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Digital data communications for measurement and control – Fieldbus for use in industrial control systems –

Part 4: Data Link protocol specification

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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DIGITAL DATA COMMUNICATIONS FOR MEASUREMENT AND CONTROL – FIELDBUS FOR USE IN INDUSTRIAL CONTROL SYSTEMS –

Part 4 : Data Link protocol specification

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 61158-4, which is a technical specification, has been prepared by subcommittee 65C: Digital communications, of IEC technical committee 65: Industrial-process measurement and control.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
65C/198/FDIS	65C/206+206A/RVD

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

IEC 61158 consists of the following parts, under the general title *Digital data communications for measurement and control — Fieldbus for use in industrial control systems*:

Part 1: Introductory guide (under preparation)
Part 2: Physical layer specification and service definition
Part 3: Data Link Service definition
Part 4: Data Link Protocol specification
Part 5: Application layer service definition
Part 6: Application layer protocol specification
Part 7: System management (under consideration)
Part 8: Conformance testing (under consideration)

Annexes A to E form an integral part of this technical specification.

Annexes F to H are for information only.

This publication will be reviewed by the committee responsible for its preparation before 2002. Information relating to confirmation, amendment or revision of the publication is available from the IEC web site (http:/www.iec.ch) or from IEC Central Office.

A bilingual version of this standard may be issued at a later date.

INTRODUCTION

This technical specification is one of a series produced to facilitate the interconnection of automation system components. It is related to other International Standards and technical specifications in the series as defined by the Fieldbus Reference Model, which is based in part on the Reference Model for Open Systems Interconnection. Both Reference Models subdivide the area of standardization for interconnection into a series of layers of specification, each of manageable size.

The Data Link Protocol provides the Data Link Service by making use of the services available from the Physical Layer. The relationship between the International Standards for Fieldbus Data Link Service, Fieldbus Data Link Protocol, Fieldbus Physical Service, and OSI Network or Fieldbus Application Protocol is illustrated in figure 1.

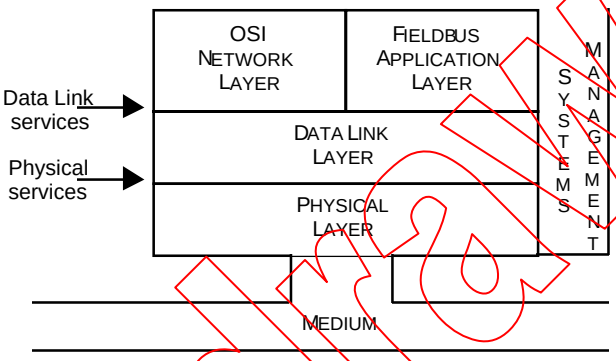

Figure 1 — Relationship of this part of IEC 61158 to other Fieldbus and OSI standards

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 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 technical specification together with other technical specifications positioned within the OSI or Fieldbus Reference Models, otherwise incompatible systems may work together in any combination.

Remark: Throughout this technical specification, gray boxes have been used in the tables to indicate that the specified field is not a conceptula part of the specific DPDU.

DIGITAL DATA COMMUNICATIONS FOR MEASUREMENT AND CONTROL – FIELDBUS FOR USE IN INDUSTRIAL CONTROL SYSTEMS –

Part 4 : Data Link protocol specification

1 Scope and object

The Fieldbus Data Link Layer provides basic time-critical messaging communications between devices in an automation environment.

The purpose of this technical specification is to define the Fieldbus Data Link Protocol. It is most closely related to, and lies within the field of application of, the Fieldbus Data Link Service Definition.

1.1 Specifications

This standard specifies

a) procedures for a single protocol 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) the structure of the Fieldbus Data Link (DL) Protocol Data Units used for the transfer of data and control information, and their representation as Physical Interface Data Units.

The specified protocol provides communication opportunities to all participating data-link entities

1) in a cyclic asynchronous manner, sequentially to each of those data-link entities, and

2) in a synchronous manner, either cyclically or acyclically, according to a pre-established schedule.

The specified protocol also provides means of changing the set of participating data-link entities and of modifying the set of scheduled communications opportunities. When the set of scheduled communications opportunities is null, the distribution of communication opportunities to the participating data-link entities is completely asynchronous.

Thus this protocol can be characterized as one which provides access asynchronously but with a synchronous overlay.

1.2 Procedures

The procedures are defined in terms of

a) the interactions between peer DL-entities (DLEs) through the exchange of Fieldbus Data Link Protocol Data Units;

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 Physical service provider in the same system through the exchange of Physical service primitives.

1.3 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. Clause 10 specifies profiles for this Fieldbus protocol.

1.4 Conformance

This technical specification also specifies conformance requirements for systems implementing these procedures. This part of this technical specification does not contain tests to demonstrate compliance with such requirements.

The supplier of a protocol implementation which is claimed to conform to this technical specification shall complete a copy of the PICS proforma (see annex E), and shall provide the information necessary to identify both the supplier and the implementation.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this technical specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61158-2:1993, *Fieldbus standard for use in industrial control systems – Part 2 : Physical layer specification and service definition*

IEC 61158-3:1999, *Digital data communications for measurement and control – Fieldbus for use in industrial control systems – Part 3 : Data link service definition*

ISO/IEC 3309:1993, *Information technology – Telecommunications and information exchange between systems – High level data link control (HDLC) procedures – Frame structure*

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

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

ISO/IEC TR 8802-1:1997, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Overview of Local Area Network Standards*

ISO/IEC 8802-3:1996, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carier sense multiple acces with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 8802-4:1990, *Information processing systems– Local area networks – Part 4: Token-passing bus access method and physical layer specifications*

ISO/IEC 8802-5:1995, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 5: Token ring access method and physical layer specifications*

ISO/IEC 8802-6:1994, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 6: Distributed Queue Dual Bus (DQDB) access method and physical layer specifications*

ISO/IEC 8886:1996, *Information technology — Open systems interconnection — Data link service definition*

ISO/IEC 9314-2:1989, *Information processing systems – Fibre Distributed Data Interface (FDDI) – Part 2: Token Ring Media Access Control (MAC)*

ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts*

ISO/IEC 9646-2:1994, *Information technology – Open Systems nterconnection – Conformance testing methodology and framework – Part 2: Abstract test suite specification*

ISO/IEC 10038:1993, *Information technology – Telecommunications and information exchange between systems – Local area networks – Media access control (MAC) bridges*

ISO/IEC 10731:1994, *Information technology – Basic reference model – Open systems interconnection – Conventions for the definition of OSI services*

ISO/IEC 15802-1:1995, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common specifications – Part 1: Medium Access Control (MAC) service definition*