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Intelligent transport systems — Guided transportation service planning data exchange

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The purpose of this document is to facilitate the planning of railway operations between organizations in the transportation sector (communication between interested parties).

The aim is to provide a common format for necessary railway data exchange between interested parties in the industry during the conceptual, strategic and tactical phases of railway service planning.

Examples of roles of interested parties are:

— railway authorities;

— public transport authorities;

— train operators;

— infrastructure managers;

— rolling stock companies;

— suppliers to the railway sector (rolling stock, signalling systems, etc.);

— consultants.

These roles can be fulfilled by separate entities or by different units within one integrated entity or company.

This document covers various planning aspects, including the following:

a) **Conceptual planning:** Years in advance of construction of the new or improved infrastructure.

b) **Strategic planning:** Usually for new timetable concepts, new rolling stock or improved infrastructure, more than 15 months before implementation of new annual timetable, including:

— tendering process for passenger train operators (calculating tenders);

— feasibility studies for commercial train operators (freight and passengers);

— temporary infrastructure capacity restrictions.

c) **Tactical planning:** Usually for producing a new timetable, typically for construction of the annual timetable, including:

— train path and capacity requests (train operators);

— train path and capacity allocation (infrastructure managers).

During planning there is a continuous need for exchange of (machine readable) information between different stakeholders.

These stakeholders use different applications for their internal processes (runtime calculations, rostering, temporary capacity restrictions, etc). Within large organizations there can also be different applications in use, where effective exchange of information is essential.

A common (standardized) format for exchanging information between different applications will reduce time-consuming manual work and will improve accuracy. Railway Data Exchange (RailDax) is a format standard for exchanging railway data between applications.

The RailDax format is intended to be used by railway and transportation authorities, infrastructure managers and train operators during long-term planning, tendering processes, commercial evaluations and the yearly capacity allocation processes leading to the annual timetable.

RailDax has been developed in parallel with the data exchange language railML 2.5 (Railway Modelling Language 2.5), which is managed by railML.org.[1)]

Figure 1 illustrates the use of RailDax for conceptual, strategic and tactical planning of railway services and operations, leading to an annual timetable. Other exchange formats will be more suited for the exchange of network and timetable data for public (customers') travel planning and ticketing solutions.

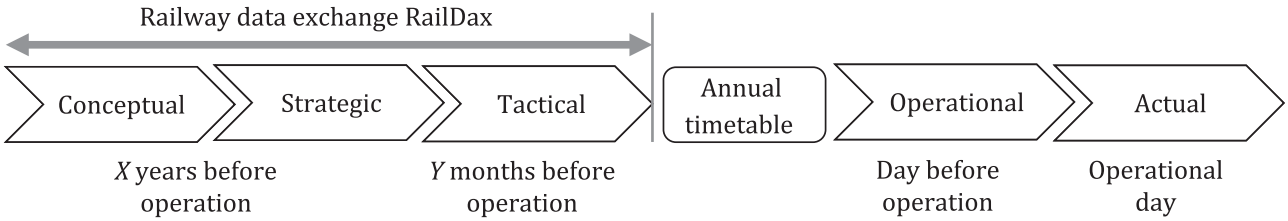

Figure 1 — RailDax as a railway data exchange format for conceptual, strategic and tactical planning

RailDax is not intended as a data exchange format for applications serving the following purposes:

1) asset development and maintenance applications for infrastructure and rolling stock;

2) public travel plan and fare management.

The interface between RailDax and purpose 2) will typically be the annual timetable.

Train operators can be legally obliged to publish in other formats, for example in Europe, the Network Timetable Exchange (NeTEx) for public travel plan and fare management, and Telematics Applications for Passenger services (TAP) and Technical Specifications for Interoperability (TSI) for slot ordering at national access points. The relationship between RailDax and these specifications is explained in Annex A.

When launching the RailDax project it was deemed necessary to base the format on a mature (proven in use) data exchange language and to cover the RailDax use cases. Based on a study, railML 2.x was chosen. For the same reason, RaiDax is developed as a pair to railML version 2.5. The development of possible future revisions of RailDax may be considered to pair with later railML versions or other formats.

1) railML® and the logos of railML.org are copyrighted by railML.org e.V., as they are registered at the European Union Intellectual Property Office as a trademark with the number 12576492. This trademark is provided for reasons of public interest or public safety. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO.

Intelligent transport systems — Guided transportation service planning data exchange

1 Scope

This document specifies an open, XML-based data format which enables an efficient and unambiguous exchange of static information concerning the operational functionality of the infrastructure, rolling stock and timetable of a track-bound transportation system. The main objective is to enable heterogeneous railway applications to communicate with each other.

The purpose of the data format is to facilitate common (integrated) planning of track-bound operations between organizations in the transportation sector.

Railway Data Exchange (RailDax) serves as a data exchange format between applications used for railway service planning: connecting information about infrastructure, rolling stock and timetable basics which are necessary for capacity management and timetable planning.

This document describes infrastructure and rolling stock from an operational perspective. To achieve this, the infrastructure and rolling stock is described with a clearly defined meaning from an operational perspective.

RailDax will typically be used by railway authorities, train operators, infrastructure managers and suppliers to the railway industry for communication between applications serving the use cases listed in Clause 7 in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/TS 14812, *Intelligent transport systems — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 14812 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
RailDax file
railway data exchange file

Note 1 to entry: The RailDax file is constructed according to the principles of this document.

3.2
infrastructure
tracks, switches, engineering structures (bridges, tunnels, etc.), platforms, zones of access (including the needs of persons with reduced mobility), safety and protective equipment

[SOURCE: railML RailGlossary[10]]

3.3
infrastructure capacity
potential to schedule train paths requested for an element of infrastructure for a certain period

[SOURCE: European Directive 2001/14/EC[5]]

3.4
capacity
maximum number of trains which can be planned to move in both directions over a specified section of track in a 24-hour period

[SOURCE: railML RailGlossary[10]]

3.5
guided transportation
track-bound public transport, such as railway, metro and tram systems

3.6
border
location where a line or frontier area separates the railway network between legal jurisdictions, e.g. countries, regions, tariff zones, infrastructure managers, project areas, etc.

[SOURCE: railML RailGlossary[10]]

3.7
train path
infrastructure capacity needed to run a train between two places over a given time-period

[SOURCE: European Directive 2001/14/EC[5]]

3.8
train route
course of a train over the tracks through its defined stations

Note 1 to entry: The train's route usually spans its entire service line from first to last operational point (station).

3.9
speed change
change of speed on a given location on the track

[SOURCE: railML RailGlossary[10]]

3.10
signal route
specific directional course over the tracks from one signal to the next for a train's safe passage

3.11
mileage
classical location framework in railways, given in form of a kilometre value

[SOURCE: railML RailGlossary[10]]

3.12
network
entire railway infrastructure owned or managed by an infrastructure manager

[SOURCE: European Directive 2001/14/EC[5]]

3.13
network statement
statement which sets out in detail the general rules, deadlines, procedures and criteria concerning the charging and capacity allocation schemes

Note 1 to entry: The statement shall also contain such other information as is required to enable application for infrastructure capacity.

[SOURCE: European Directive 2001/14/EC[5]]

3.14
timetable
schedule listing the times at which certain events, such as arrivals and departures at a transport station, are expected to take place

Note 1 to entry: The timetable defines all planned train and rolling-stock movements which will take place on the relevant infrastructure during the period for which it is in force.

[SOURCE: railML RailGlossary[10]]

3.15
train operator
railway undertaking
public or private undertaking, the principal business of which is to provide services for the transport of goods and/or passengers by rail with a requirement that the undertaking ensures tractionNote 1 to entry: This also includes undertakings which provide traction only.

[SOURCE: European Directive 2001/14/EC[5] modified — Preferred term “train operator” added.]

3.16
infrastructure manager
any body or undertaking that is responsible in particular for establishing and maintaining railway infrastructure

Note 1 to entry: This may also include the management of infrastructure control and safety systems. The functions of the infrastructure manager on a network or part of a network may be allocated to different bodies or undertakings.

[SOURCE: European Directive 2001/14/EC[5]]

3.17
overlap
section beyond a stop signal, or a stopping point in a continuous signalling system, which must be kept clear to avoid the risk of collision should a train inadvertently run past the signal or the stopping point

[SOURCE: IEC 60050-821:2017, 821-01-21]

3.18
product
item being offered by a train service, passenger or freight

3.19
line
list of railway tracks between two major operational points used for regular railway operation

[SOURCE: railML RailGlossary[10]]

3.20
station
area defined by one or more station boundaries, where an exit main signal on a remote-controlled line, or a manually given signal on a line without remote control, signals whether the next block is free

Note 1 to entry: A station is a place where operational trains can begin and end operations.

[SOURCE: railML RailGlossary[10]]

3.21
switch
unit of track comprising of two fixed rails (stock rails) and two moveable rails (switch rails) used to direct vehicles from one track to another track

Note 1 to entry: The term “point” is sometimes used for this concept.

[SOURCE: railML RailGlossary[10]]

3.22
tunnel
covered, horizontal passageway for railway transport through or under an obstruction

[SOURCE: railML RailGlossary[10]]

3.23
bridge
structure built for the explicit purpose of spanning and providing passage for railway transport over a gap or a barrier, i.e. a river, chasm, road, lake etc.

[SOURCE: railML RailGlossary[10]]

3.24
derailer
fixed device which, when placed on the rail, derails the wheels of a vehicle, and serves to protect a converging line

[SOURCE: railML RailGlossary[10]]

3.25
stop signal
signal at route exit where a train is usually required to stop

[SOURCE: railML RailGlossary[10]]

3.26
balise
wayside transmission unit that uses the magnetic transponder technology

Note 1 to entry: Its main function is to transmit or receive signals through the air gap. The balise is a single device mounted on the track, which communicates with a train passing over it.

[SOURCE: railML RailGlossary[10]]

3.27
balise group
one or more balises that on a higher system level together create a quantity of information related to the location reference in the track, the direction of validity of data, and train protection information

Note 1 to entry: The single balises form together a functionality that is described in the balise group.

Note 2 to entry: This is the location in the track where spot transmission occurs. The telegrams transmitted by all the balises of a group form a track-to-train message.

[SOURCE: railML RailGlossary[10]]

3.28
level crossing
location where railway and other traffic types cross each other at the same level (for example, without overpass or underpass)

Note 1 to entry: Level crossings may be technically secured or non-technically secured. Technically secured level crossings must have gates, barriers, traffic lights or other means of securing.

[SOURCE: railML RailGlossary[10]]

3.29
rolling stock
collective term for the rail fleet

Note 1 to entry: This term is sometimes used for one vehicle.

Note 2 to entry: It describes all the vehicles that are used on a railway track. It usually includes both powered and unpowered vehicles, for example locomotives, hauled passenger vehicles and freight vehicles (coaches and wagons), diesel units, electric units and service stock. The term is sometimes used to refer only to non-powered vehicles, thus excluding locomotives. The term contrasts with fixed stock (infrastructure), which is a collective term for the track, signals, stations and buildings etc. necessary to operate a railway.

[SOURCE: railML RailGlossary[10]]

3.30
vehicle roster
list or plan showing turns of duty for vehicles (rolling stock) in an organization

3.31
train
movement of a single vehicle or a number of coupled vehicles/units operating on a guided ground transport system

3.32
train part
basic part of a train with the same characteristics such as formation, and that is constant during an operating period

Note 1 to entry: The train part includes the actual information regarding the path of the train as a sequence of operation or control points together with the corresponding schedule information.

4 Abbreviated terms

ERA	European Union Agency for Railways
IS	infrastructure
NeTEx	network timetable exchange
OCP	operational control point
RailDax	railway data exchange
railML	railway markup language[9]
RINF	Register of Infrastructure NOTE 1 This is the main tool for describing the static rail network characteristics and capabilities as required by Directive (EU) 2019/777 on rail Interoperability.[11]

RS	rolling stock
TAF	telematics applications for freight services
TAP	telematics applications for passenger services
TSI	technical specifications for interoperability

NOTE 2 TSI define the technical and operational standards which are required to be met by each subsystem or part of the subsystem in order to meet the essential requirements and ensure the interoperability of the railway system of the European Union.

TT	timetable and vehicle rostering
TVD	track vacancy detection area
UC	use case
UML	unified modelling language
XML	extensible markup language[8]

5 Modelling concepts

5.1 General

This clause describes modelling of infrastructure and timetable concepts as connections of infrastructure and timetable elements.

Information about and mapping with other systems is included in Annex A.

5.2 Concepts infrastructure

5.2.1 Introduction

Railway models can have different aggregation levels. The RailDax model has a microscopic level where `<track>`s are the elementary units (e.g. for infrastructure planning) and a macroscopic level where the `<ocp>`s are the basic elements (e.g. for timetable planning).

As far as the infrastructure elements' references/connections are concerned, all the `<trackElements>` and `<ocsElements>` are objects placed on the on the `<track>`. Their position on the track is specified with the pos attribute, while their mileage on the railway line is given by the absPos attribute.

Railway lines are modelled as ordered sequences of tracks, while operational control points are unordered elements without any reference to their position in the topology. The link between tracks and operational control points (OCPs) is given by `<crossSection>` elements which specify the connection and the position of the station with respect to the track.

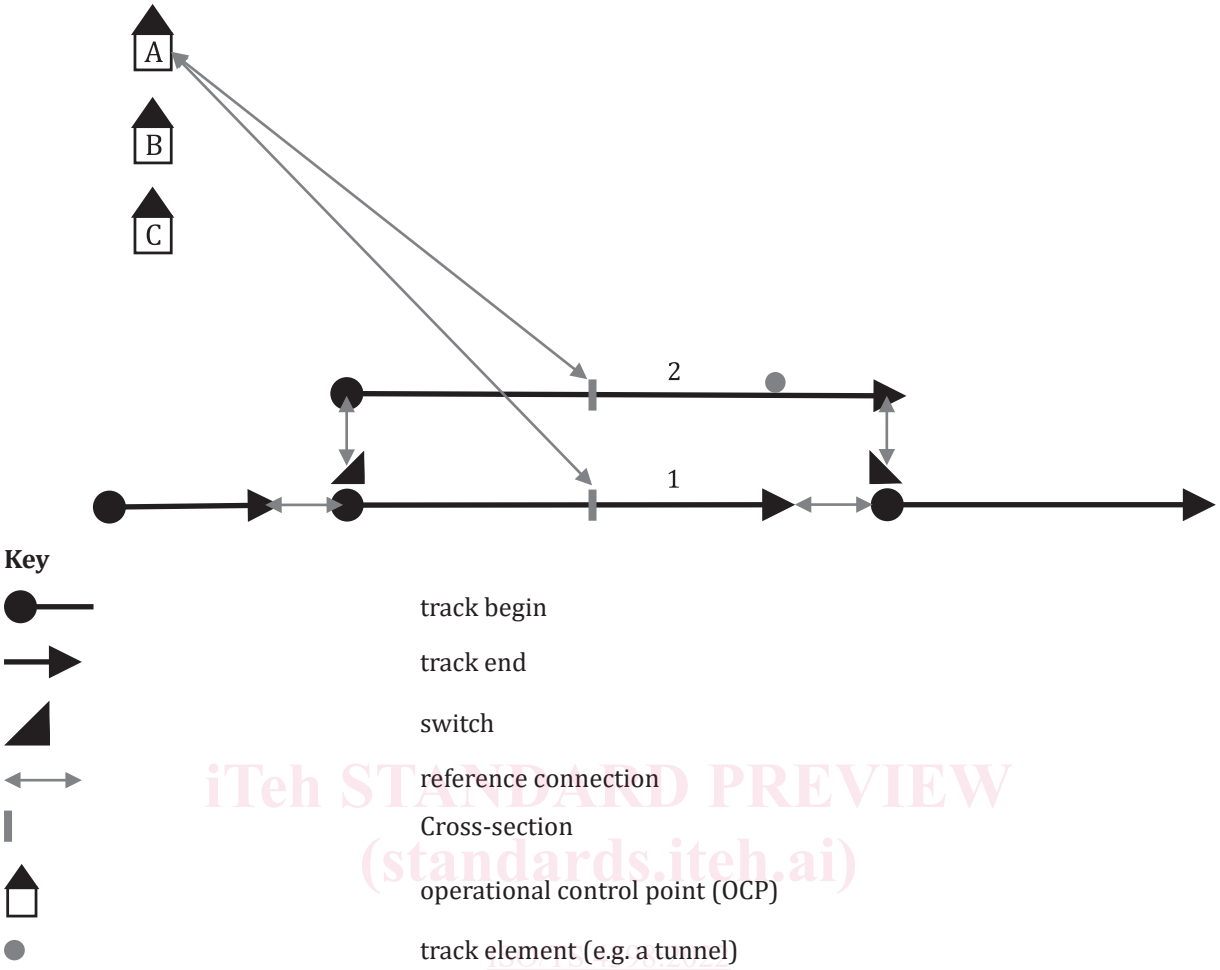

Figure 2 — Connections between `<track>`s and between `<track>`s and `<ocp>`s

5.2.2 Connections between tracks

5.2.2.1 Modelling of a switch

A switch is a connection element, which hierarchically belongs to exactly one track. However, it is connected to one more track in the form of the switch's branch. The switch is situated along the track via its relative position given by the pos attribute. Following the principle of a classic node-edge-model, the switch should only be situated in the track begin (pos = 0) or in the track end (pos = length of track). Thus, a switch always marks a change of track, no matter if the main or the branching way is chosen. Additionally, it is useful to connect the switch element with that track, from which the switch can be travelled facing.

5.2.2.2 Connections at a switch

5.2.2.2.1 General

The main track or “through track” of the switch is modelled as a connection element in the beginning or end of the track, which refers to a connection element in the beginning or end of another track. So, the main track is not included in the list of connections within the switch element, but only the branching tracks are modelled there. Most switches have exactly one branching track, but in case of a three-way-