



**ČVUT**  
ČESKÉ VYSOKÉ  
UČENÍ TECHNICKÉ  
V PRAZE

# **RailTopoModel and RailSystemModel – Two Diverging Tracks?**

**Reflection of Modern Railways in Education and Research  
Prague • 28<sup>th</sup> of May 2025**

**Czech Technical University in Prague  
Faculty of Transportation Sciences  
Department of Transport Telematics  
Ing. Adam Hlubuček, Ph.D.**

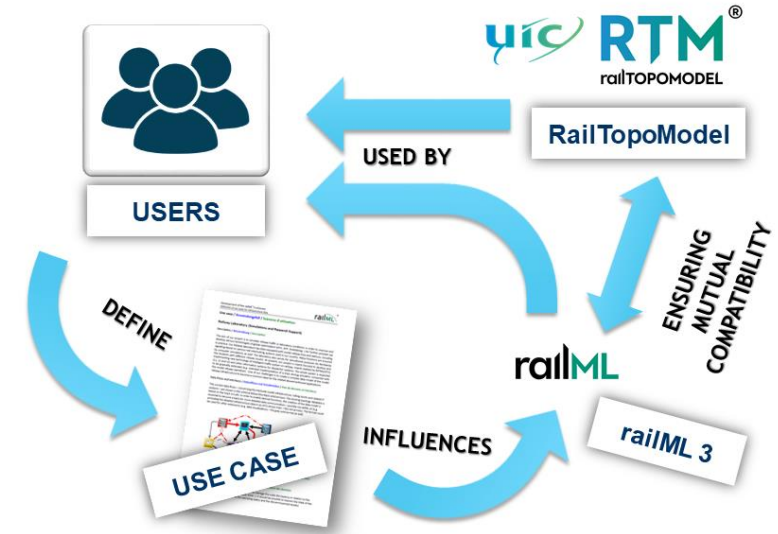
# Content

- *Introduction to the Issue*
- *RailTopoModel*
  - *Version Timeline*
  - *Packages*
  - *v1.5 Packages Compared to v1.1*
- *RailSystemModel*
  - *v1.2 Packages Compared to RTM v1.1*
  - *New Packages*
- *Comparison of RTM v1.5 and RSM v1.2 in Diagrams*
- *Conclusions*



## Introduction to the Issue

- *development of software applications using railway data*
- *increasing importance of data models describing railway infrastructure*
- *diverse approaches to modelling*
- *efforts to standardize railway infrastructure data modelling processes*
- *RailTopoModel created by UIC, later developed together with railML 3*
- *RailSystemModel evolved by extending the original RailTopoModel specifications*



**[ RSM ] v1.2 ext**

**RSM**  
railSystemModel

RailSystemModel (RSM) provides a structural backbone model to foster digital continuity across railway domains and business processes. RSM cooperates with Expert Projects in their respective domains (for example Eulynx for signaling, IfcRail for BIM process, ...).

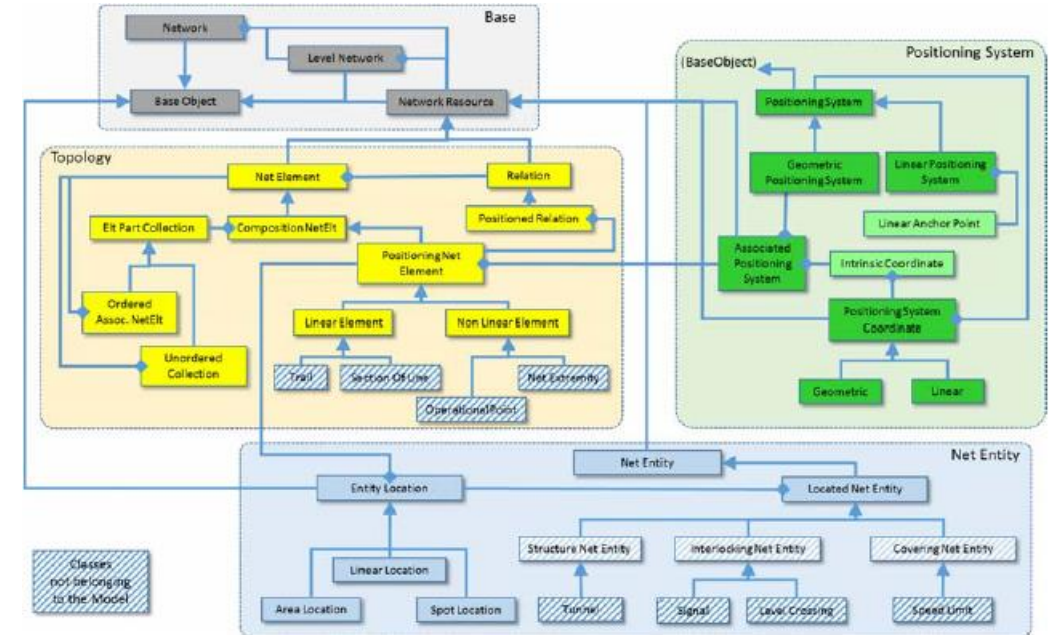
- 36 Packages
- 248 Classes
- 303 Properties
  - incl. 98 uml:Aggregations
  - incl. 154 uml:Association
- 20 Enumerations
- 10 DataTypes
- 104 uml:Literal

Tree Browser

EUPL 1.2 International License.

# RailTopoModel

- *generic logical object model to standardize the representation of railway infrastructure-related data*
- *version 1.0 published by UIC in 2016, under the designation IRS 30100 (International Railway Solution)*
- *respects the principle of separation of concepts (thematic packages)*
- *expressible using an UML class diagram*
- *developed in close cooperation with the railML 3 exchangeable data format (especially newer versions of RTM)*



source : IRS 30100

## RailTopoModel • Version Timeline

version	release date	supported until	comment
<b>0.x</b>	<b>2013 – 2016</b>	<b>December 2016</b>	<b>beta versions; internal usage only</b>
<b>1.0</b>	<b>18<sup>th</sup> of April 2016</b>	<b>6<sup>th</sup> of November 2017</b>	<b>under patronage of UIC; also known as IRS 30100</b>
<b>1.1</b>	<b>6<sup>th</sup> of November 2017</b>	<b>19<sup>th</sup> of February 2019</b>	<b>under patronage of UIC; bugfixes only</b>
<b>1.2</b>	<b>19<sup>th</sup> of February 2019</b>	<b>not yet announced</b>	<b>used in railML<sup>®</sup> 3.1</b>
<b>1.3</b>	<b>version not used to avoid confusion with forks of the same name from other projects</b>		
<b>1.4</b>	<b>26<sup>th</sup> of April 2022</b>	<b>not yet announced</b>	<b>used in railML<sup>®</sup> 3.2</b>
<b>1.5</b>	<b>5<sup>th</sup> of November 2024</b>	<b>not yet announced</b>	<b>used in railML<sup>®</sup> 3.3</b>

source of the data: <https://www.railtopomodel.org/state-of-development>





## **RailTopoModel • Packages**

- *Base – general abstract classes for object with identification and name*
- *Network – objects forming a network at different levels of detail (since version 1.1, separated from the Base package)*
- *Topology – aggregable net elements connected by relations*
- *Location – spot, linear and area location of net entities to net elements*
- *Positioning System – linear and geometric coordinates of linear and geometric positioning systems, associated positioning systems and intrinsic coordinates*
- *Net Entity – objects and features of railway infrastructure (since version 1.1, separated from the Location package)*

## **RailTopoModel · v1.5 Packages Compared to v1.1**

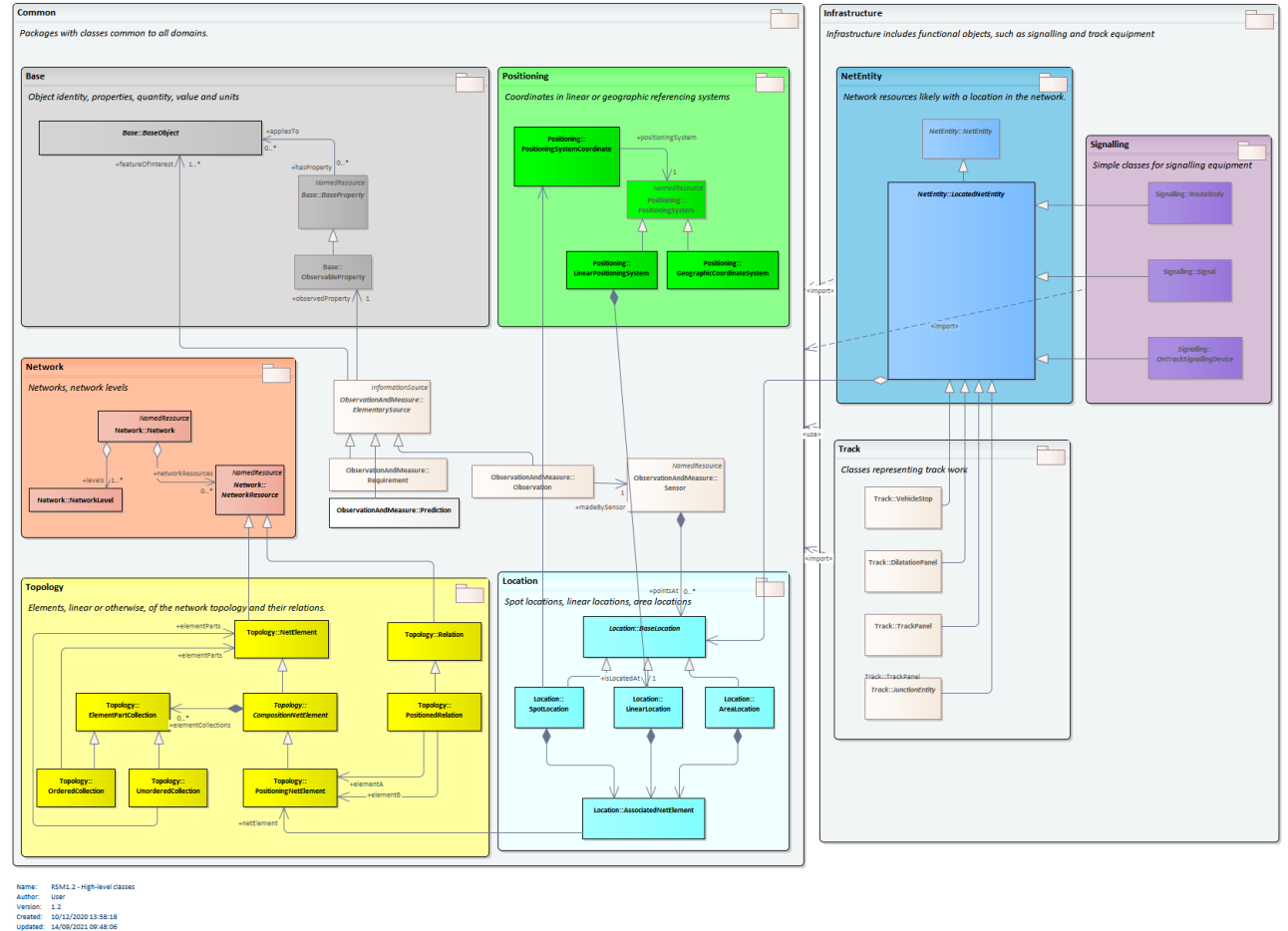
- *Base – multiple object naming and validity of network resources introduced*
- *Network – network is no longer considered an aggregation of network resources*
- *Topology – slightly modified structure (e.g. use of NetRelation class instead of PositionedRelation), implementation of the connector concept (based on the proposal of the author of this paper)*
- *Location – the attribute keepsOrientation of the AssociatedNetElement class removed, the class OrderedAssociatedNetElement removed*
- *Positioning System – new classes of associated positioning system coordinates for locations, extension of linear coordinate description*
- *Net Entity – no change (only top-level classes NetEntity and LocatedNetEntity)*

# RailSystemModel

- *successor of RTM (rebranded due to an extension of its scope)*
- *based on the same principles as RTM*
- *emphasizes the isolation of concepts, new domains*
- *specialized in other models (EULYNX DP, IFC Rail,...)*
- *for business purposes, it can be used "as is"*

## RSM1.2 - Overview of high-level classes

This diagram shows packages and important classes from RailSystemModel version 1.2. The figure is illustrative and does not represent the whole model, as some relations aren't shown for readability.



source : RSM 1.2



## **RailSystemModel · v1.2 Packages Compared to RTM v1.1**

- *Base – extended scope, in addition to name and identification, also the area of quantification and common quantities*
- *Network – scope similar to RTM, possibility of assigning net properties*
- *Topology – scope similar to RTM, extended by some details*
- *Positioning – scope similar to RTM, slightly revised and specializations added*
- *Location – scope similar to RTM, a more significant change in structure, although the basic principle remains*
- *Net Entity – at a general level, the scope remains the same as in RTM, shared locations are allowed*

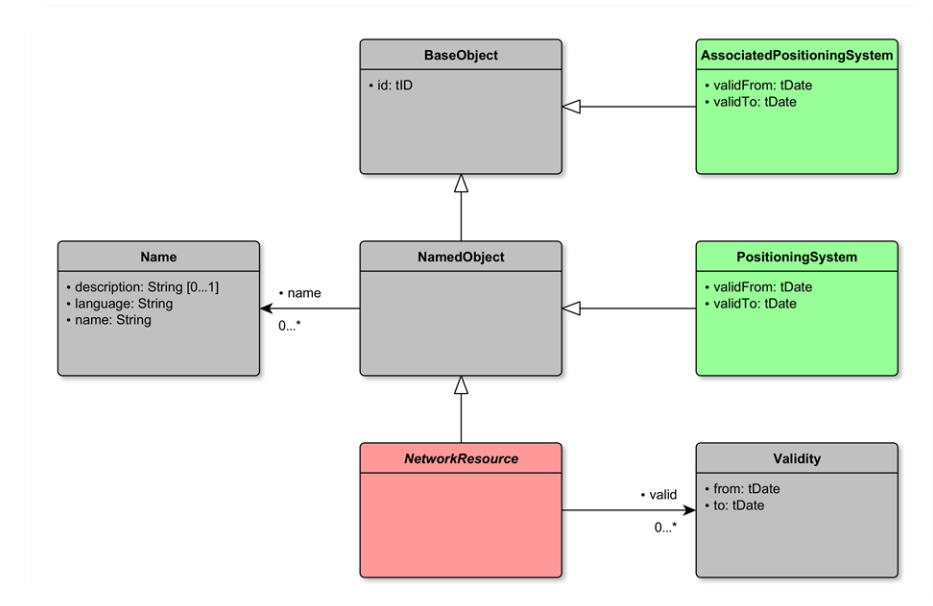


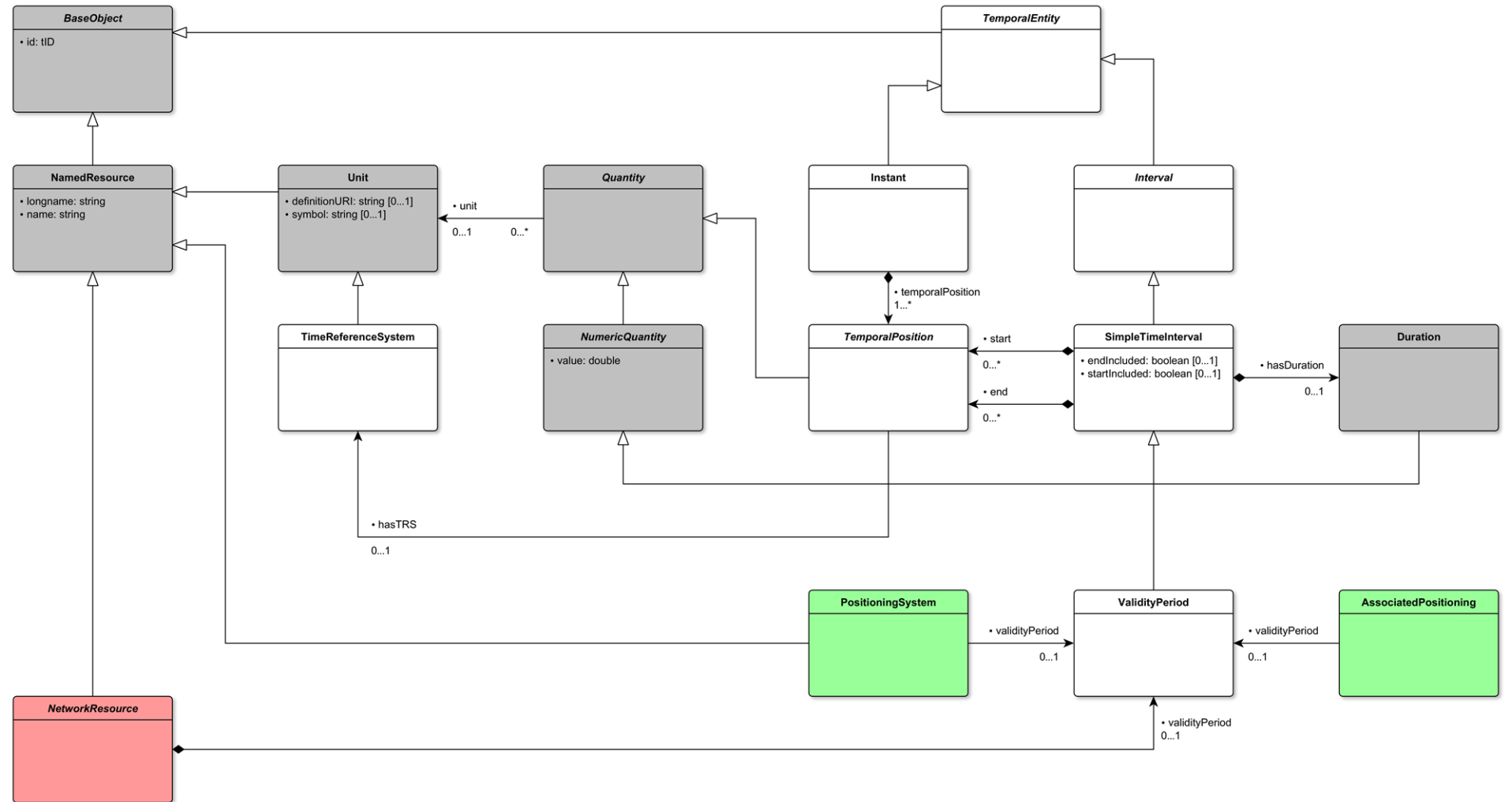
## **RailSystemModel • New Packages**

- *Geometry – alignment curves (horizontal, vertical, lateral inclination), 3D alignment curves, discretised point sets, unlike the railML approach, geometric objects are not considered net entities*
- *Observation and Measure – apparatus for expressing observations, specifications and predictions in terms of quantities*
- *Net Property – properties that can be assigned to a network or part of it*
- *Time Axis – aspects related to time features (e.g. instants and time intervals)*
- *Infrastructure – areas of specialized net entities, specifically the Track (also including Turnouts and Crossings), Signalling and Energy domains (not at a very detailed level)*
- *Environment – Legal Entities and Weather*

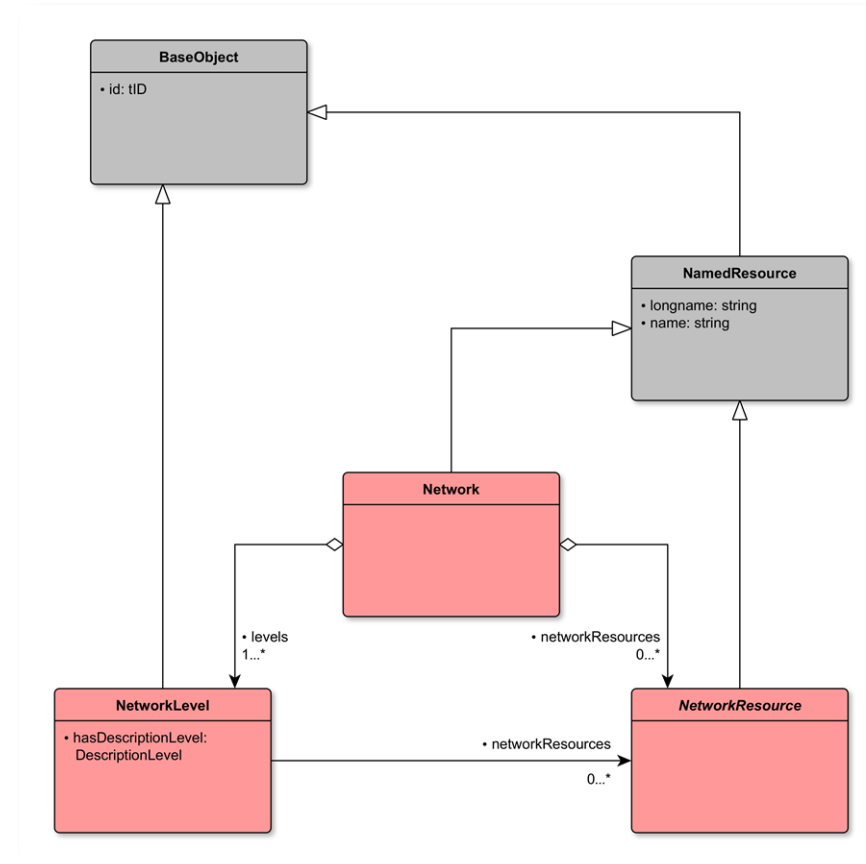
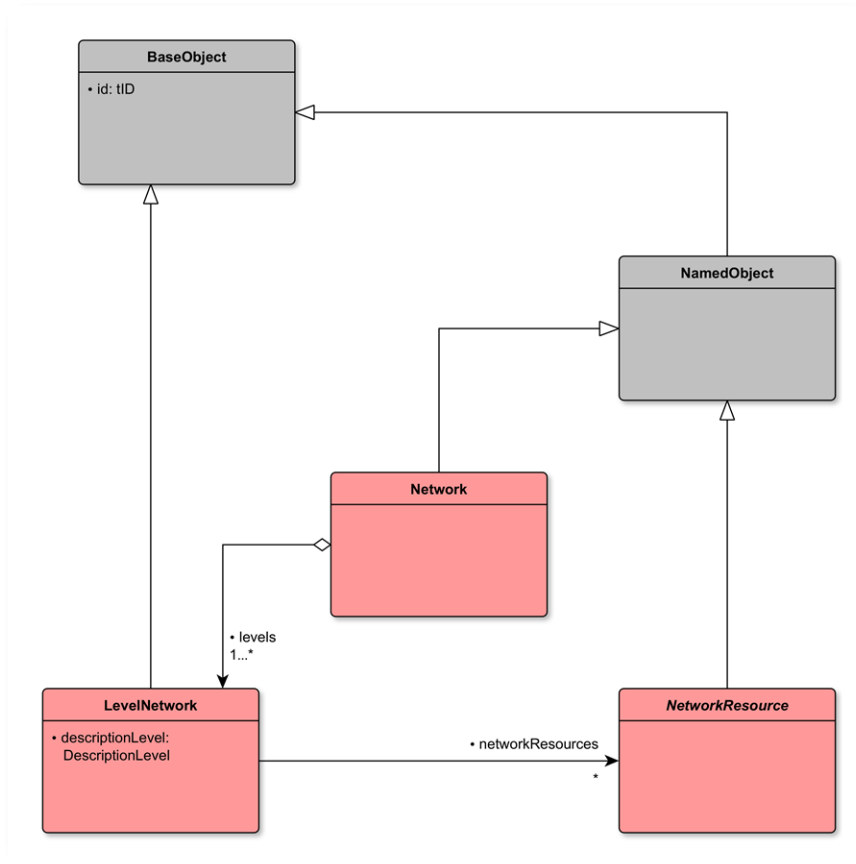
## Comparison of RTM v1.5 and RSM v1.2 in Diagrams

- *differences will be demonstrated on UML class diagrams focused on a specific aspect of modelling*
- *the classes of a certain package are dominant, connections with classes of other blocks are also shown (differentiated by colors)*
- *the comparison is not performer if there is no corresponding representation of some fact in both models*

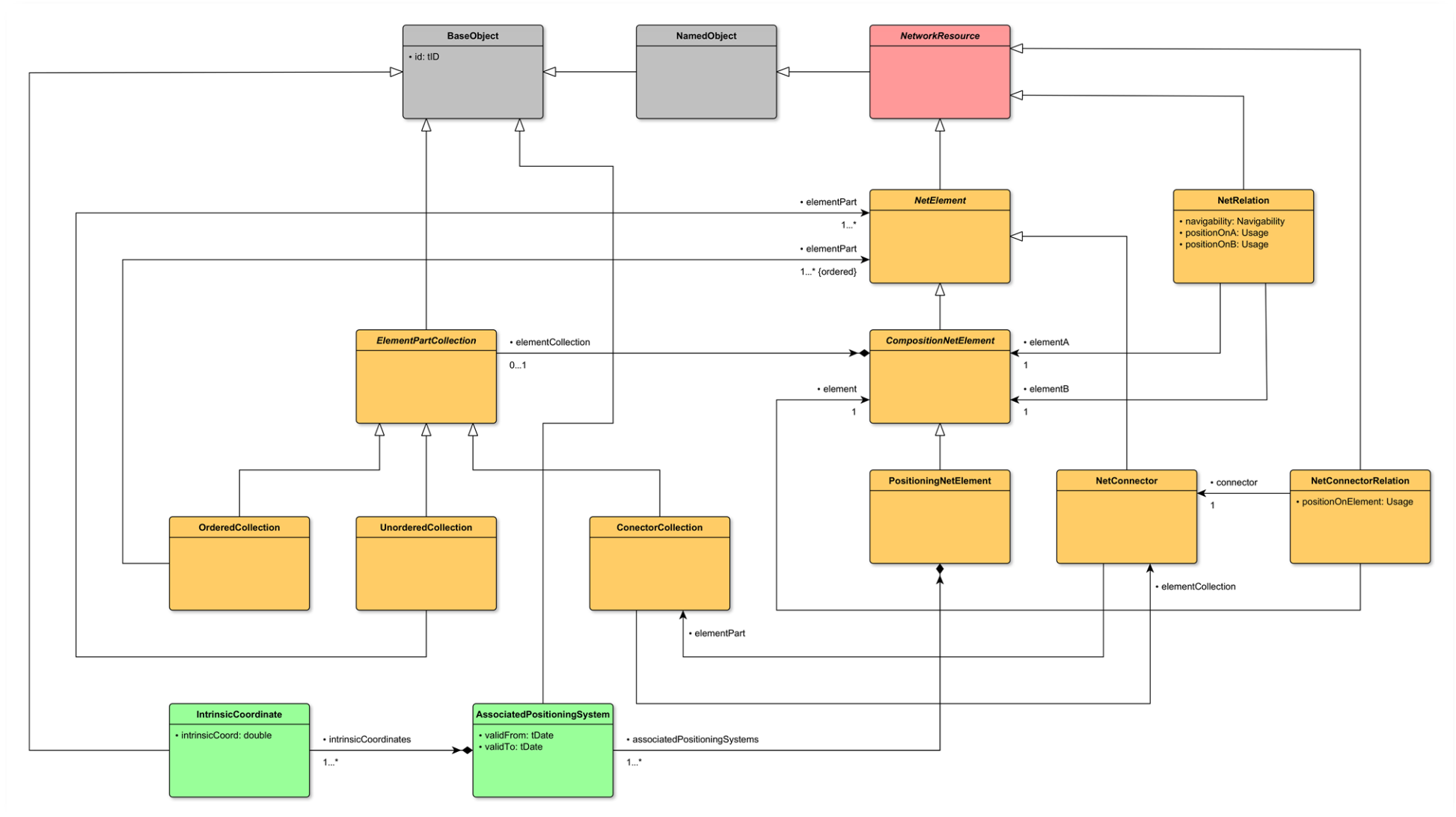




**RailSystemModel v1.2: Identification, naming and validity**

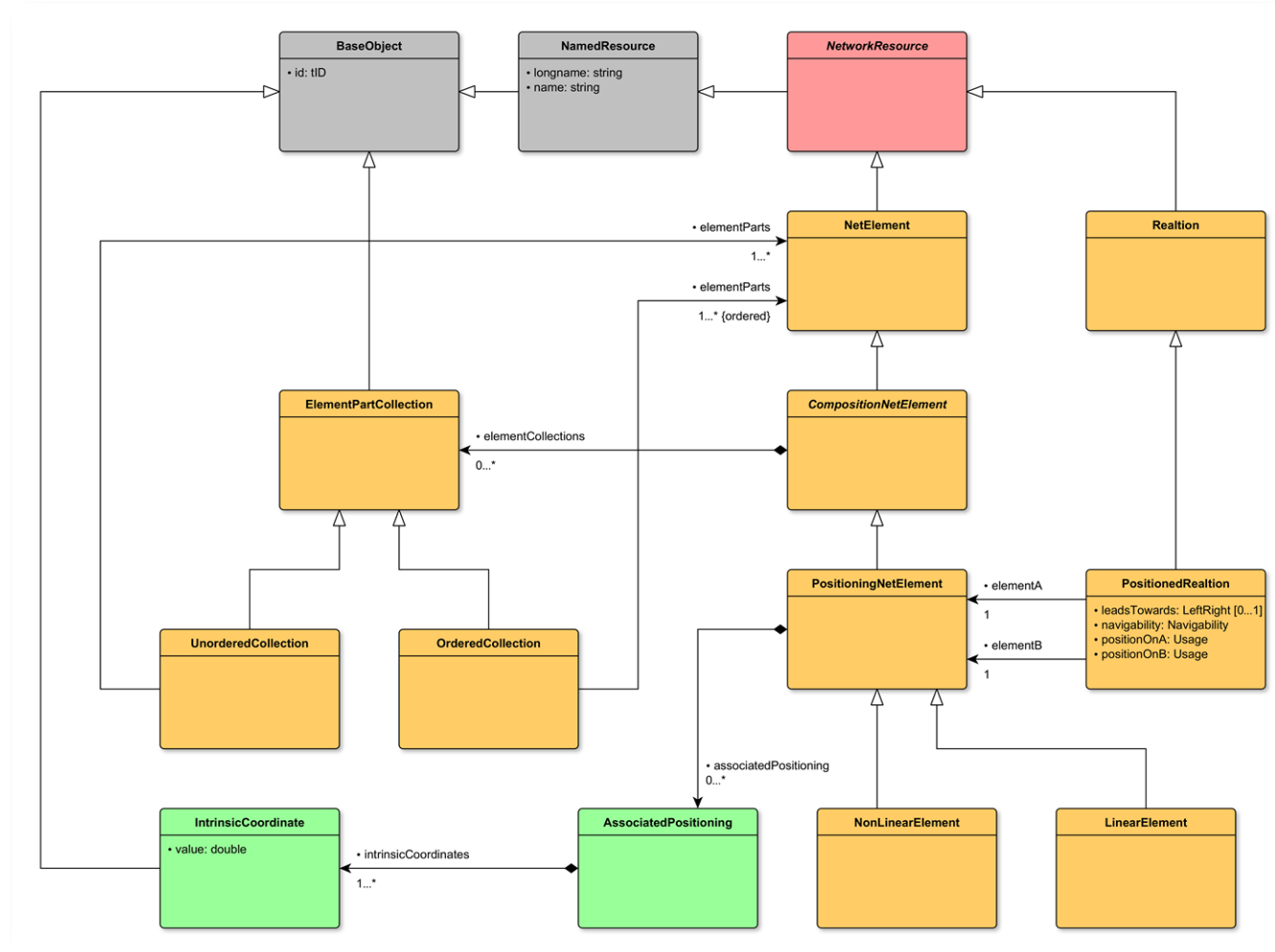


**RailTopoModel v1.5 vs. RailSystemModel v1.2: Network**

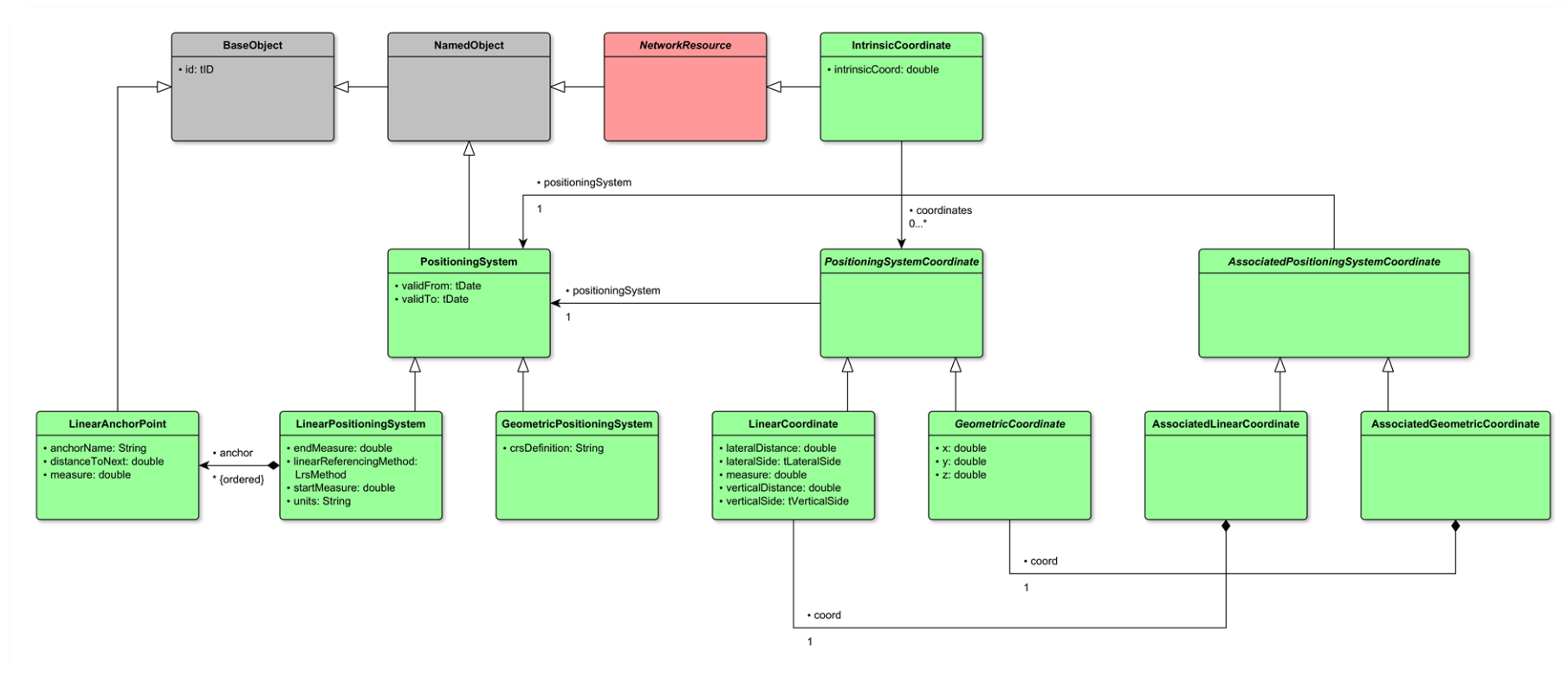


**RailTopoModel v1.5: Topology**

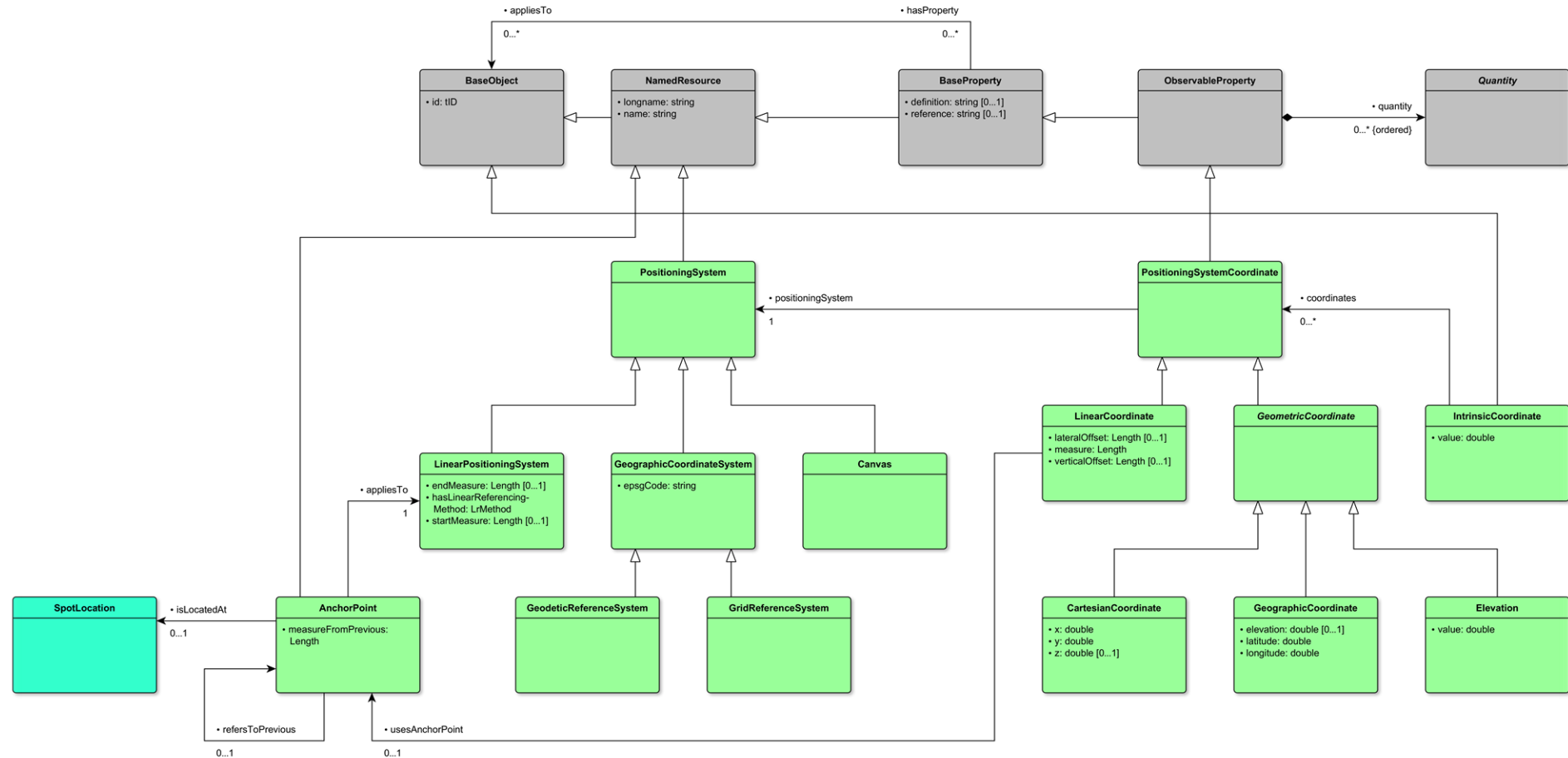




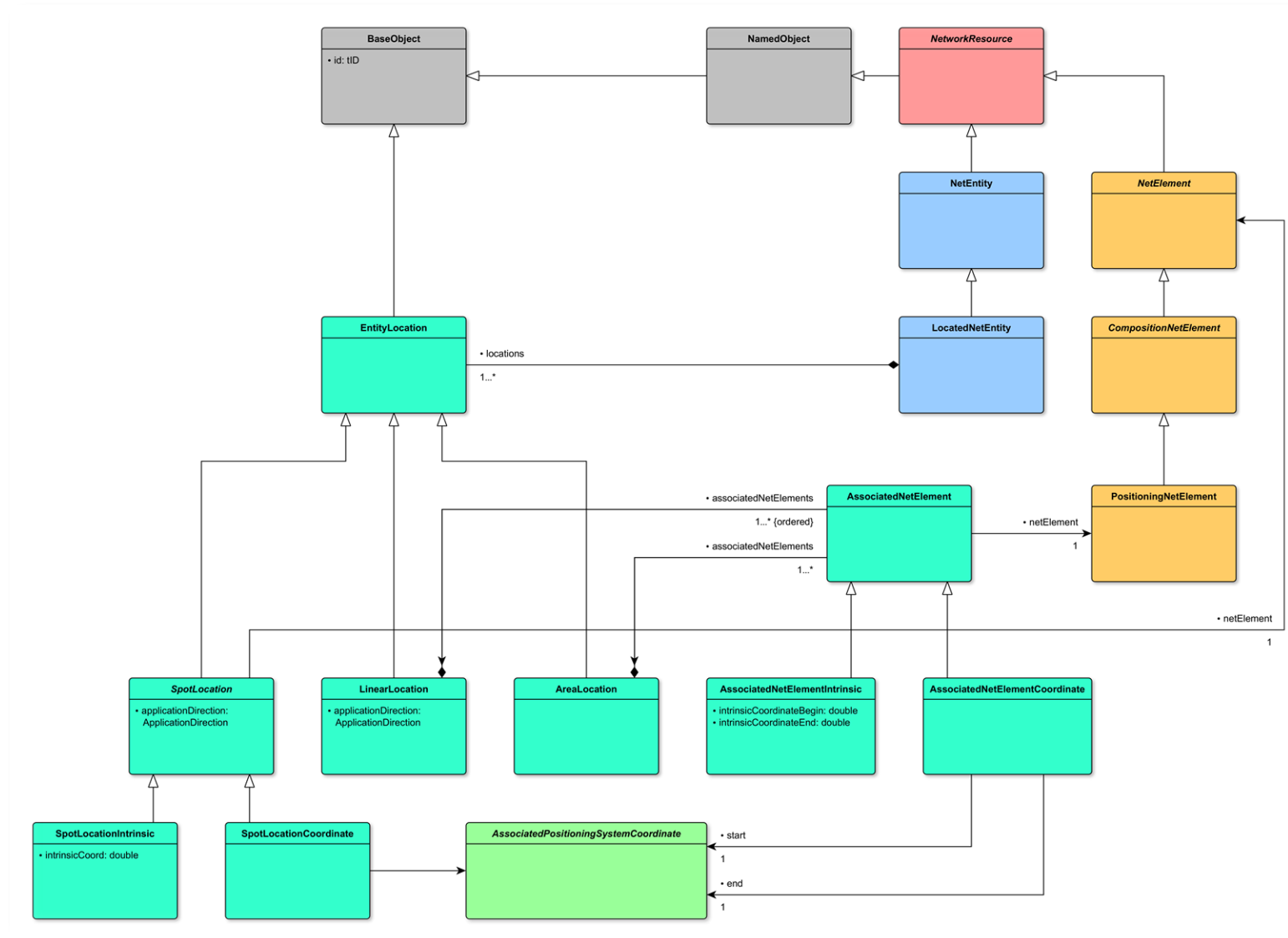
**RailSystemModel v1.2: Topology**



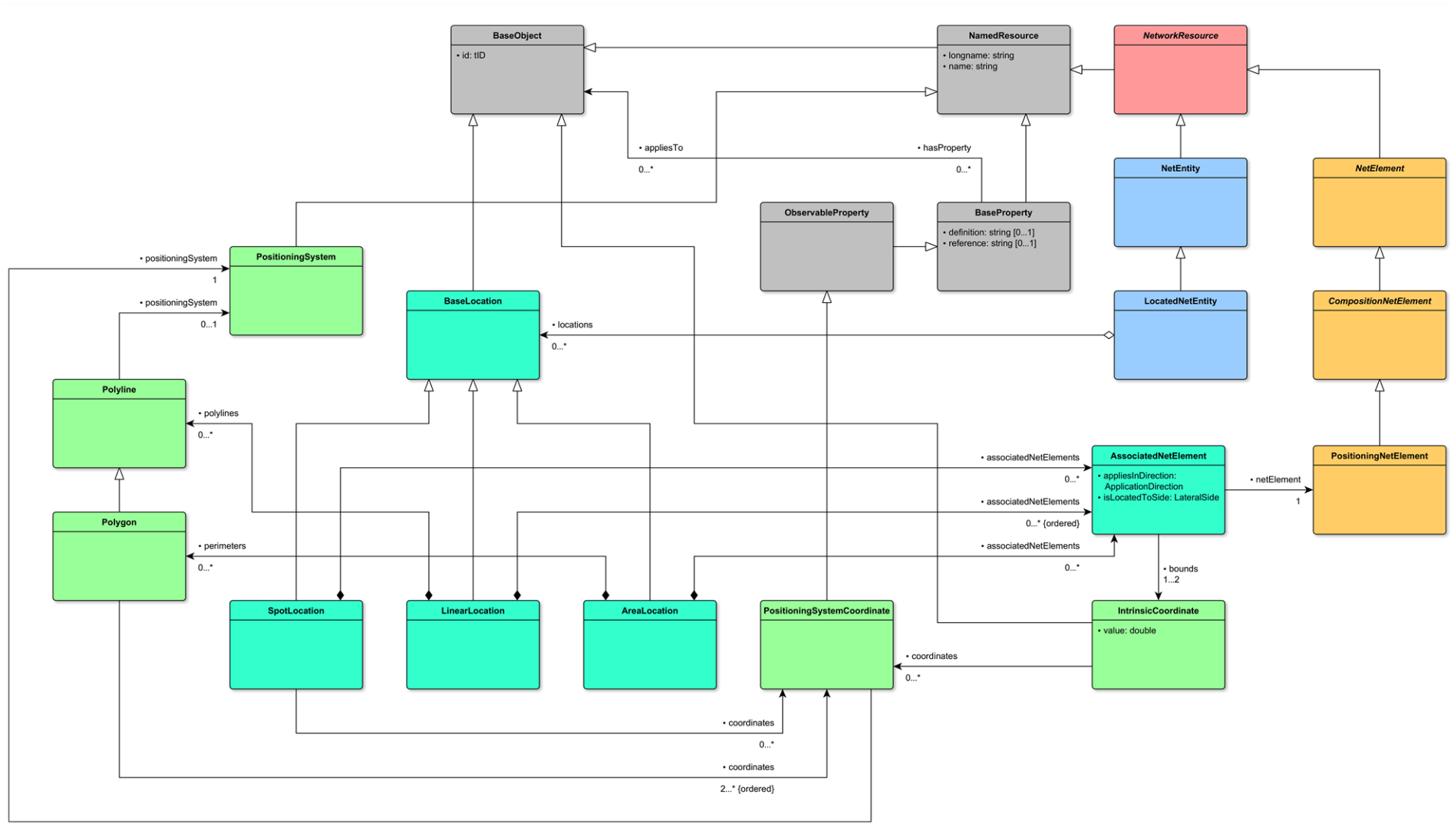
## RailTopoModel v1.5: Positioning



**RailSystemModel v1.2: Positioning**



**RailTopoModel v1.5: Location**





## Conclusions

- *both the development of RailTopoModel under the patronage of railML.org and considerable expansion towards RailSystemModel brought new concepts and improvements compared to original RailTopoModel v1.0 and v1.1*
- *each of these two approaches contributed in a different way, which to some extent disrupted the original idea of a standardized model*
- *there are cases where the same facts are expressed in different ways, or conversely, they offer the same names for not quite the same concepts*
- *a possible solution for harmonizing terms is the use of ontologies consolidating, standardizing and validating infrastructure-related concepts, it is not a tool that would help deal with the (even slightly) different scope*
- *it is advisable to strive for the (re)integration of these models in order to make the model even more robust and useful*



# **Thank You for Your Attention**

