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Industrial networks - Fieldbus specifications - WiTSnet

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Draft	Report on voting
65C/1401/DPAS	65C/1416/RVDPAS

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 Publicly Available Specification 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.

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– reconfirmed,
– withdrawn, or
– revised.

NOTE In accordance with ISO/IEC Directives, Part 1, IEC PASs are automatically withdrawn after 4 years.

INTRODUCTION

This document is 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 data-link protocol provides the data-link services by making use of the services available from the physical 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 data-link entities (DLEs) at the time of communication.

The application protocol provides the application protocol and the application services by 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 or system management can exploit. The 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.

Throughout the PAS, the term “service” refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the immediately upper and lower layers. Thus, the data-link layer services and the application layer services defined in this document are conceptual architectural services, independent of administrative and implementation divisions.

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 standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems can work together in any combination.

1 Scope

1.1 General

This document provides the common elements for basic time-critical messaging communications between devices in an automation environment and user programs with a means to access the fieldbus communication environment.

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:

a) The externally visible services provided by the WiTSnet in terms of:
   1) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL services;
   2) the primitive actions and events of the services;
   3) the parameters associated with each primitive action and event, and the form which they take;
   4) the interrelationship between these actions and events, and their valid sequences.
b) The externally visible behavior provided by the WiTSnet in terms of:
   1) the abstract syntax defining the data-link layer and application layer protocol data units conveyed between communicating data-link and application entities;
   2) the transfer syntax defining encoding rules that are applied to the data-link layer and the application layer protocol data units;
   3) the data-link and the application context state machines defining the data-link and the application service behaviors visible between communicating data-link and application entities; and
   4) the data-link and the application relationship state machines defining the data-link and the application service behaviors visible between communicating data-link and application entities.

The purpose of this document is to define the services provided to:

c) the WiTSnet fieldbus application layer at the boundary between the application and data-link layers of the Fieldbus Reference Model;
d) systems management at the boundary between the data-link layer and systems management of the Fieldbus Reference Model;
e) the FAL user at the boundary between the user and the application layer of the Fieldbus Reference Model, and
f) systems management at the boundary between the application layer and systems management of the Fieldbus Reference Model.

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

g) define the wire-representation of the service primitives defined in clause 7; and
h) define the externally visible behavior associated with their transfer.

1.2 Specifications

The principal objective of this document is to specify the characteristics of conceptual application layer services and data-link layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols and data-link 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 protocols based on Ethernet, and the corresponding application layer protocols.

This specification can be used as the basis for formal Application Programming-Interfaces and DL-Programming-Interfaces. Nevertheless, these are not formal programming interfaces, and it is crucial that any such interface 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 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the application layer and the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation’s capabilities, and thus its applicability to various time-critical communications needs.

1.4 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of application layer entities and data-link entities within industrial automation systems. This document does not contain tests to demonstrate compliance with such requirements.

Conformance is achieved through implementations of the data-link protocol and the application layer protocol specification, which fulfils the WiTSnet data-link layer services and application layer services defined in this document.

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.

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

ISO/IEC 7498-1:1994, *Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model*

ISO/IEC 7498-3:1997, *Information technology - Open Systems Interconnection - Basic Reference Model: Naming and addressing*

ISO/IEC 9545:1994, *Information technology - Open Systems Interconnection - Application Layer structure*

ISO/IEC 10646, *Information technology - Universal coded character set (UCS)*

ISO/IEC 10731:1994, *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 Modelling Language (UML) Version 1.4.2*

ISO/IEC/IEEE 8802-3, *Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Standard for Ethernet*

IEEE Std 802, *IEEE Standard for Local and Metropolitan Area Networks - Overview and Architecture, available at http://www.ieee.org*

IEEE Std 802.1AB, *IEEE Standard for Local and Metropolitan Area Networks - Station and Media Access Control Connectivity Discovery, available at http://www.ieee.org*

IETF RFC 768, *User Datagram Protocol (UDP), available at http://www.ietf.org*

IETF RFC 791, *Internet protocol DARPA internet program protocol specification, available at http://www.ietf.org*

3 Terms and definitions, symbols, abbreviated terms and conventions

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

ISO and IEC maintain terminology 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 Reference model terms and definitions

3.1.1 ISO/IEC 7498-1:1994

The following terms are defined in ISO/IEC 7498-1:1994.

1) abstract syntax (7.1.1.2);
2) acknowledgement (5.8.1.16);
3) application-entity (7.1.1.1);
4) application process (4.1.4);
5) application protocol data unit (5.6.1.3);
6) application process-invocation (4.1.7);
7) correspondent (N)-entities (5.3.1.5);
8) DL address (5.4.1.1);
9) DL address-mapping (5.4.1.3);
10) DL connectionless-mode transmission (5.3.1.18);
11) DL duplex-transmission (5.3.1.10);
12) DL simplex-transmission (5.3.1.12);
13) DL-protocol (5.2.1.9);
14) DL-protocol-data-unit (5.6.1.3);
15) DL subsystem (5.2.1.1);
16) DL-service-data-unit (5.6.1.4);
17) DL relay (5.3.1.6);

18) DLS-user-data (5.6.1.2);
19) layer-management (8.1.6);
20) (N)-facility (5.2.1.6);
21) (N)-function (5.2.1.7);
22) (N)-entity (5.2.1.11);
23) (N)-layer (5.2.1.2);
24) (N)-service (5.2.1.5);
25) (N)-service-access-point (5.2.1.8);
26) peer-(N)-entities (5.2.1.3);
27) presentation context (7.2.1.3);
28) reset (5.8.1.17);
29) real system (4.1.1);
30) routing (5.4.1.4);
31) segmenting (5.8.1.9);
32) systems-management (8.1.4);
33) transfer syntax (7.2.1.2).

3.1.2 ISO/IEC 8824-1:2021

The following terms are defined in ISO/IEC 8824-1:2021.

1) bitstring type (3.8.7);
2) component type (3.8.15);
3) encoding (3.8.25);
4) IA5String type (3.8.65);
5) integer type (3.8.48);
6) null type (3.8.51);
7) object identifier (3.8.54);
8) octetstring type (3.8.55);
9) simple type (3.8.74);
10) sequence type (3.8.67);
11) sequence of type (3.8.68);
12) type (3.8.86).

3.1.3 ISO/IEC 9545:1994

The following terms are defined in ISO/IEC 9545:1994.

1) application-association (3.4.3);
2) application-context (3.4.5);
3) application context name (3.4.7);
4) application-service-element (3.4.8);
5) application control service element (3.4.24).

3.1.4 ISO/IEC 10731:1994

The following terms are defined in ISO/IEC 10731:1994.

1) OSI-service-primitive; primitive (3.3.4);
2) asymmetrical service (3.3.22);
3) confirm (primitive); requestor.deliver (primitive) (3.3.12);
4) deliver (primitive) (3.3.6);
5) AL service-primitive; primitive (3.3.4);
6) AL service-provider (3.3.2);
7) AL service-user (3.3.3);
8) indication (primitive); acceptor.deliver (primitive) (3.3.10);
9) request (primitive); requestor.submit (primitive) (3.3.9);
10) requestor (3.3.7);
11) response (primitive); acceptor.submit (primitive) (3.3.11);
12) submit (primitive) (3.3.5);
13) symmetrical service (3.3.21).

3.1.5 ISO/IEC 19501:2005

The following terms are defined in ISO/IEC 19501:2005.

1) Event (4.12.2.4);
2) State (4.12.2.10);
3) state machine (4.12.2.11);
4) submachine (4.12.2.14);
5) transition (4.12.2.17).

3.2 Service convention terms and definitions

This document also makes use of the following terms defined in ISO/IEC 10731 as they apply to the data-link layer:

1) confirm (primitive)
2) DL-service-primitive
3) DL-service-provider
4) DL-service-user
5) indication (primitive)
6) request (primitive)
7) requestor
8) response (primitive)
9) acceptor
10) asymmetrical service
11) confirm(primitive);
    requestor.deliver (primitive)
12) deliver (primitive)
13) DL-service-primitive
14) DL-service-provider
15) DL-service-user