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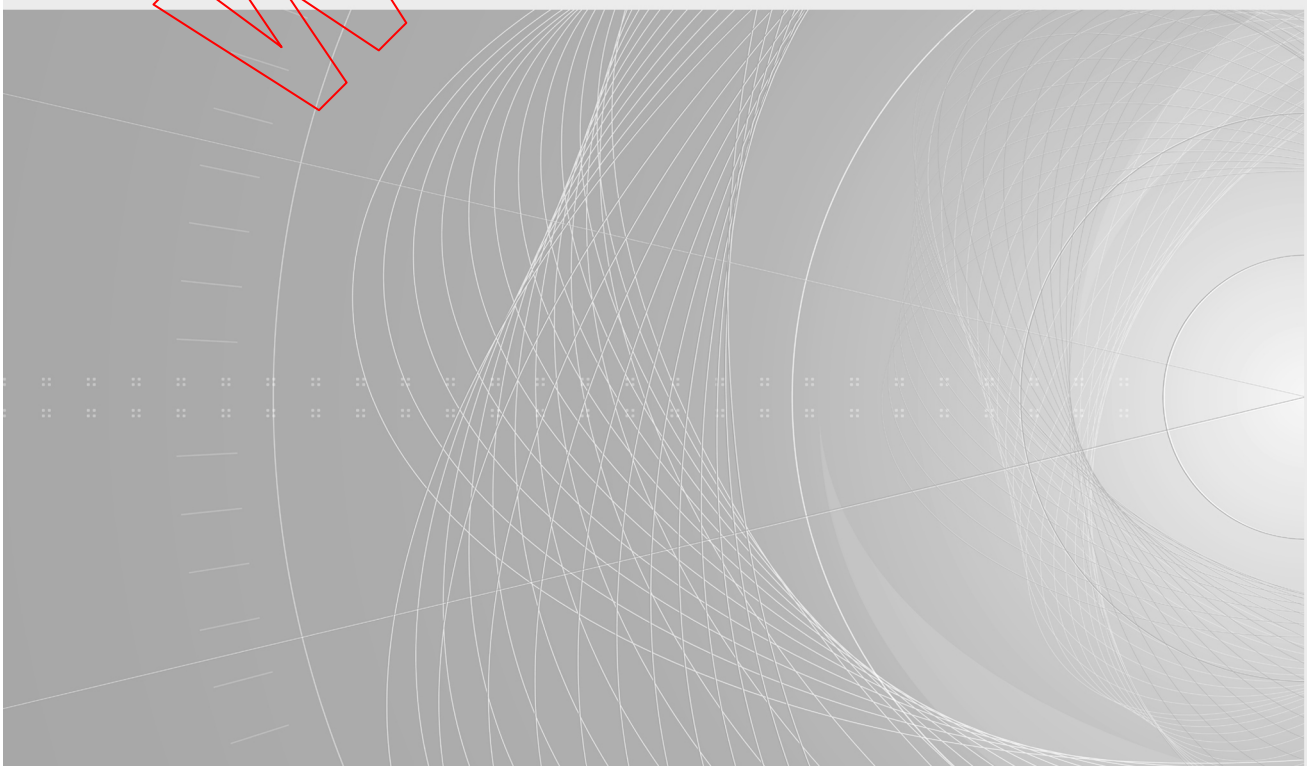
Industrial communication networks – Fieldbus specifications – Part 4-11: Data-link layer protocol specification – Type 11 elements



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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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.

International Standard IEC 61158-4-11 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 2007. This edition constitutes a technical revision.

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

- Introduction has been modified to add the patents related to the loop-architecture
- Addition of loop (ring) -architecture
- More detailes:
  - Subclause 4.4 is extended to cover the loop-architecture as 4.4.3.
  - Subclause 4.6; structure has changed in order to include the loop-architecture, and the data types of variables have been added:

— 4.6.1 Overview;

— 4.6.1.2 Summary of variables of existing star-architecture;

— 4.6.1.3 Summary of variables of additional loop-architecture;

— 4.6.2 Type 11 common variables, parameters, counters, timers and queues;

— 4.6.3 Star-architecture specific variables, parameters, counters, timers and queues;

— 4.6.4 Loop-architecture specific variables, parameters, counters, timers and queues.

— All variables, parameters, counters, timers and queues are rearranged in alphabetical order.

— Subclause 5.4 is modified to cover the loop-architecture.

— Clause 6 is modified to cover the loop-architecture.

— Explanations of symbols referenced in each figure are modified to appear in the form of Key out of each figure object.

— Clause 7 is changed in the structure for inclusion and extension of the loop-architecture as follows:

— DLE elements of procedure for existing star-architecture are maintained in 7.1 after restructuring with no change to the existing specification;

— DLE elements of procedure for loop-architecture are added in 7.2;

— Serializer and deserializer is maintained in 7.3 after restructuring;

— DLL management protocol is in 7.4 after restructuring, and

— DLL management protocol for star-architecture is maintained in 7.4.1 without change,

— DLL management protocol for loop-architecture is added in 7.4.2.

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

FDIS	Report on voting
65C/605/FDIS	65C/619/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 the 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.

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

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/TR 61158-1.

The data-link protocol provides the data-link service by making use of the services available from the physical 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 data-link entities (DLEs) 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:

a) as a guide for implementors and designers;

b) for use in the testing and procurement of equipment;

c) as part of an agreement for the admittance of systems into the open systems environment;

d) 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.

NOTE Use of some of the associated protocol types is restricted by their 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 particular data-link layer protocol type to be used with physical layer and application layer protocols in Type combinations as specified explicitly in the profile parts. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning Type 11 elements and possibly other types given in the subclause 4.2, 4.4, 4.5, 5.4, 6.2 to 6.10, 7.1 and 7.2 as follows:

US 4,930,121 [TO] Network system using token-passing bus with multiple priority levels

US 5,414,813 [TO] Direct transfer from a receive buffer to a host in a token-passing type network data transmission system

US 6,711,131 [TO] Data transmitting apparatus, network interface apparatus, and data transmitting system

PCT/JP2007/55292 [TO] Double ring network system, communication control method thereof, transmission station, and communication control program of double ring network system

JP 3,461,954 [TO] Data transmission system

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holder of these patent rights has assured the IEC that he/she is willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of thess patent rights is registered with IEC. Information may be obtained from:

[TO]Toshiba Corporation
1-1, Shibaura 1-Chome
Minato-ku Tokyo 105-8001, Japan
Attention: Intellectual Property Rights Section.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (http://www.iec.ch/tctools/patent_decl.htm) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-11: Data-link layer protocol specification – Type 11 elements

1 Scope

1.1 General

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides communication opportunities to all participating data-link entities

a) in a synchronously-starting cyclic manner, according to a pre-established schedule, and

b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This standard specifies

a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed data-link service provider;

b) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals up to one millisecond;

c) procedures for giving communication opportunities available for time-critical data transmission together with non-time-critical data transmission without prejudice to the time-critical data transmission;

d) procedures for giving cyclic and acyclic communication opportunities for time-critical data transmission with prioritized access;

e) procedures for giving communication opportunities based on standard ISO/IEC 8802-3 medium access control, with provisions for nodes to be added or removed during normal operation;

f) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;

b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;

c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within 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.

1.5 Conformance

This standard also specifies conformance requirements for systems implementing these procedures. This standard does not contain tests to demonstrate compliance with such requirements.

2 Normative references

The following referenced documents are indispensable for the application 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.

IEC 61158-3-11:2007, *Industrial communication networks – Fieldbus specifications – Part 3-11: Data-link layer service definition – Type 11 elements*

IEC 61158-5-11:2007, *Industrial communication networks – Fieldbus specifications – Part 5-11: Application layer service definition – Type 11 elements*

IEC 61158-6-11:2007, *Industrial communication networks – Fieldbus specifications – Part 6-11: Application layer protocol specification – Type 11 elements*

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

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

ISO/IEC 8802-3:2000, *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 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

3 Terms, definitions, symbols and abbreviations

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

3.1 Reference model terms and definitions

This standard is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3, and makes use of the following terms defined therein.

3.1.1	**called-DL-address**	[ISO/IEC 7498-3]
3.1.2	**calling-DL-address**	[ISO/IEC 7498-3]
3.1.3	**centralized multi-end-point-connection**	[ISO/IEC 7498-1]
3.1.4	**correspondent (N)-entities** **correspondent DL-entities (N=2)** **correspondent Ph-entities (N=1)**	[ISO/IEC 7498-1]
3.1.5	**demultiplexing**	[ISO/IEC 7498-1]
3.1.6	**DL-address**	[ISO/IEC 7498-3]
3.1.7	**DL-address-mapping**	[ISO/IEC 7498-1]
3.1.8	**DL-connection**	[ISO/IEC 7498-1]
3.1.9	**DL-connection-end-point**	[ISO/IEC 7498-1]
3.1.10	**DL-connection-end-point-identifier**	[ISO/IEC 7498-1]
3.1.11	**DL-connection-mode transmission**	[ISO/IEC 7498-1]
3.1.12	**DL-connectionless-mode transmission**	[ISO/IEC 7498-1]
3.1.13	**DL-data-sink**	[ISO/IEC 7498-1]
3.1.14	**DL-data-source**	[ISO/IEC 7498-1]
3.1.15	**DL-duplex-transmission**	[ISO/IEC 7498-1]
3.1.16	**DL-facility**	[ISO/IEC 7498-1]
3.1.17	**DL-local-view**	[ISO/IEC 7498-3]
3.1.18	**DL-name**	[ISO/IEC 7498-3]
3.1.19	**DL-protocol**	[ISO/IEC 7498-1]
3.1.20	**DL-protocol-connection-identifier**	[ISO/IEC 7498-1]
3.1.21	**DL-protocol-control-information**	[ISO/IEC 7498-1]
3.1.22	**DL-protocol-data-unit**	[ISO/IEC 7498-1]
3.1.23	**DL-protocol-version-identifier**	[ISO/IEC 7498-1]
3.1.24	**DL-relay**	[ISO/IEC 7498-1]
3.1.25	**DL-service-connection-identifier**	[ISO/IEC 7498-1]
3.1.26	**DL-service-data-unit**	[ISO/IEC 7498-1]
3.1.27	**DL-simplex-transmission**	[ISO/IEC 7498-1]
3.1.28	**DL-subsystem**	[ISO/IEC 7498-1]
3.1.29	**DL-user-data**	[ISO/IEC 7498-1]
3.1.30	**flow control**	[ISO/IEC 7498-1]
3.1.31	**layer-management**	[ISO/IEC 7498-1]
3.1.32	**multiplexing**	[ISO/IEC 7498-3]