



railML.org

Infrastructure data from rail to RINF

Experiences from the German
Open Data Project *Indres*

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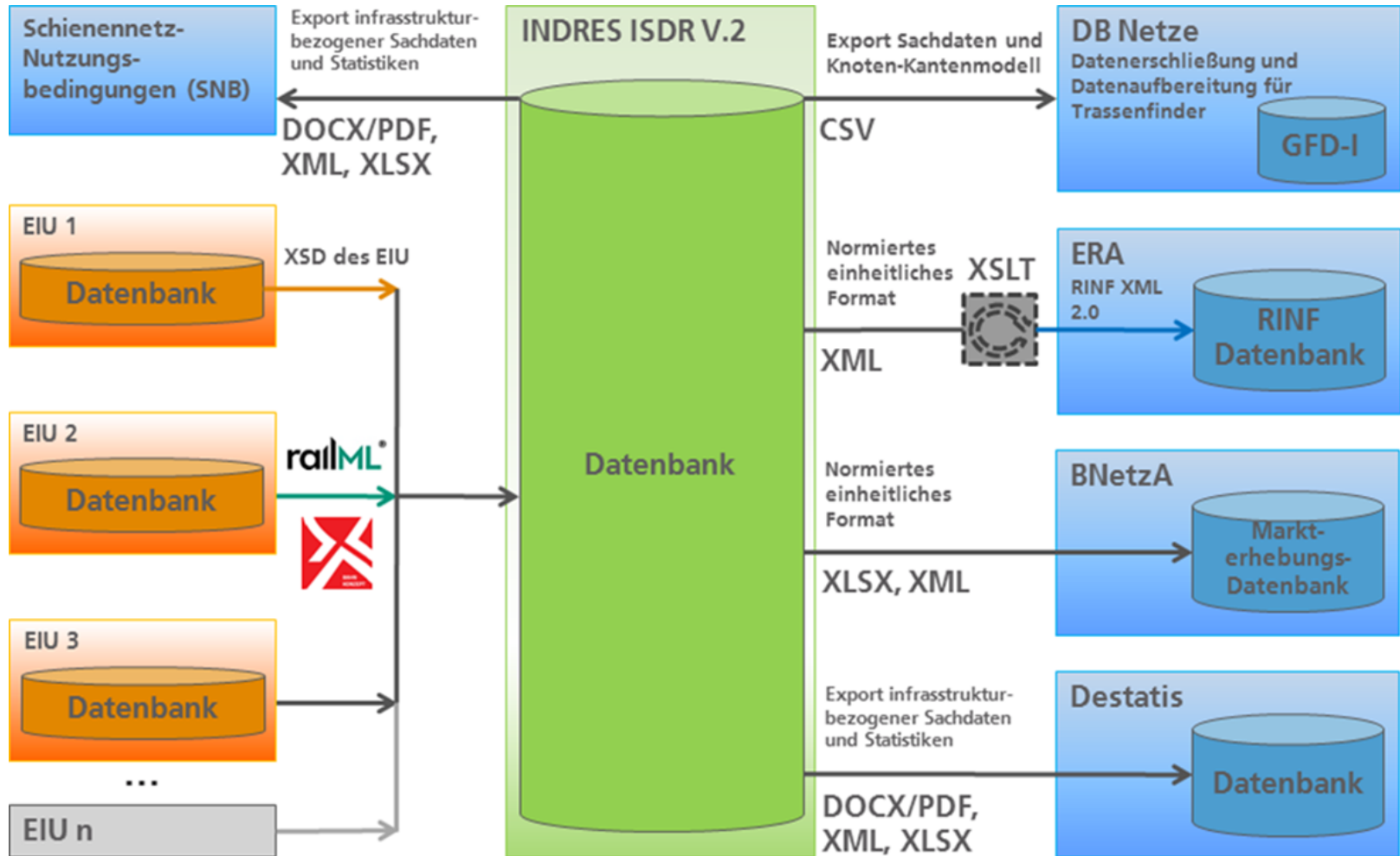
Agenda

1. Overview of the Indres Project
2. Project Objectives
3. Use Case: RINF
4. railML3-based Indres database schema
5. Introduction to railML®
6. ISO Railway Data Exchange (Raildax) standard
7. RailTopoModel and what it can do

Overview

- **Project Objective:** Design and development of a publicly usable **infrastructure data register** for the target group of **regional and private railways**
 - Detailed description of use cases from the user's point of view
 - Collection and evaluation of existing infrastructure data inventories
 - Development of a complete system specification
 - Technical implementation of the **Indres** system specification
 - Commissioning of **Indres** use-case-specific prototypes as demonstrators
- **Use Cases**
 - European Railway Infrastructure Data Register **RINF** and **Network Statement**
 - **Market research** for statistics, e.g. by BNetzA
 - For RU: IM-independent **Train path search** and **Train path order**
 - For IM: IM-independent / superordinate **Timetable creation**
 - **Ownership structure** (property boundaries)
- **Project period:** 07/2020 – 10/2023
- **Project volume:** more than 3 million euros (out of which 74 % funding by the Federal Ministry for Digital and Transport)
- **Link:** <https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/mfund-projekte/indres.html>

Project Objectives



It's all about data – but how to get it?



It's all about data – but how to get it?



Foto: Thilo

Partners



dresden elektronik



Use Case: Trassenfinder

- Slot information system of German IM DB Netz for their network (app. 33 tkm)
- Private railways are not integrated due to the missing data (also for RINF)
- Integration of data successful for two IM's (EVB & RIN) with app. 330 km each

DB InfraGO Trassenfinder

Einfachbahn

(1) Start: YWME (Meyenburg Streckenwechsel)

(2) Via: WPI (Priemerburg - NUP) 0

(3) Via: (Bremshaven-Wulsdorf) 0

(4) Ziel: rsefeld Streckenwechsel 1300/9128

Triebfahrzeug: V-Tfz - Gravita 10BB (SG)

Wagenzuglänge [m]: 600

Wagenzugmasse [t]: 1.200

Streckenklasse: D4

KV-Profil (P/C): N/N

Abfahrt: 12.03.2024 14:08

2024

EVB

RIN

Check out: www.trassenfinder.de

Introduction to railML®

railML® - A type of XML-documents



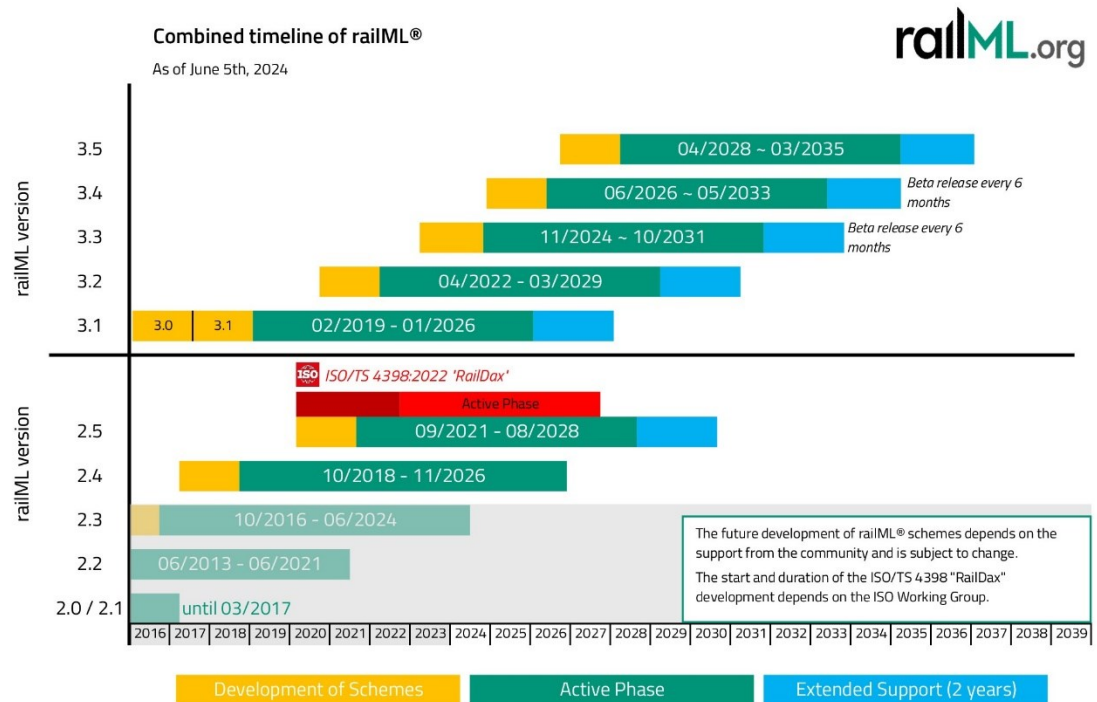
- railML applies the systematic of XML for the description of railway specific data; sub-schemes use other XML-schemes such as MathML (*developed by W3C*) and GML (*developed by Open Geospatial Consortium*)
- Various types of data are described as railML sub-schemes
- Currently the following sub-schemes are in productive use:
 - **Infrastructure** for the topological description of tracks and networks
 - **Rolling stock** for the description of vehicles
 - **Timetable** for the description of timetables
 - **Interlocking** for the logical description of signalling and routes (*from railML 3*)
- railML-data is mainly used for the exchange between different software of various manufacturers by files or direct process exchange (e.g. TCP/IP)
- railML is enhanced according to the demands of the data exchange processes of railways, industry and authorities driven by use cases; there is no aim is to define a complete railway world model

railML: Scheme Planning and Lifecycle Policy



- railML 2.5 was released in Sep. 2021 and will be supported until August 2028
- railML 2.3: Support period **will end** on June 30th, 2024 (**update projects/tenders!**). Existing railML interfaces can be used but **no new interface certifications** possible.
- From railML 3.2, the interface provides all necessary functionality to replace railML 2.x interfaces
- Development of railML 3.3 underway, expected release in November, 2024

- Guaranteed: railML 2.4-2.5 3.x supported for a min. years after release
- Extended support for developers with paid partnership
- Support end of each version will be announced at least 2 years in advance



ISO Railway Data Exchange (RailDax) norm

ISO/TS 4398:2022

- Technical specification (TS) based on **railML**
- Data format norm used for data exchange between IT for railway service planning
- Initiated and led by **Jernbanedirektoratet**
- Aimed at facilitating for planning of railway operations between organisations in the transportation sector
- Based on proven railML experience during the previous 20 years and developed as a **twin to railML® 2.5**
- Leads to an annual timetable: conceptual, strategic, and tactical
- Project website: <https://www.RailDax.org>
- **ISO 4398:202x** - new release based on railML® 3.x expected in the next years

The screenshot shows the Standard Norge website interface. At the top, there is a navigation bar with links for English, Jobb, Nyhetsbrev, Om oss, and Hjelp og kontakt. A search bar is prominently displayed with the text "Søk etter standarder, produkter og innhold på nettsiden". Below the search bar, there are several menu items: Standardisering, Standarder på høring, Fagområder, Kurs og rådgivning, Abonnement, and Nettbutikk. The main content area features the product "ISO/TS 4398:2022" with a price of NOK 2 827,00 (eks. mva). There are buttons for "Skriv ut på papir" and "Trykket og innbundet". A table below the product details lists various attributes such as Status (Gyldig), Norsk tittel, Engelsk tittel, Varetype, Språk, Utgave, Antall sider, and Pris. The description of the standard is also visible.

| | |
|-----------------|--|
| Status: | ✓ Gyldig |
| Norsk tittel: | Intelligent transport systems — Guided transportation service planning data exchange |
| Engelsk tittel: | Intelligent transport systems — Guided transportation service planning data exchange |
| Varetype: | Standard |
| Språk: | 🇬🇧 Engelsk |
| Utgave: | 1 (2022-09-13) |
| Antall sider: | 73 |
| Pris: | NOK 2 827,00 (eks. mva) NOK 3 533,75 (inkl. mva) |

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.

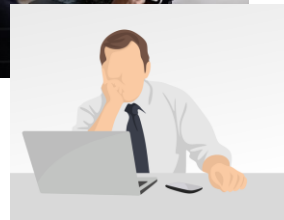
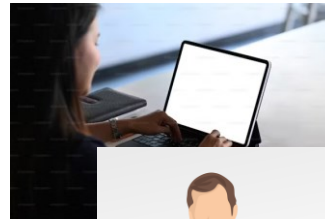
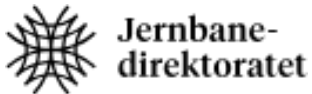
railML.org e.V. (1/2)

railML.org
e.V.

Stakeholders
(Governance
issues)

Coordinators
(Technical
issues)

railML
community



railML.org e.V. (2/2)

- The railML.org e.V. association is the **legal backbone** of the railML initiative
- Registered in the German registry of associations in Dresden.
- The association is **open to all interested companies**
- Decisions are made by the **stakeholders** and the **coordinators**
- Input from the **community and the users**



20+

years experience
with around 20
developer
companies



150+

partners including
over 70 supporting
firms, research
institutes and
authorities



40+

railways, railway
undertakings and
infrastructure
managers



40+

international
conferences

railML partners

Members (selection) - Railways



railML partners

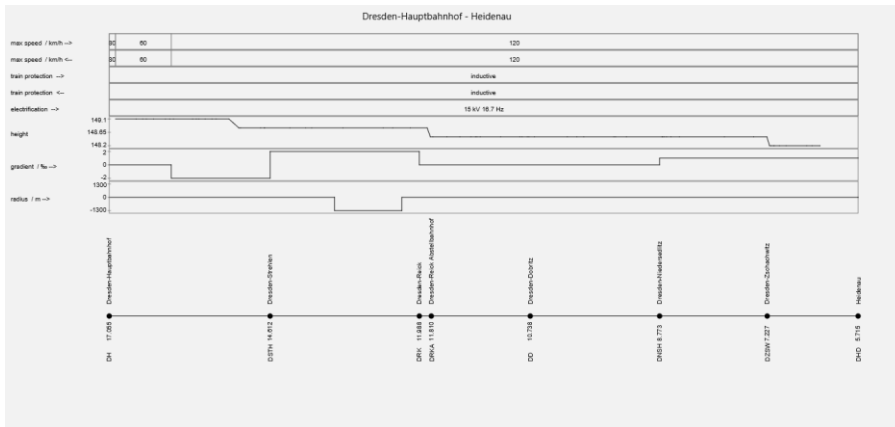
Members (selection) – Software developers



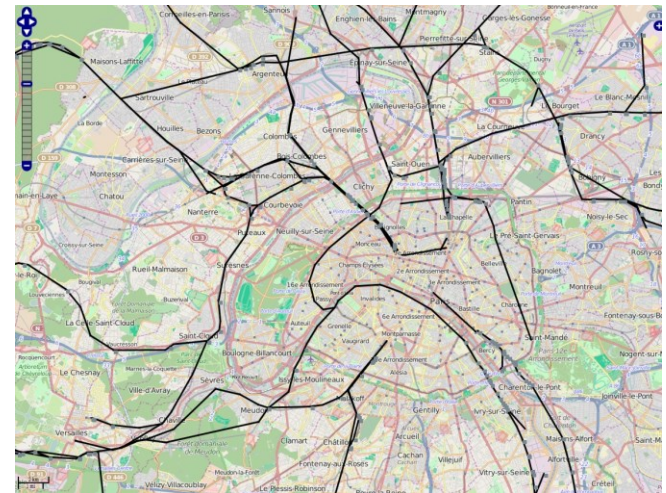
Technical introduction to railML (1/2)

railML Infrastructure schema

- Track elements (signals, switches, tunnels, bridges, chainage, balises, maxSpeed, electrification, radius, ...)
- Coordinates (geo and sheet coordinates)
- Track topology (nodes & edges)
- Track geometry (curves, slopes)
- Track topography / elements



[Source: railVIVID]



[Source: railVIVID]

Technical introduction to railML (2/2)

railML Infrastructure example

```
<infrastructure id='infra_Ostsachsen'>
  <metadata>
    <dc:source>&lt;FBS&gt;\Dt1.bsv</dc:source>
  </metadata>
  <tracks>
    <track id='tr_80.6228' name='DAF W-DAF N' type='mainTrack'>
      <trackTopology>
        <trackBegin id='trn_DAF_W_80.6228' pos='0' absPos='942'>
          <macroscopicNode ocpRef='ocp_DAF_W'/>
        </trackBegin>
        <trackEnd id='trn_DAF_N_80.6228' pos='942' absPos='0'>
          <macroscopicNode ocpRef='ocp_DAF_N'/>
        </trackEnd>
        <crossSections/>
      </trackTopology>
      <trackElements>
        <speedChanges>
          <speedChange id='spc_80.6228u1_0' pos='0' absPos='942' dir='up' profileRef='spp_0' vMax='100'/>
          <speedChange id='spc_80.6228d2_942' pos='942' absPos='23982' dir='down' profileRef='spp_1' vMax='100'/>
          <speedChange id='spc_80.6228u3_0' description='R500' pos='0' absPos='942' dir='up' profileRef='spp_2' vMax='100'/>
          <speedChange id='spc_80.6228u3_112' pos='112' absPos='830' dir='up' profileRef='spp_2' vMax='110'/>
          <speedChange id='spc_80.6228d4_942' pos='942' absPos='23982' dir='down' profileRef='spp_2' vMax='100'/>
        </speedChanges>
        <gradientChanges>
          <gradientChange id='grc_80.6228_0' pos='0' absPos='942' dir='up' slope='0.000'>
            <geoCoord coord='0 0' extraHeight='250.03' heightEpsgCode='5783'/>
          </gradientChange>
          <gradientChange id='grc_80.6228_149' pos='149' absPos='793' dir='up' slope='1.500'>
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          </gradientChange>
          <gradientChange id='grc_80.6228_197' pos='197' absPos='745' dir='up' slope='3.600'>
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          </gradientChange>
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          </gradientChange>
        </gradientChanges>
        <radiusChanges>
          <radiusChange id='rch_80.6228_149' pos='149' absPos='793' dir='up' radius='500'/>
          <radiusChange id='rch_80.6228_774' pos='774' absPos='168' dir='up' radius='-302'/>
          <radiusChange id='rch_80.6228_792' pos='792' absPos='150' dir='up' radius='2500'/>
          <radiusChange id='rch_80.6228_904' pos='904' absPos='38' dir='up' radius='0'/>
        </radiusChanges>
        <ownerChanges>
          <ownerChange id='och_80.6228_0' pos='0' absPos='942' dir='up' uic-no='80' infrastructureManagerRef='ou_0'/>
        </ownerChanges>
        <electrificationChanges>
          <electrificationChange id='elc_80.6228_0' pos='0' absPos='942' dir='up' type='none'/>
        </electrificationChanges>
        <gaugeChanges>
```

Position on track

Speed

Slope

Height

Coordinates

Radius change

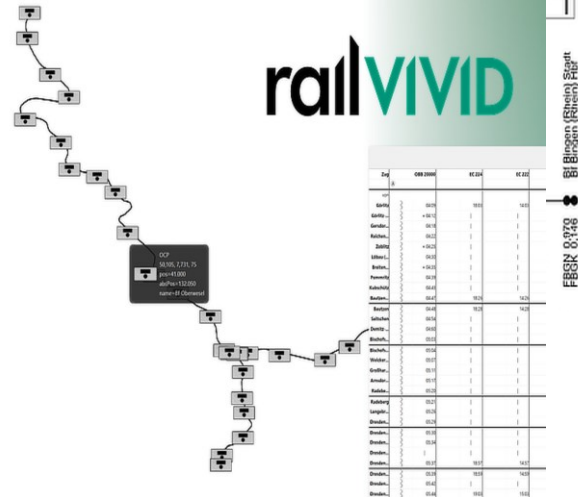
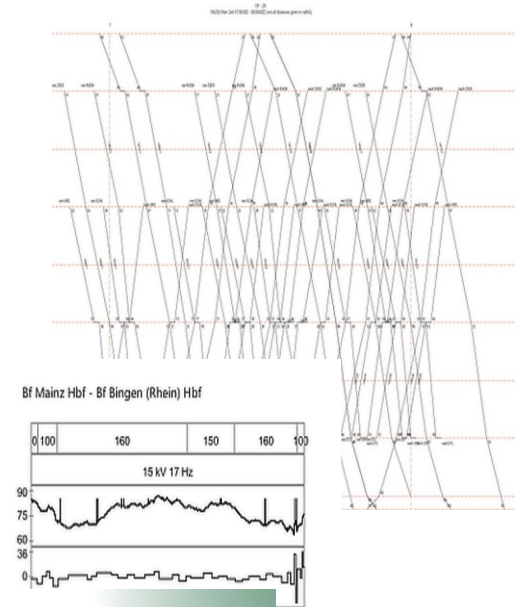
Border/IM change

railVIVID® - The railML Viewer and Validator

- **Last version:**
 - May 2019 (1.21 beta), then development frozen
- **New Versions Released:**
 - September 15th, 2022
 - June 6th, 2024

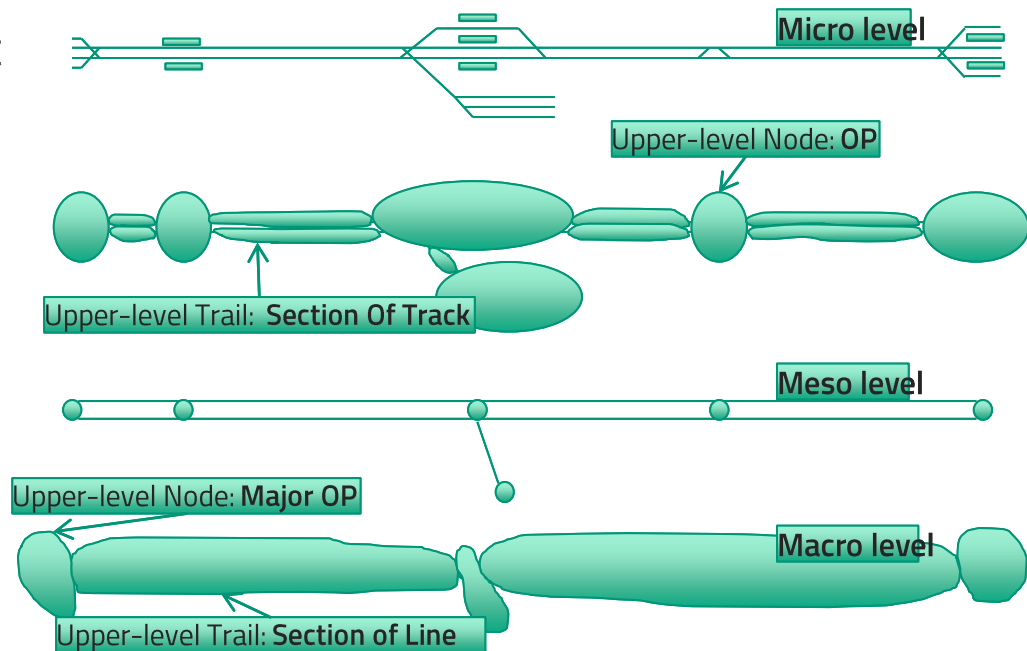
- **Key Information:**
 - Used as the main tool for export certification
 - Code moved to railML's new repository on Gitlab
 - Code clean-up needed
- Usage and feature feedback requested

- **New railVIVID's implementation (2.0.0)**
 - The focus is on validator and basic viewers
 - Web and desktop versions
 - Technology: C# and .NET



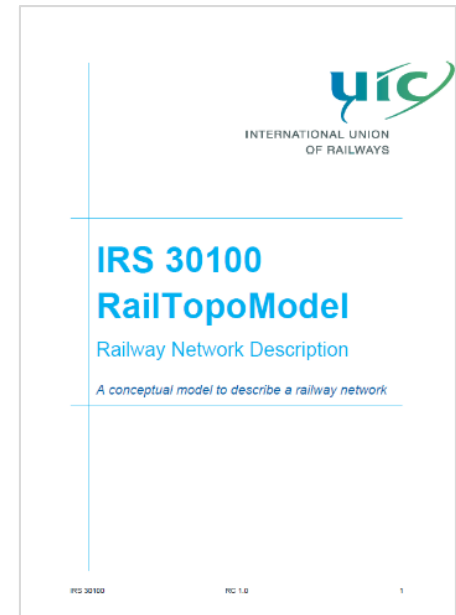
RailTopoModel and what it can do

- RailTopoModel is designed to have the same structure at each level of details.
- Data model which supports all railway business needs, including:
 - **Multi-Referencing:** Geo- and screen coordinates, Linear referencing, mileage posts and "rail addresses"
 - Topology, objects and event locations, paths...
 - Consistent multi-scale aggregation:
 - ❖ Track → Micro
 - ❖ Line → Meso
 - ❖ Network → Macro



RailTopoModel development now and later

- Need of a topological model to cater databases as well as interfaces for large infrastructure interfaces
- Development in the UIC's ERIM working group 2014-2016
- In the Spring of 2016, the UIC RTM 1.1 became the UIC International Railway Solution: **IRS 30100**
- UIC project ends in 2017; continuation in own development independently from RailTopoModel for research project
- **railML.org continues RailTopoModel development with the whole community in following versions:**
 - **RTM 1.2:** Last version available for railML 3.1; no new features or maintenance planned
 - **RTM 1.4:** Released by railML.org for use with railML 3.2; includes small patches and improvements
 - **RTM 1.5:** Planned with open, transparent development for whole community and a ticket system for railML 3.3
- Public Gitlab repository, website and wiki available



Connect with us on LinkedIn

- Stay informed about the latest news, updates and events from railML (every 4 weeks):

- Industry Insights
- Project Updates
- Community Engagement

➤ <https://linkedin.com/company/railml>

- You can also find the news on our website:

➤ <https://www.railml.org/en/public-relations/news.html>

The screenshot displays the LinkedIn profile for railML.org. The profile header includes the railML logo and a banner image of a train crossing a bridge. The company name 'railML.org' is prominently displayed, followed by the tagline 'Data exchange by railML: As easy as changing the train' and 'Rail Transportation · Dresden, Saxony · 65 followers · 11-50 employees'. A notification indicates that 'Andreas & 31 other connections follow this page'. The main content area features a post from 'railML.org' (65 followers) dated '3w • Edited', which announces a collaboration with the Ukrainian State University of Science and Technologies (USUST) in Dnipro, Ukraine. The post includes a video thumbnail and a list of project partners. The right sidebar shows 'Pages people also viewed' including 'neat', 'Unisphere', and 'neurocat', and 'People also follow' including 'InnoTrans'.



Thank you for your attention!



[linkedin.com/company/railml](https://www.linkedin.com/company/railml)

Vasco Paul Kolmorgen

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