IEC 61158-4-21

Edition 2.0 2019-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial communication networks – Fieldbus specifications – Part 4-21: Data-link layer protocol specification – Type 21 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 4-21: Spécification du protocole de la couche liaison de données – Éléments de type 21

IEC 61158-4-21:2019-04(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
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COMMISSION
ELECTROTECHNIQUE
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ICS 25.040.40; 35.100.20; 35.110

ISBN 978-2-8322-9146-7

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CONTENTS

FOREWORD 7
INTRODUCTION 9
1 Scope 10
1.1 General 10
1.2 Specifications 10
1.3 Procedures 10
1.4 Applicability 10
1.5 Conformance 10
2 Normative references 11
3 Terms, definitions, symbols and abbreviations 11
3.1 Reference model terms and definitions 11
3.2 Service convention terms and definitions 13
3.3 Common terms and definitions 14
3.4 Additional Type 21 definitions 17
3.5 Common symbols and abbreviations 17
3.6 Additional Type 21 symbols and abbreviations 18
4 Overview of the data-link protocol 19
4.1 General 19
4.2 Overview of medium access control 19
4.3 Service assumed from the physical layer 19
4.4 DLL architecture 20
4.4.1 General 20
4.4.2 DLL management (DLM) interface support function 21
4.5 Data type 22
4.5.1 General 22
4.5.2 Boolean 22
4.5.3 Unsigned integer 22
4.5.4 Signed integer 23
4.5.5 Octet String 23
4.5.6 Visible String 23
4.5.7 Time of day 24
4.6 Local parameters and variables 24
4.6.1 General 24
4.6.2 DLE configuration parameters 24
4.6.3 Queues to support data transfer 25
4.6.4 Variables to support SAP management 26
4.6.5 Variables to support local device information management 27
4.6.6 Variables and counter to support network information management 31
4.6.7 Variables and counter to support a device path information management 35
4.6.8 Variables, counters, timers, and queues to support path table management 39
5 General structure and encoding 39
5.1 Overview 39
5.2 MAPDU structure and encoding 39
5.3 Common MAC frame structure, encoding and elements of procedure 40
5.3.1 MAC frame structure 40

5.3.2 Elements of the MAC frame 40
5.3.3 Elements of the Type 21 DLPDU 41
5.4 Order of bit transmission 49
5.5 Invalid DLPDU 49
6 DLPDU structure and procedure 49
6.1 General 49
6.2 Common DLPDU Field 49
6.2.1 General 49
6.2.2 Version 50
6.2.3 Length 50
6.3 DL-DATA Transfer 50
6.3.1 DT DLPDU 50
6.4 DL-SPDATA Transfer 53
6.4.1 SPDT DLPDU 53
6.5 Network control messages 54
6.5.1 General 54
6.5.2 NCM_LA DLPDU 54
6.5.3 NCM_AT DLPDU 56
6.5.4 NCM_LS DLPDU 57
6.5.5 NCM_RS DLPDU 58
6.5.6 NCM_AR DLPDU 59
6.5.7 NCM_AR DLPDU structure 59
7 DLE elements of procedure 60
7.1 Overall structure 60
7.2 DL-protocol machine (DLPM) 61
7.2.1 Overview 61
7.2.2 Primitive definitions 61
7.2.3 DLPM state table 64
7.2.4 DLPM functions 68
7.3 DLL management Protocol 69
7.3.1 Overview 69
7.3.2 Primitive definitions 69
7.3.3 DLM state table 72
7.3.4 DLM functions 96
8 Constants and error codes 105
8.1 General 105
8.2 Constants 106
8.3 Data-link layer error codes 107
Bibliography 108

Figure 1 – Interaction of PhS primitives with DLE 20
Figure 2 – Data-link layer architecture 21
Figure 3 – Relationships of DLSAPs, DLSAP-addresses, and group DL-addresses 26
Figure 4 – Common MAC frame format for Type 21 DLPDU 40
Figure 5 – MAC frame format for other protocols 40
Figure 6 – Version and Length field 41
Figure 7 – DST_addr field 42

Figure 8 – SRC_addr field 43
Figure 9 – Frame Control Field 43
Figure 10 – Extension field 46
Figure 11 – DSAP field 47
Figure 12 – Source service access point field 48
Figure 13 – Length of group mask and extension information 48
Figure 14 – Group mask option field 48
Figure 15 – Common DLPDU field 50
Figure 16 – Building a DT DLPDU 50
Figure 17 – DT DLPDU structure 50
Figure 18 – SPDT DLPDU structure 53
Figure 19 – NCM_LA DLPDU structure 55
Figure 20 – DLL structure and elements 60
Figure 21 – State transition diagram of the DLPM 64
Figure 22 – State transition diagram of DLM 73

Table 1 – DLL components 20
Table 2 – UNSIGNEDn data type 22
Table 3 – INTEGERn data type 23
Table 4 – DLE configuration parameters 25
Table 5 – Queues to support data transfer 25
Table 6 – Variables to support SAP management 26
Table 7 – Variables to support device information management 27
Table 8 – DL–entity identifier 28
Table 9 – Device Flags 28
Table 10 – DLM state 28
Table 11 – Device Unique Identification 29
Table 12 – Unique identification of device connected to R-port1 29
Table 13 – Unique identification of device connected to R-port2 29
Table 14 – MAC address 29
Table 15 – Port information 30
Table 16 – Protocol version 30
Table 17 – Device type 31
Table 18 – Device description 31
Table 19 – Hop count 31
Table 20 – Variables to support managing network information 32
Table 21 – Topology 32
Table 22 – Collision count 32
Table 23 – Device count 33
Table 24 – Topology change count 33
Table 25 – Last topology change time 33
Table 26 – RNMP device UID 33
Table 27 – RNMS device UID 34

Table 28 – LNM device UID for R-port1 34
Table 29 – LNM device UID for R-port2 34
Table 30 – Network flags 35
Table 31 – Variables and counter to support managing path information 36
Table 32 – Hop count for R-port1 direction 36
Table 33 – Hop count for R-port2 direction 37
Table 34 – Preferred R-port 37
Table 35 – Destination R-port 37
Table 36 – In net count 38
Table 37 – In net time 38
Table 38 – Out net count 39
Table 39 – Out net time 39
Table 40 – Version and Length 42
Table 41 – Destination DL–entity identifier 42
Table 42 – Source DL–entity identifier 43
Table 43 – Frame control 44
Table 44 – Extension 47
Table 45 – Destination service access point 47
Table 46 – source service access point 48
Table 47 – DT DLPDU parameters 51
Table 48 – Primitives exchanged between DLS-user and DLE to send a DT DLPDU 52
Table 49 – Primitives exchanged between DLS-user and DLEs to receive a DT DLPDU 53
Table 50 – SPDT DLPDU Parameters 53
Table 51 – Primitive exchanged between DLS-User and DLEs to send an SPDT DLPDU 54
Table 52 – Primitives exchanged between DLS-user and DLEs to receive an SPDT DLPDU 54
Table 53 – NCM_LA DLPDU parameters 55
Table 54 – NCM_AT DLPDU parameters 56
Table 55 – NCM_LS DLPDU parameters 57
Table 56 – NCM_RS DLPDU parameters 58
Table 57 – NCM_AR DLPDU parameters 59
Table 58 – Primitives exchanged between DLPM and DLS-user 61
Table 59 – Parameters exchanged between DLPM and DLS-user 62
Table 60 – Primitives exchanged between DLPM and DLM 63
Table 61 – Parameters used with primitives exchanged between DLPM and DLM 64
Table 62 – DLPM state table 65
Table 63 – DLPM functions table 68
Table 64 – Primitives exchanged between DLM and DLS-user 70
Table 65 – Parameters used with primitives exchanged between DLM and DLS-user 71
Table 66 – Primitive exchanged between DLM and DMAC 71
Table 67 – Parameters used with primitives exchanged between DLM and DMAC 72
Table 68 – Primitive exchanged between DLM and DPHY 72
Table 69 – Parameters used with primitives exchanged between DLM and DPHY 72

Table 70 – DLM state table 74
Table 71 – DLM function table 96
Table 72 – DLL constants 106
Table 73 – Type 21 DLL error codes 107

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-21: Data-link layer protocol specification – Type 21 elements

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NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-4-21 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 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- added Frame control Value, DLM function and DLL constants;
- changed NCM_RETRY_RNMS to NCM_CHECK_NET_INTEGRITY_REQ;
- updated DLM state table;
- miscellaneous editorial corrections.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/946/FDIS	65C/955/RVD

Full information on the voting for the approval of this International 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 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.

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 data-link protocol provides the data-link service 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. 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 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 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 of their respective intellectual-property-right holders.

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KR 0789444	[LS]	A communication packet processing apparatus and method for ring topology Ethernet network capable of preventing permanent packet looping
KR 0732510	[LS]	Network system
KR 0870670	[LS]	Method for determining a Ring Manager Node

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-21: Data-link layer protocol specification – Type 21 elements

1 Scope

1.1 General

The DLL provides basic time-critical data communications between devices in an automated environment. Type 21 provides priority-based cyclic and acyclic data communication using an internal collision-free, full-duplex dual-port Ethernet switch technology. For wide application in various automation applications, Type 21 does not restrict the cyclic/acyclic scheduling policy in the DLL.

1.2 Specifications

This document describes:

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 communication opportunities based on ISO/IEC/IEEE 8802-3 MAC, with provisions for nodes to be added or removed during normal operation;

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

1.3 Procedures

The procedures are defined in terms of:

a) the interactions between peer data link entities (DLEs) through the exchange of fieldbus DLPDUs;

b) the interactions between a data link 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 layer 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 that support time-critical communications services in the data link layer of the OSI or fieldbus reference models, and that 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-deterministic communications needs.

1.5 Conformance

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

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 IEC 61784 1 and IEC 61784 2 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 61158-3-21:2019, *Industrial Communication Networks – Fieldbus specifications – Part 3-21: Data-link layer service definition – Type 21 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/IEEE 8802-3:2017, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

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, abbreviations and conventions apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Reference model terms and definitions

This document 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 [ISO/IEC 7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=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]

3.1.33 naming-(addressing)-authority [ISO/IEC 7498-3]

3.1.34 naming-(addressing)-domain [ISO/IEC 7498-3]

3.1.35 naming-(addressing)-subdomain [ISO/IEC 7498-3]

3.1.36 (N)-entity [ISO/IEC 7498-1]
DL-entity
Ph-entity

3.1.37 (N)-interface-data-unit [ISO/IEC 7498-1]
DL-service-data-unit (N=2)
Ph-interface-data-unit (N=1)

3.1.38 (N)-layer [ISO/IEC 7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.39 (N)-service [ISO/IEC 7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.40 (N)-service-access-point [ISO/IEC 7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.1.41 (N)-service-access-point-address [ISO/IEC 7498-1]
DL-service-access-point-address (N=2)
Ph-service-access-point-address (N=1)

3.1.42 peer-entities [ISO/IEC 7498-1]

3.1.43 Ph-interface-control-information [ISO/IEC 7498-1]

3.1.44 Ph-interface-data [ISO/IEC 7498-1]

3.1.45 primitive name [ISO/IEC 7498-3]

3.1.46 reassembling [ISO/IEC 7498-1]

3.1.47 recombining [ISO/IEC 7498-1]

3.1.48 reset [ISO/IEC 7498-1]

3.1.49 responding-DL-address [ISO/IEC 7498-3]

3.1.50 routing [ISO/IEC 7498-1]

3.1.51 segmenting [ISO/IEC 7498-1]

3.1.52 sequencing [ISO/IEC 7498-1]

3.1.53 splitting [ISO/IEC 7498-1]

3.1.54 synonymous name [ISO/IEC 7498-3]

3.1.55 systems-management [ISO/IEC 7498-1]

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: