

INTERNATIONAL STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 5-24: Application layer service definition – Type 24 elements**

IEC 61158-5-24:2023

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FIELDBUS SPECIFICATIONS –****Part 5-24: Application layer service definition –
Type 24 elements**

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

IEC 61158-5-24 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- a) modify to the AP type definition in Table 1;
- b) modify to the Support list of service for each class of FDC ASE in Table 8.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1203/FDIS	65C/1244/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This document 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 document defines the application service characteristics that fieldbus applications and/or system management can 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 document is a conceptual architectural service, independent of administrative and implementation divisions.

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-24: Application layer service definition – Type 24 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 document 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 24 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 document defines in an abstract way the externally visible service provided by the different Types of fieldbus Application Layer in terms of

- an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- the primitive actions and events of the service,
- the parameters associated with each primitive action and event, and the form which they take, and
- the interrelationship between these actions and events, and their valid sequences.

The purpose of this International Standard is to define the services provided to

- the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This document specifies the structure and services of the IEC 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 document to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this document 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 the IEC 61158-6 series.

This document can 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

- the sizes and octet ordering of various multi-octet service parameters, and
- the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This document 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 fulfil any given Type of application layer services as defined in this part of IEC 61158.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series 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 61158-1:2023, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-4-24:2023, *Industrial communication networks – Fieldbus specifications – Part 4-24: Data link layer protocol specification – Type 24 elements*

IEC 61158-6-24:2023, *Industrial communication networks – Fieldbus specifications – Part 6-24: Application layer protocol specification – Type 24 elements*

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

ISO/IEC 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1) – Part 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, abbreviated terms and conventions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

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) abstract syntax;
- b) application-entity;
- c) application process;
- d) application protocol data unit;
- e) application-process-invocation;
- f) (N)-facility;
- g) (N)-function;
- h) correspondent-(N)-entities;
- i) presentation context;
- j) real system;
- k) transfer syntax.

3.1.2 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-entity-invocation;
- d) application-entity-type;
- e) application-service-element.

3.1.3 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.

3.1.4 Terms and definitions from ISO/IEC 10731

For the purposes of this document, the following terms as defined in ISO/IEC 10731 apply:

- a) OSI-service-primitive; primitive;
- b) OSI-service-provider; provider;
- c) OSI-service-user; user.

3.2 Additional terms and definitions

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

3.2.1

alarm

field device status to tell that the device has detected a fatal problem to be solved and cannot continue normal working, through the field device control (FDC) service of the type 24 fieldbus

Note 1 to entry: Any alarm statuses are latched and need some operation to be cleared.

Note 2 to entry: Alarms are classified into three groups; communication alarms, illegal-command-related ones, and application specific ones. But concrete definitions are dependent on implementation of each field devices.

3.2.2

application process object

network representation of a specific aspect of an application process (AP), which is modelled as a network accessible object contained within an AP or within another APO

Note 1 to entry: Refer IEC 61158-1, 9.3.4.

3.2.3

application process context

AP context

shared knowledge or a common set of rules, governing communication of FAL application entities (AEs) and describing the permissible collective communications behavior between the AEs that are party to a specific set of application relationships (ARs)

Note 1 to entry: Data within AP context can be specified by the user in advance, by the option selected while the user uses a field bus management (FSM) service to read out the facility of peer AP, by the automatic negotiation function that the FSM system handles, and so on. The method that is to be adopted depends on the specification of each implementation.

3.2.4

application process type

AP type

description of a classification of application processes (APs) in terms of a set of capabilities for FAL of the type 24 fieldbus

Note 1 to entry: AP types are classified into three ones, C1 master AP, C2 master AP and slave AP, by their application roles in the fieldbus network. See 6.2.

3.2.5

async command

type of a command application protocol data unit (APDU) of the FDC service of the type 24 FAL, which can be issued any time after the previous transaction without consideration of synchronization with the communication cycle

Note 1 to entry: Definitions, which command should be async one or not, are dependent on an application. They can be provided as a registered set of commands and responses or device profiles (see IEC 61158-6-24, 4.4 and Annex A).

3.2.6**asynchronous communication**

state or a way of communication for the FDC service of the type 24 FAL, in which a command can be issued any time after the previous transaction without consideration of synchronization with the communication cycle

Note 1 to entry: In this state, sync commands cannot be issued, but async commands can.

3.2.7**attribute**

information or parameter contained in variable portions of an object

Note 1 to entry: Typically, they provide status information or govern the operation of an object. Attributes also affect the behavior of an object.

3.2.8**C1 master**

AP type that has master facilities for the FDC service of the type 24 FAL, or the device implementing that AP type

Note 1 to entry: Only one C1 master exists in a network of the type 24 fieldbus

3.2.9**C2 master**

AP type that has only monitor facilities for the FDC service but requester facilities for message (MSG) service of the type 24 FAL, or the device implementing that AP type

Note 1 to entry: Less than two C2 masters can exist in a network of the type 24 fieldbus

3.2.10**command**

PDU issued by a requester or a master to make a responder or a slave execute some functions

3.2.11**communication**

process to exchange information in a formal manner between two or more devices, users, APs or entities

3.2.12**transfer**

process to convey a PDU from a sender to a receiver

3.2.13**transmission**

process to send out and propagate electrical signals or encoded data

3.2.14**communication cycle**

period of repetitive activities synchronized with the transmission cycle while the connection establishing for the FDC protocol of the type 24 FAL

Note 1 to entry: Communication cycle can synchronize with a cycle multiplying the transmission cycle by a specified scaling factor.

3.2.15**connection**

context or logical binding under specific conditions for the FDC protocol between a master object and a slave object for the type 24 FAL

3.2.16**cyclic**

repetitive in a regular manner

3.2.17**cyclic communication**

transmission mode in which request PDUs and response PDUs are exchanged repetitively in the scheduled time slots synchronized with a transmission cycle for the lower layer protocol of the type 24 fieldbus

Note 1 to entry: In the AL, the communication cycle arises from the transmission cycle in this mode.

3.2.18**cycle scale counter**

counter to generate a communication cycle by means of scaling a primary cycle or a transmission cycle

3.2.19**device ID**

part of "device information" to identify the device for a specific product type or model of the type 24 fieldbus

3.2.20**device information**

formatted and device-embedded information to characterize a device, which mainly consists of data for device model identification and device-profile specific parameters for the type 24 fieldbus

3.2.21**device profile**

collection of device model-common information and functionality providing consistency between different device models among the same kind of devices

3.2.22**dual transfer**

transfer mode for the FDC protocol of the type 24 FAL, in which a sender sends a same PDU twice a transaction and a receiver uses them to detect and recover a communication error such as data-corruption or data-loss in cyclic communication mode

3.2.23**event driven communication**

transmission mode for the lower layer protocol of the type 24 fieldbus in which a transaction of command-response-exchanging arises as user's demands

Note 1 to entry: Both the transmission cycle and the communication cycle don't arise in this mode.

3.2.24**error**

abnormal condition or malfunction for communication or any other activities

3.2.25**field device control service****FDC service**

time-critical communication service that handles a fixed length command data to control a field device and the corresponding feedback response data in a severe restriction on delay or jitter for the communication timing for the type 24 FAL