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Entwurf

**Elektronische Betriebsmittel für Bahnen –
Zug-Kommunikations-Netzwerk –
Teil 1: TCN – Zug-Kommunikations-Netzwerk Allgemeiner Aufbau
(IEC 9/1273/CDV:2009);
Englische Fassung FprEN 61375-1:2009**

Electronic railway equipment –
Train communication network –
Part 1: TCN – Train Communication Network General Architecture
(IEC 9/1273/CDV:2009);
English version FprEN 61375-1:2009

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2009-09-21 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

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

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an dke@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.dke.de/stellungnahme abgerufen werden;
- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (Hausanschrift: Stresemannallee 15, 60596 Frankfurt am Main).

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

Gesamtumfang 50 Seiten

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Nationales Vorwort

Die englische Originalfassung des Internationalen Dokuments IEC 9/1273/CDV:2009 „Electronic railway equipment – Train communication network – Part 1: TCN – Train Communication Network General Architecture“ (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

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. Dem entsprechend ist das internationale Dokument IEC 9/1273/CDV:2009 „Electronic railway equipment – Train communication network – Part 1: TCN – Train Communication Network General Architecture“ unverändert in den Entwurf FprEN 61375-1:2009 übernommen worden.

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

Das Präsidium des DIN hat mit Präsidiumsbeschluss 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 Normentwurf erfüllt.

Das internationale Dokument wurde vom TC 9 „Electrical equipment and systems for railways“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Bei der Abstimmung zu dem Europäischen Schluss-Entwurf bei CENELEC und dem Internationalen Schluss-Entwurf bei IEC [Final Draft International Standard (FDIS)] sind jeweils nur „JA/NEIN“-Entscheidungen möglich, wobei „NEIN“-Entscheidungen fundiert begründet werden müssen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Für diesen Norm-Entwurf ist das nationale Arbeitsgremium UK 351.1 „Fahrzeuge“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

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

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

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen 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.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRONIC RAILWAY EQUIPMENT –
TRAIN COMMUNICATION NETWORK –**

Part 1: TCN - Train Communication Network - General Architecture

FOREWORD

This Committee Draft for Vote was prepared by the IEC TC9 WG43 according to the following resolution that was taken by TC9 during the Plenary Meeting in Kista (Sweden) on November 2008.

Resolution 48/13

Noting the comments received on documents 9/1162/CD to 9/1167/CD, TC9 instructs WG43 Convenor to prepare the CDV texts for 61375 series (except 61375-3-4) by May 2009 at the latest.

INTRODUCTION

IEC 61375-1 defines the general architecture of the Train Communication Network so as to achieve compatibility between Consist Networks defined by this part of IEC61375 and Train Backbones defined by this part of IEC61375.

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 IEC61375 specifies Train Backbones with different characteristics
- b) for connecting standard on-board equipment, this part of IEC61375 specifies Consist Networks with different characteristics

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

- a) 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
- b) establish basic rules for the Train Backbone and for the Consist Network
- c) 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 –

Part 1: TCN - Train Communication Network - 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 IEC61375 to the train network technologies as defined in allow 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 IEC61375 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 3.

NOTE 2 Road vehicles such as buses and trolley buses are not considered in this part of IEC61375.

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 61375-2 Train Network IEC 61375-2-1, *Electronic railway equipment – Train Communication Network – Wire Train Bus*

IEC 61375-2-2, *Electronic railway equipment – Train Communication Network – Wire Train Bus Conformance Testing*

IEC 61375-2-3 *Electronic railway equipment – Train Communication Network – (UIC) Communication Profile*

IEC 61375-2-4 *Electronic railway equipment – Train Communication Network – (UIC) Application Profile*

IEC 61375-2-5, *Electronic railway equipment – Train Communication Network – Ethernet Train Backbone*

IEC 61375-3 Vehicle Network IEC 61375-3-1, *Electronic railway equipment – Train Communication Network – Multifunction Vehicle Bus*

IEC 61375-3-2, *Electronic railway equipment – Train Communication Network – Multifunction Vehicle Bus Conformance Testing*

IEC 61375-3-3, *Electronic railway equipment – Train Communication Network – CANopen Consist Network*

IEC 61375-3-4, *Electronic railway equipment – Train Communication Network – Ethernet Consist Network*

ISO/IEC 7498-1, *Information Processing Systems – Open System Interconnection – Basic Reference Model*

IEC 60571, *Electronic equipment used on rail vehicles*

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.

3.1.1

active Train Bus Node

Train Bus Node receiving a sequence number during inauguration and forwarding user data packets between Consist Network and Train Backbone

3.1.2

Application Layer

upper layer in the OSI model, interfacing directly to the Application

3.1.3

Application Layer Interface

definition of the services offered by the Application Layer

3.1.4

Application process

an element within a real open system which performs the information processing for a particular application

3.1.5

bridge

device which stores and forwards frames from one bus to another on the base of their Link Layer addresses

3.1.6

broadcast

nearly simultaneous transmission of the same information to several destinations. Broadcast in the TCN is not considered reliable, i.e. some destinations may receive the information and others not

3.1.7

bus

communication medium which broadcasts the same information to all attached participants at nearly the same time, allowing all devices to obtain the same sight of its state, at least for the purpose of arbitration

3.1.8

closed train

train composed of one or a set of Consists, where the configuration does not change during normal operation, for instance metro, sub-urban train, or high speed train units.

3.1.9

communication devices

devices connected to Consist Network or Train Backbone with the ability to transport, source or sink data..

3.1.10

composition

number and characteristics of the vehicles forming a train

3.1.11

configuration

definition of the topology of a network, the devices connected to it, their capabilities and the traffic they produce; by extension, the operation of loading the devices with the configuration information before going to regular operation

3.1.12

Consist

train set

rake of coaches

single vehicle or a group of vehicles which are not separated during normal operation. A Consist contains no, one or several Consist networks.

3.1.13

Consist Network

communication network interconnecting communication devices in one Consist.

3.1.14

Consist network address

network address, which does not change after inauguration and which is used to address communication device in the own consist network.

3.1.15

Consist sequence number

Sequence number of the Consist in the train as obtained during train inauguration.

3.1.16

Consist Switch

Consist Network Node

Network component used in Consist Network based on switched technology (ECN)). See "switch".

3.1.17

Consumer

receiver of a message at the Transport Layer (see: Producer)

3.1.18**destination device**

receiver of a data packet (see: Source Device)

3.1.19**End Device**

unit connected to one Consist Network or to one set of Consist Networks prepared for redundancy reasons

3.1.20**End Node**

Node which terminates the Train Backbone

3.1.21**function**

Application Process which exchanges messages with another Application Process

3.1.22**gateway**

connection between different communication technologies

3.1.23**group address**

address of a multicast group to which a device belongs

3.1.24**inauguration**

operation executed in case of composition change, which gives all Nodes of the Train Backbone their Train Backbone address, their orientation and information about all named Nodes on the same backbone

3.1.25**integrity**

property of a system to recognize and to reject wrong data in case of malfunction of its parts

3.1.26**intermediate node**

Node which establishes continuity between two bus sections connected to it, but does not terminate them

3.1.27**jumper cable**

cable connecting the trunk cables of two consecutive vehicles, possibly of a larger cross-section than the trunk cable, and which is plugged by hand in the case of the UIC-cable. There are generally two jumper cables between vehicles

3.1.28**linear topology**

topology where the nodes are connected in series, with two nodes each connected to only one other node and all others each connected to two other nodes (that is, connected in the shape of a line).

[IEC 61784-2]

3.1.29

Local Area Network

part of a network characterized by a common medium access and address space

3.1.30

Medium Access Control

sublayer of the Link Layer, which controls the access to the medium (arbitration, mastership transfer, polling)

3.1.31

medium

physical carrier of the signal: electrical wires, optical fibers, etc.

3.1.32

message

data item transmitted in one or several packets

3.1.33

Mobile Train Unit

part of a train which shall be uniquely addressable from ground. A mobile train unit provides one active mobile communication gateway for train to ground communication.

3.1.34

multicast

transmission of the same message to a group of receivers, identified by their Group Address. The word "multicast" is used even if the group includes all receivers

3.1.35

Multiple Unit Train

a train consisting of a set of closed trains, where the composition of the set may change during normal operation

3.1.36

network

set of possibly different communication systems which interchange information in a commonly agreed way

3.1.37

network address

address which identifies a communication device on network layer.

3.1.38

Network Device

components used to set up Consist Networks and Train Networks. These may be passive components like cables or connectors, active unmanaged components like repeaters, media converters or (unmanaged) switches, or managed active components like gateways, routers and (managed) switches.

3.1.39**network layer**

layer in the OSI model responsible for routing between different busses

3.1.40**network management**

operations necessary to remotely configure, monitor, diagnose and maintain the network

3.1.41**node**

Device on the Train Backbone, which may act as a gateway between Train Backbone and Consist Network

3.1.42**octet**

byte

8-bit word stored in memory or transmitted as a unit

3.1.43**open train**

a train composed of a set of Consists, where the configuration may change during operation, for instance international UIC trains

3.1.44**operator**

enterprise or organization which is operating trains.

3.1.45**packet**

unit of a message (information, acknowledgement or control) transmitted by protocols on network or transport layer

3.1.46**passive Train Backbone Node**

Train Backbone Node which is in standby to an active Train Backbone Node in a Consist Network.

3.1.47**Producer**

sender of a message at the Transport Layer (see: Consumer)

3.1.48**Publisher**

source of a Dataset for broadcasting (see: Subscriber)

3.1.49**receiver**

electronic device which may receive signals from the physical medium

3.1.50

repeater

connection at the Physical Layer between bus segments, providing an extension of the bus beyond the limits permitted by passive means. The connected segments operate at the same speed and with the same protocol. The delay introduced by a repeater is in the order of one bit duration

3.1.51

residual error rate

probability of integrity breach (unrecognized wrong bit) per transmitted bit

3.1.52

ring topology

active network where each node is connected in series to two other nodes

[IEC 61918]

NOTE - Ring may also be referred to as loop.

3.1.53

router

connection between two busses at the Network Layer, which forwards datagrams from one bus to another on the base of their Network Address

3.1.54

service

capabilities and features of a sub-system (e.g. a communication layer) provided to a user

3.1.55

sporadic data

transmission of data on a demand basis

3.1.56

subscriber

one of the sinks of a broadcast Dataset (see: Publisher)

3.1.57

switch

MAC bridge as defined in IEEE 802.1D

3.1.58

topography

data structure describing the Nodes attached to the Train Backbone, including their address, orientation, position and Node Descriptor

3.1.59

topology

possible cable interconnection and number of devices in a given network

3.1.60**topography counter**

counter in a Node which is incremented at each new inauguration

3.1.61**Train Communication Network**

data communication network for connecting programmable electronic equipment on-board rail vehicles

3.1.62**Train Backbone**

bus connecting the vehicles of a train and which conforms to the TCN protocols

3.1.63**train backbone node**

node

device on the Train Backbone which receives a train backbone node number during inauguration. A train backbone node can be used to connect an End Device or a Consist Network to the Train Backbone.

3.1.64**train backbone node number**

node address

node number

Each train backbone node is assigned a number during inauguration, which indicates the position of the train backbone node on the Train Backbone.

3.1.65**train network address**

dynamic network address, which is used to address communication devices in other consist networks. This address can change after each inauguration.

3.1.66**Train Network Management**

services of the Network Management for TCN

3.1.67**Transport Layer**

layer of the OSI model responsible for end-to-end flow control and error recovery

3.2 Abbreviations and Acronyms

ANSI	American National Standard Institute, a standardisation body in the United States
ALG	Application Layer Gateway
BER	Bit Error Rate, the rate of bit errors in a data stream, mainly caused by noise (random bit errors), but also caused by memory defects in data storing devices (systematic bit errors).
BR	Bit Rate, the rate of data throughput on the medium expressed in bits per second (bit/s) or in hertz (Hz), whichever is appropriate
CAN	Controller Area Network

CN	Consist Network
CPS	Communication Protocol Stack
CRC	Cyclic Redundancy Check, a data integrity check based on polynomial division
DIN	Deutsches Institut für Normung, the German national standardisation body
ECN	Ethernet Consist Network
ED	End Device
EIA	Electronics Industries Association, a standardisation body in the United States
ETB	Ethernet Train Backbone
IEC	International Electrotechnical Commission, Geneva
IEEE	Institute of Electrical and Electronics Engineers, New York
ISO	International Standard Organisation, Geneva
ITU	International Telecommunication Union, the international standardisation body for telecommunications based in Geneva
MAC	Medium Access Control, a sub-layer within the Link Layer ruling which device is entitled to send on the bus
MCG	Mobile Communication Gateway
MTU	Mobile Train Unit
MVB	Multifunction Vehicle Bus
ND	Network Device
OSI	Open System Interconnection, a universal communication model defined in the ISO/IEC 7498
PCTR	Protocol Conformance Test Report, defined in ISO/IEC 9646
PICS	Protocol Implementation Conformance Statement, defined in ISO/IEC 9646
RFC	Request For Comments, Internet Standard published by the Internet Engineering Task Force (IETF)
TB	Train Backbone
TBN	Train Backbone Node
TCN	Train Communication Network, a set of communicating vehicle and Train Backbones
UIC	International Union of Railways , the international railways operators association
URI	Uniform Resource Identifier
UML	Unified Modeling Language
WTB	Wire Train Bus