IEC 61158-5-22

Edition 2.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 5-22: Application layer service definition – Type 22 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 5-22: Définition des services de la couche application – Éléments de type 22

IEC 61158-5-22:2014-08(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

IEC 61158-5-22

Edition 2.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 5-22: Application layer service definition – Type 22 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 5-22: Définition des services de la couche application – Éléments de type 22**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX XC

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-1742-9

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-22: Application layer service definition – Type 22 elements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

Attention is drawn to the fact that the use of the associated protocol type is restricted by its 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 layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-5-22 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

This edition includes the following technical changes with respect to the previous edition.

- Adopted revisions dates of cited standards.

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

FDIS	Report on voting
65C/763/FDIS	65C/773/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.

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 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 5-22: Application layer service definition – 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 service provided by 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

a) the FAL user at the boundary between the user and the application layer of the fieldbus reference model; and

b) 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 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) 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, and the corresponding protocols standardized in subparts of 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 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 this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill the application layer services as defined in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE All parts of the IEC 61158 series, as well as IEC 61784-1 and IEC 61784-2 are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

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

IEC 61158-1:2014, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-4-22:2014, *Industrial communication networks – Fieldbus specifications – Part 4-22: Data-link layer protocol specification – Type 22 elements*

IEC 61158-6-22, *Industrial communication networks – Fieldbus specifications – Part 6-22: Application layer protocol specification – Type 22 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: 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*

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

ISO/IEC 10646, *Information technology – Universal Coded Character Set (UCS)*

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

ISO/IEC/IEEE 60559, *Information technology – Microprocessor systems – Floating-point arithmetic*

3 Terms, definitions, abbreviations, symbols and conventions

For the purposes of this document, the following terms, definitions, symbols and abbreviations 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 8824-1 terms

a) object identifier

b) type

3.5 Type 22 fieldbus application-layer specific definitions

3.5.1
application
function for which data is exchanged

3.5.2
application object
representation of a particular component within a device

3.5.3
acyclic data
data which is transferred from time to time for dedicated purposes

3.5.4
bit
unit of information consisting of a 1 or a 0

Note 1 to entry: This is the smallest data unit that can be transmitted.

3.5.5
cell
synonym for a single DL-segment which uses RTFL communication model

3.5.6
channel
path provided for conveying data

3.5.7
client
object which uses the services of a server by initiating a message to perform a task

3.5.8
communication cycle
fixed time period between which the root device issues empty DLPDUs for cyclic communication initiation in which data is transmitted utilizing CDC and MSC

3.5.9
connection
logical binding between two application objects

3.5.10
cycle time
duration of a communication cycle

3.5.11
cyclic
events which repeat in a regular and repetitive manner

3.5.12
cyclic communication
periodic exchange of telegrams

3.5.13
cyclic data
data which is transferred in a regular and repetitive manner for dedicated purposes

3.5.14
cyclic data channel
CDC
part of one or more DLPDUs, which is reserved for cyclic data

3.5.15
data
generic term used to refer to any information carried over a fieldbus

3.5.16
device
physical entity connected to the fieldbus

3.5.17
error
discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

3.5.18
error code
identification number of a specific type of error

3.5.19
gateway
device acting as a linking element between different protocols

3.5.20
index
position of an object within the object dictionary

3.5.21
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

3.5.22
interface
shared boundary between two functional units, defined by functional characteristics, signal characteristic, or other characteristics as appropriate

3.5.23
intra-cell communication
communication between a RTFL device and another RTFL device in the same cell

3.5.24
logical double line
sequence of root device and all ordinary devices processing the communication DLPDU in forward and backward direction

3.5.25
mapping parameters
set of values defining the correspondence between application objects and process data objects

3.5.26
master clock
global time base for the PCS mechanism

3.5.27
message
ordered sequence of octets intended to convey data

3.5.28
message channel
MSC
part of one or more DLPDUs, which is reserved for acyclic data

3.5.29
network
set of devices connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

3.5.30
ordinary device
OD
slave in the communication system, which utilizes RTFL for cyclic and acyclic data interchange with other ODs in the same logical double line

3.5.31
precise clock synchronization
PCS
mechanism to synchronize clocks of RTFL devices and maintain a global time base

3.5.32
process data
data designated to be transferred cyclically or acyclically for the purpose of processing

3.5.33
process data object
dedicated data object(s) designated to be transferred cyclically or acyclically for the purpose of processing

3.5.34
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.5.35
root device
RD
master in the communication system, which organises, initiates and controls the RTFL cyclic and acyclic data interchange for one logical double line

3.5.36
real time frame line
RTFL
communication model communicating in a logical double line

3.5.37
real time frame network
RTFN
communication model communicating in a switched network

3.5.38
round trip time
transmission time needed by a DLPDU from the RD to the last OD in forward and backward direction

3.5.39
sub-index
sub-position of an individual element of an object within the object dictionary

3.5.40
timing signal
time-based indication of the occurrence of an event, commonly as an interrupt signal, used for DL-user synchronization

3.5.41
topology
physical network architecture with respect to the connection between the stations of the communication system

3.6 Abbreviations and symbols

AE	Application entity
AL	Application layer
ALME	Application layer management entity
AP	Application process
APDU	Application layer protocol data unit
APO	Application process object
AR	Application relationship
AREP	Application relationship end point
ASE	Application service element
CAN	Controller area network
CDC	Cyclic data channel
CDCL	CDC line
CDCN	CDC network
CeS	CANopen expands Type 22
CL	Communication layer
Cnf	Confirmation
DA	Device address
DHCP	Dynamic Host Configuration Protocol
DL-	Data-link layer (as a prefix)
DLL	DL-layer
DLPDU	DL-protocol data unit
EDS	Electronic data sheet