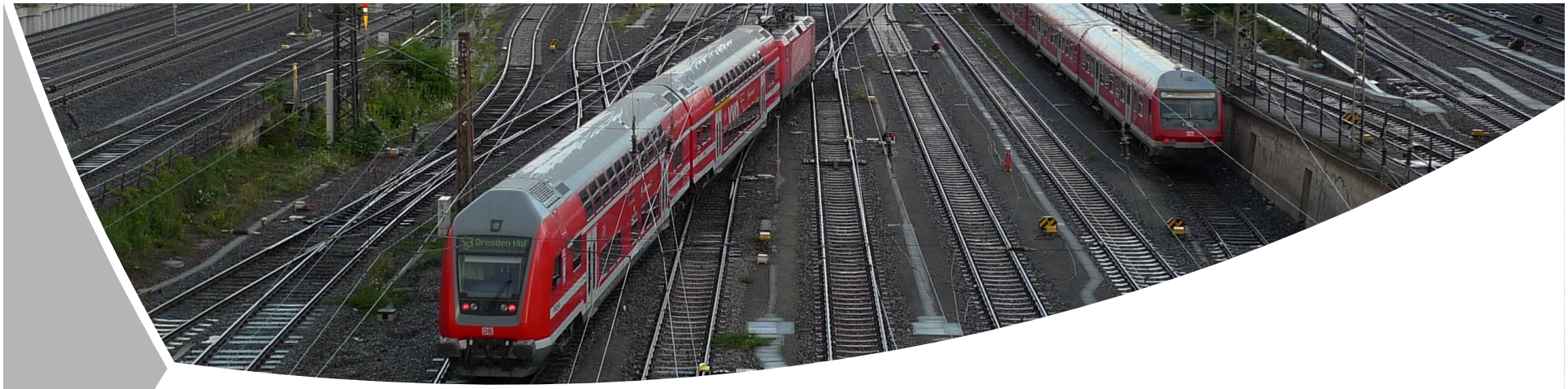


PSI

Daten für PSI*traffic*: Standardisiertes Datenmanagement mit railML® und dem UIC RailTopoModel

Vasco Paul Kolmorgen; railML.org Koordinator, Dresden

PSI Anwender- und Diskussionsforum · Berlin, 26. Juni 2015

railML.org

railML.org
All rights reserved.

railML.org and railML® files

More than 10 years of developing and implementation

The **Problem** of nearby all railway planning and operating processes:

- Operation concepts, slot management, simulation or infrastructure planning will need infrastructure data (track geometry, signals, routes), timetables (departure/arrival times, intervals, slots) and rolling stock data.
- Mostly this data is available in digital, but there are a lot of different legacy formats. Exchange of these data is possible only with a lot of special developed interfaces with loss of time and cost problems for IM / RU.

The **Solution**, which fulfils the

- **Technical case:** easy and handy, self-describing format close to existing standards; must be tolerant towards changes and faults
- **Business case:** decrease the wide range of interfaces and the time/cost of development, speed up data exchange processes

was searched and developed since 2002: **railML®**.

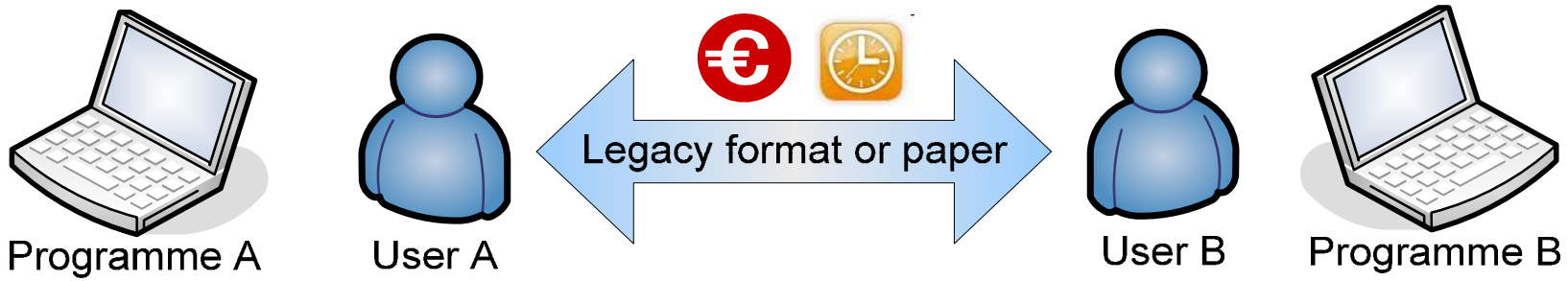
railML.org®

PSI

Data exchange by standardised XML interfaces

What is it needed for?

- Data exchange between applications has to be carried out by hand or with manually-created interfaces → very expensive and time-consuming



- XML brings data to be machine-readable and easy automatable

railML.org®

PSI

Extendable Markup Language(s) – XML

What is it and how does it work?

- Presentation in plain text (no binary) → readable by every human
- Definition by W3C → worldwide, open standard
- XML has to take shape via a document-type-definition (DTD) or a scheme-definition (XSD) => useable by computers
- General example:

```
<?xml version='1.0' encoding='UTF-8' ?>
<note>
     <heading>Wikipedia List of Cities</heading>
     <entry>
          <name>Geneva</name>
          <description>Geneva is the seat of...</description>
     </entry>
     <entry>
          <name>Cologne</name>
          <description>Cologne is a city that ...</description>
     </entry>
</note>
```

railML.org®

PSI

railML®
A type of XML-dokuments

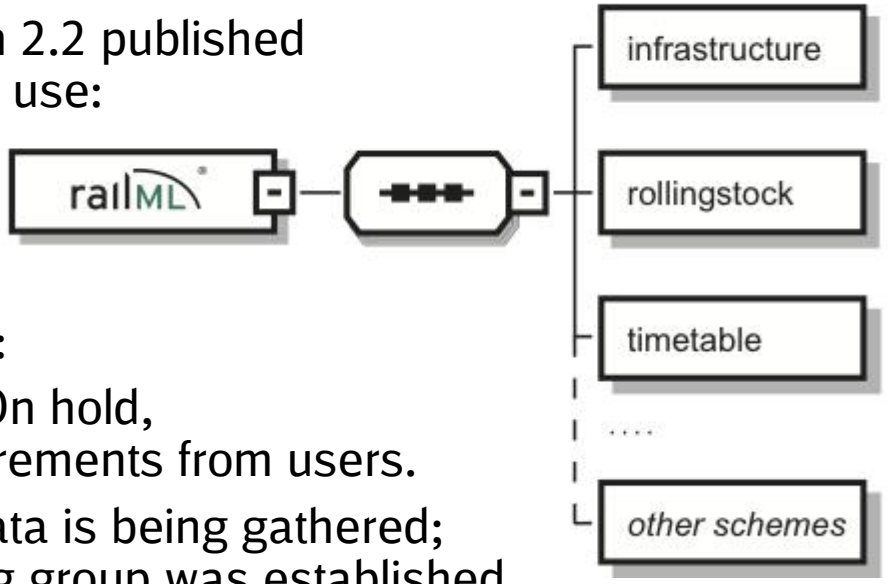
- railML employs the systematic of XML for the description of rail-specific data; sub-areas use other XML-schemes such as *MathML* and *LandXML*
- Various types of data are described as railML-subschemes.
- At the moment the following subschemes are in productive use:
  - *infrastructure* for the (priority topological) description of tracks and signalling equipment
  - *rolling stock* for the description of vehicles
  - *timetable* for the description of timetables
- railML-data is mainly used for the exchange between different computer programmes of various manufacturers
- railML-model is driven by the demands of the data exchange processes of railways, industry and authorities; not for defining a full railway model

railML.org®

PSI

railML®
Subschemes at a glance

- Currently railML version 2.2 published and in productive use:



- Additional subschemes:
  - *station facilities*: On hold, currently no requirements from users.
  - *crew rostering*: Data is being gathered; railML.org-working group was established.
  - *interlocking*: railML.org-working group active with regular meetings, Compilation of elements, allowing connection to existing sub-schemes achieved. First use case: Interlocking data for ETCS.
  - ...

railML.org® PSI

railML.org
How‘s the consortium working?

- Continuous development work based mainly internet based (discussion boards, SVN for development and *alpha* versions)
- Semi-annual conferences to exchange experience and discuss basics (next meeting: November 4th, 2015 at UIC Paris/France)
- Project coordinators for the individual subschema moderate and establish *releases*
- Documentation with a railML-Wiki and HTML explanation files
- Discussions in German and English; Documentation is entirely in English
- Coordination in Dresden & Zurich

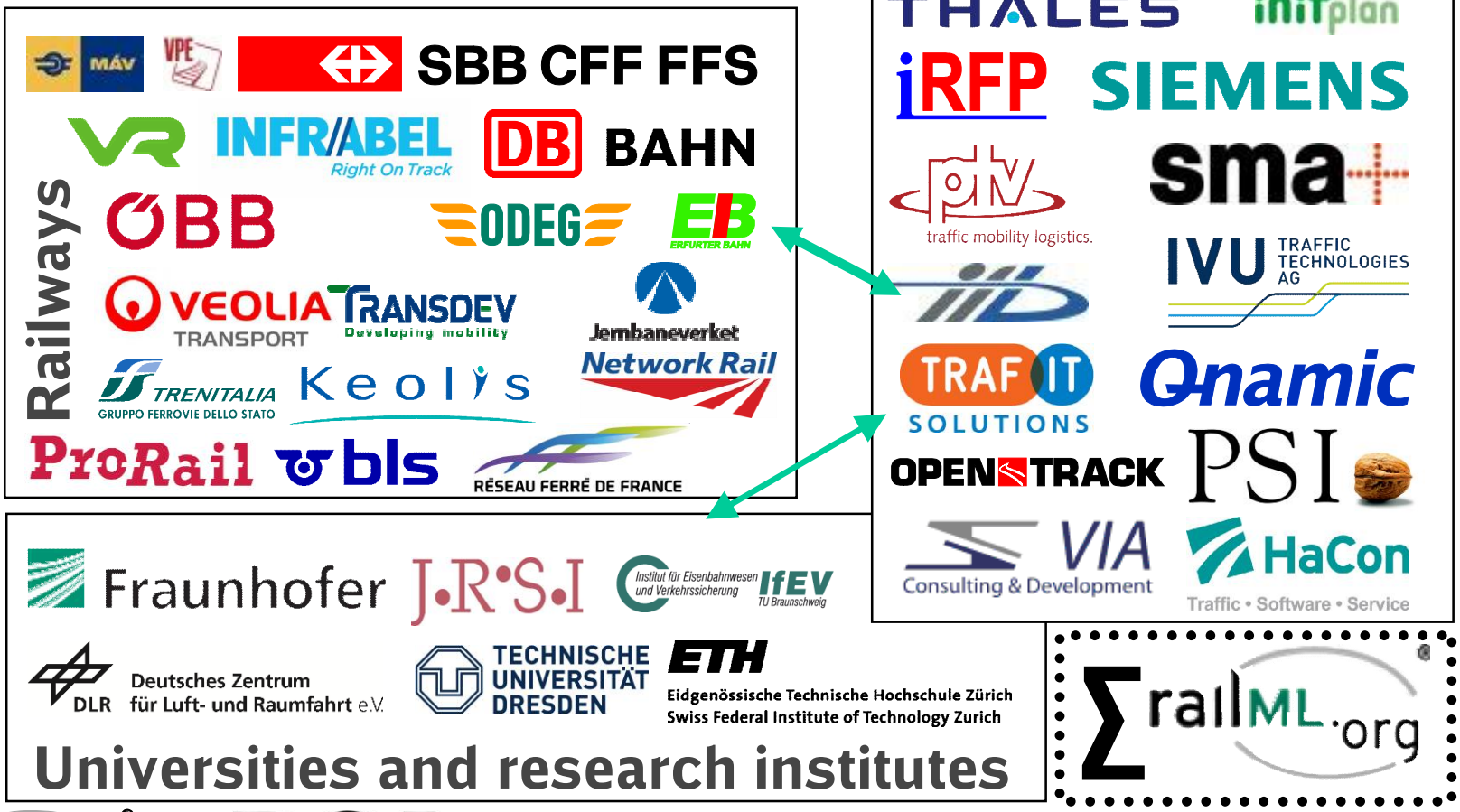
railML.org®

PSI

railML.org
Who is who in the railML-consortium?

- The railML-consortium is a „Development partnership of independent companies and establishments“, established in 2002
  - Costs of the work carried by each member
  - no financial support from the Governments / EU / Railways
  - railML.org is independent of manufacturers and operators
- Currently:
  - app. 20 certified developer companies, predominant from Germany, Switzerland, France
  - more than 30 railways, mainly from all over Europe
  - over 50 supporting firms, research institutes und authorities from all over Europe, North America, Russia and Japan
- The use of railML® requires a membership at railML.org and licensing of the schemes (both currently free of charge).

railML.org
Members in general (selection)



railML.org®

PSI

railML.org
Members of the interlocking group

- The railML®-consortium established in 2012 a development group to incorporate the needs of the signalling industry (predominantly with the background of upcoming ETCS installations) in a future railML 3.x version
- Members:

Industry

SIEMENS

THALES

ALSTOM

CAF Signalling

Railways

INFRABEL Right On Track

SBB CFF FFS

RÉSEAU FERRÉ DE FRANCE

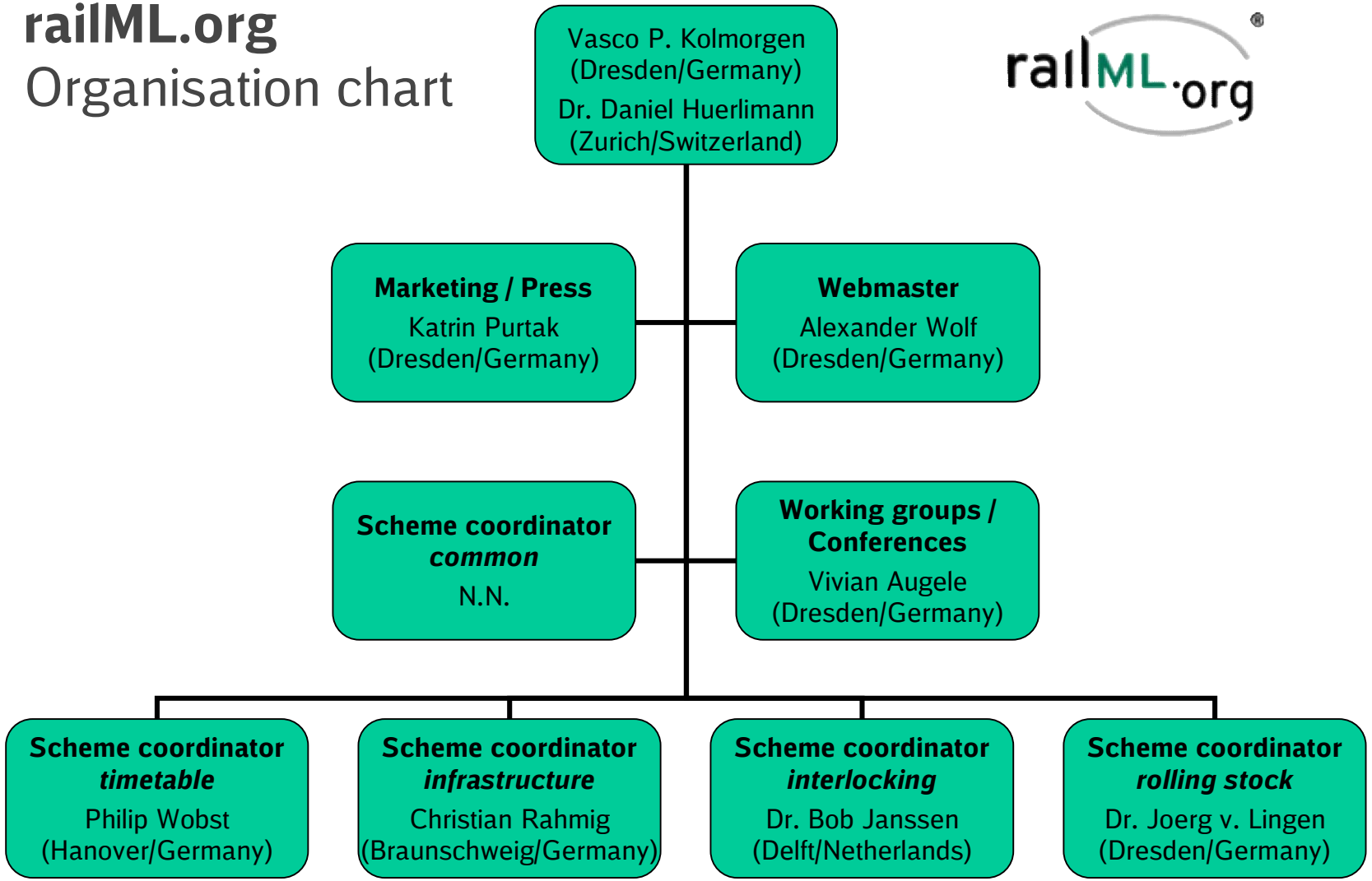
Research

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

railML.org

PSI

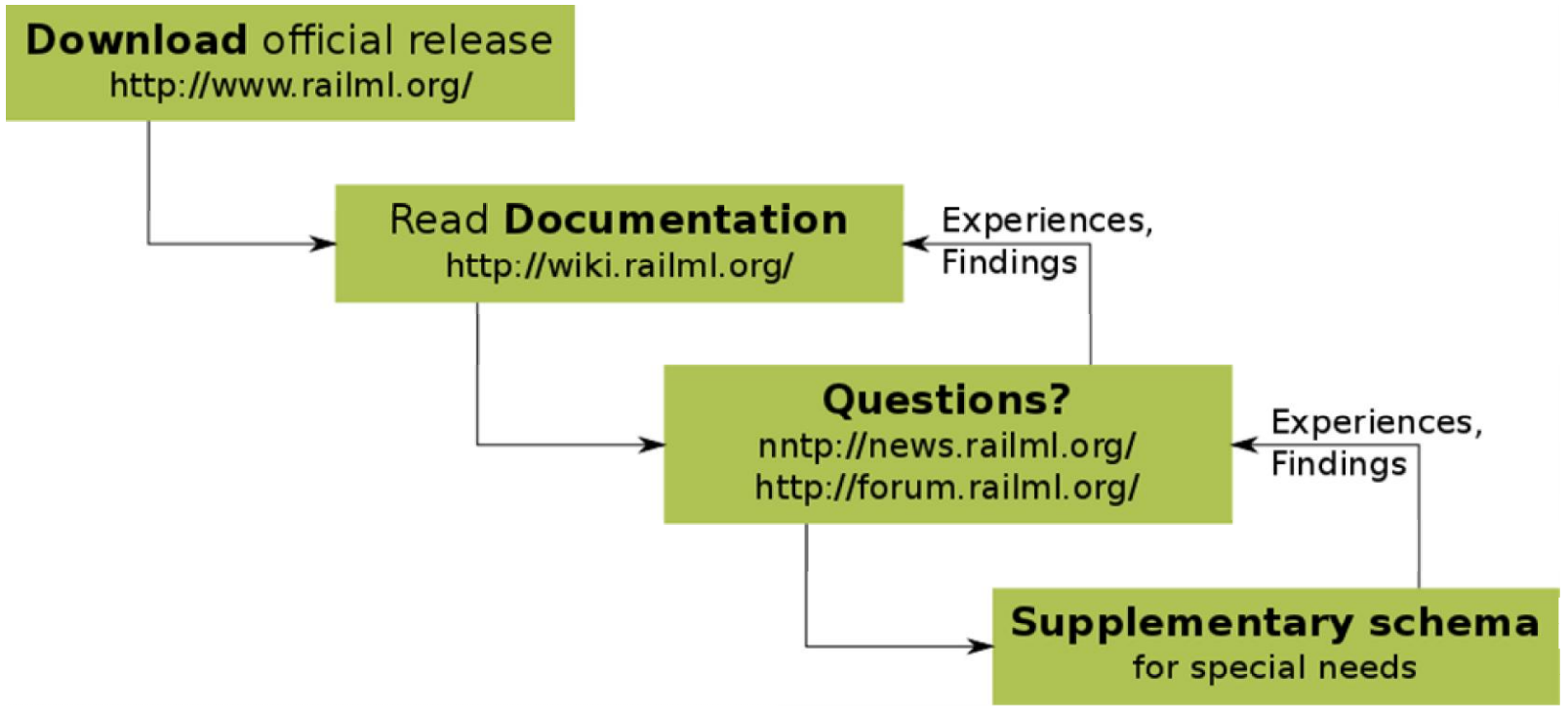
railML.org
Organisation chart



railML.org

How to implement railML in your software/business?

- Registration as an railML-participant is required > support during tests
- Typical timeframes from first scratch to productive use app. 4-12 months



railML.org®

PSI

Example of an railML-timetable

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with OpenTrack (http://www.opentrack.ch) -->
<railml xmlns:xsi="http://www.w3.org/2000/10/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="timetable.xsd">
    <timetable version="0.95" scheduleformat="hh:mm:ss"periodformat="s">
            <train trainID="RX 100.2" type="planned"  source="opentrack">
                <timetableentries>
                    <entry posID="ZU" departure="06:08:00" type="begin"></entry>
                    <entry posID="ZWI" departure="06:10:30" type="pass"></entry>
                    <entry posID="ZOER" arrival="06:16:00“ departure="06:17:00"
                                                minStopTime="9" type="stop"></entry>
                    <entry posID="WS" departure="06:21:00" type="pass"></entry>
                    <entry posID="DUE" departure="06:23:00" type="pass"></entry>
                    <entry posID="SCW" departure="06:27:00" type="pass"></entry>
                    <entry posID="NAE" departure="06:29:00" type="pass"></entry>
                    <entry posID="UST" arrival="06:34:30" type="stop"></entry>
                </timetableentries>
            </train>
    </timetable>
</railml>
```

railML-version

Train code

Departure time

Stop

End of a train information

railML.org®

PSI

Maturity Level

How good is railML®?

- 2002 - 2005: initial work; beta version *timetable*
- December 2005: release of railML's first productive version: *railML 1.0*
- 2005 – 2009: first practical application; learning curve; alignment to existing schemes; processing of inconsistencies/ incompatibilities
- November 2009: release of *railML 2.0*
- July 2011: release of *railML 2.1*
- June 2013: release of *railML 2.2* (V2.1/V2.2 are downwardly compatible)
- railML achieves maturity in this process and is now in multiple productive use.
- The current and some previous schemes and examples may be downloaded from www.railML.org.

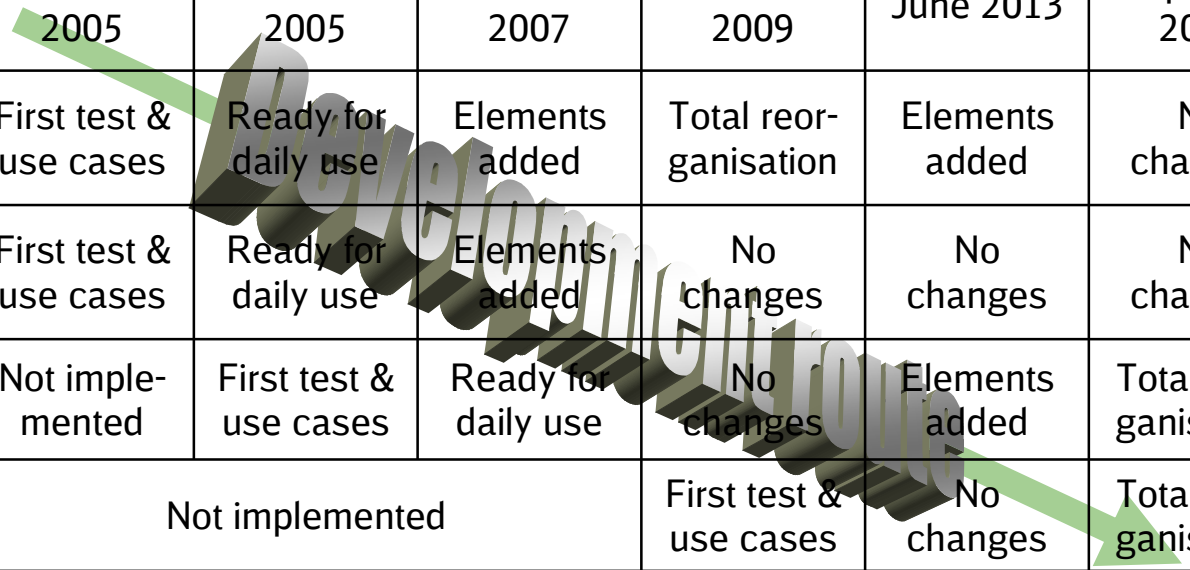
railML.org®

PSI

Maturity Level

How good is railML®? (Detailed view)

Version and subscheme	railML V 0.x	railML V 1.0	railML V 1.1	railML V 2.0	railML V2.2	railML V 3.x
Year	2002 - 2005	December 2005	November 2007	November 2009	June 2013	expected 2014
Timetable	First test & use cases	Ready for daily use	Elements added	Total reor-ganisation	Elements added	No changes
Rolling stock	First test & use cases	Ready for daily use	Elements added	No changes	No changes	No changes
Infrastructure *macroscopic*	Not imple-mented	First test & use cases	Ready for daily use	No changes	Elements added	Total reor-ganisation
Infrastructure *microscopic*	Not implemented			First test & use cases	No changes	Total reor-ganisation
Infrastructure *interlocking*	Not implemented					Ready for daily use



railML.org®

PSI

XML/railML® as „open source“

What are its strong points and where is it weak?

- Utilization 1:1 or expansion by user or in third order possible
- As many contributors as you like
- Utilization/revision free of charge
- Shared cost of development
- Development understandable
- Sources are open and may be verified as quality criteria

- Development success depends on commitment of coordinators and participants
- Development direction will be determined by majority
- Unstable continuity of the development or slowing down possible
- Know-how ist unprotected, making it difficult to earn money from it

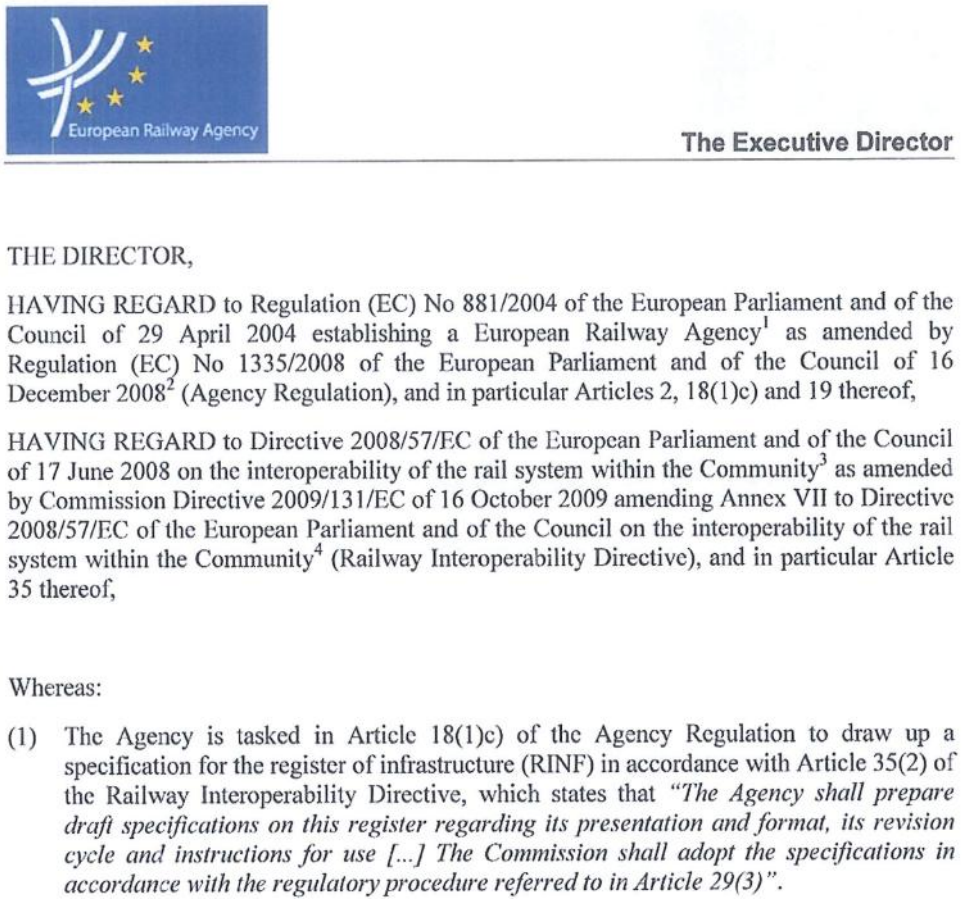
- About 32% Market Share of IT-Services in EU[1]
- Open source projects save money, but require strong users

[1] UNU-MERIT: Study on the: Economic impact of open source software…, EU Commission, 2006, p.10

Example from current projects and developments

RINF database of EU and UIC's RailTopoModel

- EU rules 881/2004 and 1335/2008 forcing the ERA to build an **R**egister of **INF**rastructure
- All MS must deliver data to RINF from 2015 with updates every 2-3 months
- No specific railway model was used as basis for RINF and the structures
- First tests 2014/15



European Railway Agency

The Executive Director

THE DIRECTOR,

HAVING REGARD to Regulation (EC) No 881/2004 of the European Parliament and of the Council of 29 April 2004 establishing a European Railway Agency[1] as amended by Regulation (EC) No 1335/2008 of the European Parliament and of the Council of 16 December 2008[2] (Agency Regulation), and in particular Articles 2, 18(1)c) and 19 thereof,

HAVING REGARD to Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community[3] as amended by Commission Directive 2009/131/EC of 16 October 2009 amending Annex VII to Directive 2008/57/EC of the European Parliament and of the Council on the interoperability of the rail system within the Community[4] (Railway Interoperability Directive), and in particular Article 35 thereof,

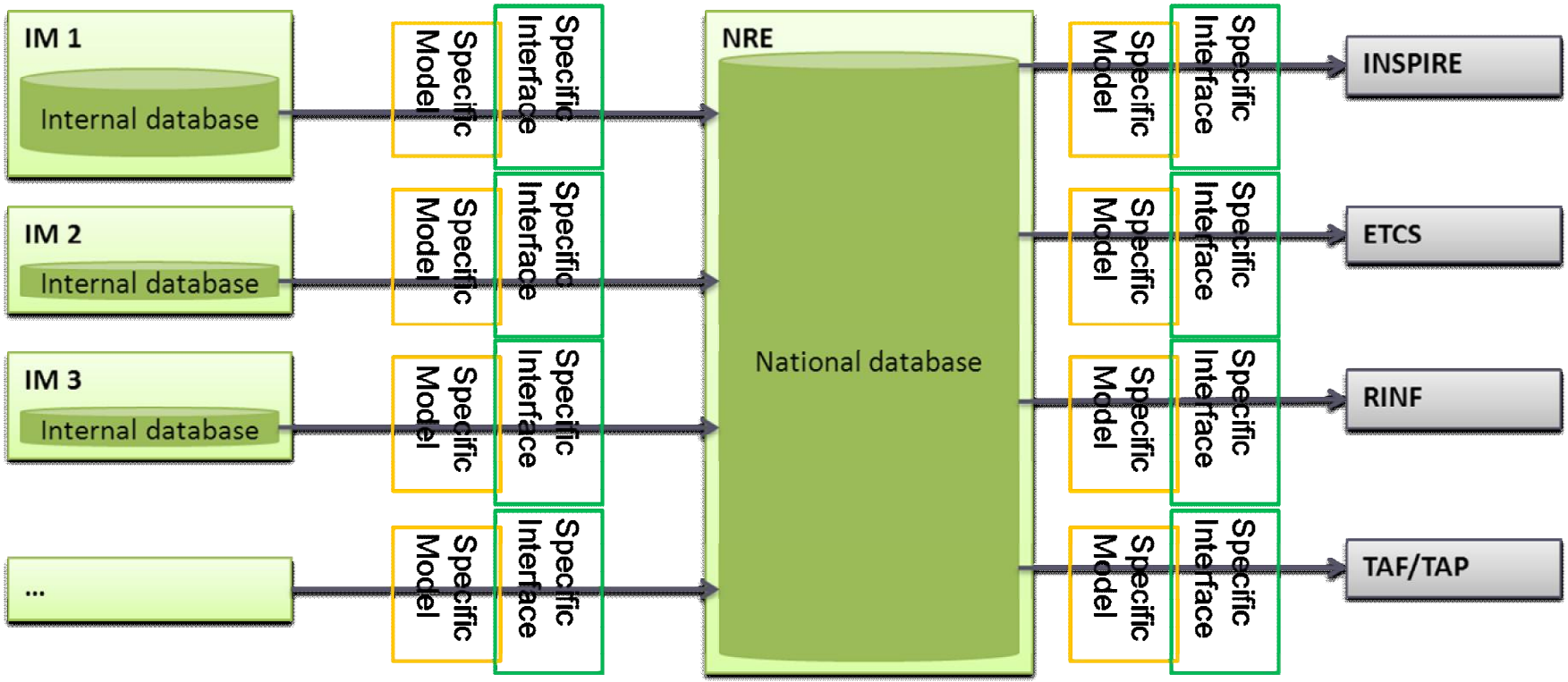
Whereas:

(1) The Agency is tasked in Article 18(1)c) of the Agency Regulation to draw up a specification for the register of infrastructure (RINF) in accordance with Article 35(2) of the Railway Interoperability Directive, which states that *"The Agency shall prepare draft specifications on this register regarding its presentation and format, its revision cycle and instructions for use [...] The Commission shall adopt the specifications in accordance with the regulatory procedure referred to in Article 29(3)"*.

railML.org®

PSI

Current problem of data exchange for Railways/IM's

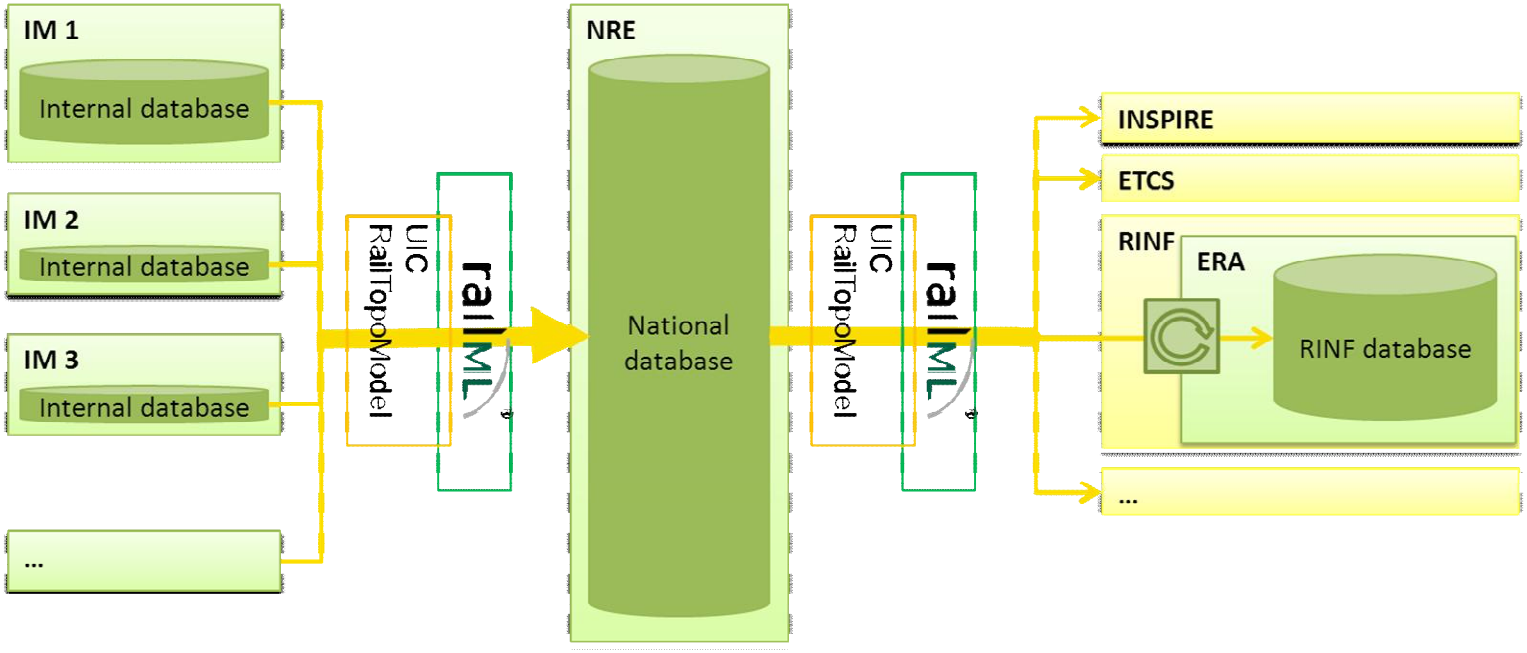


- **Absence** of available **standards**: Each data exchange requires a specific data definition (model) and file format (interface) leading to a specific computer interface programme
- **Consequences:** Heavy IT development and high costs with long project times, no re-use of data and software development, less place for industrial approach

railML.org®

PSI

railML® proposal from the UIC-ERIM project

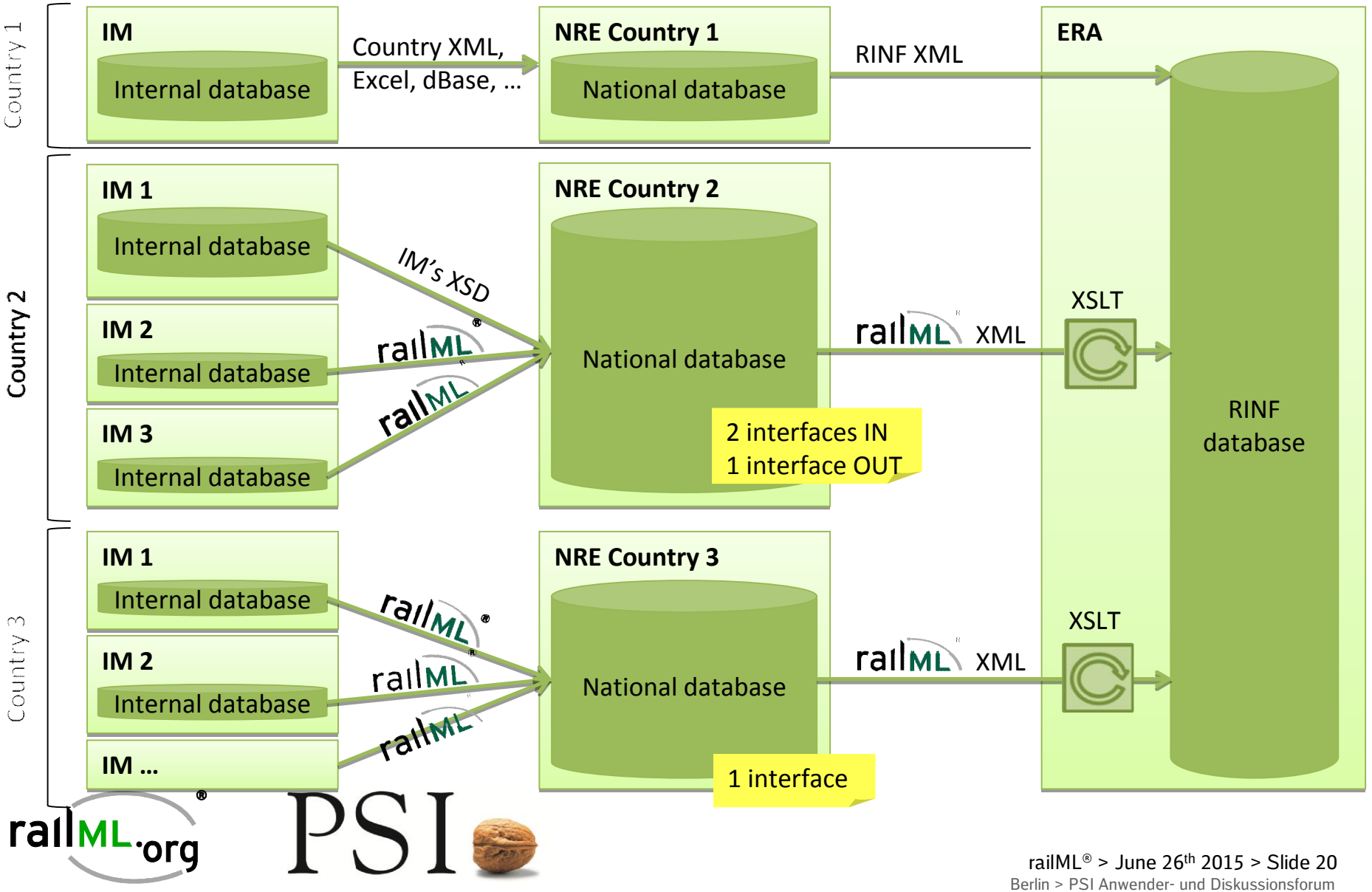


- Creation of a data exchange standard: Systemic approach describing only the infrastructure characteristics. The usage related data is added on top of this reference / "basic" infra data.
- **Advantages:** Opportunity for each IM to invest for future re-use of the IT development, the complete set of tools developed for data mapping and extract, quality check, formatting, would be re-usable for all future needs for exchange of infrastructure data, the "millions €" would then be an investment and not a one shot expense

railML.org®

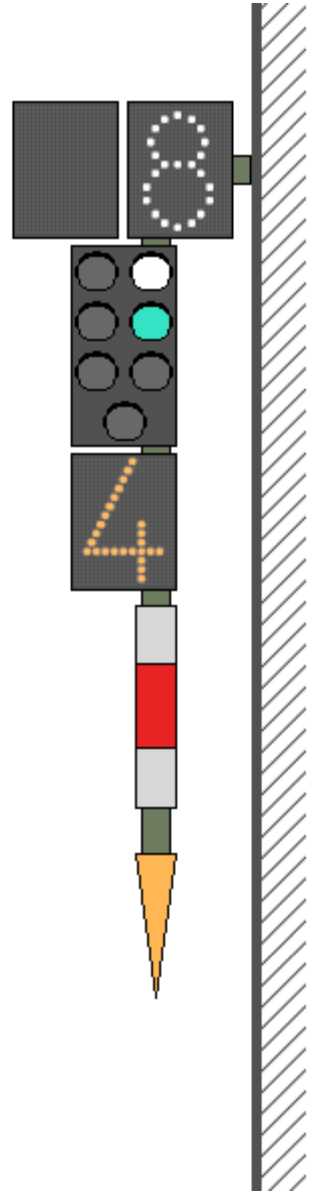
PSI

RINF process with and without standard formats



UIC RailTopoModel (1/2)

- Developed in 2013 in the UIC financed ERIM project
- Basis for a common exchange format *(e.g. railML)*
- Systemic approach describing only core infrastructure characteristics
- Data model supporting all railway business needs:
  - ✓ Topology: The logical representation of the railway network as a graph (Nodes, Edges) as well as the track geometry
  - ✓ Objects & Events location with the following types:
    - ✓ Spot *(e.g. Signals, …)*
    - ✓ Linear *(e.g. Speed limits, Platforms, …)*
    - ✓ Area *(e.g. Locally controlled areas, Zones, ..*
  - ✓ Paths: The possible movements on the network.

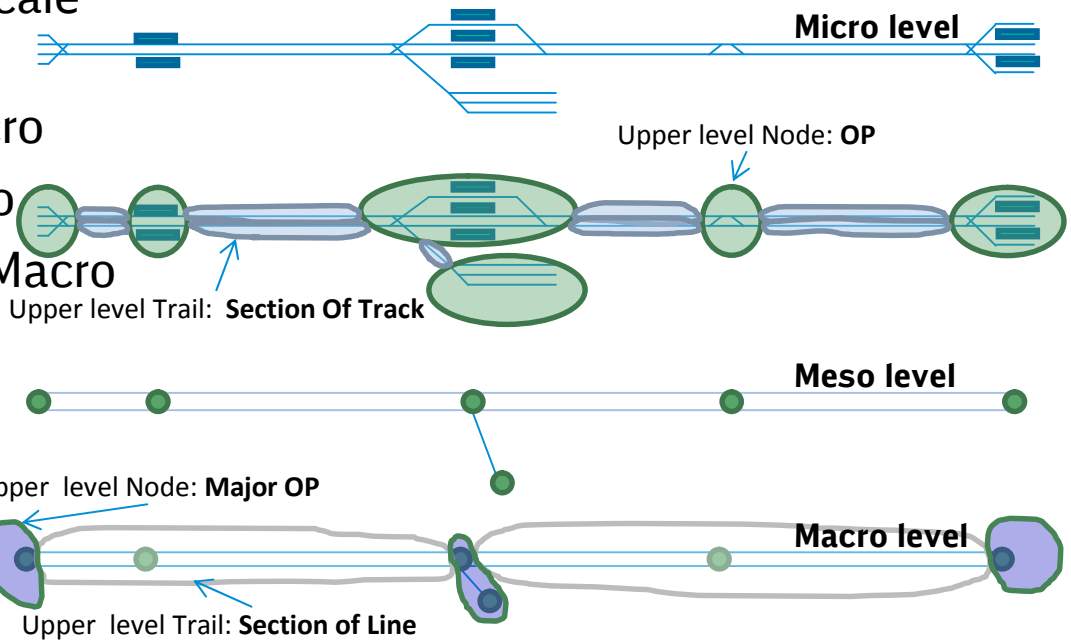


railML.org®

PSI

UIC RailTopoModel (2/2)

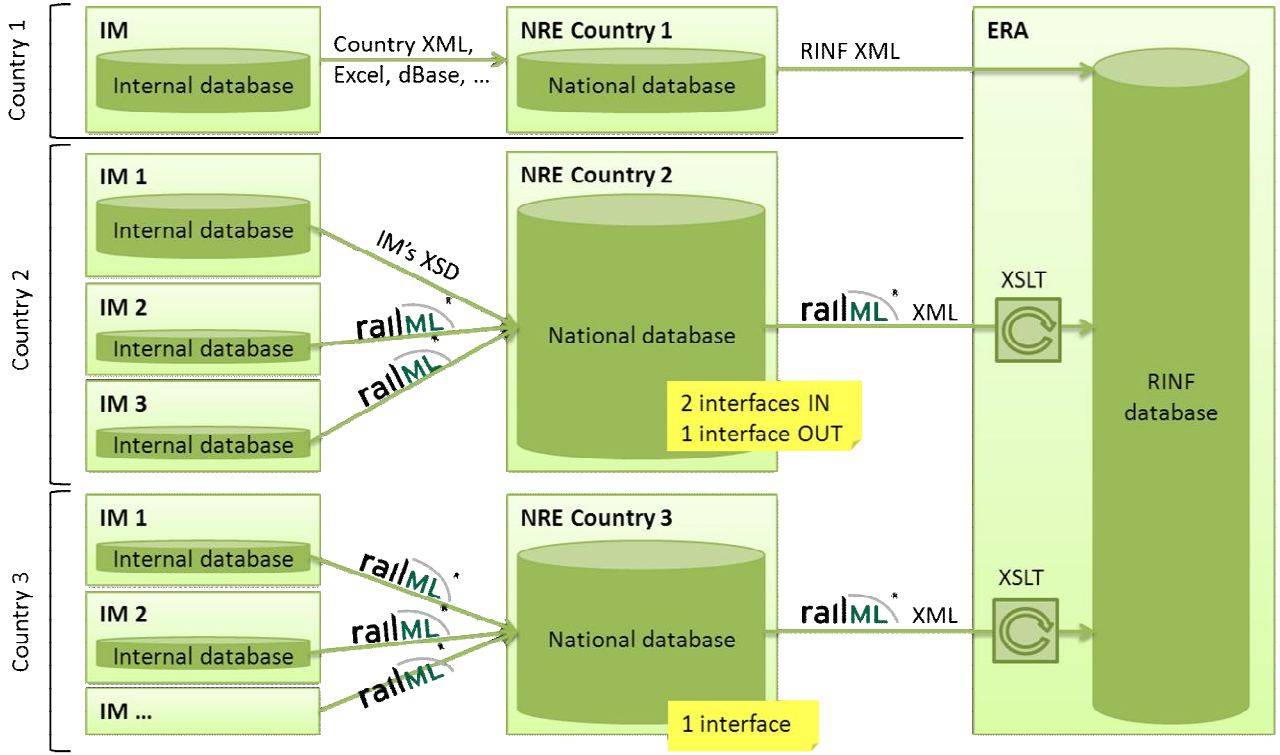
- Data model which supports all railway business needs, including:
  - ✓ Multi-Referencing: Geo- and screen coordinates, Linear referencing, mileage posts and “rail addresses”
  - ✓ Consistent multi scale aggregation:
    - ✓ Track → Micro
    - ✓ Line → Meso
    - ✓ Network → Macro
    - ✓ Corridor?
- ✓ UIC RailTopoModel is designed to have the same structure at each level of details.



railML.org®

PSI

First use case: RINF Project



Country 1: Using of proprietary formats for gathering data and specific RINF XML format for transferring data to ERA
Country 2: Using of railML® for the exchange towards ERA
Country 3: Using of railML® as only exchange format for both processes

- The RINF project plan as designed in 2012 demands a **specific XML format** *(RINF XML by ED)* to be adopted by each IM / MS for the ERA data delivery
- **railML** is an additional format proposed by some IMs
- All MS / IMs can choose whether they want to use railML XML or the specific RINF XML format.
- Knowing that hundreds of IMs (nationals railways and smaller networks) will be subject to the RINF legislation, describing their infrastructure in a standard railway data format, the **potential savings** might arise **in millions of Euros.**

Programmes and the use of railML

Who uses railML® and what for?

- At the moment more than 20 programmes are listed at www.railml.org, they are able to import and/or export railML®-data in different schemes.
- Present use cases: planning and simulation of railway operations; timetable construction and duty rostering; infrastructure planning
- **Example:** Timetabling and duty rostering at German private railways
  - FBS (Institut für Regional- und Fernverkehrsplanung, Dresden)
  - IVU.rail (IVU Traffic Technologies, Berlin)
  - Trapeze (Trapeze Group Deutschland, Hamburg)
  - Various railways (Veolia, BeNEX, Agilis, ODEG, EIB, ARRIVA)

1. All railways compiles timetables using FBS (with railML-Interface)
2. Exports from FBS → railML-File → Import to IVU.rail or Trapeze
3. Railways 1, 2 und 3 compile duty shifts in IVU.rail;
   Railways 4, 5 und 6 compile duty shifts in Trapeze

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study Austria: ÖBB-Personenverkehr (1/6)

- **Example ÖBB-Personenverkehr (ÖBB-PV)**
  Project Connection FBS-VISUM by railML®

ÖBB Personenverkehr AG

- Partners: ÖBB-PV, Vienna
  iRFP, Dresden
  PTV, Karlsruhe

ÖBB-PV in figures (as of 2010):

Passengers Rail: 209,8 Mio. p.a.
Passenger kilometers: 10,2 Mrd. p.a.
Train kilometers: 98 Mio. p.a.
Local trains: 4.150 per day
Long distance trains: 300 per day
1.400 Stations and local stops

11.000 km tracks, davon 7.900 electrified
17.000 points, of which 11.000 remote contr.
53.200 signals, of which 30.100 electric signals
800 signal boxes, of which 130 electronic contr.

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study Austria: ÖBB-Personenverkehr (2/6)

FBS

Graphic Timetables

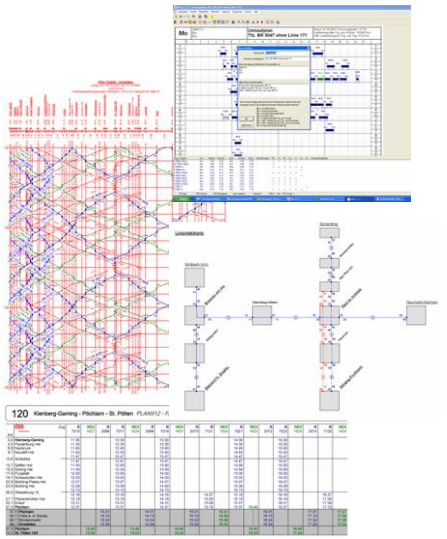
Customer's Timetable

Interval Graphic

Circulation Plan

Statistic and performance data

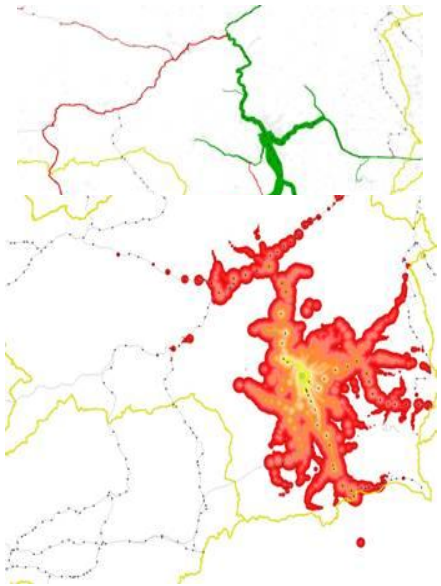
Slot ordering at ÖBB-Infra



VISUM SUPERNOVA

Modelling of passengers flow and appearance in future

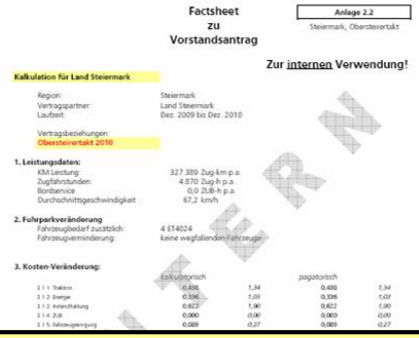
Visualisation of data



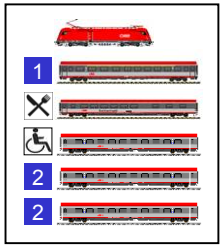
Internal calculation tool

Economic assessment of timetable concepts

Basis for business planning and offers



Cosware



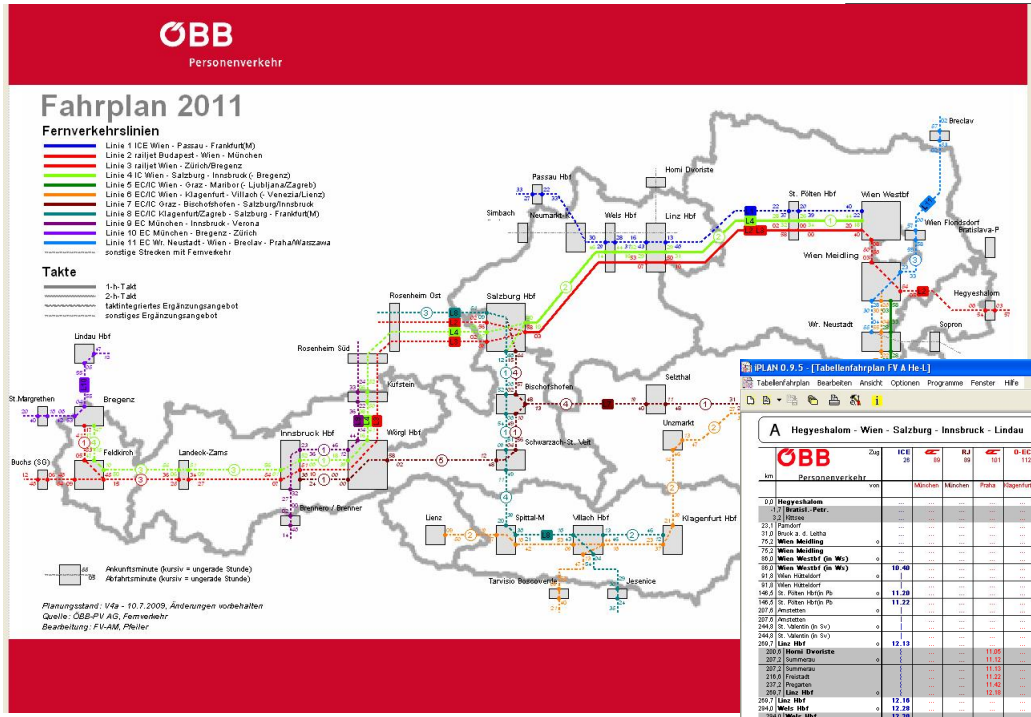
Train order plans

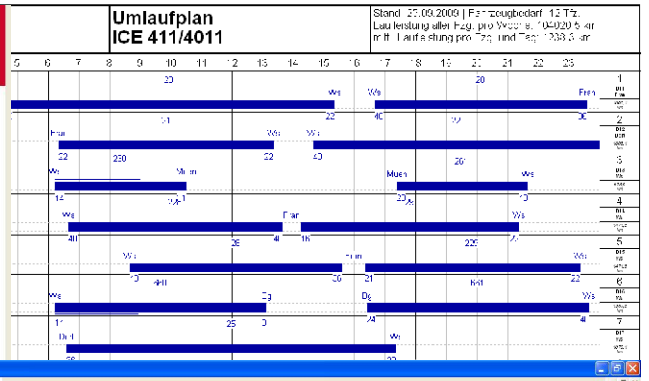
railML.org®

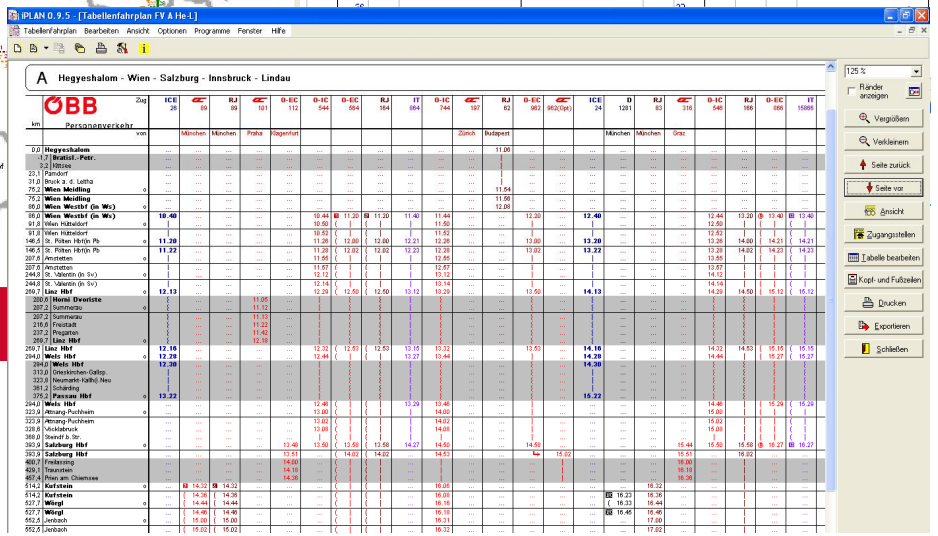
PSI

Working report: Who uses railML® and what for?

Case study Austria: ÖBB-Personenverkehr (3/6)







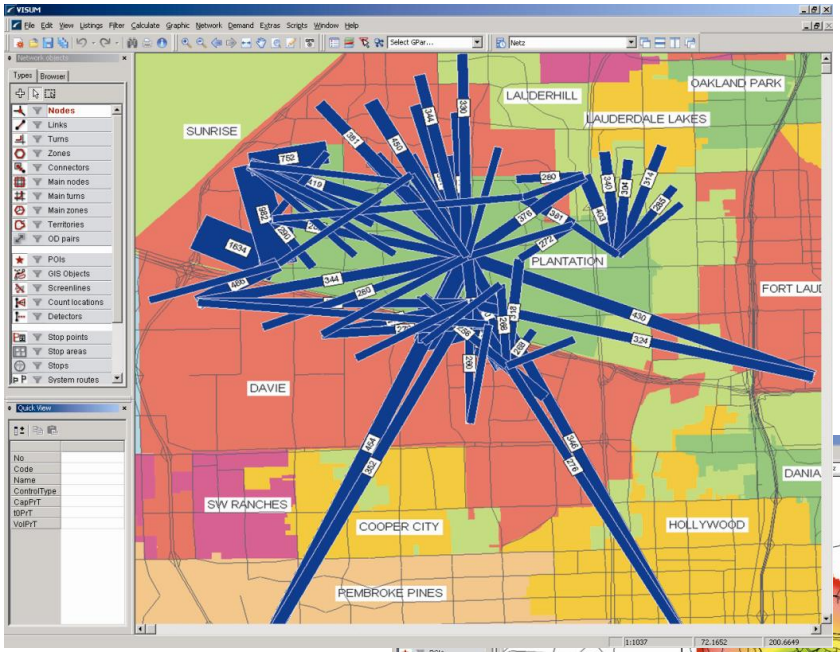
FBS
So macht man Fahrpläne!

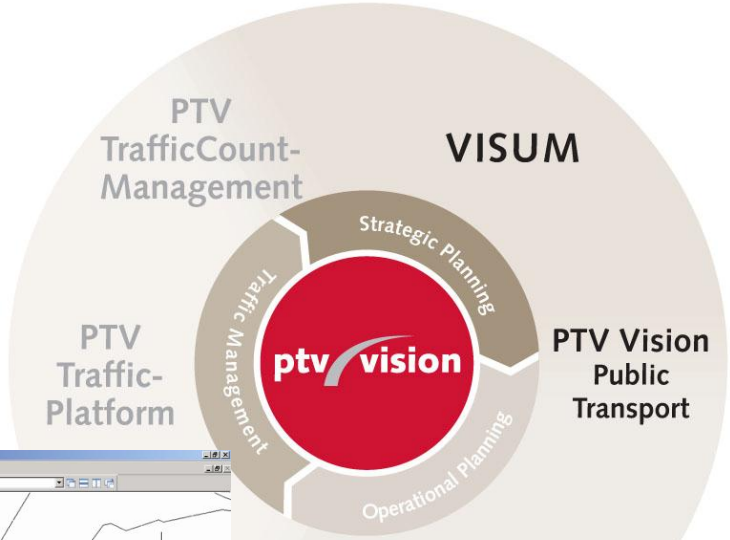
railML.org®

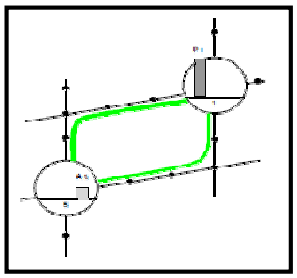
PSI

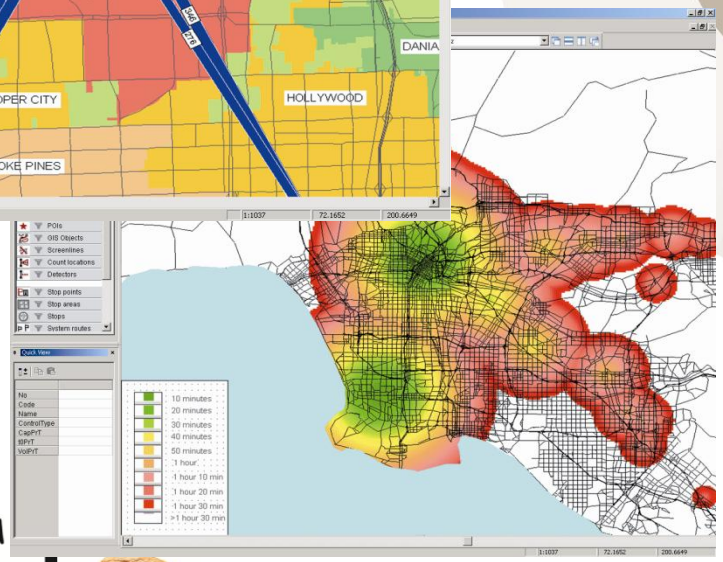
Working report: Who uses railML® and what for?

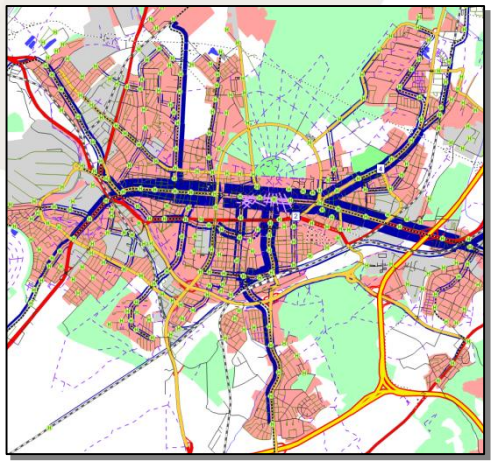
Case study Austria: ÖBB-Personenverkehr (4/6)









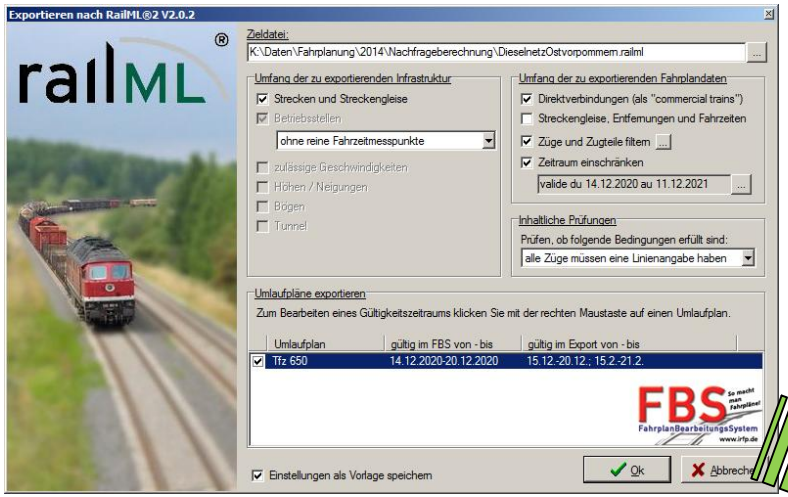


railML.org®

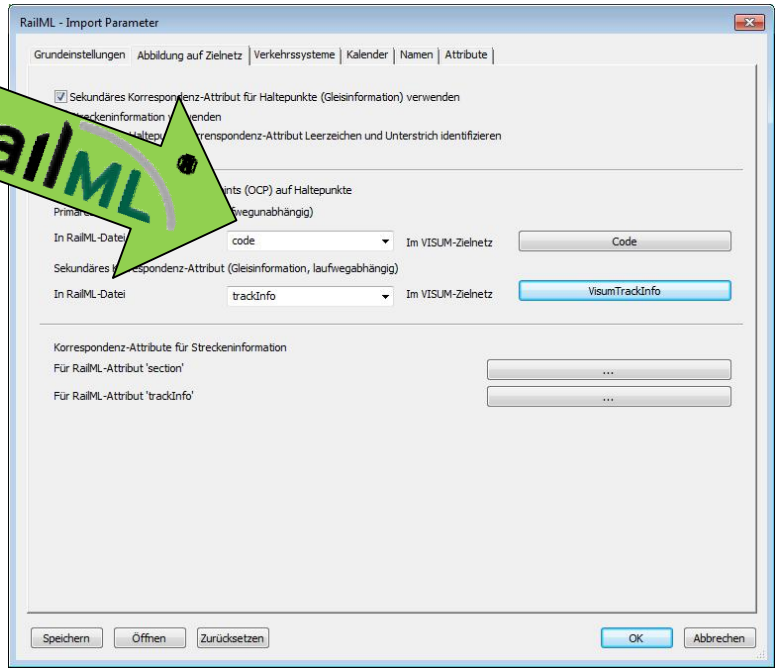
PSI

Working report: Who uses railML® and what for?

Case study Austria: ÖBB-Personenverkehr (5/6)



- **Export as railML-file from FBS**
- **railML-file via ÖBB-PV‘s server (or transfer via internet‘s FTP)**
- **Import as railML 2.0-file into VISUM**



- **Export takes only minutes for the whole network of ÖBB-PV**
- **Files may become large; but well to compress**
- **Due to the easy exchange time-table variants may be simulated very quick within VISUM**

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study Austria: ÖBB-Personenverkehr (6/6)

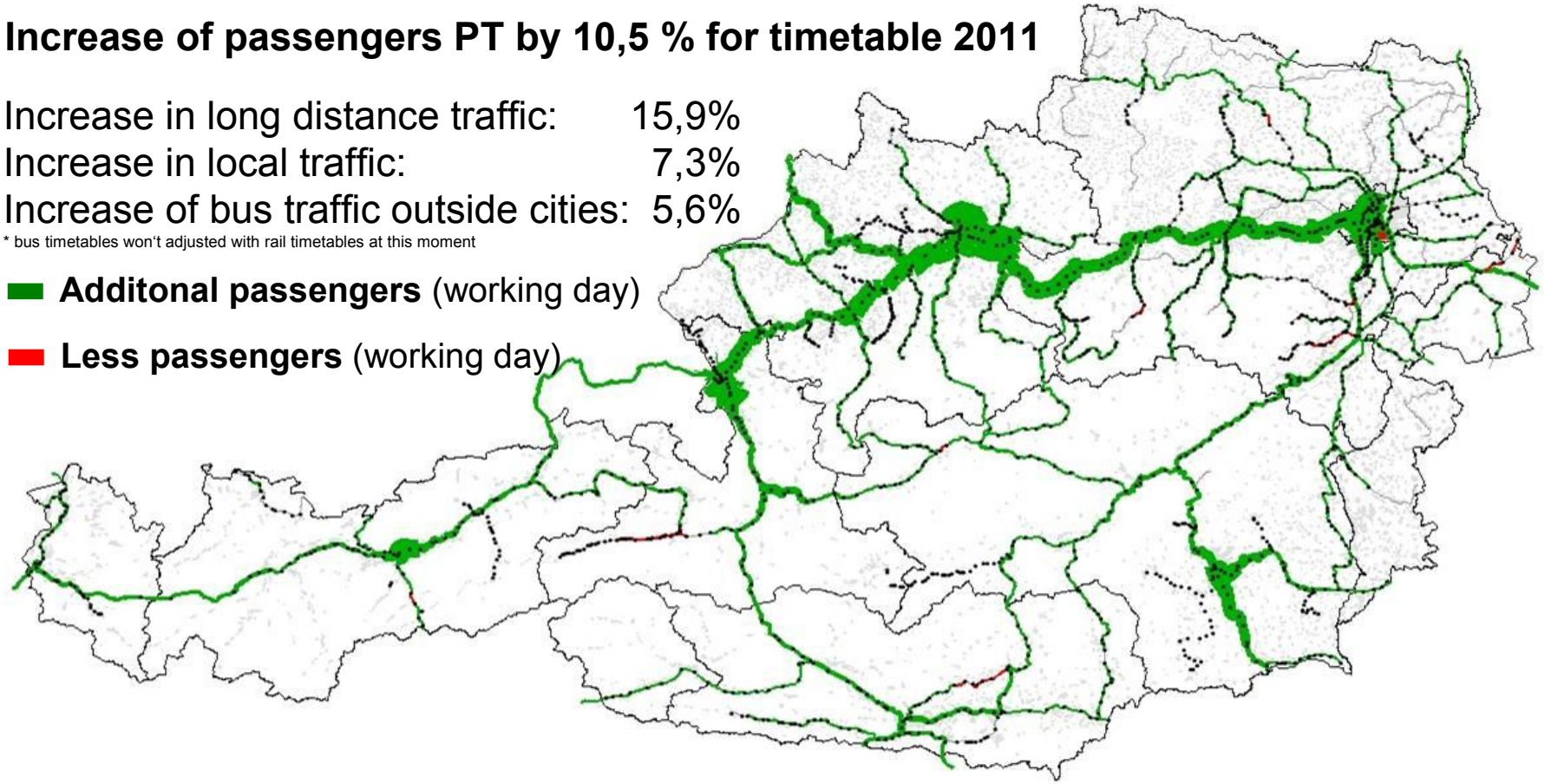
Increase of passengers PT by 10,5 % for timetable 2011

Increase in long distance traffic: 15,9%
Increase in local traffic: 7,3%
Increase of bus traffic outside cities: 5,6%

* bus timetables won't adjusted with rail timetables at this moment

Additonal passengers (working day)

Less passengers (working day)



railML.org®

PSI

Working report: Who uses railML® and what for?

Case study Saudi Arabia: Saudi Railways Organisation

- **Example GPSinfradat and FBS for Saudi Railways Organisation**
  Project Unique Infrastructure Database for Operation using railML®

- Partners: SRO, Dammam[SA]
  iRFP, Dresden[DE]
  Bahnkonzept, Dresden[DE]

المؤسسة العامة للخطوط الحديدية
Saudi Railways Organization

- Aims of the project:
  - Improve quality of Timetabling Services
  - Less Delays for Passenger Trains, Real Time Train Management
  - Increase usage of existing Network of SRO
  - More trains without costs for line upgrade
  - Improved Safety due to less radio communication
  - Base for Future Asset Manangement System

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (2/15): Problem for Planning/Operation

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (3/15): Problem for Planning/Operation

railML.org®

PSI

Working report: Who uses railML® and what for?
Case study SRO (4/15): Solution GPSinfradat

railML.org®

PSI

Working report: Who uses railML® and what for?
Case study SRO (5/15): Aim of the GPSinfradat project

- For the simulation of railway network operation and for training and documentation issues a lot of infrastructure data (track geometry, signals, track system / routes) is needed.
- If these data won‘t be available not just yet (new build lines) or not be avialable as digital data (existing or old lines), a manual input by experts is needed. For many lines in foreign countries no or only fragmentary data is available.
- **Engineering intention**
  adequate exact data for simulation of railway network operation and for training and documentation issues by mobile data recording with GPS-based hardware and specific analysis software
- **Business case**
  economic, easy to use solution with less post processing effort due to the use of optimised *GPSinfradat*-software

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (6/15): Use cases

- Infrastructure data for operation concepts and -simulation
  - » To avoid reading of secondary sources (actuality, errors, problem of synchronising of different sources)
  - » Gathering of data for railway operation tenders or to build an operating concept on infrastructure of other operators
- Infrastructure-Information-System (Video-GIS for railways)
  - » Overview over own or used infrastructure from computers in your office, e.g. to avoid business trips or meetings
  - » Basis for feasibility studies or decisions about variants
  - » Connection to other data (e.g. line data of FBS)
- Train drivers training and simulation of railway signals
  - » Training of line knowledge for drivers for new build or completely upgraded lines or stations
  - » Simulation of new signalling systems

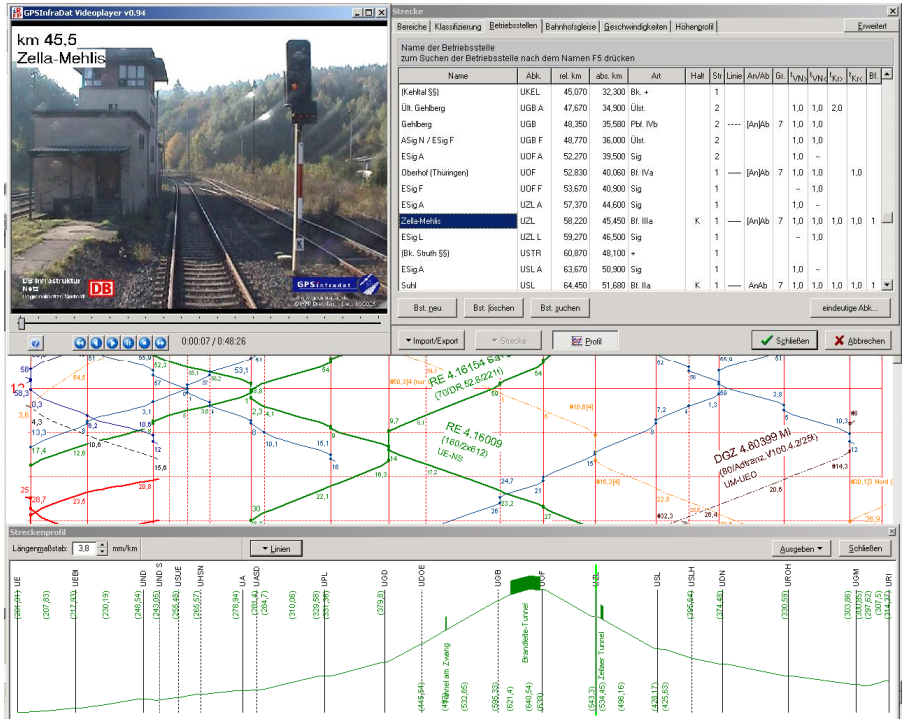
railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (7/15): Infrastructure data for operation

- For timetable planning (e.g. by *FBS*) infrastructure data is needed
  - » position and art of operational units
  - » numbers of stations- and main tracks
  - » speed, gradients, if necessary: curves and tunnels too
- Data isn't available or only available in a bad quality or only on paper plans (abroad; like *CVRD, SETRAG*)
- Operation concept variants causes changes of infra-structure; decision on versions is necessary in planning process



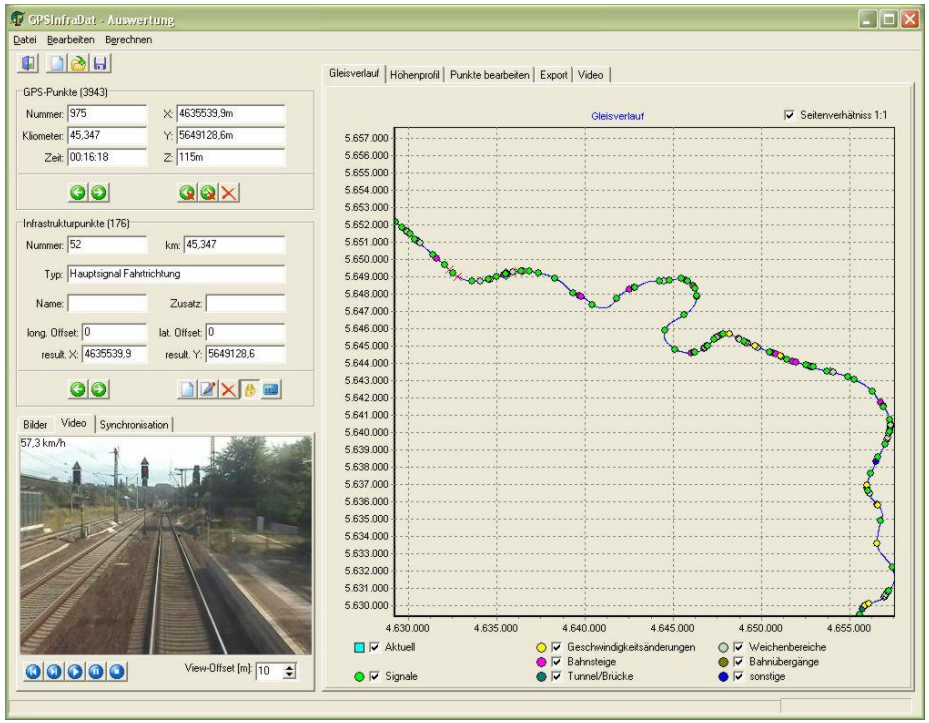
railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (8/15): Infrastructure information system

- Infrastructure companies mostly planning very decidedly; construction and supervision / project control is contracted externally
- Transport companies or authorities may decide about infrastructure
- GPSinfradat as video based GIS / Infrastructure information system:
  - » Overview from office, no on-site visit necessary
  - » Basis for prompt decision
  - » Conjunction with line characteristics
- Viewing & printing mode with video or photo



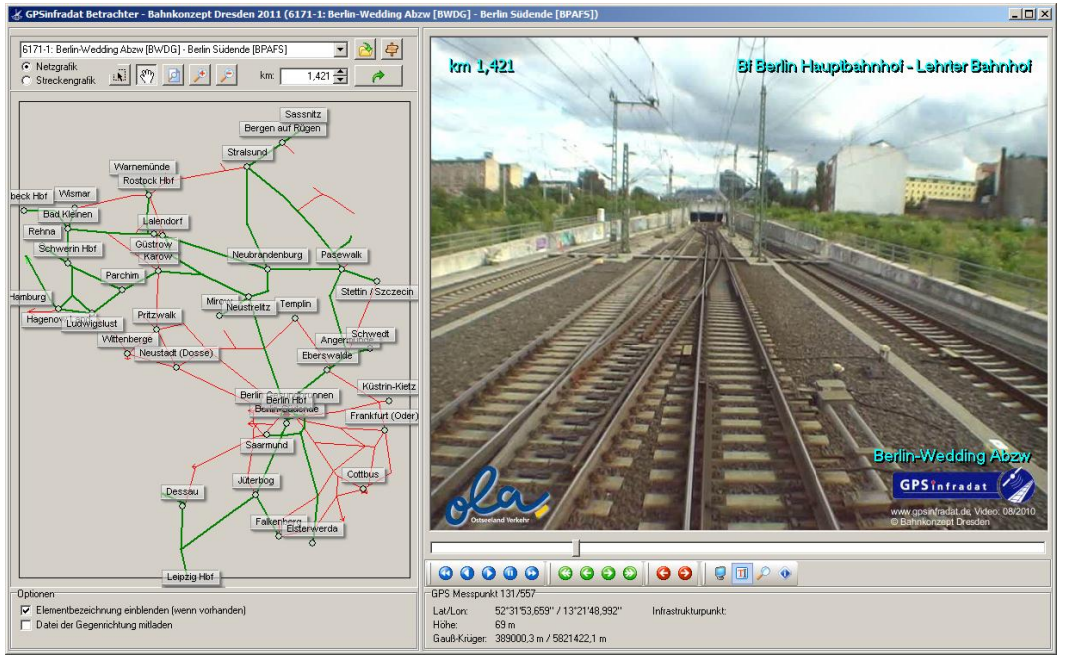
railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (9/15): Drivers training

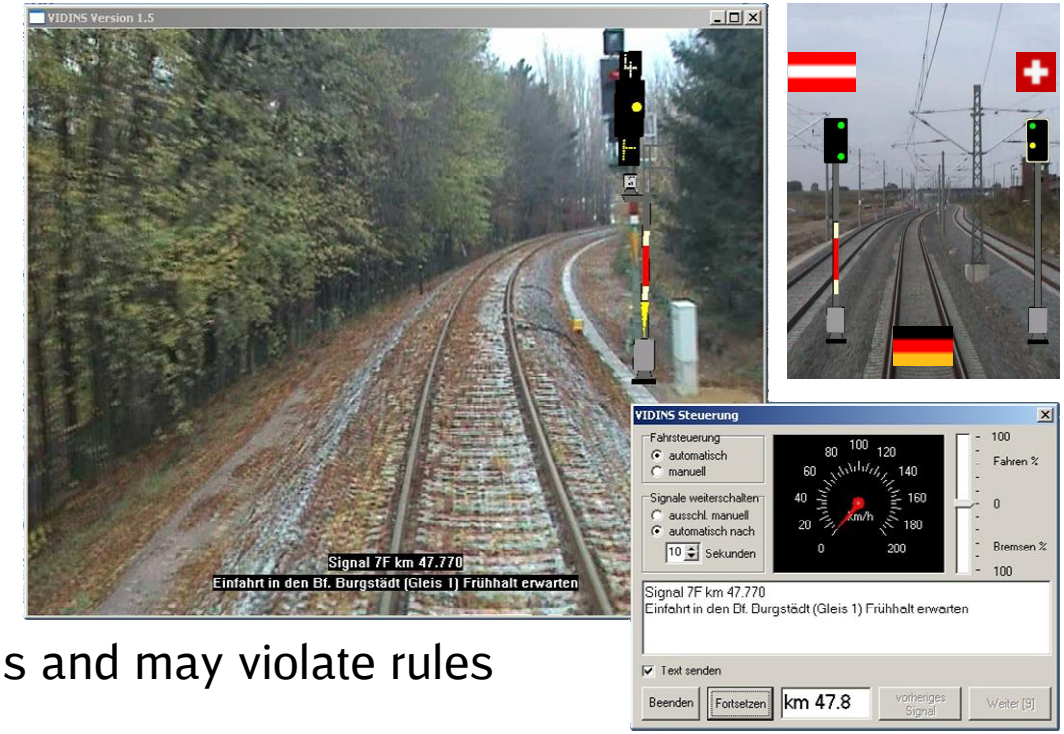
- Acquisition of line knowledge for drivers for new and existing upgraded lines or in case of taking over of additional lines
- Fulfils requirements of German annex 8 „Triebfahrzeugführerschein-verordnung“ (§ 6 (3) TfV) and DB-rule 492 (*Merkblatt-Film-Verfahren*)
- Use as computer-programme (Windows), on the intranet via browser or via connection on *Google Maps/Earth* possible



Working report: Who uses railML® and what for?

Case study SRO (10/15): Signal simulation for drivers

- Train drivers will be trained by theoretic lessons or by driving on the railway network in special/empty trains; runs are very expensive
- Replacement by simulation systems is state of the art today
- Line sections without exceptions can driven faster; saved time can be used to check/drive complex sections of the network (e.g. line changes, nodes, large stations, …) more than one time or to train situations with exceptions (e.g. failure in signalling or radio system), where driver has to act in stress situations and may violate rules



railML® > June 26th 2015 > Slide 40
Berlin > PSI Anwender- und Diskussionsforum

Working report: Who uses railML® and what for?

Case study SRO (11/15): Simulators for staff and drivers

- Simulation and training of irregularity of daily operation (wrong line order, track works) or change of operation mode (foreign network)
- Interaction via trainer-trainee-interface & dispatcher workplace
- Driving in the video by user with real driving dynamic (*FBS*)
- Additional overlay / fade-in of 3D-graphics (signals, obstacles, fog, environment) possible
- Video may be gathered by regular operation areas
- Simple solution with PC and control via keyboard, mouse and joystick possible
- Driver training workplaces using (modified) video data are much cheaper than today's 3D-simulations

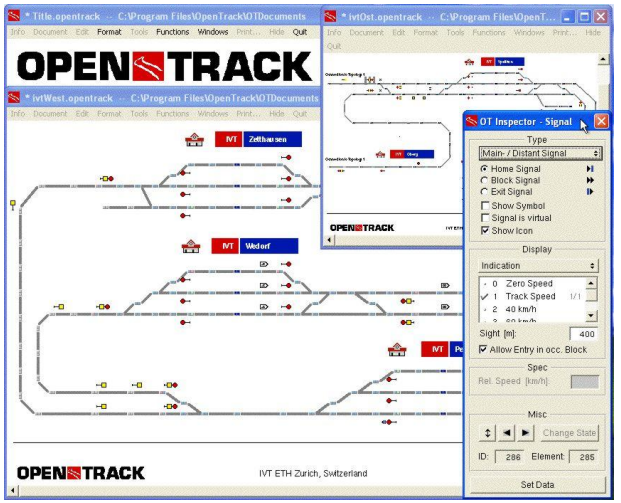
railML.org®

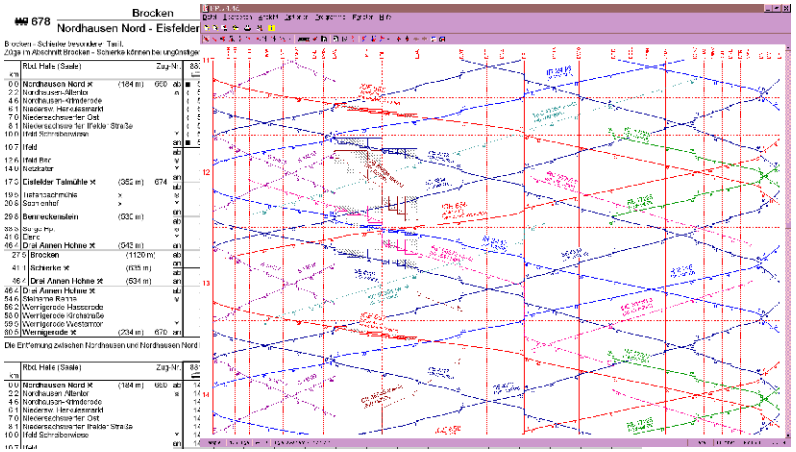
PSI

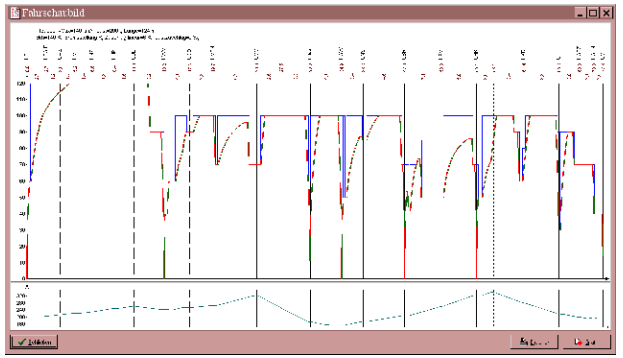
Working report: Who uses railML® and what for?

Case study SRO (12/15): Problem for Planning/Operation

- Use of the data in external data-bases, viewers or planning/simu-lation/construction tools
- Export via railML®-*infrastructure*
- Possibility of data use by railway operators, software manufacturers in the railML®-consortium







Working report: Who uses railML® and what for?

Other customers (13/15)

Selected large projects

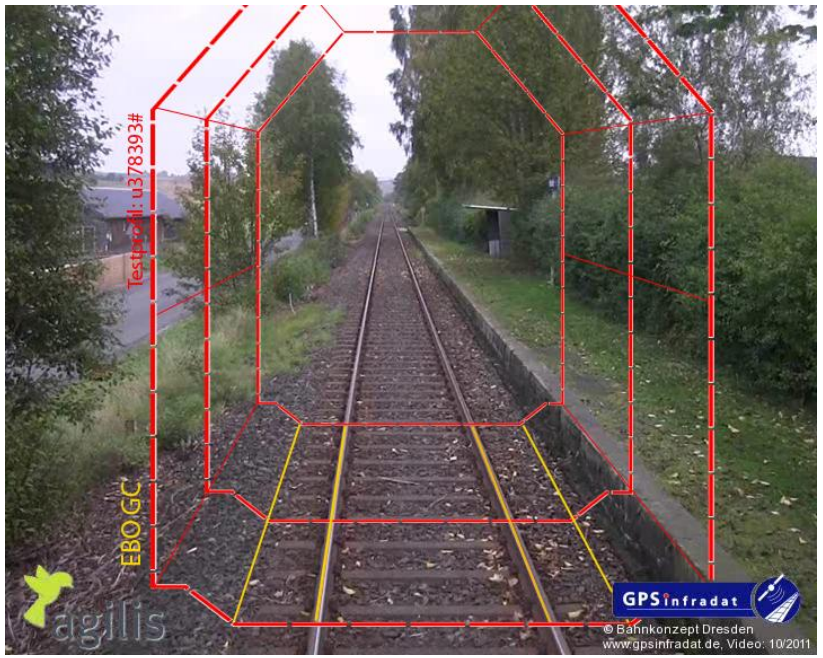
- BEG Bavaria 2004-2014
- SBB Cargo Germany 2008-2012
- MGB (Suisse) 2006/2011
- CVRD (Brazil) 2006
- SETRAG (Gabon) 2007
- Deutsche Bahn 2012-2015

Working report: Who uses railML® and what for?

Case study SRO (14/15): GPSinfradat Outlook

Further development

- Kinetic envelope / distance measurement
- Mobile viewer (laptop) with video
- Mobile viewer (smartphone) without video
- Portable simulator
  with VIDINS technology



Survey technics

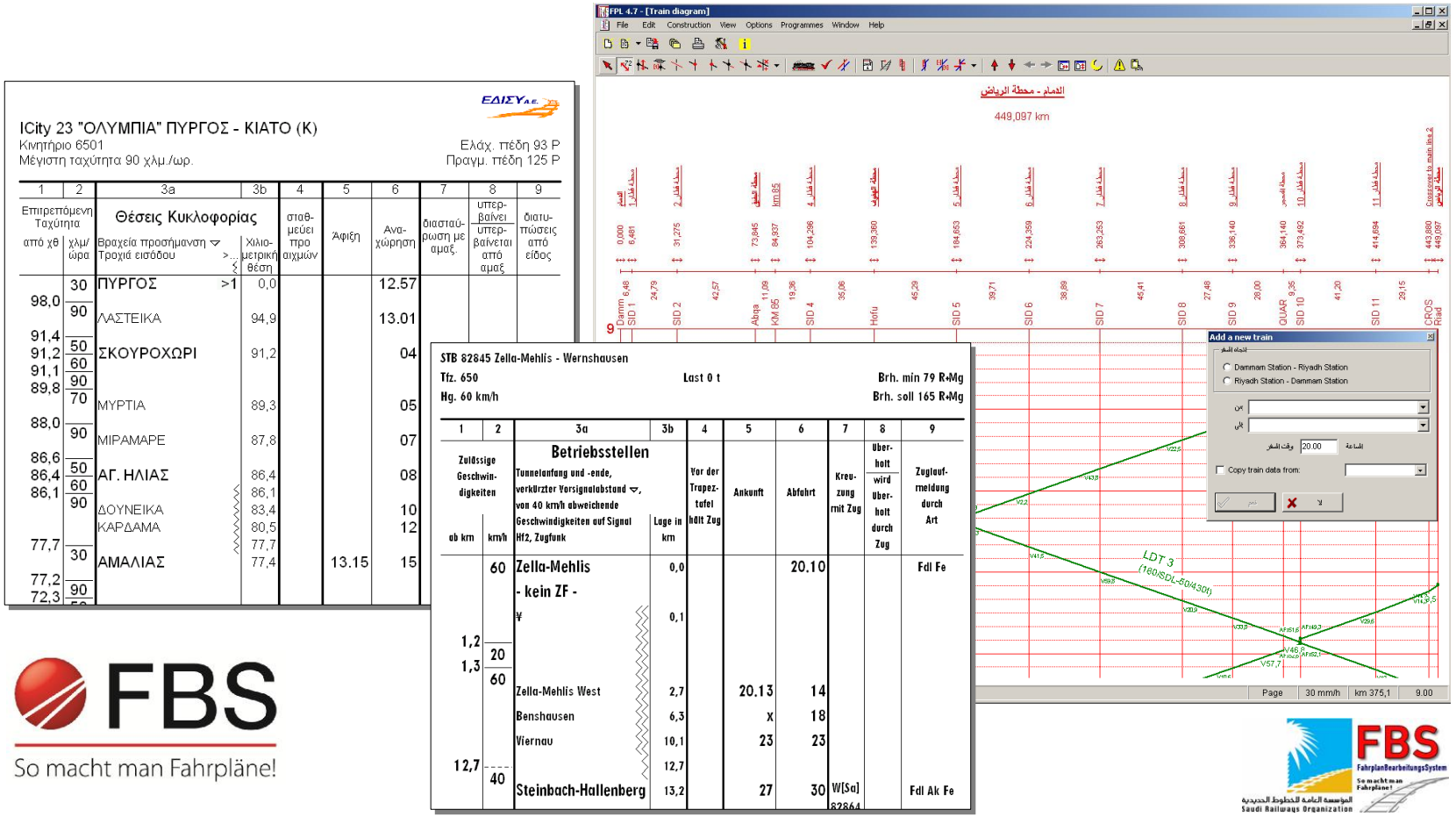
- Improved height measurement
- HD video
- Infrared for tunnels

railML.org®

PSI

Working report: Who uses railML® and what for?

Case study SRO (15/15): Usage in timetabling



ICity 23 "ΟΛΥΜΠΙΑ" ΠΥΡΓΟΣ - ΚΙΑΤΟ (K)
Κινητήριο 6501
Μέγιστη ταχύτητα 90 χλμ./ωρ.
Ελάχ. πτέδη 93 P
Πραγμ. πτέδη 125 P

1	2	3a	3b	4	5	6	7	8	9
Επιτρεπόμενη Ταχύτητα		Θέσεις Κυκλοφορίας							
από χθ	χλμ/ώρα	Βραχεία προσήμανση / Τροχιά εισόδου	Χιλιομετρική θέση	σταθμεύει προ αιχμών	Άφιξη	Αναχώρηση	διασταύρωση με αμαξ.	υπερβαίνει / υπερβαίνεται από αμαξ	διατυπώσεις από είδος
	30	ΠΥΡΓΟΣ >1	0,0			12.57			
98,0	90	ΛΑΣΤΕΙΚΑ	94,9			13.01			
91,4									
91,2	50	ΣΚΟΥΡΟΧΩΡΙ	91,2			04			
91,1	60								
89,8	90								
	70	ΜΥΡΤΙΑ	89,3			05			
88,0	90	ΜΙΡΑΜΑΡΕ	87,8			07			
86,6									
86,4	50	ΑΓ. ΗΛΙΑΣ	86,4			08			
86,1	60		86,1						
	90	ΔΟΥΝΕΙΚΑ	83,4			10			
		ΚΑΡΔΑΜΑ	80,5			12			
77,7			77,7						
	30	ΑΜΑΛΙΑΣ	77,4		13.15	15			
77,2									
72,3	90								

STB 82845 Zella-Mehlis - Wernshausen
Tfz. 650 — Last 0 t — Brh. min 79 R+Mg
Hg. 60 km/h — Brh. soll 165 R+Mg

1	2	3a	3b	4	5	6	7	8	9
Zulässige Geschwindigkeiten		Betriebsstellen							
ab km	km/h	Tunnelanfang und -ende, verkürzter Vorsignalabstand, von 40 km/h abweichende Geschwindigkeiten auf Signal Hf2, Zugfunk	Lage in km	Vor der Trapeztafel hält Zug	Ankunft	Abfahrt	Kreuzung mit Zug	Überholt wird Überholt durch Zug	Zuglaufmeldung durch Art
	60	Zella-Mehlis	0,0			20.10			Fdl Fe
		- kein ZF -							
		¥	0,1						
1,2	20								
1,3	60								
		Zella-Mehlis West	2,7		20.13	14			
		Benshausen	6,3		x	18			
		Viernau	10,1		23	23			
12,7			12,7						
	40	Steinbach-Hallenberg	13,2		27	30	W[Sa] 82864		Fdl Ak Fe

FBS
So macht man Fahrpläne!

railML.org®

PSI

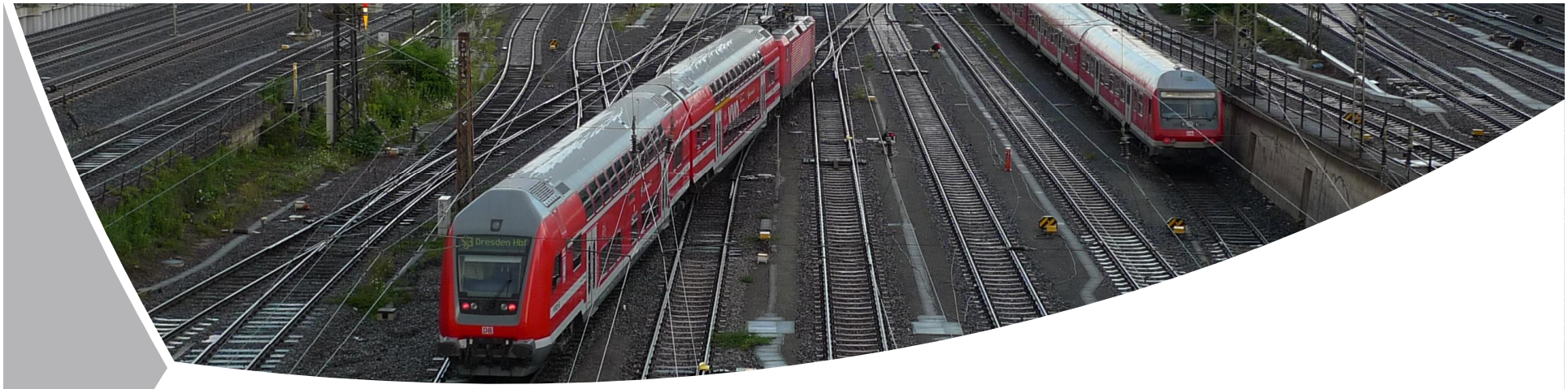
Summary and Outlook

What is it and how does it work?

- railML® is an open standard for the exchange of railway data
- Three railML® Schemes for *infrastructure*, *rolling stock* and timetable have already been published; *interlocking* scheme in preparation
- The railML-consortium is a union of partners from industry, rail and research, who are working together on the development of the railML-schemes
- 15 programmes are listed on the railML-website which use railML® data for exchange
- Development of further subschemes under consideration
- Participation for additional members possible

railML.org®

PSI



railML®: The standard interface for data exchange in railway business

Discussion / Examples & Demonstration / Questions

Vasco Paul Kolmorgen; railML.org

coordination@railml.org +49 351 46676939

railML.org

railML.org
All rights reserved.