

INTERNATIONAL STANDARD

IEC
61375-1

Second edition
2007-04

**Electric railway equipment –
Train bus –**

**Part 1:
Train communication network**



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XS**

For price, see current catalogue

CONTENTS

FOREWORD.....	13
INTRODUCTION.....	15
1 General	17
1.1 Scope.....	17
1.2 Normative references	17
1.3 Terms and definitions	18
1.4 Abbreviations.....	35
1.5 Conventions	37
1.6 General considerations	43
1.7 Conformance Test.....	48
2 Real-Time protocols.....	49
2.1 General	49
2.2 Variables – Services and Protocols.....	51
2.3 Messages Services and Protocols.....	72
2.4 Presentation and encoding of transmitted and stored data.....	173
3 Multifunction Vehicle Bus	193
3.1 General	193
3.2 Physical Layer	195
3.3 Medium-dependent signalling.....	229
3.4 Frames and telegrams	236
3.5 Link Layer Control	242
3.6 Medium allocation.....	248
3.7 Mastership transfer.....	260
3.8 Link Layer Interface	265
4 Wire Train Bus (WTB)	273
4.1 General	273
4.2 Physical layer	275
4.3 Medium-dependent signalling.....	296
4.4 Frames and telegrams	304
4.5 Link Layer Control	308
4.6 Medium allocation.....	329
4.7 Inauguration	331
4.8 Link layer interface	380
5 Train Network Management	393
5.1 General	393
5.2 Manager, Agents and interfaces.....	394
5.3 Managed objects	397
5.4 Services and management messages	407
5.5 Interface Procedures	469
 Annex A (informative) Tutorial on the TCN architecture	 473
Annex B (normative) Guidelines for conformance testing	599
 Bibliography	 600

Figure 1 – Layering of the TCN.....	16
Figure 2 – State transition example	42
Figure 3 – Interfaces between equipment	43
Figure 4 – Interfaces between vehicles	43
Figure 5 – Train Bus and Vehicle Bus	44
Figure 6 – TCN configurations	45
Figure 7 – TCN device configuration options.....	46
Figure 8 – Structure of the Train Communication Network	49
Figure 9 – Real-Time Protocols layering	50
Figure 10 – LPI primitives exchange	54
Figure 11 – Check_Variable	59
Figure 12 – Individual access	63
Figure 13 – Set access.....	67
Figure 14 – Cluster access.....	70
Figure 15 – Terminal station.....	72
Figure 16 – Router station between WTB and MVB.....	73
Figure 17 – Packet format	75
Figure 18 – Link layer data transmission.....	77
Figure 19 – Link_Message_Data_Interface (LMI).....	78
Figure 20 – Example of MVB Message_Data frame	79
Figure 21 – Example of WTB Message_Data frame.....	80
Figure 22 – LMI primitives	81
Figure 23 – Network layer on a Node.....	88
Figure 24 – Encoding of the Network_Address.....	91
Figure 25 – Building of the addresses in an outbound packet.....	93
Figure 26 – Network address encoding on the vehicle bus (example MVB).....	95
Figure 27 – Network address encoding on the train bus (example with WTB).....	96
Figure 28 – Transport packet exchange.....	102
Figure 29 – Packet formats (transport layer body).....	105
Figure 30 – State transition diagram of the MTP	114
Figure 31 – Time-out SEND_TMO	118
Figure 32 – Time-out ALIVE_TMO	118
Figure 33 – Transport interface	127
Figure 34 – Multicast message with no retransmission.....	134
Figure 35 – Short multicast message with no BD packets and no loss.....	135
Figure 36 – Exchange with lost packets	136
Figure 37 – Packet formats	138
Figure 38 – Protocol machine states.....	139
Figure 39 – Session layer transfer	150
Figure 40 – Session_Header in Call_Message (of type Am_Result).....	151
Figure 41 – Application_Messages_Interface.....	152
Figure 42 – Encoding of AM_ADDRESS.	156

Figure 43 – Reference device and structure of the document	195
Figure 44 – MVB configuration	196
Figure 45 – Transceiver interface	199
Figure 46 – Example of ESD segment	201
Figure 47 – Example of terminator	202
Figure 48 – ESD backplane section (double-line)	204
Figure 49 – ESD connector arrangement	205
Figure 50 – ESD terminator connector arrangement	206
Figure 51 – Example of start of frame (ESD)	207
Figure 52 – End of an ESD frame (both cases)	208
Figure 53 – EMD medium	209
Figure 54 – Shielding (single-line segment)	211
Figure 55 – Single-line device attachment	212
Figure 56 – Double-line device attachment to EMD	213
Figure 57 – EMD connectors arrangement	214
Figure 58 – EMD terminator strapping	215
Figure 59 – Measurement of an EMD device	216
Figure 60 – Attenuation measurement	216
Figure 61 – Example of start of an EMD frame	217
Figure 62 – EMD transmitter test circuits	218
Figure 63 – Example of pulse waveform at EMD transmitter	220
Figure 64 – Example of end of EMD frame	221
Figure 65 – EMD receiver test signal	222
Figure 66 – Optical link	224
Figure 67 – Optical connector (dimensions in millimeters)	225
Figure 68 – Example of start of OGF frame	226
Figure 69 – Edge jitter	227
Figure 70 – Example of active star coupler	228
Figure 71 – Example of a duplicated star coupler	229
Figure 72 – "0" and "1" data encoding	229
Figure 73 – Non_Data symbols encoding	230
Figure 74 – Master Start Delimiter	230
Figure 75 – Slave Start Delimiter	231
Figure 76 – Example of End Delimiter for EMD medium	231
Figure 77 – Example of a valid frame (OGF medium)	232
Figure 78 – Signal skew	233
Figure 79 – Example of repeater for single-line attachment	235
Figure 80 – Example of repeater connecting a double-line to a single line segment	236
Figure 81 – Master Frame Format	236
Figure 82 – Slave Frames	237
Figure 83 – Telegram timing	238
Figure 84 – Example of Reply delay	239
Figure 85 – Frame spacing at the source side	240

Figure 86 – Frame spacing at the destination(s)	240
Figure 87 – Frame spacing at the master side	241
Figure 88 – Master Frame contents	243
Figure 89 – Word ordering in a Slave Frame.....	245
Figure 90 – Process Data telegram	245
Figure 91 – Message Data telegram	247
Figure 92 – Supervisory Data telegram	248
Figure 93 – Basic Periods	249
Figure 94 – Example of construction of the Macro_Cycle	251
Figure 95 – General_Event_Request frame format	255
Figure 96 – Group_Event_Request frame (M = 6, C = ABCDEF).....	256
Figure 97 – Single_Event_Request frame	256
Figure 98 – Event_Identifier_Response frame	257
Figure 99 – Device_Status_Request.....	257
Figure 100 – Device_Status_Response	258
Figure 101 – Device_Status of Class 1 device	258
Figure 102 – Device_Status of Class 2/3/4/5 device.....	258
Figure 103 – Device_Status of a device with Bus Administrator capability	259
Figure 104 – Device_Status of a device with Gateway capability	259
Figure 105 – Mastership Transfer states.....	263
Figure 106 – Device_Status_Request (sent by current master)	264
Figure 107 – Device_Status_Response (sent by proposed master)	264
Figure 108 – Mastership_Transfer_Request (sent by current master).....	265
Figure 109 – Mastership_Transfer_Response (sent by proposed next master)	265
Figure 110 – Link Layer Layering.....	266
Figure 111 – Wire Train Bus.....	273
Figure 112 – Reference model of the WTB	275
Figure 113 – Train Composition (two Intermediate Nodes shown)	276
Figure 114 – Vehicle measurement	277
Figure 115 – Connected nodes in regular operation	278
Figure 116 – Double-line attachment	278
Figure 117 – Grounded shield concept	281
Figure 118 – Floating shield concept	282
Figure 119 – Terminator	282
Figure 120 – Direct node attachment (optional double-line).....	283
Figure 121 – Indirect attachment	284
Figure 122 – WTB connector, front view	285
Figure 123 – Example of MAU Structure	286
Figure 124 – Node with redundant Line Units.....	288
Figure 125 – Attenuation measurement	289
Figure 126 – Shield grounding in the Line Unit.....	290
Figure 127 – Fritting source and load	290
Figure 128 – Transmitter test circuits	292

Figure 129 – Pulse wave form at transmitter.....	293
Figure 130 – Signal and idling at transmitter.....	294
Figure 131 – Receiver signal envelope	295
Figure 132 – Receiver edge distortion	296
Figure 133 – Idealised frame on the line (16 bit Preamble shown).....	297
Figure 134 – Bit encoding.....	297
Figure 135 – Preamble.....	298
Figure 136 – End Delimiter.....	298
Figure 137 – Valid frame, RxS, CS and SQE signals.....	299
Figure 138 – Garbled frame, RxS, CS, SQE signals.....	300
Figure 139 – Redundant Lines (as seen at a receiver).....	300
Figure 140 – Line_Disturbance signals	301
Figure 141 – HDLC Frame structure	304
Figure 142 – Telegram timing.....	305
Figure 143 – Example of Interframe spacing.....	306
Figure 144 – Frame spacing measured at the master side	307
Figure 145 – Frame spacing at the slave	307
Figure 146 – HDLC Data format	308
Figure 147 – Format of HDLC Data	309
Figure 148 – Process Data telegram.....	313
Figure 149 – Format of Process Data Request	314
Figure 150 – Format of Process Data Response.....	315
Figure 151 – Message Data telegram	315
Figure 152 – Format of Message Data Request	315
Figure 153 – Format of Message Data Response	316
Figure 154 – Supervisory telegram	316
Figure 155 – Detection telegram.....	317
Figure 156 – Format of Detect Request	318
Figure 157 – Format of Detect Response	318
Figure 158 – Presence telegram.....	319
Figure 159 – Format of Presence Request.....	319
Figure 160 – Format of Presence Response.....	320
Figure 161 – Status telegram	320
Figure 162 – Format of Status Request	321
Figure 163 – Format of Status Response.....	322
Figure 164 – Set-to-Intermediate telegram.....	322
Figure 165 – Format of SetInt Request	322
Figure 166 – Format of SetInt Response	323
Figure 167 – Naming telegram	323
Figure 168 – Format of Naming Request	324
Figure 169 – Format of Naming Response.....	324
Figure 170 – Unnaming telegram.....	325
Figure 171 – Format of Unname Request	325

Figure 172 – Set to End telegram	325
Figure 173 – Format of SetEnd Request	326
Figure 174 – Format of SetEnd Response	326
Figure 175 – Topography telegram	327
Figure 176 – Format of Topography Request	327
Figure 177 – Format of Topography Response	328
Figure 178 – Structure of the Basic Period	329
Figure 179 – Node position numbering	332
Figure 180 – Format of Node Descriptor	333
Figure 181 – Format of Node Report	334
Figure 182 – Format of User Report	334
Figure 183 – Format of Composition Strength	335
Figure 184 – Master_Report	336
Figure 185 – Format of Topo Counter	336
Figure 186 – Format of Master Topo	336
Figure 187 – Timing Diagram of detection protocol	339
Figure 188 – Major node states and application settings	340
Figure 189 – Node processes (End Setting)	341
Figure 190 – AUXILIARY_PROCESS states	347
Figure 191 – NAMING_RESPONSE macro	348
Figure 192 – States of MAIN PROCESS	349
Figure 193 – Macro 'START_NODE'	352
Figure 194 – Procedure REQUEST_RESPONSE	354
Figure 195 – Procedures 'SET_TO_INT' and 'SET_TO_END'	355
Figure 196 – Macro 'INIT_MASTER'	356
Figure 197 – Macro 'NAMING_MASTER'	357
Figure 198 – Macro ASK_END	358
Figure 199 – Procedure NAME_ONE	361
Figure 200 – Macro TEACHING_MASTER	363
Figure 201 – Macro 'UNNAMING_MASTER'	364
Figure 202 – Macro 'REGULAR_MASTER'	366
Figure 203 – Macro CHECK_DESC	367
Figure 204 – Macro PERIODIC_POLL	369
Figure 205 – Macro MESSAGE_POLL	370
Figure 206 – States 'UNNAMED_SLAVE'	372
Figure 207 – States 'NAMED_SLAVE'	374
Figure 208 – Macro 'LEARNING_SLAVE'	376
Figure 209 – Macro 'REGULAR_SLAVE'	378
Figure 210 – Link layer layering	380
Figure 211 – Management messages	395
Figure 212 – Agent Interface on a (gateway) Station	396
Figure 213 – Station_Status	398
Figure A.1 – Train_Bus and Vehicle_Busses	475

Figure A.2 – Data transfer over the Train Communication Network	477
Figure A.3 – Example of Periodic_Data and Sporadic_Data transmission.....	478
Figure A.4 – TCN Services	479
Figure A.5 – Application Tasks and TCN services.....	480
Figure A.6 – Layering of the Real-Time Protocols	480
Figure A.7 – Variable transmission and Ports	482
Figure A.8 – Broadcasting of source-addressed Process_Data	483
Figure A.9 – Port and Traffic_Store	484
Figure A.10 – Ports on the Wire_Train_Bus.....	486
Figure A.11 – Dataset	487
Figure A.12 – Validity bits.....	488
Figure A.13 – Multiple Process_Variable instances	489
Figure A.14 – Instances of a Process_Variable.....	490
Figure A.15 – Transmission of Periodic_Data through the network.....	491
Figure A.16 – Individual copying	494
Figure A.17 – Cluster transfer	495
Figure A.18 – Application_Layer and Link_Layer Interface to Process_Variables.....	496
Figure A.19 – Several Applications access the same Traffic_Store	496
Figure A.20 – Application access to several Traffic_Stores	497
Figure A.21 – Two-level hierarchy	498
Figure A.22 – Call_Message/Reply_Message exchange.....	500
Figure A.23 – Example of actual architecture.....	501
Figure A.24 – Message_Data transmission over queues	502
Figure A.25 – Link_Layer in the OSI hierarchy	503
Figure A.26 – Message_Data format	504
Figure A.27 – Node position numbering	504
Figure A.28 – Vehicle numbering according to UIC 556 – not TCN.....	505
Figure A.29 – Example of vehicle types	506
Figure A.30 – Nodes and Vehicle_Bus Devices.....	507
Figure A.31 – Vehicle_Bus spanning several vehicles.....	507
Figure A.32 – System view of communication	508
Figure A.33 – Station_Directory.....	509
Figure A.34 – Actual Station location	510
Figure A.35 – Dual-processor Node.....	511
Figure A.36 – Further hierarchical level	512
Figure A.37 – Functions within a passenger coach.....	512
Figure A.38 – Mapping of Functions to Devices	513
Figure A.39 – Function view of communication	514
Figure A.40 – Function_Directory	514
Figure A.41 – Function Directories in a three-level hierarchy.....	515
Figure A.42 – End-to-end Message_Data transfer.....	516
Figure A.43 – Packet forwarding over the network	517
Figure A.44 – Network_Address (origin or final) for messages	517

Figure A.45 – WTB and MVB Message_Data frame with Network_Addresses	518
Figure A.46 – Routing messages over the Train_Bus	520
Figure A.47 – Execution of the transport control.	521
Figure A.48 – Message Transport_Layer in the OSI model.....	522
Figure A.49 – Sliding window protocol	523
Figure A.50 – Frame exchange at the transport level	524
Figure A.51 – Packet formats (bus-independent)	526
Figure A.52 – Multicast transmission	527
Figure A.53 – Remote Procedure Call.....	529
Figure A.54 – Call nesting	530
Figure A.55 – Example of message exchange at the session level	531
Figure A.56 – Message Software structure	532
Figure A.57 – Multifunction_Vehicle_Bus in a locomotive	537
Figure A.58 – Multifunction_Vehicle_Bus in a coach	537
Figure A.59 – Electrical Short Distance medium	539
Figure A.60 – MVB spanning three vehicles.....	540
Figure A.61 – Vehicle_Bus optical star configuration.....	540
Figure A.62 – Topology of the Vehicle Bus	541
Figure A.63 – Bus_Controller	542
Figure A.64 – Bus interface for class 1 device	543
Figure A.65 – Bus Interface for Class 2/3 devices.....	544
Figure A.66 – Frame delimiter, Manchester-encoded data and Check_Sequence	545
Figure A.67 – Telegram.....	545
Figure A.68 – Master_Frame and Slave_Frame formats	546
Figure A.69 – MVB Process_Data Telegram	548
Figure A.70 – MVB Message_Data Telegram.....	548
Figure A.71 – MVB Supervisory_Data Telegram	549
Figure A.72 – Ports in the Traffic_Store.....	550
Figure A.73 – MVB Traffic	551
Figure A.74 – Periodic traffic configuration	551
Figure A.75 – Single response to a General_Event_Request (Start) frame	553
Figure A.76 – Event_Round with single response (no arbitration).....	553
Figure A.77 – First Event_Arbitration	554
Figure A.78 – Group_Event_Request.....	555
Figure A.79 – Event_Arbitration tree	555
Figure A.80 – Fully redundant bus	558
Figure A.81 – MVB redundant optical layout	558
Figure A.82 – Mastership transfer with multiple masters	559
Figure A.83 – Wire_Train_Bus	560
Figure A.84 – WTB topology.....	561
Figure A.85 – WTB cable arrangement (top view).....	562
Figure A.86 – Medium_Attachment_Unit (switches shown for an End_Node).....	563
Figure A.87 – WTB MAU with duplicated Line_Unit.....	564

Figure A.88 – WTB signal encoding.....	564
Figure A.89 – WTB Frame (extended ISO/IEC 13239)	565
Figure A.90 – WTB Telegram	566
Figure A.91 – WTB Process_Data Telegram.....	567
Figure A.92 – Message_Data Telegram.....	567
Figure A.93 – Supervisory_Data Telegram.....	568
Figure A.94 – WTB Periodic and Sporadic Transmission	569
Figure A.95 – Summary of frames for regular operation	570
Figure A.96 – Node position addressing scheme	571
Figure A.97 – MAU elements for inauguration (single line attachment)	573
Figure A.98 – Typical named composition.....	574
Figure A.99 – An additional Node is connected to a named composition	574
Figure A.100 – Unnamed Nodes.....	575
Figure A.101 – Status and Detection	576
Figure A.102 – Set-to-intermediate	576
Figure A.103 – Naming.....	576
Figure A.104 – Topography	577
Figure A.105 – Meeting of two compositions	578
Figure A.106 – Composition strength exchanges	579
Figure A.107 – Detection exchange	580
Figure A.108 – Telegram exchanges when two compositions meet	582
Figure A.109 – Bus shortening	583
Figure A.110 – Supervisory frames for inauguration.....	586
Figure A.111 – Master redundancy	588
Figure A.112 – Management environment.....	589
Figure A.113 – Class 2 Station configuration	592
Figure A.114 – Manager and Agent on two Stations.....	593
Figure A.115 – Management_Messages	594
Figure A.116 – Packet format.....	595
Figure A.117 – Summary of managed objects.....	596
Table 1 – Template for the specification of an interface procedure.....	39
Table 2 – Example of message structure	40
Table 3 – Example of textual message form (corresponding to Table 2).....	41
Table 4 – State transitions table	42
Table 5 – Interoperability testing.....	48
Table 6 – LPI primitives.....	54
Table 7 – Var_Size and Var_Type encoding in a PV_Name.....	61
Table 8 – LMI primitives	82
Table 9 – Routing situations	97
Table 10 – Routing of packets coming from the transport layer	99
Table 11 – Routing of packets coming from a vehicle bus.....	100
Table 12 – Routing of packets coming from the train bus.....	101

Table 13 – Message Transport Control encoding	106
Table 14 – Connect_Request	109
Table 15 – Connect_Confirm	109
Table 16 – Disconnect_Request	110
Table 17 – Disconnect_Confirm	110
Table 18 – Data_Packet	110
Table 19 – Ack_Packet	111
Table 20 – Nak_Packet	111
Table 21 – Broadcast_Connect (BC1, BC2, BC3)	111
Table 22 – Broadcast_Data	112
Table 23 – Broadcast_Repeat	112
Table 24 – Broadcast_Stop (BSC, BSO)	113
Table 25 – MTP states	113
Table 26 – MTP incoming events	115
Table 27 – MTP outgoing events	115
Table 28 – MTP control parameters	116
Table 29 – MTP auxiliary variables	117
Table 30 – MTP time-outs (worst case)	119
Table 31 – Implicit actions	119
Table 32 – Compound actions	120
Table 33 – Producer states and transitions	121
Table 34 – Consumer states and transitions	124
Table 35 – TMI primitives	128
Table 36 – States of the MCP machine	139
Table 37 – Incoming Events	140
Table 38 – Outgoing Events	140
Table 39 – Control fields in packets	141
Table 40 – Auxiliary variables	142
Table 41 – MCP constants	143
Table 42 – MCP time-outs	143
Table 43 – MCP Compound actions	144
Table 44 – Filtering of BR packets	145
Table 45 – MCP Producer state event table	146
Table 46 – MCP Consumer state event table	148
Table 47 – AMI primitives	153
Table 48 – Address constants	155
Table 49 – System Address and User Address	158
Table 50 – MVB devices capabilities	197
Table 51 – Pin assignment for the ESD connector	205
Table 52 – Pin assignment for the EMD connector	214
Table 53 – Master Frame types and F_code	244
Table 54 – LS_RESULT encoding	268
Table 55 – MVB_Status object	268

Table 56 – MVB_Control object	269
Table 57 – MVB_Devices object	270
Table 58 – MVB_Administrator object	271
Table 59 – LS_V_REPORT encoding.....	273
Table 60 – WTB connector pin assignment.....	285
Table 61 – Signals of the Line Unit Interface.....	303
Table 62 – Link Control encoding	310
Table 63 – NodeControl data structure	342
Table 64 – MyStatus data structure	343
Table 65 – Shared Variables of a node	344
Table 66 – Variables of Main Process.....	344
Table 67 – Lists of Main Process.....	345
Table 68 – ‘START_NODE’	350
Table 69 – ‘MASTER STATES’	350
Table 70 – ‘SLAVE STATES’	351
Table 71 – Time constant values	379
Table 72 – Example of mvb_administrator_list.....	429
Table A.1 – Summary of the Train Communication Network.....	474
Table A.2 – Summary of the Real-Time Protocols.....	481
Table A.3 – Packet formats (bus-independent)	525
Table A.4 – Summary of data types	535
Table A.5 – Type equivalence	536
Table A.6 – Summary of the Multifunction_Vehicle_Bus.....	538
Table A.7 – MVB throughput for 20 m and 2000 m (physical layer).....	547
Table A.8 – F_codes of the MVB (Master_Frame types)	548
Table A.9 – Example of Event_Round	556
Table A.10 – Arbitration delay in function of the number of simultaneous events	557
Table A.11 – Summary of the WTB	560
Table A.12 – Parameters for supervisory frames	587
Table A.13 – Summary of the Train Network Management.....	590

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC RAILWAY EQUIPMENT –
TRAIN BUS –****Part 1: Train communication network**

FOREWORD

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

International Standard IEC 61375-1 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This second edition cancels and replaces the first edition published in 1999 and constitutes a technical revision.

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

- technical amendments concern Clauses 2, 3 and 4. Some inconsistencies between clauses have been solved, some parameters and values have been changed according to the suggestion of the experts of National Committees involved in the application of the standard;
- the pre-emphasis has been introduced for the MVB transmitted signal;

- Annex B has been superseded by IEC 61375-2.

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

FDIS	Report on voting
9/1013/FDIS	9/1033/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.

The following items are to be taken into consideration:

- in France the needs of data communication between equipment in vehicles and between vehicles are dealt with using products covered by other standards or technical specifications (many trains introduced in the last 10 years are equipped with data communication systems; care has been taken to make use as much as possible of different relevant industrial standards) incompatible with the provisions of this standard and making it inapplicable in that country;
- for instance, in modern rolling stock recently commissioned in France, technical specifications for train communication networks comply with IEC 61158-2 and EN 50170, which are the field bus international standards. On the other hand, token-passing bus access method has been used in technical specifications for data communication networks for the latest generation of high speed trains;
- in China, for closed trains and multiple units, the technical specifications of a train communication network may be based on an agreement between user and manufacturer alternatively to this standard.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

INTRODUCTION

This part of IEC 61375 defines interfaces so as to achieve plug-in compatibility:

- a) between equipment located in different vehicles, and
- b) between equipment located within the same vehicle.

This standard defines these interfaces as connections to a data communication network, called the Train Communication Network (TCN).

The TCN has a hierarchical structure with two levels of busses, a Train Bus and a Vehicle Bus:

- a) for interconnecting vehicles in Open Trains (see definition) such as international UIC trains, this standard specifies a Train Bus called the Wire Train Bus (WTB);
- b) for connecting standard on-board equipment, this standard specifies a Vehicle Bus called the Multifunction Vehicle Bus (MVB).

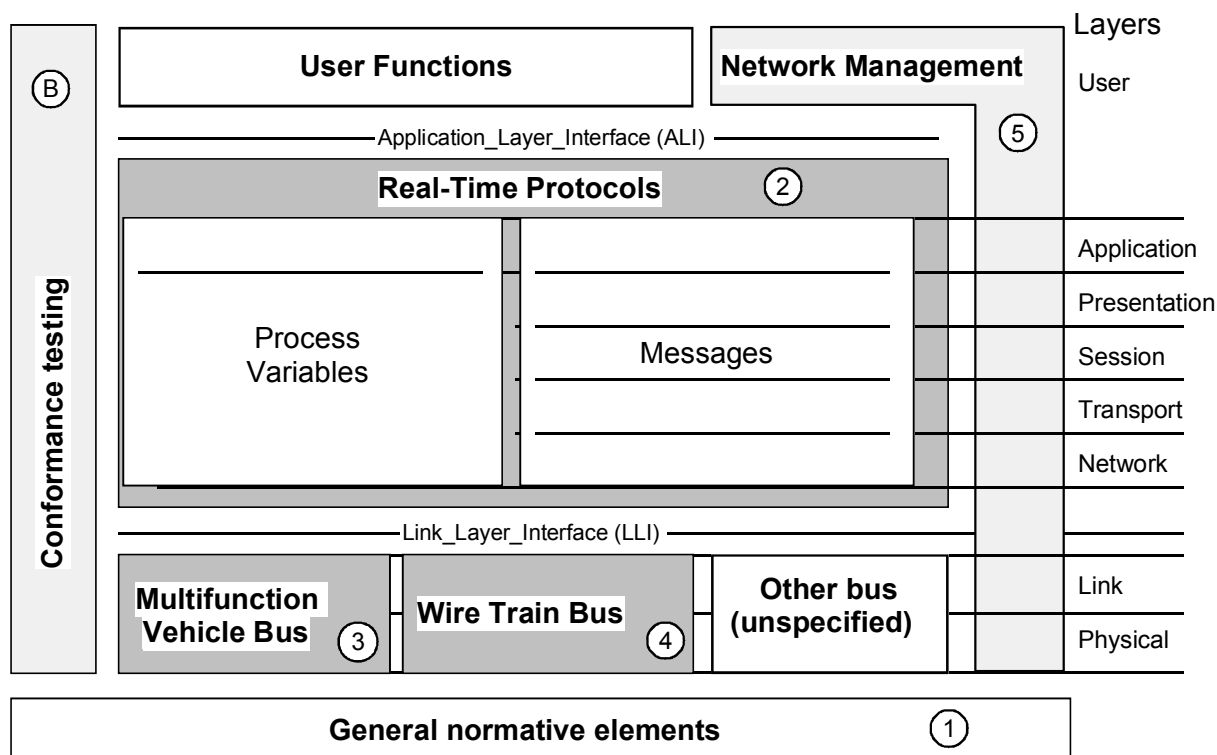
In the TCN architecture, all busses share the same Real-Time Protocols, which offer two communication services:

- a) Process Variables, a distributed, real-time database, periodically refreshed through broadcasting;
- b) messages, transmitted on demand either as:
 - unicast messages (point-to-point) or/and
 - multicast messages.

All busses in the TCN share a common Network Management, which allows debugging, commissioning and maintenance over the network.

Guidelines for conformance testing are included in this standard.

The TCN is structured similarly to the Open System Interconnection model defined in ISO/IEC 7498-1 (see Figure 1).



NOTE The circled numbers refer to the clauses and annexes of this standard.

Figure 1 – Layering of the TCN

This standard has been, for editorial reasons, divided into five clauses and two annexes:

Clause 1: General,

- Definitions and informative overview;

Clause 2: Real-Time Protocols,

- Variables: Link Layer Interface and Application Layer Interface;
- Messages: Link Layer Interface, Protocols, Application Layer Interface;
- Data Representation;

Clause 3: Multifunction Vehicle Bus,

- Physical Layer, Link Layer and Link Layer Management;

Clause 4: Wire Train Bus,

- Physical Layer, Link Layer and Link Layer Management;

Clause 5: Train Network Management,

- Configuration, supervision and control of the network;

Annex A: Tutorial on the Train Communication Network

Annex B: Guidelines for Conformance Test.

ELECTRIC RAILWAY EQUIPMENT – TRAIN BUS –

Part 1: Train communication network

1 General

1.1 Scope

This part of IEC 61375 applies to data communication in Open Trains, i.e. it covers data communication between vehicles of the said open trains and data communication within the vehicles of the said open trains.

The applicability of this standard to the train communication bus (WTB) allows for interoperability of individual vehicles within Open Trains in international traffic. The data communication bus inside vehicles (MVB) is given as recommended solution to cope with the said TCN. In any case, proof of compatibility between WTB and a proposed vehicle bus will have to be brought by the supplier.

This standard may be additionally applicable to closed trains and multiple unit trains when so agreed between purchaser and supplier.

NOTE 1 For a definition of Open Trains, Multiple Unit Trains and Closed Trains, see 1.3.

NOTE 2 Road vehicles such as buses and trolley buses are not considered in this standard.

1.2 Normative references

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

IEC 60096-1: *Radio-frequency cables – Part 1: General requirements and measuring methods*

IEC 60245-1, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 60332-1-1, *Tests on electric and optical fibre cables under fire conditions – Part 1-1: Test for vertical flame propagation for a single insulated wire or cable – Apparatus*

IEC 60571, *Electronic equipment used on rail vehicles*

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General*

IEC 60807 (all parts), *Rectangular connectors for frequencies below 3 MHz*

IEC 60870-5-1, *Telecontrol equipment and systems. Part 5: Transmission protocols - Section One: Transmission frame formats*

IEC 60874-10-1, *Connectors for optical fibres and cables – Part 10-1: Detail specification for fibre optic connector type BFOC/2,5 terminated to multimode fibre type A1*

IEC 60874-10-2, *Connectors for optical fibre and cables – Part 10-2: Detail specification for fibre optic connector BFOC/2,5 terminated to single-mode fibre type B1*

IEC 60874-10-3, *Connectors for optical fibre and cables – Part 10-3: Detail specification for fibre optic connector BFOC/2,5 terminated to single and multimode fibre*

ISO/IEC 8482, *Information technology – Telecommunications and information exchange between systems – Twisted pair multipoint interconnections*

ISO/IEC 8802-2, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control*

ISO/IEC 8824 (all parts), *Information technology – Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8825 (all parts), *Information technology – ASN.1 encoding rules*

ISO/IEC 8859-1, *Information technology – 8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1*

ISO/IEC 9646 (all parts), *Information technology – Open Systems Interconnection – Conformance testing methodology and framework*

ISO/IEC 10646, *Information Technology – Universal Multiple Octet Coded Character Set (UCS)*

ISO/IEC 13239, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures*

ITU-T Recommendation V24, *List of definitions for interchange circuits between data terminal equipment (DTE) and data-circuit terminating equipment (DCE)*

ITU-T Recommendation Z.100, *Specification and Description Language (SDL)*

UIC 556 ORE B 108.3 Fiche No. 556, *Information transmission in the train (train-bus)*

UIC 557, *Diagnostics on passenger rolling stock*

IEEE 754, *Standard for Binary Floating-Point Arithmetic*