



IEC 61158-4-14

Edition 2.0 2010-08

# INTERNATIONAL STANDARD

---

**Industrial communication networks – Fieldbus specifications –  
Part 4-14: Data-link layer protocol specification – Type 14 elements**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE



---

ICS 25.04.40; 35.100.20; 35.110

ISBN 978-2-88912-088-8

## CONTENTS

|  |    |
|--|----|
| FOREWORD.....  | 4  |
| INTRODUCTION.....  | 6  |
| 1 Scope.....   | 7  |
| 1.1 General.....   | 7  |
| 1.2 Specifications.....  | 7  |
| 1.3 Procedures.....  | 7  |
| 1.4 Applicability.....   | 8  |
| 1.5 Conformance.....   | 8  |
| 2 Normative references .....   | 8  |
| 3 Terms, definitions, symbols and abbreviations.....                             | 8  |
| 3.1 Reference model terms and definitions.....                                   | 9  |
| 3.2 Service convention terms and definitions.....                                | 11 |
| 3.3 ISO/IEC 8802-3 terms .....   | 11 |
| 3.4 Common terms and definitions .....   | 12 |
| 3.5 Symbols and abbreviations.....   | 15 |
| 4 Overview of the DL-protocol .....  | 16 |
| 4.1 General.....   | 16 |
| 4.2 Services provided by the DL.....   | 17 |
| 4.3 Structure of deterministic communication scheduling.....                     | 18 |
| 5 Procedure of deterministic communication scheduling.....                       | 19 |
| 5.1 Overview.....  | 19 |
| 5.2 State transitions .....  | 20 |
| 5.3 State table.....   | 22 |
| 5.4 Function descriptions .....  | 23 |
| 6 Structure and encoding of ECSME PDU .....                                      | 27 |
| 6.1 ECSME PDU structure .....  | 27 |
| 6.2 Encoding of ECSME packet.....  | 29 |
| Bibliography.....  | 32 |
| Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses ..... | 13 |
| Figure 2 – Communication model.....  | 16 |
| Figure 3 – Type 14 packet identifier .....                                       | 18 |
| Figure 4 – Time-sharing communication scheduling .....                           | 18 |
| Figure 5 – State transitions of ECSME.....                                       | 20 |
| Figure 6 – Format of NonPeriodicDataAnnunciation PDU.....                        | 27 |
| Figure 7 – Format of EndofNonPeriodicDataSending PDU .....                       | 28 |
| Figure 8 – Format of Type 14 PDU.....  | 28 |
| Figure 9 – Format of Type 14 PDU for FRT application .....                       | 28 |
| Table 1 – ECSME state transitions.....   | 22 |
| Table 2 – NonperiodicDataSendingSuc() description.....                           | 23 |
| Table 3 – NonperiodicDataAnnunciation() description .....                        | 23 |
| Table 4 – NonperiodicDataSending() description .....                             | 23 |
| Table 5 – NonperiodicDataSendingSuc() description.....                           | 24 |

|   |    |
|---|----|
| Table 6 – FirstNonperiodicDataSending() description.....      | 24 |
| Table 7 – NonperiodicDataPriority() description .....         | 24 |
| Table 8 – NonperiodicDataTimeEnough() description.....        | 25 |
| Table 9 – NonperiodicDataSending() description .....          | 25 |
| Table 10 – EndOfNonperiodicDataSending() description.....     | 25 |
| Table 11 – IsDeviceConfigured() description.....              | 26 |
| Table 12 – CountOffsetTime() description.....                 | 26 |
| Table 13 – DataSendingTiming() description.....               | 26 |
| Table 14 – RecEndofNonPeriodicDataSending() description ..... | 26 |
| Table 15 – NonPeriodicDataAnnunciation message encoding ..... | 29 |
| Table 16 – EndofNonPeriodicDataSending message encoding.....  | 30 |
| Table 17 – Type 14 DL-management Tag encoding .....           | 30 |
| Table 18 – Type 14 message encoding.....                      | 31 |
| Table 19 – Type 14 message for FRT application encoding ..... | 31 |

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELDBUS SPECIFICATIONS –****Part 4-14: Data-link layer protocol specification –  
Type 14 elements**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 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 61158-4-14 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:

- Provide stability date for the publication;
- Update the Normative references and Bibliography;
- Corrections the edit error;
- specification changes for CPF3;
  - update of the requirements for all conformance classes;
  - update of the requirements for all conformance services.

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 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 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 a patent concerning Type 14 elements and possibly other types given in subclause 5 as follows:

CN200410088676.7 [SP] Scheduling method with deterministic communication based on Ethernet

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

The holder of this patent right 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 this patent right is registered with IEC. Information may be obtained from:

[SP] Zhejiang SUPCON Technology Co., Ltd.  
Dongqin FENG  
Liuhe Road 309, Bingjiang District,  
Hangzhou, 310053  
China

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](http://www.iso.org/patents)) and IEC ([http://www.iec.ch/tctools/patent\\_decl.htm](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 4-14: Data-link layer protocol specification – Type 14 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;
- 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/TR 61158-1:2010<sup>1</sup>, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-5-14:2010<sup>1</sup>, *Industrial communication networks – Fieldbus specifications – Part 5-14: Application layer service definition – Type 14 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, *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*

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

IETF RFC 791, *Internet protocol*, available at <<http://www.ietf.org>>

---

<sup>1</sup> To be published