IFC Rail Project

WP3 – Conceptual Model Report

Overview and content of the business-related part of the Railway UML model

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Contents

Glossary

- **EA:** Enterprise Architect, the modelling tool adopted by Rail TS.
- **BIMQ:** the information management tool adopted by Rail TS.
- **CMR:** Conceptual Model Report.
- **Pset:** Property sets (Pset) are custom properties for objects in IFC that may be applicable internationally, regionally, or specific to organization or project. A basic set of international Pset are documented in the IFC specification as reference data.
- **Qto:** Quantity sets (Qto) are specific types of properties, which are quantity features (e.g. length, area, volume) of objects. A basic set of international Qto are documented in the IFC specification as reference data.
- **UML:** Unified Modeling Language (UML) is a standard language defined to specify, visualize and document models in software systems. It is defined by Object Management Group (OMG).
- **XML:** Extensible Markup Language (XML) is a standard markup language. It is a W3C Recommendation.
- **Concept**
    - **In the IFC context:** it indicates any IFC Concept (e.g. IfcDoor, IfcWallType, etc.)
    - **In UML context:** it indicates any UML Element (i.e. Class, Interface, Enumeration, etc.)
- **Domains:** the business domain of the IFC Rail Project, namely Track; Signalling; Telecom; Energy.
- **Business object:** it refers to any generic object (e.g. Rail switch, Bridge pillar, Road signal, etc.). Not to be intended as the IFC concepts, unless otherwise stated.
- **Railway UML model**: this term is used to indicate the entire EA file of the IFC Rail Project. It includes: the Conceptual Model; the IFC Rail Model; the IFC Candidate Standard (Phase I) package.
- **Conceptual Model**: for this document, the term indicates the business model of railway domains, independently from IFC.
- **IFC Rail model**: this term refers to the combination of the Conceptual Model plus the IFC extension to the business model. It includes existing and proposed IFC entities.
- **IFC Candidate Standard (Phase I) package**: this package includes only the diagrams used to map railway concepts to IFC concepts for the purpose of the IFC specification. As planned, it includes objects in priority #1 (trackside objects).
- **TS**: Technical Service team of the IFC Rail Project.

Note: some figures contained in the following guidelines may refer to the specific tool used in the IFC Rail Project (Enterprise Architect [EA], by SparxSystems). This does not affect by any means the principles and the semantics of UML.

Executive summary

The present document is part of the official deliverables of the IFC Rail Project (Phase I), as shown in the picture below. Please refer to the IFC Rail – Context & Approach document for further details.

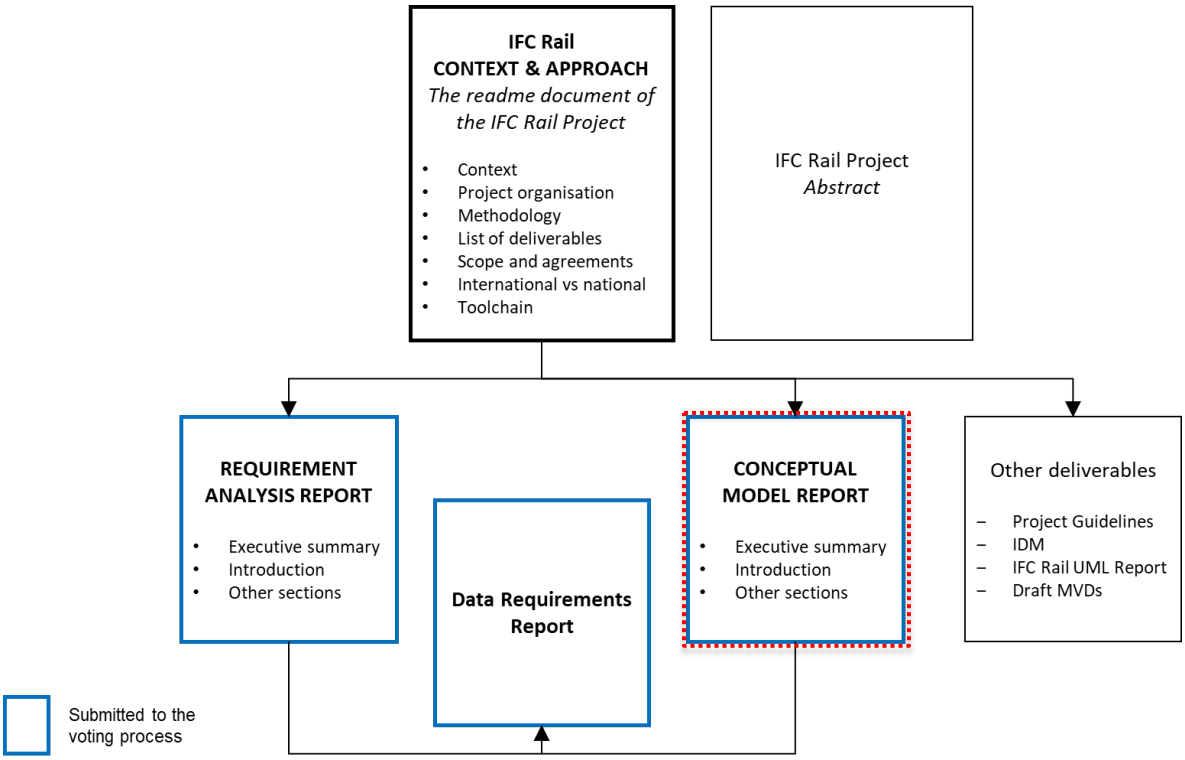


Figure 1 - IFC Rail documents' structure

This document describes the content of the (UML) Conceptual Model produced by the IFC Rail Project (Phase I). The Conceptual Model is a conceptualization of the data requirements contained in the Requirement Analysis Report. The Conceptual Model is decoupled from the later IFC specification, but it serves as a reference for the extension proposal of IFC. The Conceptual Model is part of the greater Railway UML model, which also contains the IFC extension proposal and the IFC mapping.

The Conceptual Model is organized in packages dedicated to each project domain: track, signaling, energy, telecom, and common-shared. The track, signaling, energy and telecom packages are further decomposed into the following sub-packages: structural (or physical), spatial, and functional (this last one not being part of the project scope, and thus not delivered). The structural sub-package contains only physical objects and it describes how these objects are physically decomposed. The spatial sub-package contains spatial concepts, and it describes how objects occupy space (places / volumes / zones). The Conceptual Model includes only the objects that have the highest priority for the project, i.e., trackside and lineside objects.

In addition to the packages of the four domains, a specific package is dedicated to the Common – Shared topics. This package contains:

- The identified shared and common concepts;
- Alignment proposal: which includes the conceptual representation of the alignment geometry for Railway;
- LRS & Alignment: which includes a diagram to clarify the distinction between Alignment as geometry curves and the Linear Reference Systems (LRS) that might use those curves;
- Positioning: which includes the Data Types used to indicate explicitly the positioning of certain Railway objects.

The modeling process followed rigid guidelines and conventions, that are also part of this document.

The Conceptual model documentation is automatically generated from the UML model.

1 Introduction

The present chapter describes the structure of the Conceptual Model Report and its role inside the overall process of the IFC Rail Project. In the next chapters are presented:

1. **The context** in which the present document fits, in order to understand its role in the overall process of the IFC Rail Project;
2. **The objectives** of the Conceptual Model for the IFC Rail Project;
3. **The framework** upon which the Conceptual Model is built (set of rules used to create the Model).

1.1 Context of the document

To capture the Rail Data Requirements of the Phase I, the IFC Rail Project adopted a model-based approach. In particular, the object-modelling notation of UML (Unified Modelling Language) is used.

The present document describes the content of the (UML) Conceptual Model produced by the IFC Rail Project (Phase I). It is one of many documents produced during the Project, to understand its hierarchy inside the overall process documentation see the following diagram (highlighted in red).

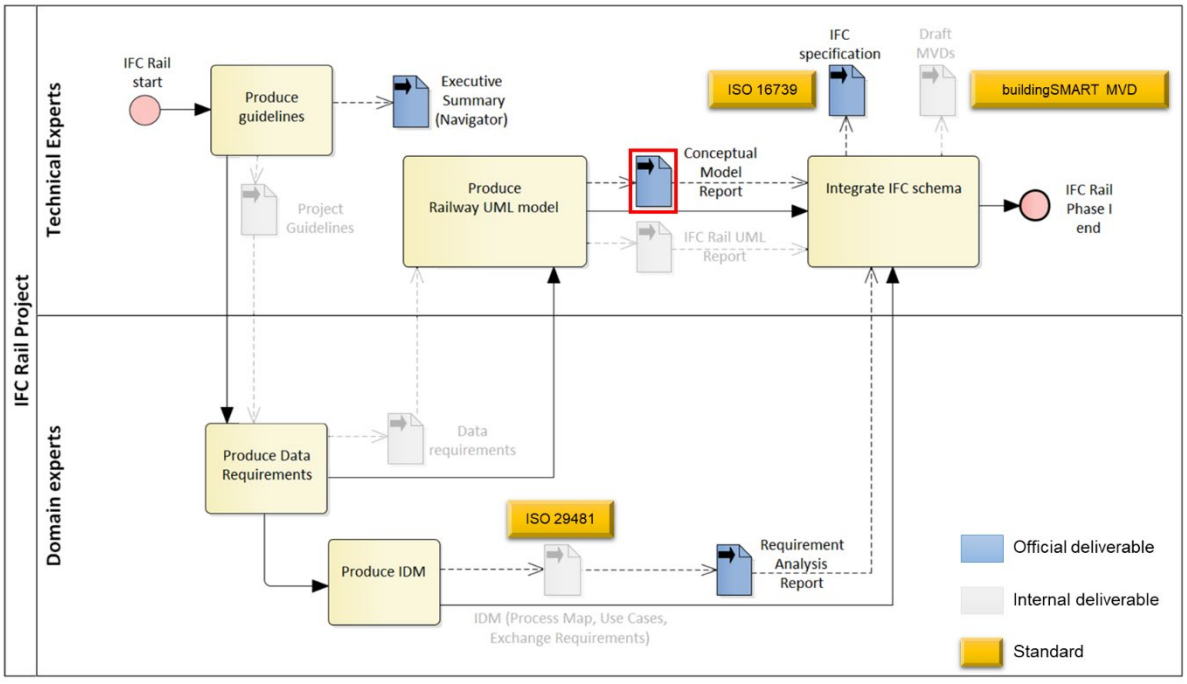


Figure 2 - Overall process and relative documentation of the IFC Rail Project (Phase I)

The Conceptual Model Report (CMR) is made of two major parts, plus one annex:

1. The present introduction, which aims at providing background to the reader;
2. The content of the Conceptual Model itself, from the point of view of the Domains. It includes the business Concepts expressed by the railway expert. This part is automatically generated from the Model and it is organized in as follow:
    - Five chapters, one per each railway domain;
        - Inside each chapter, objects are grouped according to business criteria. Such groups are reflected in the report as paragraphs;
            - Inside each paragraph, a class diagram shows the Concepts and the relationships among them;
            - Also, a sub-paragraph for each Class illustrates the functional description and, if applicable, a table showing the relationships of Class itself;

Additionally, the CMR refers to the Data Requirements Report for a full understanding of the business needs. The Data Requirements are also automatically generated. Please refer to the Tool-chain paragraph of the IFC Rail – Context & Approach for further details.

1.2 Objectives of the document

The Conceptual Model serves as:

- Formalization of the Concepts that define a business domain (i.e. Track, Signalling, etc.);
- Representation of the business requirements expressed by rail experts;
- Reference for the extension proposal of the IFC schema;
- Reference for mapping between rail Concepts and IFC Concepts;
- Reference for BIMQ mapping;
- Additional documentation to the IFC specification.

Also, it is important to note that:

1. The Conceptual Model IS NOT the simple replica of the Data Requirements expressed by domain groups, but a conceptualization of them;
2. A conceptual model IS NOT a Product Breakdown Structure (PBS).

Since it is not possible to deliver the UML Model itself, the objective of the present document is to reflect part of the content of the Model, allowing the reader to evaluate the quality of the proposal.

1.3 Framework and Methodology

The aim of this paragraph is to explain the methodology adopted by the IFC Rail Project for the Railway UML model. This is **essential** to understand the structure of the Model, and the rules used to create and maintain it.

The Railway UML model is composed of two entities:

1. **Conceptual Model**, represents the business model of railway domains, independently from IFC;
2. **IFC Rail model**, represents the IFC extension of the business model. It is realized by two activities:
    a. **IFC extension proposal**, in which extensions to the existing IFC schema are proposed, based on business need;
    b. **IFC mapping**, in which the business objects and relations are mapped toward the IFC schema, both the existing and the proposed extension;

Note: evidence of this mapping activities can be found inside the **IFC Candidate Standard package**. This package includes only the diagrams used to map railway concepts to IFC concepts for the purpose of the IFC specification.

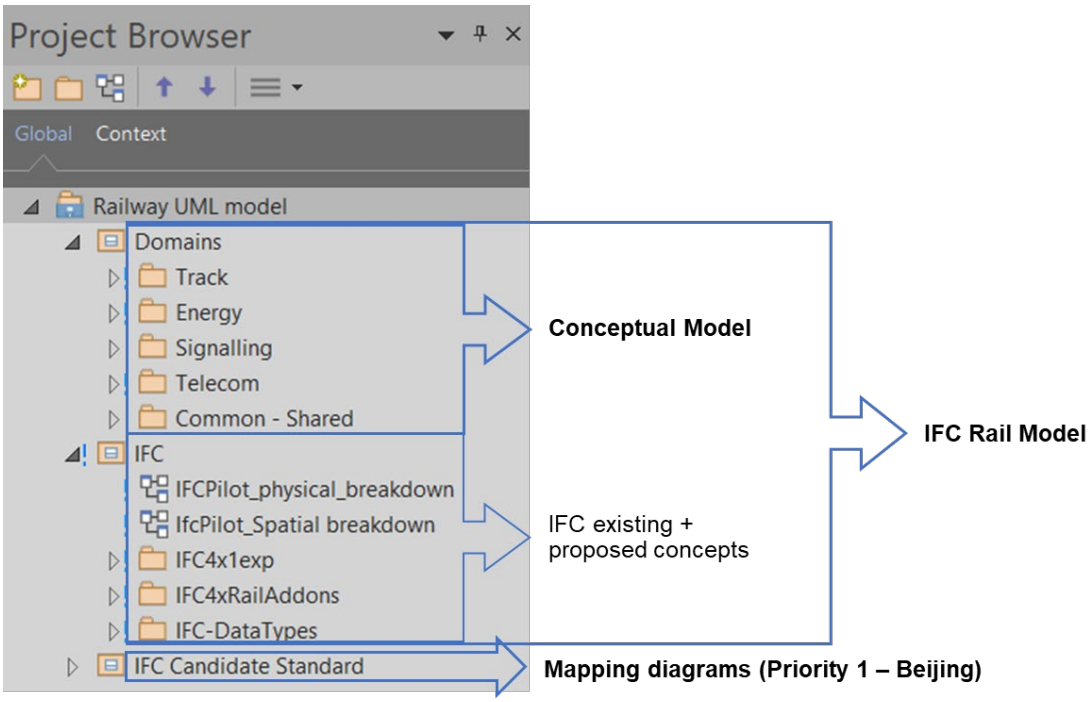


Figure 3 - Structure overview of the Railway UML model

Note: The **Conceptual Model** and the **IFC Rail model** are always referred to as two different entities, although they are contained in one unique EA file.

IMPORTANT: the present document describes only a part of the Conceptual Model. As planned, it includes objects in priority #1 (Trackside and Lineside objects).

For the following details:

- File extension and backward compatibility;
- Architecture or the Cloud model;
- Backup strategy;

please refer to the IFC Rail Modelling Guidelines (Internal document).

1.3.1 Model content

At the end of the IFC Rail Project (Phase I), the **Conceptual Model** will contain solely:

- Rail objects;
- Objects' description;
- Objects' attributes;
- Attributes' description;
- Business relationship between objects;

It will not contain:

- Pictures;
- Multiple language translations;

At the end of the IFC Rail Project (Phase I), the **IFC Rail model** will contain solely:

- IFC Rail Spatial Structure entities;
- Mapping of Spatial Structure entities toward relative IFC entities;
- All IFC 4.1 entities;

All IFC 4.2 entities;

- All proposed IFC entities;
- Mapping of rail objects toward relative IFC entities (both 4.1 and proposed);

It will not contain:

- Mapping of rail properties toward IFC Pset & Qto.

NOTE: the content of the IFC Rail model is not described in the present document.

1.3.2 Package structure

The picture below represents the structure of the packages contained inside the Railway UML model.

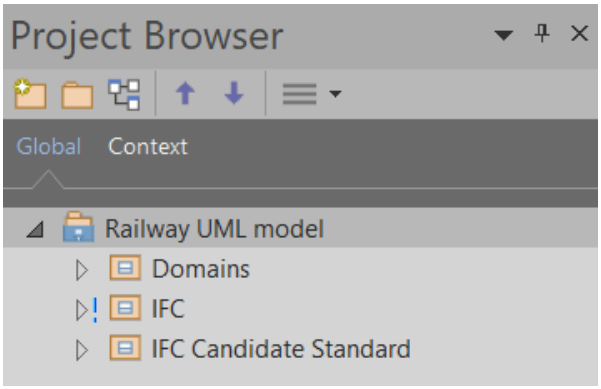


Figure 4 - Package structure of the Railway UML model, first level

On the first level there are 3 main packages:

- **Domains**: which includes one sub-package for each railway domain (Track, Energy, Signalling, Telecom, and Common-Shared);
- **IFC**: which includes all IFC concepts (existing 4.2 schema, new IFC concepts proposed by IFC Rail Project, Data Types);
- **IFC Candidate Standard**: which includes all diagrams used to depict the concepts proposed as Candidate Standard for the Phase I.

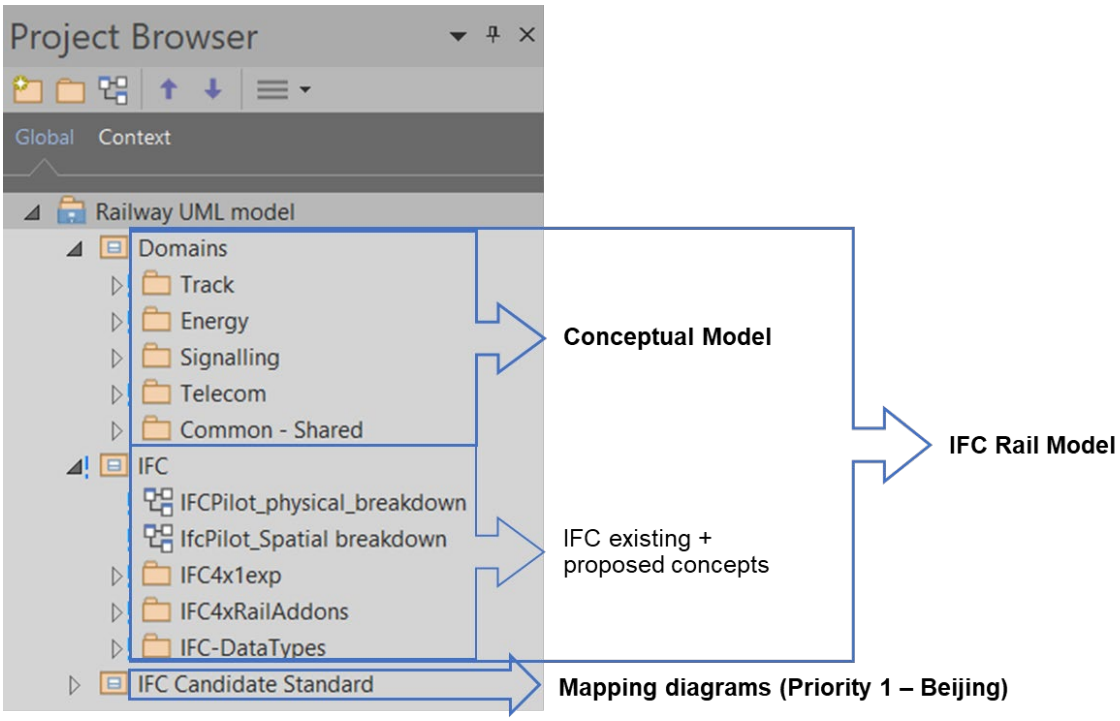


Figure 5 - Package structure of the Railway UML model, with naming convention

For the following reasons:

- To help reading the UML model;
- To help identify the concepts that need to be mapped toward IFC.

Inside each domain's package, the following sub-package organization is enforced:

1. *domain name* Structural (physical);
2. *domain name* Spatial;
3. *domain name* Functional;
4. _Workbench (WIP).

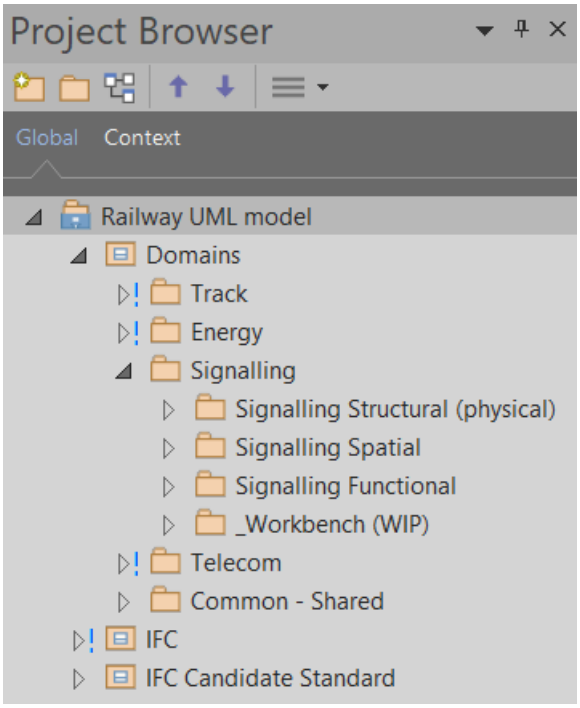


Figure 6 - Package structure of the Railway UML model, detail of domains' sub-packages

The purpose and content of such packages is the following. Each railway object is a unique Concept inside the Conceptual Model, meaning it is described one time and for all inside the Model. However, the same object can be seen under multiple *points of view*. To facilitate the readings and comprehension of the Conceptual Model, three major modelling *views* are adopted and encapsulated into the mentioned sub-packages.

The organization of the content of these sub-packages is subject to domains' need and peculiarities. The purpose and minimum requirement of the four packages are described in the following table.

Table 1 - Modelling views and their use

#	View	Used to express	Minimum content
1	Structural (Physical)	How objects are (de)composed, using (e.g.) Aggregation (i.e. part of, composed of) and Generalization of rail objects	• all physical Concepts; • **structural diagrams** to express physical breakdown of components, if needed
2	Spatial	How objects occupy the space. Namely, places / volumes / zones where rail objects are located	• only spatial Concepts; • **spatial diagrams** (which of course can contain link to physical objects from Structural package)
3	Functional	How objects are linked together and why. Namely, functional spaces/areas where objects are gathered under certain criteria, or functional groups where objects are collected under certain criteria	• only functional Concepts; • **functional diagrams** (which of course can contain link to physical objects from Structural package)
4	_Workbench (WIP)	All Work-In-Progress items and discussion of each domain	n.a.

NOTE: for all domains, the content of the packages (3), (4) is not described in the present document.

In addition to the packages of the four domains, a specific package is dedicated to the Common – Shared topics. This package contains:

- The identified shared and common concepts;
- *Alignment proposal: which includes the conceptual representation of the alignment geometry for Railway;
- *LRS & Alignment: which includes a diagram to clarify the distinction between Alignment as geometry curves and the Linear Reference Systems (LRS) that might use those curves;
- *Positioning: which includes the Data Types used to indicate explicitly the positioning of certain Railway objects.

* See the document RWR-Railway-WP2_RequirementAnalysisReport for details

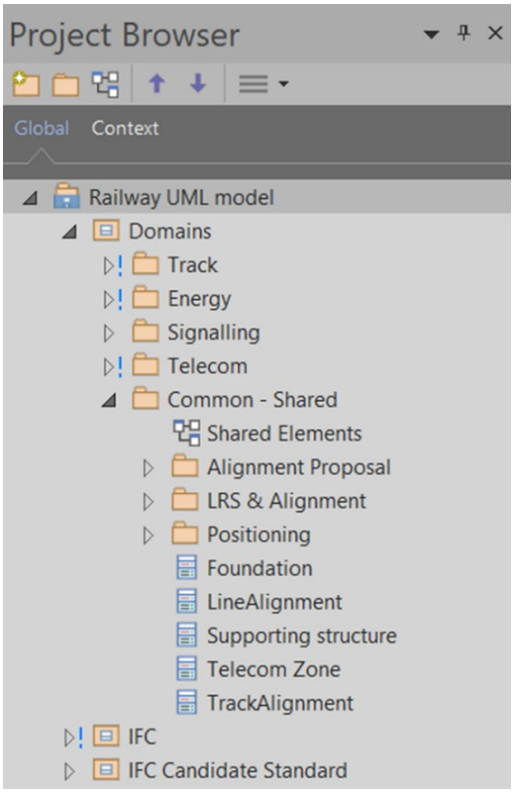


Figure 7 - Package structure of the Railway UML model, detail of Common - Shared package

The second major package is the IFC one. It includes:

- IFC4x1exp: containing all IFC existing concepts (4.1 and 4.2 schema);
- IFC4xRailAddons: containing all new concepts proposed by IFC Rail Project;
- IFC-DataTypes: containing all existing IFC data types.

1.3.3 Naming convention

- All names, descriptions, notes of any element of the model are in English;
- Ifc prefix is forbidden in Conceptual Model;
- Regular case is used (no *camelCase*, *PascalCase*, *snake_case*, nor else).

1.3.4 Colour-code

- In the Conceptual Model, elements are differentiated as follows:
  - Spaces / Zones / Volumes (all non-product concepts) → WHITE background;
  - Functional Spaces → Brown background;
  - Functional Groups → Grey background;
  - Alignment → Blue;
  - Physical elements → Any background colour EXCEPT WHITE, BROWN, GREY.
- Furthermore, notes in diagrams are represented according to this convention:
  - Open notes or questions → Yellow
  - Solved notes or general info → Green

1.3.5 Objects

- Rail objects are modelled as UML Classes;
- Element's Name is the English name of the object (according to Data Requirements);
- Element's Alias is left to domain usage. Sometimes is used for the Chinese name of the object (according to Data Requirements);
- No Element Stereotype is allowed for the Conceptual Model;

1.3.6 Attributes

- Attributes which are related to geometrical representation are included in the Conceptual Model. These are expressed as attribute of the UML Class
- These attributes are intended to be defined in the IFC schema;

1.3.7 Business properties

- Business properties of the objects are not included in the Conceptual Model. They are reported in the Data Requirement Report document;

1.3.8 Enumerations

- Subtyping using enumerations is strictly prohibited inside the Conceptual Model;
- Enumerations are sometimes used to represent a list of predefined values of attributes;

1.3.9 Relationships

- UML Associations must be used to express business relationships between objects. No IFC implementation consideration is used for the Conceptual Model;
- The allowed UML associations for Conceptual Model are described in the table below.

Table 2 - Relationships used inside the Conceptual Model

RELATIONSHIP	DESCRIPTION
Aggregation [Sharing]	• It is used to depict elements which are made up of smaller components
Generalization [Typing]	• It is used to indicate inheritance. The source inherits the target's characteristics • It is drawn from the specific classifier (source) to a general classifier (target)
Association [general use]	• It is the general relationship type between elements • Use this when not sure of none of the above relationships • To provide further understanding, add a description to this association

- For all the above association there are two possible uses:
  - Plain (no text), means that the two concepts are somehow related;
  - Described (with text), to express constraints or any other relationship (e.g. supports; connects; etc.);
- Stereotyped relationships are forbidden in the Conceptual Model;
- Only for the Conceptual Model, multiple inheritance is accepted;
- Multiplicity (a.k.a. Cardinality) is considered as "optional".

1.3.10 Descriptions

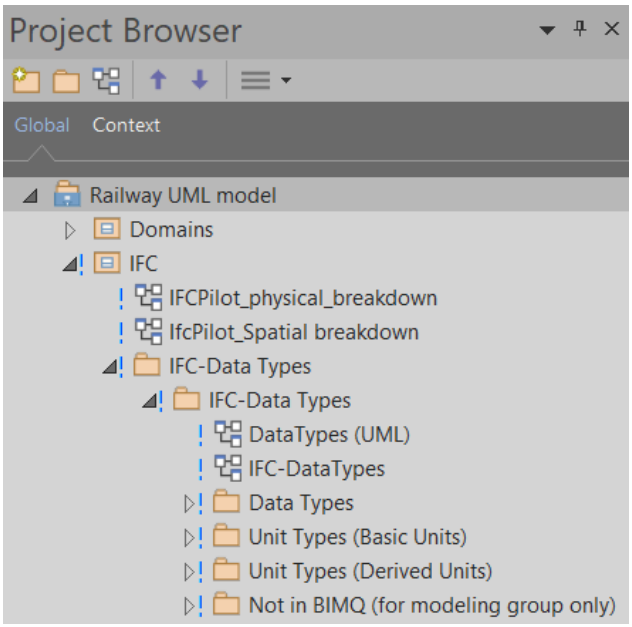
- English description of objects and attributes is included as Element's note.

1.3.11 Tag values

- Only one tag value is admitted and used inside the Conceptual Model: IFC_RAIL_ID. This is compiled with values from Domains' Data Requirements and it is used for BIMQ synchronization (tooling purpose only).

1.3.12 Data types

- A set of Data Type is defined by TS. This is included in the Conceptual Model as a separate package;
- The structure in EA is as follows:



- For each data type the following info are included:
  - Name of the element = BIMQ Data Type
  - Alias of the element = IFC4X2 Data Type
  - Constraints of the element = Constraints
  - Notes of the element = description
  - Link of the element = Related file
- Each Element's attribute is classified using such Data Types.

2 Track

2.1 Track Structural (physical)

2.1.1 Class diagram "Track" Structural (physical), overview: candidate

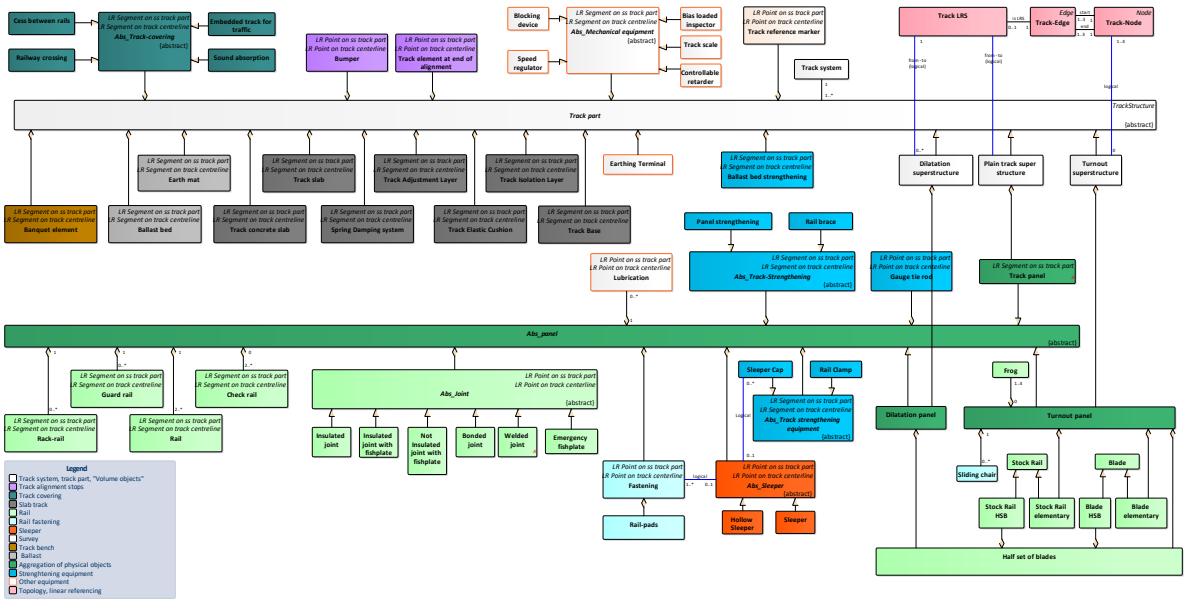


Table 1: Class diagram "Track" Structural (physical), overview: candidate

2.1.1.1 Track- and turnout panel

2.1.1.2 Class diagram "Track- and turnout panel"

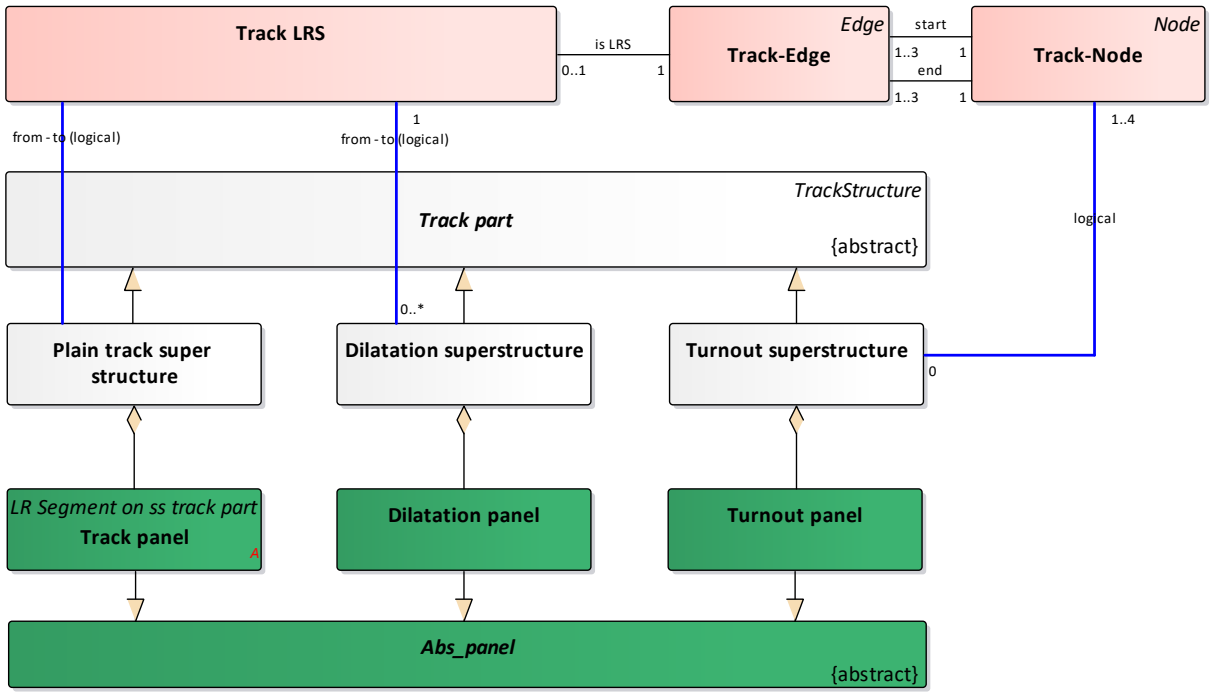


Table 2: Class diagram "Track- and turnout panel"

2.1.1.3 Abs_panel

Abstract class representing any panel for track physical objects.

Relationships

Source	Type	Target
Check rail	Aggregation	Abs_panel
Turnout panel	Generalization	Abs_panel
Track panel	Generalization	Abs_panel
Guard rail	Aggregation	Abs_panel
Lubrication	Aggregation	Abs_panel
Fastening	Aggregation	Abs_panel
Rail	Aggregation	Abs_panel
Abs_Joint	Aggregation	Abs_panel
Transistion Layer	Aggregation	Abs_panel
Gauge tie rod	Aggregation	Abs_panel
Dilatation panel	Generalization	Abs_panel

Source	Type	Target
Abs_Sleeper	Aggregation	Abs_panel
Foundation Layer	Aggregation	Abs_panel
Abs_Track strengthening equipment	Aggregation	Abs_panel
Abs_Track-Strengthening	Aggregation	Abs_panel
Rack-rail	Aggregation	Abs_panel
Barrier layer	Aggregation	Abs_panel

2.1.1.4 Track panel

The track panel is a functional view made up of the running rail, rail fastening and sleeper. One property of the track panel is that the components are permanently assembled and cannot be moved independently.

The track panel as a whole absorbs and transfers the forces into the superstructure. This may consist of a ballast bed or a slab track. In extreme cases (on simple railways), the track panel may lie on bare soil.

The track panel follows the routing in 3D space. It is uniquely identified by the track centre (routing/alignment) and the track centre's characteristics. It runs in the centre between the upper edges of the running rail. The track panel therefore has parameters regarding the horizontal and vertical routing and also carries information regarding cant.

In processes, the track panel is often considered as one unit, not just when planning for projects but also as part of numerous superstructure maintenance measures.

A track panel may consist of the following object types but does not necessarily have to have all of them according to the conceptual model:

- Running rail

- Rail fastening

- Sleepers

- Rail joints

- Other objects

Relationships

Source	Type	Target
Track panel	Generalization	Abs_panel
Track panel	Generalization	LR Segment on ss track part
Track panel	Aggregation	Plain track super structure

2.1.1.5 Turnout panel

Like the track panel, the turnout panel is a functional view made up of the running rail, rail fastening and sleeper. Turnout panels also include specific turnout objects such as frogs, check rail, half set of blades, etc.

One property of the turnout panel is that the components are permanently assembled and cannot be moved independently. Often, “turnout panels” are even supplied and installed as a single unit.

The turnout panel as a whole absorbs and transfers the forces into the superstructure. This may consist of ballast or a slab track. In extreme cases (on simple railways), the turnout panel may lie on bare soil. The internal geometric restrictions on turnout between the tip of the turnout and the last continuous sleeper (no bends, curvatures, etc.) must be taken into account for the Placement of the objects.

The turnout panel follows the routing in 3D space. It is uniquely identified by the track centre and the track centre’s characteristics. It runs in the centre between the upper edges of the running rail (SiOK). The turnout panel therefore has parameters regarding the horizontal and vertical routing and also carries information regarding cant.

In processes, the turnout panel is often considered one unit, not just when planning for projects from a topological point of view but also as part of numerous superstructure upgrade measures.

The turnout panel has an internal reference system which is recorded in the “Installation plan”.

The entire rail system is defined as a seamless sequence of track and turnout panels which follows the topology and routing.

Relationships

Source	Type	Target
Turnout panel	Generalization	Abs_panel
Turnout panel	Aggregation	Turnout superstructure
Stock Rail elementary	Aggregation	Turnout panel

Source	Type	Target
Frog	Aggregation	Turnout panel
Half set of blades	Aggregation	Turnout panel
Sliding chair	Aggregation	Turnout panel
Blade elementary	Aggregation	Turnout panel

2.1.1.6 Dilatation panel

Sliding transition in the longitudinal direction between two neighbouring running rails.

Device which permits longitudinal relative rail movement of two adjacent rails (i.e. due to themical expansion forces), while maintaining correct guidance and support.

Electrically connected

Inhomogeneity in the supporting strength of the running rail (longitudinal and lateral forces)

Inhomogeneity in the stability of the track panel

Special design with reinforcing elements in the track panel

Relationships

Source	Type	Target
Dilatation panel	Aggregation	Dilatation superstructure
Dilatation panel	Generalization	Abs_panel
Dilatation panel	NoteLink	Note
Half set of blades	Aggregation	Dilatation panel

2.1.2 Rail

2.1.2.1 Class diagram "Rail positioning"

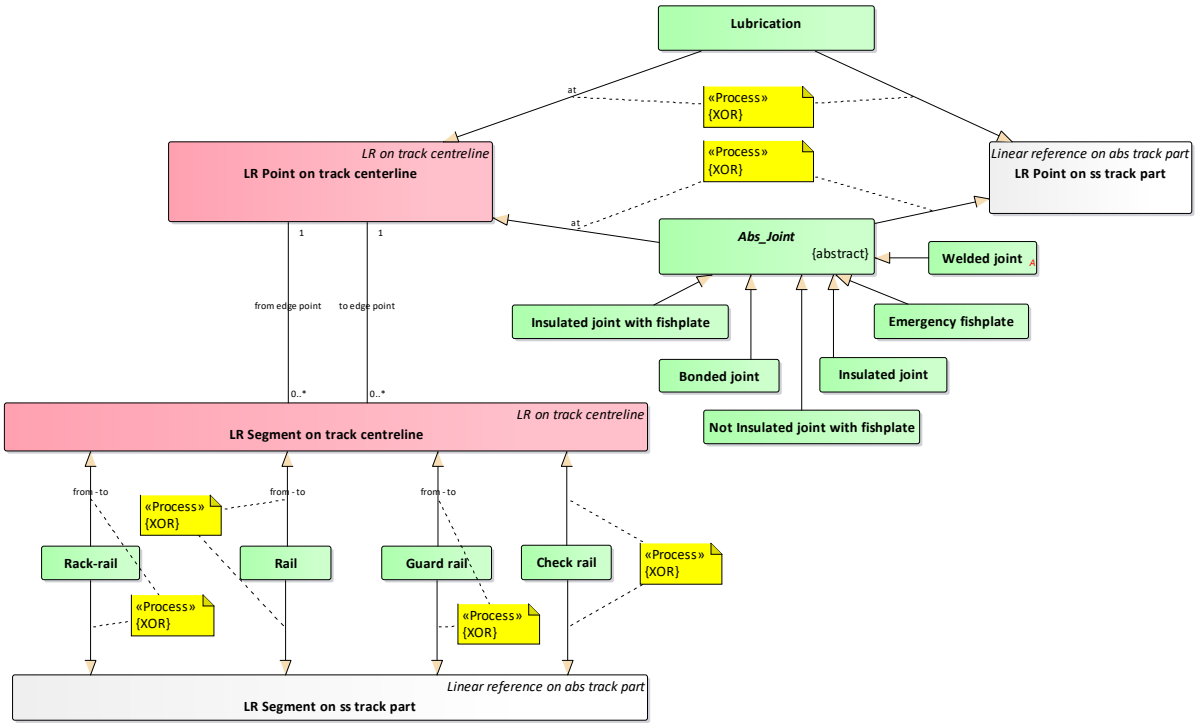


Table 3: Class diagram "Rail positioning"

The diagram shows the requirements for the positioning of the objects belonging to the rail package.

It must be possible to locate a rail object i.e. Lubrication, bonded joint either on a track centerline or on a superstructure track part.

The diagram is representative for all other themes inside of the track domain.

2.1.2.2 Class diagram "Rail"

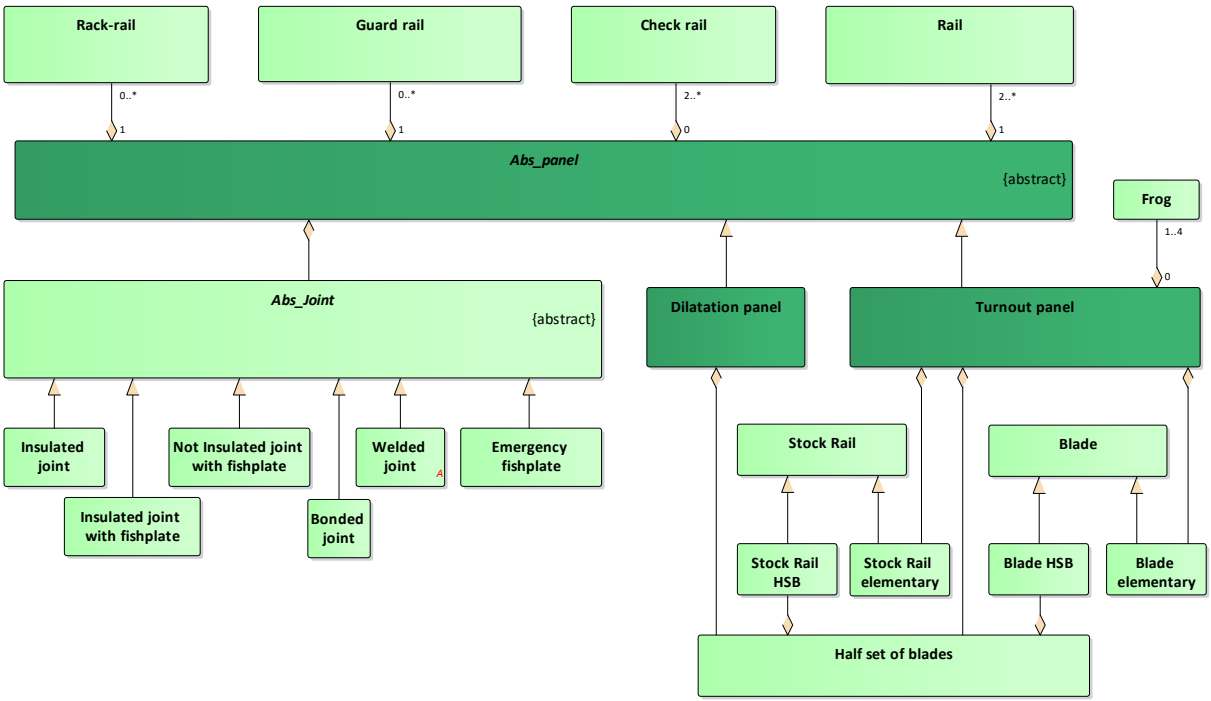


Table 4: *Class diagram "Rail"*

The diagram shows the classes and relationships for the objects in rail.

2.1.2.3 Rail

Absorption of force in the wheel/rail system (running surface and wheel flange), hunting oscillation

Distribution of force in the longitudinal direction (static and dynamic traffic loads)

Absorption of force in the longitudinal direction (temperature)

In case of a Switch: Special components are modeled separately.

Depending from location/panel function: different specifications are possible (eg Wing rail)

Relationships

Source	Type	Target
Rail	Aggregation	Abs_panel
Rail	Generalization	LR Segment on track centreline
Rail	Generalization	LR Segment on ss track part

2.1.2.4 Check rail

Rail laid close to gauge face of a running rail which does not carry a railway wheel but ensures, by guidance of the wheel, the safe passage of both wheels of the axle through small radius curves, turnouts, crossings by not allowing the flange of either wheel to ride up over the running surface of the running rails.

Relationships

Source	Type	Target
Check rail	Aggregation	Abs_panel
Check rail	Generalization	LR Segment on track centreline
Check rail	Generalization	LR Segment on ss track part

2.1.2.5 Guard rail

Non-running rail mounted either inside or outside the running rail to protect vehicle, bridge, viaduct and other structures in the event of a derailment.

Relationships

Source	Type	Target
Guard rail	Aggregation	Abs_panel
Guard rail	Generalization	LR Segment on ss track part
Guard rail	Generalization	LR Segment on track centreline

2.1.2.6 Frog

Arrangement ensuring the intersection of two opposite running edges of turnouts or diamond crossings having crossing vees (single or double) and wing rails.

Direct contact with wheel (with running surface and wheel flange, depending on the design)

Relationships

Source	Type	Target
Frog	Aggregation	Turnout panel

2.1.2.7 Half set of blades

"Half set of blades" is composed of one blade and one stock rail. Only replaceable as one unit during railway maintenance.

It is right or left hand as seen by an observer in the centre of the track facing the turnout heel from the turnout toe.

Function: change the direction.

Relationships

Source	Type	Target
Half set of blades	Aggregation	Turnout panel
Half set of blades	Aggregation	Dilatation panel
Stock Rail HSB	Aggregation	Half set of blades
Blade HSB	Aggregation	Half set of blades

2.1.2.8 Blade

Movable machined rail, often of special section, but fixed and/or joined at the heel end to a rail to provide continuity of wheel support.

"Half set of blades" is composed of one blade and one stock rail. Only replaceable as one unit during railway maintenance. Where blade or stock rail can be replaced separately (i.e. Metro) the objects are assigned as "blade elementary" and "stock rail elementary" in the conceptual model.

Relationships

Source	Type	Target
Blade elementary	Generalization	Blade
Blade HSB	Generalization	Blade

2.1.2.9 Blade elementary

Subtype of blade as a separated manufactured element (i.e. tramways)

Relationships

Source	Type	Target
Blade elementary	Generalization	Blade
Blade elementary	Aggregation	Turnout panel

2.1.2.10 Blade HSB

Subtype of blade only used in half set of blades

Relationships

Source	Type	Target
Blade HSB	Aggregation	Half set of blades
Blade HSB	Generalization	Blade

2.1.2.11 Stock Rail

Fixed machined rail, ensuring the continuity on the main or diverging track with the switch in the open position. The machined part of the stock rail supports its switch rail in the closed position, giving continuity of line through this switch rail.

"Half set of blades" is composed of one blade and one stock rail. Only replaceable as one unit during railway maintenance. Where blade or stock rail can be replaced separately (i.e. Metro) the objects are assigned as "blade elementary" and "stock rail elementary" in the conceptual model.

Relationships

Source	Type	Target
Stock Rail HSB	Generalization	Stock Rail
Stock Rail elementary	Generalization	Stock Rail

2.1.2.12 Stock Rail elementary

Subtype of stock rail as a separated manufactured element (i.e. tramways)

Relationships

Source	Type	Target
Stock Rail elementary	Aggregation	Turnout panel
Stock Rail elementary	Generalization	Stock Rail

2.1.2.13 Stock Rail HSB

Subtype of stock rail only used in half set of blades

Relationships

Source	Type	Target
Stock Rail HSB	Aggregation	Half set of blades
Stock Rail HSB	Generalization	Stock Rail

2.1.2.14 Abs_Joint

Abstract class for joints.

Relationships

Source	Type	Target
Abs_Joint	Generalization	LR Point on ss track part
Abs_Joint	Aggregation	Abs_panel
Abs_Joint	Generalization	LR Point on track centerline
Bonded joint	Generalization	Abs_Joint
Welded joint	Generalization	Abs_Joint
Insulated joint with fishplate	Generalization	Abs_Joint
Emergency fishplate	Generalization	Abs_Joint
Insulated joint	Generalization	Abs_Joint
Not Insulated joint with fishplate	Generalization	Abs_Joint

2.1.2.15 Insulated joint

Transition between two neighbouring rails.

Electrically insulated for use of track circuits (incl. return electric traction circuit)

Usage has relevance for operations.

Used for Continuous Welded Rails (CWR).

Inhomogeneity in the supporting strength of the running rail (longitudinal, vertical and lateral forces).

Inhomogeneity in the stability of the track panel.

Origin of noise emissions.

Relationships

Source	Type	Target
Insulated joint	Generalization	Abs_Joint

2.1.2.16 Emergency fishplate

Is it an emergency fish plate yes/no, potentially restricted use (travel slowly)

Relationships

Source	Type	Target
Emergency fishplate	Generalization	Abs_Joint

2.1.2.17 Bonded joint

Transition between two neighbouring running rails.

Electrically connected.

Used for Continuous Welded Rails (CWR).

Inhomogeneity in the supporting strength of the running rail (longitudinal, vertical and lateral forces).

Inhomogeneity in the stability of the track panel.

Origin of noise emissions.

Relationships

Source	Type	Target
Bonded joint	Generalization	Abs_Joint

2.1.2.18 Welded joint

Continuous transition between two neighbouring running rails.

Electrically connected.

Special quality requirements for ensuring the continuous supporting strength of the running rail (primarily temperature fluctuations in the continuously welded track).

Relationships

Source	Type	Target
Welded joint	Generalization	Abs_Joint

2.1.2.19 Insulated joint with fishplate

Transition between two neighbouring running rails but in not continuous rail zone.

Electrically insulated.

Used for jointed track.

Inhomogeneity in the supporting strength of the running rail (longitudinal, lateral and vertical forces).

Inhomogeneity in the stability of the track panel.

The gap between the rails is the origin of noise emissions.

Relationships

Source	Type	Target
Insulated joint with fishplate	Generalization	Abs_Joint

2.1.2.20 Not Insulated joint with fishplate

Transition between two neighbouring running rails.

Electrically connected.

Used for jointed track.

Inhomogeneity in the supporting strength of the running rail (longitudinal, lateral and vertical forces).

Inhomogeneity in the stability of the track panel.

The gap between the rails is the origin of noise emissions.

Relationships

Source	Type	Target
Not Insulated joint with fishplate	Generalization	Abs_Joint

2.1.2.21 Rack-rail

Building module for enhancing traction and break performance (mountains)

Reinforces the track panel.

Located centrical in the track panel on the rail axes.

(Formerly also known as ""Rack"".)

Relationships

Source	Type	Target
Rack-rail	Generalization	LR Segment on track centreline
Rack-rail	Generalization	LR Segment on ss track part
Rack-rail	Aggregation	Abs_panel

2.1.3 Rail fastening

2.1.3.1 Class diagram "Rail fastening"

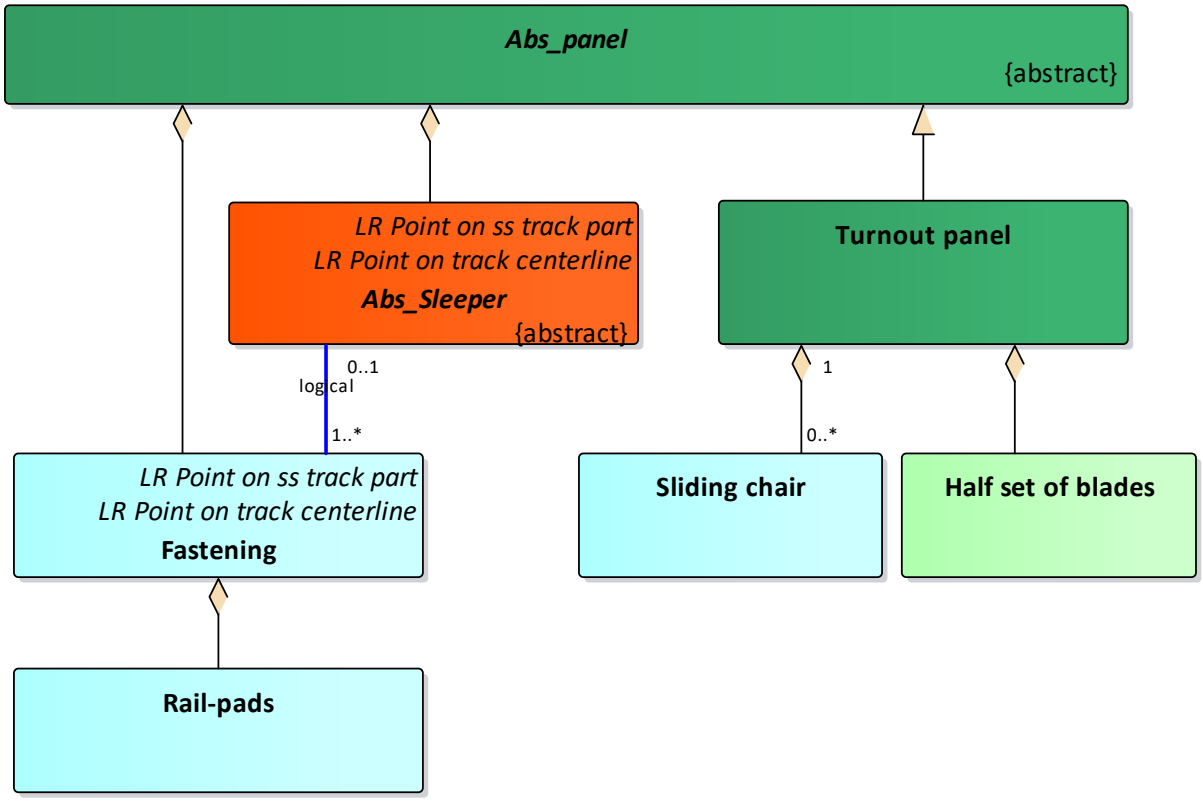


Table 5: Class diagram "Rail fastening"

2.1.3.2 Fastening

Assembly of components which secures a rail to the supporting structure and retains it in the required position whilst permitting any necessary vertical, lateral and longitudinal movement.

Essential for stability of the track panel.

Absorbes the shear forces from the rail.

Depending on the construction type the different effects regarding vertical and horizontal forces.

Proper contact prevents dynamic impacts on the track pannel (e.g. hits from the rail to the sleepers or risk of losing holding force in the sleepers due to dynamic loads from the traffic loads (hole bearing etc.)

Note: The major part of the vertical force absorbtion happended throught a direct contact of the rail an the track slab (fastening on the sleeper) or to the sleeper itself (depending on the type)

Relationships

Source	Type	Target
Fastening	Generalization	LR Point on ss track part
Fastening	Generalization	LR Point on track centerline
Fastening	NoteLink	Note
Fastening	Aggregation	Abs_panel
Fastening	Association	Abs_Sleeper
Rail-pads	Aggregation	Fastening

2.1.3.3 Rail-pads

Non-metallic pad placed between rail and baseplate or rail and sleeper, bearer or slab.

Frequent replacemets are necessary.

Absorbing shocks and reduce vibrations in the rail (leads to a better wheel-rail contact).

Reduce damages to the rail, wearing and noise issues.

Often used on heavy-load routes and/or curves.

Relationships

Source	Type	Target
Rail-pads	Aggregation	Fastening

2.1.3.4 Sliding chair

Part which supports and retains the stock rail and a flat surface upon which the foot of the switch rail slides.

Only used in turnouts.

Different types of construction (rolls, bearing plates, lubricated or dry-running).

Relationships

Source	Type	Target
Sliding chair	Aggregation	Turnout panel
Sliding chair	NoteLink	Note

2.1.4 Sleeper

2.1.4.1 Class diagram "Sleeper"

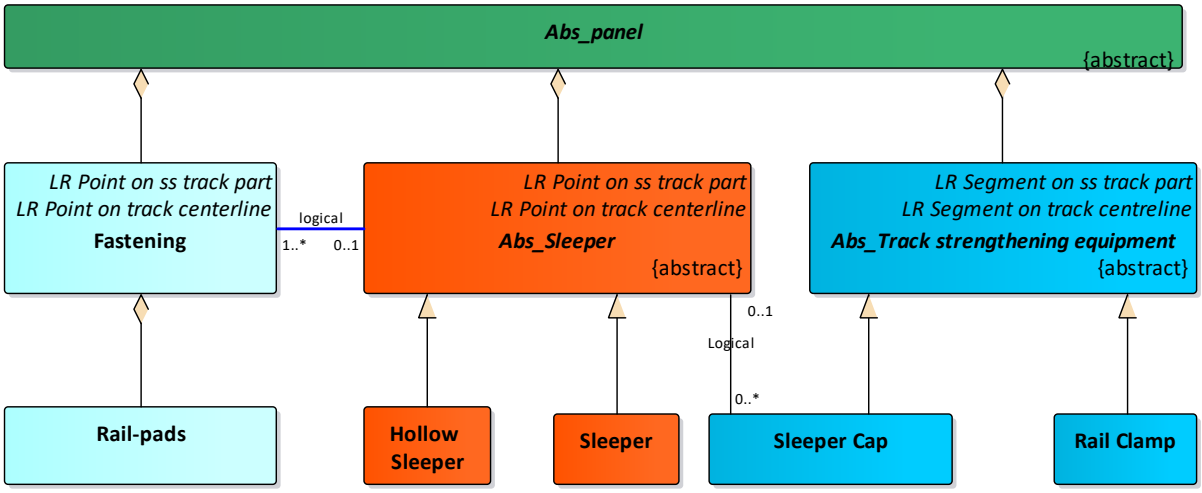


Table 6: Class diagram "Sleeper"

2.1.4.2 Abs_Sleeper

Abstract class for sleepers

Relationships

Source	Type	Target
Abs_Sleeper	Generalization	LR Point on track centerline
Abs_Sleeper	Generalization	LR Point on ss track part
Abs_Sleeper	Aggregation	Abs_panel
Sleeper Cap	Association	Abs_Sleeper
Hollow Sleeper	Generalization	Abs_Sleeper

Source	Type	Target
Fastening	Association	Abs_Sleeper
Note	NoteLink	Abs_Sleeper
Sleeper	Generalization	Abs_Sleeper

2.1.4.3 Sleeper

Transverse components of the track which control the gauge and transmit loads from the rail to the ballast or other sleeper support.

Dissipation of longitudinal and lateral forces caused by friction/dovetailing (ballast) or supporting plate (slab track).

When it's used for turnouts and crossings, it's also called "bearer".

Often a special sleeper spacing is used under joints (i.e. insulated joint).

Relationships

Source	Type	Target
Sleeper	Generalization	Abs_Sleeper

2.1.4.4 Hollow Sleeper

Special type of sleeper. Contains technical equipment (e.g. safety installations)

Protects equipment elements (e.g. turnout-setting mechanisms)

Allows equipment (e.g. cables) to safely run across the track panel

Limited absorption of force from running rail (via rail fastenings)

Limited dissipation of vertical load into ballast or supporting plate

Limited dissipation of longitudinal and lateral forces caused by friction/dovetailing (ballast) or supporting plate (slab track)

Can also be installed between normal sleepers.

Relationships

Source	Type	Target
Hollow Sleeper	Generalization	Abs_Sleeper

2.1.5 Strengthening equipment

2.1.5.1 Class diagram "Strengthening equipment"

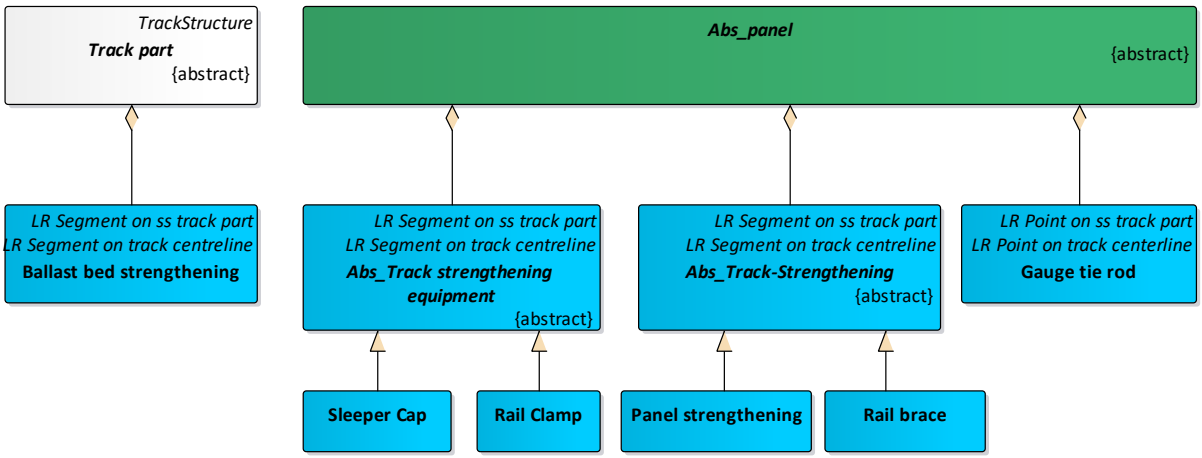


Table 7: Class diagram "Strengthening equipment"

2.1.5.2 Abs_Track-Strengthening

Abstract class for track strengthening

Relationships

Source	Type	Target
Abs_Track-Strengthening	Generalization	LR Segment on ss track part
Abs_Track-Strengthening	Generalization	LR Segment on track centreline
Abs_Track-Strengthening	Aggregation	Abs_panel
Panel strengthening	Generalization	Abs_Track-Strengthening
Rail brace	Generalization	Abs_Track-Strengthening

2.1.5.3 Panel strengthening

Used in transitions of different types of superstructure (e.g. from ballast to slab track or bridges/tunnels with different stiffness in the substructure).

Distributes the dynamic load peaks.

Improves stability and minimize shocks on the substructure.

Relationships

Source	Type	Target
Panel strengthening	Generalization	Abs_Track-Strengthening

2.1.5.4 Rail brace

Device to prevent rails from tipping and twisting.

Ensures track spacing between two running rails.

Relationships

Source	Type	Target
Rail brace	Generalization	Abs_Track-Strengthening

2.1.5.5 Ballast bed strengthening

Structural elements which are usually applied to the sides of ballast bed.

Reinforces the cross-resistance of the superstructure.

Can also be ballast bonding or similar.

Relationships

Source	Type	Target
Ballast bed strengthening	Generalization	LR Segment on ss track part

Source	Type	Target
Ballast bed strengthening	Generalization	LR Segment on track centreline
Ballast bed strengthening	Aggregation	Track part
Note	NoteLink	Ballast bed strengthening

2.1.5.6 Abs_Track strengthening equipment

Component for increasing the positional stability and functionality of a sleeper

Use often depends on topology and line routing

Main function: Increasing the lateral stability (Often used in low radius curves in the case of continuous welded rail.)

Dovetails with ballast

Improves the transmission of longitudinal forces from the running rail into the sleeper (e.g. anti creep device)

Assigned to a sleeper

Changed to abstract class, GoToMeeting / 22.7.2019

Relationships

Source	Type	Target
Abs_Track strengthening equipment	Generalization	LR Segment on ss track part
Abs_Track strengthening equipment	Generalization	LR Segment on track centreline
Abs_Track strengthening equipment	NoteLink	Note
Abs_Track strengthening equipment	Aggregation	Abs_panel
Rail Clamp	Generalization	Abs_Track strengthening equipment
Sleeper Cap	Generalization	Abs_Track strengthening equipment

2.1.5.7 Sleeper Cap

Main function: Increasing the lateral stability (Often used in low radius curves in the case of continuous welded rail.)

Dovetailed with ballast.

Assigned to a sleeper.

Relationships

Source	Type	Target
Sleeper Cap	Association	Abs_Sleeper
Sleeper Cap	Generalization	Abs_Track strengthening equipment

2.1.5.8 Rail Clamp

Component for increasing the positional stability of rail in continuous welded rail.

Main function: resistance to longitudinal movement of the rail.

Assigned to rail.

Relationships

Source	Type	Target
Rail Clamp	Generalization	Abs_Track strengthening equipment

2.1.5.9 Gauge tie rod

Device to ensure rail distance for simple track panel.

Can assure the function of a rail fastening or a sleeper.

Often used at build conditions oder in temporary solutions.

Also popular in forms of construction for driveable surfaces (e.g. tramways).

Relationships

Source	Type	Target
Gauge tie rod	Generalization	LR Point on track centerline
Gauge tie rod	Aggregation	Abs_panel
Gauge tie rod	Generalization	LR Point on ss track part

2.1.6 Ballast

2.1.6.1 Class diagram "Ballast"

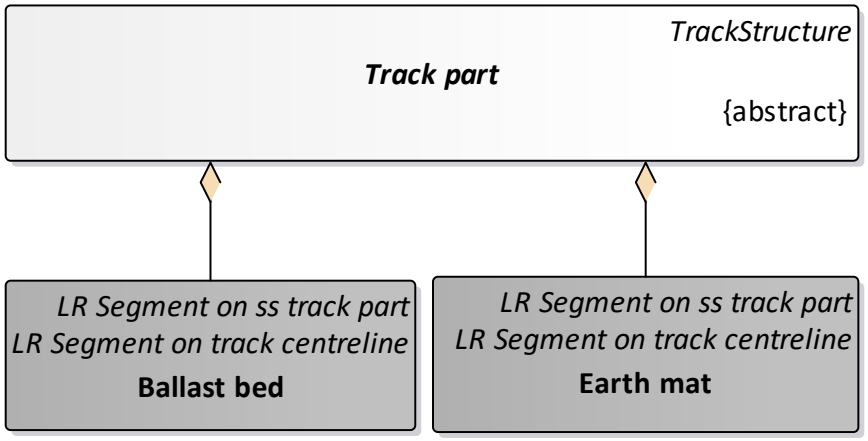


Table 8: Class diagram "Ballast"

2.1.6.2 Ballast bed

Consists of broken stones which are called ballast.

Main purpose: ensures stability of track, transfers forces from sleepers to substructure and allows to readjust the track geometry according to the correct alignment.

Wear and dirt reduce stability.

Relationships

Source	Type	Target
Ballast bed	Generalization	LR Segment on ss track part

Source	Type	Target
Ballast bed	Generalization	LR Segment on track centreline
Ballast bed	Aggregation	Track part
Note	NoteLink	Ballast bed

2.1.6.3 Earth mat

Located between the ballast bed and the top foundation layer.

Not necessarily required. Often used to control the elasticity of the whole track and prevents the ballast fast degradation (if there is a hard subgrade).

Relationships

Source	Type	Target
Earth mat	Generalization	LR Segment on ss track part
Earth mat	Aggregation	Track part
Earth mat	Generalization	LR Segment on track centreline
Note	NoteLink	Earth mat

2.1.7 Slab track

2.1.7.1 Class diagram "Slab track"

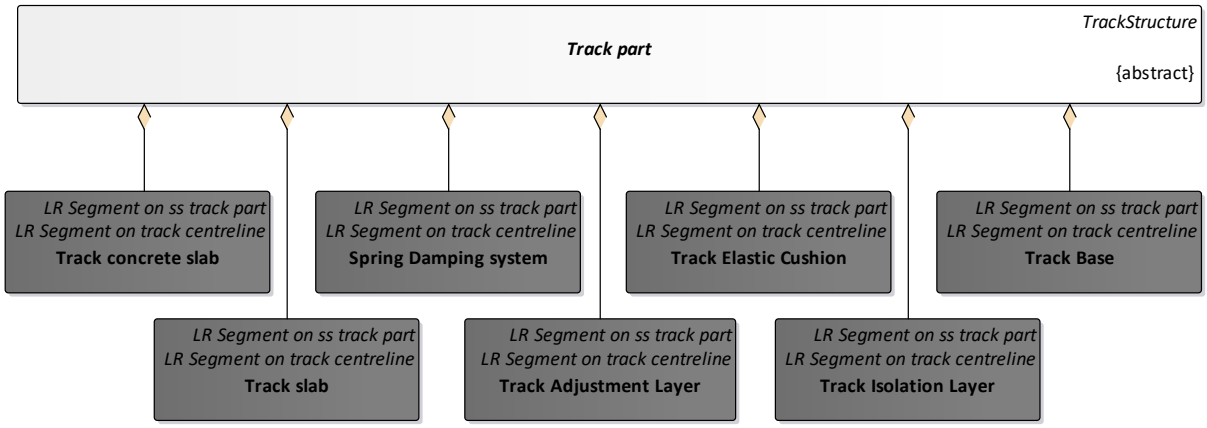


Table 9: Class diagram "Slab track"

2.1.7.2 Track concrete slab

Track concrete slab is an integral reinforced concrete layer cast in-situ, in which bi-block sleepers, concrete turnout sleepers or other sleepers are embedded.

Track concrete slab shall only appear in ballastless track structures.

Relationships

Source	Type	Target
Track concrete slab	Generalization	LR Segment on ss track part
Track concrete slab	NoteLink	Note
Track concrete slab	Aggregation	Track part
Track concrete slab	Generalization	LR Segment on track centreline

2.1.7.3 Track slab

Track slab is prefabricated reinforced concrete slab or prestressed reinforced concrete slab, which is a main element of slab track.

It transfers the load from rails and fastenings to sub-structures uniformly and longitudinal and lateral load of track structures to displacement-stopping structures.

Track Slab shall only appear in ballastless track structures.

The line where install track slab provide the place for installing fastening system. No sleeper is needed.

Relationships

Source	Type	Target
Track slab	Aggregation	Track part
Track slab	Generalization	LR Segment on track centreline
Track slab	Generalization	LR Segment on ss track part
Note	NoteLink	Track slab

2.1.7.4 Spring Damping system

Elastic elements are inserted between the superstructure (track and plate on slab track or ballast bed with ballast inserted in) and the tunnel structure (tunnel floor). Some of the elastic elements have a partial decoupling effect between the superstructure and underground due to vibrations. Both helical springs and elastomer blocks or elastomer strips can be used as suspension systems.

Relationships

Source	Type	Target
Spring Damping system	Aggregation	Track part
Spring Damping system	Generalization	LR Segment on ss track part
Spring Damping system	Generalization	LR Segment on track centreline
Note	NoteLink	Spring Damping system

2.1.7.5 Track Adjustment Layer

Track adjustment layer is a concrete layer or mortar layer cast or paved in-situ, which is used for supporting track slabs or track concrete slabs.

Track adjustment layer shall only appear in ballastless track structures.

Relationships

Source	Type	Target
Track Adjustment Layer	Generalization	LR Segment on ss track part
Track Adjustment Layer	Aggregation	Track part
Track Adjustment Layer	Generalization	LR Segment on track centreline
Note	NoteLink	Track Adjustment Layer

2.1.7.6 Track Elastic Cushion

Track elastic cushion is a kind of layer set on grooved sides of a concrete base, which is used for mitigating the impact of longitudinal and lateral load on track structures.

Track elastic cushion shall only appear in ballastless track structures.

Relationships

Source	Type	Target
Track Elastic Cushion	Generalization	LR Segment on track centreline
Track Elastic Cushion	Aggregation	Track part
Track Elastic Cushion	Generalization	LR Segment on ss track part
Note	NoteLink	Track Elastic Cushion

2.1.7.7 Track Isolation Layer

Track isolation layer is a structure layer placed on top surface of track bases. It may implement functions of damage repair of track superstructure under special circumstances and coordinate temperature deformation.

Track isolation layer shall only appear in ballastless track structures.

Relationships

Source	Type	Target
Track Isolation Layer	Generalization	LR Segment on track centreline
Track Isolation Layer	Aggregation	Track part
Track Isolation Layer	Generalization	LR Segment on ss track part
Note	NoteLink	Track Isolation Layer

2.1.7.8 Track Base

Concrete base is a kind of reinforced foundation cast in-situ, which is used for supporting track slabs or track concrete slabs.

Concrete base shall only appear in ballastless track structures.

Relationships

Source	Type	Target
Track Base	Aggregation	Track part
Track Base	Generalization	LR Segment on track centreline
Track Base	Generalization	LR Segment on ss track part

2.1.8 Track coverage

2.1.8.1 Class diagram "Track coverage"

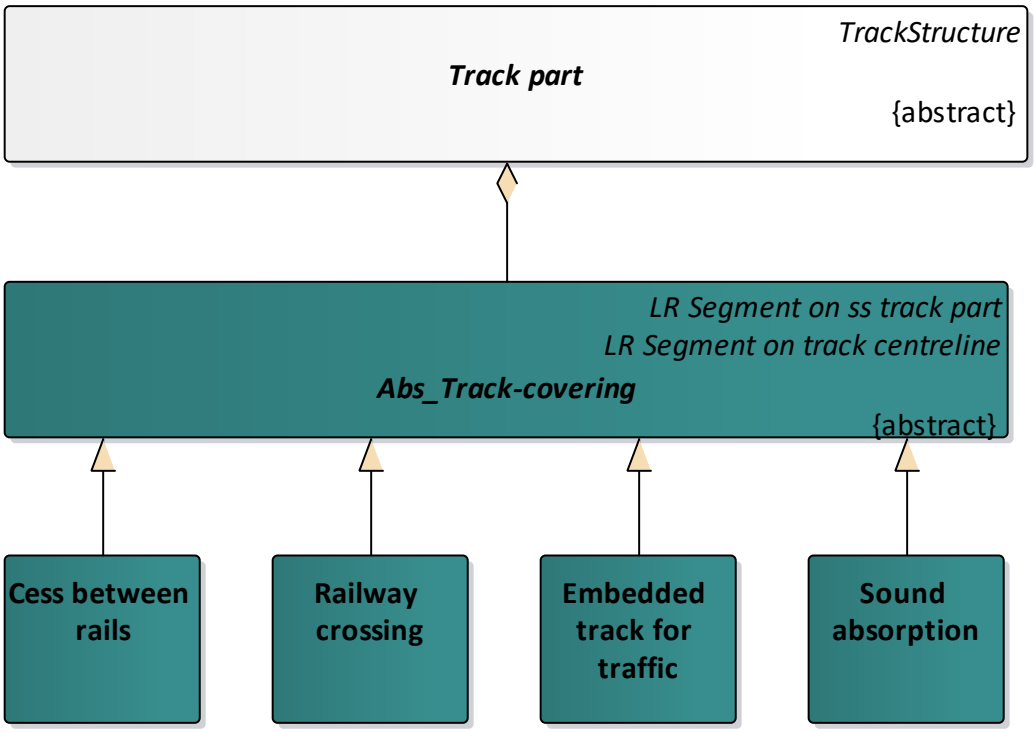


Table 10: Class diagram "Track coverage"

2.1.8.2 Abs_Track-covering

Abstract class for track covering

Relationships

Source	Type	Target
Abs_Track-covering	Generalization	LR Segment on ss track part
Abs_Track-covering	Generalization	LR Segment on track centreline
Abs_Track-covering	Aggregation	Track part
Embedded track for traffic	Generalization	Abs_Track-covering
Cess between rails	Generalization	Abs_Track-covering
Sound absorption	Generalization	Abs_Track-covering
Railway crossing	Generalization	Abs_Track-covering

2.1.8.3 Embedded track for traffic

Tracks recessed into road surface.

Superstructure type usually specific (slab track/grooved rail).

Covering can be driven on in all directions.

Usually used in public areas.

Combined drainage systems normally used.

Relationships

Source	Type	Target
Embedded track for traffic	Generalization	Abs_Track-covering

2.1.8.4 Railway crossing

Railway crossing covering for roads (secured/unsecured).

Superstructure type also possible with ballast.

Covering can be driven on in the transverse direction.

Usually used in public areas.

Often entails changes to the stiffness of the superstructure/substructure.

Relationships

Source	Type	Target
Railway crossing	Generalization	Abs_Track-covering
Note	NoteLink	Railway crossing

2.1.8.5 Cess between rails

Covering between rails for internal maintenance purposes.

Can be walked on.

Situated in the track.

Not public.

Relationships

Source	Type	Target
Cess between rails	Generalization	Abs_Track-covering

2.1.8.6 Sound absorption

Components in the track for sound absorption.

May also absorb vibrations.

Not included noise barriers at track side.

Often used in combination with slab track.

Relationships

Source	Type	Target
Sound absorption	Generalization	Abs_Track-covering

2.1.9 Track bench

2.1.9.1 Class diagram "Track bench"

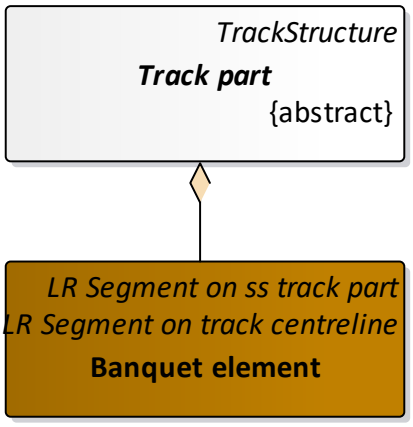


Table 11: *Class diagram "Track bench"*

2.1.9.2 Banquet element

Usually at ballast level.

Outside of structure gauge.

Function: walkway, service path.

Access to track.

Relationships

Source	Type	Target
Banquet element	Aggregation	Track part
Banquet element	NoteLink	Note
Banquet element	Generalization	LR Segment on ss track part
Banquet element	Generalization	LR Segment on track centreline

2.1.10 Track alignment stops

2.1.10.1 Class diagram "Track alignment stops"

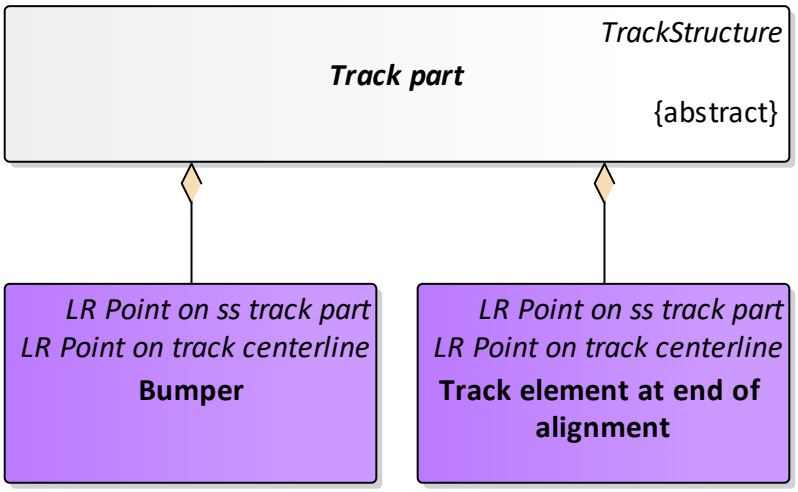


Table 12: Class diagram "Track alignment stops"

2.1.10.2 Bumper

Buffer, object at end of track.

Function: prevents driving over; can be fixed on rails or the track panel - Can also be a natural element (rock, sand).

Relationships

Source	Type	Target
Bumper	Generalization	LR Point on ss track part
Bumper	Generalization	LR Point on track centerline
Bumper	Aggregation	Track part
Note	NoteLink	Bumper

2.1.10.3 Track element at end of alignment

Alignment stop

Special functional installations such as axle-gauge changeover point; transporter wagon loading point.

Relationships

Source	Type	Target
Track element at end of alignment	Generalization	LR Point on ss track part
Track element at end of alignment	Generalization	LR Point on track centerline
Track element at end of alignment	Aggregation	Track part

2.1.11 Survey

2.1.11.1 Class diagram "Survey"

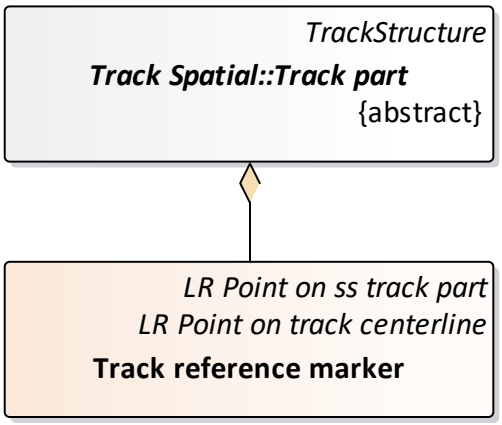


Table 13: Class diagram "Survey"

2.1.11.2 Track reference marker

Generally bolts which are firmly fixed to permanent components such as foundations, platform edges or civil engineering structures. Their position and elevation are known to the nearest mm (planar, x/y/z coordinates).

Serve as a reference for inspecting or ensuring (e.g. by mechanical tamper) the ideal location and elevation of the track panel and other installation elements.

Serve to hold technical measuring elements (e.g. prism mirrors)

Relationships

Source	Type	Target
Track reference marker	Generalization	LR Point on track centerline
Track reference marker	Generalization	LR Point on ss track part
Track reference marker	Aggregation	Track part

2.1.12 Other equipment

2.1.12.1 Class diagram "Other equipment"

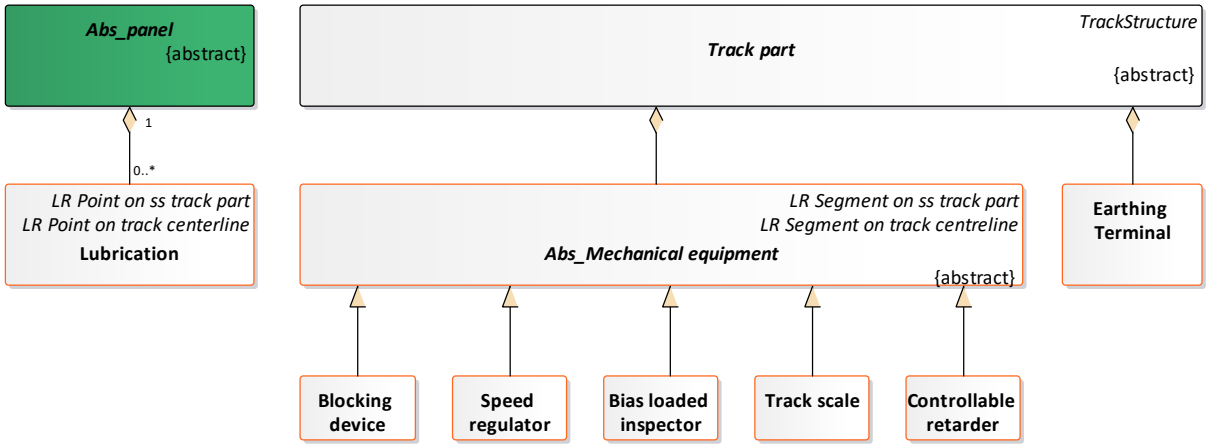


Table 14: *Class diagram "Other equipment"*

2.1.12.2 Abs_Mechanical equipment

Abstract class for mechanical equipment

Relationships

Source	Type	Target
Abs_Mechanical equipment	Generalization	LR Segment on track centreline
Abs_Mechanical equipment	Aggregation	Track part
Abs_Mechanical equipment	Generalization	LR Segment on ss track part
Speed regulator	Generalization	Abs_Mechanical equipment
Track scale	Generalization	Abs_Mechanical equipment

Source	Type	Target
Blocking device	Generalization	Abs_Mechanical equipment
Controllable retarder	Generalization	Abs_Mechanical equipment
Bias loaded inspector	Generalization	Abs_Mechanical equipment

2.1.12.3 Bias loaded inspector

Equipment installed on track to inspect whether the load of vehicles is biased.

Relationships

Source	Type	Target
Bias loaded inspector	Generalization	Abs_Mechanical equipment
Note	NoteLink	Bias loaded inspector

2.1.12.4 Blocking device

Equipment installed on classification yard (also named as shunting yard) to block rolling vehicles.

Relationships

Source	Type	Target
Blocking device	Generalization	Abs_Mechanical equipment
Note	NoteLink	Blocking device

2.1.12.5 Controllable retarder

Equipment installed on classification yard (also named as shunting yard) to regulate the speed of rolling vehicles.

Relationships

Source	Type	Target
Controllable retarder	Generalization	Abs_Mechanical equipment
Note	NoteLink	Controllable retarder

2.1.12.6 Speed regulator

Equipment installed on railway hump and classification yard (also named as shunting yard) to regulate the speed of rolling vehicles.

Relationships

Source	Type	Target
Speed regulator	Generalization	Abs_Mechanical equipment
Note	NoteLink	Speed regulator

2.1.12.7 Track scale

Equipment installed on track of freight yard to measure the weight of vehicles.

Relationships

Source	Type	Target
Track scale	Generalization	Abs_Mechanical equipment
Note	NoteLink	Track scale

2.1.12.8 Earthing Terminal

Object used for earthing.

Installed in track slab or concrete slab.

Welded to reinforcing bar in track slab or concrete slab.

Relationships

Source	Type	Target
Earthing Terminal	Aggregation	Track part

2.1.12.9 Lubrication

Prevent wearing of the rails throught the flange of wheel.

Reduce noise emissions.

Often located at inner side of the outer rail in a curve or near turnouts (depends from function wearing or noise reduction)

Relationships

Source	Type	Target
Lubrication	Generalization	LR Point on ss track part
Lubrication	Aggregation	Abs_panel
Lubrication	Generalization	LR Point on track centerline

2.2 Track Spatial

2.2.1 Class diagram track spatial structure

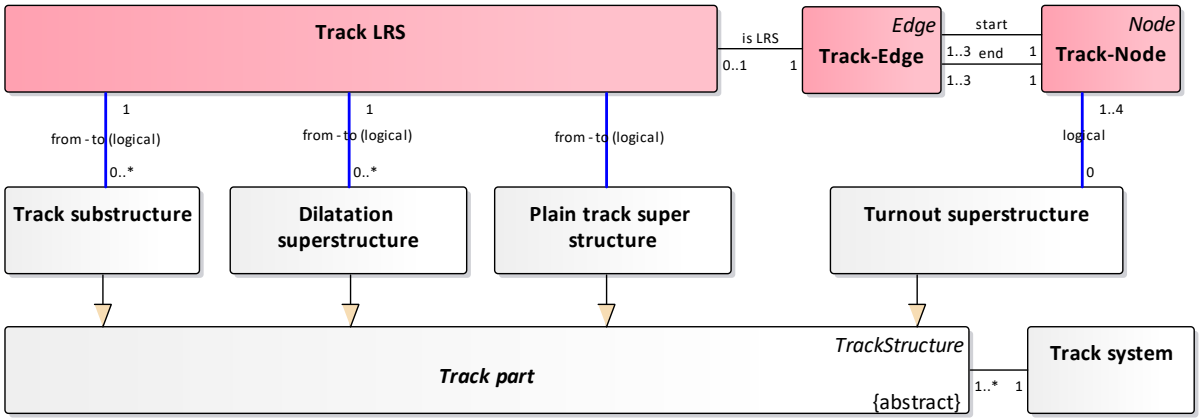


Table 15: Class diagram track spatial structure

2.2.2 Track system

Track System refers to a functional track with the explicit terminals. It refers a continuous sequence of track parts.

Relationships

Source	Type	Target
Track system	Association	Track part

2.2.3 Track part

Track part is the basic volume object for all objects of track superstructure. It refers to a segment of track system engineering which is part of the track system and has a unique structural type and functional type.

Relationships

Source	Type	Target
Track part	Aggregation	TrackStructure
Track part	Generalization	TrackStructure
Track system	Association	Track part
Dilatation superstructure	Generalization	Track part
Track slab	Aggregation	Track part
Linear reference on abs track part	Association	Track part
Banquet element	Aggregation	Track part
Traverser	Generalization	Track part
Earthing Terminal	Aggregation	Track part
Abs_Mechanical equipment	Aggregation	Track part
Track Adjustment Layer	Aggregation	Track part
Track Elastic Cushion	Aggregation	Track part
Track Base	Aggregation	Track part
Track reference marker	Aggregation	Track part

Source	Type	Target
Spring Damping system	Aggregation	Track part
Turn table	Generalization	Track part
Track concrete slab	Aggregation	Track part
Turnout superstructure	Generalization	Track part
Bumper	Aggregation	Track part
Track Isolation Layer	Aggregation	Track part
Earth mat	Aggregation	Track part
Track substructure	Generalization	Track part
Plain track super structure	Generalization	Track part
Abs_Track-covering	Aggregation	Track part
Ballast bed	Aggregation	Track part
Ballast bed strengthening	Aggregation	Track part
Track element at end of alignment	Aggregation	Track part

2.2.4 Plain track super structure

Plain track super structure is one subtype of track part without turnout panel or dilatation panel.

Relationships

Source	Type	Target
Plain track super structure	Generalization	Track part
Track LRS	Association	Plain track super structure
Track Asset version	Association	Plain track super structure
Track panel	Aggregation	Plain track super structure

2.2.5 Turnout superstructure

Turnout superstructure is one subtype of track part with turnout panel.

Relationships

Source	Type	Target
Turnout superstructure	Association	Track-Node
Turnout superstructure	Generalization	Track part
Dilatation/Turnout Asset version	Association	Turnout superstructure
Turnout panel	Aggregation	Turnout superstructure

2.2.6 Dilatation superstructure

Dilatation superstructure is one subtype of track part with Dilatation panel.

Relationships

Source	Type	Target
Dilatation superstructure	Association	Track LRS
Dilatation superstructure	Generalization	Track part
Dilatation panel	Aggregation	Dilatation superstructure
Dilatation/Turnout Asset version	Association	Dilatation superstructure

3 Signalling

3.1 Signalling Structural (physical)

3.1.1 Class diagram Objects overview pt.1

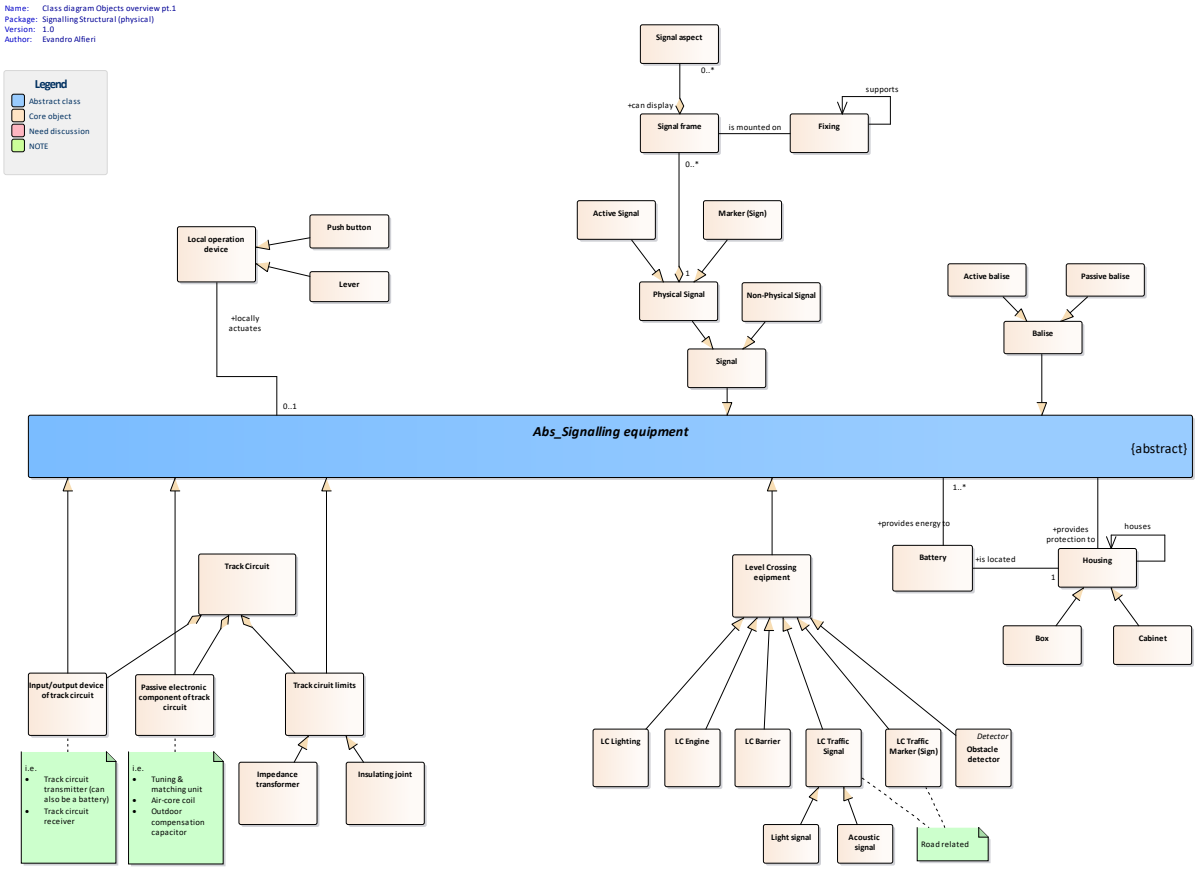


Table 16: Class diagram Objects overview pt.1

3.1.2 Class diagram Objects overview pt.2

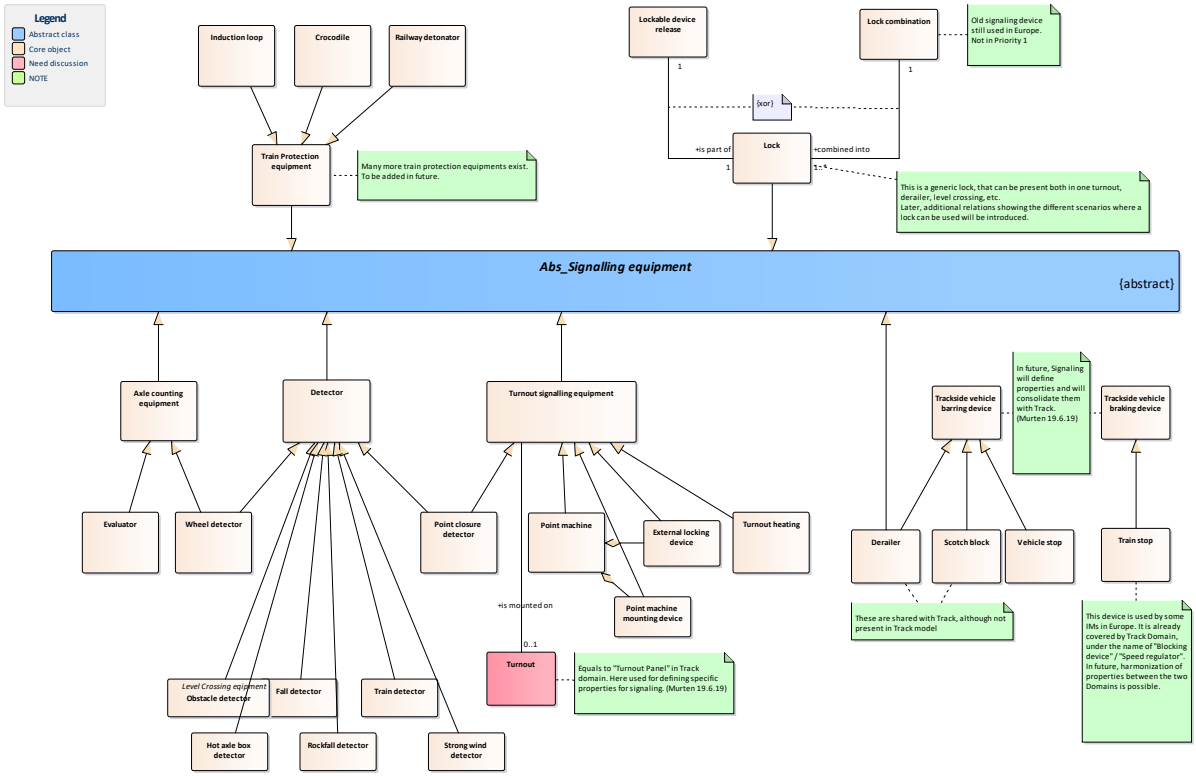


Table 17: Class diagram Objects overview pt.2

3.1.3 Abstract_equipment

3.1.3.1 Abs_Signalling equipment

Abstract, common ancestor of all Signalling elements.

Relationships

Source	Type	Target
Abs_Signalling equipment	Aggregation	Signalling equipment volume
Track ciruit limits	Generalization	Abs_Signalling equipment
Passive electronic component of track circuit	Generalization	Abs_Signalling equipment
Turnout signalling equipment	Generalization	Abs_Signalling equipment
Derailer	Generalization	Abs_Signalling equipment
Detector	Generalization	Abs_Signalling equipment

Source	Type	Target
Lock	Generalization	Abs_Signalling equipment
Train Protection equipment	Generalization	Abs_Signalling equipment
Battery	Association	Abs_Signalling equipment
Level Crossing eqipment	Generalization	Abs_Signalling equipment
Abs_Signalling non-trackside equipment	Generalization	Abs_Signalling equipment
Axle counting equipment	Generalization	Abs_Signalling equipment
Note	NoteLink	Abs_Signalling equipment
Input/output device of track circuit	Generalization	Abs_Signalling equipment
Balise	Generalization	Abs_Signalling equipment
Housing	Association	Abs_Signalling equipment
Signal	Generalization	Abs_Signalling equipment
Local operation device	Association	Abs_Signalling equipment

3.1.4 Axle counting equipment

3.1.4.1 Class diagram Axle counting equipment

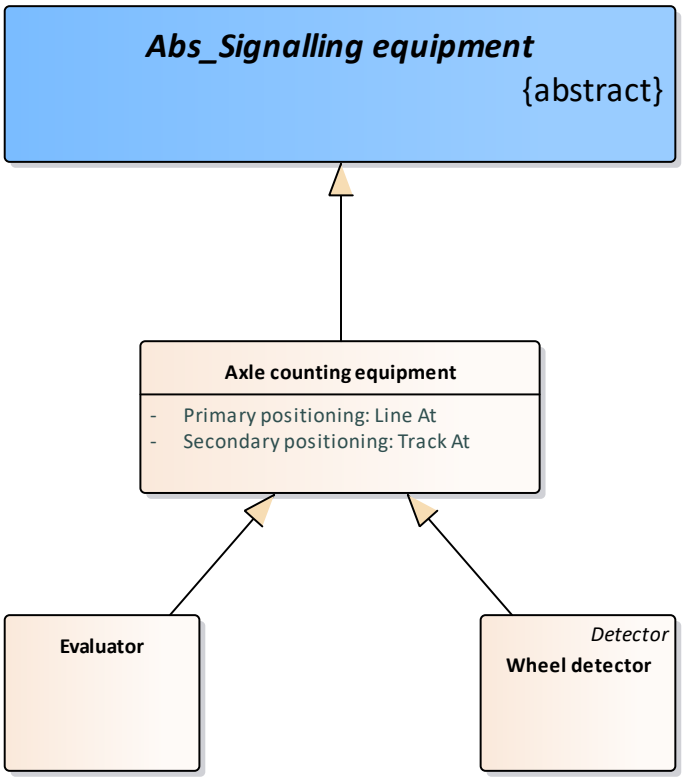


Table 18: Class diagram Axle counting equipment

3.1.4.2 Axle counting equipment

System using counting points with a wheel detector and a counter which detects the occupancy of a section of track by comparing the number of axles which enter the section with the number of axles which leave the section, parity of the numbers being necessary to give a clear indication.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Axle counting equipment	Generalization	Abs_Signalling equipment
Evaluator	Generalization	Axle counting equipment
Wheel detector	Generalization	Axle counting equipment

3.1.4.3 Evaluator

Centrally located computer.

Relationships

Source	Type	Target
Evaluator	Generalization	Axle counting equipment

3.1.5 Balise

3.1.5.1 Class diagram Balise

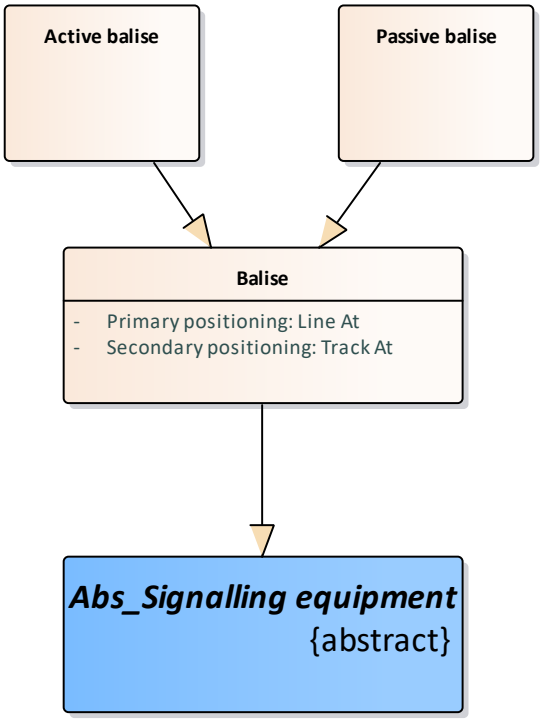


Table 19: Class diagram Balise

3.1.5.2 Active balise

The active balise is a point device used to transmit variable data packets to the train from the ground.

Relationships

Source	Type	Target
Active balise	Generalization	Balise

3.1.5.3 Passive balise

The passive balise is a point device for transmitting fixed data packets from the trackside to the train.

Relationships

Source	Type	Target
Passive balise	Generalization	Balise

3.1.5.4 Balise

Apparatus in the track by means of which data are transmitted to a train to update the train-borne automatic protection equipment regarding the track and signal conditions of the line ahead.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Balise	Generalization	Abs_Signalling equipment
Passive balise	Generalization	Balise
Active balise	Generalization	Balise

3.1.6 Cable and Wire

3.1.6.1 Class diagram Cable and Wire

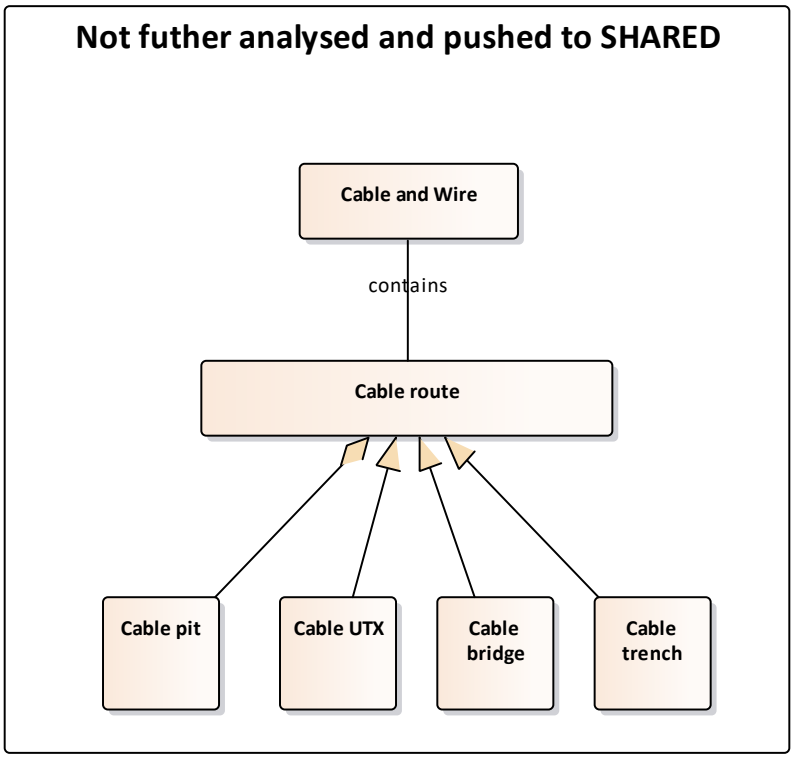


Table 20: Class diagram Cable and Wire

3.1.6.2 Cable and Wire

A cable segment is a flow segment used to carry electrical power, data, or telecommunications signals.A cable segment is used to typically join two sections of an electrical network or a network of components carrying the electrical service.

Relationships

Source	Type	Target
Cable and Wire	Association	Cable route

3.1.6.3 Cable bridge

Special type of a Cable route crossing a track or an obstacle in a certain height.

Relationships

Source	Type	Target
Cable bridge	Generalization	Cable route

3.1.6.4 Cable UTX

Special type of a Cable route crossing under the track.

Relationships

Source	Type	Target
Cable UTX	Generalization	Cable route

3.1.6.5 Cable pit

Manhole for inspection of cable routes under the earth.

Relationships

Source	Type	Target
Cable pit	Aggregation	Cable route

3.1.6.6 Cable route

Housing for cables connecting Cable pits and Cable joints.

Relationships

Source	Type	Target
Cable UTX	Generalization	Cable route
Cable pit	Aggregation	Cable route
Cable bridge	Generalization	Cable route
Cable and Wire	Association	Cable route

Source	Type	Target
Cable trench	Generalization	Cable route

3.1.7 Control Equipment

3.1.7.1 Class diagram Control Equipment

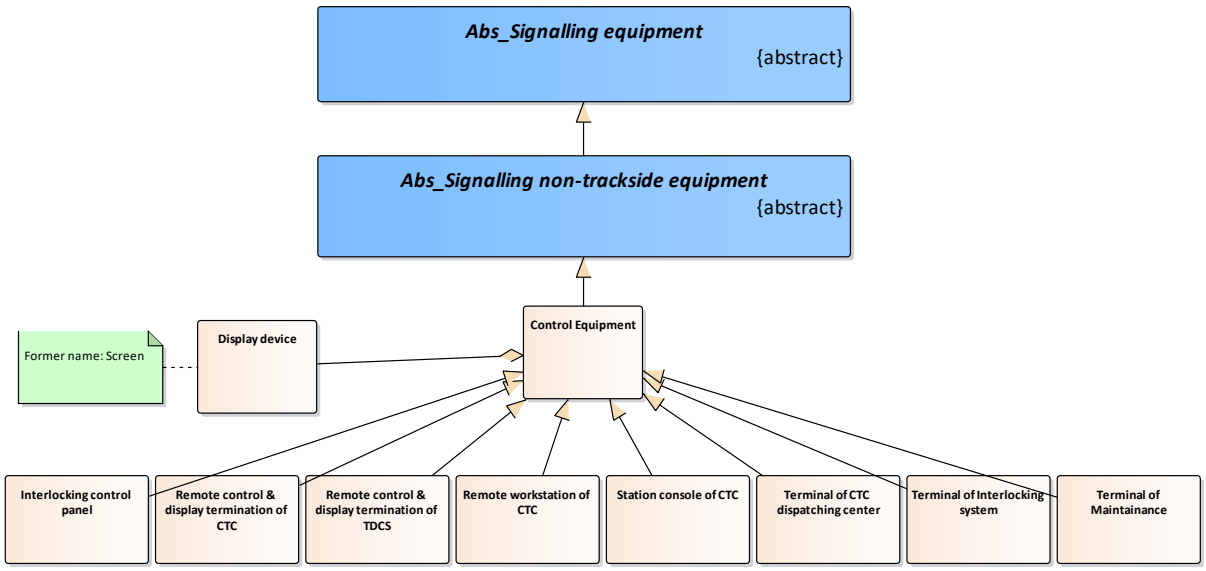


Table 21: Class diagram Control Equipment

3.1.7.2 Control Equipment types

3.1.8 Detector types

3.1.8.1 Class diagram Detector types

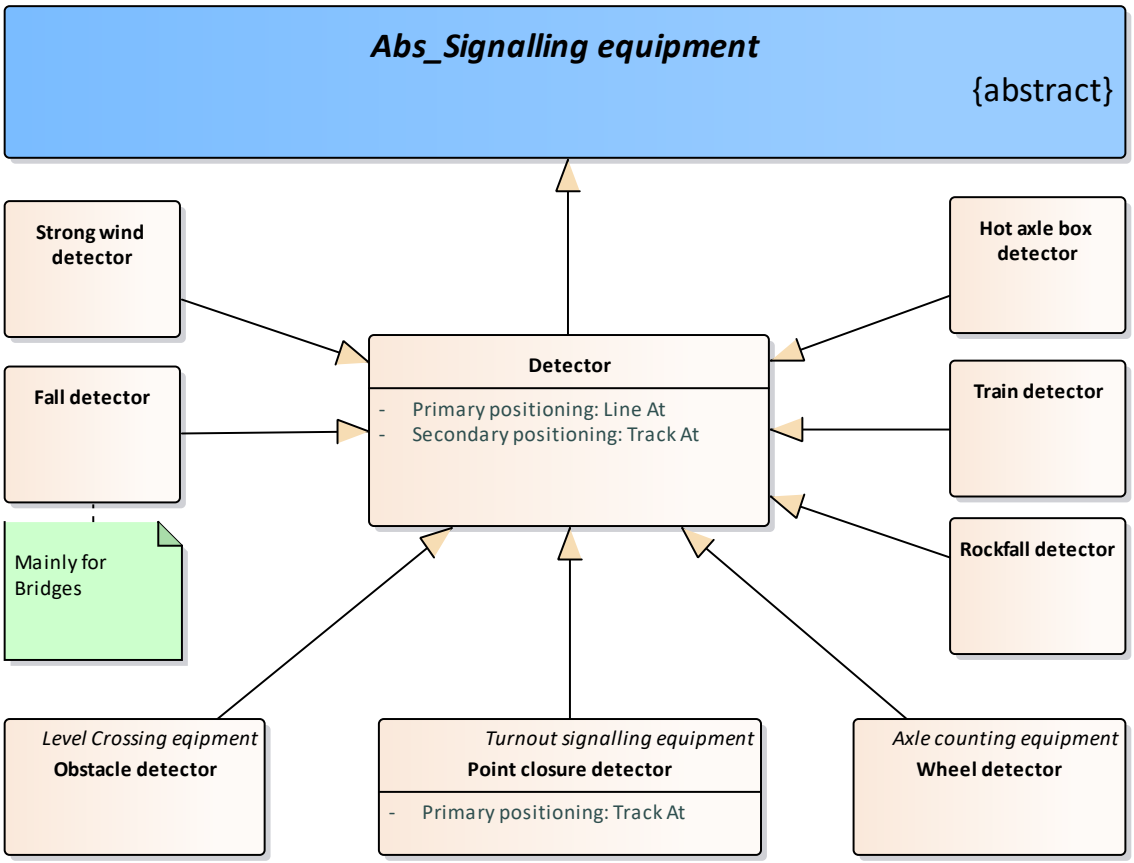


Table 22: Class diagram Detector types

3.1.8.2 Detector

Generic element for all kind of sensors which detect e. g. the passage of a wheel, falling rocks, strong wind etc.

Relationships

Source	Type	Target
Detector	Generalization	Abs_Signalling equipment
Detector	NoteLink	Note
Hot axle box detector	Generalization	Detector
Obstacle detector	Generalization	Detector
Strong wind detector	Generalization	Detector
Train detector	Generalization	Detector
Rockfall detector	Generalization	Detector

Source	Type	Target
Fall detector	Generalization	Detector
Wheel detector	Generalization	Detector
Point closure detector	Generalization	Detector

3.1.8.3 Fall detector

Device for detecting the descent on the track of obstacles such as vehicles

Relationships

Source	Type	Target
Fall detector	Generalization	Detector
Fall detector	NoteLink	Note

3.1.8.4 Hot axle box detector

Device for detecting an overheated bearing by measuring the level of infrared radiation emitted by the axle box of a vehicle.

Relationships

Source	Type	Target
Hot axle box detector	Generalization	Detector

3.1.8.5 Obstacle detector

Device for detecting any obstacle

Relationships

Source	Type	Target
Obstacle detector	Generalization	Detector

Source	Type	Target
Obstacle detector	Generalization	Level Crossing eqipment

3.1.8.6 Point closure detector

Device checking the position of a blade.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Point closure detector	Generalization	Detector
Point closure detector	Generalization	Turnout signalling equipment

3.1.8.7 Rockfall detector

Device for detecting the descent on the track of obstacles such as stones.

Relationships

Source	Type	Target
Rockfall detector	Generalization	Detector

3.1.8.8 Strong wind detector

Device for detecting the strong wind.

Relationships

Source	Type	Target
Strong wind detector	Generalization	Detector
Strong wind detector	NoteLink	Note

3.1.8.9 Train detector

Device attached to the rear end of the last vehicle of a train acting on a fixed equipment to give an indication that the train is complete.

Relationships

Source	Type	Target
Train detector	Generalization	Detector

3.1.8.10 Wheel detector

Sensor which detects the passage of a wheel. A wheel detector can be used as part of an axle counter or as a treadle.

Relationships

Source	Type	Target
Wheel detector	Generalization	Axle counting equipment
Wheel detector	Generalization	Detector

3.1.9 Housing

3.1.9.1 Class diagram Housing + Trackside Battery

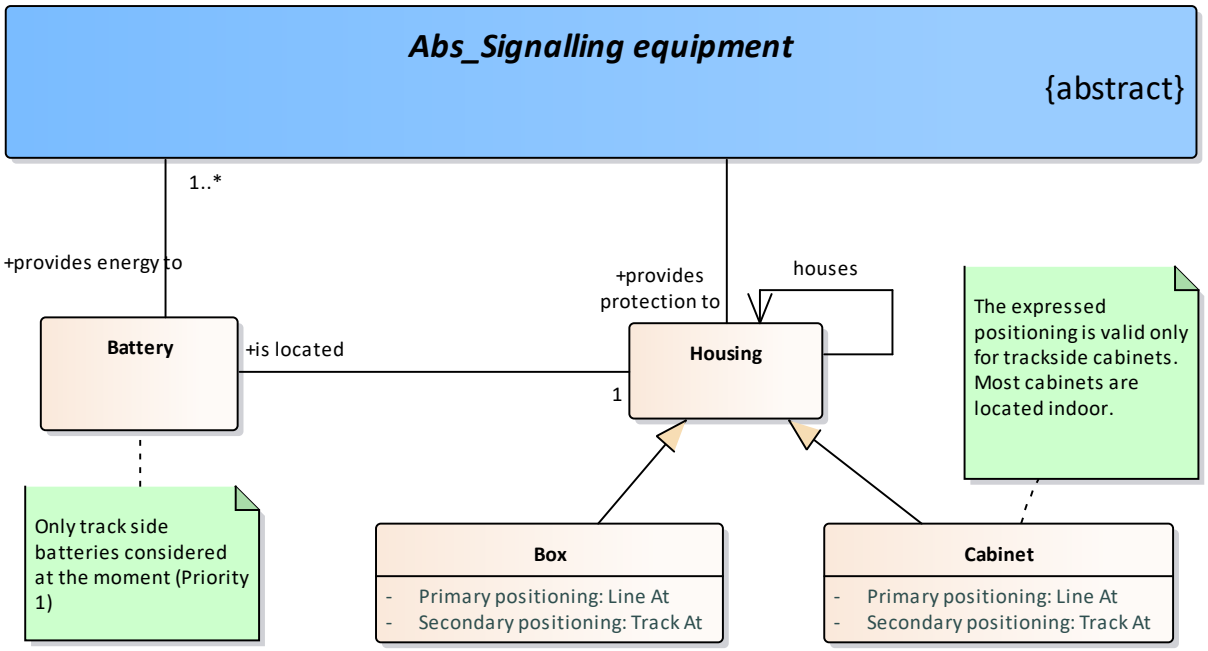


Table 23: Class diagram Housing + Trackside Battery

3.1.9.2 Box

1. Housing for placing equipment/objects and having protective functions.

2. It is used to place outdoor signal devices/objects, and realize wiring, electrical connection and protection of the device (with certain protection functions).

Relationships

Source	Type	Target
Box	Generalization	Housing
Transformer box	Generalization	Box
Outdoor direction box	Generalization	Box
Box for optical cable and cable connection	Generalization	Box
Outdoor terminal box	Generalization	Box
Protection box (Outoor)	Generalization	Box
Power distribution box	Generalization	Box

3.1.9.3 Cabinet

The equipment cabinet is usually made of cold-rolled steel or alloy for storing computer and related control equipment, and provides protection against electromagnetic interference.

Relationships

Source	Type	Target
Cabinet	Generalization	Housing
Cabinet for web server of monitoring system	Generalization	Cabinet
Cabinet of interlocking system power supply	Generalization	Cabinet
Cabinet of network safety server	Generalization	Cabinet
Cabinet of digital IT equipment control system	Generalization	Cabinet
Electric control cabinet (Outdoor)	Generalization	Cabinet
Cabinet of simulation network pannel equipment	Generalization	Cabinet
Cabinet for train control center of relay station	Generalization	Cabinet
Cabinetof station monitoring equipment	Generalization	Cabinet
Cabinet of interlocking system monitoring equipment	Generalization	Cabinet
Network management server（NMS）cabinet	Generalization	Cabinet
Cabinet for computer power & environmental monitoring system	Generalization	Cabinet
Temporary speed restriction server（TSRS）cabinet	Generalization	Cabinet
Cabinet for data server of monitoring system	Generalization	Cabinet
Cabinet of database server	Generalization	Cabinet
Cabinet of distributing terminal board	Generalization	Cabinet
Cabinet of interface network	Generalization	Cabinet

Source	Type	Target
Cabinet of simulation training server	Generalization	Cabinet
Cabinet of spare machine	Generalization	Cabinet
Cabinet of communication prepositive server	Generalization	Cabinet
Cabinet of power supply	Generalization	Cabinet
RBC Host cabinet	Generalization	Cabinet
Cabinet of clock server	Generalization	Cabinet
Cabinet for station train control center equipment INDOOR	Generalization	Cabinet
PIO cabinet of train control center	Generalization	Cabinet
LEU cabinet of train control center	Generalization	Cabinet
Cabinet of driver and acquisition interface equipment	Generalization	Cabinet
Cabinet for application server of monitoring system	Generalization	Cabinet
Cabinet for station ZPW-2000 track circuit interface and monitoring device	Generalization	Cabinet
Note	NoteLink	Cabinet
Cabinet of station unit block	Generalization	Cabinet
Cabinet of interface server	Generalization	Cabinet
Cabinet of system software management server	Generalization	Cabinet
Temporary speed restriction server（TSRS） communication device cabinet	Generalization	Cabinet
Distribution Cabinet of lightning-protection device	Generalization	Cabinet
Cabinet of 25Hz track rack	Generalization	Cabinet
RBC interface cabinet	Generalization	Cabinet
Cabinet for interface server of monitoring system	Generalization	Cabinet

Source	Type	Target
Host cabinet of interlocking system	Generalization	Cabinet
Cabinet for network management server of monitoring system	Generalization	Cabinet
Cabinet of blocks unit combination	Generalization	Cabinet
Cabinet of external information providing server	Generalization	Cabinet
Cabinet for clock server of monitoring system	Generalization	Cabinet
Note	NoteLink	Cabinet
Network management server（EMS）cabinet	Generalization	Cabinet
Cabinet of local interlocking system actuator	Generalization	Cabinet
Cabinet of signalling total wiring	Generalization	Cabinet
Cabinet of station frequency-shift	Generalization	Cabinet
Note	NoteLink	Cabinet
LEU（outdoor cabinet）	Generalization	Cabinet
Cabinet of interlocking system electronic terminal	Generalization	Cabinet
Cabinet of interlocking system remote control and display	Generalization	Cabinet
Cabinet of repeating & query terminal server	Generalization	Cabinet
Cabinet of storage device	Generalization	Cabinet
Cabinet of network equipment	Generalization	Cabinet
Cabinet of power supply for local interlocking system	Generalization	Cabinet
Cabinet for ZPW-2000 track circuit interface and monitoring device of relay station	Generalization	Cabinet
Cabinet of communication quality supervision equipment	Generalization	Cabinet

Source	Type	Target
station coding composite cabinet	Generalization	Cabinet
Cabinet for internet safety device of monitoring system	Generalization	Cabinet
Cabinet for communication preprocessor of monitoring system	Generalization	Cabinet
Cabinet of application server	Generalization	Cabinet
Cabinet for acquisition equipment of station monitoring equipment	Generalization	Cabinet
Cabinet of blocks frequency-shift equipment	Generalization	Cabinet

3.1.9.4 Housing

Housing is a generic class to be used by various elements/installations which can be placed in a structure for protection (metal or concrete boxes etc). The Shelter/Housing describes the type of protection and its location.

Relationships

Source	Type	Target
Housing	Association	Housing
Housing	Association	Abs_Signalling equipment
Housing	Association	Housing
Box	Generalization	Housing
Battery	Association	Housing
Cabinet	Generalization	Housing

3.1.10 Trackside battery

3.1.10.1 Battery

A device that stores and releases electrical energy.

Relationships

Source	Type	Target
Battery	Association	Abs_Signalling equipment
Battery	NoteLink	Note
Battery	NoteLink	Note
Battery	Association	Housing
Battery	NoteLink	Note

3.1.11 Level Crossing equipment

3.1.11.1 Class diagram Level Crossing equipment

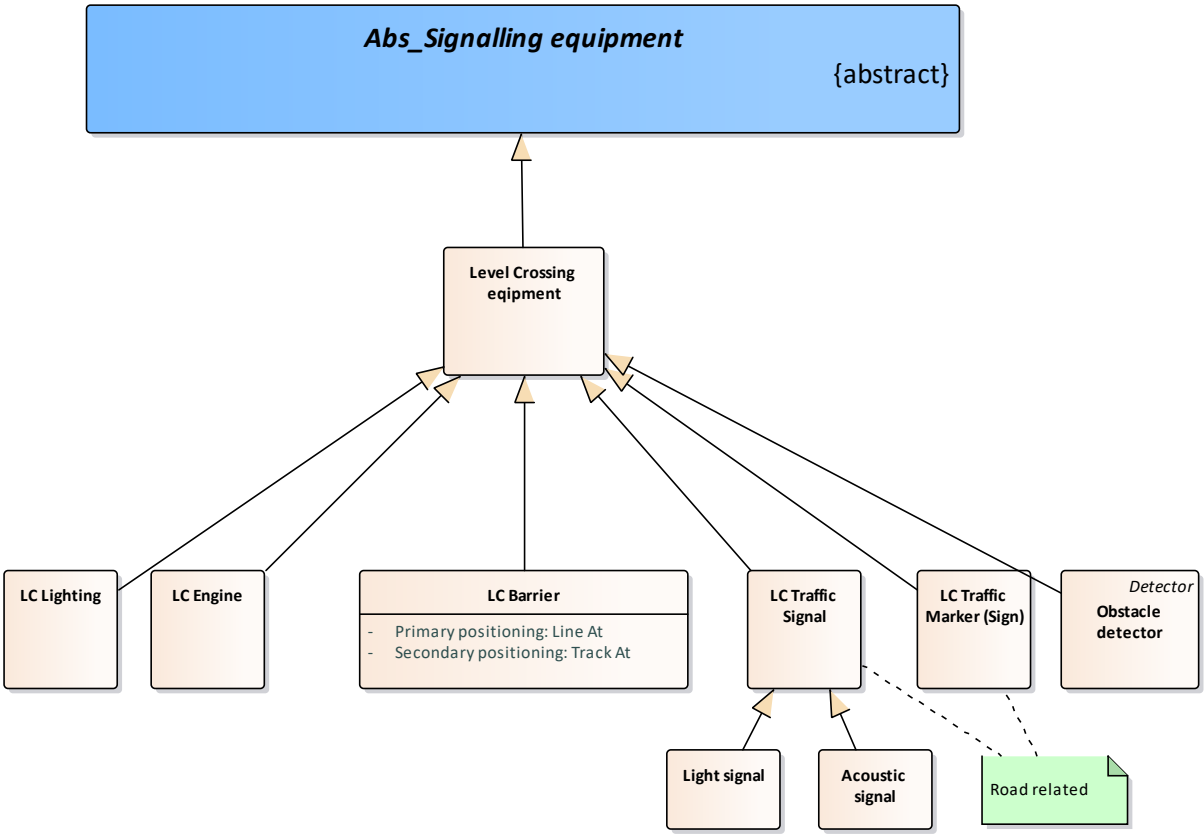


Table 24: Class diagram Level Crossing equipment

3.1.11.2 Acoustic signal

It is a danger signal that announces the arrival of the train near the level crossing.

Relationships

Source	Type	Target
Acoustic signal	Generalization	LC Traffic Signal

3.1.11.3 LC Barrier

Installation which hinders road traffic passing the level crossing.

Relationships

Source	Type	Target
LC Barrier	Generalization	Level Crossing eqipment

3.1.11.4 LC Engine

An engine that raises or lowers the barrier at a crossing

Relationships

Source	Type	Target
LC Engine	Generalization	Level Crossing eqipment

3.1.11.5 LC Lighting

Light signal for Level crossing

Relationships

Source	Type	Target
LC Lighting	Generalization	Level Crossing eqipment

3.1.11.6 LC Traffic Marker (Sign)

Sign related to the road at a level crossing.

Relationships

Source	Type	Target
LC Traffic Marker (Sign)	NoteLink	Note
LC Traffic Marker (Sign)	NoteLink	Note
LC Traffic Marker (Sign)	NoteLink	Note
LC Traffic Marker (Sign)	Generalization	Level Crossing eqipment

3.1.11.7 LC Traffic Signal

Signal related to the road at a level crossing.

Relationships

Source	Type	Target
LC Traffic Signal	Generalization	Level Crossing eqipment
Light signal	Generalization	LC Traffic Signal
Note	NoteLink	LC Traffic Signal
Note	NoteLink	LC Traffic Signal
Note	NoteLink	LC Traffic Signal
Acoustic signal	Generalization	LC Traffic Signal

3.1.11.8 Level Crossing eqipment

A level crossing is an intersection where a railway line crosses a road or path at the same level. The purpose of LCSE is to prevent vehicles or pedestrians from crossing the railway after the train has been notified. It includes: LC Traffic signal, LC Traffic sign, LC Barrier, LC Engine, Obstacle detector, etc.

Relationships

Source	Type	Target
Level Crossing eqipment	Generalization	Abs_Signalling equipment
LC Barrier	Generalization	Level Crossing eqipment
LC Engine	Generalization	Level Crossing eqipment
LC Lighting	Generalization	Level Crossing eqipment
LC Traffic Marker (Sign)	Generalization	Level Crossing eqipment
Obstacle detector	Generalization	Level Crossing eqipment
LC Traffic Signal	Generalization	Level Crossing eqipment

3.1.11.9 Light signal

A lighting device is installed near the level crossing. In the presence of the light signal, it is necessary to moderate the speed and stop.

Relationships

Source	Type	Target
Light signal	Generalization	LC Traffic Signal

3.1.12 Local operation device

3.1.12.1 Class diagram Local operation device

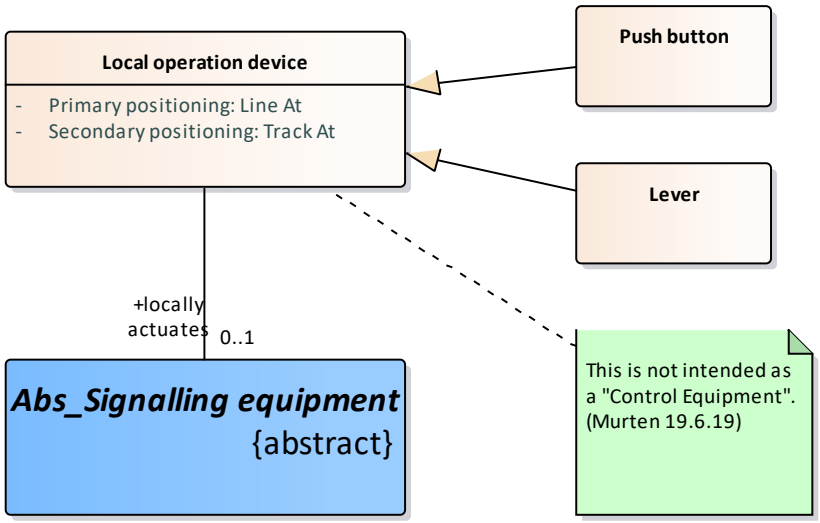


Table 25: Class diagram Local operation device

3.1.12.2 Lever

A bar of metal, wood or other rigid substance, used to trigger or control a mechanical device (like a point or a derailer).

Relationships

Source	Type	Target
Lever	Generalization	Local operation device

3.1.12.3 Push button

A simple switch mechanism for controlling some aspect of a device or a process

Relationships

Source	Type	Target
Push button	Generalization	Local operation device

3.1.12.4 Local operation device

Installation providing push buttons, indicators and switching devices, lever for local operation. In case there is no point machine. (is a track side equipment)

Relationships

Source	Type	Target
Local operation device	Association	Abs_Signalling equipment
Local operation device	NoteLink	Note
Lever	Generalization	Local operation device
Push button	Generalization	Local operation device

3.1.13 Lock

3.1.13.1 Class diagram Lock

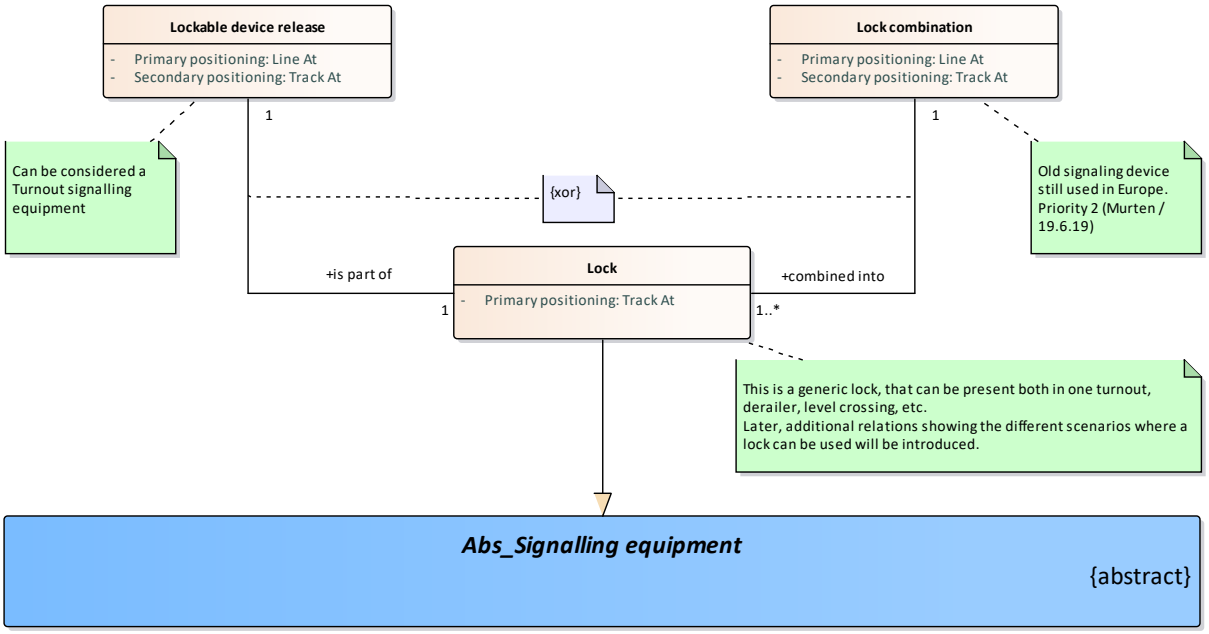


Table 26: *Class diagram Lock*

3.1.13.2 Lock

Mechanical device to fix an element (point, derailer, level crossing) in a certain position.

Relationships

Source	Type	Target
Lock	Generalization	Abs_Signalling equipment
Lock	NoteLink	Note
Lock	Association	Lockable device release
Lock	Association	Lock combination
Lock	NoteLink	Note
Lock	NoteLink	Note

3.1.13.3 Lock combination

Mechanical device for release of several dependent keys by a main key.

Relationships

Source	Type	Target
Lock combination	NoteLink	Note
Lock combination	NoteLink	Note
Lock combination	NoteLink	Note
Lock	Association	Lock combination

3.1.13.4 Lockable device release

Electro-mechanical device related to the interlocking to include locally operated elements. The lockable device release checks the presence of a key and releases the key by command.

Relationships

Source	Type	Target
Lockable device release	NoteLink	Note
Lockable device release	NoteLink	Note
Lockable device release	NoteLink	Note

Source	Type	Target
Lock	Association	Lockable device release

3.1.14 Signal

3.1.14.1 Class diagram Signal

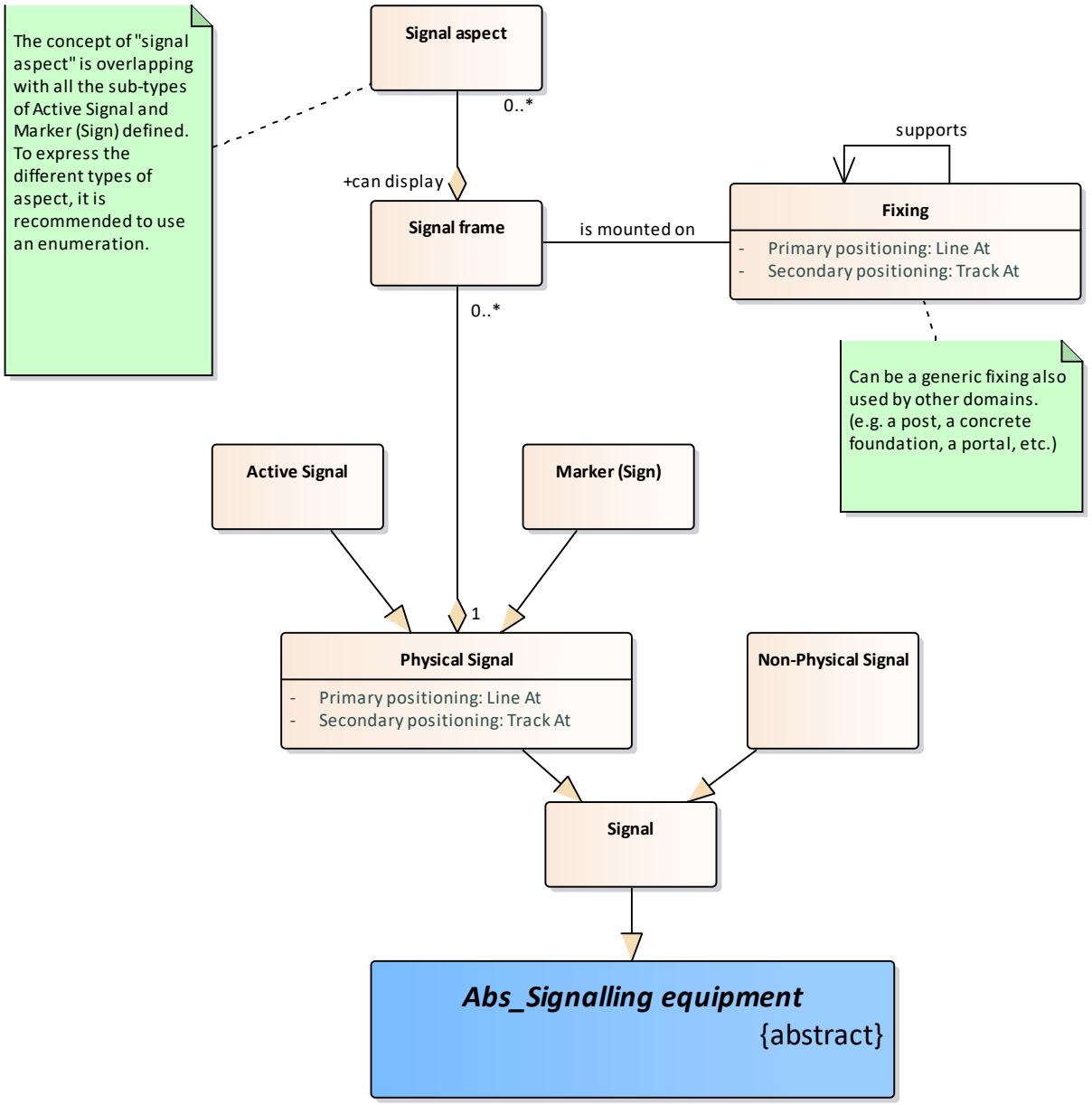


Table 27: Class diagram Signal

3.1.14.2 Active Signal

A general term for the fixed signal display equipment.

Relationships

Source	Type	Target
Active Signal	Generalization	Physical Signal
Note	NoteLink	Active Signal
Fixing	Association	Active Signal
Fixing	Aggregation	Active Signal

3.1.14.3 Fixing

1. Physical structure that supports equipment (e. g. signal frames as components of a signal).
2. A fixing is a generic term for a structure that supports equipment. Fixings can be decomposed like so:

- Fixing of type post is mounted on fixing of type foundation.
- Fixing of type cantilever is mounted on fixing of type rail.

Relationships

Source	Type	Target
Fixing	Association	Fixing
Fixing	Association	Active Signal
Fixing	NoteLink	Note
Fixing	NoteLink	Note
Fixing	NoteLink	Note
Fixing	Aggregation	Active Signal
Fixing	Association	Signal frame
Fixing	Association	Fixing

3.1.14.4 Marker (Sign)

1. A fixed signal on the side of a rail track that provides information for driver and staff.
2. A signal showing a permanent message that is a function of a normalised physical appearance, i.e. shape or colour. A sign is not controlled by the signalling system.

Relationships

Source	Type	Target
Marker (Sign)	Generalization	Physical Signal

3.1.14.5 Non-Physical Signal

Virtual or ficticious signals. The neutral term "non physical" avoids confusion among IMs.

As opposed to the physical signal, the non-physical signal *need not send information* to the train. E.g. a fictitious signal on the signalman's display needed to define the route exit towards open line where there's no real signal.

A virtual ERTMS L2 signal is also a non-physical signal but can have a physical presence, i.e. a stop marker board along the track.

Relationships

Source	Type	Target
Non-Physical Signal	NoteLink	Note
Non-Physical Signal	Generalization	Signal

3.1.14.6 Physical Signal

A signal with a physical trackside appearance.

Relationships

Source	Type	Target
Physical Signal	Generalization	Signal
Marker (Sign)	Generalization	Physical Signal
Active Signal	Generalization	Physical Signal
Signal frame	Aggregation	Physical Signal

3.1.14.7 Signal

Apparatus by means of which a conventional indication is given.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Signal	Generalization	Abs_Signalling equipment
Non-Physical Signal	Generalization	Signal
Physical Signal	Generalization	Signal

3.1.14.8 Signal aspect

1. Single information shown to the train driver.
2. A signal can carry several signal frames, active or passive, each of which conveys an aspect. The combination of aspects constitutes a signal message. The aspect can represent speed information.

Relationships

Source	Type	Target
Signal aspect	Aggregation	Signal frame
Signal aspect	NoteLink	Note

3.1.14.9 Signal frame

1. Trackside component, most often part of a signal, that sends a message to the driver.
2. Some IMs consider that a name plate is not an aspect. Thus, not all signal frames have an aspect (i.e. a signal frame of type name plate has 0 aspect)

Relationships

Source	Type	Target
Signal frame	Aggregation	Physical Signal
Signal aspect	Aggregation	Signal frame
Fixing	Association	Signal frame

3.1.15 Track Circuit

3.1.15.1 Class diagram Track Circuit

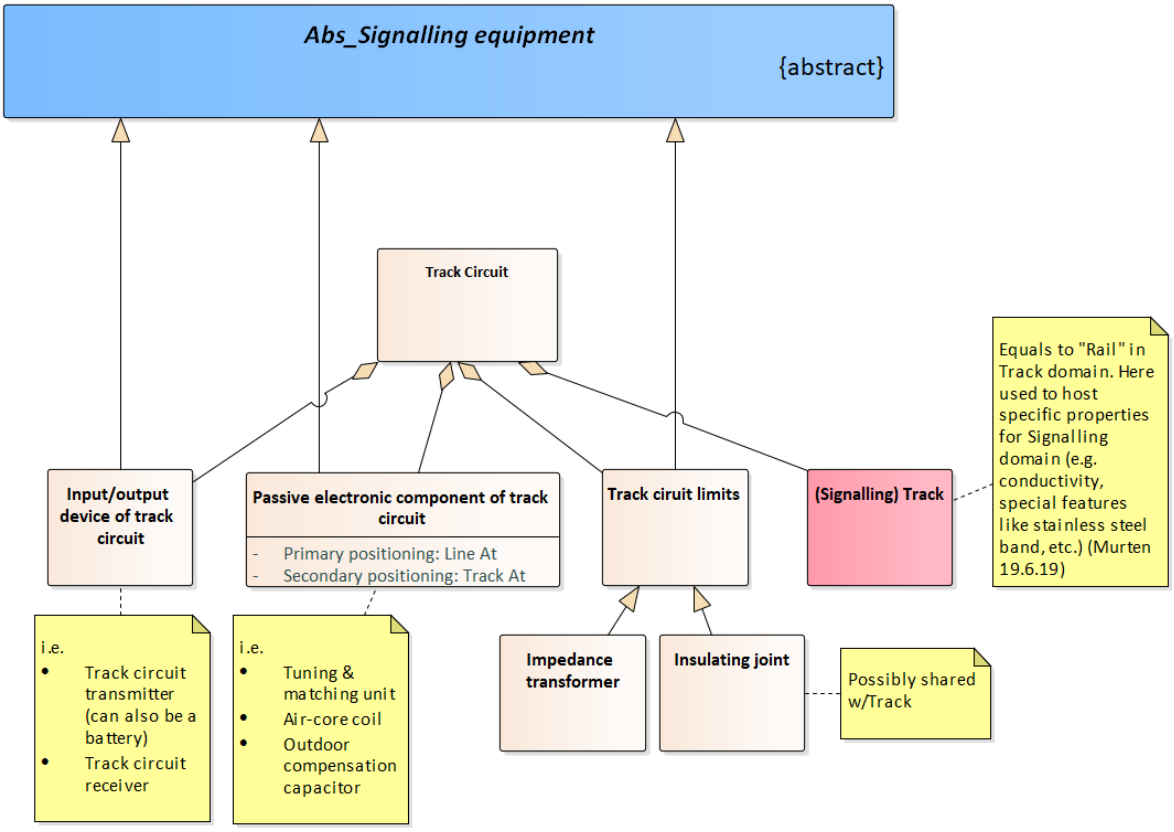


Table 28: Class diagram Track Circuit

3.1.15.2 Impedance transformer

In the AC electrified section track circuit, the impedance transformer makes the traction current cross the rail insulation, and connects the track circuit transmitting and receiving equipment to the rail by transformer coupling.

Relationships

Source	Type	Target
Impedance transformer	Generalization	Track ciruit limits

3.1.15.3 Input/output device of track circuit

Device of Track circuit receiver or Track circuit transmitter

Relationships

Source	Type	Target
Input/output device of track circuit	NoteLink	Note
Input/output device of track circuit	Aggregation	Track Circuit
Input/output device of track circuit	NoteLink	Note
Input/output device of track circuit	Generalization	Abs_Signalling equipment
Input/output device of track circuit	NoteLink	Note

3.1.15.4 Insulating joint

It is set at the boundary of a track circuit to achieve electrical insulation with an adjacent rail. It can be "mechanical" insulation or "electrical" insulation.

Relationships

Source	Type	Target
Insulating joint	Generalization	Track ciruit limits
Note	NoteLink	Insulating joint
Note	NoteLink	Insulating joint
Note	NoteLink	Insulating joint

3.1.15.5 Passive electronic component of track circuit

Generic passive two-terminal electronic component. e.g. Tuning & matching unit, Outdoor Compensation capacitor, Impedance transformer.

Relationships

Source	Type	Target
Passive electronic component of track circuit	Generalization	Abs_Signalling equipment
Passive electronic component of track circuit	NoteLink	Note
Passive electronic component of track circuit	Aggregation	Track Circuit
Passive electronic component of track circuit	NoteLink	Note
Passive electronic component of track circuit	NoteLink	Note

3.1.15.6 Track Circuit

Electric circuit of which the rails of a track section form a part, with usually a source of current connected at one end and a detection device at the other end for detecting whether this track section is clear or occupied by a vehicle. In a continuous signalling system, the track circuit can be used to transmit information between the ground and the train.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Track ciruit limits	Aggregation	Track Circuit
(Signalling) Track	Aggregation	Track Circuit
Input/output device of track circuit	Aggregation	Track Circuit
Passive electronic component of track circuit	Aggregation	Track Circuit

3.1.15.7 Track ciruit limits

The boundary of track circuit.

Relationships

Source	Type	Target
Track ciruit limits	Generalization	Abs_Signalling equipment
Track ciruit limits	Aggregation	Track Circuit
Insulating joint	Generalization	Track ciruit limits
Impedance transformer	Generalization	Track ciruit limits

3.1.16 Train protection equipment

3.1.16.1 Class diagram Train protection equipment

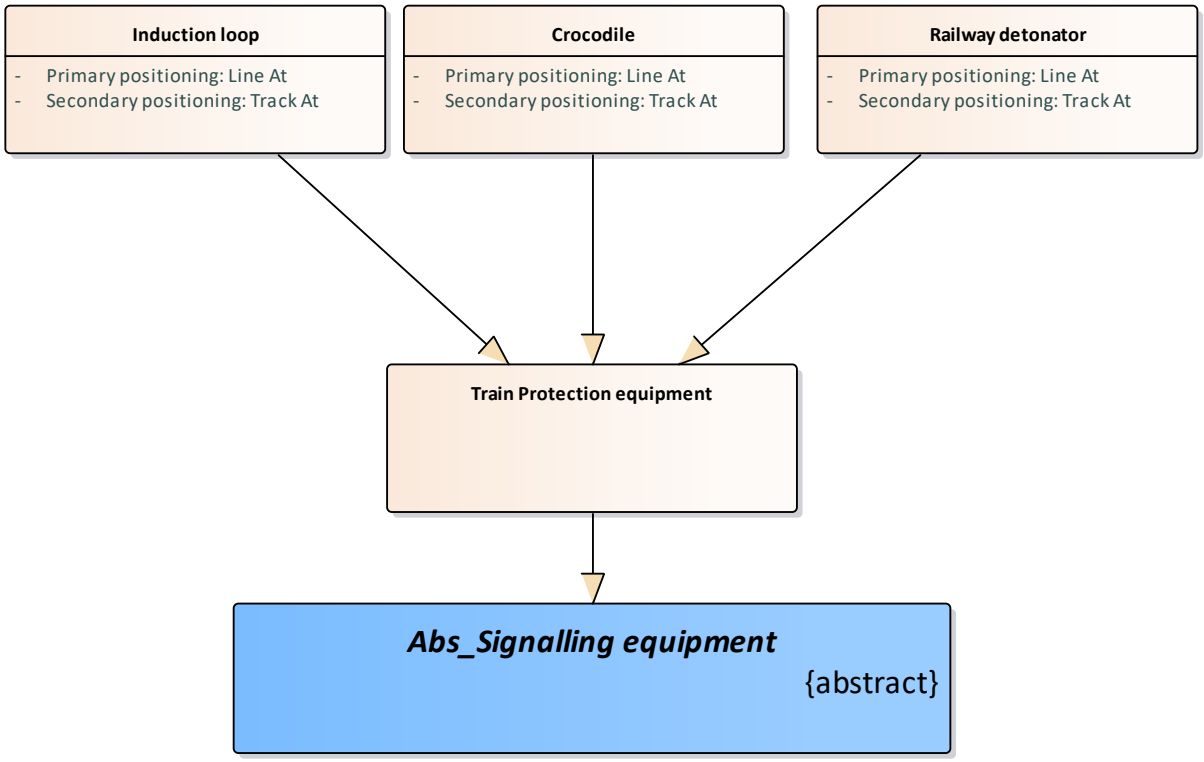


Table 29: Class diagram Train protection equipment

3.1.16.2 Crocodile

Component of a train protection system. It is an electrical contact placed between the rails which, in case of a danger situation, may cause a warning horn to beep in the driver's cab.

Relationships

Source	Type	Target
Crocodile	Generalization	Train Protection equipment

3.1.16.3 Induction loop

Equipment for detection of the presence of a vehicle where a cable in the form of a loop between the rails, energized by alternating current derived from a local generator, detects the metallic mass of a vehicle, by its influence on the field of the loop, in order to provide an electric signal.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Induction loop	Generalization	Train Protection equipment

3.1.16.4 Railway detonator

Explosive capsule placed on the rail to give an audible danger signal to driver.

Relationships

Source	Type	Target
Railway detonator	Generalization	Train Protection equipment

3.1.16.5 Train Protection equipment

Railway technical installation to ensure safe operation in the event of human failure (magnet, crocodile etc.).

Relationships

Source	Type	Target
Train Protection equipment	Generalization	Abs_Signalling equipment
Train Protection equipment	NoteLink	Note
Railway detonator	Generalization	Train Protection equipment
Crocodile	Generalization	Train Protection equipment
Induction loop	Generalization	Train Protection equipment

3.1.17 Turnout signalling equipment

3.1.17.1 Class diagram Turnout signalling equipment

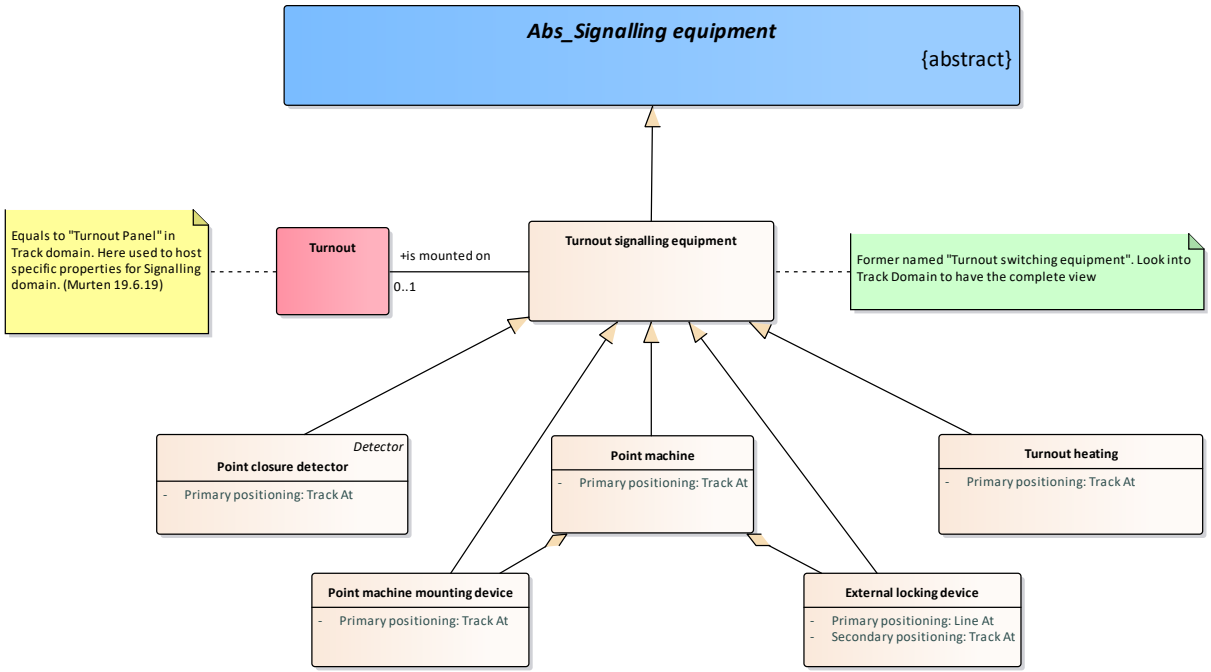


Table 30: Class diagram Turnout signalling equipment

3.1.17.2 External locking device

1. An external locking device is a mechanical device that locks the switch machine in a certain position from the outside .

2. The hook type external locking device locks the basic rail and the turnout sharp, the movable rail and the wing rail safely, and ensures the safety, stability and reliability of the switch under the lock state (in the process of high-speed and heavy-duty train running).

Relationships

Source	Type	Target
External locking device	Generalization	Turnout signalling equipment
External locking device	Aggregation	Point machine

3.1.17.3 Point machine

The point machine is a device that can switch and lock the turnout and indicate its position.

Relationships

Source	Type	Target
Point machine	Generalization	Turnout signalling equipment
External locking device	Aggregation	Point machine
Point machine mounting device	Aggregation	Point machine

3.1.17.4 Point machine mounting device

A device used to install a point machine and to connect the point machine to a turnout components (to fix the point machine and connect it to the turnout).

Relationships

Source	Type	Target
Point machine mounting device	Generalization	Turnout signalling equipment
Point machine mounting device	Aggregation	Point machine

3.1.17.5 Turnout heating

A series of devices used to remove snow from railways. E.g. electric heating device, sensor of rail temperature, electric control cabinet, isolating transformer, etc.

Relationships

Source	Type	Target
Turnout heating	Generalization	Turnout signalling equipment

3.1.17.6 Turnout signalling equipment

Devices, such as point switches, locks, etc., which are used to control the turnout to the normal position or reverse position, realize the turnout lock and give corresponding position information.

Relationships

Source	Type	Target
Turnout signalling equipment	Generalization	Abs_Signalling equipment
Turnout signalling equipment	NoteLink	Note
Turnout signalling equipment	NoteLink	Note
Turnout signalling equipment	NoteLink	Note
External locking device	Generalization	Turnout signalling equipment
Point machine mounting device	Generalization	Turnout signalling equipment
Turnout heating	Generalization	Turnout signalling equipment
Turnout	Association	Turnout signalling equipment
Point closure detector	Generalization	Turnout signalling equipment
Point machine	Generalization	Turnout signalling equipment

3.1.18 Vehicle barring/breaking device

3.1.18.1 Class diagram Vehicle barring/breaking device

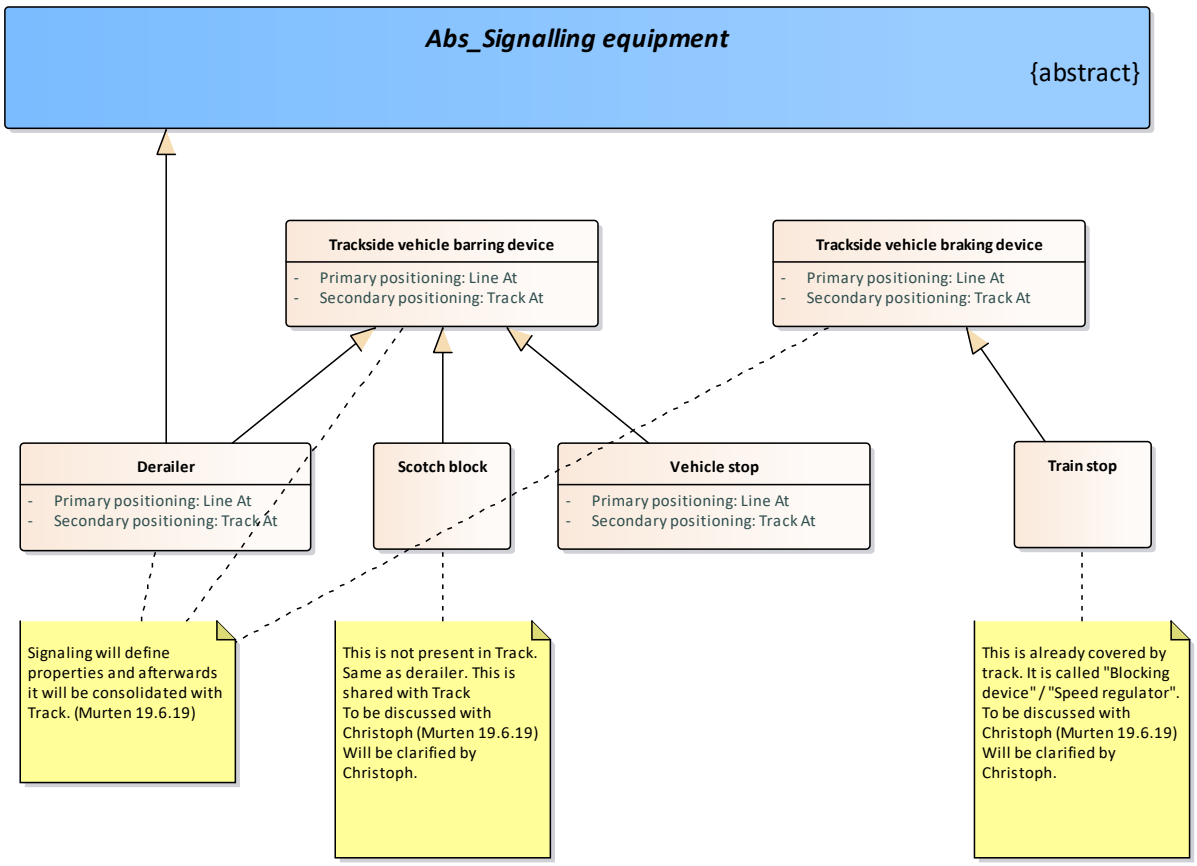


Table 31: Class diagram Vehicle barring/breaking device

3.1.18.2 Derailer

Fixed device which, when placed on the rail, derails the wheels of a vehicle, and serves to protect a converging line.

[source: IEC 60050-821]

Relationships

Source	Type	Target
Derailer	Generalization	Trackside vehicle barring device
Derailer	NoteLink	Note
Derailer	Generalization	Abs_Signalling equipment
Derailer	NoteLink	Note
Note	NoteLink	Derailer

3.1.18.3 Scotch block

Wedge which is put under or in front of a wheel so that the vehicle can't move. Fixed installation at the end of sidings.

Relationships

Source	Type	Target
Scotch block	Generalization	Trackside vehicle barring device
Scotch block	NoteLink	Note
Scotch block	NoteLink	Note
Scotch block	NoteLink	Note

3.1.18.4 Trackside vehicle barring device

Device for stopping any vehicle movement permanently.

Relationships

Source	Type	Target
Note	NoteLink	Trackside vehicle barring device
Derailer	Generalization	Trackside vehicle barring device
Scotch block	Generalization	Trackside vehicle barring device
Note	NoteLink	Trackside vehicle barring device
Vehicle stop	Generalization	Trackside vehicle barring device
Note	NoteLink	Trackside vehicle barring device

3.1.18.5 Trackside vehicle braking device

It is a set of pneumatic, mechanic or electric components causing a braking in the case the train is passing at danger.

Relationships

Source	Type	Target
Train stop	Generalization	Trackside vehicle braking device
Note	NoteLink	Trackside vehicle braking device
Note	NoteLink	Trackside vehicle braking device
Note	NoteLink	Trackside vehicle braking device

3.1.18.6 Train stop

A train stop is a set of pneumatic, mechanic or electric components causing a breaking in the case the train is passing at danger. So this element belongs to the Intermittent Train Protection package of EULYNX model.

Relationships

Source	Type	Target
Train stop	Generalization	Trackside vehicle braking device
Train stop	NoteLink	Note
Train stop	NoteLink	Note
Train stop	NoteLink	Note

3.1.18.7 Vehicle stop

A Vehicle stop is a (normally fixed) installation at the end of the track which stops any vehicle movement (e.g. buffer stop, sand hump etc.).

Relationships

Source	Type	Target
Vehicle stop	Generalization	Trackside vehicle barring device

3.1.19 _Shared (not analysed)

3.1.19.1 _Shared (not analysed)

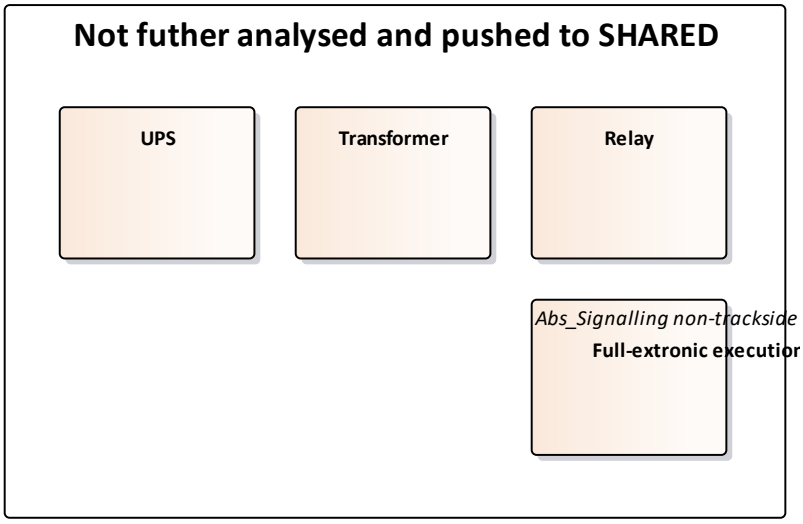


Table 32: _Shared (not analysed)

3.1.19.2 Full-extronic execution unit

FEU is a computer interlocking execution representation circuit using full electronic circuits, replacing safe relay as the control unit circuit, combining with computer interlocking, completed at the end of the computer interlocking system of control and acquisition function, can realize monitoring and control of all kinds of point machine, signal, track circuit, block, level crossing, etc. FEU can consist of Signal module, turnout module, track module.

Relationships

Source	Type	Target
Full-extronic execution unit	Generalization	Abs_Signalling non-trackside equipment

Source	Type	Target

3.1.19.3 Relay

1.It is an electromagnetic device that is remotely or automatically controlled to switch on the state of the circuit and converting other devices (such as converters, current circuit breakers) in the same circuit or different circuits.

2.Relays are usually used in automated control circuits. They are actually "automatic switches" that use small currents to control the operation of large currents. It can control multiple loops and multiple control objects, and can also control remote objects. It plays the role of automatic regulation, security protection, conversion circuit and so on in the circuit.

Relationships

Source	Type	Target
Relay	NoteLink	Note
Relay	Association	Abs_Signalling non-trackside equipment

3.1.19.4 Transformer

A transformer is an inductance device that transfers electric energy from one circuit to another. It is used for voltage transformation, current change, impedance transformation, isolation, voltage regulation and so on.

Relationships

Source	Type	Target
Transformer	Association	Abs_Signalling non-trackside equipment
Note	NoteLink	Transformer

3.1.19.5 UPS

Uninterruptible power supply refers to the power supply equipment which will not be interrupted due to short power outages, and can always supply high-quality power, and effectively protect precision instruments. It provides continuous, stable and uninterrupted power supply for load equipment.

Relationships

Source	Type	Target
UPS	Association	Abs_Signalling non-trackside equipment
Note	NoteLink	UPS

3.2 Signalling Spatial

3.2.1 Signalling Spatial Structure

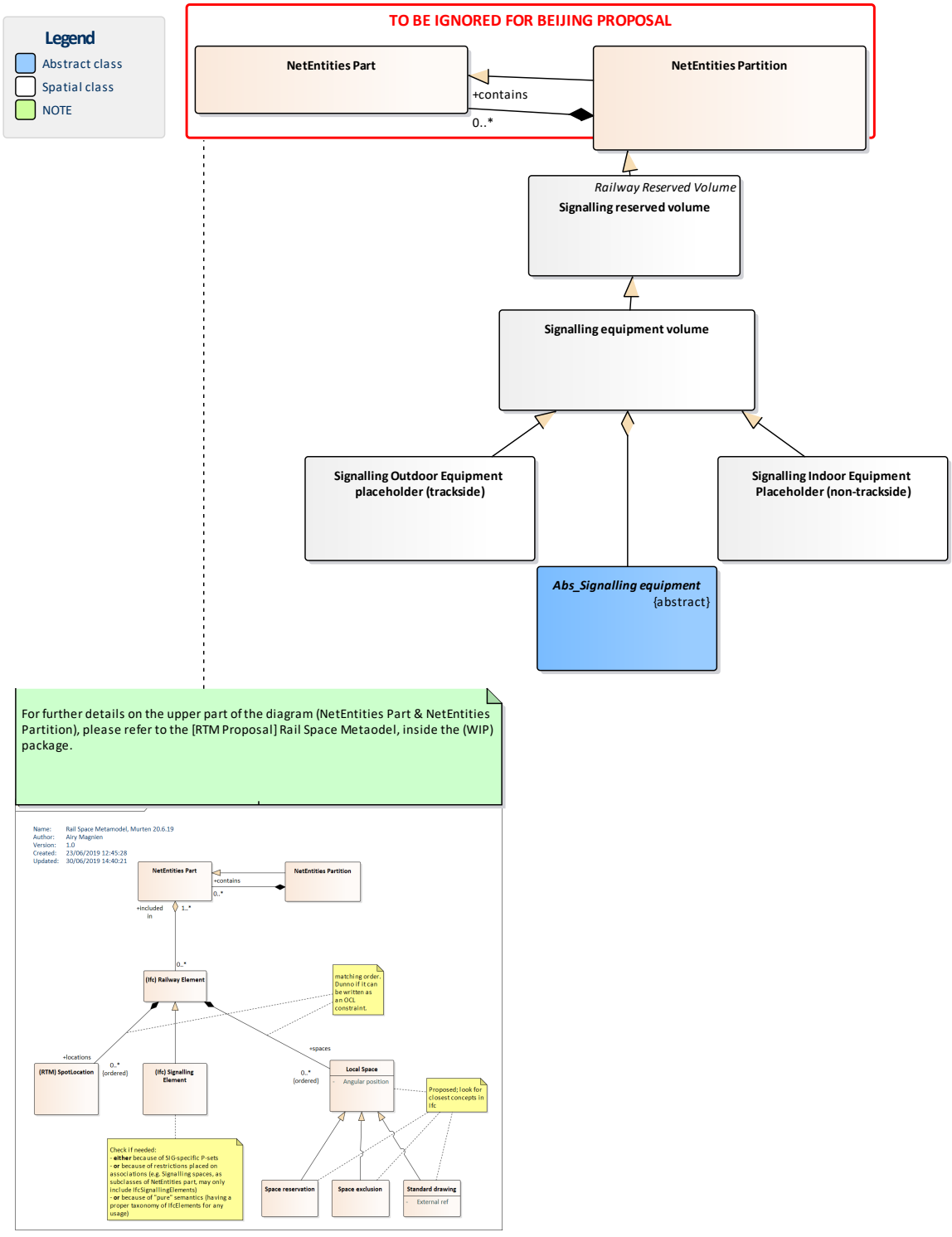


Table 33: Signalling Spatial Structure

4 Telecom

4.1.1 Telecom Structural (physical)

4.1.2 Class diagram Telecom Structural overview

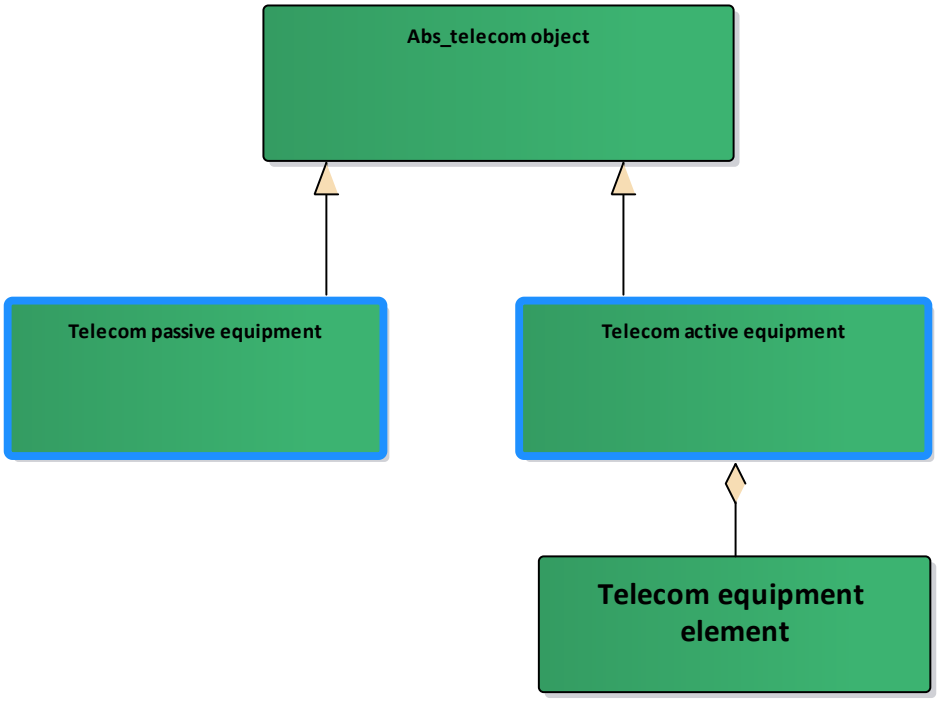


Table 34: Class diagram Telecom Structural overview

4.1.3 Abs_telecom object

A general telecom object with some general property groups, which can be inherited by its subclasses.

Relationships

Source	Type	Target
Abs_telecom object	Aggregation	Telecom reserved volume
Telecom passive equipment	Generalization	Abs_telecom object
Telecom active equipment	Generalization	Abs_telecom object
Telecom casing elements	Association	Abs_telecom object

Source	Type	Target

4.1.4 Telecom active equipment

This class regroups all the telecommunication equipment that must be powered in order to be able to function.

Relationships

Source	Type	Target
Telecom active equipment	Association	Telecom support infrastructure
Telecom active equipment	Generalization	Abs_telecom object
Intelligent peripheral	Generalization	Telecom active equipment
Gateway	Generalization	Telecom active equipment
Modem	Generalization	Telecom active equipment
Primary reference clock	Generalization	Telecom active equipment
Trackside telephony exchange	Generalization	Telecom active equipment
Automatic gate	Generalization	Telecom active equipment
Tandem MSC signaling transfer point	Generalization	Telecom active equipment
Recording equipment	Generalization	Telecom active equipment
Indoor telecom equipment zone	Association	Telecom active equipment
Sensor	Generalization	Telecom active equipment
Remote unit	Generalization	Telecom active equipment
Access point	Generalization	Telecom active equipment
Desktop console	Generalization	Telecom active equipment
Acknowledgement center	Generalization	Telecom active equipment
Dispatching switch	Generalization	Telecom active equipment
Mobility management entity	Generalization	Telecom active equipment
Optical network unit	Generalization	Telecom active equipment
Tunnel emergency telephone exchange	Generalization	Telecom active equipment

Source	Type	Target
E-utran node B	Generalization	Telecom active equipment
Integrated telephony exchange	Generalization	Telecom active equipment
Base station controller	Generalization	Telecom active equipment
Ticket vending machine	Generalization	Telecom active equipment
Optical line terminal	Generalization	Telecom active equipment
Service GPRS support node	Generalization	Telecom active equipment
Railway self service identity verification gate	Generalization	Telecom active equipment
Equipment identity register	Generalization	Telecom active equipment
Synchronization support unit	Generalization	Telecom active equipment
Base transceiver station	Generalization	Telecom active equipment
Transcoding rate adaptation unit	Generalization	Telecom active equipment
Redundant array of independent disk	Generalization	Telecom active equipment
On-site control unit	Generalization	Telecom active equipment
Transport equipment	Generalization	Telecom active equipment
Baseband unit	Generalization	Telecom active equipment
Telecom equipment element	Aggregation	Telecom active equipment
IP network equipment	Generalization	Telecom active equipment
Private branch exchange	Generalization	Telecom active equipment
Master unit	Generalization	Telecom active equipment
Mobile switching center	Generalization	Telecom active equipment
Data transmission unit	Generalization	Telecom active equipment
Server	Generalization	Telecom active equipment
Transceiver module	Generalization	Telecom active equipment
Packet control unit	Generalization	Telecom active equipment
Home location register	Generalization	Telecom active equipment
Service control point	Generalization	Telecom active equipment
Telephone	Generalization	Telecom active equipment
Remote radio unit	Generalization	Telecom active equipment

Source	Type	Target

4.1.5 Telecom equipment element

Telecom Equipment Element refers to the elementary component of the Telecom active Equipments which can not decomposed (breaks down) into other telecom equipments. It represents only the equipment sub-units (e.g. Connection interface; chassis; Cooling fan; etc.)

Relationships

Source	Type	Target
Telecom equipment element	Aggregation	Telecom active equipment
Connection interface	Generalization	Telecom equipment element

4.1.6 Telecom passive equipment

Telecom equipment that does not need power supply

Relationships

Source	Type	Target
Telecom passive equipment	Generalization	Abs_telecom object
Utility marking post	Generalization	Telecom passive equipment
Telecom outlet	Generalization	Telecom passive equipment
Cabling accessory	Generalization	Telecom passive equipment
Optical adapter	Generalization	Telecom passive equipment
Antenna	Generalization	Telecom passive equipment
Distribution frame	Generalization	Telecom passive equipment
Telecom casing elements	Generalization	Telecom passive equipment
Cable	Generalization	Telecom passive equipment
Optical splitter	Generalization	Telecom passive equipment

4.1.7 Cabling & Cables

4.1.7.1 Class diagram Cables

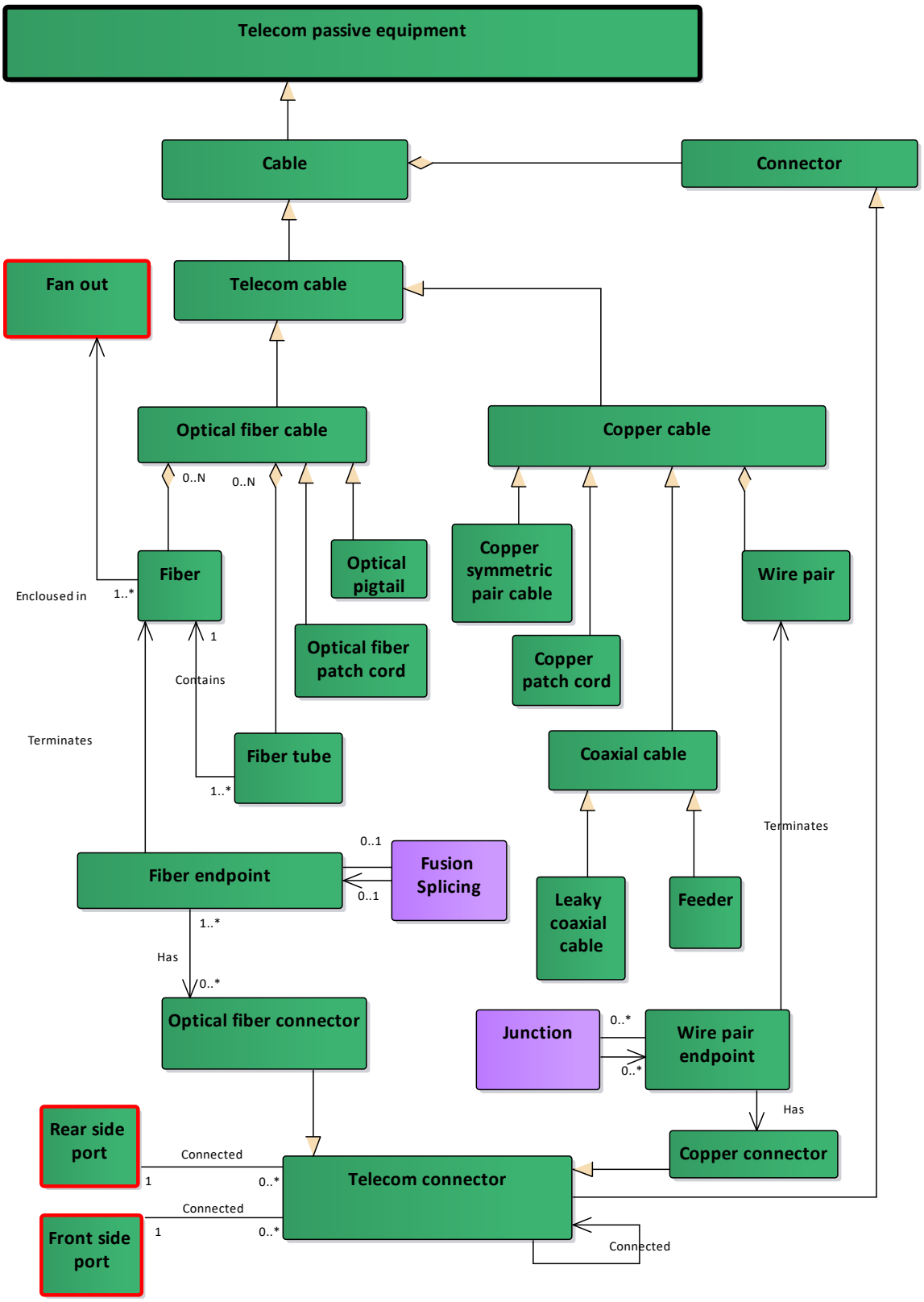


Table 35: Class diagram Cables

4.1.7.2 Class diagram Cabling

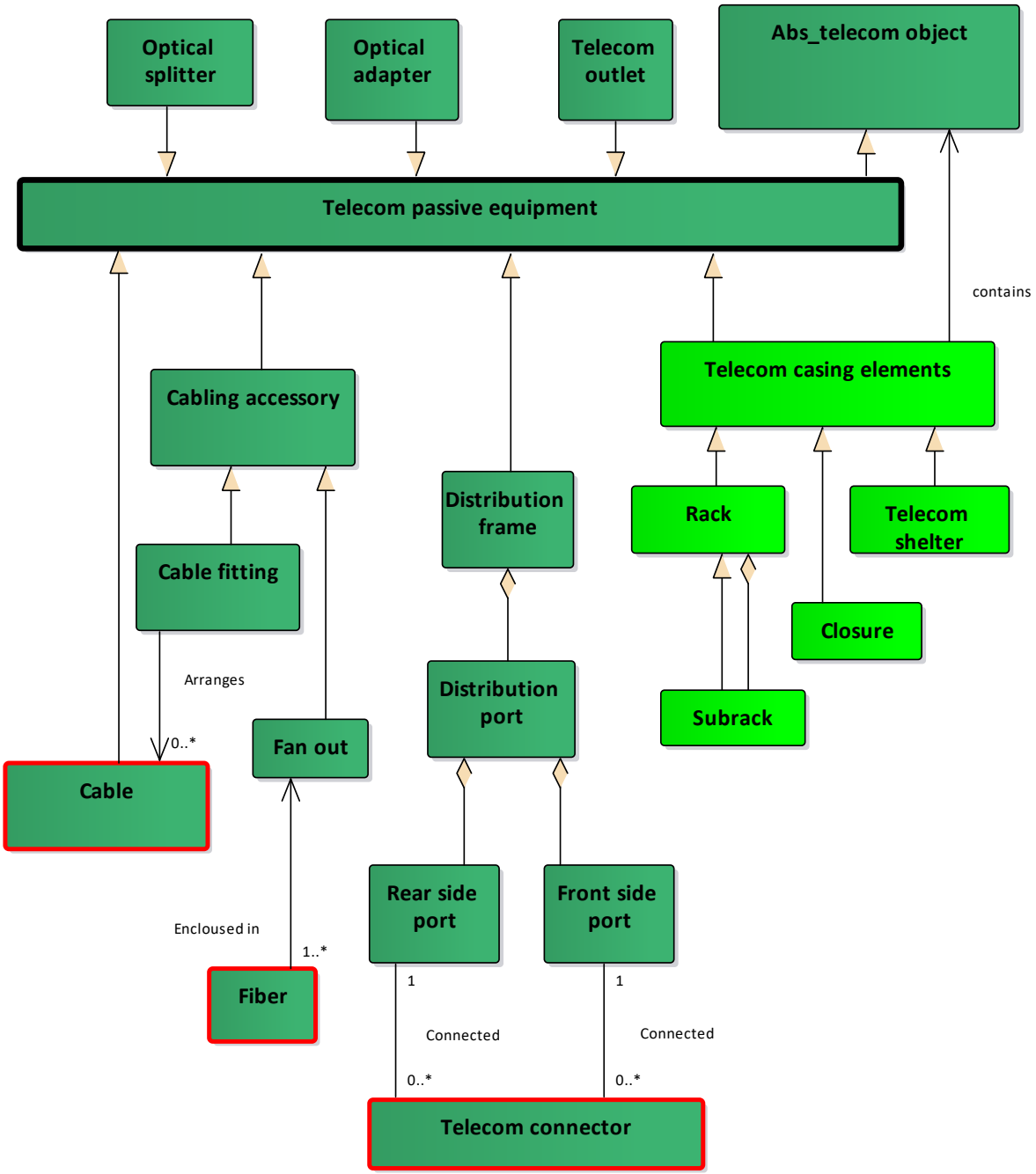


Table 36: *Class diagram Cabling*

4.1.7.3 Cabling accessory

This class collects all the required accessories in cabling work.

Relationships

Source	Type	Target
Cabling accessory	Generalization	Telecom passive equipment
Fan out	Generalization	Cabling accessory
Cable fitting	Generalization	Cabling accessory

4.1.7.4 Distribution port

Port of distribution frame.

Relationships

Source	Type	Target
Distribution port	Aggregation	Distribution frame
Front side port	Aggregation	Distribution port
Rear side port	Aggregation	Distribution port

4.1.7.5 Fiber endpoint

The termination point of an optical fiber. Each optical fiber has two termination points.

Relationships

Source	Type	Target
Fiber endpoint	Association	Fiber
Fiber endpoint	Association	Fusion Splicing
Fiber endpoint	Association	Optical fiber connector
Fusion Splicing	Association	Fiber endpoint

4.1.7.6 Front side port

The front side port of the distribution frame.

Relationships

Source	Type	Target
Front side port	Aggregation	Distribution port
Front side port	Association	Telecom connector

4.1.7.7 Optical fiber connector

Mechanical connector used to terminate a fiber end point so as to allow mechanical connection to another connectorized fiber end point or to a connectorized telecom equipment port.

Relationships

Source	Type	Target
Optical fiber connector	Generalization	Telecom connector
Fiber endpoint	Association	Optical fiber connector

4.1.7.8 Rear side port

The rear side port of the distribution frame.

Relationships

Source	Type	Target
Rear side port	Association	Telecom connector
Rear side port	Aggregation	Distribution port

4.1.7.9 Telecom casing elements

A passive element which houses and protects Telecom equipments

Relationships

Source	Type	Target
Telecom casing elements	Generalization	Telecom passive equipment
Telecom casing elements	Association	Abs_telecom object
Closure	Generalization	Telecom casing elements
Rack	Generalization	Telecom casing elements
Telecom shelter	Generalization	Telecom casing elements

4.1.7.10 Wire pair endpoint

The termination point of a wire pair. Each wire pair has two termination points.

Relationships

Source	Type	Target
Wire pair endpoint	Association	Wire pair
Wire pair endpoint	Association	Junction
Wire pair endpoint	Association	Copper connector
Junction	Association	Wire pair endpoint

4.1.7.11 Connector

Mechanical connector used to couple two cable endpoints, or to connect a cable endpoint to an equipment port. It is the supertype of telecom connector.

Relationships

Source	Type	Target
Connector	Aggregation	Cable
Telecom connector	Generalization	Connector
Power Cable Connector	Generalization	Connector

Source	Type	Target

4.1.7.12 Cable

This class collects all the objects which describe type of cables, containing either fiber or copper wire used in telecom or power supply systems.

Always contained in a linearly placed object, thus it is generally positioned with respect to local reference.

Relationships

Source	Type	Target
Cable	Association	Telecom laying infrastructure
Cable	Generalization	Telecom passive equipment
Cable	Association	Telecom support infrastructure
Cable fitting	Association	Cable
Connector	Aggregation	Cable
Power Supply Cable	Generalization	Cable
Telecom cable	Generalization	Cable

4.1.7.13 Cable fitting

Installed in a rack, used for arranging the wires.

Relationships

Source	Type	Target
Cable fitting	Association	Cable
Cable fitting	Generalization	Cabling accessory

4.1.7.14 Closure

Box to contain a cable junction, a component for the uninterrupted connection of two pipes or cables.

Relationships

Source	Type	Target
Closure	Generalization	Telecom casing elements

4.1.7.15 Coaxial cable

Coaxial cable, a subtype of copper cable, is a copper cable with a variable number of copper coaxial pair conductors used to transmit data by means of electrical signals, especially at radio frequency.

Relationships

Source	Type	Target
Coaxial cable	Generalization	Copper cable
Leaky coaxial cable	Generalization	Coaxial cable
Feeder	Generalization	Coaxial cable

4.1.7.16 Copper cable

Copper cable is a subtype of telecom cable, with a variable number of copper coaxial conductors or pair conductors used to transmit data by means of electrical signals.

Relationships

Source	Type	Target
Copper cable	Generalization	Telecom cable
Coaxial cable	Generalization	Copper cable
Copper patch cord	Generalization	Copper cable
Copper symmetric pair cable	Generalization	Copper cable

Source	Type	Target
Wire pair	Aggregation	Copper cable

4.1.7.17 Copper connector

Mechanical connector used to terminate a wire pair end point so as to allow mechanical connection to another connectorized wire pair end point or to a connectorized telecom equipment port. It can realize electric coupling between two wire pair endpoints.

Relationships

Source	Type	Target
Copper connector	Generalization	Telecom connector
Wire pair endpoint	Association	Copper connector

4.1.7.18 Copper symmetric pair cable

Telecom copper symmetric pair cable, a subtype of copper cable, is a copper cable with a variable number of copper twisted symmetric pair conductors used to transmit data by means of electrical signals.

Relationships

Source	Type	Target
Copper symmetric pair cable	Generalization	Copper cable

4.1.7.19 Copper patch cord

Copper patch cord, a subtype of copper cable, is a copper cable capped at either end with copper connectors that allow it to be rapidly and conveniently connected to other cable or to distribution panels.

Relationships

Source	Type	Target
Copper patch cord	Generalization	Copper cable

4.1.7.20 Distribution frame

Distribution frame is used to interconnect and manage wiring between active equipment and subscriber.

Relationships

Source	Type	Target
Distribution frame	NoteLink	Note
Distribution frame	Generalization	Telecom passive equipment
Distribution port	Aggregation	Distribution frame

4.1.7.21 Fan out

Provide a safe transition from multi-fiber cable units to individual fibers.

Relationships

Source	Type	Target
Fan out	Association	Fiber
Fan out	Generalization	Cabling accessory

4.1.7.22 Feeder

Feeder is the radio-frequency transmission line interconnecting an antenna and a transmitter or receiver, it is a subtype of coaxial cable.

Relationships

Source	Type	Target
Feeder	Generalization	Coaxial cable

Source	Type	Target

4.1.7.23 Fiber

Optical fiber is used in telecommunication systems to transmit data by means of optical signals.

Relationships

Source	Type	Target
Fiber	Aggregation	Optical fiber cable
Fan out	Association	Fiber
Fiber tube	Association	Fiber
Fiber endpoint	Association	Fiber

4.1.7.24 Optical fiber cable

Cable containing a variable number of optical fibers.

Relationships

Source	Type	Target
Optical fiber cable	Generalization	Telecom cable
Fiber tube	Aggregation	Optical fiber cable
Optical fiber patch cord	Generalization	Optical fiber cable
Fiber	Aggregation	Optical fiber cable
Optical pigtail	Generalization	Optical fiber cable

4.1.7.25 Fiber tube

A very small radius, semi-rigid hollow plastic tube that houses and protects a certain number of optical fibers. An optical fiber cable may contain many loose fiber tubes.

Relationships

Source	Type	Target
Fiber tube	Aggregation	Optical fiber cable
Fiber tube	Association	Fiber

4.1.7.26 Leaky coaxial cable

Leaky coaxial cable is a coaxial cable whose outer conductor is not completely closed, it is a subtype of coaxial cable.

Part of the electromagnetic energy transmitted along the cable can be radiated or coupled to a wireless transmission system consisting of the outer conductor and the surrounding environment through a slot or gap on the outer conductor or in the opposite direction as mentioned above.

Relationships

Source	Type	Target
Leaky coaxial cable	Generalization	Coaxial cable

4.1.7.27 Optical pigtail

Optical pigtail, a subtype of optical fiber cable, is a specific hardware connection used for cable termination. On a fiber pigtail, one end of the wire is simply exposed fiber and the other end has a pre-installed connector on it. Fiber pigtails are commonly spliced onto individual strands of a multi-fiber trunk cable.

Relationships

Source	Type	Target
Optical pigtail	Generalization	Optical fiber cable

4.1.7.28 Optical splitter

A passive device used to split the optical signal.

Relationships

Source	Type	Target
Optical splitter	Generalization	Telecom passive equipment

4.1.7.29 Optical adapter

Optical adapter is used to convert one type of optical port to another type of optical port.

Relationships

Source	Type	Target
Optical adapter	Generalization	Telecom passive equipment

4.1.7.30 Optical fiber patch cord

Optical fiber patch cord, a subtype of optical fiber cable, is an optical fiber cable capped at either end with connectors that allow it to be rapidly and conveniently connected to other cable or to distribution panels.

Relationships

Source	Type	Target
Optical fiber patch cord	Generalization	Optical fiber cable

4.1.7.31 Rack

Metal frame container for equipment.

Relationships

Source	Type	Target
Rack	Generalization	Telecom casing elements

Source	Type	Target
Rack	Aggregation	Telecom equipment volume
Equipment access zone	Association	Rack
Subrack	Generalization	Rack
Subrack	Aggregation	Rack

4.1.7.32 Subrack

Part of a rack.

Relationships

Source	Type	Target
Subrack	Generalization	Rack
Subrack	Aggregation	Rack

4.1.7.33 Telecom cable

Cable containing either fiber or copper wire used to transmit telecom signals, this class is a supertype of optical fiber cable and copper cable.

Relationships

Source	Type	Target
Telecom cable	Generalization	Cable
Optical fiber cable	Generalization	Telecom cable
Copper cable	Generalization	Telecom cable

4.1.7.34 Telecom connector

Mechanical connector used to couple two telecom cable endpoints or to connect a telecom cable endpoint to a telecom equipment port. This class is a supertype of optical fiber connector and copper cable connector.

Relationships

Source	Type	Target
Telecom connector	Association	Telecom connector
Telecom connector	Generalization	Connector
Copper connector	Generalization	Telecom connector
Telecom connector	Association	Telecom connector
Wired communication port	Association	Telecom connector
Rear side port	Association	Telecom connector
Optical fiber connector	Generalization	Telecom connector
Front side port	Association	Telecom connector

4.1.7.35 Telecom outlet

Telecom plug allowing telephone or network access.

Relationships

Source	Type	Target
Telecom outlet	Generalization	Telecom passive equipment

4.1.7.36 Telecom shelter

Building used to contain telecom equipment along trackside / outdoor.

Relationships

Source	Type	Target
Telecom shelter	Generalization	Telecom casing elements

4.1.7.37 Wire pair

A pair of conductors contained in a copper cable, the pair is always used together to form a circuit to transmit data by means of electric signals.

Relationships

Source	Type	Target
Wire pair	Aggregation	Copper cable
Wire pair endpoint	Association	Wire pair

4.1.8 Interface with Other Domain

4.1.9 Fixed telephony system

4.1.9.1 Class diagram Fixed telephony system

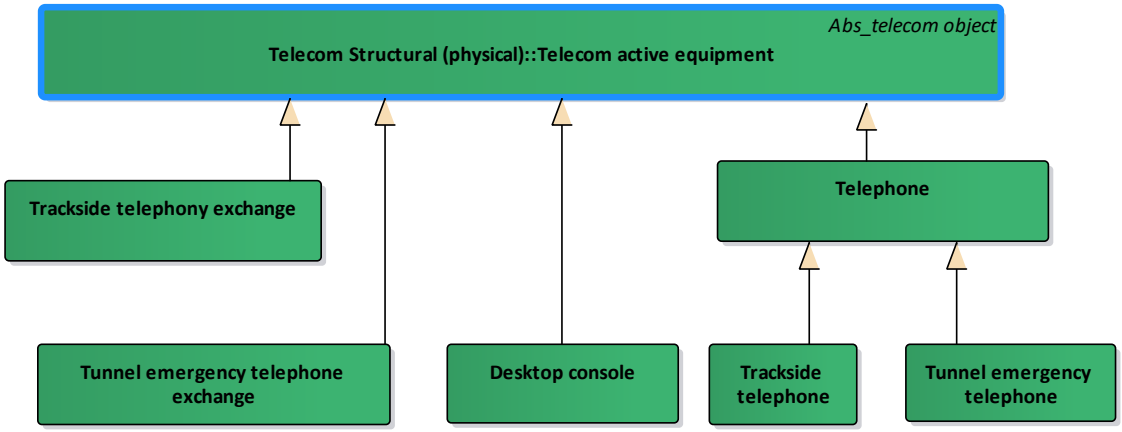


Table 37: Class diagram Fixed telephony system

4.1.9.2 Trackside telephone

These telephone sets are installed along the railway right-of-way in order to be used by the general public or railway agents. They allow hands-free communication that can be established by pressing a button

Relationships

Source	Type	Target
Trackside telephone	Generalization	Telephone

4.1.9.3 Desktop console

A desktop terminal equipment used by railway dispatching system, mainly realizing dispatching voice communication.

Relationships

Source	Type	Target
Desktop console	Generalization	Telecom active equipment

4.1.9.4 Telephone

A terminal device that realizes bidirectional voice communication by means of electrical signals.

Relationships

Source	Type	Target
Telephone	Generalization	Telecom active equipment
Office telephone	Generalization	Telephone
Railway operational telephone	Generalization	Telephone
Tunnel emergency telephone	Generalization	Telephone
Trackside telephone	Generalization	Telephone

4.1.9.5 Trackside telephony exchange

A device that ensures the routing of trackside telephone calls and communications.

Relationships

Source	Type	Target
Trackside telephony exchange	Generalization	Telecom active equipment

4.1.9.6 Tunnel emergency telephone

A phone specifically provided for making calls to emergency services in tunels

Relationships

Source	Type	Target
Tunnel emergency telephone	Generalization	Telephone

4.1.9.7 Tunnel emergency telephone exchange

Electronic components that allows tunnel emergency telephones to establish calls with the operation center.

Relationships

Source	Type	Target
Tunnel emergency telephone exchange	Generalization	Telecom active equipment

4.1.10 Fixed transmission network

4.1.10.1 Class diagram Fixed transmission network

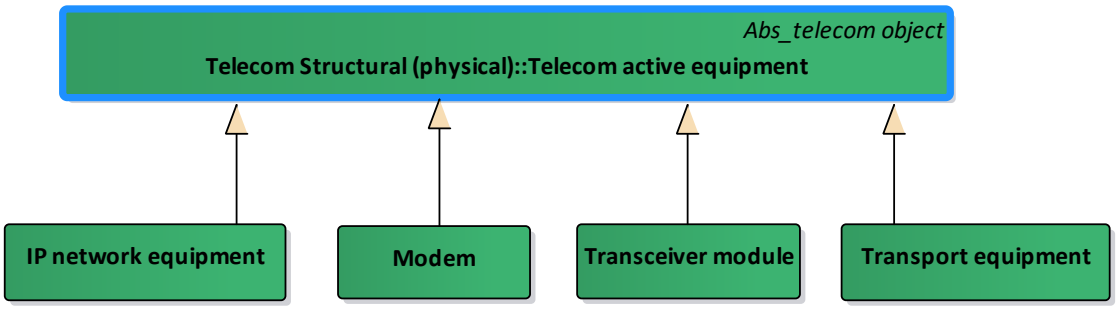


Table 38: Class diagram Fixed transmission network

Table 39: IP network equipment

Generic IP network equipment can represent all kind of IP network equipment, which provide IP data transmission channel for telecom subsystems or other subsystems e.g., routers, network switches or firewalls.

Relationships

Source	Type	Target
IP network equipment	Generalization	Telecom active equipment

4.1.10.2 Modem

Modem is a device that converts data into a format suitable for a transmission medium which can be copper cables or optical fibers.

Relationships

Source	Type	Target
Modem	Generalization	Telecom active equipment

4.1.10.3 Transceiver module

A device that can convert electric signal to optical signal at the sender, and convert optical signal to electric signal at the receiver.

Relationships

Source	Type	Target
Transceiver module	Generalization	Telecom active equipment

4.1.10.4 Transport equipment

Generic transport equipment can represent all kind of transport equipment, which provides transmission channel for telecom subsystems or other subsystems.

Relationships

Source	Type	Target
Transport equipment	Generalization	Telecom active equipment

4.1.11 Mobile network (GSMR - WiFi - LTE)

4.1.11.1 Class diagram Mobile network (GSMR - WiFi - LTE)

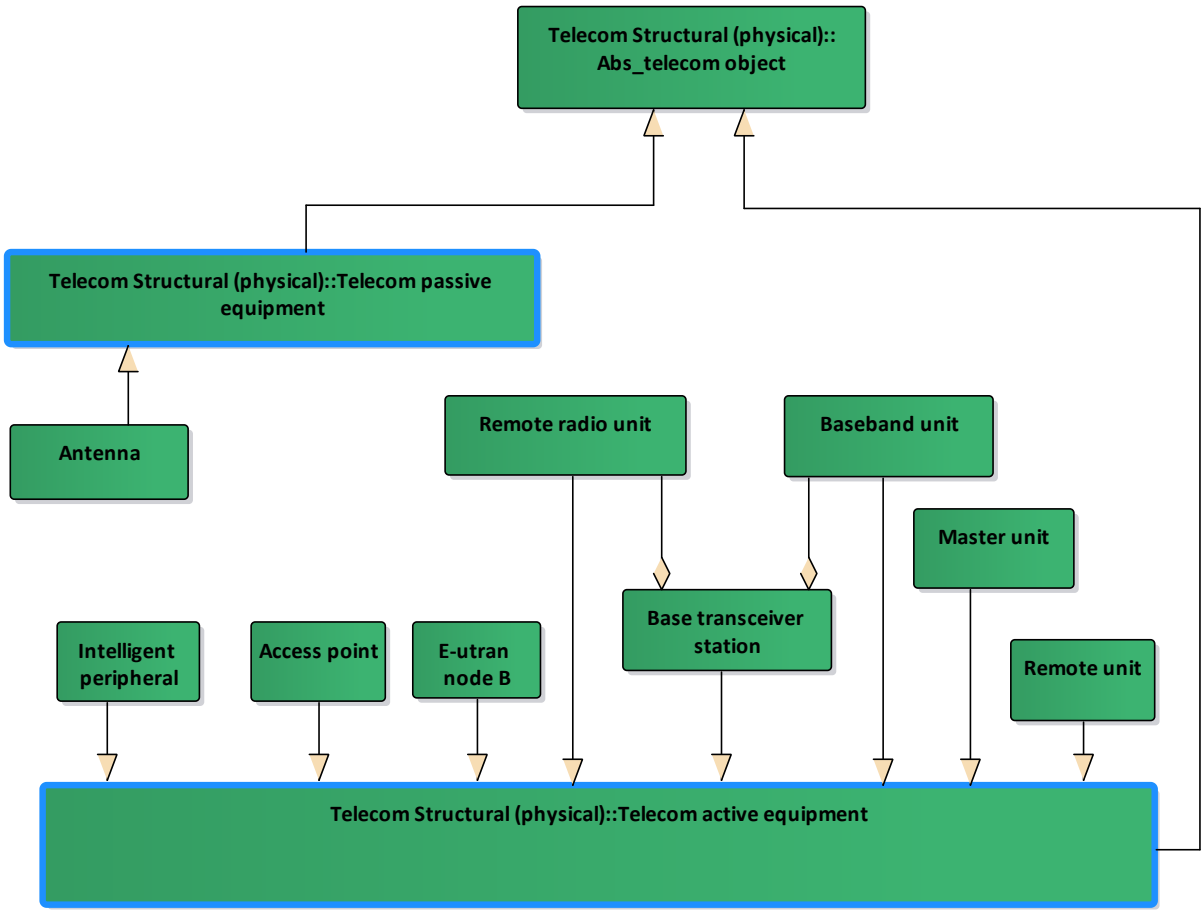


Table 40: Class diagram Mobile network (GSMR - WiFi - LTE)

4.1.11.2 Antenna

Antenna is a device that effectively radiates or receives electromagnetic waves, coupling a transmission line to space or other media.

Relationships

Source	Type	Target
Antenna	Generalization	Telecom passive equipment

4.1.11.3 Access point

In a network, a point at which wireless devices may connect to the network. Access point allows a Wi-Fi device to connect to a wired network.

Relationships

Source	Type	Target
Access point	Generalization	Telecom active equipment

4.1.11.4 Baseband unit

A component of a distributed base station for implementing baseband processing functions.

Relationships

Source	Type	Target
Baseband unit	Aggregation	Base transceiver station
Baseband unit	Generalization	Telecom active equipment

4.1.11.5 Base transceiver station

A Base Transceiver Station (BTS) is a network component which serves one cell.

It completes the conversion between BSC and wireless channel, and realize the wireless transmission and related control functions between BSC and MS through the air interface.

BTS has the functions of rate matching, channel coding/decoding, modulation/demodulation and other air interface physical layer.

Relationships

Source	Type	Target
Base transceiver station	Generalization	Telecom active equipment
Baseband unit	Aggregation	Base transceiver station
Remote radio unit	Aggregation	Base transceiver station

4.1.11.6 E-utran node B

An eNB is a logical network component which serves one or more E-UTRAN cells.

It is the hardware connected to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity), which communicates directly with UEs (User Equipment) in wireless way.

On the basis of the original functions of Node B, eNB added the physical layer, MAC layer, RRC, scheduling, access control, load bearing control, mobility management and wireless resource management of adjacent cells of RNC, providing functions equivalent to the original RLC/MAC/PHY and RRC layer.

Relationships

Source	Type	Target
E-utran node B	Generalization	Telecom active equipment

4.1.11.7 Intelligent peripheral

Under the control of SCP, IP offers a variety of specialized resources according to the corresponding service logical program. And these resources contain the receiver of DTMF (Dual –Tone Multi-Frequency, signal generator, record notice, etc.

IP provides dedicated resource functions in the intelligent network, allocates, controls and manages various dedicated resources, communicates with other entities in the network, and completes SRF resource functions as well as the maintenance, management and statistics functions of resources.

Relationships

Source	Type	Target
Intelligent peripheral	Generalization	Telecom active equipment

4.1.11.8 Master unit

A component of a repeater for coupling base station signals.

Relationships

Source	Type	Target
Master unit	Generalization	Telecom active equipment

4.1.11.9 Remote radio unit

A component of a distributed base station that converts digital baseband signals into high-frequency (rf) signals and sends high-frequency (rf) signals to the antenna for radiation.

Relationships

Source	Type	Target
Remote radio unit	Aggregation	Base transceiver station
Remote radio unit	Generalization	Telecom active equipment

4.1.11.10 Remote unit

Remote unit is used to amplify a base station signal.

Relationships

Source	Type	Target
Remote unit	Generalization	Telecom active equipment

4.1.12 Railway natural disaster and Foreign object intrusion monitoring system

4.1.12.1 Class diagram Railway natural disaster and Foreign object intrusion monitoring system

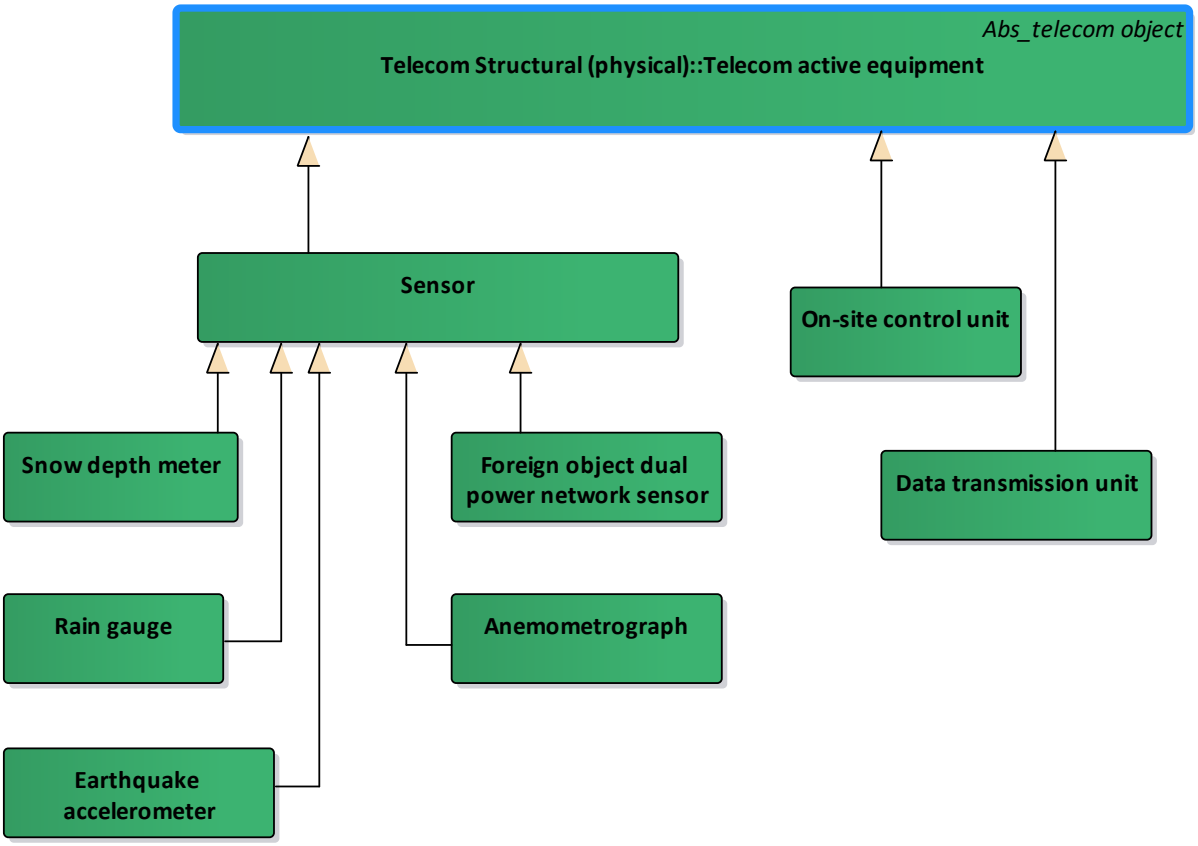


Table 41: Class diagram Railway natural disaster and Foreign object intrusion monitoring system

4.1.12.2 Anemometrograph

Device used to measure wind speed and direction.

Relationships

Source	Type	Target
Anemometrograph	Generalization	Sensor

4.1.12.3 Data transmission unit

Device used to transfer data to on-site control unit, which can be fixed near the rain gauge, snow depth meter, foreign object dual power network sensor or earthquake accelerometer.

The data are amplified and modulated, and then sent to the on-site unit.

Relationships

Source	Type	Target
Data transmission unit	Generalization	Telecom active equipment

4.1.12.4 Earthquake accelerometer

Device used to detect the seismic wave and measure the seismic intensity in case of earthquake.

Relationships

Source	Type	Target
Earthquake accelerometer	Generalization	Sensor

4.1.12.5 Foreign object dual power network sensor

Device which can alarm when foreign objects shock and break the dual power network.

Relationships

Source	Type	Target
Foreign object dual power network sensor	Generalization	Sensor

4.1.12.6 On-site control unit

Device used to receive monitoring data from data transmission unit and send the monitoring data to central system, usually located in telecom equipment room.

Relationships

Source	Type	Target
On-site control unit	Generalization	Telecom active equipment

4.1.12.7 Rain gauge

Device used to collect and indicate rainfall related information.

Relationships

Source	Type	Target
Rain gauge	Generalization	Sensor

4.1.12.8 Sensor

Supertype of all different kinds of sensors, collecting different kinds of information.

Relationships

Source	Type	Target
Sensor	Generalization	Telecom active equipment
Foreign object dual power network sensor	Generalization	Sensor
Rain gauge	Generalization	Sensor
Earthquake accelerometer	Generalization	Sensor
Snow depth meter	Generalization	Sensor
Anemometrograph	Generalization	Sensor

4.1.12.9 Snow depth meter

Device used to measure the depth of snowfall.

Relationships

Source	Type	Target
Snow depth meter	Generalization	Sensor

4.1.13 Relationships

4.1.13.1 Fusion Splicing

A relationshipt representing the act of joining two optical fibers end-to-end and fusiong them together.

Relationships

Source	Type	Target
Fusion Splicing	Association	Fiber endpoint
Fiber endpoint	Association	Fusion Splicing

4.1.13.2 Junction

A relationship representing electric connection between cooper wires.

Relationships

Source	Type	Target
Junction	Association	Wire pair endpoint
Wire pair endpoint	Association	Junction

4.1.13.3 Laying Infrastructure Connection

A relationsip representing the connection of laying infrastructure such as tubes, gutters and ducts.

Relationships

Source	Type	Target
Laying Infrastructure Connection	Association	Telecom laying infrastructure connection point
Telecom laying infrastructure connection point	Association	Laying Infrastructure Connection

4.1.14 Support and laying infrastructure

4.1.14.1 Class diagram Support and laying infrastructure

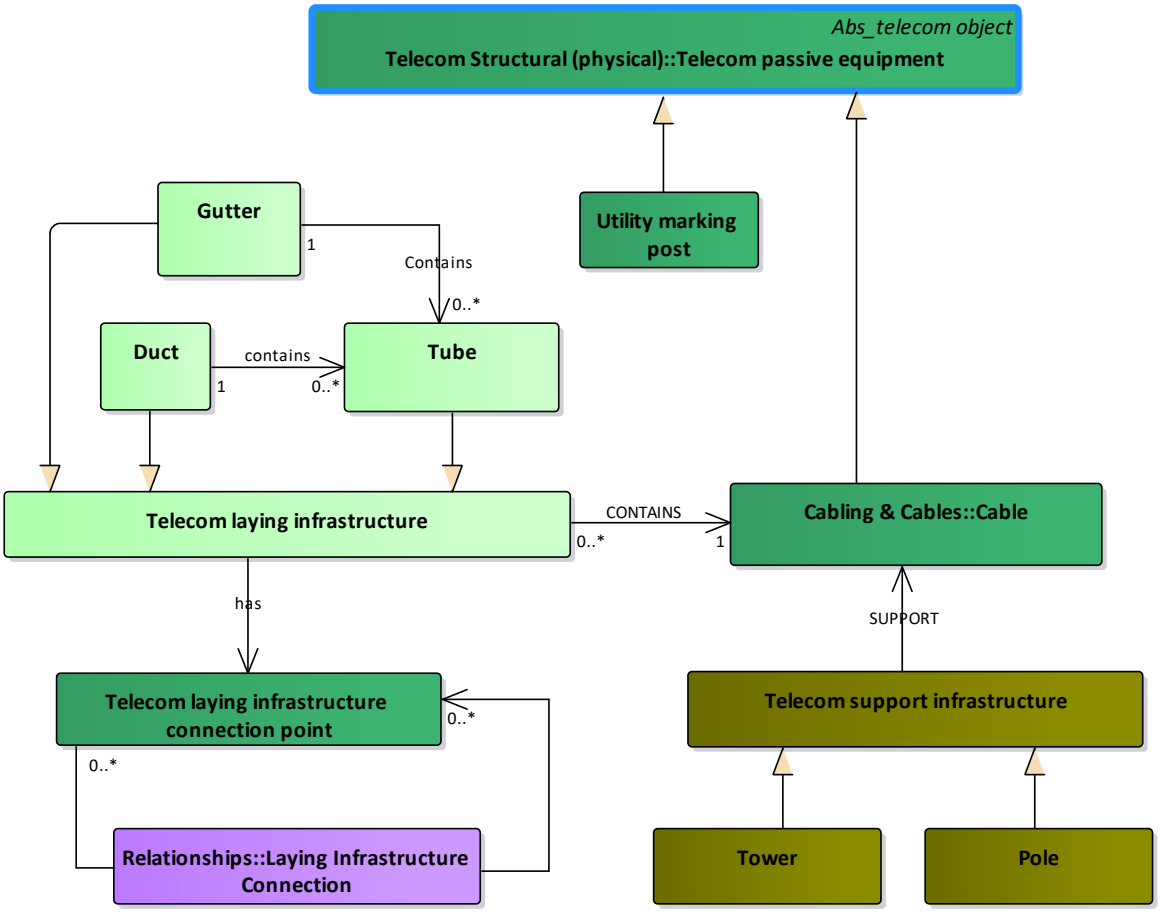


Table 42: Class diagram Support and laying infrastructure

4.1.14.2 Telecom laying infrastructure connection point

A joiner that connects two laying infrastructures such as ducs, gutters or tubes.

Relationships

Source	Type	Target
Telecom laying infrastructure connection point	Association	Laying Infrastructure Connection
Laying Infrastructure Connection	Association	Telecom laying infrastructure connection point
Telecom laying infrastructure	Association	Telecom laying infrastructure connection point

4.1.14.3 Duct

A concrete/metallic/plastic duct that contains tubes and/or cables.

Relationships

Source	Type	Target
Duct	Association	Tube
Duct	Generalization	Telecom laying infrastructure

4.1.14.4 Gutter

Metallic or plastic support for passing cables.

Relationships

Source	Type	Target
Gutter	Association	Tube
Gutter	Generalization	Telecom laying infrastructure

4.1.14.5 Telecom laying infrastructure

This class collects all the objects related to laying infrastructure aimed to support or contain cables.

Relationships

Source	Type	Target
Telecom laying infrastructure	Association	Telecom laying infrastructure connection point
Telecom laying infrastructure	Aggregation	Telecom laying infrastructure zone
Cable	Association	Telecom laying infrastructure
Manhole	Generalization	Telecom laying infrastructure
Duct	Generalization	Telecom laying infrastructure
Tube	Generalization	Telecom laying infrastructure
Note	NoteLink	Telecom laying infrastructure
Gutter	Generalization	Telecom laying infrastructure

4.1.14.6 Manhole

Concrete covered opening used to install cable junctions or reserve cable.

Relationships

Source	Type	Target
Manhole	Generalization	Telecom laying infrastructure
Manhole	Association	Tube

4.1.14.7 Pole

Metallic or concrete pole used to hold up cables or antennas.

Relationships

Source	Type	Target
Pole	Generalization	Telecom support infrastructure

Source	Type	Target

4.1.14.8 Utility marking post

Concrete stake for cable location and route indication.

Relationships

Source	Type	Target
Utility marking post	Generalization	Telecom passive equipment

4.1.14.9 Telecom support infrastructure

A tall structure using for installing telecom devices such as antennas.

Relationships

Source	Type	Target
Telecom support infrastructure	Aggregation	Telecom infrastructure volume
Telecom support infrastructure	NoteLink	Note
Telecom active equipment	Association	Telecom support infrastructure
Tower	Generalization	Telecom support infrastructure
Cable	Association	Telecom support infrastructure
Pole	Generalization	Telecom support infrastructure

4.1.14.10 Tower

Metallic framed structure used to hold antennas or cables.

Relationships

Source	Type	Target
Tower	Generalization	Telecom support infrastructure

4.1.14.11 Tube

Plastic or metallic tubes that contain cables.

Relationships

Source	Type	Target
Tube	Generalization	Telecom laying infrastructure
Duct	Association	Tube
Gutter	Association	Tube
Manhole	Association	Tube

4.1.15 Telecom interfaces

4.1.15.1 Class diagram Telecom interfaces

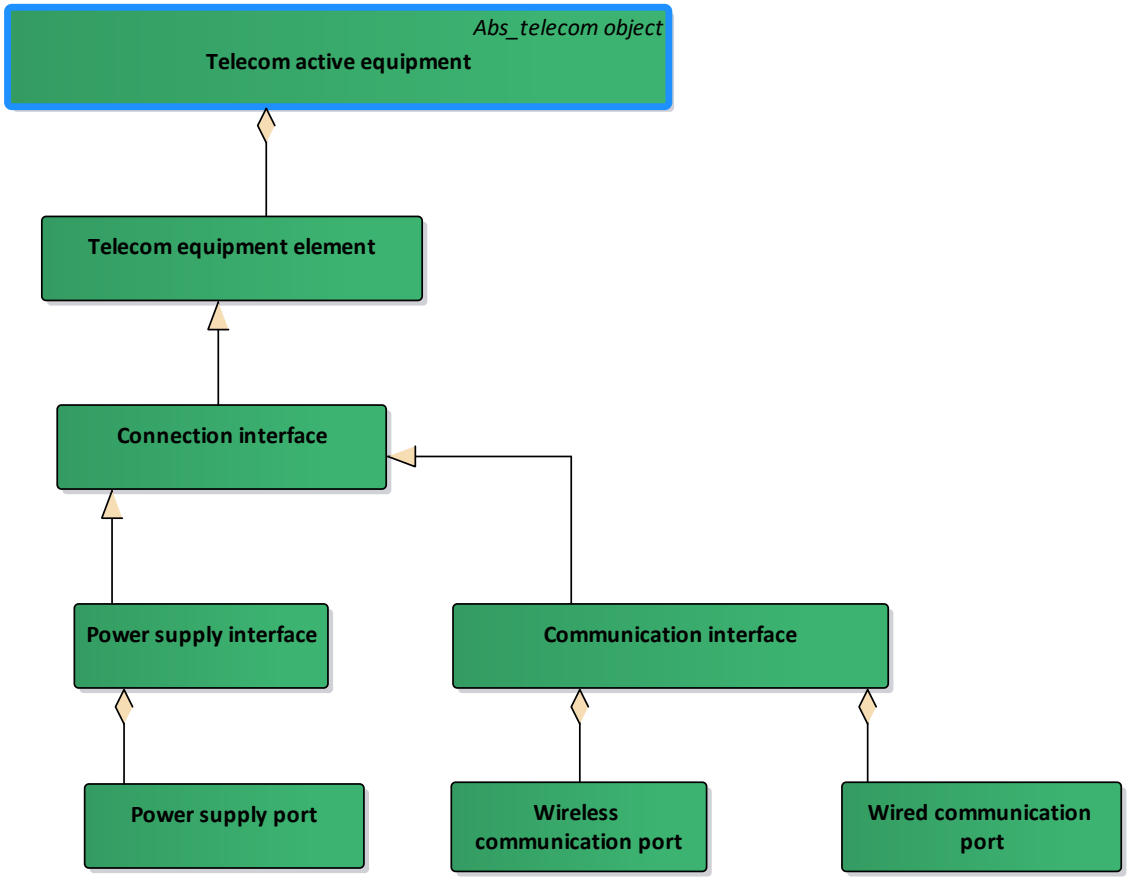


Table 43: *Class diagram Telecom interfaces*

4.1.15.2 Communication interface

An interface of an active telecom equipment, used for data input or output. It is a subtype of connection interface.

Relationships

Source	Type	Target
Communication interface	Generalization	Connection interface
Wireless communication port	Aggregation	Communication interface
Wired communication port	Aggregation	Communication interface

4.1.15.3 Connection interface

An interface of an active telecom equipment, used for data input or output. It is a subtype of connection interface.

Relationships

Source	Type	Target
Connection interface	Generalization	Telecom equipment element
Power supply interface	Generalization	Connection interface
Communication interface	Generalization	Connection interface

4.1.15.4 Power supply interface

Power supply interface of a telecom active equipment, using which the equipment can be powered through power supply cables.

Relationships

Source	Type	Target
Power supply interface	Generalization	Connection interface
Power supply port	Aggregation	Power supply interface

4.1.15.5 Power supply port

A subtype of power supply interface.

Relationships

Source	Type	Target
Power supply port	Association	Power Cable Connector
Power supply port	Aggregation	Power supply interface

4.1.15.6 Wired communication port

Port of a telecom active equipment, used for wired connection.

Relationships

Source	Type	Target
Wired communication port	Association	Telecom connector
Wired communication port	Aggregation	Communication interface

4.1.15.7 Wireless communication port

Port of a telecom active equipment, used for wireless connection.

Relationships

Source	Type	Target
Wireless communication port	Aggregation	Communication interface

4.1.16 Ticketing system

4.1.16.1 Class diagram Ticketing system

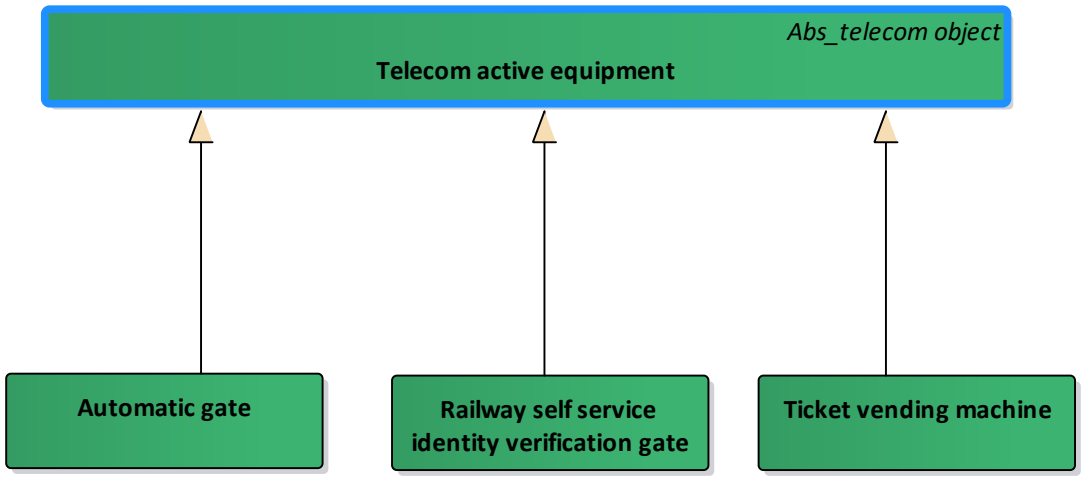


Table 44: Class diagram Ticketing system

4.1.16.2 Automatic gate

An equipment for ticket inspection and processing. Passengers are allowed or forbidden to pass according to the validity of tickets.

Relationships

Source	Type	Target
Automatic gate	Generalization	Telecom active equipment

4.1.16.3 Railway self service identity verification gate

Railway Self-service Identity Verification Gate:

An equipment for consistency check of tickets, id card and face image. Passengers are allowed or forbid to pass according to the check result.

Relationships

Source	Type	Target
Railway self service identity verification gate	Generalization	Telecom active equipment

4.1.16.4 Ticket vending machine

A self-service device with functions of choosing ticket, payment and ticket making, etc. With this device, passengers can buy and collect tickets themselves.

Ticket vending machine shall provide a stable, reliable, friendly self-service environment for passengers to purchase or collect tickets conveniently and effectively.

Relationships

Source	Type	Target
Ticket vending machine	Generalization	Telecom active equipment

Source	Type	Target

4.1.17 Time and frequency synchronization system

4.1.18 Wired access network

4.1.18.1 Class diagram Wired access network

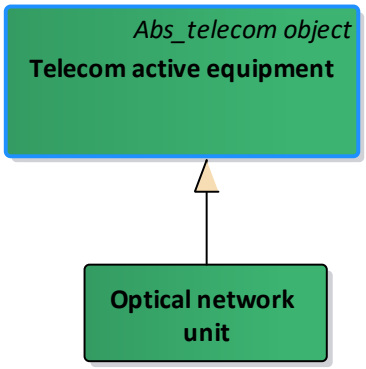


Table 45: Class diagram Wired access network

4.1.18.2 Optical network unit

A kind of optical transmission network connection equipment which is installed at user side.

Relationships

Source	Type	Target
Optical network unit	Generalization	Telecom active equipment

4.2 Telecom Spatial

4.2.1 Class diagram Telecom Spatial_Model

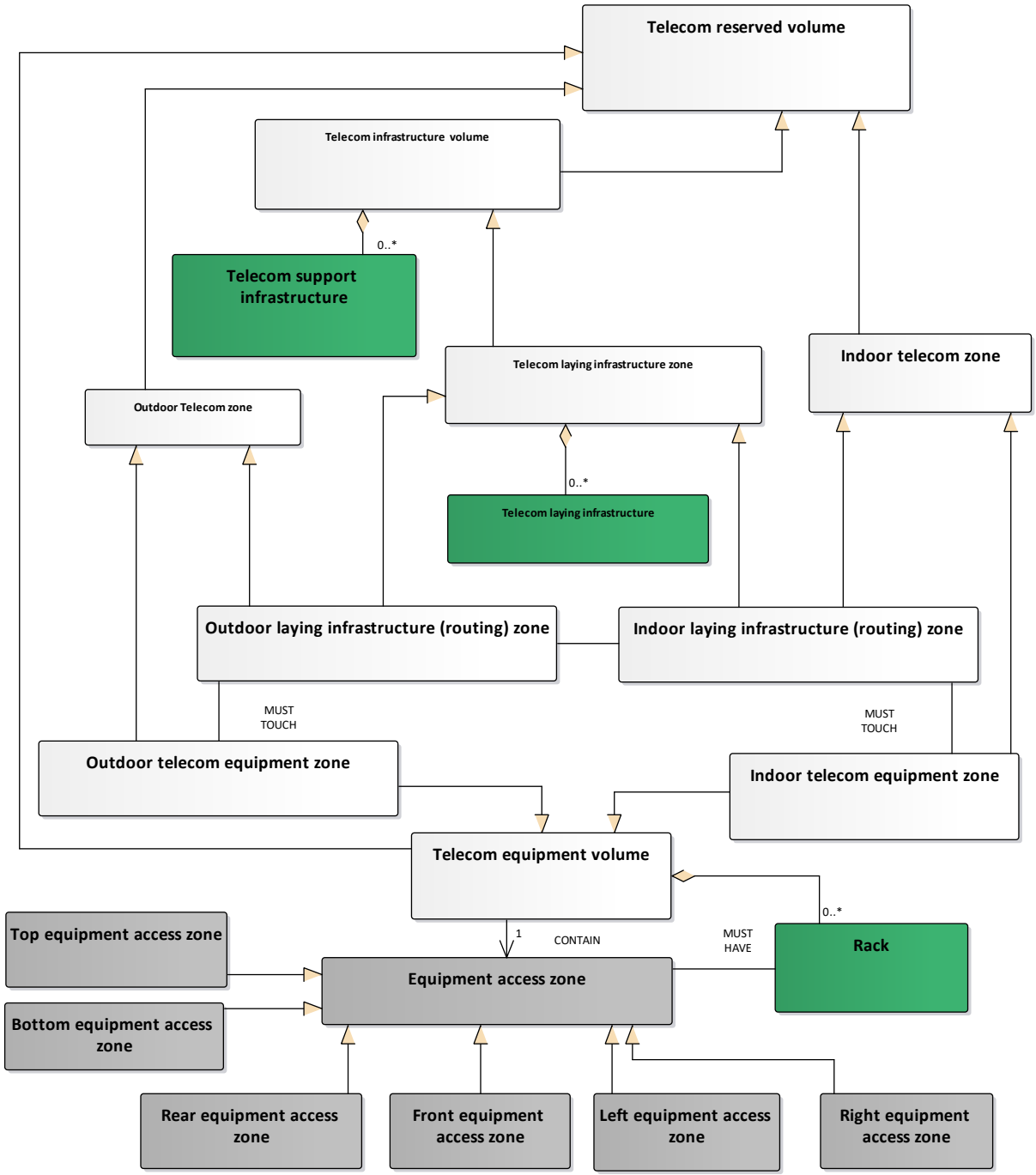


Table 46: Class diagram Telecom Spatial_Model

4.2.2 Bottom equipment access zone

A space that allows to access to the equipment from the bottom side.

It is defined by the minimal distance that must be kept free in the bottom side of the equipment

Relationships

Source	Type	Target
Bottom equipment access zone	Generalization	Equipment access zone

4.2.3 Equipment access zone

Space that allows to access to the equipment. It is defined by the side, top, rear and front access zones.

Relationships

Source	Type	Target
Equipment access zone	Association	Rack
Bottom equipment access zone	Generalization	Equipment access zone
Left equipment access zone	Generalization	Equipment access zone
Front equipment access zone	Generalization	Equipment access zone
Right equipment access zone	Generalization	Equipment access zone
Telecom equipment volume	Association	Equipment access zone
Rear equipment access zone	Generalization	Equipment access zone
Top equipment access zone	Generalization	Equipment access zone

4.2.4 Front equipment access zone

A space that allows to access to the equipment from the front side.

It is defined by the minimal distance that must be kept free in the front side of the equipement

Relationships

Source	Type	Target
Front equipment access zone	Generalization	Equipment access zone

4.2.5 Indoor laying infrastructure (routing) zone

An indoor space that is reserved for laying Telecom cables, ducts, tubes, gutters or manholes

Relationships

Source	Type	Target
Indoor laying infrastructure (routing) zone	Generalization	Indoor telecom zone
Indoor laying infrastructure (routing) zone	Generalization	Telecom laying infrastructure zone
Indoor laying infrastructure (routing) zone	Association	Outdoor laying infrastructure (routing) zone
Indoor telecom equipment zone	Association	Indoor laying infrastructure (routing) zone

4.2.6 Indoor telecom equipment zone

Indoor space that is reserved to install telecom equipment

Relationships

Source	Type	Target
Indoor telecom equipment zone	Association	Telecom active equipment
Indoor telecom equipment zone	Generalization	Telecom equipment volume
Indoor telecom equipment zone	Generalization	Indoor telecom zone
Indoor telecom equipment zone	Association	Indoor laying infrastructure (routing) zone

4.2.7 Indoor telecom zone

Indoor space that is reserved to install telecom equipment and facilities

Relationships

Source	Type	Target
Indoor telecom zone	Generalization	Telecom reserved volume
Indoor telecom equipment zone	Generalization	Indoor telecom zone
Indoor laying infrastructure (routing) zone	Generalization	Indoor telecom zone

4.2.8 Left equipment access zone

A space that allows to access to the equipment from the left side.

It is defined by the minimal distance that must be kept free in the left side of the equipement

Relationships

Source	Type	Target
Left equipment access zone	Generalization	Equipment access zone

4.2.9 Outdoor laying infrastructure (routing) zone

Outdoor space that is reserved for laying telecom cables, ducts, tubes, gutters or manholes

Relationships

Source	Type	Target
Outdoor laying infrastructure (routing) zone	Association	Outdoor telecom equipment zone
Outdoor laying infrastructure (routing) zone	Generalization	Outdoor Telecom zone
Outdoor laying infrastructure (routing) zone	Generalization	Telecom laying infrastructure zone
Indoor laying infrastructure (routing) zone	Association	Outdoor laying infrastructure (routing) zone

4.2.10 Outdoor telecom equipment zone

Outdoor space that is reserved to install telecom equipment

Relationships

Source	Type	Target
Outdoor telecom equipment zone	Generalization	Outdoor Telecom zone
Outdoor telecom equipment zone	Generalization	Telecom equipment volume
Outdoor laying infrastructure (routing) zone	Association	Outdoor telecom equipment zone

4.2.11 Outdoor Telecom zone

An outdoor space that is reserved to install Telecom equipments and facilities

Relationships

Source	Type	Target
Outdoor Telecom zone	Generalization	Telecom reserved volume
Outdoor laying infrastructure (routing) zone	Generalization	Outdoor Telecom zone
Outdoor telecom equipment zone	Generalization	Outdoor Telecom zone

4.2.12 Rear equipment access zone

A space that allows to access to the equipment from the rear side.

It is defined by the minimal distance that must be kept free in the rear side of the equipement

Relationships

Source	Type	Target
Rear equipment access zone	Generalization	Equipment access zone

4.2.13 Right equipment access zone

A space that allows to access to the equipment from the right side.

It is defined by the minimal distance that must be kept free in the right side of the equipement

Relationships

Source	Type	Target
Right equipment access zone	Generalization	Equipment access zone

4.2.14 Telecom laying infrastructure zone

Space that is reserved for laying telecom cables.

Relationships

Source	Type	Target
Telecom laying infrastructure zone	Generalization	Telecom infrastructure volume
Indoor laying infrastructure (routing) zone	Generalization	Telecom laying infrastructure zone
Outdoor laying infrastructure (routing) zone	Generalization	Telecom laying infrastructure zone
Telecom laying infrastructure	Aggregation	Telecom laying infrastructure zone

4.2.15 Top equipment access zone

A space that allows to access to the equipment from the top side.

It is defined by the minimal distance that must be kept free in the top side of the equipement

Relationships

Source	Type	Target
Top equipment access zone	Generalization	Equipment access zone

5 Energy

5.1 Energy Structural (physical)

5.1.1 Auxiliary Services

5.1.1.1 Class diagram "Auxiliary Services"

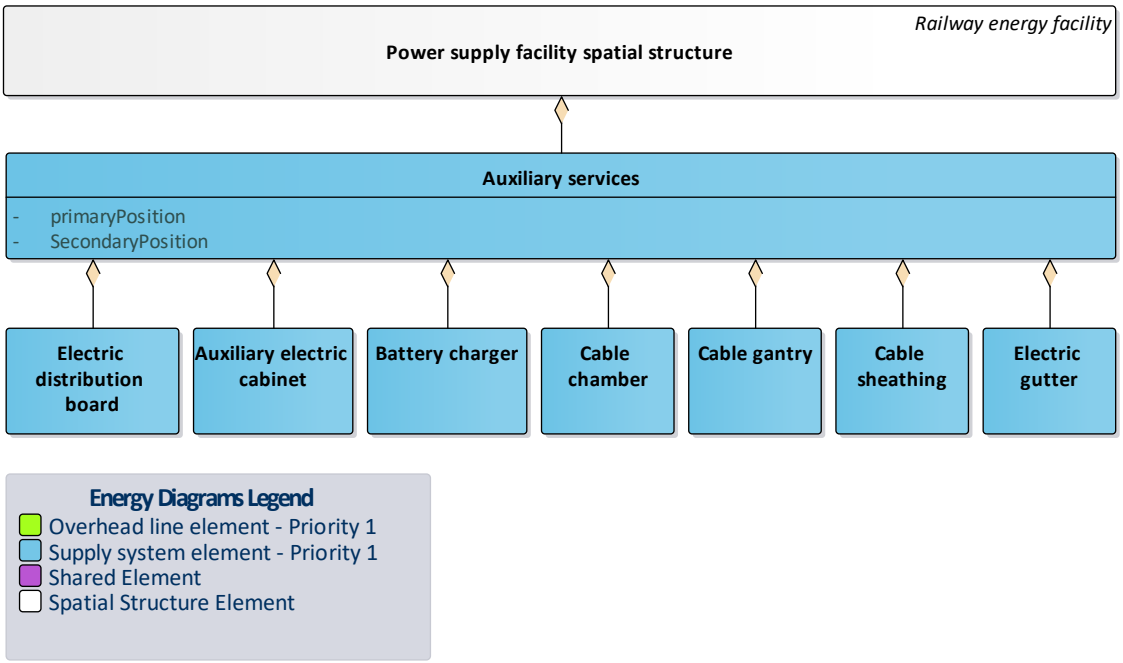


Table 47: Class diagram "Auxiliary Services"

5.1.1.2 Cable chamber

An opening to a confined space such as a shaft, utility vault, or large vessel, used as an access point for underground cable, allowing inspection, maintenance, and system upgrades. It' also called manhole.

Relationships

Source	Type	Target
Cable chamber	Aggregation	Auxiliary services

Source	Type	Target

5.1.1.3 Cable gantry

Horizontal cable supports fixed at one end only, spaced at intervals, on which cables rest.(IEC 60050-826-15-10)

Relationships

Source	Type	Target
Cable gantry	Aggregation	Auxiliary services

5.1.1.4 Cable sheathing

Flexible accessory or a part of a component placed around the cable to minimize flexing of the cable at the point of entry into the component.

Relationships

Source	Type	Target
Cable sheathing	Aggregation	Auxiliary services

5.1.1.5 Electric gutter

Electrical conduit used to protect and route electrical wiring in a building or structure.

Relationships

Source	Type	Target
Electric gutter	Aggregation	Auxiliary services

5.1.1.6 *Auxiliary electric cabinet*

Cabinet for different low voltage services (signaling, telecom..)

Relationships

Source	Type	Target
Auxiliary electric cabinet	Aggregation	Auxiliary services

5.1.1.7 *Auxiliary services*

Provide Energy port for different low voltage services (signaling, telecom..)

Relationships

Source	Type	Target
Auxiliary services	Aggregation	Power supply facility spatial structure
Electric gutter	Aggregation	Auxiliary services
Cable sheathing	Aggregation	Auxiliary services
Battery charger	Aggregation	Auxiliary services
Cable gantry	Aggregation	Auxiliary services
Cable chamber	Aggregation	Auxiliary services
Auxiliary electric cabinet	Aggregation	Auxiliary services
Electric distribution board	Aggregation	Auxiliary services

5.1.1.8 *Battery charger*

Equipment used to charge the battery, which is storing electric energy for substation.

Relationships

Source	Type	Target
Battery charger	Aggregation	Auxiliary services

Source	Type	Target

5.1.1.9 *Electric distribution board*

Electric distribution board used to dispatch electric power.

Relationships

Source	Type	Target
Electric distribution board	Aggregation	Auxiliary services

5.1.2 Earthing Circuit

5.1.2.1 *Class diagram "Earthing Circuit"*

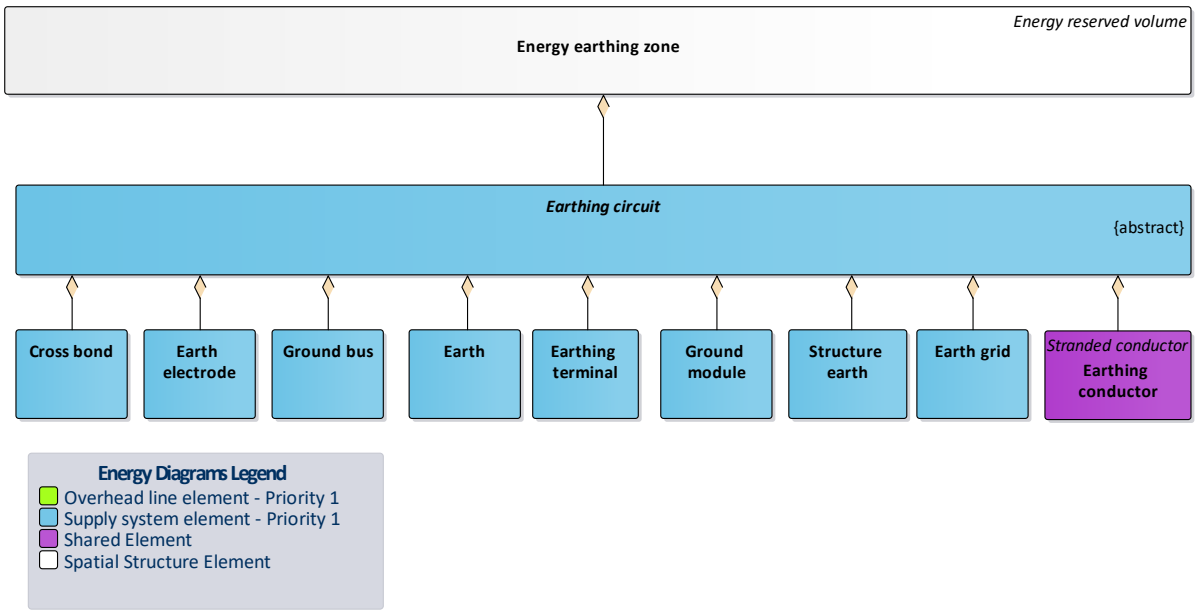


Table 48: Class diagram "Earthing Circuit"

5.1.2.2 *Earthing circuit*

All conductors which form the intended path for the earthing.

Relationships

Source	Type	Target
Earthing circuit	Aggregation	Energy earthing zone
Ground bus	Aggregation	Earthing circuit
Earth	Aggregation	Earthing circuit
Ground module	Aggregation	Earthing circuit
Structure earth	Aggregation	Earthing circuit
Earthing conductor	Aggregation	Earthing circuit
Rigid catenary grounding clamp	Aggregation	Earthing circuit
Earthing terminal	Aggregation	Earthing circuit
Earth grid	Aggregation	Earthing circuit
Earth electrode	Aggregation	Earthing circuit
Cross bond	Aggregation	Earthing circuit
Earthing fitting	Aggregation	Earthing circuit

5.1.2.3 Cross bond

Electrical connection intended to connect in parallel the conductors of the return circuit.

Relationships

Source	Type	Target
Cross bond	Aggregation	Earthing circuit

5.1.2.4 Earth electrode

Conductive part, which may be embedded in a specific conductive medium, e.g. concrete or coke, in electric contact with the Earth.(Grounding rod)(IEC 60050-826-13-05)

Relationships

Source	Type	Target
Earth electrode	Aggregation	Earthing circuit

5.1.2.5 Ground bus

Grounding grid consisting of horizontal grounding bodies.

Relationships

Source	Type	Target
Ground bus	Aggregation	Earthing circuit

5.1.2.6 Earth

Part of the Earth which is in electric contact with an earth electrode and the electric potential of which is not necessarily equal to zero.(IEC 60050-195-01-03)

Relationships

Source	Type	Target
Earth	Aggregation	Earthing circuit

5.1.2.7 Earthing terminal

Grounding terminal provided on equipment or on a device and intended for the electric connection with the earthing arrangement.

Relationships

Source	Type	Target
Earthing terminal	Aggregation	Earthing circuit

5.1.2.8 Ground module

Grounding Composed of nonmetallic minerals with good conductivity and stability.

Relationships

Source	Type	Target
Ground module	Aggregation	Earthing circuit

5.1.2.9 Structure earth

Construction made of metallic parts or construction including interconnected metallic structural parts, which can be used as an earth electrode.

Relationships

Source	Type	Target
Structure earth	Aggregation	Earthing circuit

5.1.2.10 Earth grid

Part of an earthing arrangement comprising only the earth electrodes and their interconnections.(IEC 60050-826-13-06)

Relationships

Source	Type	Target
Earth grid	Aggregation	Earthing circuit

5.1.3 Earthing Line

5.1.3.1 Class diagram "Earthing Line"

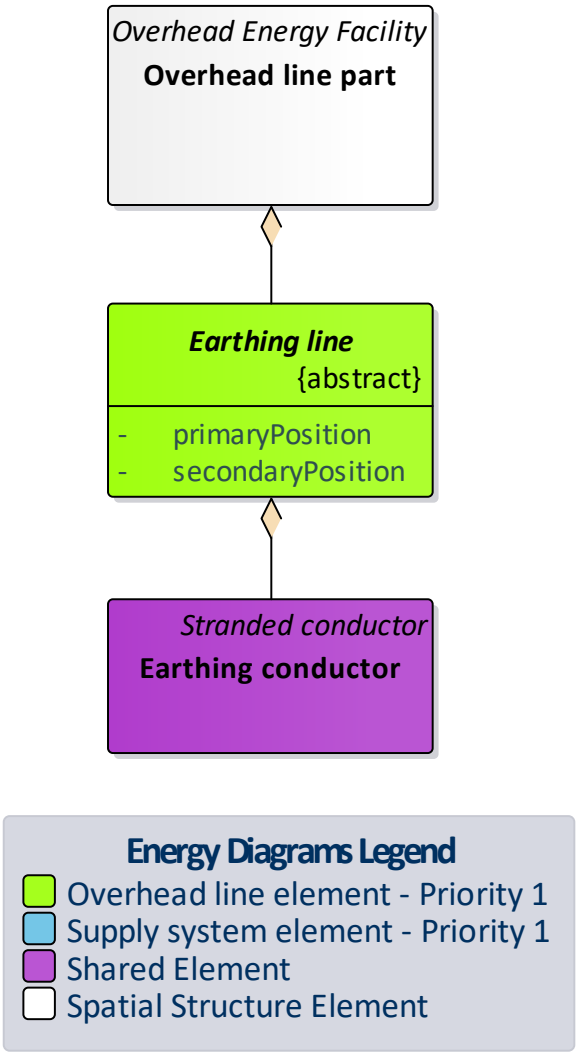


Table 49: Class diagram "Earthing Line"

5.1.3.2 Earthing line

Earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

Relationships

Source	Type	Target
Earthing line	Aggregation	Overhead line part

Source	Type	Target
Earthing line	Association	Tensioning section
Earthing conductor	Aggregation	Earthing line

5.1.4 Electric Power Converter

5.1.4.1 Class diagram "Electric Power Converter"

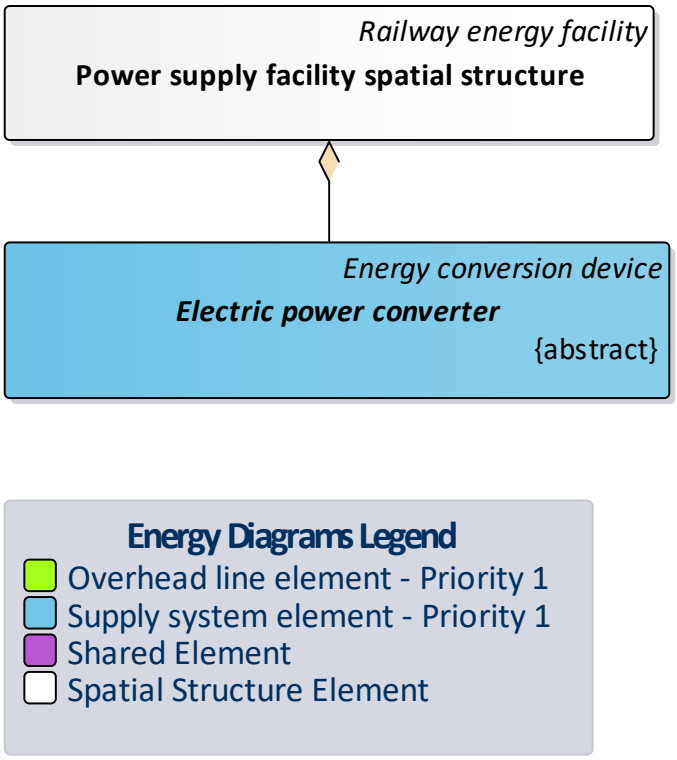


Table 50: Class diagram "Electric Power Converter"

5.1.4.2 Electric power converter

an electrical or electro-mechanical device for converting electric energy from one form to another such as converting between AC and DC; or changing the voltage or frequency; or some combination of these.

Relationships

Source	Type	Target
Electric power converter	Aggregation	Power supply facility spatial structure
Electric power converter	Generalization	Energy conversion device
Chopper	Generalization	Electric power converter
Inverter	Generalization	Electric power converter
Rectifier	Generalization	Electric power converter

5.1.5 Electric Storage

5.1.5.1 Class diagram "Electric Storage"

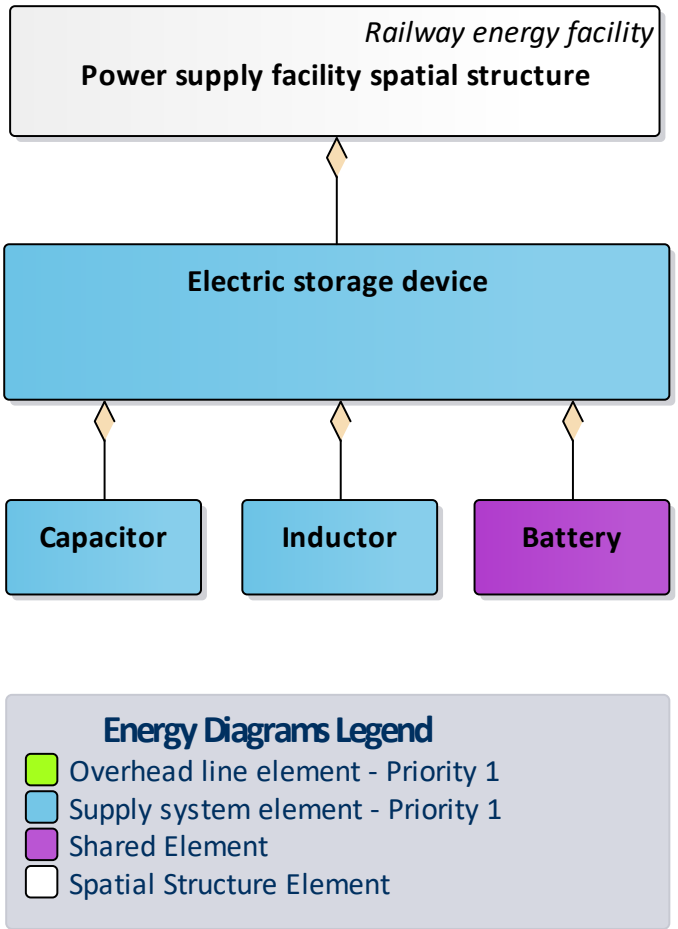


Table 51: Class diagram "Electric Storage"

5.1.5.2 Electric storage device

A Device that stores electric energy.

Relationships

Source	Type	Target
Electric storage device	Aggregation	Power supply facility spatial structure
Inductor	Aggregation	Electric storage device
Capacitor	Aggregation	Electric storage device
Battery	Aggregation	Electric storage device

5.1.5.3 Capacitor

Assembly of one or more capacitor elements assembled in the same housing with lead terminals.

Relationships

Source	Type	Target
Capacitor	Aggregation	Electric storage device

5.1.5.4 Inductor

Electrical appliances used in circuits or power systems due to their inductance.(IEC 60050-811-26-19)

Relationships

Source	Type	Target
Inductor	Aggregation	Electric storage device

5.1.5.5 Battery

One or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices. (IEC 60050-482-01-04)

Relationships

Source	Type	Target
Battery	Aggregation	Electric storage device

5.1.6 Feeder Line

5.1.6.1 Class diagram "Feeder Line"

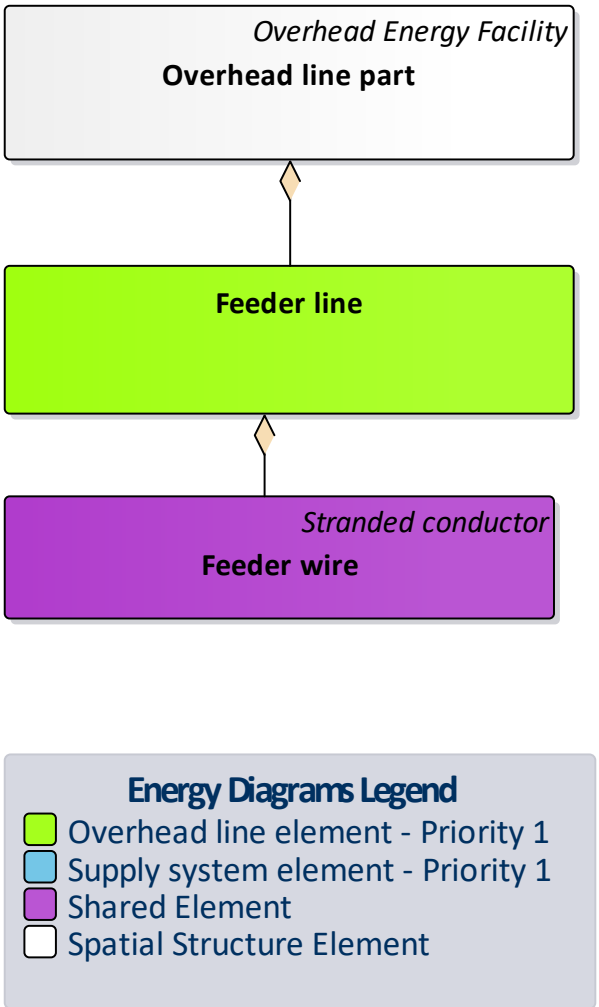


Table 52: Class diagram "Feeder Line"

Device intended for electrical insulation and mechanical fixing of equipment or conductors which are subject to electric potential differences.(IEC 60050-471-01-10)

5.1.6.2 Feeder line

In traction power system, overhead conductors besides overhead contact line include feeder line, reinforcing feeder, return line, positive feeder, protective wire, lightning protective wire, earth wire and so on.

Relationships

Source	Type	Target
Feeder line	Aggregation	Overhead line part
Feeder line	Association	Tensioning section
Positive feeder	Generalization	Feeder line
Along-track feeder	Generalization	Feeder line
Negative feeder	Generalization	Feeder line
Insulator	Aggregation	Feeder line
By-pass feeder	Generalization	Feeder line
Feeder wire	Aggregation	Feeder line
Reinforcing feeder	Generalization	Feeder line

5.1.7 Instrument Transformer

5.1.7.1 Class diagram "Instrument Transformer"

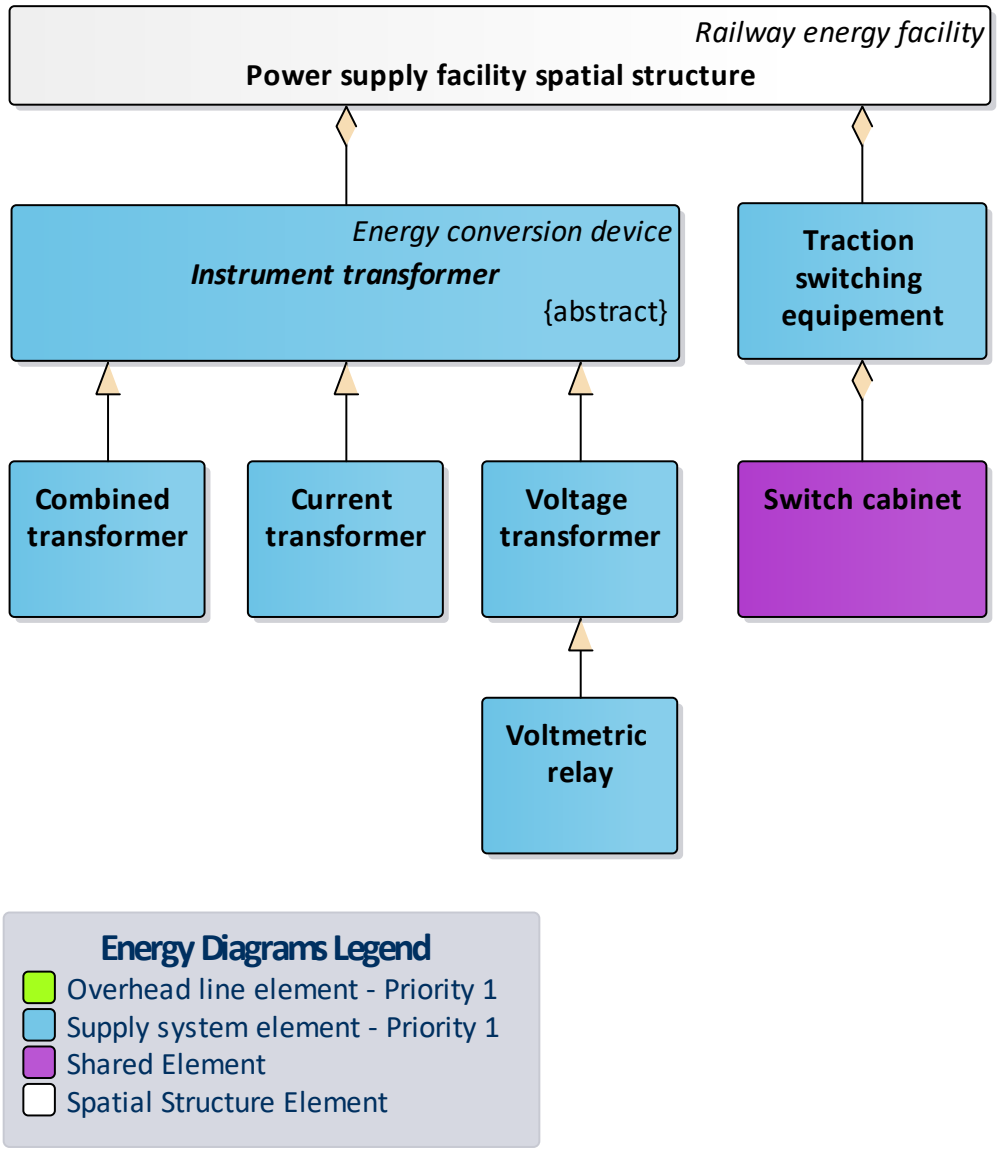


Table 53: Class diagram "Instrument Transformer"

5.1.7.2 Combined transformer

an instrument transformer consisting of a current and a voltage transformer in the same case (IEC 60050-321-01-03)

Relationships

Source	Type	Target
Combined transformer	Generalization	Instrument transformer

5.1.7.3 Current transformer

An instrument transformer in which the secondary current, in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections.(IEC 60050-321-02-01)

Relationships

Source	Type	Target
Current transformer	Generalization	Instrument transformer

5.1.7.4 Instrument transformer

A transformer intended to transmit an information signal to measuring instruments, meters and protective or control devices.(IEC 60050-321-01-01)

Relationships

Source	Type	Target
Instrument transformer	Generalization	Energy conversion device
Instrument transformer	Aggregation	Power supply facility spatial structure
Current transformer	Generalization	Instrument transformer
Combined transformer	Generalization	Instrument transformer
Voltage transformer	Generalization	Instrument transformer

5.1.7.5 Voltage transformer

An instrument transformer in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections.(IEC 60050-321-03-01)

Relationships

Source	Type	Target
Voltage transformer	Generalization	Instrument transformer
Voltmetric relay	Generalization	Voltage transformer

5.1.7.6 Voltmetric relay

A relay device used to observe the voltage level and disconnect the circuit from the supply if any variations are occurs from the standard range.

Relationships

Source	Type	Target
Voltmetric relay	Generalization	Voltage transformer

5.1.8 Mooring

5.1.8.1 Class diagram "Mooring"

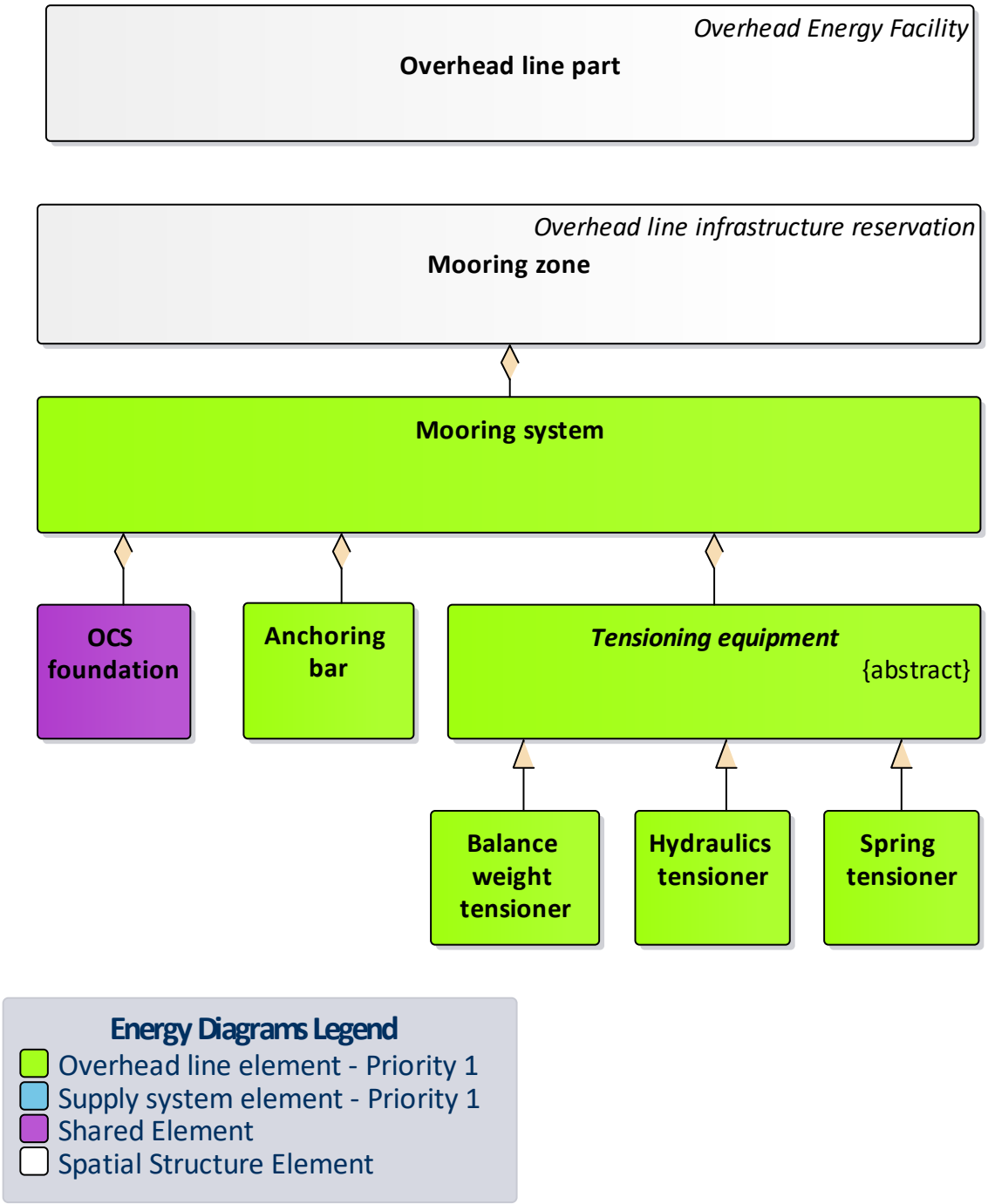


Table 54: Class diagram "Mooring"

5.1.8.2 Anchoring bar

Used to connect stay from pole to the foundation.

Relationships

Source	Type	Target
Anchoring bar	Aggregation	Mooring system
Note	NoteLink	Anchoring bar

5.1.8.3 Mooring system

Mooring equipement for overheadline.

Relationships

Source	Type	Target
Mooring system	Aggregation	Mooring zone
Mooring system	Aggregation	Overhead line infrastructure reservation
Tensioning equipment	Aggregation	Mooring system
Tensioning fitting	Aggregation	Mooring system
Anchoring bar	Aggregation	Mooring system
OCS foundation	Aggregation	Mooring system

5.1.8.4 Balance weight tensioner

Automatic tensioner attached to a mast to ensure constant tension in conductors by means of balance weights.(UIC R 791-2006)

Relationships

Source	Type	Target
Balance weight tensioner	Generalization	Tensioning equipment

5.1.8.5 Hydraulics tensioner

Automatic tensioner attached to a mast to ensure constant tension in conductors by means of Hydraulics.

Relationships

Source	Type	Target
Hydraulics tensioner	Generalization	Tensioning equipment

5.1.8.6 Spring tensioner

Automatic tensioner attached to a mast to ensure constant tension in conductors or in cross-span registration cables by means of springs.(UIC R 791-2006)

Relationships

Source	Type	Target
Spring tensioner	Generalization	Tensioning equipment

5.1.8.7 Tensioning equipment

Device to maintain the tension of conductors within the system design parameters.(EN 50119/IEC 60050-811-33-45)

Arrangement enabling the mechanical tension of conductors to be adjusted.(UIC R 791-2006)

Relationships

Source	Type	Target
Tensioning equipment	Aggregation	Mooring system
Balance weight tensioner	Generalization	Tensioning equipment
Hydraulics tensioner	Generalization	Tensioning equipment
Spring tensioner	Generalization	Tensioning equipment

5.1.9 Overhead Contact Line System

5.1.9.1 Class diagram "Overhead Contact Line System"

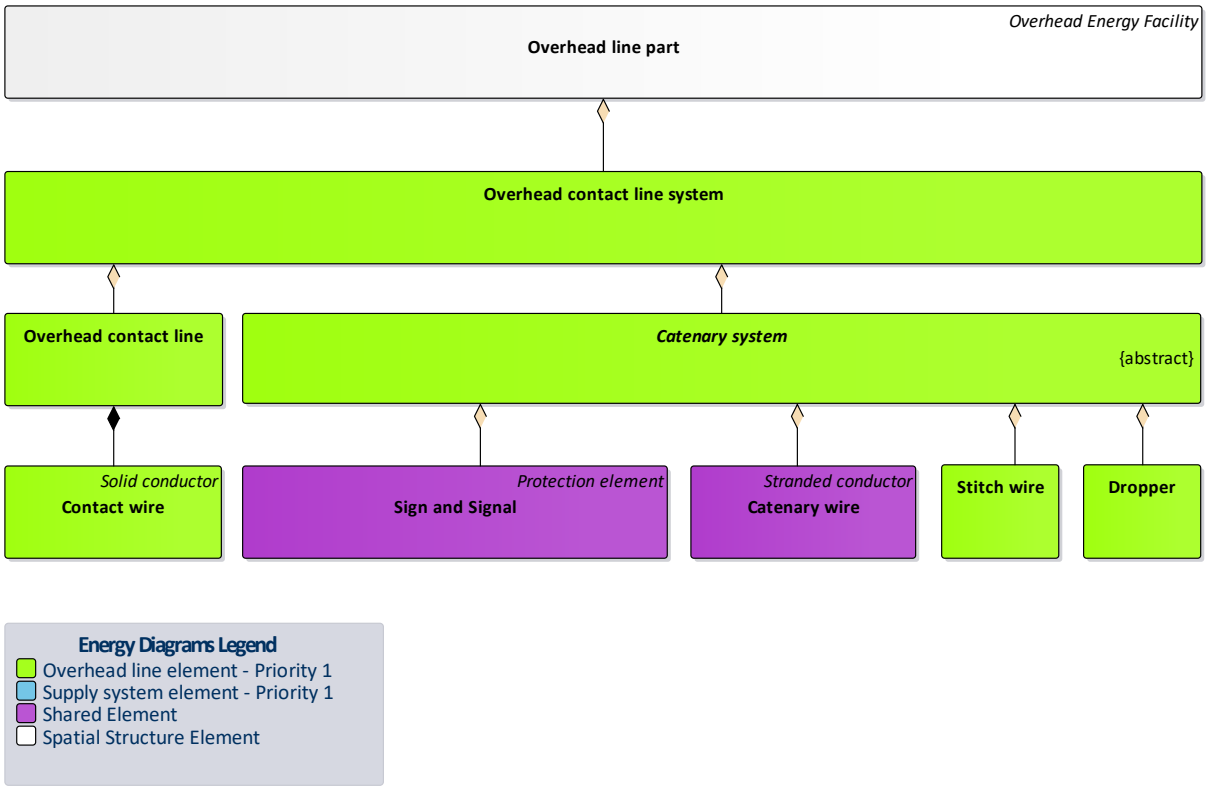


Table 55: Class diagram "Overhead Contact Line System"

5.1.9.2 Catenary system

The longitudinal wire that supports the contact wire, including catenary wire dropper and stich wire.

Relationships

Source	Type	Target
Catenary system	Aggregation	Tensioning section
Catenary system	Aggregation	Overhead contact line system
Sign and Signal	Aggregation	Catenary system
Catenary wire	Aggregation	Catenary system
Insulator	Aggregation	Catenary system
Stitch wire	Aggregation	Catenary system

Source	Type	Target
Dropper	Aggregation	Catenary system

5.1.9.3 *Contact wire*

Electric conductor of an OCL with which the current collectors make contact. Carries the electricity which is supplied to the train by its pantograph. (IEC 60050-811-33-15/UIC R 791-2006)

Relationships

Source	Type	Target
Contact wire	Generalization	Solid conductor
Contact wire	Aggregation	Overhead contact line

5.1.9.4 *Dropper*

Component used to suspend a registration, an auxiliary catenary or a contact wire from a head-span or a longitudinal catenary wire.(IEC 60050-811-33-22/UIC R 791-2006)

Relationships

Source	Type	Target
Dropper	Aggregation	Catenary system

5.1.9.5 *Overhead contact line system*

Contact line above the upper limit of the train using an overhead contact line to supply current for use by traction units.

Relationships

Source	Type	Target
Overhead contact line system	Aggregation	Overhead line part
Connected Overlap	Aggregation	Overhead contact line system
Overhead contact line	Aggregation	Overhead contact line system
Rigid catenary	Generalization	Overhead contact line system
Catenary system	Aggregation	Overhead contact line system

5.1.9.6 Overhead contact line

Contact line placed above the upper limit of the vehicle gauge and supplying vehicles with electrical energy through pantographs.(UIC R 791-2006)

Relationships

Source	Type	Target
Overhead contact line	Aggregation	Overhead contact line system
Contact wire	Aggregation	Overhead contact line
Insulator	Aggregation	Overhead contact line

5.1.9.7 Stitch wire

The auxiliary wire used in stitched suspension.(IEC 60050-811-33-18/UIC R 791-2006)

Relationships

Source	Type	Target
Stitch wire	Aggregation	Catenary system

5.1.10 OverHead Line Supporting

5.1.10.1 OCS supporting system

Include foundation, supporting elements and suspension.

Relationships

Source	Type	Target
OCS supporting system	Aggregation	Overhead line infrastructure reservation
OCS foundation	Aggregation	OCS supporting system
OCS supporting elements	Aggregation	OCS supporting system
OCS suspension	Aggregation	OCS supporting system
Sign and Signal	Aggregation	OCS supporting system
OCS fitting	Aggregation	OCS supporting system
Bird protection	Aggregation	OCS supporting system
Anti-arcing device	Aggregation	OCS supporting system
Anticlimbing	Aggregation	OCS supporting system

5.1.10.2 OCS Support

5.1.10.2.1 Class diagram "OCS Support"

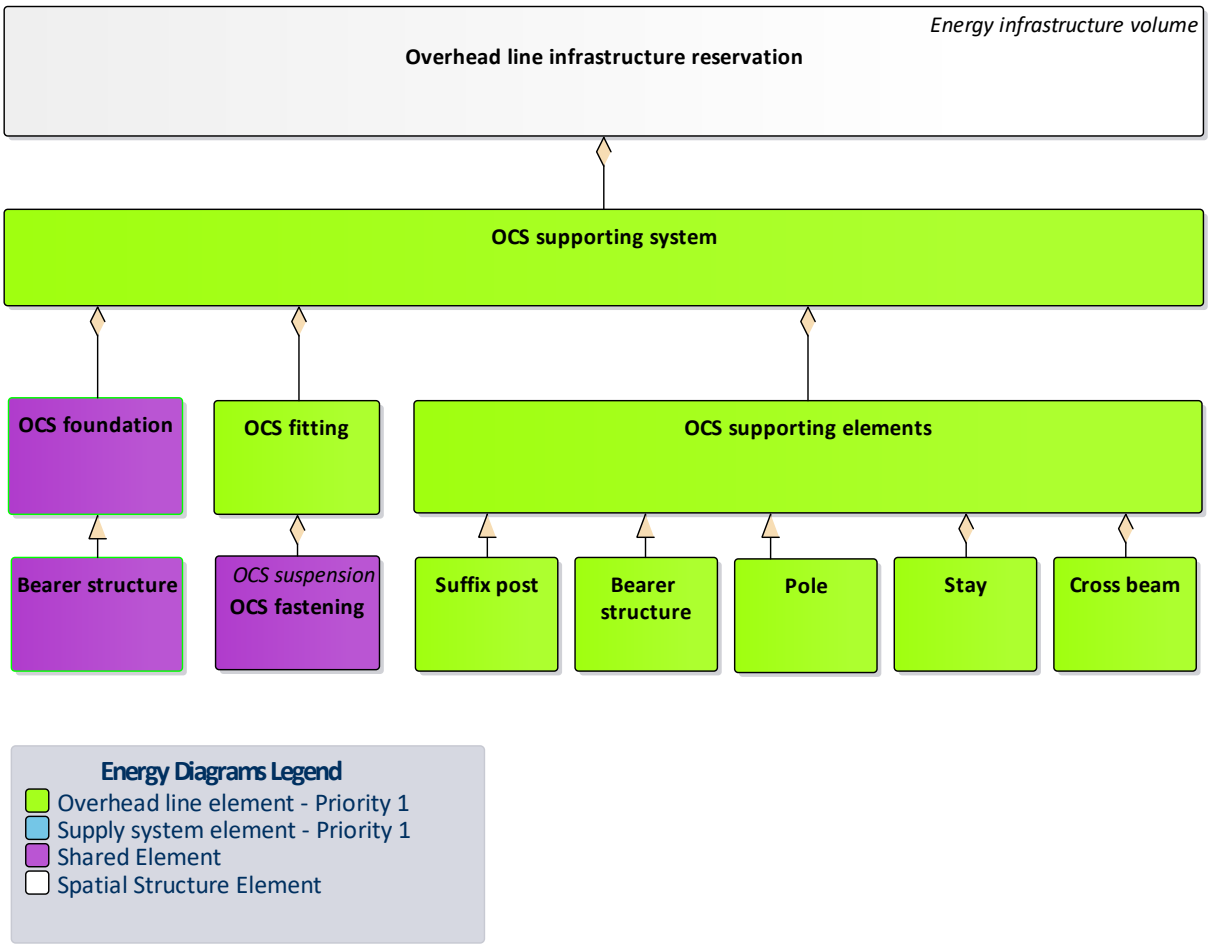


Table 56: Class diagram "OCS Support"

1.Head spans carry overhead contact lines by means of rope elements and insulators under tensile load only.(EN 50119)

2.A portal arrangement in which the beam is replaced by an arrangement of cross-span wires.(UIC R 791-2006)

3.Portal arrangement in which the horizontal element is formed by an arrangement of cross-spans.(IEC 60050-811-33-39)

5.1.10.2.2 OCS supporting elements

Parts which support the conductors and the associated insulators of an OCL.(UIC R 791-2006/IEC 60050-811-33-19)

Relationships

Source	Type	Target
OCS supporting elements	Aggregation	OCS supporting system
Head-span	Generalization	OCS supporting elements

Source	Type	Target
Stay	Aggregation	OCS supporting elements
Cross beam	Aggregation	OCS supporting elements
Suffix post	Generalization	OCS supporting elements
Bearer structure	Generalization	OCS supporting elements
Pole	Generalization	OCS supporting elements

5.1.10.2.3 Cross beam

Rigid cross span structures consist of bending resistant beams which are fixed onto the structures either by hinges or by bending resistant joints.(EN 50119)

Support consisting of a transverse beam and masts situated on either side of tracks.(IEC 60050-811-33-38/UIC R 791-2006)

Relationships

Source	Type	Target
Cross beam	Aggregation	OCS supporting elements

5.1.10.2.4 Bearer structure

Insure the function of holding registration component in tunnel context.

Relationships

Source	Type	Target
Bearer structure	Generalization	OCS supporting elements

5.1.10.2.5 OCS fitting

Clamps and fittings provide the mechanical and structural connection of components and provide electrical connections in contact line systems and within cross-span structures.They have to withstand both operating currents and short-circuit current loadsin the energised part of the overhead contact line system.In addition to the mechanical stresses,short-circuit current

loads occur in the passive part of the overhead contact line system,at rigid and flexible terminations and also in cross-span equipment.

Relationships

Source	Type	Target
OCS fitting	Aggregation	OCS supporting system
Termination fitting	Generalization	OCS fitting
Fitting accessory	Aggregation	OCS fitting
Tube	Aggregation	OCS fitting
Tensioning fitting	Generalization	OCS fitting
Steady fitting	Aggregation	OCS fitting
Suspension fitting	Generalization	OCS fitting
Support fitting	Generalization	OCS fitting
OCS fastening	Aggregation	OCS fitting
Joint fitting	Generalization	OCS fitting
Earthing fitting	Generalization	OCS fitting
Turn bukle	Aggregation	OCS fitting
Registration fitting	Generalization	OCS fitting
Clamp	Aggregation	OCS fitting
Insulator	Aggregation	OCS fitting

5.1.10.2.6 Pole

1.Vertical support in solid wood, concrete or steel, or of steel lattice construction, with one end planted in the ground at the side of the track, either directly or through a separate base or foundation(IEC 60050-811-33-20)

2.A main vertical support construction with one end embedded in the ground adjacent to the track,tensioning and registion of the OCL.(UIC R 791-2006)

Relationships

Source	Type	Target
Pole	Generalization	OCS supporting elements

5.1.10.2.7 Stay

Rod, wire or cable, with a tensioner, to anchor a mast or a cantilever(IEC 60050-811-33-47/UIC R 791-2006)(tie, guy)

Relationships

Source	Type	Target
Stay	Aggregation	OCS supporting elements

5.1.10.2.8 Suffix post

Insure the function of holding registration component in specific condition like tunel or under-bridge.

Relationships

Source	Type	Target
Suffix post	Generalization	OCS supporting elements

5.1.10.3 OCS Suspension

5.1.10.3.1 Class diagram "OCS Suspension"

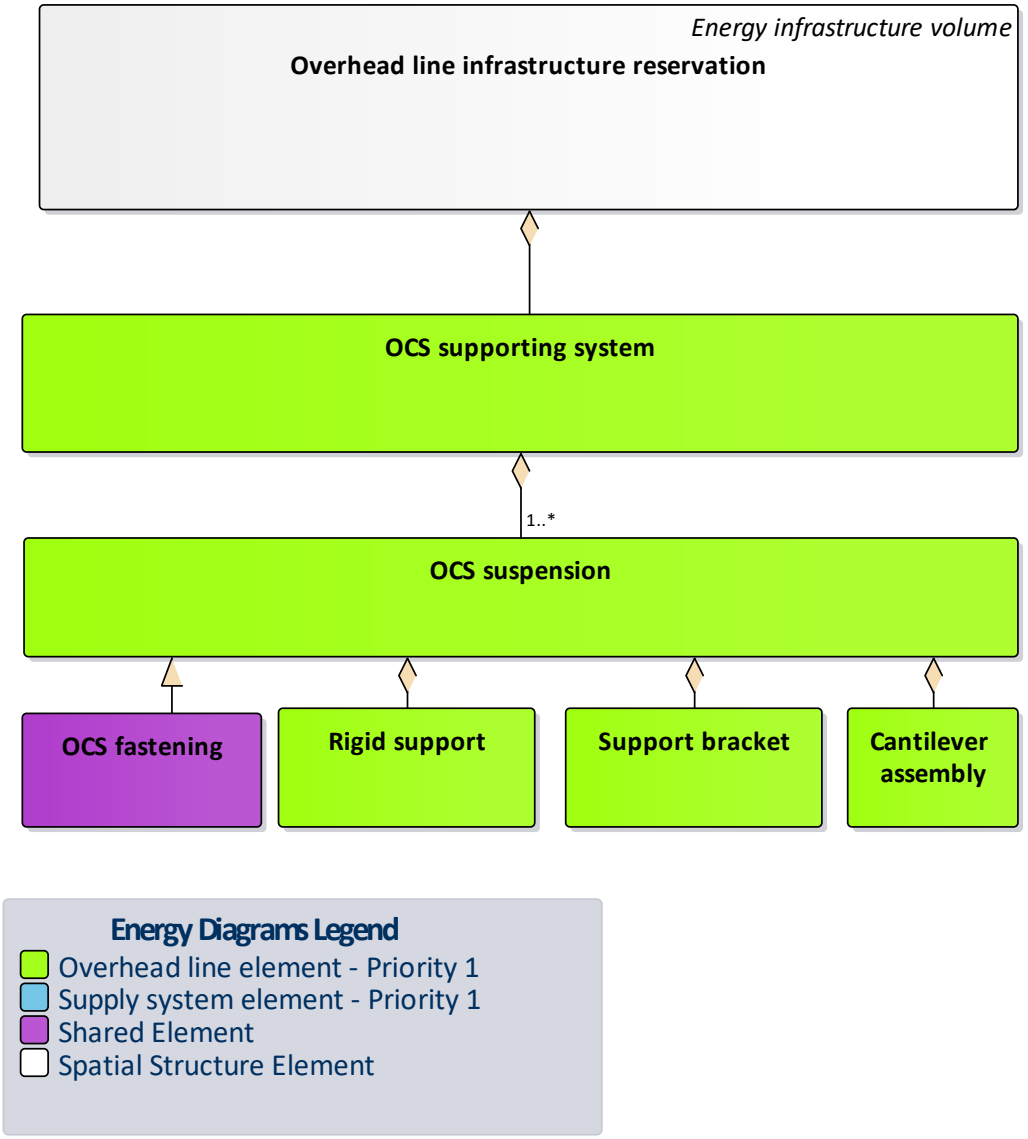


Table 57: Class diagram "OCS Suspension"

5.1.10.3.2 OCS fastening

Fastening device that mechanically joins or affixes two or more objects together for OCS equipement.

Relationships

Source	Type	Target
OCS fastening	Generalization	OCS suspension
OCS fastening	Aggregation	OCS fitting

5.1.10.3.3 OCS suspension

The group which used to support directly contactline, feeder or earthwire, contains all the parts installed between supports and conductors(including insulators).

Relationships

Source	Type	Target
OCS suspension	Aggregation	OCS supporting system
OCS fastening	Generalization	OCS suspension
Rigid support	Aggregation	OCS suspension
Insulator	Aggregation	OCS suspension
Contact line suspension	Generalization	OCS suspension
Feeder suspension	Generalization	OCS suspension
Rigid catenary suspension	Generalization	OCS suspension
Cantilever assembly	Aggregation	OCS suspension
Support bracket	Aggregation	OCS suspension

5.1.10.3.4 Rigid support

Method of attaching an overhead contact line rigidly to its supports.(IEC 60050-811-33-32/UIC R 791-2006)

Relationships

Source	Type	Target
Rigid support	Aggregation	OCS suspension

5.1.10.3.5 Support bracket

A device designed to carry, through insulators(or no), a set of conductors of overhead line.

Relationships

Source	Type	Target
Support bracket	Aggregation	OCS suspension

5.1.11 Power Transformer

5.1.11.1 Class diagram "Power Transformer"

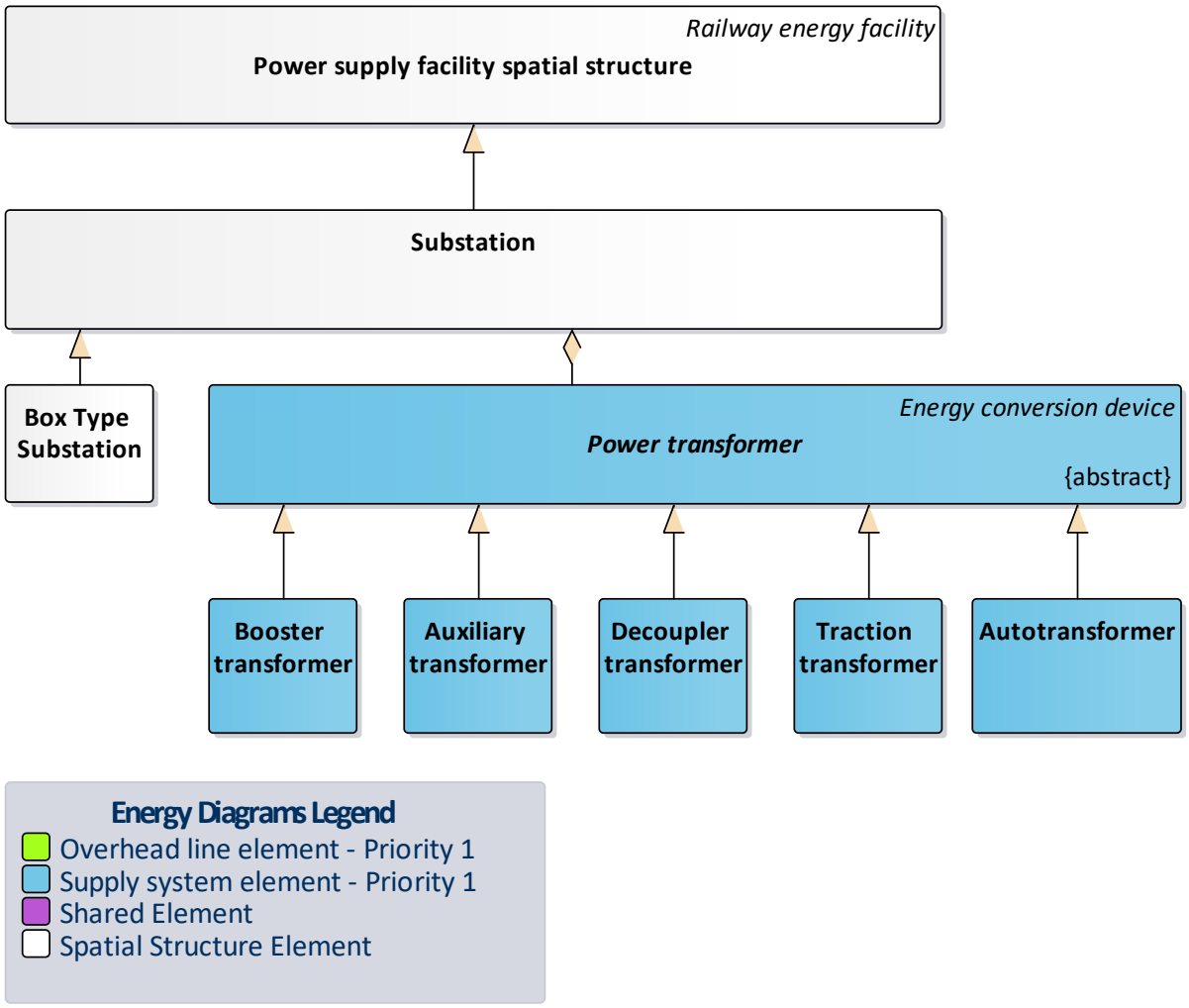


Table 58: Class diagram "Power Transformer"

5.1.11.2 Autotransformer

A transformer in which at least two windings have a common part (IEC - 811-26-03; 421-01-11)

Relationships

Source	Type	Target
Autotransformer	Aggregation	Autotransformer post
Autotransformer	Generalization	Power transformer
Note	NoteLink	Autotransformer

5.1.11.3 Auxiliary transformer

In a substation, a transformer intended to provide supply to the auxiliary equipment (IEC 60050-605-02-46)

Relationships

Source	Type	Target
Auxiliary transformer	Generalization	Power transformer

5.1.11.4 Booster transformer

A transformer of which one winding is intended to be connected in series with a circuit in order to alter its voltage and the other winding is an energizing winding (IEC 60050-811-26-05, 60050-421-01-12)

Relationships

Source	Type	Target
Booster transformer	Generalization	Power transformer

5.1.11.5 Decoupler transformer

Phase separation transformer.

Relationships

Source	Type	Target
Decoupler transformer	Generalization	Power transformer

5.1.11.6 Power transformer

A static piece of apparatus with two or more windings which, by electromagnetic induction, transforms a system of alternating voltage and current into another system of voltage and current usually of different values and at the same frequency for the purpose of transmitting electrical power (IEC 60050-811-26-01)

Relationships

Source	Type	Target
Power transformer	Aggregation	Substation
Power transformer	Generalization	Energy conversion device
Booster transformer	Generalization	Power transformer
Decoupler transformer	Generalization	Power transformer
Auxiliary transformer	Generalization	Power transformer
Autotransformer	Generalization	Power transformer
Traction transformer	Generalization	Power transformer

5.1.11.7 Traction transformer

A stationary device with two or more windings, in order to transmit electrical energy, converts the AC voltage and current of one system to the AC voltage and current of another system at the same frequency by electromagnetic induction.(GB 1094, IEC 60076)

electric energy converter without moving parts that changes voltages and currents associated with electric energy without change of frequency.(IEC 60050)

Relationships

Source	Type	Target
Traction transformer	Generalization	Power transformer

5.1.12 Protecting Devices

5.1.12.1 Class diagram "Protecting Devices"

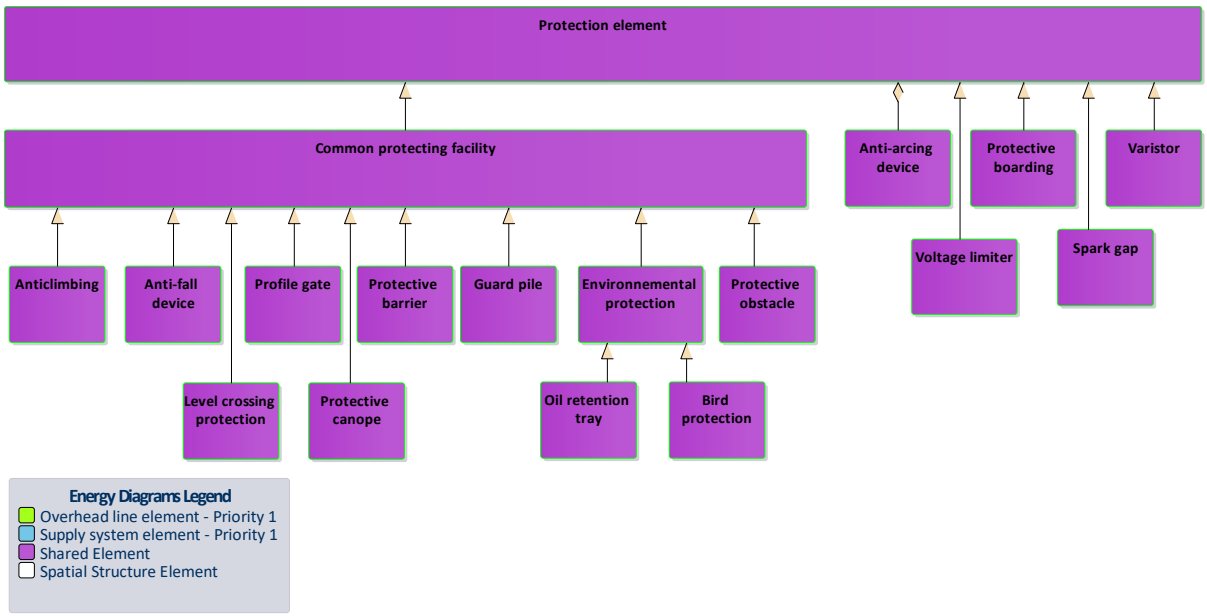


Table 59: Class diagram "Protecting Devices"

part preventing unintentional direct contact, but not preventing direct contact by deliberate action IEV 195-06-16

5.1.12.2 Anticlimbing

protection against climbing

Relationships

Source	Type	Target
Anticlimbing	Generalization	Common protecting facility
Anticlimbing	Aggregation	OCS supporting system

5.1.12.3 Anti-fall device

protection against operator falling

Relationships

Source	Type	Target
Anti-fall device	Generalization	Common protecting facility

5.1.12.4 Bird protection

Avoid a sitting down of the birds at electrically critical points of the catenary system.Thus the birds are protected against electrical shocks and disturbances by short circuit are avoided.

Relationships

Source	Type	Target
Bird protection	Generalization	Environnemental protection
Bird protection	Aggregation	OCS supporting system

5.1.12.5 Common protecting facility

Basic protection against electric shock.

Relationships

Source	Type	Target
Common protecting facility	Generalization	Protection element
Protective barrier	Generalization	Common protecting facility
Guard pile	Generalization	Common protecting facility
Profile gate	Generalization	Common protecting facility
Anti-fall device	Generalization	Common protecting facility
Environnemental protection	Generalization	Common protecting facility
Anticlimbing	Generalization	Common protecting facility
Protective canope	Generalization	Common protecting facility
Level crossing protection	Generalization	Common protecting facility
Protective obstacle	Generalization	Common protecting facility

Source	Type	Target

5.1.12.6 Environnemental protection

Equipement and system dedicated to environnement protection.

Relationships

Source	Type	Target
Environnemental protection	Generalization	Common protecting facility
Oil retention tray	Generalization	Environnemental protection
Bird protection	Generalization	Environnemental protection

5.1.12.7 Guard pile

Pile or barrier provided for mechanical protection.

Relationships

Source	Type	Target
Guard pile	Generalization	Common protecting facility

5.1.12.8 Level crossing protection

Equipement dedicated to level crossing protection.

Relationships

Source	Type	Target
Level crossing protection	Generalization	Common protecting facility

5.1.12.9 Lightning arrester

Surge arrestor: Device intended to protect the electrical apparatus from high transient overvoltage and to limit the duration and amplitude of the follow-on current.(UIC R 791-2006)

Relationships

Source	Type	Target
Lightning arrester	Generalization	Protection element
Lightning arrester	Association	Substation

5.1.12.10 Oil retention tray

Retention tray for environnemental protection against oil.

Relationships

Source	Type	Target
Oil retention tray	Generalization	Environnemental protection
Oil retention tray	Association	Substation

5.1.12.11 Profile gate

Profile gate.

Relationships

Source	Type	Target
Profile gate	Generalization	Common protecting facility

5.1.12.12 Protection element

Protection against electric shock for people and equipments.

Relationships

Source	Type	Target
Protection element	Aggregation	Traction power system
Voltage limiter	Generalization	Protection element
Rigid catenary protective sheath	Generalization	Protection element
Varistor	Generalization	Protection element
Lightning arrester	Generalization	Protection element
Sign and Signal	Generalization	Protection element
Lightning protection cable	Generalization	Protection element
Spark gap	Generalization	Protection element
Common protecting facility	Generalization	Protection element
Insulator	Generalization	Protection element
High voltage fuse	Generalization	Protection element
Anti-arcing device	Aggregation	Protection element
Protective boarding	Generalization	Protection element

5.1.12.13 Protective barrier

Part providing protection against direct contact from any usual direction of access.(IEC 60050-195-06-15)

Relationships

Source	Type	Target
Protective barrier	Generalization	Common protecting facility
Protective barrier	Association	Sector

5.1.12.14 Protective boarding

Non-conducting barrier to protect persons from coming into direct contact with the live conductor rail.

Relationships

Source	Type	Target
Protective boarding	Generalization	Protection element

5.1.12.15 Protective canope

Conductive screen used to separate an electric circuit and/or conductors from hazardous-live-parts.

Relationships

Source	Type	Target
Protective canope	Association	Sector
Protective canope	Generalization	Common protecting facility

5.1.12.16 Sign and Signal

5.1.13 Regulating Devices

5.1.13.1 Regulating Devices

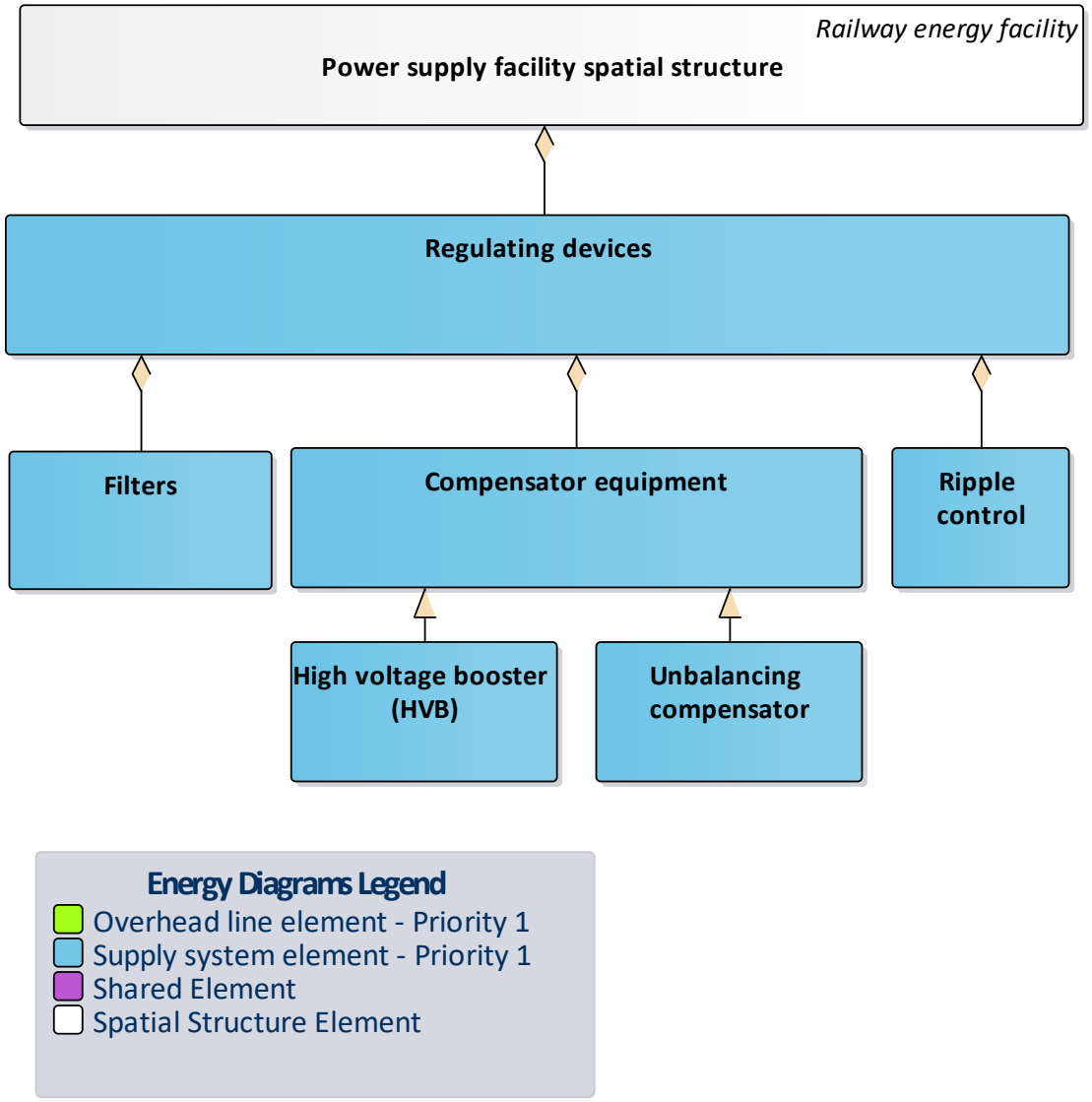


Table 60: Regulating Devices

5.1.13.2 Compensator equipment

A device that is used to 'fix' the parameter of electric energy, such as voltage loss, power factor and so on.

Relationships

Source	Type	Target
Compensator equipment	Aggregation	Regulating devices
Unbalancing compensator	Generalization	Compensator equipment

Source	Type	Target
High voltage booster (HVB)	Generalization	Compensator equipment
Power factor correction(PFC)	Generalization	Compensator equipment

5.1.13.3 Filters

Linear two-port device designed to transmit spectral components of the input quantity according to a specified law, generally in order to pass the components in certain frequency bands and to attenuate those in other bands

(IEC - 151-13-55)

Relationships

Source	Type	Target
Filters	Aggregation	Regulating devices
Low pass filter	Generalization	Filters
Band pass filter	Generalization	Filters
High pass filter	Generalization	Filters
Band stop filter	Generalization	Filters
Harmonic filter	Generalization	Filters

5.1.13.4 High voltage booster (HVB)

Range extender for increasing the voltage supplied so that the spply distance could be extended.

Relationships

Source	Type	Target
High voltage booster (HVB)	Generalization	Compensator equipment

5.1.13.5 Regulating devices

A device that is used to reguate electric energy.

Relationships

Source	Type	Target
Regulating devices	Aggregation	Power supply facility spatial structure
Ripple control	Aggregation	Regulating devices
Compensator equipment	Aggregation	Regulating devices
Filters	Aggregation	Regulating devices

5.1.13.6 Ripple control

The remote control of a switch by electrical impulses.

Relationships

Source	Type	Target
Ripple control	Aggregation	Regulating devices

5.1.13.7 Unbalancing compensator

A device that is used to correct voltage umbalance in the system.

Relationships

Source	Type	Target
Unbalancing compensator	Generalization	Compensator equipment

5.1.14 Return Circuit

5.1.14.1 Class diagram "Return Circuit"

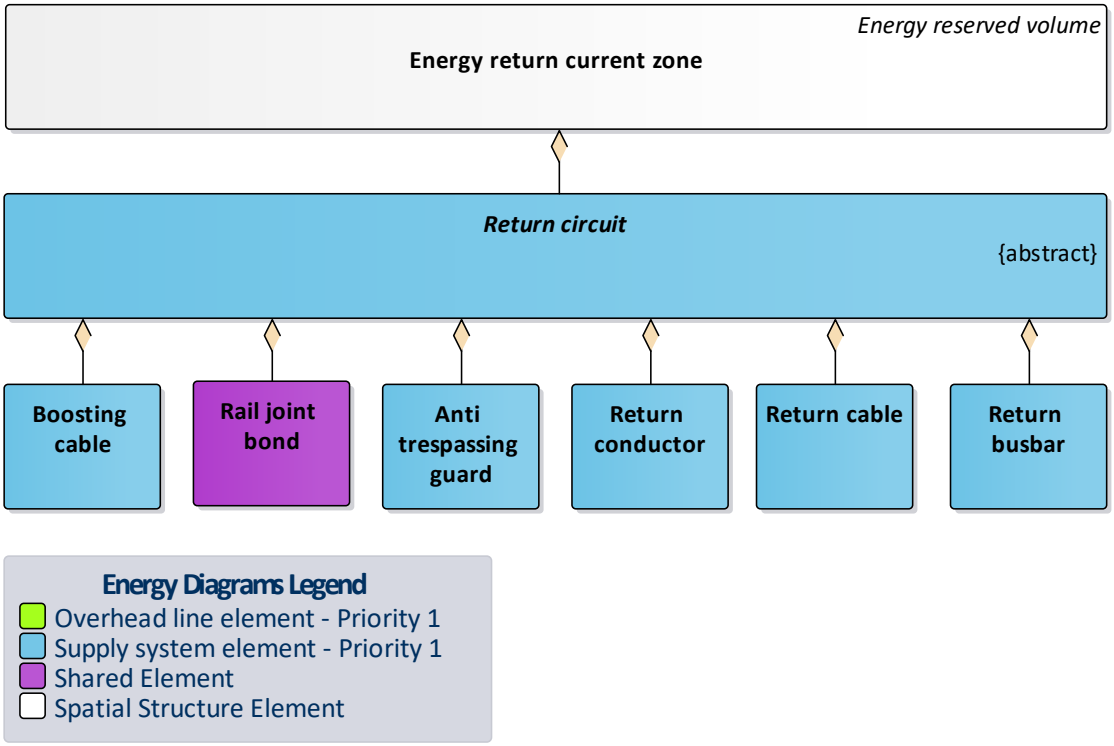


Table 61: Class diagram "Return Circuit"

5.1.14.2 Anti trespassing guard

Equipment provided to deter entry to a restricted area, structure or building by an unauthorized person.

Relationships

Source	Type	Target
Anti trespassing guard	Aggregation	Return circuit

5.1.14.3 Boosting cable

Cable used to connect between rail and return line.

Relationships

Source	Type	Target
Boosting cable	Aggregation	Return circuit

5.1.14.4 Rail joint bond

Conductor ensuring the electrical continuity of rails at a joint.(UIC R 791-2006/IEC 60050-811-35-07)

Relationships

Source	Type	Target
Rail joint bond	Aggregation	Return circuit

5.1.14.5 Return conductor

Conductor paralleling the track return and connected to the running rails at periodic intercals.(IEC 60050-811-35-13)

Relationships

Source	Type	Target
Return conductor	Aggregation	Return circuit

5.1.14.6 Return busbar

Busbar in return current circuit

Relationships

Source	Type	Target
Return busbar	Aggregation	Return circuit

5.1.14.7 Return cable

Insulated return conductor forming part of the return circuit and connecting the rest of the return circuit of the sub-station.(UIC R 791-2006)

Relationships

Source	Type	Target
Return cable	Aggregation	Return circuit

5.1.14.8 Return circuit

The electric circuit comprising the running rails or a return current rail, their electrical connections and the return cables to the sub-station.(UIC R 791-2006)

All conductors which form the intended path for the traction return current and the current under fault conditions

Note 1 to entry: The conductors can be for example:

-running rails;

-return conductor rails;

-return conductors;

-return cables.(IEC 60050-811-35-01)

Relationships

Source	Type	Target
Return circuit	Association	Sector
Return circuit	Aggregation	Energy return current zone
Rail joint bond	Aggregation	Return circuit
Return cable	Aggregation	Return circuit
Boosting cable	Aggregation	Return circuit
Return conductor	Aggregation	Return circuit
Anti trespassing guard	Aggregation	Return circuit
Return busbar	Aggregation	Return circuit

5.1.15 Sectioning

5.1.15.1 Sectioning

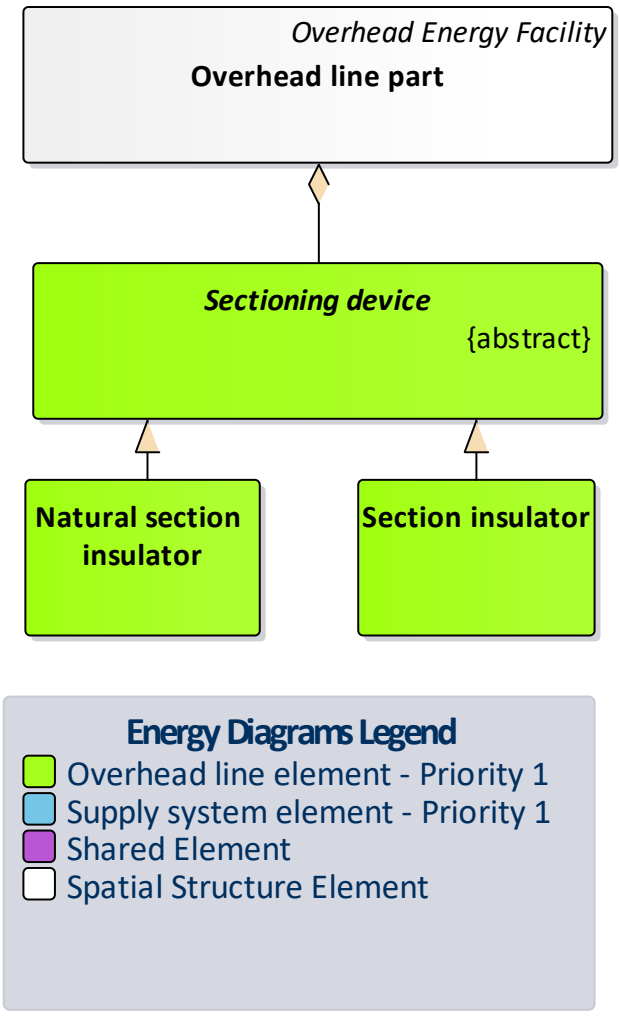


Table 62: Sectioning

5.1.15.2 Sectioning device

The division of the contact line into electrical sections, each of which may be isolated from the adjacent sections e.g. by means of a switch.(UIC R 791-2006)

Relationships

Source	Type	Target
Sectioning device	Aggregation	Overhead line part
Natural section insulator	Generalization	Sectioning device
Section insulator	Generalization	Sectioning device

5.1.15.3 Natural section insulator

Neutral sections are required as phase separations with a neutral gap, when individual feeder sections are connected to different phases of the national electricity supply grid.

Relationships

Source	Type	Target
Natural section insulator	Generalization	Sectioning device

5.1.15.4 Section insulator

Sectioning point formed by insulators inserted in a continuous run of a contact line, with skids or similar devices to maintain continuous electrical contact with the current collector.(IEC 60050-811-36-15)

Relationships

Source	Type	Target
Section insulator	Generalization	Sectioning device

5.1.16 Shared

5.1.16.1 Class diagram "Shared"

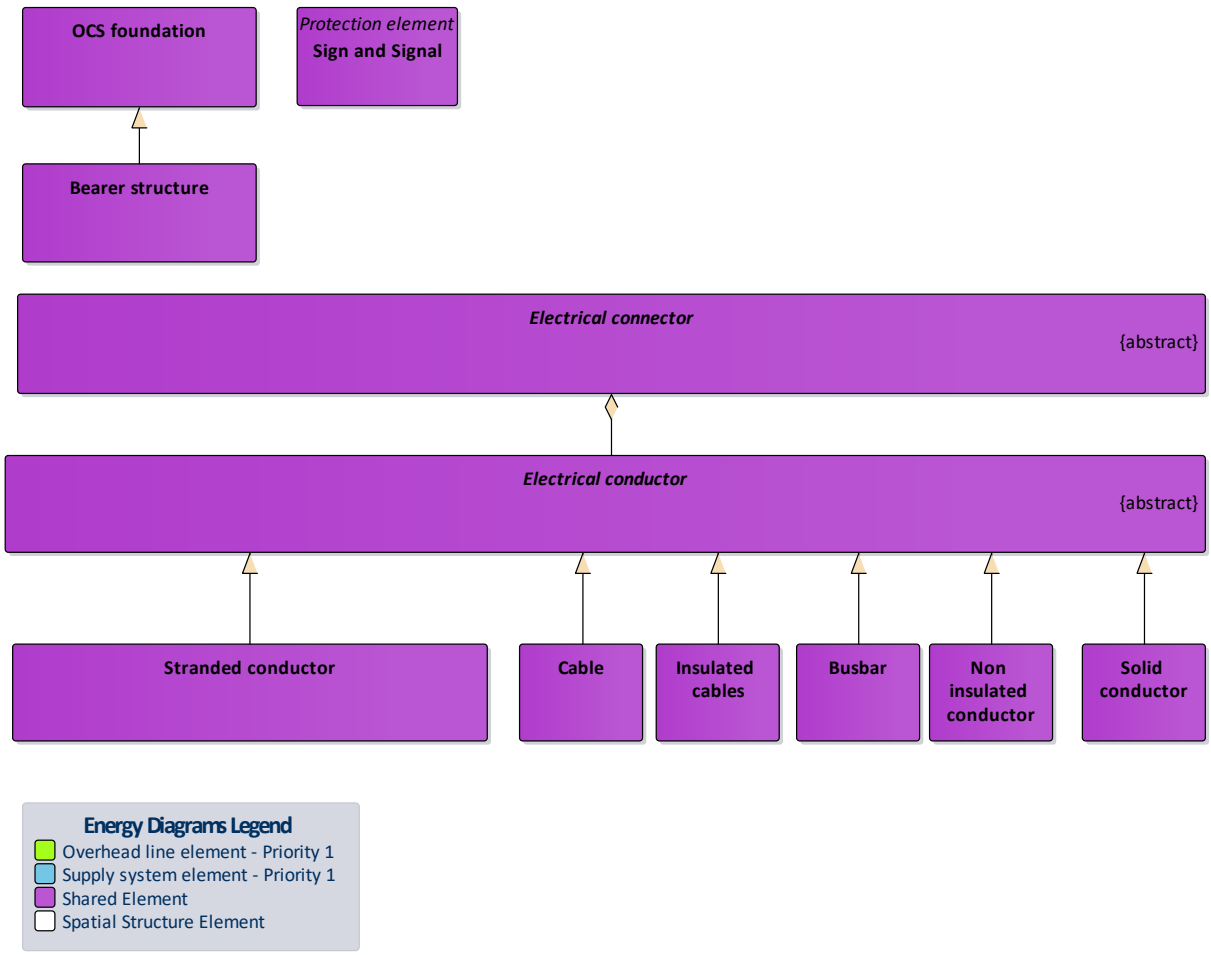


Table 63: Class diagram "Shared"

5.1.16.2 Bearer structure

Insure the function of holding registration component in tunnel context.

Relationships

Source	Type	Target
Bearer structure	Generalization	OCS foundation

5.1.16.3 OCS foundation

Construction, usually of concrete or steel, completely or partly buried in the ground on which the support is mounted. The foundation must provide stability to all loads borne by the support.(UIC R 791-2006)

Relationships

Source	Type	Target
OCS foundation	Aggregation	OCS supporting system
OCS foundation	Aggregation	Mooring system
Corbel	Generalization	OCS foundation
Block foundation	Generalization	OCS foundation
Pile foundation	Generalization	OCS foundation
Bearer structure	Generalization	OCS foundation
Sealing	Generalization	OCS foundation

5.1.16.4 Sign and Signal

Signs and signal for electrical protection and traction power equipement identification

Relationships

Source	Type	Target
Sign and Signal	Aggregation	Catenary system
Sign and Signal	Aggregation	OCS supporting system
Sign and Signal	Generalization	Protection element
Lowerpantograph Signs	Generalization	Sign and Signal
Protective Plates	Generalization	Sign and Signal
Structure Number Plate	Generalization	Sign and Signal

5.1.16.5 Electrical Connector

5.1.16.5.1 Cable

Assembly consisting of:

– one or more cores,

– their individual covering(s) (if any),

– assembly protection (if any),

– protective covering(s) (if any).

(IEC 60050-461-06-01)

Relationships

Source	Type	Target
Cable	Generalization	Electrical conductor

5.1.16.5.2 Busbar

A low impedance conductor to which several electric circuits can be separately connected.(IEC 60050-605-02-01)

Relationships

Source	Type	Target
Busbar	Generalization	Electrical conductor

5.1.16.5.3 Catenary wire

Longtitudinal wire supporting the grooved contact wires either directly or indirectly.(IEC 60050-811-33-06/UIC R 791-2006)

Relationships

Source	Type	Target
Catenary wire	Aggregation	Catenary system
Catenary wire	Generalization	Stranded conductor
Auxiliary catenary wire	Generalization	Catenary wire
Main catenary wire	Generalization	Catenary wire

5.1.16.5.4 Earthing conductor

Conductor which provides a conductive path, or part of the conductive path, between a given point in a system or in an installation or in equipment and an earth electrode.

Relationships

Source	Type	Target
Earthing conductor	Generalization	Stranded conductor
Earthing conductor	Aggregation	Earthing circuit
Earthing conductor	Aggregation	Earthing line

5.1.16.5.5 Electrical conductor

A wire or combination of wires not insulated from one another, suitable for carrying an electric current.(IEC 60050-466-01-15)

Relationships

Source	Type	Target
Electrical conductor	Aggregation	Electrical connector
Electrical conductor	Aggregation	Power supply facility spatial structure
Cable	Generalization	Electrical conductor
Busbar	Generalization	Electrical conductor
Solid conductor	Generalization	Electrical conductor
Non insulated conductor	Generalization	Electrical conductor
Insulated cables	Generalization	Electrical conductor
Stranded conductor	Generalization	Electrical conductor

5.1.16.5.6 Electrical connector

Permanent and switched electrical connections are used in the overhead contact line system to provide electrical current transfer.

Relationships

Source	Type	Target
Electrical connector	Association	Overhead Line
Electrical conductor	Aggregation	Electrical connector

5.1.16.5.7 Feeder wire

Electrical connection between the contact line and sub-station or the switch station.(IEC 60050-811-36-08/UIC R 791-2006)

Relationships

Source	Type	Target
Feeder wire	Aggregation	Feeder line
Feeder wire	Generalization	Stranded conductor

5.1.16.5.8 Insulated cables

Common insulated cable

Relationships

Source	Type	Target
Insulated cables	Generalization	Electrical conductor

5.1.16.5.9 Insulator

Device intended for electrical insulation and mechanical fixing of equipment or conductors which are subject to electric potential differences.(IEC 60050-471-01-10)

Relationships

Source	Type	Target
Insulator	Aggregation	Feeder line
Insulator	Aggregation	Catenary system
Insulator	Generalization	Protection element
Insulator	Aggregation	OCS suspension
Insulator	Aggregation	Overhead contact line
Insulator	Aggregation	OCS fitting
Insulator	Aggregation	Power supply facility spatial structure
Suspension insulator	Generalization	Insulator
Pin insulators	Generalization	Insulator
Long rod insulator	Generalization	Insulator
Strain insulator	Generalization	Insulator
Post insulator	Generalization	Insulator

5.1.16.5.10 Non insulated conductor

a wire or combination of wires not insulated from one another, suitable for carrying an electric current.(IEC 60050-466-01-15)

Relationships

Source	Type	Target
Non insulated conductor	Generalization	Electrical conductor

5.1.16.5.11 Solid conductor

A conductor consisting of a single wire.(IEC 60050-466-10-01)

Relationships

Source	Type	Target
Solid conductor	Generalization	Electrical conductor
Contact wire	Generalization	Solid conductor

5.1.16.5.12 Stranded conductor

A conductor consisting of a number of individual uninsulated wires laid up together in alternating left- and right-hand helical layers.(IEC 60050-466-10-03)

Relationships

Source	Type	Target
Stranded conductor	Generalization	Electrical conductor
Earthing conductor	Generalization	Stranded conductor
Feeder wire	Generalization	Stranded conductor
Catenary wire	Generalization	Stranded conductor

5.1.17 Substation Control Equipment and technical building

5.1.17.1 SubstationControlEquipment

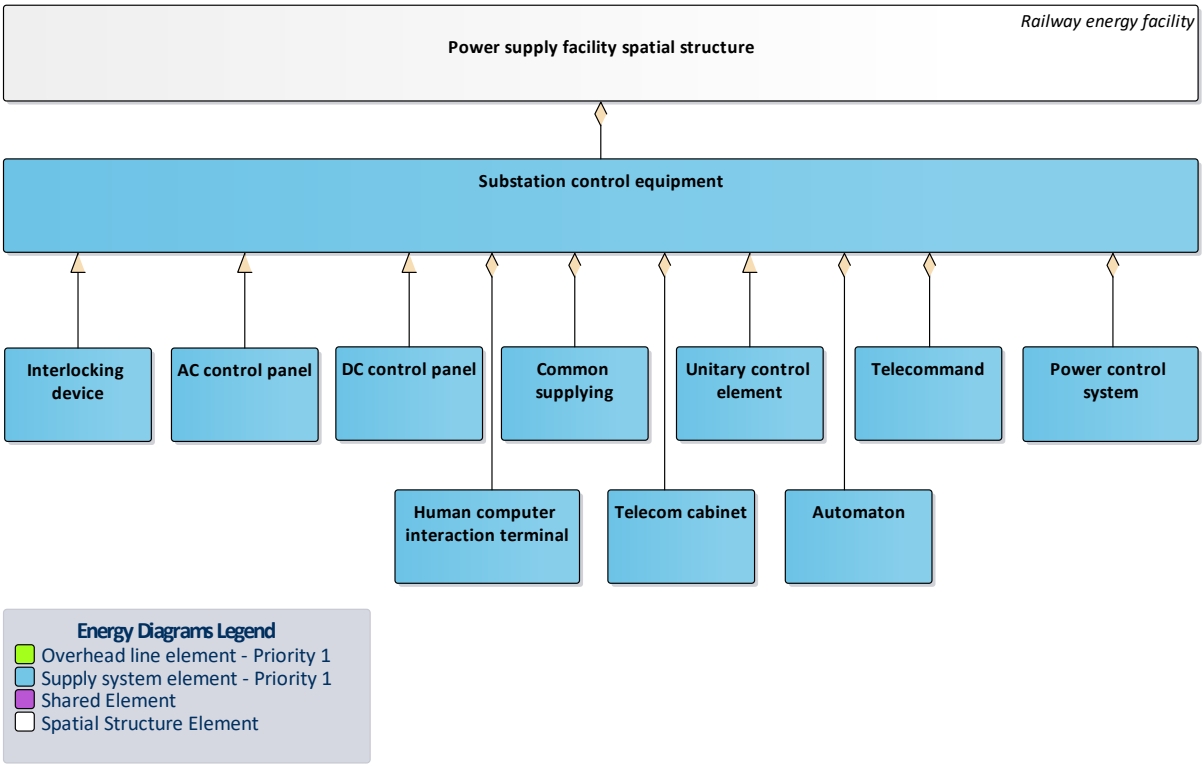


Table 64: SubstationControlEquipment

5.1.17.2 Automaton

Self-acting artificial system the behaviour of which is governed either in a stepwise manner by given decision rules or continuously in time by defined relationships, while the output variables of which are created from its input and state variables.(IEC 60050-351-42-32)

Relationships

Source	Type	Target
Automaton	Aggregation	Substation control equipment

5.1.17.3 AC control panel

According to different electrical equipment and different power consumption, the AC power distribution panel generally controls the distribution cabinet by a branch switch consisting of a voltmeter, an ammeter, a switch (or an automatic switch), an insurance, a signal light, and a line.

Relationships

Source	Type	Target
AC control panel	Generalization	Substation control equipment

5.1.17.4 Common supplying

Power distribution facilities for low-voltage equipements or auxillary equipements.

Relationships

Source	Type	Target
Common supplying	Aggregation	Substation control equipment

5.1.17.5 DC control panel

A cabinet that distributes and outputs DC power. The complex power distribution panel also configures the battery pack and monitoring unit.

Relationships

Source	Type	Target
DC control panel	Generalization	Substation control equipment

5.1.17.6 Human computer interaction terminal

Panel or interface for engineers to control the equipment.

Relationships

Source	Type	Target
Human computer interaction terminal	Aggregation	Substation control equipment

5.1.17.7 Interlocking device

A device which makes the operation of a switching device dependent upon the position or operation of one or more other pieces of equipment. (IEC 60050-441-16-49)

Equipement for interdependent liaison between the control levers or the electric control circuits of different apparatus such as points and signals, which makes it impossible to place them in positions which are unsafe.

Relationships

Source	Type	Target
Interlocking device	Generalization	Substation control equipment

5.1.17.8 Power control system

Control the entire network and manage protection control and auxiliaries services of traction power system.

Relationships

Source	Type	Target
Power control system	Aggregation	Substation control equipment

5.1.17.9 Substation control equipment

Equipement used to control operational equipment at a distance using the transmission of information by telecommunication techniques. (IEC 60050-371-01-01)

Relationships

Source	Type	Target
Substation control equipment	Aggregation	Power supply facility spatial structure
Telecommand	Aggregation	Substation control equipment

Source	Type	Target
Human computer interaction terminal	Aggregation	Substation control equipment
Interlocking device	Generalization	Substation control equipment
DC control panel	Generalization	Substation control equipment
Common supplying	Aggregation	Substation control equipment
AC control panel	Generalization	Substation control equipment
Unitary control element	Generalization	Substation control equipment
Automaton	Aggregation	Substation control equipment
Power control system	Aggregation	Substation control equipment
Telecom cabinet	Aggregation	Substation control equipment

5.1.17.10 Telecom cabinet

Cabinet contaning the telecommunication equipment.

Relationships

Source	Type	Target
Telecom cabinet	Aggregation	Substation control equipment

5.1.17.11 Telecommand

A system sending command to control and monitor the switches and circuit breakers or systems not directly connected (e.g. via wires) within the traction power system remotly.

Relationships

Source	Type	Target
Telecommand	Aggregation	Substation control equipment

5.1.17.12 Unitary control element

A unitary control element combines a number of control components into a single product, such as a thermostat or humidistat.

A unitary control element provides a housing for an aggregation of control or electrical distribution elements that, in combination, perform a singular (unitary) purpose. Each item in the aggregation may have its own geometric representation and location. (IFC4)

Relationships

Source	Type	Target
Unitary control element	Generalization	Substation control equipment

5.1.18 Switch

5.1.18.1 Switch

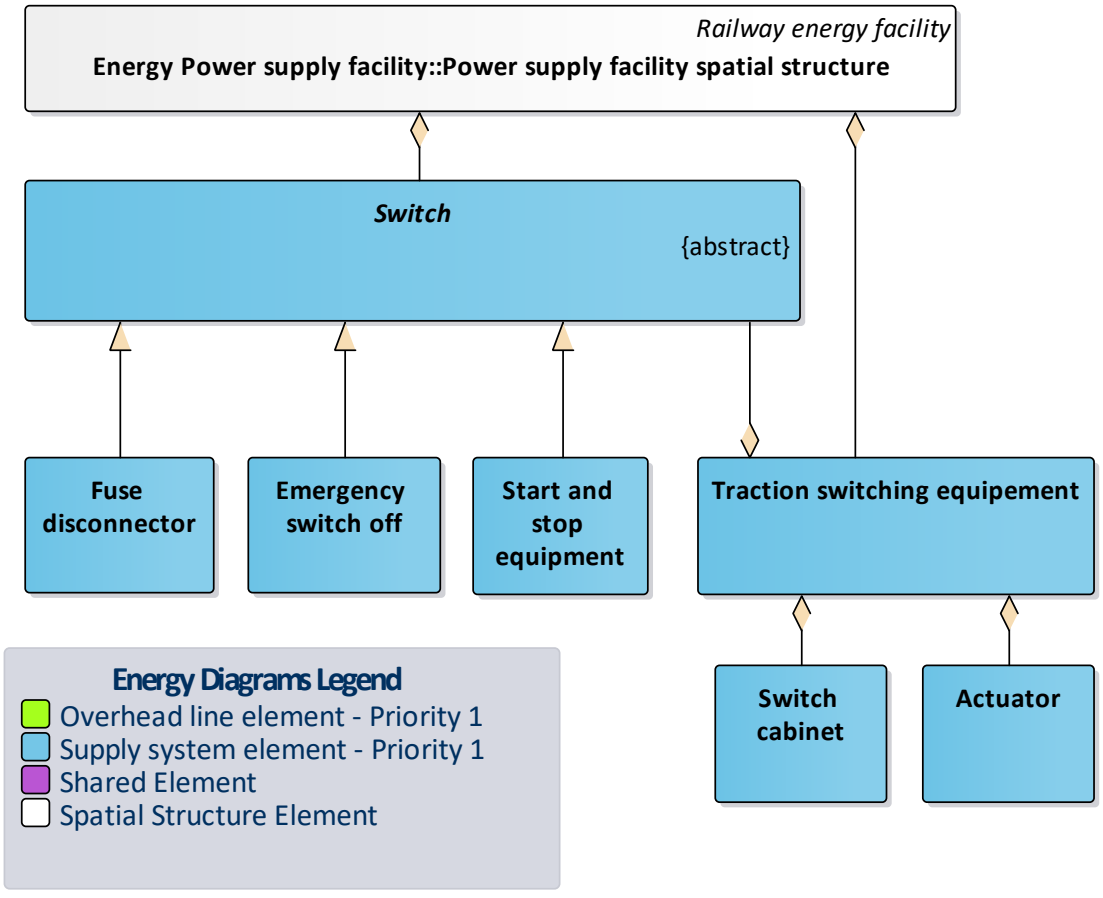


Table 65: Switch

5.1.18.2 Actuator

The part of the actuating system to which an external actuating force is applied.

(IEC-441-15-22)

Used for operating the switches.

Relationships

Source	Type	Target
Actuator	Aggregation	Traction switching equipement
Manual actuators	Generalization	Actuator
Electrical actuators	Generalization	Actuator
Mechanical actuators	Generalization	Actuator

5.1.18.3 Emergency switch off

Opening operation of a switching device intended to remove electric power from an electrical installation to avert or alleviate a hazardous situation. (IEC 60050-826-17-03)

Relationships

Source	Type	Target
Emergency switch off	Generalization	Switch

5.1.18.4 Fuse disconnector

a disconnector in which one or more poles have a fuse in series in a composite unit.(IEC 60050-441-14-15)

Relationships

Source	Type	Target
Fuse disconnector	Generalization	Switch

5.1.18.5 Start and stop equipment

Switch for alternatively closing and opening one or more electric circuits.(IEC 60050-151-12-23)

Relationships

Source	Type	Target
Start and stop equipment	Generalization	Switch

5.1.18.6 Switch

Switch for alternatively closing and opening one or more electric circuits (IEC

60050-151-12-23)

Relationships

Source	Type	Target
Switch	Aggregation	Traction switching equipement
Switch	Association	Sub sector
Switch	Aggregation	Power supply facility spatial structure
Switch	Association	Elementary sector
Circuit breaker	Generalization	Switch
Change over switch	Generalization	Switch
Earthing switch	Generalization	Switch
Sectioning disconnector switch	Generalization	Switch
Load switch	Generalization	Switch

Source	Type	Target
Start and stop equipment	Generalization	Switch
Emergency switch off	Generalization	Switch
Sectioning breaking switch	Generalization	Switch
Load break switch	Generalization	Switch
Fuse disconnector	Generalization	Switch
Switch disconnector	Generalization	Switch
Blade switch	Generalization	Switch
Disconnector	Generalization	Switch

5.1.18.7 Switch cabinet

In addition to the incoming and outgoing lines, the switchgear is completely enclosed by a grounded metal casing.

Switch cabinets/switchgear contain sensitive electrical, electronic and mechanical components to perform control, drive, power supply and safety functions. As a rule, these components are of high quality.

Switch cabinets consist of the cabinet housing and door and the interior components (e.g. mounting plates), which generally take the form of drawer units or are mounted on a panel.

Relationships

Source	Type	Target
Switch cabinet	Aggregation	Traction switching equipement

5.1.18.8 Traction switching equipement

Switching equipement used for traction power, which is usually composed by switch(s), cabinet (might be), instrument tranformer (might be), and other auxillary equipements.

Relationships

Source	Type	Target
Traction switching equipement	Aggregation	Power supply facility spatial structure
Switch	Aggregation	Traction switching equipement
Actuator	Aggregation	Traction switching equipement
Switch cabinet	Aggregation	Traction switching equipement

5.1.19 Underground Facilities

5.1.19.1 Underground Facilities

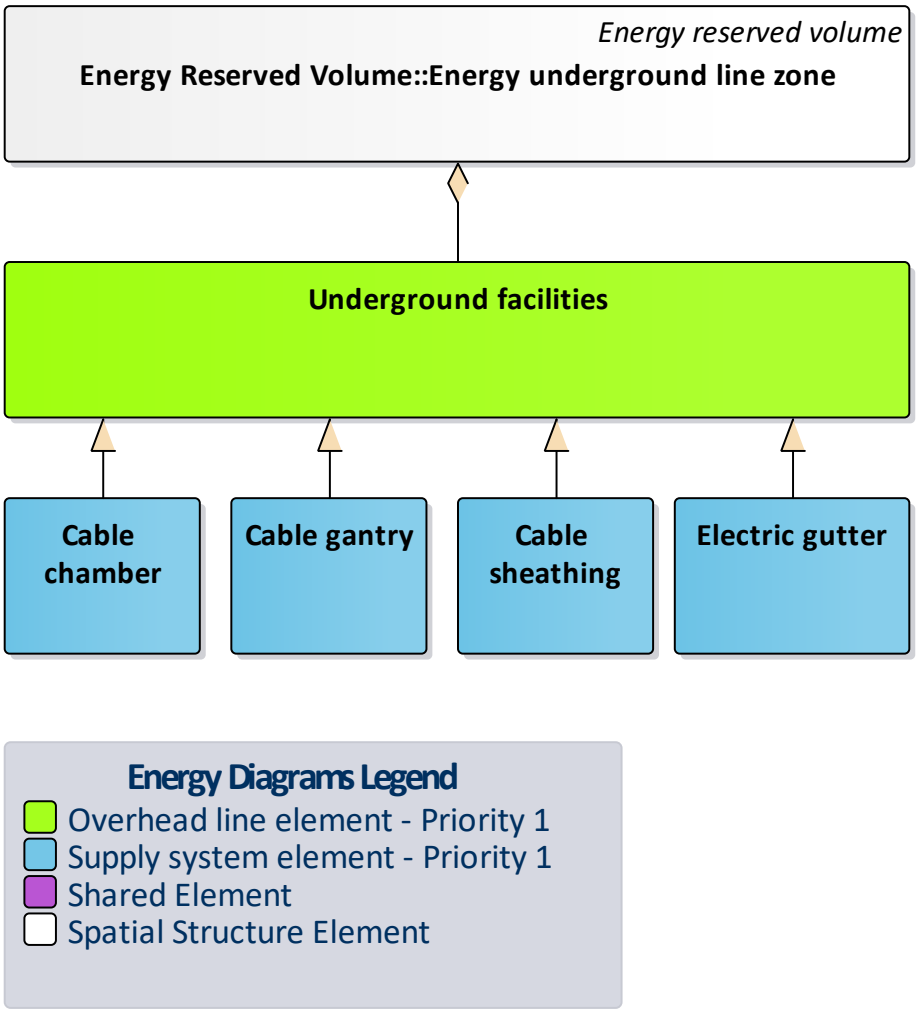


Table 66: Underground Facilities

5.1.19.2 Cable chamber

An opening to a confined space such as a shaft, utility vault, or large vessel, used as an access point for underground cable, allowing inspection, maintenance, and system upgrades. It' also called manhole.

Relationships

Source	Type	Target
Cable chamber	Generalization	Underground facilities

5.1.19.3 Cable gantry

Horizontal cable supports fixed at one end only, spaced at intervals, on which cables rest.(IEC 60050-826-15-10)

Relationships

Source	Type	Target
Cable gantry	Generalization	Underground facilities

5.1.19.4 Cable sheathing

Flexible accessory or a part of a component placed around the cable to minimize flexing of the cable at the point of entry into the component.

Relationships

Source	Type	Target
Cable sheathing	Generalization	Underground facilities

5.1.19.5 Electric gutter

Electrical conduit used to protect and route electrical wiring in a building or structure.

Relationships

Source	Type	Target
Electric gutter	Generalization	Underground facilities

5.1.19.6 Underground facilities

Cables and other facilities needed to connect OCS to substation and to low voltage services

Relationships

Source	Type	Target
Underground facilities	Aggregation	Energy underground line zone
Electric gutter	Generalization	Underground facilities
Cable chamber	Generalization	Underground facilities
Cable gantry	Generalization	Underground facilities
Cable sheathing	Generalization	Underground facilities
Signal connection plate	Generalization	Underground facilities

5.2 Energy Spatial

5.2.1 Class diagram energy spatial

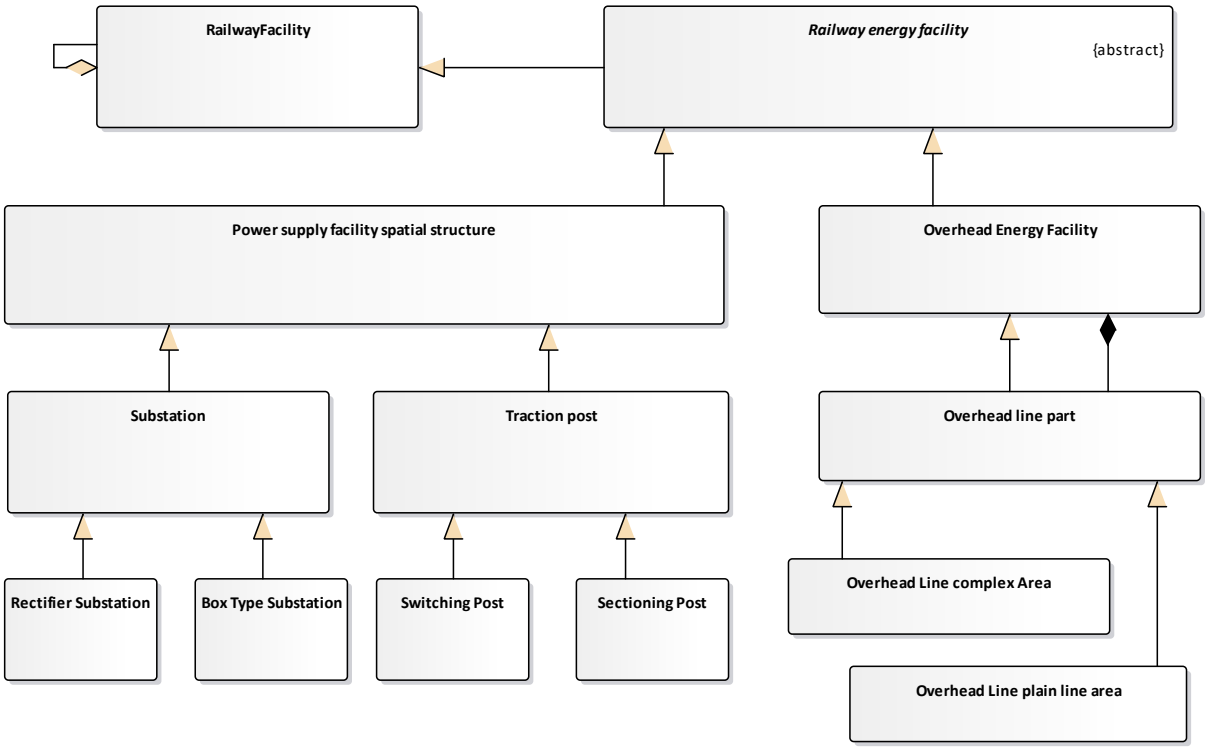


Table 67: Class diagram energy spatial

5.2.2 Class diagram energy reserved volume

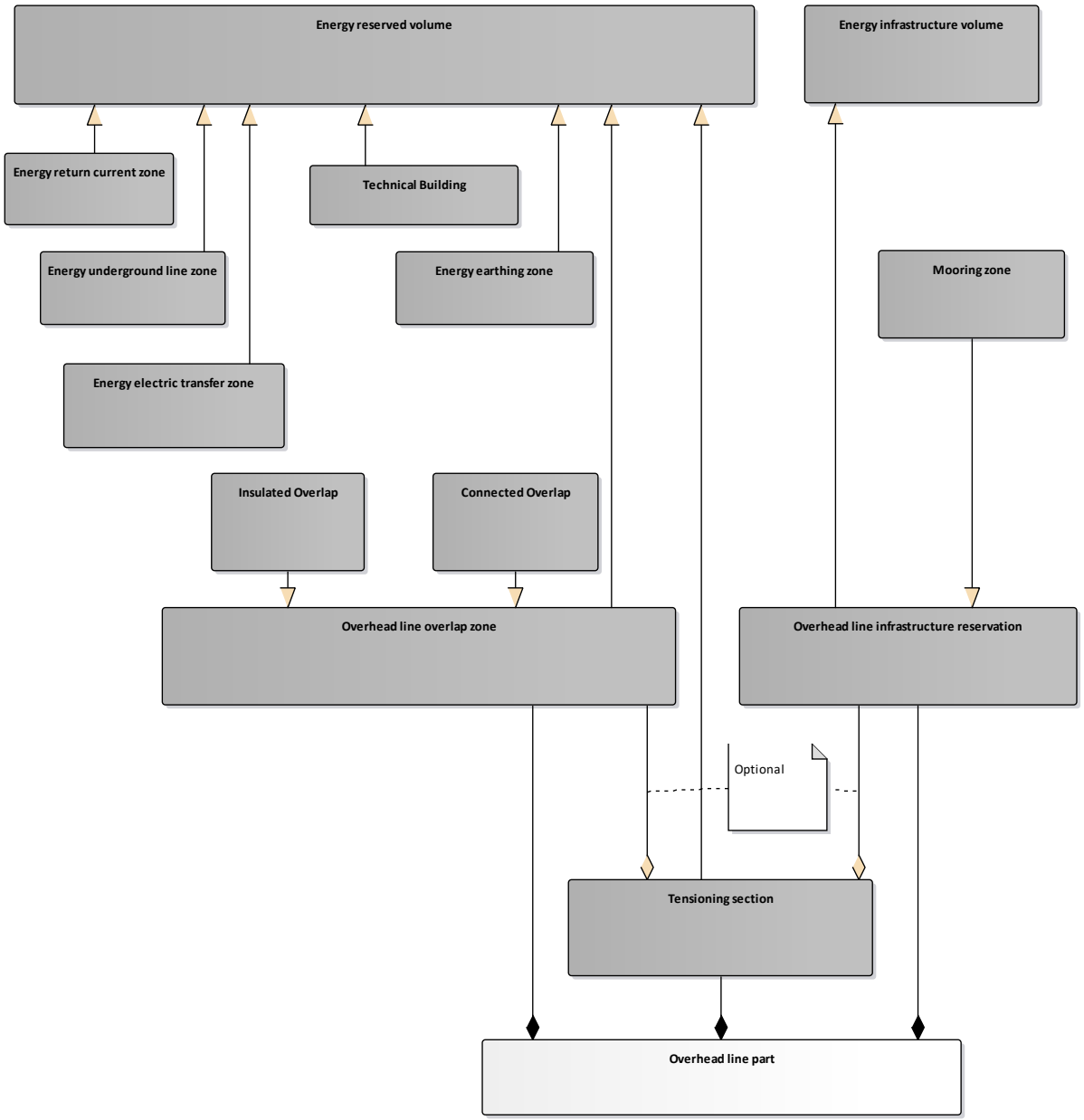


Table 68: Class diagram energy reserved volume

5.2.3 Energy Overhead Line

5.2.3.1 Overhead line infrastructure reservation

Equipment to support ContactLine, Feeder or Earthwire

Relationships

Source	Type	Target
Overhead line infrastructure reservation	Aggregation	Overhead line part
Overhead line infrastructure reservation	Aggregation	Tensioning section
Overhead line infrastructure reservation	Generalization	Energy infrastructure volume
Mid point anchor	Aggregation	Overhead line infrastructure reservation
Mooring system	Aggregation	Overhead line infrastructure reservation
Mooring zone	Generalization	Overhead line infrastructure reservation
OCS supporting system	Aggregation	Overhead line infrastructure reservation

5.2.3.2 Overhead line part

An electric line whose conductors are supported above ground, generally by means of insulators and appropriate supports

Note – Certain overhead lines may also be constructed with insulated conductors.(IEC 60050-466-01-02)

Relationships

Source	Type	Target
Overhead line part	Aggregation	Overhead Energy Facility
Overhead line part	Generalization	Overhead Energy Facility
Sectioning device	Aggregation	Overhead line part
Overhead Line complex Area	Generalization	Overhead line part
Earthing line	Aggregation	Overhead line part
Overhead line infrastructure reservation	Aggregation	Overhead line part
Overhead contact line system	Aggregation	Overhead line part
Overhead Line plain line area	Generalization	Overhead line part

Source	Type	Target
Feeder line	Aggregation	Overhead line part
Overhead line overlap zone	Aggregation	Overhead line part
Note	NoteLink	Overhead line part
Tensioning section	Aggregation	Overhead line part

5.2.4 Energy Power supply facility

5.2.4.1 Rectifier Substation

Rectifier substation

Relationships

Source	Type	Target
Rectifier Substation	Generalization	Substation
Note	NoteLink	Rectifier Substation

5.2.4.2 Sectioning Post

Power supply post for sectioning

Relationships

Source	Type	Target
Sectioning Post	Generalization	Traction post
Note	NoteLink	Sectioning Post

5.2.4.3 Switching Post

Power supply post for swithing

Relationships

Source	Type	Target
Switching Post	Generalization	Traction post
Note	NoteLink	Switching Post

5.2.4.4 Box Type Substation

Pre build substation

Relationships

Source	Type	Target
Box Type Substation	Association	Sub sector
Box Type Substation	Generalization	Substation
Traction power system	Association	Box Type Substation

5.2.4.5 Substation

Substation the main function of which is to supply an electric traction system.(IEC 60050-811-36-02)

Relationships

Source	Type	Target
Substation	Generalization	Power supply facility spatial structure
Rectifier Substation	Generalization	Substation
Power transformer	Aggregation	Substation
Oil retention tray	Association	Substation
Energy conversion device	Aggregation	Substation
Lightning arrester	Association	Substation
Box Type Substation	Generalization	Substation

5.2.4.6 Power supply facility spatial structure

To supply electric traction system from high voltage.

Relationships

Source	Type	Target
Power supply facility spatial structure	Generalization	Railway energy facility
Power supply facility spatial structure	Aggregation	Traction power system
Power supply facility spatial structure	Association	Sector
Energy conversion device	Aggregation	Power supply facility spatial structure
Electric power converter	Aggregation	Power supply facility spatial structure
Substation control equipment	Aggregation	Power supply facility spatial structure
Traction post	Generalization	Power supply facility spatial structure
Electric storage device	Aggregation	Power supply facility spatial structure
Substation	Generalization	Power supply facility spatial structure
Autotransformer post	Generalization	Power supply facility spatial structure
Regulating devices	Aggregation	Power supply facility spatial structure
Traction switching equipement	Aggregation	Power supply facility spatial structure
Insulator	Aggregation	Power supply facility spatial structure
Switch	Aggregation	Power supply facility spatial structure
Instrument transformer	Aggregation	Power supply facility spatial structure
Auxiliary services	Aggregation	Power supply facility spatial structure

Source	Type	Target
Bases	Aggregation	Power supply facility spatial structure
Electrical conductor	Aggregation	Power supply facility spatial structure

5.2.4.7 Traction post

Power Supply system

Relationships

Source	Type	Target
Traction post	Generalization	Power supply facility spatial structure
Switching Post	Generalization	Traction post
Sub sector	Association	Traction post
Sectioning Post	Generalization	Traction post

5.2.5 Energy Reserved Volume

5.2.5.1 Energy earthing zone

Element that make the connections between ground and return circuit.

Relationships

Source	Type	Target
Energy earthing zone	Generalization	Energy reserved volume
Earthing circuit	Aggregation	Energy earthing zone

5.2.5.2 Energy return current zone

Zone that are contening - elements of electrical continuity for the rails,

- links to the impedance bond for return current,

- return conductor.

Relationships

Source	Type	Target
Energy return current zone	Generalization	Energy reserved volume
Return circuit	Aggregation	Energy return current zone

5.2.5.3 Energy underground line zone

Reserved area for underground facilities like gutter etc.

Relationships

Source	Type	Target
Energy underground line zone	Generalization	Energy reserved volume
Underground facilities	Aggregation	Energy underground line zone

5.2.5.4 Tensioning section

Length of the overhead contact line between two terminating points.(IEC 60050-811-33-61)

Relationships

Source	Type	Target
Tensioning section	Generalization	Energy reserved volume
Tensioning section	Aggregation	Overhead line part
Tensioning section	Association	Sector
Elementary sector	Association	Tensioning section
Overhead line overlap zone	Aggregation	Tensioning section

Source	Type	Target
Catenary system	Aggregation	Tensioning section
Earthing line	Association	Tensioning section
Overhead line infrastructure reservation	Aggregation	Tensioning section
Neutral section	Generalization	Tensioning section
Feeder line	Association	Tensioning section

5.2.5.5 Technical Building

Building on track side dedicated to railways operation.

Relationships

Source	Type	Target
Technical Building	Generalization	Energy reserved volume
Building foundation	Aggregation	Technical Building
Note	NoteLink	Technical Building
Sector	Association	Technical Building

6 Common - Shared

This Package contents all the classes which are candidate for common schema and shared elements. Currently it contents:

- The proposal for alignment
- The overview of possible instances of alignments and dependent linear reference systems for rail
- The possible positionings for objects which can be used as data types
- The definition of domain specific spatial structures

6.1 Alignment Proposal

This class model describes the requirements for alignment for the rail domain. The model is structured in such a way that several classes are also valid for other domains (i.e. road) if not specified as railway.

6.1.1 Principles

In the field of railway the term alignment is usually used for the description of several geometries i.e. track centreline, catenary line, ...and for associated linear reference systems.

The requirements for the geometries are specifically defined in the alignment proposal as where the requirements for the linear referencing are defined in the chapters "LRS & Alignment" and "Positioning".

6.1.1.1 Principles diagram

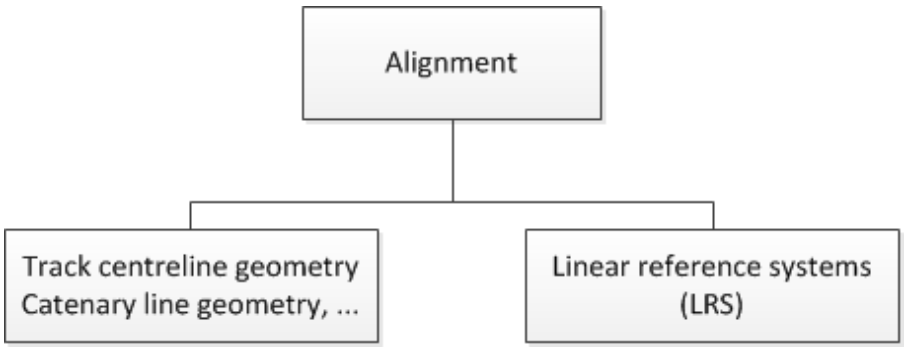


Table 69: Principles diagram

6.1.2 Overview

The class diagram distinguishes the parameterized description of alignment curves from the discretized representation.

6.1.2.1 Class diagram "Alignment (IFC Rail)"

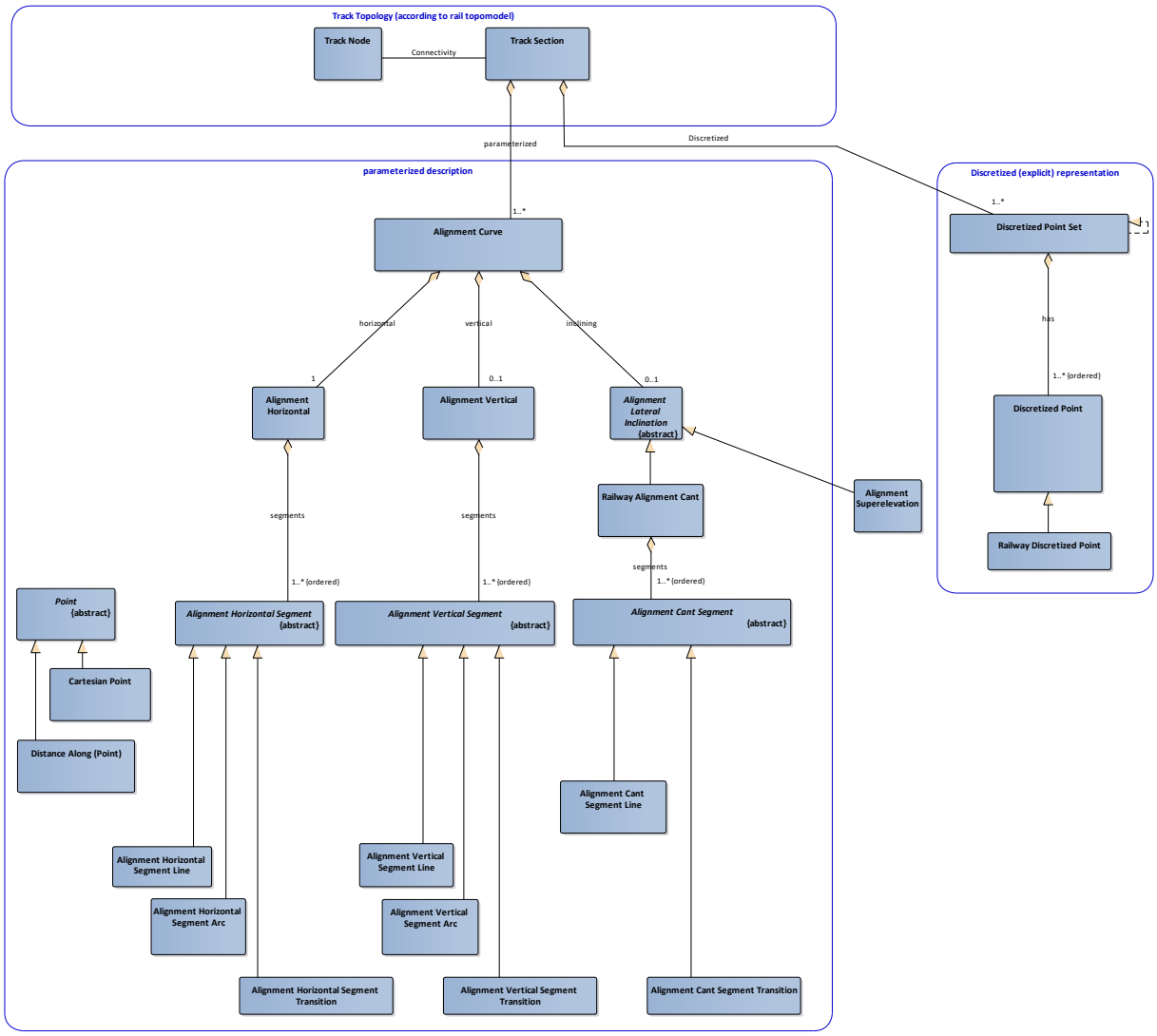


Table 70: *Class diagram "Alignment"*

6.1.3 Parameterized description

Package for the parameterized description of the alignment.

6.1.3.1 Alignment Curve

The alignment curve is a parameterized space curve which represents the geometry of any track section. It is defined by three alignments (= layouts), which are to be regarded as independent from each other:

1. an horizontal alignment (2D)
2. a vertical alignment (1D)
3. a cant alignment (1D) (synonym = superelevation)

Each of these three alignments is defined by a sequence of ordered geometric segments composed of various geometry types that are linked together in a chain.

Properties

Name	Type	Description
Acceptable tangential tolerance	double	Parameter used to check if the tangential continuity of two geometric segments is respected.

Relationships

Source	Type	Target
Alignment Curve	Aggregation	Track Section
Alignment Lateral Inclination	Aggregation	Alignment Curve
Alignment Vertical	Aggregation	Alignment Curve
Alignment Horizontal	Aggregation	Alignment Curve

6.1.3.2 Alignment Horizontal

The horizontal alignment is composed of geometric segments with the following three geometry types:

1. straight line
2. arc of a circle
3. transition curve

The horizontal alignment delivers the metric for the linear reference system used to position the vertical alignment segments and the cant segments.

The tolerance limits for lengthwise, crosswise and angle errors must be kept. Otherwise the chain will not be deemed to be linked together. If no absolute coordinates are known, the initial coordinates of the geometric elements are entered as (0,0) or using less precise coordinates (graphical coordinates) in the geodetic reference system. The type of geodetic reference system and/or the map projection must be given. The measurement respectively the calculation date must be stated.

Relationships

Source	Type	Target
Alignment Horizontal	Aggregation	Alignment Curve
Alignment Horizontal Segment	Aggregation	Alignment Horizontal

6.1.3.3 Alignment Horizontal Segment

Geometric segments are used to define the horizontal alignment. The segments are ordered. Each horizontal segment is defined with:

1. a starting point known by its cartesian coordinates
2. the starting direction in form of an azimuth [gon] or alternatively [rad](radiant).
3. the segment length in [m]
4. the information on how the segment is connected to the following segment. This information is used to describe possible discontinuities (e.g. if there is a horizontal bend).

Additionally:

1. a radius, for arc segments
2. an initial and final radius for transition segments as well as the type of transition curve. Some transition curves require additional parameters.

Properties

Name	Type	Description
Starting Point	Cartesian Point	Horizontal Cartesian coordinates (X, Y) of the starting point
Starting Direction	double	Horizontal azimuth at the starting point
Segment Length	double	Length of the horizontal segment
Tangential Continuity	enum	Tangential Continuity for the end point. Possible values are: 1. Not connected according national regulation 2. Connect with directional bend 3. Connected

Relationships

Source	Type	Target
Alignment Horizontal Segment	Aggregation	Alignment Horizontal
Note	NoteLink	Alignment Horizontal Segment
Alignment Horizontal Segment Line	Generalization	Alignment Horizontal Segment
Alignment Horizontal Segment Transition	Generalization	Alignment Horizontal Segment
Note	NoteLink	Alignment Horizontal Segment
Alignment Horizontal Segment Arc	Generalization	Alignment Horizontal Segment

6.1.3.4 Alignment Horizontal Segment Line

Geometric primitive. All required attributes are defined in the class "Alignment Horizontal Segment".

Relationships

Source	Type	Target
Alignment Horizontal Segment Line	Generalization	Alignment Horizontal Segment

6.1.3.5 Alignment Horizontal Segment Arc

Geometric primitive for Arc of circle.

Attributes are defined in the class "Alignment Horizontal Segment" except the radius..

Properties

Name	Type	Description
Radius	double	Radius of the arc. Unit: meter.

Relationships

Source	Type	Target
Alignment Horizontal Segment Arc	Generalization	Alignment Horizontal Segment
Note	NoteLink	Alignment Horizontal Segment Arc

6.1.3.6 Alignment Horizontal Segment Transition

Geometric primitive for transition curves.

Attributes are defined in the class "Alignment Horizontal Segment" except the type of transition curve and initial and final radius..

Properties

Name	Type	Description
Transition Type	Transition Type	Type of transition curve
Initial Radius	double	Radius at start of transition curve
Final Radius	double	Radius at end of transition curve

Relationships

Source	Type	Target
Alignment Horizontal Segment Transition	Generalization	Alignment Horizontal Segment

6.1.3.7 Alignment Vertical

The vertical alignment is composed of geometric segments with the following three geometry types:

1. Straight line (= constant gradient)

2. Segment arc
3. Transition curves

The tolerance limits for the vertical offset and angle errors (= abrupt change of the gradient) must be kept to, otherwise the chain will be deemed to be broken.

The vertical alignment can either follow the track axis or the lower or the upper rail.

Properties

Name	Type	Description
Reference axis	enum	Defines whether the vertical alignment follows: 1. the lower rail 2. the center line 1. the higher rail

Relationships

Source	Type	Target
Alignment Vertical	Aggregation	Alignment Curve
Alignment Vertical	NoteLink	Note
Alignment Vertical Segment	Aggregation	Alignment Vertical

6.1.3.8 Alignment Vertical Segment

Geometric segments are used to define the vertical alignment. The segments are ordered. Each vertical segment is defined with:

1. a starting point known by its distance along the horizontal alignment [m]
2. the starting point elevation in [m]
3. the starting direction as a gradient [‰]
4. the segment length in [m]
5. the information on how the segment is connected to the following segment. This information is used to describe possible discontinuities (e.g. if there is a vertical bend).

Additionally:

1. a radius, for arc segments [m]
2. the initial and final radius for transition segments as well as the type of transition curve. Some transition curves require additional parameters.

The elevation (= Cartesian Z-coordinate) of the starting point, the segment length and the starting gradient are defined for each geometric element.

Properties

Name	Type	Description
Starting Point	Distance Along (Point)	Starting point defined by the distance along the horizontal alignment.
Starting Point alternative	Cartesian Point	Alternative to the distance along the starting point can also be defined with horizontal Cartesian coordinates (X, Y).
Starting Point Elevation	double	Elevation of the starting point (= Cartesian Z-coordinate)
Starting Direction	double	Gradient (=Vertical azimuth) at the starting point
Segment Length	double	Length of the vertical segment
Tangential Continuity	enum	Tangential Continuity for the end point. Possible values are: 1. Not connected according national regulation 2. Connect with directional bend 1. Connected

Relationships

Source	Type	Target
Alignment Vertical Segment	Aggregation	Alignment Vertical
Note	NoteLink	Alignment Vertical Segment
Alignment Vertical Segment Transition	Generalization	Alignment Vertical Segment
Alignment Vertical Segment Arc	Generalization	Alignment Vertical Segment
Note	NoteLink	Alignment Vertical Segment
Alignment Vertical Segment Line	Generalization	Alignment Vertical Segment

6.1.3.9 Alignment Vertical Segment Line

Geometric primitive. All required attributes are defined in the class "Alignment Vertical Segment".

Relationships

Source	Type	Target
Alignment Vertical Segment Line	Generalization	Alignment Vertical Segment

6.1.3.10 Alignment Vertical Segment Arc

Geometric primitive for Arc of circle.

Attributes are defined in the class "Alignment Vertical Segment" except the radius..

Properties

Name	Type	Description
Radius	double	Radius of the arc.

Relationships

Source	Type	Target
Alignment Vertical Segment Arc	Generalization	Alignment Vertical Segment

6.1.3.11 Alignment Vertical Segment Transition

Geometric primitive for transition curves.

Attributes are defined in the class "Alignment Vertical Segment" except the type of transition curve and initial and final radius..

Properties

Name	Type	Description
Transition Type	Transition Type	Type of transition curve
Initial Radius	double	Radius at start of transition curve
Final Radius	double	Radius at end of transition curve

Relationships

Source	Type	Target
Alignment Vertical Segment Transition	Generalization	Alignment Vertical Segment

6.1.3.12 Alignment Lateral Inclination

Abstract class as a placeholder for railway cant or road superelevation.

Relationships

Source	Type	Target
Alignment Lateral Inclination	Aggregation	Alignment Curve
Alignment Lateral Inclination	NoteLink	Note
Alignment Superelevation	Generalization	Alignment Lateral Inclination
Railway Alignment Cant	Generalization	Alignment Lateral Inclination
Note	NoteLink	Alignment Lateral Inclination

6.1.3.13 Railway Alignment Cant

The railway cant alignment is composed of geometric segments with the two following geometry types

1. Straight line for constant cant or constant change of cant
2. Transition curve for curved cant

Properties

Name	Type	Description
Track Gauge	int	Spacing of the rails on a railway track, measured between the inner faces of the load-bearing rails.
Rotation axis	enum	Parameter which defines which axis is used for rotation. Possible values are: 1. Center line 2. Lower rail 3. User defined

Relationships

Source	Type	Target
Railway Alignment Cant	Generalization	Alignment Lateral Inclination
Railway Alignment Cant	NoteLink	Note
Note	NoteLink	Railway Alignment Cant
Alignment Cant Segment	Aggregation	Railway Alignment Cant
Note	NoteLink	Railway Alignment Cant

6.1.3.14 Alignment Cant Segment

Geometric segments are used to define the railway cant. The segments are ordered. Each cant segment is defined with:

1. a starting point known by its distance along the horizontal alignment [m]
2. the segment length in [m]
3. the start cant value in [mm]
4. the end cant value in [mm]
5. the information on how the segment is connected to the following segment. This information is used to describe possible discontinuities (e.g. invalid sudden change of cant or missing cant information if end point and starting point differ over a threshold).

Additionally:

1. an information which describes if a smoothing was applied between two cant segments

Properties

Name	Type	Description
Starting Point	Distance Along (Point)	Starting point defined by the distance along the horizontal alignment.
Starting point alternative	Cartesian Point	Alternative to the distance along the starting point can also be defined with horizontal Cartesian coordinates (X, Y).
Segment Length	double	Length of the cant segment
Starting Cant left	double	Value of the cant left at the beginning of the segment in [mm]
Ending Cant left	double	Value of the cant left at the end of the segment in [mm]
Starting Cant right	double	Value of the cant right at the beginning of the segment in [mm]
Endig Cant right	double	Value of the cant right at the end of the segment in [mm]
Tangential Continuity	enum	Tangential Continuity for the end point. Possible values are: 1. Not connected according national regulation 2. Connect with smoothing 1. Connected

Relationships

Source	Type	Target
Alignment Cant Segment	Aggregation	Railway Alignment Cant
Alignment Cant Segment	NoteLink	Note
Note	NoteLink	Alignment Cant Segment
Note	NoteLink	Alignment Cant Segment
Note	NoteLink	Alignment Cant Segment
Alignment Cant Segment Transition	Generalization	Alignment Cant Segment
Note	NoteLink	Alignment Cant Segment
Alignment Cant Segment Line	Generalization	Alignment Cant Segment

6.1.3.15 Alignment Cant Segment Line

Geometric primitive. All needed attributes are defined in the class "Alignment Cant Segment".

Properties

Name	Type	Description
Smoothing	boolean	Semantic to be defined by SNCF

Relationships

Source	Type	Target
Alignment Cant Segment Line	NoteLink	Note
Alignment Cant Segment Line	Generalization	Alignment Cant Segment

6.1.3.16 Alignment Cant Segment Transition

Geometric primitive for transition curves.

Attributes are defined in the class "Alignment Cant Segment" except the type of transition curve and initial and final radius.

Properties

Name	Type	Description
Transition Type	Transition Type	Type of transition curve
Initial Radius	double	Radius at start of transition curve
Final Radius	double	Radius at end of transition curve

Relationships

Source	Type	Target
Alignment Cant Segment Transition	Generalization	Alignment Cant Segment

6.1.3.17 Alignment Superelevation

Class as placeholder for the requirements of IFC-Road.

Relationships

Source	Type	Target
Alignment Superelevation	Generalization	Alignment Lateral Inclination
Note	NoteLink	Alignment Superelevation
Note	NoteLink	Alignment Superelevation

6.1.3.18 Transition Type

Type of transition curves.

Relationships

Source	Type	Target
Note	NoteLink	Transition Type

6.1.4 Discretized representation

Package for the discretized description of the alignment.

6.1.4.1 Discretized Point Set

Class for grouping a set of discretized points. Each point set represents a track axis alignment. The alignment curve is a non-parameterized space curve that follows the ordered sequence of discretized points by straight lines (or splines) between consecutive points. This is an alternative representation the geometry of any track section described in the parameterized description.

Properties

Name	Type	Description
Associated discretized method	enum	With which method the discretized points where defined: 1. straight lines (polynom) 2. splines (type of spline needed)

Name	Type	Description
		3. user defined
Standard deviation horizontal	float	1-sigma standard deviation [m] of a point in the horizontal plane. The value 0 indicates that the point was calculated and not measured.
Standard deviation vertical	float	1-sigma standard deviation [m] of the point elevation. The value 0 indicates that the point was calculated and not measured. Remark: The 3D Standard deviation of a point can be calculated from the standard deviation horizontal and vertical.

Relationships

Source	Type	Target
Discretized Point Set	Aggregation	Track Section
Note	NoteLink	Discretized Point Set
Discretized Point	Aggregation	Discretized Point Set
Note	NoteLink	Discretized Point Set

6.1.4.2 Discretized Point

Elementary point as part of an ordered point set.

Properties

Name	Type	Description
Number	ID	Unique identification of the point.
Northing	double	Cartesian Y-coordinate
Elevation	double	Cartesian Z-coordinate
Chainage	float	Length of the alignment curve in the horizontal plane, if known.
Easting	double	Cartesian X-coordinate
Rotation axis	enum	Parameter which defines which axis is used for rotation. Possible values are: 1. Center line

Name	Type	Description
		2. Lower rail 1. User defined

Relationships

Source	Type	Target
Discretized Point	Aggregation	Discretized Point Set
Note	NoteLink	Discretized Point
Railway Discretized Point	Generalization	Discretized Point
Note	NoteLink	Discretized Point

6.1.4.3 Railway Discretized Point

Additional attributes specially needed for rail.

Properties

Name	Type	Description
Line Kilometer	float	The line kilometre is not to be confused with the chainage. The line kilometre follows a special horizontally defined kilometre-curve-alignment that roughly follows the exact horizontal alignment (= chainage), but is not identical to it.
Cant left	double	Height of cant on left
Cant right	double	Height of cant on right
Azimuth of Cant	double	Perpendicular to the azimuth of the horizontal alignment curve.

Relationships

Source	Type	Target
Railway Discretized Point	Generalization	Discretized Point

6.1.5 Topology reference

6.1.5.1 Track Node

Relationships

Source	Type	Target
Track Node	Association	Track Section
Note	NoteLink	Track Node

6.1.5.2 Track Section

Properties

Name	Type	Description
Track Number	char	
Line Number	char	

Relationships

Source	Type	Target
Alignment Curve	Aggregation	Track Section
Note	NoteLink	Track Section
Discretized Point Set	Aggregation	Track Section
Track Node	Association	Track Section

6.2 LRS & Alignment

6.2.1 Class diagram "LRS & Alignment"

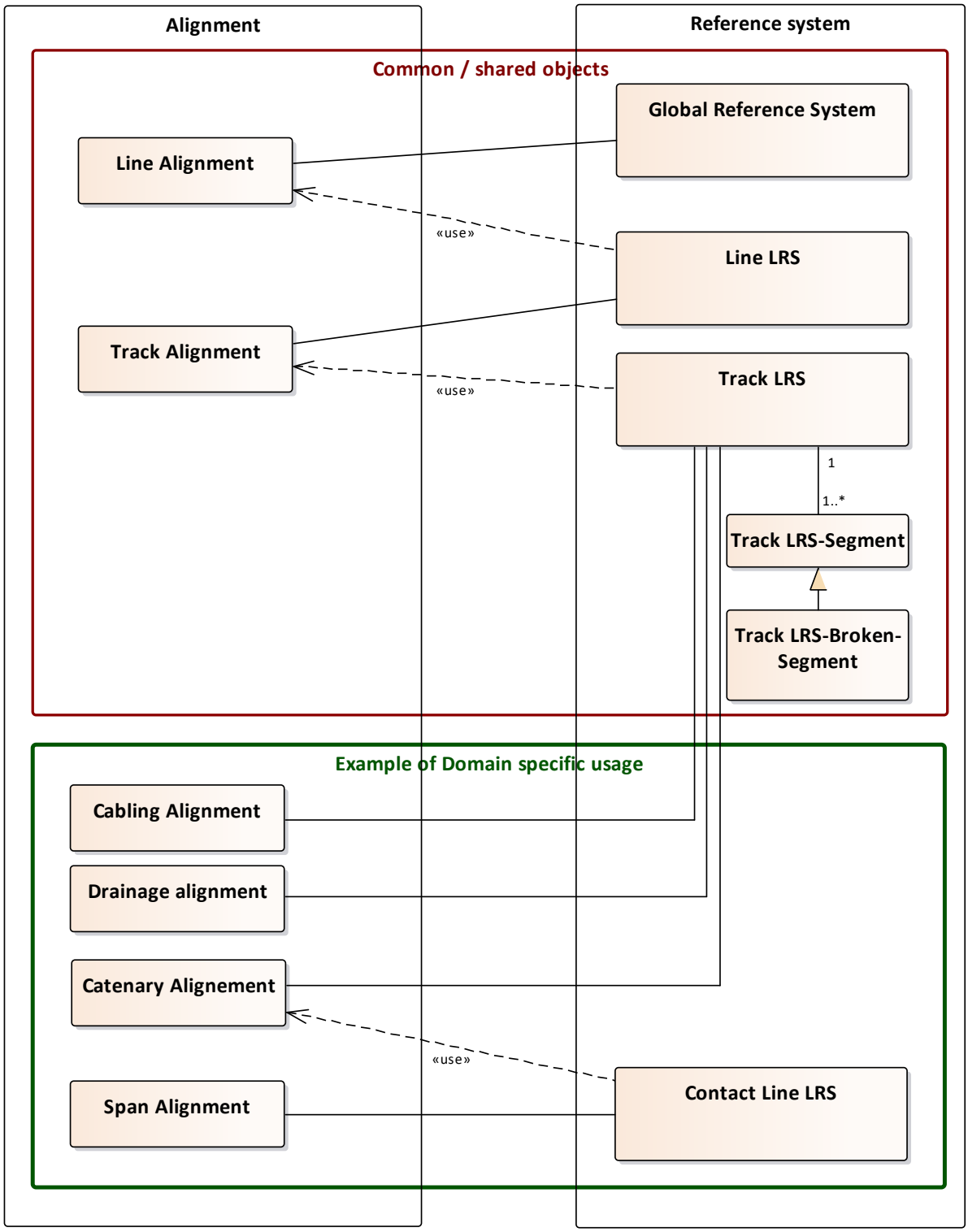


Table 71: *Class diagram "LRS & Alignment"*

6.2.2 Global Reference System

The Global position of the project in the World Geode.

Relationships

Source	Type	Target
Global Reference System	NoteLink	Note
Line Alignment	Association	Global Reference System

6.2.3 Line Alignment

This alignment represents the center of the railway.

Needed for early design to place the railway in it surrounding.

Relationships

Source	Type	Target
Line Alignment	Association	Global Reference System

6.2.4 Line LRS

This Linear Reference System is based on the railway alignment and provide a gross, human useful reference system to place some infrastructures (station, bridges, tunnel) and the tracks.

Relationships

Source	Type	Target
Line LRS	NoteLink	Note
Line LRS	Association	Track Alignment
Line From - To	Association	Line LRS
Line At	Association	Line LRS

6.2.5 Track Alignment

Precise alignment of the track (center top of rail) calculated in respect with speed, tonnage and capacity planned in the project.

Relationships

Source	Type	Target
Line LRS	Association	Track Alignment

6.2.6 Track LRS-Segment

Linear Reference System based on the track alignment, used to place some of the trackside objects commonly used within railway.

Properties

Name	Type	Description
Segment start name	char	Name that uniquely identifies a segment inside a Track LRS
Prefixe	char	Prefixe of the segment
Sequence	int	Sequence which gives the sorting of the segments from a track LRS
Start distance along	Length (non-negative, >=0)	Distance from start of the track LRS
Length	Length (positive, >0)	Length of the segment.

Relationships

Source	Type	Target
Track LRS-Segment	Association	Track LRS
Track At	Association	Track LRS-Segment
Track From - To	Association	Track LRS-Segment
Track LRS-Broken-Segment	Generalization	Track LRS-Segment

6.2.7 Track LRS-Broken-Segment

Linear Reference System based on the track alignment, used to place some of the trackside objects commonly used within railway.

Properties

Name	Type	Description
Restart name	Text	Name for the broken segment
Restart distance	Length (non-negative, >=0)	Distance for the broken chainage

Relationships

Source	Type	Target
Track LRS-Broken-Segment	Generalization	Track LRS-Segment

6.2.8 Cabling Alignment

Example alignment base on the track LRS to position cable aside of the tracks.

Relationships

Source	Type	Target
Cabling Alignment	Association	Track LRS

6.2.9 Catenary Alignement

Alignment of the contact line based on the track LRS and calculated with external constraints (bridge / tunnel crossing).

Relationships

Source	Type	Target
Track LRS	Association	Catenary Alignement

6.2.10 Contact Line LRS

Linear Reference System based on the catenary Alignment and used to precisely specify the place of real contact line depending the mast implementation.

Relationships

Source	Type	Target
Span Alignment	Association	Contact Line LRS
Contact Line At	Association	Contact Line LRS
Contact Line From - To	Association	Contact Line LRS

6.2.11 Drainage alignment

Example alignment of drainage to evacuate water near the tracks.

Relationships

Source	Type	Target
Drainage alignment	Association	Track LRS

6.2.12 Span Alignment

Very precise traveling of the contact line during span, based on the contact line LRS and mast positions.

Relationships

Source	Type	Target
Span Alignment	Association	Contact Line LRS

6.3 Positioning

6.3.1 Class diagram "Positioning"

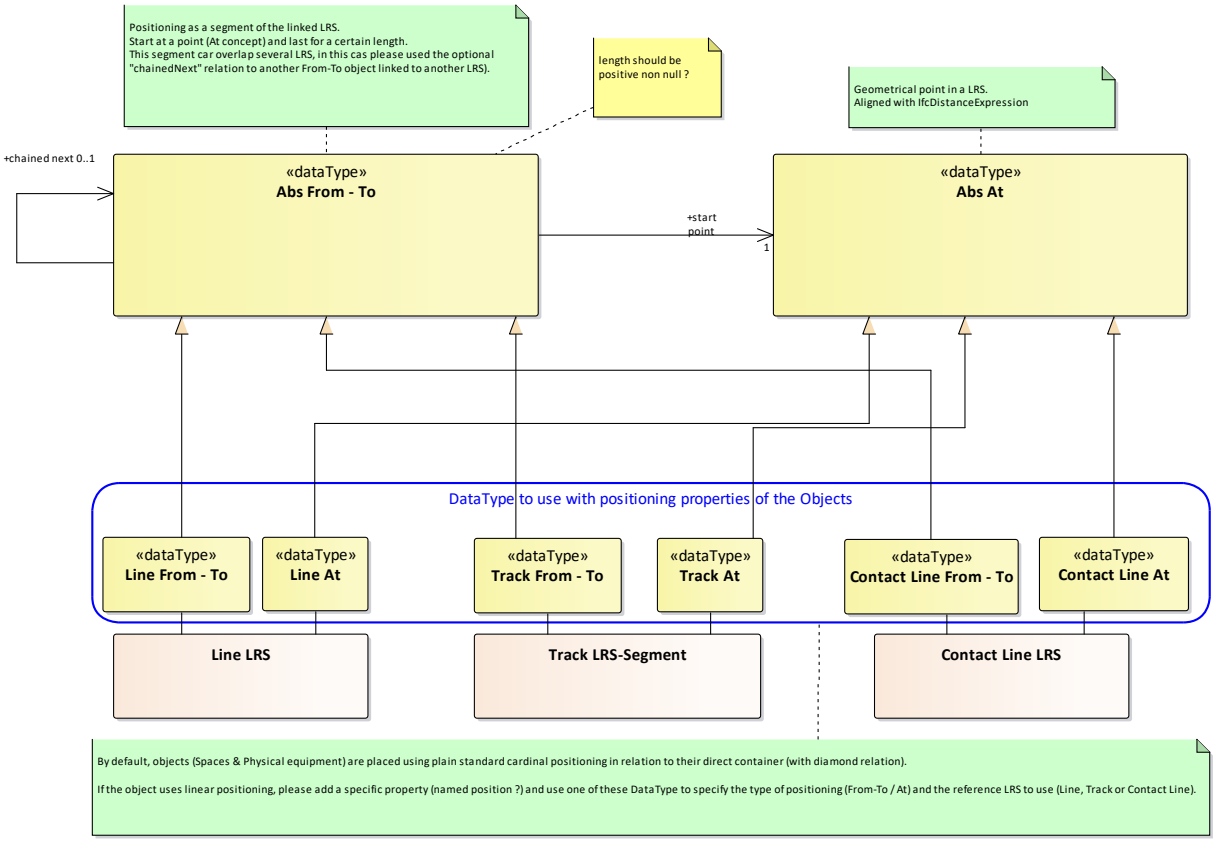


Table 72: Class diagram "Positioning"

6.3.2 Abs At

Abstracted At DataType used to gather common properties used by all usage of the At (point-based type) positioning.

Properties

Name	Type	Description
DistanceAlong	float	
OffsetLateral	float	
OffsetVertical	float	
OffsetLongitudinal	float	
AlongHorizontal	boolean	

Relationships

Source	Type	Target
Abs From - To	Association	Abs At
Line At	Generalization	Abs At
Contact Line At	Generalization	Abs At
Note	NoteLink	Abs At
Track At	Generalization	Abs At

6.3.3 Abs From - To

Abstracted From-To DataType used to gather common properties used by all usage of the From - To (segment type) positioning.

Properties

Name	Type	Description
start point	Abs At	
length	float	
chained next	Abs From - To	

Relationships

Source	Type	Target
Abs From - To	Association	Abs At
Abs From - To	Association	Abs From - To
Abs From - To	NoteLink	Note
Abs From - To	NoteLink	Note
Track From - To	Generalization	Abs From - To
Abs From - To	Association	Abs From - To
Line From - To	Generalization	Abs From - To
Contact Line From - To	Generalization	Abs From - To

6.3.4 Contact Line At

Data type to specify a point-based positioning relative to the Line.

Relationships

Source	Type	Target
Contact Line At	Generalization	Abs At
Contact Line At	Association	Contact Line LRS

6.3.5 Contact Line From - To

Data type to specify a linear positioning relative to the Contact Line.

Relationships

Source	Type	Target
Contact Line From - To	Association	Contact Line LRS
Contact Line From - To	Generalization	Abs From - To

6.3.6 Line At

Data type to specify a point-based positioning relative to the Line.

Relationships

Source	Type	Target
Line At	Association	Line LRS
Line At	Generalization	Abs At

6.3.7 Line From - To

Data type to specify a linear positioning relative to the Line.

Relationships

Source	Type	Target
Line From - To	Association	Line LRS
Line From - To	Generalization	Abs From - To

6.3.8 Track At

Data type to specify a point-based positioning relative to the Line.

Relationships

Source	Type	Target
Track At	Generalization	Abs At
Track At	Association	Track LRS-Segment

6.3.9 Track From - To

Data type to specify a linear positioning relative to the Track.

Relationships

Source	Type	Target
Track From - To	Generalization	Abs From - To
Track From - To	Association	Track LRS-Segment

6.4 Spatial Structure

6.4.1 Class diagram shared spatial structure - overview

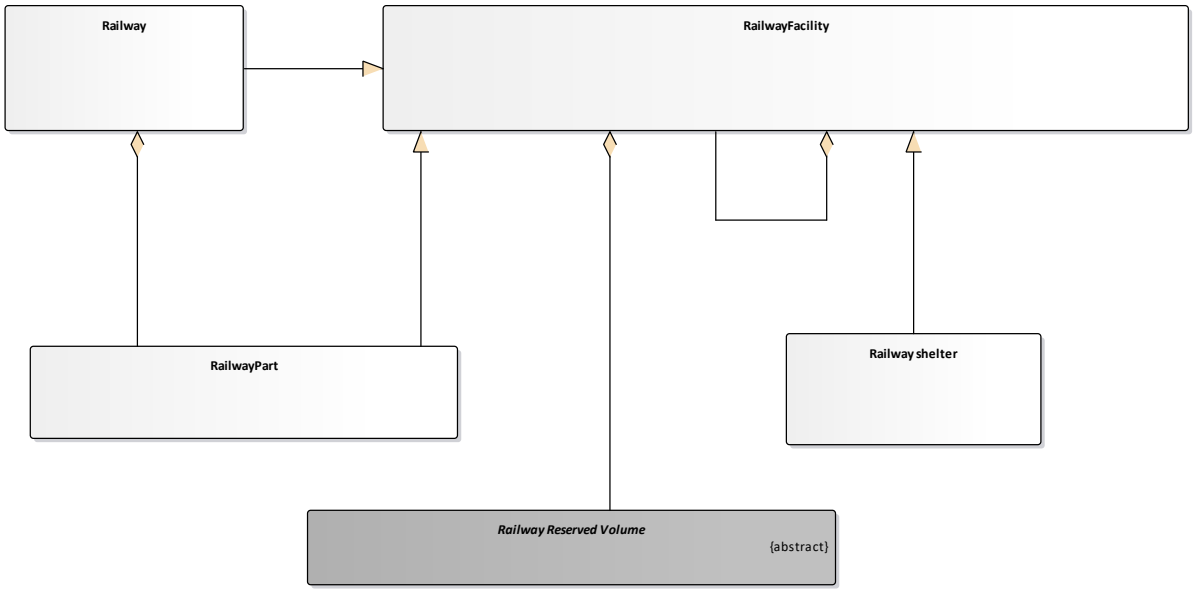


Table 73: Class diagram shared spatial structure - overview

6.4.2 Class diagram shared spatial structure - railway

Name: Class diagram shared spatial structure - railway
Author: Matthieu Perin
Version: 1.0
Created: 18.07.2019 12:01:58
Updated: 29.08.2019 13:13:48

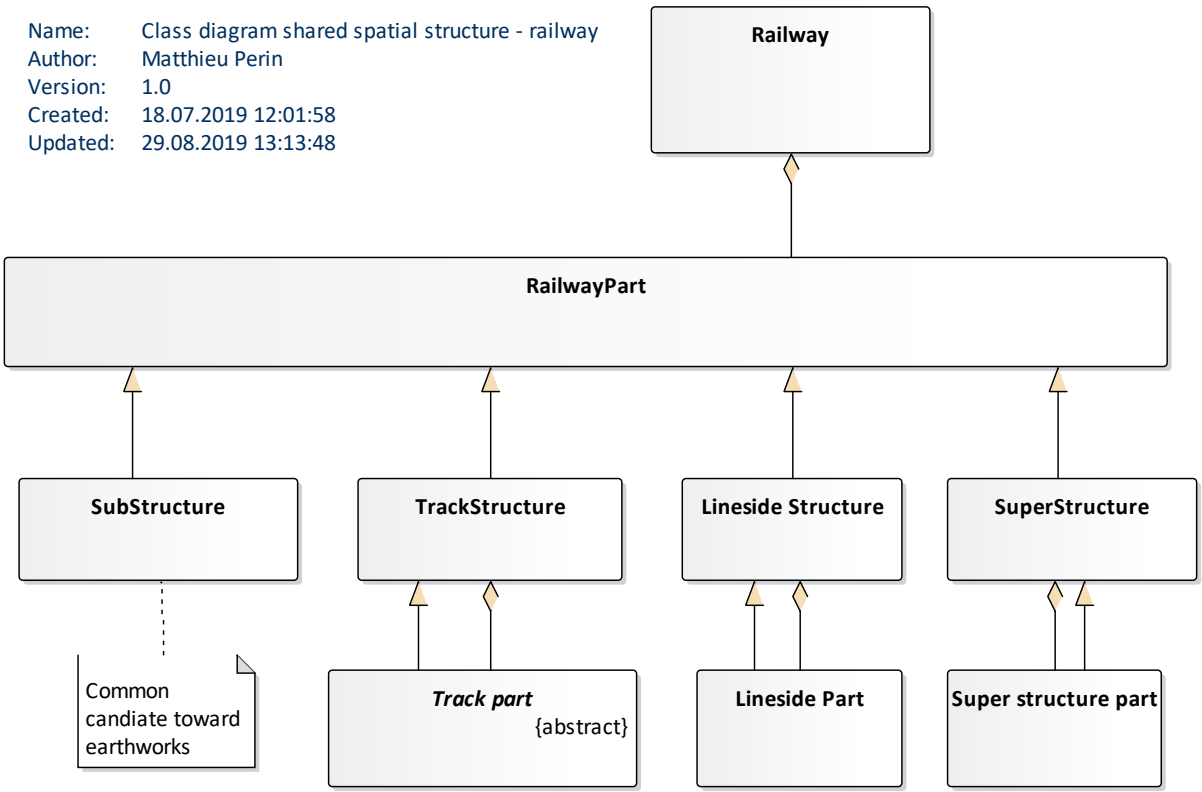


Table 74: *Class diagram shared spatial structure - railway*

6.4.3 Class diagram shared spatial structure - domain reserved volumes

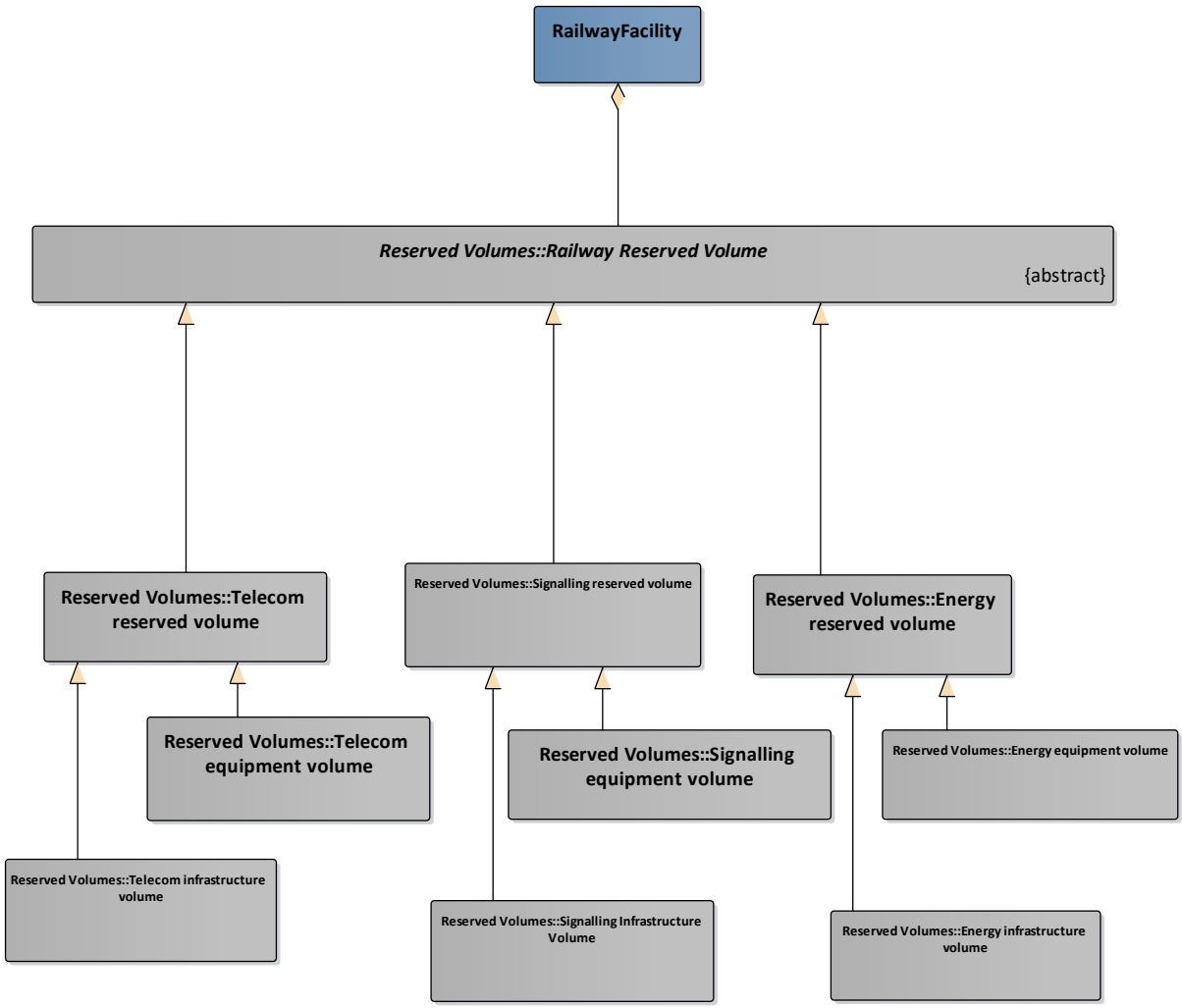


Table 75: Class diagram shared spatial structure - domain reserved volumes

6.4.4 Railway

This object represents the high level IfcSpace where train & rail objects operates.

Relationships

Source	Type	Target
Railway	Generalization	RailwayFacility
RailwayPart	Aggregation	Railway

6.4.5 Railway shelter

This concept represent railway related shelter.

Relationships

Source	Type	Target
Railway shelter	Generalization	RailwayFacility

6.4.6 RailwayFacility

Facility to ebe used for railway related operations.

Relationships

Source	Type	Target
RailwayFacility	Aggregation	RailwayFacility
RailwayFacility	NoteLink	Note
Railway	Generalization	RailwayFacility
Railway shelter	Generalization	RailwayFacility
Railway Reserved Volume	Aggregation	RailwayFacility
Railway energy facility	Generalization	RailwayFacility
RailwayFacility	Aggregation	RailwayFacility
RailwayPart	Generalization	RailwayFacility

6.4.7 Railway Spatial Structure

6.4.7.1 Lineside Part

Further decomposition of the lineside structure in more manageable volume for engineering purposes.

Relationships

Source	Type	Target
Lineside Part	Aggregation	Lineside Structure
Lineside Part	Generalization	Lineside Structure

6.4.7.2 Lineside Structure

This is the spatial structure that will hold the element that are in a railway but lineside (not in or over the tracks)

Relationships

Source	Type	Target
Lineside Structure	Generalization	RailwayPart
Lineside Part	Aggregation	Lineside Structure
Lineside Part	Generalization	Lineside Structure

6.4.7.3 RailwayPart

Represents a subdivision of an IfcRailway such as Lines & Tracks

Relationships

Source	Type	Target
RailwayPart	Aggregation	Railway
RailwayPart	Generalization	RailwayFacility
SuperStructure	Generalization	RailwayPart
SubStructure	Generalization	RailwayPart
TrackStructure	Generalization	RailwayPart
RailwayAssembly	Aggregation	RailwayPart
Lineside Structure	Generalization	RailwayPart

6.4.7.4 *SubStructure*

Spatial structure to hold earthwork related element

Relationships

Source	Type	Target
SubStructure	NoteLink	Note
SubStructure	Generalization	RailwayPart

6.4.7.5 *Super structure part*

This a further decomposition of railway superstructure in section to help engineering.

Relationships

Source	Type	Target
Super structure part	Aggregation	SuperStructure
Super structure part	Generalization	SuperStructure

6.4.7.6 *SuperStructure*

Spatial structure to hold elements that are over the tracks such as catenaries.

Relationships

Source	Type	Target
SuperStructure	Generalization	RailwayPart
Super structure part	Aggregation	SuperStructure
Super structure part	Generalization	SuperStructure

6.4.7.7 *TrackStructure*

Spatial structure to hold track related element

Relationships

Source	Type	Target
TrackStructure	Generalization	RailwayPart
TrackStructure	Association	LineAlignment
Track part	Generalization	TrackStructure
Track part	Aggregation	TrackStructure

6.4.8 Reserved Volumes

6.4.8.1 Energy equipment volume

Space that is reserved to install energy equipment

Relationships

Source	Type	Target
Energy equipment volume	Generalization	Energy reserved volume

6.4.8.2 Energy infrastructure volume

Space that is reserved to install energy infrastructure

Relationships

Source	Type	Target
Energy infrastructure volume	Generalization	Energy reserved volume
Overhead line infrastructure reservation	Generalization	Energy infrastructure volume

6.4.8.3 *Energy reserved volume*

Space that is reserved to install energy equipment and facilities

Relationships

Source	Type	Target
Energy reserved volume	Generalization	Railway Reserved Volume
Overhead line overlap zone	Generalization	Energy reserved volume
Tensioning section	Generalization	Energy reserved volume
Energy return current zone	Generalization	Energy reserved volume
Energy earthing zone	Generalization	Energy reserved volume
Energy infrastructure volume	Generalization	Energy reserved volume
Energy electric transfer zone	Generalization	Energy reserved volume
Energy equipment volume	Generalization	Energy reserved volume
Energy underground line zone	Generalization	Energy reserved volume
Technical Building	Generalization	Energy reserved volume

6.4.8.4 *Railway Reserved Volume*

Abstract concept of a volume reserved for railways domain placement of infrastructure and equipment.

Relationships

Source	Type	Target
Railway Reserved Volume	Aggregation	RailwayFacility
Signalling reserved volume	Generalization	Railway Reserved Volume
Energy reserved volume	Generalization	Railway Reserved Volume
Telecom reserved volume	Generalization	Railway Reserved Volume

6.4.8.5 *Signalling Infrastructure Volume*

This is the zone (non-strictly reserved space) where any signalling infrastructure -mast, pole, layout) can be installed.

It has shape, and this shape is flexible.

Relationships

Source	Type	Target
Signalling Infrastructure Volume	Generalization	Signalling reserved volume

6.4.8.6 Telecom equipment volume

Space that is reserved to install telecom equipment

Relationships

Source	Type	Target
Telecom equipment volume	Generalization	Telecom reserved volume
Telecom equipment volume	Association	Equipment access zone
Outdoor telecom equipment zone	Generalization	Telecom equipment volume
Indoor telecom equipment zone	Generalization	Telecom equipment volume
Rack	Aggregation	Telecom equipment volume

6.4.8.7 Telecom infrastructure volume

Space that is reserved to install telecom infrastructure (support or layout)

Relationships

Source	Type	Target
Telecom infrastructure volume	Generalization	Telecom reserved volume

Source	Type	Target
Telecom support infrastructure	Aggregation	Telecom infrastructure volume
Telecom laying infrastructure zone	Generalization	Telecom infrastructure volume

6.4.8.8 Telecom reserved volume

Space that is reserved to install telecom equipment and facilities

Relationships

Source	Type	Target
Telecom reserved volume	Generalization	Railway Reserved Volume
Indoor telecom zone	Generalization	Telecom reserved volume
Telecom infrastructure volume	Generalization	Telecom reserved volume
Overhead line	Association	Telecom reserved volume
Abs_telecom object	Aggregation	Telecom reserved volume
Track	Association	Telecom reserved volume
Telecom equipment volume	Generalization	Telecom reserved volume
Outdoor Telecom zone	Generalization	Telecom reserved volume

6.4.8.9 Signalling reserved volume

Space that is reserved to install signalling equipment and facilities

Relationships

Source	Type	Target
Signalling reserved volume	Generalization	Railway Reserved Volume
Signalling reserved volume	Generalization	NetEntities Partition
Signalling Infrastructure Volume	Generalization	Signalling reserved volume

Source	Type	Target
Signalling equipment volume	Generalization	Signalling reserved volume

6.4.8.10 Signalling equipment volume

This is the zone (non-strictly reserved space) where any signalling equipment can be installed.

It has shape, and this shape is flexible.

Relationships

Source	Type	Target
Signalling equipment volume	Generalization	Signalling reserved volume
Abs_Signalling equipment	Aggregation	Signalling equipment volume
Signalling Outdoor Equipment placeholder (trackside)	Generalization	Signalling equipment volume
Signalling Indoor Equipment Placeholder (non-trackside)	Generalization	Signalling equipment volume