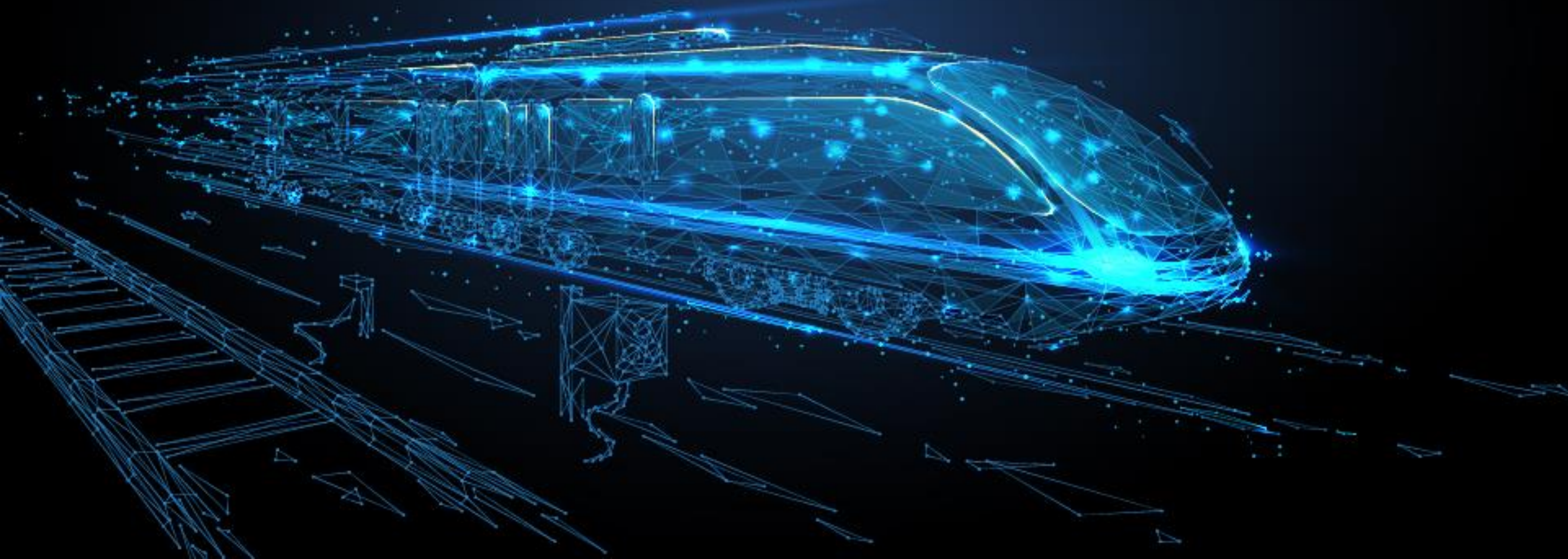




INTERNATIONAL UNION
OF RAILWAYS

DIGITAL MODELLING INITIATIVES FOR THE OPERATIONAL RAILWAY



Webinar

June 30, 2021

Opening remarks

François Davenne

Director General, UIC



Opening Remarks (François Davenne, UIC Director General)

Session 1 (11.00-12.30)

RailSystemModel

- RailSystemModel fundamentals
- What's new in RSM1.2?
- Example of projects in relation to RailSystemModel

OntoRail

- What is OntoRail?
- What are ontologies?
- OntoRail fundamentals

Session 2 (13.30-15.30)

Perspectives

- RailSystemModel & OntoRail as enablers of the Conceptual Data Model (UIC)
- Digital Twin at SNCF (Gilles Dessagne, SNCF Réseau)
- RSM in support of FRMCS (UIC)
- Signalling data preparation with RailSystemModel and EULYNX (Dr. Bob Janssen, EULYNX information modeller)

Next Steps

Closing Remarks (Pierre-Etienne Gautier, SNCF Réseau)

RSM[®]
Rail SystemMODEL

RSM

Rail System Model: RSM fundamentals



What is RSM ?

A conceptual and implementable model of the railway system...

- “One concept, one class” – SOLID design principles
- Project-independent, not limited to specific “use cases”

A set of UML packages and class diagrams...

- UML most widespread
- Suitable for code (Java, C#...) and scheme (XSD...) generation

An ontology in Ontorail...

- “True image” UML to OWL extraction
- For model linking and information exchange

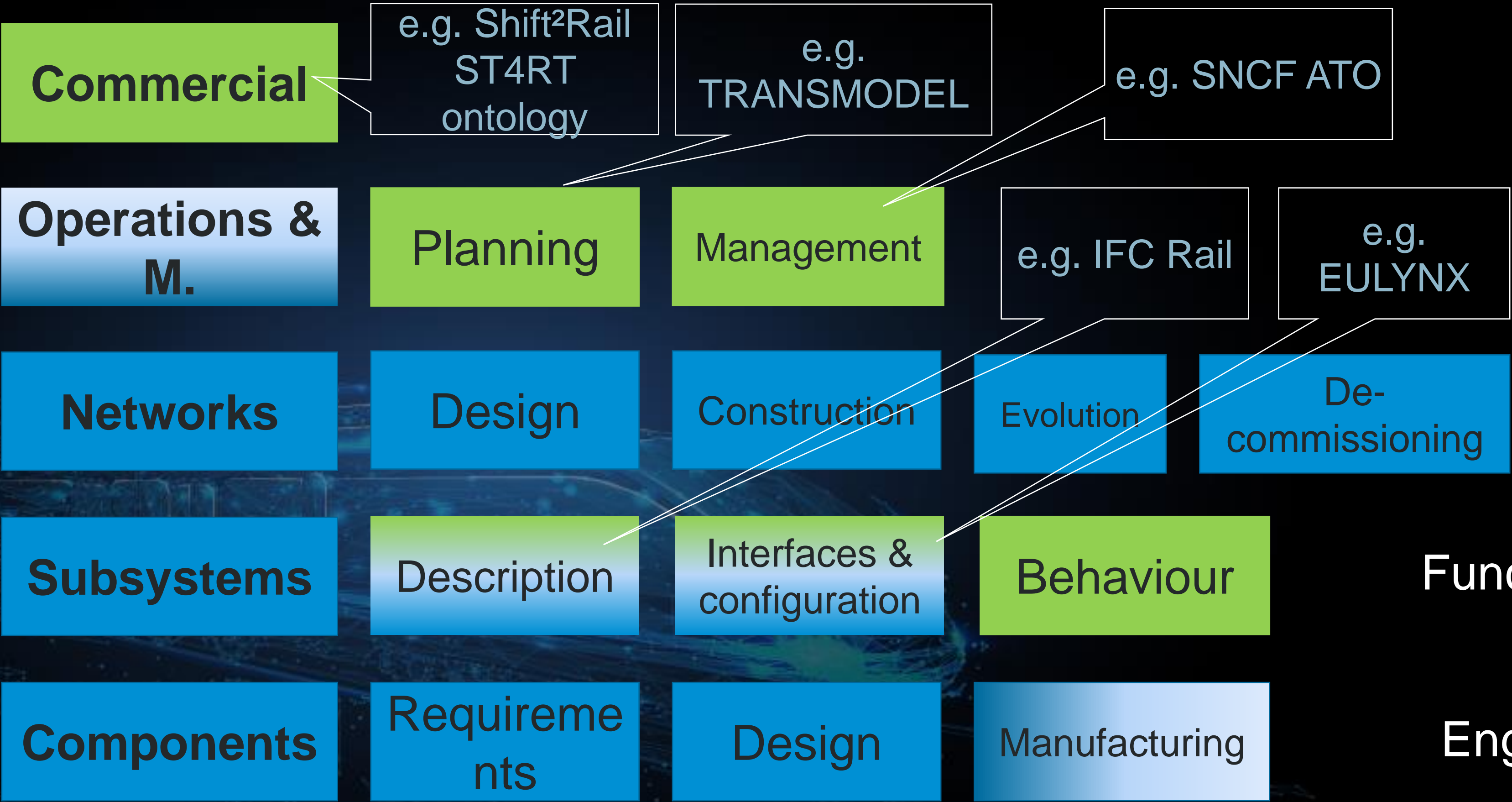
An International Railway Standard by UIC.

- RTM 1.1 : IRS 30100
- RSM: 1.2
 - Live documentation on rsm.uic.org
 - Later published as eIRS

RSM coverage

Green = delegated

Business capability levels



Project stages

Functional modelling

Engineering stages

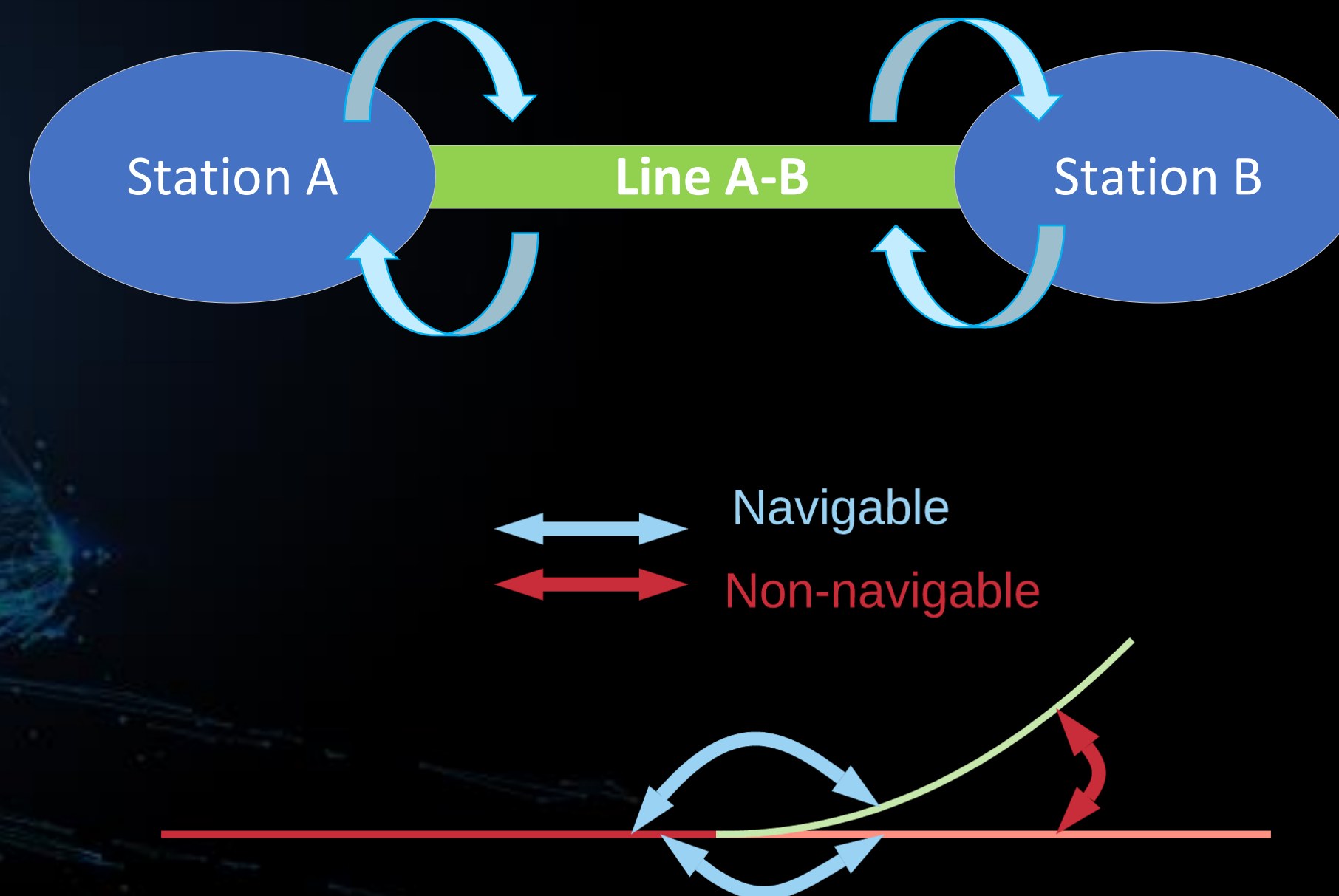
Topology: Kernel of RSM

Topology answers the question “**what railway net element is connected to what other net element**”, using one formal representation, regardless of **scale** or **level of detail**.

Net elements can correspond to lines, or tracks, or stations...
Topology relations are explicit and allow correct pathfinding.

MACRO level: stations and line have bi-directionally navigable relations

MICRO level: topological (track) segments relations may be navigable or not



RSM 1.2 highlights



Package overview

Infrastructure

*Sorted by subsystem,
broken down into Net Entities*

Currently:

Track

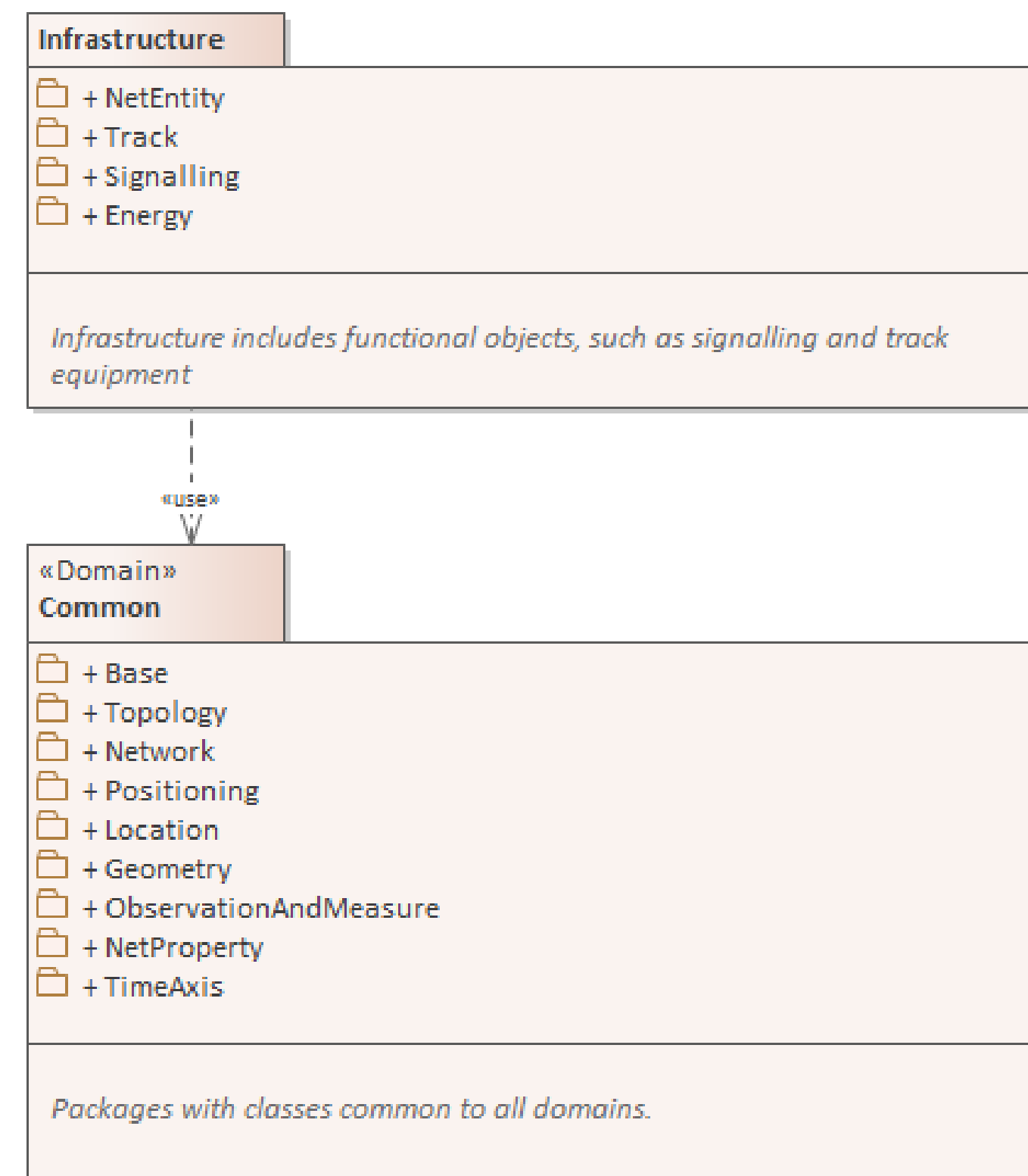
Signalling

Energy

Common

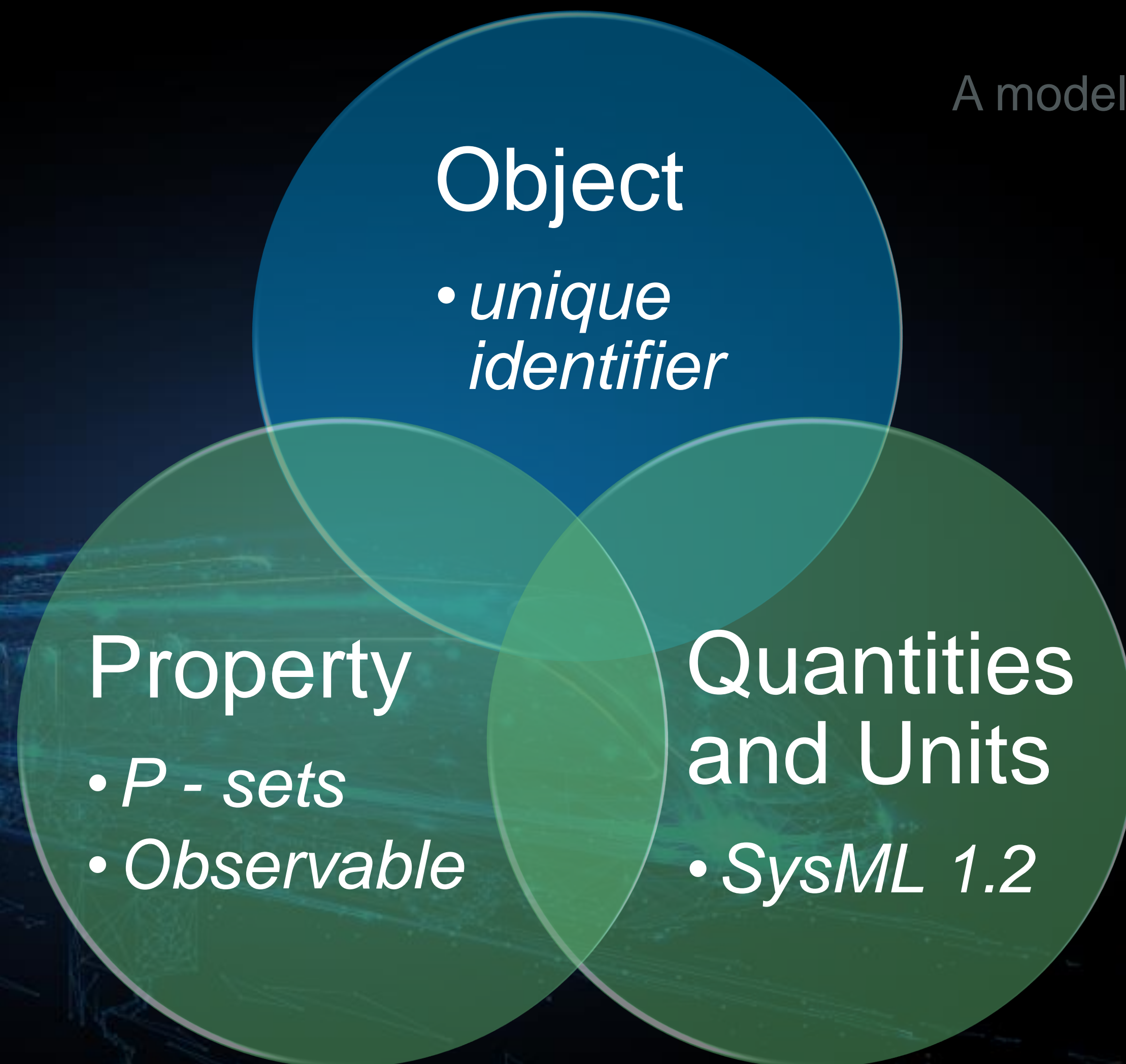
RSM1.2 - Overview of packages

This diagram presents an overview of the packages in version 1.2 of RailSystemModel (RSM).

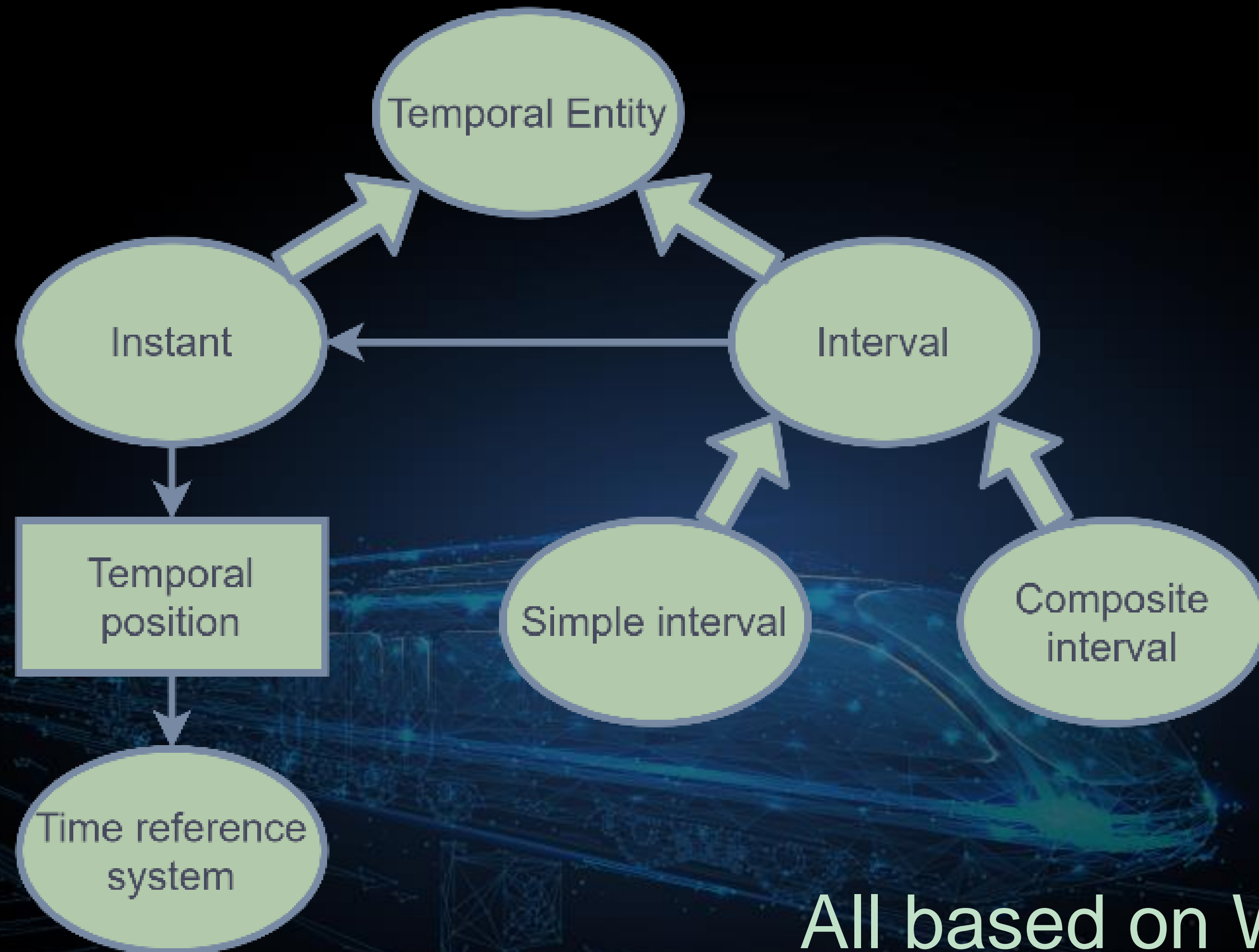


Base package : **new responsibilities**

A model by engineers, for all professionals

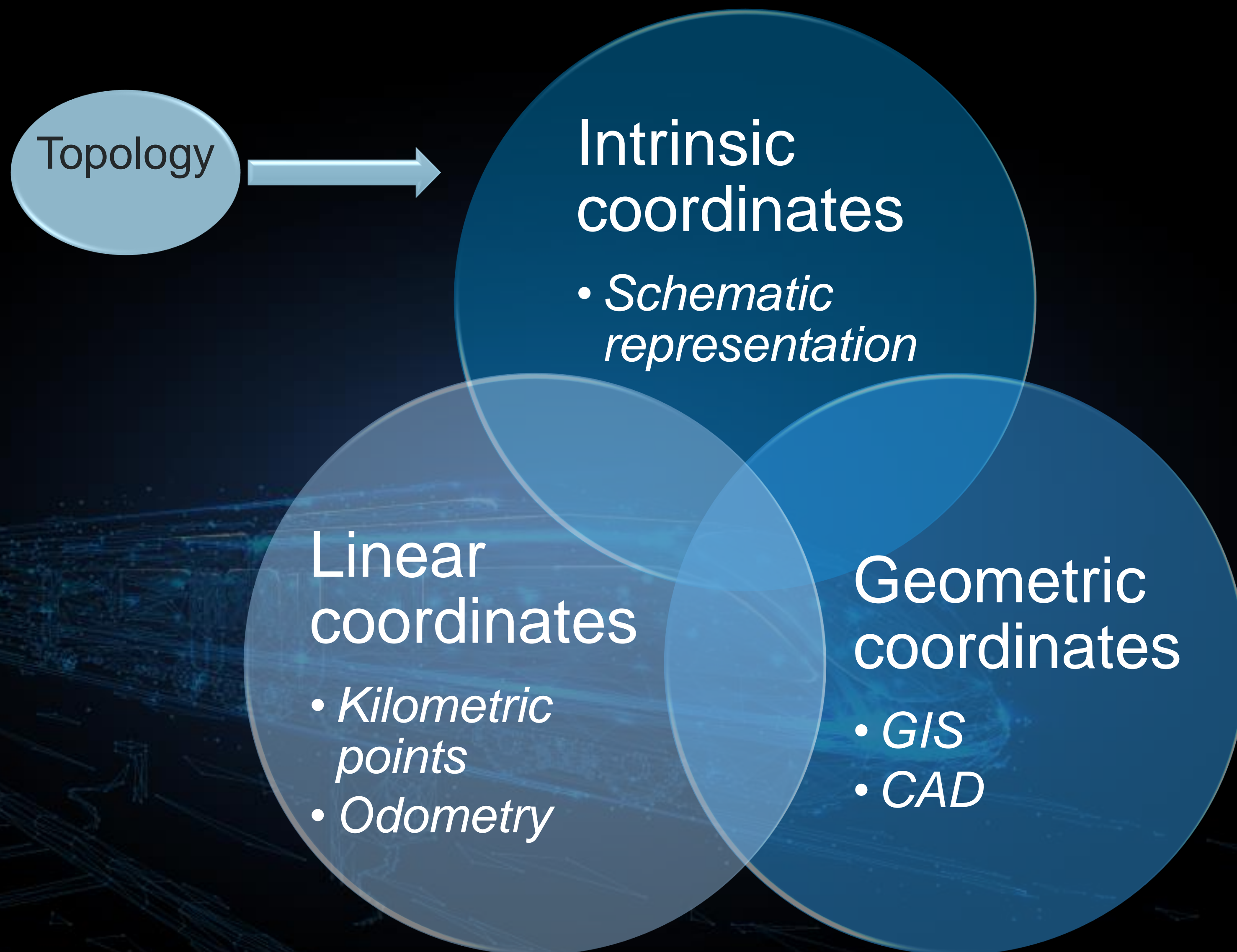


Time Axis : instants, intervals, calendars



All based on W3C / OGC time ontology
<https://www.w3.org/TR/owl-time/>

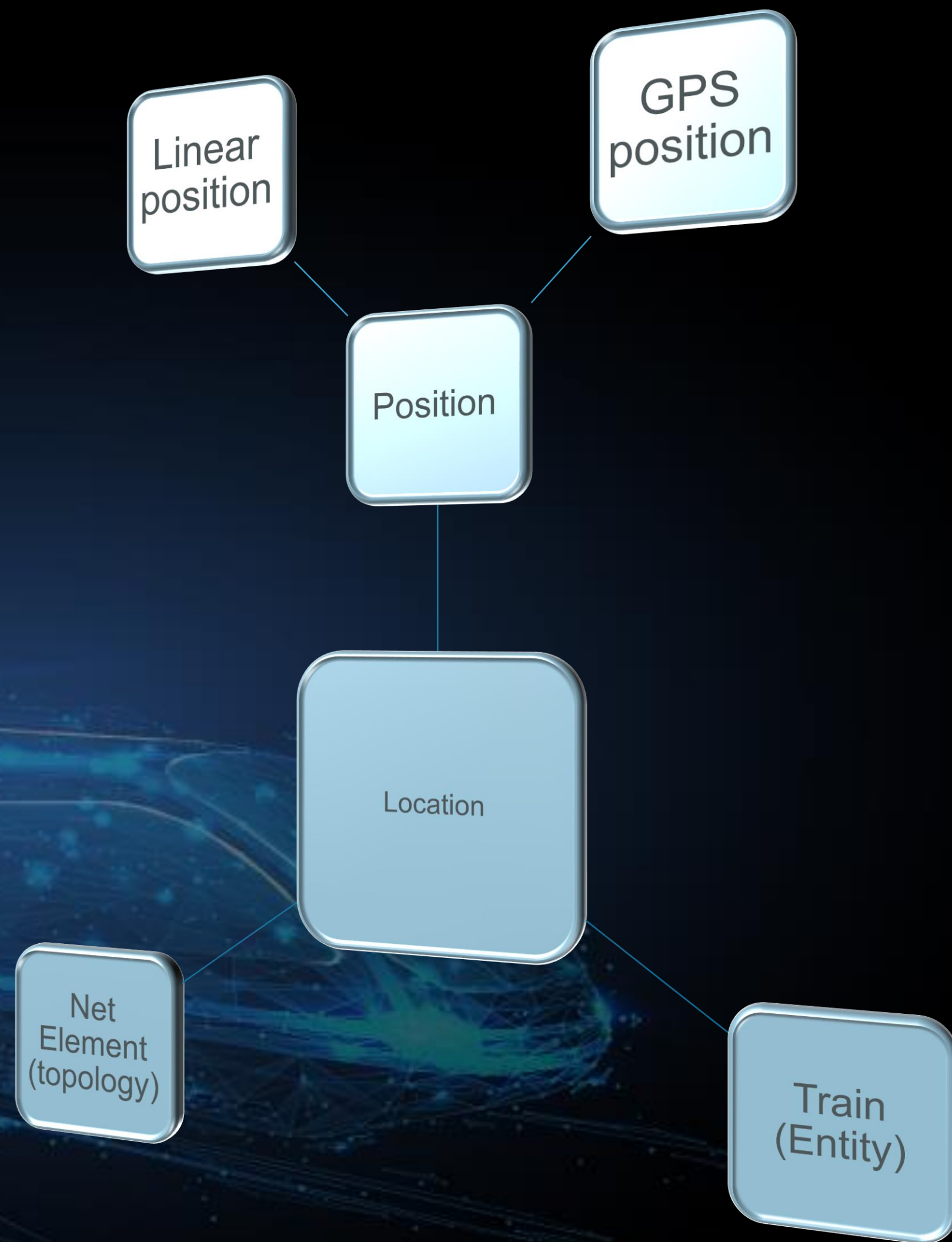
Positioning : OGC concepts adapted to railways



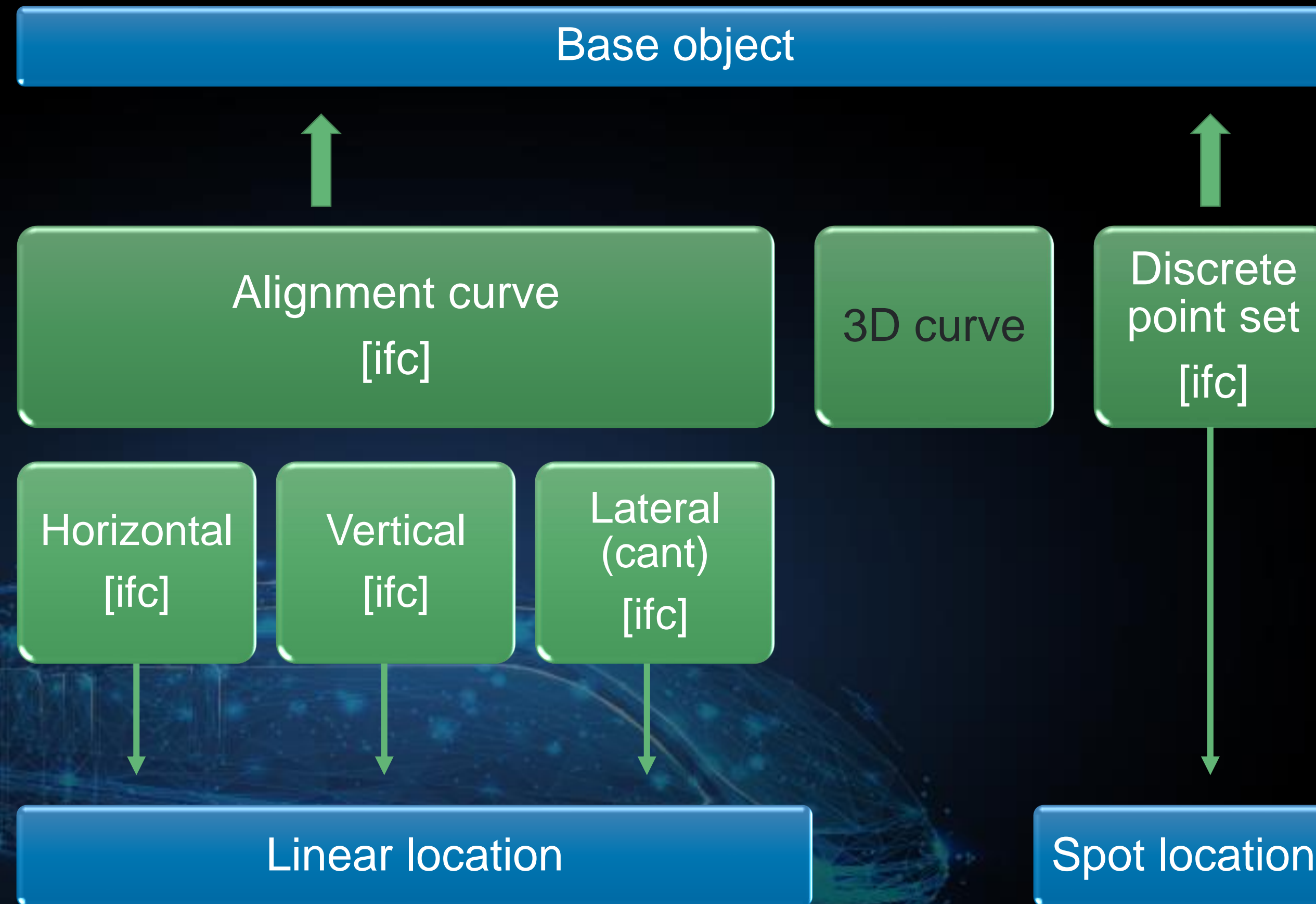
Location : simplified

Sample use case:
“where is my train?”

“Location” pulls the
information together.

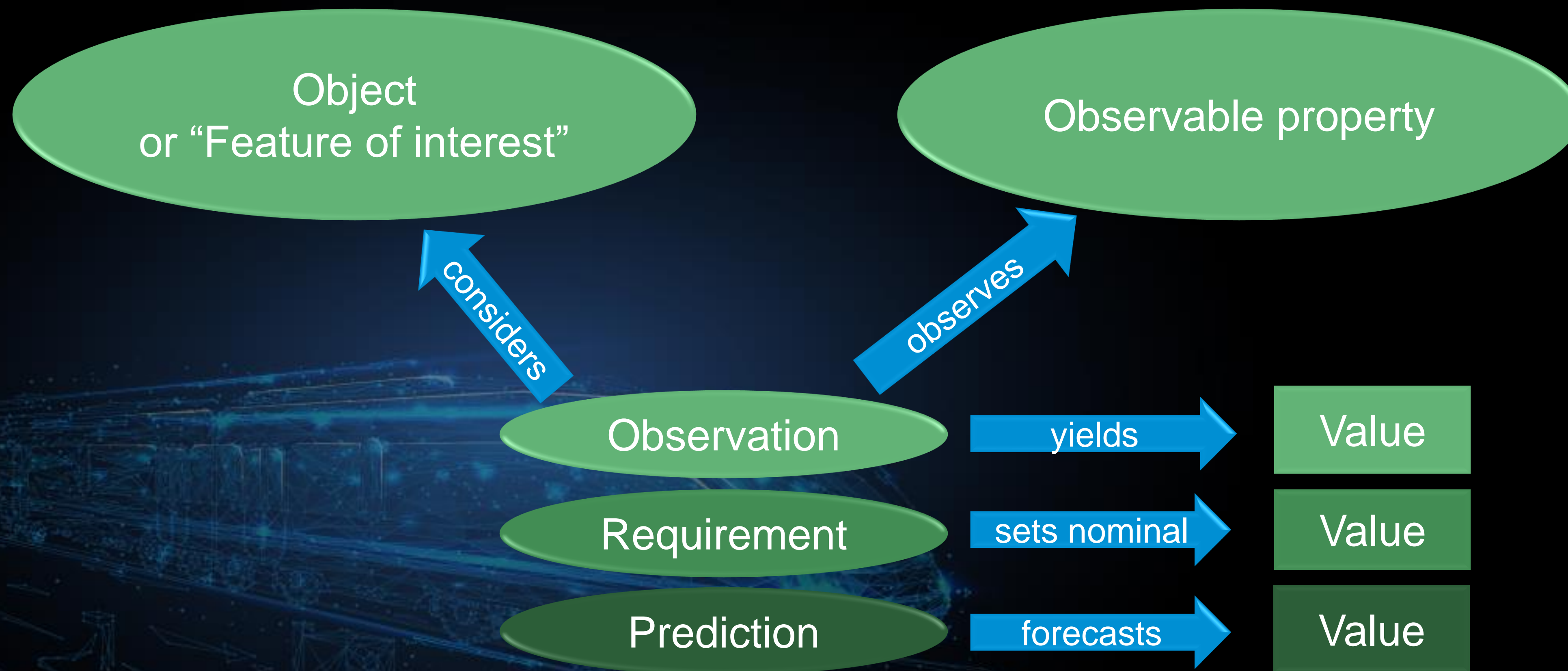


Geometry : cooperating with bSI - IFC Rail project



Geometry rests on classes defined by buildingSMART International, for the purpose of IFC (Industry Foundation Classes) and extended with railway-specific notions (cant / inclination). bSI classes themselves inspired by OGC.
3D-curves added: not widely used, but futureproof.

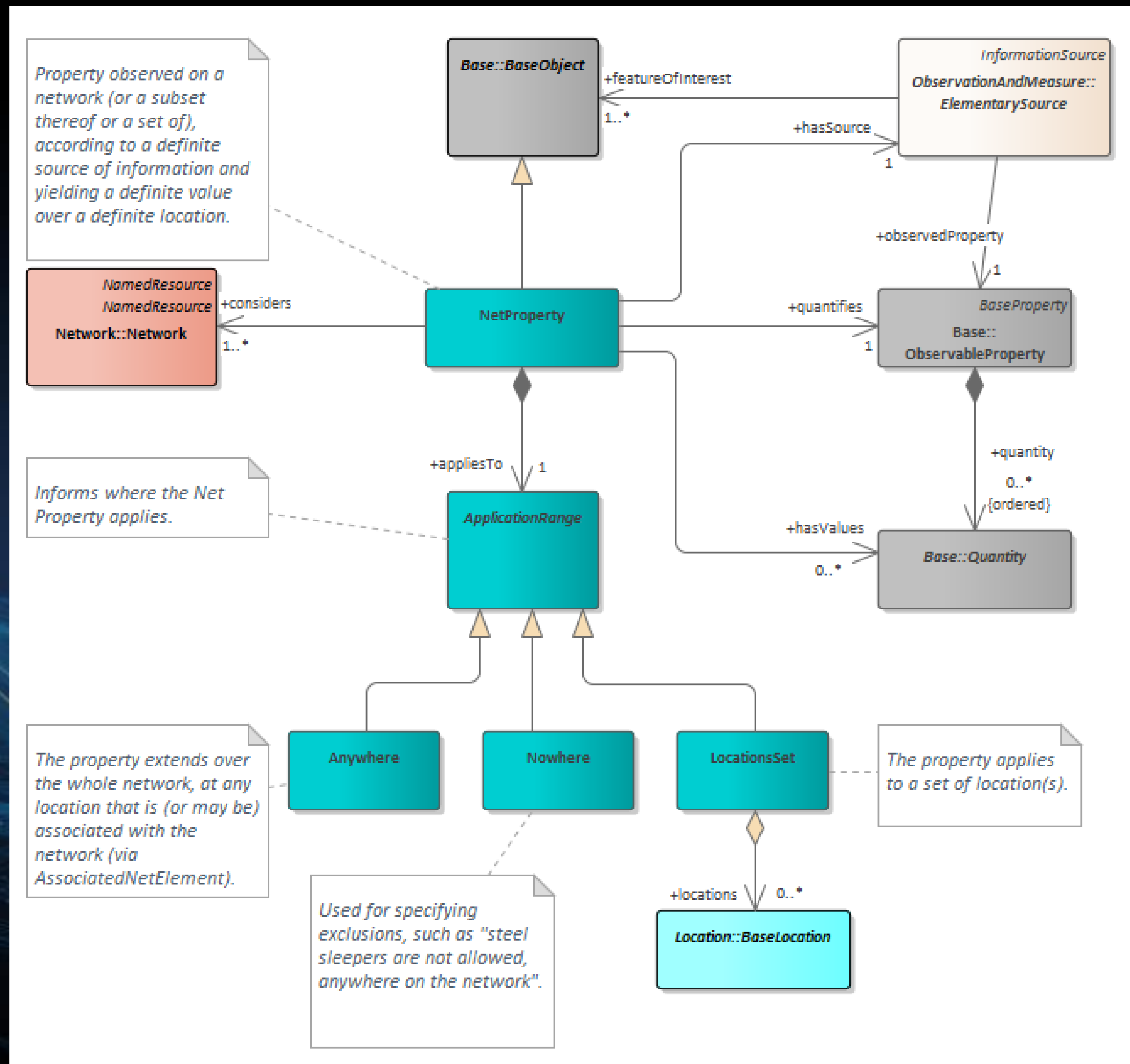
Observation and Measure : ready for IOT and predictive maintenance



Package rests on ontology SOSA / SSN, jointly developed by W3C and OGC
(Sensors, observation, actuation and sampling / Semantic sensor network)
Requirement and Prediction added: a use case examined with buildingSMART Intl. (IFC Rail project).

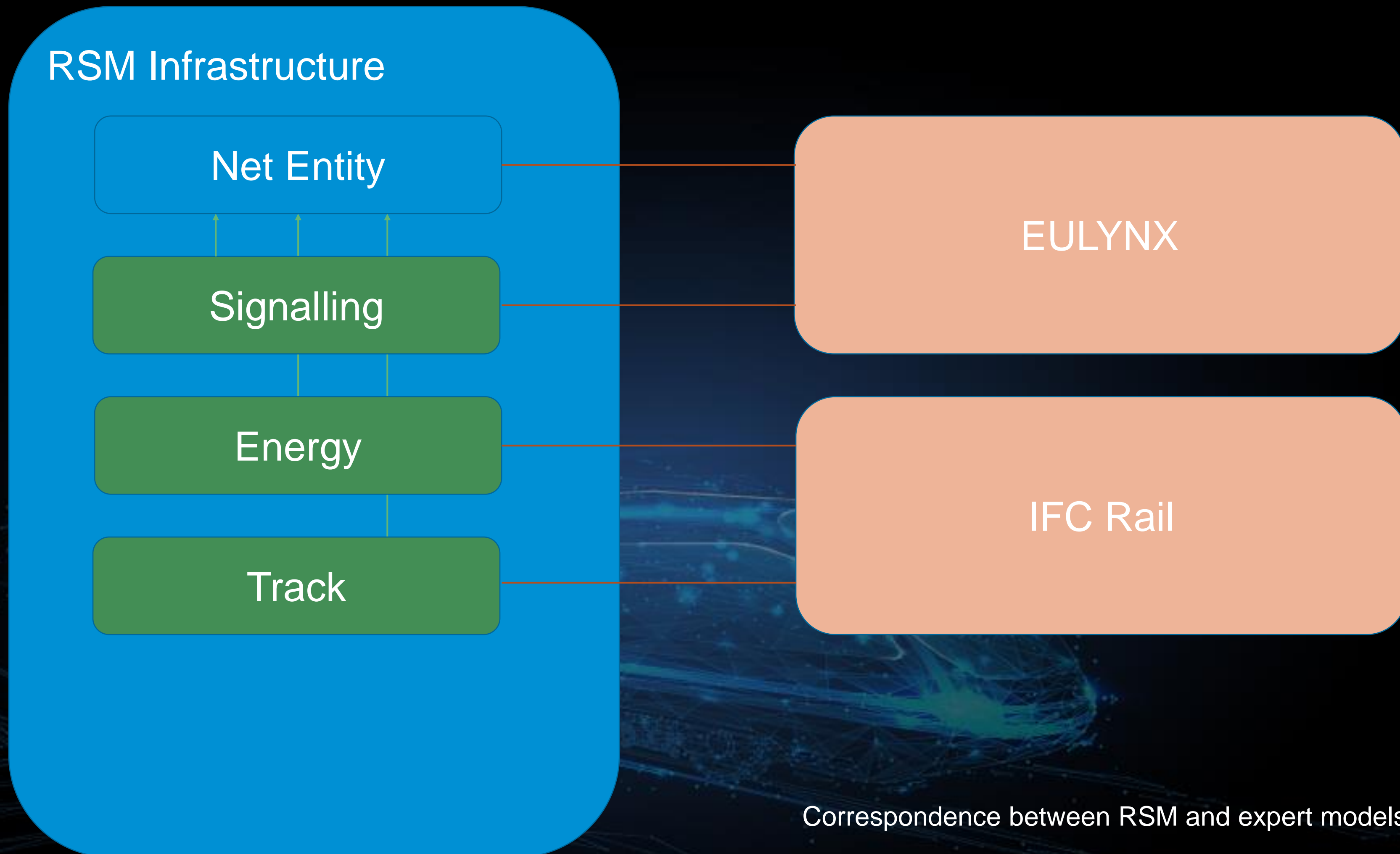
Net Property : a bird's eye view on the network

- “Net property” or “Line property” observes atomic data (property values) and sums them up over arbitrary “networks” (sets of net elements or net entities)
- “Net property” or “Line property” values are **derived** (and **distinct**) from observed or nominal values
- E.g. “760mm” and “600mm” can be summed up into “narrow gauge”
- Can yield property values for RINF



Package results from cooperation with bSI / IFC Rail

Track, Signalling, Energy



Correspondence between RSM and expert models was established.

RSM at use in projects



EULYNX DataPrep (current)

See EULYNX presentation:

Signalling data preparation with RailSystemModel and EULYNX



SIA (H2020): predictive maintenance

General goal

- Develop 4 ready-to-use new services to provide prognosis of health status of the railway's most cost-intensive assets, at the points of interaction between the vehicle and the infrastructure (wheelset / rail, pantograph / catenary)

Specific goal

- UML model and XSD generation to support data exchange from sensors to diagnosis centres

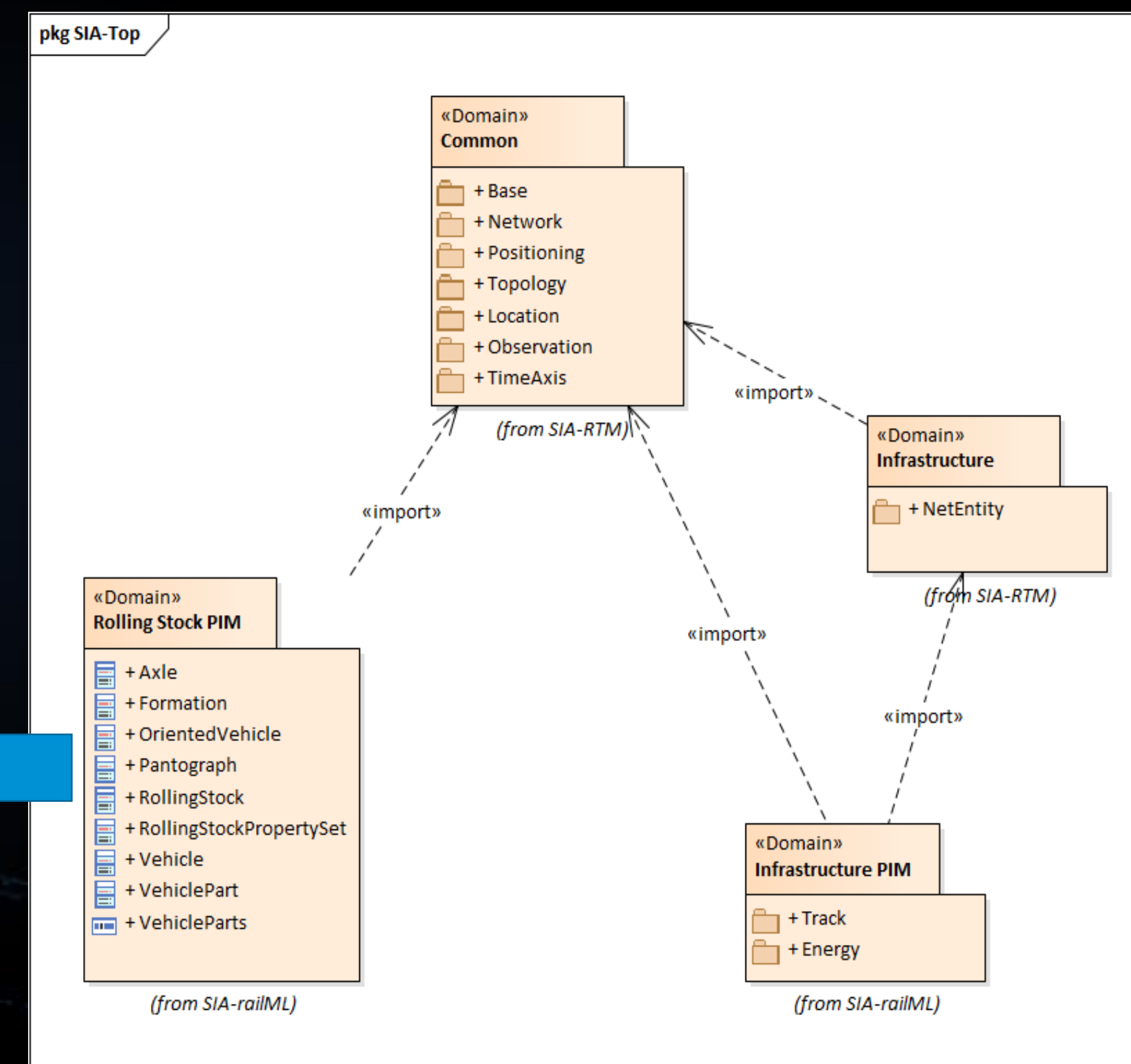
Achievement

- Model federation: RSM basis + railML3 parts (subsystems)

```

<xs:complexType name="ElectrificationSection">
  <xs:complexContent>
    <xs:extension base="LocatedNetEntity">
      <xs:sequence>
        <xs:element name="contactLineType" type="ContactLineType" minOccurs="1" maxOccurs="1"/>
        <xs:element name="has" type="ContactWire" minOccurs="0" maxOccurs="1"/>
        <xs:element name="belongsToParent" type="ElectrificationSection" minOccurs="0" maxOccurs="1"/>
        <xs:element name="energyCatenary" type="EnergyCatenary" minOccurs="0" maxOccurs="1"/>
        <xs:element name="energyPantograph" type="EnergyPantograph" minOccurs="0" maxOccurs="1"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="EnergyCatenary">
  <xs:sequence>
    <xs:element name="maxTrainCurrent" type="MaxTrainCurrent" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="EnergyPantograph">
  <xs:sequence/>
</xs:complexType>
<xs:complexType name="InfrastructureManager">

```



OPTIMA (Shift²Rail open call): Traffic Management System

The power of a conceptual model (Python implementation) at the service of a data model

OSM geometry

RSM network instantiation
(Python)

KML export

Display in
Google Earth

JSON export

py/object	RSM12beta.Common.XTN_Base.Sidecar
sID	10
_Name	Test Ventimiglia-Albenga import from osm file, sidecar
_resources	
DualGraph	
Geometric positioning system WGS84 (epsg:4326)	
Grid reference system ETRS89 LAEA Europe (epsg:3035)	
LRS	
Riferimento_lineare_binario_Nord	
py/object	RSM12beta.Common.XTN_Positioning.LinearLocationBasedLRS
sID	1765
_Name	Riferimento_lineare_binario_Nord
hasLinearReferencingMethod	relative
startMeasure	# 0
endMeasure	# null
anchors	
[]	
[]	
[]	
py/object	RSM12beta.Common.RSM_Positioning.AnchorPoint
sID	1779
_Name	kp2
_measure	
py/object	RSM12beta.Common.RSM_Base.Length
q_kind	
unit	
Value	# 2000
_measureToNext	
py/object	RSM12beta.Common.RSM_Base.Length
q_kind	
unit	
Value	# 1005.0

Test Ventimiglia-Albenga import from osm file, 3076916635_3077102637_0

sID	606
elementlength	637.92
path	{part of 417 to 531}
selection1	shortest path from 417 to 531

Linear referencing, regenerated

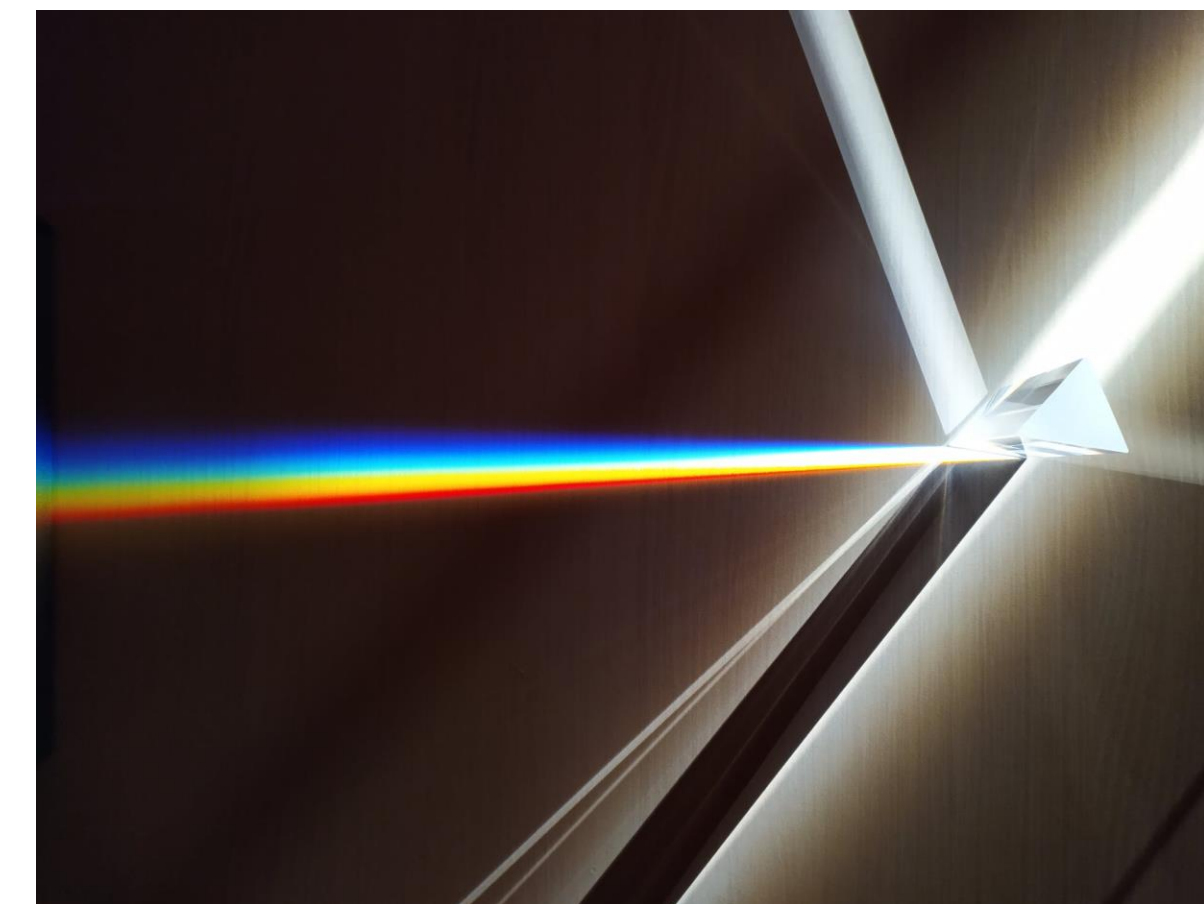
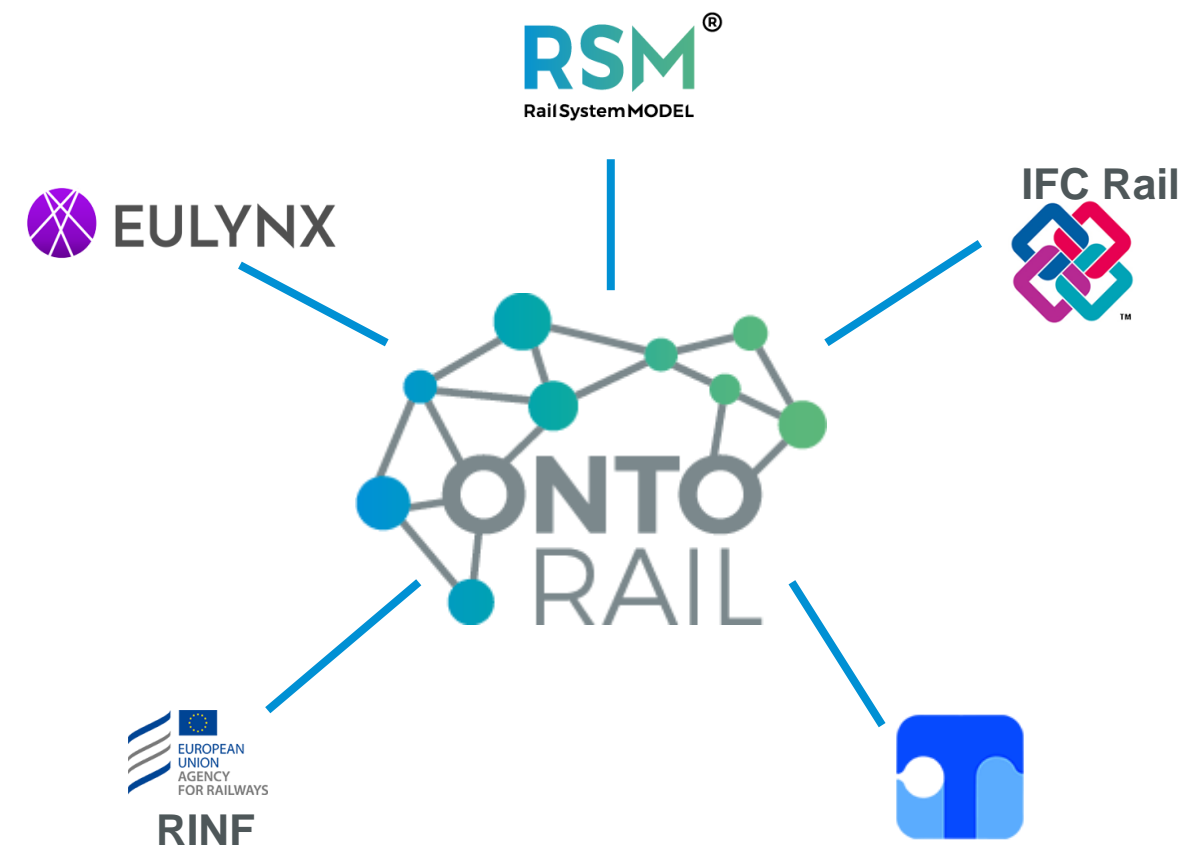


What is OntoRail?



An **Encyclopedia** to consolidate and enrich Railways Systems Modelling knowledge

A **Tool for Building Consensus** to promote and facilitate convergence and federation between models



A knowledge engine, powered by **Ontologies**

What are Ontologies?

Ontologies are formal representations of knowledge, built on a consensus on domain knowledge and on a shared and precise vocabulary to qualify relations between concepts.

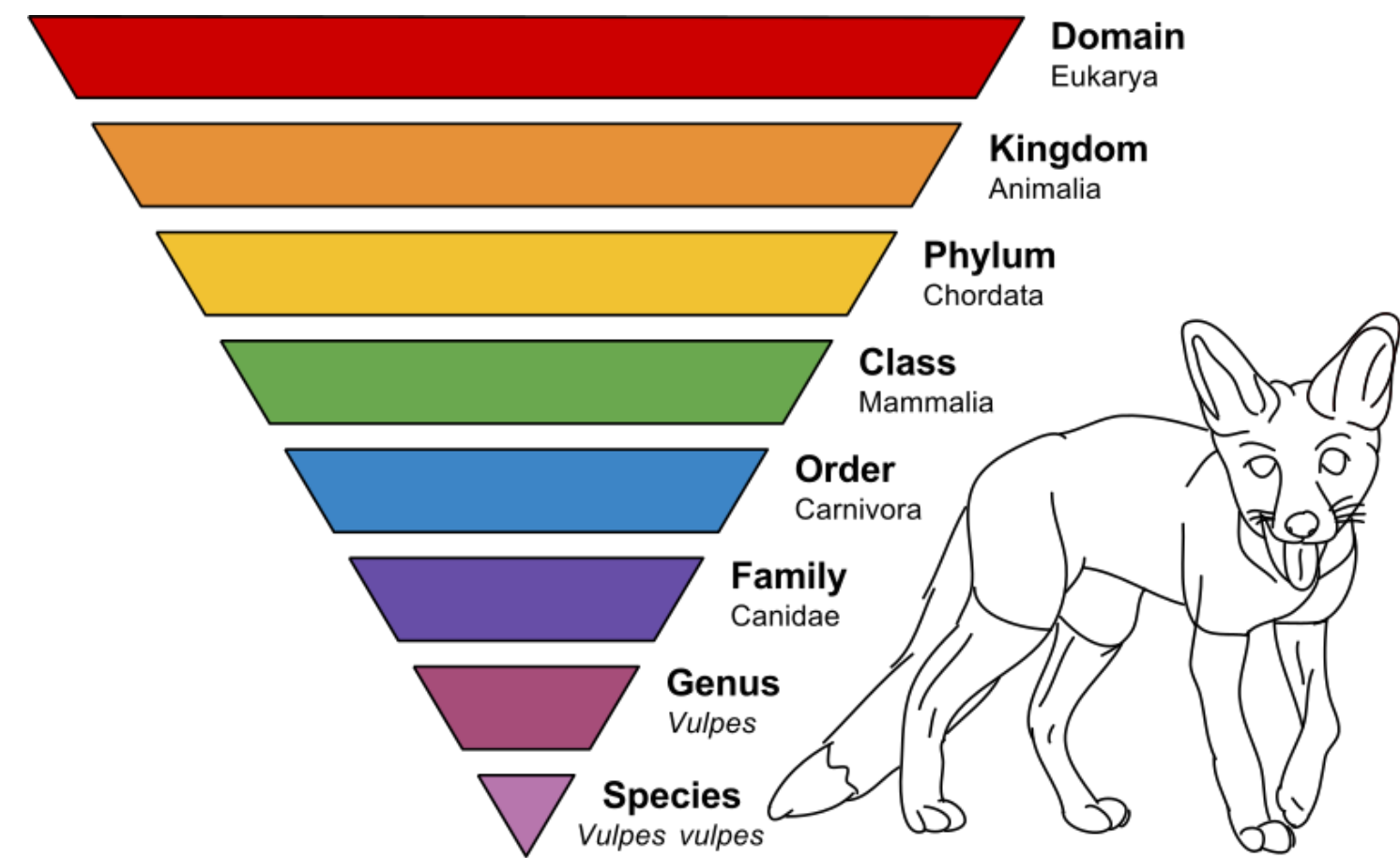


Image source: [Taxonomic Rank Graph.svg](#) by [Annina Breen](#) [CC-BY-SA]

Taxonomy

Subject-based classification
Hierarchical organization (parent / child)

- Additional statements about the subjects:
- BT broader term
 - NT narrower term (inverse of BT)
 - SN scope note
 - USE use
 - UF used for (inverse of USE)
 - TT top term
 - RT related term

Thesaurus

Extends taxonomies
Additional statements (BT, NT, SN, ...)

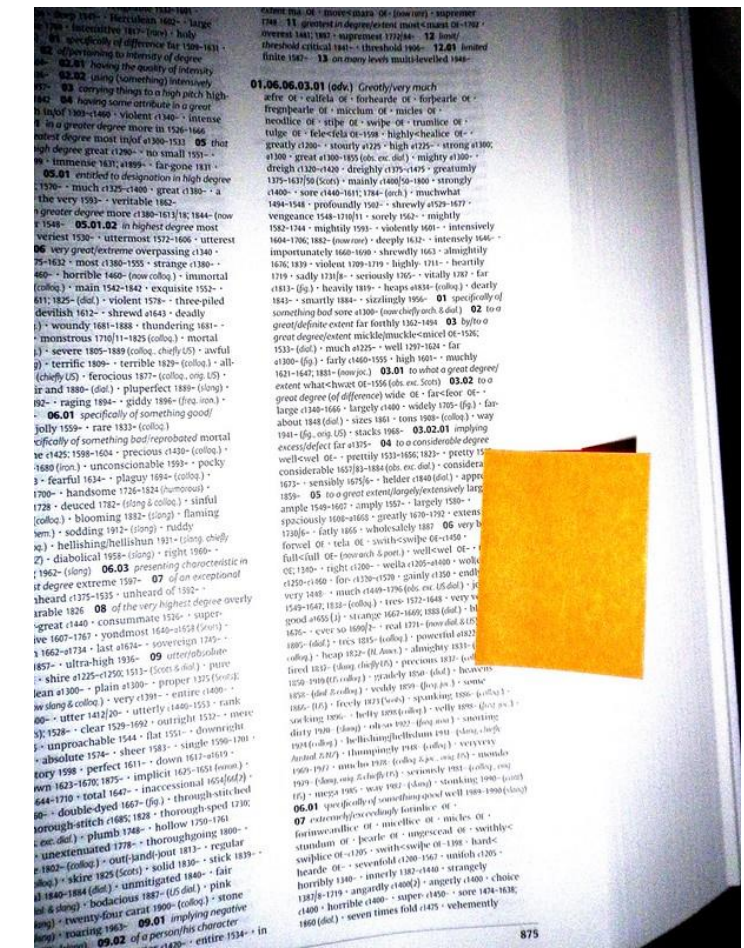
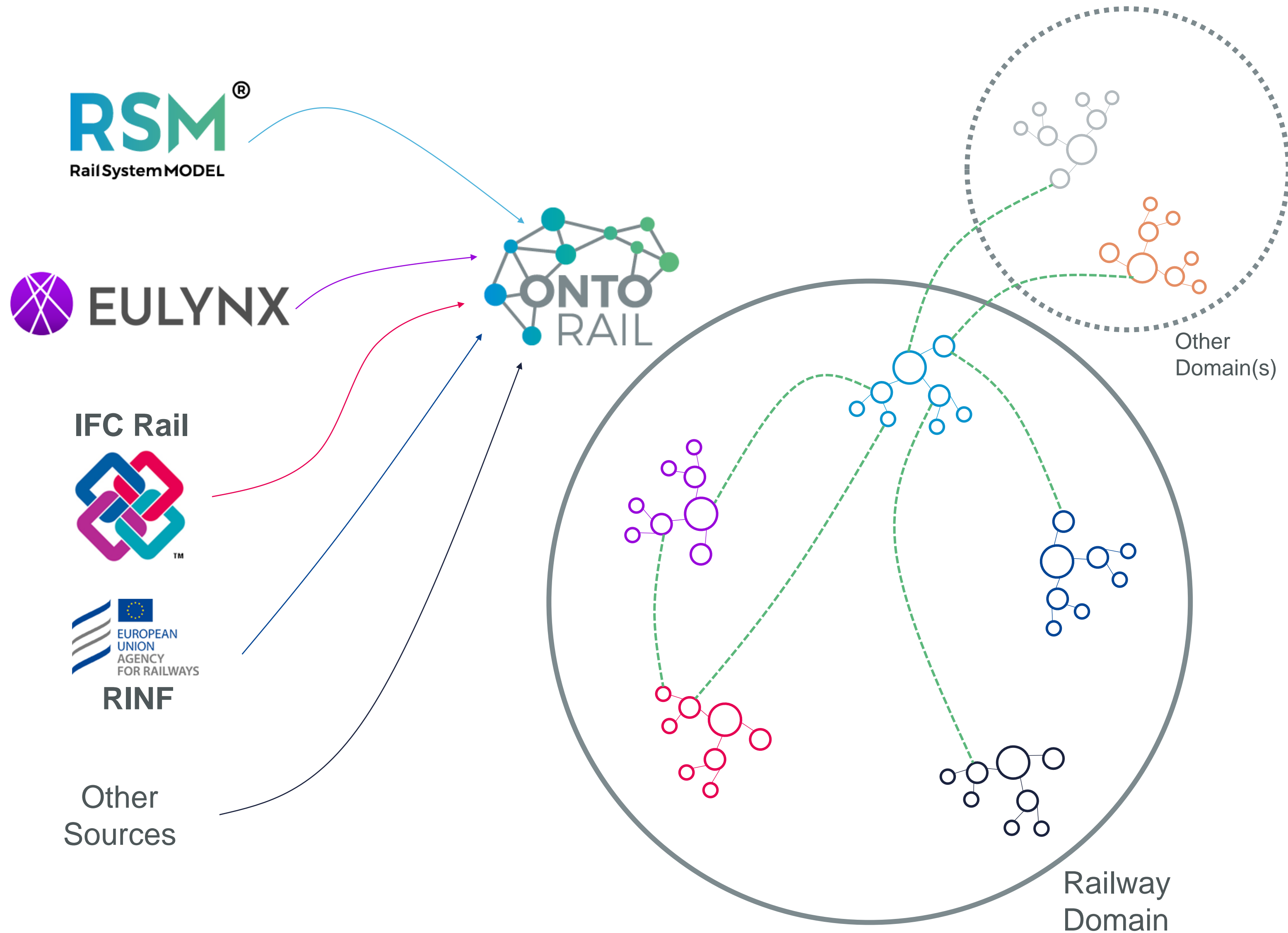


Image source: [Very, Oxford Historical Thesaurus, the office!](#) [Hackney, London, UK](#) by [Cory Doctorow](#) [CC-BY-SA]

OntoRail Fundamentals

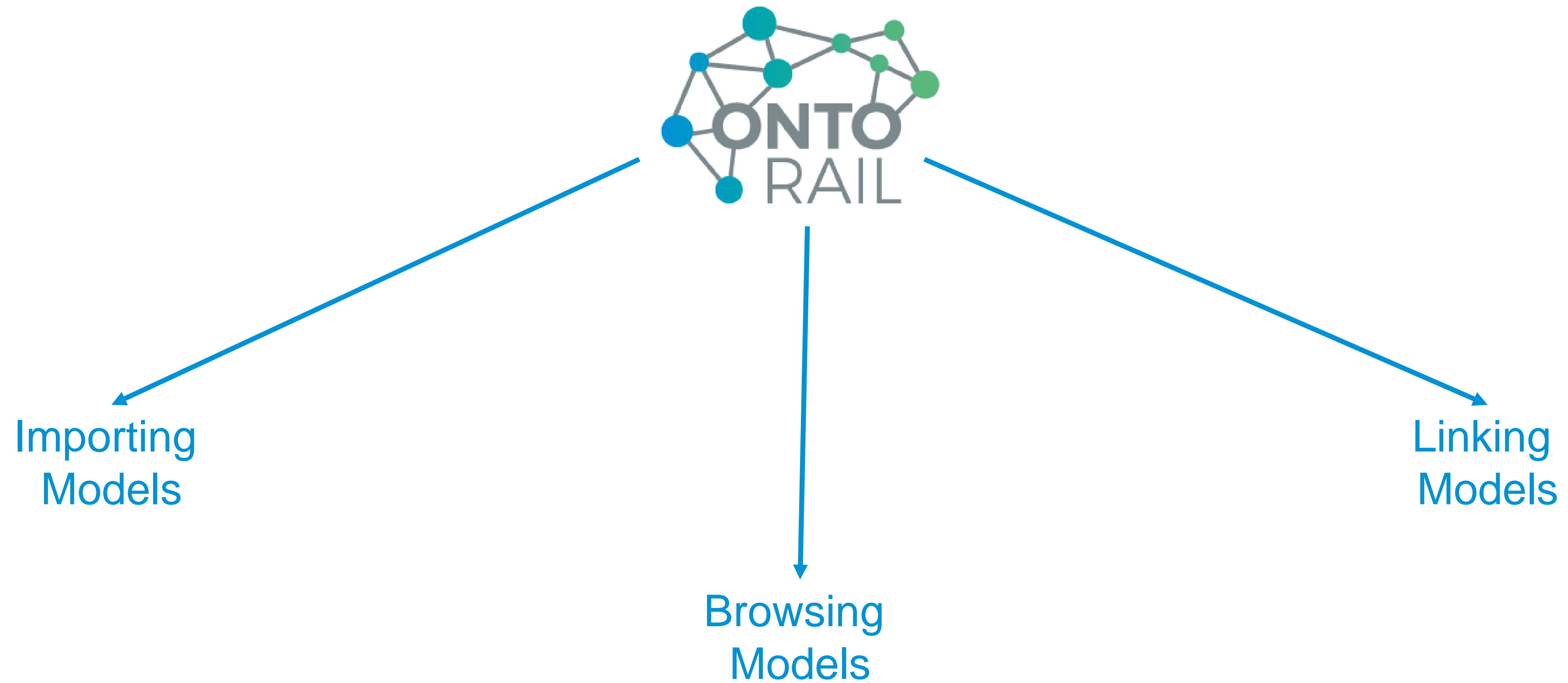


Filtering

Querying

Linking

OntoRail Fundamentals



OntoRail application homepage

29

OntoRail Aggregated Ontology



Login

» Source Ontologies:

[EULYNX]

EULYNX standardises the interfaces between the interlocking at the core of the signalling system and all peripheral subsystems, ranging from light signal to traffic control system.

- 174 Packages
- 4806 Classes
- 2518 Properties
- 165 Enumerations
- 12 DataTypes

Tree Browser
Graph

[RSM 1.2 beta]

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

- 18 Packages
- 143 Classes
- 158 Properties
- 8 Enumerations
- 2 DataTypes

Tree Browser
Graph

[Transmodel (SNAP)]

Transmodel model of the European ITS Directive.

- 5 Packages
- 256 Classes
- 170 Object Properties
- 64 Data Properties
- 3 DataTypes

Tree Browser
Graph

[IFC Rail]

IFC Rail aims at delivering open standards and extending the current buildingSMART schema to fit the needs of the Rail industry.

- 267 Packages
- 1454 Classes
- 1540 Properties
- 242 Enumerations
- 249 DataTypes

Tree Browser
Graph

[ERA 1.2.1]

Vocabulary defined by the European Union Agency for Railways to describe the concepts and relationships related to the European railway infrastructure and the vehicles authorized to operate over it.

- 13 Classes
- 50 Object Properties
- 91 Data Properties
- 0 DataTypes

Tree Browser
Graph

[Transmodel (v6.56)]

CEN European Reference Data Model for Public Transport Information Transmodel provides an abstract model of common public transport concepts and data structures that can be used to build many different kinds of public transport information system, including timetabling, fares, operational management, real time data, journey planning etc.

- 316 Packages
- 1093 Classes
- 4086 Properties
- 3 Enumerations
- 1045 DataTypes

Tree Browser
Graph

Establish a relation between entities:

Entity1... >> ontorail:hasSource >> Entity2...

Add Relation

Comment: You can attach a comment here...

Creator: DG • 28-Jun-2021

Status: Under Review

» » "Ontorail Relations" forum

OntoRail: consolidate & federate

Imported models to consolidate railway knowledge

volumetry of the imported model

» Source Ontologies:

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- 316 Packages
- 1093 Classes
- 4086 Properties
- 3 Enumerations
- 1045 DataTypes

Tree Browser | Graph

Establish a relation between entities:

rsm12beta:("RouteBody") >> ontorail:hasSource >> rsm12beta:("RouteBody")

rsm:EAID_FDE74596_9FE8_4169_AEAA_A39E0093EBEF rsm:EAID_FDE74596_9FE8_4169_AEAA_A39E0093EBEF

Add Relation

Comment: You can attach a comment here...

Creator: DG • 28-Jun-2021

Status: Under Review

» » "Ontorail Relations" forum

Establishing relations between entities to federate models

A unified interface to explore source models

Link to official documentation page

[RSM 1.2 beta]

search pattern...

Searching through a model

Tree view of the model packaging structure

Packages & Classes:

- Common
- Base
- Geometry
- Location
- NetProperty
- Network**
- Observation
- Positioning
- TimeAxis
- Topology
- ElementPartCollection (2)
- NetElement (1)**
- Relation (1)
- General documentation
- Infrastructure
- ::Property::
- ::Enumeration::
- ::DataType::

Entity properties of: NetElement

Base class for defining nodes in the connectivity graph representing the topological network.

- Class properties**
 - » a rsm:Object
 - » rdfs:subClassOf rsm:("NetworkResource")
 - » ontorail:ofPackage rsm:("Topology")
- is in domain of**
 - » rsm:Property("relation") Card: 1..*
- is in range of**
 - » rsm:Property("elementParts") Card: 1..*
 - » rsm:Property("elementParts") Card: 1..*

Object Properties

A rich, hyperlinked & unified browsing of source models

Source page:

RSM1.2 - Overview of high-level c

This diagram shows packages and important classes from RailSystemMod figure is illustrative and does not represent the whole model, as some rel readability.

Common
Packages with classes common to all domains.

Base
Object identity, properties, quantity, value and units

Object Documentation

Individual package

Individual class

Class in context

Searching through a model

The screenshot shows the 'RSM 1.2 beta' Ontology Browser interface. At the top, a search box contains the text 'linear'. Below the search box, the 'Selected: LinearCoordinate' is displayed. The main area is divided into two panes. The left pane, titled 'Packages & Classes', shows a hierarchical tree of classes. The right pane, titled 'Entity properties of: rsm:EAID_CB107995_3610_4622_824B_708281B24CEA', shows a class diagram for 'Positioning' with a description 'Coordinates in linear or geographic referencing systems'. The diagram includes classes like 'Positioning::PositioningSystemCoordinate', 'Positioning::PositioningSystem', 'Positioning::LinearPositioningSystem', and 'Positioning::GeographicCoordinateSystem'. A search box with a magnifying glass icon is visible in the top right corner of the interface.

Search box with regex support

Dynamic filtering through the model (classes, properties, ...)

Search functionality for quick insights into the contents of a model

Graph view

[RSM 1.2 beta]

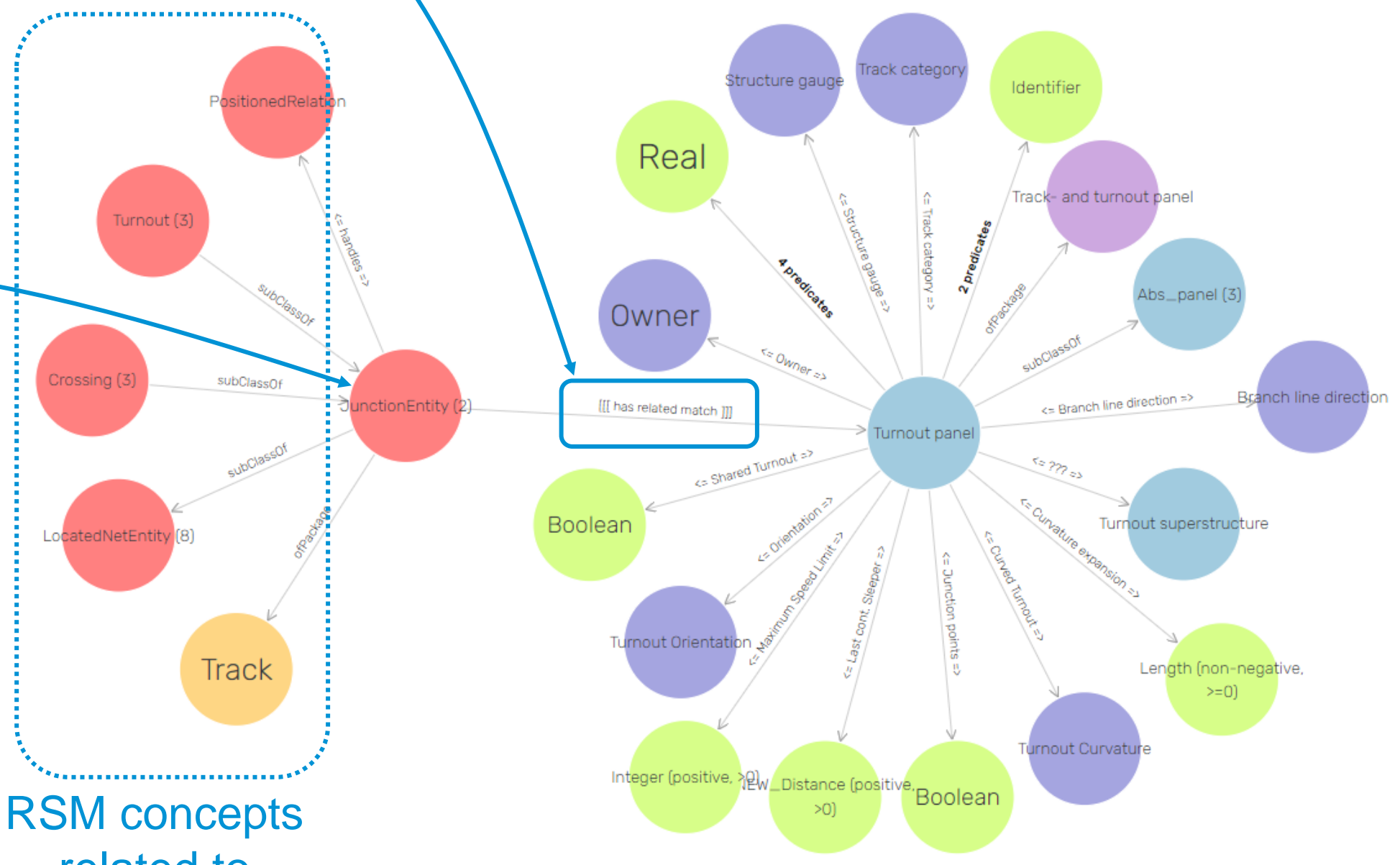
Deselect All Collapse All Load All junction

Selected: JunctionEntity

Packages & Classes: Entity properties of: undefined

- OntoRail relations
 - skos:relatedMatch ifcr:("Turnout panel")
- Class properties
 - a rsm:Object
 - rdfs:subClassOf rsm:("LocatedNetEntity")
 - xmi:isAbstract "true"
 - ontorail:ofPackage rsm:("Track")
 - xmi:ea_localid "4513"
 - xmi:isActive "false"
 - xmi:isLeaf "false"
 - xmi:isRoot "false"
 - xmi:isSpecification "false"
 - xmi:nType "0"
 - xmi:scope "public"
 - xmi:tagged "0"
 - xmi:tpos "0"
- is in domain of
 - rsm:Property("handles") Card: 1..*

Visual graph



RSM concepts related to « JunctionEntity »

Seeing objects in context of their model and in relation to other models

Supporting two versions of a model Example of Transmodel (SNAP) vs Transmodel v6.56

The screenshot shows the 'Transmodel (SNAP)' interface. At the top, the browser title is '[Transmodel (SNAP)] Ontology Browser - Google Chrome' and the URL is 'app.ontorail.org:5000/win_rec_tree/transmodel'. Below the title bar, there are buttons for 'Deselect All', 'Collapse All', and 'Load All', along with a search input field labeled 'search pattern...'. A status message reads 'The tree has been fully loaded. (484 nodes)'. The main content area is divided into two panes: 'Packages & Classes:' on the left and 'Entity properties of:' on the right. The 'Packages & Classes' pane contains a tree view with folders for 'Commons', 'Facilities', 'Fares', 'Journeys', 'Organisations', and several generic property types like '::ObjectProperty::', '::DatatypeProperty::', '::Enumeration::', and '::DataType::'. The 'Entity properties of:' pane is currently empty, showing only a '» Source page:' link.

Supporting two models to accompany lifecycle of models

The screenshot shows the 'Transmodel (v6.56)' interface. The browser title is '[Transmodel (v6.56)] Ontology Browser - Google Chrome' and the URL is 'app.ontorail.org:5000/win_rec_tree/trm6'. It features the same control buttons and search field as the SNAP version. The status message indicates 'The tree has been fully loaded. (4925 nodes)'. The 'Packages & Classes:' pane on the left shows a more detailed tree structure, including 'Additional Common Concepts', 'Part 1 - Common Concepts (C...', 'Part 2 - Public Transport Netw...', 'Part 3 - Timing Information & V...', 'Part 4 - Operations Monitoring', 'Part 5 - Fare Management (FM...', 'Part 6 - Passenger Informati...', 'Part 7 - Driver Management (D...', 'Part 8 - Management Informat...', and the same generic property types as the SNAP version. The 'Entity properties of:' pane is also empty, showing the '» Source page:' link.

Establishing relations between models

Qualified relations between models to foster convergence and federation

The screenshot shows the OntoRail web interface for creating a relation between two entities. The interface includes a header with the title "Establish a relation between entities:", two input fields for entity URIs, a dropdown menu for selecting a relation type, a comment box, and a status field. Annotations with blue lines point to various parts of the interface:

- Entities identified for a relation proposal:** Points to the two input fields containing the URIs for "RouteBody" from different models.
- Forum to establish consensus on the proposed relation:** Points to a button labeled "» » 'Ontorail Relations' forum".
- Freeform comment for context:** Points to the text input field for a comment.
- Formal vocabulary to qualify the relation (issued from ontologies):** Points to the dropdown menu showing various ontology-based relation types like "ontorail:hasSource", "skos:relatedMatch", etc.
- Traceability on the initiator, timestamp of the proposal and initial status:** Points to the "Creator: tane@uic.org • 29-Jun-2021" and "Status: Under Review" fields.

Additional text on the slide includes:

- On the left: "Qualified relations between models to foster convergence and federation" (enclosed in a blue rounded rectangle).
- At the bottom left: "Freeform comment for context".
- At the bottom center: "Formal vocabulary to qualify the relation (issued from ontologies)".
- At the bottom right: "Traceability on the initiator, timestamp of the proposal and initial status".

View and manage proposed relations

The screenshot shows the OntoRail web application interface. At the top, there is a browser window with the URL `app.ontorail.org:5000/ontorail`. Below the browser, there is a form titled "Establish a relation between entities:". The form contains two input fields for entity URIs, a dropdown menu for the relation type (currently set to `ontorail:hasSource`), a text area for a comment, and an "Add Relation" button. To the right of the form, it displays the creator's information: `Creator: tane@uic.org • 29-Jun-2021` and the status: `Status: Under Review`. Below the form is a list of proposed relations, each with a checkmark, the relation URI, and a timestamp. The list is sorted by most recent. Each relation entry has a document icon and a trash icon to its right. A blue box highlights the bottom-most relation entry: `eu("Signal_343") → skos:relatedMatch → rsm("Signal") . // 20-Jun-2021 14:00:01 "underReview"`. A blue box also highlights the trash icon for this entry. A blue box highlights the entire list of relations. A blue box highlights the first relation entry: `rsm("JunctionEntity") → skos:relatedMatch → ifcr("Turnout panel") . // 29-Jun-2021 20:55:14 "underReview"`.

View & manage proposed relations

Summary of proposed relation (additional information when hovering with a mouse)

Most recent proposed relations

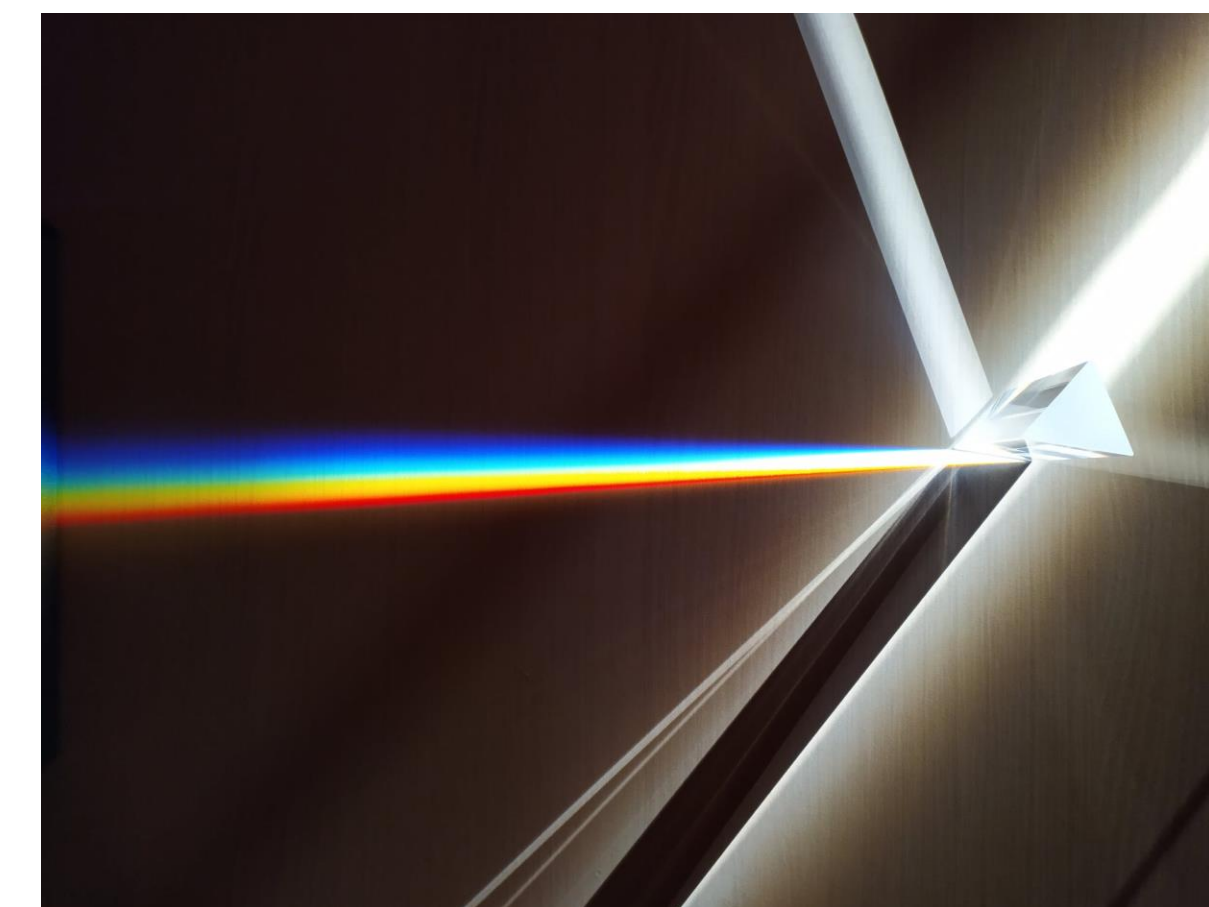
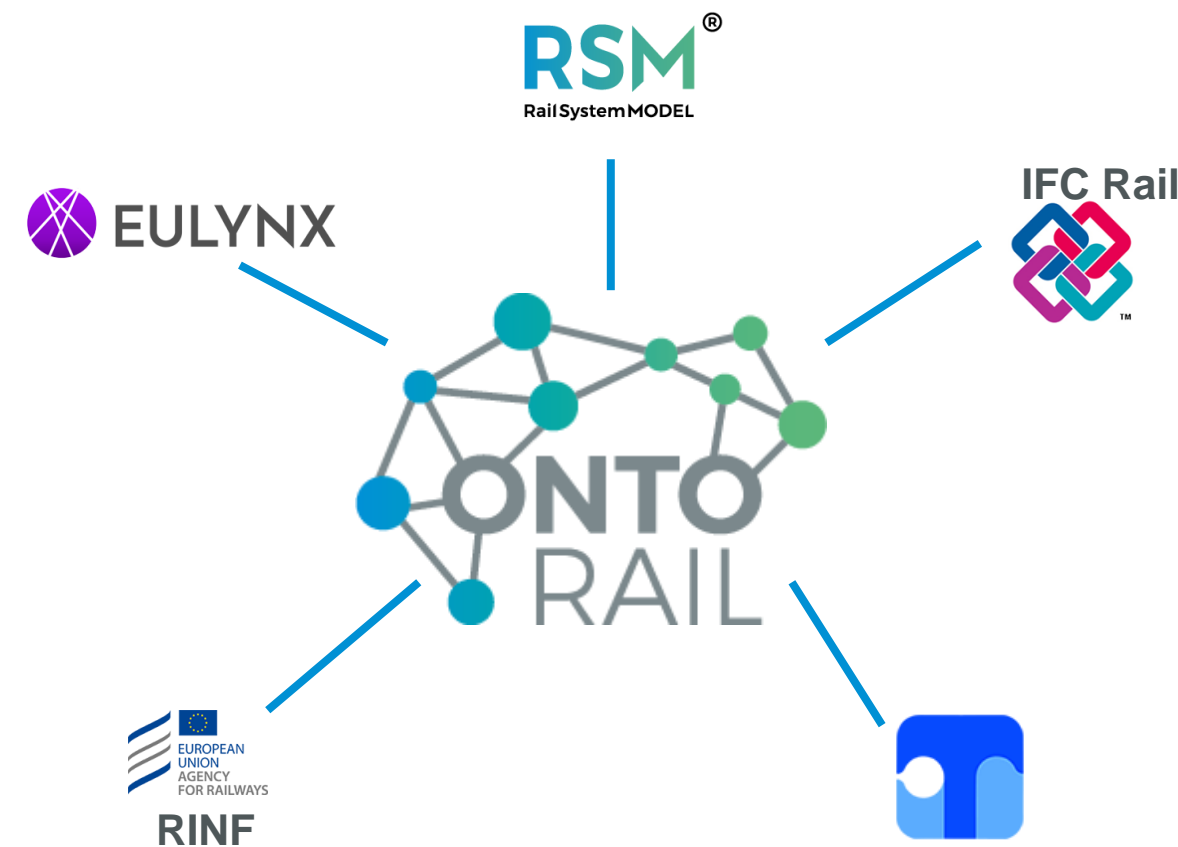
Convenience functions

OntoRail, in summary



An **Encyclopedia**
to consolidate and enrich Railways
Systems Modelling knowledge

A **Tool for Building Consensus**
to promote and facilitate convergence
and federation between models



A knowledge engine, powered by **Ontologies**

Perspectives



Perspectives

**RailSystemModel & OntoRail as enablers
of the Linx4Rail Conceptual Data Model**



LinX4Rail, a Shift²Rail project (1)

40



LinX4Rail

- « The railway sector is currently acting **in a fragmented way and in silos** corresponding most often
- to physical or functional subsystems or use cases,
 - the different owners/managers of the overall infrastructure
 - at regional/national level,
 - without global extensive view or full control of the global system involved by rail operations.

With the progress of digitization, analogue devices based on relays were progressively substituted by digital ones

What is missing is an efficient, automated and standardized way for these integrated and interplaying systems to act as one ecosystem: sharing, integrating, identifying, correlating and exploiting the right data at the right time. »

LinX4Rail, System architecture and Conceptual Data Model for railway, common data dictionary and global system modelling specifications, December 6, 2019

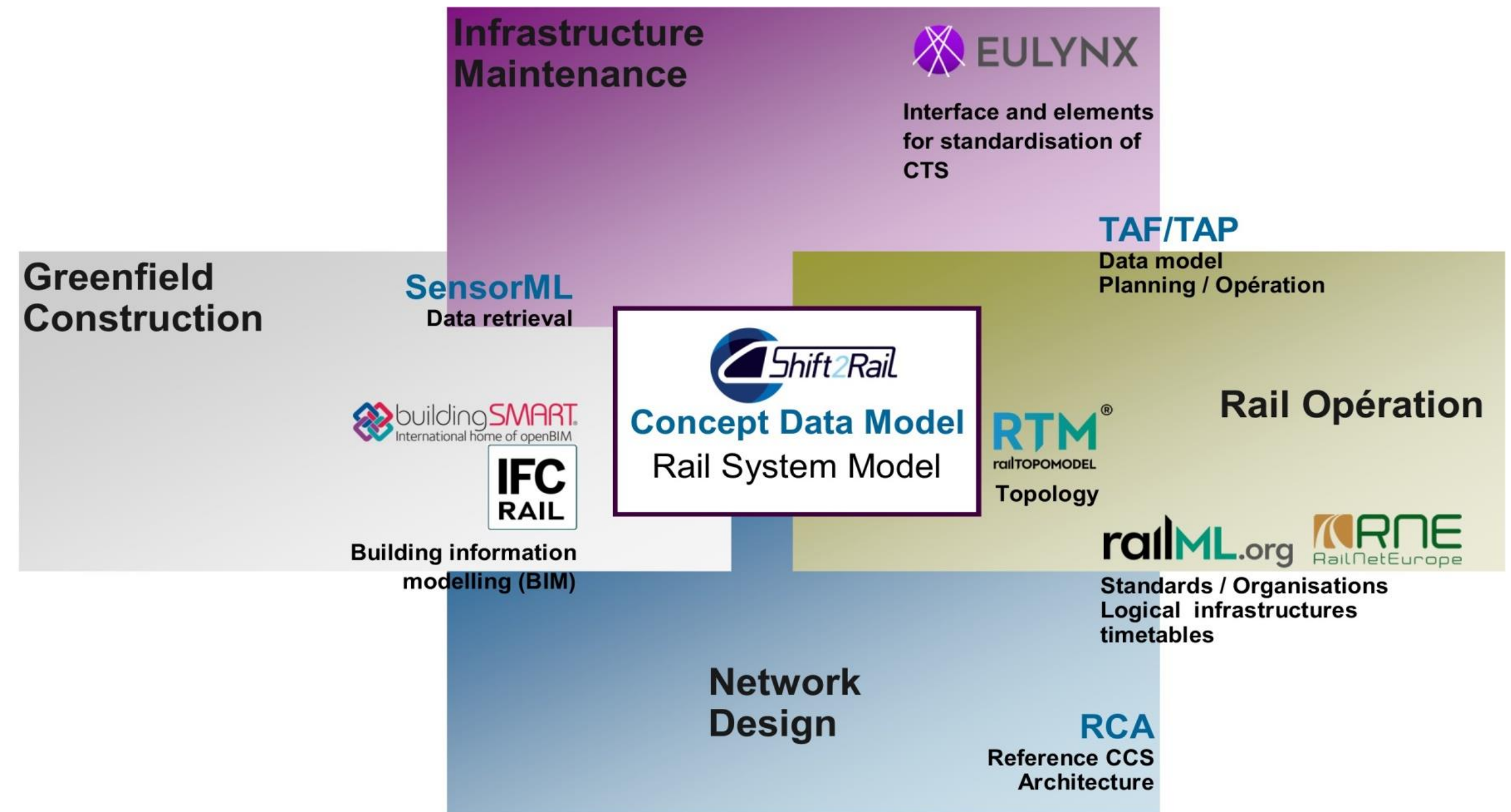
LinX4Rail, a Shift²Rail project (2)



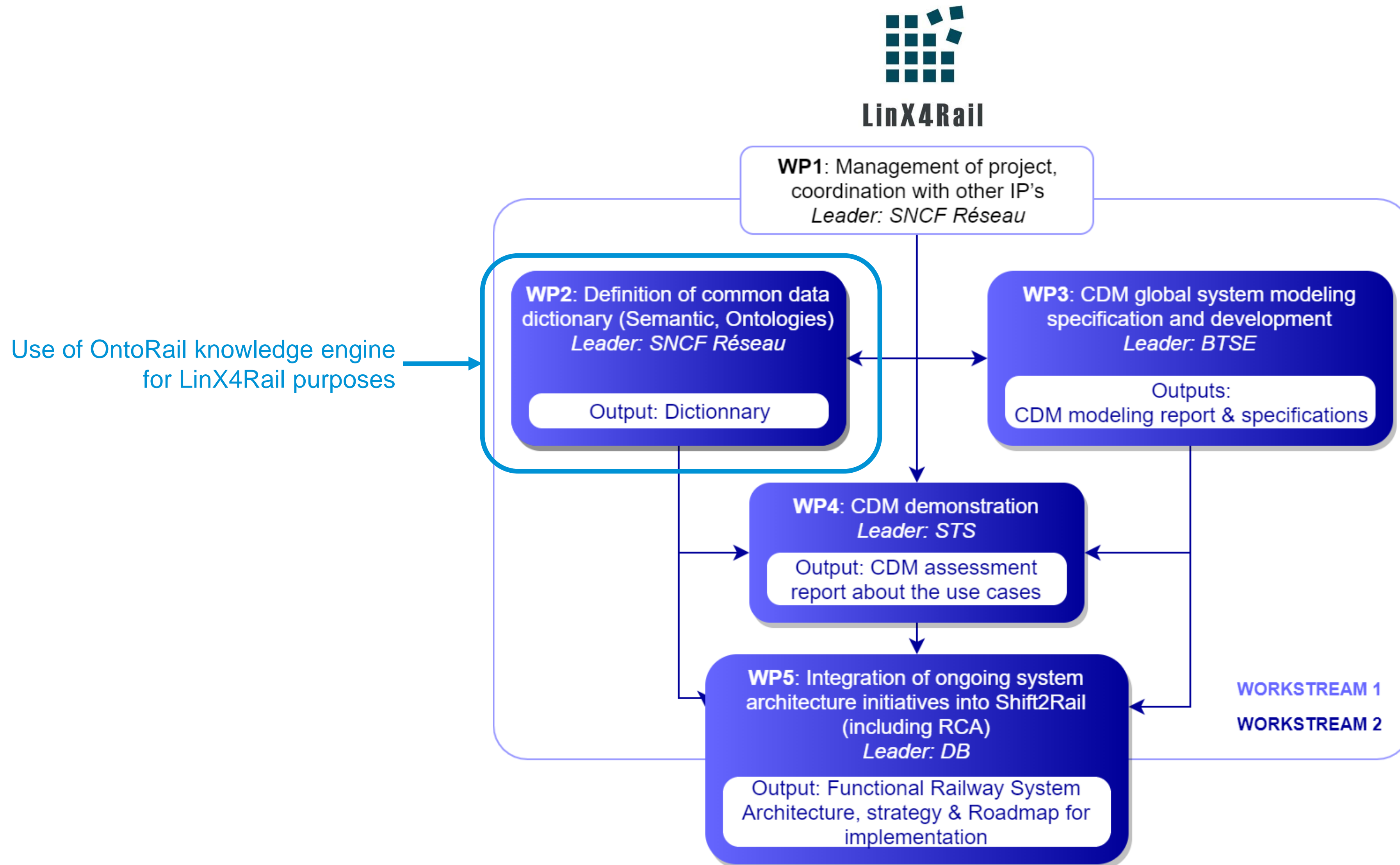
LinX4Rail

« Only the adoption of a standardized, modular, and interoperable architecture approach, reviewed and shared by the entire sector, can enable streamlined implementation of these new concepts at **affordable costs for the sector whilst ensuring a realistic transition from legacy systems.** »

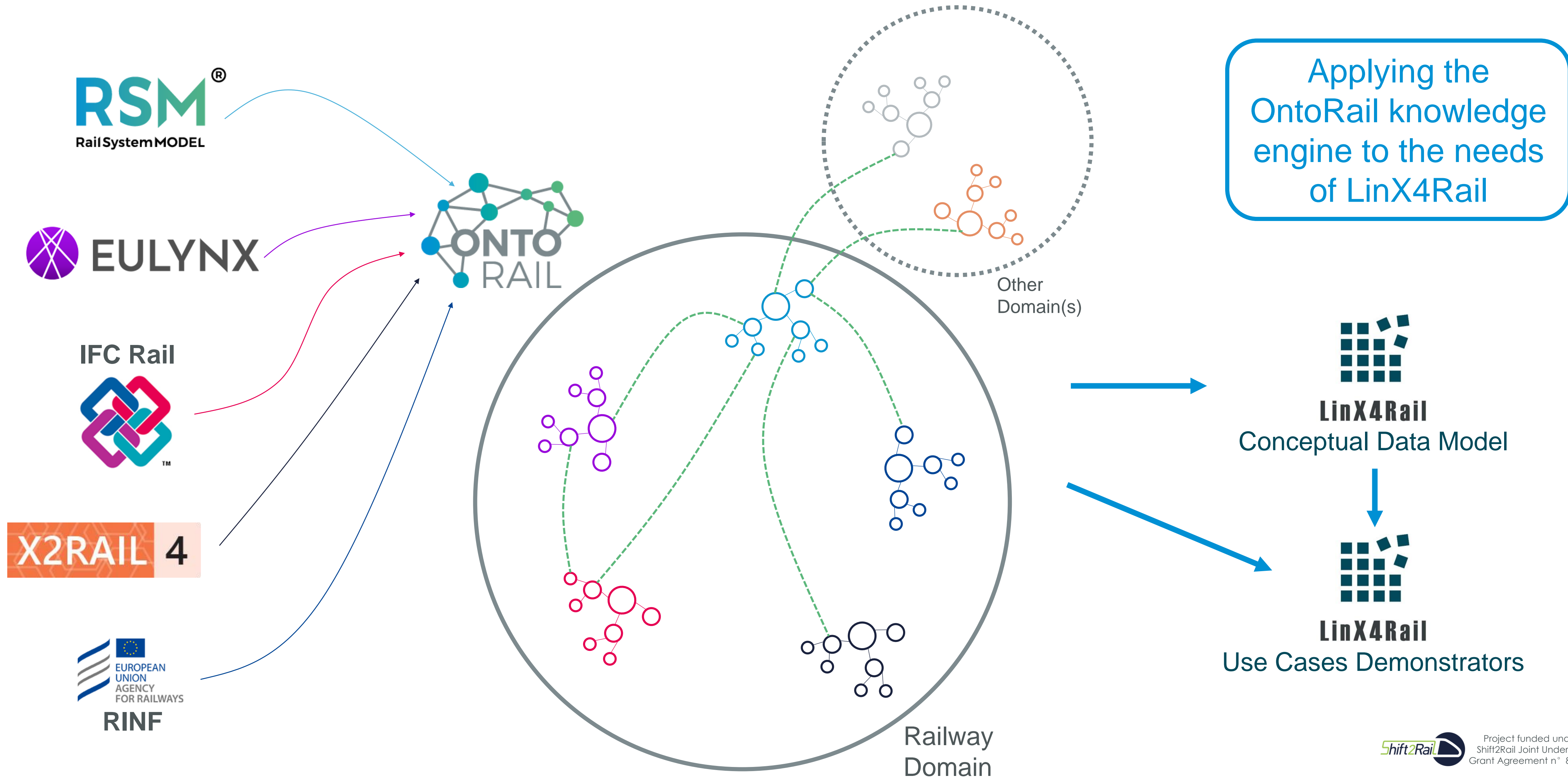
LinX4Rail, System architecture and Conceptual Data Model for railway, common data dictionary and global system modelling specifications, December 6, 2019



LinX4Rail, a Shift²Rail project (3)



From source models to L4R Conceptual Data Model



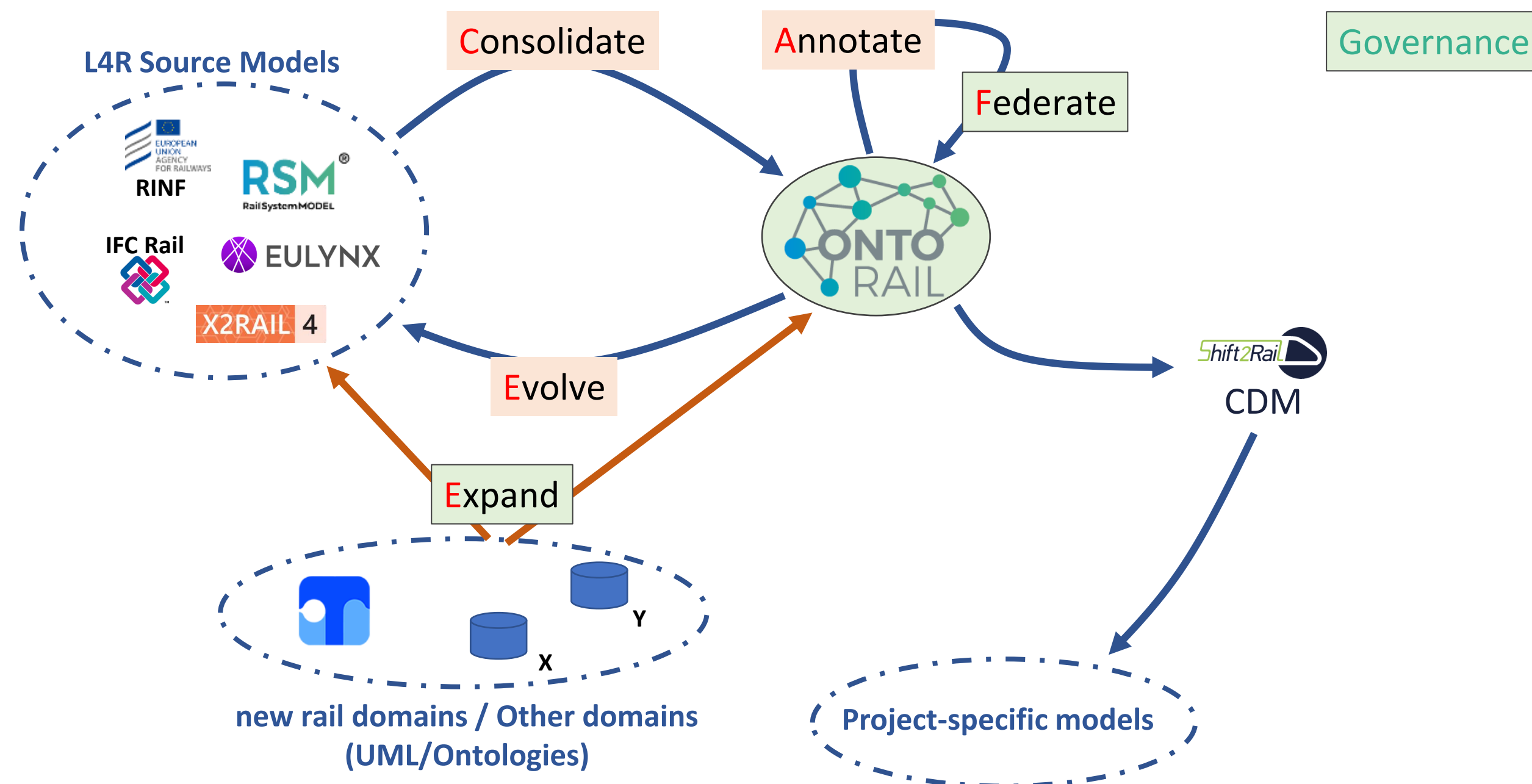
Using OntoRail within L4R

Consolidate railway domain knowledge

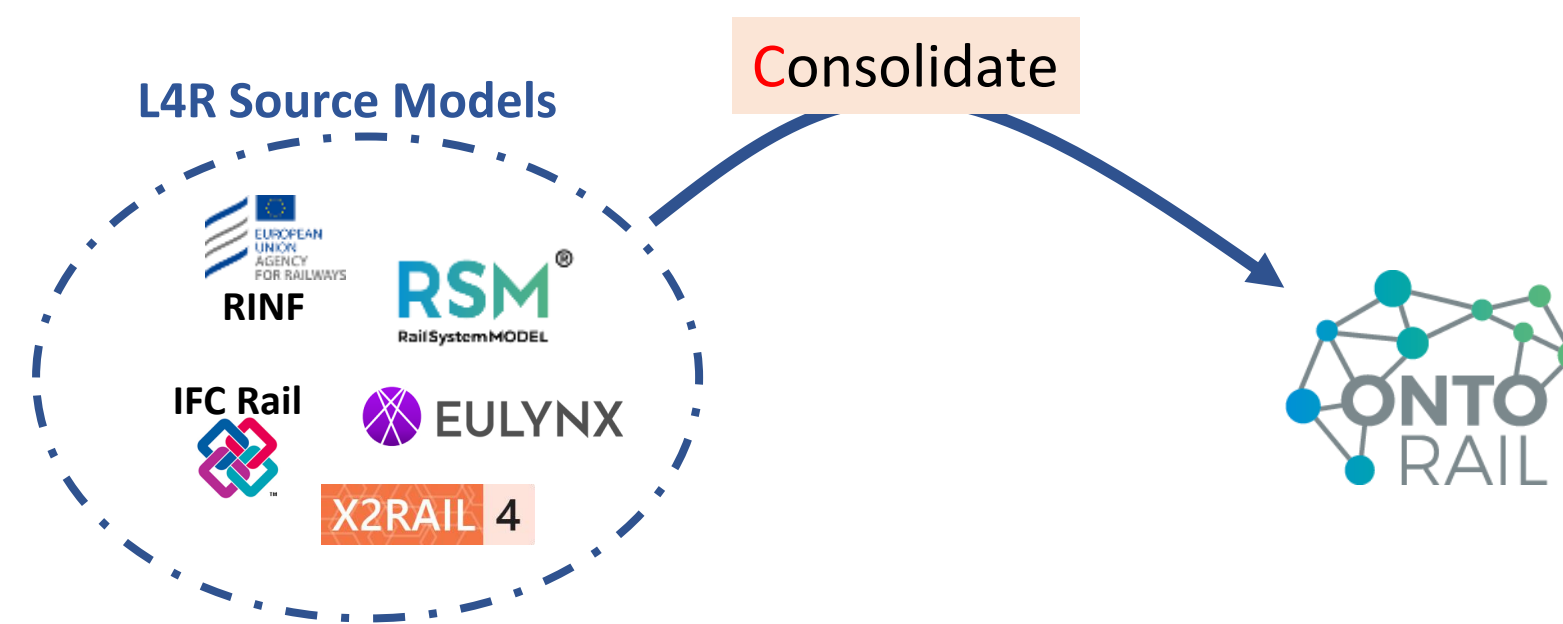
Annotate by establishing relations between concepts, enriched with semantic

Federate models by facilitating establishing a consensus on domains of authorities

Evolve source models by tagging / Expand railway domain coverage



Using OntoRail within L4R: Consolidate

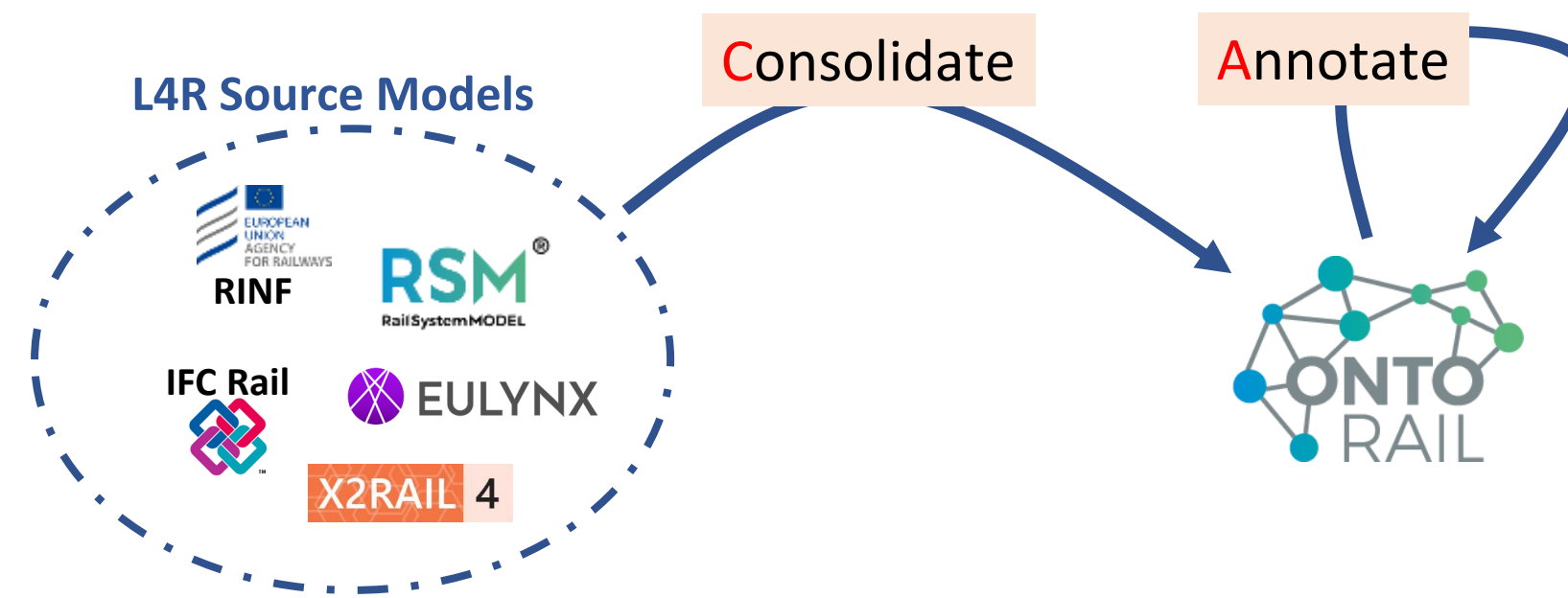


Importing
Versioning

Source Models are subject to evolution / expansion

- Need to automate importation process
 - Need to validate with source projects owners the faithfulness of the importation
- Need to support multiple versions

Using OntoRail within L4R: Annotate

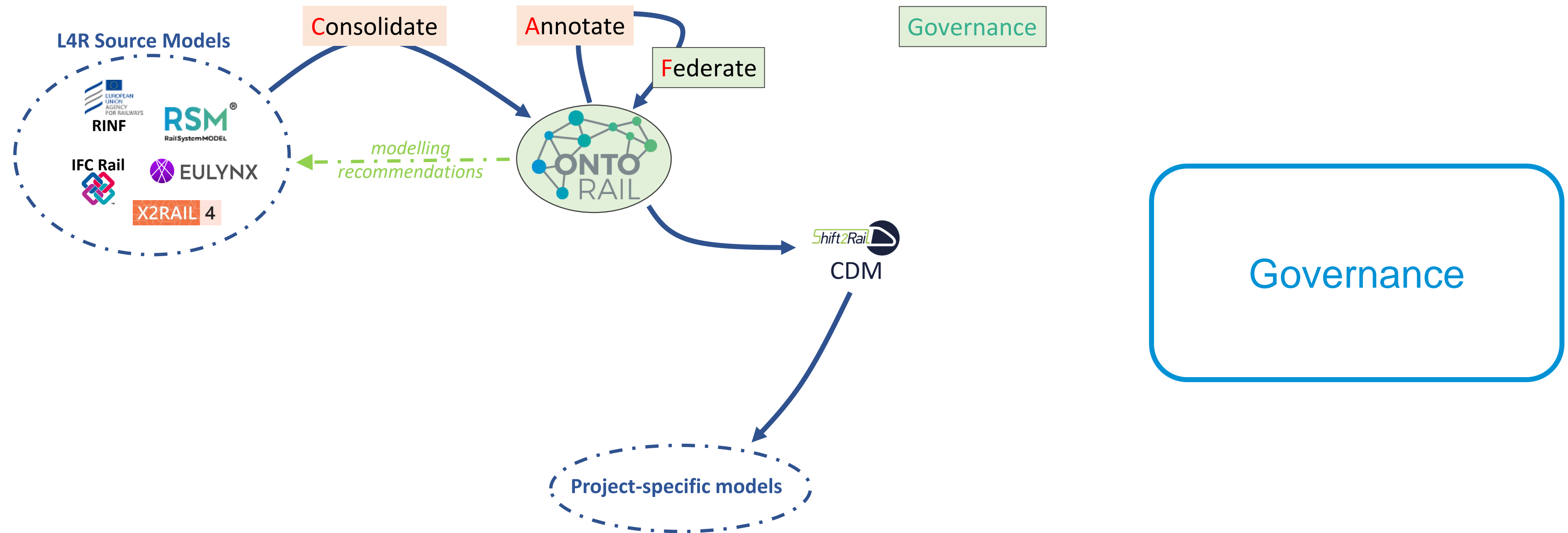


Semantic Annotation
Domain Expertise

Source Models may have overlap, commonalities, existing collaborations...

- Need to identify & qualify relations between the concepts of different models
- Domain Expertise required to support the annotation process

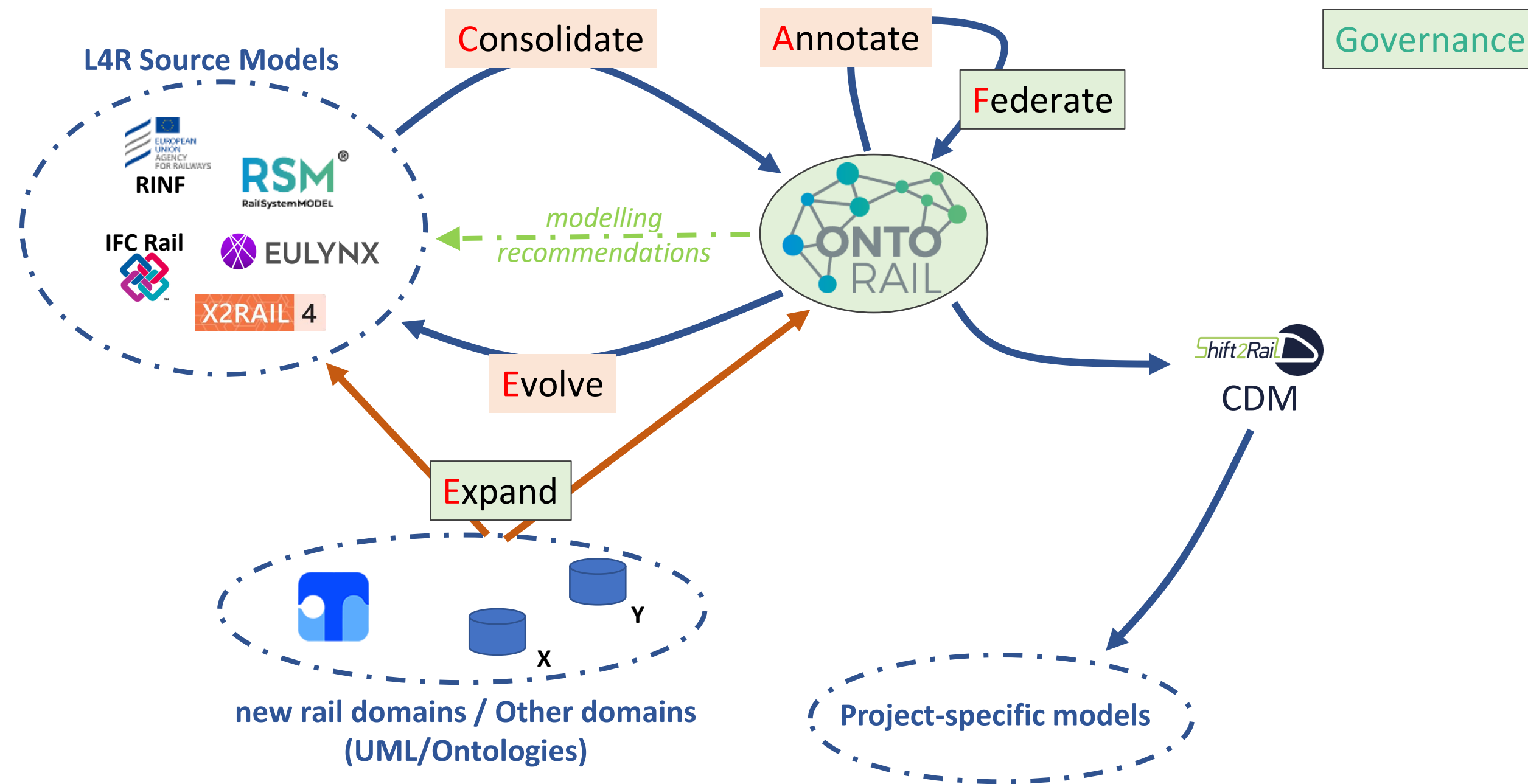
Using OntoRail within L4R: Federate



Federation will involve

- Building consensus on relations between models
- Identifying modelling recommendations to reflect & facilitate federation
- Identification of potential for additional modelling domains

Using OntoRail within L4R: Evolve and Expand



Feedback loop
Collaboration
Independence

Source Models are subject to evolution / expansion

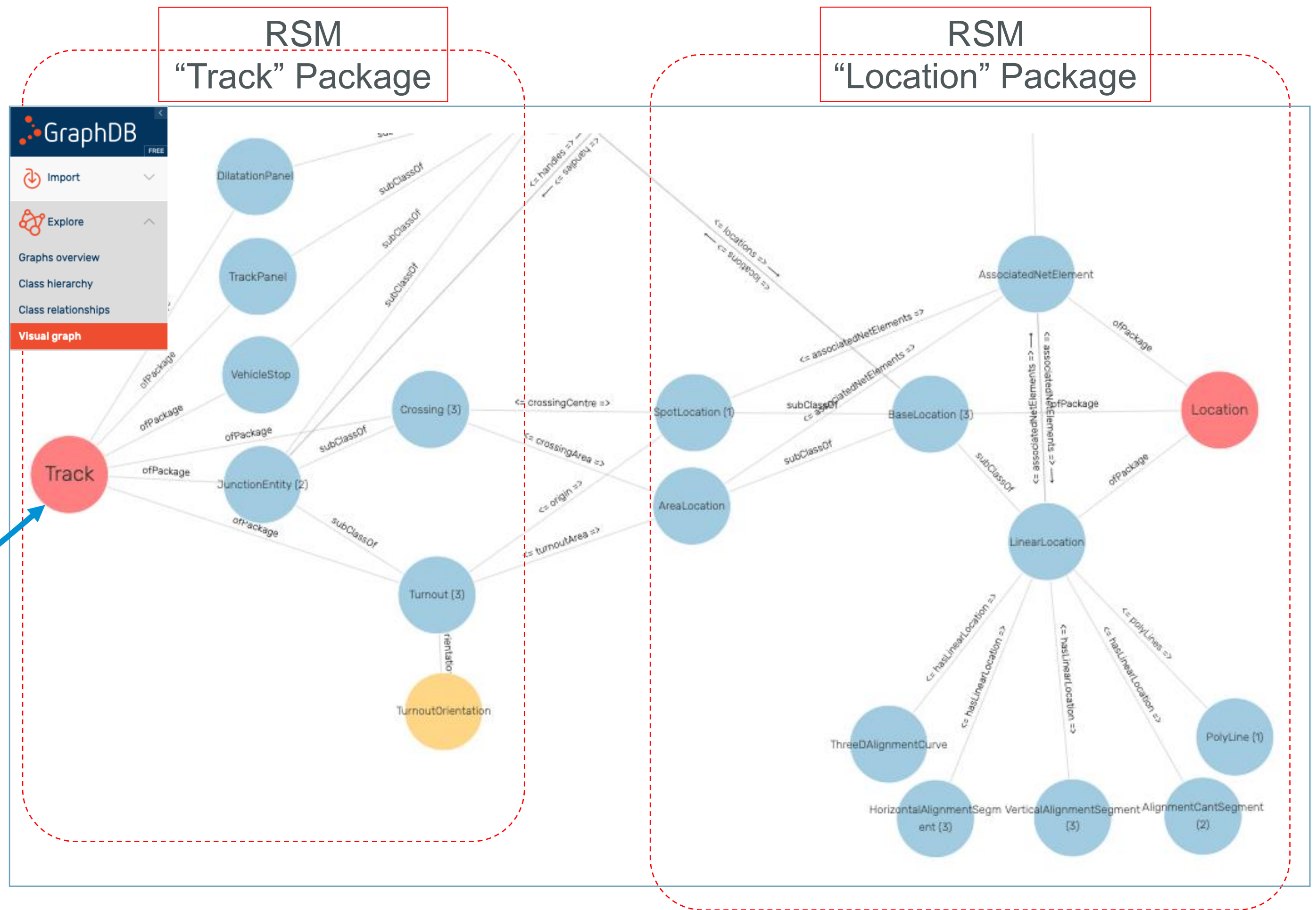
- Identify new rail domains to cover in model(s)
- Identify potential links with other domains

I am a... Source... I want to... Verify Import Faithfulness

Verify Import Faithfulness

The graph view is complementary to UML and allows easy navigation in, and between, packages

The screenshot shows the RSM 1.2 beta interface. On the left, a package tree lists various categories like 'Common', 'Infrastructure', 'Energy', and 'Track'. The 'Track' package is selected. On the right, the 'Entity properties of: Track' are displayed, including class properties and source page information. Below this, a detailed UML class diagram for the 'Track' package is shown, illustrating relationships between classes like 'DilatationPanel', 'TrackPanel', 'JunctionEntity', 'Crossing', and 'Turnout'.



I am a... **User of Models**... I want to... **Browse**

Explore the richness of source models

Source models each model their area of expertise from a certain angle. Some particular use cases may require modelling coming from these different perspectives, potentially at different stages in a project lifecycle.

Search functionality is essential for identifying in multiple sources the potential classes to fit particular Use Cases.

* The tree representation might display a same class at different positions, while graph representation will show multiple links

The image displays three screenshots of model browsers for different projects: IFC Rail, EULYNX, and RSM 1.2 beta. Each screenshot shows a tree view of classes and packages. The IFC Rail view shows 'Balise' classes under 'Signalling Structural (physical)'. The EULYNX view shows 'Balise' classes under 'BaliseGroup'. The RSM 1.2 beta view shows 'Balise' classes under 'NetworkResource'. A blue arrow points from the text above to the 'Balise' classes in the IFC Rail view.

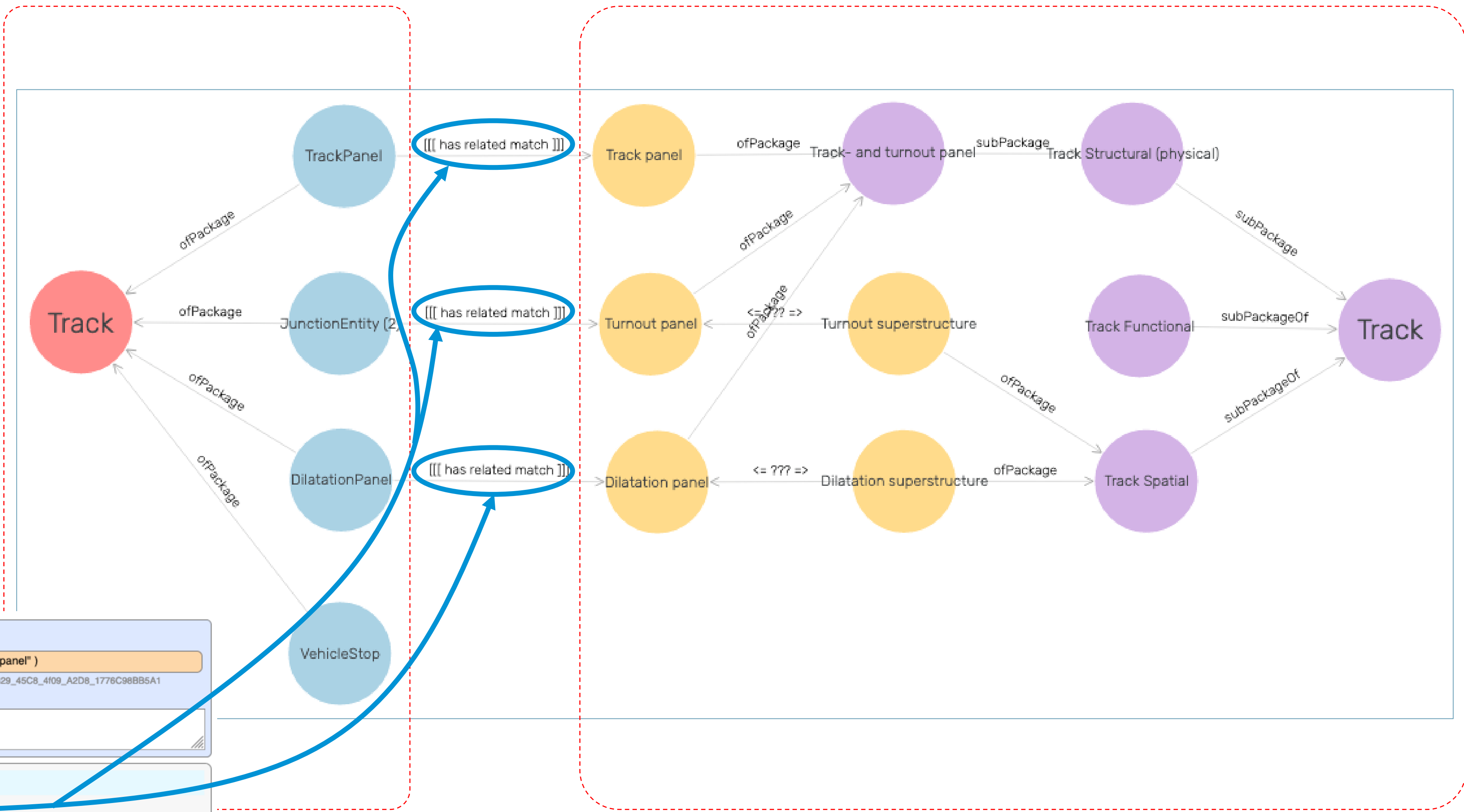
I am a... Domain Expert... I want to... assert a candidate link between concepts

Propose a candidate relation

- OntoRail allows to:
- Search and select relevant classes to be linked
 - Create a link (with multiple types of proposed relations within a controlled vocabulary)
 - Qualify the candidate link
 - View the models joined by the proposed relation

RSM

IFC Rail



Establish a relation between entities:

rsm12beta:("JunctionEntity") << skos:relatedMatch >> ifcr:("Turnout panel")

rsm:EAID_7F470B5D_0D74_4b99_B643_4D5A9E84AF20 ifcr:EAID_214C7B29_45C8_4f09_A2D8_1776C98BB5A1

Add Relation Comment: Explore relation

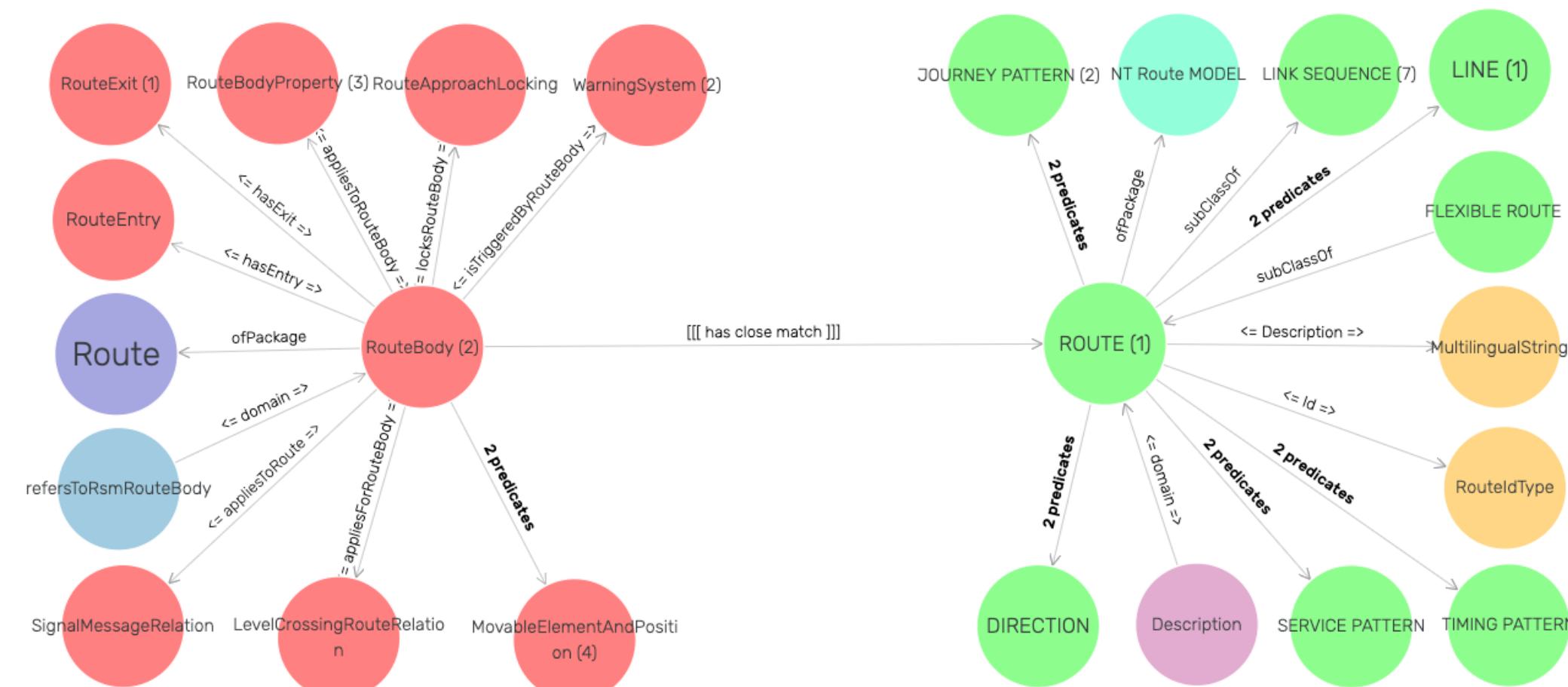
- ✓ rsm12beta("TrackPanel") → skos:relatedMatch → ifcr("Track panel") .
- ✓ rsm12beta("DilatationPanel") → skos:relatedMatch → ifcr("Dilatation panel") .
- ✓ rsm12beta("JunctionEntity") → skos:relatedMatch → ifcr("Turnout panel") .

I am a... **Group of Domain Expert...** I want to... **federate the concept of Route**

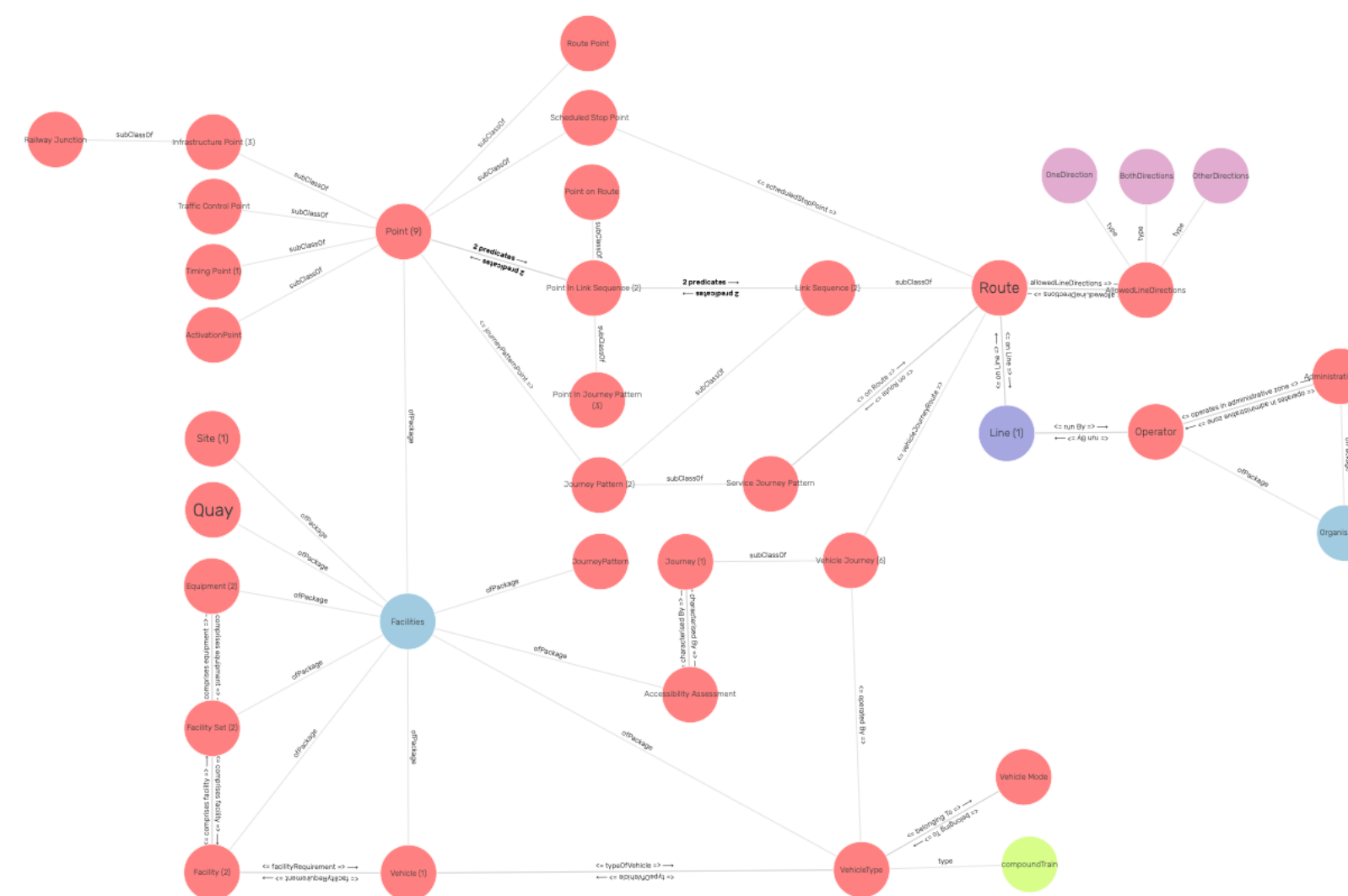
Foster a discussion around the federation of a Concept

- Domain Experts can propose relations between concepts within the consolidated knowledge graph
 - Proposals are annotated with relevant metadata (author, timestamp, comment, status, ...)
- Discussion on the proposed relation take place in an external forum allowing historical tracking of subsequent discussions between domain experts.
- Eventually, consensus can be reached as to whether the proposed relation is accepted or rejected after discussion.
- Discussion may also entail actions on source models (tagging, ...), on CDM (superclass, ...) or on the OntoRail knowledge engine (new proposals, ...).

Visual graph



Visual graph



Perspectives

Digital Twin at SNCF, the importance of a common digital model for operation

Gilles Dessagne

Responsable Division Urbanisme DSI/CSI/URB, SNCF Réseau

Perspectives

RSM in support of FRMCS



RSM in support of FRMCS?

GSM^r railways

1998

2025

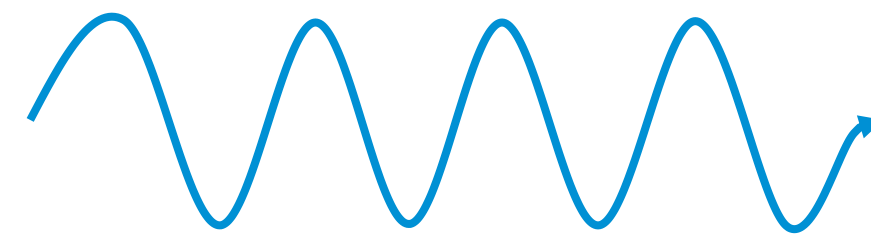
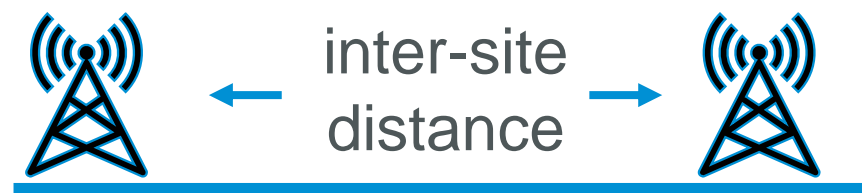
FRMCS

Future Railway Mobile Communication System



900 MHz spectrum

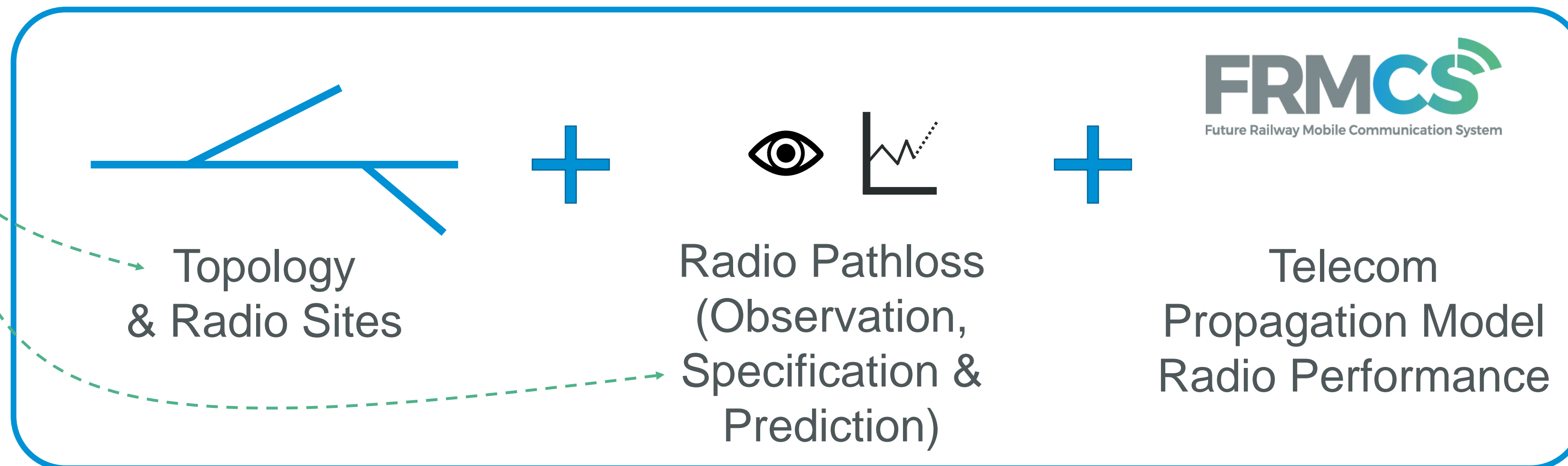
GSM-R



900 MHz & 1900 MHz spectrum

Reuse of 900 MHz Infrastructure?

Simulating reuse of 900 MHz infrastructure



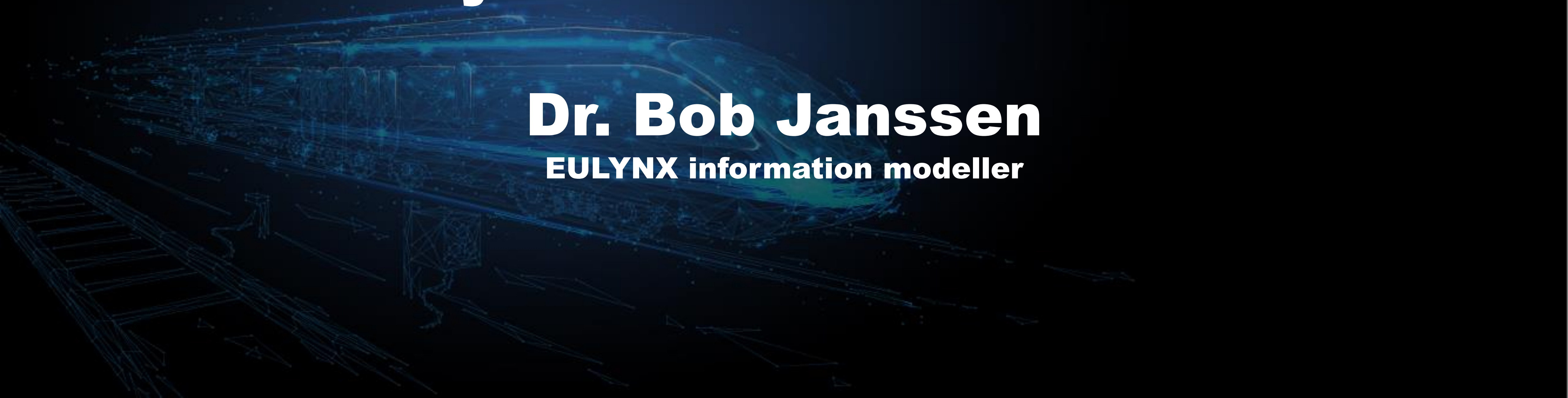
RSM[®]
RailSystemMODEL

Perspectives

Signalling data preparation with RailSystemModel and EULYNX

Dr. Bob Janssen

EULYNX information modeller



Next Steps



RSM Futures

Structure

- Generic separation functional / structural / physical objects

Links

- RINF
- Transmodel ?

Substance

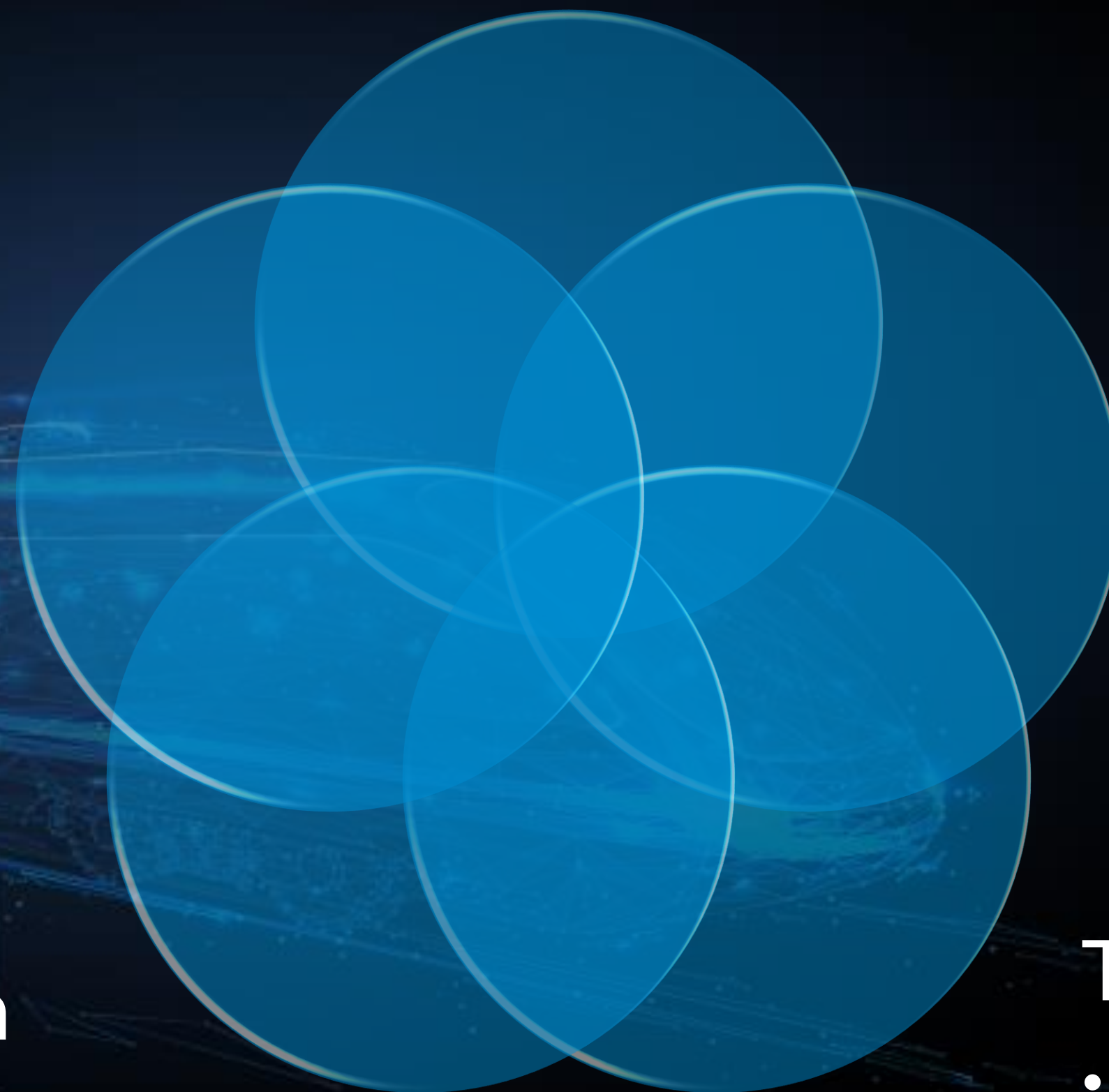
- Project phasing
- Rolling stock
- Operations
- Telecom (FRMCS, ...)

Documentation

- Ontorail ontologies

Tools

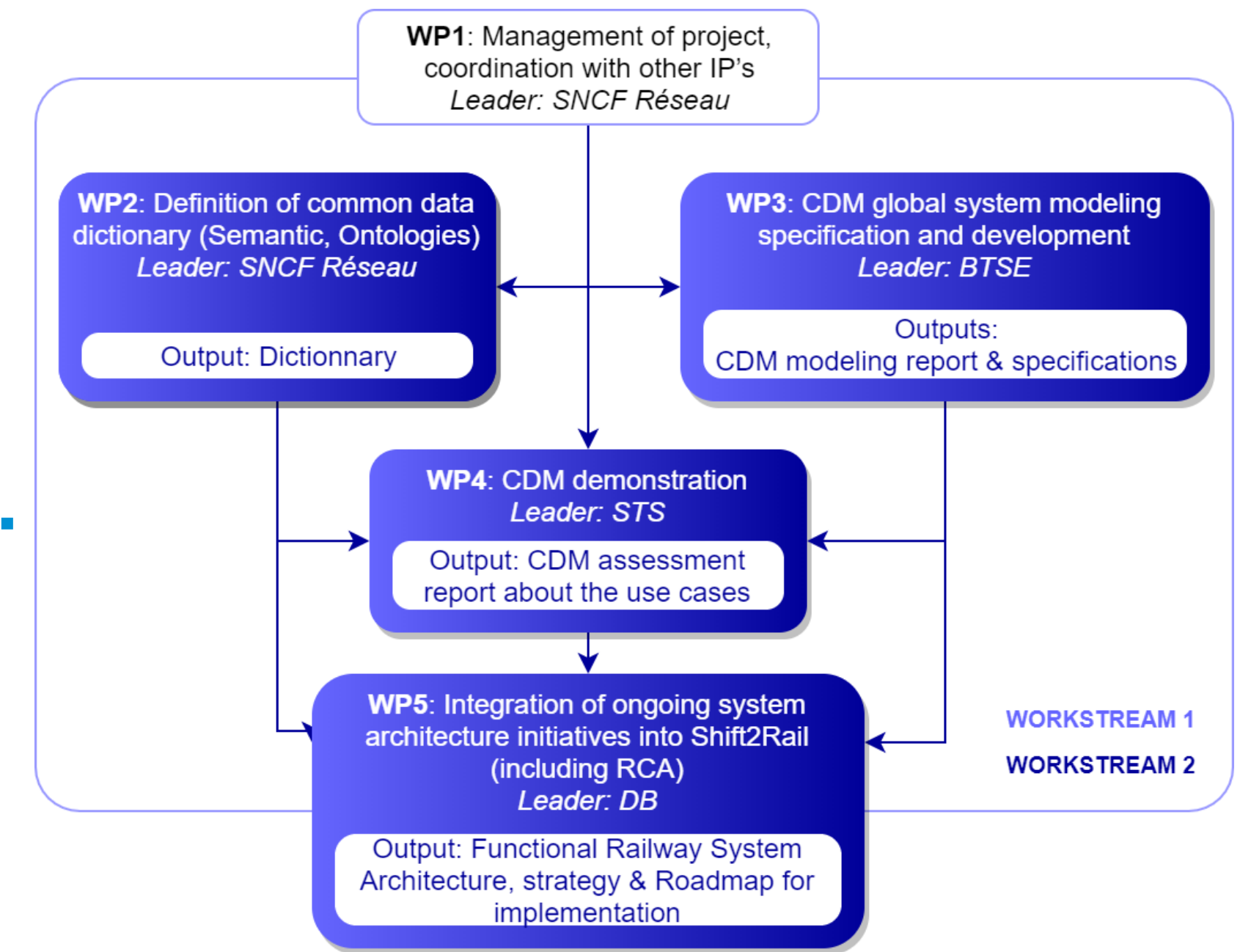
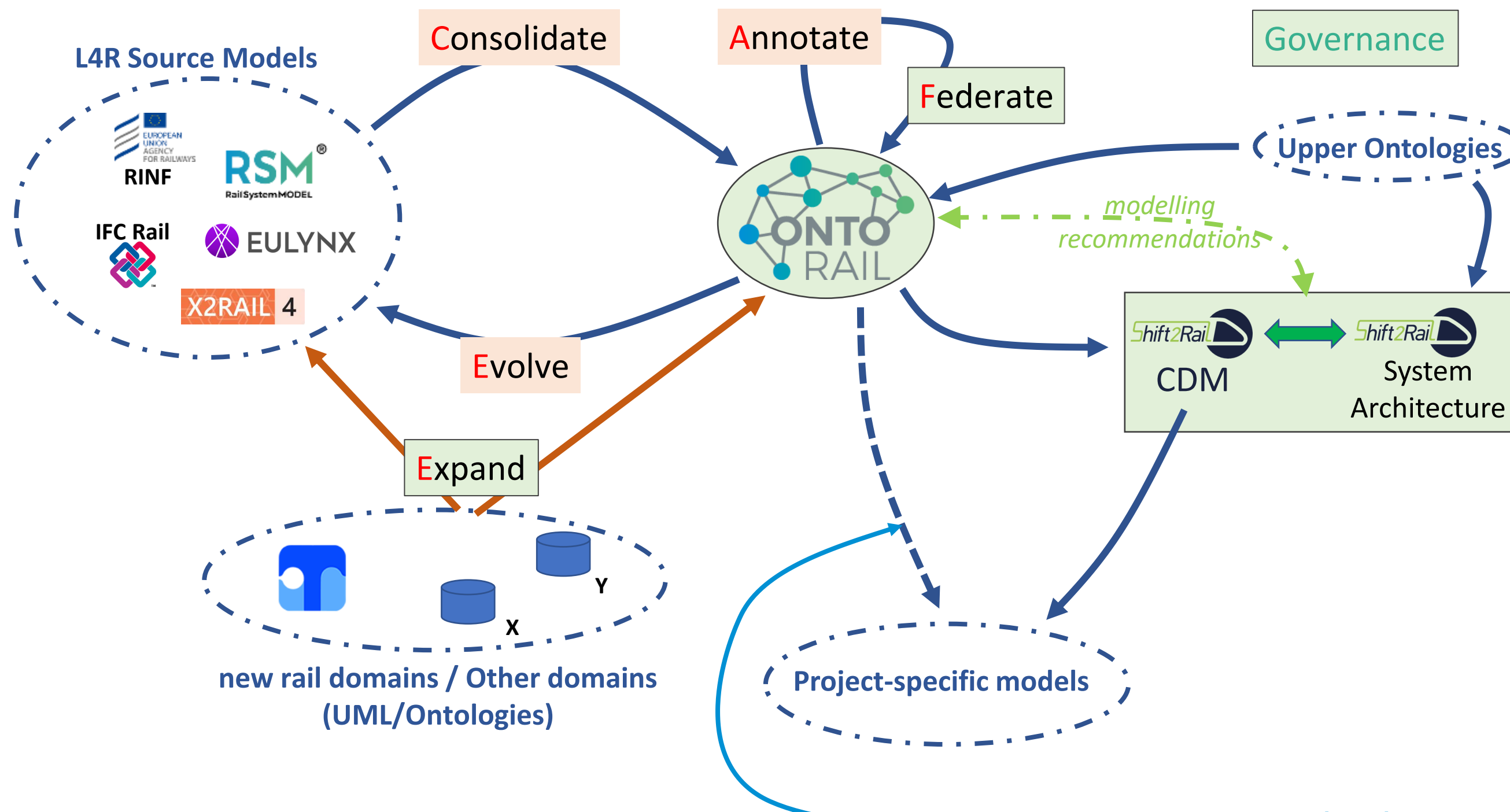
- Live Model (IT code)
- Sample networks



Towards CCS+ with RSM



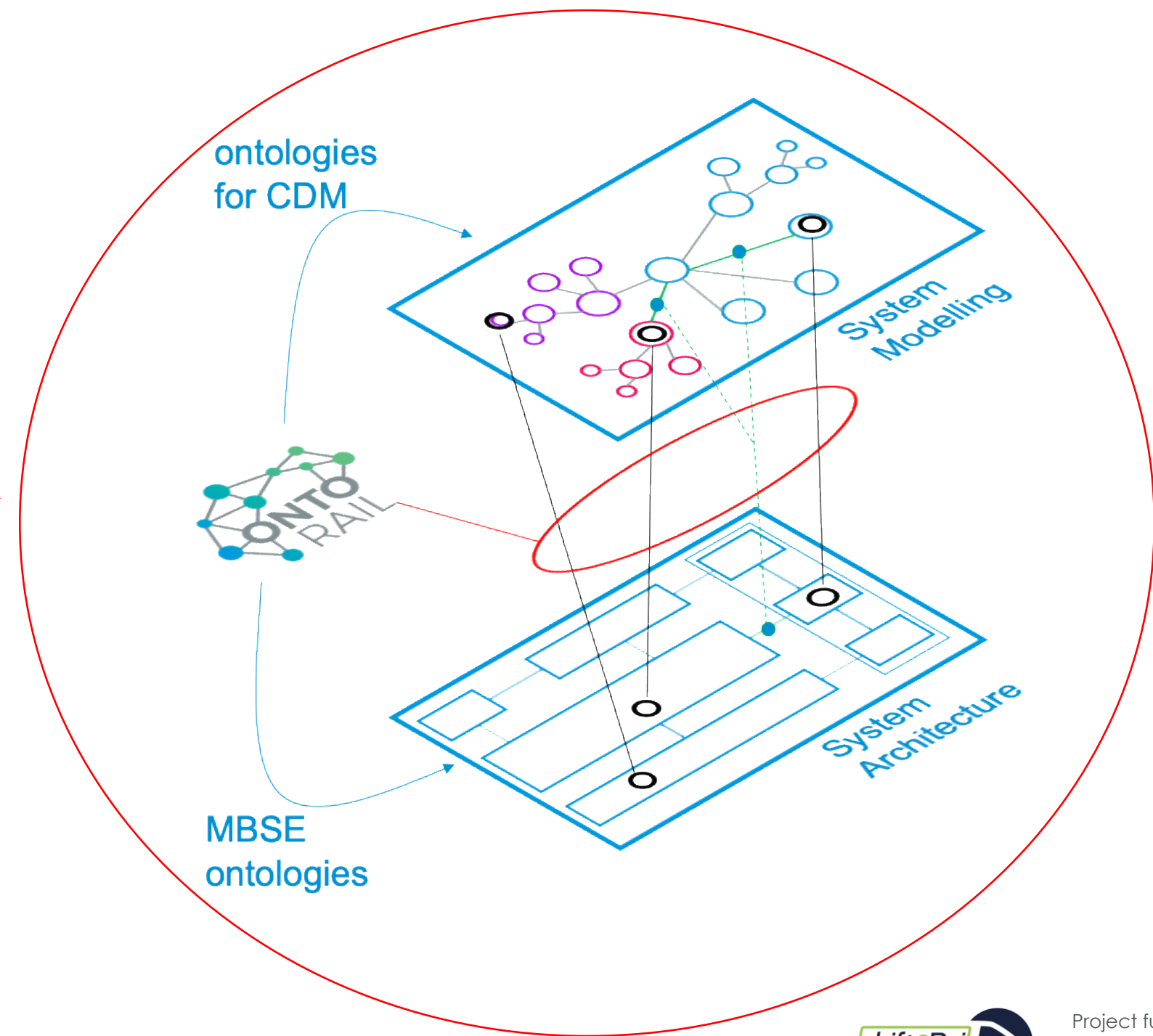
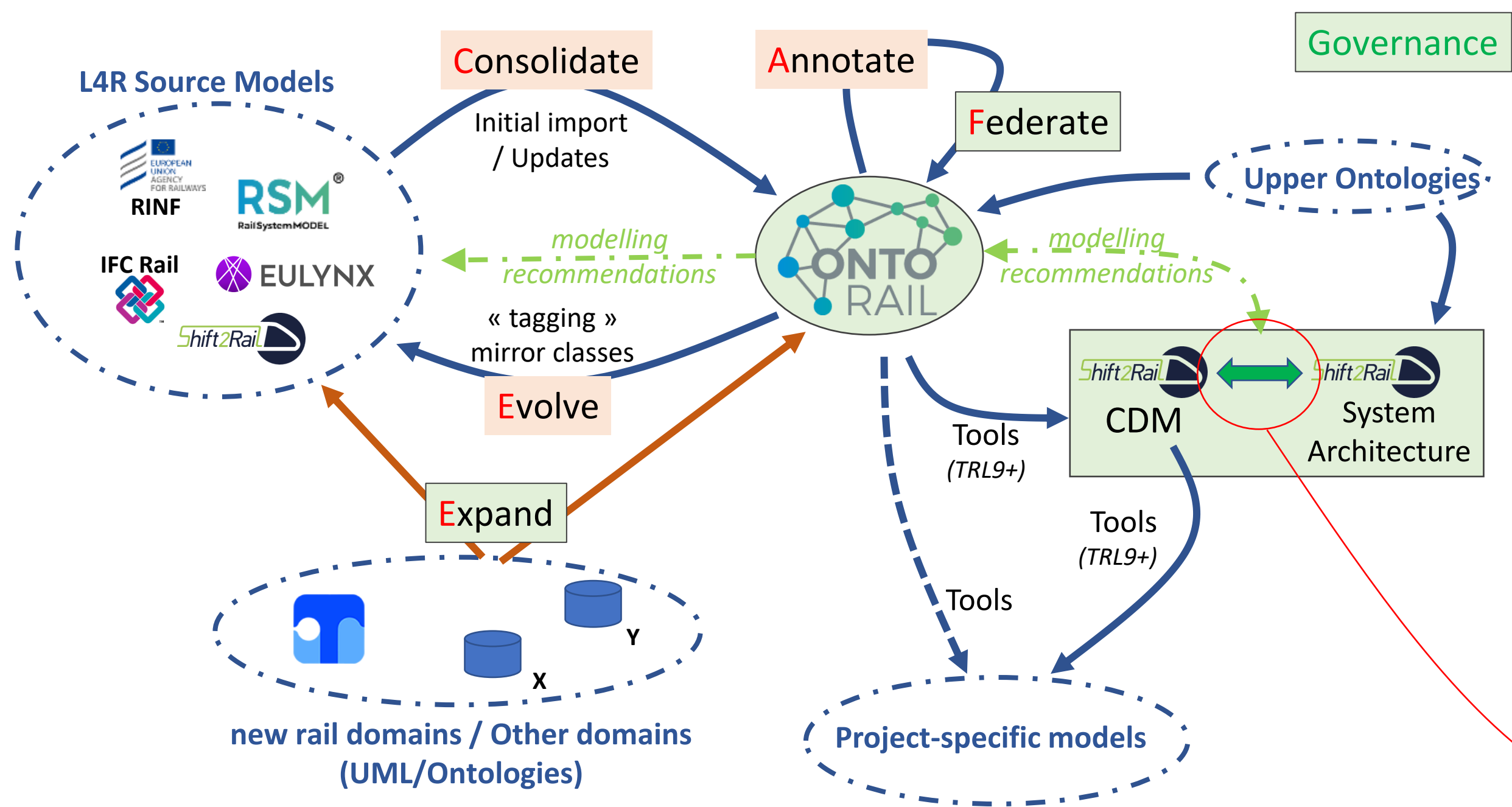
LinX4Rail: Dictionary, Conceptual Data Model ... and System Architecture



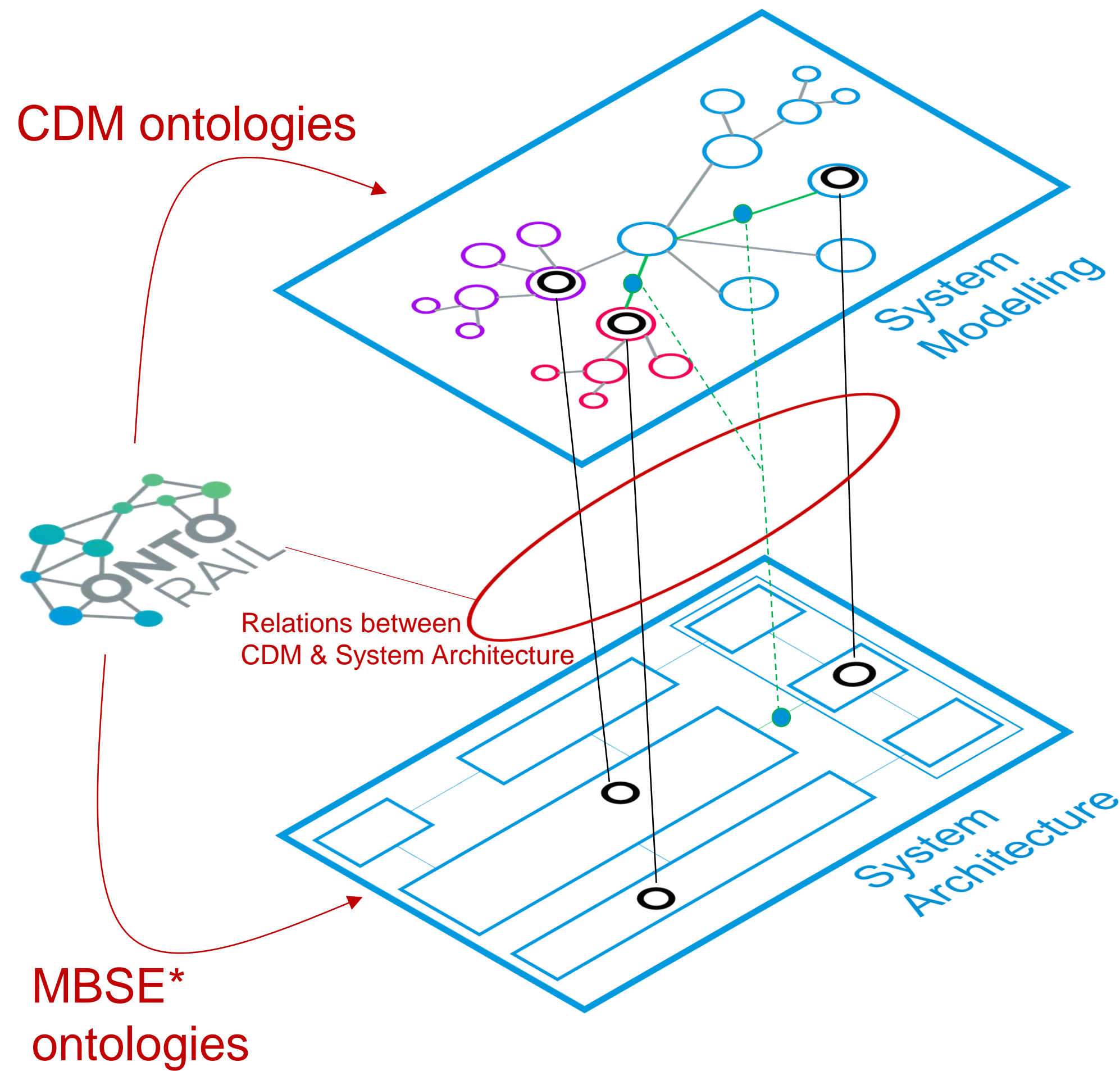
Investigating transformation from ontologies to project-specific models

OntoRail knowledge engine powering the Dictionary as an input to L4R Conceptual Data Model and System Architecture

Weaving System Architecture & System Modelling



Weaving System Architecture & System Modelling ... with Ontologies



System Architecture and Data Modelling represent different aspects of the railway system, intrinsically linked

OntoRail is engaged in building CDM while federating multiple source models

We propose to include System Architecture as an additional source model, and link it with CDM concepts/Packages/functions...

Semantic continuity across architecture & CDM, a key building block of the Digital Twin

*MBSE: Model Based System Engineering



<https://rsm.uic.org>



<https://gitlab.com/rail.system.model/rtm>



<https://ontorail.org/> (website)



<http://app.ontorail.org:5000/ontorail> (the web application)



Source code will be published at a later stage

Closing remarks

Pierre-Etienne Gautier

Directeur du programme BIM et continuité numérique, SNCF Réseau
LinX4Rail & LinX4Rail2 (Shift2Rail) coordinator
RSF Sector Chair of the Railway Digital Modelling, UIC



