

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial communication networks – Fieldbus specifications –
Part 6-19: Application layer protocol specification – Type 19 elements**

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 6-19: Spécification du protocole de la couche application – Eléments
de type 19**

IEC 61158-6-19:2014

<https://standards.iteh.ai/couche/standards/iec/57924d08-b521-43ca-92e0-95ae35db4a65/iec-61158-6-19-2014>



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**INDUSTRIAL COMMUNICATION NETWORKS –
FIELD BUS SPECIFICATIONS –****Part 6-19: Application layer protocol specification –
Type 19 elements**

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

International Standard IEC 61158-6-19 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision. The main changes with respect to the previous edition are listed below:

- introducing connections based on a producer-consumer model;
- introducing additional mechanisms to realize features such as timestamping and oversampling;
- improving the hotplug and redundancy features;
- improving the phase switching and the error handling;
- editorial improvements.

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

FDIS	Report on voting
65C/764/FDIS	65C/774/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.

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- withdrawn;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.

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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 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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WITHDRAWN

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-19: Application layer protocol specification – Type 19 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 19 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 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 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, and the corresponding protocols standardized in subparts of IEC 61158-6.

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 any given Type of 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 61158-3-19, *Industrial communication networks – Fieldbus specifications – Part 3-19: Data-link layer service definition – Type 19 elements*

IEC 61158-4-19, *Industrial communication networks – Fieldbus specifications – Part 4-19: Data-link layer protocol specification – Type 19 elements*

IEC 61158-5-19, *Industrial communication networks – Fieldbus specifications – Part 5-19: Application layer service definition – Type 19 elements*

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

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 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, definitions, symbols, abbreviations and conventions apply.

3.1 Referenced 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 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

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

- a) abstract syntax
- b) presentation context

3.1.3 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

3.1.4 ISO/IEC 8824-1 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8824-1 apply:

- a) object identifier
- b) type

3.1.5 Fieldbus Data Link Layer terms

For the purposes of this document, the following terms as defined in IEC 61158-3-19 and IEC 61158-4-19 apply.

- a) DL-Time
- b) DL-Scheduling-policy
- c) DLCEP
- d) DLC
- e) DL-connection-oriented mode
- f) DLPDU
- g) DLSDU
- h) DLSAP
- i) fixed tag
- j) generic tag
- k) link
- l) MAC ID
- m) network address
- n) node address
- o) node
- p) tag
- q) scheduled
- r) unscheduled

3.2 Additional terms and definitions

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

3.2.1

communication cycle

fixed time period between two master synchronization telegrams in which real-time telegrams are transmitted in the RT channel and non real-time telegrams are transmitted in the IP channel

3.2.2

control unit

control device (e.g., a PLC as specified in the IEC 61131 standard family)

3.2.3

control word

two adjacent octets inside the master data telegram containing commands for the addressed device

3.2.4

cycle time

duration of a communication cycle

3.2.5

device

a slave in the communication network, (e.g., a power drive system as defined in the IEC 61800 standard family, I/O stations as defined in the IEC 61131 standard family).

3.2.6**device status**

four adjacent octets inside the acknowledge telegram containing status information for each device

3.2.7**identification number****IDN**

designation of operating data under which a data block is preserved with its attribute, name, unit, minimum and maximum input values, and the data

3.2.8**little endian**

model of memory organisation which stores the least significant octet at the lowest address, or for transfer, which transfers the lowest order octet first

3.2.9**master data telegram****MDT**

telegram, in which the master inserts its data

3.2.10**protocol**

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

3.2.11**slave**

node, which is assigned the right to transmit by the master

3.2.12**status word**

two adjacent octets inside the acknowledge telegram containing status information of a device

3.2.13**S-0-nnnn**

designation of IDNs

3.3 Additional abbreviations and symbols

AT	acknowledge telegram
CC	cross communication between participants
IDLE	inter packet gap (see IPG)
IDN	identification number
IPG	inter packet gap
IPOSYNC	synchronization for PDS interpolator
MDT	master data telegram
PDS	power drive system
RTC	real-time channel
SERCOS	serial real-time communication system interface

3.4 Conventions

The FAL is defined as a set of object-oriented ASEs. Each ASE is specified in a separate subclause. Each ASE specification is composed of three parts: its class definitions, its services, and its protocol specification. The first two are contained in IEC 61158-5-19. The protocol specification for each of the ASEs is defined in this standard.

The class definitions define the attributes of the classes supported by each ASE. The attributes are accessible from instances of the class using the Management ASE services specified in IEC 61158-5-19. The service specification defines the services that are provided by the ASE.

This standard uses the descriptive conventions given in ISO/IEC 10731.

4 Abstract syntax

The abstract syntax and the transfer syntax are merged into a fixed format that is defined in Clause 5.

5 Transfer syntax

5.1 Introduction

Type 19 transfer syntax shall be bit-coded, and therefore does not comply with usual data type specifications such as integer32 and alike.

The octet encoding shall use little endian.

5.2 RTC PDU merged abstract and transfer syntax

The merged abstract and transfer syntax for attributes belonging to this class is described in Table 1.

Table 1 – RTC PDU attribute format

Attribute	Format	Size (bits)
Connection control word	2 Octets, bit mapped	16
Reserved for DLL	16 Bit	16
Configurable part of data record with connection data	List of 2, 4 or 8 Octets	
Operation data IDN 1	2, 4 or 8 Octets	
Operation data IDN 2	2, 4 or 8 Octets	
...	...	
Configured data IDN n	2, 4 or 8 Octets	
Number and length of operation data k shall be configured in S-0-1050.x.06 (Configuration List) or by the selected standard telegram S-0-0015 (Telegram type).		

6 Structure of FAL protocol state machines

Clause 6 specifies the interface to FAL services and the protocol machines.

The behavior of the FAL is described by three integrated protocol machines. Specific sets of these protocol machines are defined for different AREP types. The three protocol machines are: FAL Service Protocol Machine (FSPM), the Application Relationship Protocol Machine (ARPM), and the Data Link Layer Mapping Protocol Machine (DMPM). The relationships among these protocol machines as well as primitives exchanged among them are depicted in Figure 1.