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

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

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

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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

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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. [IEC 61375-1:2012](https://standards.iteh.ai/catalog/standards/sist/a891f2e4-4e25-4cf0-b471-b22c6e745bf3/iec-61375-1-2012)

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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.

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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.

3.1.1**active train backbone node**

train backbone 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

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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 composition does not change during normal operation, for instance metro, sub-urban train, or high speed train units

EXAMPLE Consists are coupled in a workshop to establish a closed train for operation.

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, and which contains no, one or several consist networks

EXAMPLE The vehicles of a consist are steadily connected in a workshop, and automatic couplers are mounted at both ends of the consist to facilitate the coupling and de-coupling of complete consists in the workshop or during operation.

3.1.13

consist network

communication network interconnecting communication devices in one consist

NOTE Consist networks do not spread beyond consist boundaries.

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”

3.1.58.

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3.1.17

consumer

receiver of a message at the transport layer (see: “producer” 3.1.47)

3.1.18

destination device

receiver of a data packet (see: “source device” 3.1.55)

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.

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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

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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

train composed of one or a set of consists, where the configuration may change during operation, as for instance locomotive hauled 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” 3.1.17)

3.1.48**publisher**

source of a dataset for broadcasting (see: “subscriber” 3.1.57)

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**source device**

sender of a data packet (see: “destination device” 3.1.18)

3.1.56**sporadic data**

transmission of data on a demand basis

3.1.57**subscriber**

one of the sinks of a broadcast dataset (see: “publisher” 3.1.48)