# Topological Model and Data Model RIS

RIS

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# 1 Data Model

The following data model is an integrated model that takes into account the essential objects of the respective legacy applications CRD, GeoEditor, CIP and RFP.
At the same time, the model is designed to correspond with the class model of RINF.
Large parts of the model have already been implemented in the ongoing RIS development, but since RIS is being developed according to an agile approach, the current development status does not yet include the complete model. Details may also change in the course of the project.

Locations are at the core of the model. These include the entities Primary Location, Subsidiary Locations, CIP nodes and Service Facilities.

Attributes of the respective locations are stored in sub-tables such as Property, Terminal_Data, Facility_Data, or similar.

The topology is structured in two levels, very similar to RINF:

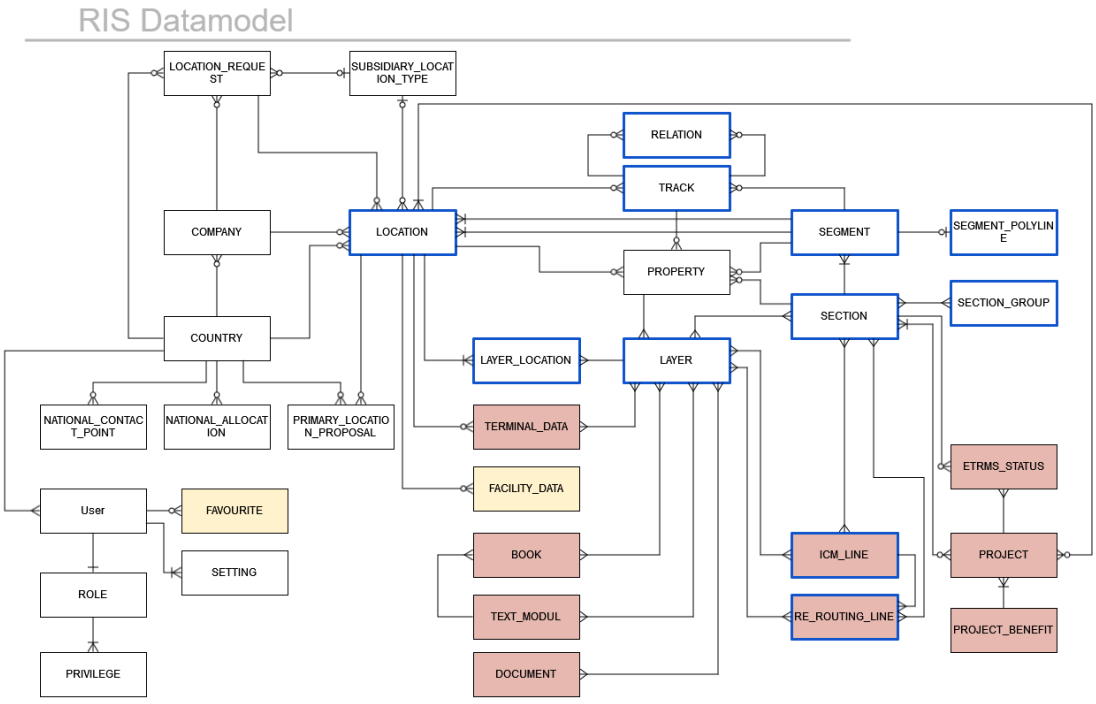
- The macroscopic level: Contains the locations and the segments connecting the locations and overlying structures.
- The mesoscopic level: Contains the detailing of the locations and segments.

Other essential entities are countries or companies for which RIS provides the infrastructure data.

The application is controlled by the privileges, roles and users of the application.

The following logical data model highlights the topology with the boxes outlined in blue. The entities highlighted in red are required for specific CIP functionalities, those highlighted in yellow are modelled specifically for RFP functionalities. All others are entities that originate from CRD or are shared from the perspective of the functions of the legacy applications GeoEditor, CIP and RFP.

There are many other entities in the existing RIS data model that have been omitted for reasons of clarity and because they are of secondary importance for the basic contexts.



## 1.1 Entities

### 1.1.1 Location

Location comprises the main and shared data of all "spots" in the topological model on macroscopic and mesoscopic level. These are

- primary locations, identified by a primary location code (PLC) according to TAF/TSI
- subsidiary locations, identified by a subsidiary location code (SLC) according to TAF/TSI
- CIP nodes, that are nodes originated from the CIP model that comprises neither a PLC or an SLC
- service facilities, that are nodes originated from RFP model and which may have a relation to a primary or subsidiary location

Locations correspond mainly to operational points (OP) in the RINF model

### 1.1.2 Company

These are the companies according to TAF/TSI and that are managed actually in CRD. All locations except service facilities have a direct relation to a company. Service facilities may have this reference as well

### 1.1.3 Country

These are the countries according to TAF/TSI and that are manged actually in CRD. All locations have a direct relation to countries (in that in which they lie).

### 1.1.4 Subsidiary_Location_Type

These are types of subsidiary location according to TAF/TSI and thar are managed actually in CRD. All subsidiry locations are assigned to a Subsidiary_Location_Type. The types "track" and "customer siding" are those types that are relevant for the topological model on mesoscopic level (see below).

### 1.1.5 Primary_Location_Proposal

This entity underlies the TAF/TSI process for requesting the creation of a Primary Location.

### 1.1.6 Location_Request

This entity underlies the TAF/TSI process for requesting the creation of a code for a primary location or a subsidiary location. As in the model for locations, both requests are kept together in a request entity. So the one for primary and the one for subsidiary location

### 1.1.7 National_Allocation

National Allocation Entity (NAE) are used to ensure uniform European standardised location codes. These handle location code requests along the intended TAF/TSI regulations

### 1.1.8 National_Contact_Point

The National Contact Point (NCP) entity comprises contact data of responsible who works with the Member State to ensure that NAE is appointed and fulfils its roles of populating RIS with primary location codes.

### 1.1.9 Segment

Segments, also known from the GeoEditor, form the point-to-point connection between locations on the macroscopic level. In principle, the data model is open, so that later more than one segment can be created between the same locations (for the moment not planned on functional level in RIS).

Segments can have properties that are stored in the property table as in the GeoEditor. Segments corresponding to thesection of lines (SoL) in the RINF model.

### 1.1.10 Segment_Polyline

Segment Polyline is a contiguous sequence of line segments intended to represent the real course of the rails along a RIS-segment. It is derived in RIS as in GeoEditor via a service API from Google. The polylines are purely used to display the topology on the map.

### 1.1.11 Section

Section is a grouping of segments strung together. These already exist in this form in GeoEditor and CIP, where they are called "segments". Sections beziehen sich auf Layer

### 1.1.12 Section_Group

Is the grouping of sections on a layer

### 1.1.13 Layer

Layer are used for the representation of the CIP-corridors or custom layers (as known currently from GeoEditor).

### 1.1.14 Layer_Location

Deviating from the basic topology of the macroscopic level, layer-specific coordinates can be assigned to the locations. For CIP corridors, this is mostly used for a more precise representation of locations on corridors.

### 1.1.15 Track

Track is the core element in the mesoscopic layer. It shows the details of railtracks within segments or within primary locations. Note that a track of a primary location has always a direct connection to a subsidiary location of either type "track" or "customer siding". Properties of tracks are foreseen in the property table

### 1.1.16 Relation

Relations are the connection of tracks. In addition to the connection to one track each for the start and end point, the direction that can be travelled in is also defined in the relation.

### 1.1.17 Book

Contains the refererence of information documents to text moduls for respective corridors

### 1.1.18 Text_Modul

Contains all pre-defined text modules that are used in the application.

### 1.1.19 Document

Contains references to the respective common or corridor-related document artefacts.

### 1.1.20 Property

The entities of the macro and mesoscopic level have different specific properties that are summarised in this entity. As in the GeoEditor, there will also be custom properties that can be defined by the users themselves.

Service Facilities have a very large number of attributes as well as e.g. documents as attachments. For the time being, these are not to be found in the properties in the model, but in Facility_Data.

### 1.1.21 Terminal_Data

The information that CIP-nodes do not have and that is specific to terminals is placed in this entity. However, it has not yet been decided whether this is necessary for architectural reasons or whether it can also be mapped in property.

### 1.1.22 Facility_Data

As mentioned above, service facilities have >150 different attributes, and they can also contain several documents each. Therefore, this data is not placed in the entity property but is mapped separately. The entity will again consist of several individual relational sub-entities.

### 1.1.23 ICM_Line

Contains all created ICM-lines of CIP (Sections that are currently blocked). Refers mainly to sections and CIP-layers (reference to country and IM-company not shown in the model above).

### 1.1.24 Re-Routing_Line

Contains all created Re-Routing-lines of CIP (Sections that shall be applied for re-routing ICM-lines)

### 1.1.25 Project

Comprises the project data of extensions, renewals or re-deployments and ETCS status of railway infrastructure and its equipment along the freight corridor (CIP-layer)

### 1.1.26 Project_benefit

Contains the data of project benefits of a project

### 1.1.27 ETRMS_Status

Contains the ETCS deployment status data of respective ERTMS projects.

### 1.1.28 User

This table comprises the user data necessary to identify the user with regards to MS Azure AD. That means, no passwords are persisted here

### 1.1.29 Role

All roles are managed in this table and on the one hand is referenced by users and references to privileges.

### 1.1.30 Privilege

Privileges is managing the possibility to access specific RIS functionality, to edit or only view data and to restrict data the user has basically the right to see (e.g. restrict to countries, companies, layers, etc.)

### 1.1.31 Favourite

A user can save favourites like RFP filter criteria. These data are persisted in this entity

### 1.1.32 Setting

Setting is a table that comprises additional user data, that are swapped out from user entity. This data is mainly used for certain application settings of the user

## 1.2 Topological Model and Rules RIS

### 1.2.1 Macroscopic level

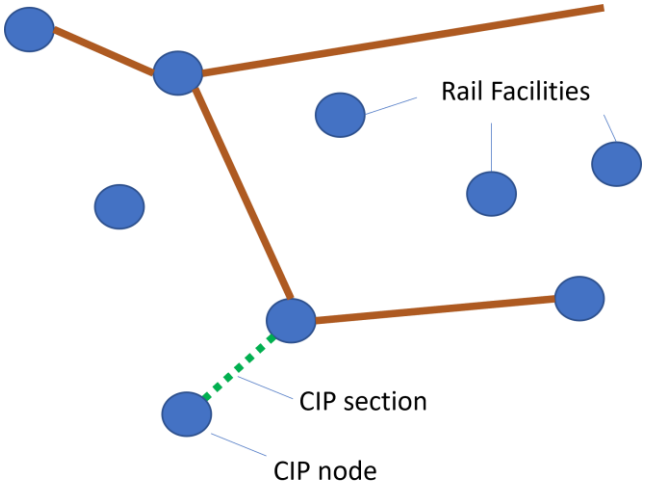
Basic model consists of

- Primary Locations - named OP in RINF;
- on the same topological level as PLs are nodes from CIP that doesn't need a PLC. Detached from the network are the facilities of RFP
- Segments (named SectionofLine in RINF), that are connecting PLs an CIP-nodes
- Grouping on higher level: Sections, Layers (corridors).


- Basic macroscopic topological network:

The PLs spans a node-edge graph whereas facilities of RFP are not connected to the network.

Nodes of CIP are connected to the node-edge graph via sections. This is modelled in detail that a user connects a CIP-node to the network by means of a section. RIS itself creates on the segment level a synthetic segment so that the graph is comprehensive.




Direction:

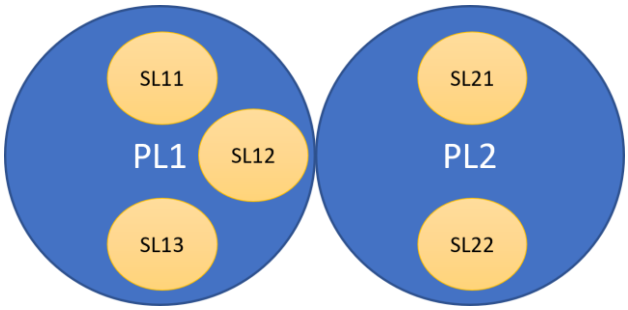
- per definition a segment has no direction which is the same as it is routable in both directions.

### 1.2.2 Mesoscopic level

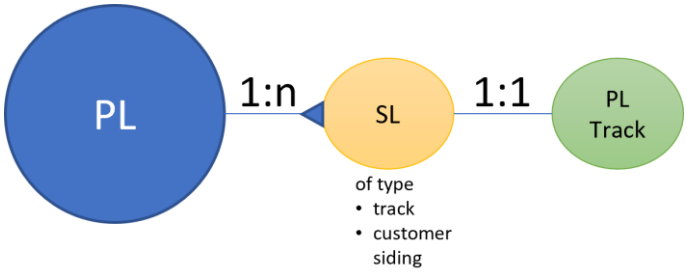
Basic model consists of

- Tracks (called Tracks in RINF) as details (children) of Segments

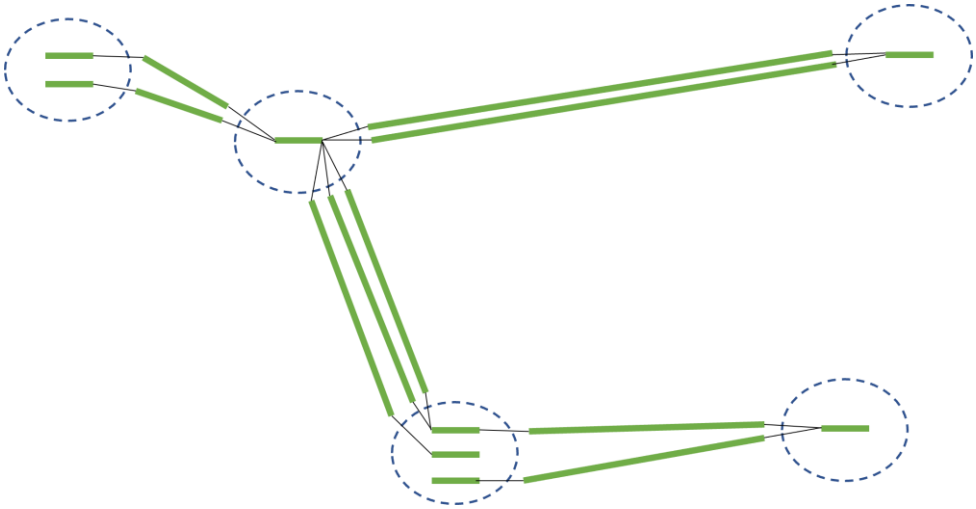

- Tracks (called Tracks in RINF) as details (children) of PLs




- Subsidiary locations (SLs) of types "tracks" or "customer siding": These are the CRD-business representation of tracks and have a 1 to 1 relation (btw: a PL can have more SLs than tracks, but can have only exactly the same amount of SLs of type "track" and "customer siding" as the amount of tracks related to this PL).




- Basic mesoscopic topological network: Tracks of PLs are connected to Tracks of Segments via Relations (called NetRelation that connects NetElements in the topological layer in RINF. NetElements and NetRelations are part of the TopologicalObject in RINF, the implementation of which is a feature which is a track, OP, SoL,...in RINF's Implementation layer)



Compared to the macroscopic layer the mesoscopic shows that

- a PL may contain more than 1 track / SL.
- a Segment may contain more than 1 track.
- SLs of type "customer siding" are connected to the network on only one end and not both

Direction:

- per definition the direction of a relation can have 3 possible states (in accordance to railML 2.0 notation):
  - None: both directions are possible
  - Up: direction from → to is possible
  - Down: direction to → from is possible

## 1.3 Connection between Macroscopic and Mesoscopic layer

Tracks of mesoscopic level are

- either connected to Segments on Macroscopic layer
- or connected via SLs to PLs on Macroscopic layer

Tracks on mesoscopic level are

- connected to each other by Relations

PLs on macroscopic level are

- connected to each other by Segments

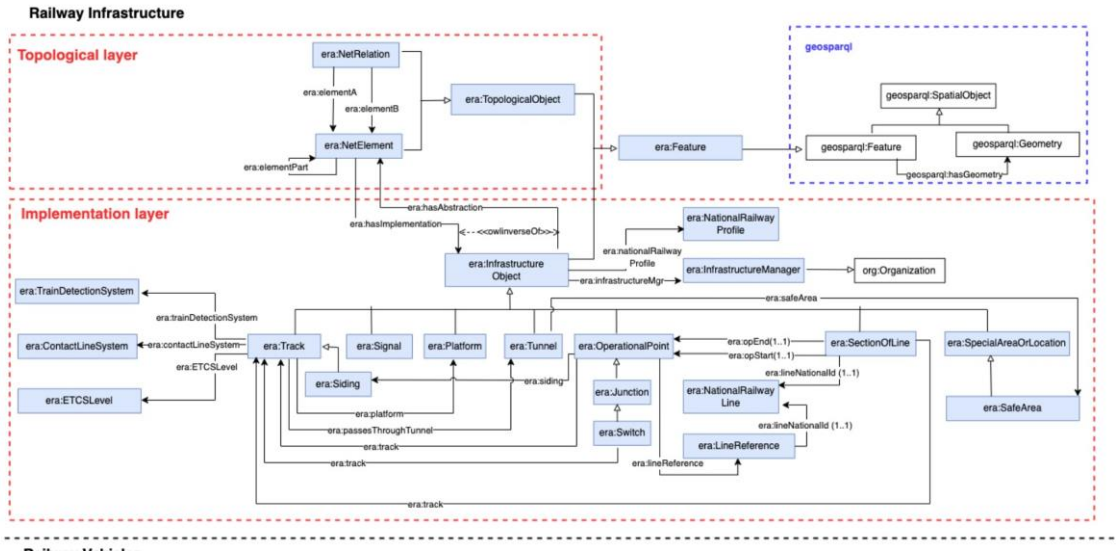
There is no need of a reference between Segments and Relations

## 1.4 Correlation of topology to RINF model

Rinf introduced a generic object  that comprises all topological aspects on macro-, meso-, and microscopic level. It defines a model that is flexible for future amendments or changes and includes all entities that RIS is dealing with.

ERA provides an instance of RINF model that is fed by several European IMs. This source shall be used for RIS to gain additional value for its users: Periodically interesting RINF data will be queried and taken over to RIS database by specific business rules. The rules have to be defined yet and will not only depend on whether the data already exists in RIS or not but also from which IM the data originate.

RINF differentiate between the generic topological layer of the railway network (node-edge graph) and the instantiation of real objects of the railway network (Implementation Layer, e.g. PLs, SLs, tracks, etc.). S. a. https://data-interop.era.europa.eu/era-vocabulary/.




The correlation between the RIS data model described here and the RINF model is explained in more detail for the macro- and mesoscopic layer respectively:

### 1.4.1 Macroscopic layer

On macroscopic layer we combine the RIS topological layer with the implementation layer. That means no abstraction of real network objects will be done. This approach is chosen as we can therefore re-use best practice code parts of Geo-Editor, to achieve high performance in querying data and for the sake of keeping the system and its maintainability as simple as possible.

The following table shows the RIS entities and its corresponding RINF object classes

| RIS entity | RINF object class | RINF topological abstraction | Remark |
|---|---|---|---|
| Primary Location | OperationalPoint | netElement | |

| RIS entity | RINF object class | RINF topological abstraction | Remark |
|---|---|---|---|
| Segment | SectionOfLine | netRelation that connects two netElements | RINF comprises the possibility to allow the existence of more than one segment between two OPs. This, however, is not allowed in Geo-Editor. The data mode of RIS will be prepared to allow such cases for the future, nevertheless Geo-Editor will keep in the business layer the restriction to maximal one segment between two OPs. If necessary, in future releases this logic can be changed though. Before that, a clear concept of the necessary changes on a functional level in the entire application is to be created. |
| CIP node | OperationalPoint | netElement | |
| Rail Facility | OperationalPoint | netElement | |

### 1.4.2 Mesoscopic layer

At the mesoscopic level, we subdivide the PLs or a segment into tracks. These are typically tracks in a station or tracks between stations. In RIS, the tracks themselves can in turn contain the affiliation to certain lines as parameters (e.g. High-Speed and National Line). Tracks are connected via relations. We model the navigability of a track via its relation.

| RIS entity | RINF object class | RINF topological abstraction | Remark |
|---|---|---|---|
| Track | Track / Siding | netElement | A track in RIS is always related to a SL. The SL itself is of type Track or Customer Siding. In RINF this distinction is made in two different object classes in the way that a Siding is a subclass of its superclass Track. As in RINF a track has a parent-child relation either to a PL (via SL) or to a Segment |
| Relation | -- | netRelation | |