

3.2 Fieldbus application-layer specific definitions

3.2.1
acyclic data
data which is transferred from time to time for dedicated purposes

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3.2.2
bit
unit of information consisting of a 1 or a 0. This is the smallest data unit that can be transmitted

3.2.3
cell
synonym for a single DL-segment which uses RTFL communication model

3.2.4
channel
path provided for conveying data

3.2.5
client
object which uses the services of a server by initiating a message to perform a task

3.2.6
communication cycle
fixed time period between which the root device issues empty frames for cyclic communication initiation in which data is transmitted utilizing CDC and MSC

3.2.7
connection
logical binding between two application objects

3.2.8
cycle time
duration of a communication cycle

3.2.9
cyclic
events which repeat in a regular and repetitive manner

3.2.10
cyclic communication
periodic exchange of telegrams

3.2.11
cyclic data
data which is transferred in a regular and repetitive manner for dedicated purposes

3.2.12
cyclic data channel
CDC
part of one or more frames, which is reserved for cyclic data

3.2.13
data
generic term used to refer to any information carried over a fieldbus

3.2.14
device
physical entity connected to the fieldbus

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3.2.15
error
discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

3.2.16
error code
identification number of a specific type of error

3.2.17
gateway
device acting as a linking element between different protocols

3.2.18
index
position of an object within the object dictionary

3.2.19
inter-cell communication
communication between a RTFL device and a RTFN device or communication between a RTFL device and another RTFL device in different cells linked by RTFN

3.2.20
interface
shared boundary between two functional units, defined by functional characteristics, signal characteristic, or other characteristics as appropriate

3.2.21
intra-cell communication
communication between a RTFL device and another RTFL device in the same cell

3.2.22
logical double line
sequence of root device and all ordinary devices processing the communication frame in forward and backward direction

3.2.23
mapping parameters
set of values defining the correspondence between application objects and process data objects

3.2.24
master clock
global time base for the PCS mechanism

3.2.25
message
ordered sequence of octets intended to convey data

3.2.26
message channel
MSC
part of one or more frames, which is reserved for acyclic data

3.2.27
network
set of devices connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

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