INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

4th UIC RailTopoModel and railML® Conference

Towards a Universal Topology Model for Railways and Data Exchange Format for Infrastructure

UIC HQ, Paris April 28th/ 29th, 2015

Agenda

1 Welcome and keynote speeches

2 Achievements

3 Business Cases & Processes

4 What else …

5 Conclusion

Agenda

1 Welcome and keynote speeches

2 Achievements

- *What was accomplished since 2013*
- *UIC RailTopoModel*
- *railML3*
- *First services: railML validator, Viewers,…*

The origin… 2012

- **On 2012 few IMs shared their issues and concerns when working on projects as ETCS, Inspire, RINF,…**
  - Lack of recommendation (standard ?) on railway modelling, to support both routes (topology) and technical objects/properties
  - No robust exchange format supporting topology, to share data with manufacturers on ETCS project
  - A lot of re-inventing… very little re-use of developments on basic functions
- **Those IMs proposed to both UIC and railML.org to work together to bring solution to the sector on 2 objectives:**
  - A universal railway object model, based on topology,
  - A new version of railML standard, based on this model.

2013…

- 6 months later, a project team is initiated, federating contributors from 7 countries.
- A feasibility study is conducted by Traf IT
- Based on the conclusion of this study, the project is launched
- October 2013 : presentation of a road map to the sector

What was accomplished since 18 months ?

1st Conference
Proposal for a scenario
to deliver accuracy and performance in business processes and data exchanges between railways partners

3rd Conference
Presentation of RailTopoModel V1
+ detailed road map of railML3 schema for Infrastructure

2nd Conference
Description of a solution
- A common language to become an industrial standard

→ UIC RailTopoModel
- A new version of raiML standard, to leverage performances

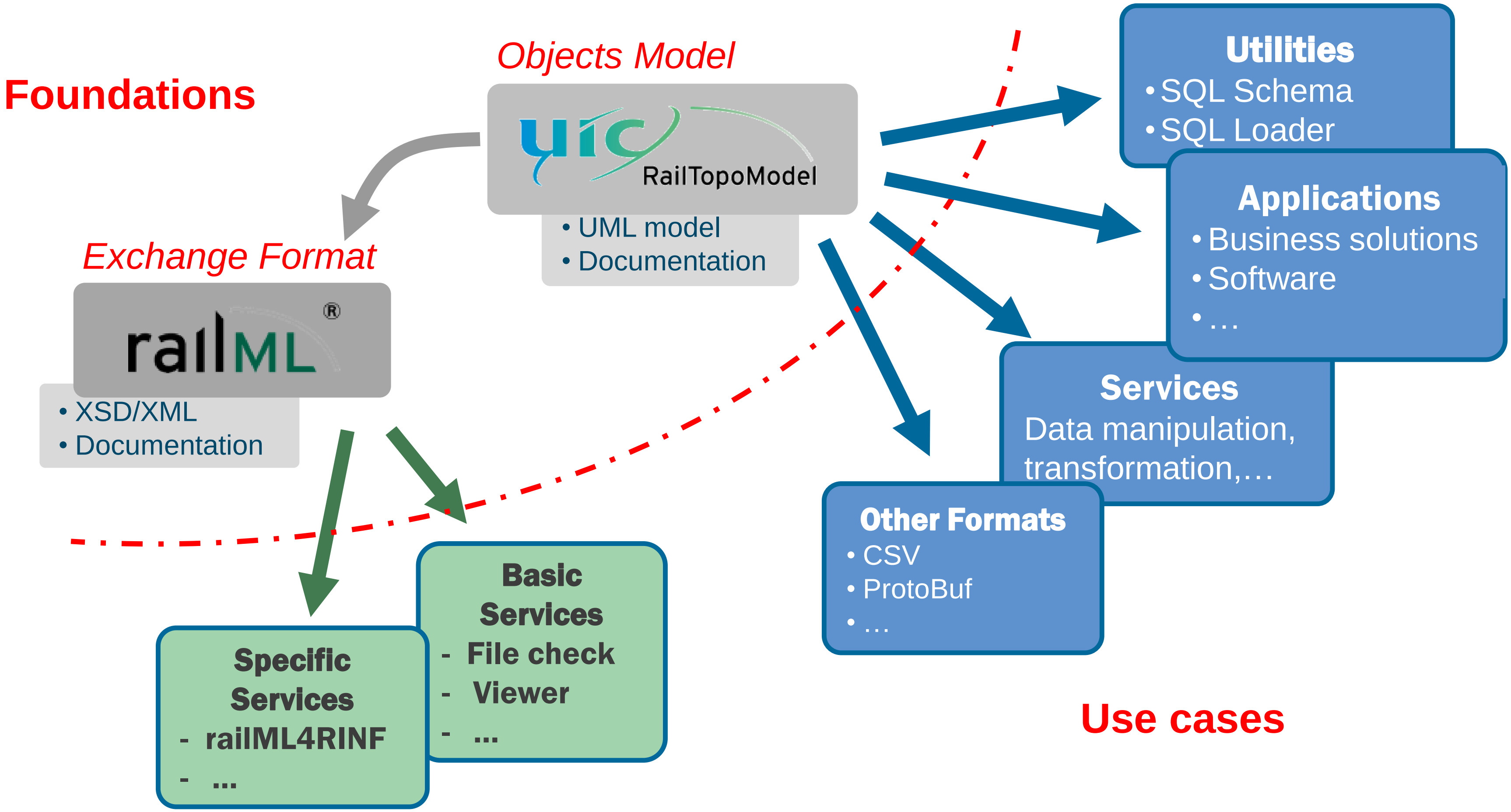
→ railML3

4th Conference
Presentation of the results after18 months of work from a large group of IMs to serve common interest of railway Industry

Reminder : RailTopoModel & railML® positionning

One main objective is to provide a robust exchange format for most use cases, and a first set of tools based on this exchange format.

The global consistency is ensured by the keystone : UIC RailTopoModel



Next step…. answering market needs

…

Intermodal

Rail – Stations
Passengers
Freight
…

RailTopoModel

Rail Network

railML®

Traffic Mngt

Route optimization
Interlocking
Simulation
Facilities Mngt
…

Asset Mngt

Design, Investments
Economic Analysis
Benchmarking

Environment

Energy
Noise
Industrial risks
…

… Business domains

Achievements and Perspectives

Any question ?
Any need or subject not addressed ?
Any additional ambition or requirement ?
….

Agenda

1 Welcome and keynote speeches

2 Achievements

3 Business Cases & Processes

4 What else…

Toward an open community for rail information systems

5 Conclusion

What else…. (1)

We are now close to finalize the 2 corner stones which will ease the alignment in IT development, and ensure fundamental quality and performance in data exchange between partners.

… Let think about next steps, and give capacity to the railway industry to

- **Share**, not only data but also IT experience,
- **Re-use** benefits of previous investments
- **Collaborate** on development of common bricks, or complex software/ algorithms (e.g. route calculation, simulation, …)
- **Capitalize** on all projects (unfortunately often unusable for further enrichments)
- … **better work together**

What else…. (2)

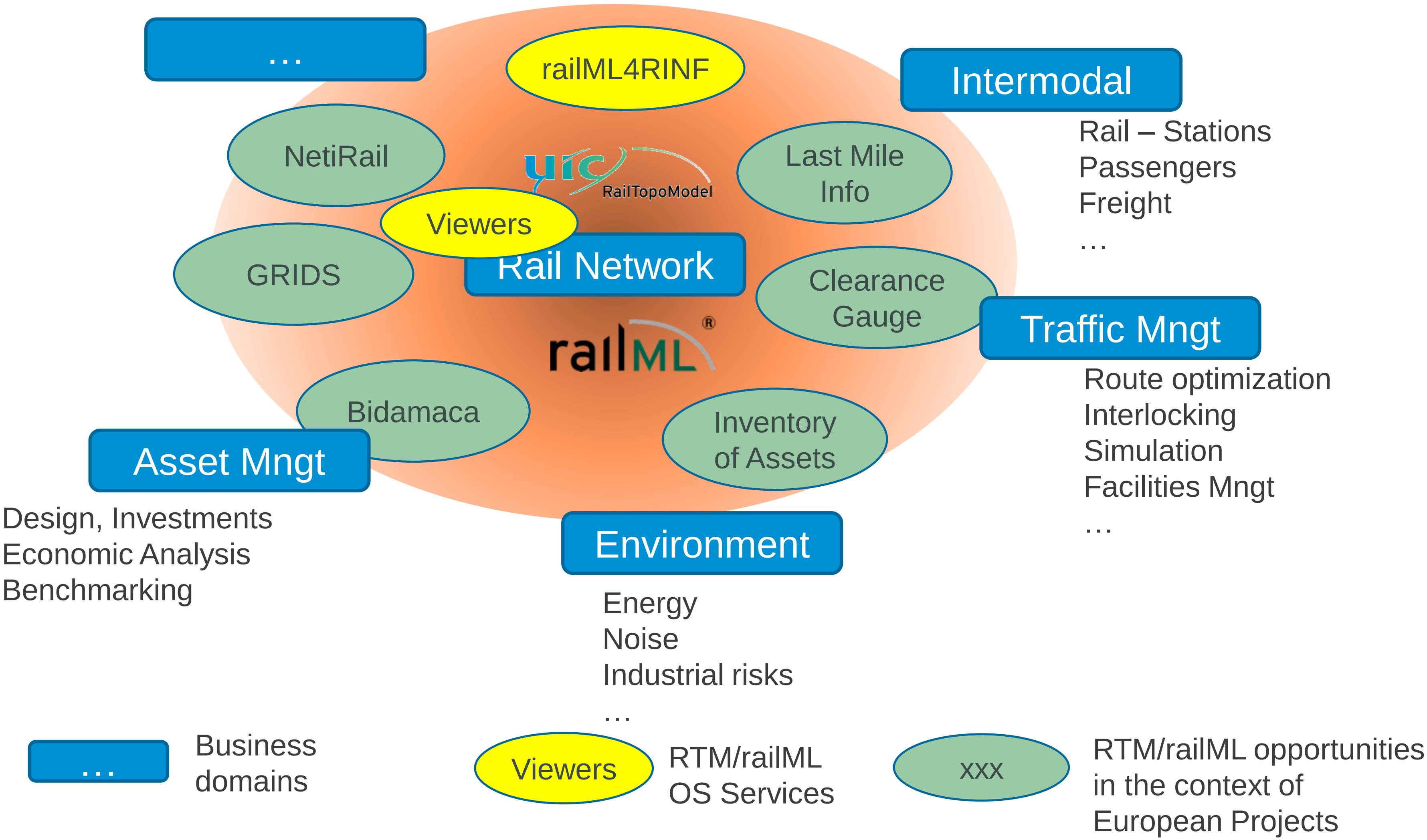
First initiatives in open data have been launched by EU…(Inspire, Rinf,…)
Many IMs have to open their data by regulation.

Like some projects already operational in the field of multimodal transport…

Let think about initiating an Open project in Railway domain

- **Define the frame** together, for the benefit of our businesses
    - Objectives, structuring principles, business priorities, governance
- **Organize the** initiative for short term benefits
    - Find the candidate projects (EU projects, common bricks, …)
    - Identify the potential early adopters in each country
    - Organize the collaborative work

Opportunities : find the candidate projects



Defining the frame for collaborative work

Having a community working separately, but contributing to the design of a consistent project, imposes a minimum of guidelines.

- Architecture is a one of them.
  - **Why an architecture ?**
  - **Why using existing OGC/ISO Standards ?**
  - **Why Open Source components ?**

Why an architecture frame ?

- **Capitalization :** By using a single Framework and keep enhancing it.
- **Reusability :** Ability to reuse 'as is', already existing and efficient software components.
- **Modularity :** To not impact whole Framework if we only change a/few components.
- **Extensibility :** Ability to extent features, without changing core software itself.
- **Security :** Securing data is a key point and must be guaranteed at architecture level

Why using existing OGC/ISO Standards ?

- Because of Interoperability.
- Allows heterogeneous architecture
- Easy to integrate in (your) existing IS/GIS
- Improves (again) architecture modularity

Why Open Source Components ?

- Several Open Source components already works well

  … and will be kept maintained by third party

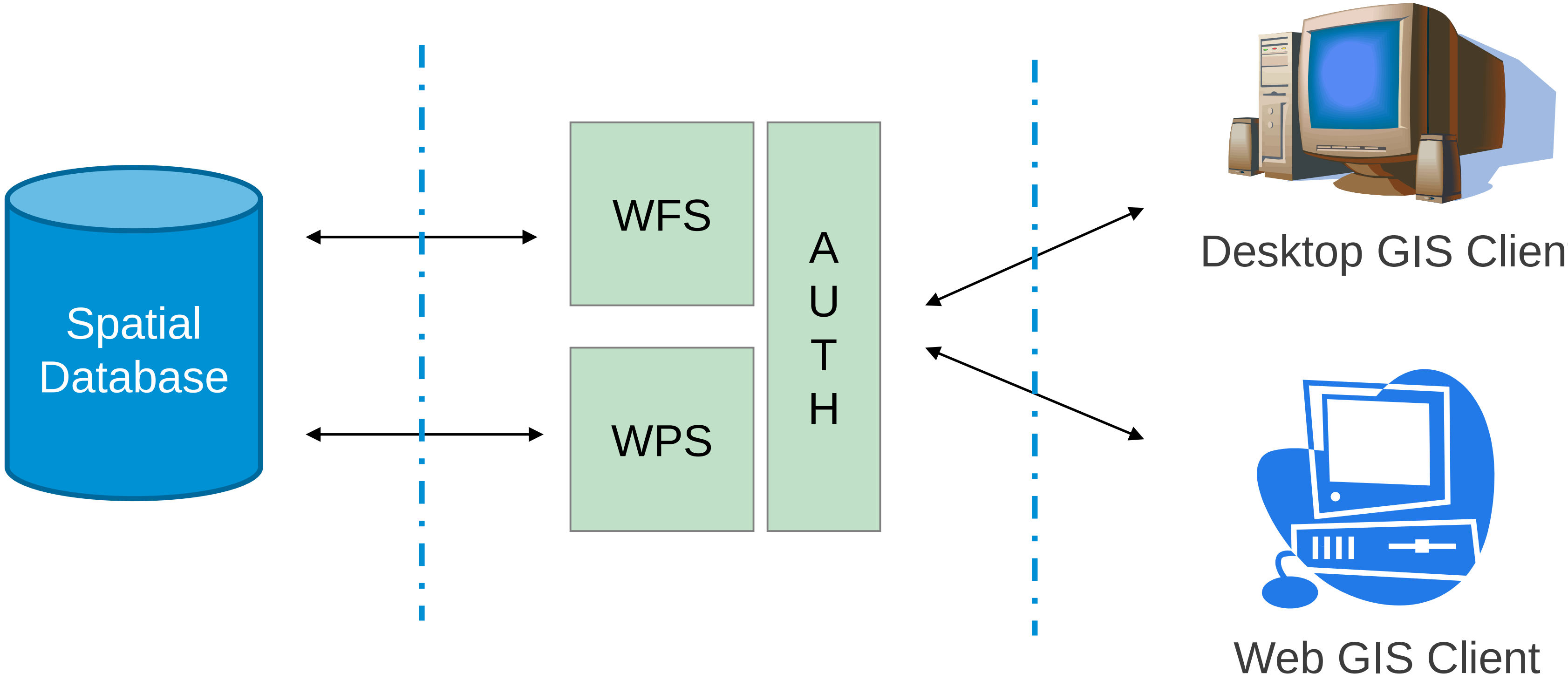
- No vendor lock-in

- Allows to fix/improve source code

- Doesn't necessarily imply that everything must be Open Source

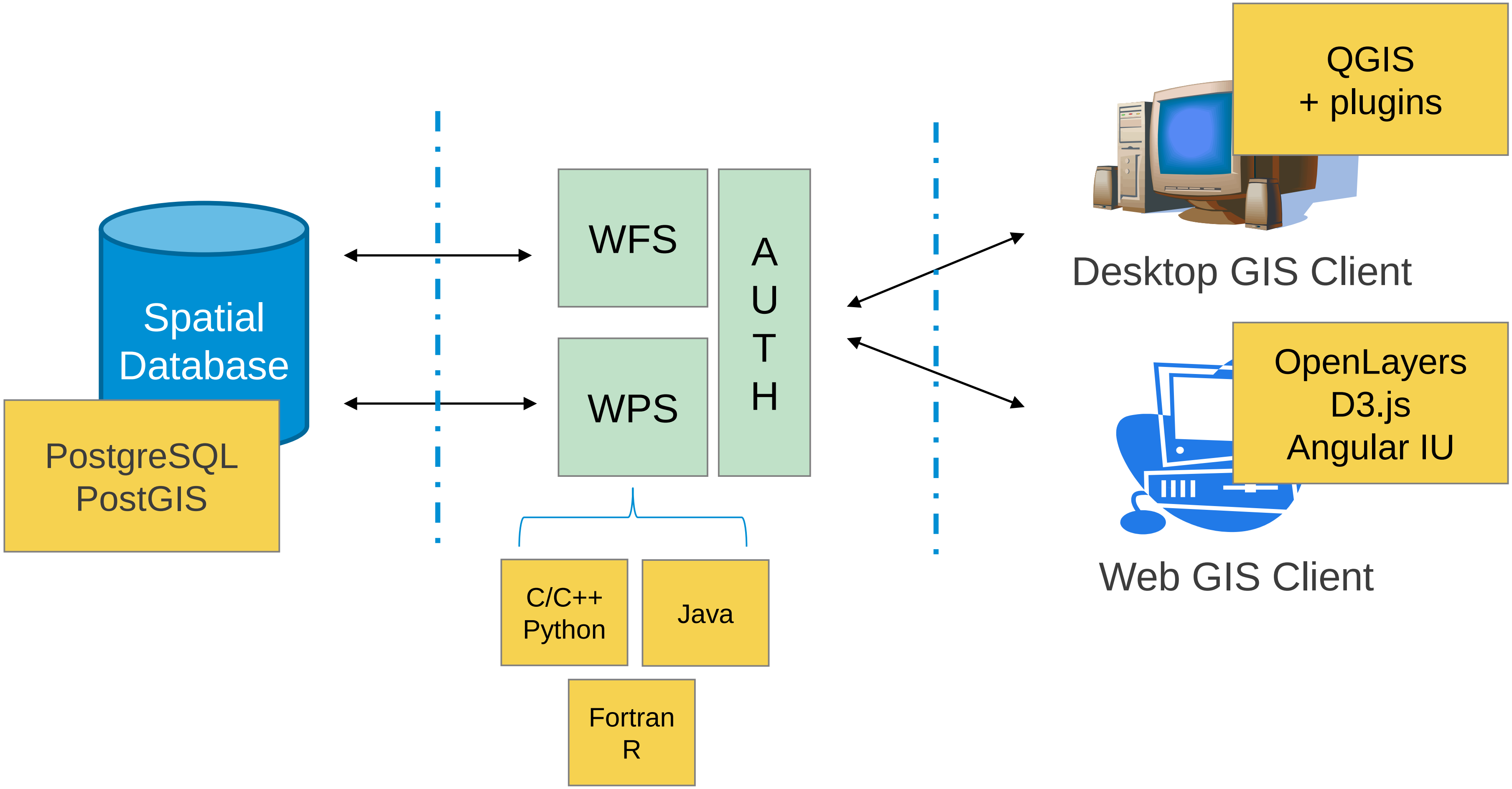
  ... and obviously your data will remain yours

Proposed architecture - principles

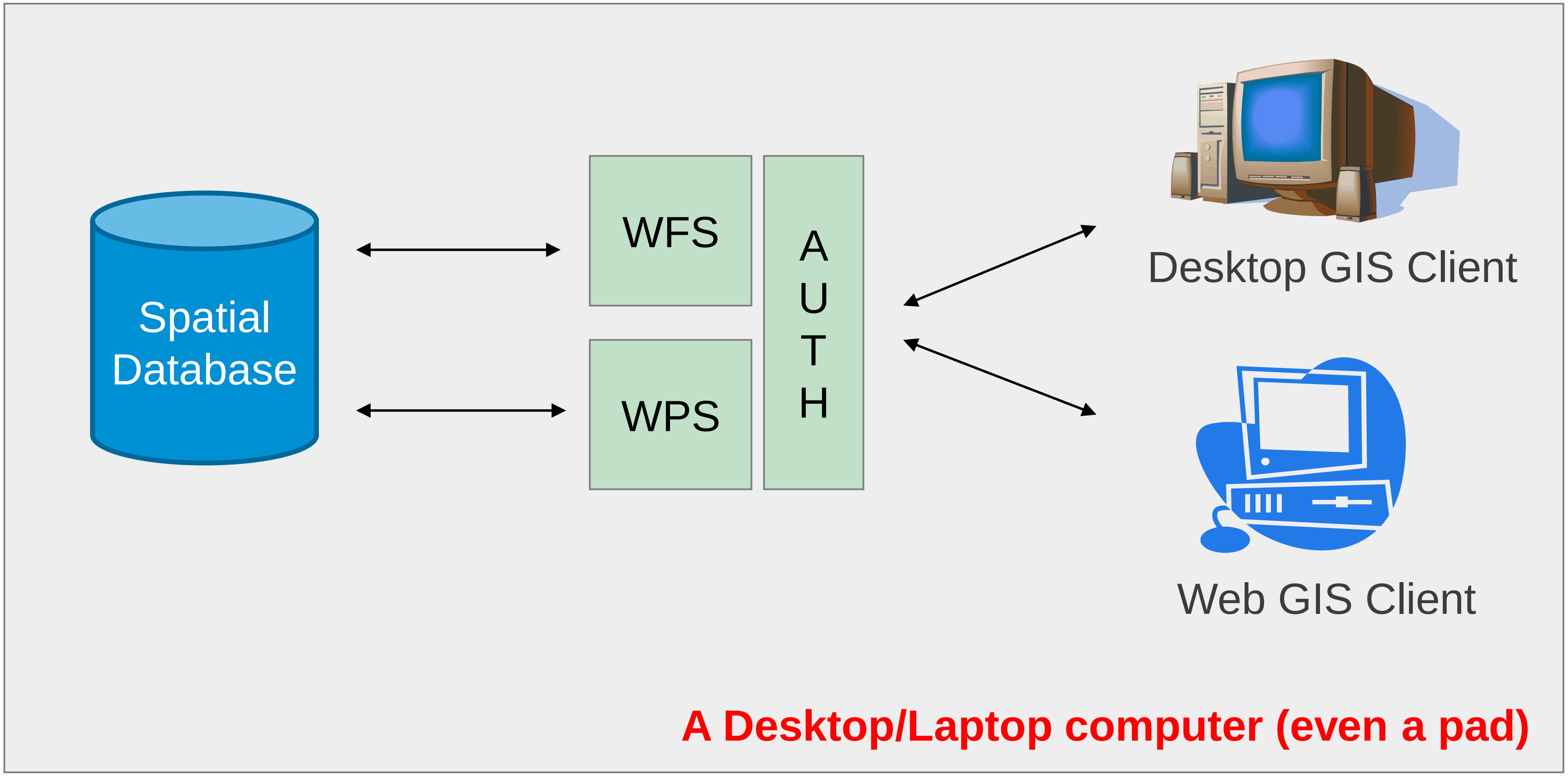


Web standards
WFS : Web Feature Service
WPS : Web Processing Service

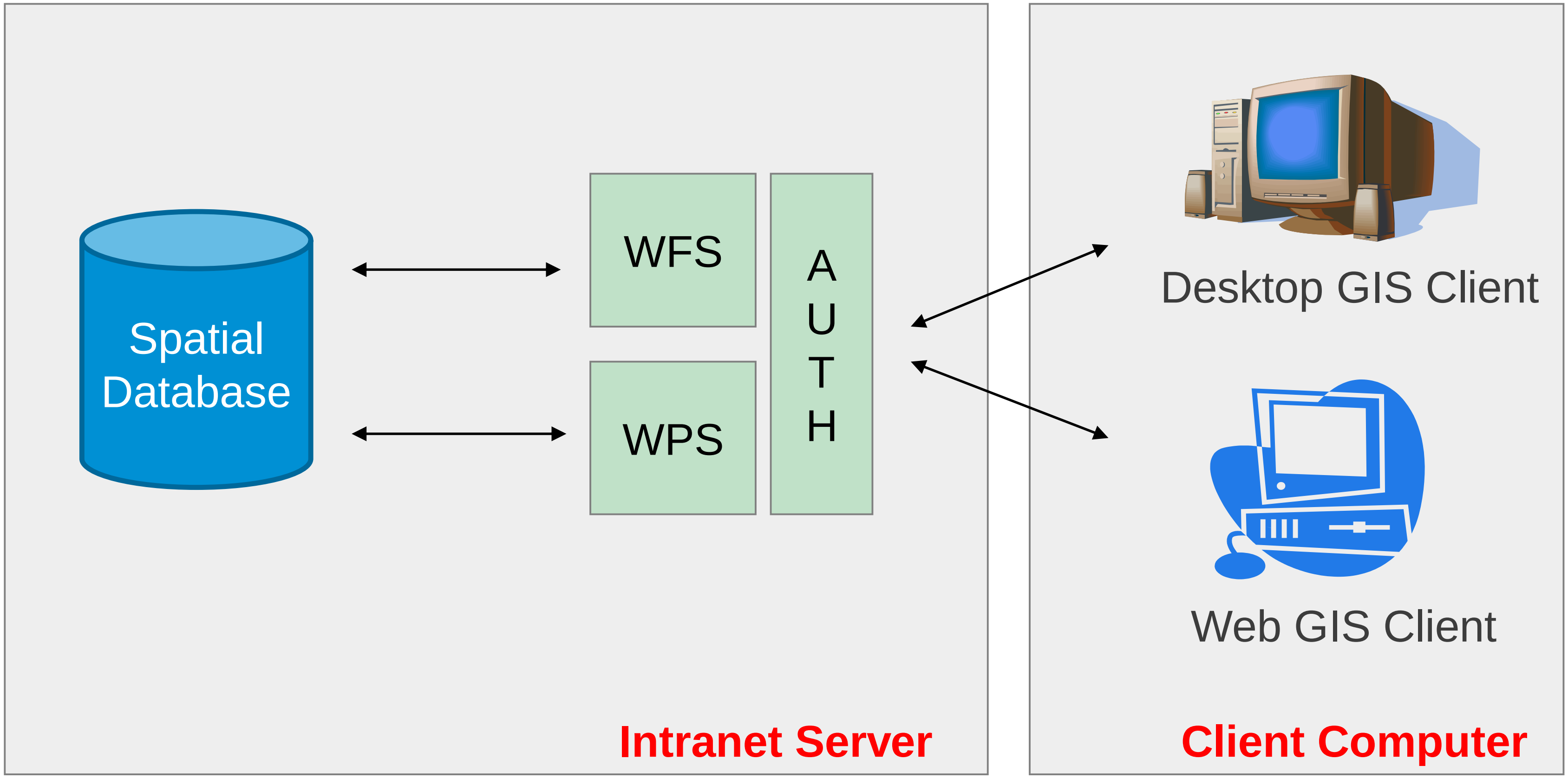
Proposed Architecture Apps & Languages



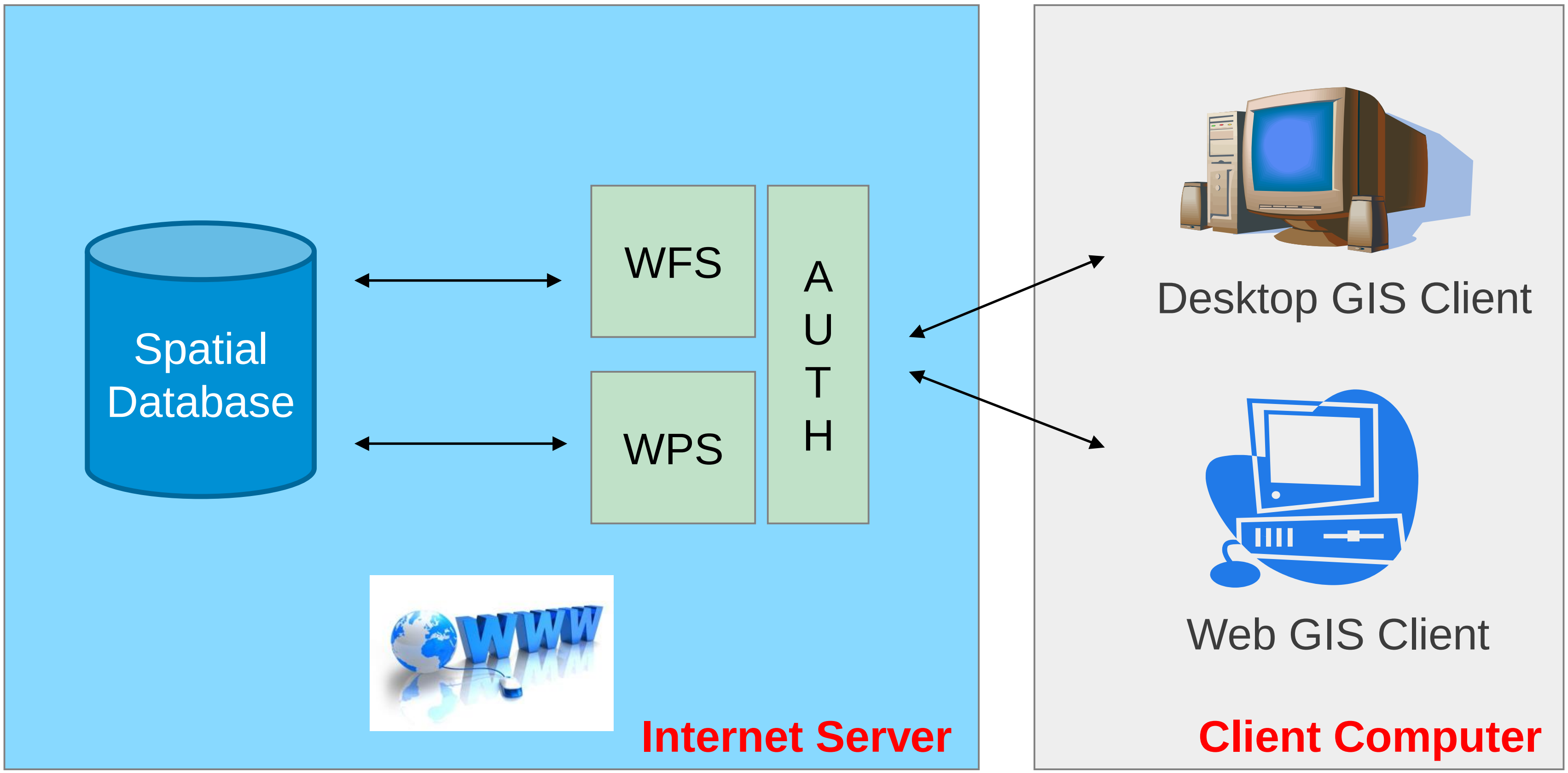
Architecture scenario #1 : On a single computer



Architecture scenario #2 : Intranet



Architecture scenario #3 : Internet



Defining Governance

- **Strategic / steering committee**
  - Structuring orientations, political decisions, long term

- To be organized within the next 12 months
  - Currently ensured by the UIC / IMs / railML.org project team

- **Operational organization**
  - Technical features, architecture, practical decisions, short term, reactivity

- To be initiated asap
  - Main structuring orientations on architecture should be published by June to early adopters
- All contributions are welcome

Contribution, Next steps

❑ Declaration of interest

- ***Who is interested in testing the Validator and Viewer modules ?***
- ***Who is interested to contribute/benefit in next developments….?***
  - work on objectives and priorities, build the frame and first guidelines,…
  - Apply the framework to develop first services
  - Propose projects to the community
  - … any idea to leverage the collaboration

➢ ***First Architecture workshop : June 16th***

- Discuss and validate the foundation of architecture framework

Open Community for Rail Information Systems

...Thank you for your attention

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railVIVID – the railML Viewer & Validator: an open tool for an open standard

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TECHNISCHE UNIVERSITÄT DRESDEN

Dr.-Ing. Martin Lehnert
Faculty of Transportation and Traffic Sciences “Friedrich List”,
Institute of Traffic Telematics,
Chair of Traffic Control and Process Automation

Overview

> About us

- TU Dresden, Faculty of Transportation and Traffic Sciences „Friedrich List“, Chair of Traffic Control and Process Automation & Projects

> railVIVID – The railML Viewer & Validator

- Today’s situation
- Aim of the tool
- Content, development
- Aspects
- Demonstration

> Summary and outlook

- beta-testing

Technische Universität Dresden
Overview

»Wissen schafft Brücken.«


Fotos: TUD/Eckold

- **University with 14 faculties in four scientific disciplines**
  - Engineering
  - arts and social sciences
  - natural sciences
  - medicine
- **People**
  - approx. 37.000 students
  - approx. 4.300 publicly funded staff members (without medical school)
  - among them approx. 500 professors
  - approx. 3.400 externally funded staff members (without medical school)
- **TU Dresden is the largest university in Saxony and one out of eleven German universities identified as an “excellence university”.**

DRESDEN concept

Faculty of Transportation and Traffic Sciences „Friedrich List“

- 24 Full and Associate Professors
- 275 scientific and technical staff (ca. 50 % third party funded)
- ca. 2.000 Students

Rail Vehicle Engineering

Institutes



Traffic Telematics

Professur für Verkehrsleitsysteme und -prozessautomatisierung

Chair of Traffic Control and Process Automation

Prof. Dr.-Ing. Jürgen Krimmling

21 staff members; approx. 800.000 Euro/a external funds

Chair of Traffic Control and Process Automation - Overview about our projects

- **Driver Advisory Systems** (DAS) and Intermodal Transport Control System (ITCS) for different railway undertakings
- **Simulation** of Railway and Tramway Systems & TU Dresden train **driving simulator**
- **Real Time Traffic Control** (Rail & Road)
- **Evaluation** of Public Transport Operation
- **Controlling and Optimisation** of Rail Systems (e.g. EU-FP7 research project ON-TIME)
- **Research on Future Railway Operation** (e.g. EU-FP7 research project Capacity4Rail, German-Gov. research project PiLoNav)
- **Validation** of signaling design data

railVIVID – The railML Viewer & Validator
Today's situation

- **Exchange of railway related data** (infrastructure, timetable, rollingstock, interlocking etc.) **ties enormous hours of work and money**
- **misinterpretation during data exchange results in incorrect data sets**

→ **A standardized data exchange format is needed**

- **topological model for infrastructure data: UIC RailTopoModel**
- **data exchange format: railML "standard" (vers. 3.0)**

→ **There is a need for easy access to railML files,** even without writing or processing tools to check the content of railML files

→ **Need for a free and easy to use viewer**

railVIVID – The railML Viewer & Validator
Aim of the tool

- **give railML users outside the classic railway IT group support to use railML® data in tenders, contracts, …**
- **create quality graphical / textual output illustrating railML contents**
- **view the railML data** (without options to change the data) **for a better understanding of the content and for quality-testing**
- **validate the railML data**
- **increase the quality of existing railML files**
- **support the wide adoption of railML data**

- **Development embedded in UIC's ERIM activity**

railVIVID – The railML Viewer & Validator
Content, development

Development

- powered by UIC
- developed at TU Dresden, VLP in very short period: Jan.-Apr. 2015
- supported by railML-community (testing data)

Content of the tool

1) Topology viewer for Infrastructure

2) Geographic viewer for Infrastructure

3) Tabular viewer for timetables (with spreadsheet export)

4) Graphic viewers for timetables

5) Rolling stock data viewer

6) Schema validator

railVIVID – The railML Viewer & Validator

Aspects

> **Aspects (see Request of Proposal)**

- Stand alone application
- Support of different operation systems
- Support of different railML version (2.0) / 2.1 / 2.2 / 3.0MockUp
- Multi language support
- Modular Open Source framework
- …

railVIVID – The railML Viewer & Validator
Demonstration

- **Live-Demonstration**

Summary and Outlook

> **RailVIVID –The railML Viewer & Validator powered by UIC validates and visualises railML data**

> **beta-test phase will start today - interested users are welcome**

- Download of Windows version via website

http://railVIVID.railML.org

- Any feedback is welcome! Via e-mail:

feedback-beta@railVIVID.railML.org

- Test and feedback in beta-test phase till 31. May 2015

> **final version and source code of railVIVID in Summer 2015**

> **further research and development are needed to strengthen the purpose of the tool**

RailVIVID – The railML Viewer & Validator
- powered by UIC -

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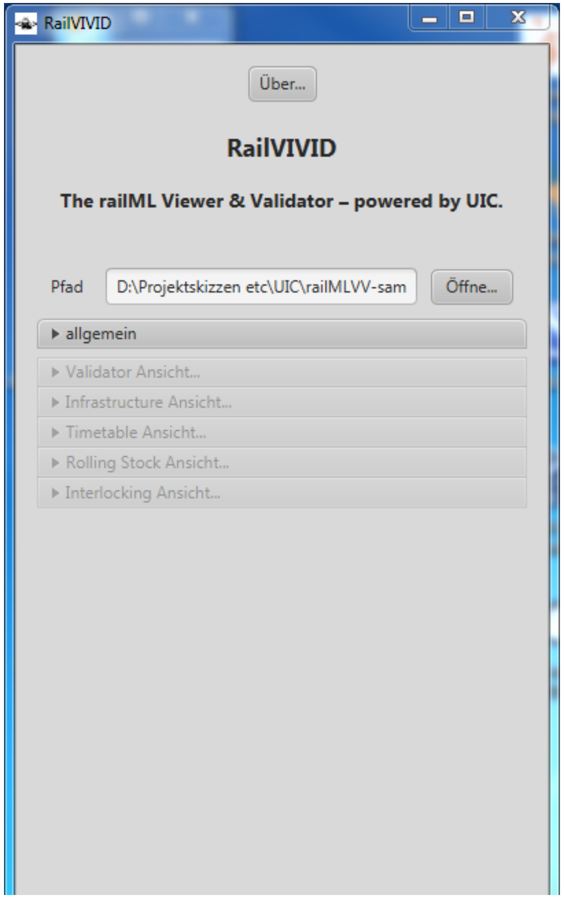
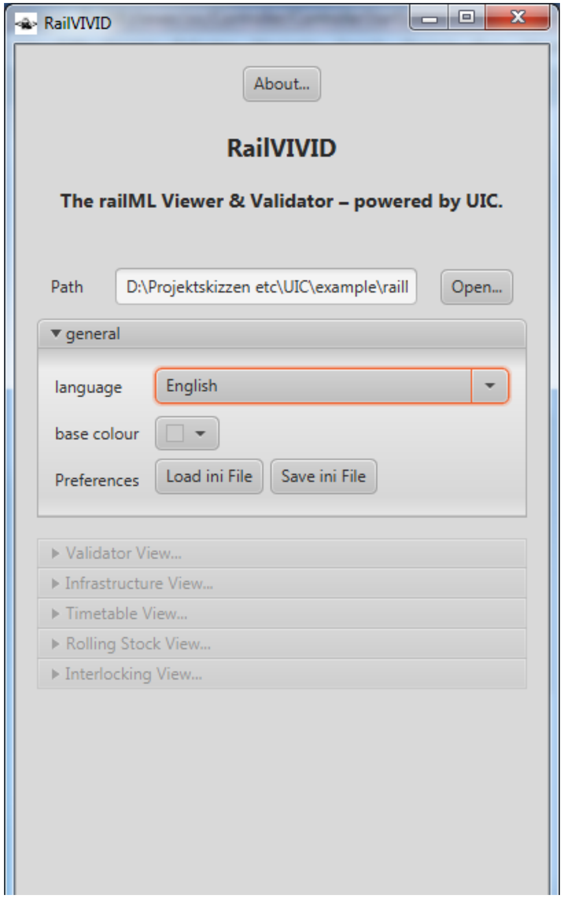
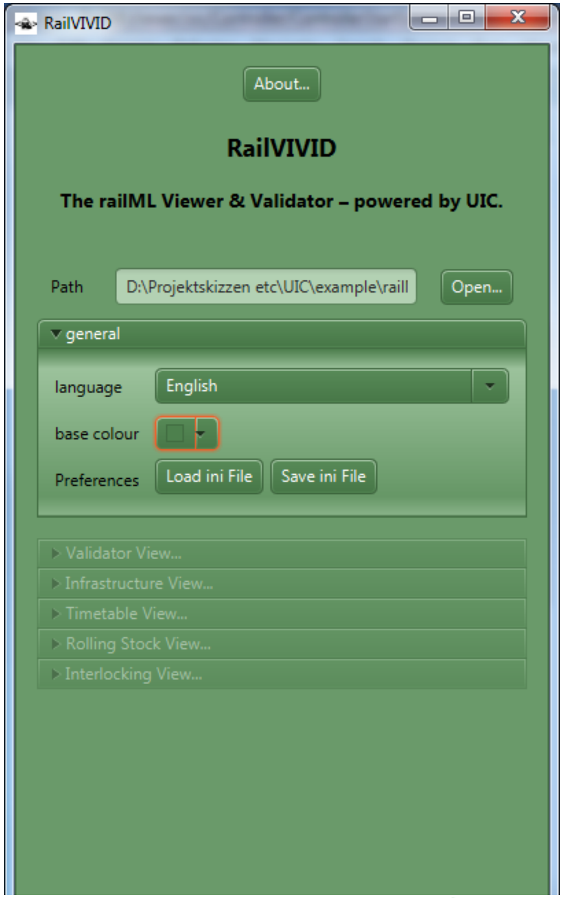
Live demonstration
General adjustments

> **change language to English & change background colour**

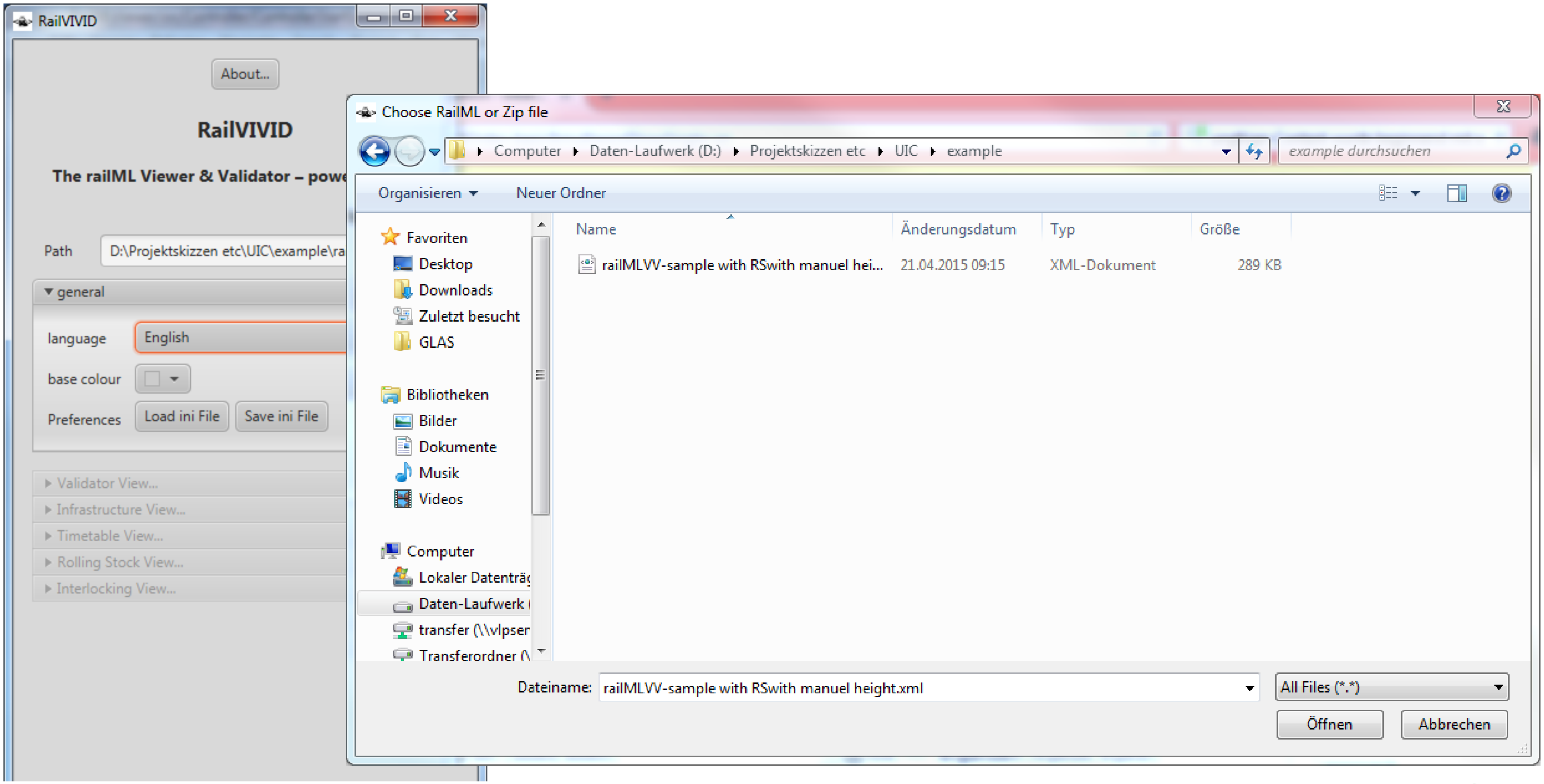






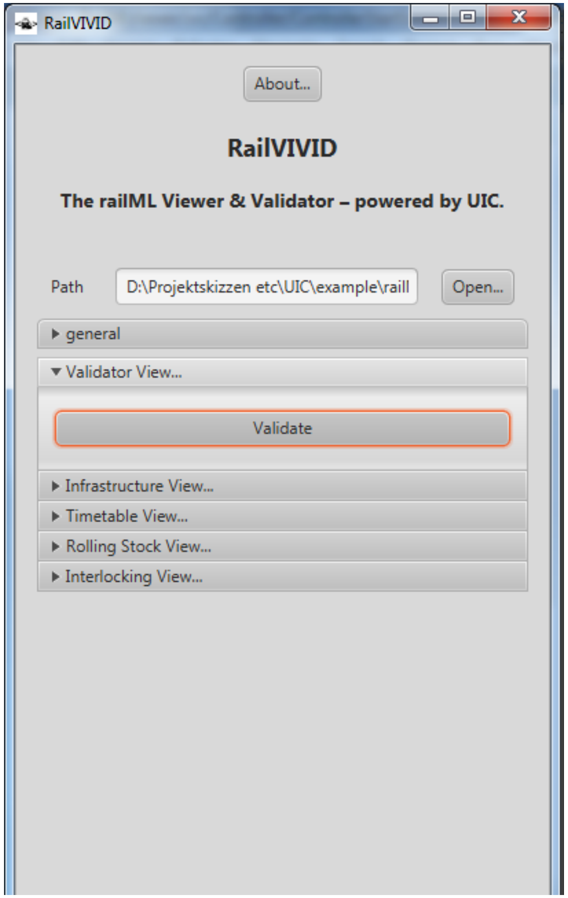
Live demonstration
Open railML file

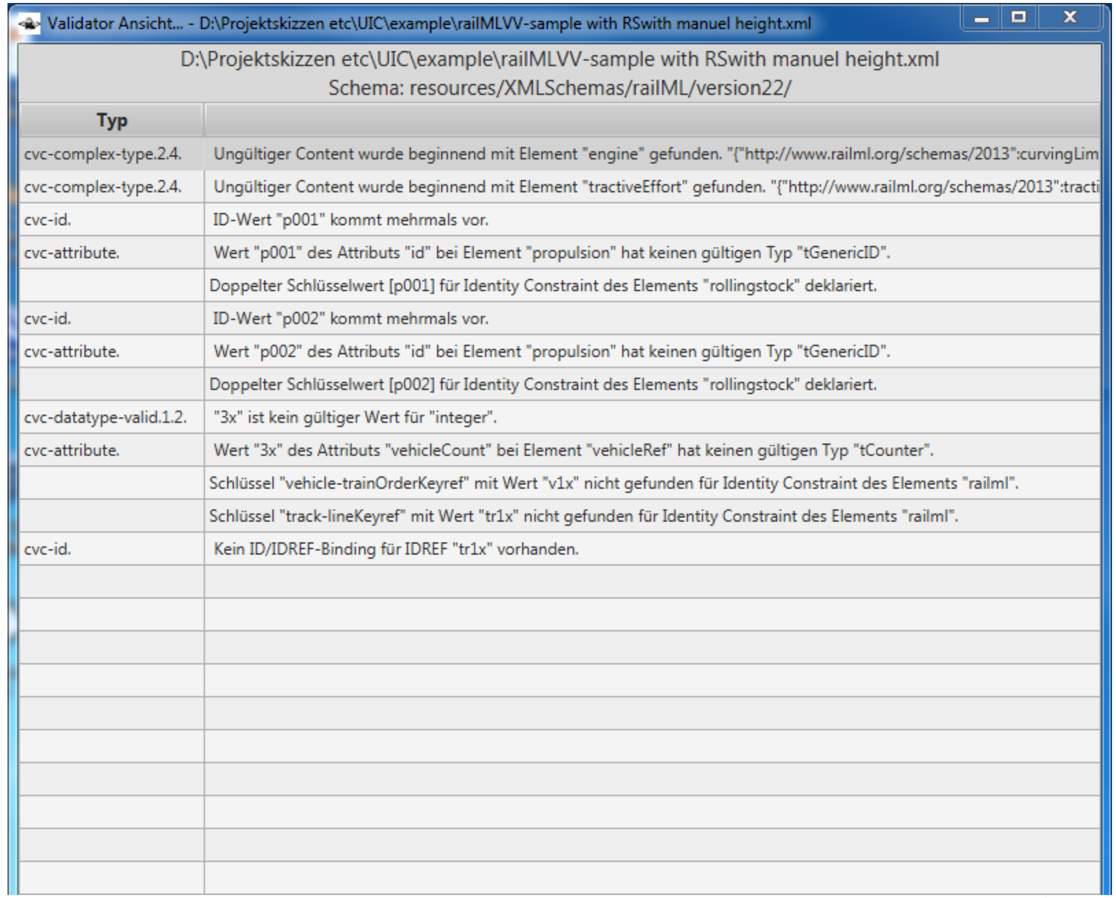
> **select file by standard open dialogue**



Live demonstration
Validation of railML file

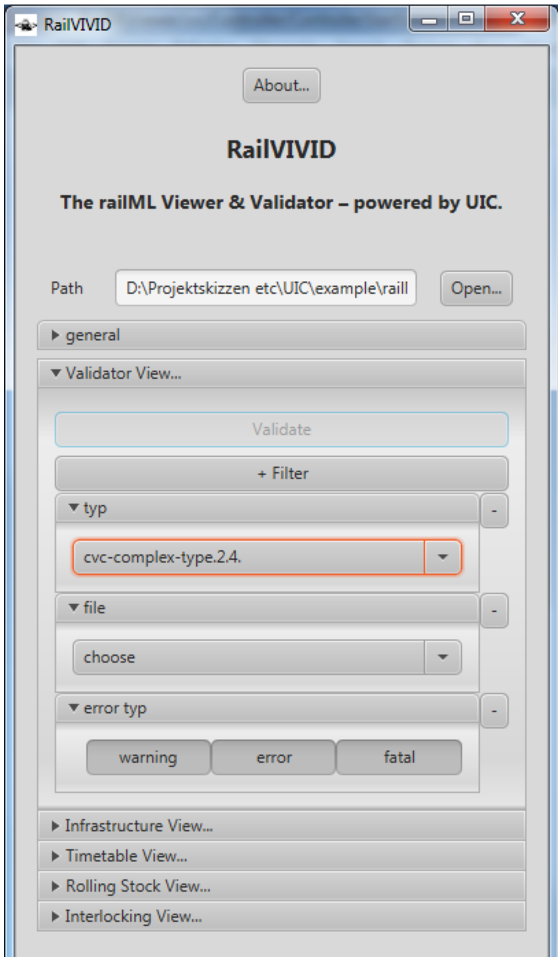
> **start and results**

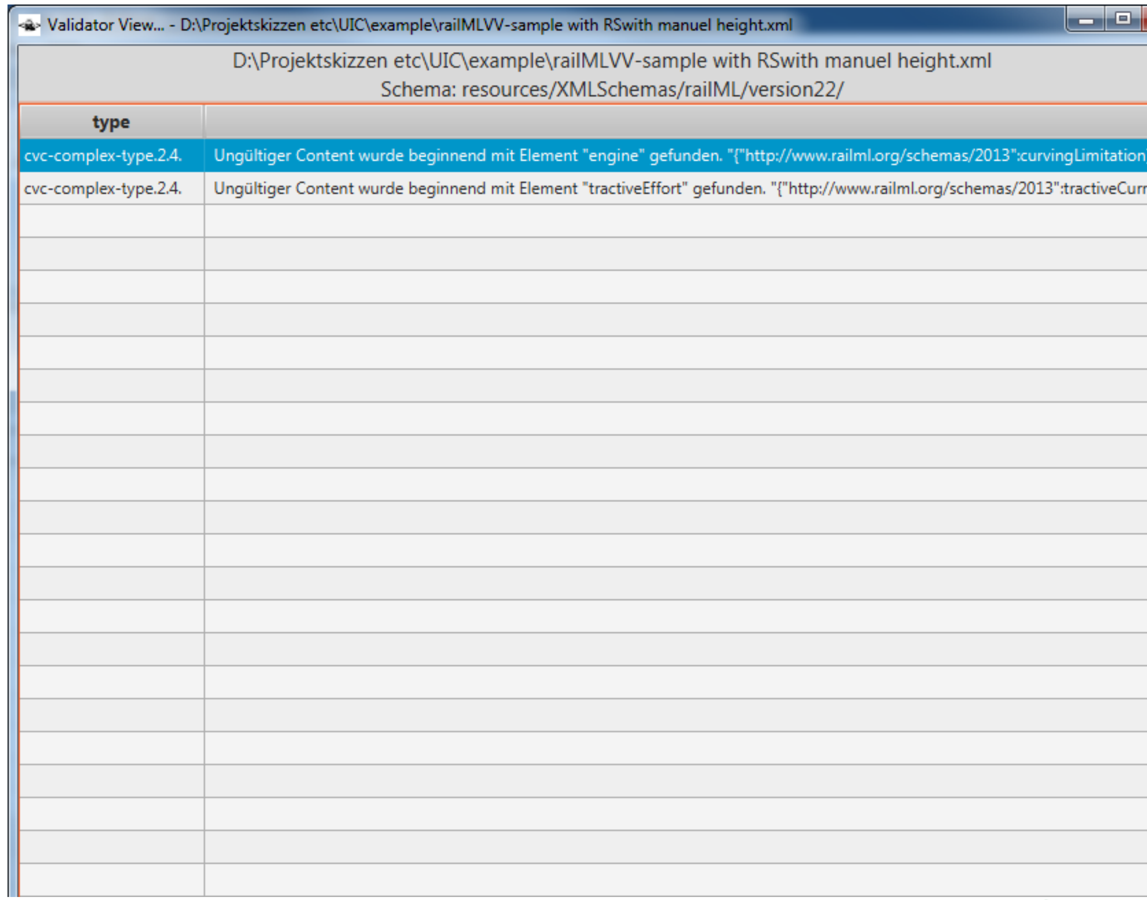




Live demonstration
Validation of railML file

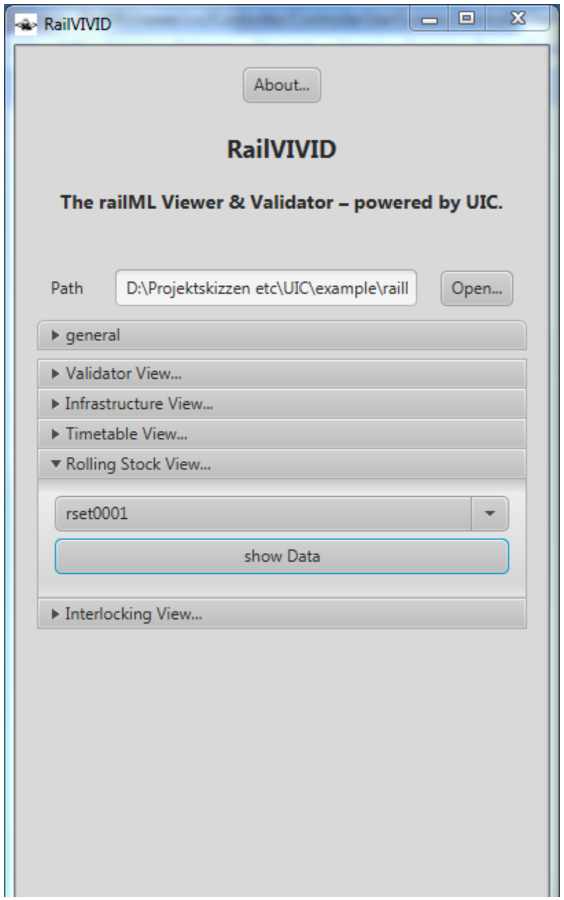
> **filtering**

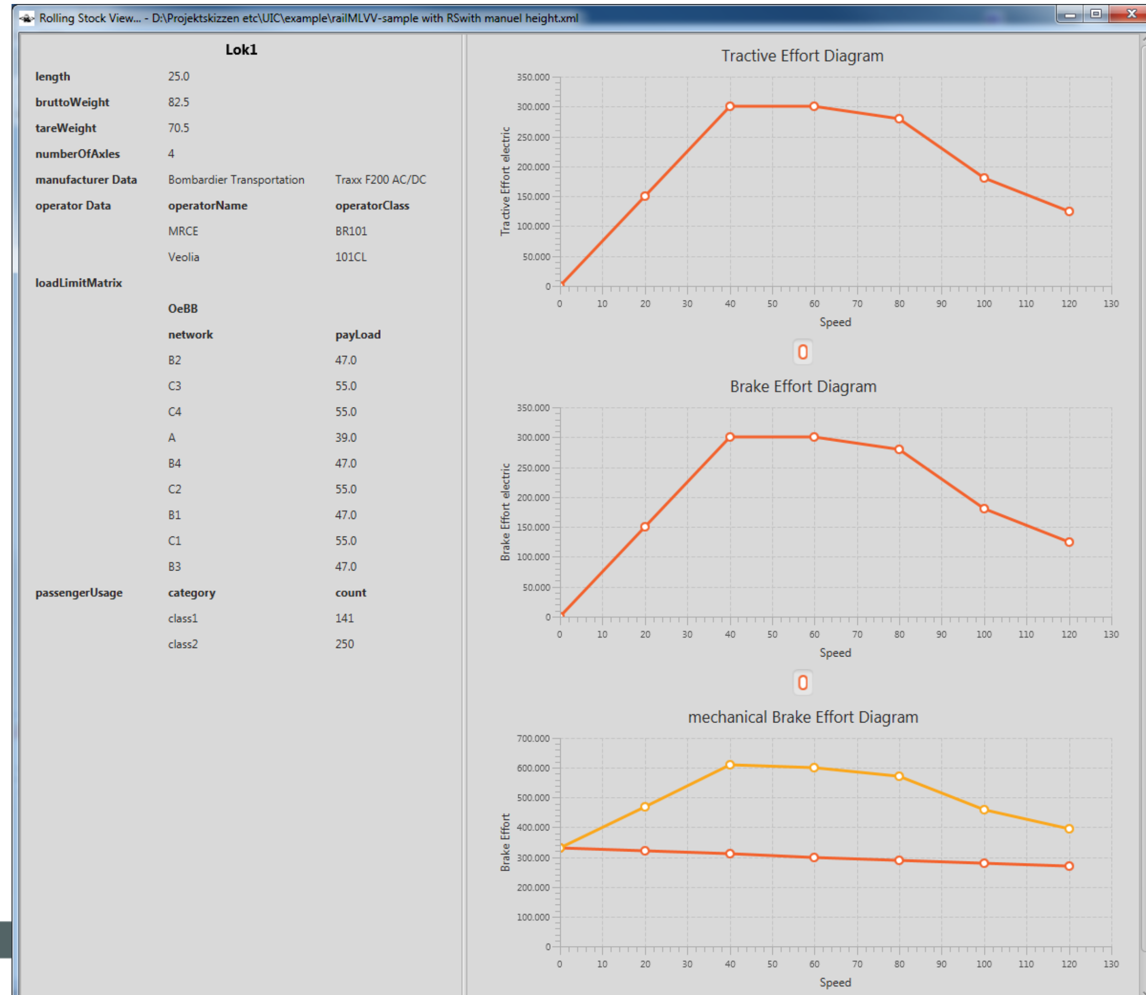




Live demonstration
Rolling Stock View

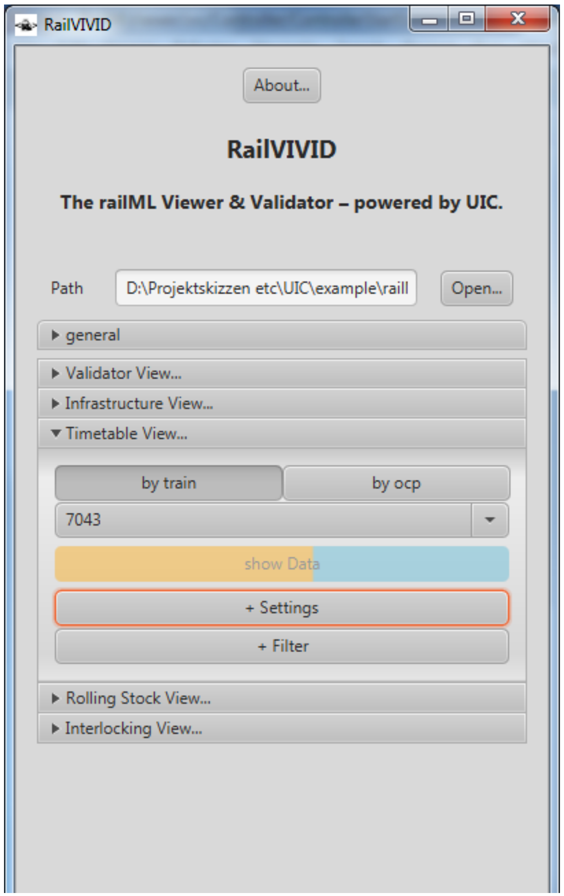
> start and results

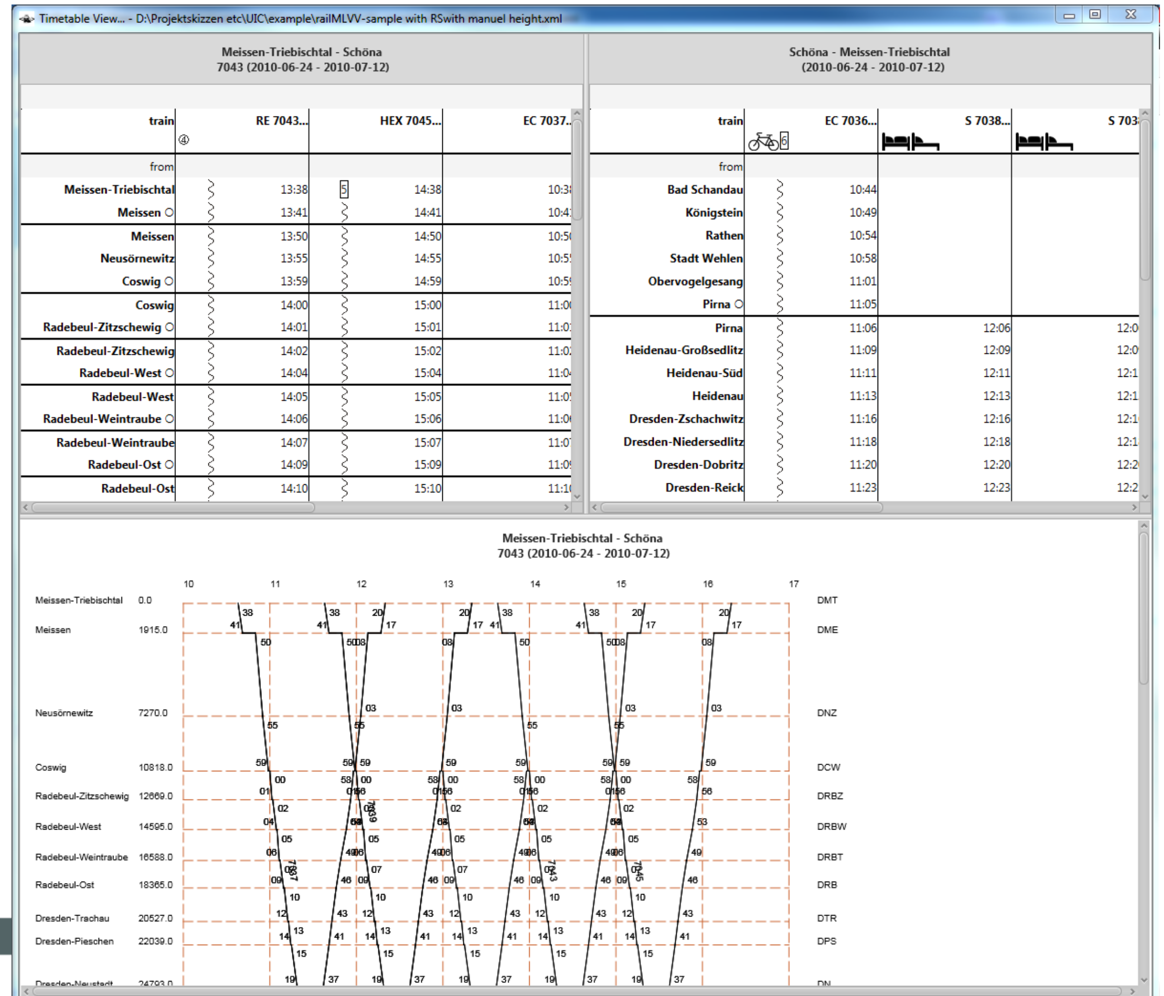




Live demonstration
Timetable view

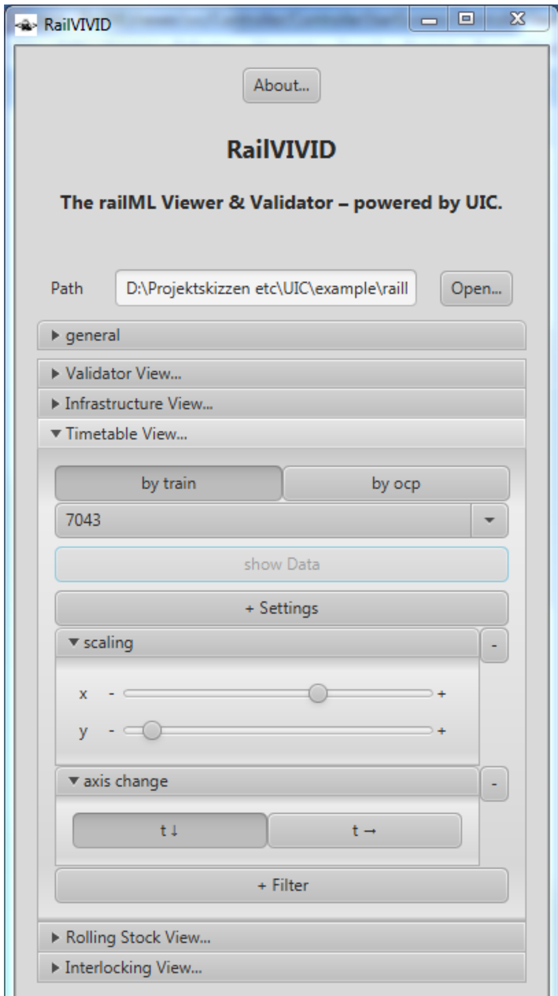
> **start by train selection and results**

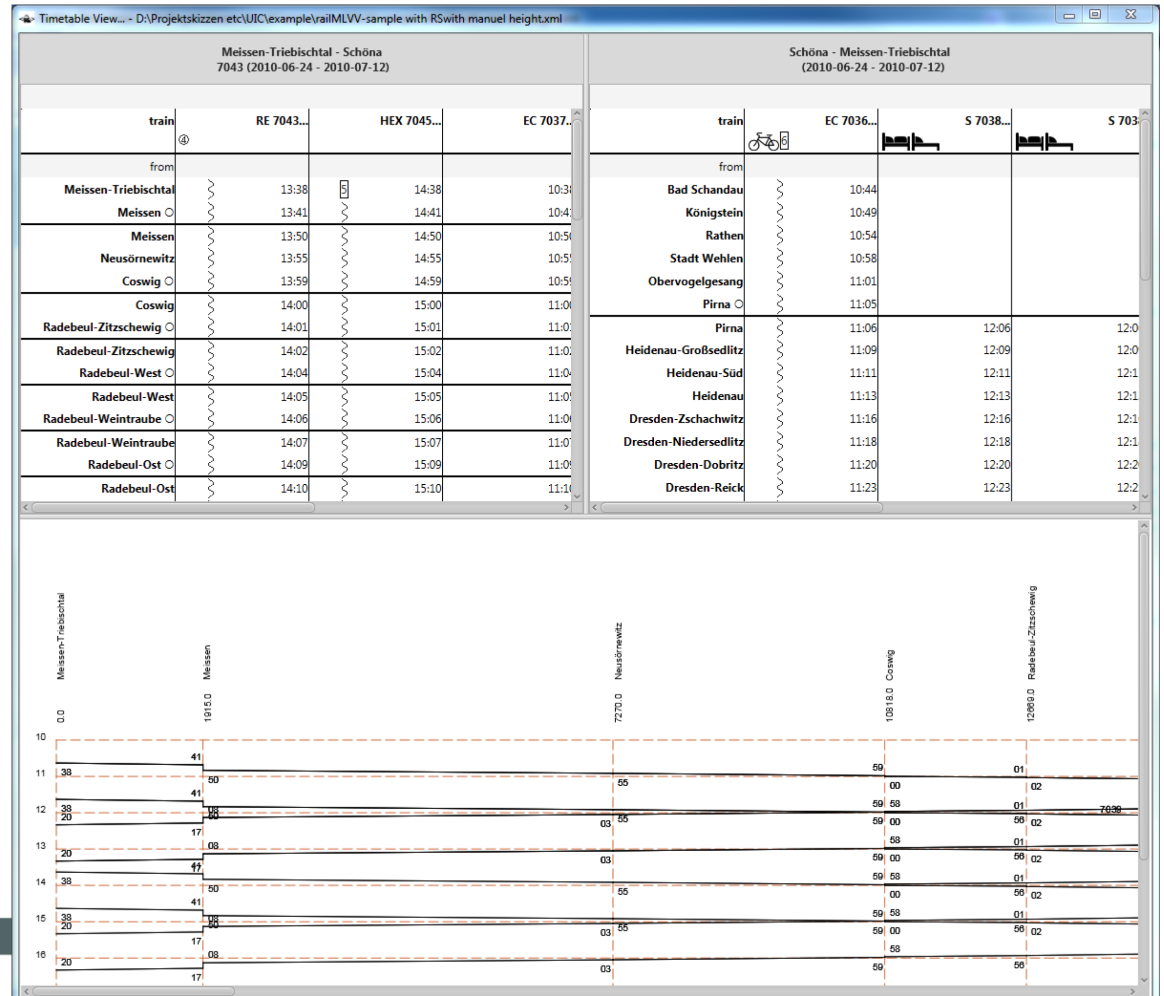




Live demonstration
Timetable view

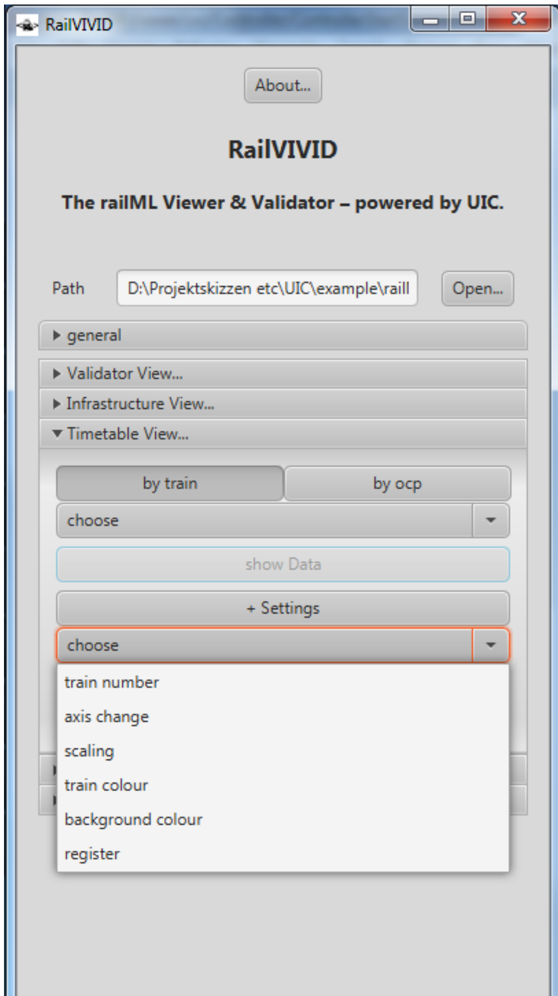
> **Settings: axis change and scaling x-y**

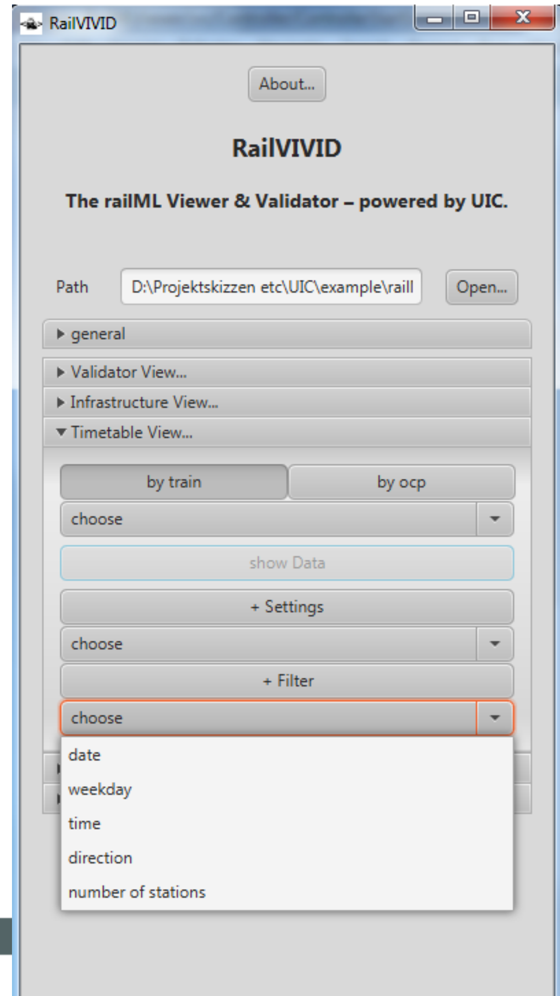




Live demonstration
Timetable view

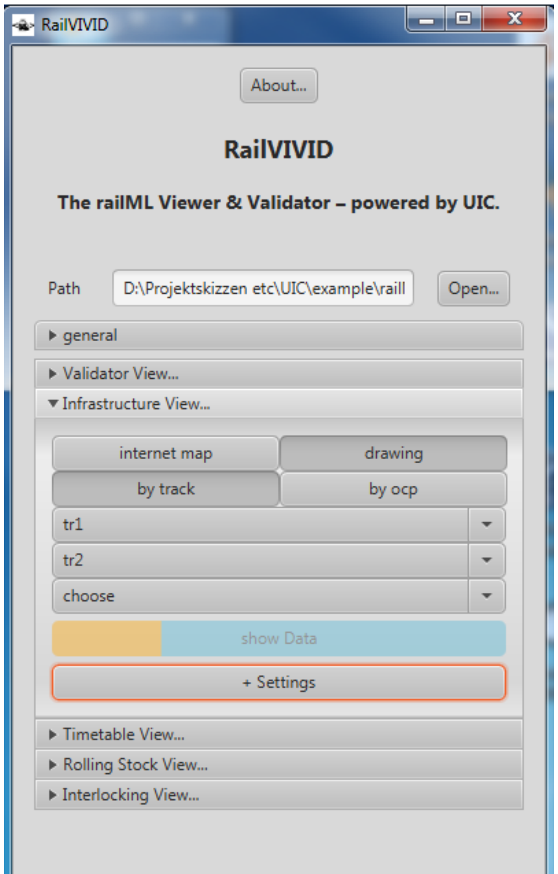
> **further settings and filter options**

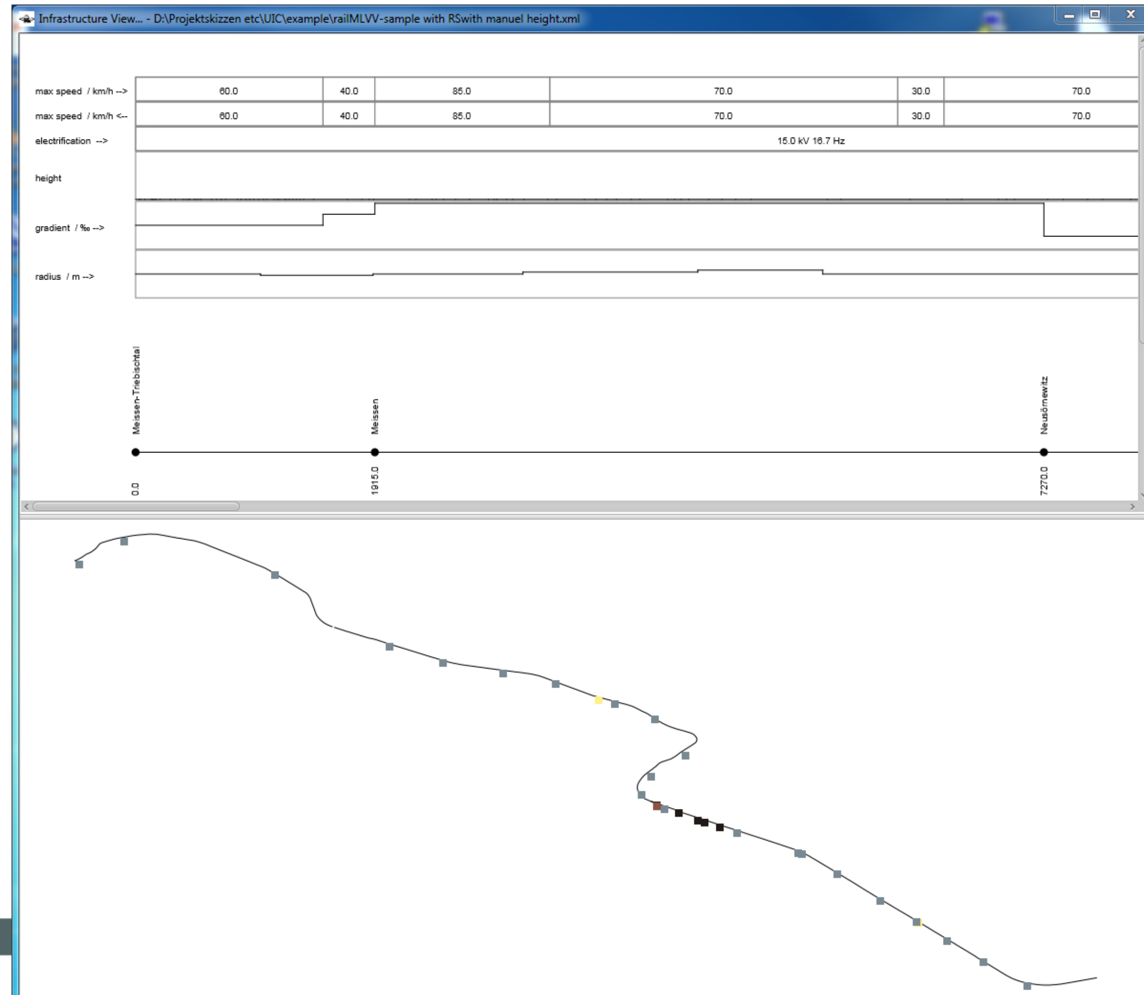




Live demonstration
Infrastructure view

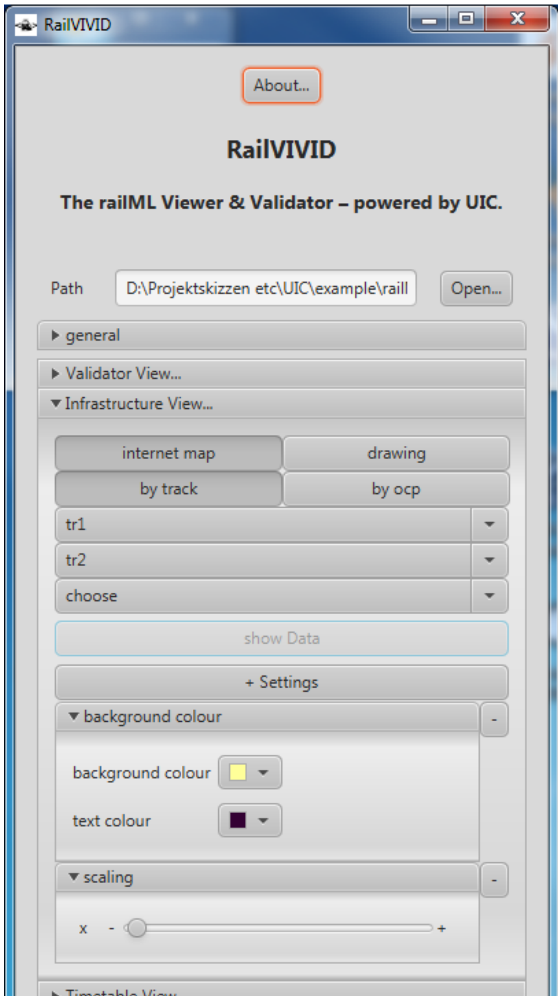
- **start by track and results**

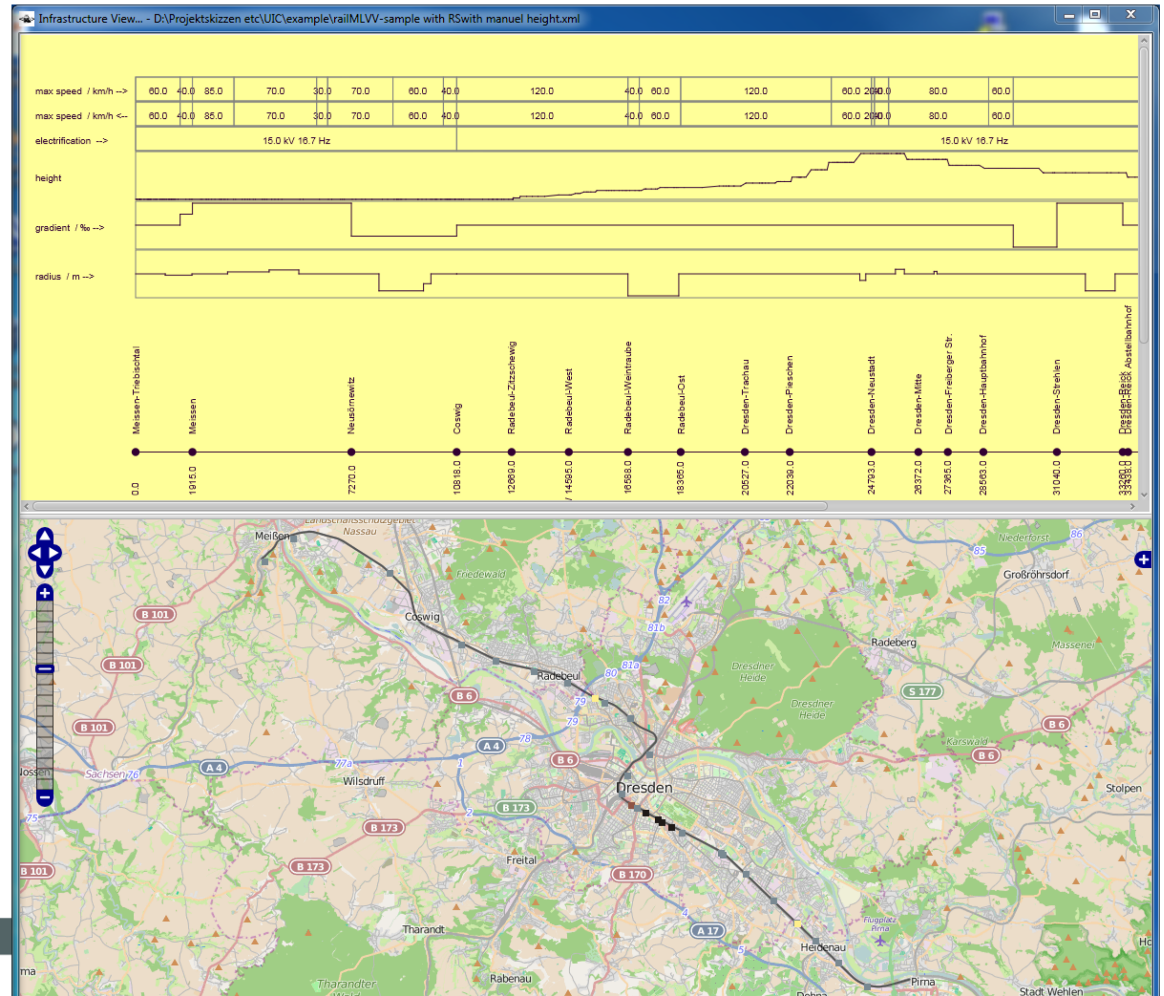




Live demonstration
Infrastructure view

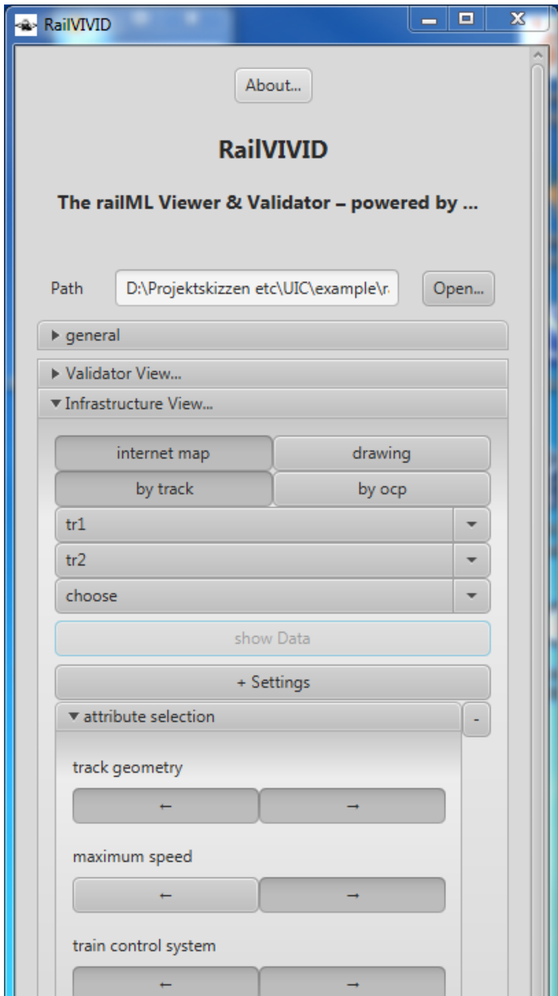
> **settings: with map and scale x and background colour**

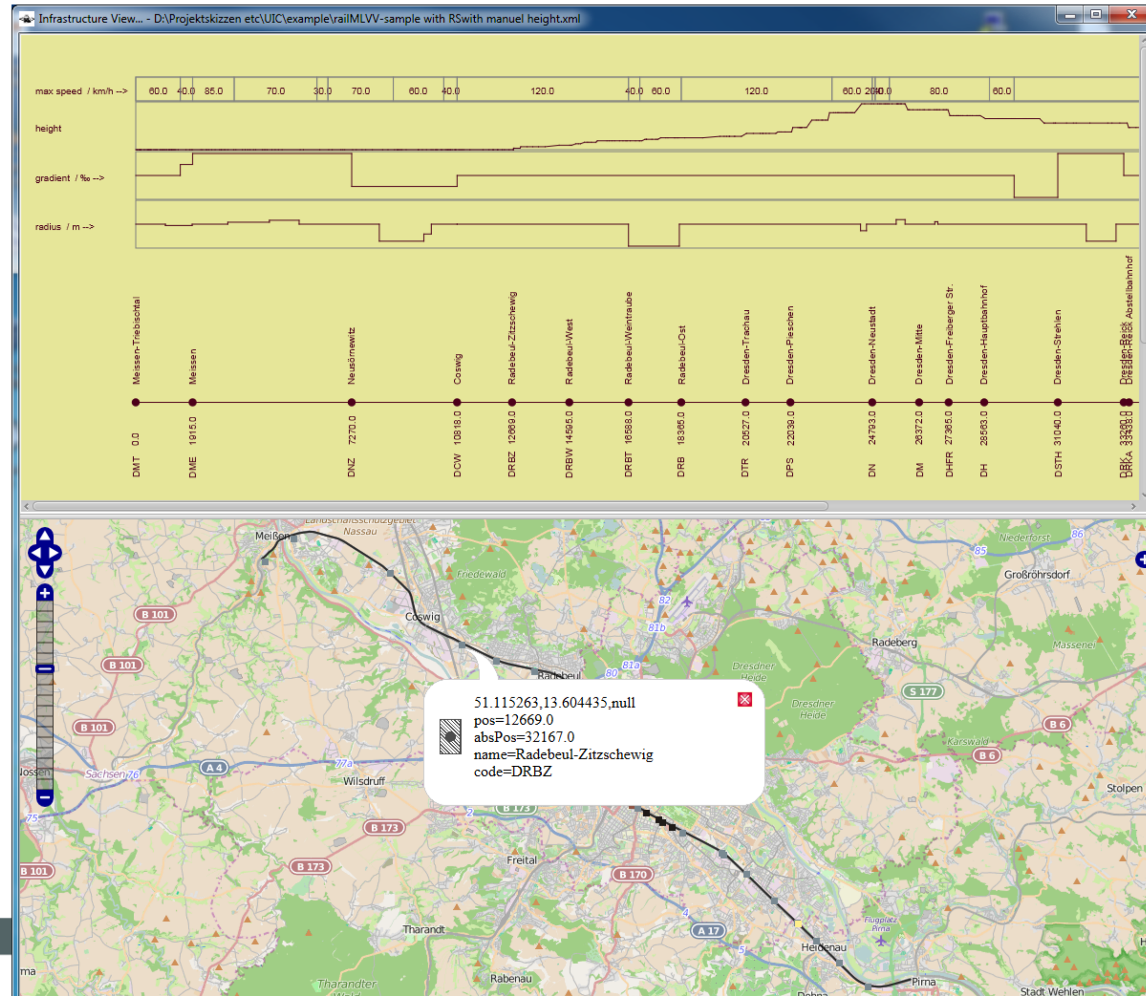




Live demonstration
Infrastructure view

> **settings: attribute selection and details in map**

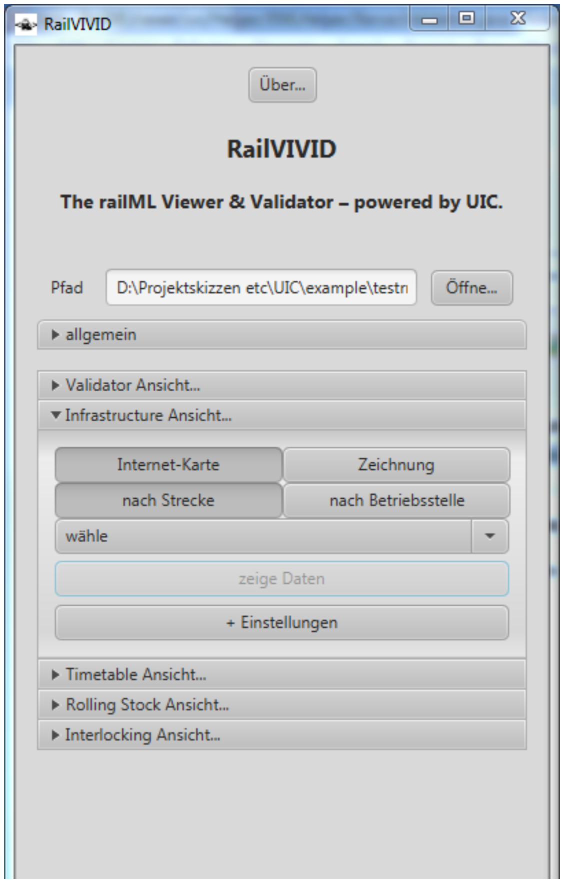


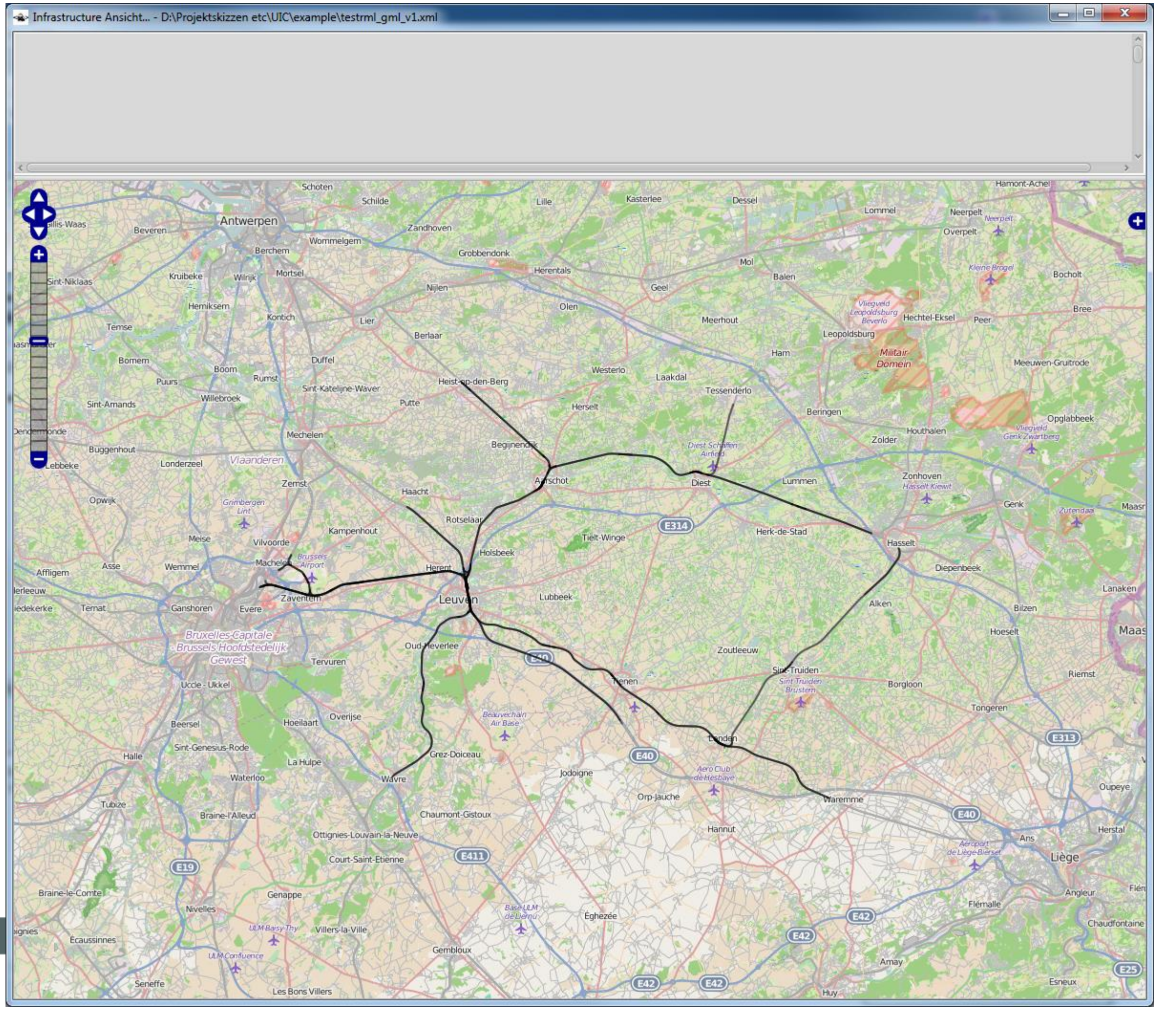


Live demonstration

Infrastructure view – railML 3.0, first example

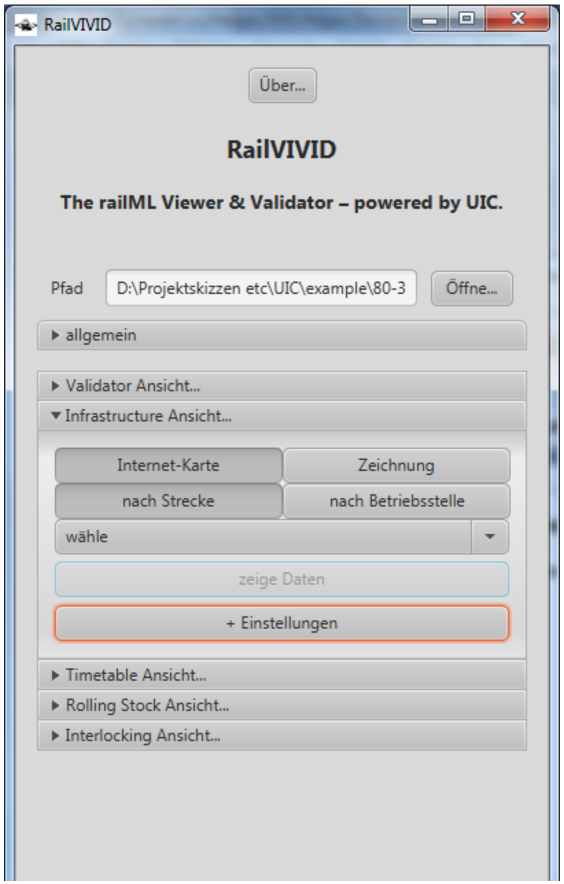
> **example infrabel (selction) from last week (knots end edges)**

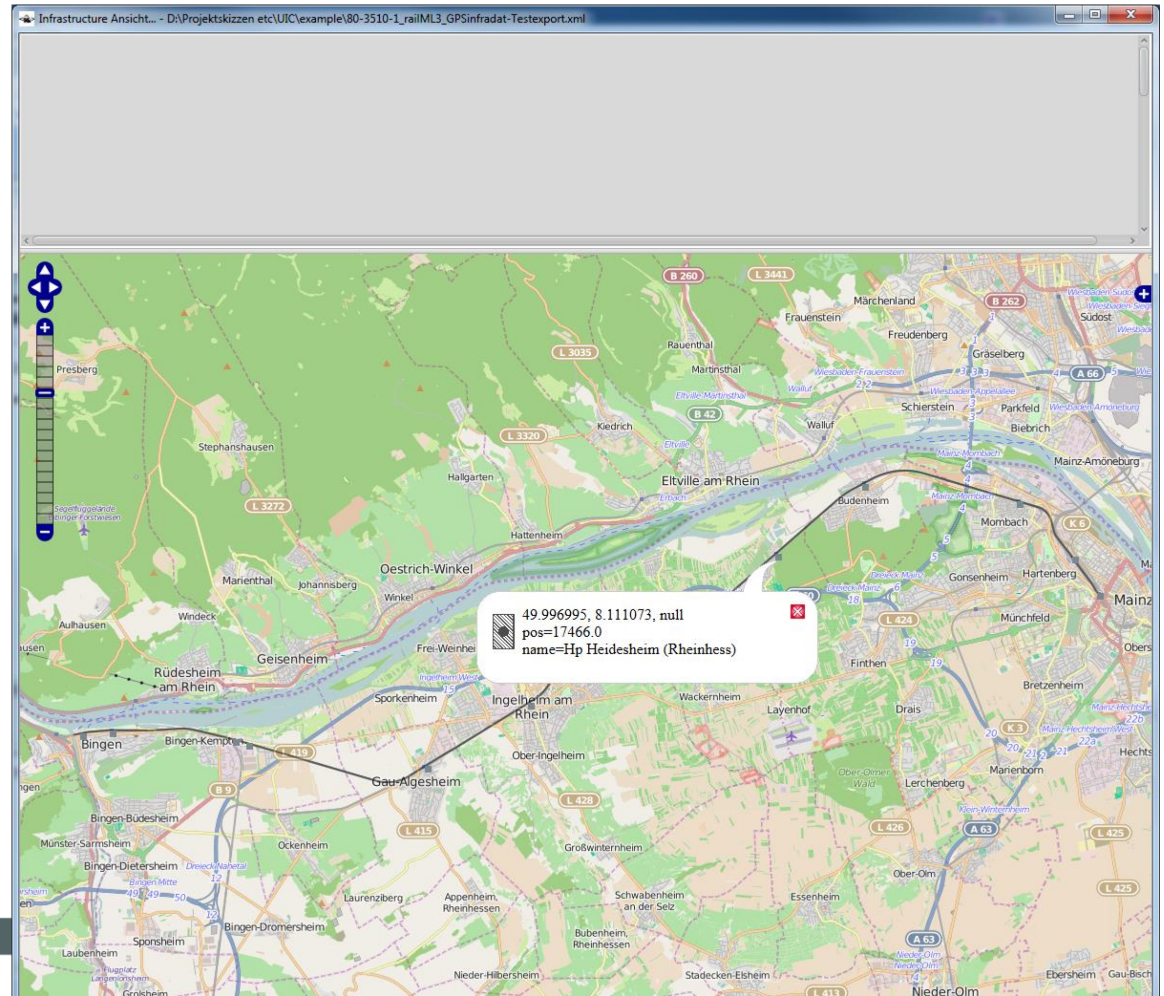




Live demonstration
Infrastructure view – railML 3.0, first examples

> **example Bahnkonzept from 24.04.2015 (nodes, edges, stations)**





Live demonstration
Iterlocking view

> **no function in current version (no railML scheme ready)**

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Towards the International Railway Standard
***Infrastructure Topology Model** and*
Data Exchange Format

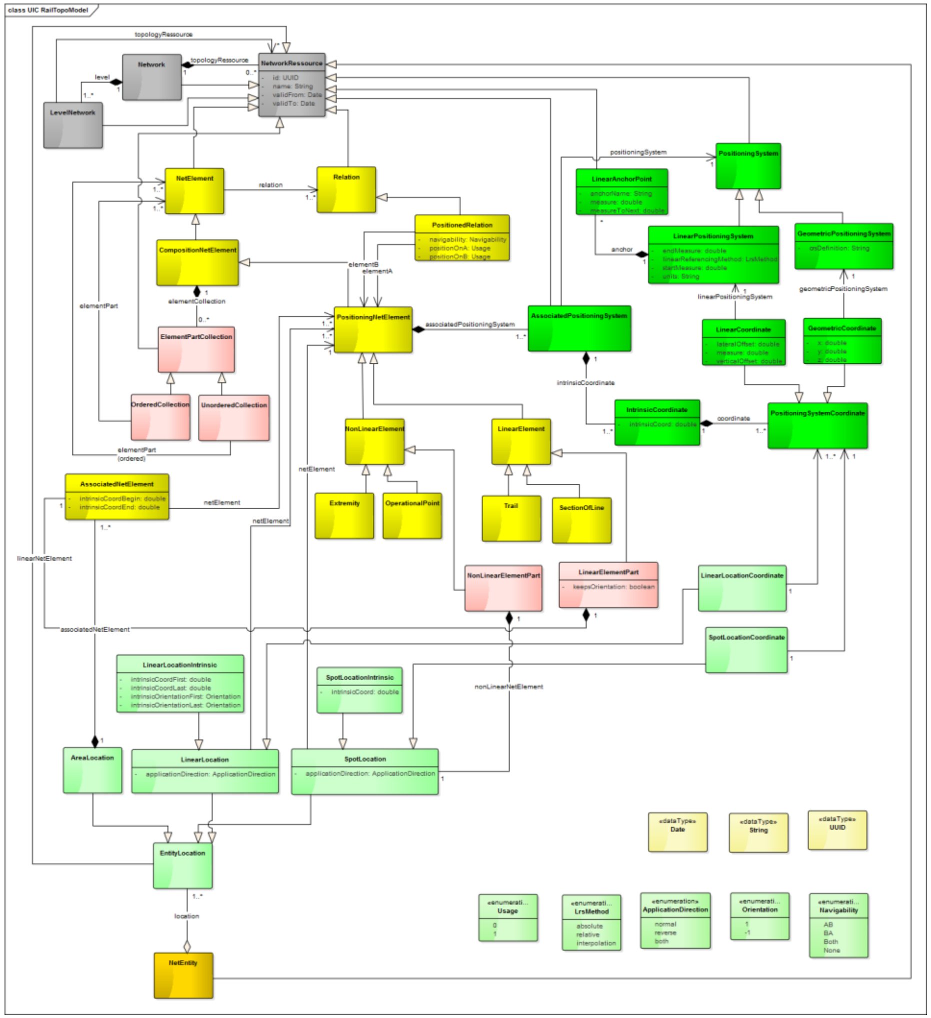
UIC HQ, Paris April 28th/29th, 2015

UIC RailTopoModel

The foundation to a

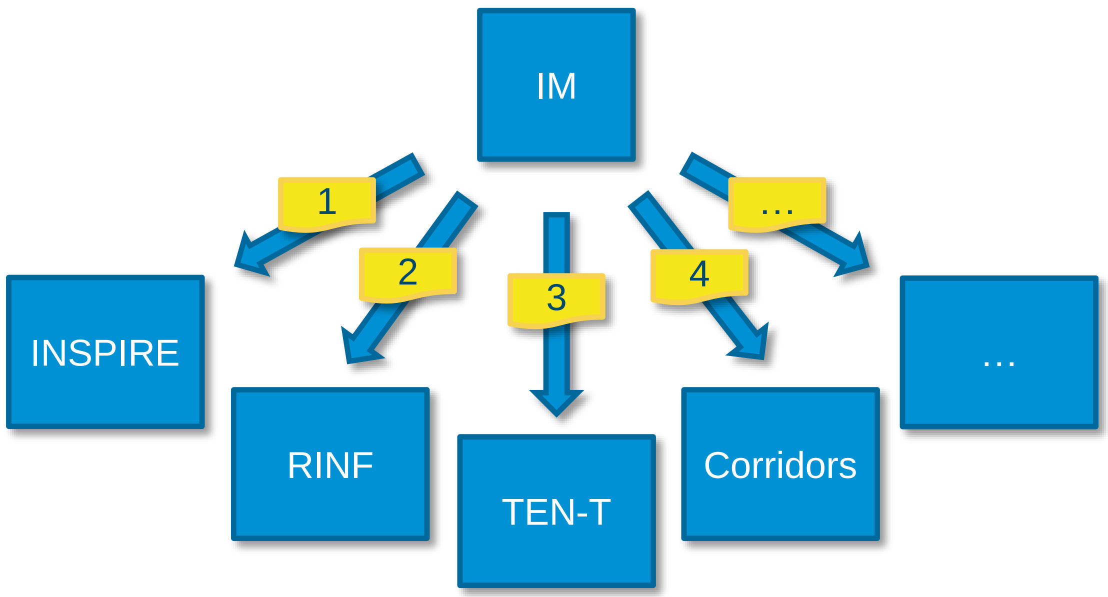
- Single
- Multipurpose

Infrastructure description model



UIC RailTopoModel : The beginning

IM's are faced with many new international data transmission needs

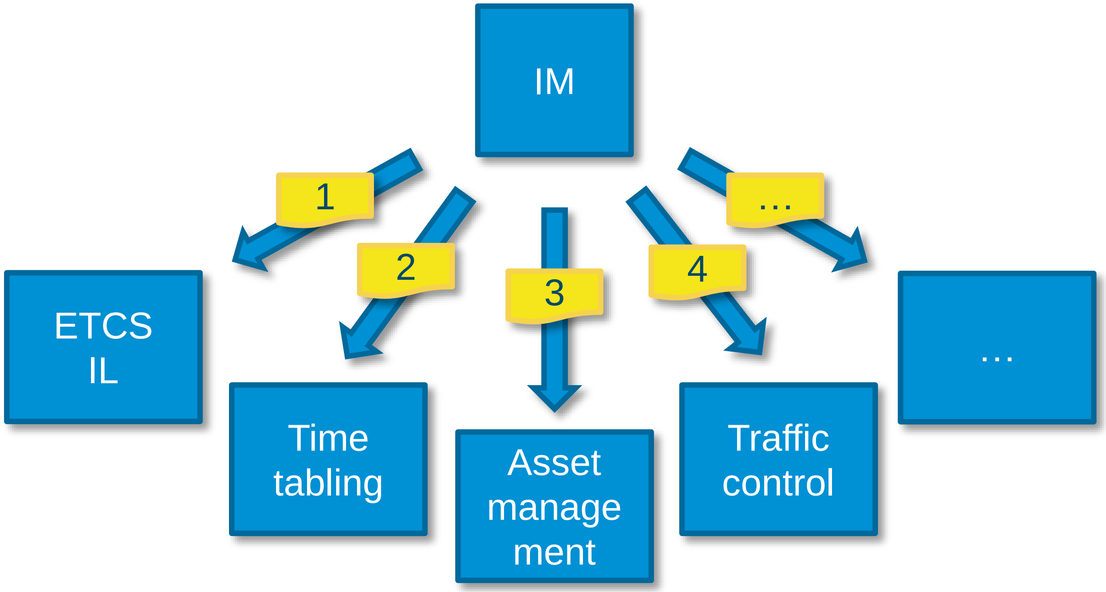


Each with its

- own data format
- own rail network structure

UIC RailTopoModel : The beginning

IM's are faced with many new industrial data transmission needs



Once again, each with its

- own data format
- own rail network structure

UIC RailTopoModel : The beginning

All those formats and network structure share a characteristic :

They are purpose/usage driven.

- Inspire only focuses on line geography,
- Rinf focuses on macroscopic network information,
- …

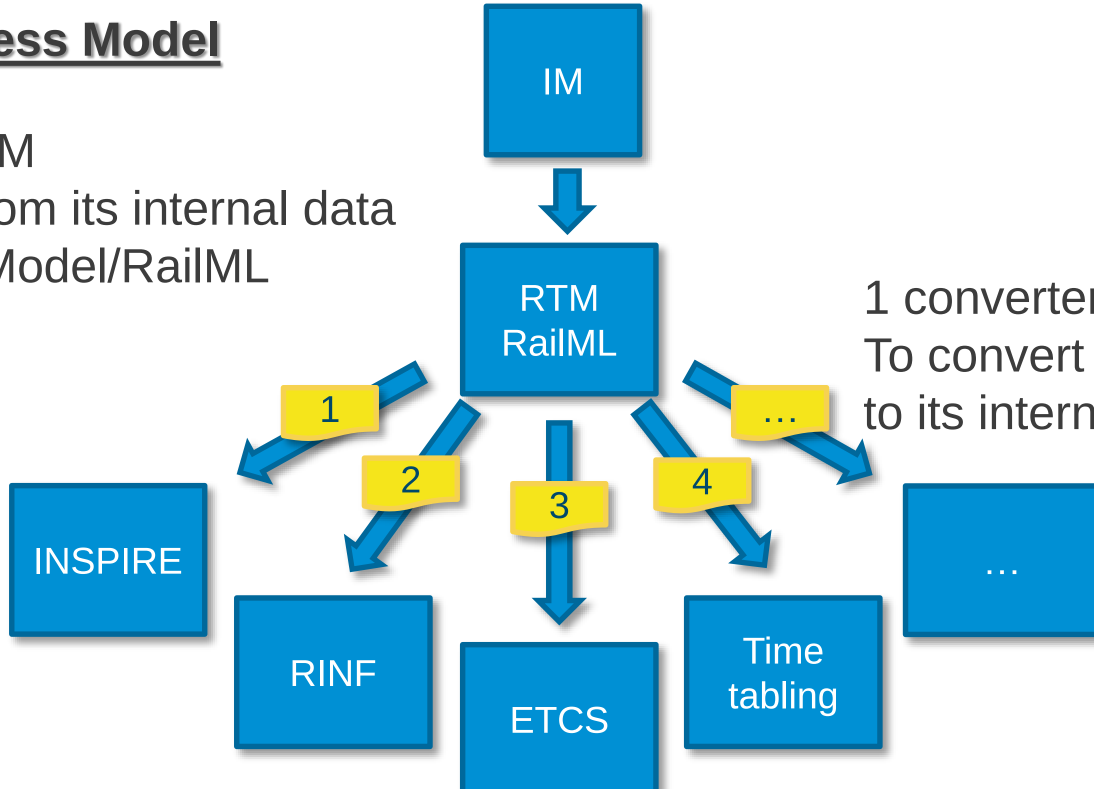
But for the IM's, it induces a great amount of work :
- Translating its own network description in as much different views

UIC RailTopoModel : The Idea

Create a **purpose independent** view of the network
Conveying all the necessary information to create purpose specific views

New Business Model

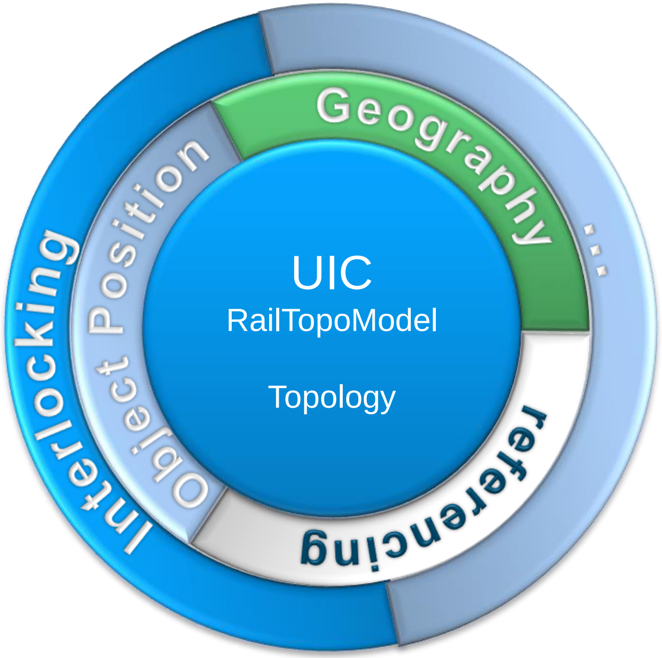
1 Extractor/IM
to convert from its internal data
to RailTopoModel/RailML



1 converter/project
To convert from RailTopoModel
to its internal data model

UIC RailTopoModel

Layered approach

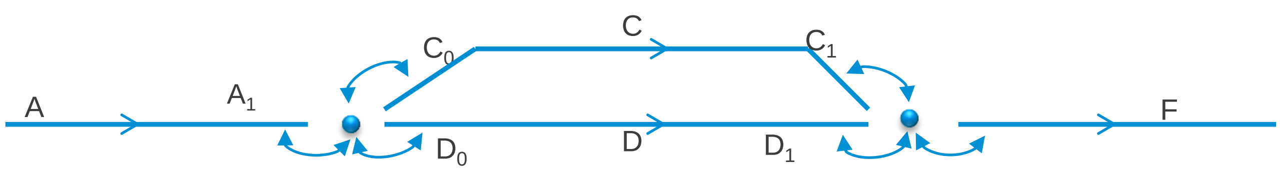


UIC RailTopoModel

First of all, the rail network is a **network**.

Constituted of Linear elements (Rail sections, lines,…)
And Non-linear elements (Switches, Stations, …)

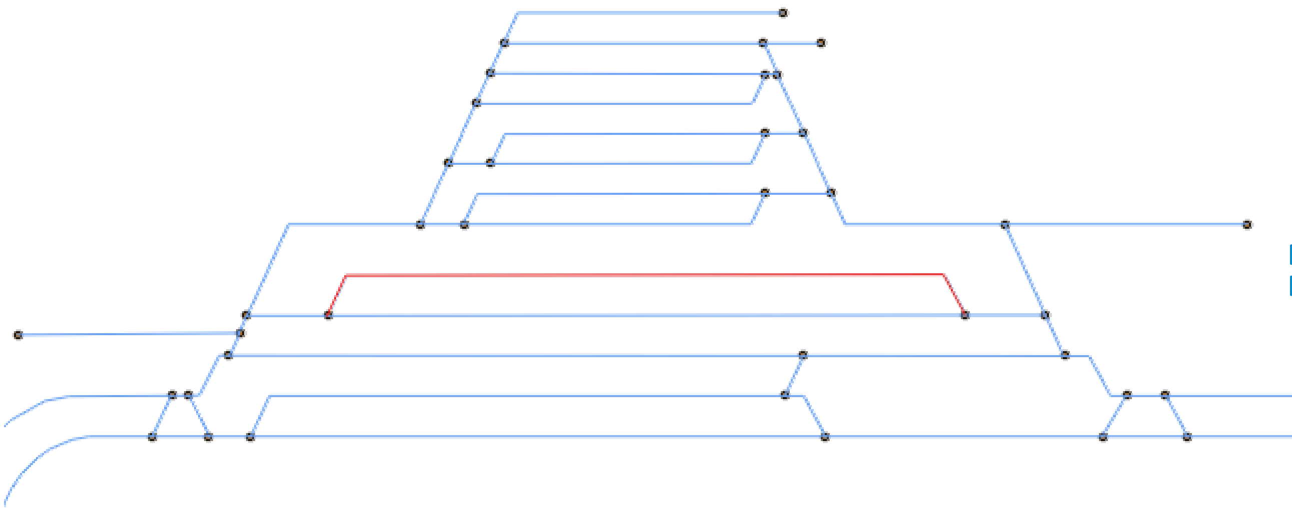
Every element of the network is related to several others.
These relations happens at one of their extremities

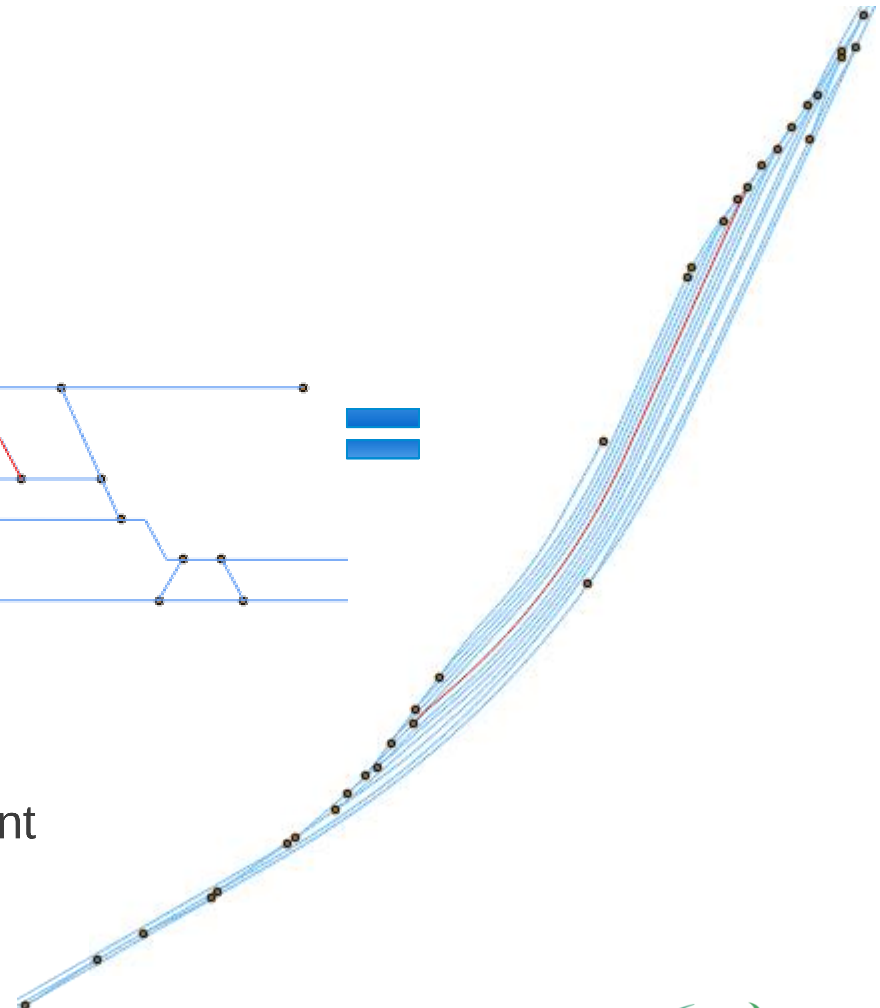


Adding navigability information allows to
describe a routable network

UIC RailTopoModel

Is able to convey geographic information





For each logical element

there is a geographical equivalent

UIC RailTopoModel

We have identified 3 types of objects/events that can happen on the network :

Punctual object :

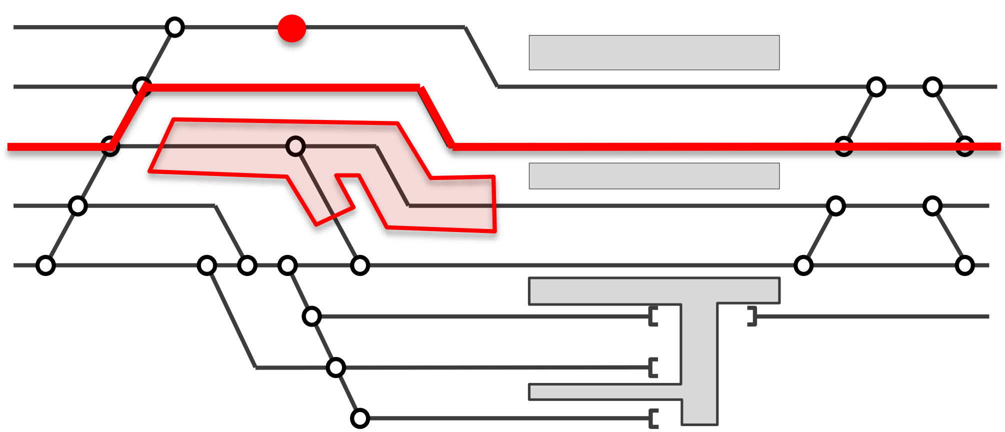
Signals, boundaries, balises, axle counter …

Linear object :

Route, slope profile, speed profile, ballast renewal, platform edge…

Areal object :

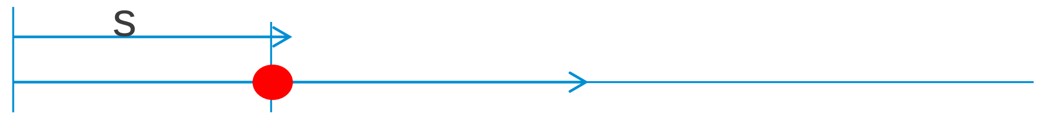
Track circuit, catenary zone, Station, bridge…



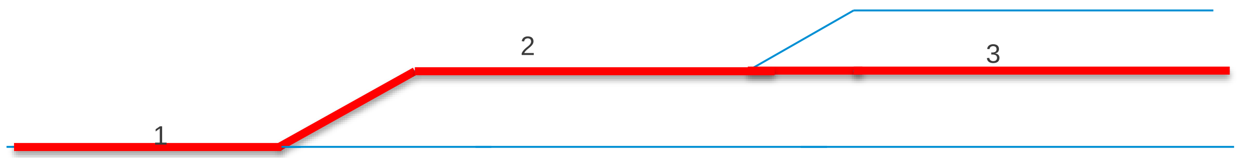
UIC RailTopoModel

We focus first on locating the object position in relation to the network : internal way

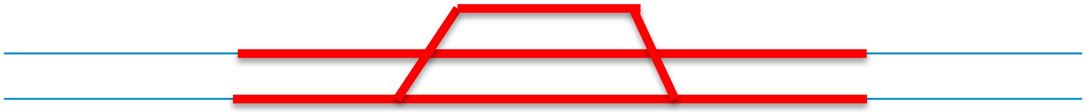
Punctual entity: Transmitted as a position on a line



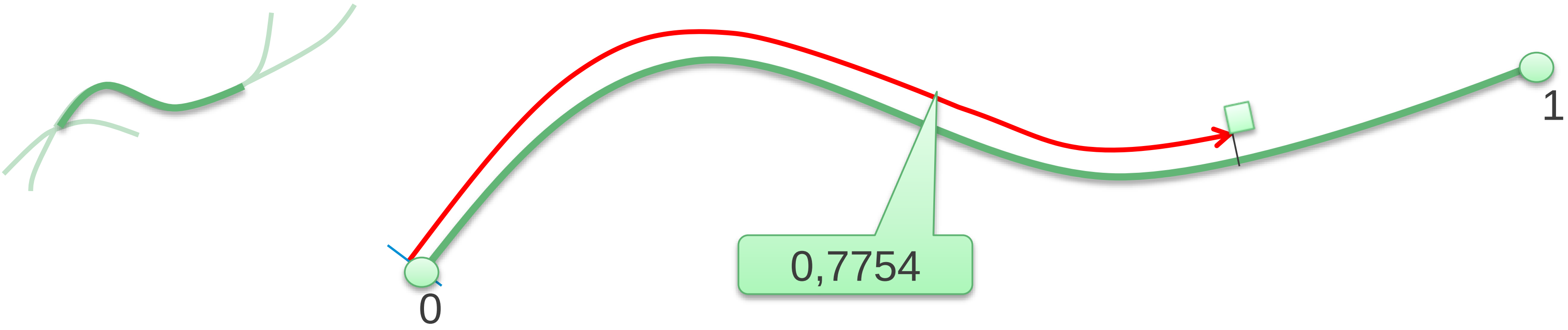
Linear entity: Transmitted as an ordered list of objects



Areal entity: Transmitted as an unordered list of objects, forming a subnetwork



UIC RailTopoModel

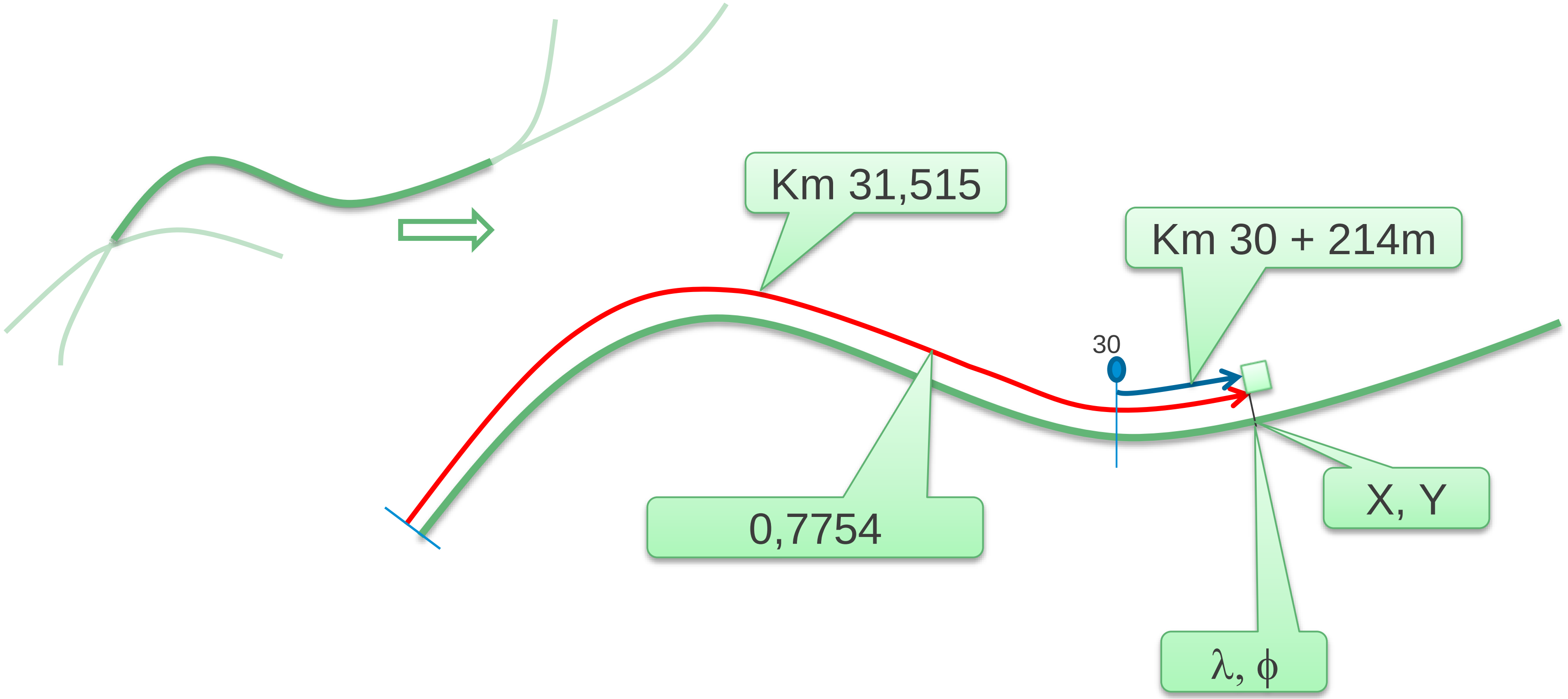


We chose the percentage of the “edge” as the internal system for network-relative position data, because

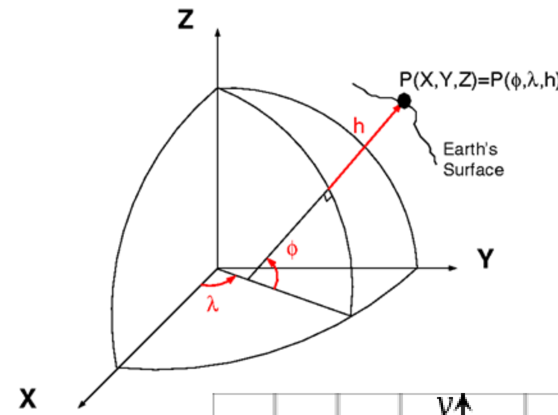
- Of its independence from Spatial Referencing system (Works in schematics as well as geographic),
- Of its Independence from the units (miles, km, m, degrees…), physical references or measuring tapes - Thus usable at any level
- Every other system can easily fall back to this one
- Every other system can be deduced from it

UIC RailTopoModel

Many other ways to reference an event, in space or along a line :



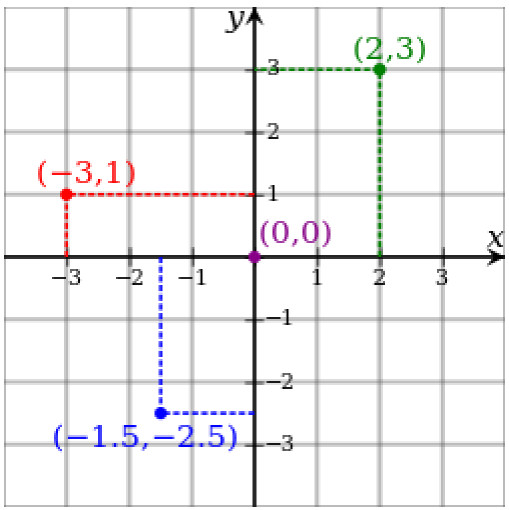
UIC RailTopoModel



Is able to convey Geographical information :

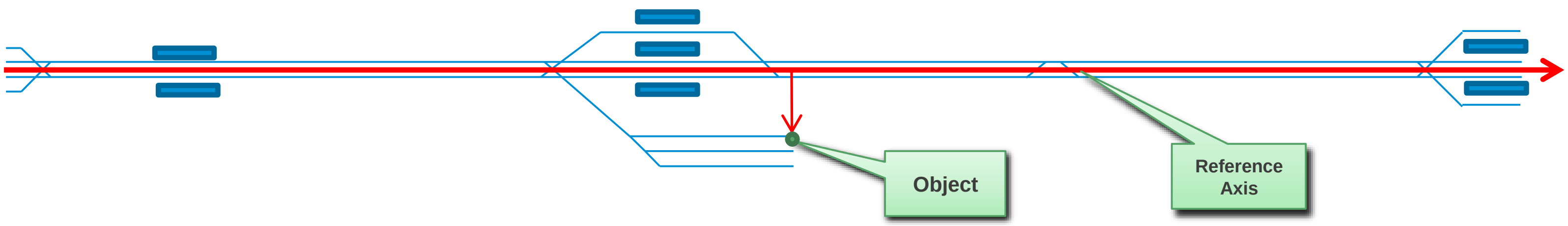
X,Y,Z or λ, ϕ ,h

Use of EPSG systems



Is able to convey Linear referencing information

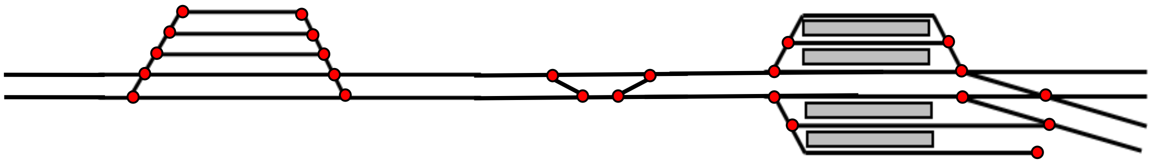
ISO 19148:2012 (simplified)



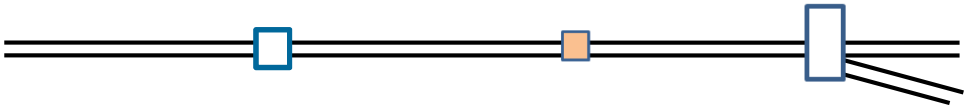
UIC RailTopoModel : Multi-level view

The users does not see the network in the same way:

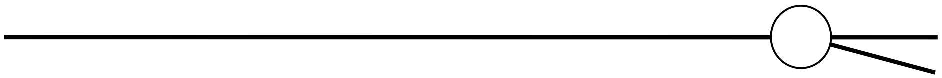
Micro : Detail infrastructure



Meso : connections between stops, sidings and junctions



Macro : connections between major cities



UIC RailTopoModel : Multi-level view

Those visions of the network describe the **same network**!

We have to ensure :

- **Data consistency**
  The network should really model the same reality, whichever the level

- **Ease of data maintenance**
  The data must be managed at the level where it is collected – 1! time.
  It should then be manipulated to fit its uses – Multiple usages.

Example :

Gauge reduction : happens at a specific location - managed as a located event

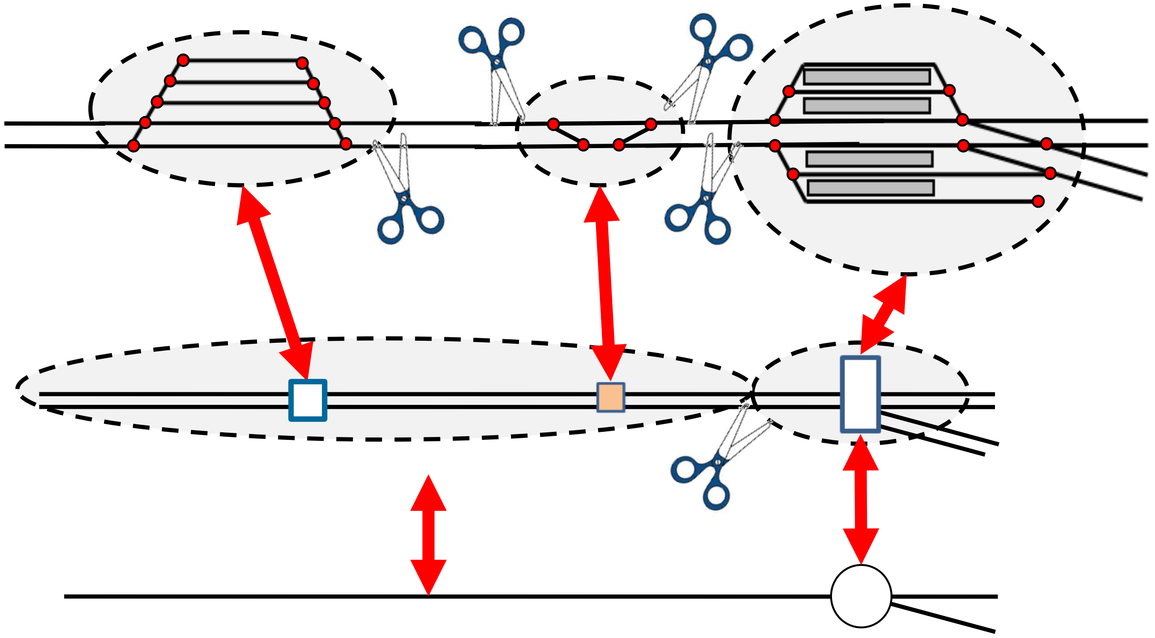
Usage : Gauge capability on the segment = minimum gauge for this segment

UIC RailTopoModel : Aggregation

Micro :

Meso :

Macro :



The aggregation mechanics ensures that

- The network definition stays coherent from one level to the other
- The information can be transmitted from one level to another

UIC RailTopoModel

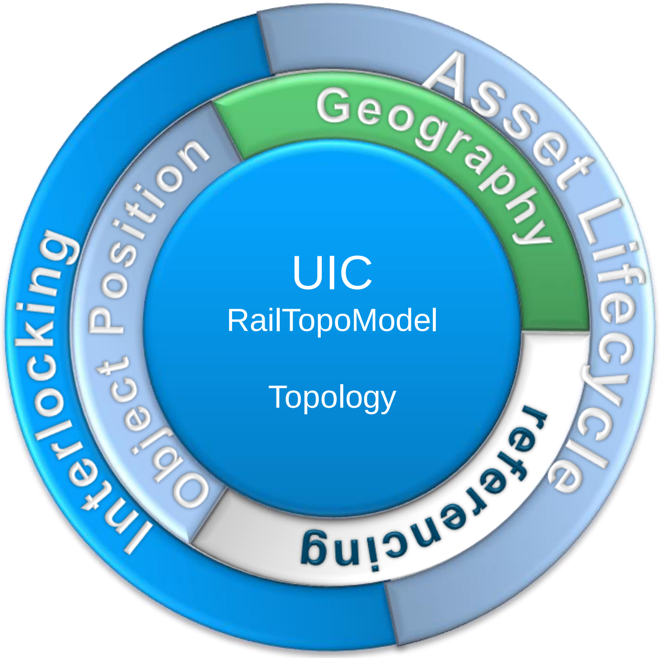
Layered approach

RailTopoModel 1.0

- Topology (including Aggregation)
- Geography
- Referencing
- Object positioning
- Topologic Lifecycle (stub)

Work in progress

- Interlocking
- Asset Lifecycle



Thank you for your kind attention
Any Questions?

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SNCF-Réseau

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INTERNATIONAL UNION
OF RAILWAYS

unity, solidarity, universality

4th UIC RailTopoModel and railML® Conference

Towards to International Railway Standards of Infra-structure Topology Model and Data Exchange Format

UIC HQ, Paris   April 28th/29th, 2015

Overview

> **UIC RailTopoModel**
>
> Result

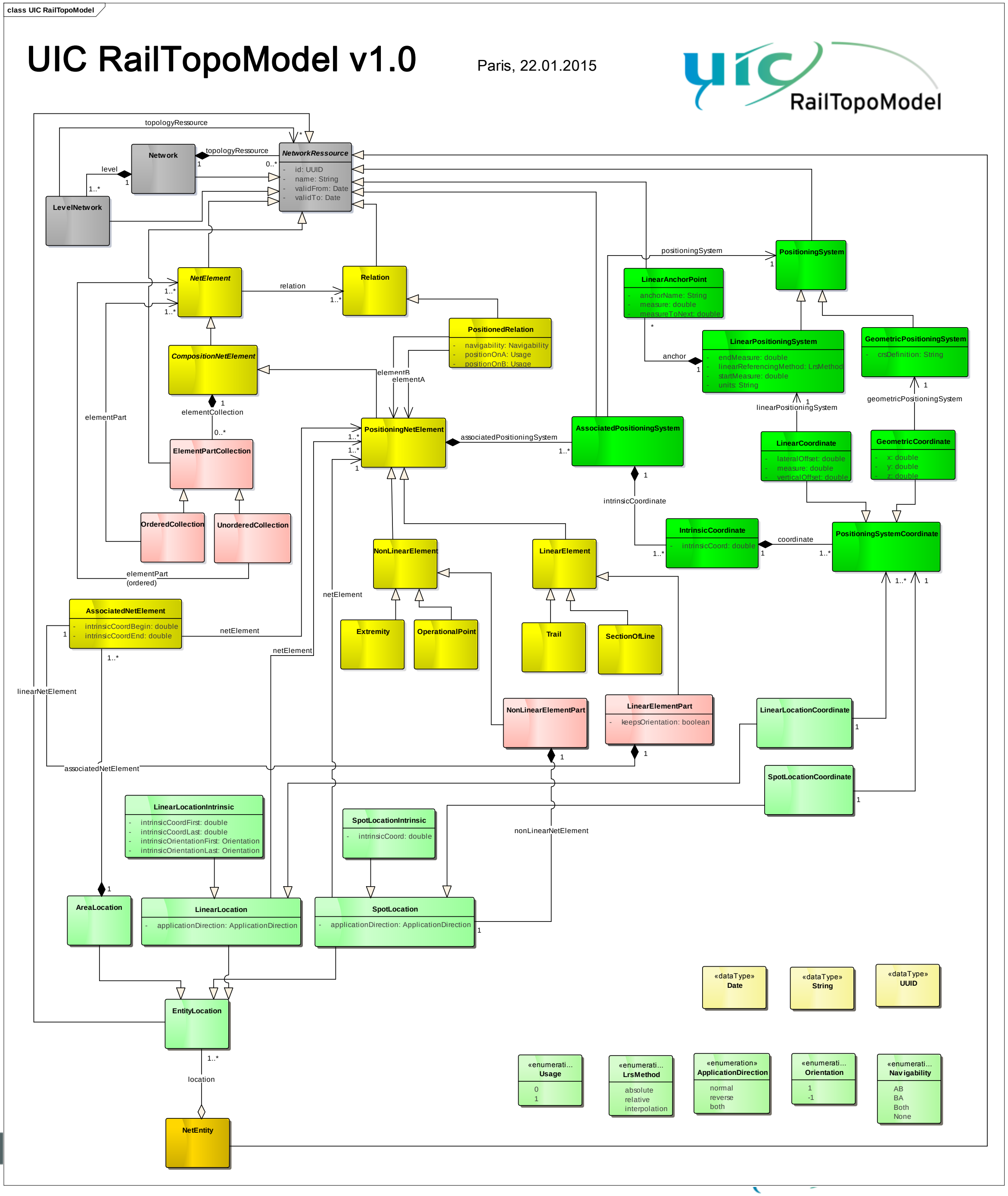
> **railML® 3**
>
> railML® 3.0 v01 RINF – Model
>
> From UML to XSD

> **Discussion points**

UIC RAILTOPOMODEL

UIC RTM
Result

> **Version 1.0 (22.01.2015)**



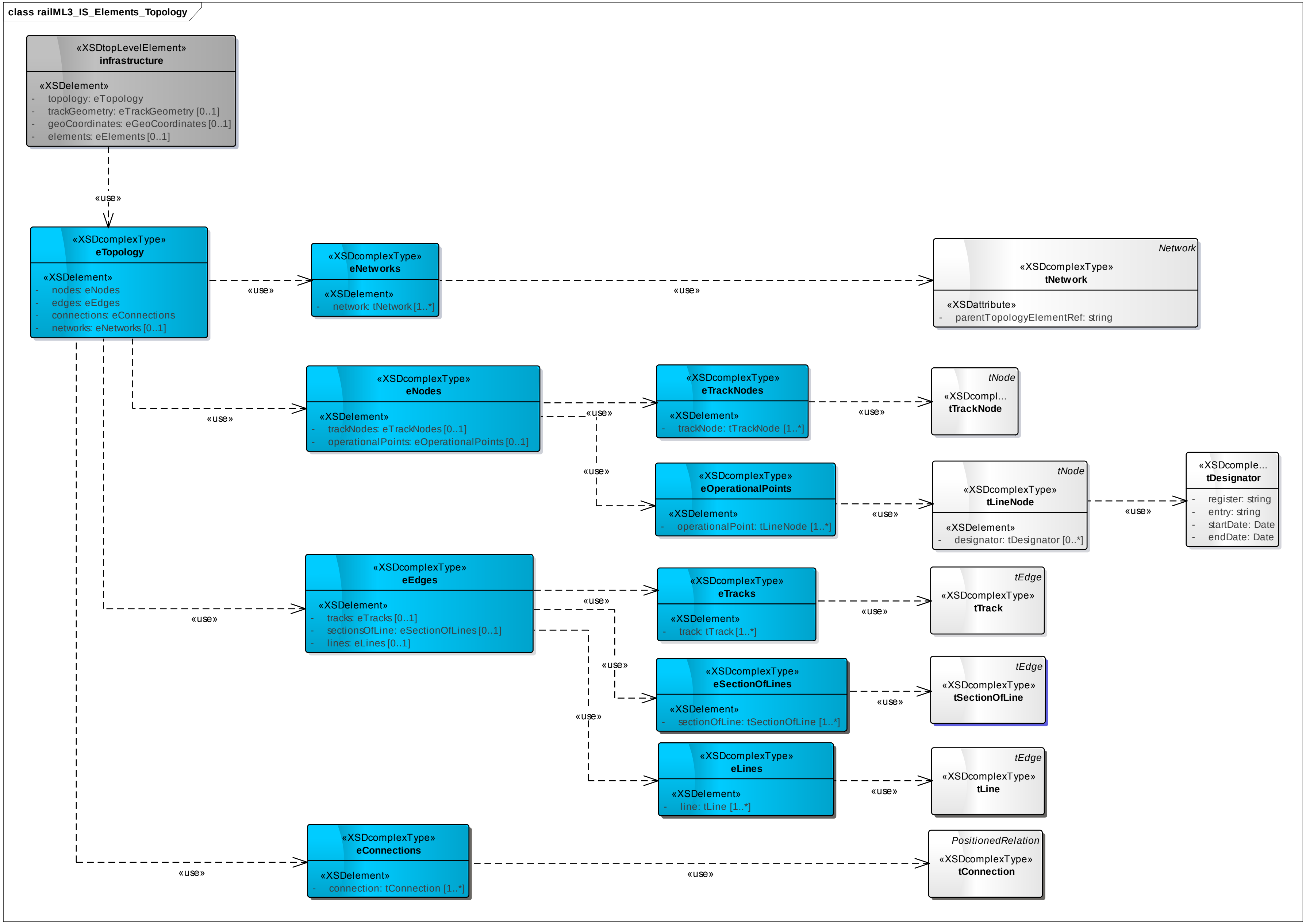
RAILML® 3

railML® 3
Model

> **Modular structure:**
  Topology
  Coordinates
  Track geometry
  Infrastructure elements
  (any other elements)

railML® 3
Model

- **Topology:**
  - **Nodes << Non-linear Elements**
    - TrackNodes
    - OperationalPoints
  - **Edges << Linear Elements**
    - Tracks
    - SectionsOfLine
    - Lines
  - **Connections << Relations**
  - **Networks** *[optional]*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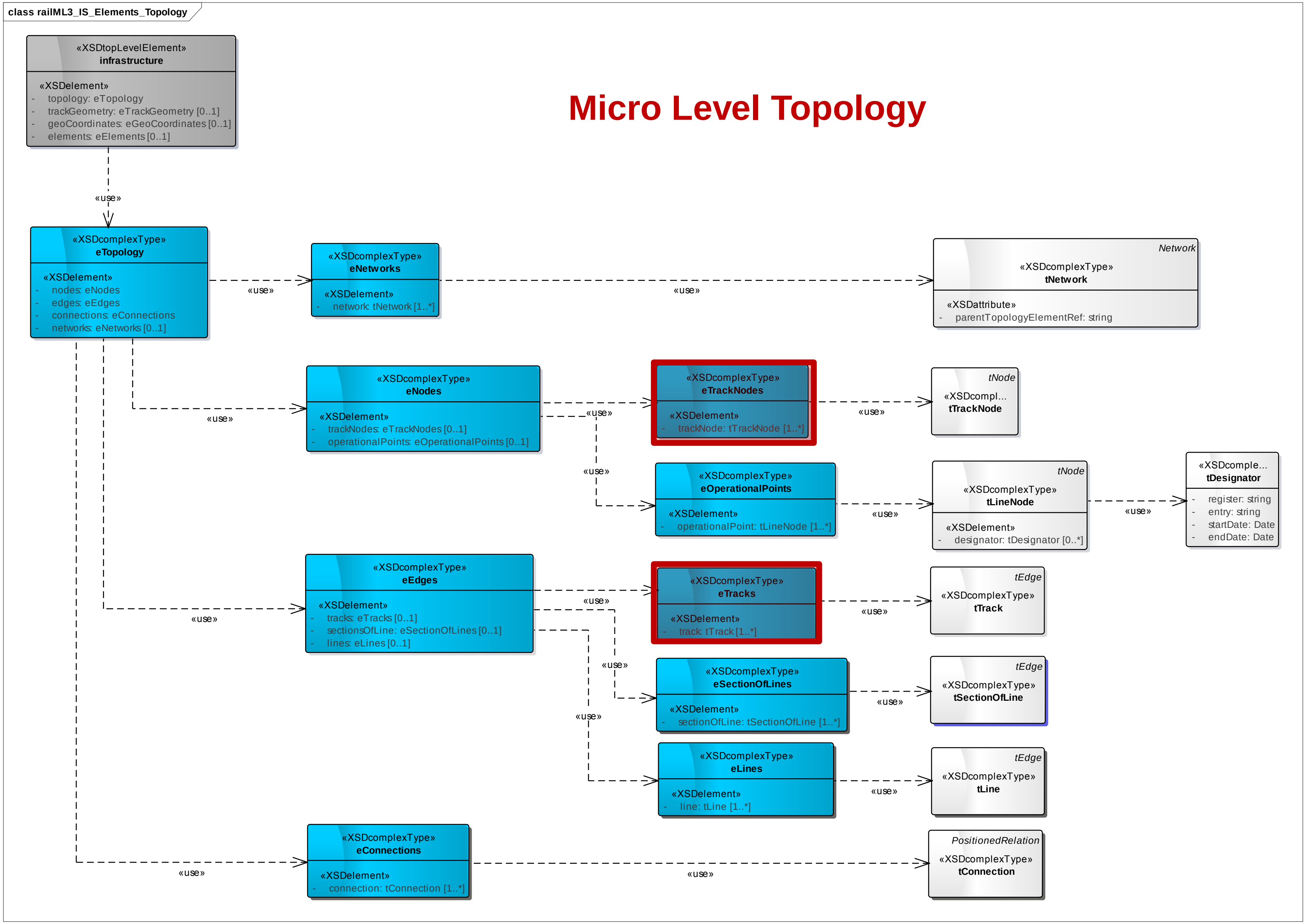
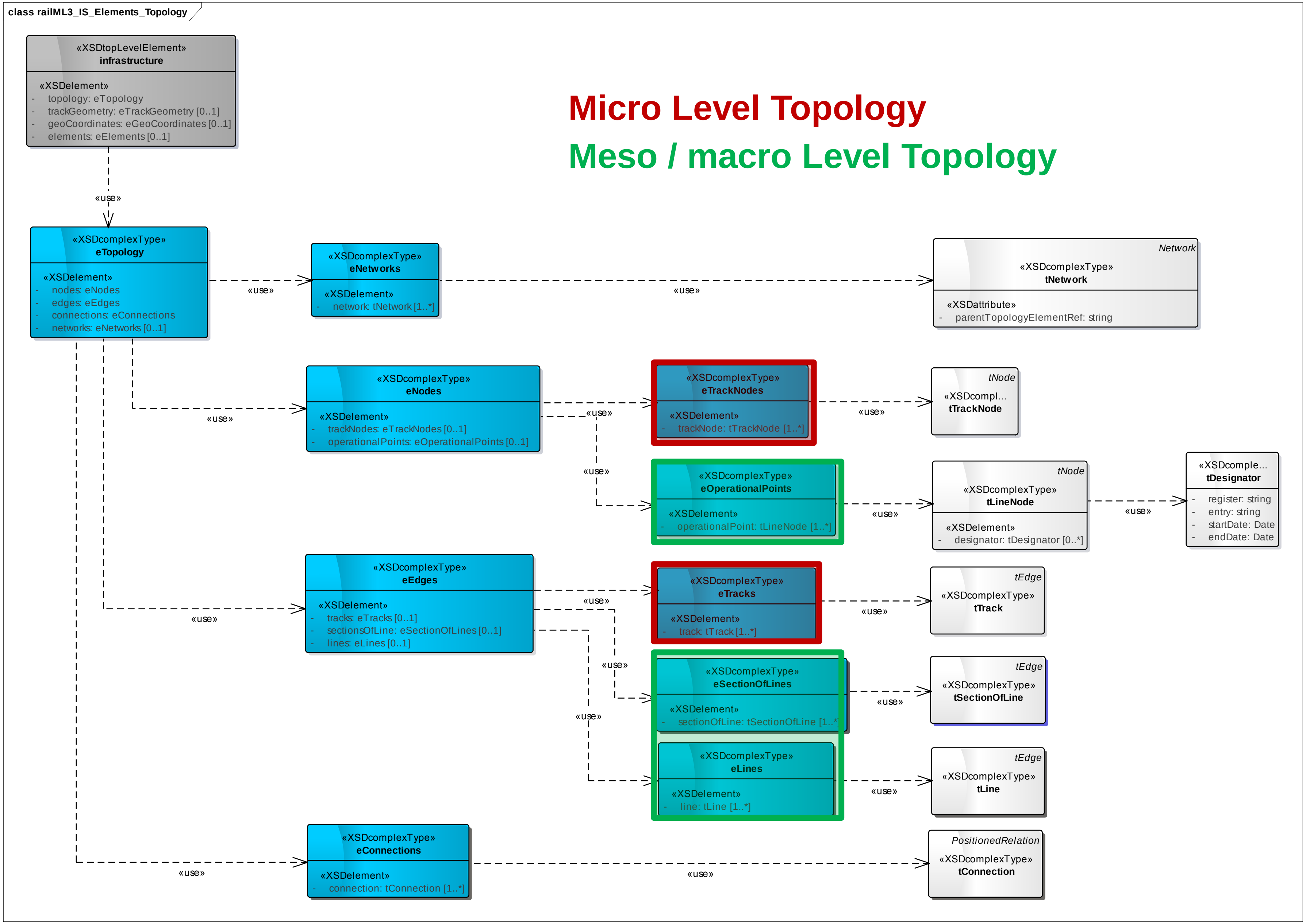
infrastructure
«XSDelement»
- topology: eTopology
- trackGeometry: eTrackGeometry [0..1]
- geoCoordinates: eGeoCoordinates [0..1]
- elements: eElements [0..1]
«use»
«XSDcomplexType»
eTopology
«XSDelement»
- nodes: eNodes
- edges: eEdges
- connections: eConnections
- networks: eNetworks [0..1]
«XSDcomplexType»
eNetworks
«XSDelement»
- network: tNetwork [1..*]
Network
«XSDcomplexType»
tNetwork
«XSDattribute»
- parentTopologyElementRef: string
«XSDcomplexType»
eNodes
«XSDelement»
- trackNodes: eTrackNodes [0..1]
- operationalPoints: eOperationalPoints [0..1]
«XSDcomplexType»
eTrackNodes
«XSDelement»
- trackNode: tTrackNode [1..*]
tNode
«XSDcompl...
tTrackNode
«XSDcomplexType»
eOperationalPoints
«XSDelement»
- operationalPoint: tLineNode [1..*]
tNode
«XSDcomplexType»
tLineNode
«XSDelement»
- designator: tDesignator [0..*]
«XSDcomple...
tDesignator
- register: string
- entry: string
- startDate: Date
- endDate: Date
«XSDcomplexType»
eEdges
«XSDelement»
- tracks: eTracks [0..1]
- sectionsOfLine: eSectionOfLines [0..1]
- lines: eLines [0..1]
«XSDcomplexType»
eTracks
«XSDelement»
- track: tTrack [1..*]
tEdge
«XSDcomplexType»
tTrack
«XSDcomplexType»
eSectionOfLines
«XSDelement»
- sectionOfLine: tSectionOfLine [1..*]
tEdge
«XSDcomplexType»
tSectionOfLine
«XSDcomplexType»
eLines
«XSDelement»
- line: tLine [1..*]
tEdge
«XSDcomplexType»
tLine
«XSDcomplexType»
eConnections
«XSDelement»
- connection: tConnection [1..*]
PositionedRelation
«XSDcomplexType»
tConnection

Micro Level Topology

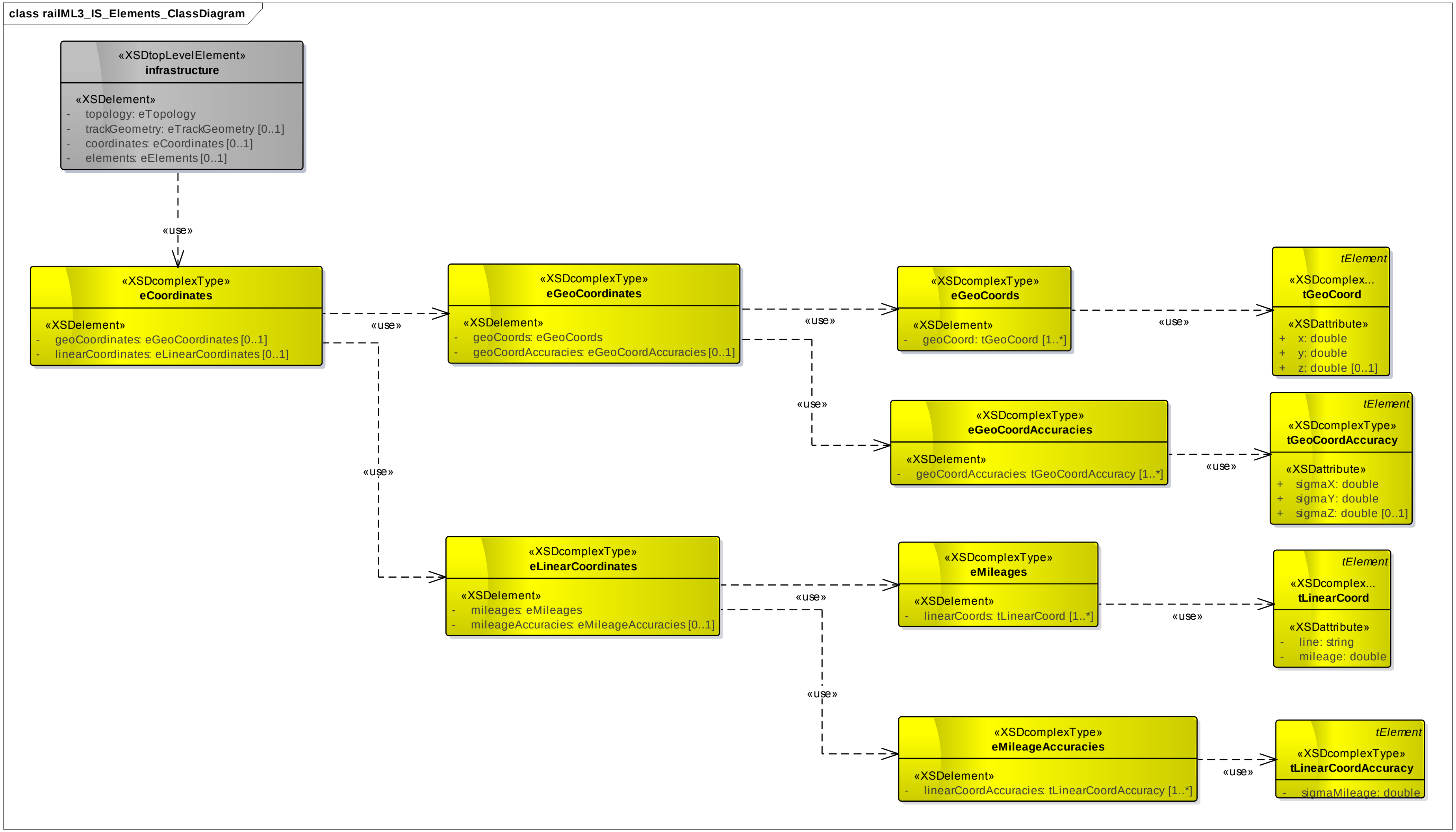



class railML3_IS_Elements_Topology
Micro Level Topology
Meso / macro Level Topology
«XSDtopLevelElement» infrastructure
«XSDelement»
- topology: eTopology
- trackGeometry: eTrackGeometry [0..1]
- geoCoordinates: eGeoCoordinates [0..1]
- elements: eElements [0..1]
«use»
«XSDcomplexType» eTopology
«XSDelement»
- nodes: eNodes
- edges: eEdges
- connections: eConnections
- networks: eNetworks [0..1]
«XSDcomplexType» eNetworks
«XSDelement»
- network: tNetwork [1..*]
Network
«XSDcomplexType» tNetwork
«XSDattribute»
- parentTopologyElementRef: string
«XSDcomplexType» eNodes
«XSDelement»
- trackNodes: eTrackNodes [0..1]
- operationalPoints: eOperationalPoints [0..1]
«XSDcomplexType» eTrackNodes
«XSDelement»
- trackNode: tTrackNode [1..*]
tNode
«XSDcompl... tTrackNode
«XSDcomplexType» eOperationalPoints
«XSDelement»
- operationalPoint: tLineNode [1..*]
tNode
«XSDcomplexType» tLineNode
«XSDelement»
- designator: tDesignator [0..*]
«XSDcomple... tDesignator
- register: string
- entry: string
- startDate: Date
- endDate: Date
«XSDcomplexType» eEdges
«XSDelement»
- tracks: eTracks [0..1]
- sectionsOfLine: eSectionOfLines [0..1]
- lines: eLines [0..1]
«XSDcomplexType» eTracks
«XSDelement»
- track: tTrack [1..*]
tEdge
«XSDcomplexType» tTrack
«XSDcomplexType» eSectionOfLines
«XSDelement»
- sectionOfLine: tSectionOfLine [1..*]
tEdge
«XSDcomplexType» tSectionOfLine
«XSDcomplexType» eLines
«XSDelement»
- line: tLine [1..*]
tEdge
«XSDcomplexType» tLine
«XSDcomplexType» eConnections
«XSDelement»
- connection: tConnection [1..*]
PositionedRelation
«XSDcomplexType» tConnection

railML® 3
Model

- **Coordinates:**
  - **Geographic coordinates**, e.g. WGS84 *[optional]*
  - **Linear coordinates** *[optional]*

railML® 3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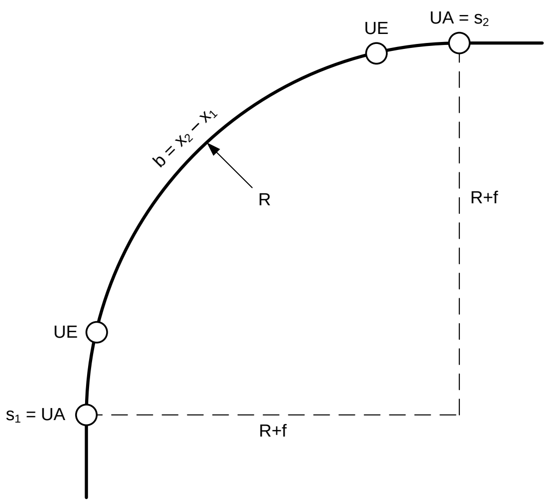
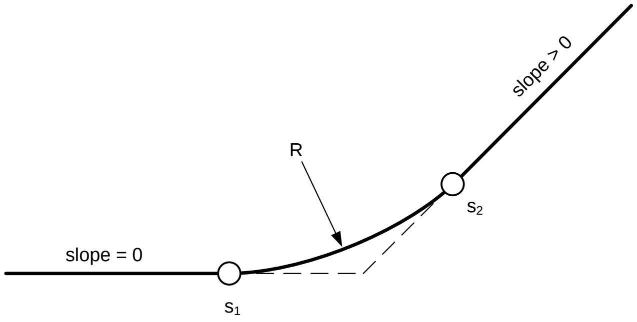
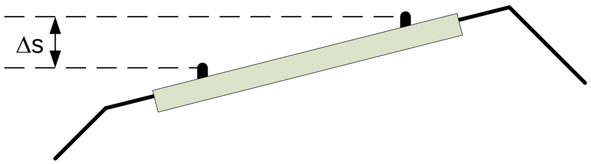
infrastructure
«XSDelement»
- topology: eTopology
- trackGeometry: eTrackGeometry [0..1]
- coordinates: eCoordinates [0..1]
- elements: eElements [0..1]
«use»
«XSDcomplexType»
eCoordinates
«XSDelement»
- geoCoordinates: eGeoCoordinates [0..1]
- linearCoordinates: eLinearCoordinates [0..1]
«XSDcomplexType»
eGeoCoordinates
«XSDelement»
- geoCoords: eGeoCoords
- geoCoordAccuracies: eGeoCoordAccuracies [0..1]
«XSDcomplexType»
eGeoCoords
«XSDelement»
- geoCoord: tGeoCoord [1..*]
tElement
«XSDcomplex...
tGeoCoord
«XSDattribute»
+ x: double
+ y: double
+ z: double [0..1]
«XSDcomplexType»
eGeoCoordAccuracies
«XSDelement»
- geoCoordAccuracies: tGeoCoordAccuracy [1..*]
tElement
«XSDcomplexType»
tGeoCoordAccuracy
«XSDattribute»
+ sigmaX: double
+ sigmaY: double
+ sigmaZ: double [0..1]
«XSDcomplexType»
eLinearCoordinates
«XSDelement»
- mileages: eMileages
- mileageAccuracies: eMileageAccuracies [0..1]
«XSDcomplexType»
eMileages
«XSDelement»
- linearCoords: tLinearCoord [1..*]
tElement
«XSDcomplex...
tLinearCoord
«XSDattribute»
- line: string
- mileage: double
«XSDcomplexType»
eMileageAccuracies
«XSDelement»
- linearCoordAccuracies: tLinearCoordAccuracy [1..*]
tElement
«XSDcomplexType»
tLinearCoordAccuracy
- sigmaMileage: double

railML® 3
Model

- **TrackGeometry: Independent modelling in all dimensions**
  - **Horizontal curves** → radius *[optional]*
  - **Gradient curves** → gradient *[optional]*
  - **Superelevation curves** → superelevation *[optional]*
  - **GeometryPoints** *[optional]*







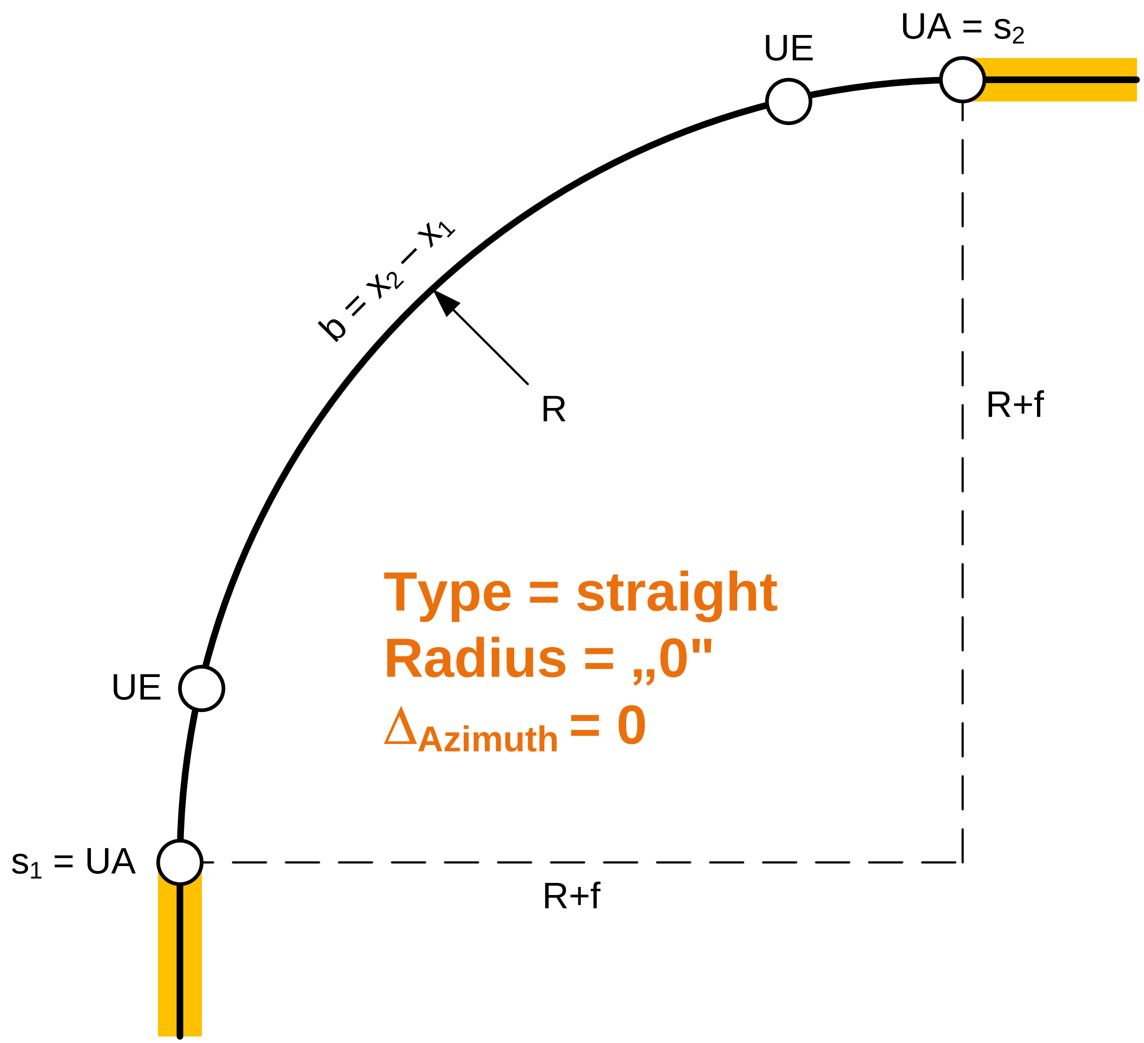
railML® 3
Model

> Horizontal curves

Straight lines

Arcs

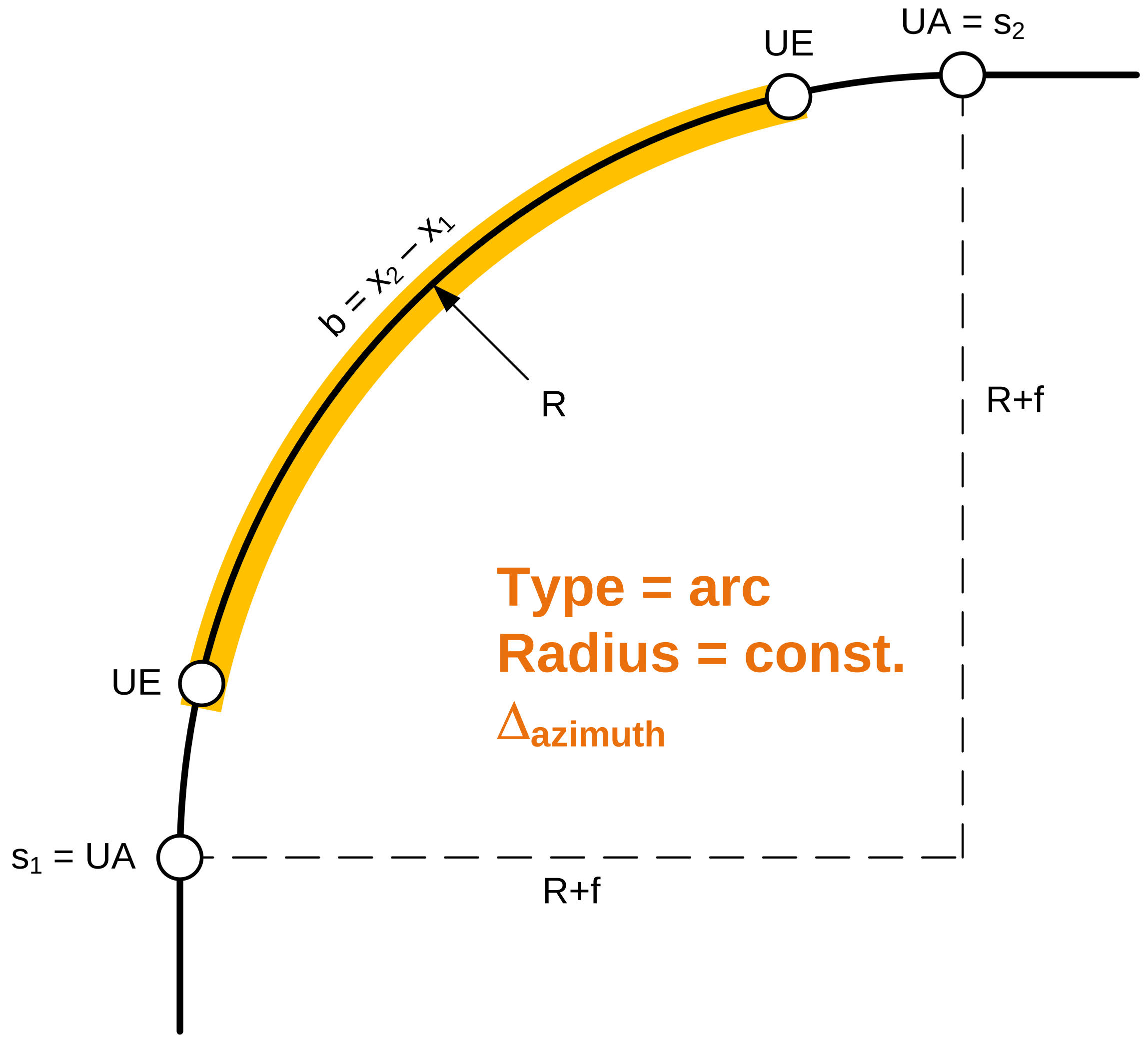
Transition curves



railML® 3
Model

> **Horizontal curves**

Straight lines
Arcs
Transition curves



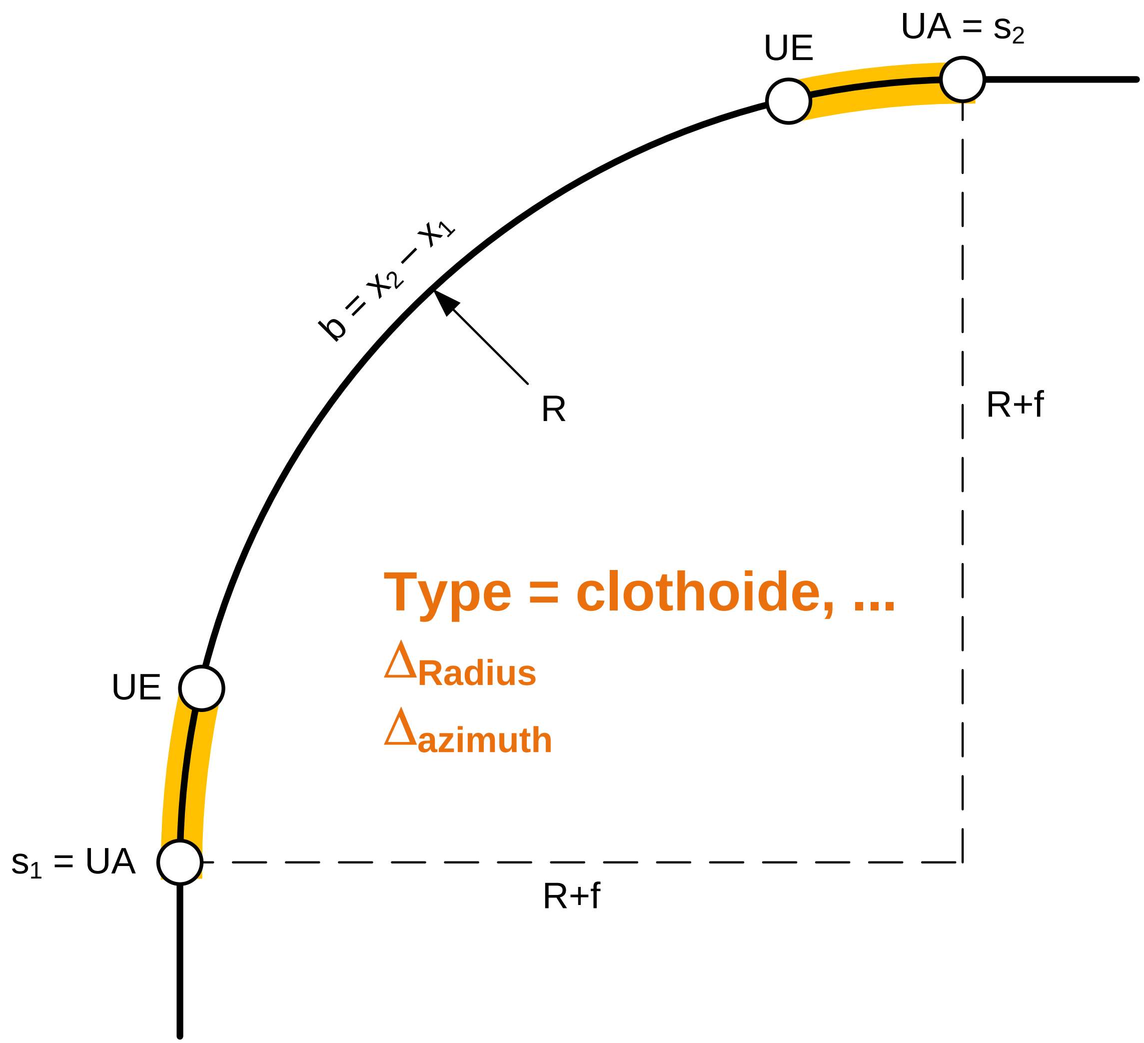
railML® 3
Model

> Horizontal curves

Straight lines

Arcs

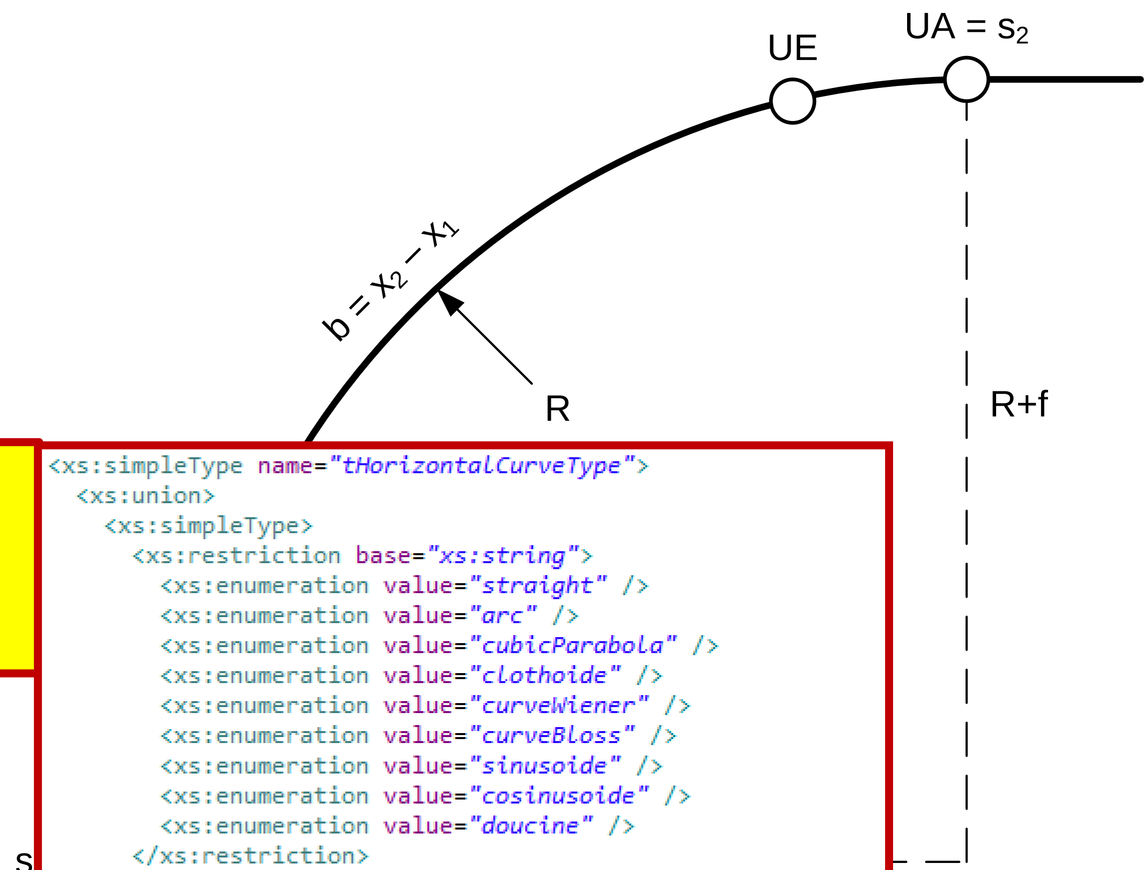
Transition curves



railML® 3
Model

> **Horizontal curves**

Straight lines
Arcs
Transition curves



curveType (required)
deltaAzimuth [deg]
radius [m]

```xml
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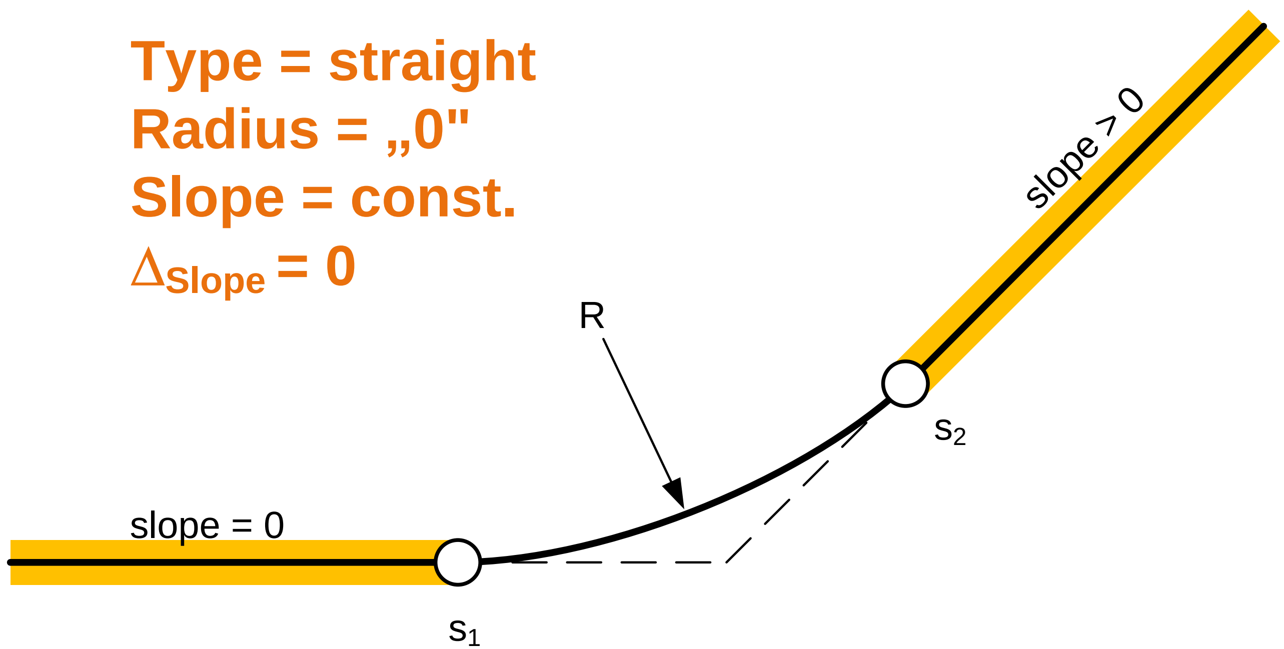
  <xs:union>
    <xs:simpleType>
      <xs:restriction base="xs:string">
        <xs:enumeration value="straight" />
        <xs:enumeration value="arc" />
        <xs:enumeration value="cubicParabola" />
        <xs:enumeration value="clothoide" />
        <xs:enumeration value="curveWiener" />
        <xs:enumeration value="curveBloss" />
        <xs:enumeration value="sinusoide" />
        <xs:enumeration value="cosinusoide" />
        <xs:enumeration value="doucine" />
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType>
      <xs:restriction base="rail:tOtherEnumerationValue" />
    </xs:simpleType>
  </xs:union>
</xs:simpleType>
```

railML® 3
Model

- **Gradient curves**
  - Straight lines
  - Arcs

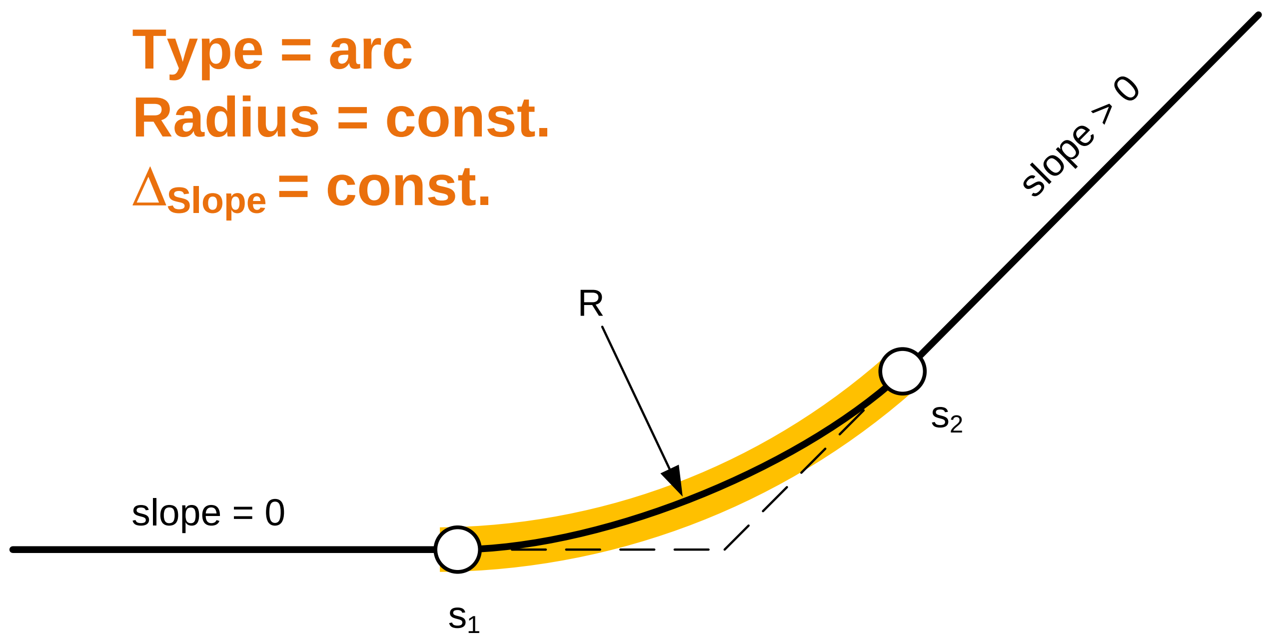
Type = straight
Radius = „0"
Slope = const.
$\Delta_{Slope} = 0$



railML® 3
Model

- **Gradient curves**
  - Straight lines
  - Arcs

Type = arc
Radius = const.
Δ_{Slope} = const.



railML® 3
Model

> Gradient curves

Straight lines

Arcs

curveType (required)
slope [promille]
radius [m]
deltaSlope [promille]

```
<xs:simpleType name="tGradientCurveType">
  <xs:union>
    <xs:simpleType>
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</xs:simpleType>
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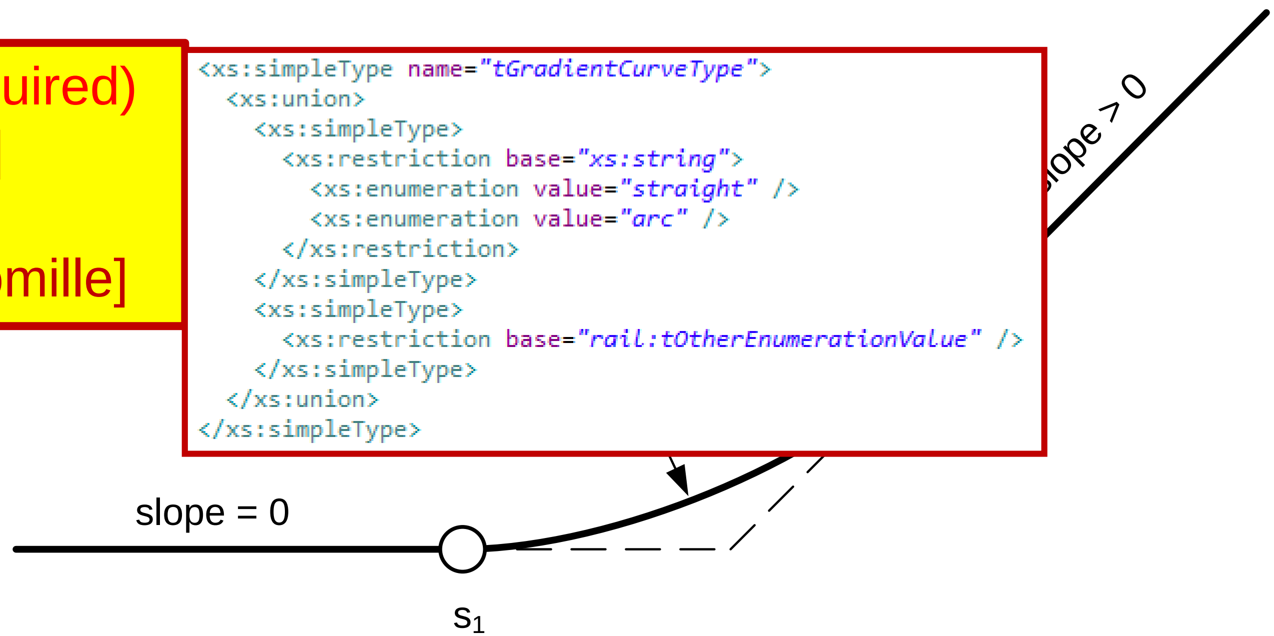
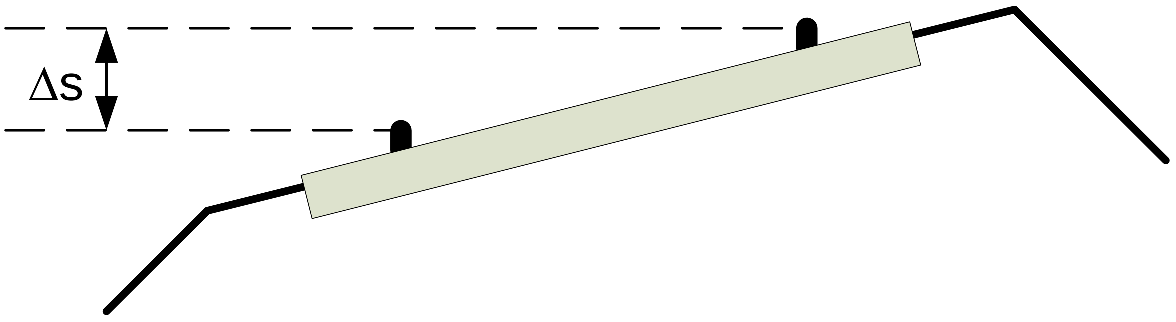


railML® 3
Model

> **Superelevation curves**
>
> Constant superelevation curves
>
> Ramps



railML® 3
Model

- **Superelevation curves**
  - Constant superelevation curves
  - Ramps

curveType (required)
superelevation [mm]
deltaSuperelevation [mm]

```xml
<xs:simpleType name="tSuperelevationCurveType">
  <xs:union>
    <xs:simpleType>
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        <xs:enumeration value="constSuperelevationCurve" />
        <xs:enumeration value="ramp" />
      </xs:restriction>
    </xs:simpleType>
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    </xs:simpleType>
  </xs:union>
</xs:simpleType>
```
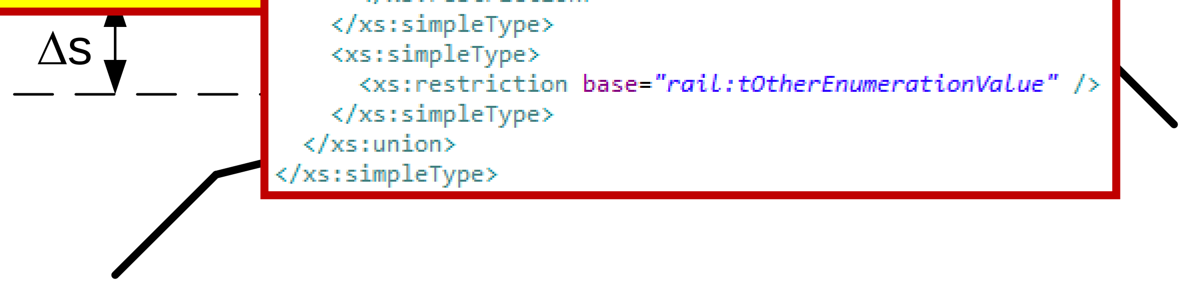
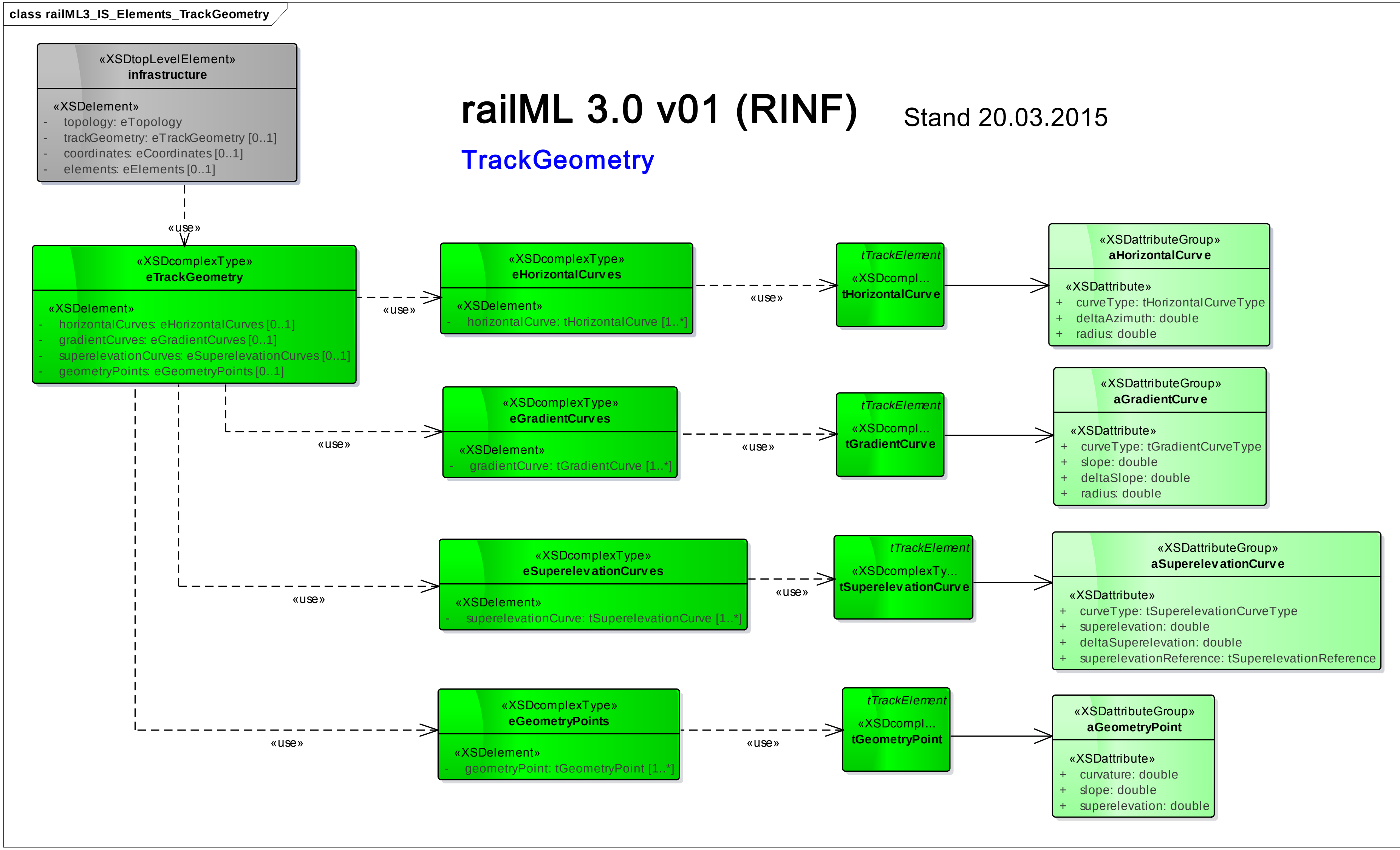
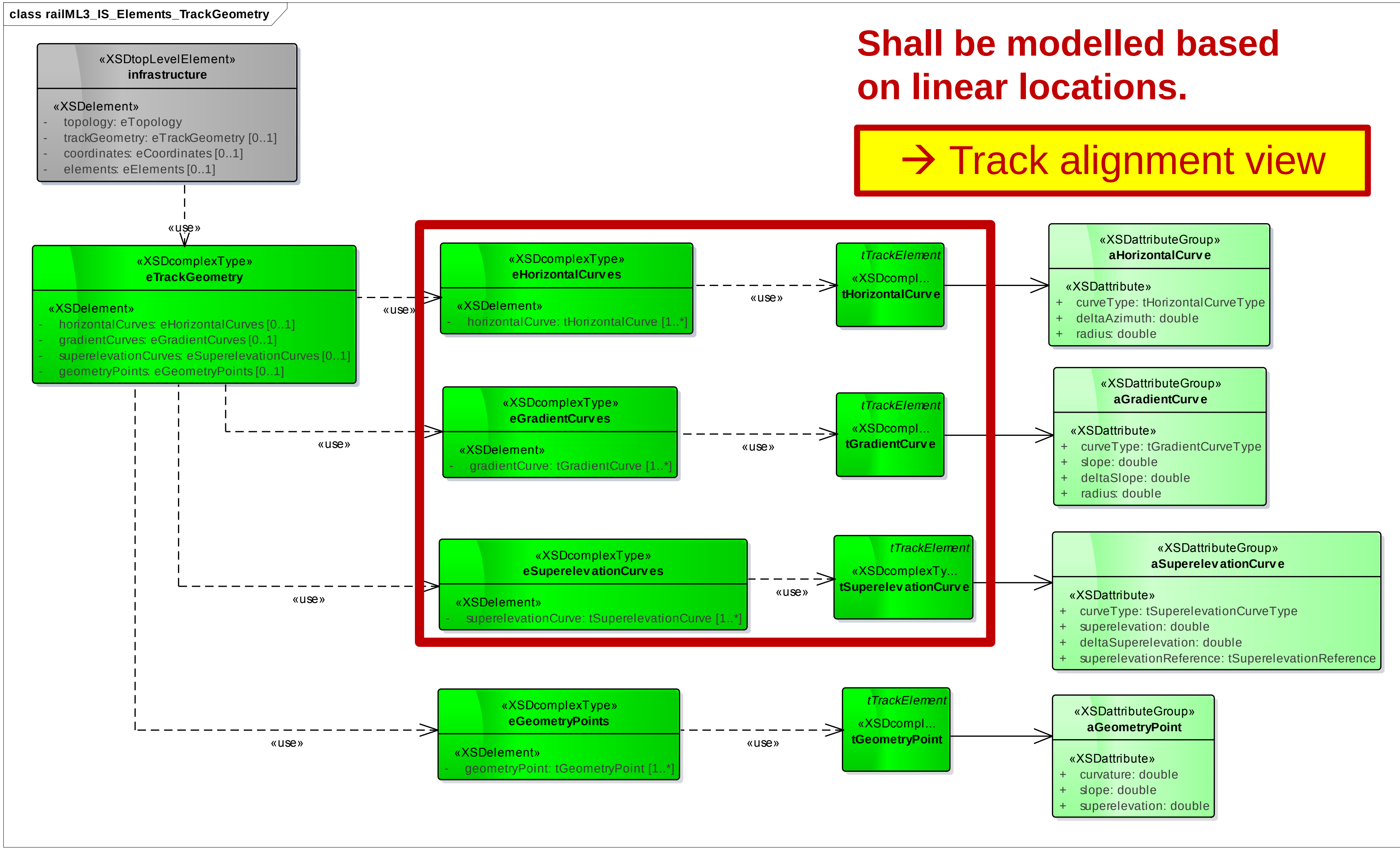



railML® 3


class railML3_IS_Elements_TrackGeometry
railML 3.0 v01 (RINF)
Stand 20.03.2015
TrackGeometry
«XSDtopLevelElement»
infrastructure
«XSDelement»
- topology: eTopology
- trackGeometry: eTrackGeometry [0..1]
- coordinates: eCoordinates [0..1]
- elements: eElements [0..1]
«use»
«XSDcomplexType»
eTrackGeometry
«XSDelement»
- horizontalCurves: eHorizontalCurves [0..1]
- gradientCurves: eGradientCurves [0..1]
- superelevationCurves: eSuperelevationCurves [0..1]
- geometryPoints: eGeometryPoints [0..1]
«XSDcomplexType»
eHorizontalCurves
«XSDelement»
- horizontalCurve: tHorizontalCurve [1..*]
tTrackElement
«XSDcompl...
tHorizontalCurve
«XSDattributeGroup»
aHorizontalCurve
«XSDattribute»
+ curveType: tHorizontalCurveType
+ deltaAzimuth: double
+ radius: double
«XSDcomplexType»
eGradientCurves
«XSDelement»
- gradientCurve: tGradientCurve [1..*]
tTrackElement
«XSDcompl...
tGradientCurve
«XSDattributeGroup»
aGradientCurve
«XSDattribute»
+ curveType: tGradientCurveType
+ slope: double
+ deltaSlope: double
+ radius: double
«XSDcomplexType»
eSuperelevationCurves
«XSDelement»
- superelevationCurve: tSuperelevationCurve [1..*]
tTrackElement
«XSDcomplexTy...
tSuperelevationCurve
«XSDattributeGroup»
aSuperelevationCurve
«XSDattribute»
+ curveType: tSuperelevationCurveType
+ superelevation: double
+ deltaSuperelevation: double
+ superelevationReference: tSuperelevationReference
«XSDcomplexType»
eGeometryPoints
«XSDelement»
- geometryPoint: tGeometryPoint [1..*]
tTrackElement
«XSDcompl...
tGeometryPoint
«XSDattributeGroup»
aGeometryPoint
«XSDattribute»
+ curvature: double
+ slope: double
+ superelevation: double
«use»

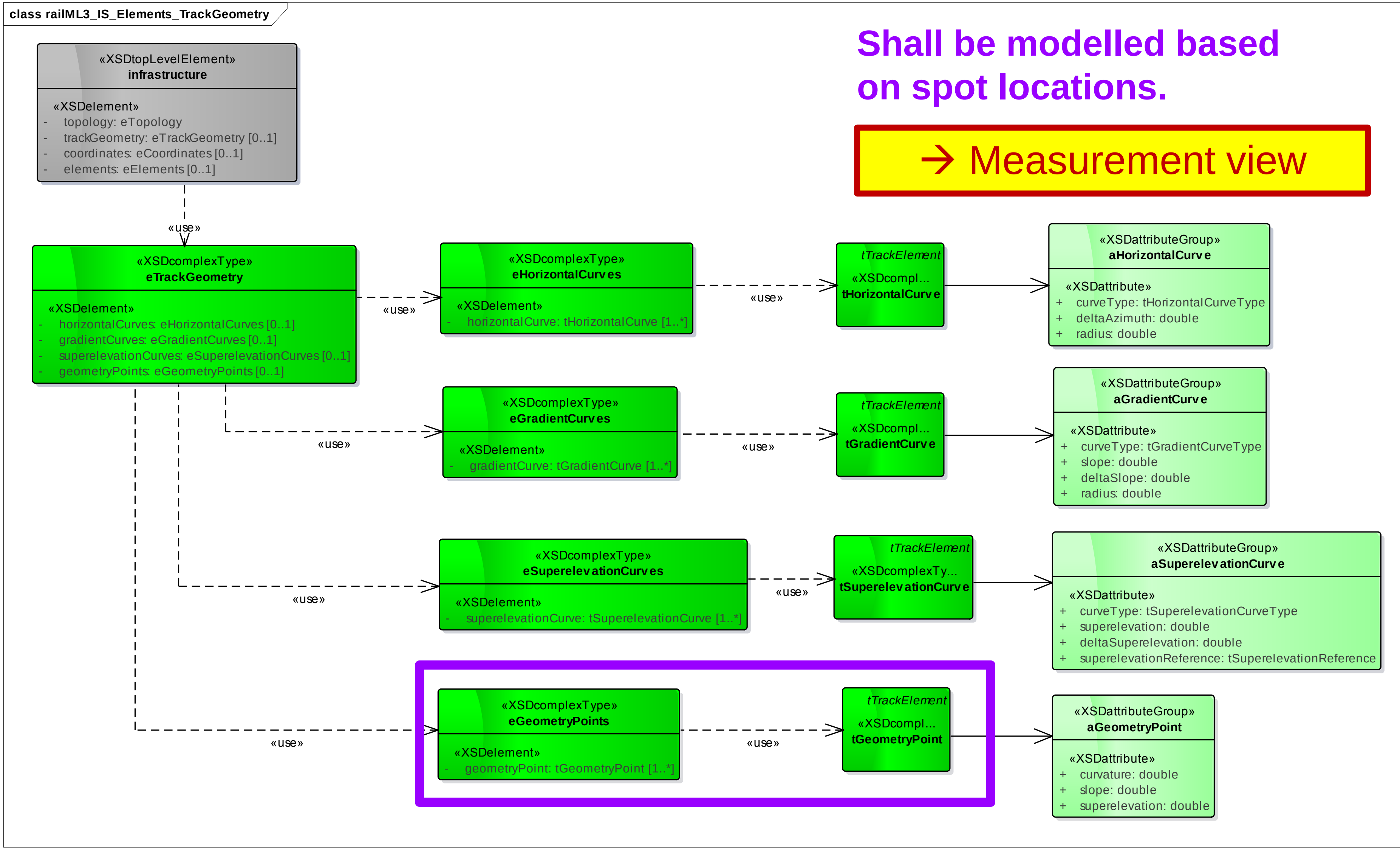
railML® 3



Shall be modelled based on linear locations.

→ Track alignment view

railML® 3



class railML3_IS_Elements_TrackGeometry
«XSDtopLevelElement»
infrastructure
«XSDelement»
- topology: eTopology
- trackGeometry: eTrackGeometry [0..1]
- coordinates: eCoordinates [0..1]
- elements: eElements [0..1]
«use»
«XSDcomplexType»
eTrackGeometry
«XSDelement»
- horizontalCurves: eHorizontalCurves [0..1]
- gradientCurves: eGradientCurves [0..1]
- superelevationCurves: eSuperelevationCurves [0..1]
- geometryPoints: eGeometryPoints [0..1]
«use»
«XSDcomplexType»
eHorizontalCurves
«XSDelement»
- horizontalCurve: tHorizontalCurve [1..*]
«use»
tTrackElement
«XSDcompl...
tHorizontalCurve
«XSDattributeGroup»
aHorizontalCurve
«XSDattribute»
+ curveType: tHorizontalCurveType
+ deltaAzimuth: double
+ radius: double
«use»
«XSDcomplexType»
eGradientCurves
«XSDelement»
- gradientCurve: tGradientCurve [1..*]
«use»
tTrackElement
«XSDcompl...
tGradientCurve
«XSDattributeGroup»
aGradientCurve
«XSDattribute»
+ curveType: tGradientCurveType
+ slope: double
+ deltaSlope: double
+ radius: double
«use»
«XSDcomplexType»
eSuperelevationCurves
«XSDelement»
- superelevationCurve: tSuperelevationCurve [1..*]
«use»
tTrackElement
«XSDcomplexTy...
tSuperelevationCurve
«XSDattributeGroup»
aSuperelevationCurve
«XSDattribute»
+ curveType: tSuperelevationCurveType
+ superelevation: double
+ deltaSuperelevation: double
+ superelevationReference: tSuperelevationReference
«use»
«XSDcomplexType»
eGeometryPoints
«XSDelement»
- geometryPoint: tGeometryPoint [1..*]
«use»
tTrackElement
«XSDcompl...
tGeometryPoint
«XSDattributeGroup»
aGeometryPoint
«XSDattribute»
+ curvature: double
+ slope: double
+ superelevation: double
Shall be modelled based on spot locations.
→ Measurement view

railML® 3
Model

- **Elements:**
  - **Speed profiles** *[optional]*
  - **Speed restrictions** *[optional]*
  - **Speed changes** *[optional]*
  - **[…]**

railML® 3
Model

> **Elements:**
  - **Speed profiles** *[optional]*
  - **Speed restrictions** *[optional]*
  - **Speed changes** *[optional]*
  - **[…]**

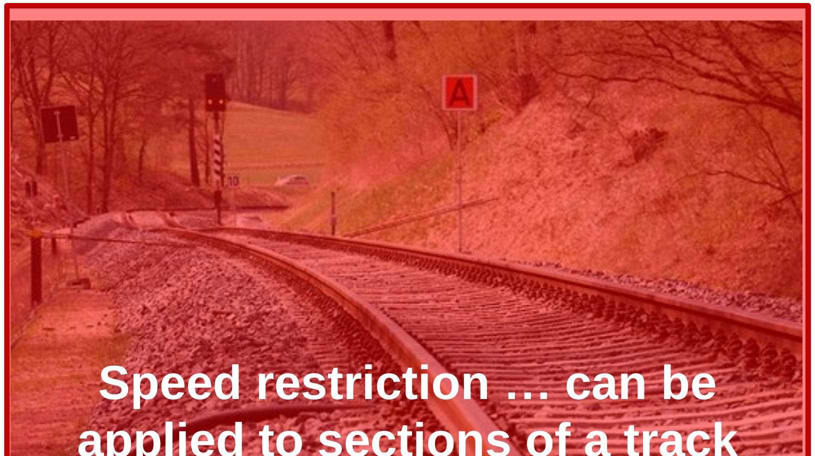
railML® 3
Model

> **Elements:**
  Speed profiles *[optional]*
  Speed restrictions *[optional]*
  Speed changes *[optional]*
  […]

railML® 3
Model

- **Elements:**
  - **Speed profiles** *[optional]*
  - **Speed restrictions** *[optional]*
  - **Speed changes** *[optional]*
  - **[…]**

Speed profile … descibes the speed attributes related to certain vehicle parameters



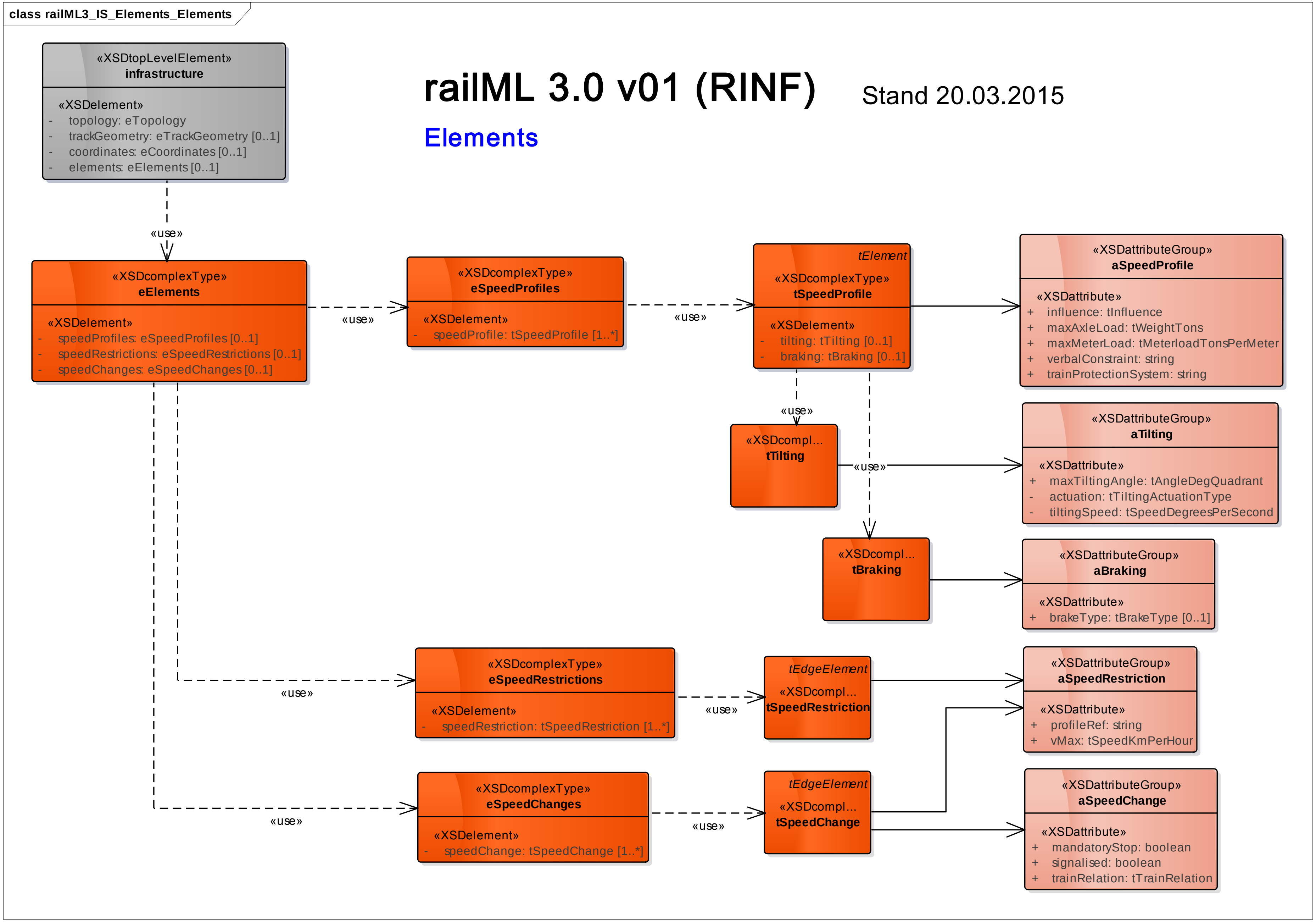
Speed restriction … can be applied to sections of a track network, e.g. TSR

Speed change… is the point on track where the allowed track speed changes

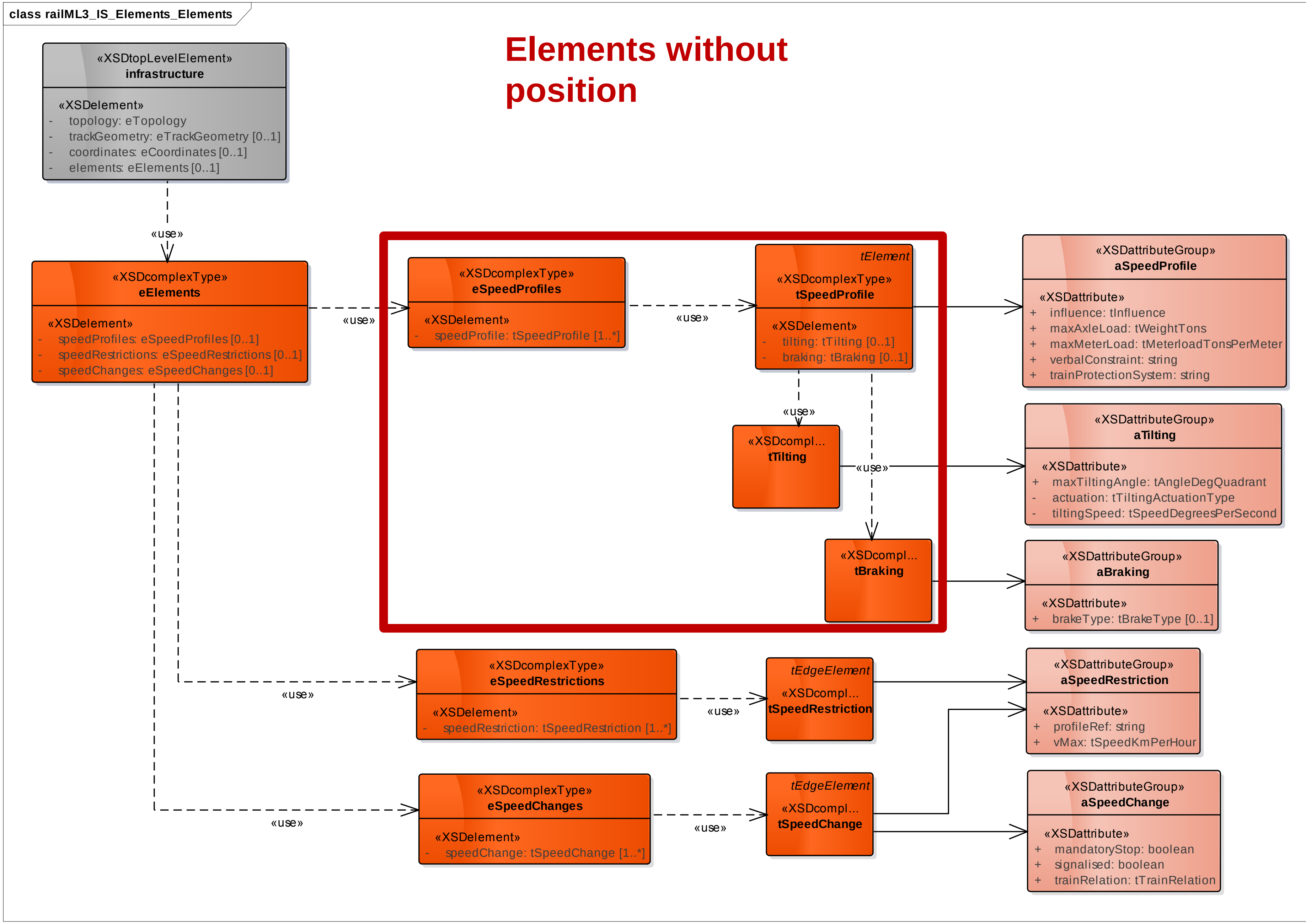
railML 3.0 v01 (RINF)

Stand 20.03.2015

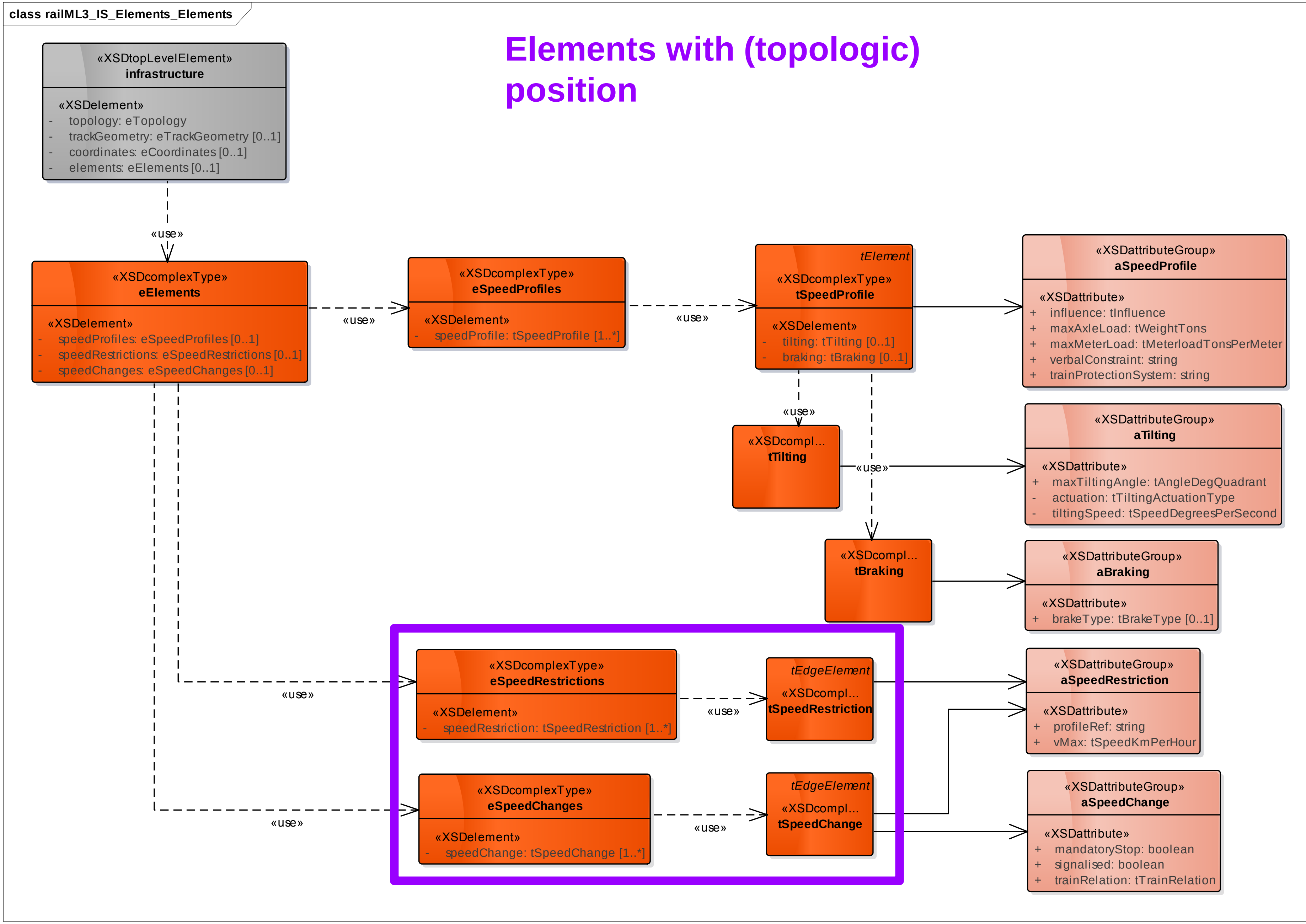
Elements



Elements without position



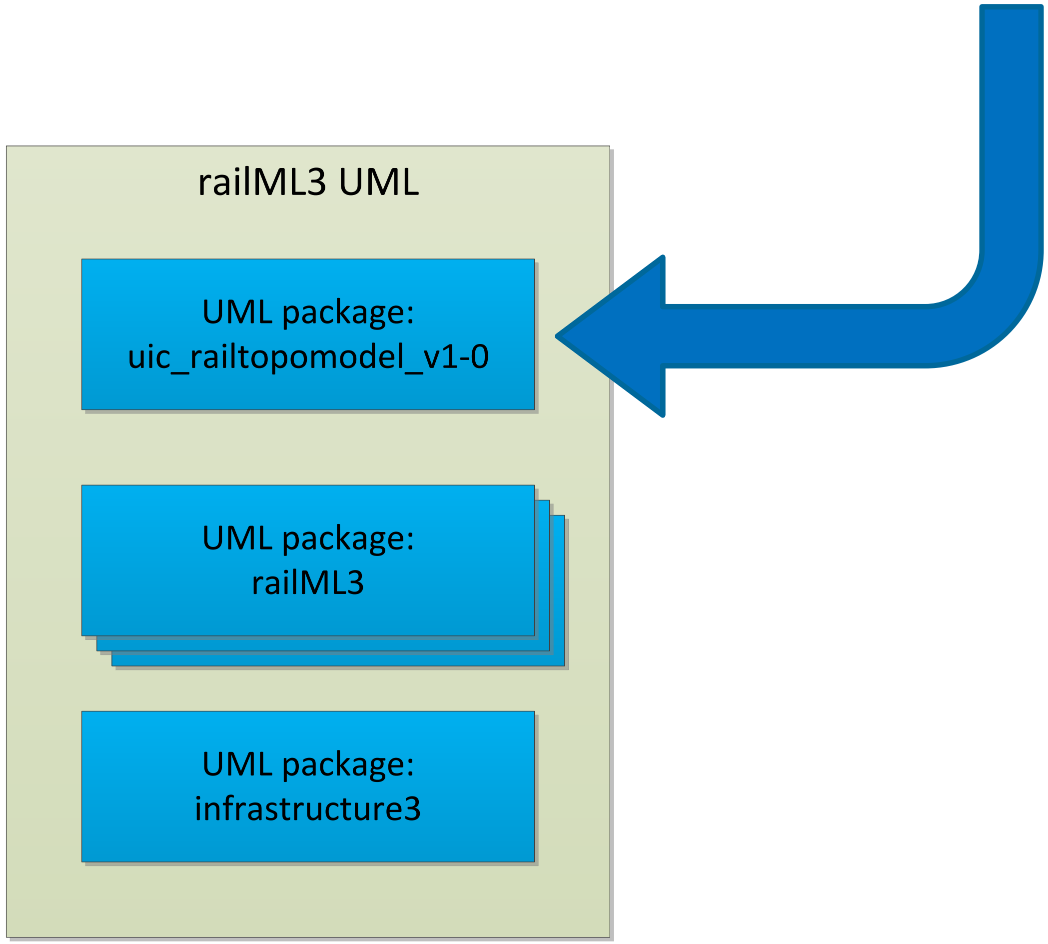
Elements with (topologic) position



railML® 3
From UML to XSD

RailTopoModel

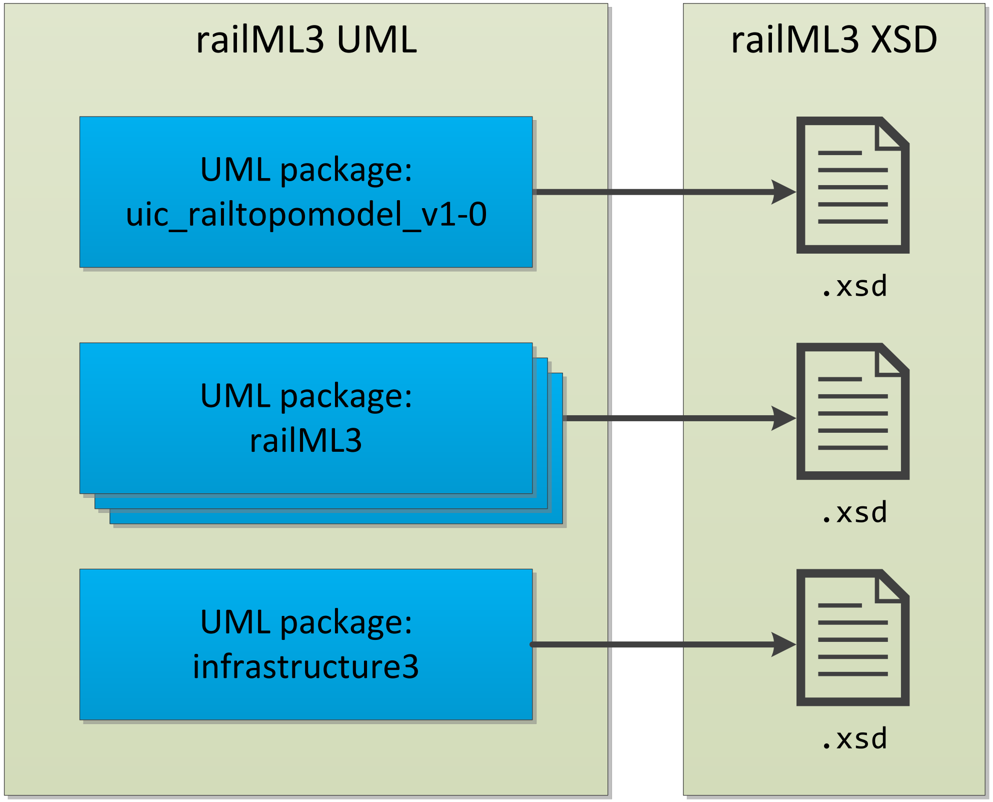
> **Concept:**



railML® 3
From UML to XSD

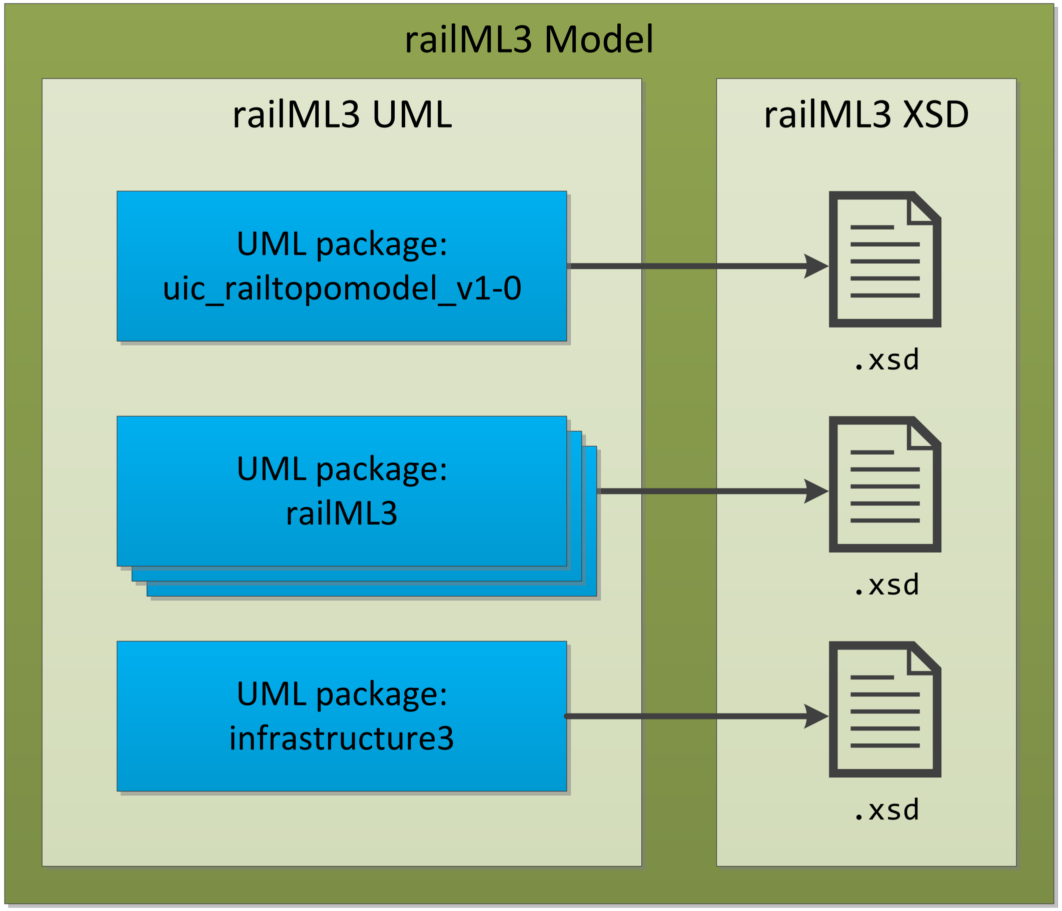
> **Concept:**

Automatic generation of XSDs



railML® 3
From UML to XSD

> **Concept:**



DISCUSSION

Include GML in railML® 3?

- Instead of using <geoCoordRef> elements in all elements, it may be also possible to use GML elements to model the track coordinates.
- Your input?

How to document railML® 3?

For Developer

> **XSD inline documentation**

> **Trac ticket system**

```
<xs:complexType name="eElements">
  <xs:sequence>
    <xs:element name="geometryElements" type="rail:eGeometryElements" minOccurs="0" maxOccurs="1">
      <xs:annotation>
        <xs:documentation>container for elements describing the railway geometry</xs:documentation>
      </xs:annotation>
    </xs:element>
```

railML®

Suche

Anmelden | Einstellungen | Hilfe/Anleitung | Über Trac

Wiki | Journal | Projektplan | Quellen durchsehen | Tickets anzeigen | Suche

Verfügbare Berichte | Individuelle Abfrage

{6} All Tickets By Milestone (Including closed) (254 Ergebnisse)

A more complex example to show how to make advanced reports.

Einträge pro Seite maximal: 100

Aktualisieren

Ergebnisse (1 - 100 von 254)

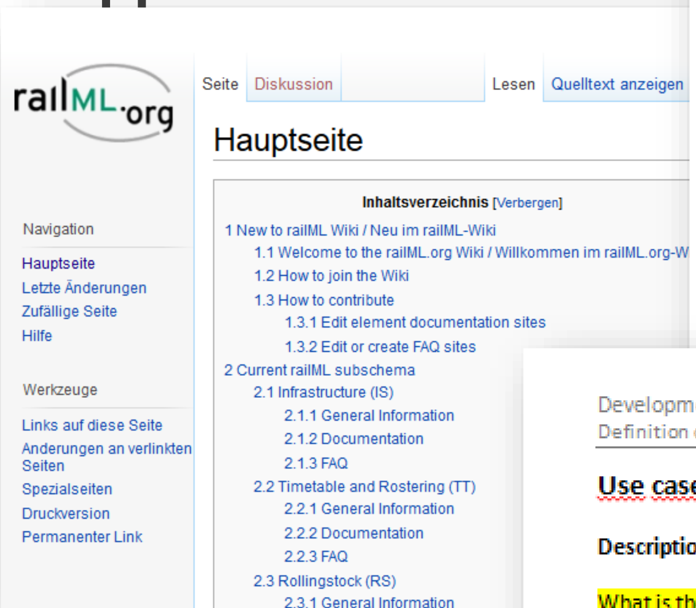
1 2 3 →

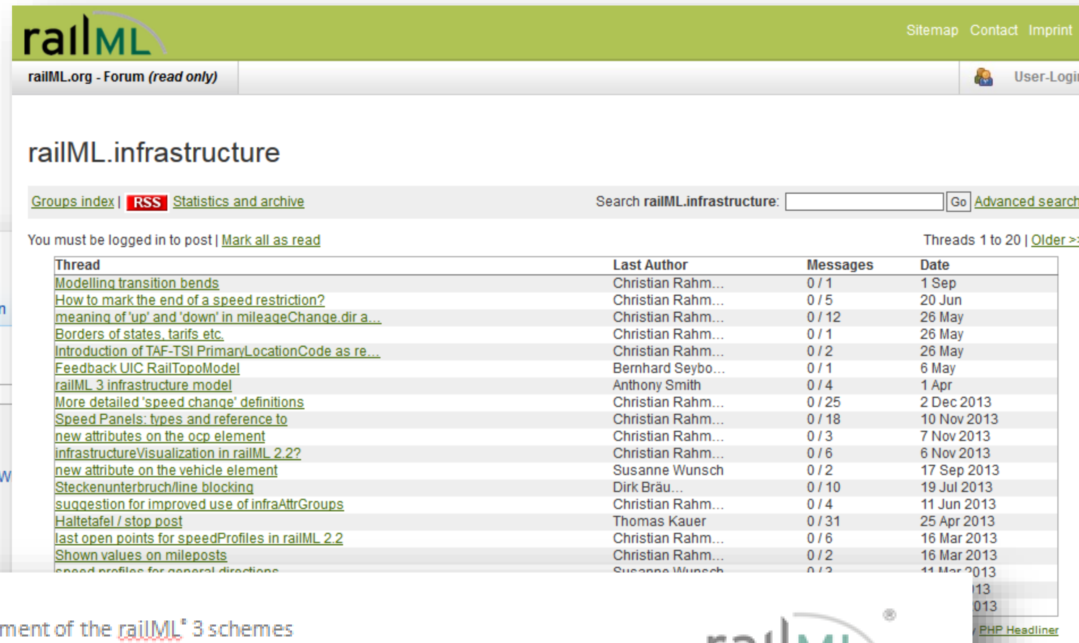
Version 3.x (2 Ergebnisse)

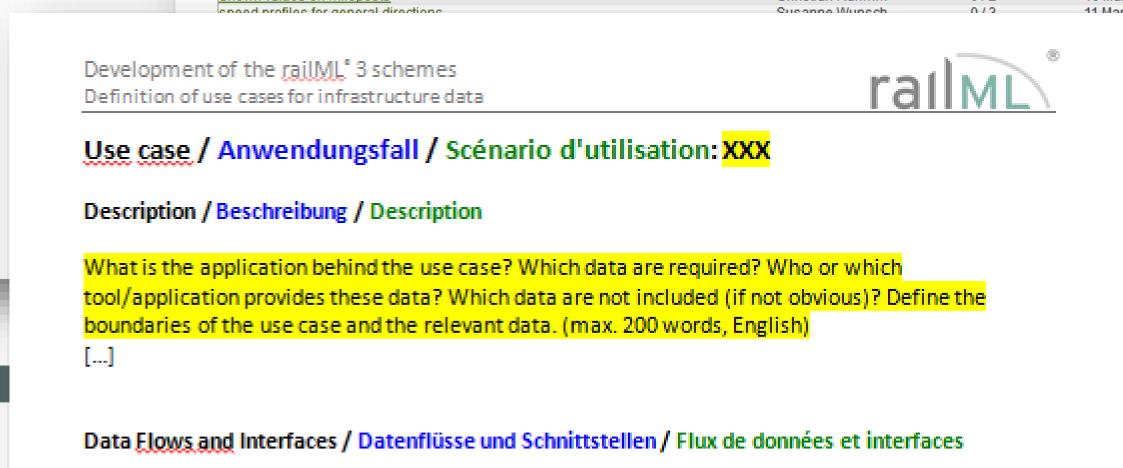
Ticket	Zusammenfassung	Komponente	Status	Lösung	Version	Typ	Priorität	Verantwortlicher	Modified
#98	Special Tunnel attributes	Infrastructure	assigned		3.x	enhancement	normal	christian.rahmig	12.05.201
#234	Stop probability	Timetable	new		3.x	task	normal	joachim.rubroeder	02.12.201

How to document railML® 3?
For User

- > **Wiki**
- > **Forum**
- > **Application Guide**







How to document railML® 3?

- **Documentation for the developer:**
  - XSD inline documentation
  - Trac ticket system
- **Documentation for the user:**
  - Wiki
  - Forum
  - Application Guide
- **Your ideas?**
  - Examples!

Thank you for your kind attention

Christian Rahmig
coord@infrastructure.railML.org