



## railML® Infrastructure v3 **concept**

Ideas and Concepts for a New Infrastructure Model

Christian Rahmig



# Overview

- Motivation:
  - Geodata applications in railways
  - Problem
- UIC RailTopoModel
  - Feasibility study
  - The first approach
  - Concepts
- *railML-4-RINF*
- Discussion
  - [open list]





# MOTIVATION

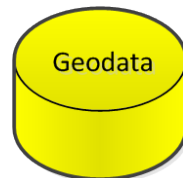


DLR

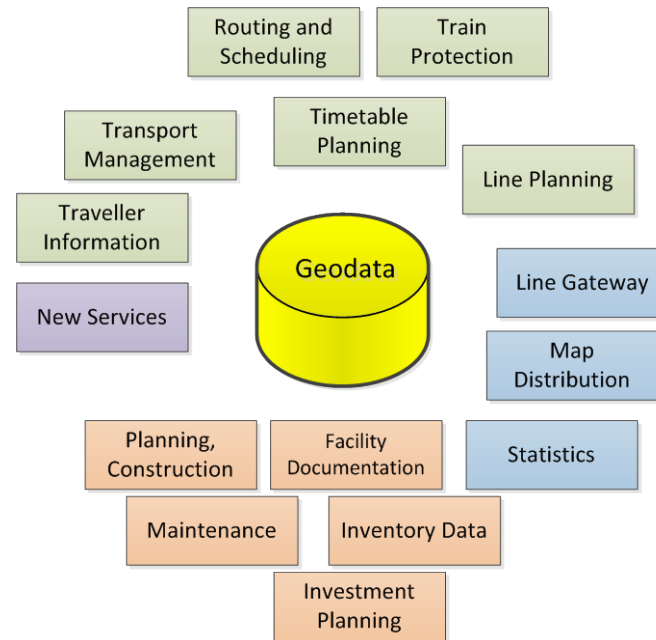
Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft



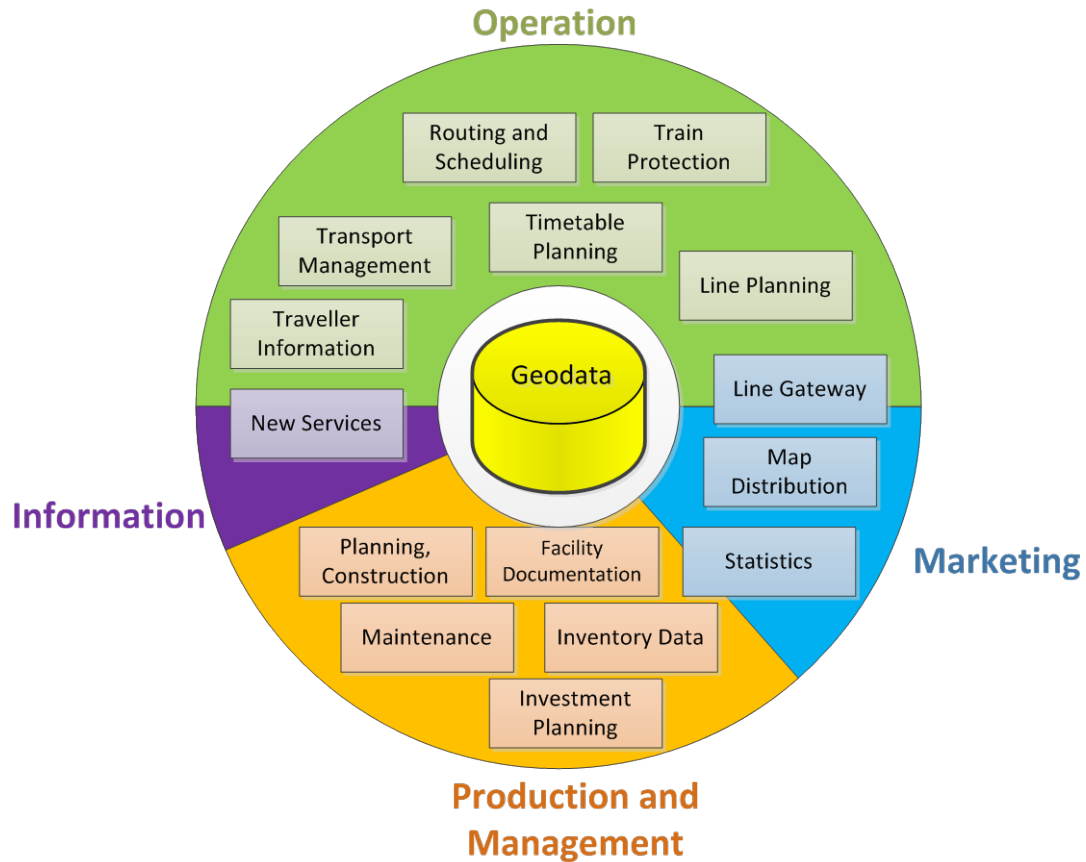
# Geodata Applications in Railways



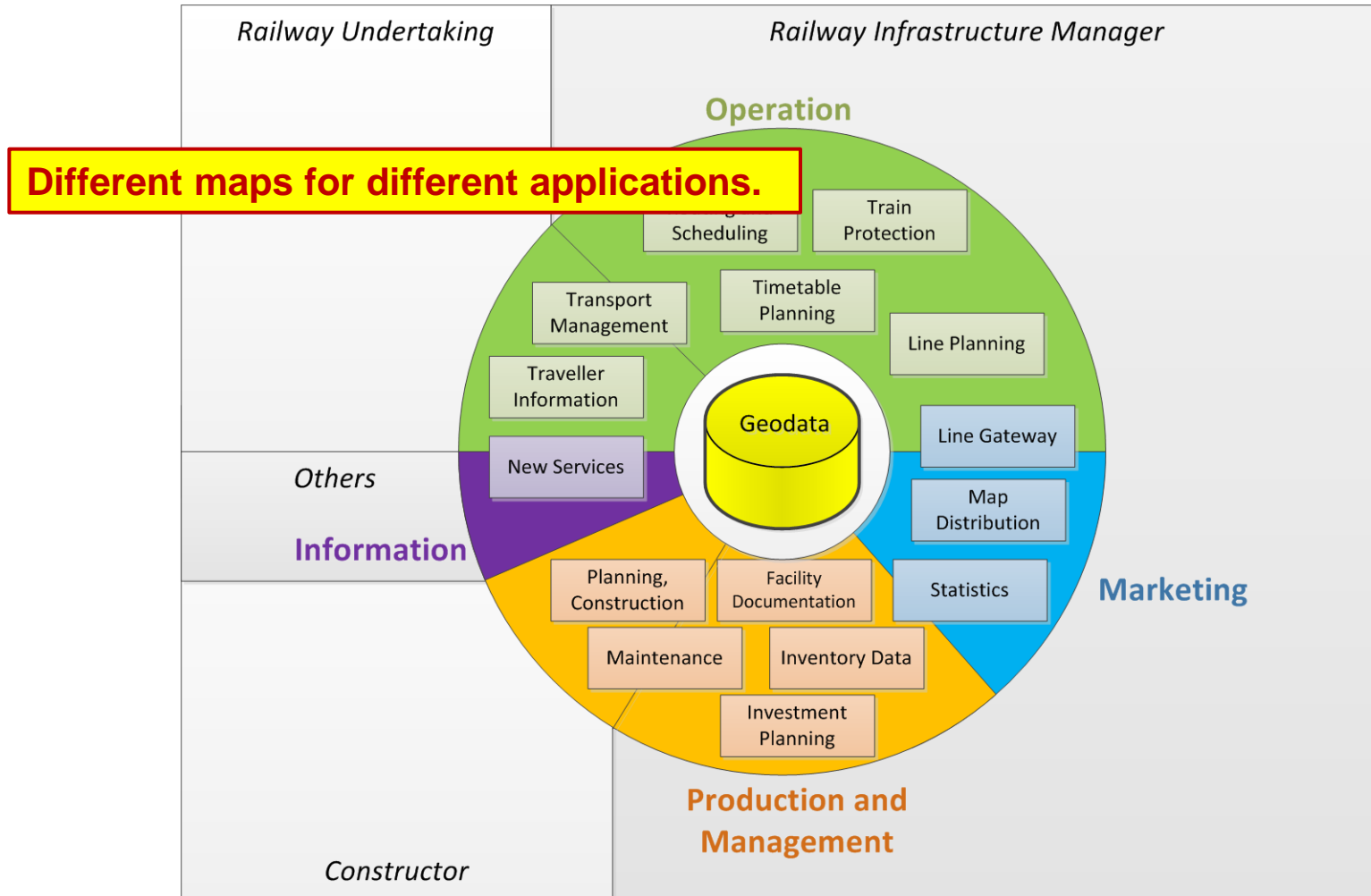
# Geodata Applications in Railways



# Geodata Applications in Railways

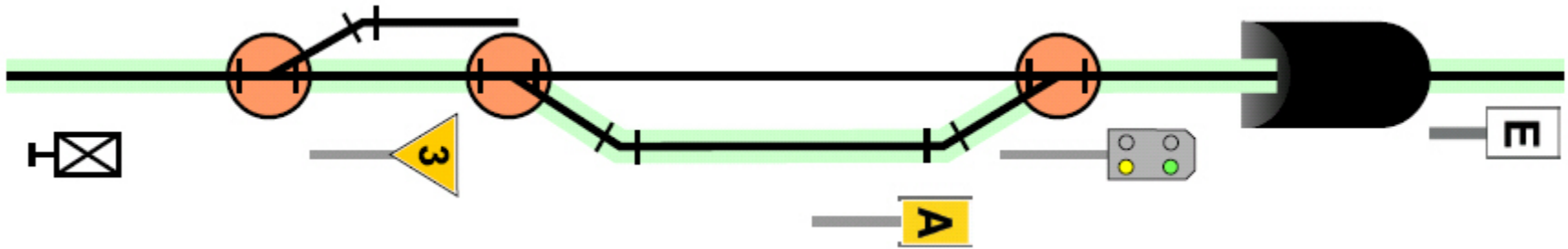


# Geodata Applications in Railways



# Problem

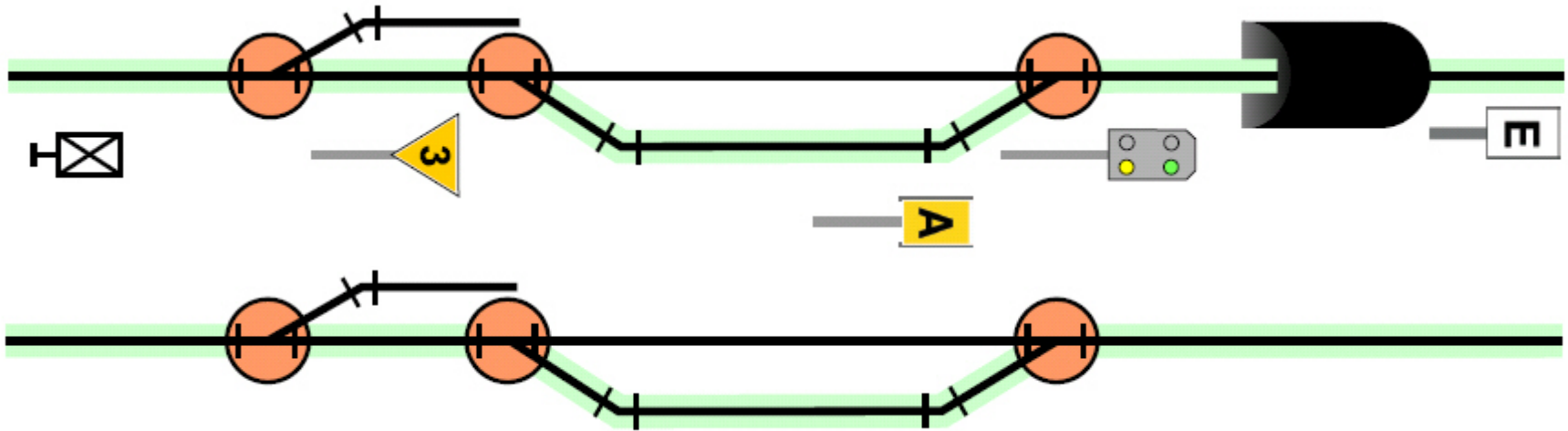
## Current railML topology model





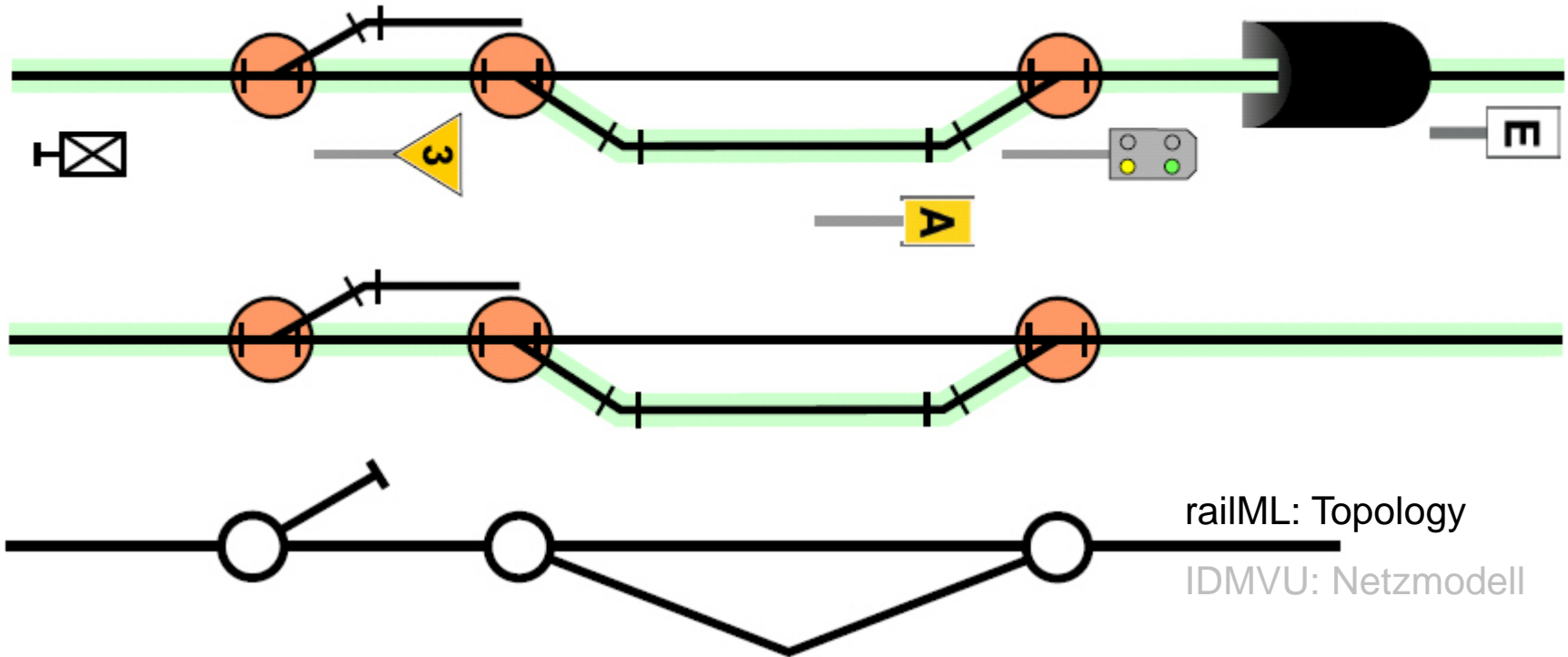
# Problem

## Current railML topology model



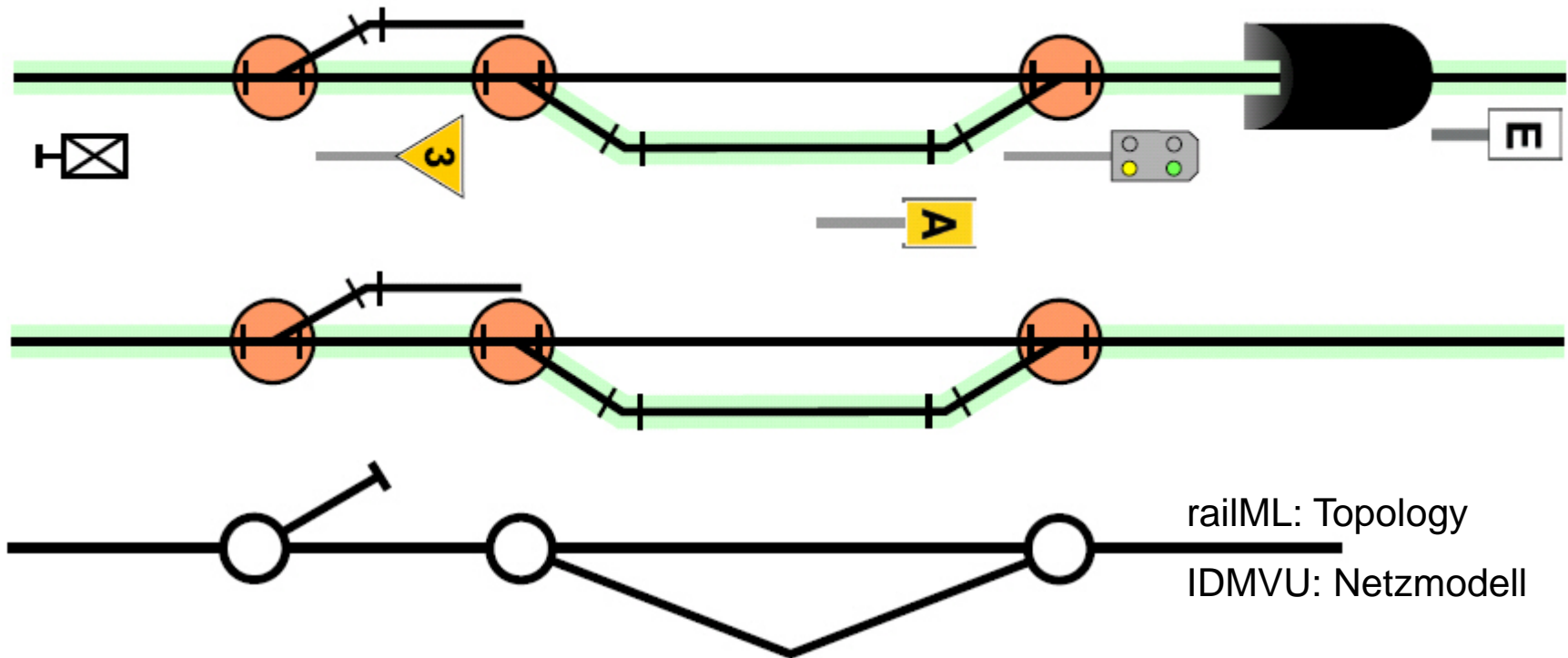
# Problem

## Current railML topology model



# Problem

## Current railML topology model



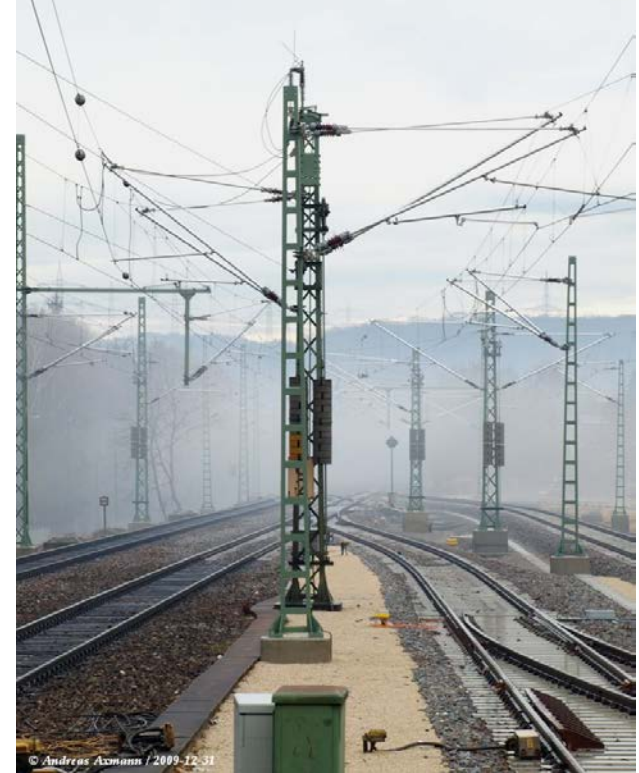
### ➤ Node-Edge Model

➤ Is it sufficient for a complete modelling of the railway infrastructure?

# Problem Infrastructure tbn...



<http://www.k2-hvaciene.de/>



<http://kbs761.startbilder.de/>



# UIC RAILTOPOMODEL

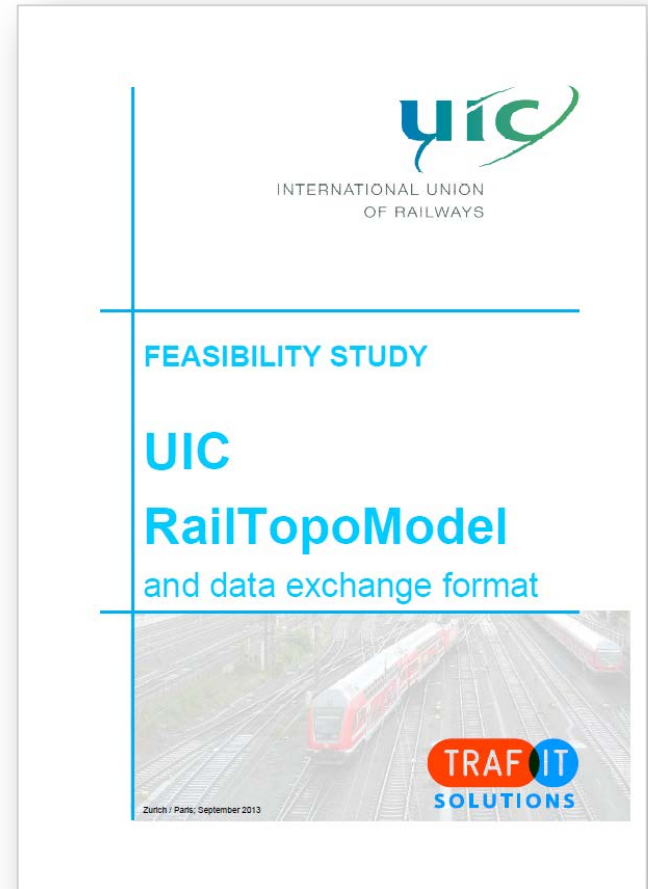




# UIC RailTopoModel

## Feasibility Study (1/3)

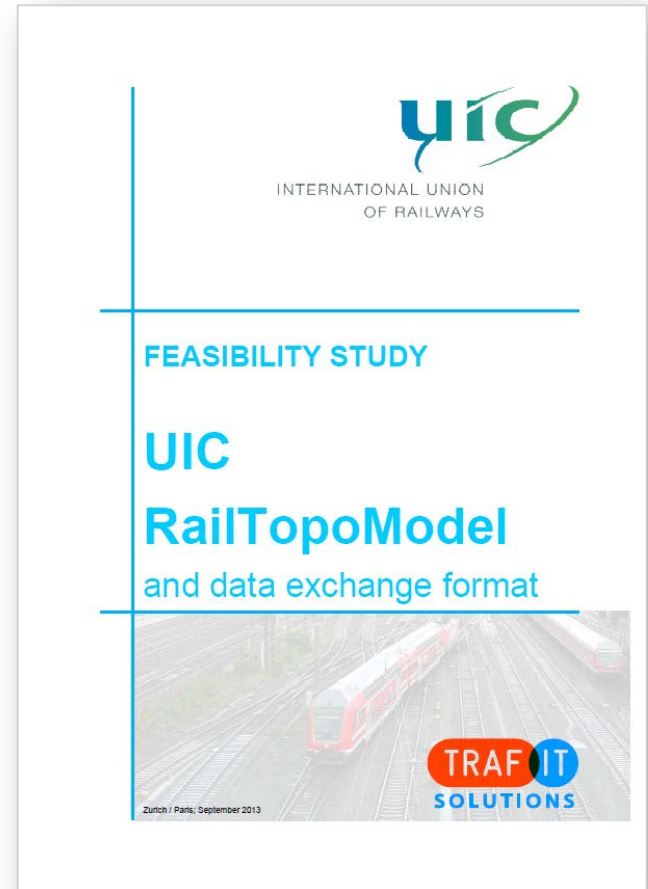
- Financed by UIC
- Done by TrafIT Solutions GmbH
- Results presented at 24<sup>th</sup> railML.org meeting in Paris, on September 16, 2013
- Available at [http://railml.org/tl\\_files/railML.org/documents/science/270913\\_trafIT\\_FinalReportFeasibilityStudyRailTopoModel.pdf](http://railml.org/tl_files/railML.org/documents/science/270913_trafIT_FinalReportFeasibilityStudyRailTopoModel.pdf)



# UIC RailTopoModel

## Feasibility Study (2/3)

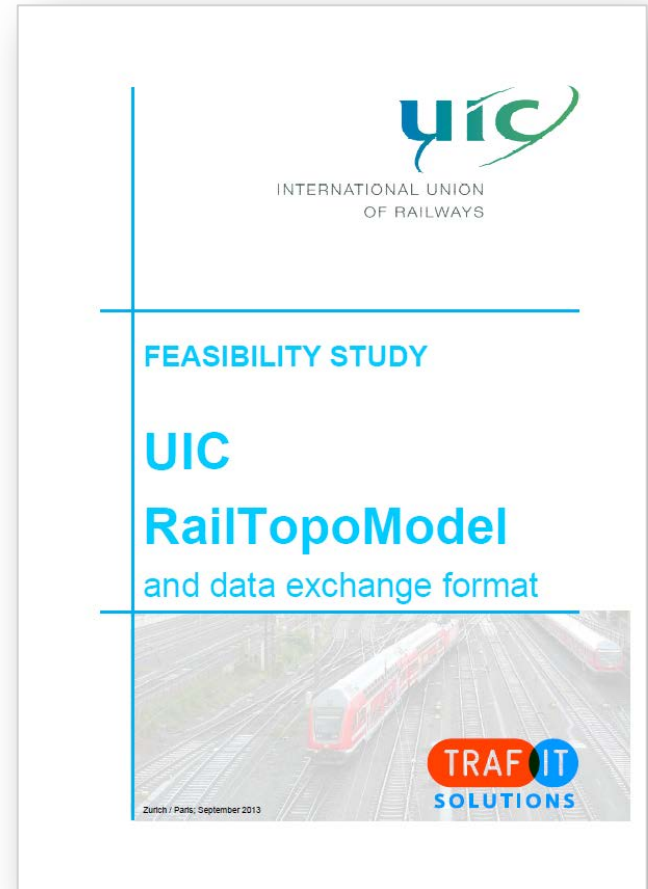
- Analyzing existing models:
  - RINF (EU)
  - INSPIRE (EU)
  - ARIANE (RFF)
  - InfraNet (Infrabel)
  - PPPROD / EADB / ADB (ÖBB)
  - Banedata (Jernbaneverket)
  - RINM (Network Rail)
- Analyzing the requirements for a generic railway topology model
- Roadmap for further development



# UIC RailTopoModel

## Feasibility Study (2/3)

- Results / conclusions:
  - 95% of features in the topology models are compatible (similar iron network)
  - Scalable core model is needed → predefined (common) and user specific (personalised) extensions
  - Topology = model core
  - Topology model should support levels of detail (micro, meso, macro, corridor)
  - The user decides which levels to fill

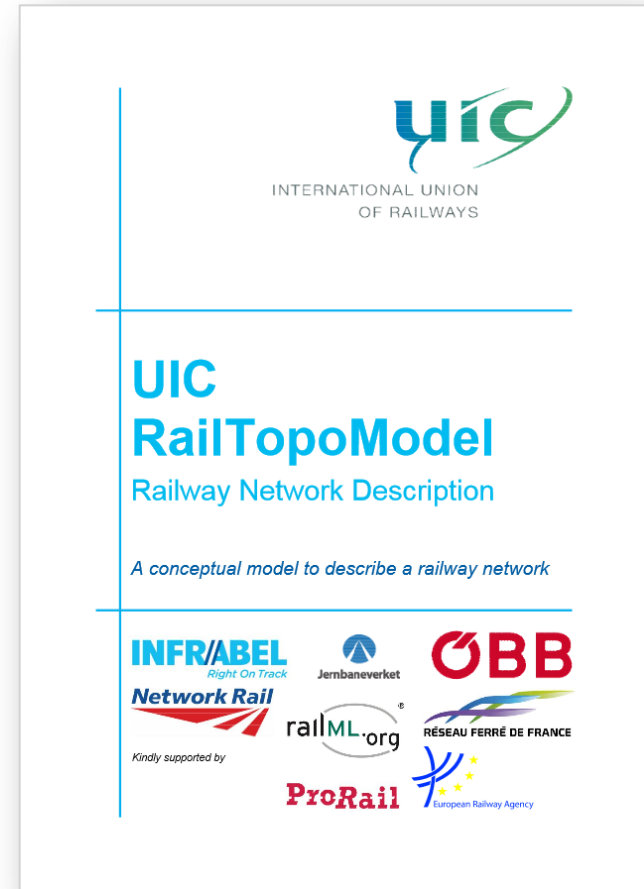




# UIC RailTopoModel

## The First Approach

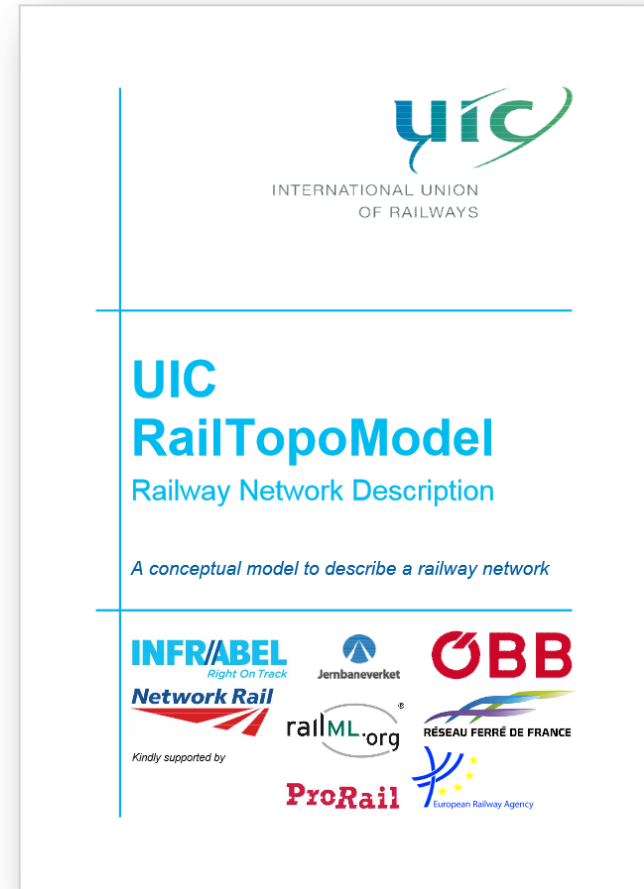
- RFF (IM France) and Infrabel (IM Belgium) initiated the development of a first version for a generic railway topology model
- Document available at [http://railml.org/tl\\_files/railML.org/documents/science/201213\\_UIC\\_RailTopoModel\\_DraftDec13.pdf](http://railml.org/tl_files/railML.org/documents/science/201213_UIC_RailTopoModel_DraftDec13.pdf)



# UIC RailTopoModel

## The First Approach

- **UIC RailTopoModel** = generic railway data model designed to support current and future business usages and needs
- **railML® 3** = a common railway data exchange format
- **Together**, they form the ERIM proposal of a standardized data exchange format

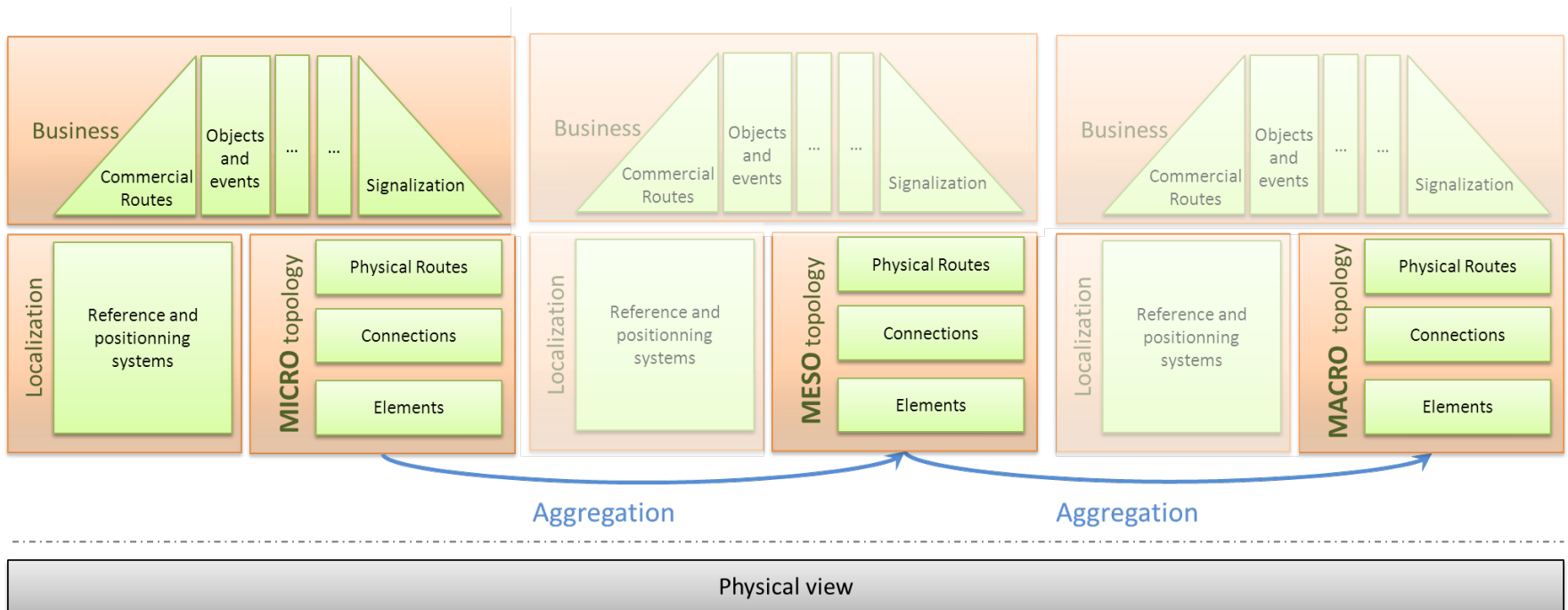


# UIC RailTopoModel

## Concepts

➤ Layers:

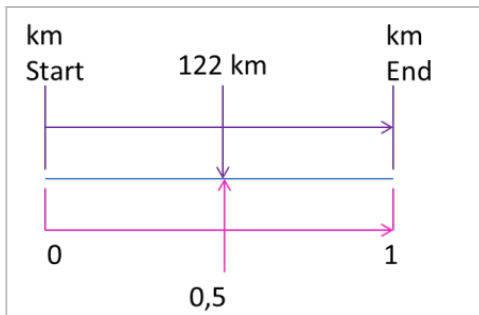
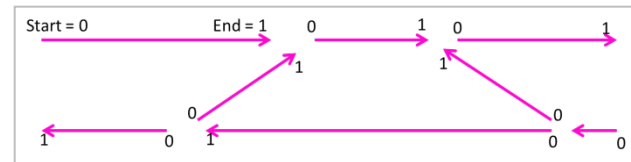
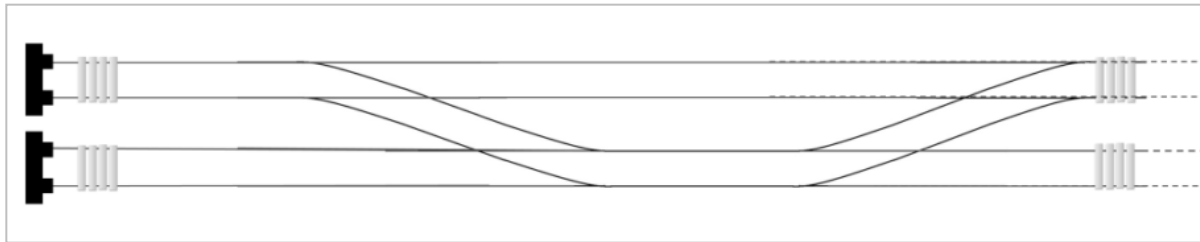
➤ Localisation and topology both form the basis for each layer



# UIC RailTopoModel

## Concepts

➤ Localisation (1/3):

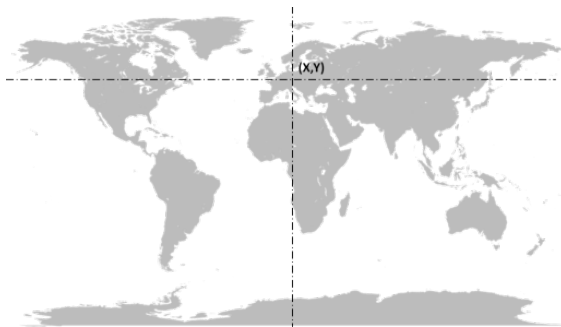


Linear positioning system  
Intrinsic positioning system

# UIC RailTopoModel

## Concepts

➤ Localisation (2/3):



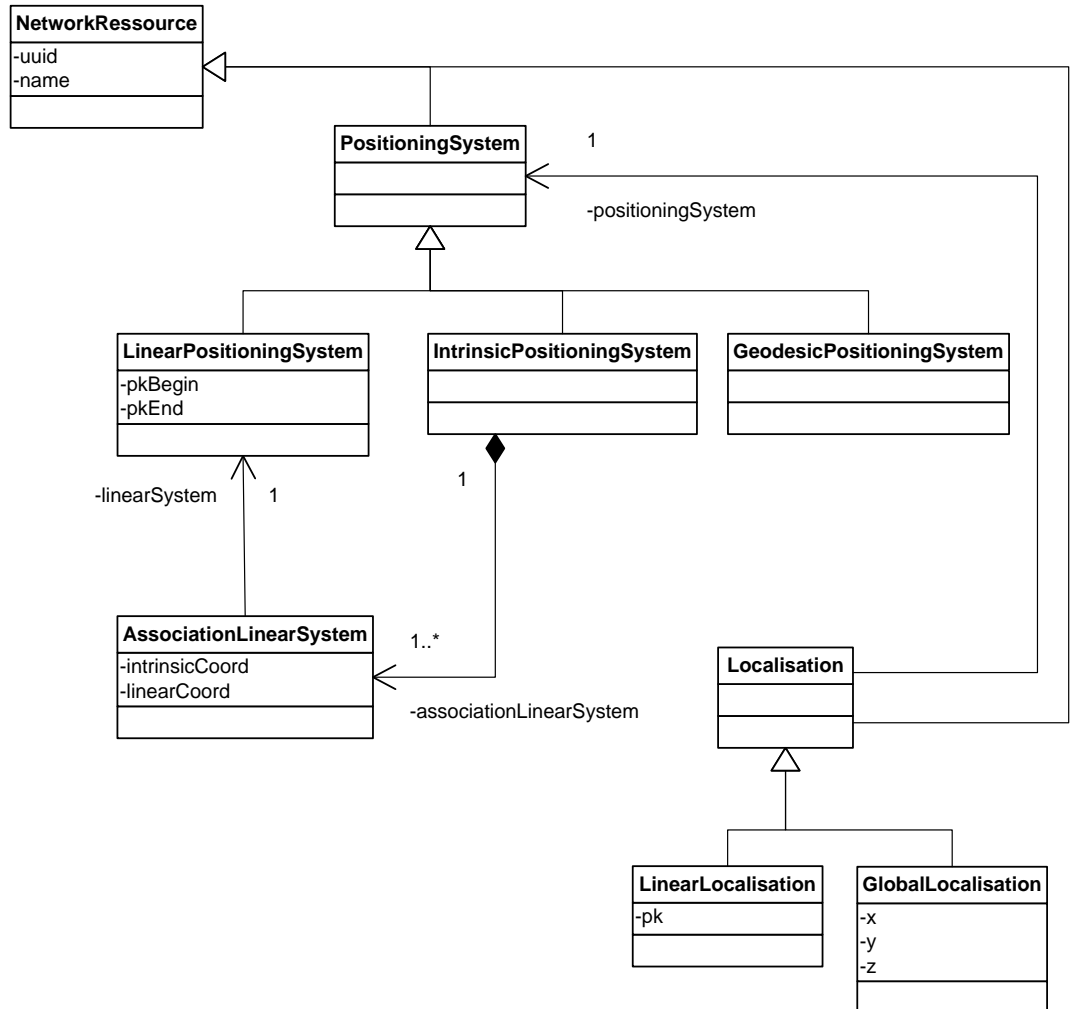
Geodesic positioning system  
(WGS84 coordinates)



# UIC RailTopoModel

## Concepts

➤ Localisation (3/3):

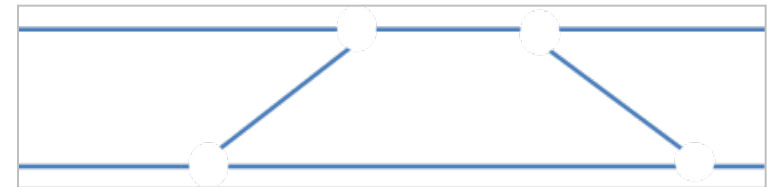


# UIC RailTopoModel

## Concepts

➤ Topology on **Micro Level**:

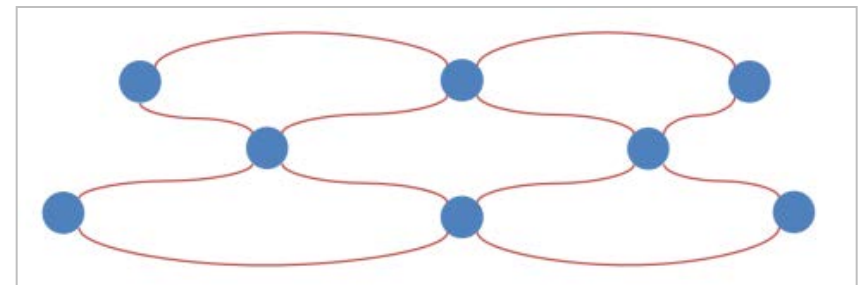
➤ Functional view: edges



➤ Model view: NetElements



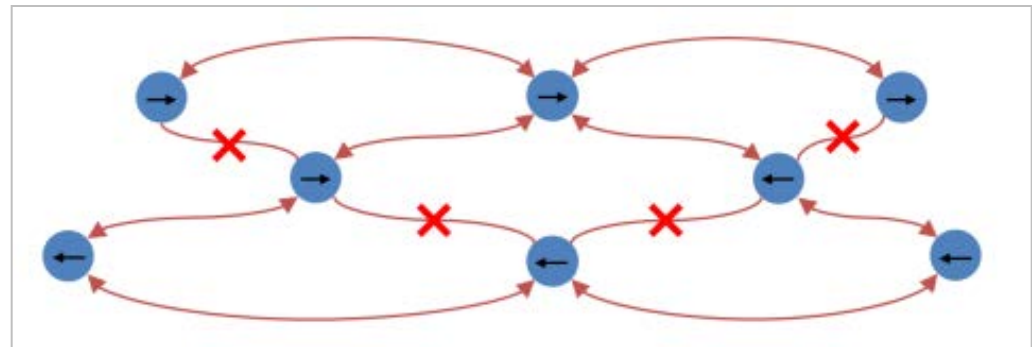
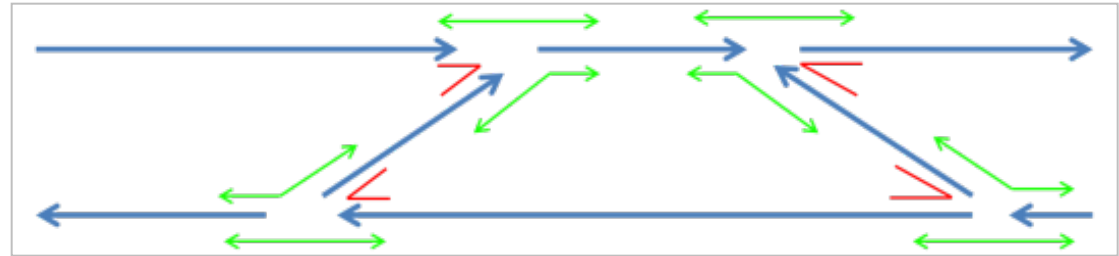
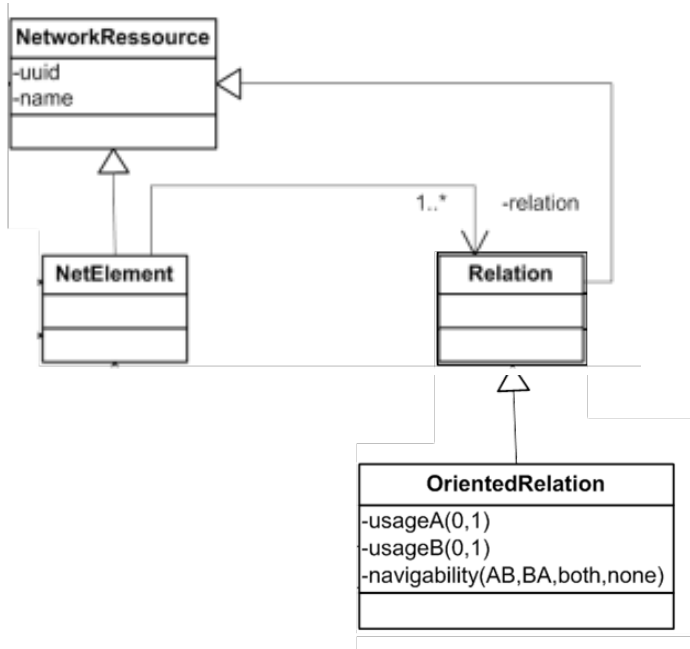
➤ “Connexitiy graph”



# UIC RailTopoModel

## Concepts

➤ Topology on **Micro Level**: Physical routes



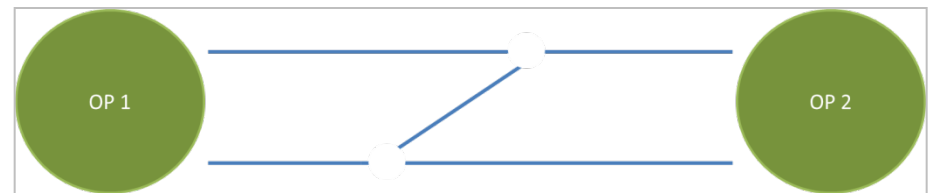


# UIC RailTopoModel

## Concepts

### ➤ Topology on **Meso Level**:

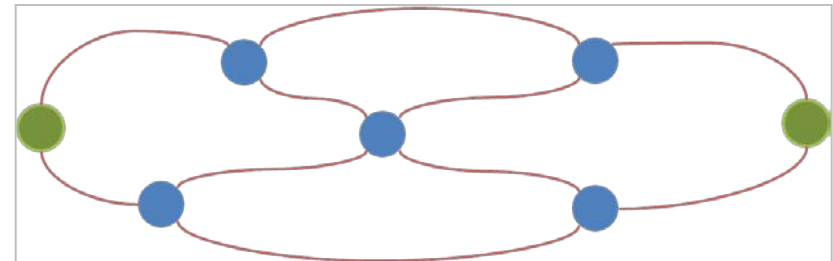
➤ Functional view:  
nodes and edges



➤ Model view:  
NetElements



➤ “Connexitiy graph”



# UIC RailTopoModel

## Concepts

➤ Topology on **Macro Level**:

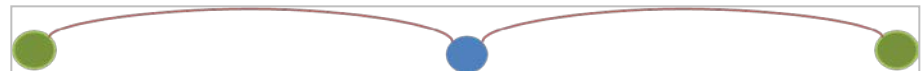
➤ Functional view:  
nodes and edges



➤ Model view:  
NetElements



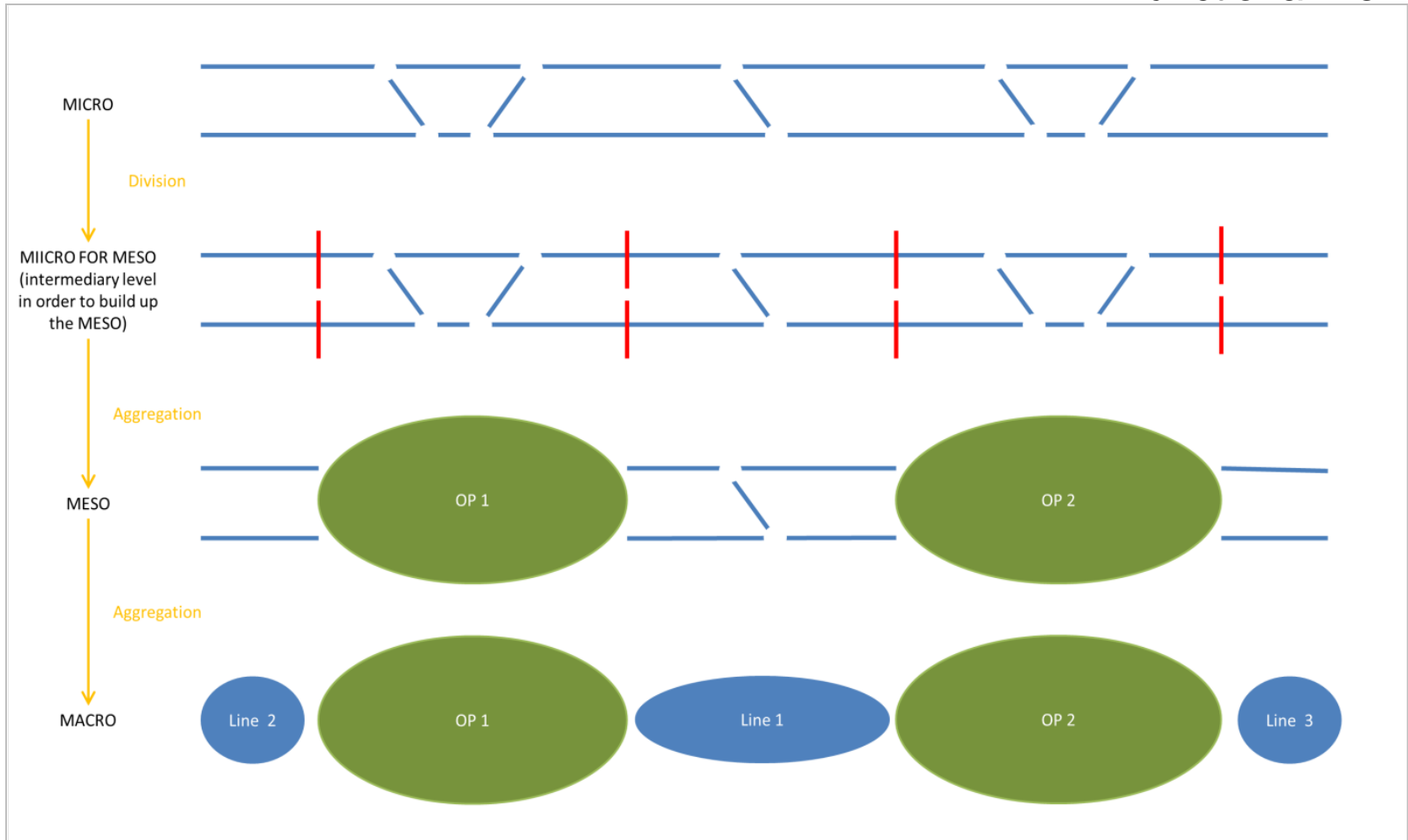
➤ “Connexitiy graph”



# UIC RailTopoModel

## Aggregation of Levels of Detail

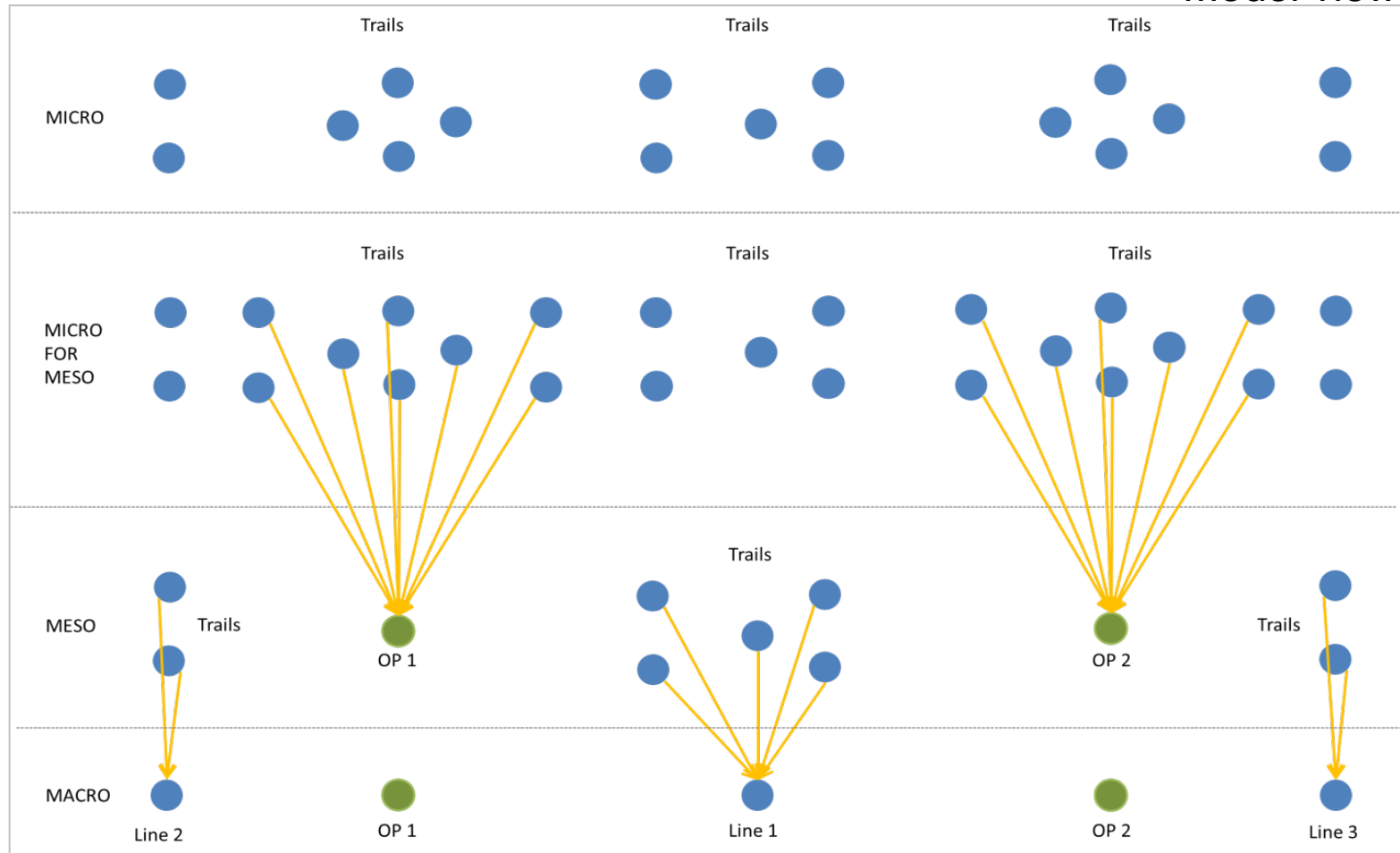
Functional view



# UIC RailTopoModel

## Aggregation of Levels of Detail

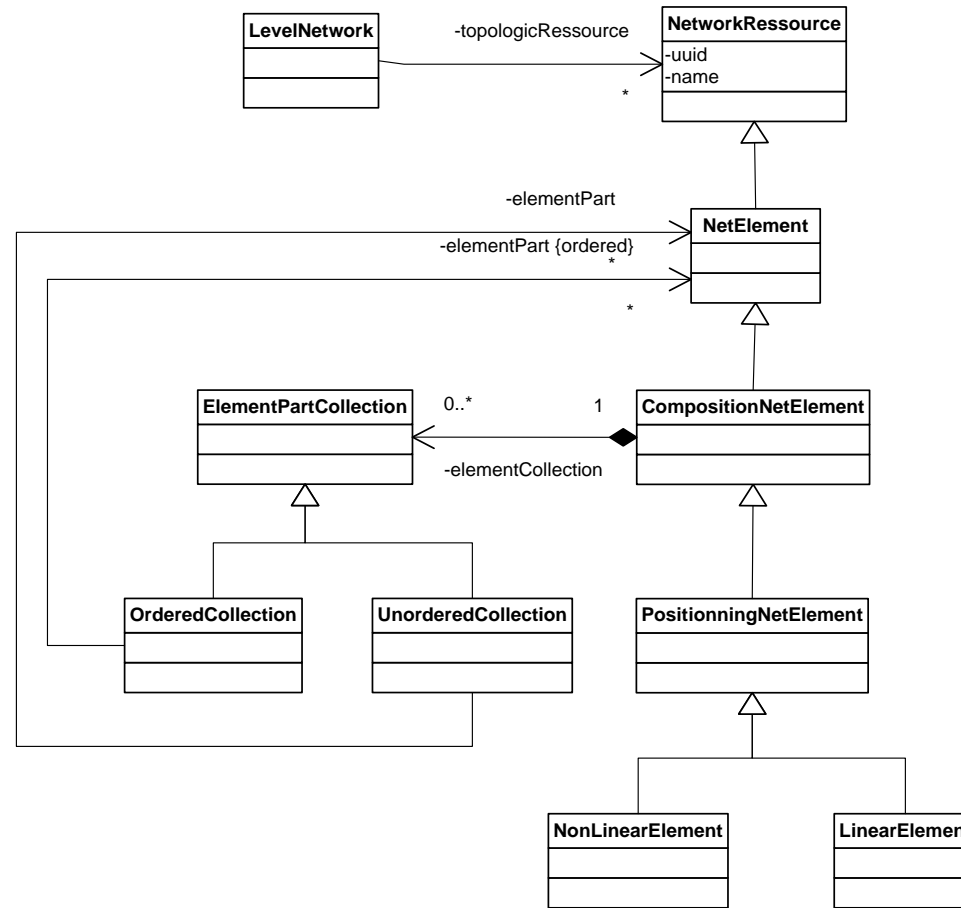
Model view



# UIC RailTopoModel

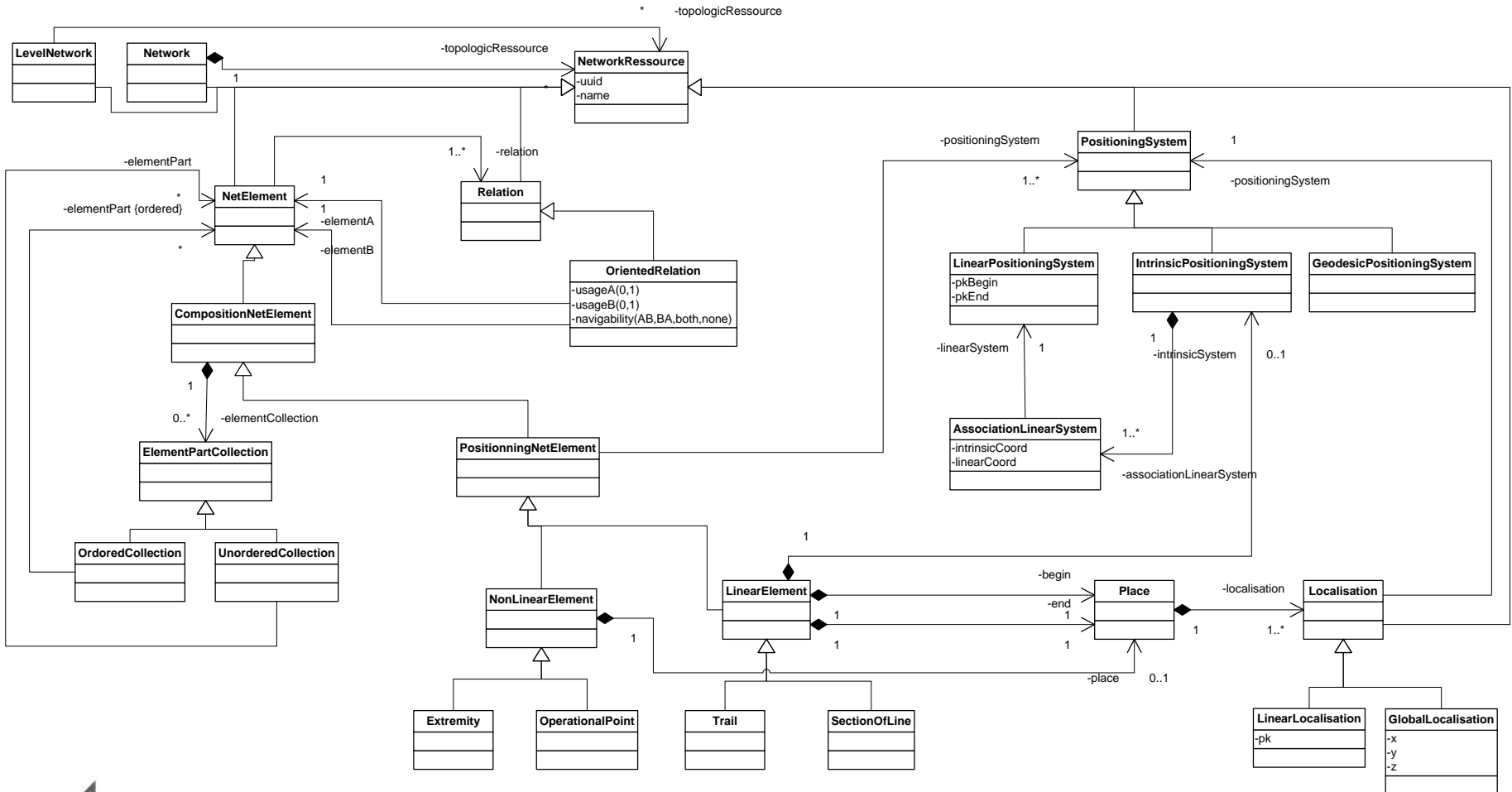
## Aggregation of Levels of Detail

UML



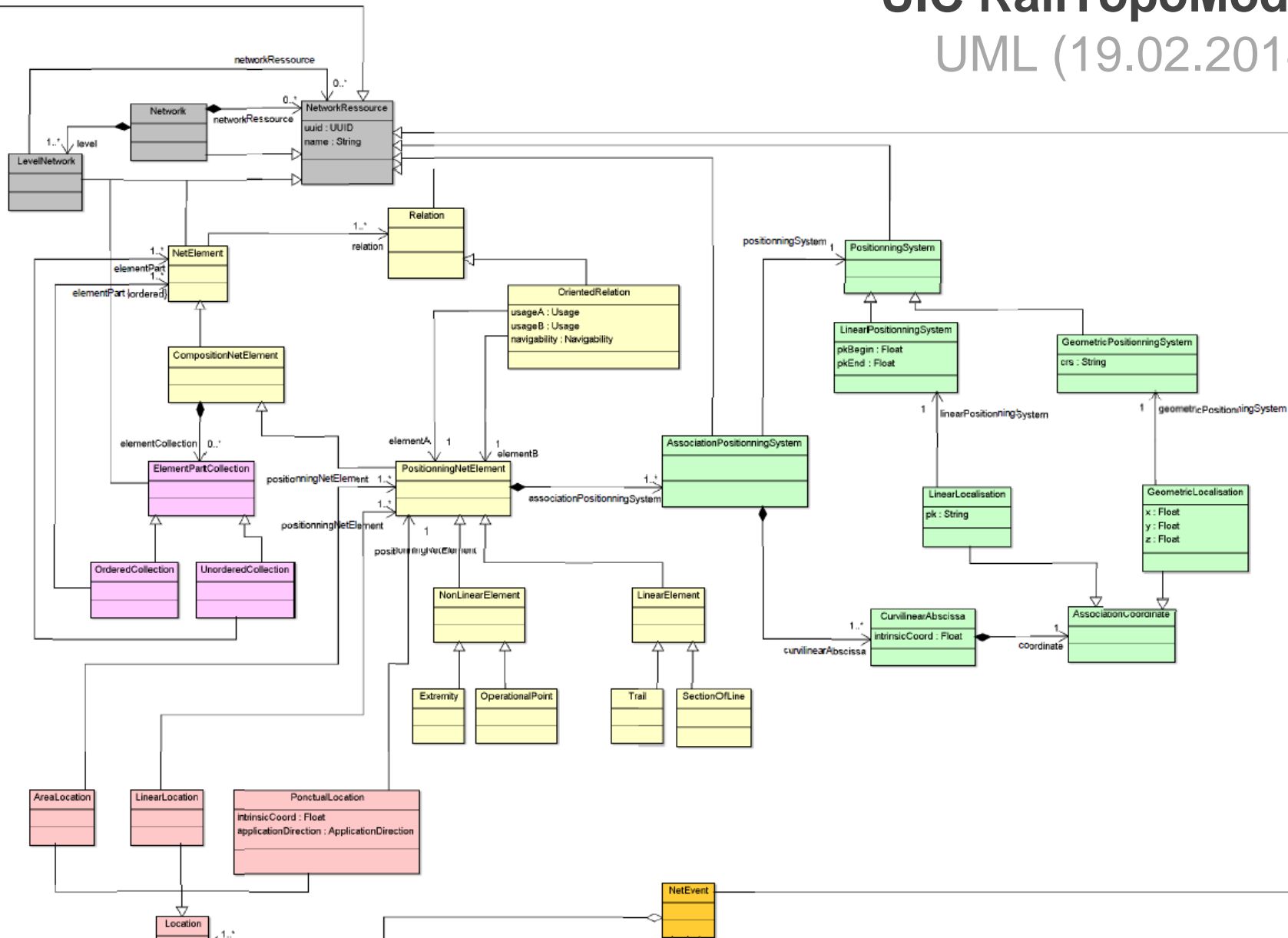
# UIC RailTopoModel

## UML (07.01.2014)



# UIC RailTopoModel

## UML (19.02.2014)





# RAILML-4-RINF



DLR

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in der Helmholtz-Gemeinschaft

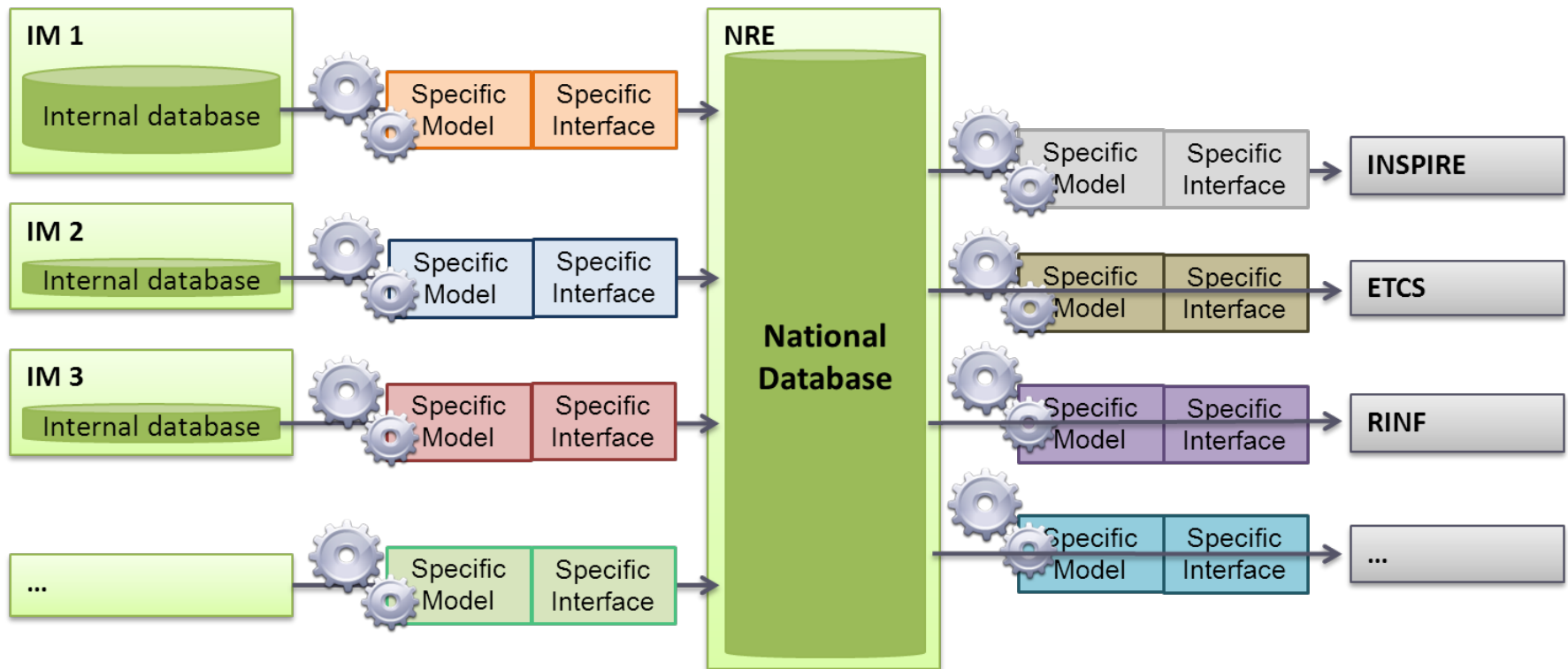




# railML-4-RINF

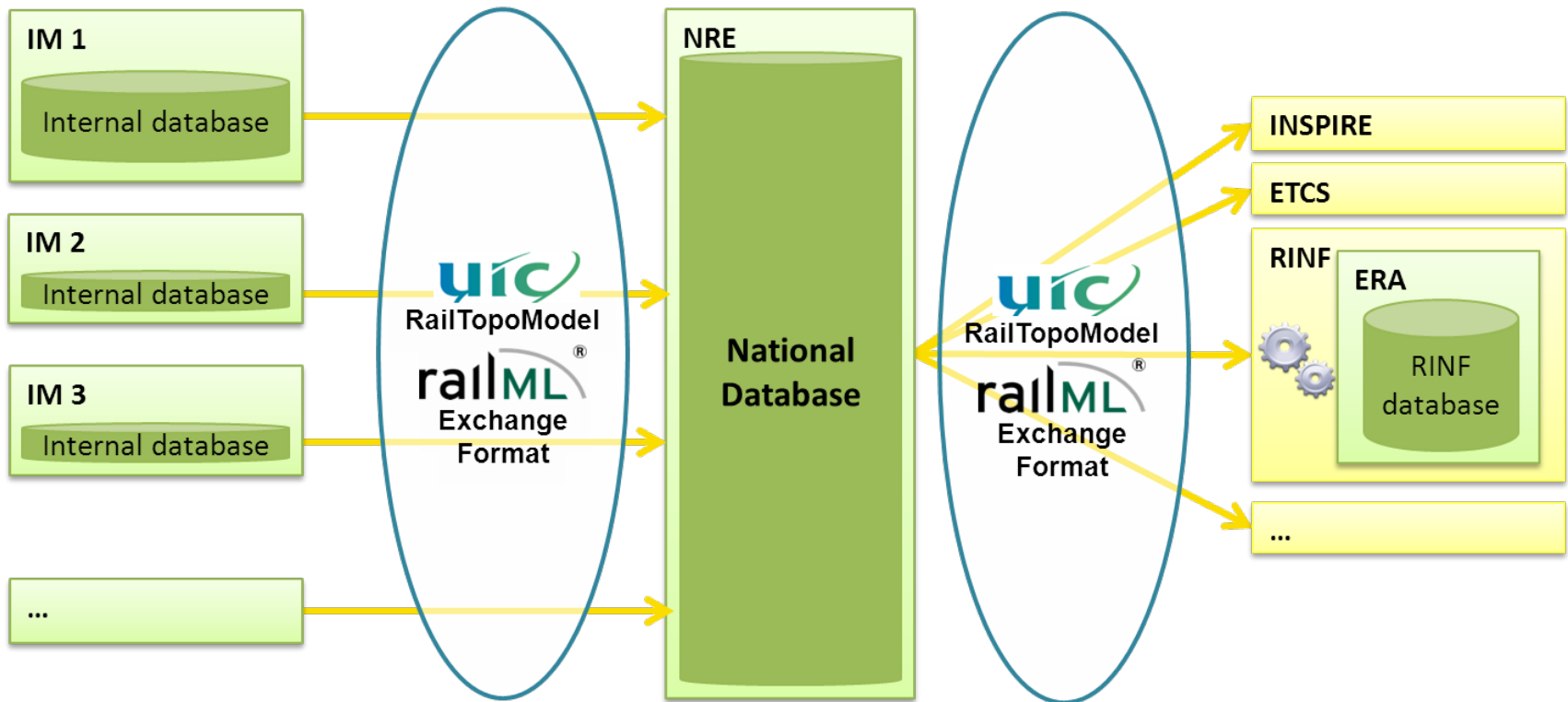
## Current Situation

➤ RINF... Register of Railway Infrastructure (EU)



# railML-4-RINF

## Future Situation?





# DISCUSSION



DLR

Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft

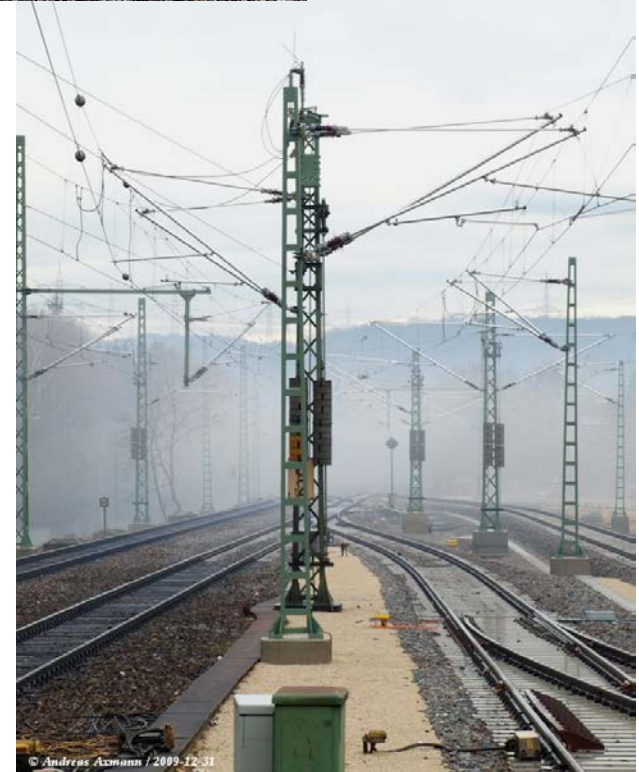


# Geo-Coordinates

➤ What is the smallest unit?



● (x, y, z)



<http://kbs761.startbilder.de/>



Deutsches Zentrum  
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in der Helmholtz-Gemeinschaft



# Geo-Coordinates

The basis of all?

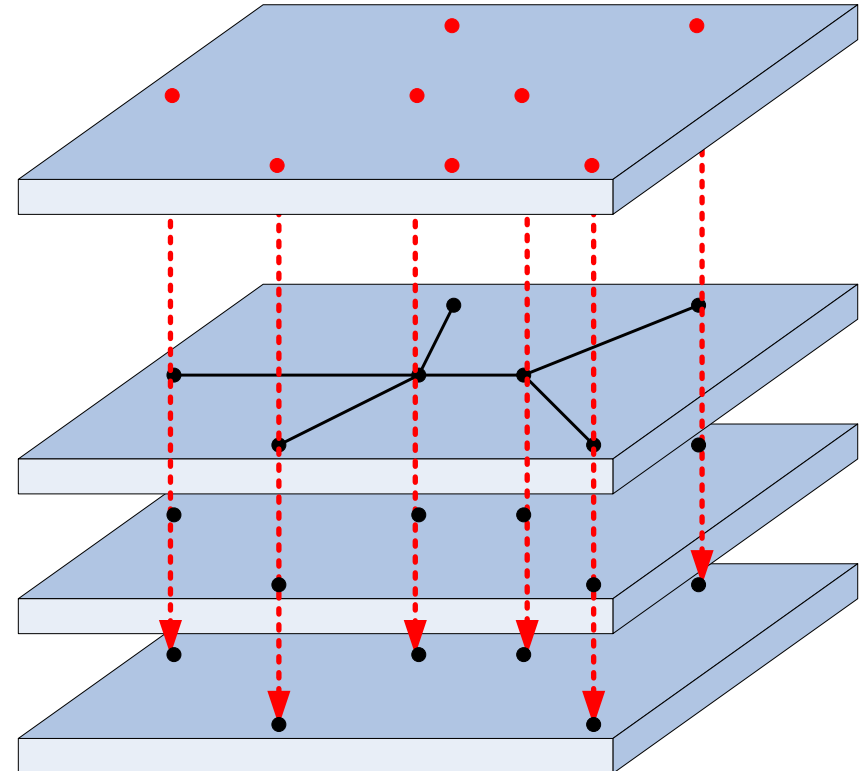
- Smallest unit is the point in 4D (lat, lon, alt, t)
- All other elements consist of a number of elements of this smallest unit

Punkte-Layer  
→ Koordinatenebene

Topologie-Layer

Themen-Layer 1

Themen-Layer n





# Geo-Coordinates

The basis of all?

- Smallest unit is the point in 4D (lat, lon, alt, t)
- All other elements consist of a number of elements of this smallest unit

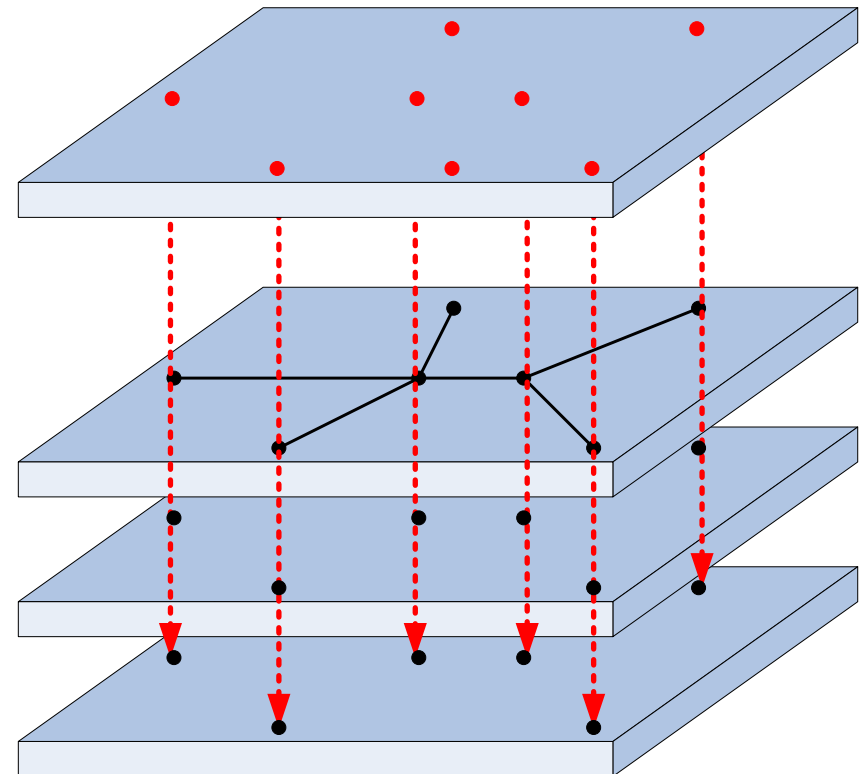
Are there any objects without coordinates?

Punkte-Layer  
→ Koordinatenebene

Topologie-Layer

Themen-Layer 1

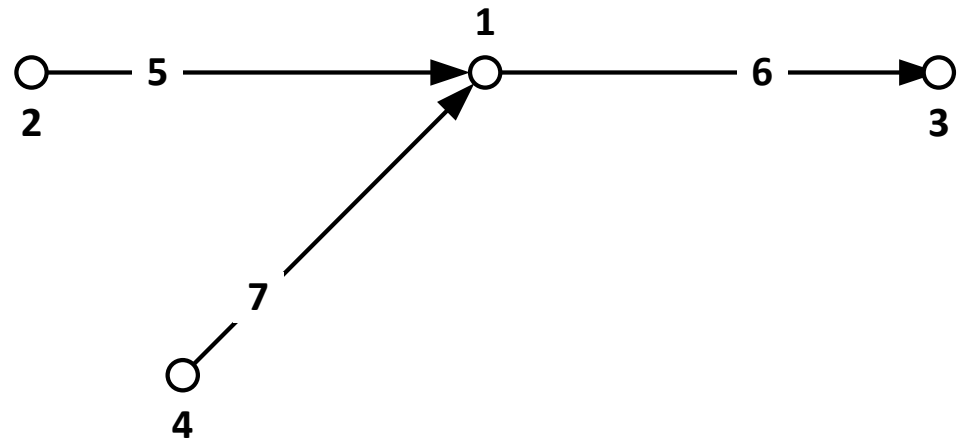
Themen-Layer n



# Topology model

## Edge vertex graph

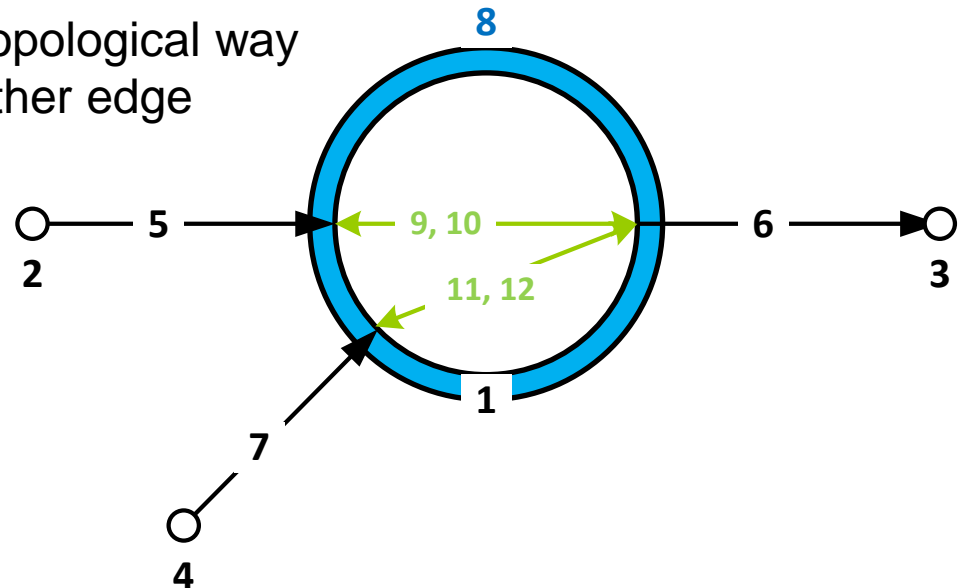
- Possible approach within railML 3.0:
  - node
  - edge



# Topology model

## Extended edge-vertex graph

- Possible approach within railML 3.0:
  - node
  - edge
  - **intersection** groups connections
  - **connection** defines topological way from one edge to another edge

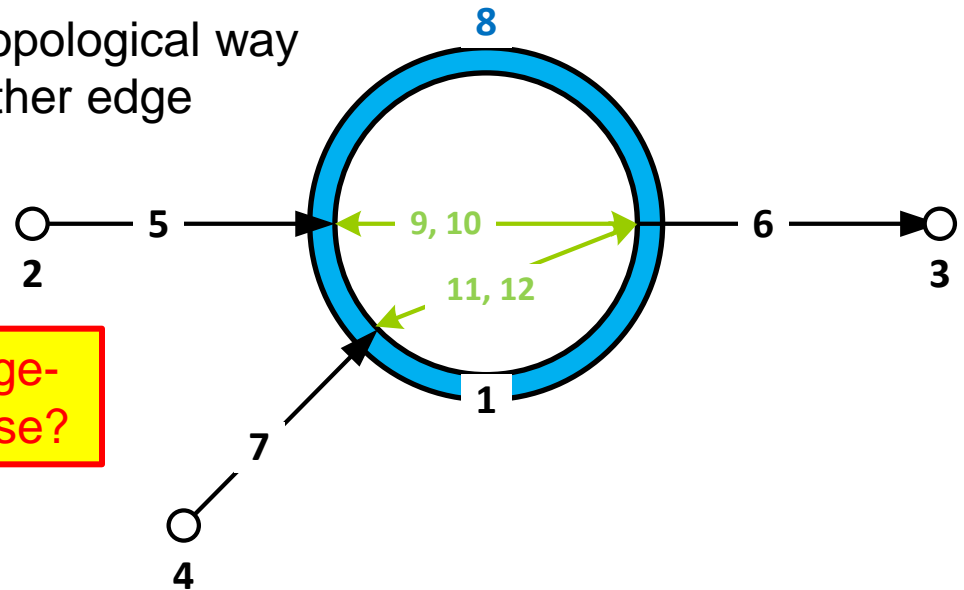




# Topology model

## Extended edge-vertex graph

- Possible approach within railML 3.0:
  - node
  - edge
  - **intersection** groups connections
  - **connection** defines topological way from one edge to another edge



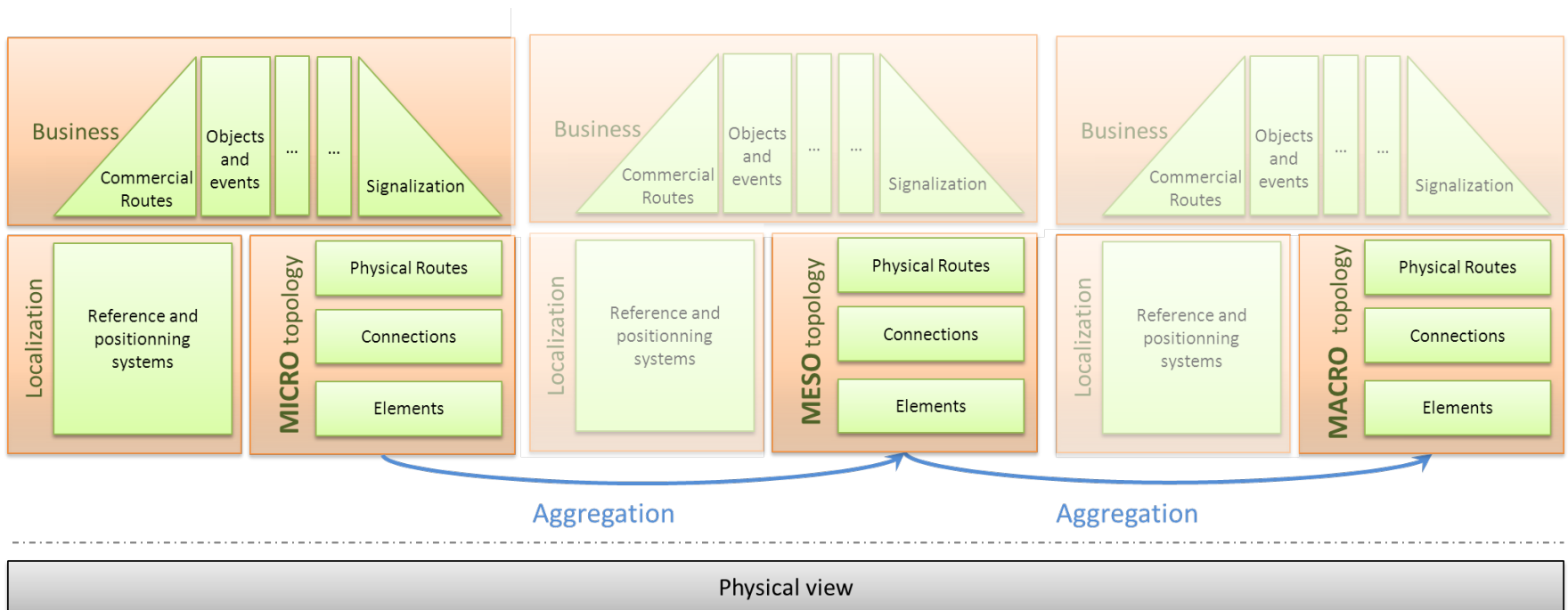
Connexitiy graph or extended edge-vertex graph? What is better to use?

# Topology model

The basis of all?

➤ Layers:

➤ Localisation and topology both form the basis for each layer



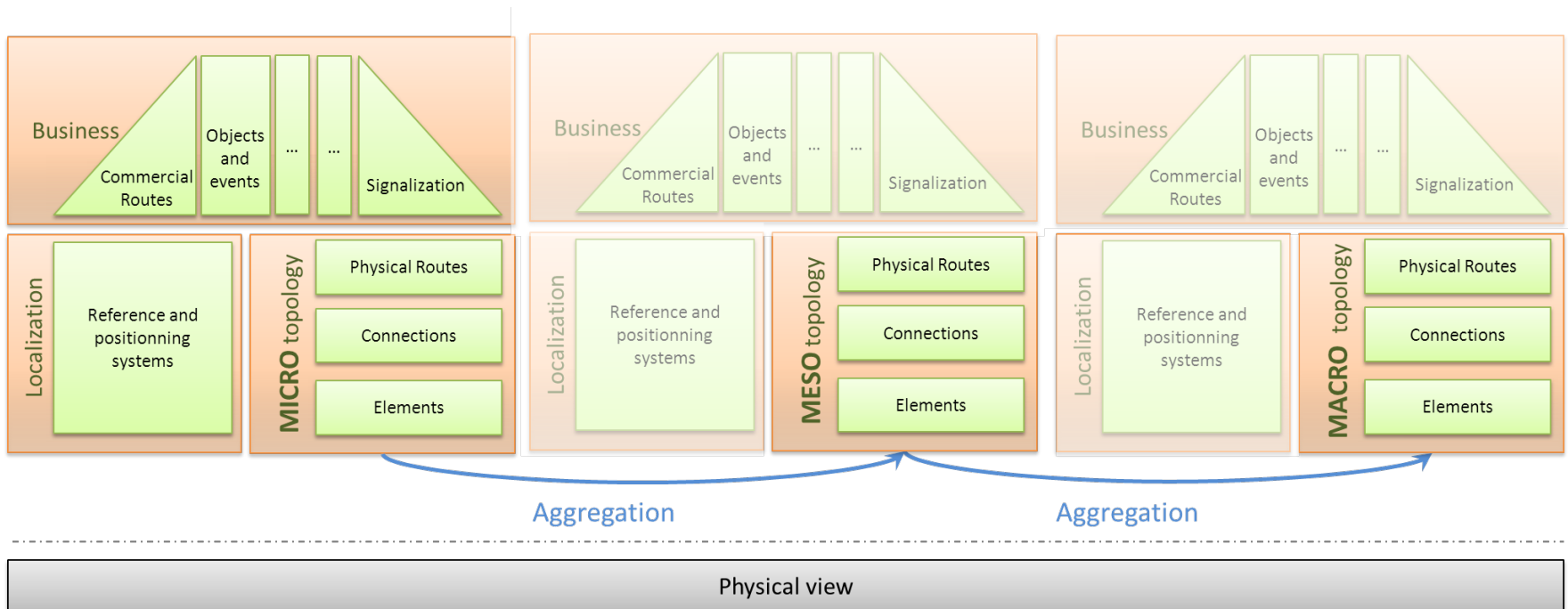
# Topology model

The basis of all?

Are there any objects that are not situated in a topologic network?

➤ Layers:

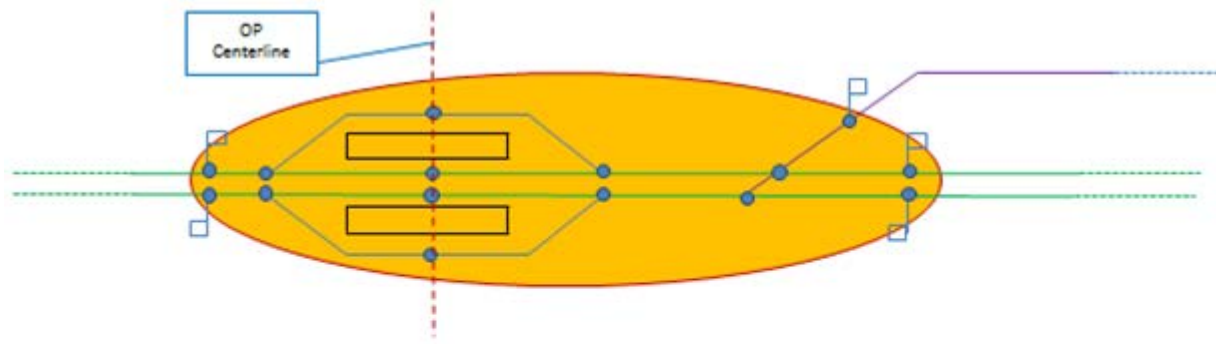
➤ Localisation and topology both form the basis for each layer



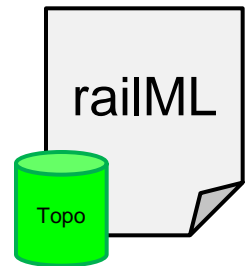
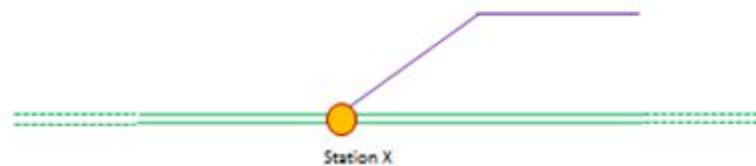
# Topology model

Modelling various levels of details

➤ Micro



➤ Meso

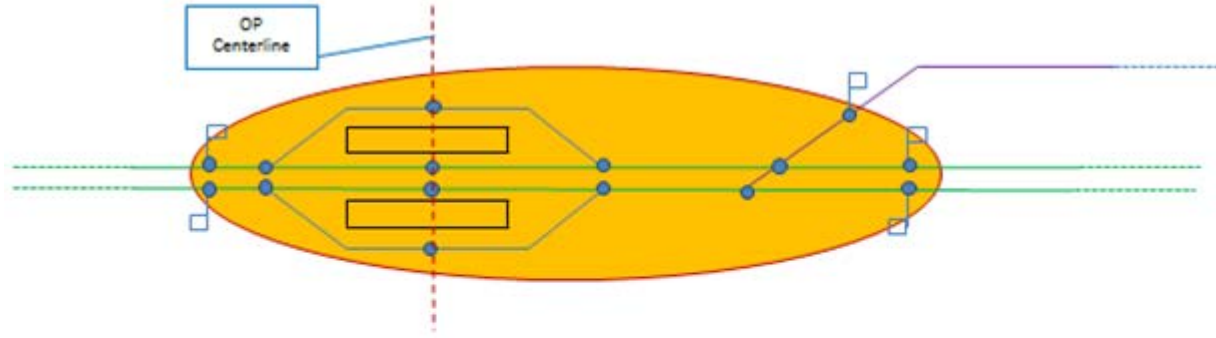


# Topology model

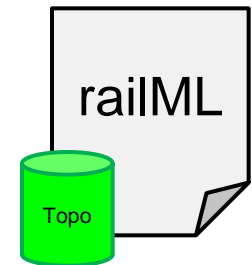
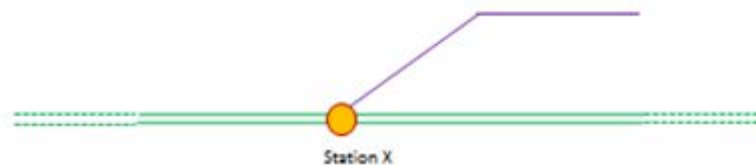
Modelling various levels of details

Should it be possible to have various levels of detail in one railML infrastructure file...?

➤ Micro



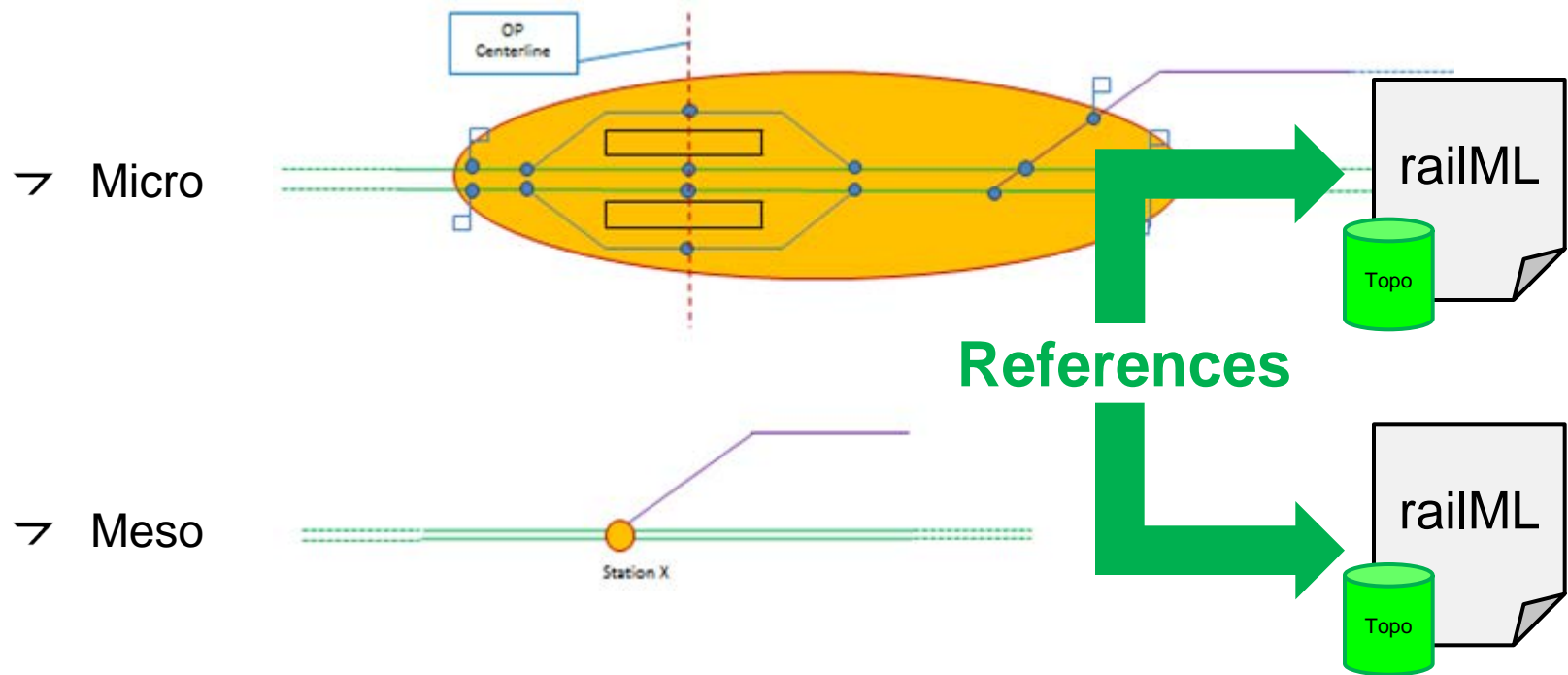
➤ Meso



# Topology model

Modelling various levels of details

... or is it better to reference between different files with different levels of detail?





# railML

timetable common  
rollingstock  
infrastructure

**Thank you for your attention!**

*Christian Rahmig*  
*coord@infrastructure.railML.org*

