



IEC 61158-5-10

Edition 4.0 2019-04

INTERNATIONAL STANDARD



**Industrial communication networks – Fieldbus specifications –
Part 5-10: Application layer service definition – Type 10 elements**





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
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

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 It also gives information on projects, replaced and withdrawn publications.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

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

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

Electropedia - 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

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 61158-5-10

Edition 4.0 2019-04

INTERNATIONAL STANDARD



**Industrial communication networks – Fieldbus specifications –
Part 5-10: Application layer service definition – Type 10 elements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 25.040.40; 35.100.70; 35.110

ISBN 978-2-8322-6741-7

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

CONTENTS

FOREWORD.....	15
INTRODUCTION.....	17
1 Scope.....	18
1.1 General.....	18
1.2 Specifications	19
1.3 Conformance	19
2 Normative references	19
3 Terms, definitions, abbreviations, symbols and conventions	22
3.1 Referenced terms and definitions.....	22
3.1.1 ISO/IEC 7498-1 terms.....	22
3.1.2 ISO/IEC 8822 terms.....	22
3.1.3 ISO/IEC 9545 terms.....	22
3.1.4 ISO/IEC 8824-1 terms.....	23
3.2 Additional Type 10 terms and definitions.....	23
3.3 Additional Type 10 terms and definitions for media redundancy	30
3.4 Abbreviations and symbols	32
3.4.1 General	32
3.4.2 Additional Type 10 abbreviations and symbols.....	33
3.4.3 Abbreviations and symbols for services	34
3.5 Conventions.....	34
3.5.1 Overview	34
3.5.2 General conventions.....	34
3.5.3 Conventions for class definitions	34
3.5.4 Conventions for service definitions	36
3.5.5 Conventions used in state machines.....	37
4 Concepts	40
5 Data type ASE.....	40
5.1 General.....	40
5.1.1 Overview	40
5.1.2 Date and time type specifics.....	41
5.1.3 Transfer of user data	41
5.1.4 Data type overview	41
5.2 Formal definition of data type objects.....	44
5.2.1 Data type class.....	44
5.3 FAL defined data types	45
5.3.1 Fixed length types	45
5.3.2 Variable Length types.....	66
5.4 Data type ASE service specification.....	69
6 Communication model for common services	69
6.1 Concepts	69
6.1.1 Overview	69
6.1.2 Middle Layer ASEs	69
6.2 ASE data types.....	69
6.3 Application Service Elements.....	69
6.3.1 Remote procedure call ASE.....	69
6.3.2 Domain name system ASE	78

6.3.3	Simple network management ASE	79
6.3.4	IP suite ASE	80
6.3.5	Real time cyclic ASE	84
6.3.6	Real time acyclic ASE.....	100
6.3.7	Discovery and basic configuration ASE.....	110
6.3.8	Dynamic host configuration ASE.....	138
6.3.9	IEEE 802.1AB ASE.....	138
6.3.10	Media redundancy ASE	151
6.3.11	Precision time control ASE	158
6.3.12	IEEE 802.1AS ASE.....	172
6.3.13	Virtual Bridges ASE	175
6.3.14	MAC Bridges ASE	178
6.3.15	Fragmentation ASE	191
6.3.16	IEEE 802.3 ASE	192
6.3.17	Common DL mapping ASE	195
7	Communication model for decentralized periphery.....	200
7.1	Concepts	200
7.1.1	User requirements	200
7.1.2	Features	200
7.1.3	Associations	201
7.1.4	Device types.....	202
7.1.5	Instance model and device addresses	210
7.1.6	Application process	210
7.1.7	Application service element	217
7.1.8	Application relationship.....	219
7.2	ASE data types	220
7.3	ASEs	220
7.3.1	AR ASE	220
7.3.2	Real Identification ASE.....	355
7.3.3	Communication Interface Management ASE	445
7.3.4	Diagnosis ASE.....	516
7.3.5	PE ASE	561
7.3.6	LogBook ASE	571
7.3.7	RS ASE	574
7.3.8	Time ASE	599
7.4	Application characteristics	604
7.4.1	Device ident number.....	604
7.4.2	Network topology.....	604
7.5	Summary of FAL services	606
7.5.1	IO device	606
7.5.2	IO controller	607
7.5.3	IO Supervisor	607
Annex A (informative)	Device instances	608
Annex B (informative)	Components of an Ethernet interface	610
Annex C (informative)	Scheme of MAC address assignment	614
Annex D (informative)	Measurement of the fast startup time	615
Annex E (informative)	Dynamic Frame Packing.....	616
Annex F (informative)	Precondition for Diagnosis.....	624

Bibliography.....	629
Figure 1 – Middle Layer ASEs communication architecture	69
Figure 2 – Sequence Chart for reading the EndPointMapper.....	71
Figure 3 – Media redundancy diagnosis dependencies	157
Figure 4 – PTCP applications.....	158
Figure 5 – Example of periods at a local port	177
Figure 6 – Example of communication between controlling devices and field devices.....	201
Figure 7 – Example of communication between an engineering station and several controlling and field devices.....	202
Figure 8 – Example of communication between field devices and a server station	202
Figure 9 – Example of communication between field devices	202
Figure 10 – Data Objects and Diagnosis Data Model	206
Figure 11 – Example for channel modelling.....	207
Figure 12 – Mapping to PROFINET device model	208
Figure 13 – Identification hierarchy	208
Figure 14 – Application Process with application process objects (APOs)	211
Figure 15 – Access to a remote APO	212
Figure 16 – Access to a remote APO for provider/consumer association.....	213
Figure 17 – Overview of application processes	214
Figure 18 – IO device with APs, slots and subslots	214
Figure 19 – Example 1 structural units for interfaces and ports within API 0.....	216
Figure 20 – Example 2 structural units for interfaces and ports within API 0.....	217
Figure 21 – FAL ASEs communication architecture	218
Figure 22 – Example of one AR with two AREPs.....	220
Figure 23 – Example IO application relationship (one-to-one)	223
Figure 24 – Example IO application relationship one-to-many	224
Figure 25 – Implicit application relationship	225
Figure 26 – State transition diagram DEVSM	257
Figure 27 – State transition diagram CTLSM.....	265
Figure 28 – Assignment of Communication Relationship to Application Relationship.....	270
Figure 29 – Overview Communication Relationship Class service interactions	273
Figure 30 – Example for an intersection of IO device, slot, and AR	336
Figure 31 – Substitute Value.....	364
Figure 32 – State transition diagram RSMSM.....	372
Figure 33 – Ownership handling.....	376
Figure 34 – State transition diagram OWNSM.....	379
Figure 35 – State transition diagram ASSSM	380
Figure 36 – State transition diagram PLUGSM.....	392
Figure 37 – State transition diagram PULLSM.....	395
Figure 38 – Basic model for isochronous applications	424
Figure 39 – General isochronous application model (example CACF == 1)	425
Figure 40 – General isochronous application model (example CACF == 2)	426

Figure 41 – ASE relations in an IO device operating in isochronous mode for a submodule	432
Figure 42 – State transition diagram of ISOM_SYNC	434
Figure 43 – State transition diagram ISOM_OUT	437
Figure 44 – State transition diagram ISOM_IN	442
Figure 45 – State transition diagram SYNC_DIAG	484
Figure 46 – MRP interconnection	506
Figure 47 – Diagnosis Base Model	516
Figure 48 – Severity classification of fault, maintenance and qualified	517
Figure 49 – Data Base Model	518
Figure 50 – State transition diagram DIAG_DIAG	547
Figure 51 – State transition diagram DIAG_MR	551
Figure 52 – State transition diagram DIAG_MD	554
Figure 53 – State transition diagram DIAG_QUALIFIED	558
Figure 54 – Architecture	562
Figure 55 – State transition diagram PESM	570
Figure 56 – Reporting System components	575
Figure 57 – AR / ARSet and Reporting System	576
Figure 58 – Max Scan Delay	584
Figure 59 – RS Incident window	587
Figure 60 – State transition diagram RSOBS	592
Figure 61 – State transition diagram RSBUF	596
Figure 62 – State transition diagram TimeSM	602
Figure 63 – Example of network topology including slower wireless segments	605
Figure 64 – Example of media redundancy including wireless segments	605
Figure A.1 – Instance model	608
Figure B.1 – Scheme of an Ethernet interface	610
Figure B.2 – Scheme of an Ethernet interface with bridging ability	611
Figure B.3 – Scheme of an Ethernet interface with optical ports	612
Figure B.4 – Scheme of an Ethernet interface with bridging ability using radio communication	613
Figure B.5 – Scheme of an Ethernet interface with radio communication	613
Figure C.1 – Scheme of MAC address assignment	614
Figure D.1 – Measurement of the fast startup time	615
Figure E.1 – Frame Layout	616
Figure E.2 – Subframe Layout	617
Figure E.3 – End to End	618
Figure E.4 – Dynamic frame packing	618
Figure E.5 – Dynamic frame packing – Truncation of outputs	619
Figure E.6 – Dynamic frame packing – Outbound Pack	619
Figure E.7 – Dynamic frame packing – Concatenation of inputs	620
Figure E.8 – Dynamic frame packing – Inbound Pack	621
Figure E.9 – Dynamic frame packing – Distributed watchdog	623
Figure E.10 – Interrelation between IO CR and dynamically packed frame	623

Table 1 – State machine description elements	37
Table 2 – Description of state machine elements	38
Table 3 – Conventions used in state machines	38
Table 4 – Conventions for services used in state machines	39
Table 5 – Data type overview.....	41
Table 6 – V2 octets.....	46
Table 7 – L2 octets	46
Table 8 – E2 octets.....	47
Table 9 – E2 value range.....	47
Table 10 – Unipolar2.16 octets	48
Table 11 – Unipolar2.16 value range	48
Table 12 – N2 value range.....	49
Table 13 – N4 value range.....	50
Table 14 – X2 value range.....	51
Table 15 – X4 value range.....	52
Table 16 – C4 value range.....	53
Table 17 – T2 value range	54
Table 18 – T4 value range	55
Table 19 – D2 value range.....	56
Table 20 – R2 value range.....	56
Table 21 – Status value range	57
Table 22 – Status value range	58
Table 23 – F message trailer with 4 octets.....	62
Table 24 – Unsigned16_S octets	64
Table 25 – Unsigned16_S meaning.....	64
Table 26 – Integer16_S octets	65
Table 27 – Integer16_S meaning	65
Table 28 – Unsigned8_S octets	65
Table 29 – Unsigned8_S meaning	65
Table 30 – OctetString_S octets	66
Table 31 – OctetString_S status bits.....	67
Table 32 – Connect.....	72
Table 33 – Release.....	73
Table 34 – Read	74
Table 35 – Write	75
Table 36 – Control	76
Table 37 – ReadImplicit	77
Table 38 – Add Static ARP Cache Entry	83
Table 39 – Remove Static ARP Cache Entry.....	83
Table 40 – PPM Set Prov Data	89
Table 41 – PPM Set Prov Status.....	90
Table 42 – PPM Activate.....	91

Table 43 – PPM Close	93
Table 44 – PPM Start.....	94
Table 45 – PPM Error	94
Table 46 – Get Cons Data	94
Table 47 – CPM Get cons status.....	95
Table 48 – CPM Set RedRole	96
Table 49 – CPM Activate	97
Table 50 – CPM NoData	99
Table 51 – CPM Stop.....	99
Table 52 – CPM New Data Indication.....	100
Table 53 – APMS Activate	103
Table 54 – APMR Activate	104
Table 55 – APMS A Data	106
Table 56 – APMR A Data	107
Table 57 – APMR Ack.....	107
Table 58 – APMS Error.....	108
Table 59 – APMS Error ERRCLS/ERRCODE	108
Table 60 – APMR Error.....	109
Table 61 – APMR Error ERRCLS/ERRCODE.....	109
Table 62 – APMS_Close.....	109
Table 63 – APMR_Close.....	110
Table 64 – Get.....	118
Table 65 – Set.....	123
Table 66 – Local Set Command	128
Table 67 – Identify.....	130
Table 68 – Hello	136
Table 69 – System capabilities	144
Table 70 – Auto negotiation support and status	145
Table 71 – MDI Power Support.....	146
Table 72 – Link aggregation status	146
Table 73 – Remote systems data change.....	150
Table 74 – Start bridge	165
Table 75 – Start slave.....	166
Table 76 – Start master	167
Table 77 – Stop bridge.....	168
Table 78 – Stop slave	169
Table 79 – Stop master.....	170
Table 80 – Sync state change.....	170
Table 81 – Line Delay change.....	171
Table 82 – Local Get Time.....	174
Table 83 – Local time state info	174
Table 84 – Allowed values of Forwarding Mode	181
Table 85 – Allowed values of Fast Forwarding Multicast MAC Add.....	181

Table 86 – Tx Port Entry	184
Table 87 – Dependencies of RedPeriodBegin and GreenPeriodBegin	187
Table 88 – Port state change	190
Table 89 – Set port state	190
Table 90 – Flush filtering data base	191
Table 91 – MAU Type change	194
Table 92 – Set MAU Type	194
Table 93 – P Data	195
Table 94 – N Data	197
Table 95 – A Data	198
Table 96 – C Data	199
Table 97 – Requirements and features	200
Table 98 – Binding application relationship services	226
Table 99 – Device Access	229
Table 100 – Companion AR	229
Table 101 – Acknowledge Companion AR	230
Table 102 – Startup Mode	230
Table 103 – Pull Module Alarm Allowed	230
Table 104 – Input Valid on Backup AR	233
Table 105 – Mode	234
Table 106 – APStructureIdentifier with API := 0	234
Table 107 – APStructureIdentifier with API != 0	235
Table 108 – RS Alarm Transport Mode	235
Table 109 – Connect	237
Table 110 – Connect Device Access	243
Table 111 – Release	244
Table 112 – Prm Begin	246
Table 113 – Prm End	248
Table 114 – Application Ready	249
Table 115 – Abort	250
Table 116 – Local AR Abort	251
Table 117 – Local Set AR State	251
Table 118 – Local AR In Data	251
Table 119 – Data elements of Read AR Data	252
Table 120 – Data elements of Expected Fast Startup Data	254
Table 121 – Remote primitives issued or received by DEVSM	255
Table 122 – Local primitives issued or received by DEVSM	256
Table 123 – State table DEVSM	258
Table 124 – Functions, Macros, Timers and Variables by DEVSM	263
Table 125 – Remote primitives issued or received by CTLISM	264
Table 126 – Local primitives issued or received by CTLISM	264
Table 127 – State table CTLISM	266
Table 128 – Functions, Macros, Timers and Variables used by CTLISM	268

Table 129 – Binding communication relationship services	274
Table 130 – Traffic Classes versus RT Class	276
Table 131 – Local Set Input	284
Table 132 – Local Set Input IOCS	285
Table 133 – Local Get Input	286
Table 134 – Local Get Input IOCS	287
Table 135 – Local New Input	288
Table 136 – Local Set Output	289
Table 137 – Local Set Output IOCS	290
Table 138 – Local Get Output	291
Table 139 – Local Get Output IOCS	292
Table 140 – Local New Output	293
Table 141 – Local Set Provider State	294
Table 142 – Local Set Redundancy	295
Table 143 – Local Set State	295
Table 144 – Local Data State Changed	296
Table 145 – Binding expected identification services	303
Table 146 – Module State	305
Table 147 – AR Info	308
Table 148 – Ident Info	309
Table 149 – General Data definition for identification services	309
Table 150 – Data elements of Read Module Diff Block	311
Table 151 – Alarm type	315
Table 152 – Alarm types attached to diagnosis ASE	317
Table 153 – Alarm types attached to ownership	317
Table 154 – Alarm types attached to common profiles, profiles, and application	318
Table 155 – Binding Alarm services	318
Table 156 – Alarm Notification	322
Table 157 – Channel Diagnosis	324
Table 158 – Manufacturer Specific Diagnosis	324
Table 159 – Submodule Diagnosis State	325
Table 160 – AR Diagnosis State	325
Table 161 – User Structure Identifier	326
Table 162 – Semantics of Specifier	328
Table 163 – Binding Record Data services	336
Table 164 – Read	338
Table 165 – Read Services	340
Table 166 – Read Implicit	342
Table 167 – Read Query	343
Table 168 – Write	344
Table 169 – Write Services	345
Table 170 – Data elements of Write Combined Object Container	346
Table 171 – Local Write Multiple	347

Table 172 – Local New Write Multiple	350
Table 173 – Binding real identification services.....	356
Table 174 – Local Add Submodule.....	359
Table 175 – Local Remove Submodule	360
Table 176 – Local Update Submodule.....	360
Table 177 – Data elements of Read API Data	362
Table 178 – Data elements of Read Record Input Data Object Element	363
Table 179 – Data elements of Read Record Output Data Object Element	366
Table 180 – Data elements of Read Substitute Value.....	367
Table 181 – Selector for Read GSD Data.....	369
Table 182 – Data elements of Read GSD Data	369
Table 183 – Remote primitives issued or received by RSMSM	371
Table 184 – Local primitives issued or received by RSMSM.....	371
Table 185 – State table RSMSM	372
Table 186 – Functions, Macros, Timers and Variables used by RSMSM	374
Table 187 – Rules for Submodule State.Ident Info	374
Table 188 – Remote primitives issued or received by OWNSM and ASSSM.....	378
Table 189 – Local primitives issued or received by OWNSM	379
Table 190 – State table OWNSM	380
Table 191 – State table ASSSM.....	387
Table 192 – Functions, Macros, Timers and Variables used by OWNSM.....	388
Table 193 – Functions, Macros, Timers and Variables used by ASSSM	389
Table 194 – Rules for Submodule State.AR Info	389
Table 195 – Remote primitives issued or received by PLUGSM	390
Table 196 – Local primitives issued or received by PLUGSM.....	391
Table 197 – State table PLUGSM	393
Table 198 – Functions, Macros, Timers and Variables used by PLUGSM.....	394
Table 199 – Remote primitives issued or received by PULLSM	395
Table 200 – Local primitives issued or received by PULLSM.....	395
Table 201 – State table PULLSM	396
Table 202 – Functions, Macros, Timers and Variables used by PULLSM	397
Table 203 – Binding I&M data services	399
Table 204 – Data elements of Read I&M0 Filter Data.....	412
Table 205 – Data elements of Read I&M0 Data.....	415
Table 206 – Data elements of Write I&M1 Data.....	416
Table 207 – Data elements of Write I&M2 Data.....	417
Table 208 – Data elements of Write I&M3 Data.....	418
Table 209 – Data elements of Write I&M4 Data.....	418
Table 210 – Data elements of Read I&M5 Data.....	419
Table 211 – Data elements of Read Asset Management Data	422
Table 212 – Binding Isochronous Mode Application services.....	426
Table 213 – Data elements of Write Isochronous Mode Data	431
Table 214 – Remote primitives issued or received by ISOM_SYNC.....	433

Table 215 – Local primitives issued or received by ISOM_SYNC	433
Table 216 – State table ISOM_SYNC	434
Table 217 – Functions, Macros, Timers and Variables used by the ISOM_SYNC	435
Table 218 – Remote primitives issued or received for ISOM_OUT	435
Table 219 – Local primitives issued or received for ISOM_OUT	436
Table 220 – State table ISOM_OUT	438
Table 221 – Functions, Macros, Timers and Variables used by the ISOM_OUT	440
Table 222 – Remote primitives issued or received for ISOM_IN	441
Table 223 – Local primitives issued or received for ISOM_IN	441
Table 224 – State table ISOM_IN	443
Table 225 – Functions, Macros, Timers and Variables used by the ISOM_IN	444
Table 226 – Binding Communication Interface Management services	446
Table 227 – Subslot number for interface submodules	449
Table 228 – Subslot number for port submodules	453
Table 229 – Data elements of Read PDev Data	458
Table 230 – Data elements of Read PD Real Data	458
Table 231 – Data elements of Read PD Expected Data	460
Table 232 – Data elements of Read PD Interface Data Real	461
Table 233 – Data elements of Write PD Interface Adjust	462
Table 234 – Data elements of Write PD Interface FSU Data Adjust	463
Table 235 – Data elements of Write PD NC Data Check	464
Table 236 – Data elements of Read PD Port Data Real	465
Table 237 – Data elements of Read PD Port Data Real Extended	466
Table 238 – Data elements of Write PD Port Data Check	467
Table 239 – Data elements of Write PD Port Data Adjust	469
Table 240 – Data elements of Read Port FO Data Real	470
Table 241 – Data elements of Write PD Port FO Data Check	471
Table 242 – Data elements of Write PD Port FO Data Adjust	471
Table 243 – Data elements of Read PD Port Statistic	472
Table 244 – Binding PTCIP services	475
Table 245 – Sync Properties Role	478
Table 246 – Sync Class	478
Table 247 – Data elements of Write PD Sync Data	479
Table 248 – Local Sync State Info	481
Table 249 – Local SYNCH Event	482
Table 250 – Remote primitives issued or received by SYNC_DIAG	483
Table 251 – Local primitives issued or received by SYNC_DIAG	483
Table 252 – State table SYNC_DIAG	485
Table 253 – Functions, Macros, Timers and Variables used by SYNC_DIAG	486
Table 254 – Binding MAC Bridge services	487
Table 255 – Distributed Watchdog Factor	489
Table 256 – Restart Factor For Distributed Watchdog	489
Table 257 – DFP Mode	490

Table 258 – SFIOCRProperties.DFPRedundantPathLayout.....	490
Table 259 – SFCRC16	490
Table 260 – Data elements of Write PD IR Data	491
Table 261 – Data elements of Write PD IR Subframe Data.....	493
Table 262 – Binding Media Redundancy services	494
Table 263 – Data elements of Read PD Interface MRP Data Real.....	496
Table 264 – Data elements of Write PD Interface MRP Data Check	498
Table 265 – Data elements of Write PD Interface MRP Data Adjust	499
Table 266 – Data elements of Read PD Port MRP Data Real.....	501
Table 267 – Data elements of Write PD Port MRP Data Adjust	501
Table 268 – Data elements of Read PD Port MRPIC Data Real	502
Table 269 – Data elements of Write PD Port MRPIC Data Check.....	503
Table 270 – Data elements of Write PD Port MRPIC Data Adjust.....	503
Table 271 – Binding IEEE 802.1AS services	507
Table 272 – Data elements of Write PD Time Data	509
Table 273 – List of supported MIBs.....	509
Table 274 – Cross-referencing of MIB-II objects	510
Table 275 – Cross-referencing of LLDP-MIB objects	510
Table 276 – Cross-referencing of LLDP-EXT-PNIO MIB objects.....	510
Table 277 – Cross-referencing of LLDP-EXT-DOT3 MIB objects	511
Table 278 – Binding Autoconfiguration Data services.....	511
Table 279 – Data elements of Read Autoconfiguration Data	514
Table 280 – Binding Diagnosis services.....	521
Table 281 – General Data definition for Diagnosis services.....	527
Table 282 – Local Add Diagnosis Entry.....	530
Table 283 – Local Remove Diagnosis Entry	531
Table 284 – Local Update Diagnosis Entry.....	532
Table 285 – Remote primitives issued or received by DIAG_DIAG	547
Table 286 – Local primitives issued or received by DIAG_DIAG	547
Table 287 – State table DIAG_DIAG	548
Table 288 – Functions, Macros, Timers and Variables used by DIAG_DIAG	549
Table 289 – Remote primitives issued or received by DIAG_MR	550
Table 290 – Local primitives issued or received by DIAG_MR.....	551
Table 291 – State table DIAG_MR	552
Table 292 – Functions, Macros, Timers and Variables used by DIAG_MR.....	552
Table 293 – Remote primitives issued or received by DIAG_MD	554
Table 294 – Local primitives issued or received by DIAG_MD	554
Table 295 – State table DIAG_MD	555
Table 296 – Functions, Macros, Timers and Variables used by the maintenance demanded entry.....	556
Table 297 – Remote primitives issued or received by DIAG_QUALIFIED	557
Table 298 – Local primitives issued or received by DIAG_QUALIFIED	557
Table 299 – State table DIAG_QUALIFIED	559

Table 300 – Functions, Macros, Timers and Variables used by DIAG_QUALIFIED	559
Table 301 – Binding PE services	563
Table 302 – Local Add PE Entity	564
Table 303 – Local Remove PE Entity	565
Table 304 – Local Update PE_OperationalMode	566
Table 305 – PE Entity Filter Data definition	567
Table 306 – PE Entity Filter Data definition	568
Table 307 – Remote primitives issued or received by PESM	570
Table 308 – Local primitives issued or received by PESM	570
Table 309 – State table PESM	571
Table 310 – Functions, Macros, Timers and Variables used by PESM	571
Table 311 – Binding LogBook services	572
Table 312 – Data elements of Read LogBook Data	573
Table 313 – Local Create LogBook Entry	574
Table 314 – Binding RS services	581
Table 315 – Immanent observers	583
Table 316 – Configured observers	583
Table 317 – Data elements of Local Add RS Event	589
Table 318 – Data elements of RS Get Event	590
Table 319 – Data elements of RS Ack Event	590
Table 320 – Data elements of RS Adjust Observer	591
Table 321 – Local primitives issued or received by RSOBS	592
Table 322 – State table RSOBS	594
Table 323 – Functions, Macros, Timers and Variables used by RSOBS	595
Table 324 – Local primitives issued or received by RSBUF	596
Table 325 – State table RSBUF	597
Table 326 – Functions, Macros, Timers and Variables used by RSBUF	599
Table 327 – Binding Time services	600
Table 328 – Local Get Time	601
Table 329 – Local primitives issued or received by TimeSM	602
Table 330 – State table TimeSM	603
Table 331 – Functions, Macros, Timers and Variables used by TimeSM	604
Table 332 – FAL services of the IO device	606
Table 333 – FAL services of the IO controller	607
Table F.1 – ChannelErrorType	624
Table F.2 – Preconditions ChannelErrorType 0 – 0xFF	625
Table F.3 – Preconditions for ChannelErrorType 0x0100 – 0x7FFF, 0x9000 – 0x9FFF	625
Table F.4 – Preconditions for ChannelErrorType “Data transmission impossible”	625
Table F.5 – Preconditions for ChannelErrorType “Remote mismatch”	626
Table F.6 – Preconditions for ChannelErrorType “Media redundancy mismatch – ring”	626
Table F.7 – Preconditions for ChannelErrorType “Media redundancy mismatch - interconnection”	627
Table F.8 – Preconditions for ChannelErrorType “Sync mismatch”	627

Table F.9 – Preconditions for ChannelErrorType “Isochronous mode mismatch”	627
Table F.10 – Preconditions for ChannelErrorType “Multicast CR mismatch”	627
Table F.11 – Preconditions for ChannelErrorType “Fiber optic mismatch”	628
Table F.12 – Preconditions for ChannelErrorType “Network component function mismatch”	628
Table F.13 – Preconditions for ChannelErrorType “Dynamic Frame Packing function mismatch”	628
Table F.14 – Preconditions for ChannelErrorType “Media redundancy with planned duplication mismatch”	628
Table F.15 – Preconditions for ChannelErrorType “Multiple interface mismatch”	628

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 5-10: Application layer service definition –
Type 10 elements**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This International Standard IEC 61158-5-10 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.

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

- integration of system redundancy basic functionality;
- integration of dynamic reconfiguration basic functionality;
- integration of reporting system basic functionality;

- integration of asset management basic functionality;
- integration of media redundancy ring interconnection basic functionality.

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

FDIS	Report on voting
65C/947/FDIS	65C/950/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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This document defines the application service characteristics that fieldbus applications and/or system management may exploit.

Throughout the set of fieldbus standards, the term “service” refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the application layer service defined in this document is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-10: Application layer service definition – Type 10 elements

1 Scope

1.1 General

The fieldbus application layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a “window between corresponding application programs.”

This part of IEC 61158 provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 10 fieldbus. The term “time-critical” is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This International Standard defines in an abstract way the externally visible service provided by the Type 10 fieldbus application layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form which they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

The purpose of this document is to define the services provided to

- a) the FAL user at the boundary between the user and the application layer of the fieldbus reference model, and
- b) Systems Management at the boundary between the application layer and Systems Management of the fieldbus reference model.

This document specifies the structure and services of the Type 10 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI application layer structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application-entities (AE) contained within the application processes. The FAL AE is composed of a set of object-oriented application service elements (ASEs) and a layer management entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can