

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Matériel électronique ferroviaire – Réseau embarqué de train (TCN) –
Partie 1: Architecture générale**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2012 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

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

About IEC publications

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

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).

It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

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

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,...).

Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Matériel électronique ferroviaire – Réseau embarqué de train (TCN) –
Partie 1: Architecture générale**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XA

ICS 45.060

ISBN 978-2-88912-069-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references.....	8
3 Terms, definitions, abbreviated terms, acronyms, and conventions.....	8
3.1 Terms and definitions	8
3.2 Abbreviations and acronyms	15
3.3 Conventions	16
3.3.1 Requirement conventions.....	16
3.3.2 Base of numeric values.....	16
3.3.3 Naming conventions.....	16
3.3.4 State diagram conventions.....	16
4 Basic architecture	16
4.1 Contents of this clause	16
4.2 General	16
4.2.1 Technology classes	16
4.2.2 Component types.....	17
4.3 Hierarchical structure.....	17
4.3.1 Network levels	17
4.3.2 Train backbone level.....	17
4.3.3 Consist network level.....	18
4.3.4 Interface between train backbone and consist network	18
4.3.5 End devices connected to train backbone.....	19
4.4 Network configurations	19
4.5 Train to ground connection (option).....	20
5 Train backbone.....	21
5.1 Contents of this clause	21
5.2 Train backbone topology.....	21
5.2.1 General	21
5.2.2 Train backbone based on bus technology.....	21
5.2.3 Train backbone based on switched technology	22
5.3 Train compositions	22
5.4 Train backbone node numbering.....	23
5.5 Train directions.....	23
5.5.1 Vehicle	23
5.5.2 Consist.....	23
5.5.3 Closed train	24
5.5.4 Train.....	24
5.6 Train inauguration.....	26
5.6.1 Objectives	26
5.6.2 Train network directory	26
5.6.3 Inauguration control	28
5.6.4 Node states	29
5.6.5 Node roles.....	32
5.6.6 Performance.....	32
6 Consist network	32

6.1	Contents of this clause	32
6.2	Scope of standardization.....	32
6.3	Consist network topology.....	33
6.3.1	Consist network based on bus technology (MVB, CANopen).....	33
6.3.2	Consist network based on switched technology	34
6.3.3	Sub-networks.....	36
6.3.4	Heterogeneous consist network	36
6.4	Gateway.....	36
6.4.1	General	36
6.4.2	Functional description.....	37
6.4.3	Application layer gateway.....	37
6.4.4	Gateway implemented by a router	39
7	On-board data communication	39
7.1	General	39
7.2	Communication patterns	39
7.2.1	Purpose.....	39
7.2.2	Definitions	39
7.2.3	Push pattern.....	40
7.2.4	Pull pattern	41
7.2.5	Subscription pattern.....	43
7.3	Addressing	43
7.3.1	General	43
7.3.2	Network layer addressing.....	43
7.3.3	Application layer addressing.....	45
7.4	Availability of data communication	45
7.5	Data classes.....	46
7.5.1	General	46
7.5.2	Service parameters.....	46
7.5.3	TCN data class definition	47
7.6	Communication profile	48
	Bibliography.....	49
	Figure 1 – Train backbone and consist network	17
	Figure 2 – Consist with two consist networks	18
	Figure 3 – End device connected to the train backbone (example)	19
	Figure 4 – Communication between train and ground (example)	21
	Figure 5 – Interfaces between consists.....	21
	Figure 6 – Train backbone bus topology	22
	Figure 7 – Train backbone switched topology	22
	Figure 8 – Directions and orientation in a vehicle	23
	Figure 9 – Directions and orientations in a consist	24
	Figure 10 – Directions and orientations in a closed train	24
	Figure 11 – Directions and orientations in train (TCN directions).....	25
	Figure 12 – Structure of train network directory (example)	27
	Figure 13 – Train inauguration block diagram	30
	Figure 14 – Train inauguration state chart	31
	Figure 15 – Consist network standard interfaces.....	33

Figure 16 – Consist network (bus technology).....	34
Figure 17 – Consist switches.....	34
Figure 18 – Examples of consist network topologies (switched technology).....	35
Figure 19 – End Device connected to two consist switches	35
Figure 20 – Sub-networks in a consist network	36
Figure 21 – Implementation example for two vehicle busses	36
Figure 22 – Example of heterogeneous train control network architecture	37
Figure 23 – Local service	38
Figure 24 – Unconfirmed service	38
Figure 25 – Confirmed service.....	38
Figure 26 – Provider initiated services	39
Figure 27 – Point to point communication pattern (push).....	40
Figure 28 – Point to multi-point communication pattern (push)	41
Figure 29 – Point to point communication pattern (pull).....	41
Figure 30 – Point to multi-point communication pattern (push)	42
Figure 31 – Subscription communication pattern.....	43
Table 1 – Train composition changes	22
Table 2 – Train network specific parameters (example)	27
Table 3 – Consist network specific parameters (example).....	27
Table 4 – Vehicle specific parameters (example).....	28
Table 5 – Device specific parameters (example).....	28
Table 6 – Service parameters.....	46
Table 7 – Principal data classes	47

Preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRONIC RAILWAY EQUIPMENT –
TRAIN COMMUNICATION NETWORK (TCN) –****Part 1: General architecture**

FOREWORD

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

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

This third edition cancels the second edition published in 2007 and constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- new structuring of standard parts. The content of the previous edition has now been moved to IEC 61375-2-1 and IEC 61375-3-1.
- this part of the standard describes now the general architecture of the onboard train communication network.

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

FDIS	Report on voting
9/1641/FDIS	9/1665/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.

A list of all parts of IEC 61375 series, under the general title *Electronic railway equipment – Train communication network (TCN)*, can be found on the IEC website.

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.

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

INTRODUCTION

IEC 61375-1 defines the general architecture of the Train Communication Network (TCN) so as to achieve compatibility between consist networks defined by this part of IEC 61375 and train backbones defined by this part of IEC 61375.

The TCN has a hierarchical structure with two levels of networks, a train backbone and a consist network:

- a) for interconnecting vehicles in close or open trains, this part of IEC 61375 specifies train backbones with different characteristics;
- b) for connecting standard on-board equipment, this part of IEC 61375 specifies consist networks with different characteristics.

The general architecture of the TCN, which is defined in this part of the standard, shall

- c) establish the rules for interconnecting consist networks with train backbones, as
 - identifying the interfaces;
 - defining the principles of how train topology changes can be discovered;
 - defining the basic communication services provided by train backbones to be used by consist networks;
- d) establish basic rules for the train backbone and for the consist network;
- e) establish rules for communalities in operation, as:
 - patterns for the communication between users;
 - addressing principles;
 - data classes to be supported.

ELECTRONIC RAILWAY EQUIPMENT – TRAIN COMMUNICATION NETWORK (TCN) –

Part 1: General architecture

1 Scope

This part of IEC 61375 applies to the architecture of data communication systems in open trains, i.e. it covers the architecture of a communication system for the data communication between vehicles of the said open trains, the data communication within the vehicles and the data communication from train to the ground.

The applicability of this part of IEC 61375 to the train network technologies allows for interoperability of individual vehicles within open trains in international traffic. The data communication systems inside vehicles are given as recommended solutions to cope with the said TCN. In any case, proof of compatibility between a proposed train backbone and a proposed consist network will have to be brought by the supplier.

This part of IEC 61375 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 Clause 3.

NOTE 2 Road vehicles such as buses and trolley buses are not considered in this part of IEC 61375.

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.

ISO/IEC 7498-1, *Information Technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1): specification of basic notation*

ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts*

ISO/IEC 19501:2005, *Information technology – Open Distributed Processing – Unified Modeling Language (UML) Version 1.4.2*

UIC CODE 556, *Information transmission in the train (train-bus)*

3 Terms, definitions, abbreviated terms, acronyms, and conventions

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.