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Industrial communication networks – Fieldbus specifications – Part 6-27: Application layer protocol specification – Type 27 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 6-27: Spécification du protocole de la couche application – Éléments de type 27

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Part 6-27: Application layer protocol specification – Type 27 elements

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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.

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

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-27: Application layer protocol specification – Type 27 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 part of IEC 61158 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 27 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.

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This document defines in an abstract way the externally visible behavior provided by the Type 27 fieldbus application layer in terms of

- the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
- the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
- the application context state machines defining the application service behavior visibly between communicating application entities, and
- the application relationship state machines defining the communication behavior visibly between communicating application entities.

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The purpose of this document is to define the protocol provided to

- define the representation-on-wire of the service primitives defined in IEC 61158-5-27, and
- define the externally visible behavior associated with their transfer.

This document specifies the protocol of the Type 27 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this document is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-27.

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 IEC 61158-6 series.

1.3 Conformance

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

Conformance is achieved through implementation of this application layer protocol specification.

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 61158-5-27:2023, *Industrial communication networks – Fieldbus specifications – Part 5-27: Application layer service definition – Type 27 elements*

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information interchange*

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

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

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ISO/IEC 9899, *Information technology – Programming languages – C*

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

ISO/IEC 19501:2005, *Information technology – Open Distributed Processing – Unified Modeling Language (UML) Version 1.4.2*

ISO/IEC/IEEE 60559:2020, *Information technology – Microprocessor Systems – Floating-Point arithmetic*

ISO/IEC/IEEE 8802-3, *Telecommunications and exchange between information technology systems − Requirements for local and metropolitan area networks − Part 3: Standard for Ethernet*

IEEE Std 802.1D, *IEEE Standards for local and metropolitan area networks – Media Access Control (MAC) Bridges*

IEEE Std 802.1Q, *IEEE Standards for local and metropolitan area networks – Bridges and Bridged Networks*

IEEE Std 802.1AB, *IEEE Standards for Local and Metropolitan Area Networks: Station and Media Access Control Connectivity Discovery*

IEEE Std 802.1AS, *IEEE Standards for Local and Metropolitan Area Networks: Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks*

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IETF RFC 1112, S.E. Deering, "*Host Extensions for IP Multicasting*", August 1989, available at <https://www.rfc-editor.org/info/rfc1112> [viewed 2022-09-16]

IETF RFC 2460, S. Deering and R. Hinden, "*Internet Protocol, Version 6 (IPv6) Specification*", December 1998, available at <https://www.rfc-editor.org/info/rfc2460> [viewed 2022-09-16]

3 Terms, definitions, abbreviated terms, symbols and conventions

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

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

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- IEC Electropedia: available at https://www.electropedia.org/
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3.1 Referenced terms and definitions

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3.1.1 Terms and definitions from ISO/IEC 7498-1

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

- abstract syntax;
- application-entity;
- application process;
- application protocol data unit;
- application-process-invocation;
- (N)-facility;
- (N)-function;
- peer-(N)-entities;
- presentation context;
- real system;
- transfer syntax.

3.1.2 Terms and definitions from ISO/IEC 9545

For the purposes of this document, the following terms as defined in ISO/IEC 9545 apply:

- application-association;
- application-context;
- application-entity-invocation;
- application-entity-type;

- application-service-element.

3.1.3 Terms and definitions from ISO/IEC 8824-1

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

- simple type;
- component;
- component type;
- integer type;
- bitstring type;
- octetstring type;
- null type;
- sequence type;
- sequence of type;
- choice type;
- IA5String type;
- encoding.

3.1.4 Terms and definitions from ISO/IEC 10731

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

- OSI-service-primitive; primitive;
- OSI-service-provider; provider;
- OSI-service-user; user.

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3.1.5 Terms and definitions from ISO/IEC 19501

For the purposes of this document, the following terms as defined in ISO/IEC 19501 apply:

- event;
- state;
- state machine;
- substate;
- submachine;
- transition.

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 27 fieldbus

Note 1 to entry: Any alarm statuses are latched and need some operations 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.