INSPIRE
Infrastructure for Spatial Information in Europe

D2.8.I.7 INSPIRE Data Specification on Transport Networks – Guidelines

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Foreword
How to read the document?

This guideline describes the INSPIRE Data Specification on *Transport Networks* as developed by the Thematic Working Group Transport Networks using both natural and a conceptual schema language. The data specification is based on the agreed common INSPIRE data specification template.

The guideline contains detailed technical documentation of the data specification highlighting the mandatory and the recommended elements related to the implementation of INSPIRE. The technical provisions and the underlying concepts are often illustrated by examples. Smaller examples are within the text of the specification, while longer explanatory examples are attached in the annexes. The technical details are expected to be of prime interest to those organisations that are/will be responsible for implementing INSPIRE within the field of *Transport Networks*.

At the beginning of the document, two executive summaries are included that provide a quick overview of the INSPIRE data specification process in general, and the content of the data specification on *Transport Networks* in particular. We highly recommend that managers, decision makers, and all those new to the INSPIRE process and/or information modelling should read these executive summaries first.

The UML diagrams (in Chapter 5) offer a rapid way to see the main elements of the specifications and their relationships. Chapter 5 also contains the Feature Catalogue including the definition of the spatial object types, attributes, and relationships. People having thematic expertise but not familiar with UML can fully understand the content of the data model focusing on the Feature Catalogue. Users might also find the Feature Catalogue especially useful to check if it contains the data necessary for the applications that they run.

The document will be publicly available as a ‘non-paper’. It does not represent an official position of the European Commission, and as such can not be invoked in the context of legal procedures.

Interoperability of Spatial Data Sets and Services – General Executive Summary

The challenges regarding the lack of availability, quality, organisation, accessibility, and sharing of spatial information are common to a large number of policies and activities and are experienced across the various levels of public authority in Europe. In order to solve these problems it is necessary to take measures of coordination between the users and providers of spatial information. The Directive 2007/2/EC of the European Parliament and of the Council adopted on 14 March 2007 aims at establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) for environmental policies, or policies and activities that have an impact on the environment.

INSPIRE will be based on the infrastructures for spatial information that are created and maintained by the Member States. To support the establishment of a European infrastructure, Implementing Rules addressing the following components of the infrastructure are being specified: metadata, interoperability of spatial data themes (as described in Annexes I, II, III of the Directive) and spatial data services, network services and technologies, data and service sharing, and monitoring and reporting procedures.

INSPIRE does not require collection of new data. However, after the period specified in the Directive[1] Member States have to make their data available according to the Implementing Rules.

Interoperability in INSPIRE means the possibility to combine spatial data and services from different sources across the European Community in a consistent way without involving specific efforts of humans or machines. It is important to note that "interoperability" is understood as providing access to spatial data sets through network services, typically via Internet. Interoperability may be achieved by either changing (harmonising) and storing existing data sets or transforming them via services for publication in the INSPIRE infrastructure. It is expected that users will spend less time and efforts on understanding and integrating data when they build their applications based on data delivered within INSPIRE.

In order to benefit from the endeavours of international standardisation bodies and organisations established under international law their standards and technical means have been referenced, whenever possible.

To facilitate the implementation of INSPIRE, it is important that all stakeholders have the opportunity to participate its specification and development. For this reason, the Commission has put in place a consensus building process involving data users and providers together with representatives of industry, research, and government. These stakeholders, organised through Spatial Data Interest Communities (SDIC) and Legally Mandated Organisations (LMO)[2], have provided reference materials, participated in the user requirement and technical[3] surveys, proposed experts for the Data Specification Drafting Team[4] and Thematic Working Groups[5], expressed their views on the drafts of the technical documents of the data specification development framework[6]; they have reviewed and tested the draft data specifications and have been invited to comment the draft structure of the implementing rule on interoperability of spatial data sets and services.

The development framework elaborated by the Data Specification Drafting Team aims at keeping the data specifications of the different themes coherent. It summarises the methodology to be used for the

[1] For Annex I data: within two years of the adoption of the corresponding Implementing Rules for newly collected and extensively restructured data and within 7 years for other data in electronic format still in use.

[2] The number of SDICs and LMOs on 21/08/2009 was 301 and 176 respectively

[3] Surveys on unique identifiers and usage of the elements of the spatial and temporal schema,

[4] The Data Specification Drafting Team has been composed of experts from Austria, Belgium, Czech Republic, France, Germany, Greece, Italy, Netherlands, Norway, Poland, Switzerland, UK, and the European Environmental Agency

[5] The Thematic Working Groups of Annex I themes have been composed of experts from Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy Netherland, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, UK, the European Commission, and the European Environmental Agency

[6] Four documents describing common principles for data specifications across all spatial data themes. See further details in the text.

data specifications and provides a coherent set of requirements and recommendations to achieve interoperability. The pillars of the framework are four technical documents:

- The Definition of Annex Themes and Scope[7] describes in greater detail the spatial data themes defined in the Directive, and thus provides a sound starting point for the thematic aspects of the data specification development.

- The Generic Conceptual Model[8] defines the elements necessary for interoperability and data harmonisation including cross-theme issues. It specifies requirements and recommendations with regard to data specification elements of common use, like the spatial and temporal schema, unique identifier management, object referencing, a generic network model, some common code lists, etc. Those requirements of the Generic Conceptual Model that are directly implementable will be included in the Implementing Rule on Interoperability of Spatial Data Sets and Services.

- The Methodology for the Development of Data Specifications[9] defines a repeatable methodology enabling to arrive from user requirements to a data specification through a number of steps including use-case development, initial specification development and analysis of analogies and gaps for further specification refinement.

- The "Guidelines for the Encoding of Spatial Data"[10] defines how geographic information can be encoded to enable transfer processes between the systems of the data providers in the Member States. Even though it does not specify a mandatory encoding rule it sets GML (ISO 19136) as the default encoding for INSPIRE.

Based on the data specification development framework, the Thematic Working Groups have created the INSPIRE data specification for each Annex I theme. The data specifications follow the structure of "ISO 19131 Geographic information - Data product specifications" standard. They include the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language[11].

A consolidated model repository, feature concept dictionary, and glossary are being maintained to support the consistent specification development process and potential further reuse of specification elements. The consolidated model consists of the harmonised models of the relevant standards from the ISO 19100 series, the INSPIRE Generic Conceptual Model, and the application schemas[12] developed for each spatial data theme. The multilingual INSPIRE Feature Concept Dictionary contains the definition and description of the INSPIRE themes together with the definition of the spatial object types present in the specification. The INSPIRE Glossary defines all the terms (beyond the spatial object types) necessary for understanding the INSPIRE documentation including the terminology of other components (metadata, network services, data sharing, and monitoring).

By listing a number of requirements and making the necessary recommendations, the data specifications enable full system interoperability across the Member States, within the scope of the application areas targeted by the Directive. They are published as technical guidelines and provide the basis for the content of the Implementing Rule on Interoperability of Spatial Data Sets and Services for data themes included in Annex I of the Directive. The Implementing Rule will be extracted from the data specifications keeping in mind the technical feasibility as well as cost-benefit considerations. The Implementing Rule will be legally binding for the Member States.

In addition to providing a basis for the interoperability of spatial data in INSPIRE, the data specification development framework and the thematic data specifications can be reused in other environments at

[7] http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf
[8] http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.1.pdf
[9] http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.6_v3.0.pdf
[10] http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.7_v3.0.pdf
[11] UML – Unified Modelling Language
[12] Conceptual models related to specific areas (e.g. INSPIRE themes)

local, regional, national and global level contributing to improvements in the coherence and interoperability of data in spatial data infrastructures.

Transport networks
Executive Summary

Purpose

INSPIRE Directive (2007/2/EC, 14.03.2007) defines the spatial data theme ("theme") Transport Networks as: "Road, rail, air and water transport networks and related infrastructure. Includes links between different networks. Also includes the trans-European transport network as defined in Decision 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network ([13]) and future revisions of that Decision."

This version (v3.0.1) of the data specification on Transport networks provides:

- the basis for the development of the part of the Implementing Rules, defined in the Article 7(1) of the INSPIRE Directive, related to the spatial data theme Transport networks and
- the implementation guidelines that will accompany the Implementing Rule on the Interoperability of Spatial Data Sets and Services according to Article 7(1) of the INSPIRE Directive.

The data specification has been prepared by the INSPIRE Thematic Working Group Transport Networks (TWG-TN), a multinational team of experts in the field drawn from different parts of the European Union ([14]), in the frame of the common and transparent development process.

This version of the INSPIRE data specification for Transport networks has been compiled from reference material submitted by the Spatial Data Interest Communities (SDICs) and Legally Mandated Organisation (LMOs) of INSPIRE, plus the responses to the User Requirements Survey and a set of agreed use cases - some of which have been specifically prepared by the TWG-TN based on their knowledge and experience, like environmental impact assessment, noise mapping, speed limits (related to the in-car information systems) and journey planning.

A large amount of submitted reference material was available for the road networks, largely from the mapping agencies and less input from road authorities. For the other sub-themes Rail, Water and Air transport networks the TWG-TN has had to undertake additional research, building on existing material and documentation. Research has included supporting material regarding trans-European networks and the objects required to support them, such as TEN-T, as well as other initiatives for example: specific documentation from Eurocontrol for air documentation.

Scope and description

The transport component should comprise of an integrated transport network, and related features, that are seamless within each national border. In accordance with Article 10(2) of the INSPIRE Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features that are related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also support the referencing of transport flows to enable the navigation services.

The data specification is extensive, covering major transport networks types that are defined in the five distinct transport themes (sub-themes): Road, Rail, Water, Air transport and Cableways[15], including the connections between those types. The sub-themes are defined in a way that they can be used together to support an integrated approach to transport and they may be used with other spatial data themes. It is evident that there are a very large number of applications that can potentially use the Transport networks.

[13] OJ L 228, 9.9.1996, p.1. Decision as last amended by Council Regulation (EC) No 1791/2006 (OJ L 363, 20.12.2006, p.1).
[14] The Thematic Working Group Transport Networks (TWG-TN) is composed of the experts from Belgium, France, Spain, Sweden and the United Kingdom.
[15] Included in the data specification as a separate sub-theme based on the comments received in the consultation process.

Taking into account the variety of responsibilities in collecting, managing and using the data and different approaches in the data base management practice, from simple models to complex data arrangements, this data specification is provided as basic framework and with the purpose to maximize the reuse and sharing of the data about a network. It is mainly focused on the "widely reused – widely referenced" segments of spatial objects, supporting the loose linkage between the diverse organizational data with these spatial objects and allowing the extensibility to fit into diverse applications and users needs.

This approach provides a framework for users to configure and associate their own information (from surface condition surveys, to journey planning, to trans-European transport policy making etc.) using existing transport networks information in each Member State.

The datasets in scope are used extensively at the "local level" and extended to regional, national and European levels. This data specification provides a coherent approach to the forms of the representation (physical topographic area objects or centreline representations) and consistency between data sets, the latest as different types of coherence (between spatial objects of the same theme at different levels of detail, between different spatial objects within a same area or coherence at state boundaries).

All the spatial data sub-themes are based on the INSPIRE Generic Conceptual Model (GCM)([16]) that relies on several ISO 19100([17]) series of geographic information standards to provide the foundations for specific aspects of interoperability.

Within the GCM, the Generic Network Model (GNM)([18]) is defined to be shared by any network spatial data theme (e.g. Hydrography) to ensure a consistent approach across all network themes.
Specific mechanisms, used in the data specification and defined in the GNM, include:

- Network connection mechanism to establish the cross-border connectivity (a simple cross-referencing system to establish cross-border connections between the transport networks) or to establish intermodal connectivity (by linking two transport network elements from different transport networks which use a different mode of transport);
- Object referencing to support the reuse of information (for example to avoid the duplication of the geometry and to link complementary feature types from different organistaions);
- Linear referencing([19]) to support and link the different transport properties to the transport elements – it is used to position phenomena along a linear object, using a distance from the beginning of the linear object and
- The mechanism to combine the network elements into high-level semantic meanings.

The elements in the network are handled as nodes, links, aggregated links, areas and points. In addition, the individual transport links can be combined to form transport link sequences or further – the combination of both can be used to form the transport link sets.

The data specification includes three types of geometry: (a) (topographic) area objects, (b) centreline objects and (c) point objects. The types (a) and (b) may be alternative representations of the same real world phenomena about which the user can associate their own information (objects). The type (c) is, apart from network nodes, only included in the specification for marker posts. The basic spatial representation type is 2D vector.

Topology is handled in the data specification implicitly rather than explicitly, with the main reason to keep the model simple as possible but expecting that most applications will use the network data within a topological environment. .There is therefore a prerequisite for "implicit topology", where the

16 Generic Conceptual Model is part of the data specification development framework;
http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.1.pdf
[17] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=54904
[18] Generic Network Model (GNM) is described in the Generic Conceptual Model (v3.1). The GNM provides the basic structure for network nodes, links, aggregated links and areas and basic mechanisms for: grade separating crossings between network elements, cross-referencing, adding properties to a network (including the use of linear referencing) and adding inter-network connections.
[19] Linear referencing is included in the GNM based on ISO 19148 (which is currently under development).

data provided must be sufficiently clean and capable of automated topological construction within a user's application. This concept is framed with the specific requirements, including the data quality information.

There are relationships with other spatial data themes, in particular with:

- Hydrography, where the water transport sub-theme reuses the INSPIRE river network model for inland transportation purposes and
- Addresses, where the majority of addresses can be linked to the transport links (roads, rivers, etc.).

Next steps in the development
It is intended that this data specification will be maintained in accordance with the future development of the INSPIRE data specification framework documents, new identified user requirements or policy requirements, development of the standards (used as a basis for data specification) and based on the best practices and on the input from the implementation of the INSPIRE Implementing Rules.

The data specification – guidelines will be will be published on INSPIRE web site([20]).

[20] http://inspire.jrc.ec.europa.eu/

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The Thematic Working Group Transport Networks (TWG-TN) included:
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The Consolidated UML repository has been set up by Michael Lutz, Anders Friis-Christensen, and Clemens Portele. The INSPIRE Registry has been developed by Angelo Quaglia and Michael Lutz. The INSPIRE Feature Concept Dictionary and Glossary has been consolidated by Darja Lihteneger. The data specification testing has been coordinated by Martin Tuchyna. The Testing Wiki has been set up by Loizos Bailas, Karen Fullerton and Nicole Ostländer. Web communication and tools for the consultations have been developed by Karen Fullerton and Hildegard Gerlach.

The stakeholders participated, as Spatial Data Interested Communities (SDIC) or Legally Mandated Organisations (LMO), in different steps of the development of the data specification development framework documents and the technical guidelines, providing information on questionnaires and user surveys, participating in the consultation process and workshops, testing the draft data specifications and supporting the work of their members in the Thematic Working Groups and Drafting Team Data Specifications.

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Table of contents

1 Scope

This document specifies a harmonised data specification for the spatial data theme *Transport Networks* as defined in Annex I of the INSPIRE Directive.

This data specification provides the basis for the drafting of Implementing Rules according to Article 7 (1) of the INSPIRE Directive [Directive 2007/2/EC]. The entire data specification will be published as implementation guidelines accompanying these Implementing Rules.

2 Overview

2.1 Name and acronyms

INSPIRE data specification for the theme *Transport Networks*

2.2 Informal description

Definition:

The *Transport Networks* theme is defined within the INSPIRE Directive as:

"Road, rail, air and water transport networks and related infrastructure. Includes links between different networks. Also includes the trans-European transport network as defined in Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community Guidelines for the development of the trans-European transport network (1) and future revisions of that Decision.

(1) OJ L 228, 9.9.1996, p. 1. Decision as last amended by Council Regulation (EC) No 1791/2006 (OJ L 363, 20.12.2006, p. 1)"

[Directive 2007/2/EC]

Description:

It is further described in the INSPIRE Feature Concept Dictionary as follows:

"The transport component should comprise an integrated transport network, and related features, that are seamless within each national border. In accordance with article 10.2 of the Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also support the referencing of *transport flow to enable our navigation services."*

[INSPIRE Feature Concept Dictionary].

2.3 Normative References

[Directive 2007/2/EC] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

[ISO 19107] EN ISO 19107:2005, Geographic Information – Spatial Schema

[ISO 19113] EN ISO 19113:2005, Geographic Information – Quality principles

[ISO 19115] EN ISO 19115:2005, Geographic information – Metadata (ISO 19115:2003)

[ISO 19118] EN ISO 19118:2006, Geographic information – Encoding (ISO 19118:2005)

[ISO 19138] ISO/TS 19138:2006, Geographic Information – Data quality measures

[Regulation 1205/2008/EC] Regulation 1205/2008/EC implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata

ISO/AWI 19148 Geographic information -- Location based services -- Linear referencing system

Regulation L228, 09/09/1996 Community Guidelines for the development of the trans-European transport network.

Decision No 884/2004/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 amending Decision No 1692/96/EC on Community guidelines for the development of the Trans-European transport network

Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC) (OJ L 175, 5.7.1985, p. 40)

2.4 Information about the creation of the specification

Document title:	INSPIRE Data Specification *Transport Networks*
Reference date:	2010-04-26
Responsible party:	INSPIRE TWG *Transport Networks*
Language:	English

2.5 Terms and definitions

Terms and definitions necessary for understanding this document are defined in the INSPIRE Glossary[21].

There are no new terms defined in this specification.

2.6 Symbols and abbreviations

This is a list of abbreviations and acronyms used in the data specification

AICM/AIXM	Aeronautical Information Exchange
ARP	Airport Reference Point
ATS	ATS Route as described in ICAO Annex 11
ATZ	Airport Traffic Zone
CEDR	Conference of European Directors of Roads
CEMT	European Conference of Ministers of Transport.
CTA	Control Area
CTR	Control Zone

[21] The INSPIRE Glossary is available from http://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY

D	Danger Area
DME	Distance Measuring Equipment
Eurocontrol	Eurocontrol is the European Organisation for the Safety of Air Navigation.
EuroRoadS	An EC funded project (2003-2006) with the aim of producing a specification framework to support interoperable road information
FATO	Final Approach and Take Off Area for Helicopters
FIR	Flight Information Region
GCM	Generic Conceptual Model
GDF	Geographic Data Files
GNM	Generic Network Model
IAF	Initial Approach Fix Point
IAP	Instrument Approach Procedure
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IHO	International Hydrographic Organization
ILS	Instrument Landing System
ILS-DME	ILS with collocated DME
IMO	International Maritime Organization
ISO	International Organization for Standardization
LOC	Localizer
LOC-DME	LOC and DME collocated
MKR	Marker Beacon
MLS	Microwave Landing System
MLS-DME	MLS with collocated DME
NAT	North Atlantic Track (part of Organized Track System)
NDB	Non-Directional Radio Beacon
NDB-DME	NDB and DME collocated
NDB-MKR	Non-Directional Radio Beacon and Marker Beacon
NVDB	Swedish National Road Database
P	Prohibited Area
R	Restricted Area
RADEF	Road Administration Data Exchange Format
RNAV	Area Navigation Route
S-100	IHO Hydrographic Geospatial Standard for Marine Data and Information
S-32	IHO International Hydrographic Dictionary
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TACAN	Tactical Air Navigation Beacon; Tactical Air Navigation Route
TEN-T	Trans-European Network - Transport
TLS	Transponder Landing System
TMA	Terminal Control Area
TN	Transport Networks
TSS	Traffic Separation Scheme
TWG	Thematic Working Group
UIR	Upper Flight Information Region
VFR	Visual Flight Rules
VOR	VHF Omnidirectional Radio Range
VOR-DME	VOR and DME collocated
VORTAC	VOR and TACAN collocated

2.7 Notation of requirements and recommendations

To make it easier to identify the mandatory requirements and the recommendations for spatial data sets in the text, they are highlighted and numbered.

Requirement X	Requirements are shown using this style.

Recommendation X Recommendations are shown using this style.

2.8 Conformance

Requirement 1	Any dataset claiming conformance with this INSPIRE data specification shall pass the requirements described in the abstract test suite presented in Annex A.

3 Specification scopes

This data specification has only one scope, the general scope.

4 Identification information

Table 1 – Information identifying the INSPIRE data specification *Transport Networks*

Title	4.1 NSPIRE data specification on *Transport Networks*
Abstract	4.2 *Transport Networks* is defined within the INSPIRE Feature Concept Dictionary as: "*The transport component should comprise an integrated transport network, and related features, that are seamless within each national border. In accordance with article 10.2 of the Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also* support the referencing of *transport flow to enable our navigation services."* [INSPIRE Feature Concept Dictionary] The INSPIRE Directive sets out the key requirements in the following Articles of the Directive. *"Article 4* *1. This Directive shall cover spatial data sets which fulfil the following conditions:*

	(a) they relate to an area where a Member State has and/or exercises jurisdictional rights; *(b) they are in electronic format;* *(c) they are held by or on behalf of any of the following:* *(i) a public authority, having been produced or received by a public authority, or being managed or updated by that authority and falling within the scope of its public tasks;* *(ii) a third party to whom the network has been made available in accordance with Article 12;* *(d) they relate to one or more of the themes listed in Annex I, II or III."* *"2. In cases where multiple identical copies of the same spatial data set are held by or on behalf of various public authorities, this Directive shall apply only to the reference version from which the various copies are derived."* *"4. This Directive does not require collection of new spatial data."* *"Article 7* *1. Implementing rules laying down technical arrangements for the interoperability and, where practicable, harmonisation of spatial data sets and services, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 22(3). Relevant user requirements, existing initiatives and international standards for the harmonisation of spatial data sets, as well as feasibility and cost-benefit considerations shall be taken into account in the development of the implementing rules."* *"4. Implementing rules referred to in paragraph 1 shall cover the definition and classification of spatial objects relevant to spatial data sets related to the themes listed in Annex I, II or III and the way in which those spatial data are geo-referenced."* *"Article 8* *1. In the case of spatial data sets corresponding to one or more of the themes listed in Annex I or II, the implementing rules provided for in Article 7(1) shall meet the conditions laid down in paragraphs 2, 3 and 4 of this Article.* *2. The implementing rules shall address the following aspects of spatial data:* *(a) a common framework for the unique identification of spatial objects, to which identifiers under national systems can be mapped in order to ensure interoperability between them;* *(b) the relationship between spatial objects;* *(c) the key attributes and the corresponding multilingual thesauri commonly required for policies which may have an impact on the environment;* *(d) information on the temporal dimension of the data;* *(e) updates of the data.* *3. The implementing rules shall be designed to ensure consistency between items of information which refer to the same location or between items of information which refer to the same object represented at different scales.* *4. The implementing rules shall be designed to ensure that information derived from different spatial data sets is comparable as regards the aspects referred to in Article 7(4) and in paragraph 2 of this Article"* To support a consistent approach to all themes the European Commission, through the Data Specifications Drafting Team, developed the "Generic Conceptual Model" [GCM] which was reviewed and published prior to the commencement of work on the Annex I themes. This is the foundation model for every theme – with the intention that any theme may be combined in future and used in a way that is predicable.

The scope of the INSPIRE *Transport Networks* Data Product Specification incorporates five distinct transport themes:

- Road transport
- Rail transport
- Water transport
- Air transport
- Cableways

This is summarised in the diagram below which shows how the Directive guides the Generic Conceptual Model [D2.5] which contains a basic framework for any kind of network model (the Generic Network Model [GNM]). From the GNM a Common Transport application schema is adapted and this then is used as the basis for all five application schema. Collectively these are drawn together in this document as the Transport Networks Data Product Specification [D2.8.1.7].

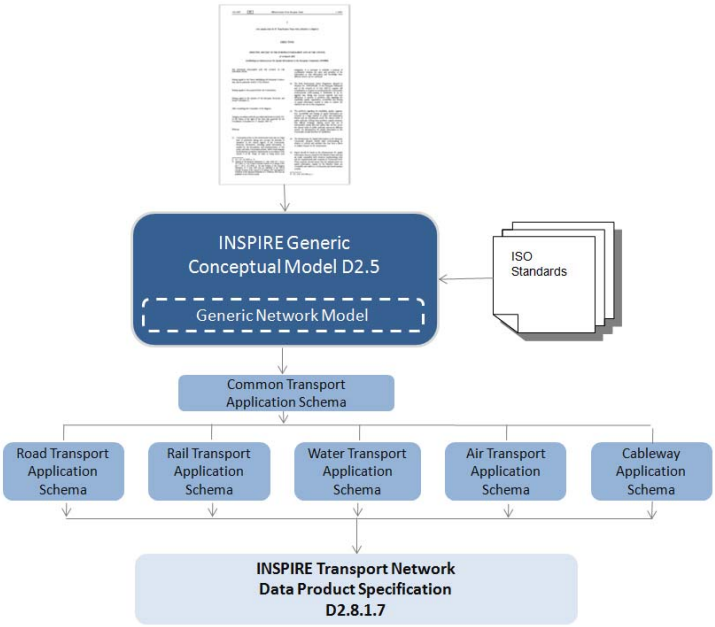
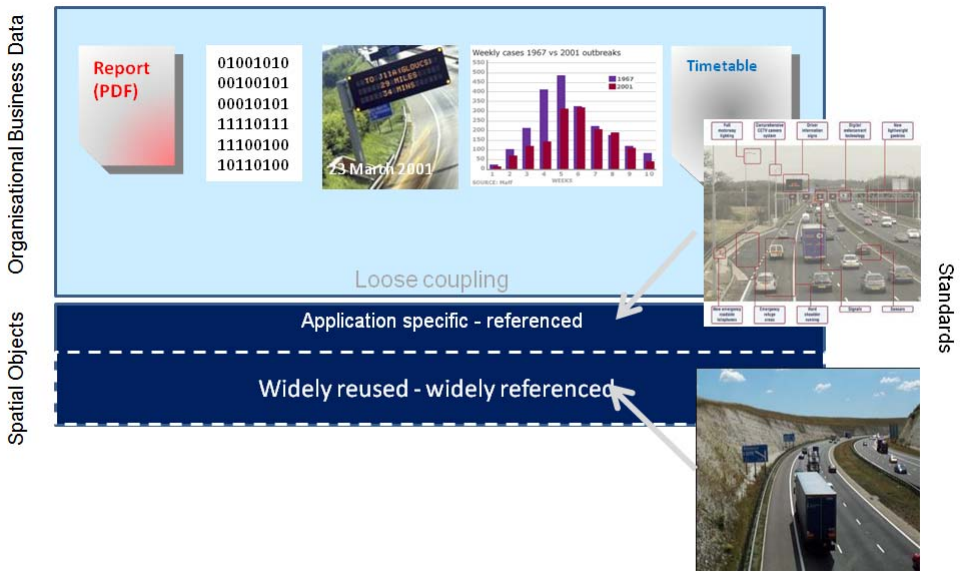


Figure 1 – Document framework for this data product specification
[key documents only]

These themes can be used together to support an integrated approach to transport but as noted above - they may be used with other themes developed to the same standard (e.g. response to an emergency where a fuel tanker over turns on a highway and discharges into an adjacent river network). It is evident that there are a very large number of applications that can potentially use the *Transport Networks* theme.

Understanding of the Generic Conceptual Model is essential and the GCM/GNM should be read in conjunction with this document. The GCM which describes the basic form of real world abstraction through to a comprehensive set of data interoperability. The GNM adapts this and describes the basic concepts that underpin and define the Common Transport Application Schema upon which all five themes are based. The GCM relies on ISO standards and the 19xxx series in

	particular.
Topic categories	4.3 Transportation – *Transport Networks*
Geographic description	4.4 This INSPIRE data specification covers spatial data sets which relate to an area where a Member State has and/or exercises jurisdictional rights.
Purpose	4.5 The purpose of this document is to specify a harmonised data specification for the spatial data theme *Transport Networks* as defined in Annex I of the INSPIRE Directive. However each organisation will have different responsibilities from the next and this will influence the kind of data they collect and manage and use. In turn some organisations may use simple models; others by necessity will have complex data arrangements. This data specification is provided as basic framework which users can adopt and if required – extend for themselves. The model is structured to maximise reuse and the sharing of organisational data about a network. The specification is concerned only with the core spatial objects required by *Transport Networks* (while acknowledging that the boundary of any object grouping is never black and white). Figure 2 below outlines the scope of the specification and how it relates to associated spatial objects which are less generically used.  **Figure 2 – Scope of Transport Network data** *Spatial Objects (core – application specific)* This specification is mainly focussed on the "widely reused – widely referenced" segment of spatial objects (ie network centrelines etc). **It does not attempt to try and incorporate every spatial object that might be used by any application**. In Figure 2 above such objects maybe lighting columns, gantries, signals, sensors etc These are all of the type "application specific "– and will be used/referenced by at least one organisation. *Associated "non-Geographic" data* Any "non geographic data" (the majority of the data holdings in any organisation) – is also out of scope of this specification – such records maybe "an asset condition report", "traffic flow records", "images of assets", "statistics", "timetables", "noise

data" and so on. Therefore much of the data used in the telematics industry is classed application specific. While associated with the network all these examples are closer to the application end of the spectrum than generic use by a wide community whether they represent a geographic entity or non-geographic data.

To maximise reuse the linkage of such organisational data with the spatial objects should be "loose" in the sense that these are ideally defined as different data objects in a database. Configured correctly such data may then reused in several different applications and any associated information shared and exchanged as desired.

User defined views and flexibility
The model itself is flexible and will permit a cross organisational approach where different users may collect and use different kinds of information about a network. By referencing they can relate one "view" e.g. a highway name, classification, route, condition survey and so on – simply by using references against a common geographic framework. Methods that will be found within the GNM that support this are the "linkset" and "link sequence". Any third party may further add their own "views", thereby enabling greater reuse and easier exchange of information around a common standard set of information components.

This approach enables several organisations to contribute and easily combine several views of the transport network. For a road example the combinations and contributors might be:

Underlying link and node geometry: mapping agency (national or state level)
Highway name: municipality
National highway classification: national highway authority
European highway classification: European highway authority

Many of these contributors may also collect and maintain application objects and business data which can be linked to the same infrastructure.

Extensibility
Users can extend the schema and add their own spatial objects to support an application. Data architects should use the GCM as the basis for any such extension. To illustrate this a small number of objects that are primarily of an application need (than generic) are included in this specification. Examples of these are:

- Linear – speed limits in the Roads theme
- Point – kilometer posts on the Roads and Rail
- Area* - Port area, Railway station area, etc.

*In practice these areas may be defined by aggregations of some other area object types using objects from other themes e.g. buildings.

Applications and use cases
While INSPIRE is primarily an environmental directive, *Transport Networks* data enjoys a wide variety of applications as recognised in the footnote to the theme statement in Annex I of the Directive. The following use cases are highlighted to demonstrate the width and breadth of applications (the list is not exhaustive).

- Asset Management
- Capacity Planning
- Construction
- Design & Planning
- Disaster management
- Emergency response

	o **Environmental Impact Assessments (incl. Noise)** o Estate management o Flow modelling o **In car information systems** o Incident management o **Journey Planning** o Maintenance o Navigation o Network operation o Rerouting & diversions o Routing o Traffic Control o Traffic management The applications **in bold** above were used as use cases in the preparation of this specification. These represent applications at the European, national, local public sector levels and in the private sector. It is evident that the scope of the specific does not attempt to support all these applications. User extensibility is supported and encouraged. Future revisions may incorporate further object types if it is felt that further standardisation is necessary. *Characteristics of the specification* The key characteristics of the *Transport Networks* datasets are: • They contain information of specific interest for the public sector in its role to support economic growth through efficient transportation, passenger safety, environmental impacts and social planning, etc. • The information is applicable from local to European levels of operation. • The data represents a structure or methods of operation that is stable over time (even if parts of the data content frequently changes). • Supports cross border (pan-European) applications. • Being a part of the European Spatial Data Infrastructure the data may be more easily used with other kinds of data themes, such as geographical names, administrative units, and addresses etc. • Private sector applications are extensive. .
Spatial representation type	4.6 The spatial representation type for this theme is: 2D vector

Spatial resolution	4.7 Local to European level capability From the use case list above it is evident that the specification has wide application and at several levels. Many applications would like to move seamlessly from the macro to micro view but this is rarely possible today for many reasons – chiefly today's datasets were not designed to operate in that way. *Local, Regional, National and European relevance of the specification* The datasets in scope are used extensively at the "local level" and extend to regional, national and European levels. Usage can change with levels of operation or within an organisation. The specification is mainly focussed on establishing a more coherent approach to those datasets that universally used, probably held at national or regional level and at the highest resolution within this context. This section describes the context within this respect. *Area and link types of representation at the higher resolution level* Some applications require a centreline network approach, some require the extent of carriageway or other form of transport, and some applications use both forms of representation. These are alternative forms of representation of a real world entity. The specification therefore supports alternative forms of representation and these may be cross referenced to support easy data exchange between the two. Only the centreline (link) can be formed into network (e.g. using the linkset). *Seamless resolution representations at the local and regional level* In these and other domains lower resolution representations may be preferred e.g. to view traffic flows in a region or capacity of the network. A user may wish to zoom from city level to a specific street seamlessly. Such an approach is recognised in D2.5 and outlined in D2.6. However such data management processes and methodologies remain immature. Ideally the lower resolution datasets would be derived from the local/high resolution data - outlined in the previous paragraph – and referenced (no geographic) data could then be aggregated and disaggregated as desired. *Multiple representations at regional, national and European levels.* Ideally the same data would be scalable dynamically from local to European level seamlessly. Since the current datasets and methods are insufficiently mature to support this - several "levels of detail" will usually be stored to represent the network at different operational levels. Unfortunately today there is very little correspondence between each level. Ideally it would be easy to seamlessly move from the highest to the lowest resolution with corresponding scaling and aggregation and disaggregation of the associated organisational information (as we do on statistical datasets) e.g. for reporting purposes or trans European analysis, real time management, planning and policy making. Such a "multiple resolution" approach is discussed in D2.6 Annex A.19 and Annex B.1 of this document. Transport networks lend themselves to such an approach. In the meantime this specification applies to all levels of detail. Further proving of the approach is required to support truly seamless integration of the levels of detail*. In the meantime data providers are encouraged to introduce this specification at the local level as a priority. *It is reported that some organisations are currently investigating such an approach but it is not yet formally adopted to such a level to document it in this version of the *Transport networks* specification (TN specification). This is an area that requires further research to improve both the capability and automation potential.

Supplementary information	4.8 Overview Structure of the *Transport Networks* data product specification and commentary on specific issues within the specification *Structure* The structure follows the ISO standard for data specifications (ISO 19xxx). Sections 1-3 are prepared to a defined pattern for all themes. This section (4) provides context, background and some introductory information to the specification. Section 5 contains a combination of the outputs from the UML model (application schemas) for the Common Transport Model and each of the five themes. This is supplemented by a descriptive narrative. Sections 6 – 11 are largely harmonised across all themes with variations that are essential to support aspects of this theme. The Annex are informative and include the Abstract Test Suite and further background information and examples. *Linear Referencing* Linear referencing is incorporated in the specification. This uses an approach aligned with the current draft standard ISO 19148; which establishes linear referencing within a spatial environment (rather than a traditional standalone approach). The aim of this is to better support data sharing across referencing mechanisms, and to offer coordinates for any object referenced linearly, in the same national coordinate system. *Logical networks* Logical networks (see Annex B.1) can be used within the model but their spatial value is very limited or in some cases may be non-existent. Therefore caution is required. Where these are in operation alongside the above forms of representation it is suggested that any corresponding nodes are reused or at least cross referenced to provide a relationship between the systems to preserve the potential for data sharing and exchange where that is both relevant and appropriate. *Network Interconnections* There are several cases where networks need to be joined up. For example at national, regional or dataset boundaries and at intermodal points within networks. This is provided by the Network Connection component which is defined in the Generic Network Model. *Relationships with other themes* There are linkages to other themes. In particular: *Hydrography* [HY] – the water transport theme reuses the INSPIRE river network model, for inland transportation purposes. To avoid undue interference with the river network - connections link inland ports with the nearest node on the river network. In marine waters the model is influenced by specifications from the International Hydrographic Office [IHO]. *Addresses* [AD] – the majority of addresses are linked to transport links (roads, some rivers etc) and thoroughfares are not part of the transport network defined in this specifications (e.g. pedestrian ways). However there is no link shown in the TN model – this is more logically made from the address to the transport object to which it is associated. The primary purpose for such a link would be to ensure consistency of geographic highway/thoroughfare name and to support address to address navigation via transport networks. *Source material* The *Transport Networks* data product specification (TN DPS) has been developed using the reference material, expertise and dialogue with LMO and SDIC. Other material submitted by LMO/SDIC has been supplemented by research to fill in the

	gaps in evidence. The TN specification is extensive and has therefore been broken into five interoperable transport themes: *Road, Rail, Water*, *Air transport and Cableway networks*. *Topology* Topology is handled implicitly rather than explicitly in the entire transport schema. This is to keep the model simple as possible. Generally systems will build topology in a form that best meets the user's application. ***It is expected that most applications will use the network data within a topological environment.*** There is therefore a prerequisite for "implicit topology". This means that the data provided must be sufficiently clean and capable of automated topological construction within a user's application. There are therefore specific data capture requirements and these are described in Chapter 7 on Data Quality and in Chapter 10 on Data Capture. *Future Updates of this specification* It is intended that this specification will be maintained in accordance with current proposals outlined by the Data Specifications Drafting Team. It is not possible to state at this time when the next update will occur.

5 Data content and structure

Requirement 2	Spatial data sets related to the theme *Transport Networks* shall be provided using the spatial object types and data types specified in the application schemas in this section.

Requirement 3	Each spatial object shall comply with all constraints specified for its spatial object type or data types used in values of its properties, respectively.

Recommendation 1	The reason for a void value should be provided where possible using a listed value from the VoidValueReason code list to indicate the reason for the missing value.

NOTE The application schema specifies requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. All properties have to be reported, if the relevant information is part of the data set. Most properties may be reported as "void", if the data set does not include relevant information. See the Generic Conceptual Model [INSPIRE DS-D2.5] for more details.

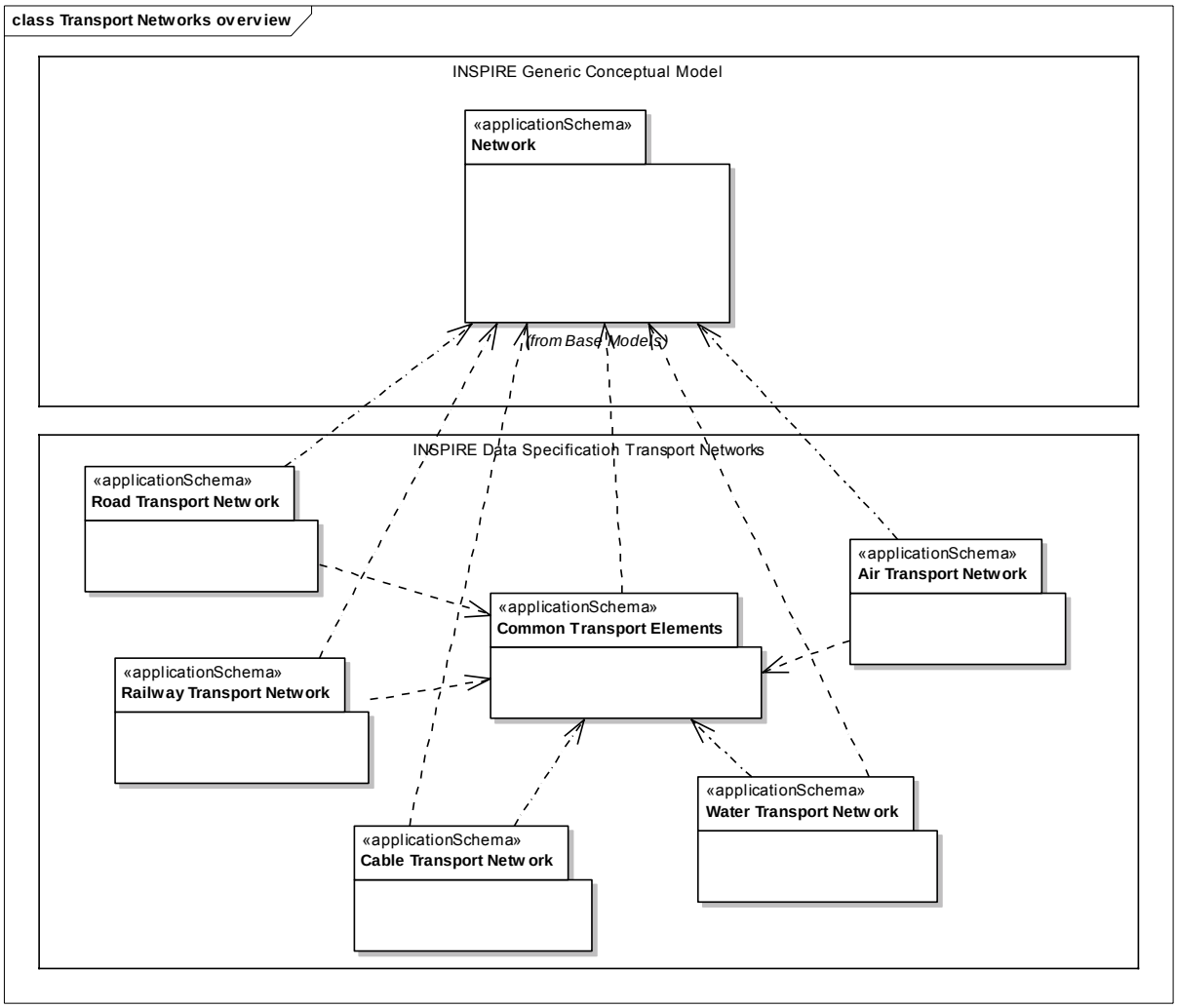


Figure 3 – UML class diagram: Overview of the *Transport Networks* UML structure and dependencies

The dependencies between the different Transport Networks application schemas are illustrated in Figure 3. All five of the Transport Networks (Road, Rail, Cable, Water and Air) application schemas depend on the Common Transport Elements application schema which defines a number of common transport classes. In turn, Common Transport Elements depends on the Generic Network Model on which it is based.

5.1 Basic notions

This section explains some of the basic notions used in the INSPIRE application schemas. These explanations are based on the GCM [DS-D2.5].

5.1.1 Placeholder and candidate types

This data specification may include types (typically spatial object types) that will be fully specified as part of an Annex II or III spatial data theme, but is already used as a value type of an attribute or association role of a type included in this data specification. Two kinds of such types are distinguished:

- A *placeholder type* acts as a placeholder for a spatial object type for which only a definition is specified (based on the requirements of the Annex I theme). It receives the stereotype «placeholder».

- A *candidate type* already has a preliminary specification comprising the definition as well as attributes and associations to other types. It does not receive a specific stereotype.

Both placeholder and candidate types are placed in the application schema package of the thematically related Annex II or III spatial data theme Their specifications will be revisited during the specification work of the Annex II or III theme.

If the existing preliminary specification elements of such types fulfil the requirements of the spatial data themes of Annex II or II they are kept and, if necessary, are complemented with further attributes or association roles.

If the existing preliminary specifications of a placeholder or candidate type do not fulfil the requirements of the spatial data theme of Annex II or III the placeholder or the candidate type will be moved into the application schema of the Annex I theme, and, if necessary, their specification will be completed. For the Annex II or III spatial data theme a new spatial object will be created.

Placeholders and candidate types are listed in a separate subsection of the Feature Catalogue.

5.1.2 Voidable characteristics

If a characteristic of a spatial object is not present in the spatial data set, but may be present or applicable in the real world, the property shall receive this stereotype.

If and only if a property receives this stereotype, the value of *void* may be used as a value of the property. A *void* value shall imply that no corresponding value is contained in the spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs, even though the characteristic may be present or applicable in the real world.

It is possible to qualify a value of void in the data with a reason using the VoidValueReason type. The VoidValueReason type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The characteristic is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the “elevation of the water body above the sea level” has not been included in a dataset containing lake spatial objects, then the reason for a void value of this property would be ‘Unpopulated’. The characteristic receives this value for all objects in the spatial data set.
- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the “elevation of the water body above the sea level” *of a certain lake* has not been measured, then the reason for a void value of this property would be ‘Unknown’. This value is applied on an object-by-object basis in a spatial data set.

NOTE It is expected that additional reasons will be identified in the future, in particular to support reasons / special values in coverage ranges.

The «voidable» stereotype does not give any information on whether or not a characteristic exists in the real world. This is expressed using the multiplicity:

- If a characteristic may or may not exist in the real world, its minimum cardinality shall be defined as 0. For example, an if an Address may or may not have a house number, the multiplicity of the corresponding property shall be 0..1.
- If at least one value for a certain characteristic exists in the real world, the minimum cardinality shall be defined as 1. For example, if an Administrative Unit always has at least one name, the multiplicity of the corresponding property shall be 1..*.

In both cases, the «voidable» stereotype can be applied. A value (the real value or void) only needs to be made available for properties that have a minimum cardinality of 1.

5.1.3 Code lists and Enumerations

5.1.3.1 Style

All code lists and enumerations shall use the following modelling style:

- No initial value, but only the attribute name part, shall be used.
- The attribute name shall conform to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

5.1.3.2 Governance

Two types of code lists can be distinguished:

- code lists that shall be managed centrally in the INSPIRE code list register and only values from that register may be used, and
- code lists that may be extended by data providers.

All code lists that are centrally managed shall receive the tagged value "codeList" with the preliminary value "urn:x-inspire:def:codeList:INSPIRE:<name of the class>".

5.1.4 Stereotypes

In the application schemas in this sections several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [INSPIRE DS-D2.5]. These are explained in Table 2 below.

Table 2 – Stereotypes (adapted from [INSPIRE DS-D2.5])

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
featureType	Class	A spatial object type.
Type	Class	A conceptual, abstract type that is not a spatial object type.
dataType	Class	A structured data type without identity.
Union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A flexible enumeration that uses string values for expressing a list of potential values.
placeholder	Class	A placeholder class (see definition in section 5.1.1).
voidable	Attribute, association role	A voidable attribute or association role (see definition in section 5.1.1).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.2 Application schema Common Transport Elements

5.2.1 Description

5.2.1.1 Narrative description

The Common Transport Elements application schema covers elements that are shared by subthemes *Road, Rail, Cable, Water* and *Air*. These subthemes have been modelled as separate application schemas within the Transport Networks theme.

Many of the common transport elements are specializations of common definitions for networks and network elements available in the GNM. Elements in networks are handled as nodes, links, aggregated links, areas and points.

Cross-border connectivity (connections between networks across national and regional borders) is also included. It uses a mechanism provided by the GNM and inherited by the specific transport network classes. Using the same mechanism from the GNM, intermodal connectivity (connections between elements in networks which use a different mode of transport) may also be included.

The Common Transport Elements application schema also defines a number of common transport property classes (as specializations of the generic Network Property class in the GNM). These classes are used to describe properties of transport network elements and they can apply to the whole of the network element they are associated with or - for linear features - be described using linear referencing.

The primary aspects modelled for transport network elements are:

- Spatial. Geometric (point, line and surface (i.e. areas (topographic areas)) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with optional points (nodes) at the ends of the lines (at junctions, road ends etc). Also, points (other than nodes) and areas with a function in a network may be represented in the dataset.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also information on when data was entered, modified or deleted in the dataset.

- Thematic. Depending on subtheme, the specializations for nodes, links and areas can be further characterized through various types of attributes and/or links to common or subtheme-specific property types.

5.2.1.2 UML Overview

As illustrated by Figure 4, many of the important mechanisms that are used to properly describe a transport network are defined by the GNM, and inherited by components of the transport network application schemas. Although these classes and relationships only appear in the informative paragraphs about imported types in the Transport Networks specification, they are very important for a correct implementation of this specification.
They include:
- The relationships between Nodes, Links, Link Sequences and Link Sets,
- Network Properties and the different ways of linking them to an element of a (transport) network,
- The mechanism for cross-border and intermodal connections,
- Grade separated crossings.

NOTE: In Figure 4, only the most important relationships between the Common Transport Networks application schema and the GNM are shown. Not all classes are present in the diagram and most of the attributes are removed in the intrest of clarity.

In the following paragraphs, the use of these mechanisms will be further explained.

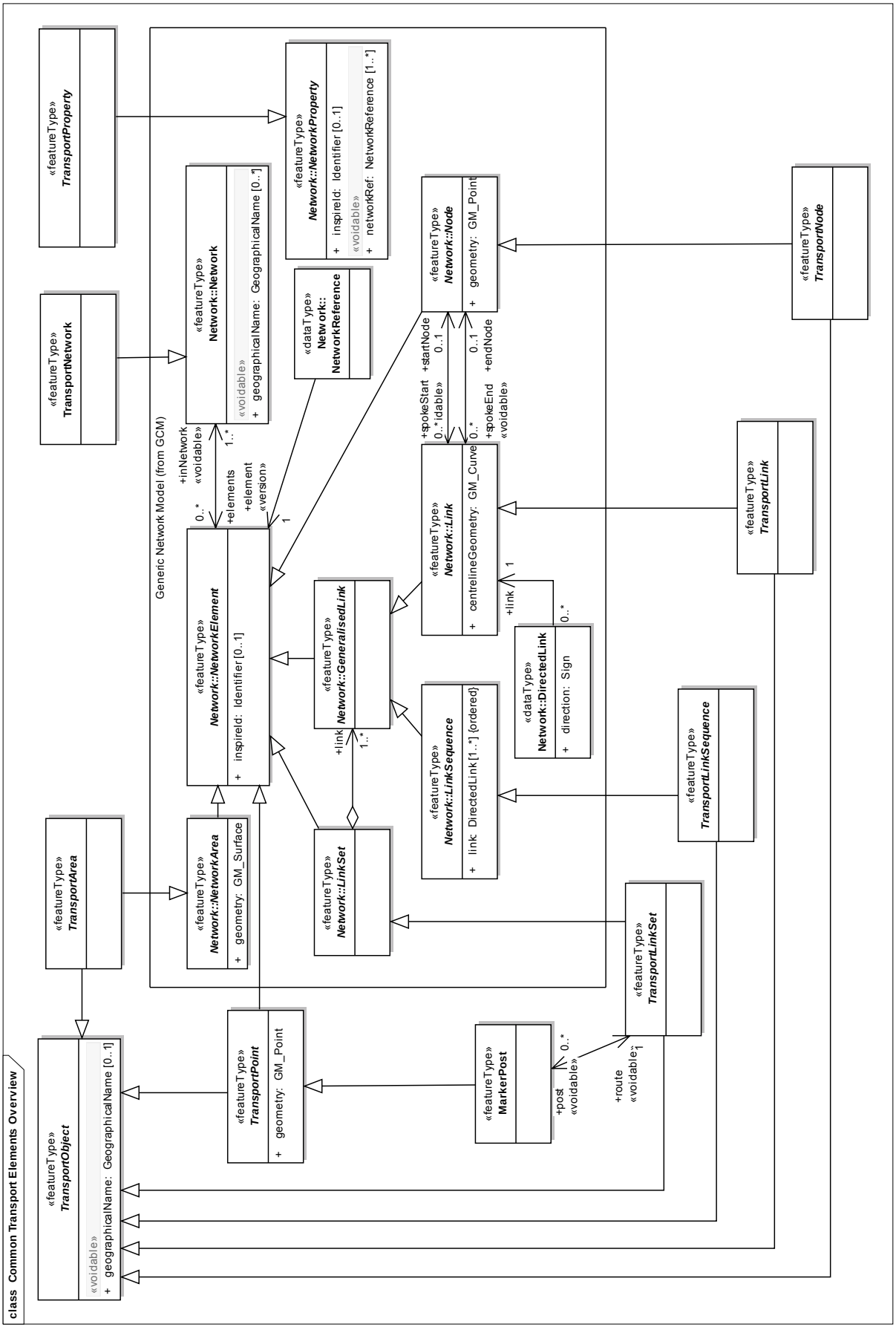


Figure 4 – UML class diagram: Overview of the *Transport Networks* application schema and its relationships with the GNM

5.2.1.3 Consistency between spatial data sets

As described in D2.6 A.18 there are three topic areas regarding consistency between spatial data sets, these are:

a) Coherence between spatial objects of the same theme at different levels of detail
b) Coherence between different spatial objects within a same area
c) Coherence at state boundaries.

[a] For *Transport networks* the specification incorporates two alternative forms of representation:

- Physical topographic area objects (usually surveyed to a high accuracy)
- Centreline representations (often an approximation of the centreline)

At any level of detail data integrity demands that these two forms need to be consistent with each other both positionally and logically. For example, where both exist, a road centreline will always fall within the limits of the corresponding road area object. Similarly, nodes in the road centreline representation will always fall inside the road area object that corresponds to the topographic junction where the node occurs.

Requirement 4	Transport Networks centreline representations and nodes shall always be located within the extent of the area representation of the same object.

[b] Both forms of representation will often be combined with other themes in a wide variety of applications. Again data integrity demands that these should be positionally consistent to ensure both a faithful representation of the real world and a professional appearance that will fill the user with confidence. For example buildings, rivers and forests with the transportation system.

Recommendation 2	The objects in the Transport Networks theme should be positionally consistent with spatial objects from other themes (e.g. with buildings and rivers, forestry extents)

[c] It is essential that continuity of transport network information is preserved positionally, logically and semantically across state borders and – where applicable – also across regional borders within member states. This is vital to interoperable pan-European spatial information. The methods to support this are outlined in D2.6 Annex B.

The GNM provides a simple cross-referencing system to establish cross-border connections between Transport Networks. In practice, this is done by linking a transport network element in a data set on one side of the border and the connected or corresponding network element in a data set on the other side of the border to a Network Connection object which has been qualified as cross-border connected (when the linked network elements connect to each other) or as cross-border identical (when the linked network elements are representations in each data set of the same real world object). The Network Connection class is defined in the GNM.

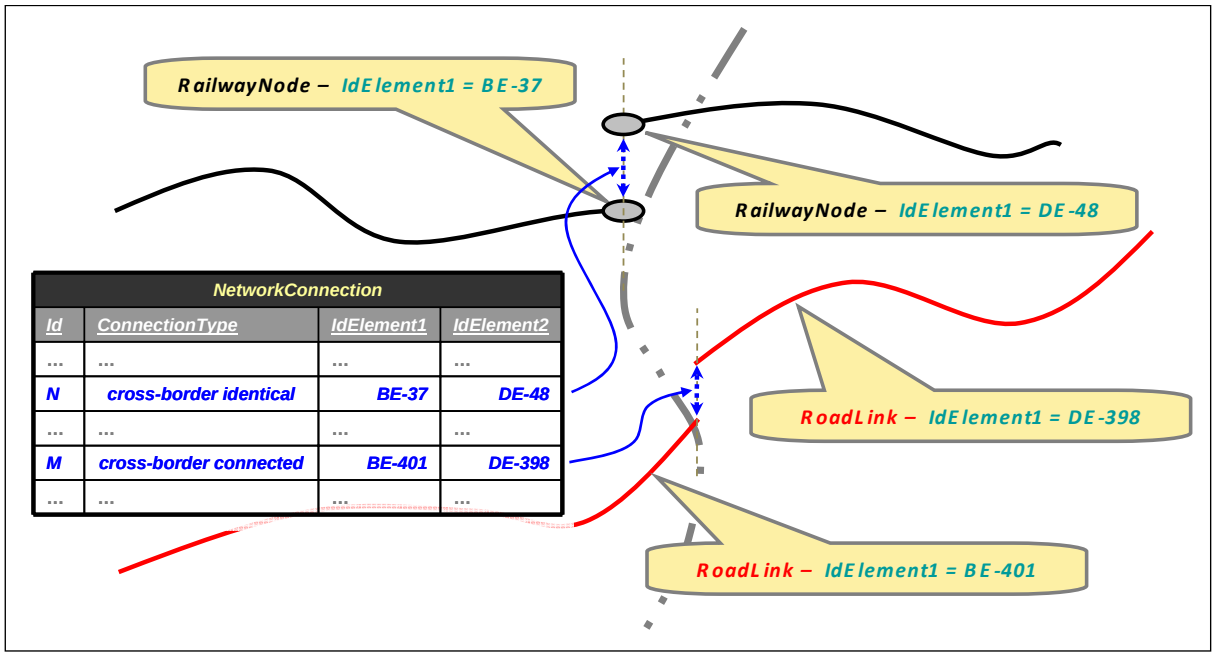


Figure 5 – Examples of cross-border connections between Transport Networks

For Transport Networks the use of a Network Connection to establish cross-border connectivity is mandatory. Furthermore, it is recommended that the respective authorities seek to fully resolve the positional alignment of cross-border connected elements of Transport Networks in accordance to the rules for network connectivity outlined in section 10.2 (Ensuring Network Connectivity).

Requirement 5	Connectivity between Transport Networks across state borders and – where applicable – also across regional borders (and data sets) within Member Sstates shall be established and maintained by the respective authorities, using the cross-border connectivity mechanisms provided by the NetworkConnection type.

Recommendation 3	In considering reconciliation across borders the respective authorities should seek to fully resolve the positional alignment that minimises positional deficiencies that would require repeated manual interval in updates or detract from the use of the data in applications.

5.2.1.4 Identifier management

As is required by the GCM, all spatial objects must have a unique identifier. This must be persistent and will usually be supported by a defined lifecycle to ensure that users understand the conditions that the identifier may be created, modified (in terms of its relationship with the spatial object) and deleted.

The unique object identifier will be modelled on the form described in D2.5 9.8.2 and 9.7 and D2.7 Chapter 7 where a country code and namespace is applied as a prefix to the existing local identifier used by the authority responsible for the data. This will both ensure that the identifier is:

- Unique in the European spatial data infrastructure
- The object is traceable in that infrastructure

All spatial objects in the *Transport networks* will have a unique object identifier – this includes those spatial objects that contain geometry and those that may not (e.g. Associated objects, AggregatedLink objects and those defined by linear referencing etc).

Requirement 6	All spatial objects in the Transport Networks themes shall have a persistent unique identifier as defined in the INSPIRE documents D2.5 and D2.7.

NOTE: All spatial object classes in the Transport Networks application schemas inherit their unique identifier from the GNM where it is defined with a cardinality of "0..1". In the transport networks classes the unique identifier is mandatory for all objects, which corresponds to a cardinality of "1".

Ideally all objects should be supported by a defined lifecycle model and a method of versioning (see D2.5 9.7) that assists the user in distinguishing between current objects and previous versions.

Recommendation 4	The spatial object unique identifier should be supported by a documented lifecycle to provide users with a defined behaviour pattern as conditions which affect the object change over time.

Recommendation 5	The spatial object unique identifier should be supported by a defined form of versioning to ensure that users refer to the correct version in applications.

5.2.1.5 Modelling of object references

The INSPIRE Directive promotes the reuse of information. Object referencing is designed to support that aim whereby an existing object e.g. a transport link is used by several other objects, which may be collected by different organisations (e.g. surface condition survey, speed limit/restrictions etc). Such objects would normally inherit geometry from underlying referenced objects.

Data Association
As described in D2.5 Chapter 13 an associated object would reference the base network (data association). The link is physically achieved by cross referencing one object with another – using the unique identifiers provided (and ideally the version information),

This is common practice in several existing transport networks and the *Transport networks* specification supports this approach.

Recommendation 6	All associated spatial objects in the Transport Networks theme should use object referencing to an existing set of transport links rather than duplicate the geometry.

Recommendation 7	All centreline spatial objects in the Transport Networks theme should use object referencing to the topographic area objects to support both data sharing of application data and the support synchronisation of the two representations over time.

Transport properties and linear referencing
Many of the thematic properties of the Transport Networks objects are defined as Transport Properties. All Transport Property classes are subtypes of the GNM Network Property class. As such, they inherit the mechanisms that are defined in the GNM to link them to transport network elements (such as Transport links, Transport Link Sequences, Transport Link Sets, Transport Nodes and Transport Areas) using object referencing.

Transport Properties also offer a way the easily extend the Transport Networks specification. For different applications, additional Transport Property classes can be defined and linked to the appropriate Network Elements.

A Transport Property can be linked to an entire transport element or, when the target is a Transport Link or – more typically – a Transport Link Sequence, to part of it using linear referencing.

Linear referencing is included in the GNM with caveats until ISO 19148 is formally adopted (see also Chapter 10.2) and a simple approach is included until the standard is more widely used. This can be of value in many applications where a consistent approach to data capture and referencing is absent today for example speed limit extents as shown in Figure 6 below.

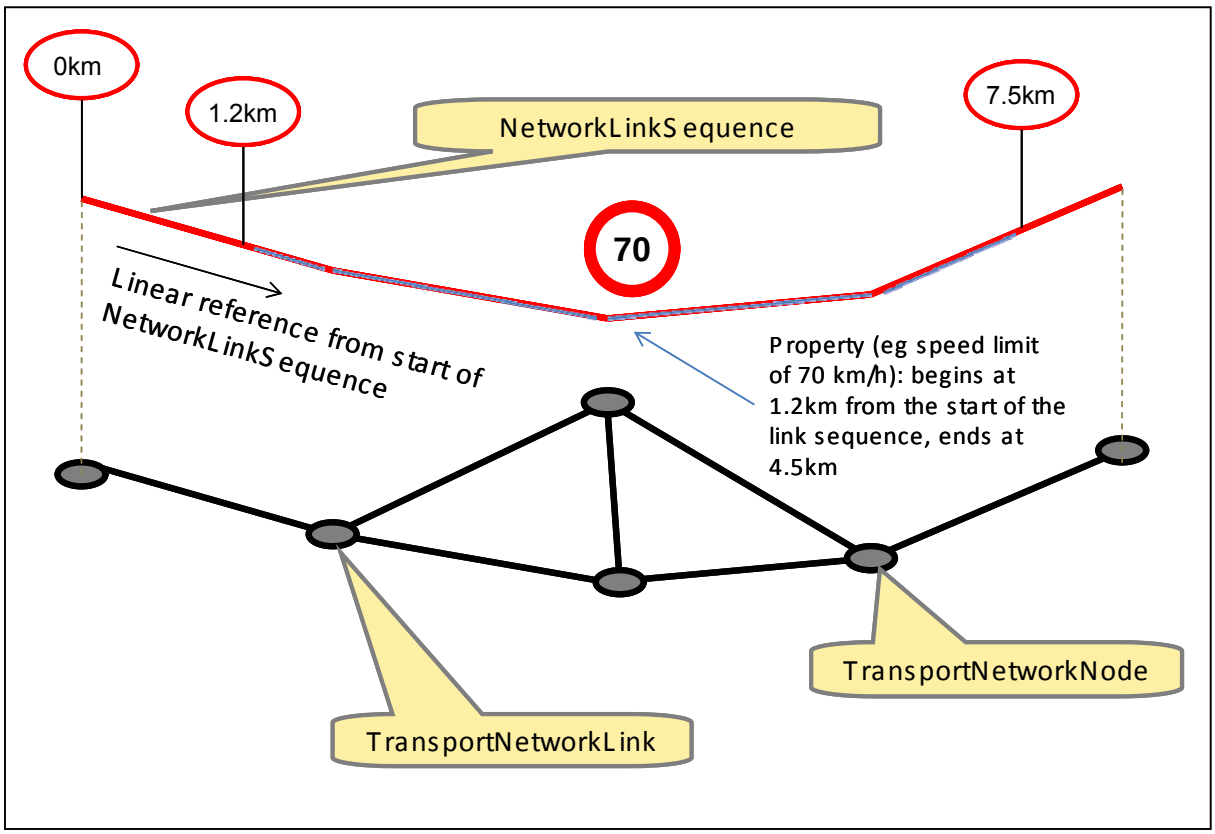


Figure 6 – example of linear referencing to locate the start and end of a speed restriction zone.

Recommendation 8 Linear referencing should be adopted to support the location of changes in condition or other phenomena along a link or link sequence where there is no requirement to disturb the link and node structure

Linear referencing is used to position phenomena a long a linear object, using a distance from the beginning of the linear object. Some systems disconnect the linear reference from the geometry of the linear object in the dataset, adding a calibrated linear coordinate to the object, corresponding to the distance measured along the real world object or interpolated between fixed marker posts (which themselves may not be exactly located at the distance they indicate).

For Transport Networks, all supplied linear references will use the distance along the geometry of the linear object in the database.

Requirement 7 When linear referencing is used in Transport Networks data, the position of referenced properties on links and link sequences shall be expressed as distances measured along the supplied geometry of the underlying link object(s).

Intermodal connections

The Transport Networks specification inherits a simple approach to intermodal connections from the GNM that has been adopted in the absence of any commonly adopted standards. Spatial objects within the Transport Networks specification can be linked (cross-referenced) to support connectivity between any two transport networks that use different modes of transport. This is to support journey planning, navigation etc.

In practice, intermodal connections can be established by linking two transport network elements (from different transport networks which use a different mode of transport) to a Network Connection object which is qualified as an intermodal connection. The Network Connection class is defined in the GNM.

Several types of transport network elements, including links, link sequences, link sets, areas and nodes can participate in intermodal connections. The use of nodes is recommended since this allows for a more accurate positioning of the connection in the two networks.

Figure 7 demonstrates the concept of the intermodal connection. In this example, a node in a road transport network is connected to a node in the railway network. These nodes may, but do not have to, share the same location.

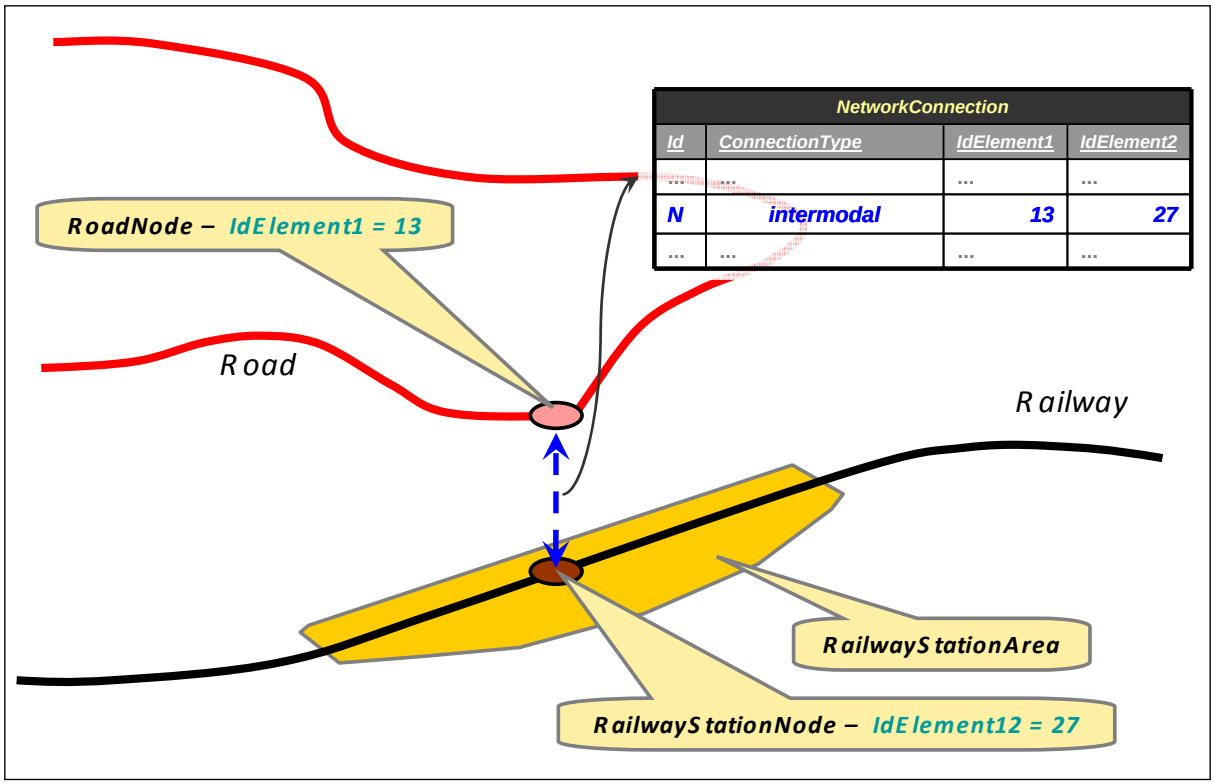


Figure 7 – The intermodal connection linking two different *Transport networks* themes *Rail* and *Road*

Requirement 8	An inter-modal connection shall always reference two elements which belong to different networks.

Recommendation 9	An intermodal connection should be established between transport nodes.

5.2.1.6 Geometry representation

There are three types of geometry in this specification:

a) (Topographic) Area objects in Transport Networks
b) Centreline objects in Transport Networks

c) Point objects in Transport Networks

Types (a) and (b) may be alternative representations of the same real world phenomena about which the user can associate their own information (objects) – See Annex B1 for more background.

Type (c) is, apart from network nodes, only included in the specification for marker posts. However users may wish to collect such data and associate it with the network (e.g. the location of network infrastructure components e.g. traffic lights, lighting columns, beacons, navigation lights etc).

The geometric basis of a transport network consists of a number of **connected** linear elements (Transport Links) with optional point elements (Transport Nodes) at the ends of the lines (at junctions, terminals, etc).

Section 10.2 (Ensuring Network Connectivity) contains the necessary rules for ensuring connectivity within Transport Networks. Connections between Transport Networks are established by using the cross-border and intermodal connection mechanisms present in the GNM and further explained in sections 5.2.1.3 (Consistency between spatial data sets) and 5.2.1.5 (Modelling of object references) respectively.

Requirement 9	Transport link ends shall be connected wherever an intersection exists between the real world phenomena they represent. No connections shall be created at crossing network elements when it is not possible to pass from one element to another..

NOTE: Grade separated crossings can be modeled using the GradeSeparatedCrossing class from the GNM. This class enables the ordered linking of two (Transport) Links. In this ordered relationship, the first Link is always the lower of the two.

Recommendation 10	In Transport Networks data, Transport Nodes should be present wherever Transport Links connect or end

If a Transport Networks data set contains nodes, they can only occur where a connection exists between two Transport Links or where a Transport Link ends (end or dangle node). Nodes shall not occur where two links cross but not intersect, for instance at grade separated crossings.

Requirement 10	In a Transport Networks data set which contains nodes, these nodes shall only be present where Transport Links connect or end.

The individual Transport Links can be combined to form Transport Link Sequences, using the mechanism provided by the GNM. As an ordered sequence of Transport Links, Transport Link Sequences have no geometry of their own. Their position is defined by the composing Transport Links.

Transport Link Sequences and/or Transport Links can be further combined to form Transport Link Sets. This way, looped and forked elements of a transport network can be represented. Like Transport Link Sequences, Transport Link Sets have no geometry of their own.

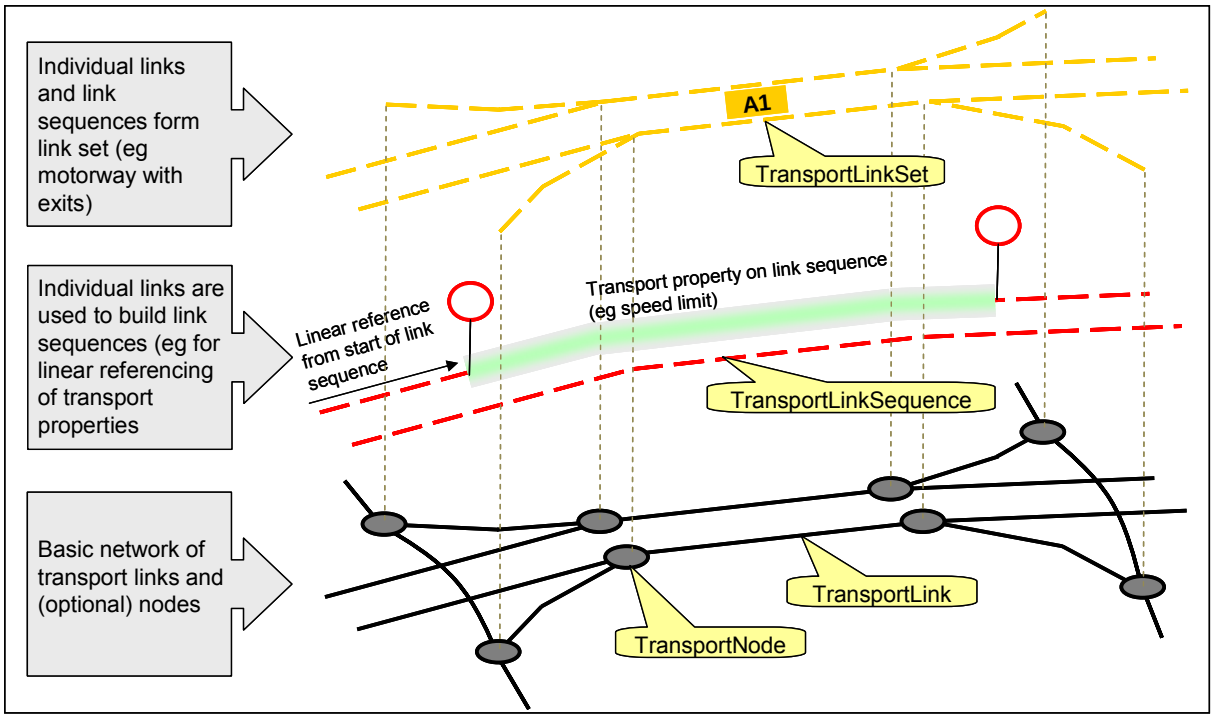


Figure 8 –Example of the use of Link, Node, Link Sequence and Link Set

Levels of detail: The specification addresses the highest resolution of data capture in Transport Networks and is also applicable to any derived lower resolution levels of detail where the number of coordinates is reduced and the geometry simplified to support viewing and reporting at regional, national and European levels. See also Chapter D10.4 and Annex B.1

This specification cannot advise on the form of representation at the highest resolution nor the accuracy since this will be driven by member state needs. Ideally derived lower resolution datasets will use the approach outlined in D2.6 A.19 where all the objects are related from lowest to highest resolution and any user information collected about the network can be simply aggregated at the lower resolution level or disaggregated as the user increases the resolution.

Recommendation 11 All Transport Networks spatial objects should be provided at the source resolution (and accuracy) where possible.

Recommendation 12 Lower order resolutions should be derived from the highest order representation of the transport network, and any user information captured once and referenced to each geometrical representation

Requirement 11 The value domain of spatial properties used in this specification shall be restricted to the Simple Feature spatial schema as defined by EN ISO 19125-1.

NOTE The specification restricts the spatial schema to 0-, 1-, 2-, and 2.5-dimensional geometries where all curve interpolations are linear.

NOTE The topological relations of two spatial objects based on their specific geometry and topology properties can in principle be investigated by invoking the operations of the types defined in ISO 19107 (or the methods specified in OGC 06-103r3).

5.2.1.7 Temporality representation

The application schemas use the derived attributes "beginLifespanObject" and "endLifespanObject" to record the lifespan of a spatial object.

The attributes "beginLifespanVersion" specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set. The attribute "endLifespanVersion" specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set.

NOTE 1 The attributes specify the beginning of the lifespan of the version in the spatial data set itself, which is different from the temporal characteristics of the real-world phenomenon described by the spatial object. This lifespan information, if available, supports mainly two requirements: First, knowledge about the spatial data set content at a specific time; second, knowledge about changes to a data set in a specific time frame. The lifespan information should be as detailed as in the data set (i.e., if the lifespan information in the data set includes seconds, the seconds should be represented in data published in INSPIRE) and include time zone information.

NOTE 2 Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

Recommendation 13 If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

The attribute “validFrom” specifies the date and time at which the real word phenomena that are represented by the spatial objects in a spatial data set started to exist in the real world. The attribute “validTo” specifies from which date and time these phenomena no longer exist.

Recommendation 14 If information about the actual start and end of the existence of transport network elements is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unknown".

5.2.1.8 Notes on constraints for transport properties

NOTE 1 The application schemas in this section specify constraints on transport properties restricting the transport objects the transport property can be associated with. In some cases, these constraints allow the transport property to be associated only with very specific types, while in other cases they refer only very generally to spatial objects that are part of a specific (e.g. road or rail) transport network. In some cases, the more specific restriction is already indicated in the name of the constraint (e.g. “Applies to WaterwayLink and WaterwayNode only”), while the natural language description is less specific (e.g. “This property can only be associated with a spatial object that is part of a water transport network.”). Ideally, these mismatches should be removed, while following the general rule that the constraints should be as specific as possible. This will be proposed in a future update of the Regulation on spatial data sets and services as well as this guidelines document.

NOTE 2 In cases where there is a mismatch between the name of the constraint and its natural language description, the OCL constraint already reflects the more specific restriction. In these cases, while the natural language description is consistent with the Regulation on spatial data sets and services, the OCL constraint already reflects the intended update of the (natural language descriptions of the) constraint.

5.2.2 Feature catalogue

Table 3 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Common Transport Elements
Scope	Common Transport Elements
Version number	3.0.2
Version date	2010-04-26
Definition source	INSPIRE data specification Common Transport Elements

Table 4 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
AccessRestriction	Common Transport Elements	«featureType»	5.2.2.1.1
ConditionOfFacility	Common Transport Elements	«featureType»	5.2.2.1.2
MaintenanceAuthority	Common Transport Elements	«featureType»	5.2.2.1.3
MarkerPost	Common Transport Elements	«featureType»	5.2.2.1.4
OwnerAuthority	Common Transport Elements	«featureType»	5.2.2.1.5
RestrictionForVehicles	Common Transport Elements	«featureType»	5.2.2.1.6
RestrictionTypeValue	Common Transport Elements	«codeList»	5.2.2.2.2
TrafficFlowDirection	Common Transport Elements	«featureType»	5.2.2.1.7
TransportArea	Common Transport Elements	«featureType»	5.2.2.1.8
TransportLink	Common Transport Elements	«featureType»	5.2.2.1.9
TransportLinkSequence	Common Transport Elements	«featureType»	5.2.2.1.10
TransportLinkSet	Common Transport Elements	«featureType»	5.2.2.1.11
TransportNetwork	Common Transport Elements	«featureType»	5.2.2.1.12
TransportNode	Common Transport Elements	«featureType»	5.2.2.1.13
TransportObject	Common Transport Elements	«featureType»	5.2.2.1.14
TransportPoint	Common Transport Elements	«featureType»	5.2.2.1.14
TransportProperty	Common Transport Elements	«featureType»	5.2.2.1.16
TransportTypeValue	Common Transport Elements	«enumeration»	5.2.2.2.1
VerticalPosition	Common Transport Elements	«featureType»	5.2.2.1.17
AccessRestrictionValue	Common Transport Elements	«codeList»	5.2.2.2.3

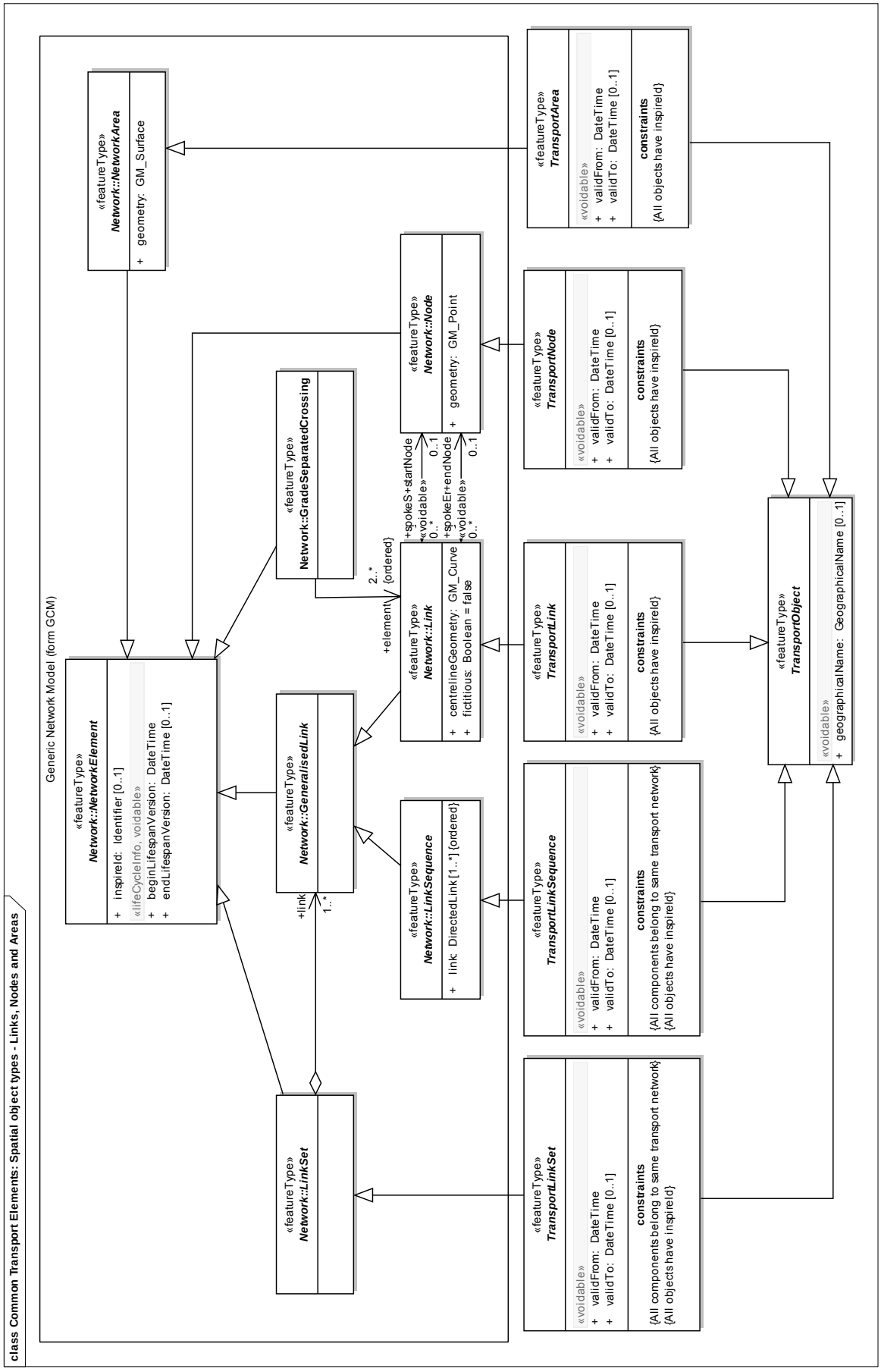


Figure 9 – UML class diagram: Spatial object types – Transport Link, Node and Area

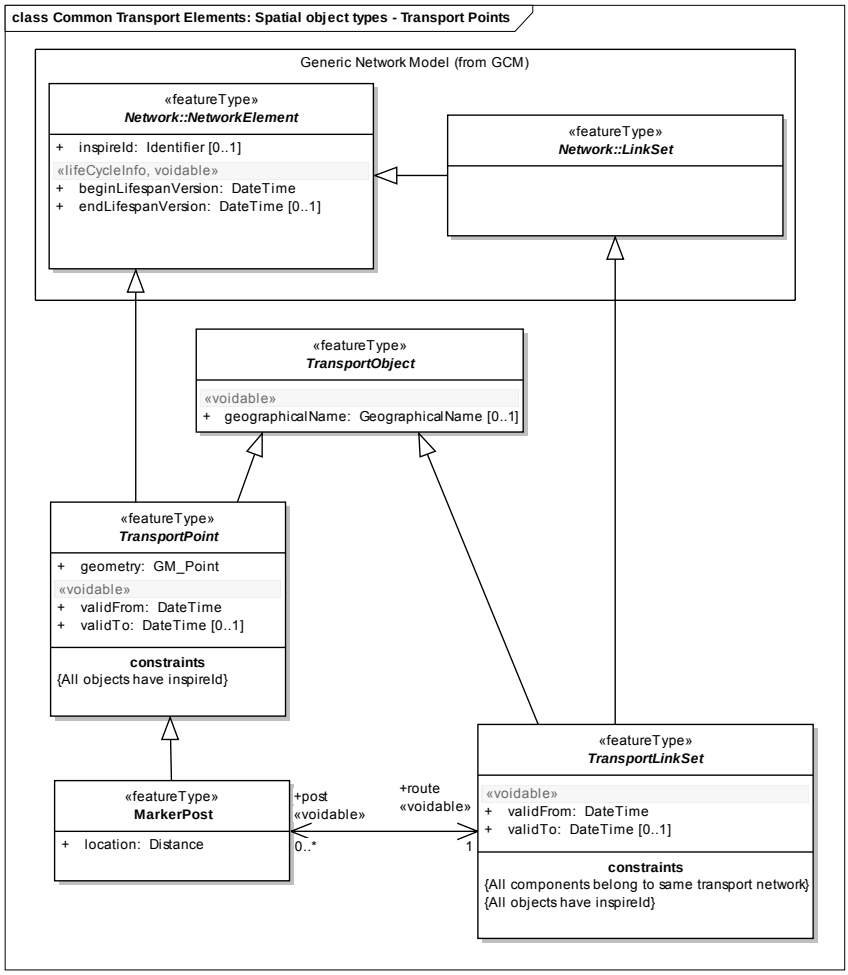


Figure 10 – UML class diagram: Spatial object types – Transport Point

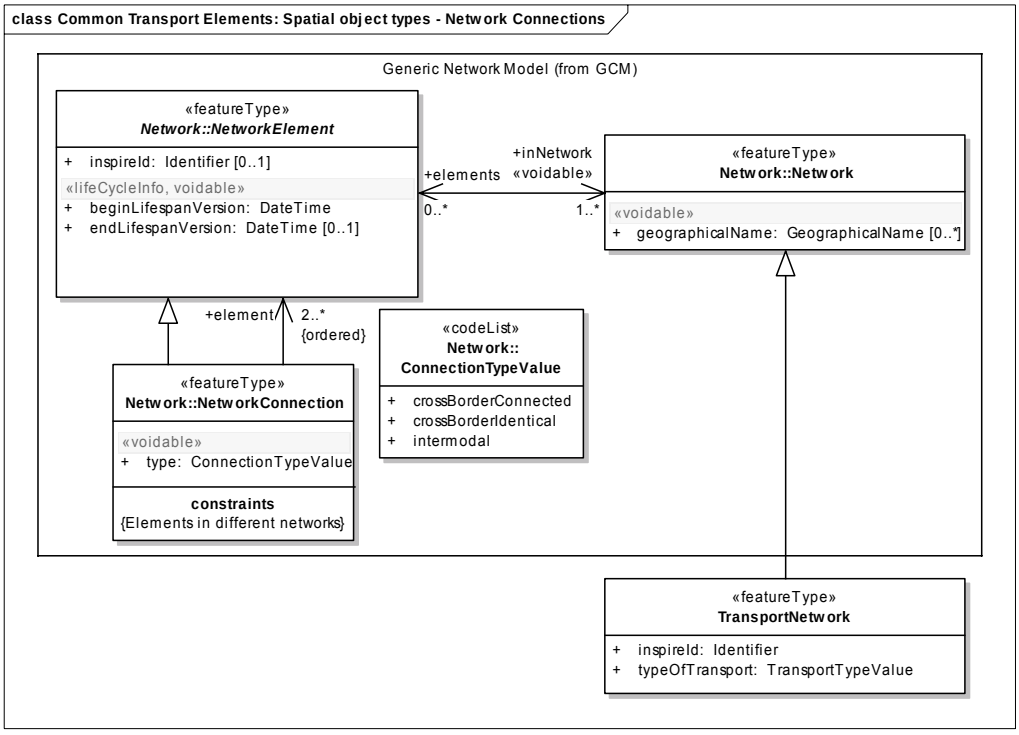


Figure 11 – UML class diagram: Spatial object types – Transport Network

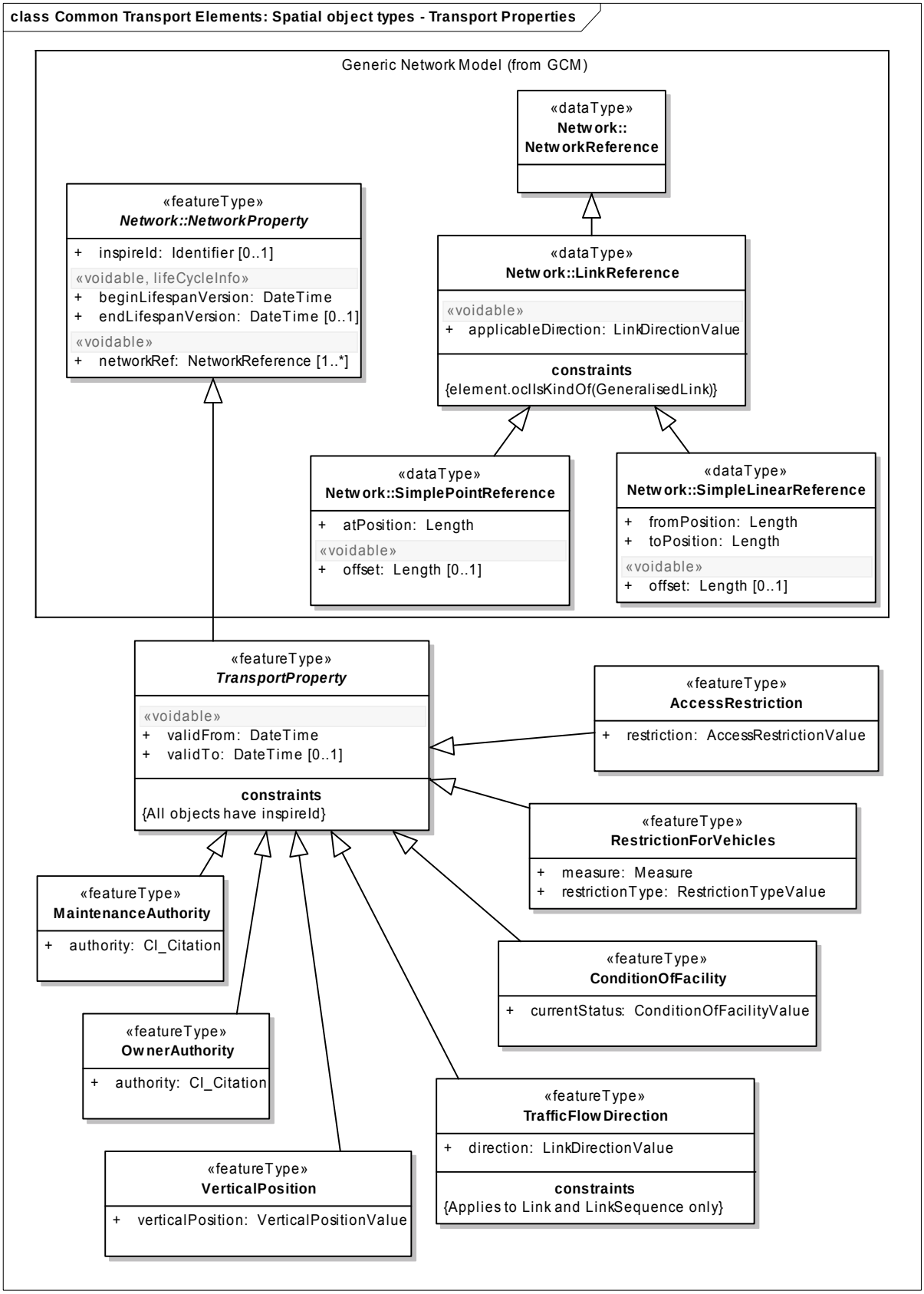


Figure 12 – UML class diagram: Spatial object types – Transport Properties

5.2.2.1 Spatial object types

5.2.2.1.1 AccessRestriction

AccessRestriction	
Subtype of:	TransportProperty
Definition:	A restriction on the access to a transport element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: restriction	
Value type:	AccessRestrictionValue
Definition:	Nature of the access restriction.
Multiplicity:	1

5.2.2.1.2 ConditionOfFacility

ConditionOfFacility	
Subtype of:	TransportProperty
Definition:	State of a transport network element with regards to its completion and use.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: currentStatus	
Value type:	ConditionOfFacilityValue
Definition:	Current status value of a transport network element with regards to its completion and use.
Multiplicity:	1

5.2.2.1.3 MaintenanceAuthority

MaintenanceAuthority	
Subtype of:	TransportProperty
Definition:	The authority responsible for maintenance of the transport element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: authority	
Value type:	CI_Citation
Definition:	Identification of the maintenance authority.
Multiplicity:	1

5.2.2.1.4 MarkerPost

MarkerPost	
Subtype of:	TransportPoint
Definition:	Reference marker placed along a route in a transport network, mostly at regular intervals, indicating the distance from the beginning of the route, or some other reference point, to the point where the marker is located.
Description:	EXAMPLE Examples of routes along which marker posts can be found are roads, railway lines and navigable waterways.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: location	
Value type:	Distance
Definition:	Distance from the beginning of the route, or some other reference point, to the point where a marker post is located.
Multiplicity:	1
Association role: route	
Value type:	TransportLinkSet
Definition:	Route in a transport network along which the marker post is placed.

MarkerPost	
Multiplicity:	1
Stereotypes:	«voidable»

5.2.2.1.5 OwnerAuthority

OwnerAuthority	
Subtype of:	TransportProperty
Definition:	The authority owning the transport element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: authority	
Value type:	CI_Citation
Definition:	Identification of the owning authority.
Multiplicity:	1

5.2.2.1.6 RestrictionForVehicles

RestrictionForVehicles	
Subtype of:	TransportProperty
Definition:	Restriction on vehicles on a transport element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: measure	
Value type:	Measure
Definition:	The measure for the restriction .
Description:	SOURCE [Euroroads].
Multiplicity:	1
Attribute: restrictionType	
Value type:	RestrictionTypeValue
Definition:	The type of restriction .
Description:	SOURCE [Euroroads].
Multiplicity:	1

5.2.2.1.7 TrafficFlowDirection

TrafficFlowDirection	
Subtype of:	TransportProperty
Definition:	Indicates the direction of the flow of traffic in relation to the direction of the transport link vector.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: direction	
Value type:	LinkDirectionValue
Definition:	Indicates the direction of the flow of traffic.
Multiplicity:	1
Constraint: Applies to Link and LinkSequence only	
Natural language:	This property can only be associated with a spatial object of the type Link or LinkSequence.
OCL:	inv: networkRef.element.oclIsKindOf(LinkReference)

5.2.2.1.8 TransportArea

TransportArea (abstract)	
Subtype of:	NetworkArea, TransportObject
Definition:	Surface that represents the spatial extent of an element of a transport network.
Status:	Proposed

TransportArea (abstract)	
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport area started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport area no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All objects have inspireId	
Natural language:	All transport areas have an external object identifier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.9 TransportLink

TransportLink (abstract)	
Subtype of:	Link, TransportObject
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport link started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport link no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All objects have inspireId	
Natural language:	All transport links have an external object identifier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.10 TransportLinkSequence

TransportLinkSequence (abstract)	
Subtype of:	LinkSequence, TransportObject
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport link sequence started to exist in the real world.

TransportLinkSequence (abstract)	
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport link sequence no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All components belong to same transport network	
Natural language:	A transport link sequence must be composed of transport links that all belong to the same transport network.
OCL:	inv: link->forAll(l | l.link.inNetwork = self.inNetwork)
Constraint: All objects have inspireId	
Natural language:	All transport link sequences have an external object identifier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.11 TransportLinkSet

TransportLinkSet (abstract)	
Subtype of:	LinkSet, TransportObject
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or significance in a transport network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport link set started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport link set no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Association role: post	
Value type:	MarkerPost
Definition:	Marker post along a route in a transport network.
Multiplicity:	0..*
Stereotypes:	«voidable»
Constraint: All components belong to same transport network	
Natural language:	A transport link set must be composed of transport links and or transport link sequences that all belong to the same transport network.
OCL:	inv: link->forAll(l | l.inNetwork = self.inNetwork)
Constraint: All objects have inspireId	
Natural language:	All transport link sets have an external object identifier.

TransportLinkSet (abstract)	
OCL:	inv: inspireId->notEmpty()

5.2.2.1.12 TransportNetwork

TransportNetwork	
Subtype of:	Network
Definition:	Collection of network elements that belong to a single mode of transport.
Description:	NOTE Road, rail, water and air transport are always considered separate transport modes. Even within these four categories, multiple modes of transport can be defined, based on infrastructure, vehicle types, propulsion system, operation and/or other defining characteristics. EXAMPLE All road transport can be considered one mode of transport for some applications. For other applications, it might be necessary to distinguish between different public road transport networks. Within water transport, marine and inland water transport can be considered to be separate modes of transport for some applications, as they use different types of ships.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the spatial object.
Multiplicity:	1
Attribute: typeOfTransport	
Value type:	TransportTypeValue
Definition:	Type of transport network, based on the type of infrastructure the network uses.
Multiplicity:	1

5.2.2.1.13 TransportNode

TransportNode (abstract)	
Subtype of:	Node, TransportObject
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport node started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport node no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All objects have inspireId	
Natural language:	All transport nodes have an external object identifier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.14 TransportObject

TransportObject (abstract)	
Definition:	An identity base for transport network objects in the real world.

TransportObject (abstract)	
Description:	NOTE Derived 'views' of real-world transport objects are represented through specialisations in other application schemas; all representations of the same real-world object share a common geographic name.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: geographicalName	
Value type:	GeographicalName
Definition:	A geographical name that is used to identify the transport network object in the real world. It provides a 'key' for implicitly associating different representations of the object.
Multiplicity:	0..1
Stereotypes:	«voidable»

5.2.2.1.15 TransportPoint

TransportPoint (abstract)	
Subtype of:	NetworkElement, TransportObject
Definition:	A point spatial object - which is not a node - that represents the position of an element of a transport network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Point
Definition:	The location of the transport point.
Multiplicity:	1
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport point started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport point no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All objects have inspireId	
Natural language:	All transport points have an external object identfier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.16 TransportProperty

TransportProperty (abstract)	
Subtype of:	NetworkProperty
Definition:	A reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: validFrom	
Value type:	DateTime
Definition:	The time when the transport property started to exist in the real world.
Multiplicity:	1
Stereotypes:	«voidable»

TransportProperty (abstract)	
Attribute: validTo	
Value type:	DateTime
Definition:	The time from which the transport property no longer exists in the real world.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: All objects have inspireId	
Natural language:	All transport properties have an external object identifier.
OCL:	inv: inspireId->notEmpty()

5.2.2.1.17 VerticalPosition

VerticalPosition	
Subtype of:	TransportProperty
Definition:	Vertical level relative to other transport network elements.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: verticalPosition	
Value type:	VerticalPositionValue
Definition:	Relative vertical position of the transport element.
Multiplicity:	1

5.2.2.2 Enumerations and code lists

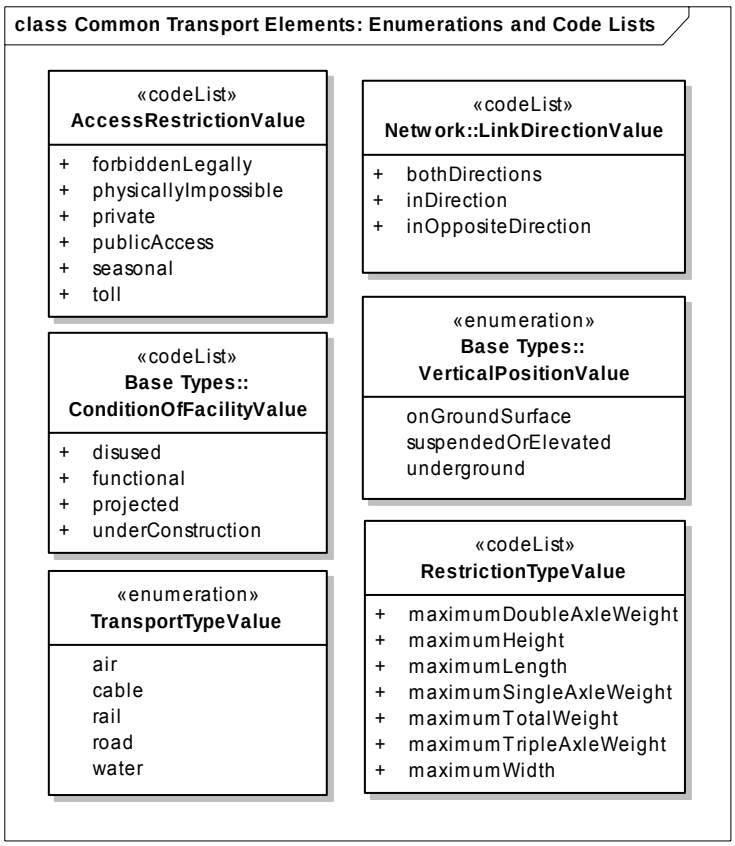


Figure 13 – UML class diagram: Enumerations and code lists

5.2.2.2.1 TransportTypeValue

TransportTypeValue	
Definition:	Possible types on transport networks.
Status:	Proposed
Stereotypes:	«enumeration»
Value: air	
Definition:	The transport network consists of transport by air.
Value: cable	
Definition:	The transport network consists of transport by cable.
Value: rail	
Definition:	The transport network consists of transport by rail.
Value: road	
Definition:	The transport network consists of transport by road.
Value: water	
Definition:	The transport network consists of transport by water.

5.2.2.2.2 RestrictionTypeValue

RestrictionTypeValue	
Definition:	Possible restrictions on vehicles that can access a transport element.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RestrictionTypeValues
Value: maximumDoubleAxleWeight	
Definition:	The maximum weight per double axle of a vehicle allowed at a transport element.
Description:	SOURCE Adapted from [Euroroads]. NOTE This value applies to wheeled vehicles only.
Value: maximumHeight	
Definition:	The maximum height of a vehicle which can pass under another object .
Description:	SOURCE [Euroroads].
Value: maximumLength	
Definition:	The maximum length of a vehicle allowed at a transport element.
Description:	SOURCE Adapted from [Euroroads].
Value: maximumSingleAxleWeight	
Definition:	The maximum weight per single axle of a vehicle allowed at a transport element.
Description:	SOURCE Adapted from [Euroroads]. NOTE This value applies to wheeled vehicles only.
Value: maximumTotalWeight	
Definition:	The maximum total weight of a vehicle allowed at a transport element.
Description:	SOURCE Adapted from [Euroroads].
Value: maximumTripleAxleWeight	
Definition:	The maximum weight per triple axle of a vehicle allowed at a transport element.
Description:	SOURCE Adapted from [Euroroads]. NOTE This value applies to wheeled vehicles only.
Value: maximumWidth	
Definition:	The maximum width of a vehicle allowed on a transport element.
Description:	SOURCE Adapted from [Euroroads].

5.2.2.2.3 AccessRestrictionValue

AccessRestrictionValue	
Definition:	Types of access restrictions for a transport element.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AccessRestrictionValues
Value: forbiddenLegally	
Definition:	Access to the transport element is forbidden by law.
Value: physicallyImpossible	
Definition:	Access to the transport element is physically impossible due to the presence of barriers or other physical obstacles.
Value: private	
Definition:	Access to the transport element is restricted because it is privately owned.
Value: publicAccess	
Definition:	The transport element is open to public access.
Value: seasonal	
Definition:	Access to the transport element depends on the season.
Value: toll	
Definition:	Access to the transport element is subject to toll.

5.2.2.3 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.2.2.3.1 GeographicalName

GeographicalName	
Package:	Geographical Names [see DS-D2.8.I.3]
Definition:	Proper noun applied to a real world entity.

5.2.2.3.2 LinkSequence

LinkSequence (abstract)	
Package:	Network [see DS-D2.5]
Definition:	A network element which represents a continuous path in the network without any branches. The element has a defined beginning and end and every position on the link sequence is identifiable with one single parameter such as length.
Description:	EXAMPLE A link sequence may represent a route.

5.2.2.3.3 NetworkArea

NetworkArea (abstract)	
Package:	Network [see DS-D2.5]
Definition:	A 2-dimensional element in a network.

5.2.2.3.4 NetworkProperty

NetworkProperty (abstract)	
Package:	Network [see DS-D2.5]
Definition:	Abstract base type representing phenomena located at or along a network element. This base type provides general properties to associate the network-related phenomena (network properties) with the network elements.

NetworkProperty (abstract)	
Description:	In the simplest case (NetworkReference), the network property applies to the whole network element. In the case of a Link, the spatial reference may be restricted to part of the Link by using a linear reference. ISO/TC 211 is currently in the early stages of developing a standard for Linear Referencing (ISO 19148). A simple mechanism to express linear references is provided in this version of the network model; it is expected that the model will be extended once ISO 19148 is stable. The current simple model requires for all linear references two expressions representing a distance from the start of the Link along its curve geometry. The network property applies to the part of the Link between fromPosition and toPosition.

5.2.2.3.5 NetworkElement

NetworkElement (abstract)	
Package:	Network [see DS-D2.5]
Definition:	Abstract base type representing an element in a network. Every element in a network provides some function that is of interest in the network.

5.2.2.3.6 Link

Link (abstract)	
Package:	Network [see DS-D2.5]
Definition:	Curvilinear network element that connects two positions and represents a homogeneous path in the network. The connected positions may be represented as nodes.

5.2.2.3.7 LinkSet

LinkSet (abstract)	
Package:	Network [see DS-D2.5]
Definition:	A collection of link sequences and/or individual links that has a specific function or significance in a network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

5.2.2.3.8 Network

Network	
Package:	Network [see DS-D2.5]
Definition:	A network is a collection of network elements.
Description:	The reason for collecting certain elements in a certain network may vary (e.g. connected elements for the same mode of transport)

5.2.2.3.9 Node

Node (abstract)	
Package:	Network [see DS-D2.5]
Definition:	Represents a significant position in the network that always occurs at the beginning or the end of a link.
Description:	NOTE if a topological representation of the network is used the road node is either a topological connection between two or more links or the termination of a ink. If a geometric representation of the network is used road nodes are represented by points or alternatively another geometric shape. [EuroRoadS]

5.2.2.3.10 Identifier

Identifier	
Package:	Base Types [see DS-D2.5]

Identifier	
Definition:	Unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object.
Description:	NOTE1 External object identifiers are distinct from thematic object identifiers. NOTE 2 The voidable version identifier attribute is not part of the unique identifier of a spatial object and may be used to distinguish two versions of the same spatial object. NOTE 3 The unique identifier will not change during the life-time of a spatial object.

5.2.2.3.11 VerticalPositionValue

VerticalPositionValue	
Package:	Base Types [see DS-D2.5]
Definition:	The relative vertical position of a spatial object.

5.2.2.3.12 LinkDirectionValue

LinkDirectionValue	
Package:	Network [see DS-D2.5]
Definition:	List of values for directions relative to a link

5.2.2.3.13 ConditionOfFacilityValue

ConditionOfFacilityValue	
Package:	Base Types [see DS-D2.5]
Definition:	The status of a facility with regards to its completion and use.

5.3 Application schema Road Transport Networks

5.3.1 Description

5.3.1.1 Narrative description

The *Road Transport Networks application* schema (Roads Schema) employs a link and node structure to represent a road system used for the transportation of vehicles in the form of a linear network. The Roads Schema inherits classes from the Common Transport Schema and also creates its own classes to describe properties of the road network such as Ownership and traffic direction that can apply to whole sections of the network element or subsections that can be described using linear referencing.

The primary aspects modelled for road network elements are:

- Spatial. Geometric (point, line and area (topographic)) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with points (nodes) at the ends of the lines (at junctions, road ends etc). Also real objects with a function in a network may be represented in the dataset. Network connectivity within the roads network is essential but between elements in the other networks is an optional spatial aspect.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also optional information on when data was entered, modified or deleted in the dataset.

- Thematic. The road schema can be thematically displayed via several of the attributes defined within the specification such as ownerAuthority or speedLimits.

5.3.1.2 UML Overview

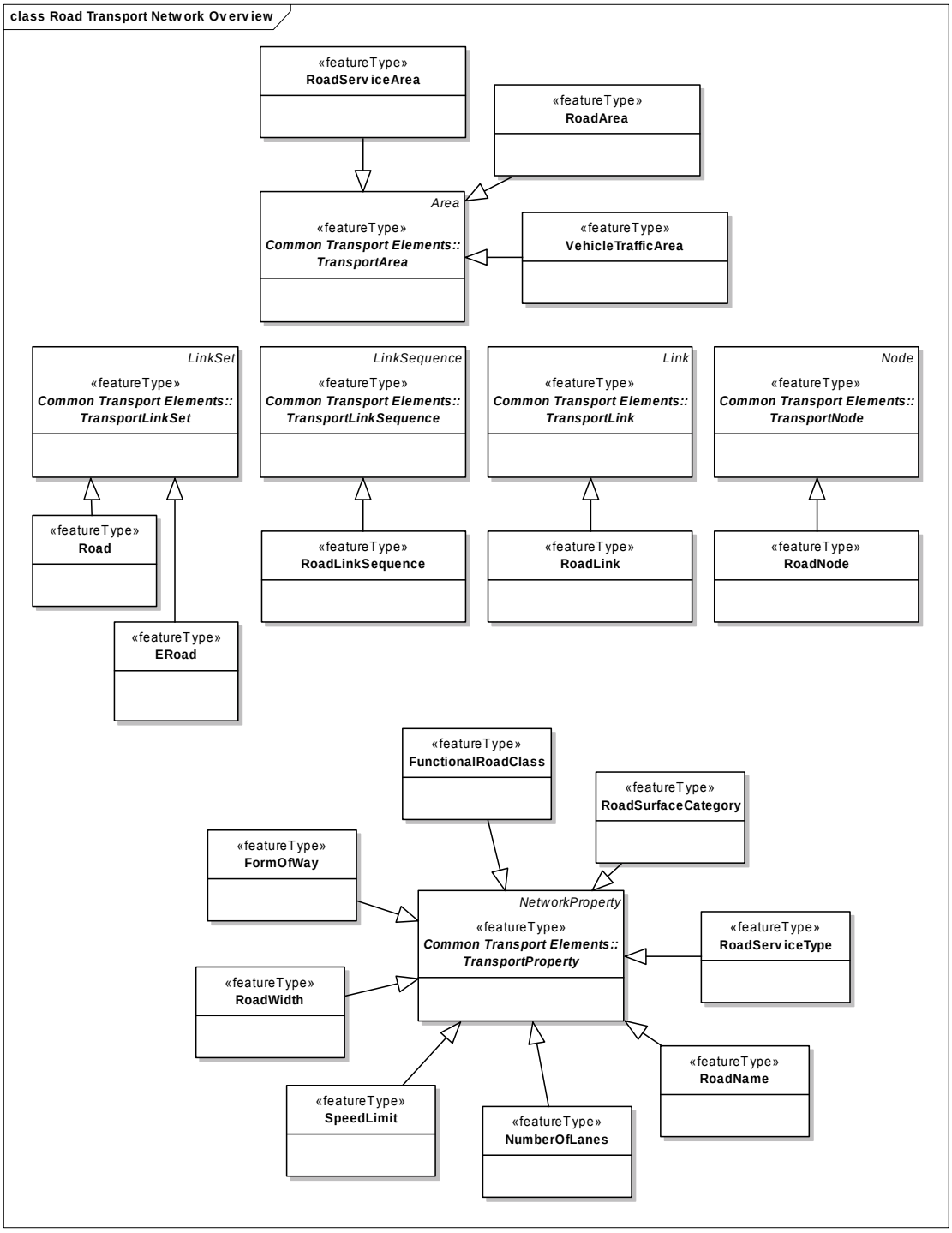


Figure 14 – UML class diagram: Overview of the *Road Transport Networks*

5.3.1.3 Consistency between spatial data sets

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.3) apply to the corresponding specialized elements/classes in the *Road transport networks*.

5.3.1.4 Identifier management

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.4) apply to the corresponding specialized elements/classes in the *Road transport networks*.

5.3.1.5 Modelling of object references

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.5) apply to the corresponding specialized elements/classes in the *Road transport networks*.

5.3.1.6 Geometry representation

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.6) apply to the corresponding specialized elements/classes in the *Road transport networks*.

5.3.1.7 Temporality representation

All attributes describing the lifespan of spatial objects or the phenomena in the real world they describe are inherited from the Common Transport Elements application schema. Refer to section 5.2.1.7 for more information.

5.3.2 Feature catalogue

Table 5 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Road Transport Network
Scope	Road Transport Network
Version number	3.0.1
Version date	2010-04-26
Definition source	INSPIRE data specification Road Transport Network

Table 6 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
AreaConditionValue	Road Transport Network	«codeList»	5.3.2.2.4
ERoad	Road Transport Network	«featureType»	5.3.2.1.1
FormOfWay	Road Transport Network	«featureType»	5.3.2.1.2
FunctionalRoadClass	Road Transport Network	«featureType»	5.3.2.1.3
MinMaxLaneValue	Road Transport Network	«enumeration»	5.3.2.2.1
NumberOfLanes	Road Transport Network	«featureType»	5.3.2.1.4
RoadLinkSequence	Road Transport Network	«featureType»	5.3.2.1.5
RoadName	Road Transport Network	«featureType»	5.3.2.1.6
RoadPartValue	Road Transport Network	«codeList»	5.3.2.2.5
RoadServiceArea	Road Transport Network	«featureType»	5.3.2.1.7
RoadServiceType	Road Transport Network	«featureType»	5.3.2.1.8
RoadSurfaceCategory	Road Transport Network	«featureType»	5.3.2.1.9
RoadSurfaceCategoryValue	Road Transport Network	«codeList»	5.3.2.2.6

Type	Package	Stereotypes	Section
RoadWidth	Road Transport Network	«featureType»	5.3.2.1.10
SpeedLimit	Road Transport Network	«featureType»	5.3.2.1.11
SpeedLimitMinMaxValue	Road Transport Network	«enumeration»	5.3.2.2.2
SpeedLimitSourceValue	Road Transport Network	«codeList»	5.3.2.2.7
VehicleTrafficArea	Road Transport Network	«featureType»	5.3.2.1.12
VehicleTypeValue	Road Transport Network	«codeList»	5.3.2.2.8
WeatherConditionValue	Road Transport Network	«codeList»	5.3.2.2.9
FormOfRoadNodeValue	Road Transport Network	«codeList»	5.3.2.2.10
FormOfWayValue	Road Transport Network	«codeList»	5.3.2.2.11
FunctionalRoadClassValue	Road Transport Network	«enumeration»	5.3.2.2.3
Road	Road Transport Network	«featureType»	5.3.2.1.13
RoadArea	Road Transport Network	«featureType»	5.3.2.1.14
RoadLink	Road Transport Network	«featureType»	5.3.2.1.15
RoadNode	Road Transport Network	«featureType»	5.3.2.1.16
RoadServiceTypeValue	Road Transport Network	«codeList»	5.3.2.2.12
ServiceFacilityValue	Road Transport Network	«codeList»	5.3.2.2.13

5.3.2.1 Spatial object types

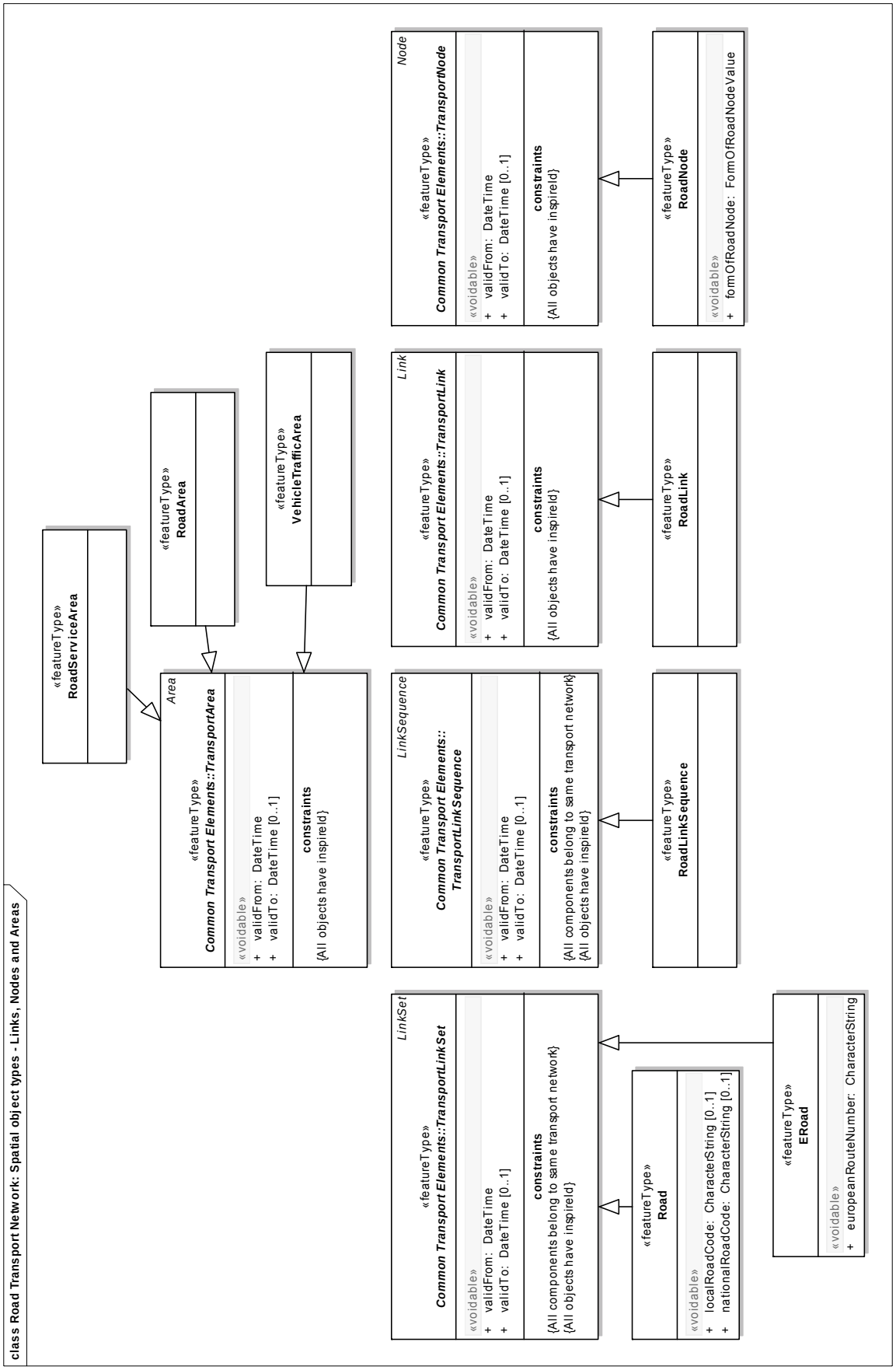


Figure 15 – UML class diagram: *Road Transport Networks* Spatial object types – Links, Nodes and Areas

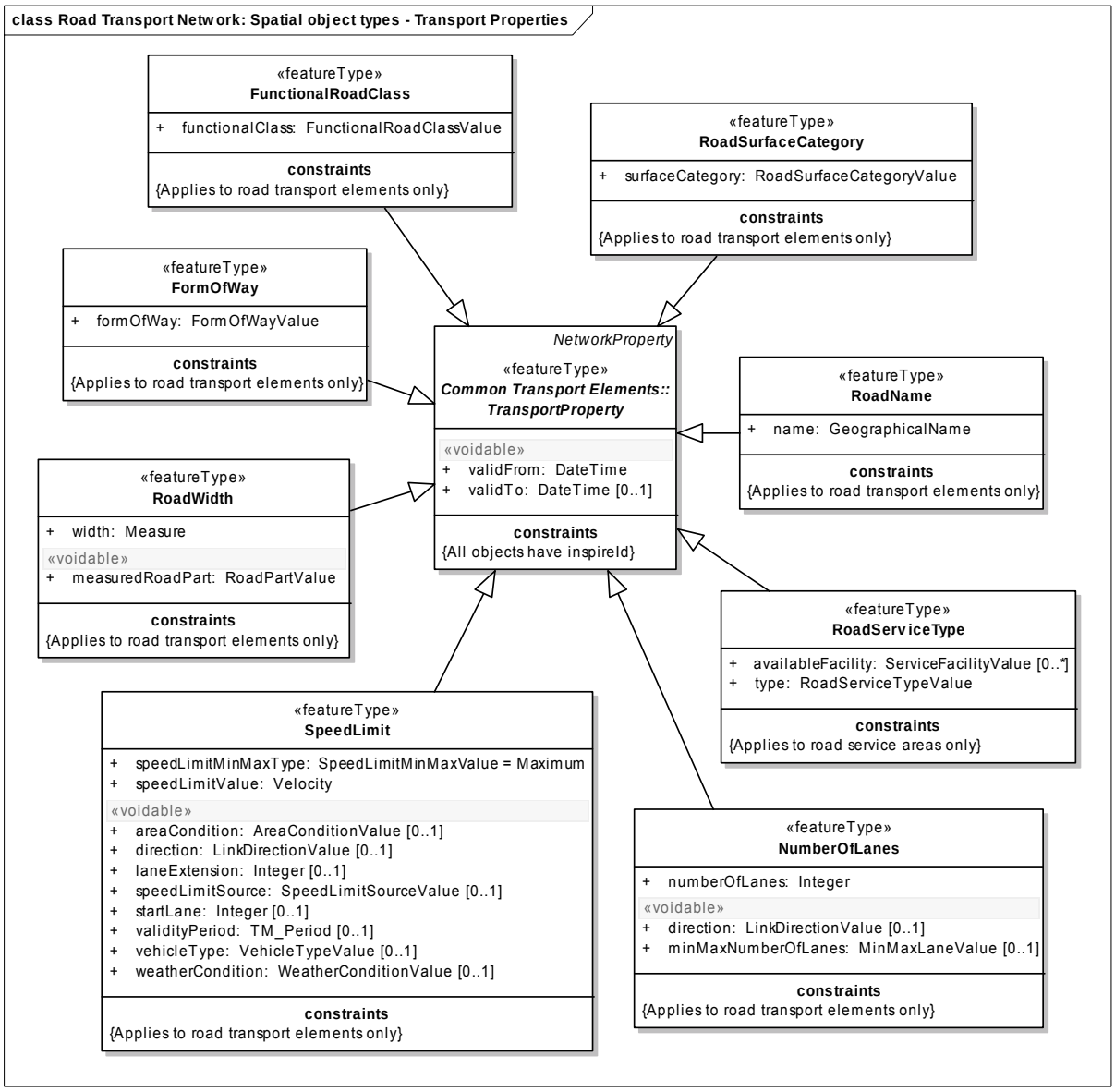


Figure 16 – UML class diagram: *Road Transport Networks* Spatial object types – Transport Properties

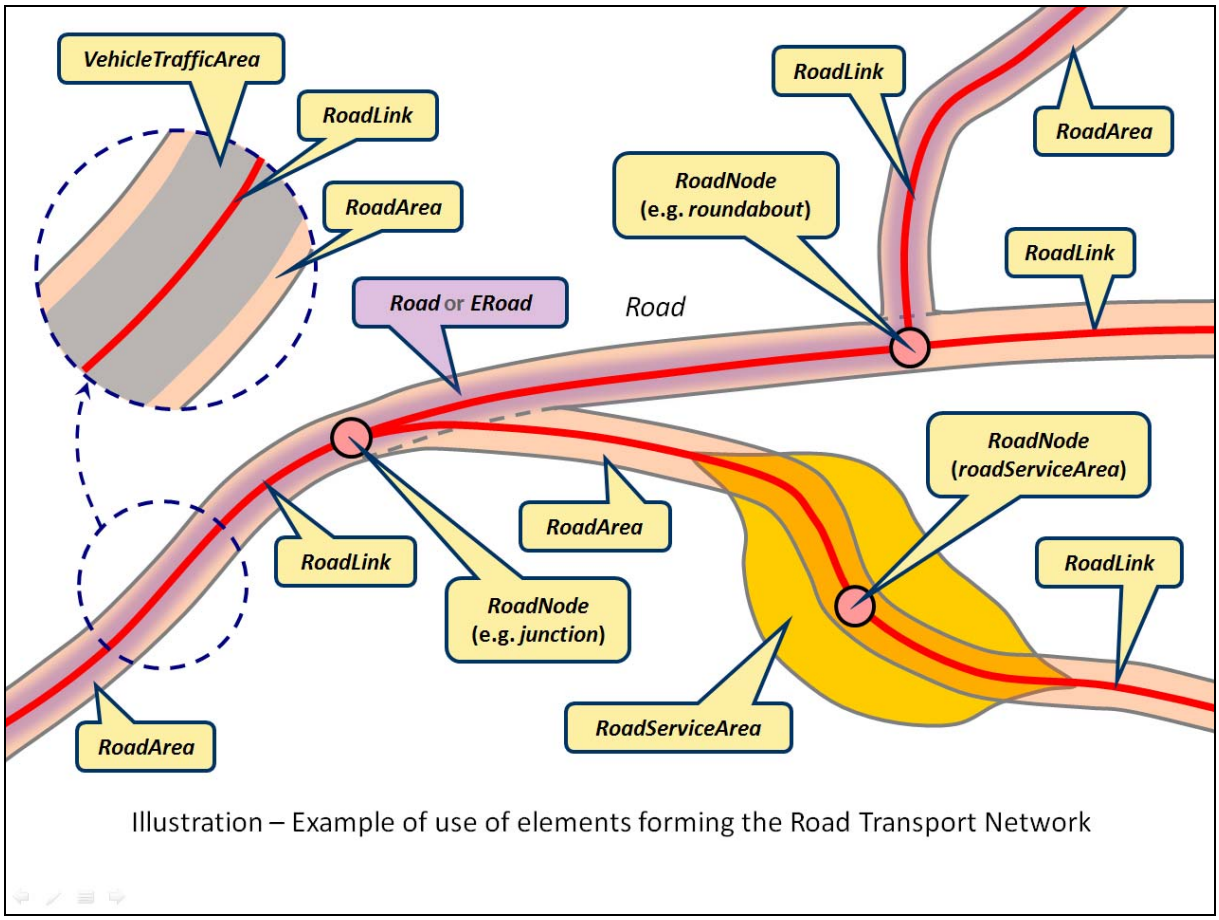


Figure 17 – Overview of the main *Road Transport Networks* objects

5.3.2.1.1 ERoad

ERoad	
Subtype of:	TransportLinkSet
Definition:	A collection of road link sequences and or individual road links that represents a route that is part of the international E-road network, characterized by its European route number.
Description:	EXAMPLE E40.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: europeanRouteNumber	
Value type:	CharacterString
Definition:	Code, identifying the route in the international E-road network. The code always starts with a letter 'E', followed by a one-, two- or three-digit number.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.1.2 FormOfWay

FormOfWay	
Subtype of:	TransportProperty
Definition:	A classification based on the physical properties of the Road Link.
Description:	SOURCE Based on [EuroRoadS]
Status:	Proposed
Stereotypes:	«featureType»
Attribute: formOfWay	
Value type:	FormOfWayValue

FormOfWay	
Definition:	Physical form of the way.
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.3 FunctionalRoadClass

FunctionalRoadClass	
Subtype of:	TransportProperty
Definition:	A classification based on the importance of the role that the road performs in the road network.
Description:	SOURCE Adapted from [GDF, EuroRoadS].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: functionalClass	
Value type:	FunctionalRoadClassValue
Definition:	Functional rank of the road link in the road network.
Description:	NOTE Where functional classification systems are used that have fewer classes/ranks than the number provided by FunctionalRoadClassValues, classes with codes 1 to n will be used, where n corresponds to the number of classes that are used in the classification system.
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.4 NumberOfLanes

NumberOfLanes	
Subtype of:	TransportProperty
Definition:	The number of lanes of a road element.
Description:	SOURCE Adapated from [Euroroads].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: direction	
Value type:	LinkDirectionValue
Definition:	Indicates which direction the number of lanes is valid for.

NumberOfLanes	
Description:	SOURCE [Euroroads]. NOTE When the value for this attribute is 'both', numberOfLanes contains the sum of the number of lanes in both directions of travel. NOTE This attribute only applies when the property is associated with a road link or road link sequence.
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: minMaxNumberOfLanes	
Value type:	MinMaxLaneValue
Definition:	Indicates if the number of lanes is counted as minimum or maximum value.
Description:	SOURCE [Euroroads]. NOTE This attribute only applies when the value in numberOfLanes is not an exact value.
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: numberOfLanes	
Value type:	Integer
Definition:	Number of lanes.
Description:	SOURCE [Euroroads].
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.5 RoadLinkSequence

RoadLinkSequence	
Subtype of:	TransportLinkSequence
Definition:	A linear spatial object, composed of an ordered collection of road links, which represents a continuous path in a road network without any branches. The element has a defined beginning and end and every position on the road link sequence is identifiable with one single parameter such as length. It describes an element of the road network, characterized by one or more thematic identifiers and/or properties.
Status:	Proposed
Stereotypes:	«featureType»

5.3.2.1.6 RoadName

RoadName	
Subtype of:	TransportProperty
Definition:	Name of a road, as assigned by the responsible authority.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: name	
Value type:	GeographicalName
Definition:	Name of the road.

RoadName	
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.7 RoadServiceArea

RoadServiceArea	
Subtype of:	TransportArea
Definition:	Surface annexed to a road and devoted to offer particular services for it.
Description:	EXAMPLES Gas station, rest area, toll area.
Status:	Proposed
Stereotypes:	«featureType»

5.3.2.1.8 RoadServiceType

RoadServiceType	
Subtype of:	TransportProperty
Definition:	Description of the type of road service area and the available facilities.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: availableFacility	
Value type:	ServiceFacilityValue
Definition:	Facility that is available for a given road service area.
Multiplicity:	0..*
Attribute: type	
Value type:	RoadServiceTypeValue
Definition:	Type of road service area.
Multiplicity:	1
Constraint: Applies to road service areas only	
Natural language:	This property can only be associated with a spatial object of the type RoadServiceArea or RoadNode (when formOfRoadNode=roadServiceArea).
OCL:	inv: networkRef.element.oclIsKindOf(RoadServiceArea) or (networkRef.element.oclIsKindOf(RoadNode) and networkRef.element. formOfRoadNode = FormOfRoadNodeValue::roadServiceArea)

5.3.2.1.9 RoadSurfaceCategory

RoadSurfaceCategory	
Subtype of:	TransportProperty
Definition:	Specification of the state of the surface of the associated Road Element. Indicates whether a road is paved or unpaved.
Description:	SOURCE [GDF3, Euroroads].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: surfaceCategory	
Value type:	RoadSurfaceCategoryValue
Definition:	Type of road surface.

RoadSurfaceCategory	
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.10 RoadWidth

RoadWidth	
Subtype of:	TransportProperty
Definition:	The width of the road, measured as an average value.
Description:	SOURCE [Euroroads].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: measuredRoadPart	
Value type:	RoadPartValue
Definition:	Indicates to which part of a road the value for the attribute 'width' applies.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: width	
Value type:	Measure
Definition:	Road width value.
Multiplicity:	1
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.11 SpeedLimit

SpeedLimit	
Subtype of:	TransportProperty
Definition:	Limit for the speed of a vehicle on a road..
Description:	SOURCE [Euroroads].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: areaCondition	
Value type:	AreaConditionValue
Definition:	Speed limit is dependent on environmental circumstances.
Description:	SOURCE [Euroroads].
Multiplicity:	0..1
Stereotypes:	«voidable»

SpeedLimit

Attribute: direction

Value type: LinkDirectionValue
Definition: Indicates which direction the speed limit is valid for.
Description: SOURCE [Euroroads].
NOTE This attribute only applies when the property is associated with a road link or road link sequence.
Multiplicity: 0..1
Stereotypes: «voidable»

Attribute: laneExtension

Value type: Integer
Definition: Number of lanes including the start lane counted from the right hand side for which the speed limit applies.
Description: SOURCE [Euroroads].
NOTE This attribute only applies when the property is associated with a road link or road link sequence.
Multiplicity: 0..1
Stereotypes: «voidable»

Attribute: speedLimitMinMaxType

Value type: SpeedLimitMinMaxValue
Definition: Indicates if the speed limit is maximum or minimum and if it is recommended.
Description: SOURCE [Euroroads].
Multiplicity: 1

Attribute: speedLimitSource

Value type: SpeedLimitSourceValue
Definition: Source for speed limit.
Description: SOURCE [Euroroads].
Multiplicity: 0..1
Stereotypes: «voidable»

Attribute: speedLimitValue

Value type: Velocity
Definition: Value for speed limit.
Description: SOURCE [Euroroads].
Multiplicity: 1

Attribute: startLane

Value type: Integer
Definition: Start lane counted from the right side for which speed limit applies.
Description: SOURCE [Euroroads].
NOTE This attribute only applies when the property is associated with a road link or road link sequence.
Multiplicity: 0..1
Stereotypes: «voidable»

Attribute: validityPeriod

Value type: TM_Period
Definition: Period during which the speed limit is valid.
Multiplicity: 0..1
Stereotypes: «voidable»

Attribute: vehicleType

Value type: VehicleTypeValue
Definition: Vehicle type the speed limit is restricted to.
Description: SOURCE Adapted from [Euroroads].
Multiplicity: 0..1
Stereotypes: «voidable»

SpeedLimit	
Attribute: weatherCondition	
Value type:	WeatherConditionValue
Definition:	Weather condition the speed limit is dependent on.
Description:	SOURCE Adapted from [Euroroads].
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: Applies to road transport elements only	
Natural language:	This property can only be associated with a spatial object that is part of a road transport network.
OCL:	inv: networkRef.element.oclIsKindOf(Road) or networkRef.element.oclIsKindOf(ERoad) or networkRef.element.oclIsKindOf(RoadLink) or networkRef.element.oclIsKindOf(RoadLinkSequence) or networkRef.element.oclIsKindOf(RoadNode) or networkRef.element.oclIsKindOf(RoadArea) or networkRef.element.oclIsKindOf(RoadServiceArea) or networkRef.element.oclIsKindOf(VehicleTrafficArea)

5.3.2.1.12 VehicleTrafficArea

VehicleTrafficArea	
Subtype of:	TransportArea
Definition:	Surface that represents the part of a road which is used for the normal traffic of vehicles.
Status:	Proposed
Stereotypes:	«featureType»

5.3.2.1.13 Road

Road	
Subtype of:	TransportLinkSet
Definition:	A collection of road link sequences and/or individual road links that are characterized by one or more thematic identifiers and/or properties.
Description:	EXAMPLE Examples are roads characterized by a specific identification code, used by road management authorities or tourist routes, identified by a specific name.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: localRoadCode	
Value type:	CharacterString
Definition:	Identification code assigned to the road by the local road authority.
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: nationalRoadCode	
Value type:	CharacterString
Definition:	The national number of the road.
Description:	SOURCE [Euroroads].
Multiplicity:	0..1
Stereotypes:	«voidable»

5.3.2.1.14 RoadArea

RoadArea	
Subtype of:	TransportArea
Definition:	Surface which extends to the limits of a road, including vehicular areas and other parts of it.
Description:	EAXMPLE Pedestrian areas.

RoadArea	
Status:	Proposed
Stereotypes:	«featureType»

5.3.2.1.15 RoadLink

RoadLink	
Subtype of:	TransportLink
Definition:	A linear spatial object that describes the geometry and connectivity of a road network between two points in the network. Road links can represent paths, bicycle roads, single carriageways, multiple carriageway roads and even fictitious trajectories across traffic squares.
Status:	Proposed
Stereotypes:	«featureType»

5.3.2.1.16 RoadNode

RoadNode	
Subtype of:	TransportNode
Definition:	A point spatial object that is used to either represent connectivity between two road links or to represent a significant spatial object such as a services station or roundabout.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: formOfRoadNode	
Value type:	FormOfRoadNodeValue
Definition:	Description of the function of a road node in the road transport network.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.2 Enumerations and code lists

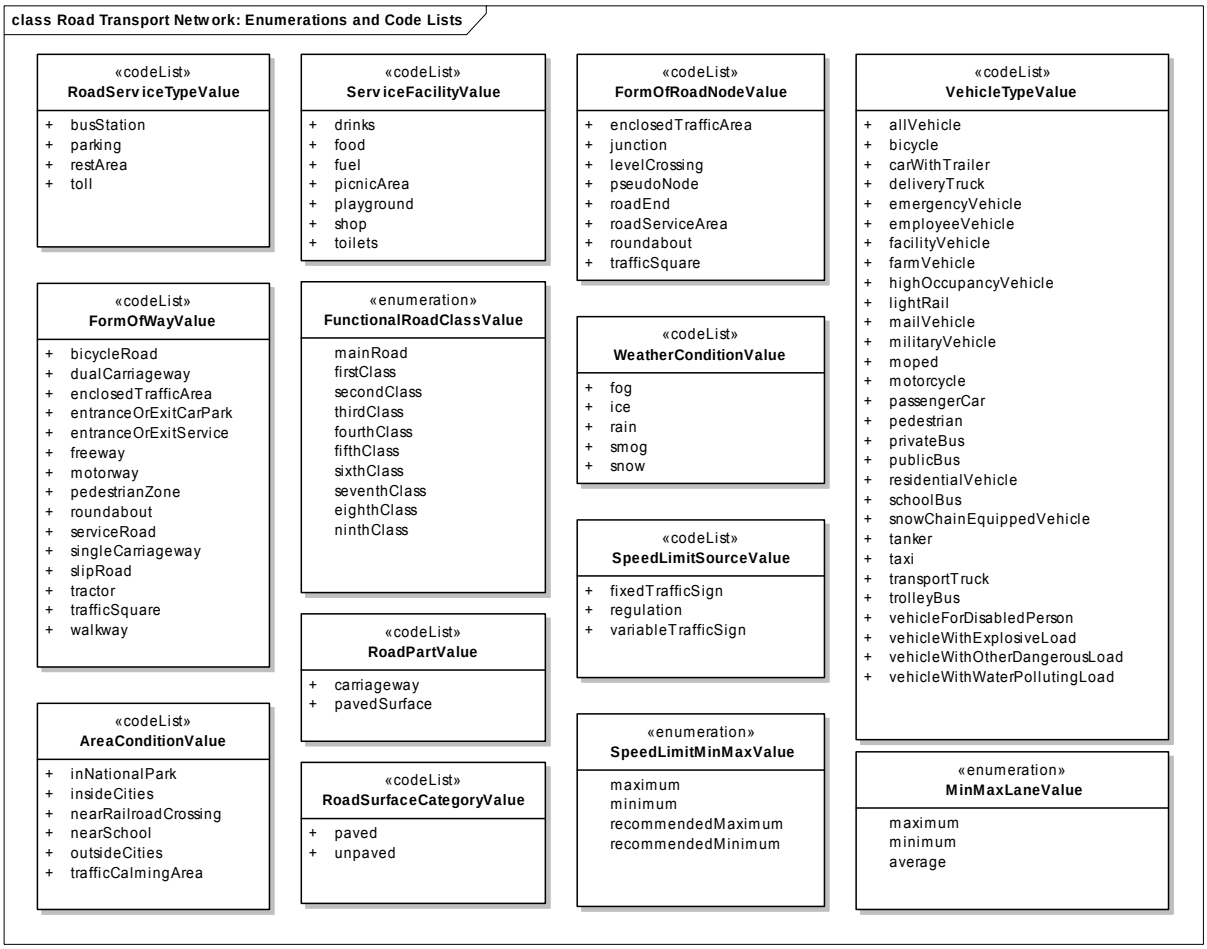


Figure 18 – UML class diagram: Road *Transport Networks* Enumerations and code lists

5.3.2.2.1 MinMaxLaneValue

MinMaxLaneValue	
Definition:	Values to indicate whether number of lanes are counted as the maximum, minimum or average number.
Description:	SOURCE Adapted from [Euroroads].
Status:	Proposed
Stereotypes:	«enumeration»
Value: maximum	
Definition:	The number of lanes is the maximum value for a given part of the road network.
Description:	SOURCE Adapted from [Euroroads].
Value: minimum	
Definition:	The number of lanes is the minimum value for a given part of the road network.
Description:	SOURCE [Euroroads].
Value: average	
Definition:	The number of lanes is the average value for a given part of the road network.
Description:	SOURCE [Euroroads].

5.3.2.2.2 SpeedLimitMinMaxValue

SpeedLimitMinMaxValue

SpeedLimitMinMaxValue	
Definition:	Possible values to indicate the nature of a speed limit.
Status:	Proposed
Stereotypes:	«enumeration»
Value: maximum	
Definition:	Speed limit is a maximum value
Description:	SOURCE [Euroroads].
Value: minimum	
Definition:	Speed limit is a minimum value
Description:	SOURCE [Euroroads].
Value: recommendedMaximum	
Definition:	Speed limit is a recommended maximum value
Description:	SOURCE [Euroroads].
Value: recommendedMinimum	
Definition:	Speed limit is a recommended minimum value
Description:	SOURCE [Euroroads].

5.3.2.2.3 FunctionalRoadClassValue

FunctionalRoadClassValue	
Definition:	Values for the functional road classification. This classification is based on the importance of the role that the road performs in the road network.
Description:	SOURCE Adapted from [GDF, EuroRoadS].
Status:	Proposed
Stereotypes:	«enumeration»
Value: mainRoad	
Definition:	The most important roads in a given network.
Description:	SOURCE [GDF], [Euroroads].
Value: firstClass	
Definition:	The second most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: secondClass	
Definition:	The third most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: thirdClass	
Definition:	The fourth most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: fourthClass	
Definition:	The fifth most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: fifthClass	
Definition:	The sixth most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: sixthClass	
Definition:	The seventh most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: seventhClass	
Definition:	The eighth most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: eighthClass	
Definition:	The ninth most important roads in a given network.
Description:	SOURCE [Euroroads].
Value: ninthClass	

FunctionalRoadClassValue	
Definition:	The least important roads in a given network.
Description:	SOURCE [GDF] NOTE The farthest ways in the forest road network. It has no regular maintenance. [NVDB] [Euroroads].

5.3.2.2.4 AreaConditionValue

AreaConditionValue	
Definition:	Speed limit restriction depending on the area..
Description:	SOURCE [Euroroads].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AreaConditionValues
Value: inNationalPark	
Definition:	Speed limit restriction inside national park.
Description:	SOURCE [Euroroads].
Value: insideCities	
Definition:	Speed limit restriction inside cities.
Description:	SOURCE [Euroroads].
Value: nearRailroadCrossing	
Definition:	Speed limit restriction near rail road crossing.
Description:	SOURCE [Euroroads].
Value: nearSchool	
Definition:	Speed limit restriction near school.
Description:	SOURCE [Euroroads].
Value: outsideCities	
Definition:	Speed limit restriction outside cities.
Description:	SOURCE [Euroroads].
Value: trafficCalmingArea	
Definition:	Speed limit restriction in traffic calming area.
Description:	SOURCE [Euroroads].

5.3.2.2.5 RoadPartValue

RoadPartValue	
Definition:	Indication to which part of a road the value of a measurement applies.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RoadPartValues
Value: carriageway	
Definition:	The part of a road which is reserved for traffic.
Value: pavedSurface	
Definition:	The part of the road which is paved.

5.3.2.2.6 RoadSurfaceCategoryValue

RoadSurfaceCategoryValue	
Definition:	Values to indicate whether a road is paved or not paved.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RoadSurfaceCategoryValues

RoadSurfaceCategoryValue	
Value: paved	
Definition:	Road with a hard paved surface.
Description:	SOURCE [Euroroads]. EXAMPLES Asphalt or concrete.
Value: unpaved	
Definition:	Road not paved.
Description:	SOURCE [Euroroads]. EXAMPLE Gravelled road.

5.3.2.2.7 SpeedLimitSourceValue

SpeedLimitSourceValue	
Definition:	Possible sources for speed limits.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:SpeedLimitSourceValues
Value: fixedTrafficSign	
Definition:	Source is a fixed traffic sign (site specific administrative order, explicit speed limit).
Description:	SOURCE [Euroroads].
Value: regulation	
Definition:	Source is a regulation (national regulation, rule or 'implicit speed limit').
Description:	SOURCE [Euroroads].
Value: variableTrafficSign	
Definition:	Source is a variable traffic sign.
Description:	SOURCE [Euroroads].

5.3.2.2.8 VehicleTypeValue

VehicleTypeValue	
Definition:	Possible types of vehicles.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:VehicleTypeValues
Value: allVehicle	
Definition:	Any vehicle, not including pedestrians.
Description:	SOURCE [Euroroads].
Value: bicycle	
Definition:	pedal-driven two-wheeled vehicle.
Description:	SOURCE [Euroroads].
Value: carWithTrailer	
Definition:	A passenger car with an attached trailer.
Description:	SOURCE [Euroroads].
Value: deliveryTruck	
Definition:	A truck vehicle of relatively small size, whose principal use is for delivery of goods and materials.
Description:	SOURCE [Euroroads].
Value: emergencyVehicle	
Definition:	A vehicle engaged in emergency response, included but not limited to police, ambulance and fire.

VehicleTypeValue	
Description:	SOURCE [Euroroads].
Value: employeeVehicle	
Definition:	A vehicle operated by an employee of an organization that is used within that organization's ground.
Description:	SOURCE [Euroroads].
Value: facilityVehicle	
Definition:	A vehicle dedicated to a localized area within a private or restricted estate.
Description:	SOURCE [Euroroads]. EXAMPLE Facilities roads within an airport or theme park.
Value: farmVehicle	
Definition:	Vehicle commonly associated with farming activities.
Description:	SOURCE [Euroroads].
Value: highOccupancyVehicle	
Definition:	Vehicle populated with a number of occupants corresponding to (or exceeding) the specified minimum number of passengers.
Description:	SOURCE [Euroroads].
Value: lightRail	
Definition:	Train-like transport vehicle limited to a rail network within a limited area.
Description:	SOURCE [Euroroads]. NOTE Does not include heavy rail lines.
Value: mailVehicle	
Definition:	A vehicle that collects, carries or delivers mail.
Description:	SOURCE [Euroroads].
Value: militaryVehicle	
Definition:	Vehicle authorized by a military authority.
Description:	SOURCE [Euroroads].
Value: moped	
Definition:	Two or three wheeled vehicle equipped with internal combustion engine, with size less than 50 cc and maximum speed that does not exceed 45 km/h (28mph).
Description:	SOURCE Adapted from [CADaS/CARE].
Value: motorcycle	
Definition:	Two or three wheeled vehicle equipped with internal combustion engine, with size more than 50 cc and maximum speed that does exceed 45 km/h (28mph).
Description:	SOURCE Adapted from [CADaS/CARE].
Value: passengerCar	
Definition:	A small vehicle designed for private transport of people.
Description:	SOURCE [Euroroads].
Value: pedestrian	
Definition:	A person on foot.
Description:	SOURCE [Euroroads].
Value: privateBus	
Definition:	A vehicle designed for transport of large groups of people, privately owned or chartered.
Description:	SOURCE [Euroroads].
Value: publicBus	
Definition:	A vehicle designed for transport of large groups of people that is generally charterized by published routes and schedules.
Description:	SOURCE [Euroroads].
Value: residentialVehicle	

VehicleTypeValue	
Definition:	A vehicle whose owner is resident (or a guest) of particular street or town area.
Description:	SOURCE [Euroroads].
Value: schoolBus	
Definition:	Vehicle operated on behalf of a school to transport students.
Description:	SOURCE [Euroroads].
Value: snowChainEquippedVehicle	
Definition:	Any vehicle equipped with snow chains.
Description:	SOURCE [Euroroads].
Value: tanker	
Definition:	A truck with more than two axels used to transport liquid loads in bulk.
Description:	SOURCE [Euroroads].
Value: taxi	
Definition:	A vehicle licensed for hire usually fitted with a meter.
Description:	SOURCE [Euroroads].
Value: transportTruck	
Definition:	A truck vehicle for long range transport of goods.
Description:	SOURCE [Euroroads].
Value: trolleyBus	
Definition:	A bus-like mass transport vehicle hooked up to an electrical network for power supply.
Description:	SOURCE [Euroroads].
Value: vehicleForDisabledPerson	
Definition:	A vehicle with supporting identification that designates a vehicle for disabled persons.
Description:	SOURCE [Euroroads].
Value: vehicleWithExplosiveLoad	
Definition:	Vehicle transporting explosive cargo.
Description:	SOURCE [Euroroads].
Value: vehicleWithOtherDangerousLoad	
Definition:	Vehicle transporting dangerous cargo, other than explosive or waterpollution loads.
Description:	SOURCE [Euroroads].
Value: vehicleWithWaterPollutingLoad	
Definition:	Vehicle transporting water-polluting cargo.
Description:	SOURCE [Euroroads].

5.3.2.2.9 WeatherConditionValue

WeatherConditionValue	
Definition:	Values to indicate weather conditions that affect speed limits.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:WeatherConditionValues
Value: fog	
Definition:	Speed applies when fog is present.
Description:	SOURCE Adapted from [Euroroads].
Value: ice	
Definition:	Speed applies when ice is present.
Description:	SOURCE Adapted from [Euroroads].
Value: rain	
Definition:	Speed applies when rain is present.

WeatherConditionValue	
Description:	SOURCE Adapted from [Euroroads].
Value: smog	
Definition:	Speed applies when a certain amount of smog is present.
Value: snow	
Definition:	Speed applies when snow is present.

5.3.2.2.10 FormOfRoadNodeValue

FormOfRoadNodeValue	
Definition:	Functions of road nodes within Euroroads.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:FormOfRoadNodeValues
Value: enclosedTrafficArea	
Definition:	The road node is situated inside and/or represents an enclosed traffic area. A traffic area is an area with no internal structure of legally defined driving directions. At least two roads are connected to the area..
Description:	SOURCE [Euroroads].
Value: junction	
Definition:	Three or more road links intersect at the road node.
Value: levelCrossing	
Definition:	A railway crosses a road on the same level at the position of the road node.
Value: pseudoNode	
Definition:	Exactly two road links connect to the road node.
Value: roadEnd	
Definition:	Only one road link connects to the road node. It signifies the end of a road.
Value: roadServiceArea	
Definition:	Surface annexed to a road and devoted to offer particular services for it.
Description:	EXAMPLES Gas station, rest area, toll area.
Value: roundabout	
Definition:	The road node represents or is a part of a roundabout.
Value: trafficSquare	
Definition:	The road node is situated inside and/or represents a traffic square. A traffic square is an area (partly) enclosed by roads which is used for non-traffic purposes and which is not a roundabout.
Description:	SOURCE [GDF, Euroroads].

5.3.2.2.11 FormOfWayValue

FormOfWayValue	
Definition:	Classification based on the physical properties of the road link.
Description:	SOURCE Based on [Euroroads].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:FormOfWayValues
Value: bicycleRoad	
Definition:	Road where bicycles are the only vehicles allowed.
Description:	SOURCE Adapted from [Euroroads].
Value: dualCarriageway	
Definition:	Road with physically separated carriageways regardless of the number of lanes, which is not a motorway or a freeway.
Description:	SOURCE Based on [NVDB/GDF, Euroroads].

FormOfWayValue	
Value: enclosedTrafficArea	
Definition:	Area with no internal structure of legally defined driving directions. At least two roads are connected to the area.
Description:	SOURCE [Euroroads].
Value: entranceOrExitCarPark	
Definition:	Road specially designed to enter or to leave a parking area.
Description:	SOURCE [GDF], [Euroroads].
Value: entranceOrExitService	
Definition:	Road used only to enter or to leave a service.
Description:	SOURCE [GDF], [Euroroads].
Value: freeway	
Definition:	Road having no single level crossings with other roads.
Description:	SOURCE Adapted from [Euroroads]. NOTE This means that connections with other roads consist of slip roads.
Value: motorway	
Definition:	Road permitted for motorized vehicles only in combination with a prescribed minimum speed. It has two or more mostly physically separated carriageways and no single level-crossings.
Description:	SOURCE [GDF], [Euroroads].
Value: pedestrianZone	
Definition:	Area with a road network which is especially designed for use by pedestrians.
Description:	SOURCE [GDF], [Euroroads]. NOTE Pedestrian zones are usually located in urban areas. Except for emergency vehicles and for delivery vehicles during certain hours no traffic is allowed on the road network elements which are located inside the zone.
Value: roundabout	
Definition:	Road which forms a ring on which traffic travelling in only one direction is allowed.
Description:	SOURCE Based on [GDF], [Euroroads]. NOTE The Road elements which make up a roundabout are connected to one another and they form exactly one ring.
Value: serviceRoad	
Definition:	Road running parallel to and connecting to a road with a relatively high connectivity function, which is especially designed to enable access from the connecting roads to roads with a low connectivity function in its vicinity.
Description:	SOURCE Based on [GDF], [Euroroads]. NOTE Generally, service roads have the same name as the higher class road it runs parallel to and are only divided from it by small constructions like walkways, traffic islands etc.
Value: singleCarriageway	
Definition:	Road where the traffic is not separated by any physical object.
Description:	SOURCE [GDF], [Euroroads]. NOTE All roads without separate carriageways are considered as roads with a single carriageway.
Value: slipRoad	
Definition:	Road especially designed to enter or leave a road.
Description:	SOURCE Adapted from [Euroroads].
Value: tractor	

FormOfWayValue	
Definition:	Arranged road only usable for a tractor (farm vehicle or forest machine) or terrain vehicle (a vehicle with higher ground clearance, big wheels and 4 wheel drive).
Description:	SOURCE Based on [Euroroads].
Value: trafficSquare	
Definition:	Area (partly) enclosed by roads which is used for non-traffic purposes and which is not a roundabout.
Description:	SOURCE [GDF], [Euroroads].
Value: walkway	
Definition:	Road reserved for pedestrian use and closed for regular vehicular use by a physically barrier.
Description:	SOURCE Adapted from [Euroroads]. NOTE Occasional use by (emergency) services may occur.

5.3.2.2.12 RoadServiceTypeValue

RoadServiceTypeValue	
Definition:	Types of road service areas.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RoadServiceTypeValues
Value: busStation	
Definition:	The road service is a bus stop.
Value: parking	
Definition:	The road service areea is a parking facility.
Value: restArea	
Definition:	The road service is a rest area.
Value: toll	
Definition:	Area that provides toll services such as ticket dispensers or toll payment services.

5.3.2.2.13 ServiceFacilityValue

ServiceFacilityValue	
Definition:	Possible service facilities available at a road service area.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:ServiceFacilityValues
Value: drinks	
Definition:	Drinks are available.
Value: food	
Definition:	Food is available.
Value: fuel	
Definition:	Fuel is available.
Value: picnicArea	
Definition:	A picnic area is present.
Value: playground	
Definition:	A playground area is present.
Value: shop	
Definition:	A shop is present.
Value: toilets	
Definition:	Toilets are present.

5.3.2.3 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.3.2.3.1 TransportLinkSequence

TransportLinkSequence (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.

5.3.2.3.2 TransportLink

TransportLink (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.

5.3.2.3.3 TransportArea

TransportArea (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Surface that represents the spatial extent of an element of a transport network.

5.3.2.3.4 TransportNode

TransportNode (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.

5.3.2.3.5 TransportProperty

TransportProperty (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.

5.3.2.3.6 TransportLinkSet

TransportLinkSet (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or siginificance in a transport network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

5.3.2.3.7 GeographicalName

GeographicalName	
Package:	Geographical Names [see EC DS-D2.8.I.3]

GeographicalName	
Definition:	Proper noun applied to a real world entity.

5.3.2.3.8 LinkDirectionValue

LinkDirectionValue	
Package:	Network [see DS-D2.5]
Definition:	List of values for directions relative to a link

5.4 Application schema Rail Transport Networks

5.4.1 Description

5.4.1.1 Narrative description

The Rail Transport Networks application schema (Rail Schema) employs a link and node structure to represent the rail tracks used for transportation in the form of a linear network. The Rail Schema inherits classes from the Common Transport Schema and also creates its own classes to describe properties of the rail network such as Ownership and restrictions that can apply to whole sections of the network element or subsections that can be described using linear referencing.

The primary aspects modelled for rail network elements are:

- Spatial. Geometric (point, line and area (topographic)) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with points (nodes) at the ends of the lines (at junctions, rail ends etc). Also real objects with a function in a network may be represented in the dataset. Network connectivity within the rail network is essential but between elements in the other networks is an optional spatial aspect.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also optional information on when data was entered, modified or deleted in the dataset.

- Thematic. The Rail Schema can be thematically displayed via several of the attributes defined within the specification such as railwayGauge or owningAuthority.

5.4.1.2 UML Overview

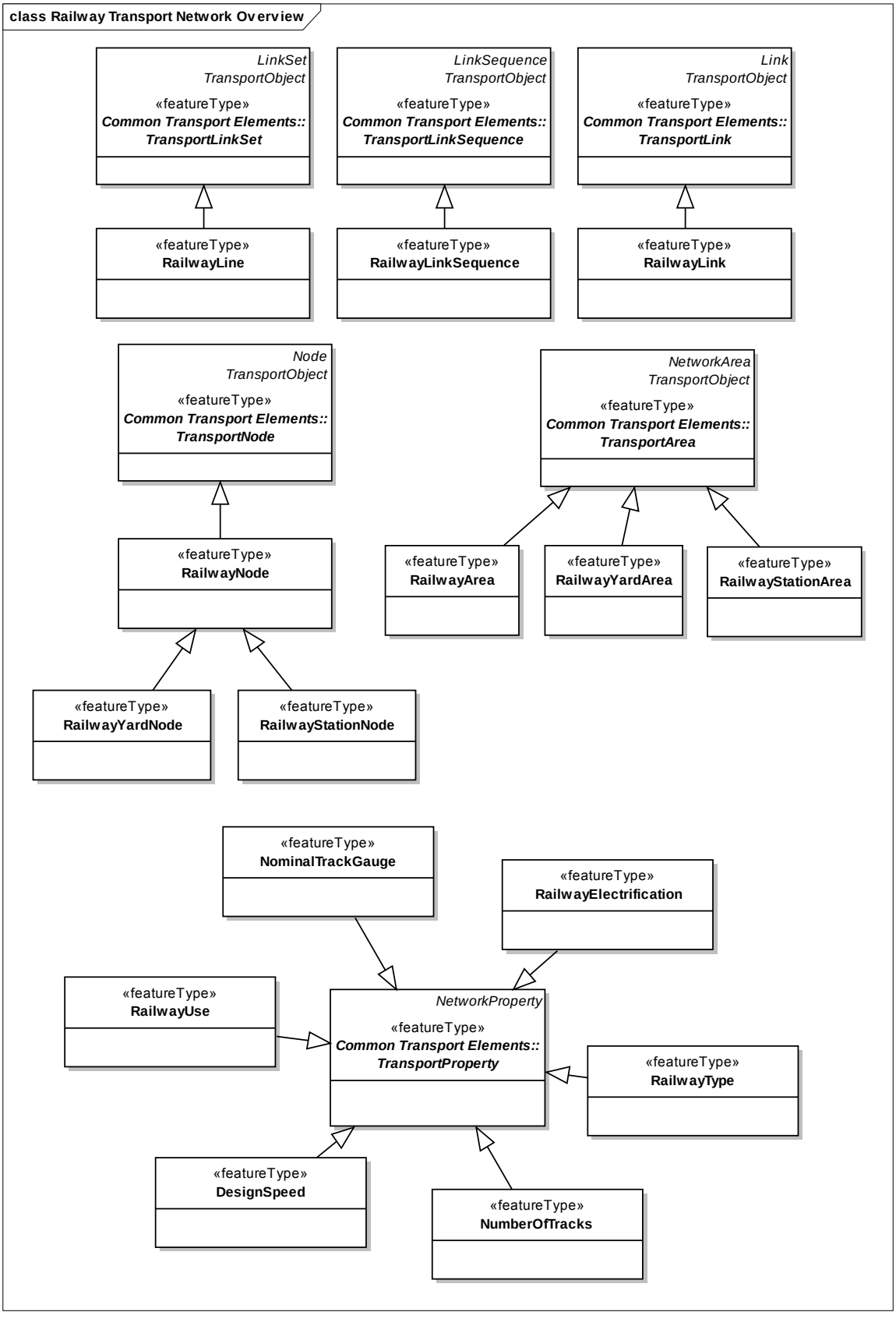


Figure 19 – UML class diagram: Overview of the *Rail Transport Networks* application schema

5.4.1.3 Consistency between spatial data sets

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.3) apply to the corresponding specialized elements/classes in the *Rail transport networks*.

5.4.1.4 Identifier management

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.4) apply to the corresponding specialized elements/classes in the *Rail transport networks*.

5.4.1.5 Modelling of object references

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.5) apply to the corresponding specialized elements/classes in the *Rail transport networks*.

5.4.1.6 Geometry representation

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.6) apply to the corresponding specialized elements/classes in the *Rail transport networks*.

5.4.1.7 Temporality representation

All attributes describing the lifespan of spatial objects or the phenomena in the real world they describe are inherited from the Common Transport Elements application schema. Refer to section 5.2.1.7 for more information.

5.4.2 Feature catalogue

Table 7 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Railway Transport Network
Scope	Railway Transport Network
Version number	3.1
Version date	2010-04-26
Definition source	INSPIRE data specification Railway Transport Network

Table 8 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
DesignSpeed	Railway Transport Network	«featureType»	5.4.2.2.1
FormOfRailwayNodeValue	Railway Transport Network	«codeList»	5.4.2.3.2
MinMaxTrackValue	Railway Transport Network	«enumeration»	5.4.2.3.1
NominalTrackGauge	Railway Transport Network	«featureType»	5.4.2.2.2

Type	Package	Stereotypes	Section
NumberOfTracks	Railway Network Transport	«featureType»	5.4.2.2.3
RailwayArea	Railway Network Transport	«featureType»	5.4.2.2.4
RailwayElectrification	Railway Network Transport	«featureType»	5.4.2.2.5
RailwayGaugeCategoryValue	Railway Network Transport	«enumeration»	**Error! Reference source not found.**
RailwayLine	Railway Network Transport	«featureType»	5.4.2.2.6
RailwayLink	Railway Network Transport	«featureType»	5.4.2.2.7
RailwayLinkSequence	Railway Network Transport	«featureType»	5.4.2.2.8
RailwayNode	Railway Network Transport	«featureType»	5.4.2.2.9
RailwayStationArea	Railway Network Transport	«featureType»	5.4.2.2.10
RailwayStationCode	Railway Network Transport	«featureType»	5.4.2.2.11
RailwayStationNode	Railway Network Transport	«featureType»	5.4.2.2.12
RailwayType	Railway Network Transport	«featureType»	5.4.2.2.13
RailwayTypeValue	Railway Network Transport	«codeList»	5.4.2.3.3
RailwayUse	Railway Network Transport	«featureType»	5.4.2.2.14
RailwayUseValue	Railway Network Transport	«codeList»	5.4.2.3.4
RailwayYardArea	Railway Network Transport	«featureType»	5.4.2.2.15
RailwayYardNode	Railway Network Transport	«featureType»	5.4.2.2.16

5.4.2.1 Spatial object types

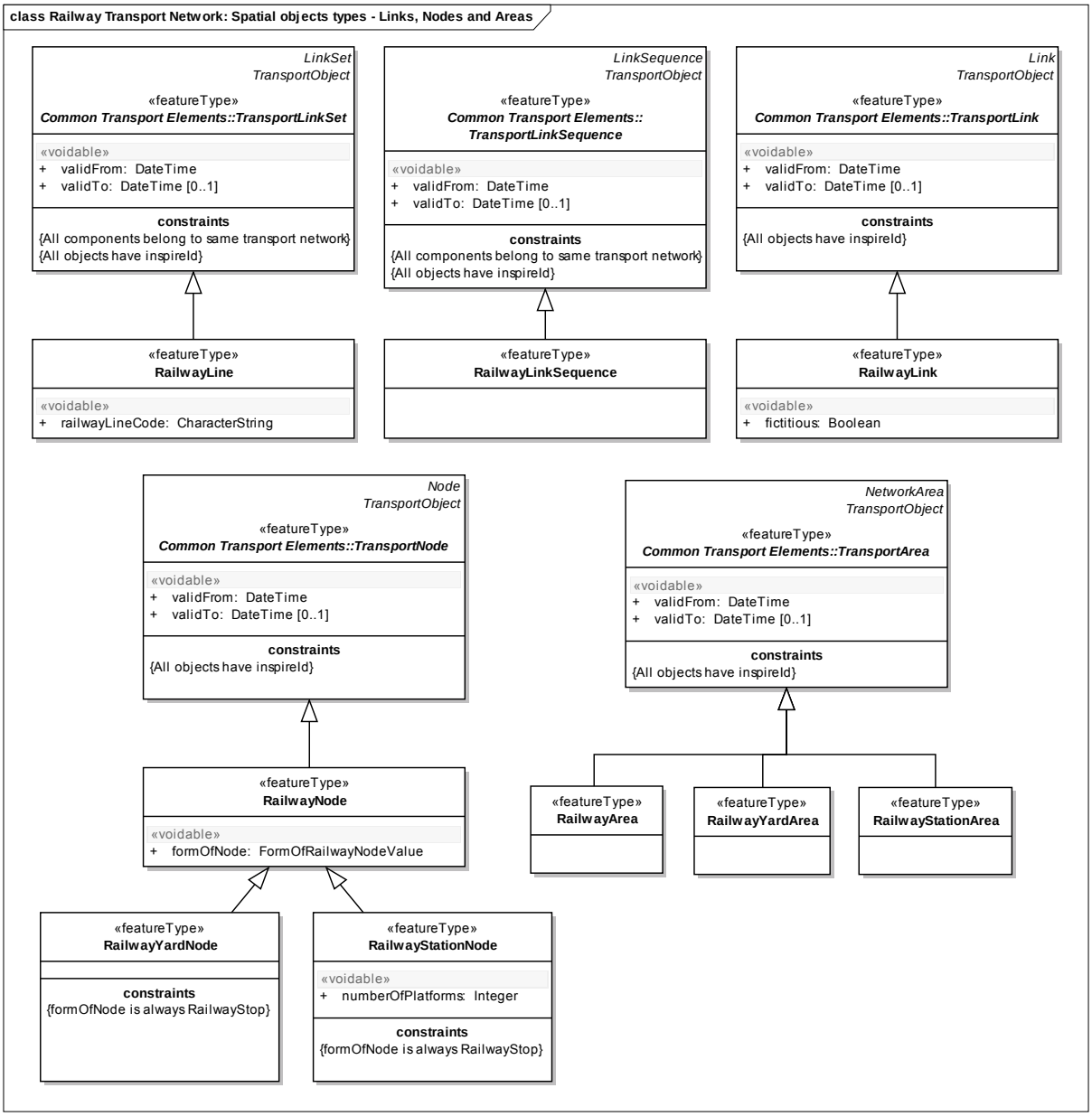


Figure 20 – UML class diagram: *Railway Transport Networks* Spatial object types – Links, Nodes and Areas

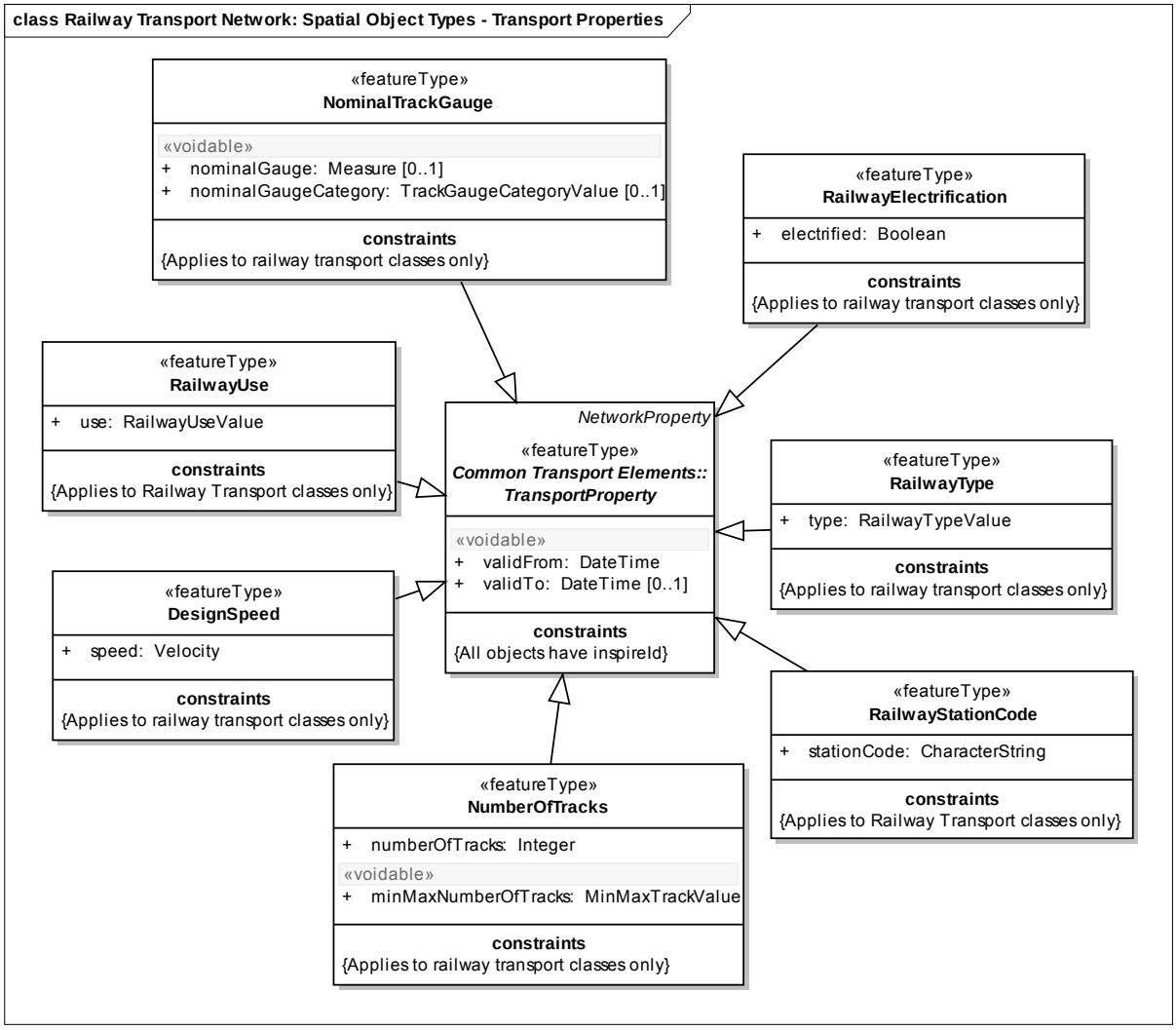


Figure 21 – UML class diagram: *Railway Transport Networks* Spatial object types – Transport Properties

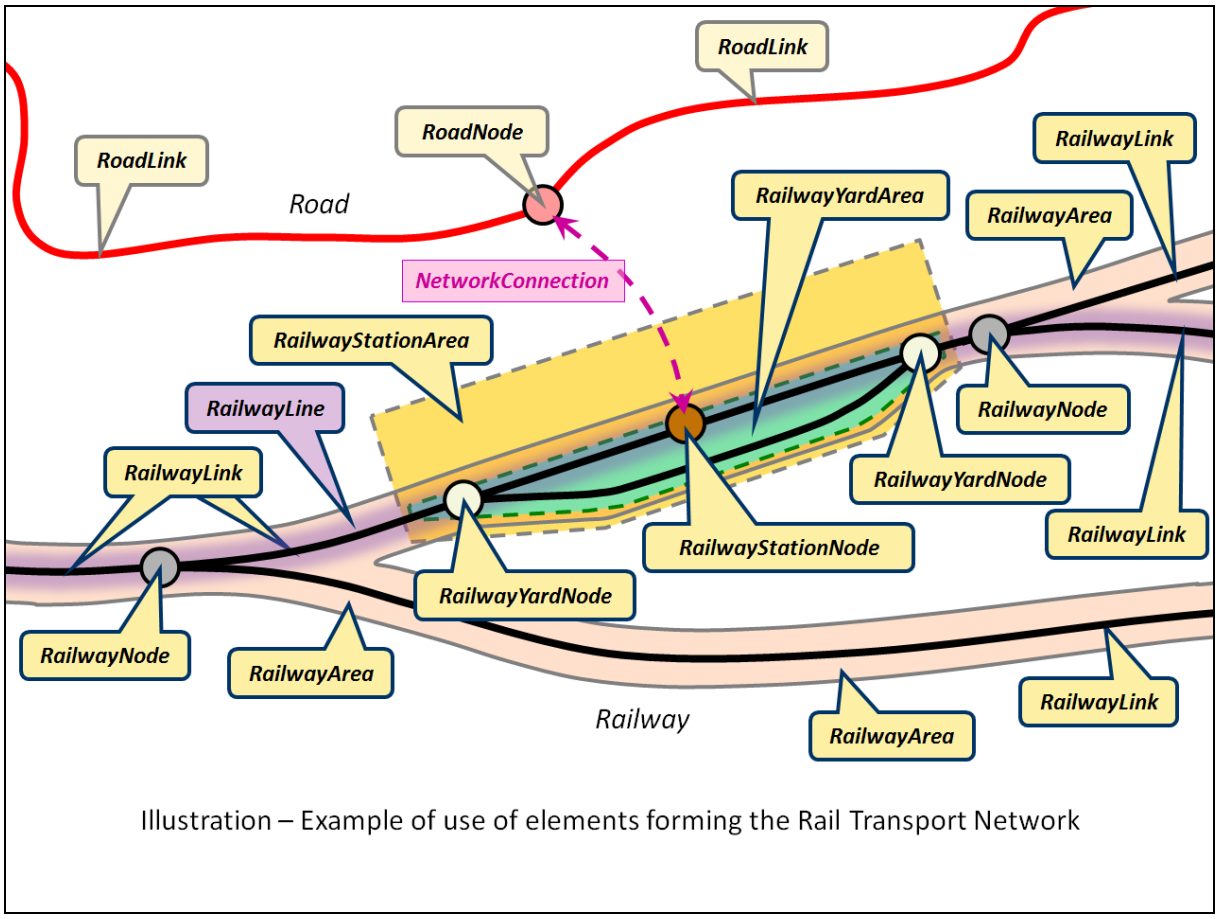


Figure 22 – Overview of the main *Rail Transport Networks* objects

5.4.2.2 Spatial object types

5.4.2.2.1 DesignSpeed

DesignSpeed	
Subtype of:	TransportProperty
Definition:	The specification of the maximum speed to which a railway line is designed for.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: speed	
Value type:	Velocity
Definition:	The specification of the maximum speed to which a railway line is designed for.
Multiplicity:	1
Constraint: Applies to railway transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.2 NominalTrackGauge

RailwayGauge

RailwayGauge	
Subtype of:	TransportProperty
Definition:	The nominal distance between the two outer rails (gauge) of a railway track.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: nominalGauge	
Value type:	Measure
Definition:	A single value that identifies the track gauge.
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: nominalGaugeCategory	
Value type:	TrackGaugeCategoryValue
Definition:	Provision of the gauge of a railway track as a fuzzy category with respect to the European standard nominal gauge.
Multiplicity:	0..1
Stereotypes:	«voidable»
Constraint: Applies to railway transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.3 NumberOfTracks

NumberOfTracks	
Subtype of:	TransportProperty
Definition:	The number of tracks for a railway stretch.
Description:	This is dependent on the resolution of the data.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: minMaxNumberOfTracks	
Value type:	MinMaxTrackValue
Definition:	Indicates whether the number of tracks are counted as minimum or maximum value.
Description:	NOTE This attribute only applies when the value in numberOfTracks is not an exact value.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: numberOfTracks	
Value type:	Integer
Definition:	The number of tracks present.
Multiplicity:	1
Constraint: Applies to railway transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.

NumberOfTracks	
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.4 RailwayArea

RailwayArea	
Subtype of:	TransportArea
Definition:	Surface occupied by a railway track, including ballast.
Status:	Proposed
Stereotypes:	«featureType»

5.4.2.2.5 RailwayElectrification

RailwayElectrification	
Subtype of:	TransportProperty
Definition:	Indication whether the railway is provided with an electric system to power vehicles moving along it.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: electrified	
Value type:	boolean
Definition:	Inidicates whether the railway is provided with an electric system to power vehicles moving along it.
Multiplicity:	1
Constraint: Applies to railway transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.6 RailwayLine

RailwayLine	
Subtype of:	TransportLinkSet
Definition:	A collection of railway link sequences and or individual railway links that are characterized by one or more thematical identifiers and/or properties.
Description:	EXAMPLE Railway lines characterized by a specific identification code, used by railroad companies or tourist railways, identified by a specific name.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: railwayLineCode	
Value type:	CharacterString
Definition:	A code assigned to a railway line which is unique within a Member State.
Multiplicity:	1
Stereotypes:	«voidable»

5.4.2.2.7 RailwayLink

RailwayLink

RailwayLink	
Subtype of:	TransportLink
Definition:	A linear spatial object that describes the geometry and connectivity of a railway network between two points in the network.
Description:	NOTE Railway links can be used to represent stretches of railway with one or multiple tracks.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: fictitious	
Value type:	boolean
Definition:	The railway link does not represent a real and existing railway track but a fictitious trajectory.
Description:	EXAMPLE A fictitious trajectory to connect railway links across a turntable.
Multiplicity:	1
Stereotypes:	«voidable»

5.4.2.2.8 RailwayLinkSequence

RailwayLinkSequence	
Subtype of:	TransportLinkSequence
Definition:	A linear spatial object, composed of an ordered collection of railway links, which represents a continuous path in a railway network without any branches. The element has a defined beginning and end and every position on the road link sequence is identifiable with one single parameter such as length. It describes an element of the railway network, characterized by one or more thematical identifiers and/or properties.
Status:	Proposed
Stereotypes:	«featureType»

5.4.2.2.9 RailwayNode

RailwayNode	
Subtype of:	TransportNode
Definition:	A point spatial object which represents a significant point along the railway network or defines an intersection of railway tracks used to describe its connectivity.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: formOfNode	
Value type:	FormOfRailwayNodeValue
Definition:	The function of a railway node within the railway network.
Multiplicity:	1
Stereotypes:	«voidable»

5.4.2.2.10 RailwayStationArea

RailwayStationArea	
Subtype of:	TransportArea
Definition:	An area spatial object which is used to represent the topographical limits of the facilities of a railway station (buildings, railway yards, installations and equipment) devoted to carry out railway station operations.
Status:	Proposed
Stereotypes:	«featureType»

5.4.2.2.11 RailwayStationCode

RailwayStationCode	
Subtype of:	TransportProperty
Definition:	The unique code assigned to a railway station.

RailwayStationCode	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: stationCode	
Value type:	CharacterString
Definition:	A unique code assigned to a railway station.
Multiplicity:	1
Constraint: Applies to Railway Transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.12 RailwayStationNode

RailwayStationNode	
Subtype of:	RailwayNode
Definition:	A railway node which represents the location of a railway station along the railway network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: numberOfPlatforms	
Value type:	Integer
Definition:	A value indicating the number of platforms available at a railway station.
Multiplicity:	1
Stereotypes:	«voidable»
Constraint: formOfNode is always RailwayStop	
Natural language:	For a railway station node, the value for the "formOfNode" attribute shall always be "RailwayStop".
OCL:	formOfNode = FormOfRailwayNodeValue::railwayStop

5.4.2.2.13 RailwayType

RailwayType	
Subtype of:	TransportProperty
Definition:	The type of railway transport the line is designed for.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: type	
Value type:	RailwayTypeValue
Definition:	The type of railway transport to which the line is designed for.
Multiplicity:	1
Constraint: Applies to railway transport classes only	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.

RailwayType	
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.14 RailwayUse

RailwayUse	
Subtype of:	TransportProperty
Definition:	The current use of the railway.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: use	
Value type:	RailwayUseValue
Definition:	The current use of the railway.
Multiplicity:	1
Constraint: Applies to Railway Transport classes oly	
Natural language:	This property can only be associated with a spatial object that is part of a railway transport network.
OCL:	inv: networkRef.element.oclIsKindOf(RailwayArea) or networkRef.element.oclIsKindOf(RailwayYardArea) or networkRef.element.oclIsKindOf(RailwayStationArea) or networkRef.element.oclIsKindOf(RailwayLine) or networkRef.element.oclIsKindOf(RailwayLinkSequence) or networkRef.element.oclIsKindOf(RailwayLink) or networkRef.element.oclIsKindOf(RailwayNode)

5.4.2.2.15 RailwayYardArea

RailwayYardArea	
Subtype of:	TransportArea
Definition:	An area spatial object which is used to represent the topographical limits of a railway yard. DEFINITION Railway yard: An area crossed by a number of parallel railway tracks (usually more than two) interconnected between them, which are used to stop trains in order to load / unload freight without interrupting the traffic of a main railway line.
Status:	Proposed
Stereotypes:	«featureType»

5.4.2.2.16 RailwayYardNode

RailwayYardNode	
Subtype of:	RailwayNode
Definition:	A railway node which occurs within a railway yard area. DEFINTION Railway yard: An area crossed by a number of parallel railway tracks (usually more than two) interconnected between them, which are used to stop trains in order to load / unload freight without interrupting the traffic of a main railway line.
Status:	Proposed
Stereotypes:	«featureType»
Constraint: formOfNode is always RailwayStop	
Natural language:	For a railway yard node, the value for the "formOfNode" attribute shall always be "RailwayStop".
OCL:	formOfNode = FormOfRailwayNodeValue::railwayStop

5.4.2.3 Enumerations and code lists

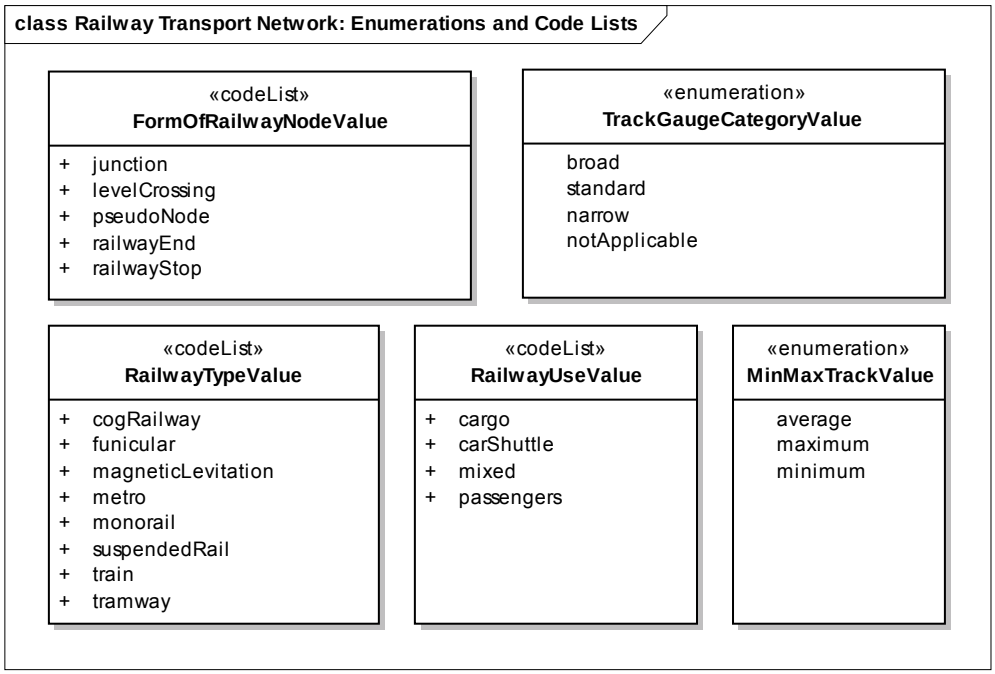


Figure 23 – UML class diagram: Railway *Transport Networks* Enumerations and Code lists

5.4.2.3.1 MinMaxTrackValue

MinMaxTrackValue	
Definition:	Values to indicate whether number of tracks are counted as the maximum, minimum or average number.
Status:	Proposed
Stereotypes:	«enumeration»
Value: average	
Definition:	The number of tracks is the average value for a given part of the railway network.
Value: maximum	
Definition:	The number of tracks is the maximum value for a given part of the railway network.
Value: minimum	
Definition:	The number of tracks is the minimum value for a given part of the railway network.

5.4.2.3.2 FormOfRailwayNodeValue

FormOfRailwayNodeValue	
Definition:	The possible functions of a railway node within the railway network.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:FormOfRailwayNodeValues
Value: junction	
Definition:	A railway node where the railway network have a mechanism consisting on a railroad track with two movable rails and the necessary connections, which let vehicles turn from one track to another.
Value: levelCrossing	

FormOfRailwayNodeValue	
Definition:	A railway node where the railway network is a crossed by a road at the same level.
Value: pseudoNode	
Definition:	A railway node which represents a point where one or more attributes of the railway links connected to it change their value, or a point necessary to describe the geometry of the network.
Value: railwayEnd	
Definition:	A railway node where the railway starts or ends. The railway network is interrupted at this point.
Value: railwayStop	
Definition:	A place in the railway network where trains stop to load/unload cargo or to let passengers get on and off the train.

5.4.2.3.3 RailwayTypeValue

RailwayTypeValue	
Definition:	The possible types of railway transport.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RailwayTypeValues
Value: cogRailway	
Definition:	A railway transport which allows the vehicles to operate on steep gradients, consisting on a railway provided with a toothed rack rail (usually between the running rails) where vehicles are fitted with one or more cog wheels or pinions that mesh with this rack rail.
Description:	Synonyms: cog railway, pens and rails railway, rack-and-pinion railway or rack railway.
Value: funicular	
Definition:	A railway transport consisting on a cable attached to a vehicle on rails which moves them up and down a very steep slope, where it is possible the ascending and descending vehicles counterbalancing each other.
Description:	Synonyms: funicular railway, incline, inclined railway, inclined plane or cliff railway.
Value: magneticLevitation	
Definition:	A railway transport based on a single rail which acts as guideway of a vehicle and support it by means of a magnetic levitation mechanism.
Value: metro	
Definition:	An urban railway transport system used in large urban areas, which runs on a separate track from other transport systems, is usually electrically powered and in some cases runs under ground. .
Description:	Synonyms: metro, subway, tube, underground.
Value: monorail	
Definition:	A railway transport based on a single rail which acts either as its only support and guideway.
Value: suspendedRail	
Definition:	A railway transport based on a single rail, acting either as support and guideway, from which a vehicle is suspended to move along the railway.
Value: train	
Definition:	A railway transport usually consisting on two parallel rails on which a powered-vehicle or train machine pulls a connected series of vehicles to move them along the railway in order to transport freight or passengers from one destination to another.
Value: tramway	

RailwayTypeValue	
Definition:	A railway transport system used in urban areas, which often runs at street level, sharing road space with motor traffic and pedestrians. Tramways are usually electrically powered.

5.4.2.3.4 RailwayUseValue

RailwayUseValue	
Definition:	The possible uses of railways.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RailwayUseValues
Value: cargo	
Definition:	The use of railway is exclusively for cargo operations.
Value: carShuttle	
Definition:	The use of railway is exclusively to perform car shuttle transport.
Value: mixed	
Definition:	The use of railway is mixed. It is used to transport passengers and cargo..
Value: passengers	
Definition:	The use of railway is exclusively to transport passengers[TWG-TN].

5.4.2.3.5 TrackGaugeCategoryValue

RailwayGaugeCategoryValue	
Definition:	The possible categories of railways concerning its nominal track gauge.
Status:	Proposed
Stereotypes:	«enumeration»
Value: broad	
Definition:	The nominal track gauge property is broader than the standard one.
Value: standard	
Definition:	The nominal track gauge property is equal to the European standard (1435 millimetres).
Value: narrow	
Definition:	The nominal track gauge property is narrower than the standard one.
Value: notApplicable	
Definition:	The definition of a nominal track gauge property is not applicable to the type of railway transport.
Description:	EXAMPLE Monorail.

5.4.2.4 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.4.2.4.1 TransportLinkSequence

TransportLinkSequence (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.

5.4.2.4.2 TransportLink

TransportLink (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.

5.4.2.4.3 TransportArea

TransportArea (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Surface that represents the spatial extent of an element of a transport network.

5.4.2.4.4 TransportNode

TransportNode (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.

5.4.2.4.5 TransportProperty

TransportProperty (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.

5.4.2.4.6 TransportLinkSet

TransportLinkSet (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or siginificance in a transport network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

5.4.2.4.7 MinMaxLaneValue

MinMaxLaneValue	
Package:	Road Transport Network [see section 5.3.2]
Definition:	Values to indicate whether number of lanes are counted as the maximum, minimum or average number.
Description:	SOURCE Adapted from [Euroroads].

5.4.2.4.8 Boolean

Boolean	
Package:	Truth [see ISO/TS 19103]
Definition:	Most valuable in the predicate calculus, where items are either True or False, unless they are ill formed.

5.5 Application schema Cable Transport Networks

5.5.1 Description

5.5.1.1 Narrative description

The Cable Transport Networks application schema (Cable Schema) employs a link and node structure to represent the cableways used for transportation of hung vehicles in the form of a linear network. It can play an important role especially in isolated areas having none or difficult access by means of other types of transport (e.g. mountain areas). The Cable Schema inherits classes from the Common Transport Elements application schema, including the possibility to create classes to describe properties of the cableway network and restrictions that can apply to whole sections of the network element or subsections that can be described using linear referencing. This type of network is modelled in a basic way in the specifications.

The primary aspects modelled for cableway network elements are:

- Spatial. Geometric (point and line) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with points (nodes) at the ends of the lines (at junctions, cable ends etc). Also real objects with a function in a network may be represented in the dataset. Network connectivity within the cable network is essential but between elements in the other networks is an optional spatial aspect.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also optional information on when data was entered, modified or deleted in the dataset.

- Thematic. The Cable Schema can be thematically enriched through the use of Transport Properties as defined in the Common Transport Elements application schema.

5.5.1.2 UML Overview

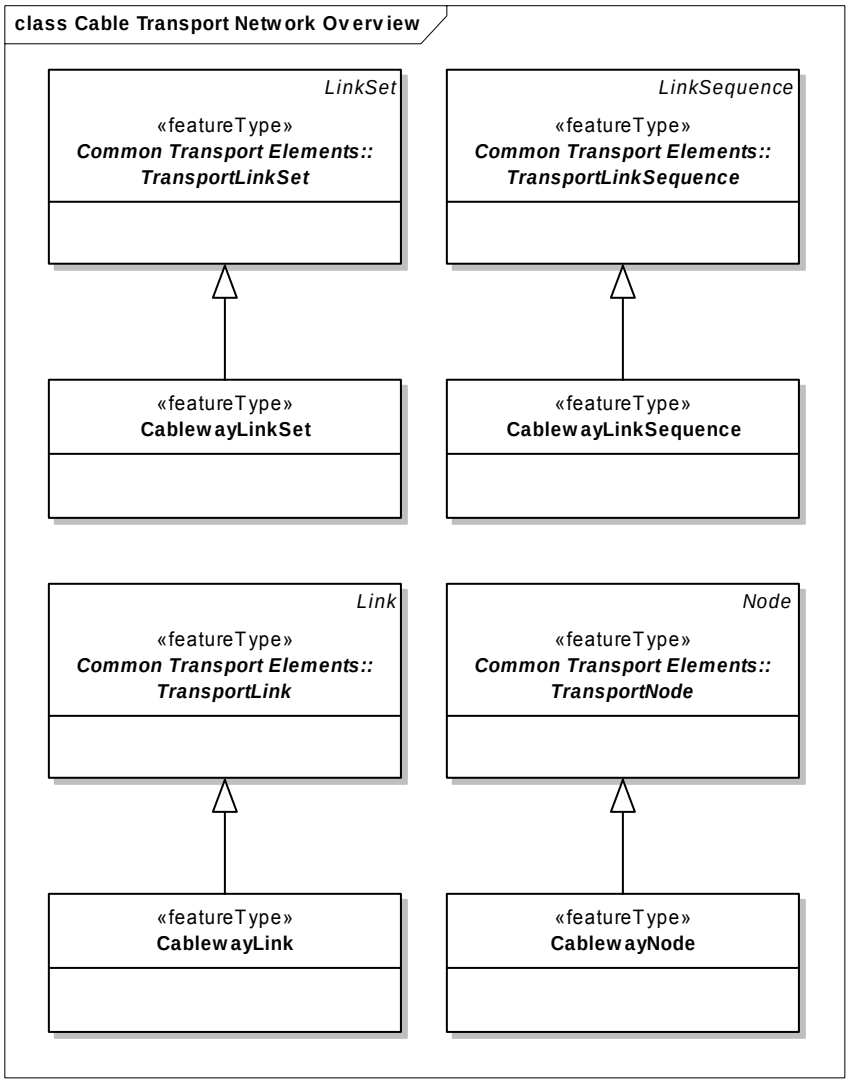


Figure 24 – UML class diagram: Overview of the *Cableway Transport Networks* application schema

5.5.1.3 Consistency between spatial data sets

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.3) apply to the corresponding specialized elements/classes in the *Cable transport networks*.

5.5.1.4 Identifier management

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.4) apply to the corresponding specialized elements/classes in the *Cable transport networks*.

5.5.1.5 Modelling of object references

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.5) apply to the corresponding specialized elements/classes in the *Cable transport networks*.

5.5.1.6 Geometry representation

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.6) apply to the corresponding specialized elements/classes in the *Cable transport networks*.

5.5.1.7 Temporality representation

All attributes describing the lifespan of spatial objects or the phenomena in the real world they describe are inherited from the Common Transport Elements application schema. Refer to section 5.2.1.7 for more information.

5.5.2 Feature catalogue

Table 9 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Cable Transport Network
Scope	Cable Transport Network
Version number	3.0
Version date	2009-09-07
Definition source	INSPIRE data specification Cable Transport Network

Table 10 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
CablewayLink	Cable Transport Network	«featureType»	5.5.2.1.1
CablewayLinkSequence	Cable Transport Network	«featureType»	5.5.2.1.2
CablewayLinkSet	Cable Transport Network	«featureType»	5.5.2.1.3
CablewayNode	Cable Transport Network	«featureType»	5.5.2.1.4
CablewayTypeValue	Cable Transport Network	«codeList»	5.5.2.2.1

5.5.2.1 Spatial object types

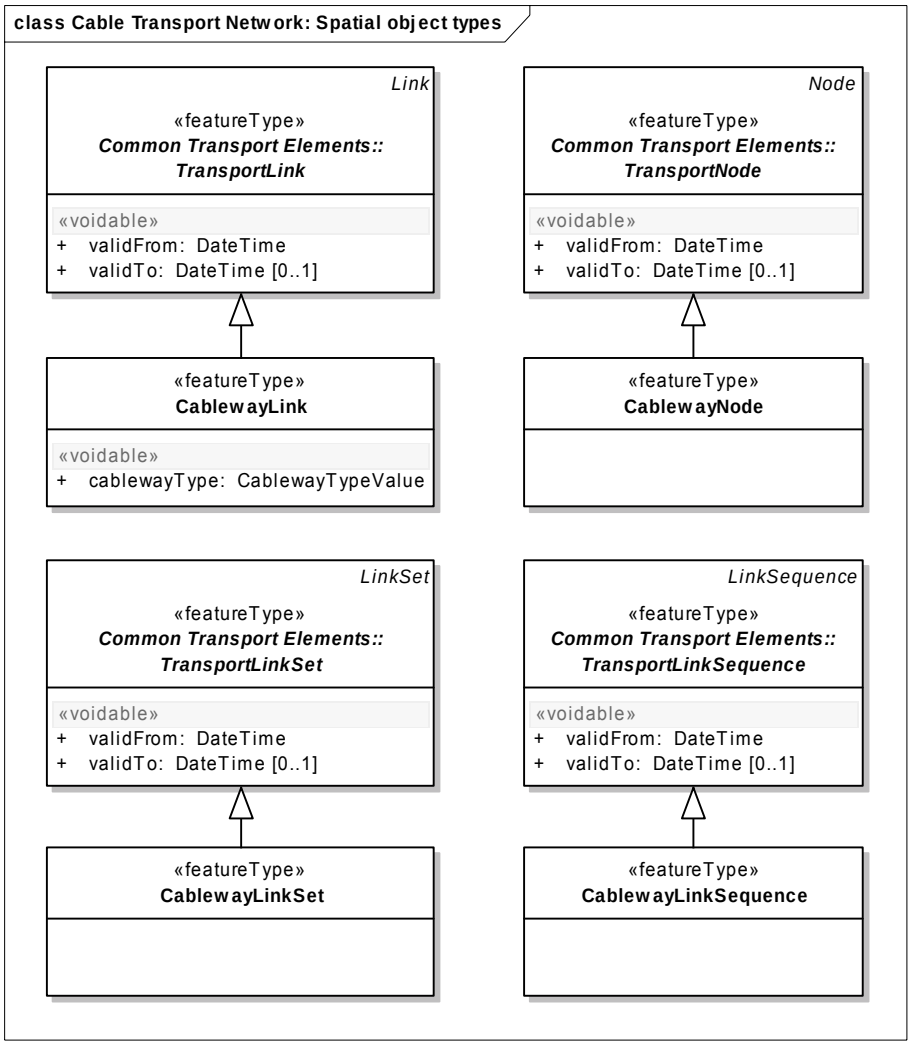


Figure 25 – UML class diagram: Cable Transport Networks Spatial object types

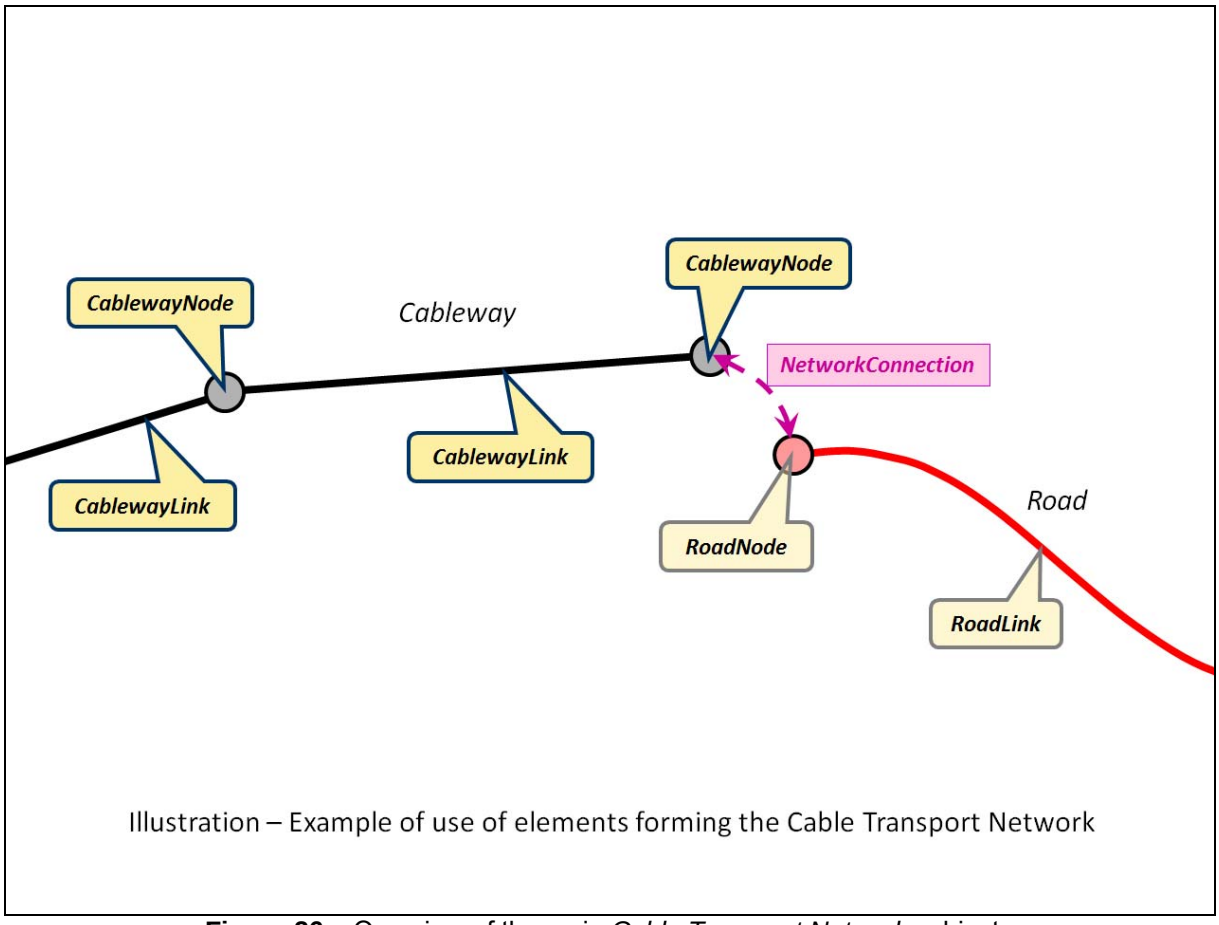


Figure 26 – Overview of the main *Cable Transport Networks* objects

5.5.2.1.1 CablewayLink

CablewayLink	
Subtype of:	TransportLink
Definition:	Linear spatial object that describes the geometry and connectivity of a cable network between two points in a cableway transport network.
Description:	NOTE Cableway transport is a form of transport based on a cable suspended normally from a set of consecutive towers.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: cablewayType	
Value type:	CablewayTypeValue
Definition:	The type of a cableway transport.
Multiplicity:	1
Stereotypes:	«voidable»

5.5.2.1.2 CablewayLinkSequence

CablewayLinkSequence	
Subtype of:	TransportLinkSequence
Definition:	An ordered collection of cableway links that are characterized by one or more thematic identifiers and/or properties.
Status:	Proposed
Stereotypes:	«featureType»

5.5.2.1.3 CablewayLinkSet

CablewayLinkSet

CablewayLinkSet	
Subtype of:	TransportLinkSet
Definition:	A collection of cableway link sequences and or individual cableway links that has a specific function or significance in a cable transport network.
Status:	Proposed
Stereotypes:	«featureType»

5.5.2.1.4 CablewayNode

CablewayNode	
Subtype of:	TransportNode
Definition:	A point spatial object that is used to represent connectivity between two consecutive cableway links.
Status:	Proposed
Stereotypes:	«featureType»

5.5.2.2 Enumerations and code lists

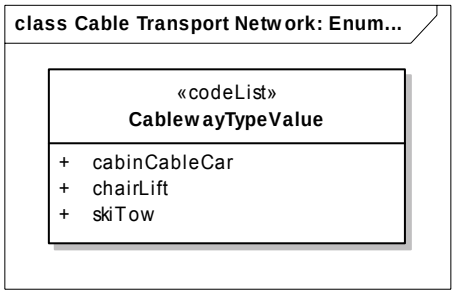


Figure 27 – UML class diagram: Cable Transport Networks Enumerations and code lists

5.5.2.2.1 CablewayTypeValue

CablewayTypeValue	
Definition:	The possible types of cableway transport.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:CablewayTypeValues
Value: cabinCableCar	
Definition:	A cableway transport whose vehicles consist on a suspended cabin to carry groups of people and/or goods inside it from one destination to another.
Value: chairLift	
Definition:	A cableway transport whose vehicles consist on suspended chairs to carry individuals or groups of people from one destination to another via a steel cable or rope which is looped around two points.
Description:	It Is traditionally found on mountains or steep hills but is being used more and more in amusement parks.
Value: skiTow	
Definition:	A cableway transport is a mechanised system for pulling skiers and snowboarders uphill.
Description:	Passengers grab hold of the rope and are pulled along while standing on their skis or snowboards and sliding up the hill. Synonyms: rope tow, handle tow.

5.5.2.3 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.5.2.3.1 TransportLinkSequence

TransportLinkSequence (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.

5.5.2.3.2 TransportLink

TransportLink (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.

5.5.2.3.3 TransportNode

TransportNode (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.

5.5.2.3.4 TransportLinkSet

TransportLinkSet (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or siginificance in a transport network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

5.6 Application schema Water Transport Networks

5.6.1 Description

5.6.1.1 Narrative description

The *Water transport network* schema employs a link and node structure to represent navigable waterways and ports within water bodies (main marine waterways and ships routeing systems - traffic separation schemes - at the sea, and inland waterways defined across rivers and canals) allowing transportation in the form of a linear network. The water transport network reuse the centreline geometry of the *Hydrography* theme's network (hydrographic network) of rivers and canals as the basis for most inland water transport. However, when this is not enough to describe it properly, specific water transport network's centrelines can also be used (waterway links), in combination to the previous ones, in order to complete the network. The water schema also inherits classes from the Common Transport Schema and also creates its own classes to describe properties of the water network such as water traffic flow direction and any restrictions that can apply to whole sections of the network element or subsections that can be described using linear referencing.

The primary aspects modelled for water network elements are:

- Spatial. Geometric (point, line and area (topographic)) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with points (nodes) at the ends of the lines (at junctions, ports etc). Also real objects with a function in a network may be represented in the dataset. Network connectivity within the water network is essential but between elements in the other networks is an optional spatial aspect.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also optional information on when data was entered, modified or deleted in the dataset.

- Thematic. The water schema can be thematically displayed via several of the attributes defined within the specification such as CEMTClass.

5.6.1.2 UML Overview

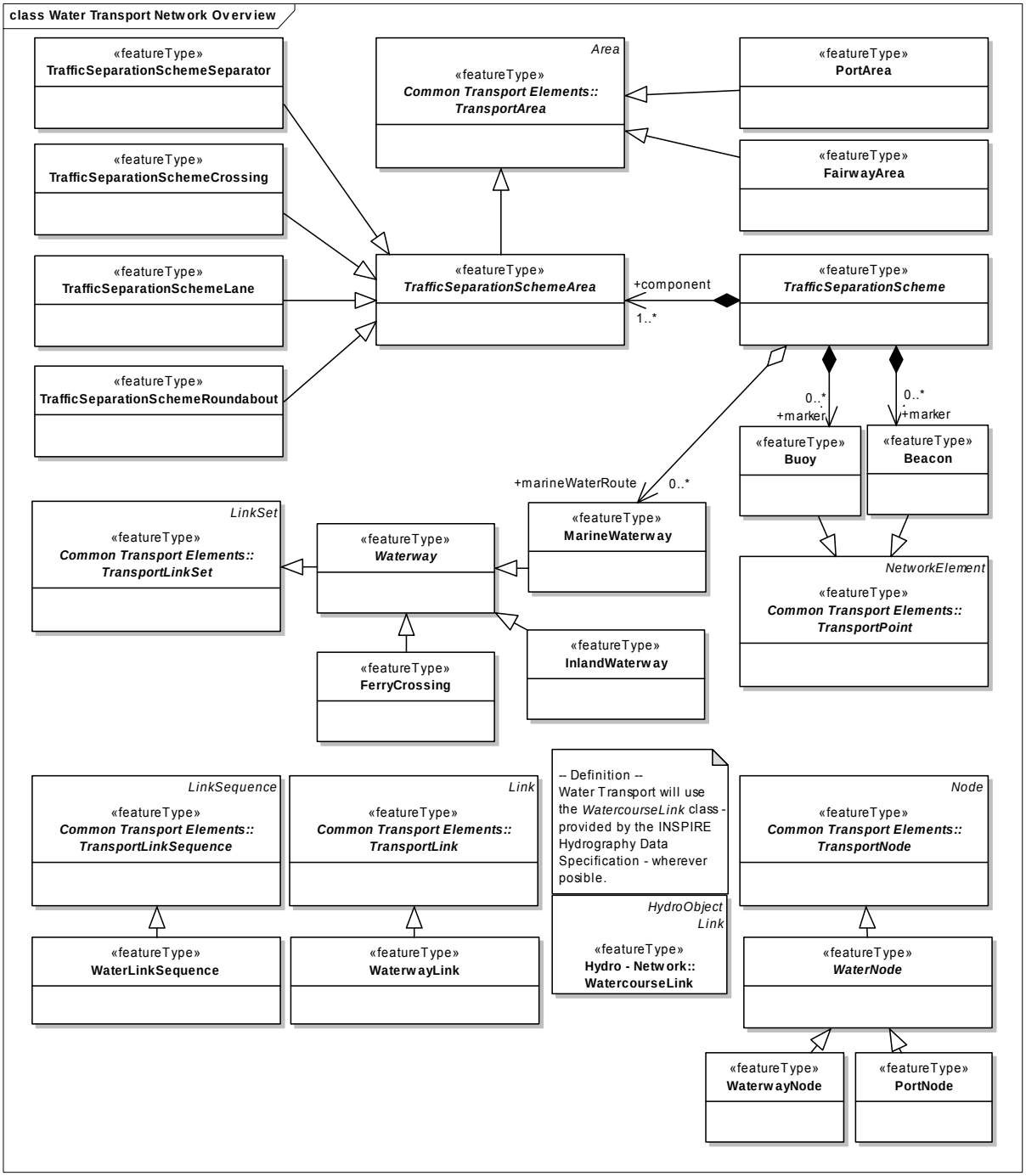


Figure 28 – UML class diagram: Overview of the *Water Transport Networks* application schema

5.6.1.3 Consistency between spatial data sets

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.3) apply to the corresponding specialized elements/classes in the *Water transport networks*.

5.6.1.4 Identifier management

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.4) apply to the corresponding specialized elements/classes in the *Water transport networks*.

5.6.1.5 Modelling of object references

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.5) apply to the corresponding specialized elements/classes in the *Water transport networks*.

In particular the *Water transport networks* theme reuses the existing water network in the *Hydrography* theme for the majority of the inland *Water transport networks* geometry. This is a case of object referencing.

Requirement 12	The Water transport networks shall re-use, where it exists and is practicable, the water network centreline geometry of the Hydrography theme. Therefore, object referencing shall be used to link the water transport course with the existing water network geometry in the Hydrography theme.

5.6.1.6 Geometry representation

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.6) apply to the corresponding specialized elements/classes in the *Water transport networks*.

5.6.1.7 Temporality representation

All attributes describing the lifespan of spatial objects or the phenomena in the real world they describe are inherited from the Common Transport Elements application schema. Refer to section 5.2.1.7 for more information.

5.6.2 Feature catalogue

Table 11 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Water Transport Network
Scope	Water Transport Network
Version number	3.0.1
Version date	2010-04-26
Definition source	INSPIRE data specification Water Transport Network

Table 12 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
Beacon	Water Transport Network	«featureType»	5.6.2.1.1
Buoy	Water Transport Network	«featureType»	5.6.2.1.2
CEMTClass	Water Transport Network	«featureType»	5.6.2.1.3
CEMTClassValue	Water Transport Network	«enumeration»	5.6.2.2.1
ConditionOfWaterFacility	Water Transport Network	«featureType»	5.6.2.1.4
FairwayArea	Water Transport Network	«featureType»	5.6.2.1.5
FerryCrossing	Water Transport Network	«featureType»	5.6.2.1.6

Type	Package	Stereotypes	Section
FerryUse	Water Transport Network	«featureType»	5.6.2.1.7
FerryUseValue	Water Transport Network	«codeList»	5.6.2.2.2
FormOfWaterwayNodeValue	Water Transport Network	«codeList»	5.6.2.2.3
InlandWaterway	Water Transport Network	«featureType»	5.6.2.1.8
MarineWaterway	Water Transport Network	«featureType»	5.6.2.1.9
PortArea	Water Transport Network	«featureType»	5.6.2.1.10
PortNode	Water Transport Network	«featureType»	5.6.2.1.11
RestrictionForWaterVehicles	Water Transport Network	«featureType»	5.6.2.1.12
TrafficSeparationScheme	Water Transport Network	«featureType»	5.6.2.1.13
TrafficSeparationSchemeArea	Water Transport Network	«featureType»	5.6.2.1.14
TrafficSeparationSchemeCrossing	Water Transport Network	«featureType»	5.6.2.1.15
TrafficSeparationSchemeLane	Water Transport Network	«featureType»	5.6.2.1.16
TrafficSeparationSchemeRoundabout	Water Transport Network	«featureType»	5.6.2.1.17
TrafficSeparationSchemeSeparator	Water Transport Network	«featureType»	5.6.2.1.18
WaterLinkSequence	Water Transport Network	«featureType»	5.6.2.1.19
WaterNode	Water Transport Network	«featureType»	5.6.2.1.20
WaterTrafficFlowDirection	Water Transport Network	«featureType»	5.6.2.1.21
Waterway	Water Transport Network	«featureType»	5.6.2.1.22
WaterwayLink	Water Transport Network	«featureType»	5.6.2.1.23
WaterwayNode	Water Transport Network	«featureType»	5.6.2.1.24

5.6.2.1 Spatial object types

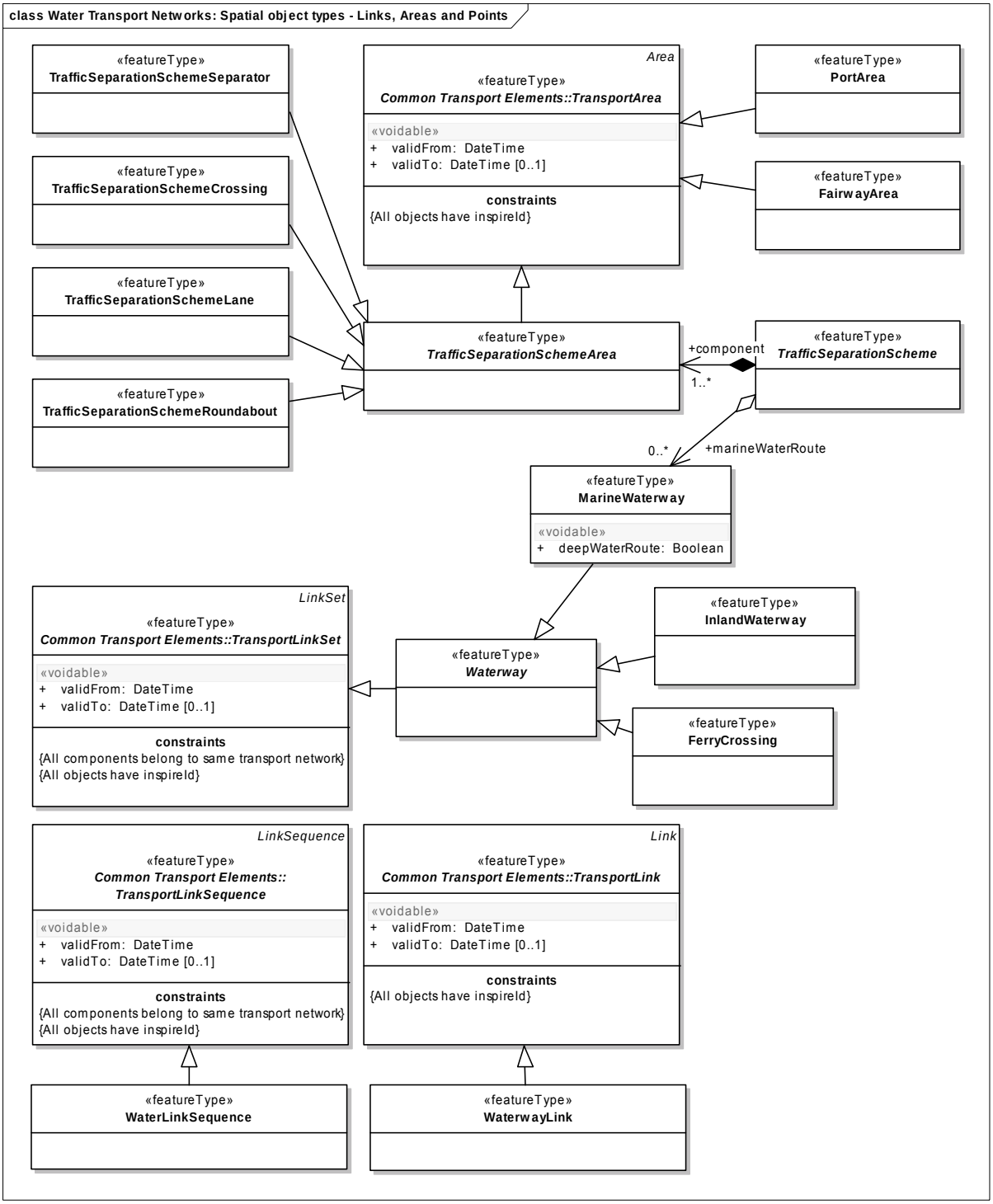


Figure 29 – UML class diagram: Water Transport Networks Spatial object types – Links and Areas

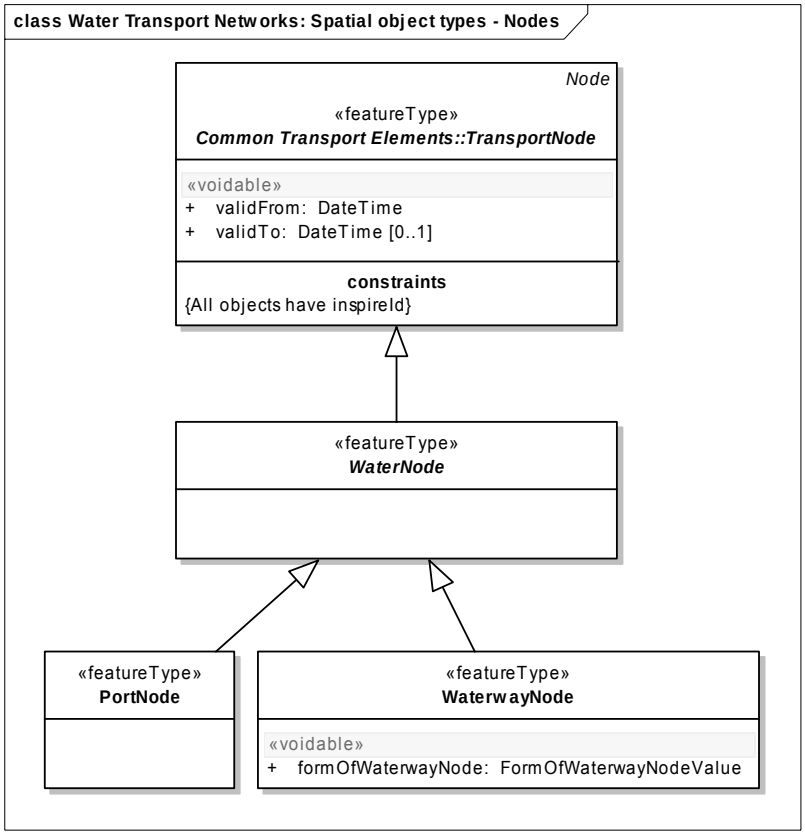


Figure 30 – UML class diagram: Water Transport Networks Spatial object types – Nodes

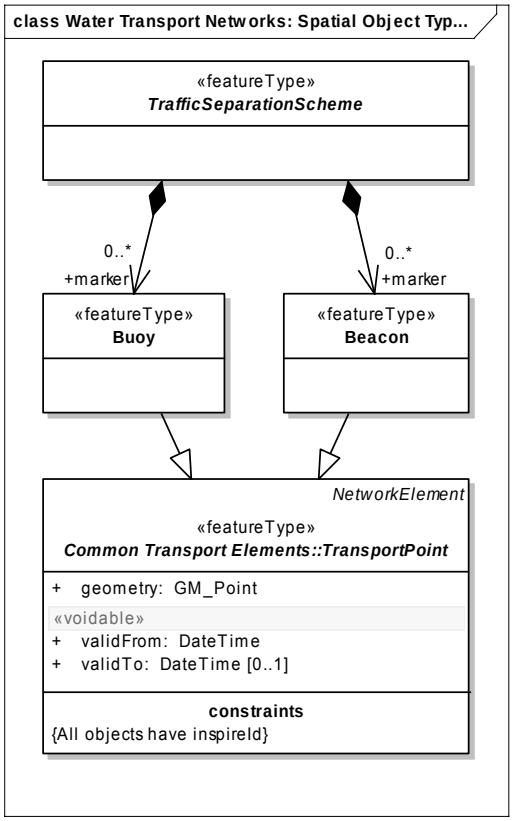


Figure 31 – UML class diagram: Water Transport Networks Spatial object types – Transport Points

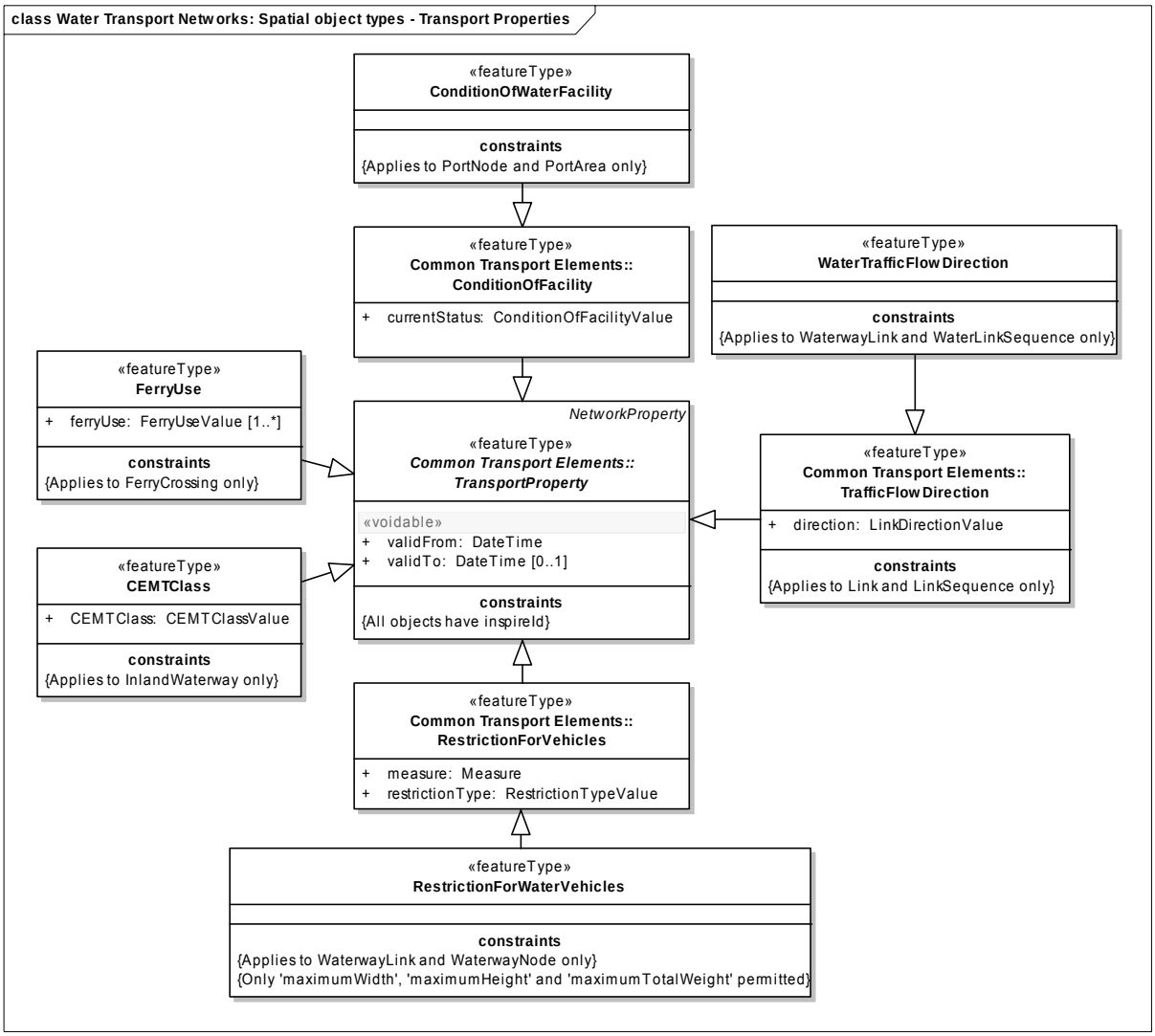


Figure 32 – UML class diagram: Water Transport Networks Spatial object types – Transport Properties

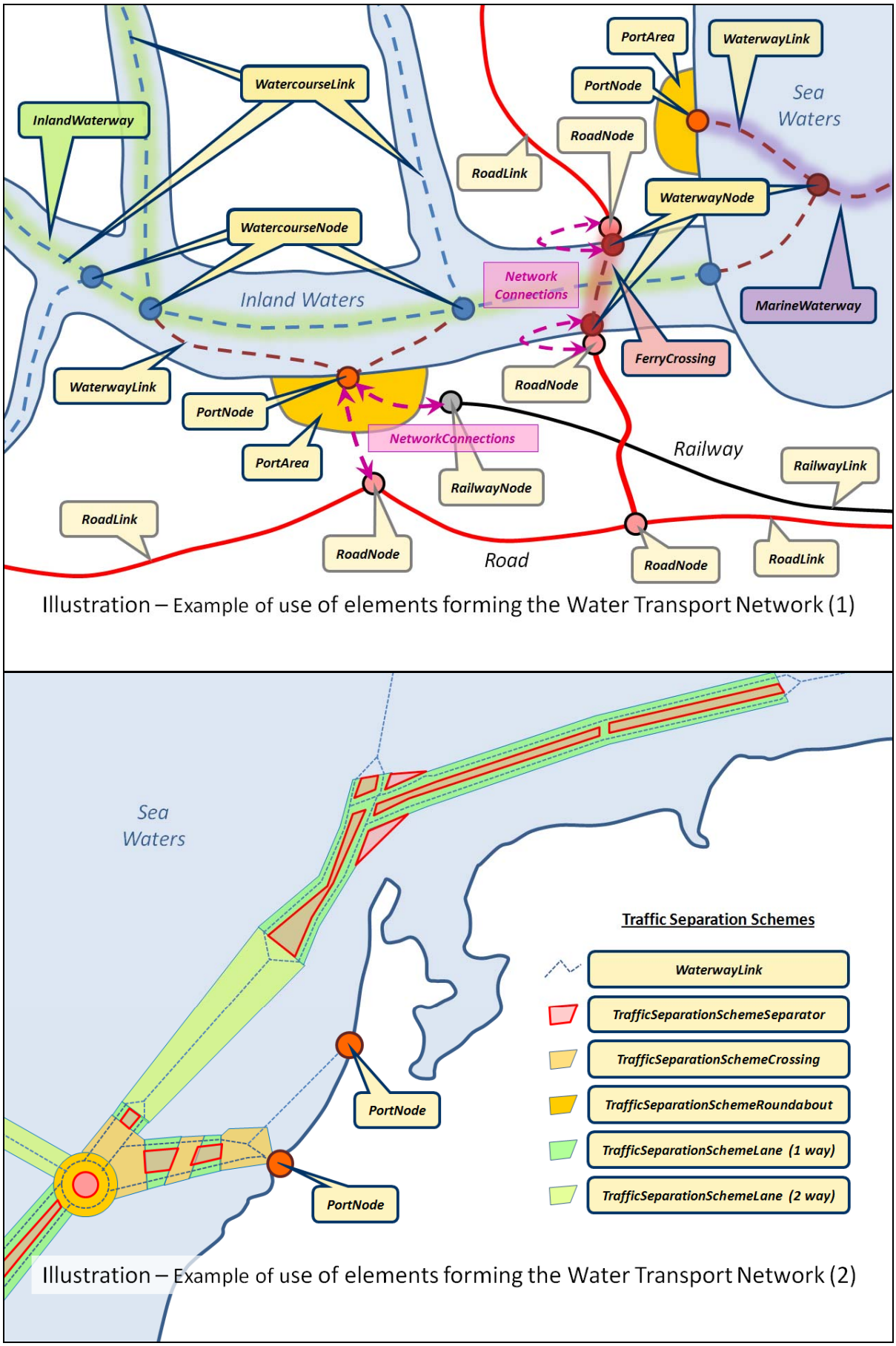


Figure 33 – Overview of the main *Water Transport Networks* objects

5.6.2.1.1 Beacon

Beacon	
Subtype of:	TransportPoint
Definition:	A prominent specially constructed object forming a conspicuous mark as a fixed aid to navigation, or for use in hydrographic survey.
Description:	SOURCE [S-32 - IHO International Hydrographic Dictionary].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.2 Buoy

Buoy	
Subtype of:	TransportPoint
Definition:	A floating object moored to the bottom in a particular (charted) place, as an aid to navigation or for other specific purposes.
Description:	SOURCE [S-32 - IHO International Hydrographic Dictionary] NOTE Navigational buoys may be classified according to: (a) their shape, appearance, or construction, such as barrel, can, cask, conical, cylindrical, dan, keg, nun, pillar, spar, spherical, or topmark buoy; (b) their colour, such as black, chequered, green, red buoy; (c) their location, such as bifurcation, fairway, junction, mid-channel, middle-ground, or turning buoy; (d) the various kinds of hazards or dangers to navigation which they mark, such as bar, isolated danger, fish trap, obstruction, spoil ground, telegraph or wreck buoy; (e) their particular purpose or use, such as anchor, anchorage, compass adjustment, dredging, farewell (or landfall), marker, quarantine, station (or watch), or warping buoy. [S-32 - IHO International Hydrographic Dictionary].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.3 CEMTClass

CEMTClass	
Subtype of:	TransportProperty
Definition:	Classification of an inland waterway according to CEMT (European Conference of Ministers of Transport).
Status:	Proposed
Stereotypes:	«featureType»
Attribute: CEMTClass	
Value type:	CEMTClassValue
Definition:	Value indicating the classification of an Inland waterway according to CEMT (European Conference of Ministers of Transport).
Multiplicity:	1
Constraint: Applies to InlandWaterway only	
Natural language:	This property can only be associated with a spatial object that is part of a water transport network.
OCL:	inv: networkRef.element.oclIsKindOf(InlandWaterway)

5.6.2.1.4 ConditionOfWaterFacility

ConditionOfWaterFacility	
Subtype of:	ConditionOfFacility
Definition:	State of a water transport network element with regards to its completion and use.
Status:	Proposed
Stereotypes:	«featureType»
Constraint: Applies to PortNode and PortArea only	

ConditionOfWaterFacility	
Natural language:	This property can only be associated with a spatial object that is part of a water transport network.
OCL:	inv: networkRef.element.oclIsKindOf(PortArea) or networkRef.element.oclIsKindOf(PortNode)

5.6.2.1.5 FairwayArea

FairwayArea	
Subtype of:	TransportArea
Definition:	The main travelled part of a waterway.
Description:	SOURCE [International Hydrographic Dictionary]. NOTE That part of a river, harbour and so on, where the main navigable channel for vessels of larger size lies. It is also the usual course followed by vessels entering or leaving harbours, called 'ship channel' [IHO Hidrographic Registry].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.6 FerryCrossing

FerryCrossing	
Subtype of:	Waterway
Definition:	A special waterway aimed at supporting the transport of passengers, vehicles or other cargo/freight across a water body, and which is normally used as a connection linking two or more nodes of a land based transport network.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.7 FerryUse

FerryUse	
Subtype of:	TransportProperty
Definition:	The type of transport carried out by a ferry crossing.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: ferryUse	
Value type:	FerryUseValue
Definition:	Value indicating the type of transport carried out by a ferry crossing.
Multiplicity:	1..*
Constraint: Applies to FerryCrossing only	
Natural language:	This property can only be associated with a spatial object that is part of a water transport network.
OCL:	inv: networkRef.element.oclIsKindOf(FerryCrossing)

5.6.2.1.8 InlandWaterway

InlandWaterway	
Subtype of:	Waterway
Definition:	Waterway which is defined at inland continental waters.
Description:	EXAMPLE The inland waterways classified by the CEMT (European Conference of Ministers of Transport).
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.9 MarineWaterway

MarineWaterway	
Subtype of:	Waterway
Definition:	Waterway which is defined at sea waters.

MarineWaterway	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: deepWaterRoute	
Value type:	Boolean
Definition:	Attribute which indicates if the maritime waterway is a deep water route. DEFINITION Deep water route: A route in a designated area within defined limits which has been accurately surveyed for clearance of sea bottom and submerged obstacles to a minimum indicated depth of water [S-32 - IHO International Hydrographic Dictionary].
Multiplicity:	1
Stereotypes:	«voidable»

5.6.2.1.10 PortArea

PortArea	
Subtype of:	TransportArea
Definition:	An area spatial object which is used to represent the physical limits of all the facilities which constitute the terrestrial zone of a sea or inland port.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.11 PortNode

PortNode	
Subtype of:	WaterNode
Definition:	A point spatial object which is used to represent a sea or inland port in a simplified way, aproximately located at the bank of the waterbody where the port is placed.
Description:	NOTE It is used to connect the port with the rest of the water transport network, by means of the different waterway links which arrive to / depart from it.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.12 RestrictionForWaterVehicles

RestrictionForWaterVehicles	
Subtype of:	RestrictionForVehicles
Definition:	Restriction on vehicles on a water transport element.
Status:	Proposed
Stereotypes:	«featureType»
Constraint: Applies to WaterwayLink and WaterwayNode only	
Natural language:	This property can only be associated with a spatial object that is part of a water transport network.
OCL:	inv: networkRef.element.oclIsKindOf(WaterwayLink) or networkRef.element.oclIsKindOf(WaterwayNode)

5.6.2.1.13 TrafficSeparationScheme

TrafficSeparationScheme (abstract)	
Definition:	A scheme which aims at reducing the risk of collision in congested and/or converging areas by separating traffic moving in opposite, or nearly opposite, directions.
Description:	SOURCE [S-32 - IHO International Hydrographic Dictionary] NOTE 1 Acronym: TSS. NOTE 2 TSSs constitute main components of maritime routing measures for hydrographic transport.

TrafficSeparationScheme (abstract)	
Status:	Proposed
Stereotypes:	«featureType»
Association role: component	
Value type:	TrafficSeparationSchemeArea
Definition:	A component of a traffic separation scheme.
Multiplicity:	1..*
Association role: marker	
Value type:	Buoy
Definition:	A marker forming part of a traffic separation scheme.
Multiplicity:	0..*
Association role: marineWaterRoute	
Value type:	MarineWaterway
Definition:	The collection of marine waterways associated with a traffic separation scheme.
Multiplicity:	0..*
Association role: marker	
Value type:	Beacon
Definition:	A marker forming part of a traffic separation scheme.
Multiplicity:	0..*

5.6.2.1.14 TrafficSeparationSchemeArea

TrafficSeparationSchemeArea (abstract)	
Subtype of:	TransportArea
Definition:	An area spatial object forming part of a traffic separation scheme.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.15 TrafficSeparationSchemeCrossing

TrafficSeparationSchemeCrossing	
Subtype of:	TrafficSeparationSchemeArea
Definition:	A defined area where traffic lanes cross.
Description:	SOURCE [IHO Hydrographic Registry].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.16 TrafficSeparationSchemeLane

TrafficSeparationSchemeLane	
Subtype of:	TrafficSeparationSchemeArea
Definition:	An area within defined limits in which one-way traffic flow is established.
Description:	SOURCE [IMO Ships Routeing, 6th Edition], [IHO Hydrographic Registry].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.17 TrafficSeparationSchemeRoundabout

TrafficSeparationSchemeRoundabout	
Subtype of:	TrafficSeparationSchemeArea
Definition:	A traffic separation scheme in which traffic moves in a counter-clockwise direction around a specified point or zone.
Description:	SOURCE [IHO Hydrographic Registry].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.18 TrafficSeparationSchemeSeparator

TrafficSeparationSchemeSeparator

TrafficSeparationSchemeSeparator	
Subtype of:	TrafficSeparationSchemeArea
Definition:	A zone separating the lanes in which ships are proceeding in opposite or nearly opposite directions; or separating traffic lanes designated for particular classes of ships proceeding in the same direction.
Description:	SOURCE [IHO Hydrographic Registry].
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.19 WaterLinkSequence

WaterLinkSequence	
Subtype of:	TransportLinkSequence
Definition:	A linear spatial object, composed of an ordered collection of waterway and/or watercourse links (as necessary), which represents a continuous path in the water network without any branches.
Description:	NOTE The element has a defined beginning and end and every position on the water link sequence is identifiable with one single parameter such as length. It describes a element of the water network, which is a navigable path within a water body (oceans, seas, rivers, lakes, channels or canals) and could be characterized by one or more thematical identifiers and/or properties.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.20 WaterNode

WaterNode (abstract)	
Subtype of:	TransportNode
Definition:	A point spatial object which is used to represent the connectivity between two different waterway links, or between a waterway link and a watercourse link, in the water transport network.
Description:	NOTE It is also used to represent a significant feature in the network, such as a port.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.21 WaterTrafficFlowDirection

WaterTrafficFlowDirection	
Subtype of:	TrafficFlowDirection
Definition:	Indicates the direction of the flow of water transport traffic in relation to the direction of the water transport link vector.
Status:	Proposed
Stereotypes:	«featureType»
Constraint: Applies to WaterwayLink and WaterLinkSequence only	
Natural language:	This property can only be associated with a spatial object that is part of a water transport network.
OCL:	inv: networkRef.element.oclIsKindOf(WaterLinkSequence) or networkRef.element.oclIsKindOf(WaterwayLink)

5.6.2.1.22 Waterway

Waterway (abstract)	
Subtype of:	TransportLinkSet
Definition:	A collection of water link sequences and or individual waterway and/or watercourse links (as necessary) that are characterized by one or more thematical identifiers and/or properties, which perform a navigable route within a water body (oceans, seas, rivers, lakes, channels or canals).
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.23 WaterwayLink

WaterwayLink	
Subtype of:	TransportLink
Definition:	A linear spatial object that describes the geometry or connectivity of the water transport network between two consecutive waterway or watercourse nodes. It represents a linear section across a body of water which is used for shipping.
Description:	NOTE Water Transport Networks will use the *WatercourseLink* class - provided by the INSPIRE Hydrography Data Specification - wherever possible.
Status:	Proposed
Stereotypes:	«featureType»

5.6.2.1.24 WaterwayNode

WaterwayNode	
Subtype of:	WaterNode
Definition:	A point spatial object which is used to represent the connectivity between two different waterway links, or between a waterway link and a watercourse link, in the water transport network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: formOfWaterwayNode	
Value type:	FormOfWaterwayNodeValue
Definition:	Description of the function of a waterway node in the water transport network.
Multiplicity:	1
Stereotypes:	«voidable»

5.6.2.2 Enumerations and code lists

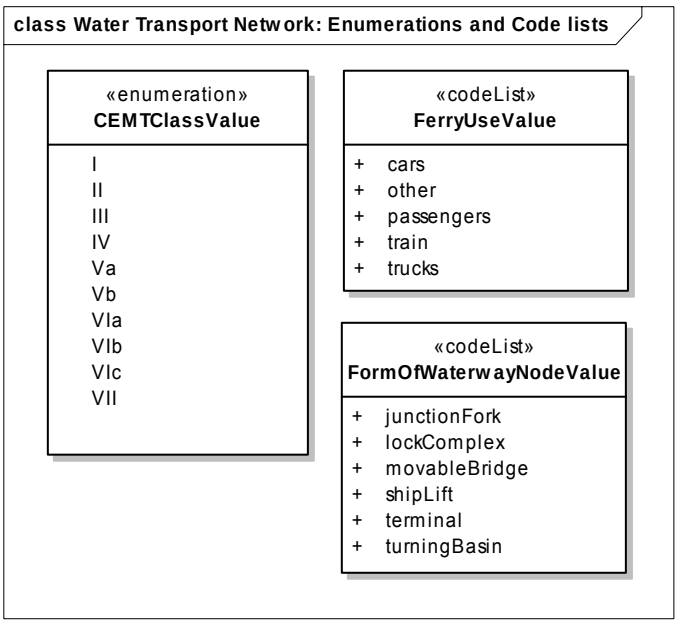


Figure 34 – UML class diagram: Water Transport Networks Enumerations and code lists

5.6.2.2.1 CEMTClassValue

CEMTClassValue	
Definition:	Inland waterway classification according to CEMT (European Conference of Ministers of Transport) Resolution No.92/2.
Status:	Proposed

CEMTClassValue	
Stereotypes:	«enumeration»
Value: I	
Definition:	Inland waterway belonging to CEMT-class I, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: II	
Definition:	Inland waterway belonging to CEMT-class II, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: III	
Definition:	Inland waterway belonging to CEMT-class III, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: IV	
Definition:	Inland waterway belonging to CEMT-class IV, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: Va	
Definition:	Inland waterway belonging to CEMT-class Va, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: Vb	
Definition:	Inland waterway belonging to CEMT-class Vb, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: VIa	
Definition:	Inland waterway belonging to CEMT-class VIa, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: VIb	
Definition:	Inland waterway belonging to CEMT-class VIb, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: VIc	
Definition:	Inland waterway belonging to CEMT-class VIc, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.
Value: VII	
Definition:	Inland waterway belonging to CEMT-class VII, defined by the European Conference of Ministers of Transport, Resolution No.92/2 - Table 1.

5.6.2.2.2 FerryUseValue

FerryUseValue	
Definition:	Types of transport carried out by a ferry.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:FerryUseValue
Value: cars	
Definition:	Ferry carries cars.
Value: other	
Definition:	Ferry carries others forms of transport than passengers, cars, trucks or trains.
Value: passengers	
Definition:	Ferry carries passengers.
Value: train	
Definition:	Ferry carries trains.
Value: trucks	
Definition:	Ferry carries trucks.

5.6.2.2.3 FormOfWaterwayNodeValue

FormOfWaterwayNodeValue

FormOfWaterwayNodeValue	
Definition:	Function of a WaterwayNode in the water transport network.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:FormOfWaterwayNodeValue
Value: junctionFork	
Definition:	Infrastructure elements where the one vessel traffic flow crosses another vessel traffic flow or points where vessel traffic flows divide or come together.
Description:	SOURCE [COMPRIS].
Value: lockComplex	
Definition:	Lock or group of locks, intended for raising and lowering boats between stretches of water of different levels on river and canal waterways.
Value: movableBridge	
Definition:	Bridge that can be raised or turned to allow the passage of ships.
Value: shipLift	
Definition:	A machine for transporting boats between water bodies at two different elevations, which is used as an alternative to the canal locks..
Description:	NOTE Synonyms: boat lift, lift lock.
Value: terminal	
Definition:	The location where goods are transhipped.
Description:	SOURCE [COMPRIS]. NOTE A terminal forms a link between the various transport modes, of which shipping is one. A terminal therefore has waterside loading and unloading places [COMPRIS].
Value: turningBasin	
Definition:	A place where a canal or narrow waterway is widened to allow boats to turn around.

5.6.2.3 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.6.2.3.1 TransportLinkSequence

TransportLinkSequence (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.

5.6.2.3.2 RestrictionForVehicles

RestrictionForVehicles	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Restriction on vehicles on a transport element.

5.6.2.3.3 TrafficFlowDirection

TrafficFlowDirection

TrafficFlowDirection	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Indicates the direction of the flow of traffic in relation to the direction of the transport link vector.

5.6.2.3.4 TransportLink

TransportLink (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.

5.6.2.3.5 ConditionOfFacility

ConditionOfFacility	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	State of a transport network element with regards to its completion and use.

5.6.2.3.6 TransportArea

TransportArea (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Surface that represents the spatial extent of an element of a transport network.

5.6.2.3.7 TransportNode

TransportNode (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.

5.6.2.3.8 TransportProperty

TransportProperty (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.

5.6.2.3.9 TransportLinkSet

TransportLinkSet (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or siginificance in a transport network.
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

5.6.2.3.10 TransportPoint

TransportPoint (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object - which is not a node - that represents the position of an element of a transport network.

5.7 Application schema Air Transport Networks

5.7.1 Description

5.7.1.1 Narrative description

The Air Transport Networks application schema (Air Schema) employs a link and node structure to represent the Air routes used for transportation in the form of a linear network. The Air Schema inherits classes from the Common Transport Schema and also creates its own classes to describe properties of the air network such as air route type and restrictions that can apply to whole sections of the network element or subsections that can be described using linear referencing.

The primary aspects modelled for air network elements are:

- Spatial. Geometric (point, line and area (topographic)) representation of various elements that are parts of a network. Typically, the network is handled as a network of connected linear elements (links) with points (nodes) at the air route junctions (usually over the position of significant points, such as navigation aids and designated points) or at the ends of the lines (at aerodromes – airports or heliports). Also real objects with a function in a network may be represented in the dataset. Network connectivity within the roads and rail networks (where this exists) is essential but between elements in the other networks is an optional spatial aspect.

- Temporal. All elements in a network may have a temporal validity (i.e. description of when the network element exists in the real world) and also optional information on when data was entered, modified or deleted in the dataset.

- Thematic. The air schema can be thematically displayed via several of the attributes defined within the specification such as altitude.

Please Note: The “ControlTower” feature has been inserted as a Placeholder in this version of the Transport Networks data specification (v3.0.1) for future population by the INSPIRE "Buildings" theme when the "[AppSchemaName]" should be updated. This affects the relevant entry in Table 14 and and in section 5.7.2.1.13.

5.7.1.2 UML Overview

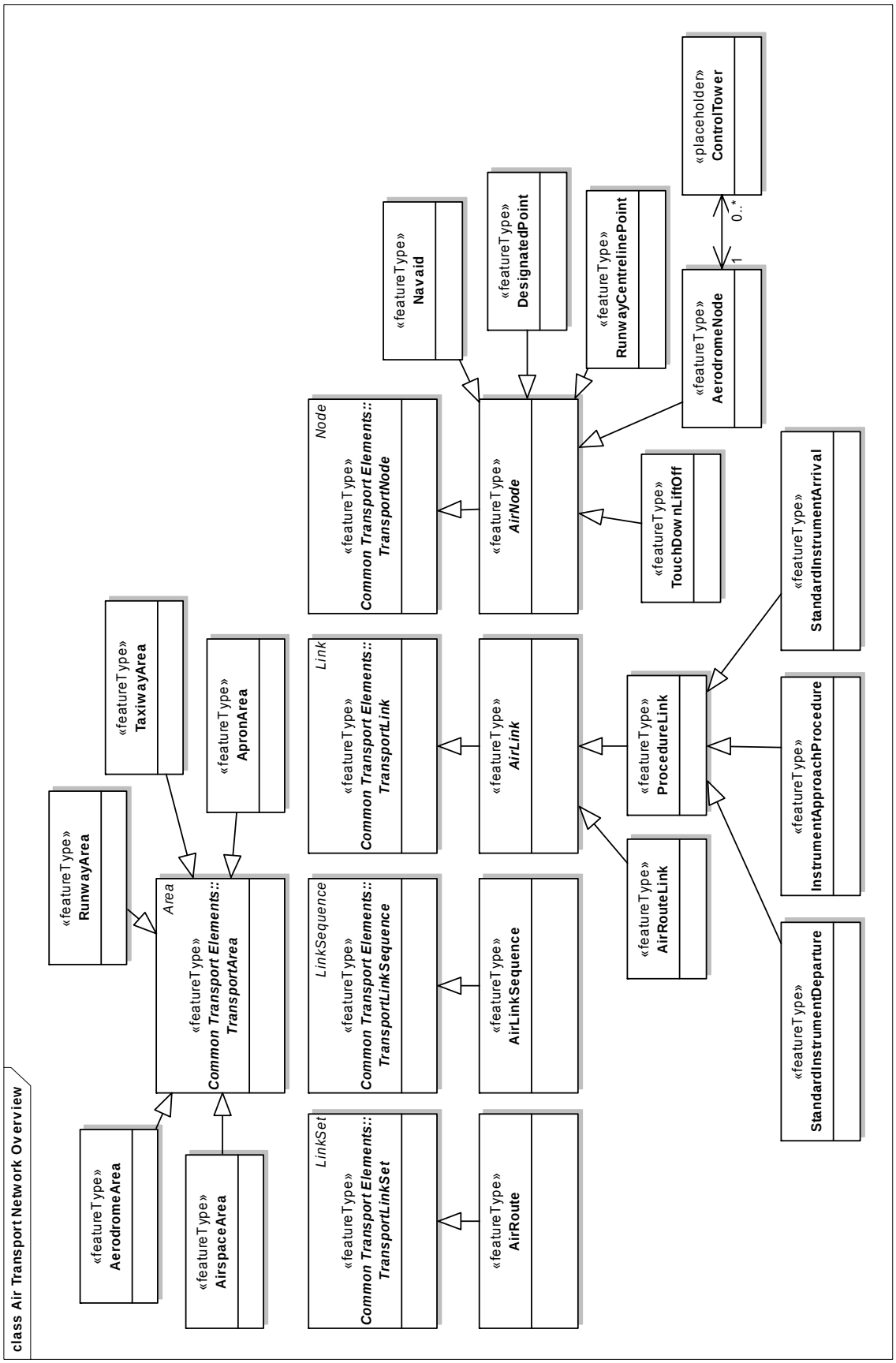


Figure 35 – UML class diagram: Overview of the *Air Transport Networks* application schema

5.7.1.3 Consistency between spatial data sets

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.3) apply to the corresponding specialized elements/classes in the *Air transport networks*.

5.7.1.4 Identifier management

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.4) apply to the corresponding specialized elements/classes in the *Air transport networks*.

5.7.1.5 Modelling of object references

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.5) apply to the corresponding specialized elements/classes in the *Air transport networks*.

5.7.1.6 Geometry representation

All requirements and recommendations on transport networks, defined in the Common Transport Elements application schema (see section 5.2.1.6) apply to the corresponding specialized elements/classes in the *Air transport networks*.

5.7.1.7 Temporality representation

All attributes describing the lifespan of spatial objects or the phenomena in the real world they describe are inherited from the Common Transport Elements application schema. Refer to section 5.2.1.7 for more information.

5.7.2 Feature catalogue

Table 13 – Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Air Transport Network
Scope	Air Transport Network
Version number	3.0.1
Version date	2010-04-26
Definition source	INSPIRE data specification Air Transport Network

Table 14 – Types defined in the feature catalogue

Type	Package	Stereotypes	Section
AerodromeArea	Air Transport Network	«featureType»	5.7.2.1.1
AerodromeCategory	Air Transport Network	«featureType»	5.7.2.1.2
AerodromeCategoryValue	Air Transport Network	«codeList»	5.7.2.2.1
AerodromeNode	Air Transport Network	«featureType»	5.7.2.1.3
AerodromeType	Air Transport Network	«featureType»	5.7.2.1.4
AerodromeTypeValue	Air Transport Network	«codeList»	5.7.2.2.2
AirLink	Air Transport Network	«featureType»	5.7.2.1.5
AirLinkSequence	Air Transport Network	«featureType»	5.7.2.1.6
AirNode	Air Transport Network	«featureType»	5.7.2.1.7

Type	Package	Stereotypes	Section
AirRoute	Air Transport Network	«featureType»	5.7.2.1.8
AirRouteLink	Air Transport Network	«featureType»	5.7.2.1.9
AirRouteLinkClassValue	Air Transport Network	«codeList»	5.7.2.2.3
AirRouteTypeValue	Air Transport Network	«codeList»	5.7.2.2.4
AirspaceArea	Air Transport Network	«featureType»	5.7.2.1.10
AirspaceAreaTypeValue	Air Transport Network	«codeList»	5.7.2.2.5
AirUseRestrictionValue	Air Transport Network	«codeList»	5.7.2.2.6
ApronArea	Air Transport Network	«featureType»	5.7.2.1.11
ConditionOfAirFacility	Air Transport Network	«featureType»	5.7.2.1.12
DesignatedPoint	Air Transport Network	«featureType»	5.7.2.1.13
ElementLength	Air Transport Network	«featureType»	5.7.2.1.14
ElementWidth	Air Transport Network	«featureType»	5.7.2.1.15
FieldElevation	Air Transport Network	«featureType»	5.7.2.1.16
InstrumentApproachProcedure	Air Transport Network	«featureType»	5.7.2.1.17
LowerAltitudeLimit	Air Transport Network	«featureType»	5.7.2.1.18
Navaid	Air Transport Network	«featureType»	5.7.2.1.19
NavaidTypeValue	Air Transport Network	«codeList»	5.7.2.2.7
PointRoleValue	Air Transport Network	«codeList»	5.7.2.2.8
ProcedureLink	Air Transport Network	«featureType»	5.7.2.1.20
RunwayArea	Air Transport Network	«featureType»	5.7.2.1.21
RunwayCentrelinePoint	Air Transport Network	«featureType»	5.7.2.1.22
RunwayTypeValue	Air Transport Network	«codeList»	5.7.2.2.9
StandardInstrumentArrival	Air Transport Network	«featureType»	5.7.2.1.23
StandardInstrumentDeparture	Air Transport Network	«featureType»	5.7.2.1.24
SurfaceComposition	Air Transport Network	«featureType»	5.7.2.1.25
SurfaceCompositionValue	Air Transport Network	«codeList»	5.7.2.2.10
TaxiwayArea	Air Transport Network	«featureType»	5.7.2.1.26
TouchDownLiftOff	Air Transport Network	«featureType»	5.7.2.1.27
UpperAltitudeLimit	Air Transport Network	«featureType»	5.7.2.1.28
UseRestriction	Air Transport Network	«featureType»	5.7.2.1.29
ControlTower	Buildings	«placeholder,featureType»	5.7.2.3.1

5.7.2.1 Spatial object types

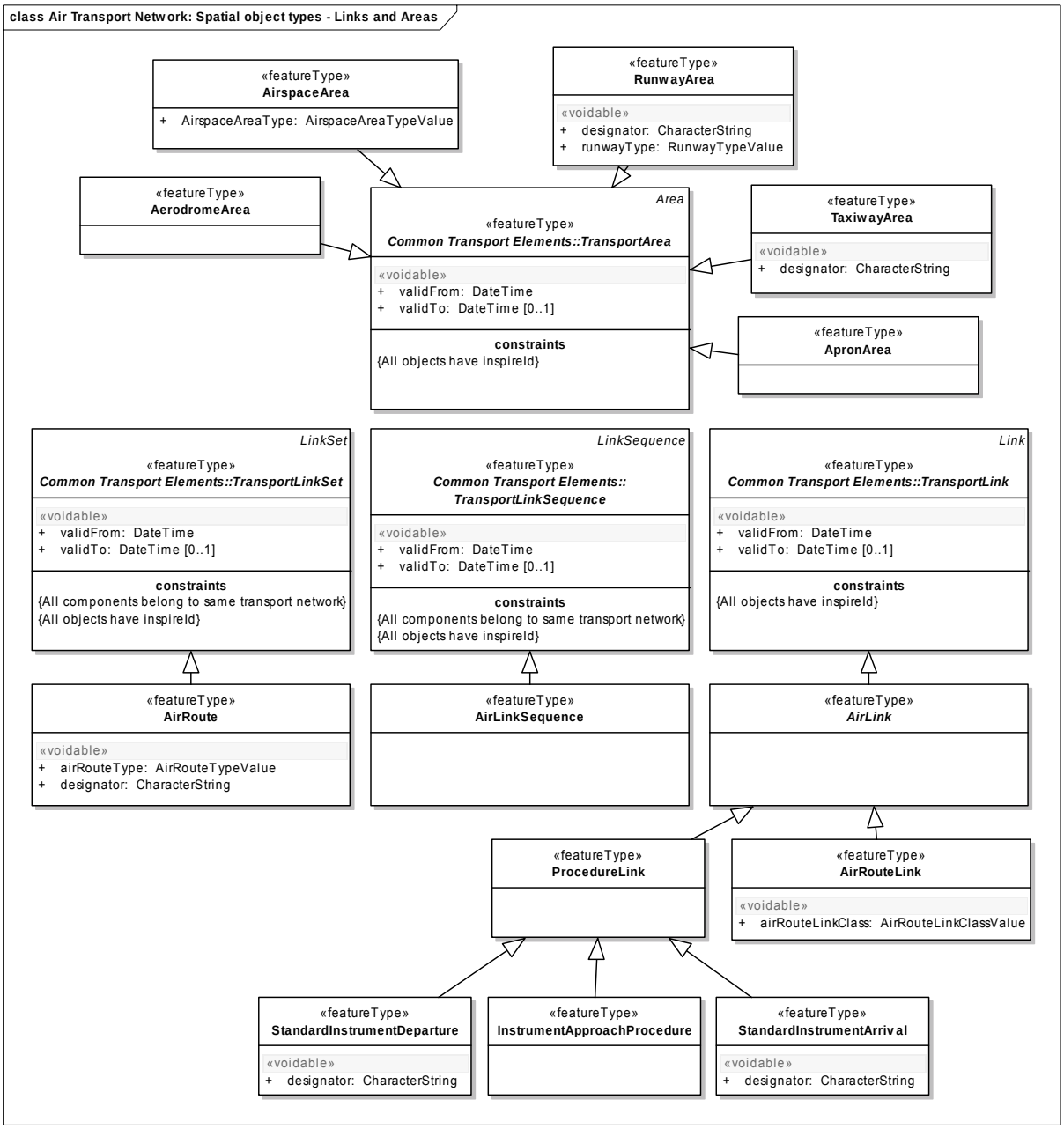


Figure 36 – UML class diagram: Air Transport Networks Spatial object types – Links and Areas

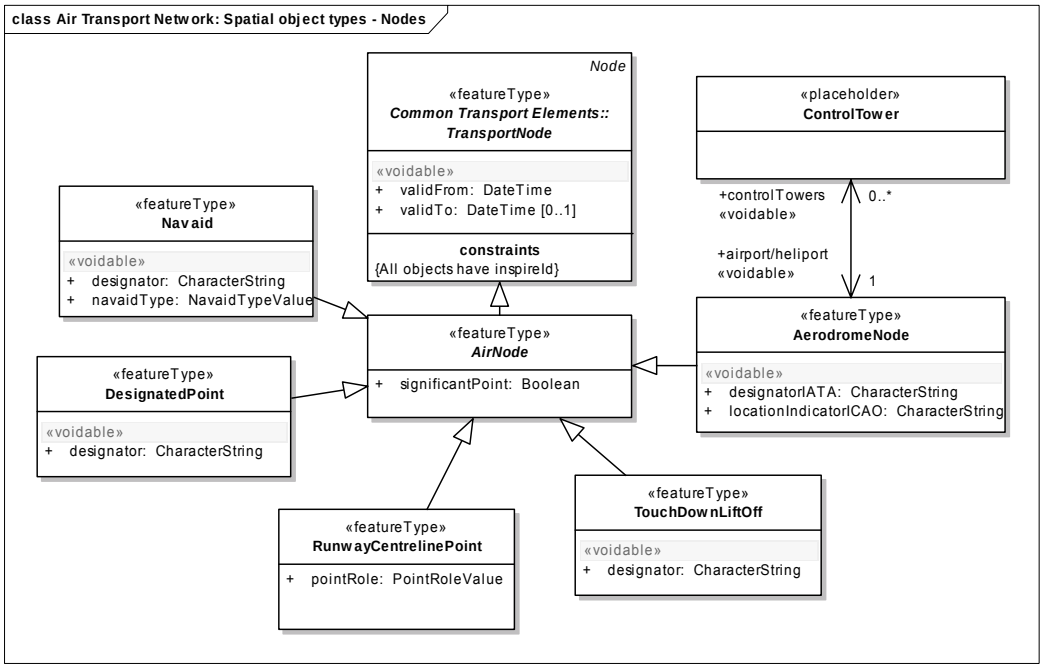


Figure 37 – UML class diagram: Air Transport Networks Spatial object types - Nodes

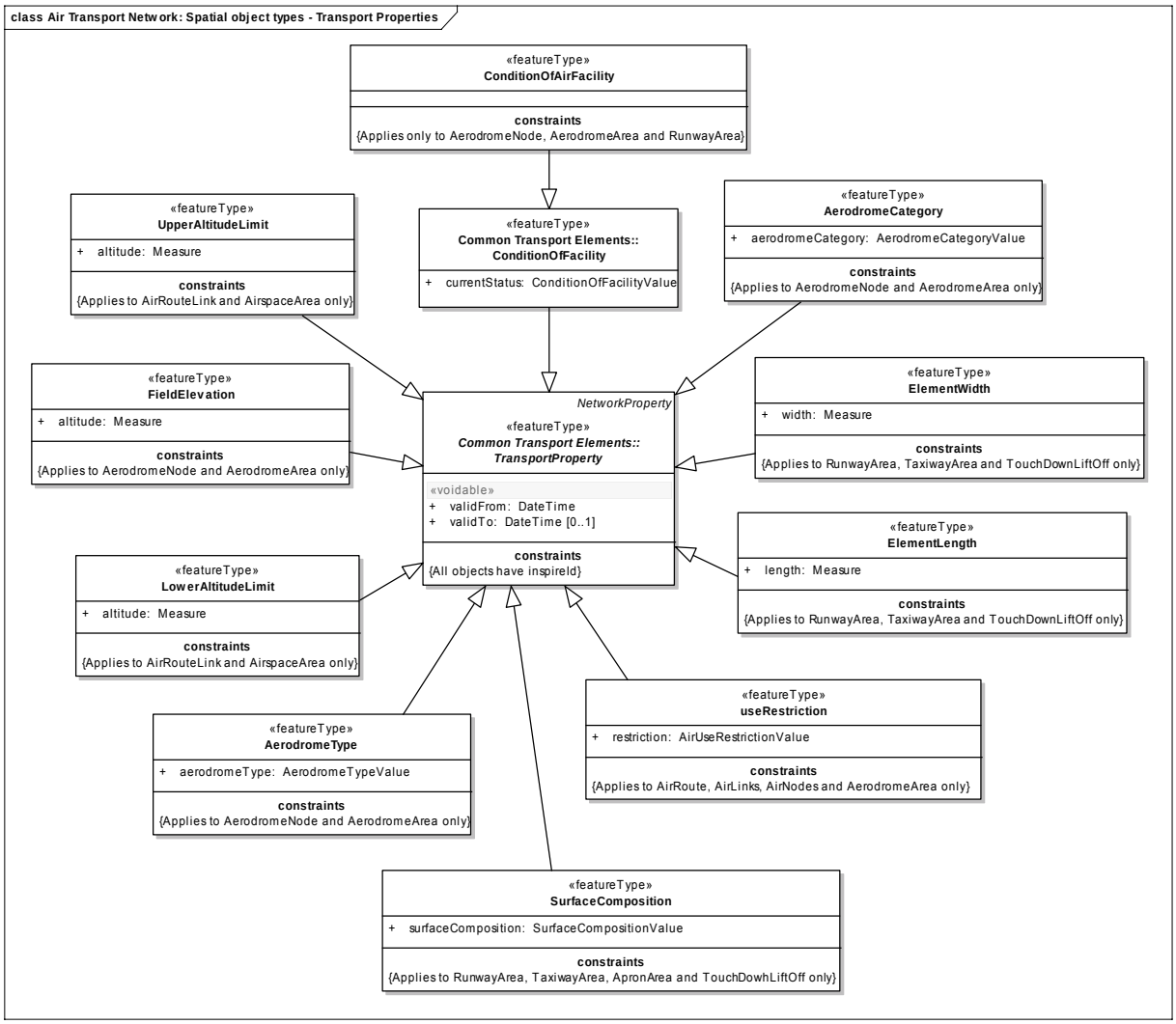


Figure 38 – UML class diagram: Air Transport Networks Spatial object types – Transport Properties

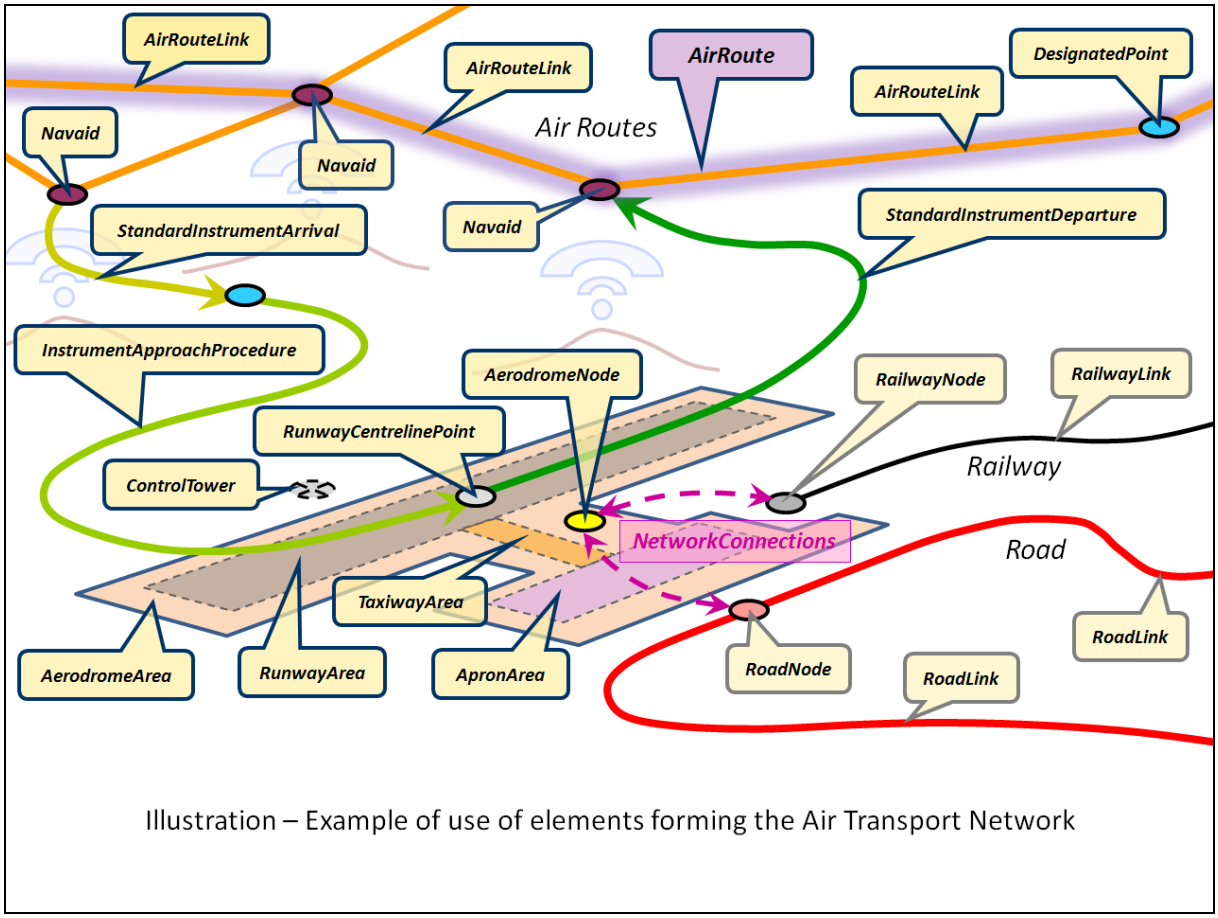


Figure 39 – Overview of the main *Air Transport Networks* objects

5.7.2.1.1 AerodromeArea

AerodromeArea	
Subtype of:	TransportArea
Definition:	A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft and/or helicopters.
Description:	SOURCE [AIXM5.0]. NOTE An area spatial object which is used to represent the physical limits of all the facilities which form part of an inland aerodrome.
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.2 AerodromeCategory

AerodromeCategory	
Subtype of:	TransportProperty
Definition:	Aerodrome category concerning the scope and importance of the air traffic services offered from and to it.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: aerodromeCategory	
Value type:	AerodromeCategoryValue
Definition:	Value which indicates the category of an aerodrome.
Multiplicity:	1

AerodromeCategory	
Constraint: Applies to AerodromeNode and AerodromeArea only	
Natural language:	This property can only be associated with a spatial object that is an Aerodrome Node or an Aerodrome Area.
OCL:	inv: networkRef.element.oclIsKindOf(AerodromeNode) or networkRef.element.oclIsKindOf(AerodromeArea)

5.7.2.1.3 AerodromeNode

AerodromeNode	
Subtype of:	AirNode
Definition:	Node located at the aerodrome reference point of an airport/heliport, which is used to represent it in a simplified way. DEFINITION Aerodrome Reference Point (ARP): The designated geographical location of an aerodrome, located near the initial or planned geometric centre of the aerodrome and normally remaining where originally established [AIXM3.3]. DEFINITION Airport/heliport: A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft/helicopters [AIXM5.0].
Description:	SOURCE [AIXM5.0].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designatorIATA	
Value type:	CharacterString
Definition:	The three letter IATA designator of the aerodrome (airport/heliport).
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: locationIndicatorICAO	
Value type:	CharacterString
Definition:	The four letter ICAO location indicator of the aerodrome (airport/heliport), as listed in ICAO DOC 7910.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»
Association role: controlTowers	
Value type:	ControlTower
Definition:	The set of control towers belonging to an aerodrome (airport/heliport).
Multiplicity:	0..*
Stereotypes:	«voidable»

5.7.2.1.4 AerodromeType

AerodromeType	
Subtype of:	TransportProperty
Definition:	A code specifying the type of aerodrome.
Description:	SOURCE [AIXM5.0]. EXAMPLE Aerodrome only, combined aerodrome/heliport or simple landing site.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: aerodromeType	
Value type:	AerodromeTypeValue
Definition:	The type of aerodrome.
Multiplicity:	1
Constraint: Applies to AerodromeNode and AerodromeArea only	

AerodromeType	
Natural language:	This property can only be associated with a spatial object that is an Aerodrome Node or Aerodrome Area.
OCL:	inv: networkRef.element.oclIsKindOf(AerodromeNode) or networkRef.element.oclIsKindOf(AerodromeArea)

5.7.2.1.5 AirLink

AirLink (abstract)	
Subtype of:	TransportLink
Definition:	A linear spatial object that describes the geometry and connectivity of the air network between two points in the network.
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.6 AirLinkSequence

AirLinkSequence	
Subtype of:	TransportLinkSequence
Definition:	A linear spatial object, composed of an ordered collection of air links, which represents a continuous path in the air network without any branches.
Description:	NOTE 1 The element has a defined beginning and end and every position on the air link sequence is identifiable with one single parameter such as length. It describes an element of the air network, which could be characterized by one or more thematical identifiers and/or properties. NOTE 2 This collection of air links is equivalent to RoutePortion feature in AIXM5.0. RoutePortion: A group of two or more consecutive segments of the same route, which have the usage and/or the same flight restrictions [AIXM5.0].
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.7 AirNode

AirNode (abstract)	
Subtype of:	TransportNode
Definition:	A node which occurs in a air network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: significantPoint	
Value type:	Boolean
Definition:	Attribute which indicates whether the air node is or is not a significant point. DEFINITION Significant point: A specified geographical location used to define an ATS route, the flight path of an aircraft or for other navigation/ATS purposes [AIXM5.0].
Description:	NOTE Significant Points are specific air nodes which normally define air routes.
Multiplicity:	1

5.7.2.1.8 AirRoute

AirRoute	
Subtype of:	TransportLinkSet
Definition:	A specified route designed for channelling the flow of traffic as necessary for the provision of air traffic services, from the end of the take-off and initial climb phase to the commencement of the approach and landing phase.
Description:	SOURCE [Route - AIXM5.0]. NOTE A collection of air link sequences and or individual air links that are characterized by one or more thematic identifiers and /or properties, which perform a Route.

AirRoute	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: airRouteType	
Value type:	AirRouteTypeValue
Definition:	Route classification.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: designator	
Value type:	CharacterString
Definition:	Code or designator that identifies an Air Route.
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.9 AirRouteLink

AirRouteLink	
Subtype of:	AirLink
Definition:	A portion of a route to be flown usually without an intermediate stop, as defined by two consecutive significant points.
Description:	SOURCE [AirRouteSegment - AIXM5.0]. NOTE The presence of air nodes (normally defining Significant Points) is not mandated.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: airRouteLinkClass	
Value type:	AirRouteLinkClassValue
Definition:	The class or type of an air route link.
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.10 AirspaceArea

AirspaceArea	
Subtype of:	TransportArea
Definition:	A defined volume in the air, described as horizontal projection with vertical limits.
Description:	SOURCE [AirspaceVolume - AIXM5.0]. NOTE 1 Definition of Airspace: A defined three dimensional region of space relevant to air traffic [AIXM5.0]. NOTE 2 Airspace regions are managed by air traffic control systems to provide a safe IFR (Instrument Flight Rules) navigation for air traffic services and aircrafts.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: AirspaceAreaType	
Value type:	AirspaceAreaTypeValue
Definition:	A code indicating the general structure or characteristics of a particular airspace.
Description:	SOURCE [Airspace.type - AIXM5.0].
Multiplicity:	1

5.7.2.1.11 ApronArea

ApronArea	
Subtype of:	TransportArea

ApronArea	
Definition:	A defined area, on a land aerodrome/heliport, intended to accommodate aircraft/helicopters for purposes of loading and unloading passengers, mail or cargo, and for fuelling, parking or maintenance.
Description:	SOURCE [Apron - AIXM5.0].
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.12 ConditionOfAirFacility

ConditionOfAirFacility	
Subtype of:	ConditionOfFacility
Definition:	State of an air transport network element with regards to its completion and use.
Status:	Proposed
Stereotypes:	«featureType»
Constraint: Applies only to AerodromeNode, AerodromeArea and RunwayArea	
Natural language:	This property can only be associated with a spatial object that is an Aerodrome Node, an Aerodrome Area or a Runway Area.
OCL:	inv: networkRef.element.oclIsKindOf(AerodromeNode) or networkRef.element.oclIsKindOf(AerodromeArea) or networkRef.element.oclIsKindOf(RunwayArea)

5.7.2.1.13 DesignatedPoint

DesignatedPoint	
Subtype of:	AirNode
Definition:	A geographical location not marked by the site of a radio navigation aid, used in defining an ATS route, the flight path of an aircraft or for other navigation or ATS purposes.
Description:	SOURCE [AIXM5.0]. NOTE Examples of Designated points are compulsory and non-compulsory reporting points.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The coded designator of the point.
Description:	SOURCE [AIXM5.0]. EXAMPLE The five-letter ICAO name of the point.
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.14 ElementLength

ElementLength	
Subtype of:	TransportProperty
Definition:	The physical length of the element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: length	
Value type:	Measure
Definition:	The physical length of the element.

ElementLength	
Description:	NOTE 1 The value of the physical length of the runway [AIXM5.0], when applied to RunwayArea. NOTE 2 Value for the length of the taxiway [AIXM5.0], when applied to TaxiwayArea. NOTE 3 The value of the physical length of the touchdown and lift-off area [AIXM5.0], when applied to TouchDownLiftOff.
Multiplicity:	1
Constraint: Applies to RunwayArea, TaxiwayArea and TouchDownLiftOff only	
Natural language:	This property can only be associated with a spatial object that is a Runway Area, Taxiway Area or Touch Down Lift Off.
OCL:	inv: networkRef.element.oclIsKindOf(RunwayArea) or networkRef.element.oclIsKindOf(TaxiwayArea) or networkRef.element.oclIsKindOf(TouchDownLiftOff)

5.7.2.1.15 ElementWidth

ElementWidth	
Subtype of:	TransportProperty
Definition:	The physical width of the element.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: width	
Value type:	Measure
Definition:	The physical width of the element.
Description:	NOTE 1 The value of the physical width of the runway [AIXM5.0], when applied to RunwayArea. NOTE 2 The value of the physical width of the taxiway [AIXM5.0], when applied to TaxiwayArea. NOTE 3 The value of the physical width of the touchdown and lift-off area [AIXM5.0], when applied to TouchDownLiftOff.
Multiplicity:	1
Constraint: Applies to RunwayArea, TaxiwayArea and TouchDownLiftOff only	
Natural language:	This property can only be associated with a spatial object that is a Runway Area, Taxiway Area or Touch Down Lift Off.
OCL:	inv: networkRef.element.oclIsKindOf(RunwayArea) or networkRef.element.oclIsKindOf(TaxiwayArea) or networkRef.element.oclIsKindOf(TouchDownLiftOff)

5.7.2.1.16 FieldElevation

FieldElevation	
Subtype of:	TransportProperty
Definition:	The aerodrome elevation as the vertical distance between the highest point of the landing area of an aerodrome and mean sea level.
Description:	SOURCE [AIXM5.0]. NOTE This might be different from the elevation of the Aerodrome Reference Point.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: altitude	
Value type:	Measure
Definition:	Value of the field altitude.

FieldElevation	
Multiplicity:	1
Constraint: Applies to AerodromeNode and AerodromeArea only	
Natural language:	This property can only be associated with a spatial object that is an Aerodrome Node or Aerodrome Area.
OCL:	inv: networkRef.element.oclIsKindOf(AerodromeNode) or networkRef.element.oclIsKindOf(AerodromeArea)

5.7.2.1.17 InstrumentApproachProcedure

InstrumentApproachProcedure	
Subtype of:	ProcedureLink
Definition:	A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en route obstacle clearance criteria apply.
Description:	SOURCE [AIXM5.0]. NOTE 1 Acronym: IAP. NOTE 2 It corresponds to the final approach and arrival during the landing phase. NOTE 3 A specific runway of an airport/heliport usually has more than one IAP, depending on the landing direction on it.
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.18 LowerAltitudeLimit

LowerAltitudeLimit	
Subtype of:	TransportProperty
Definition:	Altitude that defines the lower limit of an air transport network object.
Description:	NOTE When applied to an AirRouteLink it corresponds to the Lowest Safe Altitude, which is defined in order to provide safety for navigation.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: altitude	
Value type:	Measure
Definition:	Value of the altitude limit.
Multiplicity:	1
Constraint: Applies to AirRouteLink and AirspaceArea only	
Natural language:	This property can only be associated with a spatial object that is an Air Route Link or Airspace Area.
OCL:	inv: networkRef.element.oclIsKindOf(AirRouteLink) or networkRef.element.oclIsKindOf(AirspaceArea)

5.7.2.1.19 Navaid

Navaid	
Subtype of:	AirNode
Definition:	One or more Navaid Equipments providing navigation services. DEFINITION Navaid equipment: A physical navaid equipment like VOR, DME, localizer, TACAN or etc.
Description:	SOURCE [AIXM5.0]. NOTE 1 The Navaid Equipment share business rules like paired frequencies [AIXM5.0].

Navaid	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The coded identifier given to the navaid system.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: navaidType	
Value type:	NavaidTypeValue
Definition:	Type of the navaid service.
Description:	SOURCE [AIXM5.0]. EXAMPLES ILS, MLS, VORTAC, VOR/DME.
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.20 ProcedureLink

ProcedureLink	
Subtype of:	AirLink
Definition:	A series of predetermined manoeuvres with specified protection from obstacles.
Description:	SOURCE [Procedure - AIXM5.0]. NOTE 1 A defined airway connector designed for channelling the flow of traffic as necessary for the provision of air traffic services during the take-off or landing phase, which links an airport/heliport to a significant point, usually connected to one or more air routes. NOTE 2 When a airport/heliport is not connected with a standardized airway connector to the rest of the air network, this object can be used as a fictitious connector between the airport/heliport and a significant point on one or more ATS routes - for example for VFR (Visual Flight Rules) flights. NOTE 3 Nevertheless, three main types of standardized Procedures are usually defined for IFR (Instrument Flight Rules) flights: - Standard Instrument Departure (SID), corresponding to the take-off phase. - Standard Instrument Arrival (STAR), corresponding to the initial approach during the landing phase. - Instrument Approach Procedure (IAP), corresponding to the final approach and arrival during the landing phase.
Status:	Proposed
Stereotypes:	«featureType»

5.7.2.1.21 RunwayArea

RunwayArea	
Subtype of:	TransportArea
Definition:	A defined rectangular area on a land aerodrome/heliport prepared for the landing and take-off of aircraft.

RunwayArea	
Description:	SOURCE [Runway - AIXM5.0]. NOTE 1 This includes the concept of Final Approach and Take-Off Area (FATO) for helicopters [Runway - AIXM5.0]. NOTE 2 The runway strip is a defined area including the runway and stopway, if provided, intended : a) to reduce the risk of damage to aircraft running off a runway; and b) to protect aircraft flying over it during take-off or landing operations [ICAO].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The full textual designator of the runway, used to uniquely identify it at an aerodrome/heliport which has more than one.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: runwayType	
Value type:	RunwayTypeValue
Definition:	The type of runway, either runway for airplanes or final approach and take off area (FATO) for helicopters.
Description:	SOURCE Adapted from [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.22 RunwayCentrelinePoint

RunwayCentrelinePoint	
Subtype of:	AirNode
Definition:	An operationally significant position on the center line of a runway direction.
Description:	SOURCE [AIXM5.0]. NOTE 1 The role of the point along the runway direction centreline is indicated within the pointRole attribute. NOTE 2 Runway centreline points are used to connect the Procedure Links that connect an airport/heliport to the rest of the air network. EXAMPLE A typical example is the runway threshold [AIXM5.0].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: pointRole	
Value type:	PointRoleValue
Definition:	The role of the point along the runway direction centreline.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1

5.7.2.1.23 StandardInstrumentArrival

StandardInstrumentArrival	
Subtype of:	ProcedureLink
Definition:	A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

StandardInstrumentArrival	
Description:	SOURCE [AIXM5.0]. NOTE 1 Acronym: STAR. NOTE 2 It corresponds to the initial approach during the landing phase. Each airport/heliport could have various STAR linking significant points (usually connected to air routes) to the points designated to start the landing on a specific runway.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The textual designator of the Standard Instrument Arrival.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.24 StandardInstrumentDeparture

StandardInstrumentDeparture	
Subtype of:	ProcedureLink
Definition:	A designated instrument flight rule (IFR) departure route linking the aerodrome or a specific runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.
Description:	SOURCE [AIXM5.0]. NOTE 1 Acronym: SID. NOTE 2 It corresponds to the take-off phase. Each airport/heliport could have various SID linking the different runways to one or various significant points, usually connected to air routes.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The full textual designator of the Standard Instrument Departure.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.25 SurfaceComposition

SurfaceComposition	
Subtype of:	TransportProperty
Definition:	The composition of an aerodrome/heliport related surface.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: surfaceComposition	
Value type:	SurfaceCompositionValue
Definition:	A code indicating the composition of an aerodrome/heliport related surface.
Description:	SOURCE [SurfaceCharacteristics.composition - AIXM5.0]. EXAMPLES Asphalt, concrete.
Multiplicity:	1
Constraint: Applies to RunwayArea, TaxiwayArea, ApronArea and TouchDownLiftOff only	

SurfaceComposition	
Natural language:	This property can only be associated with a spatial object that is a Runway Area, Taxiway Area, Apron Area or Touch Down Lift Off.
OCL:	inv: networkRef.element.oclIsKindOf(RunwayArea) or networkRef.element.oclIsKindOf(TaxiwayArea) or networkRef.element.oclIsKindOf(ApronArea) or networkRef.element.oclIsKindOf(TouchDownLiftOff)

5.7.2.1.26 TaxiwayArea

TaxiwayArea	
Subtype of:	TransportArea
Definition:	A defined path at an aerodrome/heliport established for the taxiing of aircraft/helicopters and intended to provide a link between one part of the aerodrome and another.
Description:	SOURCE [Taxiway - AIXM5.0]. NOTE This includes aircraft/helicopter stand taxilines, apron taxiways, rapid exit taxiways, air taxiways etc.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The textual designator of the taxiway.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.27 TouchDownLiftOff

TouchDownLiftOff	
Subtype of:	AirNode
Definition:	A load bearing area on which a helicopter may touch down or lift-off.
Description:	SOURCE [AIXM5.0].
Status:	Proposed
Stereotypes:	«featureType»
Attribute: designator	
Value type:	CharacterString
Definition:	The textual designator of the touch down and lift-off area.
Description:	SOURCE [AIXM5.0].
Multiplicity:	1
Stereotypes:	«voidable»

5.7.2.1.28 UpperAltitudeLimit

UpperAltitudeLimit	
Subtype of:	TransportProperty
Definition:	Altitude that defines the upper limit of an air transport network object.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: altitude	
Value type:	Measure
Definition:	Value of the altitude limit.
Multiplicity:	1
Constraint: Applies to AirRouteLink and AirspaceArea only	
Natural language:	This property can only be associated with a spatial object that is an Air Route Link or Airspace Area.

UpperAltitudeLimit	
OCL:	inv: networkRef.element.oclIsKindOf(AirRouteLink) or networkRef.element.oclIsKindOf(AirspaceArea)

5.7.2.1.29 UseRestriction

useRestriction	
Subtype of:	TransportProperty
Definition:	The restrictions to the use of an air network object.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: restriction	
Value type:	AirUseRestrictionValue
Definition:	The type of use restriction for the air network object.
Multiplicity:	1
Constraint: Applies to AirRoute, AirLinks, AirNodes and AerodromeArea only	
Natural language:	This property can only be associated with a spatial object that is an Air Route, Air Link (or specialized Air Link), Air Node (or specialized Air Node) or Aerodrome Area.
OCL:	inv: networkRef.element.oclIsKindOf(AirRoute) or networkRef.element.oclIsKindOf(AirLink) or networkRef.element.oclIsKindOf(AirNode) or networkRef.element.oclIsKindOf(AerodromeArea)

5.7.2.2 Enumerations and code lists

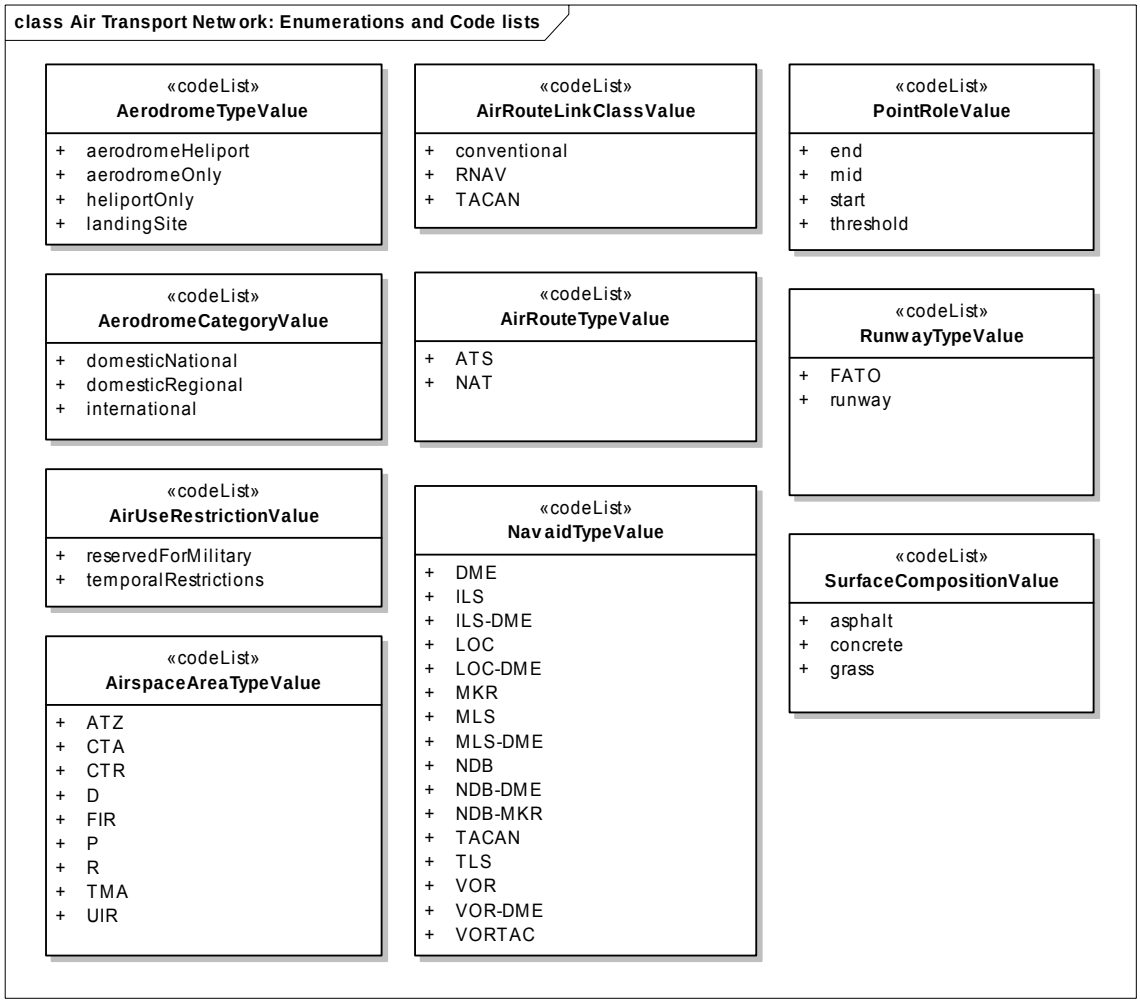


Figure 40 – UML class diagram: Air Transport Networks Enumerations and code lists

5.7.2.2.1 AerodromeCategoryValue

AerodromeCategoryValue	
Definition:	Aerodrome possible categories concerning the scope and importance of the air traffic services offered from and to it.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AerodromeCategoryValue
Value: domesticNational	
Definition:	Aerodrome serving domestic national air traffic services.
Value: domesticRegional	
Definition:	Aerodrome serving domestic regional air traffic services.
Value: international	
Definition:	Aerodrome serving international air traffic services.

5.7.2.2.2 AerodromeTypeValue

AerodromeTypeValue	
Definition:	A code specifying whether a particular entity occurrence is an Aerodrome or a Heliport.
Description:	SOURCE [CodeAirportHeliportType - AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AerodromeTypeValue
Value: aerodromeHeliport	
Definition:	Aerodrome with heliport landing area.
Description:	SOURCE [AIXM5.0].
Value: aerodromeOnly	
Definition:	Aerodrome only.
Description:	SOURCE [AIXM5.0].
Value: heliportOnly	
Definition:	Heliport only.
Description:	SOURCE [AIXM5.0].
Value: landingSite	
Definition:	Landing site.
Description:	SOURCE [AIXM5.0].

5.7.2.2.3 AirRouteLinkClassValue

AirRouteLinkClassValue	
Definition:	The type of the route from the navigation point of view.
Description:	SOURCE [CodeRouteNavigationType - AIXM5.0]. NOTE These values enumerate the possible usages of a AirRouteLink. EXAMPLES Conventional, RNAV.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AirRouteLinkClassValue
Value: conventional	

AirRouteLinkClassValue	
Definition:	Conventional navigation route: An air route which does neither use Area Navigation (RNAV) nor TACAN navigation for air traffic services. DEFINITION Definition of Area Navigation (RNAV): A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of selfcontained aids, or a combination of both [ICAO].
Description:	SOURCE [AIXM5.0].
Value: RNAV	
Definition:	Area navigation route: An air route which uses Area Navigation (RNAV) for air traffic services. DEFINTION Area Navigation (RNAV): A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of selfcontained aids, or a combination of both [ICAO].
Description:	SOURCE [AIXM5.0].
Value: TACAN	
Definition:	TACAN route: An air route which uses TACAN Navigation for air traffic services. DEFINITION TACAN Navigation: A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced Tactical Air Navigation Beacon (TACAN) navigation aids.
Description:	SOURCE [AIXM5.0].

5.7.2.2.4 AirRouteTypeValue

AirRouteTypeValue	
Definition:	The route classification as ATS route or North Atlantic Tracks.
Description:	SOURCE [CodeRouteType - AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AirRouteTypeValue
Value: ATS	
Definition:	ATS Route as described in ICAO Annex 11.
Description:	SOURCE [AIXM5.0].
Value: NAT	
Definition:	North Atlantic Track (part of Organized Track System).
Description:	SOURCE [AIXM5.0].

5.7.2.2.5 AirspaceAreaTypeValue

AirspaceAreaTypeValue	
Definition:	Recognised types of Airspace.
Description:	SOURCE [CodeAirspaceType - AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AirspaceAreaTypeValue
Value: ATZ	
Definition:	Airport Traffic Zone. Airspace of defined dimensions established around an airport for the protection of airport traffic. Description: ICAO Recognized.
Description:	SOURCE [AIXM5.0]. NOTE An ATZ usually is set up from the lower limit of a Control Zone (CTR) to the surface.
Value: CTA	
Definition:	Control area. A controlled airspace extending upwards from a specified limit above the earth. Description: ICAO Recognized.

AirspaceAreaTypeValue	
Description:	SOURCE [AIXM5.0]. NOTE 1 A CTA could exist in the vicinity of a single airport to manage a busy air traffic area in order to provide protection to aircraft climbing out from the airport. As such it is a smaller version of a Terminal Maneuvering Area or Terminal Control Area (TMA), equivalent to it but serving only to one airport. NOTE 2 Standard Intrument Departure (SID) routes usually ends at the upper limit of a TMA or CTA, where the air route phase starts.
Value: CTR	
Definition:	Control zone. A controlled airspace extending upwards from the surface of the earth to a specified upper limit. Description: ICAO Recognized.
Description:	SOURCE [AIXM5.0]. NOTE It is normally extended from the surface to a specified upper limit, set up to protect air traffic operating to and from that airport. A CTR usually is set up from the upper limit of an Aerodrome Traffic Zone (ATZ).
Value: D	
Definition:	Danger area. Airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at specified times. Description: ICAO Recognized.
Description:	SOURCE [AIXM5.0]. NOTE It is defined as a constraint airspace area to be avoided if possible, which could be dangerous for navigation of air traffic services and could be crossed only by specific routes and specific flight levels defined by the Defence Authority.
Value: FIR	
Definition:	Flight information region. Airspace of defined dimensions within which flight information service and alerting service are provided. Description: ICAO Recognized. Might, for example, be used if service provided by more than one unit.
Description:	SOURCE [AIXM5.0]. NOTE 1 A FIR is an airspace region in which information, management and search-and-rescue services are provided by an air navigation service provider. NOTE 2 Any portion of the atmosphere belongs to some specific FIR, except from some cases. Small countries could have only a single FIR; bigger ones could have some regional FIRs. The division among different countries is done by international agreement through ICAO.
Value: P	
Definition:	Prohibited area. Airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited. Description: ICAO Recognized.
Description:	SOURCE [AIXM5.0]. NOTE It is defined as a constraint airspace area to be avoided, in which navigation of air traffic services is forbidden for high security reasons.
Value: R	
Definition:	Restricted area. Airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions. Description: ICAO Recognized.

AirspaceAreaTypeValue	
Description:	SOURCE [AIXM5.0]. NOTE It is defined as a constraint airspace area in which navigation of air traffic services is restricted and could only be crossed temporarily with authorisation and at specific flight levels.
Value: TMA	
Definition:	Terminal control area. Control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes. Description: Non-ICAO Recognized. Mainly used in Europe under the Flexible Use of Airspace concept.
Description:	SOURCE [AIXM5.0]. NOTE 1 It is normally extended from a lower to an upper limit, set up at an area of confluence of busy airways in the vicinity of one or more major airports to protect traffic climbing out from and descending into the airports. NOTE 2 As such it is a larger version of a Control Area (CTA). Standard Intrument Departure (SID) routes usually ends at the upper limit of a TMA or CTA, where the air route phase starts.
Value: UIR	
Definition:	Upper flight information region (UIR). An upper airspace of defined dimensions within which flight information service and alerting service are provided. Description: Non-ICAO Recognized. Each state determines its definition for upper airspace.
Description:	SOURCE [AIXM5.0].

5.7.2.2.6 AirUseRestrictionValue

AirUseRestrictionValue	
Definition:	The use restrictions for an air network object.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:AirUseRestrictionValue
Value: reservedForMilitary	
Definition:	The air network object is exclusively for military use.
Value: temporalRestrictions	
Definition:	The temporal restrictions apply to the use of the air network object.

5.7.2.2.7 NavaidTypeValue

NavaidTypeValue	
Definition:	Types of Navaid Services.
Description:	SOURCE [AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:NavaidTypeValue
Value: DME	
Definition:	Distance Measuring Equipment.
Description:	SOURCE [AIXM5.0].
Value: ILS	
Definition:	Instrument Landing System.
Description:	SOURCE [AIXM5.0].
Value: ILS-DME	
Definition:	ILS with collocated DME.

NavaidTypeValue	
Description:	SOURCE [AIXM5.0].
Value: LOC	
Definition:	Localizer.
Description:	SOURCE [AIXM5.0].
Value: LOC-DME	
Definition:	LOC and DME collocated.
Description:	SOURCE [AIXM5.0].
Value: MKR	
Definition:	Marker Beacon.
Description:	SOURCE [AIXM5.0].
Value: MLS	
Definition:	Microwave Landing System.
Description:	SOURCE [AIXM5.0].
Value: MLS-DME	
Definition:	MLS with collocated DME.
Description:	SOURCE [AIXM5.0].
Value: NDB	
Definition:	Non-Directional Radio Beacon.
Description:	SOURCE [AIXM5.0].
Value: NDB-DME	
Definition:	NDB and DME collocated.
Description:	SOURCE [AIXM5.0].
Value: NDB-MKR	
Definition:	Non-Directional Radio Beacon and Marker Beacon.
Description:	SOURCE [AIXM5.0].
Value: TACAN	
Definition:	Tactical Air Navigation Beacon.
Description:	SOURCE [AIXM5.0].
Value: TLS	
Definition:	Transponder Landing System.
Description:	SOURCE [AIXM5.0].
Value: VOR	
Definition:	VHF Omnidirectional Radio Range.
Description:	SOURCE [AIXM5.0].
Value: VOR-DME	
Definition:	VOR and DME collocated.
Description:	SOURCE [AIXM5.0].
Value: VORTAC	
Definition:	VOR and TACAN collocated.
Description:	SOURCE [AIXM5.0].

5.7.2.2.8 PointRoleValue

PointRoleValue	
Definition:	Role of the Runway Centreline Point.
Description:	SOURCE [AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:PointRoleValue
Value: end	
Definition:	Physical end of a runway direction.

PointRoleValue	
Description:	SOURCE [AIXM5.0].
Value: mid	
Definition:	The mid point of the runway.
Description:	SOURCE [AIXM5.0].
Value: start	
Definition:	Physical start of a runway direction.
Description:	SOURCE [AIXM5.0].
Value: threshold	
Definition:	Threshold.
Description:	SOURCE [AIXM5.0].

5.7.2.2.9 RunwayTypeValue

RunwayTypeValue	
Definition:	A code that makes a distinction between runways for airplanes and FATO for helicopters.
Description:	SOURCE [CodeRunwayType - AIXM5.0].
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:RunwayTypeValue
Value: FATO	
Definition:	Final Approach and Take Off Area for helicopters.
Description:	SOURCE [AIXM5.0].
Value: runway	
Definition:	Runway for airplanes.
Description:	SOURCE [AIXM5.0].

5.7.2.2.10 SurfaceCompositionValue

SurfaceCompositionValue	
Definition:	A code indicating the composition of a surface.
Description:	SOURCE [CodeSurfaceCompositionType - AIXM5.0]. EXAMPLES Asphalt, concrete.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:SurfaceCompositionValue
Value: asphalt	
Definition:	Surface made of an asphalt layer.
Value: concrete	
Definition:	Surface made of a concrete layer.
Value: grass	
Definition:	Surface consisting on a grass layer.

5.7.2.3 Candidate types and placeholders

5.7.2.3.1 ControlTower

ControlTower	
Package:	Buildings [Placeholder to be fully specified in Annex II/III INSPIRE data specification]
Definition:	Aerodrome control tower [Unit.Type='TWR' - AIXM5.0].

ControlTower	
Description:	NOTE Point representing the situation of a Control Tower belonging to an aerodrome (airport/heliport), used to manage aircraft traffic in the runways and nearest airspace to the aerodrome.

5.7.2.4 Imported types (informative)

This section lists definitions for feature types, data types and enumerations and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.7.2.4.1 TransportLinkSequence

TransportLinkSequence (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object, composed of an ordered collection of transport links, which represents a continuous path in the transport network without any branches. The element has a defined beginning and end and every position on the transport link sequence is identifiable with one single parameter such as length. It describes an element of the transport network, characterized by one or more thematical identifiers and/or properties.

5.7.2.4.2 ConditionOfFacility

ConditionOfFacility	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	State of a transport network element with regards to its completion and use.

5.7.2.4.3 TransportLink

TransportLink (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A linear spatial object that describes the geometry and connectivity of a transport network between two points in the network.

5.7.2.4.4 TransportArea

TransportArea (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	Surface that represents the spatial extent of an element of a transport network.

5.7.2.4.5 TransportNode

TransportNode (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A point spatial object which is used for connectivity.
Description:	Nodes are found at either end of the TransportLink.

5.7.2.4.6 TransportProperty

TransportProperty (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.

5.7.2.4.7 TransportLinkSet

TransportLinkSet (abstract)	
Package:	Common Transport Elements [see section 5.2.2]
Definition:	A collection of transport link sequences and or individual transport links that has a specific function or siginificance in a transport network.

TransportLinkSet (abstract)	
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.

6 Reference systems

6.1 Coordinate reference systems

6.1.1 Datum

Requirement 13	For the coordinate reference systems used for making available the INSPIRE spatial data sets, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, and the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well established and described relationship between both systems, according to EN ISO 19111.

6.1.2 Coordinate reference systems

Requirement 14	INSPIRE spatial data sets shall be made available using one of the three-dimensional, two-dimensional or compound coordinate reference systems specified in the list below. Other coordinate reference systems than those listed below may only be used for regions outside of continental Europe. The geodetic codes and parameters for these coordinate reference systems shall be documented, and an identifier shall be created, according to EN ISO 19111 and ISO 19127.

1. Three-dimensional Coordinate Reference Systems
   - Three-dimensional Cartesian coordinates
   - Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height), using the parameters of the GRS80 ellipsoid

2. Two-dimensional Coordinate Reference Systems
   - Two-dimensional geodetic coordinates, using the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Azimuthal Equal Area projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Conformal Conic projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Transverse Mercator projection and the parameters of the GRS80 ellipsoid

3. Compound Coordinate Reference Systems
   - For the horizontal component of the compound coordinate reference system, one of the two-dimensional coordinate reference systems specified above shall be used
   - For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope
   - Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS. The geodetic codes and parameters for these vertical reference systems shall be documented and an identifier shall be created, according to EN ISO 19111 and ISO 19127
   - For the vertical component measuring the depth of the sea floor, where there is an appreciable tidal range, the Lowest Astronomical Tide shall be used as reference surface. In marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200 m, the depth of the sea floor shall be referenced to the Mean Sea Level
   - For the vertical component measuring depths above the sea floor in the free ocean, barometric pressure shall be used
   - For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere shall be used

6.1.3 Display

Requirement 15	For the display of the INSPIRE spatial data sets with the View Service specified in D003152/02 Draft Commission Regulation implementing Directive 2007/2/EC of the European Parliament and of the Council as regards Network Services, at least the two dimensional geodetic coordinate system shall be made available.

6.1.4 Identifiers for coordinate reference systems

Requirement 16	For referring to the non-compound coordinate reference systems listed in this Section, the identifiers listed below shall be used. For referring to a compound coordinate reference system, an identifier composed of the identifier of the horizontal component, followed by a slash (/), followed by the identifier of the vertical component, shall be used.

- ETRS89-XYZ for Cartesian coordinates in ETRS89
- ETRS89-GRS80h for three-dimensional geodetic coordinates in ETRS89 on the GRS80 ellipsoid
- ETRS89-GRS80 for two-dimensional geodetic coordinates in ETRS89 on the GRS80
- EVRS for height in EVRS
- LAT for depth of the sea floor, where there is an appreciable tidal range
- MSL for depth of the sea floor, in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200m
- ISA for pressure coordinate in the free atmosphere
- PFO for Pressure coordinate in the free ocean
- ETRS89-LAEA for ETRS89 coordinates projected into plane coordinates by the Lambert Azimuthal Equal Area projection
- ETRS89-LCC for ETRS89 coordinates projected into plane coordinates by the Lambert Conformal Conic projection
- ETRS89-TMzn for ETRS89 coordinates projected into plane coordinates by the Transverse Mercator projection

6.2 Temporal reference system

Requirement 17	The Gregorian Calendar shall be used for as a reference system for date values, and the Universal Time Coordinated (UTC) or the local time including the time zone as an offset from UTC shall be used as a reference system for time values.

7 Data quality

This section includes a description of data quality elements and sub-elements as well as the associated basic data quality measures to be used to describe data related to the spatial data theme *Transport networks* (see 13).

NOTE Additional guidance documents on procedures and methods that can be used to implement the basic data quality measures introduced in this section will be provided at a later stage.

For *Transport networks* theme, the provision of data quality information is necessary to cover the following specific purposes:

- Check that the different data providers supply a minimum set of data quality elements and sub-elements in order to evaluate and quantify the quality of datasets for specific purposes in the context of INSPIRE.

- Guarantee that a continuous transport network can be built from the elements provided in the transport network datasets, by assessing their conformance to some basic topological consistency rules aimed at ensure at least *clean* connections between features.

This specification is compliant with ISO 19113 and ISO 19114, but it does not fix any concrete conformance criteria for the data quality information proposed, since it should be valid for a wide range of European transport network datasets, with very different levels of detail and quality requirements.

In addition, recommendations on minimum data quality are included for specific elements

However, for the topological consistency rules mentioned above, a minimum set of measures are needed in order to make it possible the creation of a well-connected transport network.

Data quality information can be described at level of spatial object (feature), spatial object type (feature type), dataset or dataset series. Data quality information at spatial object level is modelled directly in the application schema (Chapter 5).

Chapter 8 describes the corresponding metadata elements to report about this data quality information.

The table below describes the usage (feature-level or dataset-level) and the main purpose (evaluation or network) for the data quality elements and sub-elements proposed in this specification.

Table 13 – Data quality (sub-)elements and measures used in the theme Transport Networks

INSPIRE Data Specification Transport Networks Section	Data quality element	Data quality sub-element	Data quality measures	Usage	Quality purpose
7.1.1.1	Completeness	Commission	Rate of Excess items	dataset-level	evaluation
7.1.1.2	Completeness	Commission	Number of duplicate feature instances	dataset-level	evaluation
7.1.2.1	Completeness	Omission	Rate of missing items	dataset level	evaluation

7.2.1.1	Logical consistency	Conceptual consistency	Conceptual schema compliance	dataset level	evaluation
7.2.2.1	Logical consistency	Domain consistency	Value domain non conformance rate	dataset level	evaluation
7.2.3.1	Logical consistency	Format consistency	Physical structure conflict rate	dataset-level	evaluation
7.2.4.1	Logical consistency	Topological consistency	Number of invalid overlaps of surfaces	dataset-level	network
7.2.4.2	Logical consistency	Topological consistency	Number of missing connections due to undershoots	dataset-level	network
7.2.4.3	Logical consistency	Topological consistency	Number of missing connections due to overshoots	dataset-level	network
7.2.4.4	Logical consistency	Topological consistency	Number of invalid slivers	dataset-level	network
7.2.4.5	Logical consistency	Topological consistency	Number of invalid self-intersect errors	dataset-level	network
7.2.4.6	Logical consistency	Topological consistency	Number of invalid self-overlap errors	dataset-level	network
7.3.1.1	Positional accuracy	Absolute or external accuracy	Mean value of positional uncertainties	dataset-level	evaluation
7.4.1.1	Thematic accuracy	Classification correctness	Misclassification rate	dataset-level	evaluation
7.4.2.1	Thematic accuracy	Non-quantitative attribute correctness	Rate of incorrect classification for national identifier	dataset-level	evaluation

7.1 Completeness

These data quality elements enable the assessment of presence / absence of features in the dataset, their attributes and relationships

7.1.1 Commission

The assessment of these quality sub-elements should be included in the metadata element DQ_CompletenessCommission, described in section 8.

7.1.1.1 Rate of Excess items

This quality sub-element shows excess data present in a dataset.

Name	**Rate of excess items**
Alternative name	-
Data quality element	Completeness
Data quality subelement	Commission
Data quality basic measure	Error rate
Definition	Number of excess items in the dataset in relation to the number of items that should have been present.
Description	-
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	-

Measure identifier	3 (ISO 19138)

7.1.1.2 Number of duplicate feature instances

This quality sub-element shows duplicate features present in a dataset

Name	**Number of duplicate feature instances**
Alternative name	-
Data quality element	Completeness
Data quality subelement	Commission
Data quality basic measure	Error count
Definition	Total number of exact duplications of feature instances within the data
Description	Count of all items in the data that are incorrectly extracted with duplicate geometries.
Parameter	-
Data quality value type	Integer
Data quality value structure	-
Source reference	-
Example	Features with identical attribution and identical coordinates: – two (or more) points collected on top of each other; – two (or more) curves collected on top of each other; – two (or more) surfaces collected on top of each other.
Measure identifier	4 (ISO 19138)

7.1.2 Omission

The assessment of this quality sub-element should be included in the metadata element DQ_CompletenessOmission, described in section 8.

7.1.2.1 Rate of missing items

This data quality sub element shows the number of missing items present in the data.

Name	**Rate of missing items**
Alternative name	-
Data quality element	Completeness
Data quality subelement	Omission
Data quality basic measure	Error rate
Definition	Number of items missing from the data.
Description	-
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	-
Measure identifier	5 (ISO 19138)

7.2 Logical consistency

Logical consistency elements enable the assessment of the degree of adherence to logical rules of data structure, attribution and relationships

7.2.1 Conceptual consistency

7.2.1.1 Conceptual schema compliance

This data quality sub-element should be assessed at feature level and the results should be stored in the metadata element: DQ_ConceptualConsistency.

Name	**Conceptual schema compliance**
Alternative name	-
Data quality element	Logical consistency
Data quality subelement	Conceptual consistency
Data quality basic measure	Rate of correct items
Definition	Number of items in the dataset in compliance with the rules of the conceptual schema in relation to the total number of items.
Description	No mandatory components or attributes are missing and no constraints are violated for any transport objects.
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	The 95% of the mandatory components or attributes exist and no constraints are violated within the dataset.
Measure identifier	13 (ISO 19138)

7.2.2 Domain consistency

7.2.2.1 Value domain non conformance rate

This quality sub-element shows the global adherence of values in the dataset to the predefined value domains.

The assessment of this quality sub-element should be included in the metadata element DQ_DomainConsistency.

Name	**Value domain non conformance rate**
Alternative name	-
Data quality element	Logical consistency
Data quality subelement	Domain consistency
Data quality basic measure	Incorrect items rate
Definition	Number of items in the dataset that are not in conformance with their value domain in relation to the total number of items in the dataset.
Description	Number of transport objects in the dataset that are not in conformance with their value domains in relation to the total number of objects in the transport dataset.
Parameter	-
Data quality value type	Percentage, ratio
Data quality value structure	-
Source reference	-
Example	95% of transport features consist of components whose values are within the domains stated in the application schema (i.e. giving an example for a specific feature type Railway Link, the values for Railway Type should be any of 8 values defined in RailwayTypeValues, etc.).
Measure identifier	17 (ISO 19138)

7.2.3 Format consistency

7.2.3.1 Physical structure conflict rate

This quality sub-element shows the percentage of items stored in conflict with the physical structure of the dataset.

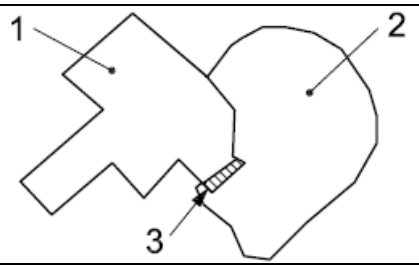
The assessment of this quality sub-element should be included in the metadata element: DQ_FormatConsistency.

Name	**Physical structure conflict rate**
Alternative name	-
Data quality element	Logical consistency
Data quality subelement	Format consistency
Data quality basic measure	Error rate
Definition	Number of items in the dataset that are stored in conflict with the physical structure of the dataset divided by the total number of items
Description	-
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	-
Measure identifier	20 (ISO 19138)

7.2.4 Topological consistency

The assessment of the following data quality sub-elements should be included in the metadata element DQ_TopologicalConsistency.

7.2.4.1 Number of invalid overlaps of surfaces

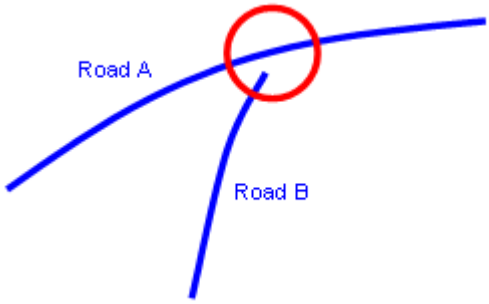
Name	**Number of invalid overlaps of surfaces**
Alternative name	Overlapping surfaces
Data quality element	Logical consistency
Data quality subelement	Conceptual consistency
Data quality basic measure	Error count
Definition	Total number of erroneous overlaps within the data.
Description	Which surfaces may overlap and which shall not is application dependent. Not all overlapping surfaces are necessarily erroneous. When reporting this data quality measure, the types of feature classes corresponding to the illegal overlapping surfaces shall be reported as well.
Parameter	-
Data quality value type	Integer
Data quality value structure	-
Source reference	-
Example: Figure 29	

	Key 1 Surface 1 2 Surface 2 3 Overlapping Area Note: Some types of area features related to air transport (e.g. *AirspaceArea* types *FIR* and *CTR*) represent the horizontal projections of 3D volumes in the air space which may overlap.
Measure identifier	11 (ISO 19138)

7.2.4.2 Number of missing connections due to undershoots

The following topological consistency quality sub-element is required in order to ensure building a "clean" and connected transport network. See also Section 10.2 Ensuring Network Connectivity.

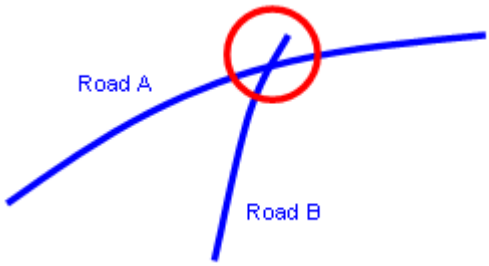
Name	**Number of missing connections due to undershoots**
Alternative name	Undershoots
Data quality element	Logical consistency
Data quality subelement	Topological consistency
Data quality basic measure	Error count
Definition	Count of items in the dataset that are mismatched due to undershoots, given the parameter *Connectivity tolerance*.
Description	Lacks of connectivity exceeding the *Connectivity tolerance* are considered as errors if the real features are connected in the transport network.
Parameter	– Name: *Connectivity tolerance* – Definition: Search distance from the end of a dangling line. – Description: This parameter is specific for each data provider's dataset and must be reported as metadata in order to ensure automatic and unambiguous creation of centreline topology – connectivity - for the transport network (See Section 10.2 Ensuring Network Connectivity). Connectivity tolerance must be specified by the data provider using the following elements of the DQ_TopologicalConsistency metadata element for the current measure: - 102. measureDescription (type: free text): Defined as "*Description of the measure*". - 107. Result (type DQ_Result): Defined as "*Value (or set of values) obtained from applying a data quality measure or the outcome of evaluating the obtained value (or set of values) against a specified acceptable conformance quality level*". Specifically, the tolerance must be defined within the two elements: - 130. specification - 131. explanation from DQ_Result class. Note: Metadata elements defined in ISO 19115.
Data quality value type	Integer
Data quality value structure	-
Source reference	-

Example Figure 30	 **Key** 1 Connectivity tolerance = 3 m
Measure identifier	23 (ISO 19138)

7.2.4.3 Number of missing connections due to overshoots

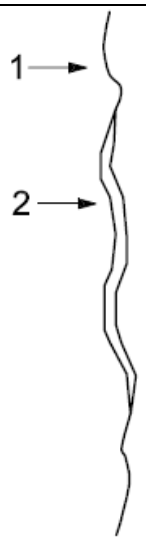
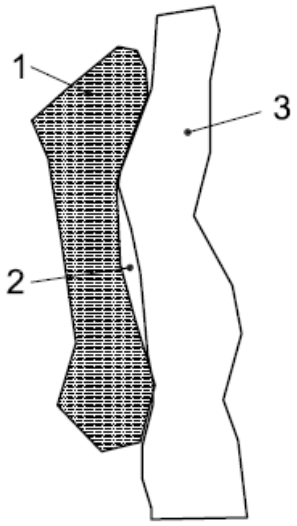
The following topological consistency quality sub-element is required in order to ensure building a "clean" and connected transport network. See also Data Capture (10.2)

Name	**Number of missing connections due to overshoots**
Alternative name	Overshoots
Data quality element	Logical consistency
Data quality subelement	Topological consistency
Data quality basic measure	Error count
Definition	Count of items in the dataset that are mismatched due to overshoots, given the parameter *Connectivity tolerance*.
Description	Lacks of connectivity exceeding the *Connectivity tolerance* are considered as errors if the real features are connected in the transport network.
Parameter	– Name: *Connectivity tolerance* – Definition: Search distance from the end of a dangling line. – Description: This parameter is specific for each data provider's dataset and must be reported as metadata in order to ensure automatic and unambiguous creation of centreline topology – connectivity - for the transport network (See Section 10.2 Ensuring Network Connectivity). Connectivity tolerance must be specified by the data provider using the following elements of the DQ_TopologicalConsistency metadata element for the current measure: - 102. measureDescription (type: free text): Defined as "*Description of the measure*". - 107. Result (type DQ_Result): Defined as "*Value (or set of values) obtained from applying a data quality measure or the outcome of evaluating the obtained value (or set of values) against a specified acceptable conformance quality level*". Specifically, the tolerance must be defined within the two elements: - 130. specification - 131. explanation from DQ_Result class. Note: Metadata elements defined in ISO 19115.
Data quality value type	Integer

Data quality value structure	-
Source reference	-
Example Figure 31	 **Key** 1 Connectivity tolerance = 3 m
Measure identifier	24 (ISO 19138)

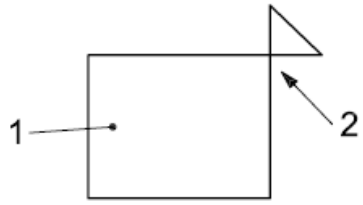
7.2.4.4 Number of invalid slivers

Name	**Number of invalid slivers**
Alternative name	Slivers
Data quality element	Logical consistency
Data quality subelement	Topological consistency
Data quality basic measure	Error count
Definition	Count of all items in the dataset that are invalid sliver surfaces.
Description	A sliver is an unintended area that occurs when adjacent surfaces are not digitized properly. The borders of the adjacent surfaces may unintentionally gap or overlap by small amounts to cause a topological error.
Parameter	This data quality measure has 2 parameters: – maximum sliver area size – thickness quotient The thickness quotient shall be a real number between 0 and 1. This quotient is determined by the following formula: T is the thickness quotient $T = 4 \pi [area]/[perimeter]^2$ T = 1 value corresponds to a circle that has the largest area/perimeter^2 value. T = 0 value corresponds to a line that has the smallest area/perimeter^2 value. The thickness quotient is independent of the size of the surface, and the closer the value is to 0, the thinner the selected sliver surfaces shall be. The maximum area determines the upper limit of a sliver. This is to prevent surfaces with sinuous perimeters and large areas from being mistaken as slivers.
Data quality value type	Integer
Data quality value structure	-
Source reference	Environmental Systems Research Institute, Inc. (ESRI) GIS Data ReViewer 4.2 User Guide

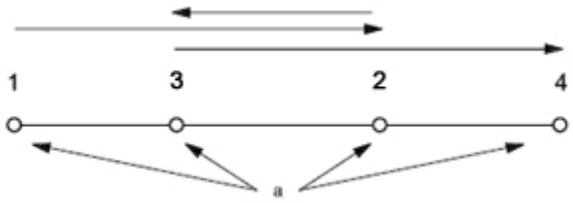
Example Figure 32	 **Key** 1 Single line rail 2 Double line rail a) Maximum area parameter prevents correct double line rail portrayal from being flagged as an error  **Key** 1 Railway station area 2 Sliver 3 Railway yard area b) Sliver is less than the maximum parameter and is flagged for evaluation of possible error
Measure identifier	25 (ISO 19138)

7.2.4.5 Number of invalid self-intersect errors

Name	**Number of invalid self-intersect errors**
Alternative name	Loops
Data quality element	Logical consistency
Data quality subelement	Topological consistency
Data quality basic measure	Error count
Definition	Count of all items in the data that illegally intersect with themselves.
Description	-
Parameter	-
Data quality value type	Integer

Data quality value structure	-
Source reference	-
Example Figure 33	 **Key** 1 Enclosed Traffic Area 2 Illegal intersection (loop)
Measure identifier	26 (ISO 19138)

7.2.4.6 Number of invalid self-overlap errors

Name	**Number of invalid self-overlap errors**
Alternative name	Kickbacks
Data quality element	Logical consistency
Data quality subelement	Topological consistency
Data quality basic measure	Error count
Definition	Count of all items in the data that illegally self overlap.
Description	-
Parameter	-
Data quality value type	Integer
Data quality value structure	-
Source reference	-
Example Figure 34	 [a] Vertices.
Measure identifier	27 (ISO 19138)

7.3 Positional accuracy

7.3.1 Absolute or external accuracy

7.3.1.1 Mean value of positional uncertainties

This quality sub-element shows the closeness of reported coordinate values to values accepted as or being true.

The assessment of this quality sub-element should be stored in the metadata element DQ_AbsoluteExternalPositionalAccuracy.

Name	**Mean value of positional uncertainties**
Alternative name	Mean value of positional uncertainties (1D, 2D and 3D)
Data quality element	Positional accuracy
Data quality subelement	Absolute or external accuracy
Data quality basic measure	Not applicable
Definition	Mean value of the positional uncertainties for a set of positions where

	the positional uncertainties are defined as the distance between a measured position and what is considered as the corresponding true position.
Description	For a number of points (N), the measured positions are given as x_{mi}, y_{mi} and z_{mi} coordinates depending on the dimension in which the position of the point is measured. A corresponding set of coordinates, x_{ti}, y_{ti} and z_{ti}, are considered to represent the true positions. The errors are calculated as 1D: $e_i=\|x_{mi}-x_{ti}\|$ 2D: $e_i=\sqrt{[(x_{mi}-x_{ti})^2+(y_{mi}-y_{ti})^2]}$ 3D: $e_i=\sqrt{[(x_{mi}-x_{ti})^2+(y_{mi}-y_{ti})^2+(z_{mi}-z_{ti})^2]}$ The mean positional uncertainties of the horizontal absolute or external positions are then calculated as $\bar{e} = \frac{1}{N}\sum_{i=1}^{N} e_i$ A criterion for the establishing of correspondence should also be stated (e.g. allowing for correspondence to the closest position, correspondence on vertices or along lines). The criterion/criteria for finding the corresponding points shall be reported with the data quality evaluation result. This data quality measure is different from the standard deviation.
Parameter	-
Data quality value type	Measure
Data quality value structure	-
Source reference	-
Example	-
Measure identifier	28 (ISO 19138)

7.4 Thematic accuracy

7.4.1 Classification correctness

7.4.1.1 Misclassification rate

This quality sub-element shows the comparison of the classes assigned to features or their attributes to a universe of discourse.

The assessment of this quality sub-element should be stored in the metadata element DQ_ThematicClassificationCorrectness.

Name	**Misclassification rate**
Alternative name	-
Data quality element	Thematic accuracy
Data quality subelement	Classification correctness
Data quality basic measure	Error rate
Definition	Average number of incorrectly classified features in relation to the number of features that are supposed to be within the dataset.
Description	To be provided globally as an average value for the whole dataset.
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	-
Measure identifier	61 (ISO 19138)

7.4.2 Non-quantitative attribute correctness

7.4.2.1 Rate of incorrect classification for national identifier

This quality sub-element shows the data absent or incorrect in a dataset.

The assessment of this quality sub-element should be stored in the metadata element DQ_ NonQuantitativeAttributeAccuracy, described in section 8.

Name	**Rate of incorrect classification for national identifier**
Alternative name	-
Data quality element	Thematic accuracy
Data quality subelement	Non-quantitative attribute correctness
Data quality basic measure	Error rate
Definition	Number of incorrect or missing national identifiers in the data set in relation to the number of items in the data set.
Description	-
Parameter	-
Data quality value type	Real, percentage, ratio
Data quality value structure	-
Source reference	-
Example	-
Measure identifier	62 (ISO 19138)

Recommendation 14 Where metadata is not supplied at the object level data providers should supply the dataset metadata described section 7.

8 Dataset-level metadata

Metadata can be reported for each individual spatial object (spatial object-level metadata) or once for a complete dataset or dataset series (dataset-level metadata). Spatial object-level metadata is fully described in the application schema (section 5). If data quality elements are used at spatial object level, the documentation shall refer to the appropriate definition in section 7. This section only specifies dataset-level metadata elements.

For some dataset-level metadata elements, in particular on data quality and maintenance, a more specific scope can be specified. This allows the definition of metadata at sub-dataset level, e.g. separately for each spatial object type. When using ISO 19115/19139 to encode the metadata, the following rules should be followed:

- The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the scope.
- Only the following values should be used for the level element of DQ_Scope: Series, Dataset, featureType.
- If the level is featureType the levelDescription/MDScopeDescription/features element (of type Set< GF_FeatureType>) shall be used to list the feature type names.

NOTE The value featureType is used to denote spatial object type.

Mandatory or conditional metadata elements are specified in Section 8.1. Optional metadata elements are specified in Section 8.2. The tables describing the metadata elements contain the following information:

- The first column provides a reference to a more detailed description.

- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.
- The fourth column specifies the condition, under which the given element becomes mandatory (only for Table 15 and Table 16).

8.1 Mandatory and conditional metadata elements

Requirement 18	The metadata describing a spatial data set or a spatial data set series related to the theme *Transport Networks* shall comprise the metadata elements required by Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) for spatial datasets and spatial dataset series (Table 15) as well as the metadata elements specified in Table 16.

Table 15 – Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata)

Metadata Regulation Section	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.
2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographic bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	

9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

Table 16 – Mandatory and conditional theme-specific metadata for the theme *Transport Networks*

INSPIRE Data Specification *Transport Networks* Section	**Metadata element**	**Multiplicity**	**Condition**
8.1.1	Coordinate Reference System	1	
8.1.2	Temporal Reference System	0..*	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
8.1.3	Encoding	1..*	
8.1.4	Character Encoding	0..*	Mandatory, if a non-XML-based encoding is used that does not support UTF-8
8.1.5	Data Quality – Logical Consistency – Topological Consistency	0..*	Mandatory if the data set do not assure centreline topology (connectivity of centrelines) for the transport network.

8.1.1 Coordinate Reference System

Metadata element name	**Coordinate Reference System**
Definition	Description of the coordinate reference system used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type(and ISO 19115 no.)	189. MD_CRS
Domain	Either the referenceSystemIdentifier (RS_Identifier) or the projection (RS_Identifier), ellipsoid (RS_Identifier) and datum (RS_Identifier) properties shall be provided.
Implementing instructions	-
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	-
Comments	-

8.1.2 Temporal Reference System

Metadata element name	**Temporal Reference System**
Definition	Description of the temporal reference systems used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	No specific type is defined in ISO 19115 for temporal reference systems. Thus, the generic MD_ReferenceSystem element and its reference SystemIdentifier (RS_Identifier) property shall be provided.
Implementing instructions	-
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry
Example XML encoding	-
Comments	-

8.1.3 Encoding

Metadata element name	**Encoding**
Definition	Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel
ISO 19115 number and name	271. distributionFormat
ISO/TS 19139 path	distributionInfo/MD_Distribution/distributionFormat
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type (and ISO 19115 no.)	284. MD_Format
Domain	See B.2.10.4. The following property values shall be used for default and alternative encodings specified in section 9.2: Default Encoding Common Transport Elements – name: Common Transport Elements GML application schema – version: version 3.0.1; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines Road Transport Networks – name: Road Transport Networks GML application schema – version: version 3.0; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines Rail Transport Networks – name: Rail Transport Networks GML application schema – version: version 3.0; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines

	Cable Transport Networks – name: Cable Transport Networks GML application schema – version: version 3.0; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines Water Transport Networks – name: Water Transport Networks GML application schema – version: version 3.0; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines Air Transport Networks – name: Air Transport Networks GML application schema – version: version 3.0; GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines
Implementing instructions	-
Example	name: Road Transport Network GML application schema version: version 3.0, GML, version 3.2.1 specification: D2.8.I.7 Data Specification on Transport Networks – Draft Guidelines
Example XML encoding	-
Comments	-

8.1.4 Character Encoding

Metadata element name	**Metadata dataset character set**
Definition	Full name of the character coding standard used for the dataset.
ISO 19115 number and name	4. characterSet
ISO/TS 19139 path	IdentificationInfo/*/characterSet
INSPIRE obligation / condition	Mandatory, if a non-XML-based encoding is used that does not support UTF-8
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	40. MD_CharacterSetCode
Domain	Codelist (See B.5.10 of ISO 19115)
Implementing instructions	
Example	
Example XML encoding	
Comments	

8.1.5 Data Quality – Logical Consistency – Topological Consistency

Metadata element name	**Data Quality – Logical Consistency – Topological Consistency**
Definition	Correctness of the explicitly encoded topological characteristics of the dataset as described by the scope (*). Note *: 138. DQ_Scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional

INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	115. DQ_TopologicalConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clauses 7.2.4.2 and 7.2.4.3 in 7.2.4 in Chapter 7 related to missing connections due to undershoots and overshoots for detailed information. This metadata element is mandatory if connectivity is not assured for transport network centrelines in the dataset. In this case the *Connectivity tolerance* parameter – as described in 7.2.4.2 and 7.2.4.3 – must be provided in order to ensure automatic and unambiguous creation of centreline topology in post-process.

8.2 Optional metadata elements

Recommendation 15 The metadata describing a spatial data set or a spatial data set series related to the theme *Transport Networks* should comprise the theme-specific metadata elements specified in Table 17.

Table 17 – Optional theme-specific metadata for the theme *Transport Networks*

INSPIRE Data Specification *Transport Networks* Section	**Metadata element**	**Multiplicity**
8.2.1	Maintenance Information	0..1
8.2.2	Data Quality – Completeness – Commission	0..*
8.2.3	Data Quality – Completeness – Omission	0..*
8.2.4	Data Quality – Logical Consistency – Topological Consistency	0..*
8.2.5	Data Quality – Positional Accuracy – Absolute or external accuracy	0..*
8.2.6	Data Quality – Logical Consistency – Conceptual Consistency	0..*
8.2.7	Data Quality – Logical Consistency – Domain Consistency	0..*
8.2.8	Data Quality – Logical Consistency - Format Consistency	0..*
8.2.9	Data Quality – Thematic Accuracy – Thematic Classification Correctness	0..*
8.2.10	Data Quality – Thematic accuracy – Non-quantitative correctness	0..*

8.2.1 Maintenance Information

Metadata element name	**Maintenance information**
Definition	Information about the scope and frequency of updating.
ISO 19115 number and name	30. resourceMaintenance
ISO/TS 19139 path	identificationInfo/MD_Identification/resourceMaintenance
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..1
Data type(and ISO 19115 no.)	142. MD_MaintenanceInformation
Domain	This is a complex type (lines 143-148 from ISO 19115). At least the following elements should be used (the multiplicity according to ISO 19115 is shown in parentheses): – maintenanceAndUpdateFrequency [1]: frequency with which changes and additions are made to the resource after the initial resource is completed / domain value: MD_MaintenanceFrequencyCode: – updateScope [0..*]: scope of data to which maintenance is applied / domain value: MD_ScopeCode – maintenanceNote [0..*]: information regarding specific requirements for maintaining the resource / domain value: free text
Implementing instructions	-
Example	maintenanceAndUpdateFrecuency: annually
Example XML encoding	-
Comments	-

8.2.2 Data Quality – Completeness – Commission

Metadata element name	**Data Quality – Completeness – Commission**
Definition	DQ Completeness: presence and absence of features, their attributes and their relationships; Commission: excess data present in the dataset, as described by the scope (*). Note *: 138. DQ_Scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	109. DQ_CompletenessCommission
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.1.1 in Chapter 7 for detailed information.

8.2.3 Data Quality – Completeness – Omission

Metadata element name	**Data Quality – Completeness – Omission**
Definition	DQ Completeness: presence and absence of features, their attributes and their relationships; Omission: data absent from the dataset, as described by the scope (*). Note *: 138. DQ_Scope
ISO 19115 number and name	18. dataQualityInfo

ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	110. DQ_CompletenessOmission
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.1.2 in Chapter 7 for detailed information.

8.2.4 Data Quality – Logical Consistency – Topological Consistency

Metadata element name	**Data Quality – Logical Consistency – Topological Consistency**
Definition	Correctness of the explicitly encoded topological characteristics of the dataset as described by the scope (*). Note *: 138. DQ_Scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	115. DQ_TopologicalConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.2.4 in Chapter 7 for detailed information.

8.2.5 Data Quality – Positional Accuracy – Absolute or external accuracy

Metadata element name	**Data Quality - Positional accuracy - Absolute or external accuracy**
Definition	Closeness of reported coordinate values to values accepted as or being true.
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	117. DQ_AbsoluteExternalPositionalAccuracy
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.3.1 in Chapter 7 for detailed information.

8.2.6 Data Quality – Logical Consistency – Conceptual Consistency

Metadata element name	**Data Quality – Logical Consistency – Conceptual Consistency**
Definition	Adherence to rules of the conceptual schema.
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	112. DQ_ConceptualConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.2.1 in Chapter 7 for detailed information.

8.2.7 Data Quality – Logical Consistency – Domain Consistency

Metadata element name	**Data Quality – Logical Consistency – Domain Consistency**
Definition	Adherence of values to the value domains.
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	113. DQ_DomainConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.2.2 in Chapter 7 for detailed information.

8.2.8 Data Quality – Logical Consistency - Format Consistency

Metadata element name	**Data Quality – Logical Consistency – Format Consistency**
Definition	Degree to which data is stored in accordance with the physical structure of the dataset, as described by the scope (*). Note *: 138. DQ_Scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	114. DQ_FormatConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.2.3 in Chapter 7 for detailed information.

8.2.9 Data Quality – Thematic Accuracy – Thematic Classification Correctness

Metadata element name	**Data Quality – Thematic Accuracy – Thematic Classification Correctness**
Definition	Comparison of the classes assigned to features or their attributes to a universe of discourse.
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	125. DQ_ThematicClassificationCorrectness.
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	-
Example XML encoding	-
Comments	See clause 7.4.1 in Chapter 7 for detailed information.

8.2.10 Data Quality – Thematic accuracy – Non-quantitative correctness

Metadata element name	**Data Quality – Thematic accuracy- Non-quantitative attribute correctness**
Definition	Accuracy of non-quantitative attributes.
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	126. DQ_NonQuantitativeAttributeAccuracy
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	**-**
Example XML encoding	-
Comments	See clause 7.4.2 in Chapter 7 for detailed information.

8.3 Guidelines on using metadata elements defined in Regulation 1205/2008/EC

8.3.1 Conformity

The *Conformity* metadata element defined in Regulation 1205/2008/EC allows to report the conformance with the Implementing Rule for interoperability of spatial data sets and services or another specification. The degree of conformity of the dataset can be *Conformant* (if the dataset is fully conformant with the cited specification), *Not Conformant* (if the dataset does not conform to the cited specification) or *Not evaluated* (if the conformance has not been evaluated).

Recommendation 16 In order to report conceptual consistency with this INSPIRE data specification, the *Conformity* metadata element should be used. The value of *Conformant* should be used for the *Degree* element only if the dataset passes all the requirements described in the abstract test suite presented in Annex A. The *Specification* element should be given as follows:
- title: "INSPIRE Data Specification on *Transport Networks* – Guidelines"
- date:
  - dateType: publication
  - date: 2010-04-26

8.3.2 Lineage

Following the ISO 19113 Quality principles, if a data provider has a procedure for quality validation of their spatial data sets then the data quality elements listed in the Chapter 8 should be used. If not, the *Lineage* metadata element (defined in Regulation 1205/2008/EC) should be used to describe the overall quality of a spatial data set.

According to Regulation 1205/2008/EC, lineage "is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist), and whether it has legal validity. The value domain of this metadata element is free text".

Recommendation 17 Apart from describing the process history, if feasible within a free text, the overall quality of the dataset (series) should be included in the *Lineage* metadata element. This statement should contain any quality information required for interoperability and/or valuable for use and evaluation of the data set (series).

8.3.3 Temporal reference

According to Regulation 1205/2008/EC, at least one of the following temporal reference metadata elements shall be provided: temporal extent, date of publication, date of last revision, date of creation.

Recommendation 18 If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

9 Delivery

9.1 Delivery medium

Requirement 19 Data conformant to this INSPIRE data specification shall be made available through an INSPIRE network service.

Requirement 20 All information that is required by a calling application to be able to retrieve the data through the used network service shall be made available in accordance with the requirements defined in the Implementing Rules on Network Services.

EXAMPLE 1 Through the Get Spatial Objects function, a download service can either download a pre-defined data set or pre-defined part of a data set (non-direct access download service), or give direct access to the spatial objects contained in the data set, and download selections of spatial

objects based upon a query (direct access download service). To execute such a request, some of the following information might be required:

- The list of spatial object types and/or predefined data sets that are offered by the download service (to be provided through the Get Download Service Metadata operation),
- And the query capabilities section advertising the types of predicates that may be used to form a query expression (to be provided through the Get Download Service Metadata operation, where applicable),
- A description of spatial object types offered by a download service instance (to be provided through the Describe Spatial Object Types operation).

EXAMPLE 2 Through the Transform function, a transformation service carries out data content transformations from native data forms to the INSPIRE-compliant form and vice versa. If this operation is directly called by an application to transform source data (e.g. obtained through a download service) that is not yet conformant with this data specification, the following parameters are required:
Input data (mandatory). The data set to be transformed.

- Source model (mandatory, if cannot be determined from the input data). The model in which the input data is provided.
- Target model (mandatory). The model in which the results are expected.
- Model mapping (mandatory, unless a default exists). Detailed description of how the transformation is to be carried out.

9.2 Encodings

9.2.1 Encoding for application schema Common Transport Elements

Requirement 21	Data conformant to the application schema Common Transport elements shall be encoded using the encoding specified in section 9.2.1.1.

9.2.1.1 Default Encoding: GML Application Schema

Format name: Common Transport Elements GML Application Schema
Version of the format: 3.0.1, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.2 Encoding for application schema of *Road transport networks*

Requirement 22	Data conformant to the application schema of *Road transport networks* shall be encoded using the encoding specified in section 9.2.2.1.

9.2.2.1 Default Encoding: GML Application Schema

Format name: Road Transport Networks GML Application Schema
Version of the format: 3.0, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.3 Encoding for application schema of *Rail transport networks*

Requirement 23	Data conformant to the application schema of *Rail transport networks* shall be encoded using the encoding specified in section 9.2.3.1.

9.2.3.1 Default Encoding: GML Application Schema

Format name: Rail Transport Networks GML Application Schema
Version of the format: 3.0, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.4 Encoding for application schema of Cable *transport networks*

Requirement 24	Data conformant to the application schema of Cable *transport networks* shall be encoded using the encoding specified in section 9.2.4.1.

9.2.4.1 Default Encoding: GML Application Schema

Format name: Cable Transport Networks GML Application Schema
Version of the format: 3.0, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.5 Encoding for application schema of *Water transport networks*

Requirement 25	Data conformant to the application schema of *Water transport networks* shall be encoded using the encoding specified in section 9.2.5.1.

9.2.5.1 Default Encoding: GML Application Schema

Format name: Water Transport Networks GML Application Schema
Version of the format: 3.0, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

9.2.6 Encoding for application schema of *Air transport networks*

Requirement 26	Data conformant to the application schema of *Air transport networks* shall be encoded using the encoding specified in section 9.2.6.1.

9.2.6.1 Default Encoding: GML Application Schema

Format name: Air Transport Networks GML Application Schema
Version of the format: 3.0, GML, version 3.2.1
Reference to the specification of the format: ISO 19136:2007
Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

10 Data Capture

The topics in this chapter highlight specific cases that require specific attention in collecting and assembling data and information that constitutes the components of *Transport networks* (*Road, Rail, Cable, Water* and *Air)*.

10.1 Centrelines

The primary way of representing a network is by a centreline (ie a line that approximates the centre of the real world object. It would be prohibitively expensive and impracticable to faithfully record the true centreline since this would result in an irregular line and far too many data points. Therefore a pragmatic approach is often taken which results in a much smoother line requiring the minimum number of data points to represent the object.

However problems can arise when too few points are used and the line will no longer be smooth or useful in most applications. Equally the centreline may often be combined with (topographic) area objects e.g. the paved or metalled surface, or track. It may also be combined with other themes (e.g. run closely adjacent to a river or another form of transport (railway and road in a narrow gorge for example). It is therefore important that the centreline falls within the physical boundary of the object it represents.

Requirement 27	The centrelines of Road and Rail objects shall fall within the extent of the physical real world object that they represent (as illustrated in Figure 41) if the Link is indicated as not being 'fictitious'.

	Not acceptable The centreline falls outside the real world object
	Acceptable The centreline falls inside the real world object
	Not acceptable

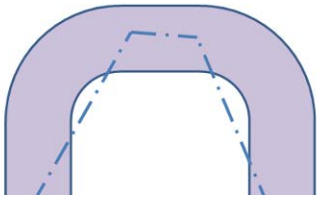
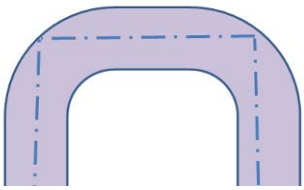
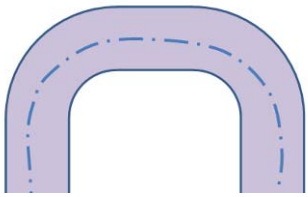
	The centreline falls outside the real world object
	Not acceptable The centreline falls inside the real world object but does not follow the shape faithfully.
	Acceptable The centreline falls inside the real world object and while it does not follow the exact centreline it is acceptable

Figure 41 – Acceptable and non acceptable forms of centreline representation.

10.2 Ensuring Network Connectivity

This data specification does not incorporate a topological model for the reasons given in Chapters 4 and 5.1.1.1. Since a users system will build the topology for an application it is essential that the data is captured in such a way that this topology build can be undertaken automatically, repeatedly and faultlessly each time.

Therefore the data has to be supplied to the user with topology “implicit” in the structure (ie it must be “clean”). This implicit topology is based on coincidence which does not have to be absolute but relies on a connectivity tolerance. This connectivity tolerance will be supplied as metadata with the transport data. (see Section 8.1.5)

When automatically constructing topological relationships:
- All points, nodes, vertices and link ends that are located at a distance of less than the connectivity tolerance of each other are considered to coincide,
- All points, nodes, vertices and link ends that are located at a distance of more than the connectivity tolerance of each other are considered not to coincide.

To ensure automatic and unambiguous creation of centreline topology:
- All link ends and the optional node that take part in a connection have to be positioned at a distance of less than the connectivity tolerance from each other,
- Link ends and nodes that are not connected shall always be separated by a distance that is greater than the connectivity tolerance.

This will ensure the correct connectivity between links and the nodes in the system. Supporting quality criteria will be found in Section 7.2.4

Requirement 28	Wherever a connection exists in a transport network, all connected link ends and the optional node that take part in this connection have to be positioned at a distance of less than the connectivity tolerance from each other.

Requirement 29	Link ends and nodes that are not connected shall always be separated by a distance that is greater than the connectivity tolerance.

Requirement 30	In datasets where both transport links and nodes are present, the relative position of nodes and link ends in relation to the specified connectivity tolerance shall correspond to the associations that exist between them in the dataset.

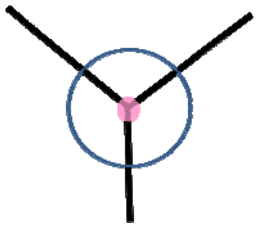
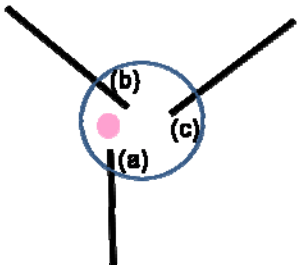
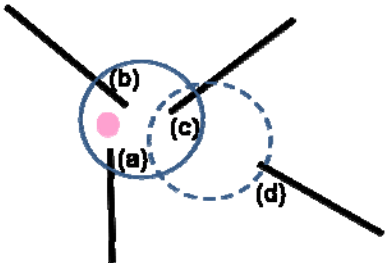
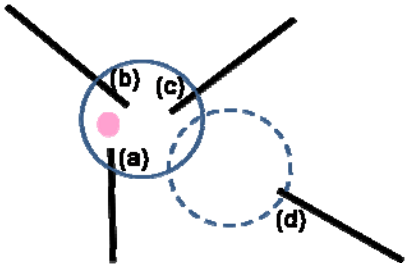
	Acceptable The perfect case where the node and all link ends share the same coordinates.
	Acceptable The three link ends (a, b and c) and the node are all within a distance of less than the connectivity tolerance (indicated by the blue circle). All of these elements will be assumed connected during an automatic topology build.
	Not acceptable The three link ends (a, b and c) and the node are all within a distance of less than the connectivity tolerance. Link end (d) lies within a distance of less than the connectivity tolerance from link end (c), but at a distance greater than the tolerance from link ends (a) and (b) and the transport node. The connectivity is ambiguous and the topology building would fail.
	Acceptable (but possible error) The three link ends (a, b and c) and the node are all within a distance of less than the connectivity tolerance and will be assumed connected during an automatic topology build. Link end (d) is at a distance greater than the tolerance from all three link ends and the node. It will be considered not connected (dangle). Note: while this is an acceptable situation for automatic topology build, it can constitute an error in the data: if, in reality, (d) is connected to (a), (b) and (c) it should be moved to within the tolerance distance from all three link ends and the node.

Figure 42 – Acceptable and unacceptable positioning of link ends and nodes.

10.3 Linear Referencing

Linear referencing as defined in the draft ISO 19148 will be adopted and aligned with the GNM (and hence this data specification) with after it reaches DIS status, The adoption in the *Transport networks* data specification is limited to a simple model at this stage.

In general it is expected that linear referencing will be used to model the relationships of objects that are associated with an network, but where the position of those associated objects is not known (or required) to a very high level of absolute accuracy ~ better than 1-3m at local level (e.g. traffic accidents, planned works, restrictions).

The position of centrelines and nodes in a network in many cases will vary from the “true position” (since the centreline is rarely that and the node is not a tangible physical feature or location (see 10.1 above).

Where absolute accuracy is required (e.g. the location of drain covers, excavations, line side signalling equipment, masts etc) such objects should be reused, and referenced, if they already exist e.g. as topographic features.

10.4 Alternative and Multiple Representations

Alternative and multiple representations are discussed further in Annex B.1.

Alternative Representations
Where centreline and topographic area objects coexist it is important that users holding information on one of these forms can share information with another e.g. details of a planned excavation at the topographic level with the corresponding centreline representation to plan diversions during the time of the works. It is important therefore that these alternative representations are well synchronised and follow the requirement in 10.1. Cross referencing them will support easy and unambiguous data exchange and support synchronised maintenance (see Annex B.1) – which ever organisation is responsible for the alternative forms.

Recommendation 16 Alternative representations should be cross referenced to support data sharing and synchronised maintenance.

Multiple Representations
In this sense the different resolutions may extend from the local to European level in a number of steps (levels of detail). An ideal model is described in D2.6 A.19 but has yet to be fully developed and realised.

At the moment transforming existing vector datasets, at different levels of detail, beyond the local level to this data specification will not necessarily result in a set of harmonised transport networks for each of the themes *Road, Rail, Water* (this will be dependent on the *Hydrography* specification) and *Air* (where there are probably fewer levels of detail).

Nevertheless as a step towards a more harmonised model users should aim to collect their own application data and hold that once and reference it to each corresponding level of detail (rather than embed the application data in the local or intermediate level). This will promote reuse, easier data sharing and make national and European reporting (through aggregation) easier.

Recommendation 17 As a step towards a more harmonised set of levels of detail, users should hold their application data once and simply reference this to each level of detail in a network.

11 Portrayal

This clause defines the rules for layers and styles to be used for portrayal of the spatial object types defined for this theme.

In section 11.1, the *types* of layers are defined that are to be used for the portrayal of the spatial object types defined in this specification. A view service may offer several layers of the same type, one for each dataset that it offers on a specific topic.

Section 11.2 specifies the default styles to be used for each of these layer types, while section 11.3 specifies other well-defined styles.

The XML fragments in these sections use the following namespace prefixes:
- sld="http://www.opengis.net/sld" (WMS/SLD 1.1)
- se="http://www.opengis.net/se" (SE 1.1)
- ogc="http://www.opengis.net/ogc" (FE 1.1)

Transport Networks can be styled using basic geometry types expressed below in section 11.1. These styles can be broken down further by organizations based upon furthering requirements as necessary. Below are some recommended stylings to allow basic visualisation.

11.1 Layer Types

Requirement 31	If an INSPIRE view services supports the portrayal of data related to the theme *Transport Networks*, it shall provide layers of the types specified in this section.

Table 18: Layer types for the spatial data theme *Transport Networks*

Layer Type	Layer Title	Spatial object type(s)	Keywords
TN.CommonTransportElements.TransportNode	Generic Transport Node Default Style	Transport Node	Generic Transport Node, default style, Transport Networks.
TN.CommonTransportElements.TransportLink	Generic Transport Link Default Style	Transport Link	Generic Transport Node, default style, Transport Networks.
TN.CommonTransportElements.TransportArea	Generic Transport Area Default Style	Area	Generic Transport Area, default style, Transport Networks.
TN.RoadTransportNetwork.RoadLink	RoadLink default Style	RoadLink	Transport Networks, RoadLink, Default Style
TN.RoadTransportNetwork.VehicleTrafficArea	Vehicle traffic Area Default Style	VehicleTrafficArea	Transport Network, Road Transport Network, Vehicle Traffic Area, Default Style
TN.RoadTransportNetwork.RoadServiceArea	Road Service Area Default Style	RoadServiceArea	Transport Network, Road Transport Network,Road Service Area, Default Style
TN.RoadTransportNetwork.RoadArea	Road Area Default Style	RoadArea	Transport Network, Road Transport Network, Road Area, Default Style
TN.RailTransportNetwo	Railway Link Default	RailwayLink	Transport Network, Rail

rk.RailwayLink	Style		Transport Network, Railway Link, Default Style
TN.RailTransportNetwork.RailwayStationArea	Railway Station Area Default Style	RailwayStationArea	Transport Network, Rail Transport Network, Railway Station Area, Default Style
TN.RailTransportNetwork.RailwayYardArea	Railway Yard Area Default Style	RailwayYardAreaDefaultStyle	Transport Network, Rail Transport Network, Railway Yard Area, Default Style
TN.RailTransportNetwork.RailwayArea	RailwayArea	RailwayAreaDefaultStyle	Transport Network, Rail Transport Network, Railway Area, Default Style
TN.WaterTransportNetwork.WaterwayLink	Waterway Link Default Style	WaterwayLinkDefaultStyle	Transport Network, Water Transport Network, Waterway Link, Default Style
TN.WaterTransportNetwork.FairwayArea	Fairway Area Default Style	FairwayAreaDefaultStyle	Transport Network, Water Transport Network, Fairway Area, Default Style
TN.WaterTransportNetwork.PortArea	Port Area Default Style	PortAreaDefaultStyle	Transport Network, Water Transport Network, Port Area, Default Style
TN.AirTransportNetwork.AirLink	Air Link Default Style	AirLinkDefaultStyle	Transport Network, Air Transport Network, Air Link, Default Style
TN.AirTransportNetwork.AerodromeArea	Aerodrome Area Default Style	AerodromeAreaDefaultStyle	Transport Network, Air Transport Network, Aerodrome Area, Default Style
TN.AirTransportNetwork.RunwayArea	Runway Area Default Style	RunwayAreaDefaultStyle	Transport Network, Air Transport Network, Runway Area, Default Style
TN.AirTransportNetwork.AirSpaceArea	Air Space Area Default Style	AirSpaceAreaDefaultStyle	Transport Network, Air Transport Network, Air Space Area, Default Style
TN.AirTransportNetwork.ApronArea	Apron Area Default Style	ApronAreaDefaultStyle	Transport Network, Air Transport Network, Apron Area, Default Style
TN.AirTransportNetwork.TaxiwayArea	Taxiway Area Default Style	TaxiwayAreaDefaultStyle	Transport Network, Air Transport Network, Taxi Runway Area, Default Style
TN.CableTransportNetwork.CablewayLink	Cableway Link Default Style	CableLinkDefaultStyle	Transport Network, Cable Transport Network, Cable Link, Default Style

11.2 Default Styles

Requirement 32	If an INSPIRE view network service supports the portrayal of spatial data sets corresponding to the spatial data theme *Transport Networks*, it shall support the default styles specified in the tables in this section. If no user-defined style is specified in a portrayal request for a specific layer to an INSPIRE view service, the default style specified in this section for that layer shall be used.

Table 19: Default styles for the spatial data theme *Transport Networks*

Layer Name	**TN.CommonTransportElements.TransportNode**
Style Name	TN.CommonTransportElements.TransportNode.Default
Style Title	Generic Transport Node Default Style
Style Description	The geometry is rendered as a circle with a size of 3 pixels, with a red (#FF0000) fill and a black outline (#000000).
Symbology	<sld:NamedLayer> <se:Name>TN.CommonTransportElements.TransportNode</se:Name> <sld:UserStyle> <se:Name> TN.CommonTransportElements.TransportNode.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Generic Node Default Style</se:Title> <se:Abstract>The geometry is rendered as a circle with a size of 3 pixels, with a red (#FF0000) fill and a black outline (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>Network:Node</se:FeatureTypeName> <se:Rule> <se:PointSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry </ogc:PropertyName> </se:Geometry> <se:Graphic/> </se:PointSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.CommonTransportElements.TransportLink**
Style Name	TN.CommonTransportElements.TransportLink.Default
Style Title	Generic Transport Link Default Style
Style Description	The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#000000). Ends are rounded and have a 2 pixel black casing (#000000).

Symbology	<sld:NamedLayer> <se:Name>TN.CommonTransportElements.TransportLink</se:Name> <sld:UserStyle> <se:Name> TN.CommonTransportElements.TransportLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Generic Link Default Style</se:Title> <se:Abstract> The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#000000). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>Network:Link</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centerlineGeometry </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.CommonTransportElements.TransportArea**
Style Name	TN.CommonTransportElements.TransportArea.Default
Style Title	Generic Transport Area Default Style
Style Description	The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.CommonTransportElements.TransportArea</se:Name> <sld:UserStyle> <se:Name> TN.CommonTransportElements.TransportArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Generic Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>Network:Area</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RoadTransportNetwork.RoadLink**
Style Name	TN.RoadTransportNetwork.RoadLink.Default
Style Title	RoadLink Default Style
Style Description	The geometry is rendered as a solid green line with a stroke width of 3 pixel (#008000). Ends are rounded and have a 2 pixel black casing (#000000).

Symbology	<sld:NamedLayer> <se:Name>TN.RoadTransportNetwork.RoadLink</se:Name> <sld:UserStyle> <se:Name> TN.RoadTransportNetwork.RoadLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>RoadLink Default Style</se:Title> <se:Abstract> The geometry is rendered as a solid Green line with a stroke width of 3 pixel (#008000). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RoadLink</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centrelineGeometry </ogc:PropertyName> </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RoadTransportNetwork.RoadServiceArea**
Style Name	TN.RoadTransportNetwork.RoadServiceArea.Default
Style Title	Road Service Area Default Style
Style Description	The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.RoadTransportNetwork.RoadServiceArea</se:Name> <sld:UserStyle> <se:Name> TN.RoadTransportNetwork.RoadServiceArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Road Service Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RoadServiceArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RoadTransportNetwork.RoadArea**
Style Name	TN.RoadTransportNetwork.RoadArea.Default
Style Title	Road Area Default Style
Style Description	The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.RoadTransportNetwork.RoadArea</se:Name> <sld:UserStyle> <se:Name> TN.RoadTransportNetwork.RoadArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Road Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RoadArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RoadTransportNetwork.VehicleTrafficArea**
Style Name	TN.RoadTransportNetwork.VehicleTrafficArea.Default
Style Title	Vehicle Traffic Area Default Style
Style Description	The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.RoadTransportNetwork.VehicleTrafficArea</se:Name> <sld:UserStyle> <se:Name> TN.RoadTransportNetwork.VehicleTrafficArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Vehicle Traffic Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a grey (#A9A9A9) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:VehicleTrafficArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RailTransportNetwork.RailwayLink**
Style Name	TN.RailTransportNetwork.RailwayLink.Default
Style Title	Railway Link Default Style
Style Description	The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#000000). Ends are rounded and have a 2 pixel black casing (#000000).

Symbology	<sld:NamedLayer> <se:Name>TN.RailTransportNetwork.RailwayLink</se:Name> <sld:UserStyle> <se:Name> TN.RailTransportNetwork.RailwayLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Railway Link Default Style</se:Title> <se:Abstract> The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#000000). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RailwayLink</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centerlineGeometry </ogc:PropertyName> </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RailTransportNetwork.RailwayStationArea**
Style Name	TN.RailTransportNetwork.RailwayStationArea.Default
Style Title	Railway Station Area Default Style
Style Description	The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.RailTransportNetwork.RailwayStationArea</se:Name> <sld:UserStyle> <se:Name> TN.RailTransportNetwork.RailwayStationArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Railway Station Area</se:Title> <se:Abstract> The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RailwayStationArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RailTransportNetwork.RailwayYardArea**
Style Name	TN.RailTransportNetwork.RailwayYardArea.Default
Style Title	Railway Yard Area Default Style
Style Description	The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.RailTransportNetwork.RailwayYardArea</se:Name> <sld:UserStyle> <se:Name> TN.RailTransportNetwork.RailwayYardArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Railway Yard Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RailwayYardArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.RailTransportNetwork.RailwayArea**
Style Name	TN.RailTransportNetwork.RailwayArea.Default
Style Title	Railway Area Default Style
Style Description	The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.RailTransportNetwork.RailwayArea</se:Name> <sld:UserStyle> <se:Name> TN.RailTransportNetwork.RailwayArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Railway Yard Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a Brown (#8B4513) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RailwayYardArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.WaterTransportNetwork.WaterwayLink**
Style Name	TN.WaterTransportNetwork.WaterwayLink.Default
Style Title	Waterway Link Default Style
Style Description	The geometry is rendered as a solid Violet line with a stroke width of 3 pixel (#EE82EE). Ends are rounded and have a 2 pixel black casing (#000000).

Symbology	<sld:NamedLayer> <se:Name>TN.WaterTransportNetwork.WaterwayLink</se:Name> <sld:UserStyle> <se:Name> TN.WaterTransportNetwork.WaterwayLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Waterway Link Default Style</se:Title> <se:Abstract>The geometry is rendered as a solid violet line with a stroke width of 3 pixel (#EE82EE). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>TN:WaterwayLink</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centerlineGeometry</ogc:PropertyName> </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.WaterTransportNetwork.FairwayArea**
Style Name	TN.WaterTransportNetwork.FairwayArea.Default
Style Title	Fairway Area default style
Style Description	The geometry is rendered using a Blue (#4169E1) fill and a solid black (#000000) outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.WaterTransportNetwork.FairwayArea</se:Name> <sld:UserStyle> <se:Name> TN.WaterTransportNetwork.FairwayArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Fairway Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a Blue (#4169E1) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:FairwayArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.WaterTransportNetwork.PortArea**
Style Name	TN.WaterTransportNetwork.PortArea.Default
Style Title	Port Area default style
Style Description	The geometry is rendered using a Grey (#696969) fill and a solid black (#000000) outline with a stroke width of 1 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.WaterTransportNetwork.PortArea</se:Name> <sld:UserStyle> <se:Name> TN.WaterTransportNetwork.PortArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Port Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a Grey (#696969) fill and a solid black (#000000) outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:PortArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.AirLink**
Style Name	TN.AirTransportNetwork.AirLink.Default
Style Title	Air Link default style
Style Description	The geometry is rendered as a solid Maroon line with a stroke width of 3 pixel (#800000). Ends are rounded and have a 2 pixel black casing (#000000).
Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.AirLink</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.AirLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>AirAir Link Default Style</se:Title> <se:Abstract> The geometry is rendered as a solid Maroon line with a stroke width of 3 pixel (#800000). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>TN:AirLink</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centerlineGeometry</ogc:PropertyName> </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.AerodromeArea**
Style Name	TN.AirTransportNetwork.AerodromeArea.Default
Style Title	Aerodrome Area default style
Style Description	The geometry is rendered using a 50% Blue (#0000CD) fill and a solid Blue (#0000CD)outline with a stroke width of 1 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.AerodromeArea</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.AerodromeArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Aerodrome Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a 50% Blue (#0000CD) fill and a solid Blue (#0000CD)outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:AerodromeArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.RunwayArea**
Style Name	TN.AirTransportNetwork.RunwayArea.Default
Style Title	Runway Area default style
Style Description	The geometry is rendered using a White (#FFFFFF) fill and a solid Blue (#0000CD)outline with a stroke width of 2 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.RunwayArea</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.RunwayArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Runway Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a White (#FFFFFF) fill and a solid Blue (#0000CD)outline with a stroke width of 2 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:RunwayArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.AirSpaceArea**
Style Name	TN.AirTransportNetwork.AirSpaceArea.Default
Style Title	Air Space Area Default Style
Style Description	The geometry is rendered using a 25% Megenta (#8B008B) fill and a solid Megenta (#8B008B) outline with a stroke width of 2 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.AirspaceArea</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.AirSpaceArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Airspace Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a 25% Megenta (#8B008B) fill and a solid Megenta (#8B008B) outline with a stroke width of 2 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:AirspaceArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.ApronArea**
Style Name	TN.AirTransportNetwork.ApronArea.Default
Style Title	Apron Area Default Style
Style Description	The geometry is rendered using a 50% grey (#808080) fill and a solid black outline with a stroke width of 1 pixel.
Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.ApronArea</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.ApronArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Apron Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a 50% grey (#808080) fill and a solid black outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:ApronArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.AirTransportNetwork.TaxiwayArea**
Style Name	TN.AirTransportNetwork.TaxiwayArea.Default
Style Title	Taxiway Area Default Style
Style Description	The geometry is rendered using a Blue (#B0E0E6) fill and a solid black outline with a stroke width of 1 pixel.

Symbology	<sld:NamedLayer> <se:Name>TN.AirTransportNetwork.TaxiwayArea</se:Name> <sld:UserStyle> <se:Name> TN.AirTransportNetwork.TaxiwayArea.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>Taxiway Area Default Style</se:Title> <se:Abstract>The geometry is rendered using a Blue (#B0E0E6) fill and a solid black outline with a stroke width of 1 pixel.</se:Abstract> </se:Description> <se:FeatureTypeName>TN:TaxiwayArea</se:FeatureTypeName> <se:Rule> <se:PolygonSymbolizer> <se:Geometry> <ogc:PropertyName>Network:geometry</ogc:PropertyName> </se:Geometry> <se:Fill/> <se:Stroke/> </se:PolygonSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>
Layer Name	**TN.CableTransportNetwork.CablewayLink**
Style Name	TN.CableTransportNetwork.CablewayLink.Default
Style Title	Cable Transport Network default style
Style Description	The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#B10787). Ends are rounded and have a 2 pixel black casing (#000000).
Symbology	<sld:NamedLayer> <se:Name>TN.CableTransportNetwork.CablewayLink</se:Name> <sld:UserStyle> <se:Name> TN.CableTransportNetwork.CablewayLink.Default</se:Name> <sld:IsDefault>1</sld:IsDefault> <se:FeatureTypeStyle version="1.1.0"> <se:Description> <se:Title>CableTransportNetworkDefaultStyle</se:Title> <se:Abstract> The geometry is rendered as a solid Black line with a stroke width of 3 pixel (#B10787). Ends are rounded and have a 2 pixel black casing (#000000).</se:Abstract> </se:Description> <se:FeatureTypeName>CablewayLink</se:FeatureTypeName> <se:Rule> <se:LineSymbolizer> <se:Geometry> <ogc:PropertyName>Network:centerlineGeometry</ogc:PropertyName> </se:Geometry> <se:Stroke/> </se:LineSymbolizer> </se:Rule> </se:FeatureTypeStyle> </sld:UserStyle> </sld:NamedLayer>

11.3 Other Well-defined Styles

Requirement 33	If an INSPIRE view service supports the portrayal of spatial data sets corresponding to the spatial data themes *Transport Networks*, apart from the

default styles specified in Section 11.2, it shall also support the well-defined styles specified in this section.

There are no Well-defined Styles specified at this time

11.4 Layers organization

There are no Layers organisation are specified at this time

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Route 500 descriptif technique
IGN France
www.ign.fr

S-100 (IHO Hydrographic Geospatial Standard for Marine Data and Information)
(only draft version available – not yet a standard)
http://www.iho-ohi.net/english/home/

S-32 (IHO International Hydrographic Dictionary) -
http://www.iho.shom.fr/Dhydro/Html/site_edition/disclaimer.html

S-57 Electronic Navigational Chart Product Specification
IHO
http://www.iho-ohi.net/english/home/

Single European Sky
http://ec.europa.eu/transport/air_portal/sesame/index_en.htm

SIS/TK 320 Road and railway information
Stanli, Sweden
www.**stanli**.se

Skyguide Glossary, Switzerland
http://www.skyguide.ch/en/Tools/Glossary/glossary.xml

Specification Georoute
IGN France
www.ign.fr

Spécifications BD Uni v0.1
IGN France
www.ign.fr

Spécifications des données de réference et Avis du CNIG
CNIG, France
www.**cnig**.gouv.fr

Specifikation for fælles objekt typer (Common object types specification)
National Survey and Cadastre, Denmark
www.**kms**.dk

SS 63 70 04-1 (draft) Geographic information – Road and railway network – Part 1: Concept model and application schema
SIS, Swedish Standards Institute
www.**stanli**.se

SS 63 70 04-1:2006 Geographic information – Road and Railway networks - Part 1: Concept model and application schema
SIS, Swedish Standards Institute
www.**stanli**.se

Annex A
(normative)

Abstract Test Suite

Any dataset conforming to this INSPIRE data specification shall meet all requirements specified in this document.

NOTE: A common abstract test suite including detailed instructions on how to test each requirement will be added at a later stage. This should also cover additional requirements.

Annex B
(informative)

Imported Types

This annex lists definitions for feature types, data types, enumerations and code lists that are defined in other documents. The annex is purely informative and should help the reader understand the feature catalogues presented in sections 5.2.2, 5.3.2, 5.4.2, 5.5.2, 5.6.2 and 5.7.2. For the normative documentation of these types, see the references in sections 5.x.2.1 to 5.x.2.3.

B.1 Spatial object types

B.1.1 CrossReference

CrossReference	
Definition:	Represents a reference between two elements in the same network.
Description:	The cross reference may represent the case where two elements are different representations of the same spatial object.
Status:	Proposed
Stereotypes:	«featureType»
Association role: element	
Value type:	NetworkElement
Definition:	The cross referenced elements
Multiplicity:	2

B.1.2 GeneralisedLink

GeneralisedLink (abstract)	
Subtype of:	NetworkElement
Definition:	Abstract base type representing a linear network element that may be used as a target in linear referencing.
Status:	Proposed
Stereotypes:	«featureType»

B.1.3 GradeSeparatedCrossing

GradeSeparatedCrossing	
Subtype of:	NetworkElement
Definition:	Indicator which of two or more intersecting elements is/are above and which is/are below, to be used if elevation coordinates are not present or cannot be trusted.
Description:	NOTE 1 In most cases, the number of elements will be two. NOTE 2 In the normal case this is when elements intersect in the x/y-plane when the z coordinate is not present or is not accurate enough.
Status:	Proposed
Stereotypes:	«featureType»
Association role: element	
Value type:	Link
Definition:	
Multiplicity:	2..*

B.1.4 Link

Link (abstract)	
Subtype of:	GeneralisedLink
Definition:	Curvilinear network element that connects two positions and represents a homogeneous path in the network. The connected positions may be represented as nodes.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: centrelineGeometry	
Value type:	GM_Curve
Definition:	The geometry that represents the centreline of the link.
Multiplicity:	1
Attribute: fictitious	
Value type:	Boolean
Definition:	Indicator that the centreline geometry of the link is a straight line with no intermediate control points – unless the straight line represents the geography in the resolution of the dataset appropriately.
Multiplicity:	1
Association role: endNode	
Value type:	Node
Definition:	The optional end node for this link. The end node may be the same instance as the start node.
Multiplicity:	0..1
Association role: startNode	
Value type:	Node
Definition:	The optional start node for this link.
Multiplicity:	0..1

B.1.5 LinkSequence

LinkSequence (abstract)	
Subtype of:	GeneralisedLink
Definition:	A network element which represents a continuous path in the network without any branches. The element has a defined beginning and end and every position on the link sequence is identifiable with one single parameter such as length.
Description:	EXAMPLE A link sequence may represent a route.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: link	
Value type:	DirectedLink
Definition:	The ordered collection of directed links that constitute the link sequence.
Multiplicity:	1..*
Collection Constraints:	ordered

B.1.6 LinkSet

LinkSet (abstract)	
Subtype of:	NetworkElement
Definition:	A collection of link sequences and/or individual links that has a specific function or significance in a network.

LinkSet (abstract)	
Description:	NOTE This spatial object type supports the aggregation of links to form objects with branches, loops, parallel sequences of links, gaps, etc. EXAMPLE A dual carriageway road, as a collection of the two link sequences that represent each carriageway.
Status:	Proposed
Stereotypes:	«featureType»
Association role: link	
Value type:	GeneralisedLink
Definition:	
Multiplicity:	1..*

B.1.7 Network

Network	
Definition:	A network is a collection of network elements.
Description:	The reason for collecting certain elements in a certain network may vary (e.g. connected elements for the same mode of transport)
Status:	Proposed
Stereotypes:	«featureType»
Attribute: geographicalName	
Value type:	GeographicalName
Definition:	Geographical name for this network.
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: elements	
Value type:	NetworkElement
Definition:	The collection of elements that constitutres the network.
Multiplicity:	0..*

B.1.8 NetworkArea

NetworkArea (abstract)	
Subtype of:	NetworkElement
Definition:	A 2-dimensional element in a network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: geometry	
Value type:	GM_Surface
Definition:	Represents the geometric properties of the area
Multiplicity:	1

B.1.9 NetworkConnection

NetworkConnection	
Subtype of:	NetworkElement
Definition:	Represents a logical connection between two or more network elements in different networks.
Description:	In the case where the networks are in different spatial data sets, a network connection object may exist in both data sets.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: type	

NetworkConnection	
Value type:	ConnectionTypeValue
Definition:	Categorisation of the network connection.
Multiplicity:	1
Stereotypes:	«voidable»
Association role: element	
Value type:	NetworkElement
Definition:	Network elements in different networks
Multiplicity:	2..*
Constraint: Elements in different networks	
Natural language:	All elements have to be in different networks
OCL:	inv: element->forAll(e1, e2 | e1<>e2 implies e1.inNetwork->excludesAll(e2.inNetwork))

B.1.10 NetworkElement

NetworkElement (abstract)	
Definition:	Abstract base type representing an element in a network. Every element in a network provides some function that is of interest in the network.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: beginLifespanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the network element was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«lifeCycleInfo,voidable»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the network element.
Description:	NOTE An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Multiplicity:	0..1
Attribute: endLifespanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the network element was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«lifeCycleInfo,voidable»
Association role: inNetwork	
Value type:	Network
Definition:	The networks in which a network element is a member.
Multiplicity:	1..*
Stereotypes:	«voidable»

B.1.11 NetworkProperty

NetworkProperty (abstract)	
Definition:	Abstract base type representing phenomena located at or along a network element. This base type provides general properties to associate the network-related phenomena (network properties) with the network elements.

NetworkProperty (abstract)	
Description:	In the simplest case (NetworkReference), the network property applies to the whole network element. In the case of a Link, the spatial reference may be restricted to part of the Link by using a linear reference. ISO/TC 211 is currently in the early stages of developing a standard for Linear Referencing (ISO 19148). A simple mechanism to express linear references is provided in this version of the network model; it is expected that the model will be extended once ISO 19148 is stable. The current simple model requires for all linear references two expressions representing a distance from the start of the Link along its curve geometry. The network property applies to the part of the Link between fromPosition and toPosition.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: networkRef	
Value type:	NetworkReference
Definition:	Spatial reference of the network-related property.
Description:	This attribute provides an indirect spatial reference based on a reference to an element of an underlying network. See the chapter on Object Referencing in the Generic Conceptual Model for a discussion on modelling object references.
Multiplicity:	1..*
Stereotypes:	«voidable»
Attribute: inspireId	
Value type:	Identifier
Definition:	External object identifier of the network property.
Description:	NOTE An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Multiplicity:	0..1
Attribute: beginLifespanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the network element was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»
Attribute: endLifespanVersion	
Value type:	DateTime
Definition:	Date and time at which this version of the network element was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

B.1.12 Node

Node (abstract)	
Subtype of:	NetworkElement
Definition:	Represents a significant position in the network that always occurs at the beginning or the end of a link.
Description:	NOTE if a topological representation of the network is used the road node is either a topological connection between two or more links or the termination of a ink. If a geometric representation of the network is used road nodes are represented by points or alternatively another geometric shape. [EuroRoadS]
Status:	Proposed
Stereotypes:	«featureType»
Attribute: geometry	

Node (abstract)	
Value type:	GM_Point
Definition:	The location of the node.
Multiplicity:	1
Association role: spokeEnd	
Value type:	Link
Definition:	The links that enter the node.
Description:	NOTE In the INSPIRE context, this spoke property is to be published when this information is published in current exchange formats of the data set.
Multiplicity:	0..*
Stereotypes:	«voidable»
Association role: spokeStart	
Value type:	Link
Definition:	The links that leave the node.
Description:	NOTE In the INSPIRE context, this spoke property is to be published when this information is published in current exchange formats of the data set.
Multiplicity:	0..*
Stereotypes:	«voidable»

B.2 Data types

B.2.1 DirectedLink

DirectedLink	
Definition:	A link either in its positive or negative direction.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: direction	
Value type:	Sign
Definition:	Indicates if the directed link agrees (positive) or disagrees (negative) with the positive direction of the link.
Multiplicity:	1
Association role: link	
Value type:	Link
Definition:	The link
Multiplicity:	1

B.2.2 LinkReference

LinkReference	
Subtype of:	NetworkReference
Definition:	A network reference to a linear network element.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: applicableDirection	
Value type:	LinkDirectionValue
Definition:	The directions of the generalised link to which the reference applies. In cases where a property does not apply *to* a direction along a link, but represents a phenomenon *along* a link, “inDirection” refers to the right side in the of the link.
Description:	EXAMPLE A speed limit is a property that applies to a direction of the link (or both directions) while a house number is a phenomenon along a link.
Multiplicity:	1
Stereotypes:	«voidable»

LinkReference	
Constraint: Linear reference targets must be linear network elements	
Natural language:	Linear reference targets must be linear network elements. I.e., if linear referencing is used or direction is relevant, the target of the network reference shall be a link or a link sequence.
OCL:	inv: element.oclIsKindOf(GeneralisedLink)

B.2.3 NetworkReference

NetworkReference	
Definition:	A network reference to a network element.
Status:	Proposed
Stereotypes:	«dataType»
Association role: element	
Value type:	NetworkElement
Definition:	
Multiplicity:	1
Stereotypes:	«version»

B.2.4 SimpleLinearReference

SimpleLinearReference	
Subtype of:	LinkReference
Definition:	A network reference that is restricted to part of a linear network element. The part is the part of the network element between the position along the network element between fromPosition and toPosition.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: fromPosition	
Value type:	Length
Definition:	The start position of the linear element, expressed as the distance from the start of the linear network element along its curve geometry.
Multiplicity:	1
Attribute: toPosition	
Value type:	Length
Definition:	The end position of the linear element, expressed as the distance from the start of the linear network element along its curve geometry.
Multiplicity:	1
Attribute: offset	
Value type:	Length
Definition:	An offset from the centerline geometry of the generalised link, where applicable; a positive offset is to the right in the direction of the link, a negative offset is to the left.
Multiplicity:	0..1
Stereotypes:	«voidable»

B.2.5 SimplePointReference

SimplePointReference	
Subtype of:	LinkReference
Definition:	A network reference that is restricted to a point on a linear network element. The point is the location on the network element at the position atPosition along the network.
Status:	Proposed
Stereotypes:	«dataType»

SimplePointReference	
Attribute: atPosition	
Value type:	Length
Definition:	Position of the point, expressed as the distance from the start of the linear network element along its curve geometry.
Multiplicity:	1
Attribute: offset	
Value type:	Length
Definition:	An offset from the centerline geometry of the generalised link, where applicable; a positive offset is to the right in the direction of the link, a negative offset is to the left.
Multiplicity:	0..1
Stereotypes:	«voidable»

B.3 Enumerations and code lists

B.3.1 ConnectionTypeValue

ConnectionTypeValue	
Definition:	Types of connections between different networks.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:ConnectionTypeValue
Value: crossBorderConnected	
Definition:	Connection between two network elements in different networks of the same type, but in adjacent areas. The referenced network elements represent the different, but spatially connected real-world phenomena.
Value: intermodal	
Definition:	Connection between two network elements in different transport networks that use a different transport mode. The connection represents a possibility for the transported media (people, goods, etc) to change from one transport mode to another.
Value: crossBorderIdentical	
Definition:	Connection between two network elements in different networks of the same type, but in adjacent areas. The referenced network elements represent the same real-world phenomena.

B.3.2 LinkDirectionValue

LinkDirectionValue	
Definition:	List of values for directions relative to a link
Status:	Proposed
Stereotypes:	«codeList»
Governance:	Centrally managed in INSPIRE code list register. URN: urn:x-inspire:def:codeList:INSPIRE:LinkDirectionValue
Value: bothDirections	
Definition:	In both directions.
Value: inDirection	
Definition:	In direction of the link.
Value: inOppositeDirection	
Definition:	In the opposite direction of the link.

Annex C
(informative)

Supplementary Information regarding alternative representations of network objects

C.1 Alternative Representations

This section describes the three main forms of road, rail and water transport network representation. The model supports Physical (topographic) and centreline representations.

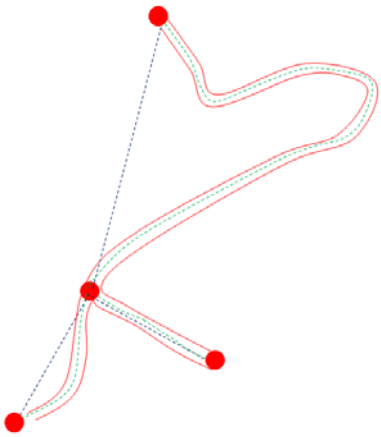

Figure C1-1. Alternative transport network Representations

In the above Figure B1-1 the road is represented in three forms:

a) **Physical (topographic) extents.** The lines shown in red above (ie edges of area objects) normally represent the extent of the surface of the highway, (or banks of the river at a given time of year e.g. winter water level). The area is normally segmented into several sub units (not shown on this sketch) where their aggregation will define the full extent of the road or river. Narrow sections will often be represented by a single line.

   This network can only be inferred since there is no knowledge of which objects connect in any ordered sequence or state (though this could be achieved if required – it is not covered on this version of the specification. Similar approaches are applicable to road, air and some aspects of cable and rail networks.

b) **Centreline model** – (the green dashed line above) is a set of (or aggregation of) lines that represent the centre of the physical object e.g. a road or river – this usually the approximate centre (sometimes known as a reference line instead because of this). Nodes (red disks) are also shown in the figure above.

   Generally this approach will support topology and specific forms of network analysis. Therefore the sequence and relationships between the lines is understood and in some cases ordered. Nodes may be implied or explicit. All spatial objects will be described by coordinates.

   Centrelines are often linked to the underlying physical (topographic) extents – see Figure B1-2 below.

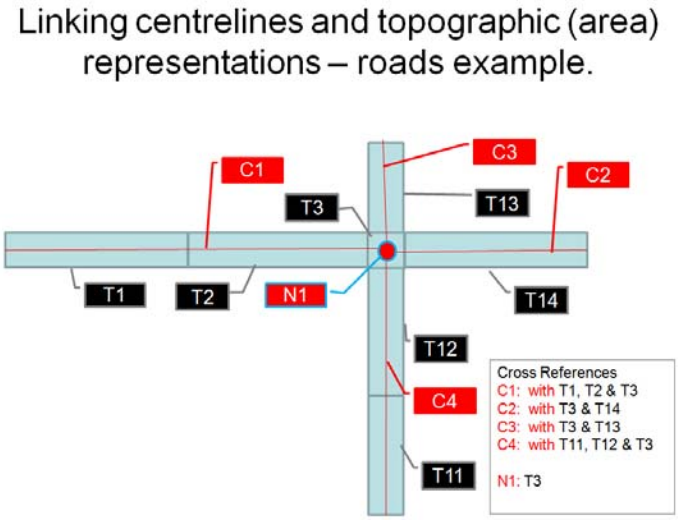

Figure C1-2: Linking centrelines and physical (topographic) extents

c) **Logical model** – (the blue dashed line in Figure B1-1 above) is a set of lines linking all the nodes of the network (chosen to be junctions & ends). The spatial content is therefore limited or non-existent (spatial coordinates of the nodes are not always included) and the logical model has limited value to a *spatial* data infrastructure but it is used in some transport operations. The approach can be modelled in this specification by simply inserting a single link between nodes.

d) **Aligning Logical and Centreline Models:** users may if they wish align a logical model with the centreline/physical models to share information between them within a set of applications. This can be achieved by relating (e.g. cross referencing all those nodes that are common in each system). The logical model can then inherit the spatial location of the centreline nodes which will provide a level of spatial positioning and interoperability.