PD CLC/TR 50501-2:2012

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Railway applications — Rolling stock — Intercommunication between vehicles and train/wayside

Part 2: Technical contents of standardization work in the field of intercommunication

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National foreword

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Bahnanwendungen - Interkommunikation zwischen Fahrzeugen und Fahrweg - Teil 2: Technischer Inhalt der Normung auf dem Gebiet der Interkommunikation

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This document (CLC/TR 50501-2:2012) has been prepared by CLC/SC 9XB "Electromechanical material on board rolling stock", of CLC/TC 9X, "Electrical and electronic applications for railways".

It provides information asked for by resolutions 33/03 and 34/04 of SC9XB.

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V2	**Second draft**	**2008/10/15**	**G. Demars**	**Intro, 4.1; Annex A**	**Updates, and corrections following comments of S. Ingenhorst**
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1 Scope

The scope of this Technical Report is to summarize all available data on standardization work in the field of Intercommunication including

1. the results of work of WG B14 carried out so far,
2. data from other related activities such as the research projects MODTRAIN and INTEGRAIL,
3. data from the sector organisation TMP.

NOTE "TMP", Technical Management Platform, is one of the structures created by the rail representatives associations in order to express common views on TSI open issues or standardization work programs (not active anymore).

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.

CLC/TR 50501-1:2007, Railway applications - Rolling stock - Intercommunication between vehicles and train/wayside - Part 1: Data dictionary and rules for functional standardisation

3 Terms and definitions

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

3.1
consist
train set
rake of coaches
single vehicle or a group of vehicles which are not separated during normal operation.

Note 1 to entry: A consist contains no, one or several consist networks.

assembly of vehicles (may be reduced to a single vehicle), which are permanently coupled while in service, and fitted with a "vehicle communication system", linking the devices, and providing one interface with the train level (such a communication system may be a vehicle bus, spanning over all the vehicle of the consist).

Note 2 to entry: A physical consist which is not capable of data communication with other consist or ground installation is not in the scope of the Reference Architecture. A consist is described by a set of static properties (as in UIC Leaflet 556 [BIB 2.])

3.2
entity
anything of interest (such as a person, material object, place or process) within a given **domain of discourse**.

Note 1 to entry: An **entity class** is a stereotyped class used to model long-lived information that may be persistent. An entity is said *complex* when it can be described by at least two other entities. Otherwise, it is called a *simple entity* or **primitive**

3.3
functional requirement
an action that the target system is able to perform

3.4
functional specification
specification of functions performed by the **entities** in a given application, in a manner that is independent of the technology adopted to implement the specified functions

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3.5
train
assembly of coupled consists (may be reduced to a single consist), configured for autonomous operation on the railway system. and in use for an operational mission; the train is a dynamic object, identified with a “train running number”, active only during its operational mission

4 Summary of results of works carried out by WG14

The main results of works carried out by WG14 so far, are documented in CLC/TR 50501-1, and are summarised below:

4.1 Proposal for a standard “reference architecture” for vehicle intercommunication

Functions which are in the scope of this series of standards are supported by distributed applications. Functional standardisation activities are supported by production of functional models.

The elaboration of a functional model for a specific function of the railway system, belonging to categories STD2 and STD3 defined in the global scope of WG14, shall use a “reference architecture”.

The purpose of this Reference Architecture is to support the standardisation of the communication procedures between vehicles and train/wayside.

To provide a common understanding among the standardisation working groups, this reference architecture includes

- a list of the interacting entities which are considered in the reference architecture
    - rolling stock entities: train, vehicles, devices,
    - external entities interacting with rolling stock entities
    - interfaces considered in the reference architecture because they are “interoperability relevant”

4.2 Methods for functional modelling

The functional modelling framework which is described is derived from MODTRAIN European project results.

This framework is intended to provide a “common language” for the experts involved functional standardisation of “communication” rail vehicle functions with interoperability constraints (i.e in the scope of further standardisation works).

4.3 Requirements for a “Functional addressing” feature

Functional addressing was identified as an important issue in CLC/TR 50501-1:2007, 4.3, 4.5.4, and 5.4.2. Annex B is dedicated to functional addressing in GSM-R and UIC leaflet 556. Is to be noted that GSM-R consider “functional addressing” as one of the main “railway specific feature” which has been added to the standard GSM communication system.

Requirements relative to functional addressing, already given in CLC/TR 50501-1, are

- a functional addressing scheme should be provided, which permits entities to be identified by a “name”, used as a “functional address”, representative of their functional roles rather than by “numbers” tied to the interface equipment they are using;
- use of functional addressing will include identifying on-train functions and other users performing particular roles such as train driver, passenger, train conductor, etc.;

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NOTE Communications protocols not belonging to the “application levels”, which are using functional addresses, and are necessary for the implementation of communications systems, should be specified (independently of the various functional models) in STD4, as these communication systems are to be shared by several user functions. These protocols should be chosen among existing open industry standards.

An important concept within the Reference Functional Architecture (defined in CLC/TR 50501-1) is dealing with how a functional element is accessed in the railway vehicle dynamic environment. Railway vehicles are mobile, and communicate with ground stations using wireless communication, which implies the existence of a ground based communication infrastructure.

Reaching a functional element implies the use of communication path. It is then necessary to associate to each relevant element:

- its identification, or name;
- its location, or address;
- and a route leading to this address.

The name shall not be bound to the address until a specific mapping process takes place. This mapping takes all its relevance in the railway transport context, where mobility may imply address changes over time.

The information exchange infrastructure shall guarantee:

- geographic independence: an entity and its functions are reachable independently of vehicle location;
- function binding: an entity and its functions are made available (published) in the communication network as soon as a communication path is available;
- function discovery: a specific function of a specific entity may be discoverable upon request from a potential user (a client);

4.4 Requirements for a central data dictionary/repository

The data dictionary is a central component necessary for development of consistent families of functional standards such as STD2 and STD3. Its purpose, related to the scope of WG14, is

- to document elements pertinent to the functional areas and essential for interoperability,
- to allow the reuse of element among functional areas, and
- to facilitate data interchange.

Main elements types are

- model elements,
- data elements,
- messages.

Data dictionary handles metadata which provide full definition of data elements, along with their essential attributes at conceptual level. In this context, data are limited to basic information elements, which are necessary to define standard messages required for interoperability, and handled on the interfaces of the communicating entities.

The central “data dictionary/model repository” shall be managed and operated by a single authority.

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5 Data from other related activities

5.1 From Integrail FP6 research project

5.1.1 Introduction

Discussions took place with representatives of InteGRail subproject ICOM. Among the subjects considered by ICOM as “candidates for standardisation”, the one which is in the scope of WG 14 is “functional addressing”, used to provide interoperability for rail vehicle applications using communications.

5.1.2 Functional addressing relevant documents from INTEGRAIL

5.1.2.1 Introduction

In InteGRail project (IGR), the topic is addressed in several documents. Integrail documents provided to WG14 are

- IGR-I-BTG-112-03 Train Onboard Addressing.doc [BIB 3.],
- IGR-D-BTG-111-11 Trainwide Communication.doc [BIB 4.],
- IGR-I-ALS-292-01 Concept for Symbolic Addressing in ICOM.ppt [BIB 5.],
- IGR-I-SIE-259-01 5.3.4 Symbolic Addressing in ICOM [BIB 6.],
- IGR-I-INR-033-01 Train to ground addressing scenario.ppt [BIB 7.],
- IGR-I-ALS-240-02 ICOM general approach for addressing trains.doc [BIB 8.].

5.1.2.2 Train on board addressing

Document reference: IGR-I-BTG-112-03 [BIB 3.]

Summary provided in the referenced document: This document defines an overall addressing scheme for the on board train devices supporting the integration of TCMSs inside the IGRIS architecture. Targets of the addressing scheme are the definition of the rules, how distributed resources of the TCMS can be identified, and the basis for the communication protocols which shall provide access to these resources.

Clause 2 in this IGR document is dedicated to “Addressing” (52 pages):

- Subclause 2.2 is dedicated to “functional addressing” (22 pages);
- Subclause 2.3 is dedicated Network addressing;
- Subclause 2.5 is dedicated to address resolution.

Relevant requirements are found in the following paragraphs of this document:

- Subclause 2.1, Hierarchical addressing scheme;
- Subclause 2.2, Functional addressing:
    - Subclause 2.2.1, Basic concept;
    - Subclause 2.2.2, IPTCS Universal resource identifier;

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  - Subclause 2.2.3, IPT-URI Direct Identifier;
  - Subclause 2.2.4, IPT-URI Range Identifier;
  - Subclause 2.2.5, IP-Train Directory.

- Subclause 2.3.6, Multicast addressing;
- Subclause 2.5.2, IP-Train Directory.

5.1.2.3 Trainwide Communication Subsystem (Deliverable: D3.3)

IGR-D-BTG-111-11 [BIB 4.] (04 April 2008).

Summary provided in the document: The goal is a proposal for a system with high bandwidth supported data types, network topology, addressing, service, security and middleware aspects based on the main operational scenarios for communication and the evaluated state of the art for communication systems in embedded networks, automation and railway.

5.1.2.4 ICOM Symbolic Addressing

Reference: IGR-I-ALS-292-01 [BIB 5.].

This introductive document, “ICOM Symbolic Addressing”, is describing the concepts, and defined which related items need to be standardised

Summary: Applications use “abstract names” for addressing, instead of network addresses (IP address for IGR). “Symbolic address” is a name to identify an entity involved in interactions between applications. The term “functional address” is used when the addressed entity is characterised as a function. ICOM resolves (translates) symbolic addresses.

What to standardise? - Rule sets (for given railway contexts, providing for extension), Generic guidelines and patterns (formats, address resolution handling)

Symbolic address format:

- basic requirements: human readable, part for network, part for application level;
- URI syntax.

Symbolic @ rules set definition:

- applicable URI schemes;
- rules to avoid address ambiguity;
- often linked to underlying physical address.

Symbolic address resolution: reliance on standard technologies: Internet offers standard and open addressing technologies (Domain Name System)

Dynamicity in train: coupling /uncoupling, configuration changes, consists vs train addresses:

- static consist addresses: need to access individual device by maintainer companies;
- dynamic train addresses: operations applications need to access “functional leader”.

An other document on the subject, named “Symbolic Addressing in ICOM”, address the issue of “rules set”.

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5.1.2.5 Symbolic addressing in ICOM: ICOM symbolic addressing rule set

IGR-I-SIE-259-01 [BIB 6.] (18/02/2008).

Citation from the introduction paragraph of this document:

ICOM has to provide communication services between many applications located on the ground and inside trains. The communication on ground mainly uses Internet technology whereas on trains an Ethernet IP technology is applied. In order to make addressing between these applications less complicate with the provision of dynamically changed physical addresses, a symbolic addressing concept and rule set are introduced.

As a logical consequence, the functional addressing schema for inter-application communication on the train, introduced in UIC 556 [3] and enhanced in the specification of the train wide communication subsystem [1], is getting a wider scope in the context of ICOM, which has to handle the functional addressing on board and on ground [5].

The set of symbolic addressing rules proposes ICOM URI schemas based on widely used internet addressing and additional symbolic function names to make use of a consistent functional addressing schema in ICOM on train wide communication [1], on train to ground [6] and on ground communication.

2 requirements in this document, about the construction of domain names.

5.2 From Modtrain FP6 research project

5.2.1 Functional modelling process

Function modelling process specified in CLC/TR 50501-1 is partially derived from the one used in MODTRAIN/MODCONTROL.

5.2.2 FRS “Trainwide communication“

MODTRAIN/MODCONTROL, main focus is on communications internal to a vehicle (or a consist), while WG14 focus is also on the external communications. The FRS about “Trainwide communication” [BIB 9.] is a relevant input.

5.2.3 “Functional open coupling” concept

This concept was introduced in MODTRAIN research project, and related definitions and requirements described the MODTRAIN/EUCOUPLER document “functional open coupling, SNCF, Release 1 - 16 Feb. 2005” [BIB 10.]

In that context “coupling” is linked to the capability, for a set of two (or more) coupled trainsets, to be operated by a single driver located inside the train configuration which is resulting from the coupling. It is to be noted that several drivers may be present during the preparation phase of the coupling process, before the “functional coupling” phase.

“Functional coupling” is performed following the mechanical, pneumatic and electrical coupling phases.

In that context, “openness” means the ability to preserve the coupling capability at train level, within a fleet where all trainsets complies with the specified “open coupling interface”, even after functional evolutions occurring in some trainsets in the fleet, and/or after modifications are made in the trainset internal structure (for instance, to take care of obsolescence,..).

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Following text is a non-exhaustive list of “Functional Open Coupling” (FOC) requirements, more or less related to functional addressing concept:

- a separate “coupling interface” specification shall be produced for each function which is to be managed through the FOC interface,
- in operation, “functional coupling” shall be performed independently for each function,
- each public train function shall be identified by a name, this name being registered in a public Central Repository, ensuring uniqueness in a given public domain (such as a set of fleets),
- each “private” function shall be identified by a name, this name being registered in a private repository, ensuring uniqueness in the corresponding private domain,
- on the FOC interface, and for each train function, train level communications shall be managed by a specific “referent”, identified by the name of the function. This “referent” is the then only access point in the trainset for the function,
- on the FOC interface, each function is seen as a set of elementary services. Each service shall be identified by a name.

From “outside” a given trainset, a service can be identified by an URI (compliant with RFC 3986 [BIB 11.]) where the following elements should be used:

- a “train number” (as defined in the TSI OPE);
- a reference to a trainset within the train formation (TBD);
- a function name (in the “Query” component, as defined in RFC 3986 [BIB 11.]);
- a service name (in the “fragment” component, as defined in RFC 3986 [BIB 11.]).

6 Data from the sector organisations

6.1 UIC Leaflet 556 [BIB 2.]: functional addressing for the UIC train bus

In the UIC 556 Leaflet, functional addressing concept is based on a user view of a train architecture, considering the actual train composition, this means the vehicles present in the train with their special properties”. Functional address resolution (into device addresses) may change when the train composition change (addition or removal of vehicles).

For independence of internal vehicle structure, information shall be exchanged between functions. This provides for “a clear interface between the train bus node and the vehicle internal structure”. All considered functions, are given function addresses, which is made in UIC Leaflet 556 by numbering functions in a standard way. A function is identified by 2 digits, 1 to 21 being presently allocated. Number 22 to 99 are reserved (see [BIB 2.]).

Vehicles are identified by their “UIC address”, corresponding to the vehicle sequence established after UIC inauguration. A functional address is then by defined by two numbers: a UIC address (or a group), and a function address. Functional addresses for source and target are included in E-telegram messages.

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