

# INTERNATIONAL STANDARD



Industrial communication networks – Fieldbus specifications –  
Part 6-10: Application layer protocol specification – Type 10 elements  
(standards.iteh.ai)

IEC 61158-6-10:2019

<https://standards.iteh.ai/catalog/standards/sist/60d75a62-a5f8-4b60-ab4b-a48627903ec0/iec-61158-6-10-2019>



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2019 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

**About the IEC**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

**IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)**

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

**IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)**

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

[IEC 61158-6-10:2019](https://standards.iec.ch/)

<https://standards.iec.ch/catalog/standards/sis/60d75a62-a5f8-4b60-ab4b-a48627903ec0/iec-61158-6-10-2019>

# INTERNATIONAL STANDARD



---

**Industrial communication networks – Fieldbus specifications –  
Part 6-10: Application layer protocol specification – Type 10 elements**

IEC 61158-6-10:2019  
<https://standards.iteh.ai/catalog/standards/sist/60d75a62-a5f8-4b60-ab4b-a48627903ec0/iec-61158-6-10-2019>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-7010-3

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

|  |     |
|--|-----|
| FOREWORD.....  | 37  |
| INTRODUCTION.....  | 39  |
| 1 Scope.....   | 41  |
| 1.1 General.....   | 41  |
| 1.2 Specifications .....   | 41  |
| 1.3 Conformance .....  | 41  |
| 2 Normative references .....   | 42  |
| 3 Terms, definitions, abbreviated terms, symbols and conventions ..... | 45  |
| 3.1 Referenced terms and definitions.....                              | 45  |
| 3.1.1 ISO/IEC 7498-1 terms.....  | 45  |
| 3.1.2 ISO/IEC 8822 terms.....  | 45  |
| 3.1.3 ISO/IEC 8824-1 terms.....  | 45  |
| 3.1.4 ISO/IEC 9545 terms.....  | 45  |
| 3.2 Terms and definitions for decentralized periphery .....            | 46  |
| 3.3 Abbreviated terms and symbols .....                                | 54  |
| 3.3.1 Abbreviated terms and symbols for media redundancy .....         | 54  |
| 3.3.2 Abbreviated terms and symbols for decentralized periphery.....   | 54  |
| 3.3.3 Abbreviated terms and symbols for services.....                  | 58  |
| 3.3.4 Abbreviated terms and symbols for IEEE 802.1Q.....               | 58  |
| 3.3.5 Abbreviated terms and symbols for IETF RFC 2474.....             | 58  |
| 3.3.6 Abbreviated terms and symbols for IETF RFC 4291.....             | 58  |
| 3.4 Conventions.....   | 58  |
| 3.4.1 General concept.....   | 58  |
| 3.4.2 Conventions for decentralized periphery.....                     | 58  |
| 3.4.3 Conventions used in state machines.....                          | 67  |
| 4 Application layer protocol specification for common protocols.....   | 72  |
| 4.1 FAL syntax description.....  | 72  |
| 4.1.1 DLPDU abstract syntax reference .....                            | 72  |
| 4.1.2 Data types .....   | 74  |
| 4.2 Transfer syntax.....   | 75  |
| 4.2.1 Coding of basic data types .....                                 | 75  |
| 4.2.2 Coding section related to common basic fields .....              | 83  |
| 4.3 Discovery and basic configuration.....                             | 94  |
| 4.3.1 DCP syntax description .....                                     | 94  |
| 4.3.2 DCP protocol state machines.....                                 | 122 |
| 4.3.3 DLL Mapping Protocol Machines.....                               | 139 |
| 4.4 Precision working time control .....                               | 140 |
| 4.4.1 FAL syntax description .....                                     | 140 |
| 4.4.2 AP-Context state machine .....                                   | 151 |
| 4.4.3 FAL Service Protocol Machines .....                              | 151 |
| 4.4.4 Application Relationship Protocol Machines.....                  | 152 |
| 4.4.5 DLL Mapping Protocol Machines.....                               | 215 |
| 4.5 Time synchronization .....   | 215 |
| 4.5.1 General .....  | 215 |
| 4.5.2 GlobalTime .....   | 216 |
| 4.5.3 WorkingClock .....   | 216 |
| 4.6 Media redundancy .....   | 217 |

|        |   |     |
|--------|---|-----|
| 4.6.1  | Media redundancy and loop prevention.....       | 217 |
| 4.6.2  | Seamless media redundancy .....                 | 220 |
| 4.7    | Real time cyclic.....                           | 220 |
| 4.7.1  | FAL syntax description .....                    | 220 |
| 4.7.2  | FAL transfer syntax .....                       | 221 |
| 4.7.3  | FAL Service Protocol Machines .....             | 231 |
| 4.7.4  | Application Relationship Protocol Machines..... | 231 |
| 4.7.5  | DLL Mapping Protocol Machines.....              | 249 |
| 4.8    | Real time acyclic.....                          | 249 |
| 4.8.1  | RTA syntax description .....                    | 249 |
| 4.8.2  | RTA transfer syntax.....                        | 250 |
| 4.8.3  | FAL Service Protocol Machines .....             | 254 |
| 4.8.4  | Application Relationship Protocol Machines..... | 254 |
| 4.8.5  | DLL Mapping Protocol Machines.....              | 269 |
| 4.9    | Fragmentation.....                              | 269 |
| 4.9.1  | General .....                                   | 269 |
| 4.9.2  | FRAG syntax description .....                   | 272 |
| 4.9.3  | FRAG transfer syntax .....                      | 273 |
| 4.9.4  | FAL Service Protocol Machines .....             | 275 |
| 4.9.5  | Application Relationship Protocol Machines..... | 275 |
| 4.9.6  | DLL Mapping Protocol Machines.....              | 275 |
| 4.10   | Remote procedure call .....                     | 286 |
| 4.10.1 | General .....                                   | 286 |
| 4.10.2 | RPC syntax description .....                    | 286 |
| 4.10.3 | RPC Transfer syntax .....                       | 288 |
| 4.10.4 | FAL Service Protocol Machines.....              | 304 |
| 4.10.5 | Application Relationship Protocol Machines..... | 304 |
| 4.10.6 | DLL Mapping Protocol Machines.....              | 305 |
| 4.11   | Link layer discovery .....                      | 305 |
| 4.11.1 | General .....                                   | 305 |
| 4.11.2 | FAL common syntax description .....             | 305 |
| 4.11.3 | LLDP transfer syntax .....                      | 307 |
| 4.11.4 | FAL Service Protocol Machines .....             | 317 |
| 4.11.5 | Application Relation Protocol Machines .....    | 317 |
| 4.11.6 | DLL Mapping Protocol Machines.....              | 317 |
| 4.12   | Bridges and End Stations.....                   | 317 |
| 4.12.1 | General .....                                   | 317 |
| 4.12.2 | Model .....                                     | 318 |
| 4.12.3 | Traffic Shaping .....                           | 333 |
| 4.12.4 | Bridge extensions .....                         | 334 |
| 4.12.5 | QueueHandler .....                              | 335 |
| 4.12.6 | FAL Service Protocol Machines .....             | 335 |
| 4.12.7 | Application Relation Protocol Machines .....    | 335 |
| 4.12.8 | DLL Mapping Protocol Machines.....              | 335 |
| 4.13   | IP suite .....                                  | 374 |
| 4.13.1 | Overview .....                                  | 374 |
| 4.13.2 | IP/UDP syntax description .....                 | 374 |
| 4.13.3 | IP/UDP transfer syntax .....                    | 375 |
| 4.13.4 | ARP.....  | 378 |

|        |   |     |
|--------|---|-----|
| 4.14   | Domain name system.....   | 380 |
| 4.14.1 | General .....   | 380 |
| 4.14.2 | Primitive definitions .....   | 380 |
| 4.14.3 | DNS state transition diagram .....  | 381 |
| 4.14.4 | State machine description .....   | 381 |
| 4.14.5 | DNS state table .....   | 381 |
| 4.14.6 | Functions, Macros, Timers and Variables .....                             | 381 |
| 4.15   | Dynamic host configuration .....  | 381 |
| 4.15.1 | General .....   | 381 |
| 4.15.2 | Primitive definitions .....   | 382 |
| 4.15.3 | DHCP state transition diagram.....  | 382 |
| 4.15.4 | State machine description .....   | 382 |
| 4.15.5 | DHCP state table .....  | 382 |
| 4.15.6 | Functions, Macros, Timers and Variables .....                             | 382 |
| 4.16   | Simple network management .....   | 383 |
| 4.16.1 | Overview .....  | 383 |
| 4.16.2 | IETF RFC 1213-MIB .....   | 383 |
| 4.16.3 | Enterprise number for PNIO MIB .....                                      | 383 |
| 4.16.4 | MIB cross reference .....   | 384 |
| 4.16.5 | Behavior in case of modular built bridges .....                           | 384 |
| 4.16.6 | LLDP EXT MIB .....  | 384 |
| 4.17   | Common DLL Mapping Protocol Machines.....                                 | 384 |
| 4.17.1 | Overview .....  | 384 |
| 4.17.2 | Data Link Layer Mapping Protocol Machine .....                            | 385 |
| 4.18   | Additional definitions.....   | 390 |
| 5      | Application layer protocol specification for decentralized periphery..... | 390 |
| 5.1    | FAL syntax description.....   | 390 |
| 5.1.1  | DLPDU abstract syntax reference .....                                     | 390 |
| 5.1.2  | APDU abstract syntax.....   | 390 |
| 5.2    | Transfer syntax.....  | 409 |
| 5.2.1  | Coding section related to BlockHeader specific fields .....               | 409 |
| 5.2.2  | Coding section related to RTA-SDU specific fields.....                    | 424 |
| 5.2.3  | Coding section related to common address fields .....                     | 429 |
| 5.2.4  | Coding section related to AL services .....                               | 445 |
| 5.2.5  | Coding section related to ARVendorBlock.....                              | 479 |
| 5.2.6  | Coding section related to PNIOStatus.....                                 | 481 |
| 5.2.7  | Coding section related to I&M Records .....                               | 498 |
| 5.2.8  | Coding section related to Alarm and Diagnosis PDUs .....                  | 505 |
| 5.2.9  | Coding section related to upload and retrieval .....                      | 527 |
| 5.2.10 | Coding section related to iParameter .....                                | 527 |
| 5.2.11 | Coding section related to Physical Device Interface Data .....            | 528 |
| 5.2.12 | Coding section related to Physical Device Port Data.....                  | 528 |
| 5.2.13 | Coding section related to Physical Device IR Data.....                    | 531 |
| 5.2.14 | Coding section related to Physical Sync Data .....                        | 554 |
| 5.2.15 | Coding section related to Isochrone Mode Data .....                       | 559 |
| 5.2.16 | Coding section related to Physical Time Data .....                        | 561 |
| 5.2.17 | Coding section related to Media Redundancy .....                          | 564 |
| 5.2.18 | Coding section related to fiber optics .....                              | 575 |
| 5.2.19 | Coding section related to network components .....                        | 577 |

ITD STANDARD PREVIEW

(standards.iteh.ai)

IEC 61158-6-10:2019

<https://standards.iteh.ai/catalog/standards/sist/60d75a62-a5f8-4b60-ab4b-44827905c00c/iec-61158-6-10-2019>

|         |  |     |
|---------|--|-----|
| 5.2.20  | Coding section related port statistic .....  | 578 |
| 5.2.21  | Coding section related to fast startup.....  | 581 |
| 5.2.22  | Coding section related to DFP .....  | 583 |
| 5.2.23  | Coding section related to MRPD .....   | 587 |
| 5.2.24  | Coding section related to auto configuration .....                                 | 588 |
| 5.2.25  | Coding section related to controller to controller communication.....              | 591 |
| 5.2.26  | Coding section related to system redundancy .....                                  | 592 |
| 5.2.27  | Coding section related to energy saving .....                                      | 595 |
| 5.2.28  | Coding section related to asset management.....                                    | 595 |
| 5.2.29  | Coding section related to reporting system .....                                   | 600 |
| 5.2.30  | Coding section related to Logbook.....   | 606 |
| 5.2.31  | Coding section related to Time .....   | 607 |
| 5.2.32  | Coding section related to Channel Related Process Alarm Reason.....                | 607 |
| 5.2.33  | PDU checking rules .....   | 610 |
| 5.3     | FAL protocol state machines.....   | 643 |
| 5.3.1   | Overall structure .....  | 643 |
| 5.4     | AP-Context state machine.....  | 645 |
| 5.5     | FAL Service Protocol Machines .....  | 645 |
| 5.5.1   | Overview .....   | 645 |
| 5.5.2   | FAL Service Protocol Machine Device .....  | 645 |
| 5.5.3   | FAL Service Protocol Machine Controller .....                                      | 654 |
| 5.6     | Application Relationship Protocol Machines .....                                   | 665 |
| 5.6.1   | Alarm Protocol Machine Initiator .....   | 665 |
| 5.6.2   | Alarm Protocol Machine Responder .....   | 669 |
| 5.6.3   | Device .....   | 673 |
| 5.6.4   | Controller .....   | 756 |
| 5.7     | DLL Mapping Protocol Machines.....   | 818 |
| Annex A | (normative) Unified establishing of an AR for all RT classes .....                 | 819 |
| A.1     | General.....   | 819 |
| A.2     | AR establishing.....   | 820 |
| A.3     | Startup of Alarm transmitter and receiver .....                                    | 825 |
| Annex B | (normative) Compatible establishing of an AR.....                                  | 828 |
| Annex C | (informative) Establishing of a device access AR.....                              | 831 |
| Annex D | (informative) Establishing of an AR (accelerated procedure).....                   | 832 |
| Annex E | (informative) Establishing of an AR (fast startup procedure).....                  | 835 |
| Annex F | (informative) Example of the upload, storage and retrieval procedure .....         | 837 |
| Annex G | (informative) OSI reference model layers.....                                      | 839 |
| Annex H | (informative) Overview of the IO controller and the IO device state machines ..... | 840 |
| Annex I | (informative) Priority regeneration .....  | 842 |
| Annex J | (informative) Overview of the PTCIP synchronization master hierarchy .....         | 843 |
| Annex K | (informative) Optimization of bandwidth usage.....                                 | 845 |
| Annex L | (informative) Time constraints for bandwidth allocation .....                      | 847 |
| Annex M | (informative) Time constraints for the forwarding of a frame .....                 | 849 |
| M.1     | Principle .....  | 849 |
| M.2     | Forwarding.....  | 849 |
| Annex N | (informative) Principle of dynamic frame packing .....                             | 851 |
| Annex O | (informative) Principle of Fragmentation .....                                     | 855 |

Annex P (informative) MRPD – Principle of seamless media redundancy ..... 858

Annex Q (normative) Principle of a RED\_RELAY without forwarding information in PDIRFrameData ..... 860

Annex R (informative) Optimization for fast startup without autonegotiation ..... 863

Annex S (informative) Example of a PrmBegin, PrmEnd and ApplRdy sequence ..... 866

Annex T (informative) List of supported MIBs ..... 867

Annex U (informative) Structure and content of BLOB ..... 868

Annex V (normative) LLDP EXT MIB ..... 869

Annex W (normative) Cross reference to the IEC 62439-2 ..... 887

    W.1 Cross reference to the IEC 62439-2 ..... 887

        W.1.1 General ..... 887

        W.1.2 Ring ..... 887

        W.1.3 Interconnection ..... 888

Annex X (normative) Maintaining statistic counters for Ethernet ..... 890

    X.1 General ..... 890

    X.2 Counting model ..... 890

    X.3 Explanation of the IETF RFC defined statistic counters ..... 892

    X.4 Value range of the IETF RFC defined statistic counters ..... 893

Bibliography ..... 894

**iTeh STANDARD PREVIEW**

Figure 1 – Common structure of specific fields for octet 1 (high) ..... 60

Figure 2 – Common structure of specific fields for octet 2 ..... 60

Figure 3 – Common structure of specific fields for octet 3 ..... 60

Figure 4 – Common structure of specific fields for octet 4 ..... 61

Figure 5 – Common structure of specific fields for octet 5 ..... 61

Figure 6 – Common structure of specific fields for octet 6 ..... 61

Figure 7 – Common structure of specific fields for octet 7 ..... 62

Figure 8 – Common structure of specific fields for octet 8 ..... 62

Figure 9 – Common structure of specific fields for octet 9 ..... 62

Figure 10 – Common structure of specific fields for octet 10 ..... 63

Figure 11 – Common structure of specific fields for octet 11 ..... 63

Figure 12 – Common structure of specific fields for octet 12 ..... 63

Figure 13 – Common structure of specific fields for octet 13 ..... 64

Figure 14 – Common structure of specific fields for octet 14 ..... 64

Figure 15 – Common structure of specific fields for octet 15 ..... 64

Figure 16 – Common structure of specific fields for octet 16 (low) ..... 65

Figure 17 – Coding of the data type BinaryDate ..... 77

Figure 18 – Encoding of TimeOfDay with date indication value ..... 77

Figure 19 – Encoding of TimeOfDay without date indication value ..... 78

Figure 20 – Encoding of TimeDifference with date indication value ..... 78

Figure 21 – Encoding of TimeDifference without date indication value ..... 78

Figure 22 – Encoding of a NetworkTime value ..... 79

Figure 23 – Encoding of NetworkTimeDifference value ..... 79

Figure 24 – Encoding of TimeStamp value ..... 80



|   |     |
|---|-----|
| Figure 25 – Encoding of TimeStampDifference value .....                       | 81  |
| Figure 26 – Encoding of TimeStampDifferenceShort value.....                   | 82  |
| Figure 27 – FastForwardingMulticastMACAdd.....                                | 88  |
| Figure 28 – State transition diagram of DCPUCS .....                          | 123 |
| Figure 29 – State transition diagram of DCPUCR.....                           | 127 |
| Figure 30 – State transition diagram of DCPMCS.....                           | 131 |
| Figure 31 – State transition diagram of DCPMCR .....                          | 134 |
| Figure 32 – State transition diagram of DCPHMCS .....                         | 137 |
| Figure 33 – State transition diagram of DCPHMCR.....                          | 139 |
| Figure 34 – PTCP_SequenceID value range .....                                 | 144 |
| Figure 35 – Timescale correspondence between PTCP_Time and CycleCounter ..... | 147 |
| Figure 36 – Message timestamp point.....                                      | 152 |
| Figure 37 – Timer model.....  | 152 |
| Figure 38 – Four message timestamps .....                                     | 153 |
| Figure 39 – Line delay protocol with follow up.....                           | 154 |
| Figure 40 – Line delay protocol without follow up.....                        | 154 |
| Figure 41 – Line delay measurement .....                                      | 156 |
| Figure 42 – Model parameter for GSDML usage.....                              | 158 |
| Figure 43 – Bridge delay measurement.....                                     | 159 |
| Figure 44 – Delay accumulation.....   | 160 |
| Figure 45 – Worst case accumulated time deviation of synchronization .....    | 161 |
| Figure 46 – Signal generation for measurement of deviation.....               | 161 |
| Figure 47 – Measurement of deviation.....                                     | 162 |
| Figure 48 – PTCP master sending Sync-Frame without Follow Up-Frame .....      | 163 |
| Figure 49 – PTCP master sending Sync-Frame with FollowUp-Frame.....           | 163 |
| Figure 50 – !FU Sync Slave Forwarding Sync-Frame .....                        | 164 |
| Figure 51 – FU Sync Slave Forwarding Sync- and FollowUp-Frame.....            | 165 |
| Figure 52 – FU Sync Slave Forwarding Sync- and Generating FollowUp-Frame..... | 166 |
| Figure 53 – Principle of the monitoring of the line delay measurement.....    | 167 |
| Figure 54 – State transition diagram of DELAY_REQ.....                        | 169 |
| Figure 55 – State transition diagram of DELAY_RSP .....                       | 177 |
| Figure 56 – Overview of PTCP.....   | 181 |
| Figure 57 – State transition diagram of SYN_BMA.....                          | 184 |
| Figure 58 – State transition diagram of SYN_MPSM .....                        | 193 |
| Figure 59 – State transition diagram of SYN_SPSM.....                         | 199 |
| Figure 60 – State transition diagram of SYNC_RELAY.....                       | 206 |
| Figure 61 – State transition diagram of SCHEDULER .....                       | 212 |
| Figure 62 – GlobalTime timer model .....                                      | 216 |
| Figure 63 – WorkingClock timer model.....                                     | 217 |
| Figure 64 – Media redundancy – Ring.....                                      | 217 |
| Figure 65 – Media redundancy – Interconnection.....                           | 219 |
| Figure 66 – CycleCounter value range .....                                    | 222 |
| Figure 67 – Structure of the CycleCounter .....                               | 223 |

|   |     |
|---|-----|
| Figure 68 – Optimized CycleCounter setting .....                                | 224 |
| Figure 69 – SFCRC16 generation rule .....                                       | 228 |
| Figure 70 – SFCycleCounter value range.....                                     | 229 |
| Figure 71 – Basic structure of a PPM with frame structure .....                 | 232 |
| Figure 72 – Basic structure of a PPM with subframe structure.....               | 233 |
| Figure 73 – State transition diagram of PPM.....                                | 235 |
| Figure 74 – Basic structure of a CPM.....                                       | 239 |
| Figure 75 – State transition diagram of CPM.....                                | 241 |
| Figure 76 – Addressing scheme of RTA.....                                       | 251 |
| Figure 77 – Structure of the APM.....   | 255 |
| Figure 78 – Structure of the APMS.....  | 256 |
| Figure 79 – State transition diagram of APMS.....                               | 258 |
| Figure 80 – Structure of the APMR .....   | 263 |
| Figure 81 – State transition diagram of APMR .....                              | 265 |
| Figure 82 – State transition diagram of FRAG_D .....                            | 276 |
| Figure 83 – State transition diagram of FRAG_S.....                             | 280 |
| Figure 84 – State transition diagram of DEFRAG .....                            | 283 |
| Figure 85 – DLL Mapping Protocol Machines (DMPM).....                           | 317 |
| Figure 86 – Principle traffic flow model of a bridge.....                       | 322 |
| Figure 87 – Principle resource model of a bridge.....                           | 323 |
| Figure 88 – End station – on port bridge – transmit.....                        | 328 |
| Figure 89 – End station – on port bridge – receive.....                         | 329 |
| Figure 90 – Bridge with End Station.....  | 330 |
| Figure 91 – Transmit – one port of a bridge .....                               | 330 |
| Figure 92 – Forwarding process – bridge .....                                   | 331 |
| Figure 93 – Receive – on port of a bridge .....                                 | 331 |
| Figure 94 – Transmit – Management port.....                                     | 332 |
| Figure 95 – Receive – Management port.....                                      | 333 |
| Figure 96 – State transition diagram of RTC3PSM .....                           | 339 |
| Figure 97 – State transition diagram for generating events .....                | 343 |
| Figure 98 – State transition diagram of RED_RELAY .....                         | 345 |
| Figure 99 – Scheme of the DFP_RELAY .....                                       | 349 |
| Figure 100 – Scheme of the DFP_RELAY_INBOUND and DFP_RELAY_IN_STORAGE .....     | 349 |
| Figure 101 – Scheme of the DFP_RELAY_OUTBOUND.....                              | 350 |
| Figure 102 – State transition diagram of DFP_RELAY .....                        | 351 |
| Figure 103 – State transition diagram of DFP_RELAY_INBOUND .....                | 354 |
| Figure 104 – State transition diagram of DFP_RELAY_IN_STORAGE.....              | 358 |
| Figure 105 – State transition diagram of DFP_RELAY_OUTBOUND .....               | 362 |
| Figure 106 – State transition diagram of MUX.....                               | 366 |
| Figure 107 – State transition diagram of DEMUX .....                            | 371 |
| Figure 108 – State transition diagram of ACCM .....                             | 379 |
| Figure 109 – Structuring of the protocol machines within the DMPM (bridge)..... | 385 |
| Figure 110 – State transition diagram of LMPM.....                              | 388 |

ITeH STANDARD PREVIEW  
(standards.iteh.ai)

IEC 61158-6-10:2019  
<https://standards.iteh.ai/catalog/standards/sist/60d75a62-a5f8-4b60-ab4b-4d627903cc04/iec-61158-6-10-2019>

|   |     |
|---|-----|
| Figure 111 – AlarmSpecifier.SequenceNumber value range .....                          | 427 |
| Figure 112 – FrameSendOffset vs. duration of a cycle .....                            | 472 |
| Figure 113 – Severity classification of fault, maintenance and normal .....           | 526 |
| Figure 114 – Calculation principle for a cycle .....                                  | 548 |
| Figure 115 – Calculation principle for the minimum YellowTime .....                   | 549 |
| Figure 116 – Definition of the reserved interval .....                                | 556 |
| Figure 117 – Toplevel view to the PLL window .....                                    | 559 |
| Figure 118 – Definition of PLL window .....   | 559 |
| Figure 119 – Toplevel view to the time PLL window .....                               | 562 |
| Figure 120 – Definition of time PLL window .....                                      | 563 |
| Figure 121 – Detection of dropped frames – appear .....                               | 578 |
| Figure 122 – Detection of dropped frames – disappear .....                            | 578 |
| Figure 123 – Detection of DFP late error – appear and disappear .....                 | 586 |
| Figure 124 – MediaRedundancyWatchDog expired – appear and disappear .....             | 588 |
| Figure 125 – EndPoint1 and Endpoint2 scheme – above and below .....                   | 593 |
| Figure 126 – EndPoint1 and Endpoint2 scheme – left and right .....                    | 593 |
| Figure 127 – Relationship among Protocol Machines .....                               | 643 |
| Figure 128 – State transition diagram of ALPMI .....                                  | 666 |
| Figure 129 – State transition diagram of ALPMR .....                                  | 670 |
| Figure 130 – Scheme of the IO device CM .....   | 674 |
| Figure 131 – State transition diagram of the IO device CM .....                       | 676 |
| Figure 132 – State transition diagram of CMDEV .....                                  | 680 |
| Figure 133 – Scheme of the IO device CM – device access .....                         | 685 |
| Figure 134 – State transition diagram of CMDEV_DA .....                               | 687 |
| Figure 135 – State transition diagram of CMSU .....                                   | 691 |
| Figure 136 – State transition diagram of CMIO .....                                   | 696 |
| Figure 137 – State transition diagram of CMRS .....                                   | 699 |
| Figure 138 – State transition diagram of CMWRR .....                                  | 702 |
| Figure 139 – State transition diagram of CMRDR .....                                  | 707 |
| Figure 140 – State transition diagram of CMSM .....                                   | 709 |
| Figure 141 – State transition diagram of CMPBE .....                                  | 713 |
| Figure 142 – State transition diagram of CMDMC .....                                  | 718 |
| Figure 143 – State transition diagram of CMINA .....                                  | 723 |
| Figure 144 – State transition diagram of CMRPC .....                                  | 734 |
| Figure 145 – Intersection and residual amount using different ARUUIID.ConfigIDs ..... | 740 |
| Figure 146 – Intersection and removed amount using different ARUUIID.ConfigIDs .....  | 741 |
| Figure 147 – State transition diagram of CMSRL .....                                  | 742 |
| Figure 148 – Single Input and single Output buffer of CMSRL .....                     | 748 |
| Figure 149 – Dynamic reconfiguration with CMSRL .....                                 | 749 |
| Figure 150 – Alarm queue management of CMSRL .....                                    | 750 |
| Figure 151 – Reporting System management of CMSRL .....                               | 751 |
| Figure 152 – Primary: Switchover time between two ARs of an ARset .....               | 751 |
| Figure 153 – Backup: Switchover time between two ARs of an ARset .....                | 752 |

Figure 154 – State transition diagram of CMSRL\_AL ..... 754

Figure 155 – Scheme of the IO controller CM ..... 757

Figure 156 – State transition diagram of the IO controller CM ..... 758

Figure 157 – State transition diagram of CMCTL..... 762

Figure 158 – State transition diagram of CTLSM..... 769

Figure 159 – State transition diagram of CTLIO ..... 771

Figure 160 – State transition diagram of CTRLDI ..... 775

Figure 161 – State transition diagram of CTRLDR..... 778

Figure 162 – State transition diagram of CTRLRPC..... 782

Figure 163 – State transition diagram of CTLSU ..... 787

Figure 164 – State transition diagram of CTLWRI ..... 792

Figure 165 – State transition diagram of CTLWRR..... 796

Figure 166 – State transition diagram of CTLPBE ..... 799

Figure 167 – State transition diagram of CTLDINA..... 805

Figure 168 – Automatic NameOfStation assignment..... 810

Figure 169 – State transition diagram of CTLSRL ..... 812

Figure 170 – Input and Output buffer of CTLSRL ..... 816

Figure 171 – Input and Output buffer with dynamic reconfiguration ..... 816

Figure 172 – Alarm queue management of CTLSRL..... 817

Figure 173 – Alarm queue management with dynamic reconfiguration ..... 818

Figure A.1 – Establishing of an AR using RT\_CLASS\_1, RT\_CLASS\_2 or RT\_CLASS\_3 (Initial connection monitoring w/o RT) ..... 820

Figure A.2 – Establishing of an AR using RT\_CLASS\_1, RT\_CLASS\_2 or RT\_CLASS\_3 (Connection monitoring with RT) ..... 821

Figure A.3 – Principle of the data evaluation during startup (delayed RED channel establishment) ..... 822

Figure A.4 – Principle of the data evaluation during startup (immediate RED channel establishment) ..... 823

Figure A.5 – Principle of the data evaluation during startup (Special case: Isochronous mode application) ..... 824

Figure A.6 – Startup of Alarm transmitter and receiver without System Redundancy..... 825

Figure A.7 – Startup of Alarm transmitter and receiver with System Redundancy..... 826

Figure A.8 – Startup of Alarm transmitter and receiver during a PrmBegin / PrmEnd / ApplRdy sequence ..... 827

Figure B.1 – Establishing of an AR using RT\_CLASS\_3 AR with startup mode “Legacy” ..... 829

Figure B.2 – Establishing of an AR using RT\_CLASS\_1, 2 or UDP AR with startup mode “Legacy” ..... 830

Figure C.1 – Establishing of a device access AR ..... 831

Figure D.1 – Accelerated establishing of an IOAR without error ..... 833

Figure D.2 – Accelerated establishing of an IOAR with “late” error ..... 834

Figure E.1 – Establishing of an IOAR using fast startup ..... 836

Figure F.1 – Example of upload with storage ..... 837

Figure F.2 – Example of retrieval with storage ..... 838

Figure G.1 – Assignment of the OSI reference model layers ..... 839

Figure H.1 – Overview of the IO controller state machines ..... 840

iteh STANDARD PREVIEW  
(standardsiteh)

<https://standards.iteh.ai/catalog/standards/sist/60d75a62-a5f8-4b60-ab4b-a48627983ecb/iec-61158-6-10-2019>

|  |     |
|--|-----|
| Figure H.2 – Overview of the IO device state machines .....  | 840 |
| Figure J.1 – Level model for synchronization master hierarchy .....  | 843 |
| Figure J.2 – Two level variant of the synchronization master hierarchy .....   | 844 |
| Figure K.1 – Devices build up in a linear structure .....  | 845 |
| Figure K.2 – Propagation of frames in linear transmit direction .....  | 845 |
| Figure K.3 – Propagation of a frames in receive direction .....  | 846 |
| Figure L.1 – Overview of time constraints for bandwidth allocation.....  | 847 |
| Figure L.2 – Calculation of the length of a RED period.....  | 847 |
| Figure L.3 – Calculation of the length of a GREEN period.....  | 848 |
| Figure M.1 – IEEE 802.3 definition.....  | 849 |
| Figure M.2 – Minimization of bridge delay.....   | 849 |
| Figure N.1 – Dynamic frame packing .....   | 851 |
| Figure N.2 – Dynamic frame packing – truncation of outputs.....  | 852 |
| Figure N.3 – Dynamic frame packing – concatenation of inputs.....  | 852 |
| Figure N.4 – End node mode .....   | 853 |
| Figure N.5 – DFPPFeed definition.....  | 853 |
| Figure O.1 – Principle of fragmentation.....   | 855 |
| Figure O.2 – Protocol elements of fragments .....  | 855 |
| Figure O.3 – Bandwidth allocation using fragmentation.....   | 856 |
| Figure O.4 – Guardian for a fragmentation domain.....  | 856 |
| Figure P.1 – Principle of seamless media redundancy – I/OCR.....   | 858 |
| Figure P.2 – Principle of seamless media redundancy – MCR.....   | 859 |
| Figure P.3 – Principle of seamless media redundancy – Line.....  | 859 |
| Figure Q.1 – Generating the FrameSendOffset for a RED_RELAY without forwarding<br>information in PDIRFrameData ..... | 860 |
| Figure R.1 – Scheme of a 2-port switch .....   | 863 |
| Figure R.2 – Scheme of 2-ports .....   | 863 |
| Figure S.1 – PrmBegin, PrmEnd and ApplRdy procedure .....  | 866 |
| Figure X.1 – IEEE 802 structure used for statistic counters.....   | 891 |
| Figure X.2 – IEEE 802 summary for statistic counters.....  | 892 |
| <br>   |     |
| Table 1 – One octet .....  | 65  |
| Table 2 – Two subsequent octets.....   | 66  |
| Table 3 – Four subsequent octets .....   | 66  |
| Table 4 – Eight subsequent octets .....  | 67  |
| Table 5 – Sixteen subsequent octets .....  | 67  |
| Table 6 – State machine description elements .....   | 68  |
| Table 7 – Description of state machine elements .....  | 68  |
| Table 8 – Conventions used in state machines .....   | 69  |
| Table 9 – Conventions for services used in state machines .....  | 70  |
| Table 10 – IEEE 802.3 DLPDU syntax .....   | 72  |
| Table 11 – IEEE 802.11 DLPDU syntax .....  | 73  |
| Table 12 – IEEE 802.15.1 DLPDU syntax .....  | 74  |

|   |    |
|---|----|
| Table 13 – Status .....                                     | 79 |
| Table 14 – Time source .....                                | 81 |
| Table 15 – SourceAddress.....                               | 83 |
| Table 16 – Single port device.....                          | 83 |
| Table 17 – DCP_MulticastMACAdd for Identify .....           | 84 |
| Table 18 – DCP_MulticastMACAdd for Hello.....               | 84 |
| Table 19 – DCP_MulticastMACAdd .....                        | 84 |
| Table 20 – MulticastMACAdd range 1 .....                    | 84 |
| Table 21 – MulticastMACAdd range 2 .....                    | 84 |
| Table 22 – MulticastMACAdd range 3 .....                    | 85 |
| Table 23 – PTCP_MulticastMACAdd range 2 .....               | 85 |
| Table 24 – PTCP_MulticastMACAdd range 3 .....               | 85 |
| Table 25 – PTCP_MulticastMACAdd range 4 .....               | 85 |
| Table 26 – PTCP_MulticastMACAdd range 5 .....               | 86 |
| Table 27 – PTCP_MulticastMACAdd range 6 .....               | 86 |
| Table 28 – PTCP_MulticastMACAdd range 7 .....               | 86 |
| Table 29 – MulticastMACAdd range 8 .....                    | 86 |
| Table 30 – MulticastMACAdd range 9 .....                    | 86 |
| Table 31 – MulticastMACAdd range 10 .....                   | 87 |
| Table 32 – MulticastMACAdd range 11 .....                   | 87 |
| Table 33 – RT_CLASS_3 destination multicast address .....   | 88 |
| Table 34 – RT_CLASS_3 invalid frame multicast address ..... | 89 |
| Table 35 – LT (Length/Type).....                            | 89 |
| Table 36 – TagControllInformation.VID .....                 | 89 |
| Table 37 – TagControllInformation.DEI .....                 | 90 |
| Table 38 – TagControllInformation.PCP .....                 | 90 |
| Table 39 – FrameID range 1 .....                            | 90 |
| Table 40 – FrameID range 2 .....                            | 91 |
| Table 41 – FrameID range 3 .....                            | 91 |
| Table 42 – FrameID range 4 .....                            | 91 |
| Table 43 – FrameID range 5 .....                            | 91 |
| Table 44 – FrameID range 6 .....                            | 92 |
| Table 45 – FrameID range 7 .....                            | 92 |
| Table 46 – FrameID range 8 .....                            | 92 |
| Table 47 – FrameID range 9 .....                            | 93 |
| Table 48 – FrameID range 10 .....                           | 93 |
| Table 49 – FrameID range 11 .....                           | 93 |
| Table 50 – FrameID range 12 .....                           | 93 |
| Table 51 – FrameID range 13 .....                           | 93 |
| Table 52 – FragmentationFrameID.FragSequence .....          | 94 |
| Table 53 – FragmentationFrameID.Constant.....               | 94 |
| Table 54 – DCP APDU syntax.....                             | 94 |
| Table 55 – DCP substitutions.....                           | 95 |

ITC STANDARD PREVIEW  
 (standards.iteh.ai)  
 IEC 61158-6-10:2019  
<https://standards.iteh.ai/catalog/standards/sis/60d75a62-a5f8-4b60-ab4b-a48627903cc0/iec-61158-6-10-2019>

|   |     |
|---|-----|
| Table 56 – ServiceID .....  | 98  |
| Table 57 – ServiceType.Selection .....  | 98  |
| Table 58 – ServiceType.Reserved .....   | 98  |
| Table 59 – ServiceType.Selection .....  | 99  |
| Table 60 – ServiceType.Reserved_1 .....   | 99  |
| Table 61 – ServiceType.Response .....   | 99  |
| Table 62 – ServiceType.Reserved_2 .....   | 99  |
| Table 63 – ResponseDelayFactor .....  | 100 |
| Table 64 – List of options .....  | 101 |
| Table 65 – List of suboptions for option IPOption .....   | 102 |
| Table 66 – List of suboptions for option DevicePropertiesOption .....   | 102 |
| Table 67 – List of suboptions for option DHCPOption .....   | 102 |
| Table 68 – List of suboptions for option ControlOption .....  | 103 |
| Table 69 – List of suboptions for option DeviceInitiativeOption .....   | 103 |
| Table 70 – List of suboptions for option AllSelectorOption .....  | 103 |
| Table 71 – List of suboptions for option ManufacturerSpecificOption .....   | 103 |
| Table 72 – SuboptionDHCP .....  | 105 |
| Table 73 – Coding of DCPBlockLength in conjunction with SuboptionStart .....  | 106 |
| Table 74 – Coding of DCPBlockLength in conjunction with SuboptionStop .....   | 106 |
| Table 75 – Coding of DCPBlockLength in conjunction with SuboptionSignal .....   | 106 |
| Table 76 – Coding of DCPBlockLength in conjunction with SuboptionFactoryReset .....   | 107 |
| Table 77 – Alignment between FactoryReset and ResetToFactory .....  | 107 |
| Table 78 – Coding of DCPBlockLength in conjunction with SuboptionResetToFactory .....                                       | 107 |
| Table 79 – Meaning of the different ResetToFactory modes .....  | 108 |
| Table 80 – Coding of DCPBlockLength in conjunction with SuboptionDeviceInitiative .....                                     | 108 |
| Table 81 – Coding of DCPBlockLength .....   | 109 |
| Table 82 – BlockQualifier with options IPOption, DevicePropertiesOption, DHCPOption<br>and ManufacturerSpecificOption ..... | 109 |
| Table 83 – BlockQualifier with option ControlOption and suboption<br>SuboptionResetToFactory .....                          | 110 |
| Table 84 – BlockQualifier with option ControlOption and NOT suboption<br>SuboptionResetToFactory .....                      | 111 |
| Table 85 – BlockError .....   | 111 |
| Table 86 – BlockInfo for SuboptionIPParameter .....   | 111 |
| Table 87 – Bit 1 and Bit 0 of BlockInfo for SuboptionIPParameter .....  | 112 |
| Table 88 – Bit 7 of BlockInfo for SuboptionIPParameter .....  | 112 |
| Table 89 – BlockInfo for all other suboptions .....   | 112 |
| Table 90 – DeviceInitiativeValue .....  | 112 |
| Table 91 – SignalValue .....  | 113 |
| Table 92 – DeviceRoleDetails .....  | 115 |
| Table 93 – IPAddress .....  | 115 |
| Table 94 – Subnetmask .....   | 117 |
| Table 95 – StandardGateway .....  | 118 |
| Table 96 – Correlation between the subfields of IPSuite .....   | 119 |