



BSI Standards Publication

## Industrial communication networks - Fieldbus specifications

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Part 4-2: Data-link layer protocol specification - Type 2 elements

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## National foreword

This British Standard is the UK implementation of EN IEC 61158-4-2:2019. It is identical to IEC 61158-4-2:2019. It supersedes BS EN 61158-4-2:2014, which will be withdrawn on 23 May 2022.

The UK participation in its preparation was entrusted to Technical Committee GEL/65/3, Industrial communications: process measurement and control, including fieldbus.

A list of organizations represented on this committee can be obtained on request to its secretary.

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## EUROPÄISCHE NORM

June 2019

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English Version

**Industrial communication networks - Fieldbus specifications -  
Part 4-2: Data-link layer protocol specification - Type 2 elements  
(IEC 61158-4-2:2019)**

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(IEC 61158-4-2:2019)

Industrielle Kommunikationsnetze - Feldbusse - Teil 4-2:  
Protokollspezifikation des Data Link Layer  
(Sicherheitsschicht) - Typ 2-Elemente  
(IEC 61158-4-2:2019)

This European Standard was approved by CENELEC on 2019-05-23. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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## **European foreword**

The text of document 65C/946/FDIS, future edition 4 of IEC 61158-4-2, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61158-4-2:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-02-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-05-23

This document supersedes EN 61158-4-2:2014.

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The text of the International Standard IEC 61158-4-2:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

- IEC 61158-1:2019 NOTE Harmonized as EN IEC 61158-1:2019 (not modified)
- IEC 61158-2:2014 NOTE Harmonized as EN 61158-2:2014 (not modified)
- IEC 61784-1:2019 NOTE Harmonized as EN IEC 61784-1:2019 (not modified)
- IEC 61784-2:2019 NOTE Harmonized as EN IEC 61784-2:2019 (not modified)

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(normative)

### Normative references to international publications with their corresponding European publications

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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

| <u>Publication</u>     | <u>Year</u>  | <u>Title</u>  | <u>EN/HD</u>      | <u>Year</u> |
|------------------------|--------------|---|-------------------|-------------|
| IEC 61131-3            | -            | Programmable controllers - Part 3: Programming languages  | 3:EN 61131-3      | -           |
| IEC 61158-3-2<br>Amd 1 | 2014<br>2019 | Industrial communication networks - Part 3-2: Data-link layer service definition - Type 2 elements  | -EN 61158-3-2     | 2014        |
| IEC 61158-5-2          | 2019         | Industrial communication networks - Part 5-2: Application layer service definition - Type 2 elements  | -EN IEC 61158-5-2 | 2019        |
| IEC 61158-6-2          | 2014         | Industrial communication networks - Part 6-2: Application layer protocol specification - Type 2 elements  | -EN 61158-6-2     | 2014        |
| IEC 61588              | 2009         | Precision clock synchronization protocol for networked measurement and control systems  |                   | -           |
| IEC 61784-3-2          | -            | Industrial communication networks -- Profiles - Part 3-2: Functional safety fieldbuses - Additional specifications for CPF 2  |                   | -           |
| IEC 62026-3            | 2014         | Low-voltage switchgear and controlgear -- Controller-device interfaces (CDIs) - Part 3: DeviceNet   |                   | -           |
| IEC 62439-3            | 2012         | Industrial communication networks - High availability automation networks -- Part 3: Parallel Redundancy Protocol (PRP) and High availability Seamless Redundancy (HSR) | EN 62439-3        | 2012        |
| ISO 11898              | 1993         | Road vehicles - Interchange of digital-information - Controller area network (CAN) for high-speed communication   |                   | -           |
| ISO/IEC 3309           | -            | Information technology -- Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Frame structure                |                   | -           |

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|                     |      |   |   |
|---------------------|------|---|---|
|                     |      | Interconnection - Basic reference model:<br>The basic model   |   |
| ISO/IEC 7498-3      | -    | Information technology - Open Systems-<br>Interconnection - Basic reference model:<br>Naming and addressing | - |
| ISO/IEC/IEEE 8802-3 | -    | Standard for Ethernet   | - |
| IEEE Std 802.1D     | 2004 | IEEE Standard for Local and Metropolitan-<br>Area Networks – Media Access Control<br>(MAC) bridges          | - |
| IEEE Std 802.1Q     | 2005 | IEEE Standard for Local and Metropolitan-<br>Area Networks – Virtual bridged local area<br>networks         | - |
| IEEE Std 802.3      | 2015 | IEEE Standard for Ethernet  | - |
| IETF RFC 951        | -    | Bootstrap Protocol (BOOTP)  | - |
| IETF RFC 1213       | -    | Management Information Base for Network-<br>Management of TCP/IP-based Internets:<br>MIB-II                 | - |
| IETF RFC 1542       | -    | Clarifications and Extensions for the-<br>Bootstrap Protocol  | - |
| IETF RFC 1643       | -    | Definitions of Managed Objects for the-<br>Ethernet-like interface types                                    | - |
| IETF RFC 2131       | -    | Dynamic Host Configuration Protocol   | - |
| IETF RFC 2132       | -    | DHCP Options and BOOTP Vendor-<br>Extensions  | - |
| IETF RFC 2863       | -    | The Interfaces Group MIB  | - |
| IETF RFC 3635       | -    | Definitions of managed objects for the-<br>ethernet-like interface types                                    | - |
| IETF RFC 4541       | -    | IGMP and MLD Snooping Switches  | - |
| IETF RFC 5227       | 2008 | IPv4 Address Conflict Detection   | - |

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## CONTENTS

|  |    |
|--|----|
| FOREWORD.....  | 15 |
| INTRODUCTION.....  | 17 |
| 1 Scope.....   | 19 |
| 1.1 General.....   | 19 |
| 1.2 Specifications .....   | 19 |
| 1.3 Procedures .....   | 19 |
| 1.4 Applicability .....  | 20 |
| 1.5 Conformance .....  | 20 |
| 2 Normative references .....   | 20 |
| 3 Terms, definitions, symbols, abbreviated terms and conventions .....                       | 22 |
| 3.1 Reference model terms and definitions .....  | 22 |
| 3.2 Service convention terms and definitions .....   | 24 |
| 3.3 Common terms and definitions.....  | 24 |
| 3.4 Additional Type 2 definitions .....  | 25 |
| 3.5 Type 2 symbols and abbreviated terms .....   | 33 |
| 3.6 Conventions for station management objects .....   | 34 |
| 4 Overview of the data-link protocol.....  | 35 |
| 4.1 General.....   | 35 |
| 4.1.1 DLL architecture .....   | 35 |
| 4.1.2 Access control machine (ACM) and scheduling support functions .....                    | 36 |
| 4.1.3 Connection-mode, connectionless-mode data transfer and DL service.....                 | 37 |
| 4.2 Services provided by the DL .....  | 37 |
| 4.2.1 Overview .....   | 37 |
| 4.2.2 QoS.....   | 37 |
| 4.3 Structure and definition of DL-addresses .....   | 38 |
| 4.3.1 General .....  | 38 |
| 4.3.2 MAC ID address .....   | 38 |
| 4.3.3 Generic tag address .....  | 39 |
| 4.3.4 Fixed tag address .....  | 39 |
| 4.4 Services assumed from the PhL.....   | 40 |
| 4.4.1 General requirements .....   | 40 |
| 4.4.2 Data encoding rules.....   | 41 |
| 4.4.3 DLL to PhL interface.....  | 41 |
| 4.5 Functional classes .....   | 43 |
| 5 General structure and encoding of PhIDUs and DLPDUs and related elements of procedure..... | 43 |
| 5.1 Overview .....   | 43 |
| 5.2 Media access procedure .....   | 43 |
| 5.3 DLPDU structure and encoding .....   | 47 |
| 5.3.1 General .....  | 47 |
| 5.3.2 DLPDU components .....   | 47 |
| 5.3.3 Preamble.....  | 47 |
| 5.3.4 Start and end delimiters.....  | 47 |
| 5.3.5 DLPDU octets and ordering .....  | 47 |
| 5.3.6 Source MAC ID.....   | 48 |
| 5.3.7 Lpackets field .....   | 48 |
| 5.3.8 Frame check sequence (FCS).....  | 48 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|        |   |    |
|--------|---|----|
| 5.3.9  | Null DLPDU .....  | 51 |
| 5.3.10 | Abort DLPDU .....   | 51 |
| 5.4    | Lpacket components .....                                      | 51 |
| 5.4.1  | General Lpacket structure .....                               | 51 |
| 5.4.2  | Size .....  | 51 |
| 5.4.3  | Control .....   | 52 |
| 5.4.4  | Generic tag Lpackets .....                                    | 52 |
| 5.4.5  | Fixed tag Lpackets .....                                      | 53 |
| 5.5    | DLPDU procedures .....  | 53 |
| 5.5.1  | General .....   | 53 |
| 5.5.2  | Sending scheduled DLPDUs .....                                | 54 |
| 5.5.3  | Sending unscheduled DLPDUs .....                              | 54 |
| 5.5.4  | Receiving DLPDUs .....  | 54 |
| 5.6    | Summary of DLL support services and objects .....             | 54 |
| 6      | Specific DLPDU structure, encoding and procedures .....       | 56 |
| 6.1    | Modeling language .....                                       | 56 |
| 6.1.1  | State machine description .....                               | 56 |
| 6.1.2  | Use of DLL- prefix .....                                      | 57 |
| 6.1.3  | Data types .....  | 57 |
| 6.2    | DLS user services .....                                       | 58 |
| 6.2.1  | General .....   | 58 |
| 6.2.2  | Connected mode and connectionless mode transfer service ..... | 58 |
| 6.2.3  | Queue maintenance service .....                               | 60 |
| 6.2.4  | Tag filter service .....                                      | 60 |
| 6.2.5  | Link synchronization service .....                            | 61 |
| 6.2.6  | Synchronized parameter change service .....                   | 61 |
| 6.2.7  | Event reports service .....                                   | 62 |
| 6.2.8  | Bad FCS service .....   | 63 |
| 6.2.9  | Current moderator service .....                               | 63 |
| 6.2.10 | Power up and online services .....                            | 64 |
| 6.2.11 | Enable moderator service .....                                | 64 |
| 6.2.12 | Listen only service .....                                     | 64 |
| 6.3    | Generic tag Lpacket .....                                     | 64 |
| 6.3.1  | General .....   | 64 |
| 6.3.2  | Structure of the generic-tag Lpacket .....                    | 65 |
| 6.3.3  | Sending and receiving the generic-tag Lpacket .....           | 65 |
| 6.4    | Moderator Lpacket .....                                       | 65 |
| 6.4.1  | General .....   | 65 |
| 6.4.2  | Structure of the moderator Lpacket .....                      | 65 |
| 6.4.3  | Sending and receiving the moderator Lpacket .....             | 66 |
| 6.5    | Time distribution Lpacket .....                               | 67 |
| 6.5.1  | General .....   | 67 |
| 6.5.2  | Structure of the time distribution Lpacket .....              | 67 |
| 6.5.3  | Sending and receiving the time distribution Lpacket .....     | 69 |
| 6.6    | UCMM Lpacket .....  | 69 |
| 6.6.1  | General .....   | 69 |
| 6.6.2  | Structure of the UCMM Lpacket .....                           | 69 |
| 6.6.3  | Sending and receiving the UCMM Lpacket .....                  | 69 |



This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|        |   |     |
|--------|---|-----|
| 6.7    | Keeper UCMM Lpacket .....   | 69  |
| 6.7.1  | General .....   | 69  |
| 6.7.2  | Structure of the Keeper UCMM Lpacket .....                          | 70  |
| 6.7.3  | Sending and receiving the Keeper UCMM Lpacket .....                 | 70  |
| 6.8    | TUI Lpacket .....   | 70  |
| 6.8.1  | General .....   | 70  |
| 6.8.2  | Structure of the TUI Lpacket .....                                  | 70  |
| 6.8.3  | Sending and receiving the TUI Lpacket .....                         | 71  |
| 6.9    | Link parameters Lpacket and tMinus Lpacket .....                    | 71  |
| 6.9.1  | General .....   | 71  |
| 6.9.2  | Structure of link parameters and tMinus Lpackets .....              | 72  |
| 6.9.3  | Sending and receiving the tMinus and Link parameters Lpackets ..... | 72  |
| 6.10   | I'm-alive Lpacket .....   | 73  |
| 6.10.1 | General .....   | 73  |
| 6.10.2 | Structure or the I'm-alive Lpacket .....                            | 73  |
| 6.10.3 | Sending and receiving I'm Alive .....                               | 73  |
| 6.10.4 | I'm alive state processing .....                                    | 73  |
| 6.11   | Ping Lpackets .....   | 74  |
| 6.11.1 | General .....   | 74  |
| 6.11.2 | Structure of the ping Lpackets .....                                | 75  |
| 6.11.3 | Sending and receiving the ping Lpackets .....                       | 75  |
| 6.12   | WAMI Lpacket .....  | 76  |
| 6.12.1 | General .....   | 76  |
| 6.12.2 | Structure of the WAMI Lpacket .....                                 | 76  |
| 6.12.3 | Sending and receiving the WAMI Lpacket .....                        | 76  |
| 6.13   | Debug Lpacket .....   | 76  |
| 6.14   | IP Lpacket .....  | 77  |
| 6.15   | Ethernet Lpacket .....  | 77  |
| 7      | Objects for station management .....                                | 77  |
| 7.1    | General .....   | 77  |
| 7.2    | ControlNet™ object .....  | 79  |
| 7.2.1  | Overview .....  | 79  |
| 7.2.2  | Class attributes .....  | 79  |
| 7.2.3  | Instance attributes .....   | 79  |
| 7.2.4  | Common services .....   | 87  |
| 7.2.5  | Class specific services .....                                       | 88  |
| 7.2.6  | Behavior .....  | 89  |
| 7.2.7  | Module status indicator .....                                       | 89  |
| 7.3    | Keeper object .....   | 90  |
| 7.3.1  | Overview .....  | 90  |
| 7.3.2  | Revision history .....  | 90  |
| 7.3.3  | Class attributes .....  | 90  |
| 7.3.4  | Instance attributes .....   | 90  |
| 7.3.5  | Common services .....   | 98  |
| 7.3.6  | Class specific services .....                                       | 99  |
| 7.3.7  | Service error codes .....   | 105 |
| 7.3.8  | Behavior .....  | 106 |
| 7.3.9  | Miscellaneous notes .....   | 107 |
| 7.3.10 | Keeper power up sequence .....                                      | 108 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|        |  |     |
|--------|--|-----|
| 7.4    | Scheduling object .....                              | 113 |
| 7.4.1  | Overview .....                                       | 113 |
| 7.4.2  | Class attributes .....                               | 114 |
| 7.4.3  | Instance attributes .....                            | 114 |
| 7.4.4  | Common services .....                                | 115 |
| 7.4.5  | Class specific services .....                        | 117 |
| 7.4.6  | Typical scheduling session .....                     | 123 |
| 7.5    | TCP/IP Interface object.....                         | 124 |
| 7.5.1  | Overview .....                                       | 124 |
| 7.5.2  | Revision history.....                                | 124 |
| 7.5.3  | Class attributes .....                               | 125 |
| 7.5.4  | Instance attributes .....                            | 125 |
| 7.5.5  | Common services .....                                | 139 |
| 7.5.6  | Class specific services .....                        | 141 |
| 7.5.7  | Behavior .....                                       | 142 |
| 7.5.8  | Address Conflict Detection (ACD).....                | 144 |
| 7.6    | Ethernet link object.....                            | 150 |
| 7.6.1  | Overview .....                                       | 150 |
| 7.6.2  | Revision history.....                                | 150 |
| 7.6.3  | Class attributes .....                               | 150 |
| 7.6.4  | Instance attributes .....                            | 151 |
| 7.6.5  | Common services .....                                | 161 |
| 7.6.6  | Class specific services .....                        | 163 |
| 7.6.7  | Behavior.....  | 163 |
| 7.7    | DeviceNet™ object.....                               | 164 |
| 7.7.1  | Overview .....                                       | 164 |
| 7.7.2  | Revision history.....                                | 164 |
| 7.7.3  | Class attributes .....                               | 165 |
| 7.7.4  | Instance attributes .....                            | 165 |
| 7.7.5  | Common services .....                                | 172 |
| 7.7.6  | Class specific services .....                        | 173 |
| 7.8    | Connection configuration object (CCO).....           | 173 |
| 7.8.1  | Overview .....                                       | 173 |
| 7.8.2  | Revision history.....                                | 174 |
| 7.8.3  | Class attributes .....                               | 174 |
| 7.8.4  | Instance attributes .....                            | 176 |
| 7.8.5  | Connection Configuration Object change control ..... | 185 |
| 7.8.6  | Common services .....                                | 185 |
| 7.8.7  | Class specific services .....                        | 192 |
| 7.8.8  | Behavior .....                                       | 195 |
| 7.9    | DLR object.....                                      | 196 |
| 7.9.1  | Overview .....                                       | 196 |
| 7.9.2  | Revision history.....                                | 196 |
| 7.9.3  | Class attributes .....                               | 197 |
| 7.9.4  | Instance attributes .....                            | 197 |
| 7.9.5  | Common services .....                                | 208 |
| 7.9.6  | Class specific services .....                        | 212 |
| 7.10   | QoS object.....                                      | 213 |
| 7.10.1 | Overview .....                                       | 213 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|        |  |     |
|--------|--|-----|
| 7.10.2 | Revision History .....                         | 213 |
| 7.10.3 | Class attributes .....                         | 213 |
| 7.10.4 | Instance Attributes.....                       | 214 |
| 7.10.5 | Common services .....                          | 215 |
| 7.10.6 | Get_Attributes_All response (class level)..... | 216 |
| 7.11   | Port object .....                              | 216 |
| 7.11.1 | Overview .....                                 | 216 |
| 7.11.2 | Revision History .....                         | 216 |
| 7.11.3 | Class attributes .....                         | 217 |
| 7.11.4 | Instance attributes .....                      | 217 |
| 7.11.5 | Common services .....                          | 223 |
| 7.12   | PRP/HSR Protocol object.....                   | 224 |
| 7.12.1 | Overview .....                                 | 224 |
| 7.12.2 | Revision history.....                          | 224 |
| 7.12.3 | Class attributes .....                         | 225 |
| 7.12.4 | Instance attributes .....                      | 225 |
| 7.12.5 | Common Services .....                          | 232 |
| 7.13   | PRP/HSR Nodes Table object.....                | 234 |
| 7.13.1 | Overview .....                                 | 234 |
| 7.13.2 | Revision history.....                          | 234 |
| 7.13.3 | Class attributes .....                         | 234 |
| 7.13.4 | Instance attributes .....                      | 234 |
| 7.13.5 | Common services .....                          | 237 |
| 8      | Other DLE elements of procedure.....           | 237 |
| 8.1    | Network attachment monitor (NAM).....          | 237 |
| 8.1.1  | General .....                                  | 237 |
| 8.1.2  | Default parameters .....                       | 238 |
| 8.1.3  | Auto-addressing .....                          | 239 |
| 8.1.4  | Valid MAC IDs .....                            | 239 |
| 8.1.5  | State machine description .....                | 239 |
| 8.2    | Calculating link parameters.....               | 245 |
| 8.2.1  | Link parameters.....                           | 245 |
| 8.2.2  | Conditions affecting link parameters .....     | 246 |
| 8.2.3  | Moderator change.....                          | 246 |
| 8.2.4  | NUT timing .....                               | 246 |
| 8.2.5  | Slot timing .....                              | 248 |
| 8.2.6  | Blanking .....                                 | 248 |
| 8.2.7  | Example implementation.....                    | 249 |
| 9      | Detailed specification of DL components .....  | 253 |
| 9.1    | General.....                                   | 253 |
| 9.2    | Access control machine (ACM) .....             | 253 |
| 9.3    | TxLLC.....                                     | 273 |
| 9.4    | RxLLC .....                                    | 277 |
| 9.5    | Transmit machine (TxM) .....                   | 281 |
| 9.6    | Receive machine (RxM) .....                    | 285 |
| 9.7    | Serializer .....                               | 291 |
| 9.8    | Deserializer .....                             | 293 |
| 9.8.1  | Octet construction .....                       | 293 |
| 9.8.2  | FCS checking .....                             | 293 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|          |  |     |
|----------|--|-----|
| 9.8.3    | End of DLPDU processing .....                              | 294 |
| 9.9      | DLL management.....  | 294 |
| 10       | Device Level Ring (DLR) protocol.....                      | 296 |
| 10.1     | General.....   | 296 |
| 10.2     | Support for Multiple DLR Ring Pairs.....                   | 296 |
| 10.3     | Supported topologies .....                                 | 297 |
| 10.4     | Overview of DLR operation .....                            | 298 |
| 10.4.1   | Normal operation .....                                     | 298 |
| 10.4.2   | Link failures.....   | 300 |
| 10.5     | Classes of DLR implementation .....                        | 301 |
| 10.6     | DLR behavior.....  | 302 |
| 10.6.1   | DLR variables.....   | 302 |
| 10.6.2   | Ring supervisor .....                                      | 302 |
| 10.6.3   | Ring node.....   | 305 |
| 10.6.4   | Sign on process.....                                       | 306 |
| 10.6.5   | Neighbor check process .....                               | 307 |
| 10.7     | Implementation requirements.....                           | 307 |
| 10.7.1   | Embedded switch requirements and recommendations .....     | 307 |
| 10.7.2   | DLR implementation requirements .....                      | 308 |
| 10.7.3   | IEC 61588 and CP 2/2.1 considerations.....                 | 309 |
| 10.7.4   | IEEE 802.1D/IEEE 802.1Q STP/RSTP/MSTP considerations ..... | 309 |
| 10.8     | Using non-DLR nodes in the ring network .....              | 309 |
| 10.8.1   | General considerations.....                                | 309 |
| 10.8.2   | Non-DLR end devices.....                                   | 310 |
| 10.8.3   | Non-DLR switches .....                                     | 310 |
| 10.9     | Redundant gateway devices on DLR network.....              | 313 |
| 10.9.1   | General .....  | 313 |
| 10.9.2   | Supported topologies.....                                  | 313 |
| 10.9.3   | Redundant gateway capable device.....                      | 314 |
| 10.9.4   | Redundant gateway device behavior .....                    | 314 |
| 10.10    | DLR messages .....   | 317 |
| 10.10.1  | General .....  | 317 |
| 10.10.2  | Common frame header .....                                  | 318 |
| 10.10.3  | Beacon frame .....   | 319 |
| 10.10.4  | Neighbor_Check request .....                               | 319 |
| 10.10.5  | Neighbor_Check_response.....                               | 320 |
| 10.10.6  | Link_Status/Neighbor_Status.....                           | 320 |
| 10.10.7  | Locate_Fault.....  | 321 |
| 10.10.8  | Announce .....   | 321 |
| 10.10.9  | Sign_On .....  | 321 |
| 10.10.10 | Advertise .....  | 322 |
| 10.10.11 | Flush_Tables.....  | 322 |
| 10.10.12 | Learning_Update .....                                      | 323 |
| 10.11    | State diagrams and state-event-action matrices.....        | 323 |
| 10.11.1  | Beacon-based ring node.....                                | 323 |
| 10.11.2  | Announce-based ring node .....                             | 330 |
| 10.11.3  | Ring supervisor .....                                      | 334 |
| 10.11.4  | Redundant gateway.....                                     | 349 |

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|                     |   |     |
|---------------------|---|-----|
| 10.12               | Performance analysis .....  | 354 |
| 10.12.1             | General .....   | 354 |
| 10.12.2             | Redundant gateway switchover performance .....                          | 358 |
| 11                  | PRP and HSR redundancy protocols .....                                  | 359 |
| 11.1                | General.....  | 359 |
| 11.2                | PRP overview .....  | 360 |
| 11.2.1              | General .....   | 360 |
| 11.2.2              | Address Conflict Detection (ACD).....                                   | 361 |
| 11.3                | HSR overview .....  | 362 |
| Annex A (normative) | Indicators and switches .....   | 364 |
| A.1                 | Purpose .....   | 364 |
| A.2                 | Indicators.....   | 364 |
| A.2.1               | General indicator requirements.....                                     | 364 |
| A.2.2               | Common indicator requirements .....                                     | 364 |
| A.2.3               | Fieldbus specific indicator requirements – option 1 .....               | 366 |
| A.2.4               | Fieldbus specific indicator requirements – option 2 .....               | 370 |
| A.2.5               | Fieldbus specific indicator requirements – option 3.....                | 374 |
| A.3                 | Switches .....  | 378 |
| A.3.1               | Common switch requirements.....   | 378 |
| A.3.2               | Fieldbus specific switch requirements – option 1 .....                  | 378 |
| A.3.3               | Fieldbus specific switch requirements – option 2 .....                  | 378 |
| A.3.4               | Fieldbus specific switch requirements – option 3 .....                  | 379 |
| Bibliography        | .....   | 380 |
| Figure 1            | – Data-link layer internal architecture.....                            | 36  |
| Figure 2            | – Relationships of DLSAPs, DLSAP-addresses, and group DL-addresses..... | 38  |
| Figure 3            | – Basic structure of a MAC ID address.....                              | 39  |
| Figure 4            | – Basic structure of a generic tag address .....                        | 39  |
| Figure 5            | – Basic structure of a fixed tag address .....                          | 39  |
| Figure 6            | – M_symbols and Manchester encoding at 5 MHz .....                      | 41  |
| Figure 7            | – NUT structure .....   | 44  |
| Figure 8            | – Media access during scheduled time .....                              | 45  |
| Figure 9            | – Media access during unscheduled time .....                            | 46  |
| Figure 10           | – DLPDU format.....   | 47  |
| Figure 11           | – Aborting a DLPDU during transmission .....                            | 51  |
| Figure 12           | – Lpacket format .....  | 51  |
| Figure 13           | – Generic tag Lpacket format .....                                      | 52  |
| Figure 14           | – Fixed tag Lpacket format.....   | 53  |
| Figure 15           | – Goodness parameter of TimeDist_Lpacket.....                           | 68  |
| Figure 16           | – Example I'm alive processing algorithm.....                           | 74  |
| Figure 17           | – Keeper CRC algorithm .....  | 96  |
| Figure 18           | – Keeper object power-up state diagram .....                            | 109 |
| Figure 19           | – Keeper object operating state diagram .....                           | 110 |
| Figure 20           | – Synchronized network change processing .....                          | 113 |
| Figure 21           | – State transition diagram for TCP/IP Interface object.....             | 143 |
| Figure 22           | – State transition diagram for TCP/IP Interface object.....             | 144 |

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|  |     |
|--|-----|
| Figure 23 – ACD Behavior .....   | 146 |
| Figure 24 – State transition diagram for Ethernet Link object .....                          | 164 |
| Figure 25 – Connection configuration object edit flowchart.....                              | 196 |
| Figure 26 – NAM state machine .....  | 238 |
| Figure 27 – Devices with Multiple DLR Ring Pairs.....  | 297 |
| Figure 28 – DLR rings connected to switches.....   | 298 |
| Figure 29 – Normal operation of a DLR network.....   | 299 |
| Figure 30 – Beacon and Announce frames.....  | 299 |
| Figure 31 – Link failure .....   | 300 |
| Figure 32 – Network reconfiguration after link failure .....                                 | 301 |
| Figure 33 – Neighbor Check process .....   | 307 |
| Figure 34 – Unsupported topology – example 1 .....   | 311 |
| Figure 35 – Unsupported topology – example 2 .....   | 311 |
| Figure 36 – DLR ring connected to switches through redundant gateways .....                  | 313 |
| Figure 37 – DLR redundant gateway capable device.....  | 314 |
| Figure 38 – Advertise frame.....   | 316 |
| Figure 39 – State transition diagram for Beacon frame based non-supervisor ring node.....    | 324 |
| Figure 40 – State transition diagram for Announce frame based non-supervisor ring node ..... | 330 |
| Figure 41 – State transition diagram for ring supervisor .....                               | 335 |
| Figure 42 – State transition diagram for redundant gateway.....                              | 350 |
| Figure 43 – PRP network .....  | 360 |
| Figure 44 – Directly Attached SANs .....   | 361 |
| Figure 45 – Virtual DANs .....   | 362 |
| Figure 46 – HSR network.....   | 362 |
| Figure A.1 – Non redundant network status indicator labeling .....                           | 370 |
| Figure A.2 – Redundant network status indicator labeling .....                               | 370 |
| Figure A.3 – Network status indicator state diagram .....                                    | 373 |
| Figure A.4 – Examples of multiple network status indicators .....                            | 373 |
| <br>   |     |
| Table 1 – Format of attribute tables .....   | 34  |
| Table 2 – Data-link layer components .....   | 35  |
| Table 3 – MAC ID addresses allocation .....  | 39  |
| Table 4 – Fixed tag service definitions .....  | 40  |
| Table 5 – Data encoding rules .....  | 41  |
| Table 6 – M Data symbols .....   | 42  |
| Table 7 – Truth table for ph_status_indication.....  | 42  |
| Table 8 – FCS length, polynomials and constants .....  | 49  |
| Table 9 – DLL support services and objects.....  | 55  |
| Table 10 – Elementary data types.....  | 58  |
| Table 11 – DLL events .....  | 63  |
| Table 12 – Time distribution priority .....  | 68  |
| Table 13 – Format of the TUI Lpacket.....  | 71  |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|   |     |
|---|-----|
| Table 14 – ControlNet object class attributes .....                       | 79  |
| Table 15 – ControlNet object instance attributes .....                    | 80  |
| Table 16 – TUI status flag bits .....                                     | 84  |
| Table 17 – Mac_ver bits.....  | 85  |
| Table 18 – Channel state bits .....                                       | 85  |
| Table 19 – ControlNet object common services.....                         | 87  |
| Table 20 – ControlNet object class specific services .....                | 88  |
| Table 21 – Keeper object revision history .....                           | 90  |
| Table 22 – Keeper object class attributes .....                           | 90  |
| Table 23 – Keeper object instance attributes .....                        | 91  |
| Table 24 – Keeper operating state definitions .....                       | 94  |
| Table 25 – Port status flag bit definitions .....                         | 94  |
| Table 26 – TUI status flag bits .....                                     | 95  |
| Table 27 – Keeper attributes.....   | 97  |
| Table 28 – Memory requirements (in octets) for the Keeper attributes..... | 98  |
| Table 29 – Keeper object common services .....                            | 98  |
| Table 30 – Keeper object class specific services .....                    | 100 |
| Table 31 – Service error codes .....                                      | 101 |
| Table 32 – Wire order format of the TUI Lpacket.....                      | 105 |
| Table 33 – Service error codes .....                                      | 106 |
| Table 34 – Keeper object operating states .....                           | 107 |
| Table 35 – Keeper object state event matrix .....                         | 111 |
| Table 36 – Scheduling object class attributes .....                       | 114 |
| Table 37 – Scheduling object instance attributes .....                    | 115 |
| Table 38 – Scheduling object common services .....                        | 115 |
| Table 39 – Status error descriptions for Create .....                     | 116 |
| Table 40 – Status error descriptions for Delete and Kick_Timer .....      | 117 |
| Table 41 – Scheduling object class specific services .....                | 117 |
| Table 42 – Status error descriptions for Read .....                       | 119 |
| Table 43 – Status error descriptions for Conditional_Write.....           | 120 |
| Table 44 – Status error descriptions for Forced_Write .....               | 120 |
| Table 45 – Status error descriptions for Change_Start.....                | 121 |
| Table 46 – Status error descriptions for Break_Connections .....          | 122 |
| Table 47 – Status error descriptions for Change_Complete.....             | 122 |
| Table 48 – Status error descriptions for Restart_Connections .....        | 123 |
| Table 49 – Revision history.....  | 124 |
| Table 50 – TCP/IP Interface object class attributes.....                  | 125 |
| Table 51 – TCP/IP Interface object instance attributes.....               | 126 |
| Table 52 – Status bits .....  | 129 |
| Table 53 – Configuration capability bits .....                            | 130 |
| Table 54 – Configuration control bits.....                                | 131 |
| Table 55 – Example path .....   | 132 |
| Table 56 – Interface configuration components .....                       | 133 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|  |     |
|--|-----|
| Table 57 – Alloc control values .....                                | 135 |
| Table 58 – AcdActivity values .....                                  | 136 |
| Table 59 – ArpPdu – ARP Response PDU in binary format .....          | 136 |
| Table 60 – Admin Capability member bit definitions .....             | 137 |
| Table 61 – Admin Capability member bit definitions .....             | 138 |
| Table 62 – TCP/IP Interface object common services .....             | 139 |
| Table 63 – Get_Attributes_All reply format.....                      | 140 |
| Table 64 – TCP/IP Interface object class specific services.....      | 141 |
| Table 65 – Set_Port_Admin_State service request parameters .....     | 141 |
| Table 66 – Set_Protocol_Admin_State service request parameters.....  | 142 |
| Table 67 – Class specific error codes .....                          | 142 |
| Table 68 – Ethernet link object revision history .....               | 150 |
| Table 69 – Ethernet link object class attributes .....               | 151 |
| Table 70 – Ethernet link object instance attributes .....            | 151 |
| Table 71 – Interface flags bits.....                                 | 157 |
| Table 72 – Control bits.....   | 158 |
| Table 73 – Interface type .....                                      | 159 |
| Table 74 – Interface state .....                                     | 159 |
| Table 75 – Admin state .....   | 159 |
| Table 76 – Capability Bits .....                                     | 160 |
| Table 77 – Ethernet Link object common services.....                 | 161 |
| Table 78 – Get_Attributes_All reply format.....                      | 162 |
| Table 79 – Ethernet Link object class specific services .....        | 163 |
| Table 80 – DeviceNet object revision history.....                    | 165 |
| Table 81 – DeviceNet object class attributes.....                    | 165 |
| Table 82 – DeviceNet object instance attributes.....                 | 166 |
| Table 83 – Bit rate attribute values .....                           | 168 |
| Table 84 – BOI attribute values.....                                 | 169 |
| Table 85 – Diagnostic counters bit description .....                 | 171 |
| Table 86 – DeviceNet object common services .....                    | 172 |
| Table 87 – Reset service parameter .....                             | 172 |
| Table 88 – Reset service parameter values .....                      | 172 |
| Table 89 – DeviceNet object class specific services.....             | 173 |
| Table 90 – Connection configuration object revision history .....    | 174 |
| Table 91 – Connection configuration object class attributes .....    | 174 |
| Table 92 – Format number values.....                                 | 176 |
| Table 93 – Connection configuration object instance attributes ..... | 176 |
| Table 94 – Originator connection status values.....                  | 180 |
| Table 95 – Target connection status values .....                     | 181 |
| Table 96 – Connection flags .....                                    | 181 |
| Table 97 – I/O mapping formats.....                                  | 183 |
| Table 98 – Services valid during a change operation .....            | 185 |
| Table 99 – Connection configuration object common services.....      | 186 |



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|   |     |
|---|-----|
| Table 100 – Get_Attributes_All Response – class level.....                                  | 186 |
| Table 101 – Get_Attributes_All response – instance level.....                               | 187 |
| Table 102 – Set_Attributes_All error codes .....  | 188 |
| Table 103 – Set_Attributes_All request .....  | 189 |
| Table 104 – Create request parameters .....   | 190 |
| Table 105 – Create error codes .....  | 191 |
| Table 106 – Delete error codes.....   | 191 |
| Table 107 – Restore error codes.....  | 192 |
| Table 108 – Connection configuration object class specific services .....                   | 192 |
| Table 109 – Change_Start error codes .....  | 193 |
| Table 110 – Get_Status service parameter .....  | 193 |
| Table 111 – Get_Status service response.....  | 194 |
| Table 112 – Get_Status service error codes .....  | 194 |
| Table 113 – Change_Complete service parameter .....   | 194 |
| Table 114 – Change_Complete service error codes .....                                       | 195 |
| Table 115 – Audit_Changes service parameter .....   | 195 |
| Table 116 – Audit_Changes service error codes .....   | 195 |
| Table 117 – Revision history.....   | 197 |
| Table 118 – DLR object class attributes .....   | 197 |
| Table 119 – DLR object instance attributes.....   | 198 |
| Table 120 – Network Status values .....   | 201 |
| Table 121 – Ring Supervisor Status values.....  | 201 |
| Table 122 – Capability flags.....   | 205 |
| Table 123 – Redundant Gateway Status values .....   | 207 |
| Table 124 – DLR object common services .....  | 208 |
| Table 125 – Get_Attributes_All Response – Object Revision 1, non supervisor device.....     | 209 |
| Table 126 – Get_Attributes_All Response – Object Revision 1, supervisor-capable device..... | 210 |
| Table 127 – Get_Attributes_All Response – Object Revision 2, non supervisor device.....     | 210 |
| Table 128 – Get_Attributes_All Response – All other cases .....                             | 211 |
| Table 129 – DLR object class specific services .....  | 212 |
| Table 130 – QoS object revision history.....  | 213 |
| Table 131 – QoS object class attributes.....  | 214 |
| Table 132 – QoS object instance attributes.....   | 214 |
| Table 133 – Default DCSP values and usages .....  | 215 |
| Table 134 – QoS object common services .....  | 216 |
| Table 135 – Port object revision history .....  | 217 |
| Table 136 – Port object class attributes .....  | 217 |
| Table 137 – Port object instance attributes .....   | 218 |
| Table 138 – Port Type and associated Link Object classes and Port Type Name values.....     | 220 |
| Table 139 – Port Routing Capabilities attribute bit definitions.....                        | 222 |
| Table 140 – Port object common services .....   | 223 |
| Table 141 – Get_Attributes_All response– class level.....                                   | 224 |

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|   |     |
|---|-----|
| Table 142 – Get_Attributes_All response– instance level .....                               | 224 |
| Table 143 – Revision history .....  | 225 |
| Table 144 – Class attributes .....  | 225 |
| Table 145 – Instance attributes .....   | 226 |
| Table 146 – Node Type .....   | 229 |
| Table 147 – Switching Node .....  | 230 |
| Table 148 – HSR Mode .....  | 230 |
| Table 149 – RedBox ID .....   | 231 |
| Table 150 – PRP/HSR Protocol object common services .....                                   | 232 |
| Table 151 – Get_Attributes_All response .....   | 233 |
| Table 152 – Revision history .....  | 234 |
| Table 153 – Class attributes .....  | 234 |
| Table 154 – Instance attributes .....   | 235 |
| Table 155 – Remote Node Type .....  | 236 |
| Table 156 – PRP/HSR Nodes Tables object common services .....                               | 237 |
| Table 157 – Get_Attributes_All response .....   | 237 |
| Table 158 – NAM states .....  | 238 |
| Table 159 – Default link parameters .....   | 239 |
| Table 160 – PhL timing characteristics .....  | 246 |
| Table 161 – DLR variables .....   | 302 |
| Table 162 – DLR Link speed and duplex requirements .....                                    | 308 |
| Table 163 – Redundant gateway variables .....   | 315 |
| Table 164 – MAC addresses for DLR messages .....  | 318 |
| Table 165 – IEEE 802.1Q common frame header format .....                                    | 318 |
| Table 166 –DLR message payload fields .....   | 318 |
| Table 167 – DLR frame types .....   | 319 |
| Table 168 – Format of the Beacon frame .....  | 319 |
| Table 169 – Ring State values .....   | 319 |
| Table 170 – Format of the Neighbor_Check request .....                                      | 320 |
| Table 171 – Format of the Neighbor_Check response .....                                     | 320 |
| Table 172 – Format of the Link_Status/Neighbor_Status frame .....                           | 320 |
| Table 173 – Link/Neighbor status values .....   | 321 |
| Table 174 – Format of the Locate_Fault frame .....  | 321 |
| Table 175 – Format of the Announce frame .....  | 321 |
| Table 176 – Format of the Sign_On frame .....   | 322 |
| Table 177 – Format of the Advertise frame .....   | 322 |
| Table 178 – Gateway state values .....  | 322 |
| Table 179 – Format of the Flush_Tables frame .....  | 323 |
| Table 180 – Format of the Learning_Update frame .....                                       | 323 |
| Table 181 – Parameter values for Beacon frame based non-supervisor ring node .....          | 324 |
| Table 182 – LastBcnRcvPort bit definitions .....  | 325 |
| Table 183 – State-event-action matrix for Beacon frame based non-supervisor ring node ..... | 325 |

This is a preview of "BS EN IEC 61158-4-2:....". [Click here to purchase the full version from the ANSI store.](#)

|   |     |
|---|-----|
| Table 184 – Parameter values for Announce frame based non-supervisor ring node .....          | 331 |
| Table 185 – State-event-action matrix for Announce frame based non-supervisor ring node ..... | 332 |
| Table 186 – Parameter values for ring supervisor node .....                                   | 336 |
| Table 187 – LastBcnRcvPort bit definitions .....  | 337 |
| Table 188 – State-event-action matrix for ring supervisor node .....                          | 337 |
| Table 189 – Parameter values for redundant gateway node .....                                 | 350 |
| Table 190 – State-event-action matrix for redundant gateway node .....                        | 352 |
| Table 191 – Parameters/assumptions for example performance calculations .....                 | 354 |
| Table 192 – Example ring configuration parameters and performance .....                       | 358 |
| Table 193 – Variables for performance analysis .....  | 358 |
| Table A.1 – Module status indicator .....   | 365 |
| Table A.2 – Time Sync status indication .....   | 366 |
| Table A.3 – Network status indicators .....   | 368 |
| Table A.4 – Network status indicator .....  | 372 |
| Table A.5 – Network status indicator .....  | 375 |
| Table A.6 – Combined module/network status indicator .....                                    | 376 |
| Table A.7 – I/O status indicator .....  | 377 |
| Table A.8 – Bit rate switch encoding .....  | 379 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
FIELDBUS SPECIFICATIONS –**

**Part 4-2: Data-link layer protocol specification –  
Type 2 elements**

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

International Standard IEC 61158-4-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

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

- clarifications of ControlNet object in 7.2;
- extensions and clarifications of TCP/IP interface object in 7.5;
- extensions and clarifications of Ethernet Link object in 7.6;
- clarifications of DeviceNet object in 7.7;
- extensions and clarifications of CCO object in 7.8;
- extensions and clarifications of DLR object in 7.9;
- extensions and clarifications of Port object in 7.11;
- addition of PRP/HSR Protocol and PRP/HSR Nodes Table objects in 7.12 and 7.13;
- extensions and clarifications of DLR protocol in Clause 10;
- addition of PRP/HSR protocol mapping in Clause 11;
- update of indicator behaviour in A.2.2 and A.2.4;
- 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.

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

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## 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 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 implementers 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.

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 given in several subclauses as indicated in the table below. These patents are held by their respective inventors under license to ODVA, Inc:

|              |        |  |                                  |
|--------------|--------|--|----------------------------------|
| US 5,400,331 | [ODVA] | Communication network interface with screeners for incoming messages                                   | Subclause 3.4,<br>Clauses 4 to 9 |
| US 5,471,461 | [ODVA] | Digital communication network with a moderator station election process                                |                                  |
| US 5,491,531 | [ODVA] | Media access controller with a shared class message delivery capability                                |                                  |
| US 5,493,571 | [ODVA] | Apparatus and method for digital communications with improved delimiter detection                      |                                  |
| US 5,537,549 | [ODVA] | Communication network with time coordinated station activity by time slot and periodic interval number |                                  |
| US 5,553,095 | [ODVA] | Method and apparatus for exchanging different classes of data during different time intervals          |                                  |
| US 8,244,838 | [ODVA] | Industrial controller employing the network ring topology  | Clause 10                        |

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2370 East Stadium Boulevard #1000  
Ann Arbor, Michigan 48104  
USA  
Attention: Office of the Executive Director  
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## **INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –**

### **Part 4-2: Data-link layer protocol specification – Type 2 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, sequentially and in a cyclic synchronous manner. Foreground scheduled access is available for time-critical activities together with background unscheduled access for less critical activities.

Deterministic and synchronized transfers can be provided at cyclic intervals up to 1 ms and device separations of 25 km. This performance is adjustable dynamically and on-line by re-configuring the parameters of the local link whilst normal operation continues. By similar means, DL connections and new devices may be added or removed during normal operation.

This protocol provides means to maintain clock synchronization across an extended link with a precision better than 10  $\mu$ s.

This protocol optimizes each access opportunity by concatenating multiple DLSDUs and associated DLPCI into a single DLPDU, thereby improving data transfer efficiency for data-link entities that actively source multiple streams of data.

The maximum system size is an unlimited number of links of 99 nodes, each with 255 DLSAP-addresses. Each link has a maximum of  $2^{24}$  related peer and publisher DLCEPs.

##### **1.2 Specifications**

This document 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) the structure of the fieldbus 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 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.