Linking Rail Data through the EU ERA rail ontology

An EU Rail System without Digital Barriers

30st Nov 2023 | EU Data Logistics Festival

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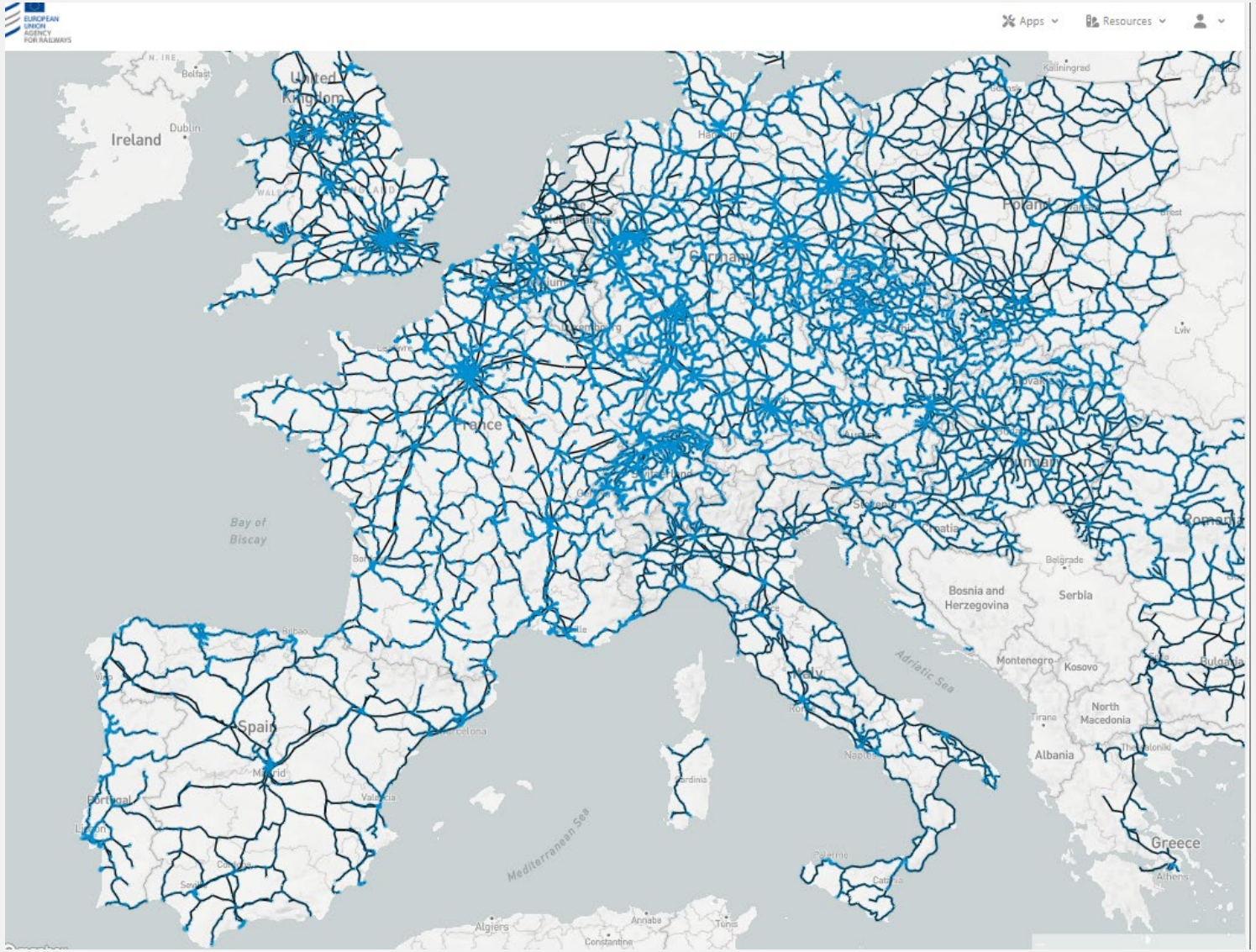
https://data-interop.era.europa.eu/



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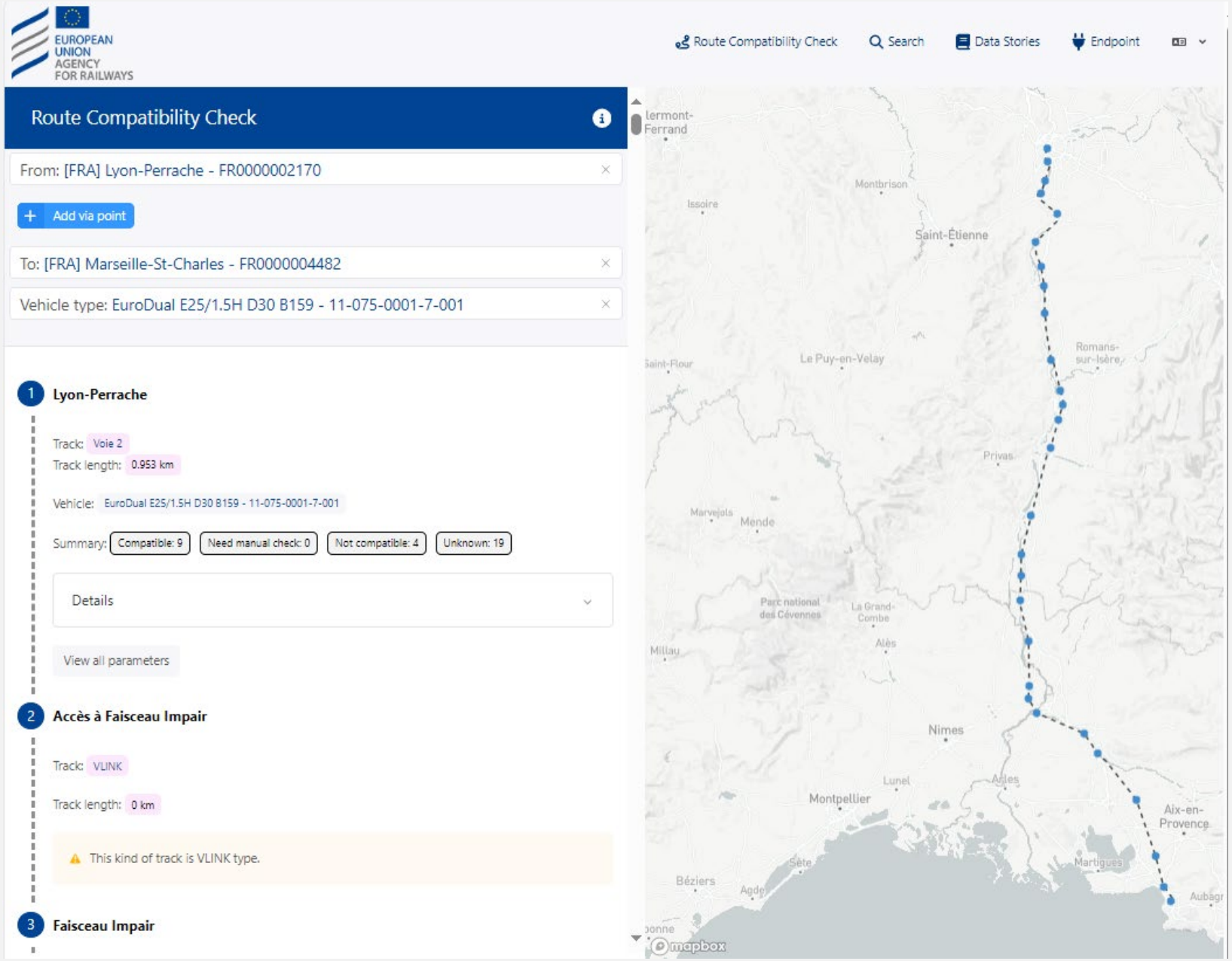
[ERA — Route Compatibility Check (europa.eu)]



European Register of Authorised Types of Vehicles
(ERATV)

The types of railway vehicles authorised by ERA or the Member States

Application

Data base

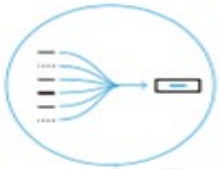
No connection

Application

Data base

Register of Infrastructure
(RINF)

Register of infrastructure stating the values of the network parameters of each subsystem or part subsystem concerned



ERA ontology

Semantic Vocabulary
Transformation to a commonly understood language

ERA knowledge graph

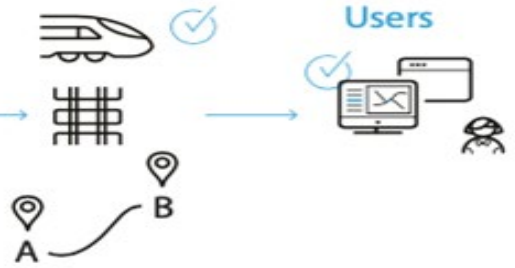
First step to extract 'operational' value from ERA base registers

Business value

Provider interest on sharing the data once and in a reusable manner ('once only' principle)

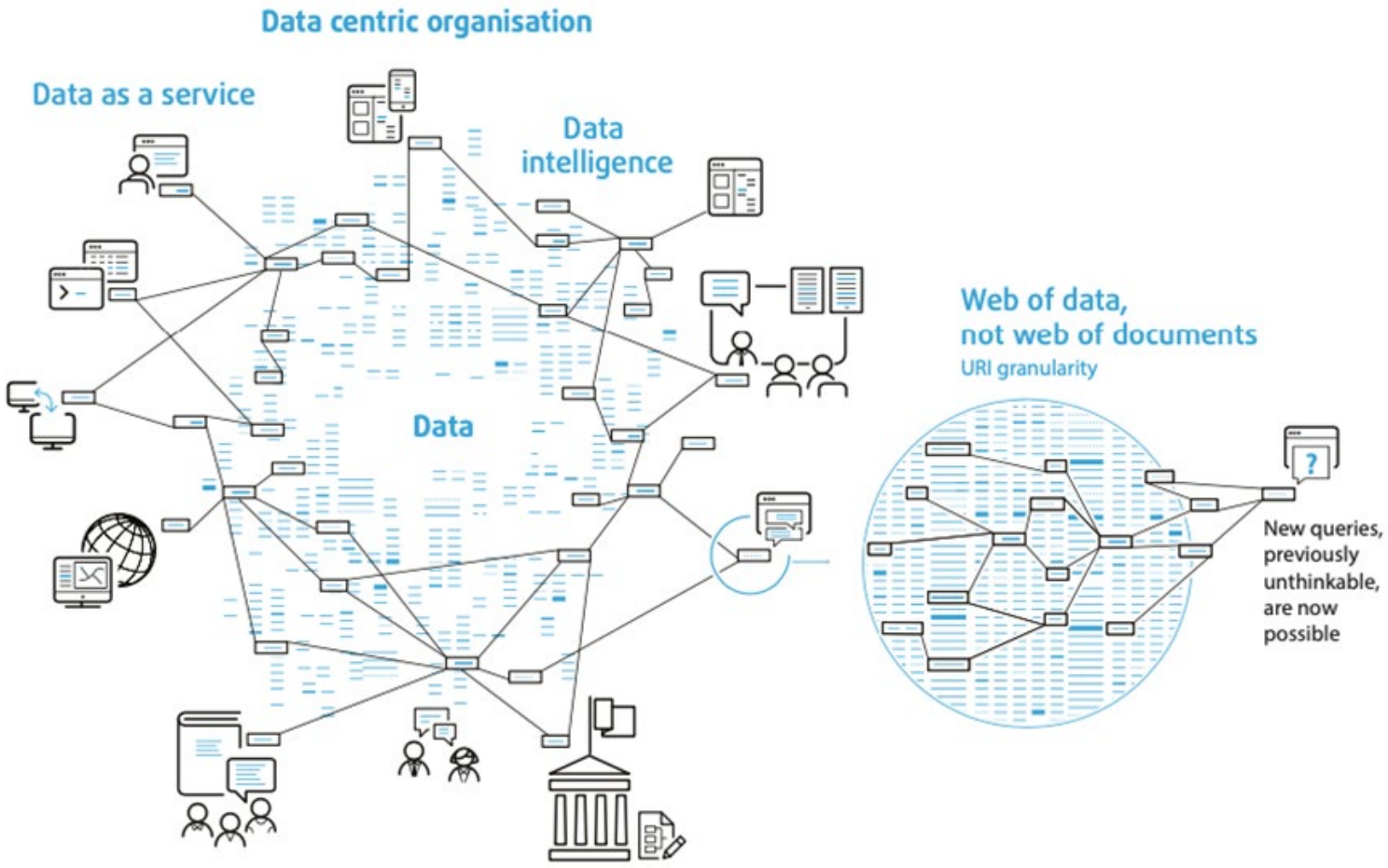
Route compatibility check

Find and analyse the information for the network topology and the vehicles to automatically display all the potential routes where a type of vehicle is technically compatible and able to run



The tool provides support for the planning activity within the operational railway cycle via a web app, a simple user interface displaying the data of a knowledge graph

Data centricity



To unlock the full potential of the data and to develop smarter systems we will need to move away from a system based on document exchange

Natural Language Queries

Automation requires digitalisation and climbing up in the data exchange model towards machine-readable meaningful data exchange to facilitate data exchange

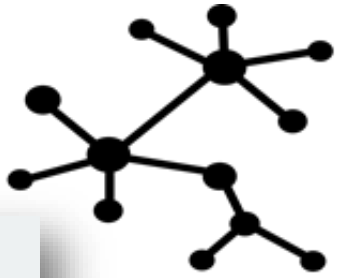
The Journey towards Data Centricity

2019

Management Board
Linked Data
Mainstream Decision

2022

Siloed data



ERATV *

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RINF - Register of Infrastructure

Connected

Extensible "Connectable" and "referential"

Wien Hauptbanhof: https://www.wikidata.org/wiki/Q697300 (look in references in station code Wbf)
Amsterdam Muiderpoort: https://www.wikidata.org/wiki/Q50724 (same there)

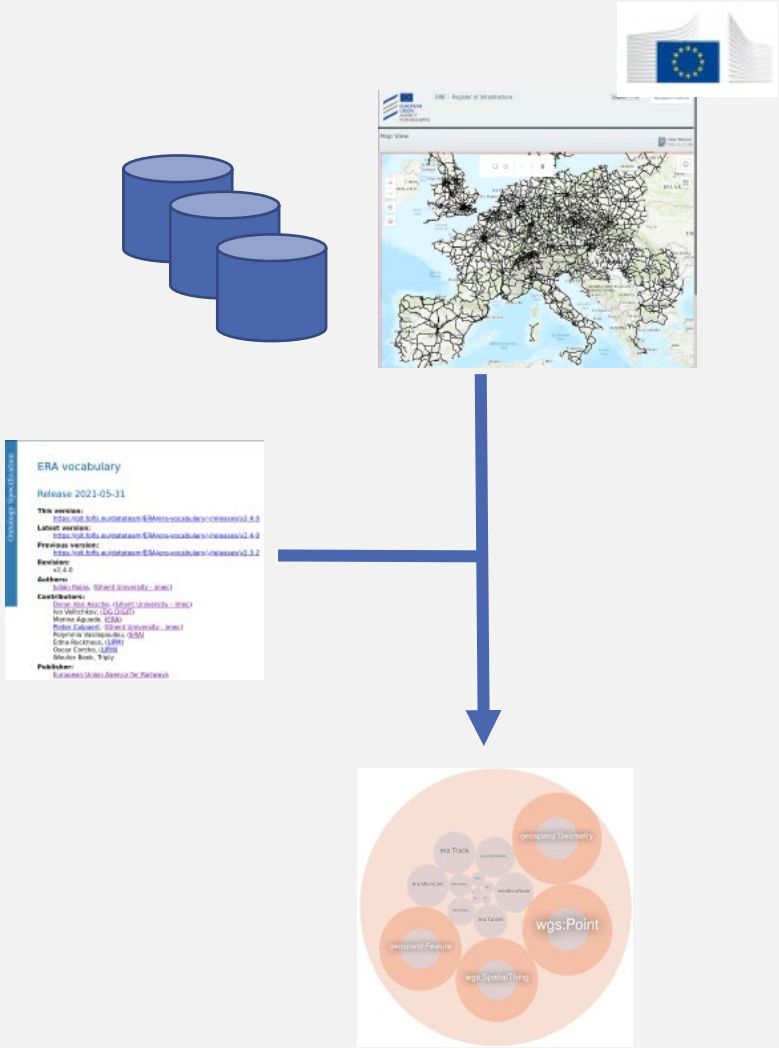
@EU Data Platform

ERA's current environment

ERA collects railway infrastructure data from all EU member states

ERA provides semantic definitions in the form of an ontology

ERA publishes a Knowledge Graph that brings semantic interoperability across multiple data sources



ERA as neutral vocabulary provider and identity provider for the data exchange in the EU Common European Mobility data space facilitating data interoperability in the Transport Sector

Sectorial Legal Basis

Harmonization of Processes

Harmonization of :

- Terms – vocabulary – ontology governance
- Reference data – taxonomies controlled vocabulary
- Management of Code Lists Master data EVN, locations

Mobility

Article 7a

ERA vocabulary

"ERA Vocabulary" means a Technical Document issued by the Agency pursuant to Article 4(8) of Directive (EU) 2016/797, establishing human and machine readable data definitions and presentations and linked quality and accuracy requirements for each data element (ontology) of the rail system.

The Agency shall ensure the ERA vocabulary is maintained to reflect regulatory and technical developments affecting the rail system. The first update shall be made available by [*PO please enter 6 months after enter into force of this regulation*]";

(6) the Annex is amended in accordance with Annex VII to this Regulation.

Ontology Specification

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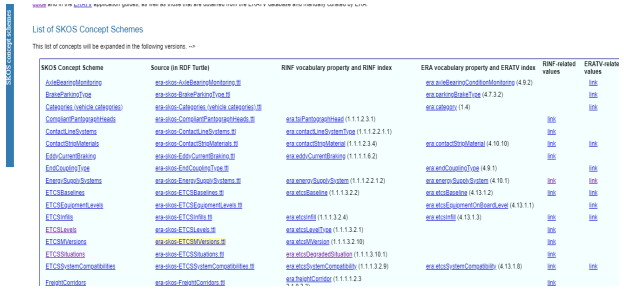
ERA vocabulary. Version 3.0.0

This version: https://data-interop.era.europa.eu/era-vocabulary/
Previous version: https://zenodo.org/record/7775344
Version: v3.0.0 (released on 2023-03-29)
Publisher: European Union Agency for Railways

ERA vocabulary (europa.eu)



SKOS Concept Schemes used in the ERA vocabulary (europa.eu)

SHACL
Validating RDF graphs

Link to ERA eng. rules

- Article 7 enacts semantic approach via ERA vocabulary/ontology
- 1st EU legal text enacting an ontology in the railway sector

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Ontology Specification

EUROPEAN UNION AGENCY FOR RAILWAYS

ERA vocabulary (with EVR Extension). Version 3.1.0

This version:
https://data-interop.era.europa.eu/era-vocabulary/
Previous version:
https://zenodo.org/record/7775344
Version:
v3.1.0 (released on 2023-07-29)
Publisher:
European Union Agency for Railways
Download serialization:
Format JSON LD Format RDF/XML Format N Triples Format TTL
Browse SKOS thesauri:
Format HTML
Download SHACL shapes:
Format TTL
License:

Cite as:
European Union Agency for Railways (2023) ERA vocabulary. Version v3.1.0. Retrieved from https://data-interop.era.europa.eu/era-vocabulary/

Abstract

This is the human and machine readable Vocabulary/Ontology governed by the European Union Agency for Railways. It represents the concepts and described in the Commission Implementing Regulation (EU) [to be updated after publication] on the common specifications for the register of railway in

Currently, this vocabulary covers the European railway infrastructure and the vehicles types authorized to operate over it. It is a semantic/browsable r experts in the RINF and ERATV working parties.

The vocabulary also includes the routebook concepts described in appendix D2 "Elements the infrastructure manager has to provide to the railway ur updated after publication] 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management Appendix D3 [to be updated after publication].

Ontology Specification Draft

ISS vocabulary

Release: 2023-09-20

Revision:
v1.0.0
Contributors:
Emmanuel Ruffin
Marina Aguado
Publisher:
European Railway Agency (ERA)
Imported Ontologies:
geosparql
skos
Download serialization:
Format JSON LD Format RDF/XML Format N Triples Format TTL
License:

Cite as:
ISS vocabulary. Revision: v1.0.0.
Provenance of this page

Abstract

This is the human and machine readable Vocabulary/Ontology governed by the European Union Agency for Railways accordance with the draft delegated act of the future CSM ASLP Regulation (hereinafter the 'CSM' or 'CSM ASLP).

Table of contents

- 1. Introduction
  - 1.1. Namespace declarations
- 2. ISS vocabulary: Overview
- 3. ISS vocabulary: Description
- 4. Cross-reference for ISS vocabulary classes, object properties and data properties
  - 4.1. Classes
  - 4.2. Object Properties
  - 4.3. Data Properties
- 5. References
- 6. Acknowledgments

RSM railSystemModel

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RailSystemModel (RSM) Version 1.2 ext

IRI:
http://ontorail.org/src/RSM/rsm12e#
Date :
13/01/2023
Current version :
v1.2 ext
Authors :
Airy MAGNIEN
Publisher :
UIC https://uic.org/
Other visualisation :
Ontology source

Abstract

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\n(for example Eulynx for signaling, IfcRail for BIM process, ...).

Source Model: https://rsm.uic.org/doc/rsm/rsm-1-2/

Table of Content

1. Classes
2. Object Properties
3. Named Individuals
4. Annotation Properties
5. Namespace Declarations

Classes

Air AirTemperature AlignmentCantSegment AlignmentCurve AnchorPoint Angle annotation property Anywhere AreaLocation BaseLocation BaseProperty bool boolean Calendar
Circumstance class CompositeSource CompositeTimeInterval CompositionNetElement Context Country Crossing DailyTrain datatype property Date DateTimeDescription Dilata
DoubleSlipCrossing Duration DurationOfSunshine ElementarySection ElementarySource ElementLength ElementPartCollection Elevation ElevationAndInclination EmptyPeriod EnergyEntity
FreightEntity GeneralDateTimeDescription GeodeticReferenceSystem GeographicCoordinate GeographicCoordinateSystem GeometricCoordinate GeopoliticalEntity Gradient GridRefere
HorizontalSegmentLine HorizontalSegmentTransition HumidityMixingRatio Inertia InformationSource InfrastructureManagerActivity Instant int int Interval IntrinsicCoordinate JunctionEntity
LinearElement LinearElementWithLength LinearLocation LinearPositioningSystem LinearTrainJourneyLocation LineString LocatedNetEntity LocatedOperationsEntity LocationsSet MarkerPoint
NamedLine NamedResource NamedTrack NetElement NetEntity NetProperty Network NetworkAccessPoint NetworkFrontierPoint NetworkLevel NetworkResource NeutralSection No
object property ObservableProperty Observation OfftrackEntity OntrackEntity OnTrackSignallingDevice OperationsEntity OrderedCollection p set package PassengerEntity Path Phenome

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Eulynx vocabulary. Version 2023-03-09

IRI:
https://ontologies.ontorail.org/Eulynx/eul-230309#
Date:
09/03/2023
Current version:
09-Mar-2023
Publisher:
EULYNX Consortium publishes EULYNX DataPrep at https://eulynx.eu/index.php/dataprep under an EUPL 1.2 license.

Abstract

Extracted ontology from the release 1.2 of EULYNX DataPrep in XMI format.
The EULYNX DataPrep model has been designed to define the format that Infrastructure Managers and suppliers/engineering companies will use to exchange information about signalling engineering and configuration data.
EULYNX is an European initiative by 15 Infrastructure Managers to standardise interfaces and elements of the signalling systems.

Table of Content

1. Classes
2. Object Properties
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5. Namespace Declarations

Classes

AccessPoint ActiveAspect ActiveAspect ActiveAspect ActiveAspectSet ActiveSignal Actor AdditionalInformation AirgapDataFile AirgapDataFile AlignmentCantSegment AlignmentSourceInformation
ApplicationSystem AreaValidity AreaWithoutTps ArsDeadlockSectionGroup ArsRoute ArsRouteTrigger ArsRouteTrigger ArsSignalGroup ArsSpeedCategory ArsSubArea Aspect AspectProvin
AssetLcControlRelation AssetUser AtbEgLoop AtbLoop AtbNgBeacon AtbNgLoop AtbVvBeacon AtbVvConnectionCabinet AtbVvController AtbVvInstallation AtbVvLoop AtcBalise
AutomaticRouteSettingSystem AutomaticRouteSettingSystem AutoRoute AwsMagnet AwsSystemProperties AxleCountingHead AxleCountingSection AxleCountingSectionConfiguration AxleCountingSection
BaliseGroupFunctionL2 BaliseGroupFunctionTilting BaliseGroupFunctionZbs BaliseGroupLinking BaliseGroupProperty BaliseGroupProperty BaliseGroupPurpose BaliseGroupType BaliseLabellingInfo
BgFunctionLevelTransition BidirectionalRouteLocking BigMetalMassArea BinaryDataFile BlockedTrack BlockElement BlockElementConfiguration BlockInstrument BlockSystem Bond boolean boolear
CableBridge CableDistributorDisconnector CableJoint CableJointInstallation CableJointRack CableJointRelation CablePipe CablePit CableProperties CableRoute CableRouteExit CableRoute
CableTerminationRack CableTray CableTrench CableTrough Cant CantDeficiencySpeed CentralControlledAreaDepartureTrack CentralInterlocking CentralSafetySystem ChangeMarker Changes
CommunicationNode CommunicationRelation CompositeRoute CompoundLogicalObject CompoundLogicalObjectAndState Condition ConditionAffectingKRI ConditionAffectingRoute Condition
ConductorRailSection Configuration ConfigurationProperty ConfiguredBaseObject ConflictingRoute ConfusionRisk ConstructionArea Container ControlArea ControlCode ControlFrame C
ControllerPlaceholder ControllerRelation ControlRelation ControlRoom CoveredObject Crocodile CrocodileSystemProperties Crossing CrossingElementAndPosition CssPropertySet DangerAr

Route book Information Flow

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RINF - Register of Infrastructure

ERA RINF chatbot

This simple chatbot answers natural languages data questions about the ERA RINF public data. It uses the OpenAI GPT-3 davinci model together with the ERA vocabulary to generate a SPARQL. Then the bot launches the query on the EU open SPARQL endpoint and returns the results.

Because the complete ontology is too big to send as prompt to GPT, the ontology is first reduced to the classes and properties that are actually in use by the public data.

This application is opensource.

Click here for some inspiration!

Here are some prompt examples:

- Please give me a list of all operational points
- Please give me a list of distinct manufacturers
- Please give me a list of distinct train detection systems
- Please give me a list of national railway lines. Return a table with uri, label and inCountry properties. Limit to 100 results

please give me a list of all operational points

Click to get your data answer

SPARQL query generated by GPT:

```
SELECT ?operationalPoint
WHERE {
  ?operationalPoint a <http://data.europa.eu/949/OperationalPoint> .
}
```

Data result:

	operationalPoint
5	http://data.europa.eu/949/functionalInfrastructure/operationalPoints/EELIIVA
6	http://data.europa.eu/949/functionalInfrastructure/operationalPoints/EEPALDI
7	http://data.europa.eu/949/functionalInfrastructure/operationalPoints/EEPAPINIIDU