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UNITED NATIONS COMMITEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

# Core Spatial Data Theme 'Transport Networks' - Recommendation for Content

Working Group A - Deliverable of Task 1.b

**Version 1.1 - 2022-06-17**

## Version History

| Version number | Date | Modified by | Comments |
|---|---|---|---|
| 1.0 | 2019-05-24 | WG A | Consolidated draft, for review by geographical and statistical community |
| 1.1 | 2022.06.17 | WG A | Final version, taking into account the comments from the geographical and statistical community |

Warning: in the following parts of this document, the paragraphs written in grey e.g. "This document has annexes containing more detailed explanations " are common to all core spatial data themes; they aim to provide context and objectives of core data. The paragraphs written in black are specific to core spatial data themes Transport Networks.

# Content

# 1 Executive Summary

In September 2015 the countries of the United Nations adopted the 2030 Agenda for Sustainable Development; a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda are supported by 169 targets and 230 indicators.

Geospatial data supports the measuring, achieving and monitoring of many of the goals and targets set by the 2030 Agenda. The 2030 Agenda demands new data acquisition and integration approaches to improve the availability, quality, timeliness and disaggregation of data. Goal 17 explicitly emphasizes the need for developing capacities and partnerships. In this context the success of the 2030 Agenda depends on senior administrators owning and leading the geospatial efforts in their respective countries.

In Europe, building on the INSPIRE Directive redirecting the focus on a cohesive spatial data infrastructure without gaps in content and discrepancies in quality, stakeholders are working on geospatial standardization and increasing richness of data through Core Data Recommendations for Content that correspond to the first phase of WGA work program. Core data is primarily meant for fulfilling the common user requirements related to SDGs in Member States and European institutions.

Transport is necessary to human activities as it is condition of accessibility to working places, to schools, to hospitals, to retail trade or to any other place of interest. However, transport is also among the main human pressure sources on environment (noise, pollution, accidents, soil sealing …). This is why data on this theme is strongly necessary to achieve most of the SDG.

Core data focus on the road and railway networks and on the main infrastructures of water and air transport (namely ports and aerodromes). Transport data is necessary at various scales, for different levels of government. It should ideally be captured at large scale and then derived by generalisation at medium and small scales. The pan-European products EuroRegionalMap and EuroGlobalMap have strongly influenced the recommendations of content for core theme Transport and are more or less implementing the medium and small scale levels of detail.

It is recommended to provide core transport data in simple GIS formats with properties directly attached as attributes to the geometric network. However, core data offers also mechanisms to attach business data to the road network by linear referencing.

Development of tools and methods to ensure easy combination of absolute and linear referencing is among the activities to be encouraged in future together with the capture of more dynamic data (for in-car navigation), of more detailed data (describing roads as surface), of richer data (including ecological transport elements) and of global data (for sailing lines).

# 2 Foreword

## 2.1 Document purpose and structure

### 2.1.1 Purpose

This document provides the main characteristics of core data for theme Transport Networks with focus on the recommendation for content. This document aims to help decision makers (from governments, data producers, national coordination bodies, etc.) to define their policy regarding the improvement of existing data and production of new geospatial data. It addresses digital data.

This document has Annexes containing more detailed explanations targeting the technical people who will be in charge of implementing or adapting core data recommendations (e.g. for production purpose, as source of other standards, etc.).

### 2.1.2 Structure

The executive summary synthesizes the main conclusions of the Working Group A (WG A) process and results to develop the recommendation for content. It is meant mainly for high level decision makers.

The foreword reminds the general context of core data, the first step achieved by WG A (i.e. selecting core data themes), and it explains the general principles set by WG A to develop the recommendations for content of core data specifications for all selected themes.

The 'recommendation for content' document itself includes four chapters:

- Overview: it provides the general scope of the theme and describes the main use cases addressed;
- Data content: it provides the main characteristics of the recommended content, such as the list of core features and attributes (for vector data), as well as data capture and quality rules;
- Other recommendations: e.g. Coordinate Reference System, Metadata, Delivery;
- Considerations for future: this chapter addresses some key trends or significant user requirements that cannot be considered as core today but that might be considered in future.

The 'recommendation for content' document is meant for medium level decision makers. It is written in natural and not too technical language.

The technical explanations included in annexes describe the relationship between the recommendation for content and the corresponding INSPIRE specification, and contain any other appropriate information useful for this theme.

## 2.2 Core data context

### 2.2.1 Rationale for core data

The following background of harmonised pan-European data was identified.[1]

*Authoritative geospatial data are used to support both the implementation of public policies and the development of downstream services. Moreover, geospatial data are required to be homogenous to enable the implementation of public policies in a coherent and coordinated way among countries and at regional or global level. Likewise, significant opportunities exist if services developed by industry can be exploited without requiring country specific adaptation.*

The INSPIRE Directive has set up the legal and technical framework for harmonisation of the existing data related to the themes in annexes I, II and III. INSPIRE specifications provide common data models that ensure a first step towards interoperability, however ensuring homogeneous content is outside their scope, as they contain no indication about levels of detail, very few recommendations about quality, and as most features and attributes are "voidable", i.e. to be supplied if available or derivable at reasonable cost.

This background led the UN-GGIM: Europe Regional Committee to setup in 2014 the Working Group A on Core Data to deal with core data content and quality, production issues, funding and data availability.

Recommendations for content of core data will complement INSPIRE data specifications by defining the priorities on the core content that is encouraged to be made available in Europe in order to fulfil the main user requirements that are common to many countries, with focus on the SDG related ones.

Core data availability may be ensured either through upgrading of existing data when feasible or through production of new data when necessary.

### 2.2.2 Core data scope

In its first phase, WG A selected core data themes according to the following criteria: core data is the geospatial data that is the most useful, either directly or indirectly, to analyse, to achieve and to monitor the Sustainable Development Goals.

Among the 34 INSPIRE data themes, 14 have been considered as core including theme Transport Networks.

More information about the selection process and results may be found in document 'Core Data Scope - Working Group A - First Deliverable of Task 1.a - Version 1.2' on http://un-ggim-europe.org/content/wg-a-core-data

[1] Extract from the Report by the Preparatory Committee on the establishment of the UN-GGIM: Europe Regional Committee, European Commission Ref. Ares(2014)1491140 - 09/05/2014.

## 2.3 Document objectives and principles

### 2.3.1 Encouraging content availability

This deliverable provides recommendations for national governments and data producers, aiming to help them to define their priorities for enriching existing data or producing new data. This deliverable is meant mainly for data producers, however it defines the recommended result and target but not the production process.

### 2.3.2 Complementing INSPIRE

Core data specifications are built upon INSPIRE data specifications. On one hand, they often simplify INSPIRE by selecting core feature types and attributes and by restricting or clarifying the scope; On the other hand, they enrich INSPIRE by recommending specific levels of detail, quality rules and sometimes data model extensions. Besides, the INSPIRE common terminology is thoroughly used for naming core features and attributes.

Regarding the levels of detail, the ELF (European Location Framework) project terminology has been used. The ELF levels of detail are the following: Global, Regional, Master level 2, Master level 1, Master level 0. These terms are defined in the glossary.

Regarding delivery, core data may be supplied according to several ways. It is expected that, very often, the core data recommendations will be used to enrich and upgrade existing products. In this case, core data will be available through these improved products. Core data may also be delivered through INSPIRE conditions (specifications and services).

### 2.3.3 Status of core data recommendations

This document contains recommendations that are not legally binding. However, some recommendations are more important than others. This order is indicated as follow:

**Core Recommendation X**

**It is first priority recommendation, considered as both necessary and achievable in principle. Ideally, it should encourage involved stakeholders to launch short-term actions (typically within a couple of years).**

Core recommendations are usually addressing only technical aspects and are meant for the organisations in charge of producing this theme. The set of core recommendations defines the basic expectations on core data.

Good Practice X
It is second priority recommendation; if adopted, it will provide significant added value to core data; it indicates a relevant trend to be adopted as much as possible. It encourages involved stakeholders to take these recommendations into account in long term, if not possible in short term.

NOTE: some of these good practices may be quite easy to achieve and are already effective in some countries whereas some others may be more difficult to achieve. This is typically the case when these good practice recommendations involve other stakeholders in addition to the organisations in charge of producing this theme, and when they address not only technical aspects but also legal or organisational ones.

A “core data set” should contain the minimum data defined by the core recommendations (and ideally also by the good practices) of this deliverable but may of course contain more and/or better information.

## 2.4 Abbreviations

| | |
|---|---|
| CRS | Coordinate Reference System |
| ERM | EuroRegionalMap |
| EGM | EuroGlobalMap |
| GIS | Geographic Information System |
| SDG | Sustainable Development Goal |
| UN-GGIM | United Nations initiative on Global Geospatial Information Management |
| TN | INSPIRE theme Transport Networks |
| UIC | International union of railways (Union Internationale des Chemins de fer) |
| WG A | (UN-GGIM: Europe) Working Group on Core data |

## 2.5 Glossary

### 2.5.1 Levels of detail

| | |
|---|---|
| Global | Level of detail defined by ELF: data to be used generally at scales between 1: 500 000 and 1: 1 000 000, i.e. mainly at international level |
| Regional | Level of detail defined by ELF: data to be used generally at scales between 1: 100 000 and 1: 500 000; data mainly for national or regional (European or cross-border) actions. |
| Master level 2 | Level of detail defined by ELF: data to be used generally at scales between 1: 25 000 and 1: 100 000); data mainly for regional (sub-national) actions. |
| Master level 1 | Level of detail defined by ELF: data to be used generally at scales between 1: 5 000 and 1: 25 000; data mainly for local level actions. |
| Master level 0 | Level of detail defined by ELF: data to be used generally at scales larger than 1: 5 000; typically, data at cadastral map level, mainly for local level actions. |

NOTE: The above definitions are indicative; in practice, detailed data (Master levels) may also be required also by national, European or international users.

## 2.6 Reference documents

INSPIRE Data Specification on Transport Networks – Technical Guidelines 3.2:
http://inspire.ec.europa.eu/id/document/tg/tn

EuroGeographics/ ERM V11.1 Data Specification

https://eurogeographics.org/wp-content/uploads/2018/05/ERM_v11-1_DataSpecification.pdf

EuroGeographics/ EGM V10.0 Data Specification

https://eurogeographics.org/wp-content/uploads/2018/04/EGM_Specification_v10.pdf

# 3 Overview

## 3.1 General scope

Definition: Road, rail, air and water transport networks and/or related infrastructure [adapted from INSPIRE]

NOTE 1: The scope of Core data theme Transport Networks is based on the one of the INSPIRE theme Transport Networks that is composed of five sub-themes, namely Road, Railway, Air, Water and Cable Transport Network. In practice, Core data theme is restricted to the key content of INSPIRE road and railway networks and the key content of INSPIRE air and water transport infrastructures, namely ports and aerodromes.

NOTE 2: In order to avoid data production duplication, the navigability characteristics of inland waterways has been considered under theme Hydrography.

NOTE 3: As a general rule, Cable Transport has not been considered as core data. However, it is relevant to capture such data if cable transport is of specific importance, e.g. if it is part of public transport.

More detailed comparison with INSPIRE is available in the annex A of this document.

## 3.2 Use cases

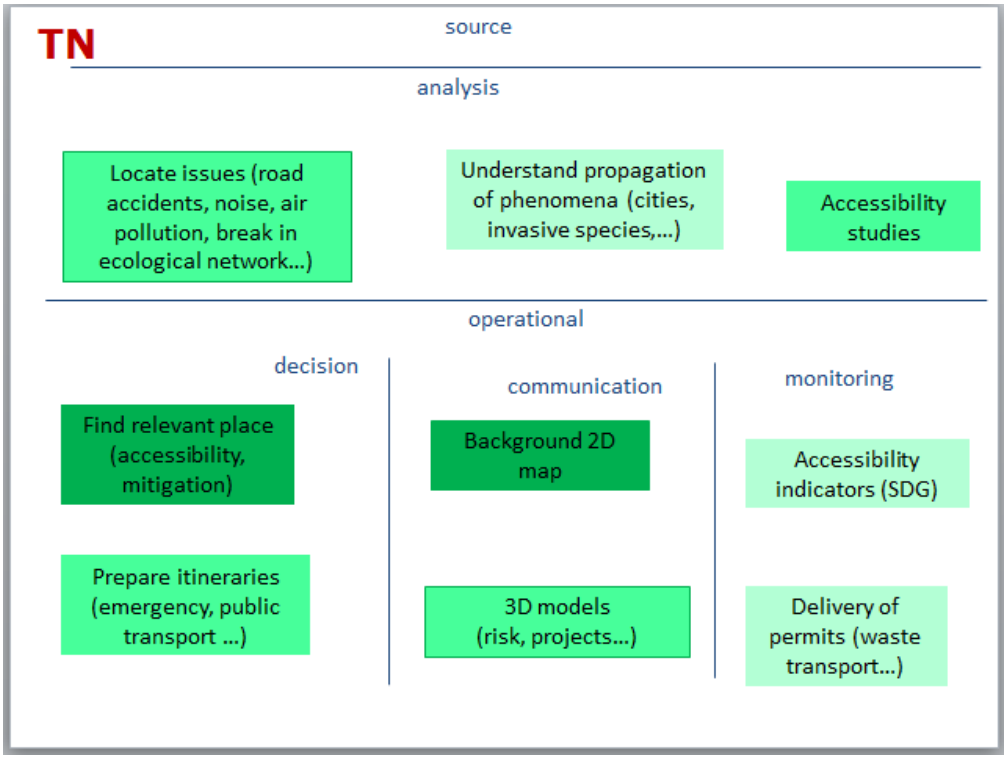



Figure 1: use case map of theme Transport Networks

Transport elements, such as roads, railways, aerodromes are key features in the landscape and are therefore necessary for communication purposes, e.g. on 2D topographic or road maps or in 3D models.

On the positive side, transport is necessary to human activities as it is condition of accessibility to working places, to schools, to hospitals, to retail trade or to any other place of interest. In the analysis phase, transport data enables studies about accessibility to basic services and helps to understand and to forecast the spreading of cities. In the operational phase, transport data is necessary to decide on relevant location of a new infrastructure, e.g. to ensure connectivity of a new road to the existing network or to ensure accessibility of a new building or other construction. It is also required for journey planning, to prepare itineraries for rescue operations in case of a crisis or for a new line of public transport or for deciding where dangerous materials may circulate with the minimum of risk. In daily life, transport data are also widely used by economic actors, by tourists, by everyone to find a relevant itinerary to an unknown place. Most of these use cases require not only data about a specific transport mode but also information about the connectivity between these various modes, development of intermodal transport being a way to improve traffic efficiency and to mitigate the pressure of transport activities on environment.

On the negative side, transport network is source of accidents, of noise, of air pollution; it contributes to the spreading of invasive species; it also contributes to soil sealing and so to floods; it is cutting ecological corridors and causing damages to the fauna. Transport itself is often using non-renewable energies and contributing to climate warming. Consequently, transport data is required in the analysis phase of all these phenomena but also, at operational level, to decide on mitigation actions (building acoustic fences to decrease noise pollution, building bridges or tunnels for wild animals, improving the road conditions to avoid accidents etc.).

# 4 Data content

## 4.1 Features types and attributes

**Core Recommendation 1**
**Core data should include the first priority feature types and attributes of the following tables.**

Good Practice 1
In addition, it is recommended to provide the second priority feature types and attributes of the following tables.

NOTE 1: There may be first priority attributes on features considered as second priorities; if the feature is captured (good practice), it should be captured with its core attributes ; if not, the feature might be meaningless or useless.

### 4.1.1 Common attributes

| Type | Attribute | Values / enumeration | Priority |
|---|---|---|---|
| **Common attributes** | identifier | CharacterString (or integer) | **1** |
| | beginLifespanVersion | Date Time | **2** |
| | endLifespanVersion | Date Time | **2** |

Table 1: Common attributes

### 4.1.2 RoadTransportNetwork

| Type | Attribute | Values / enumeration | Priority |
|---|---|---|---|
| **RoadLink (priority 1)** | geometry | GM_Curve | 1 |
| | formOfWay | FormOfWayValue<br>* freeway<br>* motorway<br>* dualCarriageway<br>* singleCarriageway<br>* slipRoad<br>* enclosedTraffic Area<br>* tractorRoad<br>* bicycleRoad<br>* walkway<br>* …. | 1 |
| | functionalRoadClass | FunctionalRoadClassValue<br>* mainRoad<br>* firstClass<br>* secondClass<br>*…..<br>* ninthClass | 1 |
| | numberOfLanes | Integer | 1 |
| | verticalPosition | VerticalPositionValue<br>* onGroundSurface<br>* suspendedOrElevated<br>* underground | 1 |
| | TransEuropean Transport Network | TenTNetworkValue<br>* Core TenT Network<br>* Comprenhensive TenT Network<br>* No TenT Network | 1 |
| | geographicalName | Geographical name<br>*(in general, a street name)* | 1 |
| | roadSurfaceCategory | RoadSurfaceCategoryValue<br>* paved<br>* unpaved | 2 |
| | trafficFlowDirection | LinkDirectionValue<br>* bothDirections<br>* indirection<br>* oppositeDirection | 2 |
| | accessRestriction | AccessRestrictionValue<br>* forbiddenLegally<br>* physicallyImpossible<br>* private<br>*publicAccess<br>*seasonal<br>*toll | 2 |
| | restrictionForVehicles | RestrictionForVehicles | 2 |
| | speedLimit | SpeedLimit | 2 |
| | conditionOfFacility | ConditionOfFacilityValue<br>* disused<br>* functional<br>* projected<br>* underConstruction<br>* decommissioned | 2 |

| | | | |
|---|---|---|---|
| **Road (priority 1)** | Geometry/ Definition | Set of road links | 1 |
| | nationalRoadCode | CharacterString | 1 |
| | europeanRouteNumber | CharacterString | 1 |
| | geographicalName | GeographicalName<br>*(road name if any, e.g. "route Napoléon)* | 1 |
| **RoadNode (priority 1)** | geometry | GM_Point | 1 |
| | name | Geographical name or CharacterString<br>*May be a real name (e.g. "Trafalgar Square" ) or a code (e.g. "issue n° 6")* | 1 |
| | formOfRoadNode | FormOfRoadNodeValue<br>* enclosedTraficArea<br>* interchange<br>* junction<br>* levelCrossing<br>* pseudoNode<br>* roadEnd<br>* roundabout<br>* trafficSquare<br>* roadServiceArea | 2 |
| **RoadService (priority 1)** | geometry | GM_Point or GM_Surface | 1 |
| | type | roadServiceTypeValue<br>* busStation<br>* parking<br>* restArea<br>* toll<br>* electric car (loading) stations | 1 |
| | name | Geographical name or CharacterString | 1 |
| **MarkerPost (priority 2)** | geometry | GM_Point | 1 |
| | Link to Road | *Road Identifier* | 1 |
| | code | CharacterString | 1 |
| | distance | Real | 1 |

Table 2: expected content of Road Transport Network

NOTE 1: Some attributes are required to assess the accessibility and navigability of the Road Transport Network (traffic flow direction, access restriction, restriction for vehicles, speed limit). However, it should be recognised it will be very difficult to capture them as dynamic data, taking into account the temporary restrictions, due for instance to accidents or works on roads. A more feasible target is to capture only the permanent restrictions.

NOTE 2: The information about Restriction for Vehicles includes mainly the maximum height, maximum weight, maximum length and maximum width. It is mainly required for the traffic of trucks and buses.

NOTE 3: In INSPIRE, SpeedLimit is defined as a complex feature type taking into account the context in which this speed limit applies (type of vehicle, weather conditions, validity period …). Though of interest, this complex model may be difficult to be applied for capturing existing speed limits. A more feasible target would be to capture, at least in a first step, only the speed limits that should be applied in any circumstances and that likely represent a significant ratio of existing speed limits.

NOTE 4: The attribute Condition of Facility is required in case a data producer provides not only functional road links but also those that are disused or under project or construction. Provision of road links under project or construction is encouraged for core data (see Good Practice 6).

NOTE 5: It is advised to provide the information about the belonging of a road link to the TransEuropean Transport Network in the most accurate way by indicating if it is part of the core or comprehensive TenT network or not at all. A Boolean value is an acceptable but less detailed way to provide this information. This NOTE also applies to Railway Links, Ports and Ferry crossings.

NOTE 6: The link from the marker to the Road is generally implemented by providing the Road Identifier on the Marker.

NOTE 7: Most of proposed code lists are coming from INSPIRE; the definitions of the possible values of an attribute are sometimes quite generic and may let place to various interpretations. Data providers are advised to provide more accurate explanations about these values, mainly those related to road link classifications, namely formOfWay and functionalRoadClass (e.g. what is the difference between a motorway and a freeway ? which criteria are used to decide on the various classes for functional road class?).

### 4.1.3 RailwayTransportNetwork

| Type | Attribute | Values / enumeration | Priority |
|---|---|---|---|
| **RailwayLink (priority 1)** | Geometry | GM_Curve | 1 |
| | Type | RailwayTypeValue<br>* cogRailway<br>* funicular<br>* magneticLevitation<br>* metro<br>* monorail<br>* suspendedRail<br>* train<br>* tramway | 1 |
| | numberOfTracks | Integer | 1 |
| | verticalPosition | VerticalPositionValue<br>* onGroundSurface<br>* suspendedOrElevated<br>* underground | 1 |
| | TransEuropean Transport Network | TenTNetworkValue<br>* Core TenT Network<br>* Comprenhensive TenT Network<br>* No TenT Network | |
| | electrified | boolean | 1 |
| **RailwayLine (priority 1)** | definition | Set of railway links | 1 |
| | railwayLineCode | CharacterString | 1 |
| | name | GeographicalName | 1 |

| | | | |
|---|---|---|---|
| **RailwayStation (priority 1)** | Geometry | GM_Surface or GM_Point | 1 |
| | geographicalName | GeographicalName<br>*(e.g. Berlin Hauptbahnhof)* | 1 |
| | stationCode (UIC code) | CharacterString | 2 |
| | railwayUse | RailwayUseValue<br>* cargo<br>* passengers<br>* mixed<br>* carShuttle | 1 |

Table 3: expected content of Railway Transport Network

### 4.1.4 Air Transport

| Type | Attribute | Values / enumeration | Priority |
|---|---|---|---|
| **Aerodrome (priority 1)** | Geometry | GM_Surface or GM_Point | 1 |
| | designatorIATA | CharacterString | 1 |
| | locationIndicatorICAO | CharacterString | 1 |
| | UN Locode | CharacterString | 1 |
| | geographicalName | GeographicalName<br>*(e.g. Heathrow Airport)* | 1 |
| | aerodromeCategory | AerodromeCategoryValue<br>* domesticNational<br>* domesticRegional<br>* International | 1 |
| | aerodromeType | AerodromeTypeValue<br>* aerodromeHeliport<br>* aerodromeOnly<br>* heliportOnly<br>* landingSite | 1 |
| | restriction | AirUseRestrictionValue<br>* reservedForMilitary<br>* temporalRestrictions | 1 |
| **Runway (priority 2)** | geometry | GM_Surface or GM-Curve | 1 |
| | surfaceComposition | SurfaceCompositionValue<br>* asphalt<br>* concrete<br>* grass | 2 |

Table 4: expected content of Air Transport

### 4.1.5 Water Transport

| Type | Attribute | Values / enumeration | Priority |
|---|---|---|---|
| **FerryCrossing (priority 1)** | Geometry | GM_Curve | 1 |
| | geographicalName | GeographicalName | 1 |
| | ferryUse | ferryUseValue<br>* cars<br>* other<br>* passengers<br>* train<br>* trucks | 1 |

| | | | |
|---|---|---|---|
| | TransEuropean Transport Network | TenTNetworkValue<br>* Core TenT Network<br>* Comprenhensive TenT Network<br>* No TenT Network | 1 |
| **Port (priority 1)** | geometry | GM_Surface or GM_Point | 1 |
| | geographicalName | GeographicalName | 1 |
| | UN Locode | CharacterString | 1 |
| | TransEuropean Transport Network | boolean | 1 |

Table 5: expected content of Water Transport

NOTE: navigability information on watercourses is considered in theme Hydrography.

### 4.1.6 Temporal aspects

**Core Recommendation 2**
**Current, valid features are considered as core data.**

NOTE 1: In other words, in general, efforts to capture features of the past (obsolete, destroyed, disused) or features of the future (under project, under construction) are not considered as a priority. However, for theme Transport Networks, roads under project or under construction are considered of interest (see good practice 6).

NOTE 2: Core data being minimum data, a data producer may of course also capture features of the past or features of the future as additional data; in these cases, it is advised to document the attribute "condition of facility" in order to make distinction between past, current and future features.

However, once features have been captured, it is recommended to keep them in the data base, even after their end in the real world

Good Practice 2
It is recommended to manage the history of features, using the mechanism provided by the INSPIRE data specifications: versioning and life-cycle attributes.

NOTE 1: The life-cycle attributes are the beginLifespanVersion and the endLifespanVersion (already included in table 1).

NOTE 2: The versioning and life-cycle attributes enable change-only updates; they also enable to retrieve the status of geographic Transport Network data, at any time of the past (since the adoption of these mechanisms).

NOTE 3: The above Core recommendation and Good practice may look contradictory but in fact they are not. Let us imagine a data producer deciding to implement the core recommendations and good practices of this deliverable from 2020:

- In a first step, according to the above Core recommendation, first priority is to capture the features that are valid (in 2020), as they are both the most useful and the easiest to be captured. For instance, capturing features from the past would require significant efforts for limited benefits.

- In a second step, for instance in 2025, a given entity disappears in the real-world; the related feature – already captured in 2020 – should be kept in the database as "deprecated", which is documented by the life-cycle attributes of INSPIRE. This may be done quite easily just through proper database management.

## 4.2 Levels of detail

**Core Recommendation 3**
**Core data on Transport Network should be produced at least at Master Level 1 and at Regional and Global levels.**

NOTE 1: Ideally, the initial capture of Transport data should be done at Master Level 1 and the other levels of detail should be derived by generalisation from the Master Level 1 data. The generalisation process implies selection of main features and simplification of geometry.

NOTE 2: Regarding Regional and Global levels, this core recommendation has already been (more or less) achieved through the pan-European products of EuroGeographics: EuroRegionalMap and EuroGlobalMap. The efforts to maintain such products should be continued in future.

NOTE 3: When there is no explicit indication about concerned level(s) of detail, it means that the core recommendation, good practice or NOTE applies to all core levels of detail, namely Master Level 1, Regional, Global.

## 4.3 Geographical extent

**Core Recommendation 4**
**Core data on Transport Network should be available on whole territory, both land and sea.**

NOTE 1: In practice, most of the core feature types are related to the land part of the territory; only the Water Transport data is related to the sea part.

## 4.4 Data capture

### 4.4.1 Segmentation of road and railway networks

Properties of a network may be modelled in two ways:

1. They may be considered as attributes of the network links; for data producers, this implies that the network is segmented where any attribute changes its value; for users, data may be easily used (e.g. with GIS) for mapping or spatial analysis purposes.
2. They may be considered as feature types and attached by linear referencing to the network; for data producers, this enables to avoid excessive segmentation of the network but data is difficult to handle by users (except by the network managers themselves who are used to linear referencing).

Good Practice 3
The road and railway networks should be segmented according to the values of core attributes.

NOTE 1: Core attributes include the first and second priority attributes of tables 2 and 3.

NOTE 2: The first option has been preferred because it is quite more user-friendly without being too disturbing for data producers: in practice, there is only a small number of core attributes, most of them keeping generally homogeneous values between two road or railway nodes (e.g. form of way, functional road class, traffic flow direction, name, railway type, railway electrification).

NOTE 3: The segmentation should depend of course of the level of detail. Good practice 3 strictly applies for Master level 1 but for Regional and Global levels, there may be some links aggregation if the change in an attribute value concerns a "small" link, i.e. a link whose length is under a given threshold. As general principle, the generalisation rules of ERM and EGM should be respected.

NOTE 4: Core data is about minimum common content. Additional properties may of course be captured; it is up to data producers to decide the most appropriate modelling choice. For the road network, it has been considered as likely that several stakeholders might be willing to add properties using linear referencing; this is why the feature types facilitating linear referencing, namely Road Nodes and Marker Posts are included as core content.

### 4.4.2 Geometry representation

**Core Recommendation 5**
**Core feature types should be captured with relevant geometric representation.**

NOTE 1: The geometric representation is indicated in tables 2, 3, 4 and 5. The question arises when there is a choice: (Surface or Point) or (Surface or Curve). At Master level 1, the relevant geometry is a surface. At Regional or Global levels, some features may or should be represented as points or as lines; it is recommended to adopt the thresholds defined in ERM and EGM to decide on relevant geometric representation (e.g. At Regional level, a point for all aerodromes + a surface if area size > 0.4 $km^2$).

Good Practice 4
At least the road and railway network should be captured as 2.5 D data.

NOTE 1: 2.5D data means that geometry of features is represented in a three-dimensional space with the constraint that, for each (X, Y) position, there is only one Z.

2.5 D data enables to derive the profile of a road (or railway), to assess if the road is accessible by any vehicle type, to forecast a vehicle speed and its fuel consumption …

### 4.4.3 Feature selection

#### *4.4.3.1 Master level 1*

- **Road Links**

The INSPIRE attribute "form of way" may take following values (whole list):

* bicycle Road
* motorway
* enclosed Traffic Area
* tractor Road
* dual Carriageway
* freeway
* walkway
* single Carriageway
* slip Road

| | | |
|---|---|---|
| * entrance Or Exit Car Park | * entrance Or Exit Service | * pedestrian Zone |
| * roundabout | * service Road | * traffic Square |

**Core Recommendation 6**
**Road links open to car traffic should be captured as first priority.**

NOTE 1: In other words, walkways, tractor roads and bicycle roads are only considered as second priority (see God practice 5).

NOTE 2: Road links open to car traffic are mainly motorways, freeways, single or dual carriage ways.

NOTE 3: Road links with other values (e.g. roundabout, service road) are in general also single carriageways. These other values may of course be used to provide more detailed information.

Good Practice 5
It is advised to capture walkways, tractor roads and bicycle roads for Master Level 1.

NOTE 1: Walkways, tractor roads and bicycle roads are not relevant for Regional and Global levels.

NOTE2: To achieve some of the SDG, ecological transport modes, such as walking or riding, should be encouraged; it is why it is recommended to capture walkways and bicycle roads. In addition, tractor roads can be useful in emergency situations for rescue vehicles.

NOTE 3: The attribute “number of lanes” is not expected to be documented for walkways, tractor roads and bicycle roads.

It is reminded that the attribute “condition of facility” may take following values: disused, decommissioned, functional, projected, under construction.

**Core Recommendation 7**
**Functional road links should be captured as first priority.**

NOTE: Core recommendation 7 is a subset and reminder of core recommendation 2, stating that valid, current features are considered as core.

Good Practice 6
It is advised to capture road links that are projected or under construction.

NOTE: roads links that are disused are not priority.

- **Road Nodes**

The attribute form of node is of limited interest for Master level 1, as the road intersections are described with detailed geometries.

- **Road Service**

**Core Recommendation 8**
**Bus stations (including bus stops) should be captured as first priority.**

NOTE 1: Bus stops are required to compute the SDG indicator 11.2.1 “Proportion of population that has convenient access to public transport”.

NOTE 2: Other types of road services (rest areas, tolls, car parks open to public) are also of interest.

NOTE 3: Electric car (loading) stations have been added to the INSPIRE code list. The capture of these features is not yet widely spread but has definitively to be encouraged in order to record and facilitate the transition in the automotive sector from combustion engines towards electric propulsion.

- **MarkerPost**

Marker Posts are also called kilometric points or road points; they are generally materialized by milestone or road signs, at least along the main roads. They are often used by road managers to locate road maintenance works, accidents, speed limits …. by linear referencing (for instance, the accident took place on road n°4, 300 m after marker post n° 43). They constitute a kind of address system on the road network.

Good Practice 7
It is advised to capture Marker Posts at least in countries where they are used by road managers to attach their business data to the core road network by linear referencing.

NOTE 1: There are other methods for linear referencing, using as origin the starting node of a road link or of a road. If road authorities are employing such linear referencing process, capture of Marker Posts is of less interest.

NOTE 2: This document provides a minimum set of attributes for Marker Posts (its related road code, the marker post code and the distance from the starting point of the road) that may be adapted and/or enriched according to the national practices and specificities.

- **Railway Links**

It is reminded that the attributes "type" may take following values: train, tramway, metro, funicular, magnetic levitation, cog railway, monorail, suspended rail.

**Core Recommendation 9**
**Railway links whose type is "train" should be captured as first priority.**

Good Practice 8
For Master Level 1, it is advised to capture also other types of railway links, such as metro or tramway.

- **Aerodromes**

It is reminded that the attribute "aerodrome type" may take following values: aerodrome and heliport, aerodrome only, heliport only, landing site.

**Core Recommendation 10**
**Aerodromes should be captured as first priority.**

NOTE: In other words, heliports and landing sites are considered as less important than aerodromes.

#### *4.4.3.2 Regional and Global levels*

Regional and Global levels offer a generalised view of the Transport theme where only the most relevant features according to the level of detail have been selected.

Good Practice 9

As a general rule, it is advised to use the selection criteria of ERM and EGM.

NOTE 1: The selection criteria of EGM and ERM benefit from a long experience of production process and user feed-back.

Some attributes are especially relevant for the generalized Levels of Detail (Regional and global), such as form of road node and the TransEuropean Transport Network information.

### 4.4.4 Geographical Names

In theme Transport Networks, there is a limited number of features having names: this is generally the case of railway stations, ports, aerodromes and of road links (that may have street names, at least for the urban ones). In addition, a few road nodes, roads or railway lines may also have some name(s).

EXAMPLES: Pasteur Street or High Street (for road links), Kings road or South coast road (for roads), Glacierexpress, Tauernbahn or Trans-Siberian (for railway lines), Roissy Charles de Gaulle or Heathrow (for airports), Concorde Square (for road nodes)

**Core Recommendation 11**

**When a transport feature has one or several names, these names should be captured, in theme Transport Network or in another core theme (Address or Geographical Names).**

NOTE 1: Geographical names are key information as they are a familiar way for to most users to identify and locate features.

NOTE 2: In practice, data producers may manage these names in theme Transport Networks but also in themes Addresses (e.g. for street names) or in theme Geographical Names as a toponymal data base. The first option is more user-friendly but the alternative ones are quite acceptable as long as there is an easy way to join the name stored in address or toponymal database to the related transport feature.

NOTE 3: The names should be captured, according to the recommendations stated in document "Spatial Core Data theme Geographical Names – Recommendations for content", i.e. with the name spelling and with information on its language, status and (if relevant) source.

## 4.5 Quality

### 4.5.1 Completeness

**Core Recommendation 12**

**Completeness should be ensured at least for the first priority feature types, according to the selection criteria of chapter 4.4.**

NOTE: In practice, it is recognised that 100% completeness may be difficult to achieve; the (very) minimum aim should be to maintain completeness of 95% of core transport feature types.

### 4.5.2 Geometric accuracy

**Core Recommendation 13**
**The geometric accuracy should be adapted to the level of detail.**

NOTE 1: For Master Level 1, accuracy should be better than 5 m for road links centre lines. It should be around 125 m for Regional Level and around 1000 m for Global Level.

### 4.5.3 Topologic consistency

**Core Recommendation 14**
**Within a given network (road or railway), great care has to be taken to ensure that the topology of road and railway network data respect the real world topology.**

NOTE 1: One of the topologic constraints is to avoid creating nodes in case of grade separated crossings, as there is no junction in real-life. In other words, in the illustration below, option A should be chosen as respecting the navigation logic of the real-world.

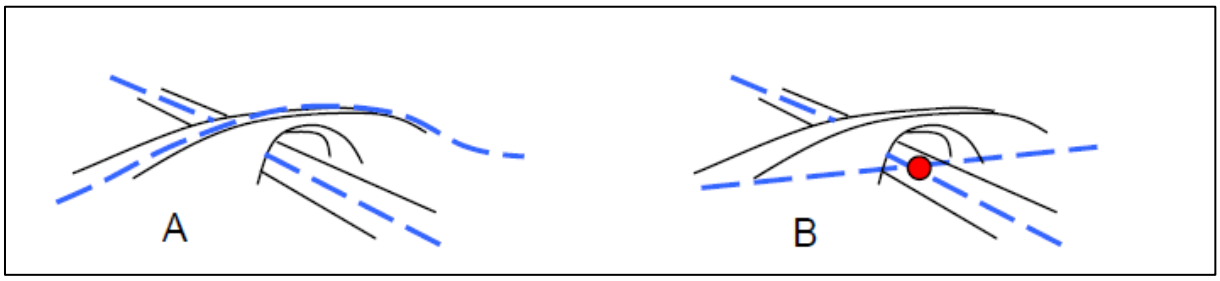



Figure 2: illustration of grade separated crossing – option B to be avoided as not respecting real-world topology

NOTE 2: Another topologic constraint is to ensure the network continuity at international boundaries. Ideally, this should be done by geometry edge-matching. An alternative is to use the INSPIRE feature Network Connection.

Good Practice 10
It is advised to ensure the intermodal connections between the different transport networks.

NOTE 1: An intermodal connection represents a possibility for the transported media (people, goods, etc.) to change from one transport mode to another.

NOTE 2: In practice, it should be ensured that the real-world connections between the road network and the railway stations, ports and aerodromes are also present in the geographic data. In general, this may be done at Master Level 1 through the detailed geometric representation. For Regional and Global levels, it may be necessary to use the INSPIRE feature Network Connection.

### 4.5.4 Update frequency

**Core Recommendation 15**
**The update frequency for theme Transport Networks should be one year or better**

# 5 Other recommendations

## 5.1 Coordinate Reference System (CRS)

### 5.1.1 Case of 2D data

Good Practice 11
Core data should be stored and managed in a CRS based on datum ETRS89 in areas within its geographical scope, either using geographic or projected coordinates.

NOTE 1: Geographical scope of ETRS-89 excludes over-sea territories, such as Canary Islands or French Guyana or Madeira Islands and Azores Islands. In these cases, it is recommended to use a CRS based on ITRS (International Terrestrial Reference System).

NOTE 2: Storing and managing data in CRS based on international datum facilitates the import of measures from modern sensors, ensures that data is managed in a well-maintained geodetic framework and of course, facilitates the export of data into international CRS (e.g. those mandated by INSPIRE).

NOTE : If core data at regional and global levels has to be provided as a single data set on an area including over-sea territories, it is recommended to use as CRS geographic coordinates with any realisation of the International Terrestrial Reference System (ITRS), known as International Terrestrial Reference Frame (ITRF). At small or medium scales, all ITRS realisations can be considered as equivalent, as deviations between them are negligible compared to data accuracy.

### 5.1.2 Case of 2.5D or 3D data

Good Practice 12
If Transport Networks are captured as 2.5D data, it is recommended to use for the Z coordinate a gravity-related height, ideally given in EVRS as vertical component of the Coordinate Reference System.

NOTE 1: EVRS states for European Vertical Reference System.

NOTE 2: It is reminded that it is advised to capture 2.5D data for theme Transport Networks (Good practice 4).

## 5.2 Metadata

Good Practice 13
Core data should be documented by metadata for discovery and evaluation, as stated in the INSPIRE Technical Guidelines for metadata and for interoperability.

NOTE: this is an INSPIRE recommendation (only the INSPIRE Implementing Rules are legally binding for the Member States belonging to the European Union, but the Technical Guidelines are considered necessary to make the European Spatial Data Infrastructure work in practice). For the other countries, this is a way to make their data easily manageable by transnational users.

## 5.3 Delivery

It is expected that core data will be made available through improved existing products (or new products) or as INSPIRE data, and perhaps as specific core products.

As stated in 4.4.1, this document recommends that the road and railway networks should be segmented according to the values of core attributes. This good practice enables simpler data schemas than the ones adopted by the INSPIRE data specifications by avoiding the property types, attached by linear referencing. Semantic information should be structured as attribute of the geometrical feature.

Good Practice 14
Core data should be made available under (at least) a few of the most currently used or the most popular encoding systems.

# 6 Considerations for future

## 6.1 Data for in-car navigation

SDG related use cases include accessibility computing that has been taken into account in these recommendations for content, by including attributes such as direction of flow or road surface category. However in-car navigation is quite more demanding in semantics and in update frequency: it requires dynamic information on all kinds of access restriction, speed limits ….

Until now, in-car navigation data is already more or less available but mainly through private companies. In future, it may be questioned if there is need (or not) for core authoritative data enabling in-car navigation.

## 6.2 Very detailed data (Master level 0)

The “Spatial Core Data Theme Transport networks - Recommendations for content” recommends data to be produced at least for Master Level 1 and for Regional and Global levels. This choice is a good balance between user requirements (as satisfying most of the SDG related use cases) and feasibility.

However, some use cases require more detailed data, especially for the Road Transport sub-theme and for urban areas. A very detailed background map be necessary to accurately locate underground water, sanitation or energy utilities (SDG 6 and SDG 7); it may also be necessary to enable the circulation of autonomous vehicles, those vehicles being a way to contribute to SDG 11 (target 11.2 provide access to safe, affordable, accessible and sustainable transport systems for all) and SDG 3 (target 3.6: halve the number of global deaths and injuries from road traffic accidents).

Such detailed maps should include a surface representation of road and streets, with description of each lane, pavement borders, horizontal and vertical road signs, etc.

There is also interest for detailed description of transport stations (railway stations, aerodromes, etc.); these stations are very often multimodal nodes with many lines of public transport and so of big interest for users. The public bodies willing to capture such data are advised to consider the Transmodel standard from CEN: http://www.transmodel-cen.eu/. Transmodel offers an EU reference data model for public transport.

These topics are still in an innovation phase. So, it is recommended to encourage further research, knowledge exchange and standardization implementation activities on this topic.

## 6.3 Coordinate reference system

As explained in 4.4.1, there are two ways to attach transport properties to the network geometry, either as attributes directly carried by the transport elements or as feature types attached by linear referencing to the transport network elements.

The first option is mainly used by the geographic data community; it is based on absolute coordinates in a given reference CRS. It requires segmenting the network according to any change in the attribute values but provides user-friendly data that is manageable by any GIS. The second option is widely

used by road managers as it enables them to avoid excessive segmentation of the network but data is difficult to be handled by other stakeholders.

This document is promoting the first option for the limited set of core attributes, in order to enable core data to be used by a wide range of stakeholders. It is also offering the mechanisms allowing the attachment of other properties to the road network by linear referencing, as it includes the nodes and marker posts. In future, it is expected that road managers might enrich core data by adding their business data using these linear referencing "hook" points.

However, to get full benefit of core and business data and to make them to be easy to be combined, there should be relevant tools and methods enabling users to transform data between the relative coordinates (linear reference) used by the road managers and the absolute coordinates used by the geographic data community. Therefore, development and test of such tools should be encouraged, together with benchmarks of user experiences.

This document is promoting some linear referencing mechanisms for the road network because use cases, requiring to link business information to core data, are expected. In theory, linear referencing may of course also be used for railway and water transport networks but, in practice, from the investigation conducted by WG A, it seems to be of very limited interest for users (except the transport network managers). As this investigation does not pretend to be exhaustive and as new use cases may occur, it is advised to monitor user requirements on this topic and, if needed, similar mechanisms for linear referencing should be added on railway and water transport networks.

## 6.4 Ecological transport elements

Until now, most of the Road Transport Networks data focus on the traffic of "traditional" cars and trucks that remain the most common transport mean. However, traditional road transport is also consuming non-renewable energy resources, contributing to air and noise pollution and is source of risks (road accidents). This is why more ecological and safer ways of transport should be promoted and why relevant data should be made available in future.

As starting point, this document promotes the capture of walkways and bicycle roads at large scale and of stations for electric cars but more data would likely be required, such as bus routes, stations with public bicycles, car sharing areas, electrified roads for trucks, etc.

Further investigation and standardization activities of data about these ecological transport elements should be promoted.

Another way to be more ecological is to promote public transport network instead of using individual cars. This is acknowledged by some SDG targets related to accessibility by public transport. However, geographic information is not enough and has to be complemented by public transport time tables. Netex, the CEN technical standard for Public Transport Schedules, should be considered when collecting such type of data: http://netex-cen.eu/

## 6.5 Sea navigation routes

Having data about the sea navigation routes would be quite useful in order to achieve several SDGs: due to their impact on environment and as potential source of pollution, sea navigation routes have an impact on environment and might be a threat for SDG 14 (Life below water) and for SDG 3 (Good health and well-being); on the other hand, sea navigation, as a relatively ecological transport mode, may contribute to SDG 8 (economic growth) and to SDG 13 (climate action).

However, UN-GGIM: Europe WG A does not seem the most relevant stakeholder to propose recommendations for content on this topic as many of these sailing lines are not limited to the European geographic extent.

Theme Transport Networks has been selected as a global fundamental data theme by the UN-GGIM Fundamental Data Themes Working Group. If considered as necessary, some cooperation between the marine community and this UN-GGIM Working Group should be envisaged in order to provide more detailed recommendations about the sailing lines.

# 7 Annex A: Relationship with INSPIRE

## 7.1 Data model

The UML models provided in this annex are only graphical illustrations of the core recommendations and of the good practices present in this document.

The recommendations for content are represented by highlighted the selected attributes in the following way:

Core recommendation

Good practice

### 7.1.1 Comparison between Core Data and INSPIRE content

#### *7.1.1.1 General principles*

- **Linear referencing**

The INSPIRE data models are based on the principle of properties considered as feature types and attached to the geometric network by linear referencing. As stated in clause 4.4.1, the "Core Spatial data theme Transport Networks – Recommendations for content" is advising another modelling approach, with properties considered as attributes and directly carried by the transport geometric elements (generally the links).

Most of the INSPIRE properties are generic: they may apply in theory to any transport element (point, link, area, link set …). In addition, some of them (Common Transport Property) may apply to any of the 5 sub-themes; road, railway, water, air and cable.

In the following illustrations, the INSPIRE data models have been partially flattened, i.e. the Transport Properties have been transformed into attributes. This choice makes the models more compact and quicker to be understood.

In addition, the generic properties have been transformed in specific ones, by considering them only on the features they are the most likely to be expected in practice, in general on the network links.

- **Geometric representation**

In the INSPIRE data models, there may are different feature types if several geometric representations are possible, for instance PortNode and PortArea, or RoadServiceNode and RoadServiceArea.

In the core data illustrative model, this has been replaced by a single feature type, e.g. Port with a generic geometry (GM_Object that shall be GM_Point or GM_Surface). As stated in Core Recommendation n° 5, the geometric representation should be adapted to the level of detail.

The following figures illustrate Core recommendation n° 1 and Good Practices n ° 1 and n°2.

### 7.1.1.2 Road Network Transport

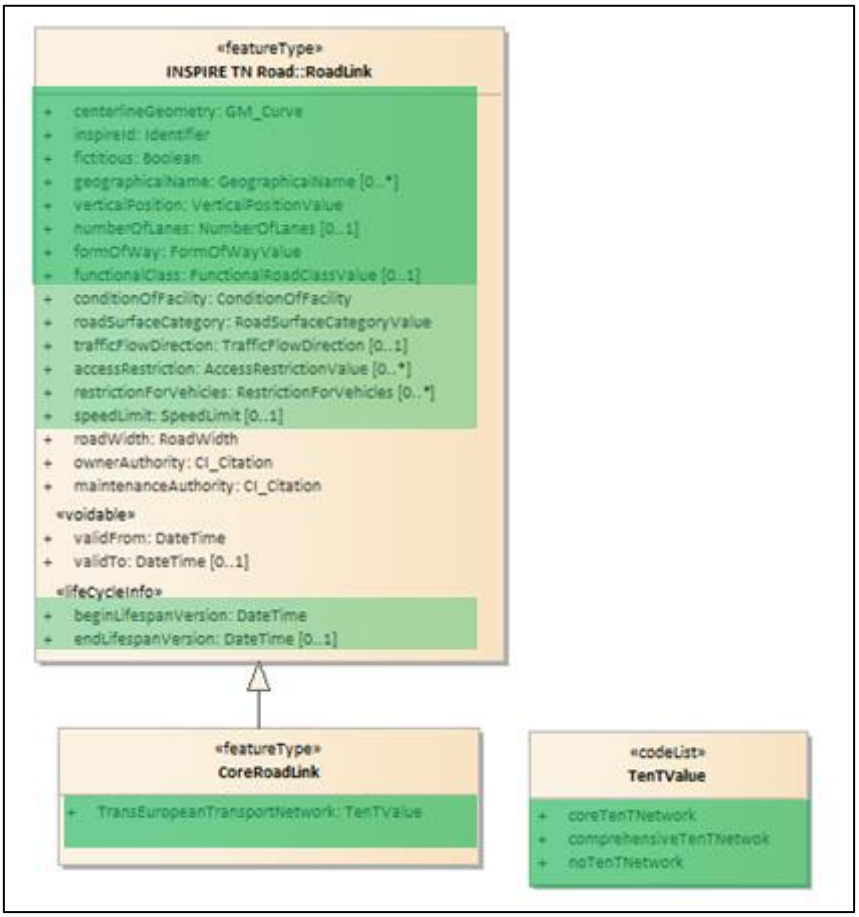



Figure 3: Core feature type Road Link

NOTE 1: In summary, the core feature type RoadLink inherits of most of the INSPIRE content and includes in addition the attribute TransEuropeanTransportNetwork.

NOTE 2: Multiplicity of attributes is indicative; multiplicity [0..1] has been used mainly for attributes that are not really meaningful for walkways, bicycle or tractor roads.

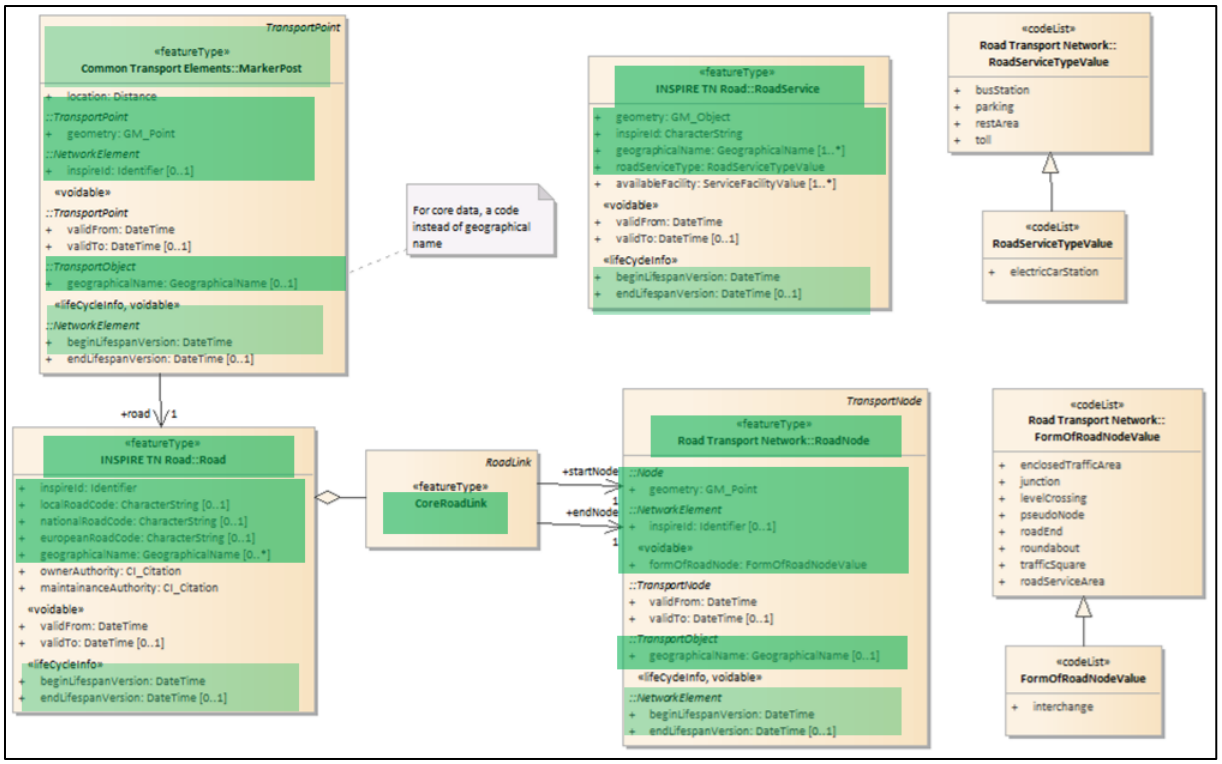



Figure 4: Core Road Network

NOTE 1: In order to make the model simpler and smaller, the INSPIRE feature types Road and ERoad have been merged into one feature type (INSPIRE TN Road :: Road) having both the explicit and implicit attributes of Road and ERoad. The implicit ones are those of the generic Transport or Road properties that may apply to Road feature type (Owner and Maintenance Authorities).

NOTE 2: For core data, the value “interchange” has been added to the INSPIRE code list FormOfRoadNodeValue (though it is currently not extensible) as necessary for Regional and Global levels.

NOTE 3: For core data (and for simplicity reasons), the value “electricCarStation” has been added to the INSPIRE code list RoadServiceTypeValue. It could have been considered as an available facility of a road service but this would have made the model more complex.

### 7.1.1.3 Railway Transport Network

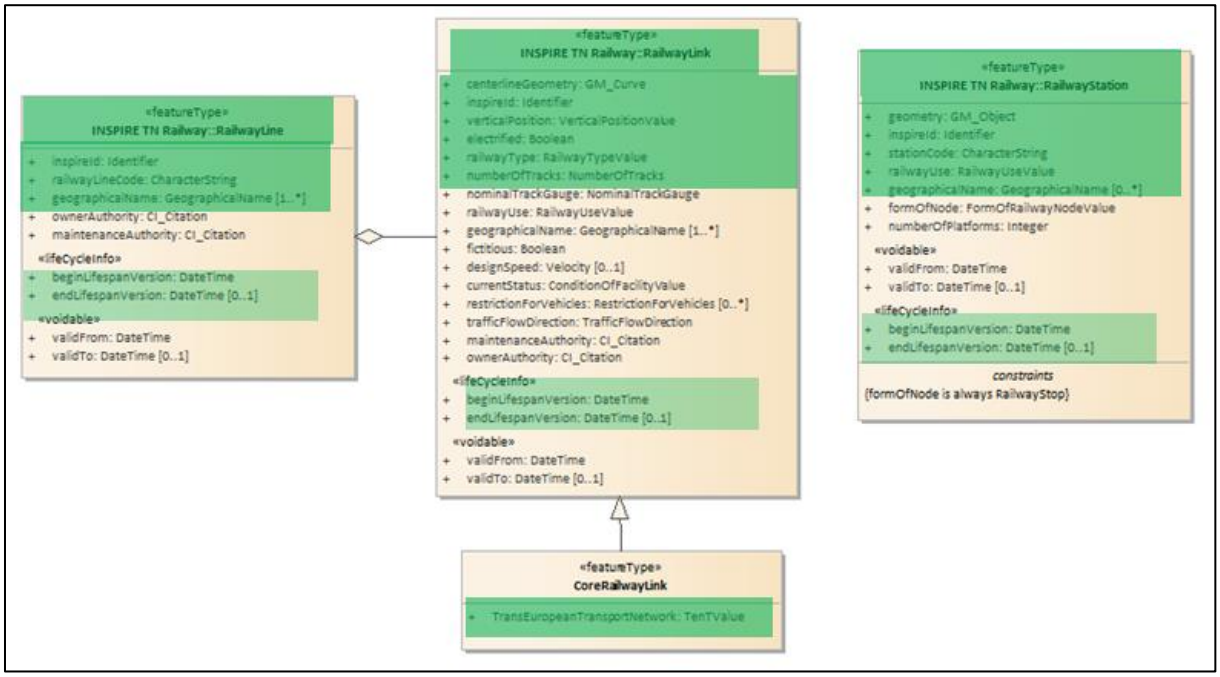



Figure 5: Core Railway Network

NOTE 1: In summary, the core Railway Network inherits of part of the INSPIRE content and includes in addition the attribute TransEuropeanTransportNetwork. Feature types RailwayNode and RailwayYardArea have not been considered as core.

### 7.1.1.4 Air Transport

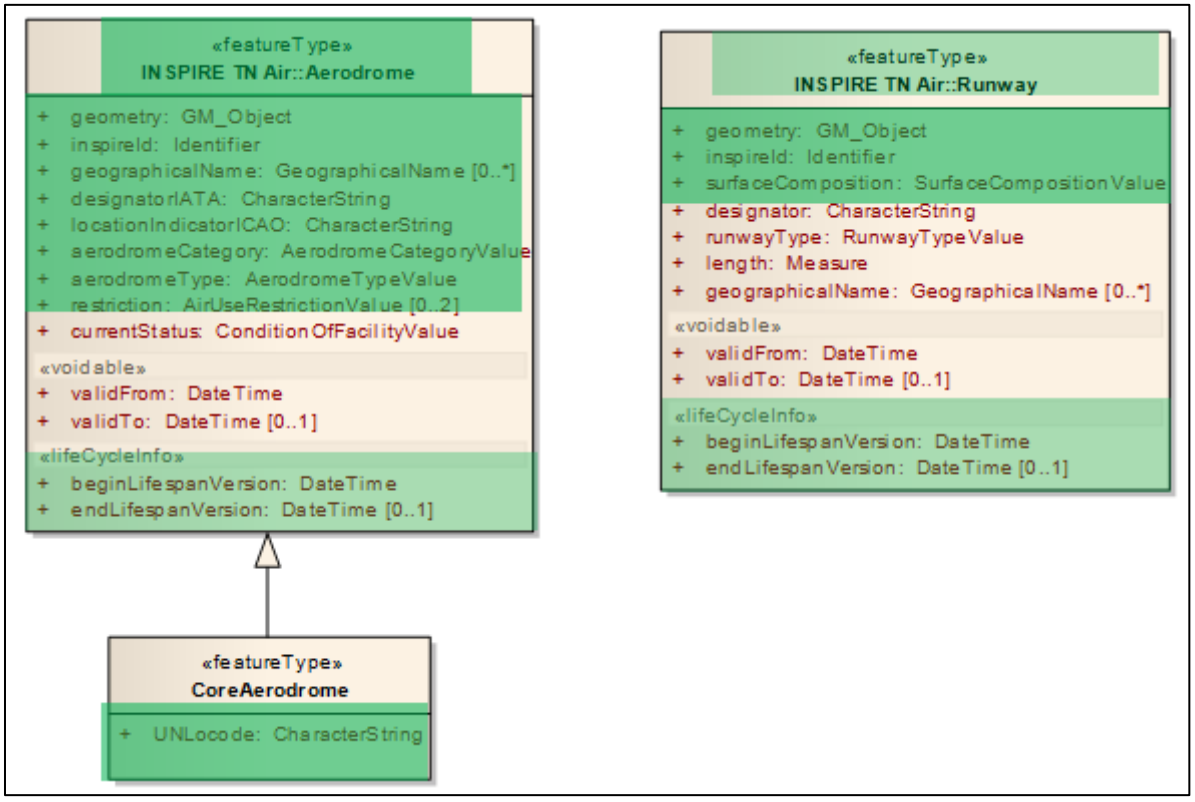



Figure 6: Core Air Transport

NOTE 1: In order to make the model simpler and smaller, the INSPIRE feature types TaxiwayArea, ApronArea and RuwayArea have been merged in a single feature type Runway. In addition, the "Area" condition has been removed to enable a linear representation at Regional level.

NOTE 2: Core data is only a small part of the INSPIRE content. INSPIRE also includes the Air Routes and a detailed description of Aerodromes (NAVAID, Procedure Links, Designated Point…).

NOTE 3: the attribute UNLocode has been added to the INSPIRE data model.

#### *7.1.1.5 Water Transport*

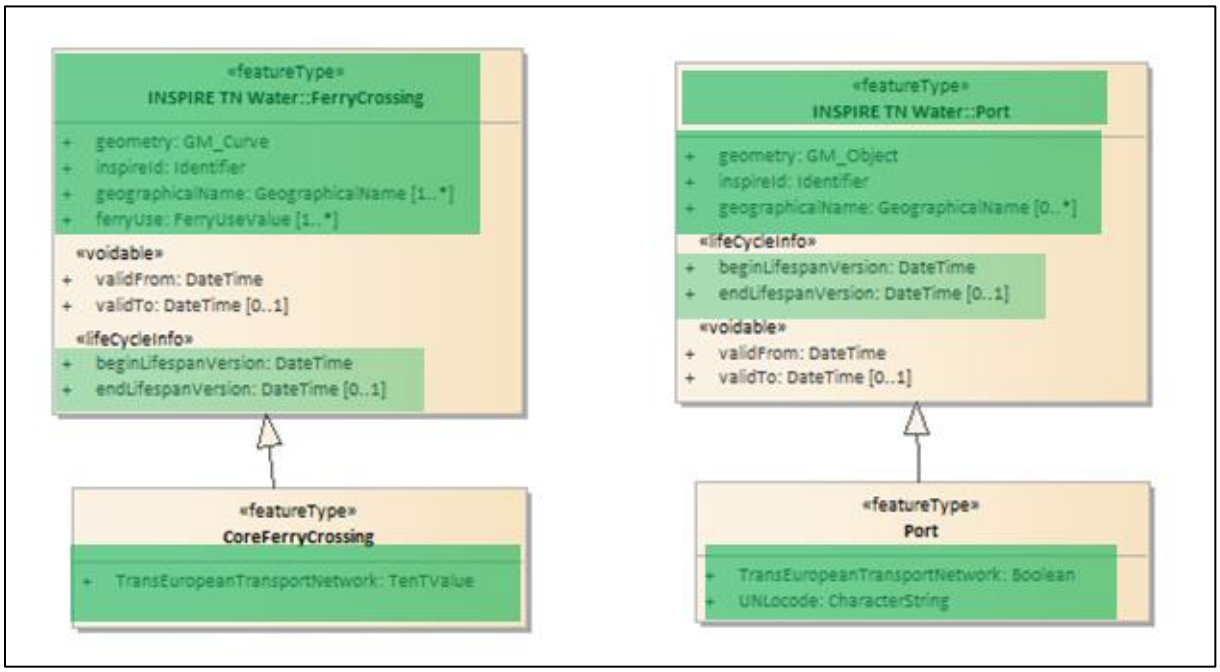



Figure 7: Core Water Transport

NOTE 1: In INSPIRE, feature type FerryCrossing is a WaterLinkSet. For core data, it is considered as a simple Link with direct geometry.

NOTE 2: Core data extends the INSPIRE content by adding the attributes UNLocode to feature type Port and the attribute TransEuopeanTransportNetwork to feature types Port and FerryCrossing.

NOTE 3: It is reminded that the navigability information of inland waterways has been considered in theme Hydrography.

NOTE 4: Core data is only a small part of the INSPIRE content. INSPIRE also includes detailed description of the Marine Waterways.

### 7.1.2 Alternative implementation data model

It is reminded that the above figures are just illustrations of the expected content of core data aiming to enable easy comparison with INSPIRE. Of course, they may be used as starting point for implementing the structure of a production database but it is up to the data producer to decide on it.

#### 7.1.2.1 Aggregated objects

Other modelling choices are possible, especially regarding aggregated objects, namely Road and RailwayLine:

- by an association from Road Link or Railway Links to the aggregate objects
- by defining the Road or RailwayLine as a set of links, i.e. by an association from the aggregate objects to the links composing them, as it is the case in INSPIRE data models
- by capturing the Road or RailwayLine attributes directly on the Road or Railway links composing them

In addition, the geometry of the aggregated objects may be derived from the link geometries, which might facilitate the handling of data by users.

#### 7.1.2.2 From complex INSPIRE feature types to simple core attributes

The INSPIRE properties are defined as more or less complex feature types. This deliverable recommends capturing core properties as simple attributes directly carried by the geometric objects. The production database may use a flatten structure. This can generally be done quite easily, just by selecting the semantic content of INSPIRE property feature types, as shown in previous figures of chapter 7.

However, in a few cases, the flattening of INSPIRE property feature types in INSPIRE may be less simple, as shown in following examples.

EXAMPLE 1: Restriction for vehicles

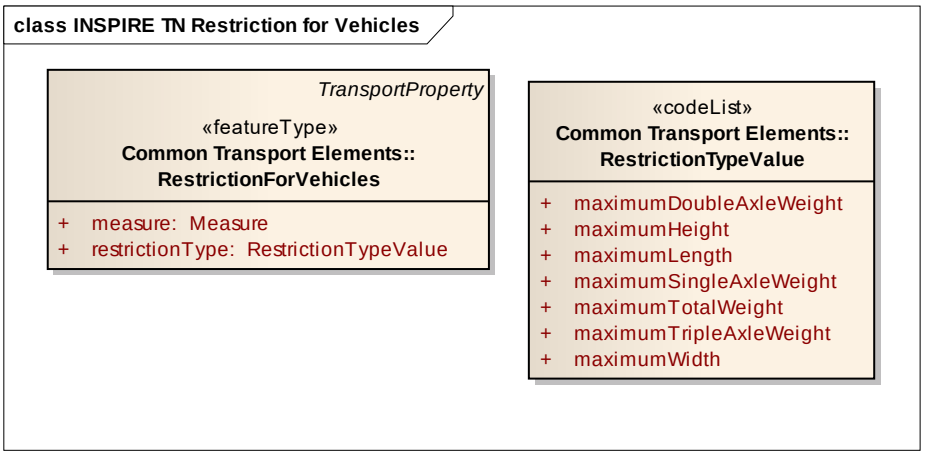
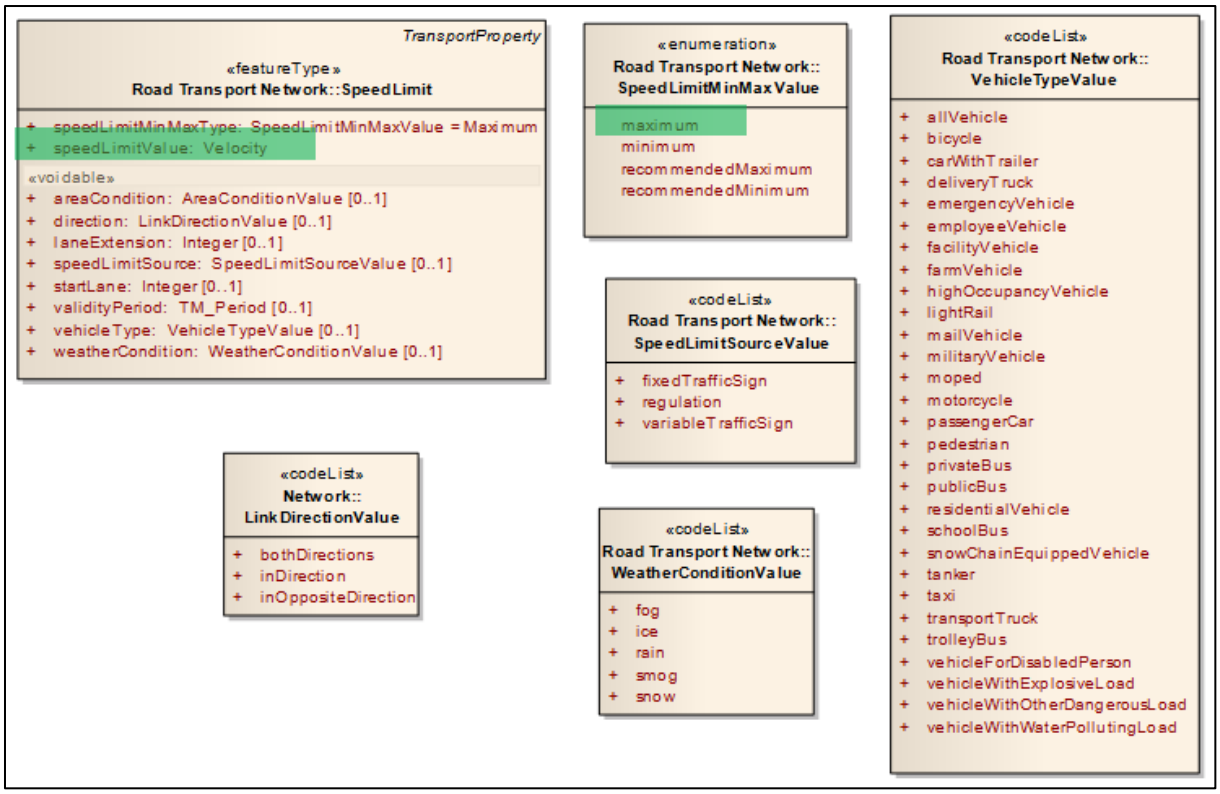



Figure 8: The INSPIRE modelling of RestrictionForVehicles

For production of core data, a potential solution is to split the INSPIRE data type into several attributes, such as maximumHeight, maximumLength, maximumWidth and maximumWeight that look the most frequent restrictions.

EXAMPLE 2: Speed Limit

As said in 4.1.2 – NOTE 3, the INSPIRE feature type SpeedLimit provides not only the speed limit itself but also the context in which this speed limit applies (type of vehicle, weather conditions, validity period …)




A potential solution for core data is to focus (at least in a first stage) to the maximum speed limit that apply under any circumstance.

## 7.2 Other topics

### 7.2.1 Levels of detail – Quality

Whereas INSPIRE is designed in order to accept as much as possible any existing data, at any scale and of whatever quality, the present document states clearly the expected levels of details (Master Level 1, Regional and Global); in addition, it includes some requirements about completeness, geometric consistency and update frequency.

However, there is a common concern about topology and connectivity. For instance, the INSPIRE feature type NetworkConnection may be used especially when the geometry is not detailed enough to provide convenient information [Core Recommendation n° 14 and Good Practice n° 10].

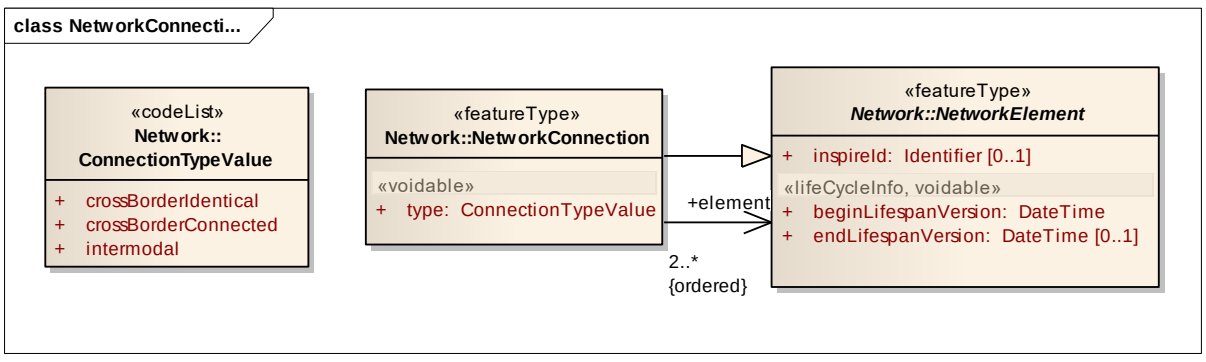



Figure 8: the INSPIRE NetworkConnection mechanism

### 7.2.2 Data capture

Core data is focusing on some core features: the following figure illustrates Core Recommendations n° 5, n° 6, n° 7, n° 8 and Good Practices n° 6, n°8, n°9 and n° 10.

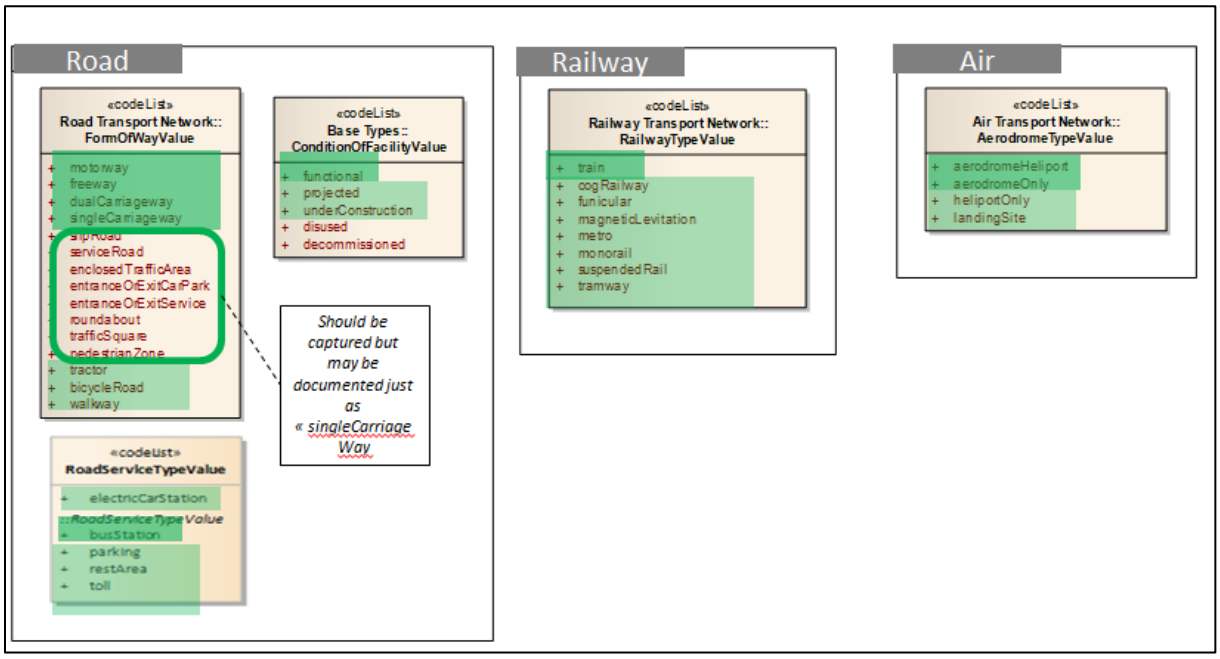



Figure 9: priorities among codelist values

# 8 Annex B: Methodology

Core data specifications have been elaborated based on one hand on user requirements (with focus on the ones related to SDG) and on the other hand on INSPIRE data specifications that offer for theme Transport Networks very rich and detailed data models.

## 8.1 Data model

Main part of the WG A work has consisted in selecting the priority content from the INSPIRE data models.

In practice, the core data recommendations for content have been strongly influenced by the specifications of the EuroGeographics pan-European product EuroRegionalMap (ERM) that has been under a continuous production and improvement process for more than 10 years.

In a first phase, the ERM specifications have been analysed and compared to the UN-GGIM: Europe core data aim. As a result, it appeared that the ERM product was globally richer than expected by core data whose aim is minimum priority data content and that further investigation was required.

However, the main characteristics of ERM have been considered as relevant for core theme Transport Networks:

- Inclusion of Road and Railway Networks with RoadLinks and RailwayLinks as main feature types;
- Focus on the Air and the Water Transport main infrastructures (Aerodromes and Ports);
- Ferries are necessary to ensure the road navigation continuity;
- Navigability information on inland waterways to be considered on theme Hydrography (capturing it as attribute of Watercourse Links is making production easier by avoiding geometry duplication);
- Cable transport not considered as core in general.

In a second phase, the WG A has carefully reviewed the part of the INSPIRE data models related to the candidate sub-themes (Road – Railway) or feature types (Aerodrome – Runway – FerryCrossing – Port). The selection of priority feature types and attributes has been done through evaluating the user requirements (SDG analysis, some user interviews, Eurostat requirements about ERM-EGM) against the feasibility. A few additional attributes have been included when considered as necessary.

As a general rule, **core data has been considered as the data required by a wide range of users and not only by transport network managers**. This is typically why only a few of the INSPIRE attributes on Railway Transport Network have been kept as core data. This is also why this deliverable promotes the principle of properties to be attached directly as attributes to the geometric feature types rather than the linear referencing method, though the last one is widely used by road or railway network managers and chosen by INSPIRE for data delivery.

## 8.2 Levels of detail

It has been considered that the priority levels of detail are Master Level 1, Regional and Global.

The selection of Master Level 1 is due to the fact that many SDG related use cases implying Transport data take place at local level and so require large scale data. In addition, core data should provide the

reference data (geometry and basic semantics) for in-car navigation and so be compatible with the GPS (Global Positioning System) or rather GNSS (Global Navigation Satellite System) measures; this is also why Master Level 1 data are required without any doubt.

Regional and Global levels have also be selected as priority levels of detail because generalised data is required for many applications on wide extent (e.g. on whole Europe) and also because the corresponding data is already more or less implemented through ERM and EGM.