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Entwurf

Elektronische Betriebsmittel für Bahnen – Zug-Kommunikations-Netzwerk (TCN) – Teil 2-8: TCN-Konformitätsprüfung (IEC 9/2485/CD:2019); Text Englisch

Electronic railway equipment –
Train communication network (TCN) –
Part 2-8: TCN conformance test
(IEC 9/2485/CD:2019);
Text in English

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2019-10-11 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfs besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise online im Norm-Entwurfs-Portal von DIN unter www.din.de/go/entwuerfe bzw. für Norm-Entwürfe der DKE auch im Norm-Entwurfs-Portal der DKE unter www.entwuerfe.normenbibliothek.de, sofern dort wiedergegeben;
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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE, Stresemannallee 15, 60596 Frankfurt am Main.

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 284 Seiten

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Nationales Vorwort

Das internationale Dokument IEC 9/2485/CD:2019 „Electronic railway equipment – Train communication network (TCN) – Part 2-8: TCN conformance test“ (CD, en: Committee Draft) ist unverändert in diesen Norm-Entwurf übernommen worden.

Das internationale Dokument wurde vom TC 9 „Electrical equipment and systems for railways“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet und den nationalen Komitees zur Stellungnahme vorgelegt.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Da der Abstimmungszeitraum für einen FDIS bzw. Schluss-Entwurf FprEN nur 6 Wochen beträgt, und dann keine sachlichen Stellungnahmen mehr abgegeben werden können, sondern nur noch eine „JA/NEIN“-Entscheidung möglich ist, wobei eine „NEIN“-Entscheidung fundiert begründet werden muss, wird bereits der CD als DIN-Norm-Entwurf veröffentlicht, um die Stellungnahmen aus der Öffentlichkeit frühzeitig berücksichtigen zu können.

Für dieses Dokument ist das nationale Arbeitsgremium UK 351.1 „Fahrzeuge“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf ein Dokument ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils aktuellste Ausgabe des in Bezug genommenen Dokuments.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe des Dokuments.

Der Zusammenhang der zitierten Dokumente mit den entsprechenden deutschen Dokumenten ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für den vorliegenden Norm-Entwurf erfüllt.

Da sich die Benutzer der vorliegenden Norm-Entwurfs der englischen Sprache als Fachsprache bedienen, wird der Englische Text der IEC 9/2485/CD:2019 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA der vorliegenden Norm-Entwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Norm-Entwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

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Nationaler Anhang NA
(informativ)

Auszugsweise Übersetzung

Reihenfolge und Inhalt der folgenden Abschnitte sind identisch mit denen in den jeweiligen Abschnitten der Englischen Fassung.

Einleitung

Das Zug-Kommunikations-Netzwerk (TCN) ist eine internationale Normenreihe mit dem Zweck, Schnittstellen zu definieren, um Plugin-Kompatibilität zu erreichen:

a) zwischen Betriebsmitteln, die in verschiedenen Fahrzeugen oder Consists angeordnet sind, und

b) zwischen Betriebsmitteln und Geräten, die im selben Fahrzeug oder Consist angeordnet sind.

Entscheidende Erfolgsfaktoren für die Entwicklung jeglicher Technologie sind die Standardisierung sowie Sicherstellung der Interoperabilität zwischen den verschiedenartigen Ausführungen. Um diese Interoperabilität zu unterstützen, sollte eine Konformitätsprüfung durchgeführt werden.

In diesem Teil der IEC 61375 wird die in IEC 61375-2-3, IEC 61375-2-5 und IEC 61375-3-4 definierte Konformitätsprüfung von ECN und ETB festgelegt.

1 Anwendungsbereich

Dieser Teil der IEC 61375 gilt für alle Betriebsmittel und Geräte, die entsprechend IEC 61375-2-3, IEC 61375-2-5 und IEC 61375-3-4 ausgeführt werden, d. h. er umfasst die Verfahren, die zur Prüfung der Konformität dieser Betriebsmittel und Geräte angewendet werden.

Die Anwendbarkeit dieser Norm für eine TCN-Ausführung erlaubt die individuelle Konformitätsprüfung der Ausführung an sich und ist eine Voraussetzung für weitere Überprüfungen der Interoperabilität unterschiedlicher TCN-Ausführungen.

3 Begriffe, Symbole, Abkürzungen und Konventionen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 61375-2-3, IEC 61375-2-5 und IEC 61375-3-4.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter http://www.electropedia.org/
- ISO-Online-Browsing-Plattform: verfügbar unter http://www.iso.org/obp

3.2 Symbole und Abkürzungen

Für die Anwendung dieses Dokuments gelten die Symbole und Abkürzungen nach IEC 61375-2-3, IEC 61375-2-5 und IEC 61375-3-4

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Full document details: E DIN EN IEC 61375-2-8:2019-11

CONTENTS

FOREWORD 13
INTRODUCTION 15
1 Scope 16
2 Normative references 16
3 Terms, definitions, symbols, abbreviated terms and conventions 17
3.1 Terms and definitions 17
3.2 Symbols and abbreviated terms 17
4 Conformance test: approach, requirements and boundaries 17
4.1 The approach 17
4.1.1 Requirements 18
4.1.2 Requirements declaration statements for an IUT 19
4.2 Boundaries 20
4.2.1 General 20
4.2.2 Basic interconnection tests 21
4.2.3 Capability tests 21
4.2.4 Behaviour tests 22
4.2.5 Conformance resolution tests 22
4.2.6 Interpretation of clauses/subclauses and statements 22
4.2.7 Relation to interoperability 24
4.2.8 Relation to performance test 25
4.2.9 Definition of test cases 25
4.3 Conformance assessment process outline 25
4.3.1 General 25
4.3.2 Analysis of results, outcomes and verdicts 26
4.4 Mapping of IUT types to conformance test suites 27
5 Basic interface test 28
5.1 Scope 28
5.2 PICS Proforma 28
5.2.1 General 28
5.2.2 PICS tables 28
5.3 Testing framework 29
5.4 Physical layer test 29
5.4.1 Test purpose 29
5.4.2 Inspection of the Hardware Ethernet interface 30
5.4.3 Inspection of the mechanical Ethernet interface construction 30
5.4.4 Check of electrical Ethernet interface design 30
5.4.5 Check of Ethernet interface characteristics 30
5.4.6 Ethernet signal wave form test (IEEE standard) 31
5.4.7 Ethernet signal wave form test (amplified signals, optional) 31
5.4.8 Auto-Crossover- and Auto-Sensing-Test (only for switches) 31
5.5 Basic communication protocol test 31
5.5.1 Test purpose 31
5.5.2 Simple communication test 31
5.5.3 UDP rising payload test (only for End Devices) 31
5.5.4 TCP rising payload test (only for End Devices) 31

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

5.5.5 UDP long term test (only for End Devices) 31
5.6 Reliability tests 32
5.6.1 Test purpose 32
5.6.2 Burst immunity test 32
5.6.3 Ethernet interface isolation test 32
6 Conformance test of End Device 33
6.1 General 33
6.2 Related requirements 33
6.3 IUT and Test scope 33
6.4 PICS PROFORMA 34
6.4.1 PICS related to IEC61375 2-3 34
6.4.2 PICS related to IEC61375 2-5 35
6.4.3 PICS related to IEC61375 3-4 37
6.5 TESTING FRAMEWORK 42
6.6 TEST SUITE IEC61375 2-3 42
6.6.1 Test case TCCT23ED_001 42
6.6.2 Test case TCCT23ED_002 43
6.6.3 Test case TCCT23ED_003 45
6.6.4 Test case TCCT23ED_004 46
6.6.5 Test case TCCT23ED_005 46
6.6.6 Test case TCCT23ED_006 47
6.6.7 Test case TCCT23ED_007 48
6.6.8 Test case TCCT23ED_008 49
6.7 TEST SUITE IEC61375 2-5 50
6.7.1 Test case TCCT25ED_001 50
6.7.2 Test case TCCT25ED_002 51
6.7.3 Test case TCCT25ED_003 52
6.7.4 Test case TCCT25ED_004 53
6.7.5 Test case TCCT25ED_005 53
6.7.6 Test case TCCT25ED_006 54
6.7.7 Test case TCCT25ED_007 55
6.7.8 Test case TCCT25ED_008 56
6.7.9 Test case TCCT25ED_009 57
6.8 TEST SUITE IEC61375 3-4 58
6.8.1 Test case TCCT34ED_001 58
6.8.2 Test case TCCT34ED_002 59
6.8.3 Test case TCCT34ED_003 60
6.8.4 Test case TCCT34ED_004 61
6.8.5 Test case TCCT34ED_005 62
6.8.6 Test case TCCT34ED_006 63
6.8.7 Test case TCCT34ED_007 63
6.8.8 Test case TCCT34ED_008 64
6.8.9 Test case TCCT34ED_009 65
6.8.10 Test case TCCT34ED_010 66
6.8.11 Test case TCCT34ED_011 67
6.8.12 Test case TCCT34ED_012 69
6.8.13 Test case TCCT34ED_013 70
6.8.14 Test case TCCT34ED_014 71
6.8.15 Test case TCCT34ED_015 72

AVA Documents Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

6.8.16 Test case TCCT34ED_016 73
6.8.17 Test case TCCT34ED_017 74
6.8.18 Test case TCCT34ED_018 75
6.8.19 Test case TCCT34ED_019 76
6.8.20 Test case TCCT34ED_020 77
6.8.21 Test case TCCT34ED_021 78
6.8.22 Test case TCCT34ED_022 78
7 Conformance test of ECN-equipped consist 80
7.1 Scope 80
7.2 Related requirements 80
7.3 PICS Proforma 80
7.3.1 General 80
7.3.2 PICS proforma table for Recovery in case of network failure 80
7.3.3 PICS proforma table for IP address assignment via DHCP 80
7.3.4 PICS proforma table for Name (TCN-URI address) resolution via DNS 81
7.3.5 PICS proforma table for Switch basic functions 83
7.3.6 PICS proforma tables for Priority levels 83
7.3.7 PICS proforma tables for Ingress rate limiting 84
7.3.8 PICS proforma tables for Egress rate shaping 84
7.3.9 PICS proforma tables for Untagged/tagged frames 84
7.3.10 PICS proforma tables for Switching and routing performance 84
7.3.11 PICS proforma table for NTP support 84
7.3.12 PICS proforma table for Management 84
7.3.13 PICS proforma tables for ECSP interface (optional) 85
7.3.14 PICS proforma tables for TTDB manager interface (optional) 85
7.3.15 PICS proforma tables for DNS TCN interface (optional) 85
7.3.16 PICS proforma tables for ETBN control interface (optional) 85
7.4 Test content 85
7.4.1 General 85
7.4.2 Recovery in case of network failure 86
7.4.3 IP address assignment via DHCP 88
7.4.4 Name (TCN-URI address) resolution via DNS 89
7.4.5 Switch basic functions 90
7.4.6 Priority levels 90
7.4.7 Ingress rate limiting 91
7.4.8 Egress rate shaping 91
7.4.9 Untagged/tagged frames 91
7.4.10 Switching and routing performance (optional) 92
7.4.11 NTP support 92
7.4.12 Management 93
7.4.13 ECSP Interface (optional) 94
7.4.14 TTDB manager interface (optional) 95
7.4.15 DNS TCN interface (optional) 95
7.4.16 ETBN control interface (optional) 96
8 Conformance test of ETBN 97
8.1 Scope 97
8.2 PICS Proforma 97
8.2.1 PICS tables 97
8.2.2 Testing framework 104

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

8.2.3 Common Consist Topologies 109
8.2.4 Test Suite: ETB port settings 111
8.2.5 Test Suite: ETB Line Status and Link Aggregation management 114
8.2.6 Test Suite: TTDP HELLO format and content 120
8.2.7 Test Suite: Unicast address assignment and unicast routing 126
8.2.8 Test Suite: Multicast address assignment and routing 129
8.2.9 Test Suite: TOPOLOGY frame format and basic functionality 130
8.2.10 Test Suite: Physical topology management and calculation 133
8.2.11 Test Suite: Logical connectivity management and calculation 138
8.2.12 Test Suite: End-node and extremity port management 144
8.2.13 Test Suite: Failing/loss of node(s) 146
8.2.14 Test Suite: Late/recovered node(s) 151
9 Conformance test of TRDP 156
9.1 Scope 156
9.2 Related requirements 156
9.3 SUT and Test scope 156
9.4 PICS Proforma 157
9.4.1 PICS related to general TRDP 158
9.4.2 PICS related to Process Data 158
9.4.3 PICS related to Message Data 159
9.5 Message Data test 166
9.5.1 Testing framework 166
9.5.2 Communication Model Test 166
9.5.3 Communication Pattern and Addressing Test 169
9.5.4 MD-PDU Test 178
9.5.5 Trdp Layer Service Primitives Test 179
9.5.6 Trdp Layer Filtering Rules Test 181
9.5.7 Caller Trdp Layer Test 185
9.5.8 Replier Trdp Layer Test 198
9.5.9 Tcp Connection Handling Test 207
9.5.10 Message Data Echo Server Test 212
9.6 Process Data test 213
9.6.1 Test setup 213
9.6.2 PD push pattern test cases 213
9.6.3 PD pull pattern test cases 231
10 SDTv2 Conformance Test 244
10.1 Scope 244
10.1.1 General 244
10.1.2 Related requirements 244
10.1.3 Terms and abbreviations 244
10.1.4 Test scope 244
10.2.1 Identification of PICS 245
10.2.2 Identification of Unit Under Test 245
10.2.3 SDTv2 Specific Settings 245
10.2.4 SDTv2 Configuration and Testing 246
10.3 SDSRC- SAFE DATA SOURCE 248
10.3.1 Purpose 248
10.3.2 Inspection of the SID Structure 248
10.3.3 Inspection of the Vital Data Packet 249

AVA Documents Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

10.3.4 Exclusivity 250
10.3.5 SDSRC performance 250
10.4 SDSINK – SAFE DATA SINK 251
10.4.1 VDP sampling 251
10.4.2 VDP Integrity Check 251
10.4.3 Sink Time Supervision 252
10.4.4 Guard Time Supervision 252
10.4.5 Latency Monitoring 252
10.4.6 Channel Monitoring 253
10.4.7 SDTv2 Application Interface 253
10.4.8 Diagnostics and statistics 253
11 Conformance test of ETB-equipped consist 254
11.1 Scope 254
11.2 Abstract consist tester architecture 254
11.3 Consist test stages 256
11.4 PICS 257
11.4.1 Instructions for filling the PICS pro-forma 257
11.4.2 Abbreviations 257
11.4.3 PICS tables 257
11.5 Related requirements 259
11.6 Testing configurations 259
11.6.1 General 259
11.6.2 Testing configuration TC1 260
11.6.3 Testing configuration TC2 260
11.6.4 Testing configuration TC3 261
11.6.5 Testing configuration TC4 261
11.7 Allocation of test cases to testing configurations 262
11.8 Consist tester operation 262
11.8.1 General 262
11.8.2 ECS addressing 263
11.8.3 Test Stimuli 263
11.8.4 Expected result verification 266
11.9 Basic test 266
11.9.1 General 266
11.9.2 TTDB computation 266
11.10 Communication profile test 266
11.10.1 General 266
11.10.2 Leading function 267
11.10.3 Confirmation/correction function 268
11.10.4 Sleep mode function 268
11.11 Performance test 268
11.11.1 General 268
11.12 Multiple ETB test 268
11.12.1 General 268
Annex A (normative) Test laboratory role and client role 269
A.1 Test laboratory and client role 269
A.1.1 General 269
A.1.2 Overview 269
A.2 Preparation for testing 269

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

A.2.1 General administrative steps 270
A.2.2 Agreement on test methods and selection of test suites 270
A.2.3 Exchange of documentation for conformance assessment 270
A.3 Test operation 271
A.3.1 Static conformance review 271
A.3.2 A.3.2 Selection of test cases and test parameterisation 272
A.3.3 Test campaign 273
A.4 Production of test reports 273
A.4.1 IUT conformance test report 273
A.4.2 Protocol conformance test report 274
Annex B (informative) Instructions for filling the PICS pro-forma 275
B.1 General 275
B.2 Abbreviations 275
B.3 Ref. column 275
B.4 Supported subclause column 275
B.5 Supported capability column 275
B.6 Requirement column 276
B.7 Implementation column 276
B.8 Parameter values columns 276
B.8.1 Allowed min. 276
B.8.2 Default value 276
B.8.3 Allowed max. 276
B.8.4 Implemented value 276
Annex C (informative) Test instrumentation and dedicated test bed 277
C.1 Test instrumentation 277
C.1.1 Standard instrumentation 277
C.1.2 Test bed architecture 277
C.1.3 Consist tester specification 277
Bibliography 281

Figure 1 – End Device conformance testing process 33
Figure 2: End Device conformance testing process 34
Figure 3 – Testing framework arquitecture 42
Figure 4 – General configuration for ECN-equipped consist test 86
Figure 5 – Example of configuration for the test of network redundancy 87
Figure 6 – Example of configuration of network redundancy with dual homing End Device interfaces 87
Figure 7 – Example of the configuration for the test of IP address assignment via DHCP 89
Figure 8 – Example of the configuration for the test of Name resolution via DNS 90
Figure 9 – Example of the configuration for the test of NTP support 93
Figure 10 – Example of the configuration for the test of Network management via SNMP 94
Figure 11 - TTS1 One ETBN connects with test system(monitoring) 107
Figure 12 - TTS2 single ETBN connects with test system (one side simulation) 107
Figure 13 - TTS3 Single ETBN connects with test system (both sides simulation) 108
Figure 14 - TTS4 Multiple ETBNs connect with test system(monitoring) 108
Figure 15 - TTS5 multiple ETBNs connect with test system (one side simulation) 109
Figure 16 - TTS6 Multiple ETBN connects with test system (both sides simulation) 109

AVA Documents Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

Figure 17 – Test environment 156
Figure 18 – System under Test 157
Figure 19 – TTS, IUT connected to the test system 213
Figure 20 – The switch in test topology 213
Figure 21 – TRDP telegram format 214
Figure 22 – DataSet of CONFTEST_PUSH_FORMAT 215
Figure 23 – DataSet of CONFTEST_UDP_PORT 216
Figure 24 – DataSet of CONFTEST_FCS 217
Figure 25 – DataSet of CONFTEST_FCS_REPLY 217
Figure 26 – DataSet of CONFTEST_PROTO_VERSION 218
Figure 27 – DataSet of CONFTEST_PROTO_VERSION_REPLY 219
Figure 28 – DataSet of CONFTEST_PUB_TOPO 220
Figure 29 – DataSet of CONFTEST_SUB_TOPO 222
Figure 30 – DataSet of CONFTEST_DATA_LEN_1432 223
Figure 31 – DataSet of CONFTEST_DATA_LEN_0 224
Figure 32 – DataSet of CONFTEST_DATA_LEN_512 224
Figure 33 – Byte alignment test of 441 bytes length telegram data 225
Figure 34 – Byte alignment test of 442 bytes length telegram data 225
Figure 35 – Byte alignment test of 443 bytes length telegram data 226
Figure 36 – DataSet of CONFTEST_PUSH_FORMAT 227
Figure 37 – DataSet of CONFTEST_TIMEOUT_BEHAVIOR_ZERO 227
Figure 38 – DataSet of CONFTEST_TIMEOUT_BEHAVIOR_KEEP 228
Figure 39 – DataSet of CONFTEST_IP_FILTER 229
Figure 40 – DataSet of CONFTEST_IP_FILTER_REPLY 229
Figure 41 – DSCP(QOS) and TTL test telegram data 230
Figure 42 – DataSet of CONFTEST_REDUNDANT 231
Figure 43 DataSet of CONFTEST_PULL_ FORMAT_REQUEST 233
Figure 44 DataSet of CONFTEST_PULL_ FORMAT_REPLY 233
Figure 45 DataSet of CONFTEST_FCS_REQUEST 234
Figure 46 DataSet of CONFTEST_FCS_REPLY 234
Figure 47 DataSet of CONFTEST_PROTO_VERSION_REQUEST 236
Figure 48 DataSet of CONFTEST_PROTO_VERSION_REPLY 236
Figure 49 DataSet of CONFTEST_REQ_TOPO 238
Figure 50 DataSet of CONFTEST_SUB_TOPO 239
Figure 51 DataSet of CONFTEST_IP_FILTER 241
Figure 52 DataSet of CONFTEST_IP_FILTER_REPLY 241
Figure 53 DataSet of CONFTEST_TIMEOUT_BEHAVIOR 242
Figure 54 DataSet of CONFTEST_TIMEOUT_BEHAVIOR_ZERO 243
Figure 55 DataSet of CONFTEST_TIMEOUT_BEHAVIOR_KEEP 243
Figure 56 – SDTv2 conformance testing process 244
Figure 57: SID Generation 248
Figure 58: Structure of a VDP 249
Figure 59: VDP with detailed trailer structure 249

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

Figure 60 Consist tester architecture 255
Figure 61 ECSP proxy 255
Figure 62 Testing configuration variants 259
Figure 63 Testing configuration TC1a 260
Figure 64 Testing configuration TC1b 260
Figure 65 Testing configuration TC2a 261
Figure 66 Testing configuration TC2b 261
Figure 68 TRDP ECSP control telegram 264
Figure E. 1 – Coach tester architecture 278
Figure E. 2 – Complete consist tester architecture 279
Figure E. 3 – Multiple ETB tester architecture 280

Table 1 – Relation to interoperability 24
Table 2 – Relation to performance test 25
Table 3 – Test case categories 25
Table 4 — Mapping conformance testing suites to IUT types 27
Table 5 – PICS pro-forma identification 28
Table 6 – PICS pro-forma implementation under test 28
Table 7 – PICS pro-forma IUT supplier and/or test laboratory client 29
Table 8 – PICS pro-forma identification of the standards 29
Table 9 – PICS pro-forma global statement of conformance 29
Common ETB Framework - Interoperability 34
Common ETB Framework – Service Addressing 35
TRDP (Train Real-Time Data Protocol) 35
SDTv2 (Safe Data Transmission) 35
ETB physical layer 35
ETB network layer: IPv4 subnets definition 36
ETB transport layer 36
ETB physical train naming convention 36
ETB Application interface 36
Architecture (Network structure) 37
Redundancy 37
IP address and related definitions – Consist Network address 37
IP address and related definitions – Train Network address 37
IP address and related definitions – Name resolution and naming definitions 38
IP address and network configuration management – Train network address management 38
IP address and network configuration management – DHCP configuration parameters 38
Network Device interface – Physical Layer - Protocols 39
Network Device interface – Physical Layer - Cables 39
End Device interface (Table 12) – Physical Layer Protocols 40
End Device interface (Table 12) – Physical Layer Cables 40
End Device interface (Table 12) – Physical Layer Connectors 40

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

End Device interface (Table 12) – Link Layer 41
End Device interface (Table 12) – Network Layer 41
End Device interface (Table 12) – Transport Layer 41
End Device interface (Table 12) – Application Layer 41
Network management 42
Table 10 – Testig framework DEVICE description 42
Table 11 – PICS proforma for recovery in case of network failure 80
Table 12 – PICS proforma for IP address assignment via DHCP 80
Table 13 – PICS proforma for Name (TCN-URI address) resolution via DNS 81
Table 14 – PICS proforma for Switch basic functions 83
Table 15 – PICS proforma for Priority levels 83
Table 16 – PICS proforma for Ingress rate limiting 84
Table 17 – PICS proforma for Egress rate shaping 84
Table 18 – PICS proforma for Untagged/tagged frames 84
Table 19 – PICS proforma for NTP support 84
Table 20 – PICS proforma for Management 84
Table 21 – PICS proforma for ECSP interface 85
Table 22 – PICS proforma for TTDB manager interface 85
Table 23 – PICS proforma for DNS TCN interface 85
Table 24– PICS proforma for ETBN control interface 85
Table 25 – ETBN major capabilities 97
Table 26 – ETB port and bypass relay capabilities 98
Table 28 – Data Link Layer 99
Table 29: Based on Table 5 of §6 100
Table 30: ETB Network Layer 100
Table 31: ETBN Multicast Services 101
Table 32: ETB Transport Layer 102
Table 33: Format and content of transmitted and received TTDP HELLO packets 104
Table 34: TTDP TOPOLOGY format and content 104
Table 35: Connectivity Table Management and related fields in TTDP TOPOLOGY frame 104
Table 36: General Train Network Directory Management and consist topology support 105
Table 37: Local consist topologies which can be formed with (units of) this ETBN implementation 105
Table 38: Remote consist topologies which the implementation can interact with 105
Table 39 – Topology transitions 106
Table 40 – Push pattern telegram test 213
Table 41 – Push pattern telegram format content 214
Table 42 – Telegram parameter of push pattern test 214
Table 43 – Destination UDP port test 215
Table 44 – Destination UDP port test telegram parameter 215
Table 45 – FCS check test 216
Table 46 – FCS check test telegram parameter 216
Table 47 – FCS check test reply telegram parameter 216

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

Table 48 – Protocol version test....217
Table 49 – Protocol version test telegram parameter....218
Table 50 – Protocol version test reply telegram parameter....218
Table 51 – Publisher topology counter test....219
Table 52 – Publisher topology counter test telegram parameter....220
Table 53 – Subscriber topology counter test....221
Table 54 Subscriber topology counter test....222
Table 55 – Data length test....222
Table 56 – Data length test of 1432 bytes length telegram parameters....223
Table 57 – Data length test of 0 byte length telegram parameters....223
Table 58 – Data length test of 512 bytes length telegram parameters....223
Table 59 – Byte alignment test....224
Table 60 – Byte alignment test of 441 bytes length telegram parameters....224
Table 61 – Byte alignment test of 442 bytes length telegram parameters....225
Table 62 – Byte alignment test of 443 bytes length telegram parameters....225
Table 63 – Timeout and validity test....226
Table 64 – Timeout and validity test telegram parameters....226
Table 65 – Timeout and validity test reply telegram parameters(ZERO mode)....227
Table 66 – Timeout and validity test reply telegram parameters(KEEP mode)....227
Table 67 – Receiving port IP filtering test....228
Table 68 – Receiving port IP filtering test telegram parameters....228
Table 69 – Receiving port IP filtering test reply telegram parameters....228
Table 70 – DSCP(QOS) and TTL test....229
Table 71 – DSCP(QOS) and TTL test telegram parameters....230
Table 72 – Redundant test....230
Table 73 – Redundant test telegram parameter....230
Table 74 Pull pattern telegram test....231
Table 75 Pull pattern request telegram format content....231
Table 76 Pull pattern reply telegram format content....232
Table 77 Request telegram parameter of pull pattern test....232
Table 78 Reply telegram parameter of pull pattern test....232
Table 79 FCS check test....233
Table 80 FCS check test request parameter....233
Table 81 FCS check test reply parameter....234
Table 82 Protocol version test....235
Table 83 Protocol version test telegram parameter....235
Table 84 Protocol version test telegram parameter....235
Table 85 Requester topology counter test....236
Table 86 – Requester topology counter test telegram parameter....237
Table 87 Subscriber topology counter test....238
Table 88 Subscriber topology counter test....239
Table 89 Receiving port IP filtering test....240
Table 90 Receiving port IP filtering test telegram parameters....240

AVA Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

Table 91 Receiving port IP filtering test reply telegram parameters 240
Table 92 Timeout and validity test 241
Table 93Timeout and validity test telegram parameters 242
Table 94Timeout and validity test reply telegram parameters(ZERO mode) 242
Table 95 Timeout and validity test reply telegram parameters(KEEP mode) 242
Table 96 – Identification of PICS document (part A) 245
Table 97 – Identification of Item Under Test (part B) 245
Table 98 – SDTv2 specific settings (part C) – SDSRC part 245
Table 99 – SDTv2 specific settings (part C) – SDSINK part 246
Table 100 – Configuration and Testing (part D) 246
Table 101 — Identification of PICS 257
Table 102 — Identification of ETB consist under test 258
Table 103 — Identification of consist ETB 258
Table 104 — Identification of consist ETB node 258
Table 105 — Identification of consist ECSP (proxy) 258
Table 106 — Configuration TC1a: single coach coupled to an open train 260
Table 107 — Configuration TC1b: single coach coupled to an open train 260
Table 108 — Configuration TC2a: closed trains 261
Table 109 — Configuration TC2b: locomotive and closed train 261
Table 110 — Configuration TC3: mix open trains and closed trains 261
Table 111 — Testing configurations 262
Table 112 — ECS addressing 263
Table 113 — ECSP control telegram for Leading request 265
Table 114 — ECSP control telegram for inauguration inhibit request 265
Table 115 — ECSP control telegram for sleep request 265
Table 116 — Test sequence for TTDB computation (open train) 266
Table 117 — Test sequence for TTDB computation (closed train) 266

Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRONIC RAILWAY EQUIPMENT – TRAIN COMMUNICATION NETWORK (TCN)

Part 2-8: TCN Conformance Test

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The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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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.

The National Committees are requested to note that for this publication the stability date is 20XX.

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66 # INTRODUCTION

67 TCN is an International Standard with the aim of defining interfaces so as to achieve plug-in
68 compatibility:

69 a) between equipment located in different vehicles or consist, and

70 b) between equipment and devices located within the same vehicle or consist.

71 One of the key success factors for the deployment of any technology is standardisation and
72 ensuring interoperability among various implementations. To facilitate interoperability a
73 conformance test should be implemented.

74 In this part of IEC 61375, the conformance testing of the ECN and ETB defined in IEC 61375-
75 2-3, IEC 61375-2-5 and IEC 61375-3-4 is specified.

76

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ELECTRONIC RAILWAY EQUIPMENT – TRAIN COMMUNICATION NETWORK (TCN)

Part 2-8: TCN Conformance Test

1 Scope

This part of IEC 61375 applies to all equipment and devices implemented according to IEC 61375-2-3, IEC 61375-2-5 and IEC 61375-3-4, i.e. it covers the procedures to be applied to such equipment and devices when the conformance should be proven.

The applicability of this standard to a TCN implementation allows for individual conformance checking of the implementation itself and is a pre-requisite for further interoperability checking between different TCN implementations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60571, *Electronic equipment used on rail vehicles*

IEC 61375-1, *Electronic railway equipment – Train communication network (TCN) – Part 1: General architecture*

IEC 61375-2-3:2015, *Electronic railway equipment – Train communication network (TCN) – Part 2-3: TCN communication profile*

IEC 61375-2-5:2014, *Electronic railway equipment – Train communication network (TCN) – Part 2-5: Ethernet train backbone*

IEC 61375-3-4:2014, *Electronic railway equipment – Train Communication Network (TCN) – Part 3-4: Ethernet Consist Network (ECN)*

IEC 61076-2-101:2012, *Connectors for electronic equipment – Product requirements – Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

IEC 61076-3-104, Connectors for electronic equipment – Product requirements – Part 3-104: Detail specification for 8-way, shielded free and fixed connectors for data transmissions with frequencies up to 1 000 MHz

IEC 61156-6, *MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS – Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification*

ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*

ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts* (Also available as ITU-T Recommendation X.290 (1995))

ISO/IEC 9646-7:1995, *Information technology – Open Systems Interconnection –Conformance testing methodology and framework – Part 7: Implementation Conformance Statements* (Also available as ITU-T Recommendation X.296 (1995))

Documents
Document Sharing Hub
Full document details: E DIN EN IEC 61375-2-8:2019-11

IEEE 802.3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access*

IEEE 802.1AX:2008, *IEEE Standard for Local and metropolitan area networks – Link Aggregation*

IEEE 802.1D:1990, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges*

IEEE 802.1Q, *IEEE Standard for Local and metropolitan area networks – Virtual Bridged Local Area Networks*

3 Terms, definitions, symbols, abbreviated terms and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61375-2-3, IEC 61375-2-5 and IEC 61375-3-4 apply.

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

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

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in IEC 61375-2-3, IEC 61375-2-5 and IEC 61375-3-4 apply.

4 Conformance test: approach, requirements and boundaries

4.1 The approach

This standard specifies a general methodology for testing the conformance to the TCN protocol standard of products in which the standard is claimed to be implemented.

This standard is organised into clauses structured into different phases of the conformance testing process, these phases being characterised by the following roles:

a) the specification of abstract test suites for particular TCN protocols according to ISO/IEC 9646-1;

b) the derivation of executable test suites and associated testing tools according to ISO/IEC 9646-7;

Annex A specifies the rules on clients and laboratory specifying:

c) the role of a client of a test laboratory, having an implementation of TCN protocols to be tested;

d) the operation of conformance testing, culminating in the production of a conformance test report which gives the results in terms of the test suite(s) used and the relevant documentation produced.

In all clauses of this standard, the scope is limited in order to meet the following objectives:

e) to achieve an adequate level of confidence in the tests as a guide to conformance;

f) to achieve comparability between the results of the corresponding tests applied in different places at different times;

g) to facilitate communication between the parties responsible for the roles described above.

Each objective involves the framework for development of TCN test suites, as listed hereinafter:

h) how they should relate to the various types of conformance requirement;

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i) the types of test to be standardised and the types not needing standardisation;

j) the criteria for selecting tests for inclusion in a conformance test suite;

k) the notation to be used for defining tests;

l) the structure of a test suite.

Certification, an administrative procedure which may follow conformance testing, is outside the scope of this standard.

Requirements for procurement and contracts are outside the scope of this standard.

4.1.1 Requirements

4.1.1.1 General

In the context of TCN, a real system is said to exhibit conformance if it complies with the requirements of applicable TCN standard clauses in its communication with a reference system, i.e. the tester.

A TCN standard is a set of interrelated clauses which, together, define behaviour of TCN systems in their communication. Conformance of an IUT will, therefore, be expressed at two levels, conformance to each individual clause, and conformance to the set of clauses.

The following clauses define the conformance requirements and classify them according to attributes and into feasible groups. Attributes and grouping are defined from the general point of view with reference to a TCN specification itself and from the IUT point of view. In the second case, the requirement shall be declared in the appropriate PICS and PIXIT.

4.1.1.2 Conformance requirements

The conformance requirements can be:

a) mandatory requirements: these are to be observed in all cases;

b) conditional requirements: these are to be observed if the conditions, set out in the clause, apply;

c) options: these can be selected to suit the implementation, provided that any requirements applicable to the option are observed.

TCN essential functionality are mandatory requirements; additional functionality can be either conditional or optional requirements.

Furthermore, conformance requirements in a Part can be stated:

d) positively: they state what shall be done;

e) negatively (prohibitions): they state what shall not be done.

f) Finally, conformance requirements fall into two groups:

g) static conformance requirements;

h) dynamic conformance requirements;

these are discussed in 4.1.1.3 and 4.1.1.4, respectively.

4.1.1.3 Static conformance requirements

To facilitate interoperability static conformance requirements, define the allowed minimum capabilities of an implementation. These requirements may be at a broad level, such as the grouping of functional units and options into protocol classes, or at a detailed level, such as a range of values that have to be supported for specific parameters of timers.

Static conformance requirements and options in TCN parts can be of two varieties:

a) those which determine the capabilities to be included in the implementation of the particular protocol;

b) those which determine multi-layer dependencies, for example those which place constraints on the capabilities of the underlying layers of the system in which the protocol

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implementation resides. These are likely to be found in upper layer parts (e.g. network management vs real time protocols).

All capabilities not explicitly stated as static conformance requirements are to be regarded as optional.

4.1.1.4 Dynamic conformance requirements

Dynamic conformance requirements are all those requirements (and options) which determine what observable behaviour is permitted by the relevant TCN part in instances of communication. They form the bulk of each TCN protocol document. They define the set of allowable behaviours of an implementation or real system. This set defines the maximum capability that a conforming implementation or real system can have within the terms of the TCN protocol document.

A system exhibits dynamic conformance in an instance of communication if its behaviour is a member of the set of all behaviours permitted by the relevant TCN protocol part in a way which is consistent with the PICS.

4.1.1.4.1 A conforming system

A conforming system or implementation is one which is shown to satisfy both static and dynamic conformance requirements, consistent with the capabilities stated in the PICS, for each protocol declared in the system conformance statement.

4.1.1.4.2 Interoperability and conformance

The primary purpose of conformance testing is to increase the probability that different implementations are able to inter-operate.

Successful interoperability of two or more real open systems is more likely to be achieved if they all conform to the same subset of a TCN part, or to the same selection of TCN parts, than if they do not.

To prepare two or more systems to successfully inter-operate, it is recommended that a comparison is made of the system conformance statements and PICSs of these systems.

If there is more than one version of a relevant TCN part indicated in the PICSs, the differences between the versions need to be identified and their implications for consideration, including their use in combination with other parts.

While conformance is a necessary condition, it is not on its own a sufficient condition to guarantee interoperability capability. Even if two implementations conform to the same TCN protocol part, they may fail to interoperate because of factors outside the scope of this standard.

Trial interoperability is recommended to detect these factors. Further information to assist interoperability between two systems can be obtained by extending the PICS comparison to other relevant information, including test reports and PIXIT. The comparison can focus on:

a) additional mechanisms claimed to work around known ambiguities or deficiencies not yet corrected in the TCN standard or in peer real systems, for example solution of multi-layer problems;

b) selection of free options which are not taken into account in the static conformance requirements of the TCN parts;

c) the existence of timers not specified in the TCN parts and their associated values.

NOTE The comparison can be made between two individual systems, between two or more types of product, or, for the PICS comparison only, between two or more specifications for procurement, permissions to connect, etc.

4.1.2 Requirements declaration statements for an IUT

4.1.2.1 Protocol implementation conformance statement (PICS)

To evaluate the conformance of a particular implementation, it is necessary to have a statement of the capabilities and options which have been implemented, and any features which have been omitted, so that the implementation can be tested for conformance against

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relevant requirements, and against those requirements only. Such a statement is called a Protocol Implementation Conformance Statement (PICS).

In a PICS there should be a distinction between the following categories of information which it may contain:

a) information related to the mandatory, optional and conditional static conformance requirements of the protocol itself;

b) information related to the mandatory, optional and conditional static conformance requirements for multi-layer dependencies.

If a set of interrelated TCN protocol has been implemented in a system, a PICS is needed for each protocol. A system conformance statement will also be necessary, summarising all protocols in the system for each of which a distinct PICS is provided.

4.1.2.2 Protocol implementation extra information for testing (PIXIT)

In order to test a protocol implementation, the test laboratory will require information relating to the IUT and its testing environment in addition to that provided by the PICS. This "Protocol Implementation eXtra Information for Testing" (PIXIT) will be provided by the client submitting the implementation for testing, as a result of consultation with the test laboratory.

The PIXIT may contain the following information:

a) information needed by the test laboratory in order to be able to run the appropriate test suite on the specific system (e.g. information related to the test method to be used to run the test cases, addressing information);

b) information already mentioned in the PICS and which needs to be made precise (e.g. a timer value range which is declared as a parameter in the PICS should be specified in the PIXIT);

c) information to help determine which capabilities stated in the PICS as being supported are testable and which are untestable;

d) other administrative matters (e.g. the IUT identifier, reference to the related PICS).

The PIXIT should not conflict with the appropriate PICS.

The abstract test suite specifier, test implementer and test laboratory will all contribute to the development of the PIXIT pro-forma.

4.2 Boundaries

4.2.1 General

Conformance testing as discussed in this standard is focused on testing for conformance to TCN clauses as they are specified in IEC 61375-2-3, IEC 61375-2-5 and IEC 61375-3-4.

In principle, the objective of conformance testing is to establish whether the implementation being tested conforms to the specification in the relevant clause. Practical limitations make it impossible to be exhaustive, and economic considerations may restrict testing still further.

Therefore, this standard distinguishes four types of testing, according to the extent to which they provide an indication of conformance:

a) basic interconnection tests, which provide prima facie evidence that an IUT conforms;

b) capability tests, which check that the observable capabilities of the IUT are in accordance with the static conformance requirements and the capabilities claimed in the PICS;

c) behaviour tests, which endeavour to provide testing which is as comprehensive as possible over the full range of dynamic conformance requirements within the capabilities of the IUT;

d) conformance resolution tests, which probe in depth the conformance of an IUT to particular requirements, to provide a definite yes/no answer and diagnostic information in relation to specific conformance issues; such tests are not covered by this standard.

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Full document details: E DIN EN IEC 61375-2-8:2019-11

The tests a), b), c) and d) are described in detail by the following subclauses.

Relations to interoperability and performance are hereinafter considered and defined to clarify their boundaries.

4.2.2 Basic interconnection tests

Basic interconnection tests provide limited testing of an IUT to establish that there is sufficient conformance for interconnection to be possible, without trying to perform thorough testing.

4.2.2.1 Applicability of basic interconnection tests

Basic interconnection tests are appropriate:

a) for detecting severe cases of non-conformance;

b) as a preliminary filter before undertaking more costly tests;

c) to give a prima facie indication that an implementation which has passed full conformance tests in one environment still conforms in a new environment (e.g. before testing an (N)-implementation, to check that a tested (N – 1)-implementation has not undergone any severe change due to being linked to the (N)-implementation);

d) for use by users of implementations, to determine whether the implementations appear to be usable for communication with other conforming implementations, for example as a preliminary to data interchange.

Basic interconnection tests are inappropriate:

e) as a basis for claims of conformance by the supplier of an implementation;

f) as a means of arbitration to determine causes for communications failure.

Basic interconnection tests are standardised a subset of a conformance test suite (including capability and behaviour tests). They can be used on their own or together with a conformance test suite. The existence and execution of basic interconnection tests are optional.

4.2.3 Capability tests

Capability tests provide limited testing of each of the static conformance requirements in a Part, to ascertain what capabilities of the IUT can be observed and to check that those observable capabilities are valid with respect to the static conformance requirements and the PICS.

4.2.3.1 Applicability of capability tests

Capability tests are appropriate:

a) to check as far as possible the consistency of the PICS with the IUT;

b) as a preliminary filter before undertaking more in-depth and costly testing;

c) to check that the capabilities of the IUT are consistent with the static conformance requirements;

d) to enable efficient selection of behaviour tests to be made for a particular IUT;

e) when taken together with behaviour tests, as a basis for claims of conformance.

f) Capability tests are inappropriate:

g) on their own, as a basis for claims of conformance by the supplier of an implementation;

h) for testing in detail, the behaviour associated with each capability which has been implemented or not implemented;

i) for resolution of problems experienced during live usage or where other tests indicate possible non-conformance even though the capability tests have been satisfied.

Capability tests are standardised within a conformance test suite. They can either be separated into their own test group(s) or merged with the behaviour tests.

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4.2.4 Behaviour tests

Behaviour tests test an implementation as thoroughly as is practical, over the full range of dynamic conformance requirements specified in a Part. Since the number of possible combinations of events and timing of events is infinite, such testing cannot be exhaustive. There is a further limitation, namely that these tests are designed to be run collectively in a single test environment, so that any faults which are difficult or impossible to detect in that environment are likely to be missed. Therefore, it is possible that a non-conforming implementation passes the conformance test suite; one aim of the test suite design is to minimise the number of times that this occurs.

Behaviour tests with capability tests are the basis for the conformance assessment process.

Behaviour tests are inappropriate:

a) for resolution of problems experienced during live usage or where other tests indicate possible non-conformance even though the behaviour tests have been satisfied.

Behaviour tests are standardised as the bulk of a conformance test suite.

NOTE Behaviour tests include tests for valid behaviour by the IUT in response to valid, inopportune and syntactically invalid protocol behaviour by the real tester. This includes testing the rejection by the IUT of attempts to use features (capabilities) which are stated in the PICS as being not implemented. Thus, capability tests do not need to include tests for capabilities omitted from the PICS.

4.2.5 Conformance resolution tests

Conformance resolution tests provide diagnostic answers, as near to definitive as possible, to the resolution of whether an implementation satisfies particular requirements. Because of the problems of exhaustiveness, the definite answers are gained at the expense of confining tests to a narrow field.

The test architecture and test method will normally be chosen specifically for the requirements to be tested and need not be ones that are generally useful for other requirements. They may even be ones that are regarded as being unacceptable for (standardised) abstract conformance test suites, for example involving implementation-specific methods using, say, the diagnostic and debugging facilities of the specific operating system.

The distinction between behaviour tests and conformance resolution tests may be illustrated by the case of an event such as a reset. The behaviour tests may include only a representative selection of conditions under which a reset might occur and may fail to detect incorrect behaviour in other circumstances. The conformance resolution tests would be confined to conditions under which incorrect behaviour was already suspected to occur and would confirm whether or not the suspicions were correct.

Conformance resolution tests are appropriate:

a) for providing a yes/no answer in a strictly confined and previously identified situation (e.g. during implementation development, to check whether a particular feature has been correctly implemented, or during operational use, to investigate the cause of problems);

b) as a means for identifying and offering resolutions for deficiencies in a current conformance test suite.

Conformance resolution tests are inappropriate

c) as a basis for judging whether or not an implementation conforms overall.

Conformance resolution tests are not standardised. As a by-product of conformance testing, errors and deficiencies in protocol parts may be identified.

4.2.6 Interpretation of clauses/subclauses and statements

The TCN described in IEC 61375-2-3, IEC 61375-2-5 and IEC 61375-3-4 is subject to a sort of interpretation to translate some clauses/subclauses and requirements into realisable test suites. The complexity of most TCN protocols makes exhaustive testing impractical on both technical and economic grounds. To cope with a real implementation and extract from in IEC

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61375-2-3, IEC 61375-2-5 and IEC 61375-3-4, all the relevant tests and some criteria were used. The criteria were grouped according to their characteristics:

a) imperatives;
b) illustrative;
c) directives;
d) options;
e) weak phrases.

The following subclauses describe the criteria.

4.2.6.1 Imperatives

Imperatives are those words and phrases commanding that something shall be provided and are classified as mandatory. They are:

a) shall: dictates the provision of a functional capability;
b) must: establishes performance requirements or constraints; :
c) is required: is a specification statement written in the passive voice;
d) is applicable: includes, by reference, standards or other documentation as an addition to the requirements being specified;
e) responsible for: is a requirement written for architectures already defined. As an example, " In extended reply delay applications, the master is responsible for spacing the master frames so that the minimum time to transmit to a slave frame and the following master frame is greater than T_safe.";
f) will: is generally used to cite things that the operational or development environment are to provide to the capability being specified. For example, " If it was a strong master, it will signal its demoting to all nodes and it will remain in control of the bus as a weak master until a strong node is appointed";
g) should: when it is used, the specification statement is considered to be very weak. For example, " Devices supporting the message data capability should have a device address smaller than 256.".

4.2.6.2 Continuance

Phrases that follow an imperative and introduce the specification of requirements at a lower level, for a supplemental requirement count.

a) as follows,
b) below,
c) following,
d) in particular,
e) listed,
f) support.

Phrases that introduces temporal indication, that may lead to definite or indefinite actions, or enumerative that may lead to infinite test cases.

g) for each,
h) while.

The requirement containing temporal or enumerative is tested with a finite time or finite sample.

4.2.6.3 Illustrative

This is information within the requirements document. The data and information pointed to by illustrative strengthens the document's specification statements and whenever possible is used as sample category input for the test. Namely:

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Full document details: E DIN EN IEC 61375-2-8:2019-11

a) figure;

b) table;

c) for example;

d) note.

4.2.6.4 Options

Options is the category of words that give the developer latitude in satisfying the specification statements that contain them. This category clearly forms the basis for the option statements declaration into the PICS. However, those requirements containing such a category of words loosen the specification, increase the risk of non-interoperability, and widen the tests sets.

a) can (Example: Gateways with Bus_Administrator capability can synchronise the busses.);

b) may (Example: Class 5 devices may offer the Bus_Administrator capability.);

c) optionally (Example: The User_Programmable capability is optional.);

d) exclusion (Example: while the IUT is naming the nodes, one node responds to the naming frame but not to the status request or sends a wrong naming response frame).

Options shall drive the PICS production.

4.2.6.5 Weak statements

Weak statements are apt to cause uncertainty leaving room for multiple interpretations, such wording provides a basis for expanding a requirement or adding future requirements. For the extent of testing, this category generates test with test cases chosen among a representative set of samples. However, by no means such sets fully represent all significant cases foreseen by the clause under test.

a) adequate,

b) be able to,

c) be capable,

d) effective,

e) normal,

f) provide for.

4.2.7 Relation to interoperability

One of the aims of this conformance test is to lead to comparability and wide acceptance of test results produced by different testers, and thereby minimise the need for repeated conformance testing of the same system. Interoperability plays a principal role, since the conformance test is aimed to facilitate interoperability, it has been taken into account with the following domains in Table 1:

Table 1 – Relation to interoperability

Domain	Description
Application interoperability	the ability of TCN to provide a consistent implementation of the syntax and semantics of the data which are interchanged
Protocol interoperability	the ability of TCN to interchange PDUs via the communications platform
Service interoperability	the ability of TCN to support a subset of its intended services
User perceived interoperability	the ability of the service user (human, application, machine) to exchange information via the TCN

No provision is made in this standard to implement or recommend an interoperability test.

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Full document details: E DIN EN IEC 61375-2-8:2019-11

4.2.8 Relation to performance test

Performance attributes relate deeply on services given by the TCN, even though this conformance test does not intend to implement a performance test, nevertheless performance attributes were taken into account in the following way in Table 2:

Table 2 – Relation to performance test

Performance Attribute	Description
Speed	This performance attribute describes the time interval that is used to perform the function or the rate at which the function is performed. (The function may or may not be performed with the desired accuracy.). An example of speed attribute evaluation is: freshness time supervision test
Accuracy	This performance attribute describes the degree of correctness with which the function is performed, no matter if the function is or is not performed with the desired speed. An example of accuracy evaluation is: the receiver hysteresis test
Dependability	This performance attribute describes the degree of certainty (or surety) with which the function is performed regardless of speed or accuracy, but within a given observation interval. An example of dependability attribute evaluation is: Connection stability for the entire inauguration time

No provision is made in this standard to implement or recommend a performance test as it is defined by IEC 60571.

4.2.9 Definition of test cases

Test cases and inspection items derived from the requirements and outlined in this document can be categorized into verification activities, measurement activities and test activities. The characteristics of these activities are defined in Table 3.

Table 3 – Test case categories

Category	Description	Keywords	Example
Verification activities	Verification of procedures, processes and documents	verification, verify	“Verify that …”
Measurement activities	Measurement of physical quantities (e.g. size, distance, voltage, current, temperature, time)	measurement, measure	“Measure the ….”
Test activities	Check of properties	test, check	“Check that …” “Test the …”

4.3 Conformance assessment process outline

4.3.1 General

The main feature of the conformance assessment process is a configuration of equipment allowing exchanges of information between the IUT and a real tester. These are controlled and observed by the real tester.

In a conceptual outline, conformance testing should include several steps, involving both static conformance reviews and live testing phases, culminating in the production of a test report which is as thorough as is practical.

These steps are:

- compilation of the PICS;
- compilation of the PIXIT;
- test selection and parameterisation;

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- basic interconnection testing (optional);
- capability testing;
- behaviour testing;
- review and analysis of test results;
- synthesis, conclusions and conformance test report production.

4.3.2 Analysis of results, outcomes and verdicts

The observed outcome (of the test execution) is the series of events which have occurred during execution of a test case; it includes all input to and output from the IUT at the points of control and observation.

The foreseen outcomes are identified and defined by the abstract test case specification taken in conjunction with the protocol part. For each test case, there may be one or more foreseen outcomes. Foreseen outcomes are defined primarily in abstract terms.

A verdict is a statement of pass, fail or inconclusive to be associated with every foreseen outcome in the abstract test suite specification.

The analysis of results is performed by comparing the observed outcomes with foreseen outcomes.

The verdict assigned to an observed outcome is that associated with the matching foreseen outcome. If the observed outcome is unforeseen then the abstract test suite specification will state what default verdict shall be assigned.

The means by which the comparison of the observed outcomes with the foreseen outcomes is made is outside the scope of this standard.

NOTE Amongst the possibilities are:

a) manual or automated comparison (or a mixture);

b) comparison at or after execution time;

c) translating the observed outcomes into abstract terms for comparison with the foreseen outcomes or translating the foreseen outcomes into the terms used to record the observed outcomes.

The verdict will be pass, fail or inconclusive:

d) pass means that the observed outcome satisfies the test purpose and is valid with respect to the relevant TCN parts and with respect to the PICS;

e) fail means that the observed outcome is syntactically invalid or inopportune with respect to the relevant TCN parts or the PICS;

f) inconclusive means that the observed outcome is valid with respect to the relevant TCN parts but prevents the test purpose from being accomplished.

The verdict assigned to a particular outcome will depend on the test purpose and the validity of the observed protocol behaviour.

The verdicts made in respect of individual test cases will be synthesised into an overall summary for the IUT based on the test cases executed.

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Full document details: E DIN EN IEC 61375-2-8:2019-11

560 ### 4.4 Mapping of IUT types to conformance test suites

561 Because this part of the standard defines conformance testing suites applicable for different
562 IUT types, a mapping of IUT types to conformance test suites will indicate which test suites
563 are mandatory or optional as it is listed in Table 4.

564 **Table 4 — Mapping conformance testing suites to IUT types**

Conformance Test DuT Type	Basic interface test	End Device test	ECN equipped consist test	ETBN test	TRDP test	SDTv2 test	ETB-equipped consist test
Consist local end device	M	O					
Train communication end device	M				O	O	
Train topology aware end device	M	O			M	O	
Repeater	M		O				
Unmanaged consist switch	M		O				
Managed consist switch	M		O				
Router	M		O				
ETBN	M		O[1)]	M	M[1)]	M[1)]	
Consist							M

565 O = optional; M = mandatory

566 [1)] If ETBN includes ECSP

567

568

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Full document details: E DIN EN IEC 61375-2-8:2019-11

5 Basic interface test

5.1 Scope

This clause shall specify conformance test cases for physical layer functions and basic communication for devices connected to ECN or ETB as given in standard parts IEC61375-2-5 and IEC61375-3-4.

5.2 PICS Proforma

5.2.1 General

The PICS provides a statement of the capabilities and options which have been implemented, and any features which have been omitted, see 4.1.2.1. Instructions about filling the PICS pro-forma are given in Annex B.

5.2.2 PICS tables

5.2.2.1 Identification of PICS

The following Table 5 is intended to be filled in in order to identify the PICS pro-forma.

Table 5 – PICS pro-forma identification

Ref. No.	Question	Response
1	Date of statement	
2	PICS serial number	

5.2.2.2 Identification of the implementation under test

The following Table 6 shall be filled in to identify the implementation under test.

Table 6 – PICS pro-forma implementation under test

Ref. No.	Question	Requirement	Response
1	Implementation name	m	
2	Version number	m	
3	Special configuration	o	
4	Power supply voltage	m	
5	Power supply current	m	
6	Other information	o	

NOTE 1 Implementation name refers to the identifier of the IUT as indicated by the client. The specific conformance test is applied to the entity identified by the implementation name.

NOTE 2 This is the version number of the IUT. When a version number is defined for an IUT, no subsystem which composes it can progress without a change of this figure (the architecture is frozen and constitutes a configuration).

NOTE 3 Indicated if PIXIT is provided for this IUT.

NOTE 4 Indicated the applicable power supply voltage. Power supply voltage is chosen amongst the values specified by IEC 60571.

NOTE 5 Indicated the applicable maximum power supply current. Power supply current is chosen amongst the values specified by IEC 60571.

NOTE 6 Other information the client considers relevant for IUT identification.

5.2.2.3 Identification of the IUT supplier and/or test laboratory client

The following Table 7 shall be filled in to identify the IUT supplier and the test laboratory client.

If the IUT supplier and the test laboratory client are not the same entity, the PICS shall be agreed between the supplier and the test laboratory client.

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Full document details: E DIN EN IEC 61375-2-8:2019-11

593 **Table 7 – PICS pro-forma IUT supplier and/or test laboratory client**

Ref. No.	Question	Requirement	Response
1	Organisation name	m	
2	Contact name(s)	m	
3	Address:	m	
4	Telephone number	m	
5	Fax number	m	
6	e-mail address	m	
7	Other information	m	

594

595 #### 5.2.2.4 Identification of the standards

596 The following Table 8 shall be filled in to identify the Standards applied to the IUT for the
597 conformance test.

598 **Table 8 – PICS pro-forma identification of the standards**

Ref.No.	Question	Response
1	Specification document title	
2	Specification document IEC reference number	
3	Specification document date of publication	
4	Specification document version number	
5	Conformance document title	
6	Conformance document number	
7	Conformance document date of publication	
8	Conformance document version number	

599

600 #### 5.2.2.5 Global statement of conformance

601 The Table 9 shall be filled by the IUT supplier in the “Implementation” column

602 **Table 9 – PICS pro-forma global statement of conformance**

Ref. No.	Question	Requirement	Implementation
1	Are all mandatory capabilities implemented?	m	[ ]

603
604 NOTE Answering "No" to this section indicates non-conformance to the protocol specification. Non-supported
605 mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-
606 conforming.

607 ### 5.3 Testing framework

608 The test is executed in a set-up with an instrumented IUT providing one or more Ethernet
609 interfaces, a tester equipment for Ethernet/IP/UDP/TCP frame sending and receiving, a 100m
610 railway suitable Ethernet cable connecting IUT and tester equipment, and necessary
611 measurement instruments.

612 ### 5.4 Physical layer test

613 #### 5.4.1 Test purpose

614 Test the correctness of mechanical and electrical parameters of the physical layer network
615 interface.

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5.4.2 Inspection of the Hardware Ethernet interface

Compliance with the physical layer requirements as specified in IEC61375-3-4 clause 4.10.2.1, 4.10.3 and IEC61375-2-5 clause 4.2.2 shall be demonstrated by the following test:

a) Check that the physical Ethernet interface of the IUT is set to 100FDX

b) Check that the IUT has a MAC address set on delivery. (The MAC address shall be unique worldwide)

c) Optional: check that the IUT supports Power over Ethernet (PoE)

d) Check that ETB ports are bypassed via relays

e) Check that the IUT has an indicator (e.g. LED) which indicates the status of the device power supply on the front panel.

f) Check that the IUT support 100m cable length over CAT5e cables

g) Check that a single point of failure from the IUT not disables more than the affected end devices (for example by executing burst test, sub-clause 5.6.2)

5.4.3 Inspection of the mechanical Ethernet interface construction

Compliance with the physical layer mechanical requirements as specified in IEC61375-3-4 clause 4.10.2.2, 4.10.2.3 and 4.10.2.4 shall be demonstrated by the following test:

a) Check that the IUT uses a M12 D-coded female connector with gold plated contacts

b) Check that the M12 D-coded connector is located at the front panel

c) Check that the M12 socket has an adequate ground connection providing lasting connection of the shield to ground

d) Check that the IUT internal Ethernet signal path (length and characteristics of internal Ethernet cabling, number of intermediate connectors) is documented

e) Check that all connectors are labelled, also the ground connector (see IEC 60571)

f) Check that the M12 and the casing screws are tightened

g) Check that the cable shield and the connector shield are connected to the mechanical earth of the car. A cable shield should be connected on a 360° circular basis in the connector.

h) Check that a RJ45 connector is only used for connecting Temporary End Devices

5.4.4 Check of electrical Ethernet interface design

a) Check that the temperature range class OT6 according to IEC 60571 (-40 to +85°C) for electronic parts is used

b) Check that the transceiver (PHY) and the transformer is compliant to IEEE802.3

c) Check the correct Ethernet termination and common mode rejection

5.4.5 Check of Ethernet interface characteristics

a) Measure that the single link pulse meets the waveform requirements from IEEE 802.3

b) Measure that the fast link pulse burst indicates, that the interface supports at least 100FDX (optional, if Auto Negotiation is used)

c) Check that all features which are specified by the fast link pulse burst code have to supported by the IUT

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655 **5.4.6 Ethernet signal wave form test (IEEE standard)**

656 Measure that the Ethernet signal parameters

657 • Amplitude incl. symmetry

658 • Rise and fall times

659 • Duty cycle distortion

660 • Transmitter jitter waveform overshoot

661 are in the ranges, which are specified in the standard IEEE 802.3.

662 **5.4.7 Ethernet signal wave form test (amplified signals, optional)**

663 Compliance with the Ethernet signal wave form test which is specified in IEC61375-3-4 Annex
664 C:

665 Measure that the Ethernet signal parameters

666 • Amplitude incl. symmetry

667 • Rise and fall times

668 • Duty cycle distortion

669 • Transmitter jitter waveform overshoot

670 are in the specified ranges.

671 **5.4.8 Auto-Crossover- and Auto-Sensing-Test (only for switches)**

672 Check that the IUT perform Auto-Crossover and Auto-Sensing.

673 **5.5 Basic communication protocol test**

674 **5.5.1 Test purpose**

675 Test the ability of sending and receiving UDP and TCP packets

676 **5.5.2 Simple communication test**

677 This measurement shall be executed with a cable length of 100m, which are specified in the
678 standard IEEE802.3

679 a) Measure that the IUT supports UDP communication.

680 b) Measure that the IUT supports TCP communication.

681 **5.5.3 UDP rising payload test (only for End Devices)**

682 This measurement shall be executed with a cable length of 100m, which are specified in the
683 standard IEEE802.3

684 a) Measure the maximum supported payload size for UDP datagrams.

685 b) Check that the IUT handles a payload size of minimum 8kByte.

686 **5.5.4 TCP rising payload test (only for End Devices)**

687 This measurement shall be executed with a cable length of 100m, which are specified in the
688 standard IEEE802.3

689 a) Measure the maximum supported payload size for TCP datagrams

690 **5.5.5 UDP long term test (only for End Devices)**

691 This measurement shall be executed with a cable length of 100m, which are specified in the
692 standard IEEE802.3

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a) Measure that the IUT communication with 100m cable length is stable over a time of 60 minutes

b) Measure that the long-term test will be done with the maximum supported payload size (maximum 32kByte)

c) Measure that the error rate is below 10^{-6} (1 error per 1 million frames)

5.6 Reliability tests

5.6.1 Test purpose

Test the reliability of the communication under railway specific stress conditions.

5.6.2 Burst immunity test

These measurements shall be executed with a cable length of 100m, which are specified in the standard IEEE802.3

a) Measure that the Ethernet port is stable against EMC stress with fast transients (bursts) according to EN 61000-4-4

b) Check that more than 40000 frames are transmitted and received from IUT

5.6.3 Ethernet interface isolation test

a) Measure that the signals are isolated against the shielding

b) Measure that are all ports isolated against each other

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6 Conformance test of End Device

6.1 General

This clause defines conformance requirements for conformance testing for end devices as given in standard parts IEC61375 2-3, IEC61375 2-5 and IEC61375 3-4.

Those requirements are used to derive test suites and test cases in order to determine whether a system, in this case, a unit connected to one Consist Network or to one set of Consist Networks, complies with the requirements.

The figure below gives an overview about the End Device conformance testing process.

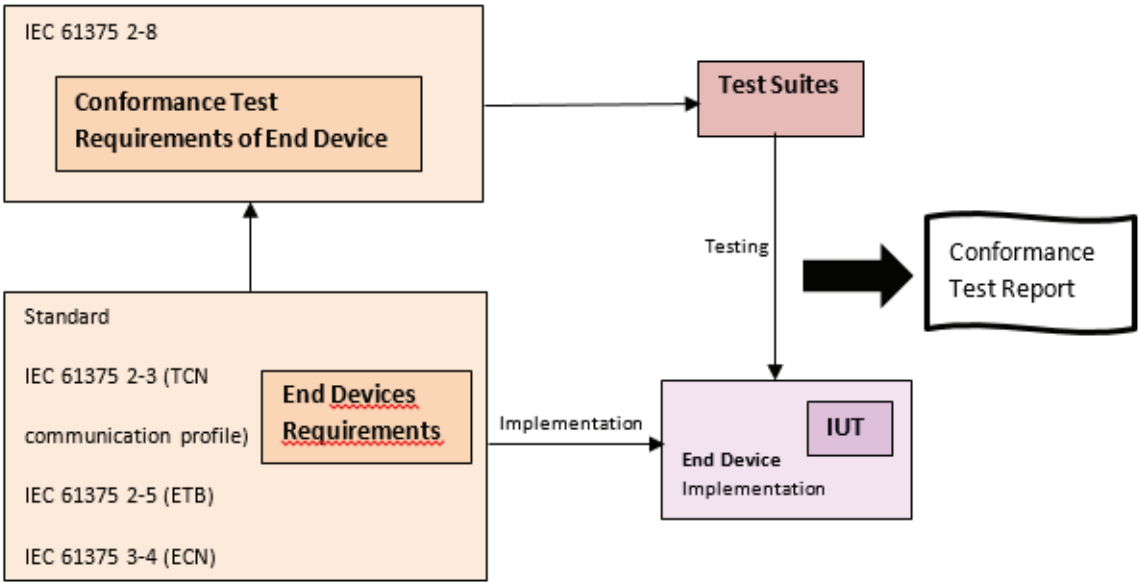

Figure 1 – End Device conformance testing process

6.2 Related requirements

As given in standard parts IEC61375 2-3, IEC61375 2-5 and IEC61375 3-4.

6.3 IUT and Test scope

The Implementation Under Test (IUT) is which implements the base standard(s) being tested, so in this clause, the end device (ED).

The end device is a unit that could be connected to one Consist Network or to one set of Consist Networks prepared for redundancy reasons. However, the end device could be connected directly to ETBN (Ethernet Train Backbone Node).

The following figure shows a consist topology and a logical view of the ECN, in order to clarify where is located an end device.

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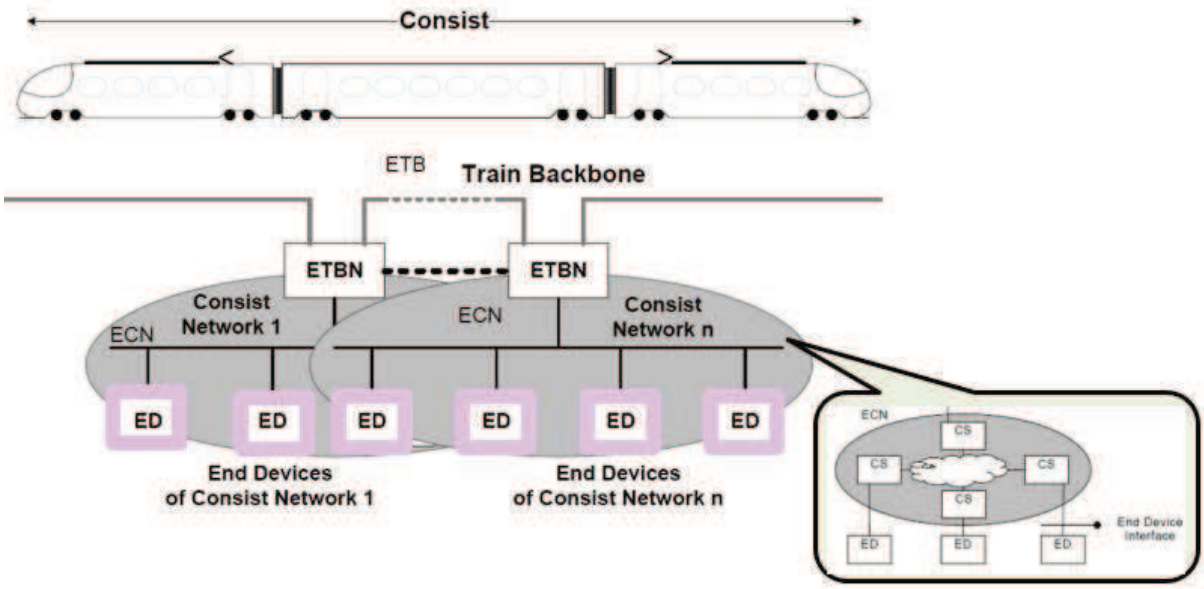

731

732 **Figure 2: End Device conformance testing process**

733 ## 6.4 PICS PROFORMA

734 This section defines what mandatory, optional or conditional features of the protocol are met.
735 PICS are filled by the supplier and distributed. So, a user can consult the PICS to determine if
736 it meets his or her requirements.

737 PICS are organised in tables which included those columns:

738 - Item number: Identification of the item.

739 - Item description: Description of the item.

740 - Reference: The section of the standard.

741 - Req.: Related requirement.

742 - Status: The level of support required for the standard.

743 The following abbreviations are used:

744 • M: mandatory

745 • O: optional

746 • C: conditional

747 - Support: Whether the item has been implemented

748 • Yes, the item has been implemented.

749 • No, the item has not been implemented.

750 ### 6.4.1 PICS related to IEC61375 2-3

751 **Common ETB Framework - Interoperability**

Item number	Item description	Reference	Req.	Status	Support
23ED_001	Follows a versioning scheme	5.1.2	Req36	M	Yes [] No []

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Full document details: E DIN EN IEC 61375-2-8:2019-11

752

753 **Common ETB Framework – Service Addressing**

Item number	Item description	Reference	Req.	Status	Support
23ED_002	Entities identified by TCN Domain Names	5.4.3	Req69	M	Yes [] No []
23ED_003	Sources/Destinations identified by TCN URI Identifier	5.4.4.3 5.4.4.6	Req72 Req75-Req78	M	Yes [] No []
23ED_004	- TCN URI User part	5.4.4.5	Req366	O	Yes [] No []
23ED_005	- Closed trains identification	5.4.4.6.5	Req367	O	Yes [] No []
23ED_006	IP routing in networks with multiple ETBs	5.4.5.5	Req84	M	Yes [] No []
23ED_007	Usage TRDP for data exchange	5.6.2	Req99	M	Yes [] No []
23ED_008	Service discovery	5.7	Req103	M	Yes [] No []

754

755 **TRDP (Train Real-Time Data Protocol)**

Item number	Item description	Reference	Req.	Status	Support
23ED_009	TRDP for the Exchange of TCN process data and TCN message data over ETB	AnnexA	Req152-Req245	M	Yes [] No []

756

757 **SDTv2 (Safe Data Transmission)**

Item number	Item description	Reference	Req.	Status	Support
23ED_010	SDTv2	AnnexB	Req248-Req363	M	Yes [] No []

758

759 ### 6.4.2 PICS related to IEC61375 2-5

760 **ETB physical layer**

Item number	Item description	Reference	Req.	Status	Support

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Full document details: E DIN EN IEC 61375-2-8:2019-11

25ED_001	PSE (Power Source Equipment) connected to a PD (Powered Device)	4.3	Req18	O	Yes [] No []

761

762 **ETB network layer: IPv4 subnets definition**

Item number	Item description	Reference	Req.	Status	Support
25ED_002	Particular hosts IP addresses	6.5.2 6.5.3	Req81, Req83	M	Yes [] No []

763

764 **ETB transport layer**

Item number	Item description	Reference	Req.	Status	Support
25ED_003	ICMP Internet Control Message Protocol IETF RFC 792	7	Req105	M	Yes [] No []
25ED_004	IGMP v2 Internet Group Management Protocol IETF RFC 2236	7	Req105	M	Yes [] No []
25ED_005	UDP User Datagram Protocol IETF RFC 768	7	Req105	M	Yes [] No []
25ED_006	TCP Transmission Control Protocol IETF RFC 793	7	Req105	M	Yes [] No []

765

766 **ETB physical train naming convention**

Item number	Item description	Reference	Req.	Status	Support
25ED_007	Hosts identified by a FQDN (Full Qualified Domain Name)	10	Req206-Req216	O	Yes [] No []

767

768 **ETB Application interface**

Item number	Item description	Reference	Req.	Status	Support
25ED_008	ETB Process Data and Message Data protocols	13.3	Req240	M	Yes [] No []

769

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6.4.3 PICS related to IEC61375 3-4

Architecture (Network structure)

Item number	Item description	Reference	Req.	Status	Support
34ED_001	Ethernet ports according with IEEE 802.3.	4.2.1	Req7	M	Yes [] No []

Redundancy

Item number	Item description	Reference	Req.	Status	Support
34ED_002	Redundancy managed at End Device level	4.5.4	Req25, Req26	M	Yes [] No []

IP address and related definitions – Consist Network address

Item number	Item description	Reference	Req.	Status	Support
34ED_003	IP address(es) as Consist Network address(es)	4.7.1	Req43	M	Yes [] No []
34ED_004	Unique Consist Network address	4.7.1	Req 44	M	Yes [] No []
34ED_005	IPv4 private address space defined in IETF RFC1918	4.7.1	Req45	M	Yes [] No []
34ED_006	Addresses follow this binary presentation: 00001010.0ddddddd.dddddddd .dddddddd / 9 Field [d] is defined in the table of subclause 4.7.1.	4.7.1	Req46	M	Yes [] No []

IP address and related definitions – Train Network address

Item number	Item description	Reference	Req.	Status	Support
34ED_007	IP address(es) as Train Network address(es)	4.7.2	Req49	M	Yes [] No []
34ED_008	IPv4 private address defined in IETF RFC 1918	4.7.2	Req51	M	Yes [] No []

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34ED_009	Addresses follow the definitions in IEC 61375-2-5	4.7.2	Req52	M	Yes [] No []
34ED_010	Addresses follow this binary presentation: 00001010.1bbxssss.sshhhhhh.hhhhhhhh / 18 The fields are defined in the table of subclause 4.7.2.	4.7.2	Req53	M	Yes [] No []

IP address and related definitions – Name resolution and naming definitions

Item number	Item description	Reference	Req.	Status	Support
34ED_011	Destination devices of ETB addressable in train wide domain name space	4.7.4.1	Req61	M	Yes [] No []
34ED_012	127.0.0.1 “localhost” as self-addressing	4.7.4.2	Req63	M	Yes [] No []

IP address and network configuration management – Train network address management

Item number	Item description	Reference	Req.	Status	Support
34ED_013	After a new inauguration, renewal of train network address	7.8.2	Req69	M	Yes [] No []
34ED_014	DHCP FORCERENEW message defined in IETF RFC 3203	7.8.2	Req70	M	Yes [] No []

IP address and network configuration management – DHCP configuration parameters

Item number	Item description	Reference	Req.	Status	Support
34ED_015	Subnet mask	4.8.4	Req73	M	Yes [] No []
34ED_016	Router option	4.8.4	Req73	M	Yes [] No []
34ED_017	Domain Name server option	4.8.4	Req73	C	Yes [] No []
34ED_018	Host Name option	4.8.4	Req160	O	Yes [] No []

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Full document details: E DIN EN IEC 61375-2-8:2019-11

34ED_019	Broadcast Address	4.8.4	Req160	O	Yes [] No []
34ED_020	Network time protocol servers option	4.8.4	Req73	C	Yes [] No []
34ED_021	Vendor Specific Information	4.8.4	Req73	O	Yes [] No []
34ED_022	IP address lease time	4.8.4	Req73	M	Yes [] No []
34ED_023	DHCP message type	4.8.4	Req73	M	Yes [] No []
34ED_024	Server Identifier	4.8.4	Req73	M	Yes [] No []
34ED_025	Parameter request list	4.8.4	Req73	M	Yes [] No []
34ED_026	Message	4.8.4	Req160	O	Yes [] No []
34ED_027	Client-Identifier	4.8.4	Req160	O	Yes [] No []
34ED_028	Relay Agent Information option	4.8.4	Req160	O	Yes [] No []

785

786 **Network Device interface – Physical Layer - Protocols**

Item number	Item description	References	Req.	Status	Support
34ED_029	100BASE-TX	4.9.4.1.1.	Req83	M	Yes [] No []
34ED_030	Full Duplex mode defined in IEEE 802.3	4.9.4.1.1.	Req84	M	Yes [] No []
34ED_031	Auto negotiation function defined in IEEE 802.3	4.9.4.1.1.	Req85	M	Yes [] No []

787

788 **Network Device interface – Physical Layer - Cables**

Item number	Item description	Reference	Req.	Status	Support
	When 100BASE-TX or 10BASE-T is used:				
34ED_032	-M12 D-coded socket/plug	4.9.4.3.1	Req93	O	Yes [] No []
34ED_033	-IEC 61076-3-104 socket/plug	4.9.4.3.1	Req93	O	Yes [] No []
34ED_034	-RJ45 socket/plug defined in TIA/EIA-568-B	4.9.4.3.1	Req93	O	Yes [] No []

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34ED_035	Pinning for M12 connector as shown in Table 11	4.9.4.3.1	Req159	M	Yes [] No []

789

790 **End Device interface (Table 12) – Physical Layer Protocols**

Item number	Item description	Reference	Req.	Status	Support
34ED_036	IEEE 802.3	4.10.2.1	Req119	M	Yes [] No []
34ED_037	100BASE-TX	4.10.2.1	Req120	M	Yes [] No []
34ED_038	Full Duplex mode defined in IEEE 802.3	4.10.2.1	Req121	M	Yes [] No []
34ED_039	Auto negotiation function defined in IEEE 802.3	4.10.2.1	Req122	M	Yes [] No []

791

792 **End Device interface (Table 12) – Physical Layer Cables**

Item number	Item description	Reference	Req.	Status	Support
34ED_040	ISO/IEC 11801 and IEC 61156-6	4.10.2.2	Req124	M	Yes [] No []
34ED_041	Class D (category 5e) with two twisted pairs	4.10.2.2	Req125	M	Yes [] No []

793

794 **End Device interface (Table 12) – Physical Layer Connectors**

Item number	Item description	Reference	Req.	Status	Support
34ED_042	M12 D-coded socket/plug defined in IEC 61076-2-101	4.10.2.3	Req127	M	Yes [] No []
34ED_043	IEC 61076-3-104 socket/plug	4.10.2.3	Req128	O	Yes [] No []
34ED_044	RJ45 socket/plug defined in TIA/EIA-568-B	4.10.2.3	Req129	O	Yes [] No []
34ED_045	Pinning for M12 connector as shown in Table 11 and Figure 5	4.10.2.3	Req130	M	Yes [] No []

795

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796 **End Device interface (Table 12) – Link Layer**

Item number	Item description	Reference	Req.	Status	Support
34ED_046	MAC defined in IEEE 802.3	4.10.3	Req132	M	Yes [] No []
34ED_047	MAC with basic frame defined in IEE 802.3	4.10.3	Req133	M	Yes [] No []

797

798 **End Device interface (Table 12) – Network Layer**

Item number	Item description	Reference	Req.	Status	Support
34ED_048	IP version4 defined in IETF RFC 791	4.10.4	Req135	M	Yes [] No []
34ED_049	ICMP defined in IETF RFC 792	4.10.4	Req136	M	Yes [] No []
34ED_050	ARP defined in IETF RFC 826	4.10.4	Req137	M	Yes [] No []

799

800 **End Device interface (Table 12) – Transport Layer**

Item number	Item description	Reference	Req.	Status	Support
34ED_051	UDP defined IETF RFC 768	4.10.5	Req139	M	Yes [] No []
34ED_052	TCP defined IETF RFC 793	4.10.5	Req140	M	Yes [] No []

801

802 **End Device interface (Table 12) – Application Layer**

Item number	Item description	Reference	Req.	Status	Support
34ED_053	DHCP defined in IETF RFC 2131	4.10.6	Req142	M	Yes [] No []
34ED_054	DNS client function defined in IETF RFC 1034	4.10.6	Req143	M	Yes [] No []
34ED_055	SNTP client function defined in IETF RFC 1361 or NTP version 3 client function defined in IETF RFC 1305	4.10.6	Req144	O	Yes [] No []

803

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Network management

Item number	Item description	Reference	Req.	Status	Support
34ED_056	SNMP agent functions. (SNMPv2 defined in IETF RFC 1901, 1905 and 1906 is the minimum requirement.)	4.12.1	Req154	M	Yes [] No []

6.5 TESTING FRAMEWORK

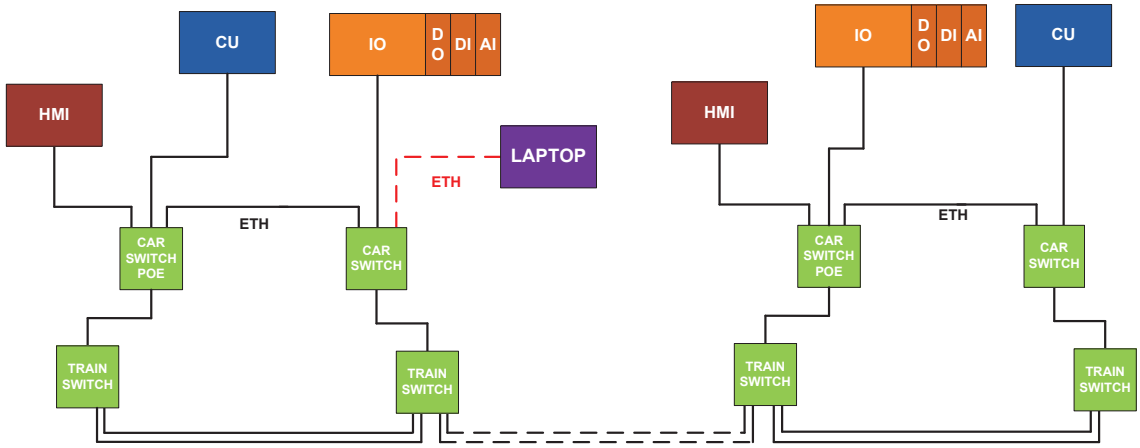

Figure 3 – Testing framework arquitecture

Table 10 – Testig framework DEVICE description

DEVICE	DESCRIPTION
HMI	**Human Machine Interface**
CU	Control Unit
IO	Input Output Device (with Digital Output Card, Digital Input Card, and Analog Input Card)
CAR SWITCH	SWITCH for connecting different devices to the Ethernet Network
CAR SWITCH POE	SWITCH for connecting different devices to the Ethernet Network, with Power over Ethernet
TRAIN SWITCH	SWITCH for coupling purposes

6.6 TEST SUITE IEC61375 2-3

6.6.1 Test case TCCT23ED_001

IDENTIFIER	TCCT23ED_001
TITLE	ETB Framework Interoperability
ITEM NUMBER	23ED_001
DESCRIPTION	The next test case will ensure that: - All changes affecting normative clauses of this standard shall be treated as incompatible changes;

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	leading to an increment of parameter 'main Version', unless otherwise specified.
REQUIREMENT	Optional
DUT	End Device
TEST SETUP	Test Bench
INITIAL CONDITIONS	Test Bench powered off

STEPS	Step 1: Supply the test bench.
	Step 2: Connect the End Device to a Train switch with the correct IP address.
	Step 3: Connect the laptop to a Train switch with the correct IP address.
	Step 4: Open the "Ethernet bus analyzer tool" to capture the frames that are going to be sent by the devices.
	Step 5: Check that as defined in part IEC 61375-2-5, following an ETB train inauguration, at least one entitled device in each consist shall send out a CSTINFO telegram over ETB to all other entitled devices within the train to inform about consist properties.
	Step 6: Check that the version has the next structure on the telegram:
	`VERSION::= RECORD`
	`{`
	`mainVersion UINT8 -- main version, incremented for incompatible changes`
	`value range: 1..255 (0 = reserved)`
	`subVersion UINT8 -- sub version, incremented for compatible changes`
	`value range: 0..255`
	`}`

FINAL CONDITIONS	Test Bench powered off.
ACCEPTANCE CRITERIA	OK if: - the End Device sends the version in a correct format.
DEPENDENCIES	

6.6.2 Test case TCCT23ED_002

IDENTIFIER	**TCCT23ED_002**
TITLE	Sources/Destinations identified by TCN URI Identifier

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ITEM NUMBER	23ED_002
DESCRIPTION	The next test case will ensure that: - Function devices shall be identified by labels following the syntax given in Table 8. - Vehicles shall be identified by labels following the syntax given in Table 10. - Consists shall be identified by labels following the syntax given in Table 12.
REQUIREMENT	Optional
DUT	End Device
TEST SETUP	Test Bench
INITIAL CONDITIONS	Test Bench powered off

STEPS	Step 1: Supply the test bench.
	Step 2: Connect the End Device to a Train switch with the correct IP address.
	Step 3: Connect the laptop to a Train switch with the correct IP address.
	Step 4: Perform a ping from the laptop to the End Device, using DNS names, checking that:
	• the function device label used is the one specified in Table 8:
	*trn://usr@**fctdev**.vehicle.consist.cltrain.train*
	`fctDev = ”lDev” | deviceName | group`
	`devicename = label`
	`group = ”grpAll” | grpDev`
	`grpDev = ”grp” 1{uchar}12`
	• the vehicle label used is the one specified in Table 10:
	*trn://usr@fctdev.**vehicle**.consist.cltrain.train*
	`veh = ”lVeh” | cstVehNo | opVehNo | ”leadVeh” | ”aVeh” | idVeh | ”anyVeh”`
	`cstVehNo = ”veh” digit digit`
	`opVehNo = ”opVeh” digit digit`
	`idVeh = label`
	• the consist label used is the one specified in Table 10:
	*trn://usr@fctdev.vehicle.**consist**.cltrain.train*
	`consist = ”lCst” | ”aCst” | ”anyCst” | ”leadCst” | cstNo | opCstNo | idCst`
	`cstNo = ”cst” digit digit`
	`opCstNo = ”opCst” digit digit`
	`idCst = label`
	Step 5: Check that the End Device responds to the ping performed by the laptop.

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FINAL CONDITIONS	Test Bench powered off.
ACCEPTANCE CRITERIA	OK if: - The End Device responds to the ping performed from the laptop, with the defined DNS parts
DEPENDENCIES	

816

817 ### 6.6.3 Test case TCCT23ED_003

IDENTIFIER	**TCCT23ED_003**
TITLE	TCN URI User part
ITEM NUMBER	23ED_003
DESCRIPTION	The next test case will ensure that: - Communicating entities (sources and destinations) shall be identified by a fully qualified TCN domain name which is derived from the TCN domain name space using a TCN URI scheme defined in RFC 3986.
REQUIREMENT	Optional
DUT	End Device
TEST SETUP	Test Bench
INITIAL CONDITIONS	Test Bench powered off
STEPS	Step 1: Supply the test bench. Step 2: Connect the End Device to a Train switch with the correct IP address. Step 3: Connect the laptop to a Train switch with the correct IP address. Step 4: Perform a ping from the laptop to the End Device, using DNS names, checking that the user part used is the one specified by the End Device: *trn://**usr**@fctdev.vehicle.consist.cltrain.train* *train = ITrn* Step 5: Check that the End Device responds to the ping performed by the laptop.
FINAL CONDITIONS	Test Bench powered off.
ACCEPTANCE CRITERIA	OK if: - The End Device responds to the ping performed from the laptop, with the defined “user” part
DEPENDENCIES	

818

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819 **6.6.4 Test case TCCT23ED_004**

IDENTIFIER	TCCT23ED_004
TITLE	Closed trains identification
ITEM NUMBER	23ED_004
DESCRIPTION	The next test case will ensure that: - Closed trains shall be identified by labels following the syntax given in Table 16. - Trains shall be identified by labels following the syntax given in Table 16.
REQUIREMENT	Mandatory
DUT	End Device
TEST SETUP	Test Bench
INITIAL CONDITIONS	Test Bench powered off
STEPS	Step 1: Supply the test bench. Step 2: Connect the End Device to a Train switch with the correct IP address. Step 3: Connect the laptop to a Train switch with the correct IP address. Step 4: Perform a ping from the laptop to the End Device, using DNS names, checking that closed trains and trains are identified by next labels: *trn://usr@fctdev.vehicle.consist.cltrain.train* *train = lTrn* Step 5: Check that the End Device responds to the ping performed by the laptop.
FINAL CONDITIONS	Test Bench powered off.
ACCEPTANCE CRITERIA	OK if: - The End Device, connected in a different ETB network, responds to the ping performed from the laptop, with closed trains and trains correctly identified.
DEPENDENCIES	

820

821 **6.6.5 Test case TCCT23ED_005**

IDENTIFIER	TCCT23ED_005
TITLE	IP routing in networks with multiple ETBs
ITEM NUMBER	23ED_005

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DESCRIPTION	The next test case will ensure that: - For transmitting IP packets to a destination ED, which is related to another ETB than the ETB the source ED is related to, the IP packet shall be transferred over the ETB the destination ED is related to.
REQUIREMENT	Mandatory
DUT	End Device
TEST SETUP	Test Bench
INITIAL CONDITIONS	Test Bench powered off
STEPS	Step 1: Supply the test bench. Step 2: Connect the End Device to a Train switch of one ETB with the correct IP address. Step 3: Connect the laptop to a Train switch of another ETB with the correct IP address. Step 4: Perform a ping from the laptop to the End Device, using DNS names. Step 5: Check that the End Device responds to the ping performed by the laptop.
FINAL CONDITIONS	Test Bench powered off.
ACCEPTANCE CRITERIA	OK if: - The End Device, connected in a different ETB network, responds to the ping performed from the laptop.
DEPENDENCIES	

822

823 ### 6.6.6 Test case TCCT23ED_006

IDENTIFIER	**TCCT23ED_006**
TITLE	Usage TRDP for data exchange
ITEM NUMBER	23ED_006
DESCRIPTION	The next test case will ensure that: - All services of the operational network shall use the TRDP protocol as specified in Annex A (with supplementary information in Annex C and Annex D) for the transfer of process data and message data between operational network functions.
REQUIREMENT	Mandatory
DUT	End Device

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