Provision of interoperable datasets to open GI to EU communities

Deliverable D-3.4 Common Data Model: Transport Networks

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as editors

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RESUME

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1 Summary

The GIS4EU project aims at providing base cartography datasets (administration units, hydrography, transportation networks and elevation themes) for Europe, and to ensure its cross-scale, cross-language and cross-border interoperability and accessibility according to International Standards and INSPIRE requirements.

The focus of this document is to compare GIS4EU Data providers' datasets with INSPIRE Data Model in order to identify the subset of features and attributes that will conform GIS4EU common data model for Transport Networks theme. It has been obtained performing a matching between each GIS4EU dataset and the INSPIRE Data model, which is extremely useful to fulfil the objectives of the GIS4EU project.

Furthermore, a critical analysis of INSPIRE Data Model and harmonisation process has been carried out aiming to identify possible elements missed in INSPIRE data model, elements of INSPIRE data model that might be not relevant and to report problems found at this stage.

Results and conclusions derived from mentioned analysis will be reported by GIS4EU project (INSPIRE LMO) during the INSPIRE Testing Phase.

Regarding the structure, the document is divided in four main parts.

- Section 3 justifies the adoption of INSPIRE Data Model in the context of GIS4EU.
- Section 4 gives an overview of the Transport Networks INSPIRE Data Model.
- From Section 5 to 8 the comparative and critical analysis is carried out.
- Finally, Section 9 is devoted to the conclusions of this document

2 Document Scope

This document defines the GIS4EU common data model for Transport Networks regarding road, rail and water transports.

The definition of the data model is done at a conceptual level. The physical model definition is not part of the scope of this document.

3 Introduction about adopting INSPIRE data model

The European Commission has led the development of data models common to each theme in Annex I of the INSPIRE directive. The INSPIRE data models offer a set of spatial object types (feature types) commonly used in datasets of each theme. The development of the data models was required under the following text of the directive:

> *The Commission should also be empowered to adopt implementing rules laying down technical arrangements for the interoperability and harmonisation of spatial data sets and services, rules governing the conditions concerning access to such sets and services, as well as rules concerning the technical specifications and obligations of network services. Since such measures are of general scope and are designed to supplement this Directive by the addition of new non-essential elements, they should be adopted in accordance with the regulatory procedure with scrutiny provided for in Article 5a of Decision 1999/468/EC. (Clause 33, INSPIRE Directive)*

Initially, one of the intentions of the GIS4EU project was to support the INSPIRE effort by developing data models for Administrative Units, Transport Networks and Hydrography. By October 2008 it was clear that the INSPIRE TWGs would produce data models by December 2008. Consequently, it was decided not to duplicate the effort of the INSPIRE TWGs but instead to contribute to INSPIRE by providing a critical analysis of the INSPIRE data models in relation to datasets supplied by GIS4EU data providers. The advantage of this approach is that the GIS4EU project can provide feedback to the INSPIRE TWGs. The disadvantage is that the GIS4EU TWGs have had to use draft/early versions of the INSPIRE data models.

In contrast, the Elevation theme is listed as an INSPIRE Annex II theme. It is currently not addressed by the INSPIRE TWGs. Therefore, the GIS4EU Elevation TWG adopted the process described in INSPIRE D2.6 *Methodology for the Development of Data Specifications* in order to develop a common data model for the Elevation theme.

In summary, it is expected that the results of this activity within GIS4EU will contribute to the testing and development of the INSPIRE implementation rules and guidelines.

4 Brief overview of the INSPIRE data model

4.1 Description of the theme context

The Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 (INSPIRE, 2007), which establish an Infrastructure for Spatial Information in the European Community (INSPIRE), defines the Transport Network Theme 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 (*) and future revisions of that Decision.*
>
> ** 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).*

According to this definition the Drafting Team "Data Specifications" (DT-DS) prepared the document D2.3 "Definition of Annex Themes and Scope" (INSPIRE D2.3, 2008) as a starting point for the development of the data specifications providing a more detailed description and scope by theme, important features and attributes and the overlaps and links with other themes.

Here it is included the description provided in D2.3 INSPIRE document, reviewed by the DT-DS Thematic Working Group on Transport Networks (DT-DS TWG TN), based on the fixed definition given in the Directive:

> *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 reflect the transport flow to enable our navigation services. (INSPIRE IMS, 2003)*
>
> *Route is a kind of "abstract" or invisible objects describing the spatial services offered within a transport system. Bus routes, ferry lines, scenic roads route, bicycle routes may*

be examples of route information. Commonly links or segments of a transport system is brought together to form a route, but may exist as separate feature data. It should be clarified if such data are included within this theme or if not, how one through the INSPIRE data and services can support such route information.

It is important to emphasise the transport network and its related features should include links between the different transport networks (i.e. intermodal connections) and be either seamless within each national border at European level.

It is envisioned that the scope of the transport networks theme will cover applications in routing, location based services (LBS) for intelligent transport systems, traffic management, environmental assessment, security, disaster and risk management, economic, transport and land use planning (also mentioned in the D2.3 document).

4.2 Description and overview of the INSPIRE Data Model

INSPIRE data specifications v1.00 has been developed by a group of experts (DT-DS TWG TN) in line with the contents of the document D2.6 "Methodology for the development of data specifications". The steps recommended by DT-DS are:

- Use case development: identification and description regarding requirements for the data model
- Identification of user requirements and spatial object types
- As-is analysis of the reference material provided by LMO and SDIC
- Gap analysis
- Data specification development: detailed description of the application schema and feature catalogue developed taking into account the requirements and analysis results.

All the information included in the present document is based on the INSPIRE Consolidated UML Model (INSPIRE Model, 2008).

4.2.1 Use cases

There are potentially a huge number of use cases that apply to one or more transport networks sub-themes, that where stated by the DT-DS TWG TN: air traffic control, asset management, capacity planning, construction, design and planning, disaster management, emergency response, environmental impact assessment, Estate management, traffic flow

modelling, in-car information systems, incident management, journey planning, maintenance, navigation, network operation, re-routing and diversions, routing, traffic control.

A selection of these possible use cases has been documented taking into account the existence of proper documentation, their relevance and application for as many sub-themes as possible:

- Journey planning (Citizen)
  The citizen is able to view European transport network information.
- Speed alerts in car navigation systems (Commercial sector)
- Noise Directive (European Commission)
  The EC is able to retrieve data to analyse in relation to the Noise directive.
- Environmental impact assessment (Public body)

The four actors identified are illustrated in Figure 1.

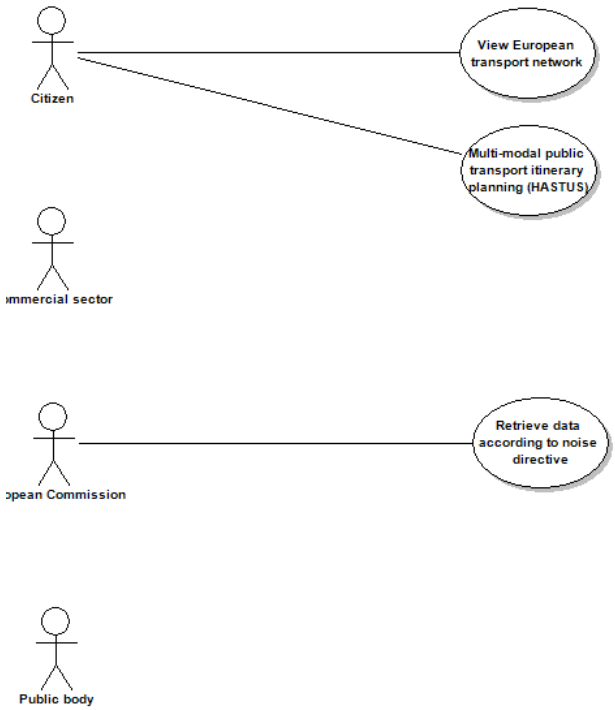

Fig. 1 - UML Use Case for Transport Networks (INSPIRE Model, 2008)

4.2.2 Transport Network Model

Transport networks model deals with four sub-themes:

- Road
- Rail
- Water
- Air

They have been modelled using the Unified Modelling Language (UML) v2.1.2 with a structure based on separate packages, therefore corresponding to four different conceptual models (one for each sub-theme).

The classes defined are considered as the transport network framework, but this structure allows potential definition of new specialised classes to cover further application level needs.

The different classes defined in the sub-themes are specializations of common definitions for networks and network elements available in the INSPIRE Generic Network Model (GNM), as a part of the INSPIRE Generic Conceptual Model (GCM).

The package structure is illustrated in Figure 2.

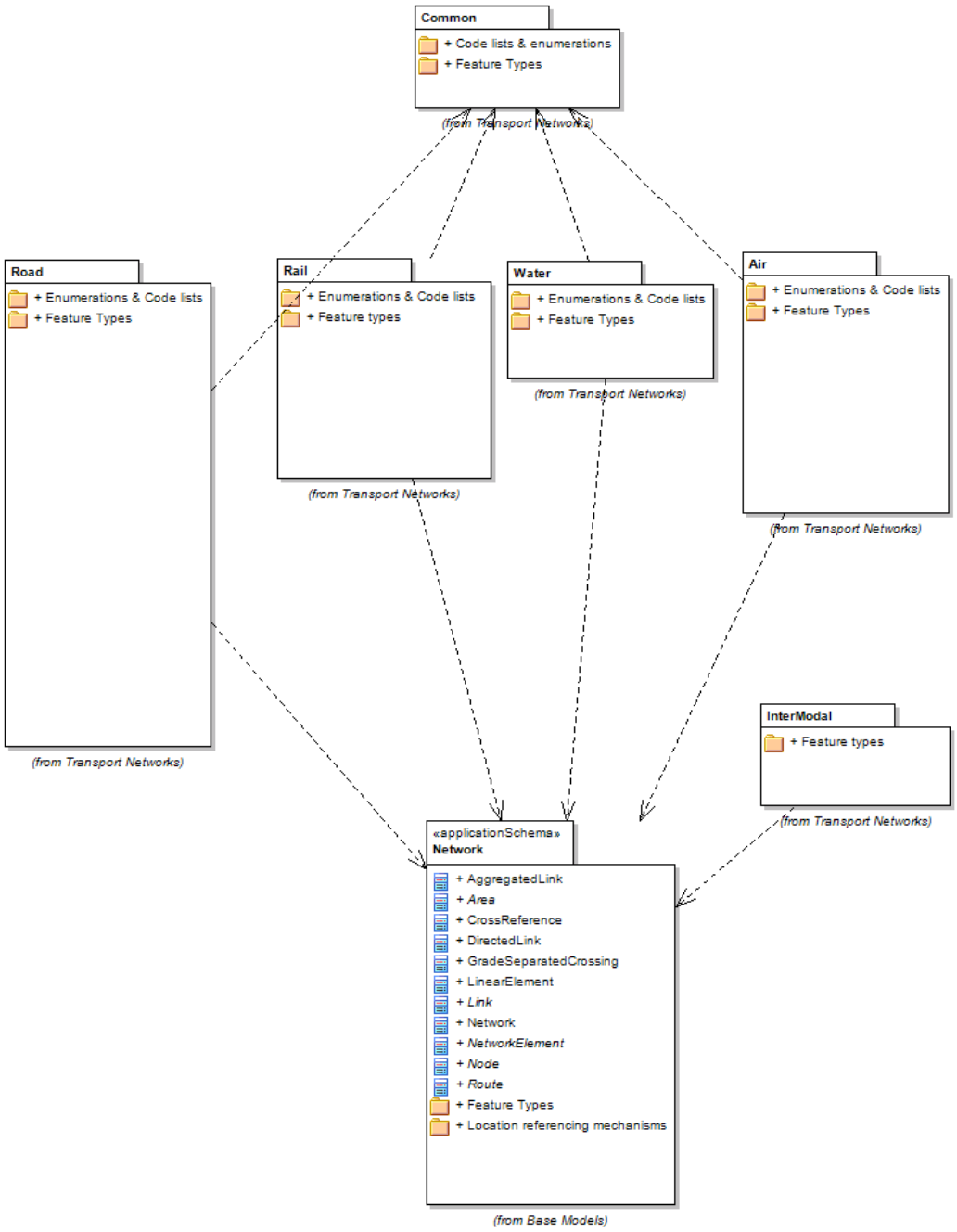

Fig. 2 - Transport Networks Overview - Package structure (INSPIRE Model, 2008)

Each package could be described as follows:

Framework package – Network application schema (GNM)

Elements in networks are handled as nodes, links, aggregated links (to define routes) and areas.

This package includes the base feature type, called NetworkElement, which has a geographical name and a unique identifier.

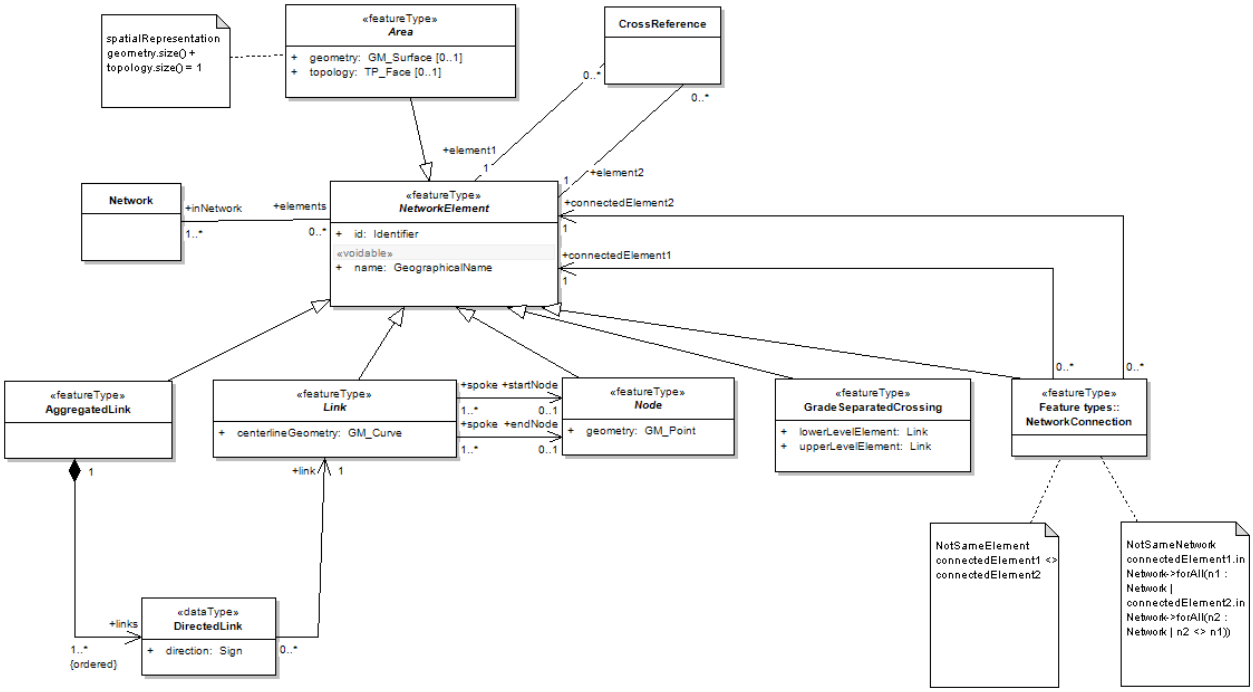

Fig. 3 - Framework package model - Network application schema (INSPIRE Model, 2008)

The NetworkElement feature type is the parent of the following feature types: Node, Link, AggregatedLink, Area, GradeSeparatedCrossing and NetworkConnection; Therefore these feature types inherit all public attributes of NetworkElement.

The Node features type represents a significant position in the network. It is always the beginning or the end of a Link feature type. It is simbolised by point geometry.

The Link feature type represents centreline segments in the network connecting two different Node features. It is simbolised by line geometry. A number of Link features could be aggregated to form a route (see AggregatedLink feature type).

The Area feature type represents a two-dimensional element in the network, and it is used to delimit the topographical extent of the network element real feature (area affected). It is simbolised by polygon geometry.

The AggregatedLink feature type represents a specific route defined as an aggregation of Link features. Therefore, it is a concatenation of line geometries.

The CrossReference relationship serves to associated two different elements of the network (i.e. an Area feature with its corresponding Link feature)

The GradeSeparatedCrossing feature identifies pairs of elements of the network which intersects in 2D but not in 3D (crossing at a different level).

Finally the NetworkConnection feature allows the definition of intermodal connections between elements of different networks or sub-themes (see Intermodal package).

These abstract classes are extended, reused and specialised in various feature types within the Transport Networks data model. Each mode of transport (i.e. road, rail, water and air) within the mentioned model is represented by its own sub-model.

Common package

This package has been defined in order to place common classes (i.e. enumerations and code lists) which could be used independently in more than one package or sub-theme.

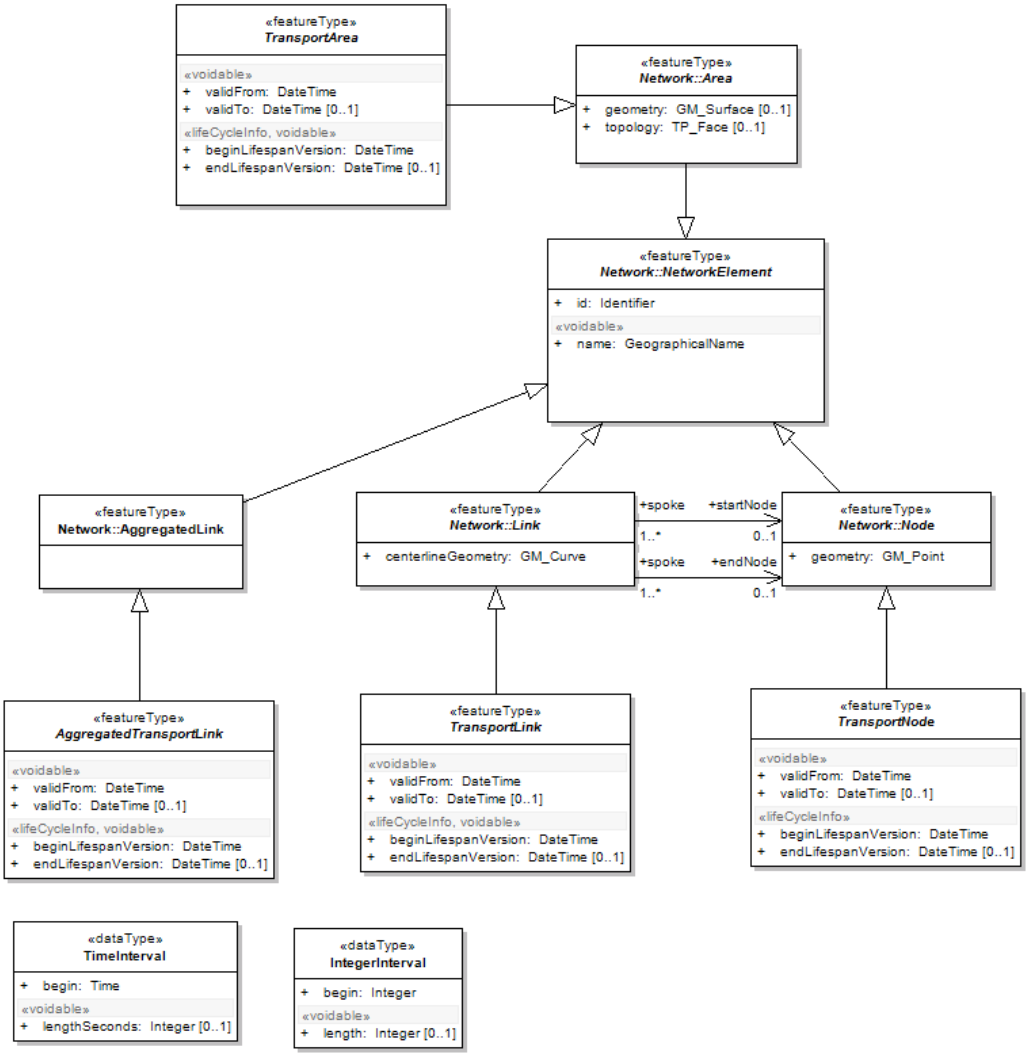

Fig. 4 - Common package model (INSPIRE Model, 2008)

In this package are also defined specific network abstract classes for the transport network: TransportNode, TransportLink, AggregatedTransportLink (transport routes defined as an aggregation of TransportLink features) and TransportArea (inherited from Node, Link, AggregatedLink and Area classes of the GNM, respectively).

Intermodal package

Intermodal connectivity (connections between elements in different networks or sub-themes) may also be modelled as an option.

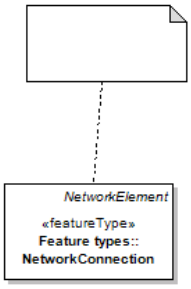

Fig. 5 - Intermodal package model (INSPIRE Model, 2008)

This basic model is simply composed of the NetworkConnection feature type (from the Framework package), which lets define a connection between two elements of a different network (i.e. a RoadNode feature with a AirportNode feature) by means of their unique identifiers.

Road package

Sub-model covering the Road sub-theme.

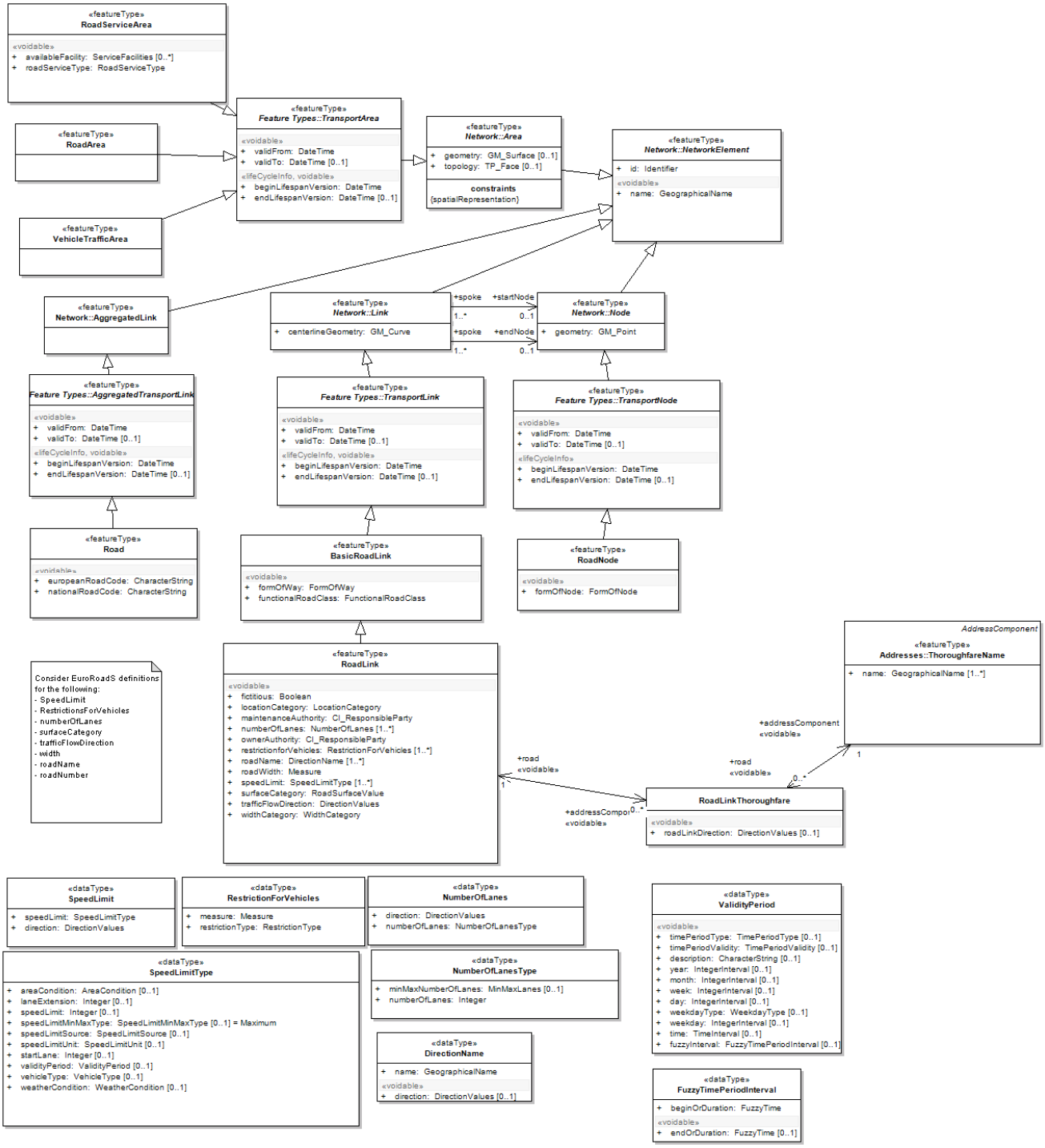

Fig. 6 - Road package model (INSPIRE Model, 2008)

The road package contains feature types like RoadNode, BasicRoadLink, RoadLink, Road (road transport routes defined as an aggregation of BasicRoadLink features or RoadLink features) and RoadArea, among others. It also contains non-spatial data types (complex data types), for example SpeedLimit, Number of Lanes and RestrictionForVehicles.

This package has apparent overlaps with the INSPIRE Addresses theme; specifically, the RoadLink feature type is associated with the ThoroughfareName feature type from the Addresses theme, which lets associate a different name for each of both link directions.

Rail package

Sub-model covering the Rail sub-theme.

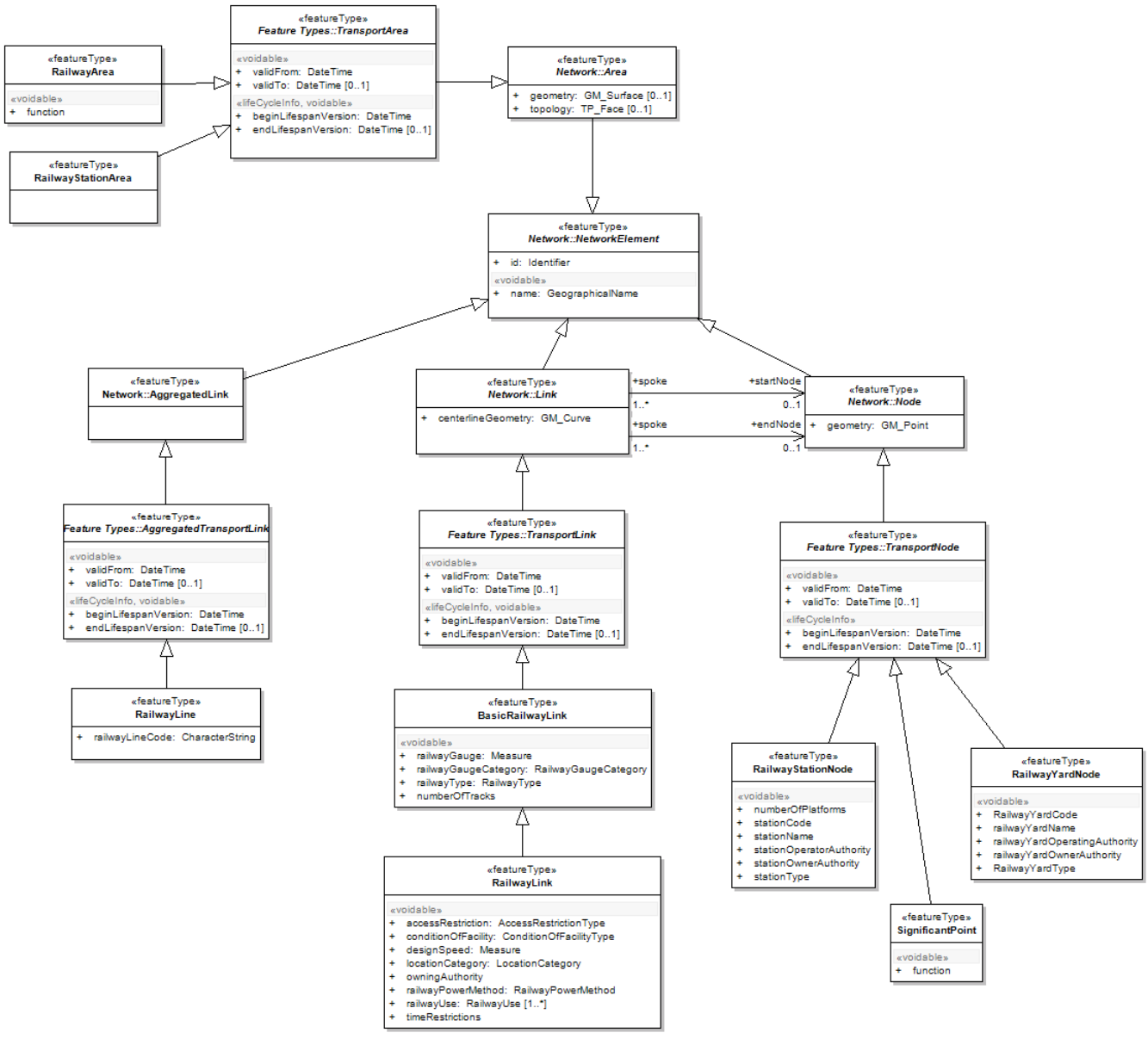

Fig. 7 - Rail package model (INSPIRE Model, 2008)

The rail package lists RailwayStationNode, RailwayYardNode, SignificantPoint, BasicRailwayLink, RailwayLink, RailwayLine (rail transport routes defined as an aggregation of RailwayLink features), RailwayArea and RailwayStationArea.

Most of the characteristics or attribution of the railway network are linked to the RailwayLink feature type.

This package also contains the definition of Cableway transport related features, but they are not currently instantiated into the rail model.

Water Package

Sub-model covering the Water sub-theme.

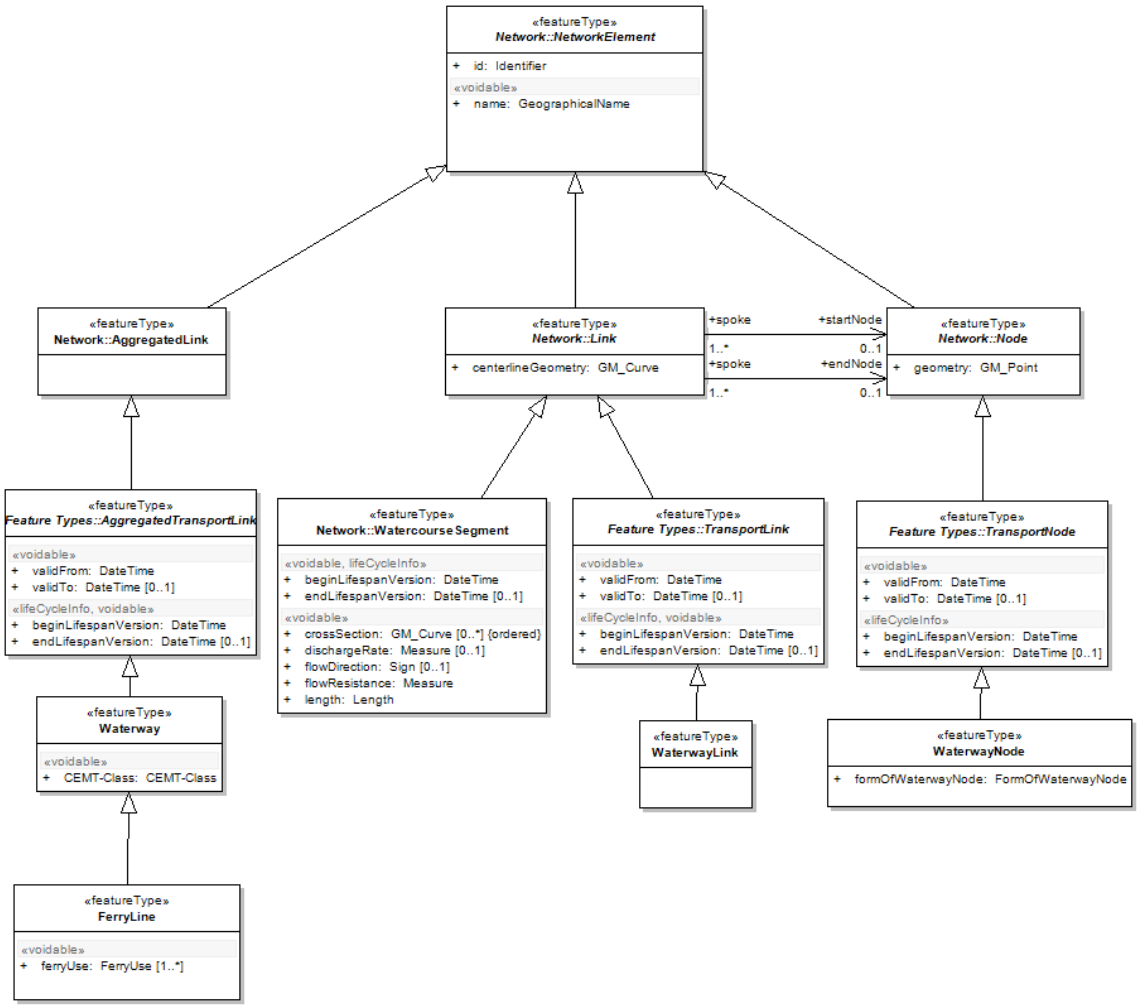

Fig. 8 - Water package model (INSPIRE Model, 2008)

The Water package lists feature types like WaterwayNode, WaterwayLink, WatercourseSegment (defined in INSPIRE Hydrography theme model), Waterway (water transport routes defined as an aggregation of WaterwayLink features or WatercourseSegment features, or a combination of them) and FerryLine (Waterway features that crosses a water-body, serving as a connection of a land-based transport).

This package has apparent overlaps with the INSPIRE Hydrography theme, since water bodies are the spatial extent for water transport services. On the other hand, both INSPIRE themes use the same base classes to define their networks (transport network; hydrography network), from the Framework package.

Air package

Sub-model covering the Air sub-theme.

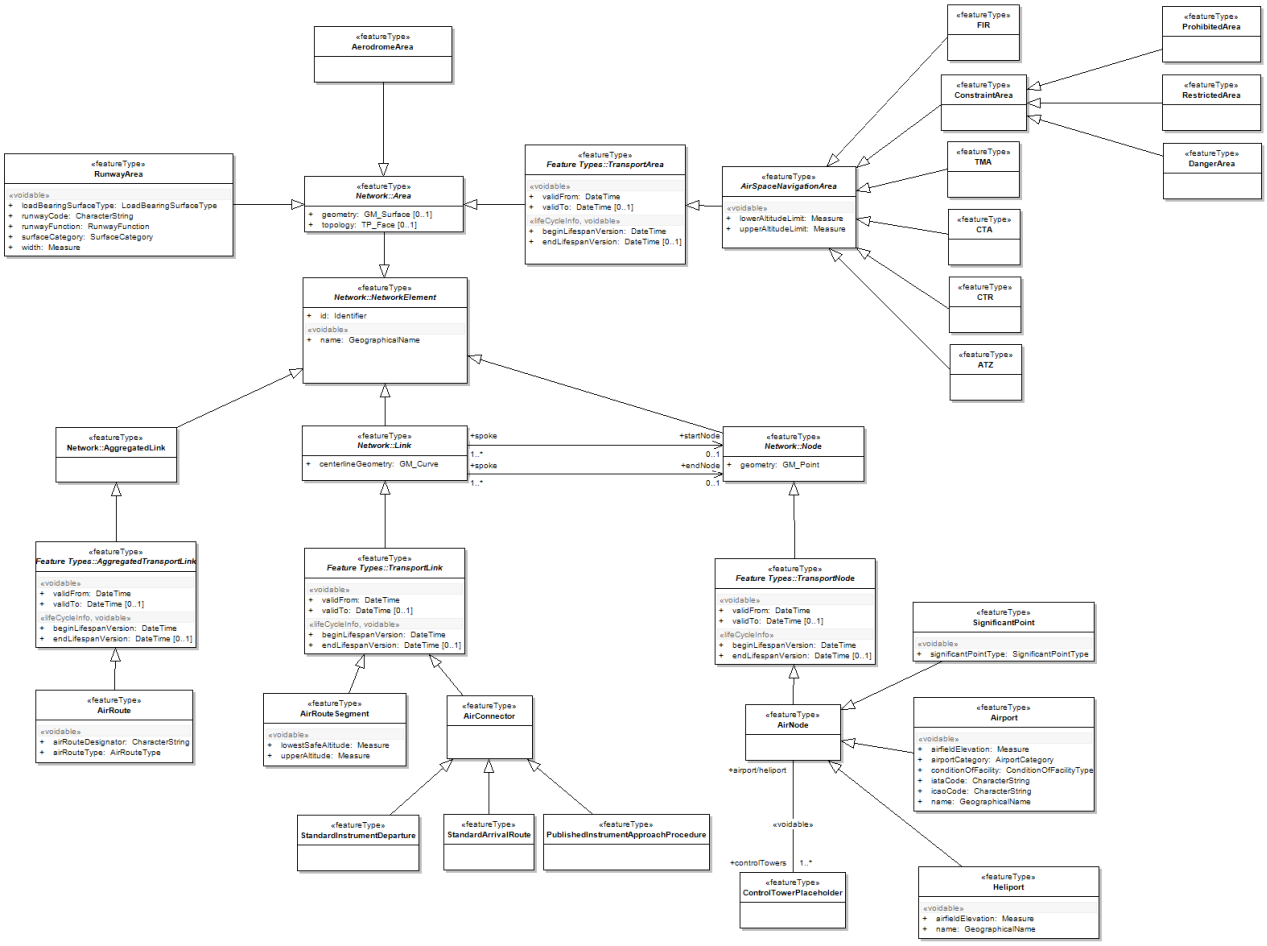

Fig. 9 - Air package model (INSPIRE Model, 2008)

The Air package defines classes like AirNode (Airport, Heliport, SignificantPoint features – are types of air nodes), AirRouteSegment and AirConnector (which represent specialised Link features for air transport), AirRoute (air transport routes or air transport lines defined as an aggregation of AirRouteSegment features) and different child features from TransportArea (RunwayArea, AerodromeArea, AirSpaceNavigationArea features).

ICAO and IATA are important identifiers foreseen in INSPIRE D2.3 as examples of possible attribution, and considered explicitly in the Airport feature (which is actually a kind of AirNode).

5 Description of the methodology used to compare GIS4EU datasets with INSPIRE data model

The goals of the comparative analysis are:

- Identify the subset of the INSPIRE data model and feature catalogue that can be completed by GIS4EU datasets.
- Find out the problems that may arise at this step of the harmonization process.
- Propose new features to the INSPIRE data model, if some new ones are identified according to INSPIRE context.
- Identify INSPIRE features/attributes that might be not relevant to INSPIRE context, if someone exists.

The analysis is carried out according to the workflow shown in figure 10.

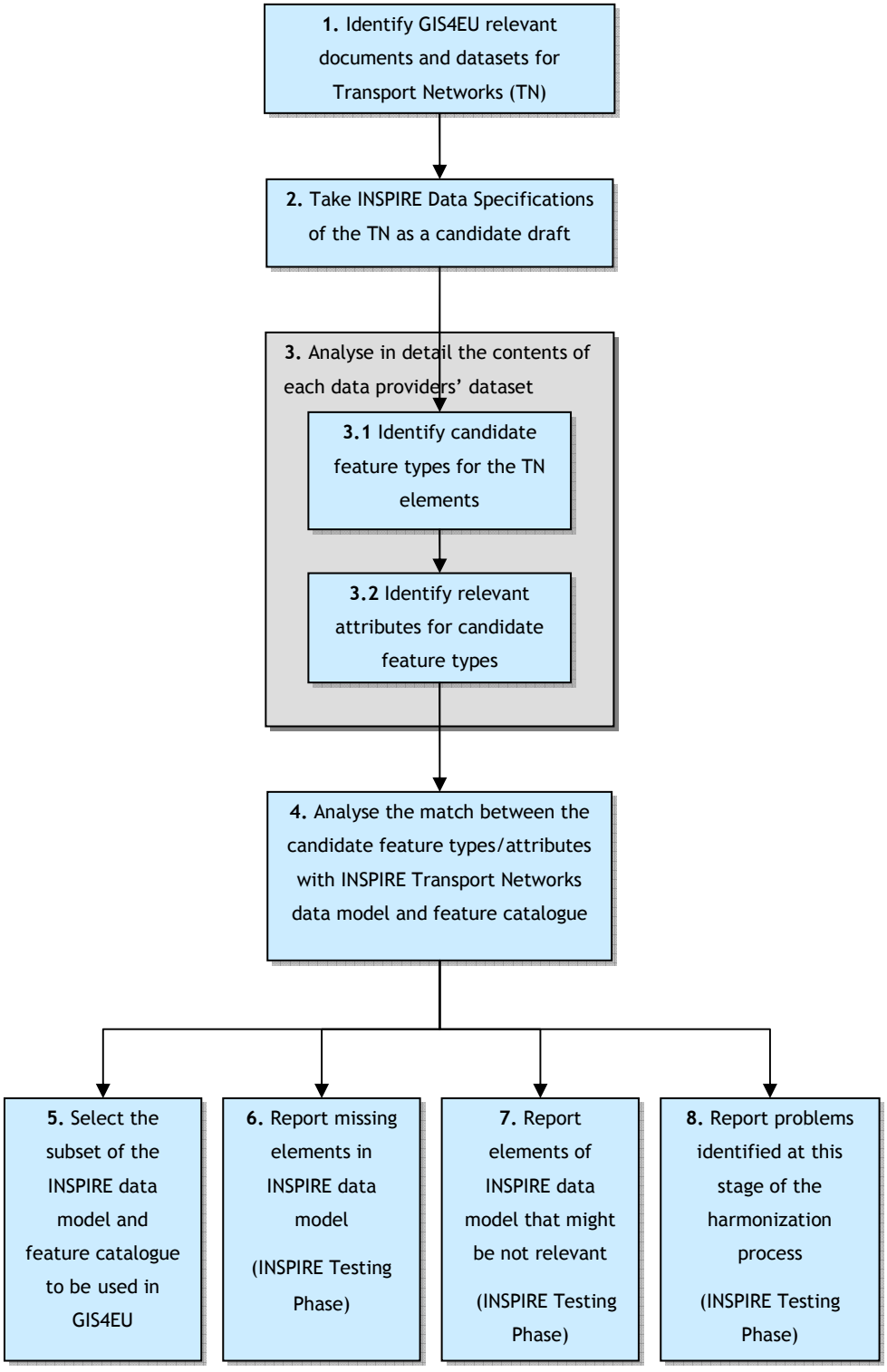

Fig. 10 – Comparative analysis workflow

The document D2.2 elaborated in the project is used to identify the GIS4EU relevant documents and datasets (step 1 of the workflow) and to analyse in detail the contents of each data providers' dataset (step 3). The INSPIRE draft Data Specifications (step 2) used corresponds to v1.00, specially the INSPIRE Consolidated UML Model (INSPIRE Model, 2008) associated to this version.

The analysis of the match (step 4) between each data providers' dataset feature types/attributes with the INSPIRE data model and feature catalogue is carried out by means of a matching table. Table 31 of the Appendix 10.2 describes the structure of the table and gives the definition of each column name.

The result is the pairing up of features and attributes from both data models as well as the classification of their features and attributes according to the following categories:

Code		Matching category description
A		Features/attributes from the dataset that fit on the INSPIRE data model
	A.1	Direct match
	A.2	Match with some semantic or data capture differences which must be stressed
	A.3	Complex match
B		Features/attributes from dataset that are not included in the INSPIRE data model
	B.1	Features/attributes that could be relevant for the INSPIRE directive
	B.2	Features/attributes that could NOT be relevant for the INSPIRE directive
C		Features/attributes from INSPIRE data model that are not included in the dataset
	C.1	Features/attributes that are considered relevant for the INSPIRE directive
	C.2	Features/attributes that might be considered NOT relevant for the INSPIRE directive

Table 2 - Classification of features and attributes according to the matching

Class A features and attributes constitute the selected subset (step 5) of the INSPIRE data model and feature catalogue to be used in the project, that is to say the common GIS4EU Transport Networks data model.

The features and attributes of the class B are analysed in detail in order to decide if some of them should be proposed for inclusion (step 6) in the INSPIRE data model and feature

catalogue in the INSPIRE testing phase. The figure 11 describes the decision flow for Class A and Class B features and attributes.

The features and attributes of the class C are not present in the dataset analysed but they have been considered important in the INPIRE analysis. Therefore the relevance of each of them is discussed and for those that are accepted it is investigated if they might be found in other datasets known by the data provider. On the other hand, those that might be considered not important to INSPIRE context are remarked in the INSPIRE testing phase report (step 7).The figure 12 describes the decision flow for Class C features and attributes.

Finally the significant aspects and problems found at this stage of the harmonization process are summarized and reported (step 8).

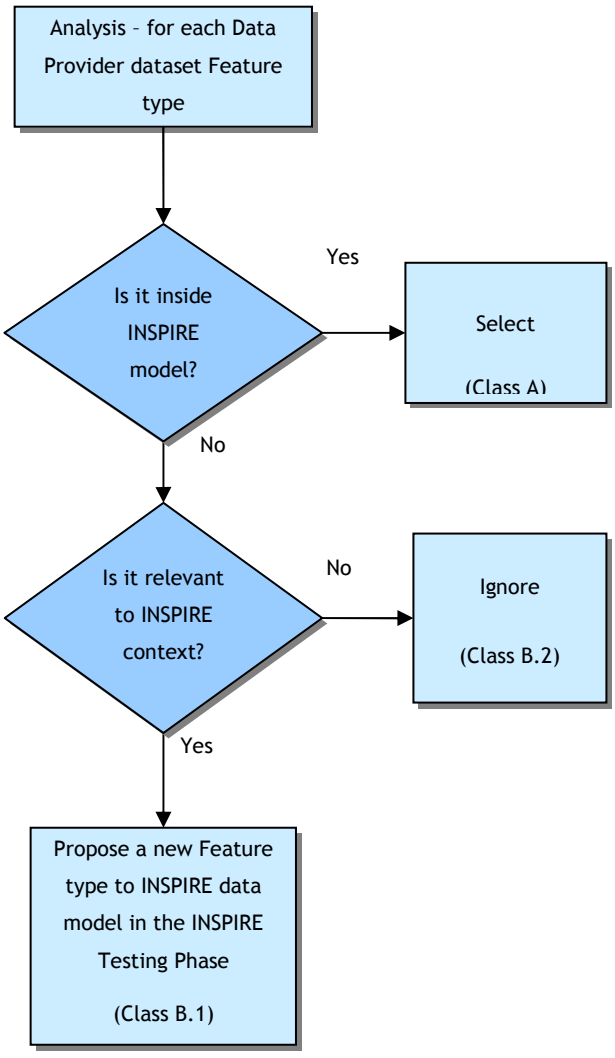

Fig. 11 –Decision flow: Class A and B features and attributes

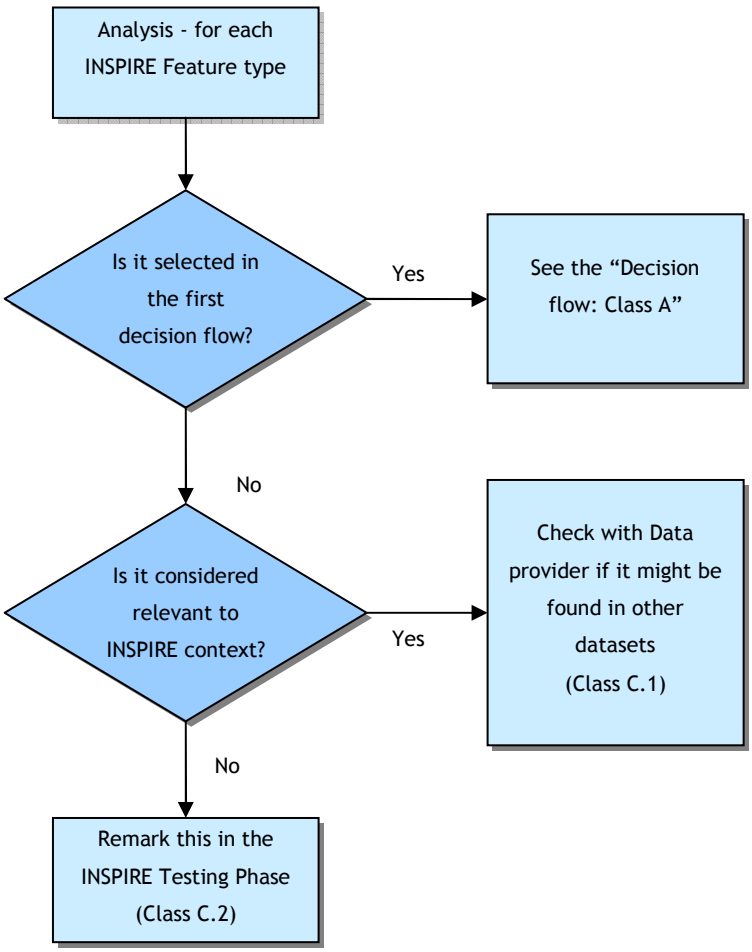

Fig. 12 - Decision flow: Class C features and attributes

6 Comparison of GIS4EU datasets with INSPIRE data model

As explained previously in this document, INSPIRE Transport Networks theme includes road, rail, water and air transport networks. For that reason there were developed four different conceptual models, one for each sub-theme.

As a consequence, the comparative analysis of GIS4EU datasets with INSPIRE data model is carried out according to the methodology described in the previous section (steps 1-4 of fig. 10), but taking each sub-theme as an independent unit of analysis.

The GIS4EU available datasets for Transport Networks theme are listed in table 30 of Appendix 10.1. The sub-themes for which they include information are identified in the corresponding column of the same table.

Applying the previously stated methodology, first of all the candidate feature types and attributes are identified for each of the datasets with available information of a sub-theme. Next, the match between the candidate feature types and attributes with INSPIRE Transport Networks sub-theme data model and feature catalogue is carried out through the matching tables. Moreover, in order to come up with a realistic and practical critical analysis and fulfil the goals of the GIS4EU Project in the INSPIRE Testing Phase, it is foreseen that data providers supply detailed information at feature and attribute level by means of comments introduced in the matching tables (see the guidelines in Appendix 10.3).

The completed tables of the comparative analysis can be reviewed trough the links included in Appendix 10.4. There is one matching table for each Data provider' dataset and sub-theme of those listed in table 30. Columns corresponding to the description of the INSPIRE feature catalogue are filled once for each sub-theme. Next, they are copied to the corresponding data providers' matching table and used as the target to which the candidate feature types and attributes identified for each sub-theme in each Data provider' dataset feature catalogue have to be matched.

As a summary of the results of the match, the following information is elaborated and presented in this section for each Sub-theme/Data provider dataset:

- The table containing the subset of features and attributes from the dataset that fit on the INSPIRE data model.
- The critical analysis of the matching process. The analysis refers to features and attributes from dataset that are not included in the INSPIRE data model (particularly the identification of possible missing elements in INSPIRE data model), features and

attributes from INSPIRE data model that are not included in the dataset (particularly the identification of elements of INSPIRE data model that might be not relevant) and reports the problems found at this stage of the harmonization process.

6.1 Road Network

6.1.1 Analysis of ICC BT-5M Dataset

Features/attributes from the ICC BT-5M dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider ICC (BT-5M) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**ROAD**	Communication way destined to the circulation of vehicles or people.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
Id	The identity of the element.	Identifier <<datatype>>	1			Unique identifier		1	
Comments					**Comments**	A unique identifier exists in the dataset (ArcInfo cover instance ID), but is not maintained when data is updated. GIS4EU id can be derived from this one.			
centerLineGeometry	The geometry that represents the centerline of the link	GM_Curve <<dataType>>	1		**Internal of ArcInfo cover format**	The geometry that represents the centerline of the link	stored in ArcInfo cover geometry format	1	

Comments					**Comments**	Feature ROAD includes the centrelines and the borders of the roads. It must be filtered by the attribute EIX_MARGE in order to select the centrelines (EIX_MARGE="axis"). Centerlines in urban areas are not compiled.			
beginLifespanVersion	Date and time at which this version of the transport link was inserted or changed in the spatial data set.	DateTime <<dataType>>	voidable - 1						
Comments	NOTE 1 If life-cycle information is not maintained as part of the spatial dataset, provide a void value with a reason of "unknown". NOTE 2 The a				**Comments**	All the transport links of the dataset had been inserted in the same date (the publication date that appears in the metadata).			
endLifespanVersion	Date and time at which this version of the transport link was superseded or retired in the spatial data set.	DateTime <<dataType>>	voidable - 0..1						
Comments	NOTE See notes in the documentation of attribute "beginLifespanVersion". These apply for this attribute, too.				**Comments**	None of the transport links of the dataset had been superseded or retired in the spatial data set.			

formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Motorway	**CTECNIC_VIA** / **TIPUSNREV_VIA**	Technical classification of the road / Type of not paved road	enumeration (vCTECNIC_VIA) / Enumeration (vTIPUSNREV_VIA)	1 / 1	"a toll motorway" / "not applicable"
				Tractor	**CTECNIC_VIA**	Technical classification of the road	enumeration (vCTECNIC_VIA)	1	“path”
Comments	There are 10 possible values in the code list but the match is only possible for one of them. The rest of the road links will have a void value assigned.				**Comments**	There are substantial differences in the categories defined for both attributes. The links for which the match of the attribute value is not possible will have a void value assigned to formOfWay. The combination of two attributes is needed in order to select the instances corresponding to formOfway=”motorway” (CTECNIC_VIA="a toll motorway" and TIPUSNREV_VIA="not applicable"). The selection of instances with CTECNIC_VIA="path" correspond to formOfway=”tractor”, but part of the paths are usable by cars. The match is not possible for the rest of values.			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**ENTORN_VIA**	Situation	enumeration (vENTORN_VIA)	1	"Generic" or "under bridge" or “connetion of axes”

				Underground					"in tunnel or subterranean "
Comments	There are 3 possible values in the code list but the match is only possible for one of them. The rest of the road links will have a void value assigned.				**Comments**	LocationCategory=”Underground” matches with ENTORN_VIA='in tunnel or subterranean'. LocationCategory=”OnGrounSurface” should be matched with ENTORN_VIA="Generic" or "under bridge" or “connection of axes”, but elevated links are also included.			
surfaceCategory	Specification of the state of the surface of the associated Road Element [GDF3] [Euroroads]	RoadSurfaceValue <<enumeration>>	voidable - 1	Paved	**REVEST_VIA**	Indicator of pavement	enumeration (vREVEST_VIA)	1	“paved”
				Unpaved					“not paved”
Comments					**Comments**				

Table 3 - Features/attributes from the ICC BT-5M Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the ICC BT-5M dataset matching process for Road Network

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

The BT-5M dataset provided by Institut Cartogràfic de Catalunya (ICC) corresponds to a topographic database which aims are to provide basic reference data for spatial applications and to produce maps. As such, it contains topographic data of several themes, as for example hydrography, roads, railways, buildings or relief. The features and attributes present in the database describe the real world from a topographic point of view. As a result of the differences between BT-5M and INSPIRE data model goals (the use cases), the subset of features and attributes from BT-5M dataset that corresponds to the road network doesn't match very well with INSPIRE road network features and attributes (See table **Erro! A origem da referência não foi encontrada.**).

The main differences are:

RoadNode	This feature class is not implemented in BT-5M data model.
BasicRoadLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RoadLink
RoadLink	This is the only feature of the INSPIRE Road Network data model that has a direct correspondent feature in BT-5M (matching class A, defined in Appendix 10.3), but as can be seen in the matching table, most of its attributes cannot be matched. Some of them deal with the same characteristic of the feature but the differences in the classification make it impossible to establish a good correspondence (formOfWay, locationCategory). This could be a recurrent issue of the harmonization process.
RoadArea	This feature class is not implemented in BT-5M data model.
VehicleTrafficArea	This feature class is implemented in BT-5M data model as part of the feature ROAD, which contains the border of the road apart from its centerline. Nevertheless, the geometry type is line" instead of "area". Unfortunately, the polygon cannot be automatically obtained.

RoadServiceArea	This feature class is not implemented in BT-5M data model.

There are some attributes in BT-5M that are not present in INSPIRE data model (class B2), however they are considered not relevant to INSPIRE context.

On the other hand, there are some features and a great number of attributes from INSPIRE data model not present in BT-5M dataset, even though most of them are considered really relevant (class C1). This is the case of functionalRoadClass, OwnerAuthority, MaintenanceAuthority, numberOfLanes, speedLimit, europeanRoadCode and nationalRoadCode. Nevertheless, the Public Works Department of the Regional Government of Catalonia, who is in charge of the road network planning and development, is compiling a database whose data model is similar to the INSPIRE one. Road centerlines of this database came from BT-5M.

Likewise, although few, there are some attributes in INSPIRE data model that we think that might be not relevant (class C2). This is the case of the "validityPeriod" data type related to the “SpeedLimit” attribute of “RoadLink” feature. The defined structure is complex and it is not easy to obtain this information. Apart from that, quite precise analyses can be done without it. The attribute “speedLimitSource” is considered not relevant too.

We also want to point out that being the value "Parking" a "roadServiceType" of the feature "RoadServiceArea", the value "EntranceOrExitCarPark" of the attribute "formOfWay" should better be included in the value "EntranceOrExitService" of the same attribute than have its own category. On the other hand, we also want to note that it would be better to establish a more general value “InProtectedSites” for the attribute speedLimit.speedLimit.areaCondition instead of the more specific “InNationalParks”.

Finally, having in mind some of the use cases selected in the INSPIRE Transport Networks theme, it would be advisable to include in the data model the information concerning the not allowed turns for each “RoadNode”. Otherwise it will be impossible to navigate trough the network.

6.1.2 Analysis of ICC BT-50M Dataset

Features/attributes from the ICC BT-50M dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider ICC (BT-50M) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**ROAD**	Communication way destined to the circulation of vehicles or people.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
Id	The identity of the element.	Identifier <<datatype>>	1			Unique identifier		1	
Comments					**Comments**	A unique identifier exists in the dataset (ArcInfo cover instance ID), but is not maintained when data is updated. GIS4EU id can be derived from this one.			
centerLineGeometry	The geometry that represents the centerline of the link	GM_Curve <<dataType>>	1		**Internal of ArcInfo cover format**	The geometry that represents the centerline of the link	stored in ArcInfo cover geometry format	1	
Comments					**Comments**	A filter excluding the links with TIPUSNREV_VIA="footpath" and the links with CFUNC_VIA="catalogued road outside Catalonia" must be applied.			

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
beginLifespanVersion	Date and time at which this version of the transport link was inserted or changed in the spatial data set.	DateTime <<dataType>>	voidable - 1						
Comments	NOTE 1 If life-cycle information is not maintained as part of the spatial dataset, provide a void value with a reason of "unknown". NOTE 2 The a				Comments	All the transport links of the dataset had been inserted in the same date (the publication date that appears in the metadata).			
endLifespanVersion	Date and time at which this version of the transport link was superseded or retired in the spatial data set.	DateTime <<dataType>>	voidable - 0..1						
Comments	NOTE See notes in the documentation of attribute "beginLifespanVersion". These apply for this attribute, too.				Comments	None of the transport links of the dataset had been superseded or retired in the spatial data set.			
formOfWay	Physical classification. The form of way describes the function as road with or without rules.	FormOfWay <<codeList>>	voidable - 1	BycicleRoad					
				DualCarriageway	NCAL_VIA	Number of tracks	enumeration (vNCAL_VIA)		double track
				EnclosedTrafficArea					
				EntranceOrExitCarPark					

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
	[EuroRoadS]			EntranceOrExitService					
				Freeway	CTECNIC_VIA	Technical classification of the road	enumeration (vCTECNIC_VIA)		preferred road
				Motorway	CTECNIC_VIA	Technical classification of the road	enumeration (vCTECNIC_VIA)		motorway
				PedestrianZone					
				Roundabout					
				ServiceRoad					
				SingleCarriageway	NCAL_VIA / TIPUSNREV_VIA / URBA_VIA	Number of tracks / Type of not paved road / Belonging to the urban plot	enumeration (vNCAL_VIA) / (vTIPUSNREV_VIA) / (vURBA_VIA)		single track / trail / urba
				SlipRoad	TIPUSTRAM_VIA	Type of line according to the representation form of the section	enumeration (vTIPUSTRAM_VIA)		catalogued section and not described as main

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
				Tractor	TIPUSNREV_VIA	Type of not paved road	enumeration (vTIPUSNREV_VIA)		path
				TrafficSquare					
				Walkway					
Comments					**Comments**	There are substantial differences in the categories defined for both attributes. The links for which the match of the attribute value is not possible will have a void value assigned to formOfWay. Instances with TIPUSTRAM_VIA="catalogued section and not described as main" and CTECNIC_VIA="motorway" or CTECNIC_VIA="preferred road" must be excluded when assigning the selected instances with NCAL_VIA=”double track” to formOfWay=”DualCarriageWay”. Instances with TIPUSTRAM_VIA="catalogued section and not described as main" must be excluded when assigning the selected instances with CTECNIC_VIA=”preferred road” to formOfWay=”Freeway”. Instances with TIPUSTRAM_VIA="catalogued section and not described as main" must be excluded when assigning the selected instances with CTECNIC_VIA=”motorway” to formOfWay=”Motorway”. Instances of types EnclosedTrafficArea, PedestrianZone, RoundAbout, TrafficSquare, Walkway are included in formOfWay=”SingleCarriageWay”. Part of the links of type ServiceRoad and BycicleRoad may be included here too.			

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
						Instances of types EntranceOrExitCarPark, EntranceOrExistservice are included included in formOfWay=”SlipRoad”. Part of the links of type ServiceRoad may be included here too. Instances of type BycicleRoad may be included in formOfWay=”Tractor”. Part of the paths is usable by cars.			
functionalRoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>	voidable - 1	MainRoad FirstClass SecondClass	**CFUNC_VIA**	Functional classification of the road according to Law 7/1993, of September 30th, highways of the Catalan Autonomous Government	enumeration (vCFUNC_VIA)	1	basic network regional network (“comarcal”) local network
Comments					Comments				
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface SuspendedOrElevated Underground	**ENTORN_VIA**	Situation	enumeration (vENTORN_VIA)	1	"Generic" or "in urban plot" "covered or subterranean"

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
Comments					Comments	LocationCategory=”Underground” matches with ENTORN_VIA='covered or subterranean'. LocationCategory=”OnGrounSurface” should be matched with ENTORN_VIA= "Generic" or "in urban plot", but elevated links are also included.			
maintenanceAuthority	The authority responsible for maintenance of the road link	CI_ResponsibleParty <<dataType>>	voidable - 1		**ORGAN_VIA**	Titular organism, competent in use and maintenance of the section of the road	enumeration (vORGAN_VIA)	1	
Comments					Comments				
ownerAuthority	The authority owning this road link	CI_ResponsibleParty <<dataType>>	voidable - 1						
Comments					Comments	Can be derived from ORGAN_VIA as follows: If CTECNIC_VIA <> "not catalogued road" and CTECNIC_VIA <> "not applicable" then (If ORGAN_VIA="EG" or ORGAN_VIA="EB" or ORGAN_VIA="ET" or ORGAN_VIA="EL" then ownerAuthority="Government of Spain" else ownerAuthority="Autonomous Government of Catalonia") else ownerAuthority=void			
surfaceCategory	Specification of the state of the surface	RoadSurfaceValue	voidable -	Paved	**REVEST_VIA**	Indicator of	enumeration	1	“paved”

INSPIRE feature catalogue					Data provider ICC (BT-50M) feature catalogue				
Target model					**Source model**				
	of the associated Road Element [GDF3] [Euroroads]	<<enumeration>>	1	Unpaved		pavement	(vREVEST_VIA)		"not paved"
Comments					Comments	A void value for surfaceCategory attribute must be assigned if REVEST_VIA="not classified" or REVEST_VIA="not applicable"			
trafficFlowDirection	direction of traffic flow in comparison to the link geometrical direction [Euroroads]	DirectionValues <<enumeration>>	voidable - 1	Both	**TIPUSTRAM_VIA**	Type of line according to the representation form of the section	enumeration (vTIPUSTRAM_VIA)	1	"main section (single axis)"
Comments	There are 4 possible values: Positive, Negative, Both and None.				Comments	A void value must be assigned to the rest of the links.			
europeanRoadCode	the Europe way number of the road [Euroroads]	CharacterString	voidable - 1		**CODIEUR_VIA**	European network code	String	1	
Comments					Comments				
nationalRoadCode	the national number of the road [Euroroads]	CharacterString	voidable - 1		**CODI_VIA**	Official code of the road	String	1	
Comments					Comments				

Table 4 - Features/attributes from the ICC BT-50M Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the ICC BT-50M dataset matching process for Road Network

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

The BT-50M dataset provided by Institut Cartogràfic de Catalunya (ICC) corresponds to a topographic database which aim is to provide basic reference data for spatial applications. As such, it contains topographic data of several themes, as for example hydrography, roads, railways, buildings or relief, and the features and attributes present in the database describe the real world from a topographic point of view.

Nevertheless, in order to increase its analysis capabilities, there have been added some specific requirements to the road, rail and hydrography networks. As a result, the road network is connected and complete and there have been added some other attributes apart from the strictly topographic ones.

The result of the match with INSPIRE Road data model can be seen in table 4. The main differences are:

RoadNode	This feature class is not implemented in BT-50M data model. However, as the road links are always connected and the road network is complete, the geometry of the feature “RoadNode” could be derived by spatial analysis if it is considered necessary.
BasicRoadLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RoadLink
RoadLink	This is the only feature of the INSPIRE Road Network data model that has a direct correspondent feature in BT-50M (matching class A, defined in Appendix 10.3). As can be seen in the matching table, some of the attributes can be well matched (class A1 or A3), as is the case of functionalRoadClass, maintenanceAuthority, ownerAuthority, surfaceCategory, europeanRoadCode and nationalRoadCode. Some other can be matched but with semantic problems (class A2), as is the case of formOfWay and locationCategory. In most cases both attributes deal with the same characteristic of the feature but the

	differences in the classification make it impossible to establish a good correspondence. This could be a recurrent issue of the harmonization process.
RoadArea	As a consequence of its level of detail, this feature class is not implemented in BT-50M data model.
VehicleTrafficArea	As a consequence of its level of detail, this feature class is not implemented in BT-50M data model.
RoadServiceArea	As a consequence of its level of detail, this feature class is not implemented in BT-50M data model.

There are some attributes in BT-50M that are not present in INSPIRE data model (class B2). All of them are considered not relevant to INSPIRE context except the attribute concerning the status of the road with regard to its usability or completion (projected, under construction, functional, etc). This attribute is included in the INPIRE Rail data model (conditionOfFacility) but is not included in the Road one.

On the other hand, there are some features and attributes from INSPIRE data model not present in BT-50M dataset, even though most of them are considered really relevant (class C1). This is the case of numberOfLanes and speedLimit.

Likewise, although few, there are some attributes that we think that might be not relevant (class C2). This is the case of the "validityPeriod" data type related to the “SpeedLimit” attribute of “RoadLink” feature. The defined structure is complex and it is not easy to obtain this information. Apart from that quite precise analyses can be done without it. The attribute “speedLimitSource” is considered not relevant too.

We also want to point out that being the value "Parking" a "roadServiceType" of the feature "RoadServiceArea", the value "EntranceOrExitCarPark" of the attribute "formOfWay" should better be included in the value "EntranceOrExitService" of the same attribute than have its own category. On the other hand, we also want to note that it would be better to establish a more general value “InProtectedSites” for the attribute speedLimit.speedLimit.areaCondition instead of the more specific “InNationalParks”.

It has to be highlighted, too, that the feature RoadServiceArea is not present in this dataset as a consequence of its level of detail. Provided that in the INSPIRE Rail Network data model the area features RailwayStationArea and RailwayArea have its correspondent point features, the same could be done in the Road Transport Network data model, adding a new feature RoadServiceNode with the same attributes than RoadServiceArea.

We also want to stress that the INSPIRE attribute functionalRoadClass classifies the road links depending on the importance and role that the Road Link has in the connectivity of the road network (a maximum of 10 levels are considered). This open classification makes it easy to match road classifications used in the different dataset with the INSPIRE one. However, when datasets from different data providers and countries are integrated, the classes would have the same name but they might not correspond to the same level of importance or role.

Finally, having in mind some of the use cases selected in the INSPIRE Transport Networks theme, it would be advisable to include in the data model the information concerning the not allowed turns for each “RoadNode”. Otherwise it will be impossible to navigate trough the network.

6.1.3 Analysis of RLIG DBPrior10K Dataset

Features/attributes from the RLIG DBPrior10K dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadNode	A node which occurs in a road network. [TWG TN] Analogous to Junction in GDF. [EuroRoadS]			Point	**dbp_intersez_str_07**	A node which occurs in a road network.			Point_2d
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**id**	The unique identity of the element	Integer	1	
Comments					**Comments**	A.1: the implementation of this attribute isn't like Inspire Indentifier, GCM clause 14, because the DBPRIOR10K Project was implemented before. ID is local identifier.			
geometry	The location of the node	GM_Point <<dataType>>	1		**gdo_geometry**	Contains the implementaton of feature geometry	Blob_binary	1	

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
formOfNode		FormOfNode <<codeList>>	voidable - 1		tipo_intersezione	This attribute shows the type of intersection between two or more occurrences of the road's network.	Enum	1	
Comments					Comments	A.2 :verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione". The values « passaggio a livello » and « Casello/barriera autostradale » do not match with any domain's value of the Inspire attribute "FormofNode" .			
formOfNode		FormOfNode <<codeList>>	voidable - 1	EnclosedTrafficArea	tipo_intersezione		Enum	1	
Comments					Comments	A.3: this value do not match with domain's value of tipo_intersezione			

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
formOfNode		FormOfNode <<codeList>>	voidable - 1	Grade separated crossing	tipo_intersezione				intersezione a livelli sfalsati con svincoli
Comments					**Comments**	A.2: verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione".			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
formOfNode		FormOfNode <<codeList>>	voidable - 1	juction					ordinaria (intersezione a raso/biforcazione)
Comments					**Comments**	A.2: verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione".			
formOfNode		FormOfNode <<codeList>>	voidable - 1	PseudoNode	tipo_intersezione		Enum		Cambio toponimo/patrimonialita
									Variazione classifica tecnico/funzionale
									Area a traffico non strutturato

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A.2 verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione". For us, the value "PseudoNode" of the attribute "FormofNode" matches with 3 values of the attribute " **tipo_intersezione**": - Cambio toponimo/patrimonialita - Variazione classifica tecnico/funzionale - Area a traffico non strutturato			
formOfNode		FormOfNode <<codeList>>	voidable - 1	RoadEnd	tipo_intersezione		Enum	1	inizio/fine tratto stradale
Comments					Comments	A.2: verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione".			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
formOfNode		FormOfNode <<codeList>>	voidable - 1	Roundabout	tipo_intersezione		Enum	1	rotatoria o minirotatoria)
Comments					Comments	A.2: verify the relation between attribute value "formofnode" and attribute value "tipo_intersezione".			
formOfNode		FormOfNode <<codeList>>	voidable - 1	Traffic Square	tipo_intersezione				

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A.3: this value do not match with domain's value of tipo_intersezione			
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**dbp_tratto_strada_07**	Road graph - objects composing the infrastructure of transport represented as an edge-node graph			Line_2d
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
ID	The identity of the element	Identifier <<datatype>>	1		**id**	The unique identity of the element	Integer	1	
Comments					Comments	A.1: the implementation of this attribute isn't like Inspire Indentifier, GCM clause 14, because the DBPRIOR10K Project was implemented before. ID is local identifier.			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
centerLineGeometry	The geometry that represents the centreline of the link	GM_Curve <<dataType>>	1		**Gdo_geometry**	contains the implementaton of feature's geometry. The geometry is the centraline of the link	Line_2d	1	

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					**Comments**				
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>	voidable - 1	MainRoad	**CLASS_TECN_FUNZ**	Road's element type	Enum	1	Autostrada
Comments					**Comments**	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]]	FunctionalRoadClass <<enumeration>>	voidable - 1	FirstClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum	1	Strada extraurbana principale
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>	voidable - 1	SecondClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum	1	Strada extraurbana secondaria
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>		ThirdClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum	1	Strada extraurbana non qualificata
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>		FourthClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum		strada urbana di scorrimento

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>		FifthClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum	1	strada urbana di quartiere
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Functional RoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>		SixthClass	**CLASS_TECN_FUNZ**	Functional Classification	Enum	1	strada urbana non qualificata
Comments					Comments	A.3 : it's necessary verify the relation between Inspire attribute value "Functional RoadClass" and RLIG attribute value "Class_tecn_funz".			
Fictitious	True if this road link does not represent a real and existing road element [TWG TN]	Boolean		YES	**PERCORSO_FITTIZIO**		Boolean		T: tratto di connessione fra tratti del medesimo grafo o di altri tipi di mobilità
				NO					F: tratto di effettiva percorrenza veicolare

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A			
LocationCategory	LocationCategory	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE**		Enum		Propria Passaggio a livello
				SuspendedOrElevated					Su ponte, viadotto
				Underground					In sottopasso In galleria
Comments					Comments	A.4 :verify the relation between attribute value "locationcategory" and attribute value "sede ». The value « altro » do not match with any domain's value of the Inspire attribute "LocationCategory " .			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
maintenanceAuthority	The authority responsible for maintenance of the road link	CI_ResponsibleParty <<dataType>>	voidable - 1		**COD_ENTE_GESTORE**	Code showing the local road administrator institute.	integer		
Comments					Comments	A.5:this attribute isn't implemented			

INSPIRE feature catalogue					Data provider RLIG (datasetDBPrior10K-Road Network) feature catalogue				
Target model					**Source model**				
WidthCategory <<enumeration>>	**Attribute not defined**	WidthCategory <<enumeration>>	voidable - 1	WidthCategory1	**CLASS_MAX_LARGH**	This attribute shows the maximum width of the occurrence.	enum		< 3.5 meter
				WidthCategory2					between 3.5 and 6.0 meters
				WidthCategory3					between 6.0 and 8.0 meters
									> 8.0 meters
Comments					**Comments**	A.6: it's difficult because in Inspire the values of attribute WidthCategory don't define.			

Table 5 - Features/attributes from the RLIG DBPrior 10K Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the RLIG DBPrior 10K dataset matching process for Road Network

The Transportation dataset provided by Regione Liguria (RLIG) was developed according to the project "DBPrior10K: Data Base of the prior Layers at scale 1:10000" (Doc. INTESA/WG01 – N 1005) carried out by the national Italian Workgroup on DB topographic "Gruppo di Lavoro sulle Specifiche per i Data Base Topografici all'interno dell'Intesa Stato - Regioni - Enti Locali per la realizzazione di banche dati di interesse generale".

The Rlig Transportation Dataset is about only RoadNetwork.

This theme was further developed in the National project Intesa Gis-DBTopo.

The Spatial Data Model of the project DBPrior10k is 2D.

This project is a national project. INSPIRE is an European project and it has many features with many fields. This is the reason because the RLIG features that match with INSPIRE features are few.

The dataset analyzed is only the DBPRIOR10k one.

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

The INSPIRE features matching with RLIG features are (as can be seen in the matching table):

- RoadNode
- RoadLink

The feature "RoadNode " matches directly with "DBP_INTERSEZ_STR_07".

The major difficulties is to establish the relation between the code values of attribute INSPIRE "formofNode" and the code values of attribute RLIG "TIPO_NODO" (see A.2 in the matching table).

For us, the values "casello/barriera autostradale" and "passaggio a livello" do not match with any domain's value of the Inspire attribute "FormofNode".

The feature "RoadLink" matches directly with "DBP_TRATTO_STRADA_07".

The major difficulty is to establish the relation between INSPIRE attributes and RLIG attributes (highlighted in the matching table):

A.3: it is necessary to verify the relation between Inspire attribute value "**FunctionalRoadClass**" and RLIG attribute value "**Class_tecn_funz**".

A.4: it is necessary to verify the relation between attribute value "**locationcategory**" and attribute value "**sede**".

The value « altro » don't match with any domain's value of the Inspire attribute **"LocationCategory "** .

A.6: the RLIG attribute **CLASS_MAX_LARGH** matches with Inspire attribute **WidthCategory** but the relation it's impossible because the values of WidthCategory are not yet defined.

In RLIG dataset is present the attribute "TIPO_TRATTO" (undifferentiated element of road, pedestrian road, road junction) showing the road's element type.

Maybe this attribute matches with the INSPIRE attribute "FormofWay " ?

In the RLIG dataset the road names are stored in the alphanumeric table "A_STR_STRADA" linked to the feature "DBP_TRATTO_STRADA_07" by the attribute COD_STRADA.

In the matching table at "line 284" there are the attributes of RLIG features "DBP_INTERSEZ_STR_07" and "DBP_TRATTO_STRADA_07" that are not present in the INSPIRE data model.

CONCLUSION

The major difficulties is about semantic definition of attributes present in the Inspire Model (e.g. "Formof Way", "FunctionalRoadClass" of feature Roadlink) in order to establish an exact matching with the RLIG attributes.

In order to accomplish this work it is necessary to have an exact specification about the INSPIRE attributes semantic definition (glossary).

6.1.4 Analysis of RPIE Piemonte Est Dataset

Features/attributes from the RPIE Piemonte Est dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadNode	A node which occurs in a road network. [TWG TN] Analogous to Junction in GDF. [EuroRoadS]			Point	**010108_P**	ROAD JUNCTION (GDF level 1)			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**posizione_L1_3D**		Point in 3D	1	
Comments					**Comments**	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	EnclosedTrafficArea	**TY_GZ_STR**	Node type	Alphanumeric string	0108	enclosed traffic area
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfNode		FormOfNode <<codeList>>	voidable - 1	Junction	**TY_GZ_STR**	Node type	Alphanumeric string	0101	intersection/fork
Comments					Comments	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	PseudoNode	**TY_GZ_STR**	Node type	Alphanumeric string	0106	change of toponym
								0110	loop interruption
								0107	change of functional classification
Comments					Comments	A2 The value "PseudoNode" of the attribute "FormofNode" matches with three possible values of the attribute attribute "TY_GZ_STR" in the RPIE dataset: 0106-change of toponym 0110-loop interruption 0107-change of functional classification			
formOfNode		FormOfNode <<codeList>>	voidable - 1	RoadEnd	**TY_GZ_STR**	Node type	Alphanumeric string	0105	start or end of the element
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfNode		FormOfNode <<codeList>>	voidable - 1	Roundabout	**TY_GZ_STR**	Node type	Alphanumeric string	0103	small roundabout (r < 10m)
Comments					Comments	A2 In the RPIE dataset only small roundabout (r<10m) are include			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**010107_L**	ROAD ELEMENT (GDF level 1)			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**tracciato_L1_3D**		Polyline in 3D	1	
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	DualCarriageway	**CL_FUNZION**	Functional Classification	Alphanumeric String	0302	main extra-urban road
Comments					Comments	A2 Partial match: the main extra-urban road sometimes are also dual carriage way, but sometimes they have only one carriage			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	EnclosedTrafficArea	**CL_FUNZION**	Functional Classification	Alphanumeric String	0103	road link of enclosed traffic area
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	EntranceOrExitCarPark	**CL_FUNZION**	Functional Classification	Alphanumeric String	010301	parking
Comments					Comments	A1			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	EntranceOrExitService	**CL_FUNZION**	Functional Classification	Alphanumeric String	010307	pertinence area
Comments					Comments	A2 Partial match: the pertinance areas includes entrance or exit services, but may include also other types of area			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Freeway	**CL_FUNZION**	Functional Classification	Alphanumeric String	0301	Motorway
Comments					Comments	A2 Intesa Gis specification does not distinguish Freeway and Motorway. In Piedmont Region there are not freeways.			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Motorway	**CL_FUNZION**	Functional Classification	Alphanumeric String	0301	Motorway
Comments					Comments	A1 Intesa Gis specification does not distinguish Freeway and Motorway. In Piedmont Region there are not freeways.			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Roundabout	**CL_FUNZION**	Functional Classification	Alphanumeric String	010205	roundabout
Comments					Comments	A1			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SingleCarriageway	**CL_FUNZION**	Functional Classification	Alphanumeric String	0303	secondary extra-urban road
Comments					Comments	A2 The secondary extra-urban road generally are single carriage way			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SlipRoad	**CL_FUNZION**	Functional Classification	Alphanumeric String	010102	ramp / motorway junction
Comments					Comments	A1 This value is present in Intesa Gis Specifications 2006, but not 2004			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	TrafficSquare	**CL_FUNZION**	Functional Classification	Alphanumeric String	010204	traffic square
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Walkway	**CL_FUNZION**	Functional Classification	Alphanumeric String	0104	walkway
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE_STR**	Type of the roadway	Alphanumeric String	0601	on ground surface
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	SuspendedOrElevated	**SEDE_STR**	Type of the roadway	Alphanumeric String	0603	suspended or elevated
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	Underground	**SEDE_STR**	Type of the roadway	Alphanumeric String	0607	underground
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
roadWidth	the width of the road or street, measured as average value [Euroroads]	Measure <<datatype>>	voidable - 1		**CL_LARGH**	Class of width	Alphanumeric String	0701	smaller than 3.5 m
								0702	from 3.5 m to 7.0 m
								0703	larger than 7.0 m
Comments					Comments	A2 In the Intesa Gis specifications the roadWidth is signified as range of road width: 701-smaller than 3.5 m 702-from 3.5 to 7.0 m 703-larger than 7.0 m			
surfaceCategory	specification of the state of the surface of the associated Road Element [GDF3] [Euroroads]	RoadSurfaceValue <<enumeration>>	voidable - 1	Paved	**TY_FONDO**	Type of road surface	Alphanumeric String	0601	paved
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
surfaceCategory	specification of the state of the surface of the associated Road Element [GDF3] [Euroroads]	RoadSurfaceValue <<enumeration>>	voidable - 1	Unpaved	**TY_FONDO**	Type of road surface	Alphanumeric String	0602	unpaved
Comments					Comments	A1			
widthCategory		WidthCategory <<enumeration>	voidable - 1	WidthCategory1	**CL_LARGH**	Class of width	Alphanumeric String	0701	smaller than 3.5 m
Comments					Comments	A2 The Inspire widthCategory values are not specified. In the Intesa Gis Specifications the WidthCategory1 is definied as smaller than 3.5 m			
widthCategory		WidthCategory <<enumeration>	voidable - 1	WidthCategory2	**CL_LARGH**	Class of width	Alphanumeric String	0702	from 3.5 m to 7.0 m
Comments					Comments	A2 The Inspire widthCategory values are not specified. In the Intesa Gis Specifications the WidthCategory2 is definied as included within 3.5 m and 7.0 m			
widthCategory		WidthCategory <<enumeration>	voidable - 1	WidthCategory3	**CL_LARGH**	Class of width	Alphanumeric String	0703	larger than 7.0 m

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
Comments					Comments	A2 The Inspire widthCategory values are not specified. In the Intesa Gis Specifications the WidthCategory3 is definied as larger than 7.0 m			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadArea	Surface which extends to the limits of a road/street, including vehicular areas and other parts of it (i.e. pedestrian areas). [TWG TN]			Area	**010104_A**	MAIN ROAD AREA			Polygon
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	Represents the geometric properties of the area	GM_Surface <<dataType>>	1		**Estensione**		Complex Surface in 2D	1	
Comments					Comments	A1			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
VehicleTrafficArea	Surface of a road/street where it is possible to circulate a with any type of vehicles. [TWG TN] It is used in large scale mapping and usually excludes pedestrian areas.			Area	**010101_A**	VEHICULAR CIRCULATION AREA			Polygon
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	Represents the geometric properties of the area	GM_Surface <<dataType>>	1		**Estensione**		Complex Surface in 2D	1	
Comments					**Comments**	A1			

Table 6 - Features/attributes from the RPIE Piemonte Est Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the RPIE Piemonte Est dataset matching process for Road Network

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

Piedmont Region has given to GIS4EU project two datasets: Piemonte Est and DBPrior10k.

The Piemonte Est dataset is more compliant with the INSPIRE model than DBPrior10k.

The Piedmonte Est datasets related with Road Network are composed by the following feature classes:

010108_P - ROAD JUNCTION (GDF level 1)
010107_L - ROAD ELEMENT (GDF level 1)
010109_L - ROAD (GDF level 2)
010110_P - INTERSECTION (GDF level 2)
010104_A – MAIN ROAD AREA
010101_A - VEHICULAR CIRCULATION AREA
010102_A - PEDESTRIAN CIRCULATION AREA
010105_A - SECONDARY ROAD AREA
010116_L - SECONDARY ROAD ELEMENT
010117_P - SECONDARY ROAD JUNCTION

Piemonte Est dataset has been realized in accordance with Intesa Gis Specifications, vers. 2004, which are less detailed than the INSPIRE model.

The main differences are:

RoadNode	in Piemonte Est dataset the feature class 010108_P - ROAD JUNCTION (GDF level 1), with some differences related to the feature attributes. However in Piemonte Est dataset a second road node feature class is present: 010110_P - INTERSECTION (GDF level 2), which is related to the road node in accordance with the level 2 of the GDF standard.

	The 010110_P – INTERSECTION feature class is not present in the INSPIRE model.
BasicRoadLink	in Piemonte Est dataset this feature class is not implemented, whereas is directly implemented the more detailed class RoadLink
RoadLink	there is a good matching between INSPIRE RoadLink and Piemonte Est 010107_L - ROAD ELEMENT (GDF level 1), both regarding semantic definition and data structure. The INSPIRE model contains some more attributes. For some feature attributes, the INSPIRE definition is not sufficiently detailed: the functionalRoadClass and the widthCategory. Furthermore some attributes are not defined clearly, such as roadName.direction. In Piemonte Est dataset a second road node feature class is present: 010109_L - ROAD (GDF level 2), which is related to the road link in accordance with the level 2 of the GDF standard. The 010109_L – ROAD feature class is not present in the INSPIRE model
RoadArea	there is a good matching between INSPIRE RoadArea and Piemonte Est 010104_A – MAIN ROAD AREA. There are some minor differences regarding the attributes and some attribute values (see the matching table).
VehicleTrafficArea	there is a good matching between INSPIRE VehicleTrafficArea and Piemonte Est 010101_A - VEHICULAR CIRCULATION AREA. For the difference, see the matching table.
RoadServiceArea	in Piemonte Est dataset this feature class is not implemented.

Furthermore, in the Intesa Gis specifications (and therefore in Piemonte Est dataset) maintenance authorities and owners, and road names are not defined as separated feature classes (Administrative Area and Toponym Area).

General comments

The major difficulties are related to the features present in the INSPIRE model and not in our datasets: the classification (C1 vs C2) is conditioned both by the local situation (regional and/or national) and by the not complete knowledge of the precise significance of the INSPIRE data model definitions (sometimes very generic or undefined). With respect to this point, a glossary would be of great help.

6.1.5 Analysis of RPIE DBPrior10k Dataset

Features/attributes from the RPIE DBPrior10k dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadNode	A node which occurs in a road network. [TWG TN] Analogous to Junction in GDF. [EuroRoadS]			Point	**010108_P**	ROAD JUNCTION (GDF level 1)			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	GM_Point <<dataType>>	1		**fid**	Feature identifier	string	1	
Comments					**Comments**	A2 This identifier is not in accordance with INSPIRE Specification on object id			
geometry	The location of the node	GM_Point <<dataType>>	1		**shape**		Point 2D	1	

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	Junction	**tipo**	Type of road junction	Integer	1	intersection/fork
Comments					Comments	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	'PseudoNode	**tipo**	Node type	Integer	3	change of toponym / change of owner
Comments					Comments	A2 The change of toponym or change of owner is one of the possible pseudo-node			
formOfNode		FormOfNode <<codeList>>	voidable - 1	RoadEnd	**tipo**	Node type	Integer	2	track start/end
Comments					Comments	A1			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**tratstra**	Road element			Polyline

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**shape**		Polyline 2D	1	
Comments					**Comments**	A1			
id		FormOfNode <<codeList>>	1		**fid**	Feature identifier	String	1	
Comments					**Comments**	A2 This identifier is not in accordance with INSPIRE Specification on object id			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	DualCarriageway	**ctf**	Functional Classification	Integer	2	extra-urban road

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A2 Partial match: the main extra-urban road sometimes are also dual carriage way, but sometimes they have only one carriage			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Freeway	**ctf**	Functional Classification	Integer	1	motorway
Comments					Comments	A2 DB Prior10k specification does not distinguish Freeway and Motorway. In Piedmont Region there are not freeways.			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Motorway	**ctf**	Functional Classification	Integer	1	motorway

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A1 DB Prior10k specification does not distinguish Freeway and Motorway. In Piedmont Region there are not freeways.			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SingleCarriageway	**ctf**	Functional Classification	Integer	2	extra-urban road
Comments					Comments	A2 The secondary extra-urban road generally are single carriage way			
maintenanceAuthority	The authority responsible for maintenance of the road link	CI_ResponsibleParty <<dataType>>	voidable - 1		**eidg**	Identifier of the Maintenance Authority	Integer	A S P R T null	A=Motorway S=State P=Province R=Region (ex-state) T=Province (ex-state) null=without number or name

INSPIRE feature catalogue		Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue	
Target model		**Source model**	
Comments		Comments	A2 The matching is partial: in DB Prior10k is recorded the category of maintenance authority, and is not specified the real Authority

Table 7 - Features/attributes from the RPIE DBPrior10k Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the RPIE DBPrior10k dataset matching process for Road Network

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

Piedmont Region has given to GIS4EU project two datasets: Piemonte Est and DBPrior10k.

The datasets of DBPrior10k related with Road Network, are composed by the following feature classes:

nodistra - Road junction
tratstra- Road element
strade.dbf – Alphanumeric table with the road names and owners

DBPrior10k dataset is less compliant with the INSPIRE model than Piemonte Est dataset.

The main differences are:

RoadNode	the feature class nodistra partially matches with INSPIRE RodeNode, with some differences related to the feature attributes
BasicRoadLink	in DBPrior10k dataset this feature class is not implemented, whereas is directly implemented the more detailed class RoadLink
RoadLink	there is a good matching between INSPIRE RoadLink and DBPrior10k tratstra, both regarding semantic definition and data structure. The INSPIRE model contains some more attributes
RoadArea	in DBPrior10k dataset this feature class is not implemented
VehicleTrafficArea	in DBPrior10k dataset this feature class is not implemented.

RoadServiceArea	in DBPrior10k dataset this feature class is not implemented.

Furthermore, in the DBPrior10k dataset, the road names are stored in the alphanumeric table strade.dbf.

General comments

The major difficulties are related to the features present in the INSPIRE model and not in our datasets: the classification (C1 vs C2) is conditioned both by the local situation (regional and/or national) and by the not complete knowledge of the precise significance of the INSPIRE data model definitions (sometimes very generic or undefined). With respect to this point, a glossary would be of great help.

6.1.6 Analysis of IGP EuroGlobalMapPT Dataset

Features/attributes from the IGP EuroGlobalMapPT dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider IGP (dataset EuroGlobalMapPT) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**Road**	An open way maintained for vehicular use.			Arc
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface SuspendedOrElevated Underground	**LOC**	Location category. Status of feature relative to surrounding area or water.	Coded Integer	1	0 Unknown 8 On ground surface 25 Suspended or elevated above ground or water surface (= bridge length more than 1000 m.)

INSPIRE feature catalogue					Data provider IGP (dataset EuroGlobalMapPT) feature catalogue				
Target model					**Source model**				
									40 Underground (= tunnel length more than 2000 m.)
surfaceCategory	specification of the state of the surface of the associated Road Element [GDF3] [Euroroads]	RoadSurfaceValue <<enumeration>>	voidable - 1	Paved Unpaved	**RST**	Road / Runway surface type.	Coded Integer	1	0 Unknown 1 Paved 2 Unpaved
europeanRoadCode	the Europe way number of the road [Euroroads]	CharacterString	voidable - 1		**RTE**	Route Number (Internat.)	Character	1	
nationalRoadCode	the national number of the road [Euroroads]	CharacterString	voidable - 1		**RTN**	Route Number (National)	Character	1	
Comments					Comments	A1 – Features are in a direct match but the attributes matched are a subset of the attributes existing in the dataset (EGM_PT)			

Table 8 - Features/attributes from the IGP EuroGlobalMapPT Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the IGP EuroGlobalMapPT dataset matching process for Road Network

The feature "RoadLink" defined in the INSPIRE data model is matched with the feature Road (FC=AP030) of the dataset under analysis.

The INSPIRE data model package for road network distinguishes a more features (5) and thus it is more detailed than the features in this dataset related with road network. However, it was not possible to find a feature in the INSPIRE data model that matches the feature "Entrance/Exit" (FC=AQ090) in this dataset, defined as "A point of entrance or exit".

6.1.7 Analysis of IGP EuroRegionalMapPT Dataset

Features/attributes from the IGP EuroRegionalMapPT dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider IGP (dataset EuroRegionalMapPT) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**Road**	An open way maintained for vehicular use.			Arc
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface SuspendedOrElevated Underground	**LOC**	Location category. Status of feature relative to surrounding area or water.	Coded Integer	1	0 Unknown 8 On ground surface 25 Suspended or elevated above ground or water surface (= bridge length more than

INSPIRE feature catalogue					Data provider IGP (dataset EuroRegionalMapPT) feature catalogue				
Target model					**Source model**				
									1000 m.) 40 Underground (= tunnel length more than 2000 m.)
surfaceCategory	specification of the state of the surface of the associated Road Element [GDF3] [Euroroads]	RoadSurfaceValue <<enumeration>>	voidable - 1	Paved Unpaved	**RST**	Road / Runway surface type.	Coded Integer	1	0 Unknown 1 Paved 2 Unpaved 997 Unpopulated
europeanRoadCode	the Europe way number of the road [Euroroads]	CharacterString	voidable - 1		**RTE**	Route Number (Internat.)	Character	1	
nationalRoadCode	the national number of the road [Euroroads]	CharacterString	voidable - 1		**RTN**	Route Number (National)	Character	1	
Comments					**Comments**	A1 – Features are in a direct match but the attributes matched are a subset of the attributes existing in the dataset (ERM_PT)			

Table 9 - Features/attributes from the IGP EuroRegionalMapPT Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the IGP EuroRegionalMapPT dataset matching process for Road Network

The feature "RoadLink" defined in the INSPIRE data model is matched with the feature “Road” (FC=AP030) of the dataset under analysis.

The INSPIRE data model package for road network distinguishes more features and thus it is more detailed than the features in this dataset related to this theme. However, it was not possible to find a feature in the INSPIRE data model that matches the following features in this dataset: "Entrance/Exit" (FC=AQ090), “Vehicle stopping Area/Rest Area” (FC=AQ135), “Level Crossing” (FC=AQ062) and “Interchange” (FC=AP020).

6.1.8 Analysis of INSIEL DBPrior_0503_Strada_administrativa Dataset

Features/attributes from the INSIEL DBPrior_0503_Strada_administrativa dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider INSIEL (dataset DbPrior_0503_Strada_administrativa) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**DbPrior_0503_Strada_administrativa**	Graph of the main roads in the region FVG and it's Provinces.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
name	The name for this element	GeographicalName <<dataType>>	voidable - 1		**NOME_STRADA**	Name of the road	Alphanumeric String	1	
Comments					**Comments**	A1			
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**Geometry1**	field Geometry	blob	1	
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider INSIEL (dataset DbPrior_0503_Strada_administrativa) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Motorway	**CLAS_FUNZ**	Functional Classification	Alphanumeric String	1	Viabilità autostradale
Comments					**Comments**	"Viabilità autostradale" include: Viabilità locale (local road network), Viabilità di interesse regionale (regional road network), Viabilità di grande comunicazione (important road network).			
functionalRoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>	voidable - 1	MainRoad	**CLAS_AMM**	Administrative Classification	String	1	Autostrada
				FirstClass					Strada Statale
				SecondClass					Strada Regionale
				ThirdClass					Strada Provinciale
				FourthClass					Strada Comunale

INSPIRE feature catalogue					Data provider INSIEL (dataset DbPrior_0503_Strada_administrativa) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
				FifthClass					Strada Militare
				SixthClass					Strada Privata
				SeventhClass					
				EighthClass					
				NineClass					
Comments					**Comments**	A3: : attribute match only for a subset of values			
maintenanceAuthority	The authority responsible for maintenance of the road link	CI_ResponsibleParty <<dataType>>	voidable - 1		**ENTE_GEST**	Name of the Administrator Agency	Alphanumeric String	1	
Comments					**Comments**	A1			

Table 10 - Features/attributes from the INSIEL DBPrior_0503_Strada_administrativa Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the INSIEL DBPrior_0503_Strada_administrativa dataset matching process for Road Network

There are some attributes in DBPrior_0503_Strada_administrativa that are not present in INSPIRE data model (class B). All attribute are considered not relevant to INSPIRE context, except:

- ISTAT_GEST: is the administrative code (unique) that identify the authority writen into the attribute "ENTE_GEST", that is the authority responsible for maintenance of the road link
- KM_FIN / KM_INI: to know the real length of the road link

Attribute Name	Attribute type	Possible values	Value Codes	Attribute definition	Code Matching
ID_INIZIO	Alphanumeric String			Initial Node	B2
ID_FINE	Alphanumeric String			Final Node	B2
ORIGINE	Alphanumeric String	Dati provenienti dal SITER (Sistema Informativo Territoriale Regionale)	01	Origin of the Data	B2
		Dati provenienti dalla CTRN 5000	02		
		Dati derivati da interpretazione su Ortofoto	03		
		Dati di provenienza ISTAT	04		

		Altro	05		
ISTAT_GEST	Alphanumeric String			Istat Code of the Administrator Agency	B1
KM_FIN	Real Number			Final kilometers	B1
KM_INI	Real Number			Start kilometers	B1

Relevant features and attributes from INSPIRE data model dataset that are not included in the dataset:

RoadNode	This feature class is not implemented in DBPrior_0503_Strada_administrativa data model. However, as the road links are always connected and the road network is complete, the geometry of the feature “RoadNode” could be derived by spatial analysis if it is considered necessary.
BasicRoadLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RoadLink
RoadLink	This is the only feature of the INSPIRE Road Network data model that has a direct correspondent feature in DBPrior_0503_Strada_administrativa (matching class A, defined in Appendix 10.3). As can be seen in the matching table, some of the attributes can be well matched (class A1) other attribute match only for a subset of values (class A3)
RoadArea	This feature class is not implemented in DBPrior_0503_Strada_administrativa data model.
VehicleTrafficArea	This feature class is not implemented in DBPrior_0503_Strada_administrativa data model.
RoadServiceArea	This feature class is not implemented in DBPrior_0503_Strada_administrativa data model.

6.1.9 Analysis of RVEN Veneto Dataset

Features/attributes from the RVEN Veneto dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					**Data provider RVEN (dataset Veneto) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RoadNode	A node which occurs in a road network. [TWG TN] Analogous to Junction in GDF. [EuroRoadS]			Point	**GiunzioneStradale**	Road Intersection			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**ID_NODO**	ID Node (Junction)	Identifier <<datatype>> char	1	
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
geometry	The location of the node	GM_Point <<dataType>>	1		**ORIG**	Data Source	Enum	1	a)Gis data b)Digital base map c)Ortho images d)ISTAT e)Others
Comments					Comments				
formOfNode		FormOfNode <<codeList>>	voidable - 1	EnclosedTrafficArea	**TIPO_NODO**	node that identifies an area in which the route of the vehicles is not defined	Enum	1	enclosed traffic area
Comments					Comments	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	Junction	**TIPO_NODO**	node that identifies an area in which the route of the vehicles is not defined	Enum	1	intersection/fork
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
formOfNode		FormOfNode <<codeList>>	voidable - 1	PseudoNode	**TIPO_NODO**	node that identifies an area in which the route of the vehicles is not defined	Enum		change of toponym
									loop interruption
									change of functional classification
									Intersection with area with non structured traffic
Comments					**Comments**	A2 The value "PseudoNode" of the attribute "FormofNode" matches with four possible values of the attribute attribute " **TIPO_NODO** " in the RVEN dataset: -change of toponym -loop interruption -change of functional classification -Intersection with area with non structured traffic			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
formOfNode		FormOfNode <<codeList>>	voidable - 1	RoadEnd	**TIPO_NODO**	node that identifies an area in which the route of the vehicles is not defined	Enum	1	start or end of the element
Comments					**Comments**	A1			
formOfNode		FormOfNode <<codeList>>	voidable - 1	Roundabout	**TIPO_NODO**	node that identifies an area in which the route of the vehicles is not defined	Enum	1	roundabout (r<10m)
Comments					**Comments**	A2 In the RVEN dataset only small roundabout (r<10m) are include			
RoadLink	A subtype of basic road link which adds specific attribution that has been found usable within this stage of INSPIRE.[TWG TN]			Line	**PercorsoAmministrativo**	Administrative route			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
ID	The identity of the element	Identifier <<datatype>>	1		**ID_PERC**	Identifier	Char	1	
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
NAME	The name for this element	GeographicalName <<dataType>>	voidable - 1		**NOME**	Name of the path	Char	1	
Comments					**Comments**	A1			
centerLineGeometry	The geometry that represents the centreline of the link	GM_Curve <<dataType>>	1		**GEOMETRY**	Geometry that represents also the centraline of the link	Polyline in 3D	1	
Comments					**Comments**	A1 In the RVEN dataset the Geometry and centreline are coincident			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	DualCarriageway	**CLASS_AMM**	Functional Classification	Enum	1	main extra-urban road

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
Comments					Comments	A2 Partial match: the main extra-urban road sometimes are also dual carriage way, but sometimes they have only one carriage			
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	EnclosedTrafficArea	**CLASS_AMM**	Functional Classification	Alphanumeric String	1	road link of enclosed traffic area
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE**	LocationCategory	Alphanumeric String	1	on ground surface
Comments					Comments	A1			
RoadLink	A Linear section Line			Line	**ElementoStradale**	Road Track			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE**	LocationCategory	Enum	1	Own Bridge/viaduct Underpass Grab Ramp Level crossing Other
Comments					Comments	A1			
roadWidth	the width of the road or street, measured as average value [Euroroads]	Measure <<datatype>>	voidable - 1	OnGroundSurface	**C_LARGH**	Max width Class	Enum	1	< 3.5 meter Among 3.5 to 6.0 meter among 6.0 to 8.0 meter > 8.0 meter
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SingleCarriageway	**CL_TF**	Functional Classification	Enum	1	secondary extra-urban road
Comments					Comments	A2 The secondary extra-urban road generally are single carriage way			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
formOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SlipRoad	**CL_TF**	Functional Classification	Enum	1	ramp / motorway junction
Comments					Comments				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
BasikRoadLink	A Linear section Line			Line	**ElementoStradale**	Road Track			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
ID	The identity of the element	Identifier <<datatype>>	1		**ID_ELEM**	ID route element	Char	1	
Comments					**Comments**	A1			
NAME	The name for this element	GeographicalName <<dataType>>	voidable - 1		**NOME**	Administrative name	Char	1	
Comments					**Comments**	A1			
CenterLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**GEOMETRY**	Geometry that represents also the centraline of the link	Polyline 3D	1	
Comments					**Comments**	A1 In the RVEN dataset the Geometry and centreline are coincident			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Motorway	**C_TF**	Technical-Functional Classification	Enum	1	Motorway
Comments					**Comments**	A1			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	Freeway	**C_TF**	Technical-Functional Classification	Enum	1	Motorway
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	DualCarriageWay	**C_TF**	Technical-Functional Classification	Enum	1	Main Road (extraurban)
Comments					**Comments**	A1			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	DualCarriageWay	**C_TF**	Technical-Functional Classification	Enum	1	High road (urban)
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SingleCarriageWay	**C_TF**	Technical-Functional Classification	Enum	1	ByWay (urban)
Comments					**Comments**	A1			
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	PedestrianZone	**TIPO_ELE**	Road Element	Enum	1	Pedestrian supplied
Comments					**Comments**	A1			
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
FormOfWay	Physical classification. The form of way describes the function as road with or without rules. [EuroRoadS]	FormOfWay <<codeList>>	voidable - 1	SlipRoad	**TIPO_ELE**	Road Element	Enum	1	SlipRoad, Tournout
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RVEN (dataset Veneto) feature catalogue				
Target model					**Source model**				
FunctionalRoadClass	A classification based on the importance of the role that the Road Link performs in the connectivity of the total road network. [GDF, EuroRoadS]	FunctionalRoadClass <<enumeration>>	voidable - 1	MainRoad FirstClass SecondClass ThirdClass FourthClass FifthClass SixthClass SeventhClass EighthClass NineClass	**CLASS_AMM**	Administrative Classification	Enum	1	SS (National road) SR (Regional road) SP (District road) SC (Municipality road) SM (Military road) PS (Private road) Other Footpaths
Comments					Comments	A1			

Table 11 - Features/attributes from the RVEN Veneto Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the RVEN dataset dataset matching process for Road Network

The INSPIRE Road theme is composed by the following feature classes:

- RoadNode
- BasicRoadLink
- RoadLink
- RoadArea
- VehicleTrafficArea
- RoadServiceArea

The RVEN dataset provided by “Regione del Veneto” corresponds to a topographic database which aim is to provide basic reference data for spatial applications. As such, it contains basic topographic data of several themes.

Nevertheless, in order to increase its analysis capabilities, there have been added some specific requirements to the road and rail networks. As a result, the road network is connected and complete and there have been added some other attributes apart from the strictly topographic ones.

RVEN dataset has been realized in accordance with Intesa GIS specifications

The result of the match with INSPIRE Road data model can be seen in table 11. The main differences are:

RoadNode	This feature class is represented in RVEN data model with the feature class GiunzioneStradale with some differences related to the feature attributes As example the value "PseudoNode" of the attribute "FormofNode" matches with four possible values of the attribute "TIPO_NODO " in the RVEN dataset: -change of toponym -loop interruption -change of functional classification -Intersection with area with non structured traffic. And also some differences on the FormOfNode attribute with the RVEN TIPO_NODO attribute in which for the value Roundabout the RVEN dataset include only that with ray <10 m..
BasicRoadLink	This feature is represented in RVEN dataset with ElementoStradale and only match the Attribute ID NAME and CenterlineGeometry with

	ID_ELEM NOME and GEOMETRY with a differences in this last in which the GEOMETRY and the centerline are coincident
RoadLink	This feature is represented in RVEN dataset in two different features depending from the Attributes: PercorsoAmministrativo and ElementoStradale Some differences are in the RVEN dataset respect the INSPIRE one, between the centerLineGeometry and the GEOMETRY attribute in RVEN (in RVEN are coincident) and a partial match in CLASS_AMM versus FormOfWay DualCarriageway (the main extra-urban road sometimes are also dual carriage way, but sometimes they have only one carriage)
RoadArea	This feature class is not implemented in RVEN data model.
VehicleTrafficArea	This feature class is not implemented RVEN data model (as a consequence of its level of detail).
RoadServiceArea	This feature class is not implemented in RVEN data model.

There are some attributes in RVEN that are not present in INSPIRE data model. All of them are considered not relevant to INSPIRE context except the attribute concerning the status of the road with regard to its usability or completion (projected, under construction, functional, etc). This attribute is included in the INPIRE Rail data model (conditionOfFacility) but is not included in the Road one.

On the other hand, there are some features and attributes from INSPIRE data model not present in RVEN dataset, even though most of them are considered really relevant. This is the case of numberOfLanes and speedLimit.

Finally we found some difficulties matching the two models depending to the real understanding of meaning of each INSPIRE attribute and the not easy readability of a big spreadsheet as the matching table is.

6.2 Rail Network

6.2.1 Analysis of ICC BT-5M Dataset

Features/attributes from the ICC BT-5M dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider ICC (BT-5M) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**RAILWAY (FER)**	Communication path destined to the circulation of vehicles on two rails.			Line
					MOUNTAIN RAILWAY (CRE)	Railway on great slopes that uses a third indented rail to obtain a traction superior than a conventional railway.			Line
					FUNICULAR (FUN)	Railway on great slopes that receives the traction of a cable to obtain a traction superior than a conventional railway.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element.	Identifier <<datatype>>	1			Unique identifier		1	
Comments					**Comments**	A unique identifier exists in the dataset (ArcInfo cover instance ID), but is not maintained when data is updated. GIS4EU id can be derived from this one.			

centerLineGeometry	The geometry that represents the centerline of the link	GM_Curve <<dataType>>	1		**Internal of ArcInfo cover format**	The geometry that represents the centerline of the link	stored in ArcInfo cover geometry format	1	
Comments					**Comments**				
beginLifespanVersion	Date and time at which this version of the transport link was inserted or changed in the spatial data set.	DateTime <<dataType>>	voidable - 1						
Comments	NOTE 1 If life-cycle information is not maintained as part of the spatial data set, provide a void value with a reason of "unknown". NOTE 2 The a				**Comments**	All the transport links of the dataset had been inserted in the same date (the publication date that appears in the metadata).			
endLifespanVersion	Date and time at which this version of the transport link was superseded or retired in the spatial data set.	DateTime <<dataType>>	voidable - 0..1						
Comments	NOTE See notes in the documentation of attribute "beginLifespanVersion". These apply for this attribute, too.				**Comments**	None of the transport links of the dataset had been superseded or retired in the spatial data set.			
railwayType	The form of way	RailwayType	voidable -	Train	**CAS**	String	Each of the	1	CAS(1:3)=”FER”

	for the rail describing the class of vehicle permitted [TWG-TN]	<<enumeration>>	1	Metro Tramway Funicular CogRailway			different combinations of attributes established.		Not included in the dataset Not included in the dataset CAS(1:3)="FUN" CAS(1:3)="CRE"
Comments					**Comments**	On ground surface sections of Metro are included in "FER" and underground sections of Metro are not compiled. Tramway is not compiled. No other type of railway exists in the dataset.			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface SuspendedOrElevated Underground	**ENTORN_FER** if CAS(1:3)="FER" **ENTORN_CRE** if CAS(1:3)="CRE" **ENTORN_FUN** if CAS(1:3)="FUN"	Situation	enumeration (vENTORN_FER) (vENTORN_CRE) (vENTORN_FUN)	1	"Generic" or "under bridge" Not available "in tunnel or subterranean "
Comments					**Comments**	LocationCategory="Underground" matches with ENTORN_*='in tunnel or subterranean'. LocationCategory="OnGrounSurface" should be matched with ENTORN_V*="Generic" or "under bridge" but elevated links are also included.			
railwayPowerMethod	method for which the	RailwayPowerMethod <<enumeration>>	voidable - 1	ElectrifiedTrack					

	vehicle is powered along the track. [TWG-TN]			NonElectrifiedTrack					
Comments					Comments	The value "ElectrifiedTrack" can be assigned to each link. There are only two or three train sections without electrical power.			

Table 12 - Features/attributes from the ICC BT-5M Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the ICC BT-5M dataset matching process for Rail Network

The INSPIRE Rail theme is composed by the following feature classes:

- RailwayYardNode
- RailwayStationNode
- SignificantPoint
- BasicRailwayLink
- RailwayLink
- RailwayStationArea
- RailwayArea

The BT-5M dataset provided by Institut Cartogràfic de Catalunya (ICC) corresponds to a topographic database which aims are to provide basic reference data for spatial applications and to produce maps. As such, it contains topographic data of several themes, as for example hydrography, roads, railways, buildings or relief. The features and attributes present in the database describe the real world from a topographic point of view. As a result of the differences between BT-5M and INSPIRE data model goals (the use cases), the subset of features and attributes from BT-5M dataset that corresponds to the rail network doesn't match very well with INSPIRE rail network features and attributes (See table 12).

The main differences are:

RailwayYardNode	This feature class is not implemented in BT-5M data model.
RailwayStationNode	This feature class is not implemented in BT-5M data model.
SignificantPoint	This feature class is not implemented in BT-5M data model.
BasicRailwaydLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RailwayLink
RailwayLink	This is the only feature of the INSPIRE Rail Network data model that has a direct correspondent feature in BT-5M (matching class A, defined in Appendix 10.3). As can be seen in the matching table, few attributes can be well matched (class A1 or A3), as is the case of railwayPowerMethod. Some other can be matched but with semantic problems (class A2), as is the case of railwayType and locationCategory. In most cases both attributes deal with the same characteristic of the feature but the differences in the classification make it impossible to establish a good correspondence. This could be a recurrent issue of the harmonization process.
RailwayStationArea	This feature class is not implemented in BT-5M data model.

RailwayArea	This feature class is not implemented in BT-5M data model.

There are some attributes in BT-5M that are not present in INSPIRE data model (class B2), however all of them are considered not relevant to INSPIRE context.

On the other hand, there are some features and a great number of attributes from INSPIRE data model not present in BT-5M dataset, even though all of them are considered really relevant (class C1). This is the case the feature “RailwaytationNode” and its attributes or the attributes railwayGauge, railwayGaugeCategory, conditionOfFacility, railwayUse or railwayCode of the feature “RailwayLink”.

Finally, there are features that might be relevant, but that should be clarified. This is the case of “SignificantPoint” (Which types of points are foreseen?) or “RailwayStationNode” (the definition is not clear enough, why an intersection of tracks is a RailwayStationNode?).

6.2.2 Analysis of ICC BT-50M Dataset

Features/attributes from the ICC BT-50M dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider ICC (BT-50M) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**RAILWAY (FER)**	Communication path destined to the circulation of vehicles on two rails.			Line
					MOUNTAIN RAILWAY (CRE)	Railway on great slopes that uses a third indented rail to obtain a traction superior than a conventional railway.			Line
					FUNICULAR (FUN)	Railway on great slopes that receives the traction of a cable to obtain a traction superior than a conventional railway.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element.	Identifier <<datatype>>	1			Unique identifier		1	
Comments					**Comments**	A unique identifier exists in the dataset (ArcInfo cover instance ID), but is not maintained when data is updated. GIS4EU id can be derived from this one.			

centerLineGeometry	The geometry that represents the centerline of the link	GM_Curve <<dataType>>	1		**Internal of ArcInfo cover format**	The geometry that represents the centerline of the link	stored in ArcInfo cover geometry format	1	
Comments					**Comments**				
beginLifespanVersion	Date and time at which this version of the transport link was inserted or changed in the spatial data set.	DateTime <<dataType>>	voidable - 1						
Comments	NOTE 1 If life-cycle information is not maintained as part of the spatial data set, provide a void value with a reason of "unknown". NOTE 2 The a				**Comments**	All the transport links of the dataset had been inserted in the same date (the publication date that appears in the metadata).			

endLifespanVersion	Date and time at which this version of the transport link was superseded or retired in the spatial data set.	DateTime <<dataType>>	voidable - 0..1						
Comments	NOTE See notes in the documentation of attribute "beginLifespanVersion". These apply for this attribute, too.				Comments	None of the transport links of the dataset had been superseded or retired in the spatial data set.			
numberOfTracks	Value indicating the number of tracks for the network (this is dependent on the resolution of the data). [TWG-TN]	Type not defined	voidable - 1		**NVIES_FER**	Number of tracks	Enumeration (vNVIES_FER)	1	“double railroad”, “single railroad”, “railroad yard”
Comments					Comments	The data type is different. The attribute NUMVIA_FER only applies to links with CAS(1:3)="FER". If CAS(1:3)="FUN" or CAS(1:3)="CRE" then the value "single railroad" must be assigned.			

railwayGauge	the measurement used to define the railways measurements [TWG-TN]	Measure <<dataType>>	voidable - 1						
Comments					**Comments**	If CAS(1:3)="FER" it must be derived from AMPLE_FER value: “wide track” -->1668 mm “international width” -->1435 mm “narrow track” --> <1435 mm If CAS(1:3)="CRE" --> <1435 mm If CAS(1:3)="FUN"--> <1435 mm			
railwayGaugeCategory	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Broad Standard NArrow	**AMPLE_FER**	Width of track	enumeration (vAMPLE_FER)	1	wide track international width narrow track
Comments					**Comments**	The attribute AMPLE_FER only applies to links with CAS(1:3)="FER". If CAS(1:3)="CRE" or CAS(1:3)="FUN" then the railwayGaugeCategory="Narrow" must be assigned to the link.			
railwayType	The form of	RailwayType	voidable -	Train	**CAS**	String	Each of the	1	CAS(1:3)=”FER”

	way for the rail describing the class of vehicle permitted [TWG-TN]	<<enumeration>>	1	Metro Tramway Funicular CogRailway			different combinations of attributes established.		Not included in the dataset Not included in the dataset CAS(1:3)="FUN" CAS(1:3)="CRE"
Comments					Comments	On ground surface sections of Metro are included in "FER" and underground sections of Metro are not compiled. Tramway is not compiled. No other type of railway exists in the dataset.			
conditionOfFacility	The measurement of the speed of the vehicle on the network e.g. high speed or low speed services. [TWG-TN]	Measure <<dataType>>	voidable - 1	Projected UnderConstruction Functional Disused	**ESTAT_FER**	State	enumeration (vESTAT_FER)	1	in construction or in project generic
Comments					Comments	Under construction and projected are included in the same value. Disused links are not included in the dataset.			

designSpeed	The measurement of the speed of the vehicle on the network e.g. high speed or low speed services. [TWG-TN]	Measure <<dataType>>	voidable - 1						
Comments					**Comments**	If (CAS(1:3)="FER" and EMPRESA_FER="RENFE" and AMPLE_FER="international width") then designSpeed="high speed" else designSpeed="low speed"			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface SuspendedOrElevated Underground	**ENTORN_FER** if CAS(1:3)="FER" **ENTORN_CRE** if CAS(1:3)="CRE" **ENTORN_FUN** if CAS(1:3)="FUN"	Situation	enumeration (vENTORN_FER) (vENTORN_CRE) (vENTORN_FUN)	1	"Generic" "covered or subterranean "
Comments					**Comments**	LocationCategory="Underground" matches with ENTORN_*='covered or subterranean'. LocationCategory="OnGrounSurface" should be matched with ENTORN_V*="Generic" but elevated links are also included.			

owningAuthoriry	Name of the owning authority for the individual sections of tracks. [TWG-TN]	Type not defined	voidable - 1		**EMPRESA_FER**	Titular company	enumeration (vEMPRESA_FER)	1	
Comments					**Comments**	The data types are different. If CAS(1:3)="FER" then assign the value of EMPRESA_FER as the owningAuthority else owningAuthority="FGC (Ferrocarrils de la Generalitat de Catalunya)"			
railwayPowerMethod	Method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	ElectrifiedTrack NonElectrifiedTrack	**ELECTRIF_FER**	Electrical power supply	enumeration (vELECTRIF_FER)	1	yes not
Comments					**Comments**	If CAS(1:3)="FER" then assign the value of ELECTRIF_FER to railWayPowerMethod else railWayPowerMethod="ElectrifiedTrack"			

Table 13 - Features/attributes from the ICC BT-50M Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the ICC BT-50M dataset matching process for Rail Network

The INSPIRE Rail theme is composed by the following feature classes:

- RailwayYardNode
- RailwayStationNode
- SignificantPoint
- BasicRailwayLink
- RailwayLink
- RailwayStationArea
- RailwayArea

The BT-50M dataset provided by Institut Cartogràfic de Catalunya (ICC) corresponds to a topographic database which aim is to provide basic reference data for spatial applications. As such, it contains topographic data of several themes, as for example hydrography, roads, railways, buildings or relief, and the features and attributes present in the database describe the real world from a topographic point of view.

Nevertheless, in order to increase its analysis capabilities, there have been added some specific requirements to the road, rail and hydrography networks. As a result, the rail network is connected and complete and there have been added some other attributes apart from the strictly topographic ones.

The result of the match with INSPIRE Rail data model can be seen in table 13. The main differences are:

RailwayYardNode	This feature class is not implemented in BT-50M data model.
RailwayStationNode	This feature class is not implemented in BT-50M data model.
SignificantPoint	This feature class is not implemented in BT-50M data model.
BasicRailwaydLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RailwayLink
RailwayLink	This is the only feature of the INSPIRE Rail Network data model that has a direct correspondent feature in BT-50M (matching class A, defined in Appendix 10.3). As can be seen in the matching table, some of the attributes can be well matched (class A1 or A3), as is the case of railwayPowerMethod, railwayGauge, railwayGaugeCategory, designSpeed. Some other can be matched but with semantic problems (class A2), as is the case railwayType, conditionOfFacility or locationCategory. They deal with the same characteristic of the feature but the differences in the classification make it difficult to

	establish a good correspondence. This could be a recurrent issue of the harmonization process.
RailwayStationArea	This feature class is not implemented in BT-50M data model.
RailwayArea	This feature class is not implemented in BT-50M data model (as a consequence of its level of detail).

There are some attributes in BT-50M that are not present in INSPIRE data model (class B2), however all of them are considered not relevant to INSPIRE context.

On the other hand, there are some features and attributes from INSPIRE data model not present in BT-50M dataset, even though all of them are considered really relevant (class C1). This is the case of the feature "RailwaytationNode" and its attributes or the attributes railwayUse, railwayCode of the feature "RailwayLink".

Finally, there are features that might be relevant, but it should be clarified. This is the case of "SignificantPoint" (Which types of points are foreseen?) or "RailwayStationNode" (the definition is not clear enough, why an intersection of tracks is a RailwayStationNode?).

6.2.3 Analysis of RPIE Piemonte Est Dataset

Features/attributes from the RPIE Piemonte Est dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayStationNode	A node that occurs along the railway network, this can be a intersection of tracks or a station. [TWG-TN]			Point	**010203_P**	RAILWAY JUNCTION			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**posizione_3D**		Point in 3D	1	
Comments					**Comments**	A2 The feature class Railway Junction in Piemonte Est dataset includes not only intersections of tracks or stations, but also level crossing and terminal node			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
SignificantPoint	A significant point that falls along the railway network that is not a station or used to describe connectivity. [TWG-TN]			Point	**010203_P**	RAILWAY JUNCTION			Point

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**posizione_3D**		Point in 3D	1	
Comments					**Comments**	A2 Some Significant Points are included in the Railway Junction feature class			
function	The function of the significant point along the network e.g. Points, marker posts etc	Type not defined	voidable - 1		**TY_GZ_FER**	Junction type	Alphanumeric string	0101 0102 0103	0101=level crossing 0102=terminal 0103=fork/confluence
Comments					**Comments**	A2 The match is valid only for nodes with TY_GZ_FER=0101 (=level crossing), TY_GZ_FER=0102 (=terminal) or TY_GZ_FER=0103 (=fork/confluence)			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**010202_L**	RAILWAY ELEMENT			Polyline

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**tracciato_3D**		Composite Curve in 3D	1	
Comments					**Comments**	A1			
numberOfTracks	Value indicating the number of tracks for the network (this is dependent on the resolution of the data). [TWG-TN]	Type not defined	voidable - 1		**NUM_BINARI**	Number of tracks	Integer		
Comments					**Comments**	A1			
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Standard	**SCARTAM**	Type of gauge	Alphanumeric string	0602	standard

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
Comments					**Comments**	A1			
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Narrow	**SCARTAM**	Type of gauge	Alphanumeric string	0601	narrow
Comments					**Comments**	A1			
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	NotAplicable	**SCARTAM**	Type of gauge	Alphanumeric string	0603	monorail
Comments					**Comments**	A2 The monorail may be considered a situation in which the railway Gauge Category is not applicable			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
railwayType	The form of way for the rail describing the class of vehicle permitted [TWG-TN]	RailwayType <<enumeration>>	voidable - 1	CogRailway	**TRAZIONE**	Type of traction	Alphanumeric string	0402	cog-rail
Comments					**Comments**	A2 The monorail may be considered a situation in which the railway Gauge Category is not applicable			
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	UnderConstruction	**TY_STATO**	State of the railway element	Alphanumeric string	0202	under construction
Comments					**Comments**	A1			
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	Functional	**TY_STATO**	State of the railway element	Alphanumeric string	0201	functional
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	Disused	**TY_STATO**	State of the railway element	Alphanumeric string	0203	disused
Comments					Comments	A1			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE_FER**	Type of railway element seat	Alphanumeric string	0701	on ground surface
Comments					Comments	A1			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	SuspendedOrElevated	**SEDE_FER**	Type of railway element seat	Alphanumeric string	0703	suspended or elevated
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	Underground	**SEDE_FER**	Type of railway element seat	Alphanumeric string	0707	underground
Comments					Comments	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	ElectrifiedTrack	**ELETTRIF**	Electrification	Alphanumeric string	0501	electrified line
Comments					Comments	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	NonElectrifiedTrack	**ELETTRIF**	Electrification	Alphanumeric string	0502	not electrified line
Comments					Comments	A1			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**

INSPIRE feature catalogue					Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue				
Target model					**Source model**				
RailwayArea	Surface usually crossed by more than one or two parallel and connected railway tracks to stop trains in order to get passengers in/out them and/or perform cargo operations, also known as 'railway yard'. [TWG TN] Examples are the areas covered by railway tracks at railway stations or cargo terminals.			Area	**010201_A**	RAILWAY AREA			Polygon
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	Represents the geometric properties of the area	GM_Surface <<dataType>>	1		**estensione**		Polygon	1	
Comments					**Comments**	A1			
function	Represents the geometric properties of the area	Type not defined	voidable - 1		**TY_TRA_FER**	Type of railway area	Alphanumeric string	0101 0102 0103 0104	0101=railway 0102=tramway 0103=underground 0104=funicolar

INSPIRE feature catalogue		Data provider RPIE (dataset Piemonte Est 1:10.000-Intesa Gis 2004) feature catalogue	
Target model		**Source model**	
Comments		Comments	A2 The attribute "TY_TRA_FER" of the Railway Area matches the attribute "function" by the following values: - railway - tramway - underground (subway, tube) - funicolar

Table 14 - Features/attributes from the RPIE Piemonte Est Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the RPIE Piemonte Est dataset matching process for Rail Network

The INSPIRE Railway theme is composed by the following feature classes:

- RailwayYardNode
- RailwayStationNode
- SignificantPoint
- BasicRailwayLink
- RailwayLink
- RailwayStationArea
- RailwayArea

Piedmont Region has given to GIS4EU project two datasets: Piemonte Est and DBPrior10k.

The Piemonte Est dataset is more compliant with the INSPIRE model than DBPrior10k.

The datasets of Piedmont Est related with Railway Network, are composed by the following feature classes:

010203_P - RAILWAY JUNCTION
010202_L - RAILWAY ELEMENT
010201_A - RAILWAY AREA

Piemonte Est dataset has been realized in accordance with Intesa Gis Specifications, vers. 2004, which are less detailed than the INSPIRE model.

The main differences are:

RailwayYardNode	has no correspondence in Piemonte Est dataset, but could be relevant in the INSPIRE context (C1).
RailwayStationNode	in Piemonte Est dataset the feature class 010203_P - RAILWAY JUNCTION corresponds to the INSPIRE RailwayStationNode class. Nevertheless, Railway Junction includes not only intersections of tracks or stations (RailwayStationNode), but also level crossing and terminal node (SignificantPoint)
SignificantPoint	in Piemonte Est dataset the SignificantPoints are included in the feature class 010203_P - RAILWAY JUNCTION

	together with the RailwayStationNode .The SignificantPoints can be derived performing a simple alphanumeric operation (filter on TY_GZ_FER -junction type- attribute).
BasicRailwayLink	in Piemonte Est dataset this feature class is not implemented, whereas is directly implemented the more detailed class RailwayLink
RailwayLink	there is a good matching between INSPIRE RailwayLink and Piemonte Est 010202_L - RAILWAY ELEMENT, both regarding semantic definition and data structure. The INSPIRE model contains some more attributes. Moreover the attribute "Railway type" is not present in 010202_L - RAILWAY ELEMENT, but some of his possible values are defined as separated feature classes (Train, Metro, Tramway, Funicular).
RailwayStationArea	In the Piemonte Est dataset the Railway Station Area is not present. Nevertheless, Intesa Gis Specifications represent the RailwayStationArea through two separated feature classes: Pertinence Area (for the station areas, goods yard areas, …) and Building (for the constructions), and could therefore be re-assembled.
RailwayArea	there is a good matching between INSPIRE RailwayArea and Piemonte Est 010201_A - RAILWAY AREA. There are some minor differences regarding the attributes and some attribute values (see the matching table).

Furthermore, in the Intesa Gis specifications (and therefore in Piemonte Est dataset) maintenance authorities and owners, and railway lines names are not defined.

General comments

The major difficulties are related to the features present in the INSPIRE model and not in our datasets: the classification (C1 vs C2) is conditioned both by the local situation (regional and/or national) and by the not complete knowledge of the precise significance of the INSPIRE data model definitions (sometimes very generic or undefined).

6.2.4 Analysis of RPIE DBPrior10k Dataset

Features/attributes from the RPIE DBPrior10k dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayStationNode	A node that occurs along the railway network, this can be a intersection of tracks or a station. [TWG-TN]			Point	**nodiferr**	Railway node			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**shape**		Point 2D	1	
Comments					**Comments**	A1			
id	The identity of the element	Identifier <<datatype>>	1		**fid**	Feature identifier	String	1	

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A2 The feature class nodiferr in DBPrior10k dataset includes not only intersections of tracks or stations, but also terminal nodes, shunting and intersection with regional boundary. This identifier is not in accordance with INSPIRE Specification on object id.			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
SignificantPoint	A significant point that falls along the railway network that is not a station or used to describe connectivity. [TWG-TN]			Point	**nodiferr**	Railway node			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**shape**		Point 2D	1	
Comments					Comments	A2 This match is valid only for objects of the feature class nodiferr with attribute "tipo"=1 or 2 or 4 or 5.			
id	The identity of the element	Identifier <<datatype>>	1		**fid**	Feature identifier	String	1	

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A2 This match is valid only for objects of the feature class nodiferr with attribute "tipo"=1 or 2 or 4 or 5. This identifier is not in accordance with INSPIRE Specification on object id.			
function	The function of the significant point along the network e.g. Points, marker posts etc	Type not defined	voidable - 1		**tipo**	Node type	Integer	1 4 5	1=terminal 4=shunting 5=intersection with regional boundary
Comments					Comments	A2 The match is valid only for nodes with tipo=1 (=terminal), tipo=4 (=shunting) or tipo=5 (=intersection with regional boundary)			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**tratferr**	Railway element			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**shape**		Line 2D	1	
Comments					**Comments**	A1			
id	The identity of the element	Identifier <<datatype>>	1		**fid**	Feature identifier	String	1	
Comments					**Comments**	A2 This identifier is not in accordance with INSPIRE Specification on object id			
numberOfTracks	Value indicating the number of tracks for the network (this is dependent on the resolution of the data). [TWG-TN]	Type not defined	voidable - 1		**numbin**	Number of tracks	Integer	1 2 0	1=1 track 2=2 track 0=not defined
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Standard	**scartam**	Railway gauge category	Integer	1	standard
Comments					Comments	A1			
railwayType	The form of way for the rail describing the class of vehicle permitted [TWG-TN]	RailwayType <<enumeration>>	voidable - 1	Train	**tipotra**	Type of railway element	Integer	1	ordinary railway
Comments					Comments	A1			
railwayType	The form of way for the rail describing the class of vehicle permitted [TWG-TN]	RailwayType <<enumeration>>	voidable - 1	CogRailway	**tipotra**	Type of railway element	Alphanumeric string	3	Cog-way

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
Comments					Comments	A1			
railwayType	The form of way for the rail describing the class of vehicle permitted [TWG-TN]	RailwayType <<enumeration>>	voidable - 1	SideTrack	**tipotra**	Type of railway element	Alphanumeric string	2	service track
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**sede**	LocationCategory	Integer	1	own seat
Comments					Comments	A1			
locationCategory	Vertical level	LocationCategory <<enumeration>>	voidable - 1	Underground	**sede**	LocationCategory	Alphanumeric String	2	underground
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RPIE (dataset DBPrior 10k Transport Network) feature catalogue				
Target model					**Source model**				
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	ElectrifiedTrack	**elettr**	Railway power method	Integer	1	electrified line
Comments					Comments	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	NonElectrifiedTrack	**elettr**	Railway power method	Integer	2	not electrified line
Comments					Comments	A1			

Table 15 - Features/attributes from the RPIE DBPrior10k Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the RPIE DBPrior 10k dataset matching process for Rail Network

The INSPIRE Railway theme is composed by the following feature classes:

- RailwayYardNode
- RailwayStationNode
- SignificantPoint
- BasicRailwayLink
- RailwayLink
- RailwayStationArea
- RailwayArea

Piedmont Region has given to GIS4EU project two datasets: Piemonte Est and DBPrior10k.

The datasets of DBPrior10k, related with Railway Network, are composed by the following feature classes:

nodiferr - Railway node
tratferr - Railway element
ferrovie.dbf – Railway names
entegest.dbf – Railway owners
stazioni.dbf – Station names

DBPrior10k dataset is less compliant with the INSPIRE model than Piemonte Est dataset.

RailwayYardNode	has no correspondence in Piemonte Est dataset, but could be relevant in the INSPIRE context (C1).
RailwayStationNode	the feature class nodiferr partially matches with INSPIRE RailwayStationNode, but includes also terminal nodes, shunting and intersection with regional boundary.
SignificantPoint	in DBPrior10k dataset this class is not present, but the significant points can be derived through a simple alphanumeric operation from the feature class nodiferr (filter on tipo -junction type- attribute).
BasicRailwayLink	in DBPrior10k dataset this feature class is not implemented, whereas is directly implemented the more detailed class RailwayLink

RailwayLink	there is a good matching between INSPIRE RailwayLink and DBPrior10k tratferr , both regarding semantic definition and data structure. The INSPIRE model contains some more attributes.
RailwayStationArea	In the DBPrior10k dataset the Railway Station Area is not present.
RailwayArea	In the DBPrior10k dataset the Railway Area is not present.

General comments

The major difficulties are related to the features present in the INSPIRE model and not in our datasets: the classification (C1 vs C2) is conditioned both by the local situation (regional and/or national) and by the not complete knowledge of the precise significance of the INSPIRE data model definitions (sometimes very generic or undefined).

6.2.5 Analysis of IGP EuroGlobalMapPT Dataset

Features/attributes from the IGP EuroGlobalMapPT dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider IGP (dataset EuroGlobalMapPT) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
BasicRailwayLink					**Railway**	A rail or set of parallel rails on which a train or tram runs. [DIGEST]			Arc
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
railwayGauge			voidable - 1		**GAW**	Gauge width (cm). The width of a single pair of rails, measured along the shortest distance from inside rail to inside rail.	Integer	1	
railwayGaugeCategory			voidable - 1		**RGC**	Railway gauge category	Coded Integer	1	0 Unknown 1 Broad (broader than 1435 mm) 2 Narrow

INSPIRE feature catalogue					Data provider IGP (dataset EuroGlobalMapPT) feature catalogue				
Target model					**Source model**				
									(narrower than 1435 mm) 3 Normal (European 1435 mm) 998 Not applicable for "monorails"
Comments					**Comments**	A1 – only a small subset of the attributes defined in the dataset is present in the INSPIRE Data Model			

Table 16 - Features/attributes from the IGP EuroGlobalMapPT Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the IGP EuroGlobalMapPT dataset matching process for Rail Network

The feature "BasicRailwayLink" defined in the INSPIRE data model is matched with the feature "Railway" (FC=AN010) of this dataset.

The INSPIRE data model package for rail network distinguishes a much larger number of features and thus it is more detailed than the features in this dataset related to this theme. However, it was not possible to find a feature in the INSPIRE data model that matches the feature "Railway station" (FC=AQ125), defined as "A stopping place for the transfer of passengers and/or freight", in this dataset.

6.2.6 Analysis of IGP EuroRegionalMapPT Dataset

Features/attributes from the IGP EuroRegionalMapPT dataset that fit on the INSPIRE Road Network data model

INSPIRE feature catalogue					Data provider IGP (dataset EuroRegionalMapPT) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayStationNode	A node that occurs along the railway network, this can be a intersection of tracks or a station.[TWG-TN]			Point	**Station**	A stopping place for the transfer of passengers and/or freight.			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**OBJECTID**	Object ID	Integer	1	
stationName	Station name as defined by owner or designated authority. [TWG-TN]	Type not defined	voidable - 1		**NAMA1**	Name in first national language	Character	1	
Comments					**Comments**				
BasicRailwayLink	"A linear section of the railway network defining an individual track between two nodes.			Line	**Railway**	A rail or set of parallel rails on which a train or tram runs. [DIGEST]			Arc

INSPIRE feature catalogue					Data provider IGP (dataset EuroRegionalMapPT) feature catalogue				
Target model					**Source model**				
	[TWG TN] The basic railway link serves as the simplest usable homogeneous curvilinear element in a railway network. One reason for not adding all possible attributes at this level is to open up for linear referencing and dynamic segmentation approaches. More attribution is added at more specific levels."								
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**OBJECTID**	Object ID	Integer	1	
railwayGauge	the measurement used to define the railways measurements [TWG-TN]	Measure <<dataType>>	voidable - 1		**GAW**	Gauge width (cm). The width of a single pair of rails, measured along the shortest distance from inside rail to inside rail.	Integer	1	
railwayGaugeCategory	The generic name used to outline category used to measure a railwayGauge	RailwayGaugeCategory <<enumeration>>	voidable - 1	Broad Standard Narrow NotAplicable	**RGC**	Railway gauge category	integer	1	0 Unknown 1 Broad (broader than 1435 mm)

INSPIRE feature catalogue					Data provider IGP (dataset EuroRegionalMapPT) feature catalogue				
Target model					**Source model**				
	[TWG-TN]								2 Narrow (narrower than 1435 mm) 3 Normal (European 1435 mm) 998 Not applicable for "monorails"
Comments					Comments	A1 – only a small subset of the attributes defined in the dataset is present in the INSPIRE Data Model			

Table 17 - Features/attributes from the IGP EuroRegionalMapPT Dataset that fit on the INSPIRE Rail Network data model

Critical analysis of the IGP EuroRegionalMapPT dataset matching process for Rail Network

The feature "BasicRailwayLink", defined in the INSPIRE data model, is matched with the feature "Railway" (FC=AN010) of the dataset under analysis and the feature "RailwayStationNode" is matched with the feature "Railway Station" (FC=AQ125). Thus, the two features in the dataset belonging to this theme have corresponding features in the INSPIRE data model. However, there are several other features (9) in the INSPIRE data model without correspondence in the dataset.

6.2.7 Analysis of DbPrior_0513_Tratta_Ferroviaria Dataset Dataset

Features/attributes from the DbPrior_0513_Tratta_Ferroviaria Dataset dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider INSIEL (INSIEL DbPrior_0513_Tratta_Ferroviaria) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**DbPrior_0513_Tratta_Ferroviaria**	The map of the railways			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**ID_OGG**	Unique Identity of the Object	Real Number	1	
Comments					**Comments**	A1			
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**Geometry1**	field Geometry		1	
Comments					**Comments**	A1			

INSPIRE feature catalogue					Data provider INSIEL (INSIEL DbPrior_0513_Tratta_Ferroviaria) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
numberOfTracks	Value indicating the number of tracks for the network (this is dependent on the resolution of the data). [TWG-TN]	Type not defined	voidable - 1	Motorway	**NUM_BIN**	Number of rail lines	Whole Number	1	
Comments					Comments	A1			
railwayGaugeCategory	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Broad Standard Narrow NotAplicable	**SCARTAMENTO**	distance from railroads	Whole Number	1	 Normale Ridotto
Comments					Comments	A3: attribute match only for a subset of values			
railwayType	The form of way for the rail	RailwayType <<enumeration>>	voidable - 1	Train Metro	**TIPO_TRATTA**	Typology of the rail line	Whole Number	1	Ferrovia ordinaria Metropolitana

INSPIRE feature catalogue					Data provider INSIEL (INSIEL DbPrior_0513_Tratta_Ferroviaria) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
	describing the class of vehicle permitted [TWG-TN]			Tramway					
				Funicular					Cremagliera, funicolare
				CogRailway					
				Monorail					
				MagneticLevitation					
				SuspendedRail					
				SideTrack					Binario di servizio
				Other					Altro (industriale,…)
Comments					Comments	A3: attribute match only for a subset of values; A2: Cremagliera and vremagliera are included within the same value “Funicular”			
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	Projected	**TIPO_OGG**	Typology of the object	Real Number	1	
				UnderConstruction					Ferrovia in costruzione
				Functional					
				Disused					Ferrovia in disarmo, abbandono

INSPIRE feature catalogue					Data provider INSIEL (INSIEL DbPrior_0513_Tratta_Ferroviaria) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
									Ferrovia a scartamento ordinario
									Tranvia e ferrovia a scartamento ridotto
									Tranvia a cremagliera, funicolare
Comments					*Comments*	A3: attribute match only for a subset of values			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE**	Identification of the place where is located the road/railway line	Whole Number	1	In sottopasso
				SuspendedOrElevated					Su ponte/viadotto
				Underground					In galleria/sotterranea
									Altro (es. diga, ecc…)
									Passaggio a livello
									Propria

INSPIRE feature catalogue					Data provider INSIEL (INSIEL DbPrior_0513_Tratta_Ferroviaria) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
Comments					*Comments*	A3 : attribute match only for a subset of values			
owningAuthoriry	Name of the owning authority for the individual sections of tracks. [TWG-TN]	Type not defined	voidable - 1		**GESTORE**	Name of the Administrator Agency	Alphanumeric String	1	
Comments					*Comments*	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1		**ELETTRIFIC**	Presence/Absence of the electrification	Boolean	1	
Comments					*Comments*	A1			

Table 18 - Features/attributes from the INSIEL DbPrior_0513_Tratta_Ferroviaria Dataset Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the INSIEL DbPrior_0513_Tratta_Ferroviaria dataset matching process for Rail Network

There are some attributes DbPrior_0513_Tratta_Ferroviaria that are not present in INSPIRE data model (class B).

All attribute are considered not relevant to INSPIRE context, excepts:

- LUNGHEZZA: to know the real lenght of the railway draft.
- ISTAT_GEST: is the administrative code (unique) that identify the authority writen into the attribute "GESTORE", that is the authority responsible for maintenance of the rail link

Attribute Name	Attribute type	Possible values	Value Codes	Attribute definition	Code Matching
STSV	Boolean			True if draft under step/on bridge	B2
ID_FINE	Alphanumeric String			Final Node	B2
ID_INIZIO	Alphanumeric String			Initial Node	B2
COD_CTRN	Alphanumeric String			Code of the element in the CTRN 5000 (Regional Technic Map in scale 1:5000), where we find the object	B2
ORIGINE	Alphanumeric String	Dati provenienti dal SITER (Sistema Informativo Territoriale Regionale)	01	Origin of the Data	B2
		Dati provenienti dalla CTRN	02		

		5000			
		Dati derivati da interpretazione su Ortofoto	03		
		Dati di provenienza ISTAT	04		
		Altro	05		
LUNGHEZZA	Real Number			Lenght of the element	B1
ISTAT_GEST	Alphanumeric String			Istat Code of the Administrator Agency	B1

Relevant features and attributes from INSPIRE data model dataset that are not included in the dataset:

RailwayYardNode	This feature class is not implemented in DbPrior_0513_Tratta_Ferroviaria data model.
RailwayStationNode	This feature class is not implemented in DbPrior_0513_Tratta_Ferroviaria data model.
SignificantPoint	This feature class is not implemented in DbPrior_0513_Tratta_Ferroviaria data model.
BasicRailwaydLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RailwayLink
RailwayLink	This is the only feature of the INSPIRE Rail Network data model that has a direct correspondent feature in DbPrior_0513_Tratta_Ferroviaria (matching class A, defined in Appendix 10.3). As can be seen in the matching table, some of the

	attributes can be well matched (class A1); other attribute match only for a subset of values (class A3) and into one attribute ("Tipo_tratta") entities are included within the same value (class A2)
RailwayStationArea	This feature class is not implemented in DbPrior_0513_Tratta_Ferroviaria data model.
RailwayArea	This feature class is not implemented in DbPrior_0513_Tratta_Ferroviaria data model

6.2.8 Analysis of RVEN Veneto Dataset

Features/attributes from the RVEN Veneto dataset that fit on the INSPIRE Rail Network data model

INSPIRE feature catalogue					**Data provider RVEN feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RailwayStationNode	A node that occurs along the railway network, this can be a intersection of tracks or a station. [TWG-TN]			Point	**IntersezioneFerroviariaP**	RAILWAY JUNCTION			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
geometry	The location of the node	GM_Point <<dataType>>	1		**ORIG**	Data source	Enum	1	Gis data Digital Base Map Ortho Images ISTAT Others
Comments					**Comments**	A2 The feature class Railway Junction in Veneto dataset includes not only intersections of tracks or stations, but also level crossing and terminal node			

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
stationType	The use of that station whether it is freight only, passengers or vehicles. [TWG-TN]	Type not defined	voidable - 1		**TIP_NODO**	Data source	Enum	1	Terminal Junction Level Crossing Railway Station Loading Dok Intersection with Region Border Intersection with mapping trimming Entry/exit point - bridge or gallery
Comments					Comments	A2 The feature class Railway Junction in Veneto dataset includes not only intersections of tracks or stations, but also level crossing and terminal node			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
SignificantPoint	A significant point that falls along the railway network that is not a station or used to describe connectivity. [TWG-TN]			Point	**IntersezioneFerroviariaP**	RAILWAY JUNCTION			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
geometry	The location of the node	GM_Point <<dataType>>	1		**ORIG**	Data source	Enum	1	Gis data Digital Base Map Ortho Images ISTAT Others
Comments					**Comments**	A2 Some Significant Points are included in the Railway Junction feature class			
function	The function of the significant point along the network e.g. Points, marker posts etc	Type not defined	voidable - 1		**TIP_NODO**	Data source	Enum	1	Terminal Junction Level Crossing Railway Station Loading Dok Intersection with Region Border Intersection with mapping trimming Entry/exit point - bridge or gallery

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
Comments					Comments	Partial Matching			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RaylwayYardNode	A Node defining a point within a railway yard area. [TWG-TN]			Point	IntersezioneFerroviaria	RAILWAY JUNCTION			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**ID_NODO**	ID Node (Intersection)	Char	1	
Comments					Comments	A1			
name	The name for this element	GeographicalName <<dataType>>	voidable - 1		**NOME**	Station, Crossroads denomination	Char	1	
Comments					Comments	A1			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
RaylwayYardNode	A Node defining a point within a railway yard area. [TWG-TN]			Point	TrattaFerroviaria	RAILWAY TRACKT			Polyline

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
railwayYardOperatingAuthoriry	The name of the operator for of that station [TWG-TN]	Type not defined	voidable - 1	Standard	**COD_ENTE**	Managed Authorities Code	Enum	1	
Comments					**Comments**	A1 RVEN dataset use code_ente for explain the property and management of the stations and railway lines and combine the information that inspire insert in two different attributes			
railwayYardOwnerAuthority	The owner of that station [TWG-TN]	Type not defined	voidable - 1	Standard	**COD_ENTE**	Managed Authorities Code	Enum	1	
Comments					**Comments**	A1 RVEN dataset use code_ente for explain the property and management of the stations and railway lines and combine the information that inspire insert in two different attributes			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
RailwayLink	A subtype of basic railway link which adds specific attribution that has been found usable within this stage of INSPIRE. [TWG TN]			Line	**TrattaFerroviaria**	RAILWAY ELEMENT			Polyline
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>>	1		**ORIG**	Data Source	Enum	1	Gis data Digital Base Map Ortho Images ISTAT Others
Comments					**Comments**	A1			
numberOfTracks	Value indicating the number of tracks for the network (this is dependent on the resolution of the data). [TWG-TN]	Type not defined	voidable - 1		**NUM_BIN**	Tracks Number	Integer		

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
Comments					Comments	A1			
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Standard	**TIP_SCAR**		Enum	1	standard
Comments					Comments	A1 this Feature Attribute partially match the RailwayGaugeCategory, only the standard and narrow categories are represented in RVEN dataset			
railwayGaugeCategorys	The generic name used to outline category used to measure a railwayGauge [TWG-TN]	RailwayGaugeCategory <<enumeration>>	voidable - 1	Narrow	**TIP_SCAR**		Enum	1	narrow
Comments					Comments	A1 this Feature Attribute partially match the RailwayGaugeCategory, only the standard and narrow categories are represented in RVEN dataset			

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	UnderConstruction	**STATO**	Status	Enum		under construction
Comments					Comments	A1 this Feature Attribute partially match the **conditionOfFacility**, only for under-construction and functional status in RVEN dataset			
conditionOfFacility	the status of the rail network with regards to it's completion [TWG-TN]	ConditionOfFacilityType <<enumeration>>	voidable - 1	Functional	**STATO**	Status	Enum		functional
Comments					Comments	A1 this Feature Attribute partially match the **conditionOfFacility**, only for under-construction and functional status in RVEN dataset			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	OnGroundSurface	**SEDE**	The relative level of the network	Enum		on ground surface
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	SuspendedOrElevated	**SEDE**	The relative level of the network	Enum		suspended or elevated
Comments					Comments	A1			
locationCategory	The relative level of the network e.g. underground or over ground services. [TWG-TN]	LocationCategory <<enumeration>>	voidable - 1	Underground	**SEDE**	The relative level of the network	Enum		underground
Comments					Comments	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	ElectrifiedTrack	**TIP_ELET**	method for which the vehicle is powered along the track	Bool		True

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
Comments					Comments	A1			
railwayPowerMethod	method for which the vehicle is powered along the track. [TWG-TN]	RailwayPowerMethod <<enumeration>>	voidable - 1	NonElectrifiedTrack	**TIP_ELET**	method for which the vehicle is powered along the track	Bool		False
Comments					Comments	A1			
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		**ID_TRAT**	Identifier	Polyline	1	
Comments					Comments	A1			

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
railwayType	The form of way for the rail describing the class of vehicle permitted [TWG-TN]	RailwayType <<enumeration>>	voidable - 1	Train Metro Tramway Funicular CogRailway Monorail MagneticLevitation SuspendedRail SideTrack Other	**TIP_TRAT**	The form of way for the rail describing the class of vehicle permitted	Enum		railway underground High speed line Lead Track Other
Comments					**Comments**	A2 The attribute " **TIP_TRAT** " of the Railway Area matches the attribute " **railwayType** " by the following values: - railway - underground (subway, tube) - Lead Track - Other			

INSPIRE feature catalogue					Data provider RVEN feature catalogue				
Target model					**Source model**				
owningAuthority	Name of the owning authority for the individual sections of tracks. [TWG-TN]	Type not defined	voidable - 1		**COD_ENTE**	Managed Authorities Code	Enum		
Comments					Comments	A2			
centerLineGeometry	The geometry that representes the centerline of the link	GM_Curve <<dataType>	voidable - 1		**GEOMETRY**	Geometry that represents also the centraline of the link	Polyline in 3D	1	
Comments					Comments	In the RVEN dataset the Geometry and centreline are coincident			

Table 19 - Features/attributes from the RVEN Veneto Dataset that fit on the INSPIRE Road Network data model

Critical analysis of the RVEN Veneto dataset matching process for Rail Network

The INSPIRE Rail theme is composed by the following feature classes:

- RailwayYardNode
- RailwayStationNode
- SignificantPoint
- BasicRailwayLink
- RailwayLink
- RailwayStationArea
- RailwayArea

Inside "Intesa Sato-Regioni-EE.LL" the Project Unit for the GIS and Cartography produced some vectorial Databases. Some of these graphs that are concerning the Rail Network proceeded from the Digital Vectorial Base Map at the 1:5000 and 1:10000 scales, following the INTESA/WG01 DBP10K specifications.

The model adopted for the structuring of the information is a georelational one. This model link spatial data with alphanumerical data; the alphanumerical attributes are inserted in database tables linking the spatial elements and relating with these through a common identifier.

The data model pay attention to the topology, the integrity constraints and the link among the spatial relations and the different elements.

About Rail elements we mean that rail track is representing the main length that is obtained by the Centreline. Every element links two railway junctions. This theme represents the infrastructure network for the Rail transport of people and goods.

The Rail Network has been acquired as a connected graph, with a rundown of the main tract like in the GDF for Roads Network, identifying the tract with a "main rail line". But in different way from the Roads GDF, the tract acquired is ever coincident with the Centreline of the track.

The result of the match with INSPIRE Rail data model can be seen in table 19. The main differences are:

RailwayYardNode	This feature is implemented in RVEN dataset with IntersezionFerroviaria (Railway Junction) with the attribute ID_NODO and NOME related to the Identity and the name of the element

RailwayStationNode	This feature is implemented in RVEN dataset with IntersezionFerroviaria (Railway Junction) with the attribute ORIG and TIP_NODO related to the location and The use of that station whether it is freight only, passengers or vehicles. The feature class Railway Junction in Veneto dataset includes not only intersections of tracks or stations, but also level crossing and terminal node
SignificantPoint	The same elements in RailwayStationNode are also inserted in this feature
BasicRailwaydLink	This feature class is not implemented, whereas it is directly implemented the more detailed class RailwayLink
RailwayLink	This is the only feature of the INSPIRE Rail Network data model that has a direct correspondent feature in RVEN (matching well class A, defined in Appendix 10.3). As can be seen in the matching table, some of the attributes can be well matched (class A1 or A3), as is the case of railwayType, railwayPowerMethod, railwayGauge, railwayGaugeCategory. Some other can be matched but with semantic problems (class A2), as is the case conditionOfFacility. Some of them deal with the same characteristic of the feature but the differences in the classification make it impossible to establish a good correspondence (formOfWay). This could be a recurrent issue of the harmonization process.
RailwayStationArea	This feature class is not implemented in RVEN data model.
RailwayArea	This feature class is not implemented in RVEN data model (as a consequence of its level of detail).

There are some attributes in RVEN that are not present in INSPIRE data model (class B2), however all of them are considered not relevant to INSPIRE context.

On the other hand, there are some features and attributes from INSPIRE data model not present in RVEN dataset, even though most of them are considered really relevant (class C1). This is the case the feature “RailwayStationNode” and its attributes or the attributes railwayUse, railwayCode of the feature “RailwayLink”.

Likewise, although few, there are some features or attributes that we think that might be not relevant in the INSPIRE context (class C2). This is the case of the features “RailwayYardNode" where RVEN dataset fit partially and “RailwayArea”.

Finally, there are features that might be relevant, but it should be clarified. This is the case of “SignificantPoint” RVEN dataset has foreseen IntersezioneFerroviaria with the attributes Orig and Tipo_nodo (data source and type of node).

6.3 Water Network

6.3.1 Analysis IGP EuroGlobalMapPT Dataset

Features/attributes from the IGP EuroGlobalMapPT dataset that fit on the INSPIRE Water Network data model

INSPIRE feature catalogue					Data provider IGP (dataset EuroGlobalMapPT) feature catalogue				
Target model					Source model				
Feature Name	Feature Definition			Feature Geometry	Feature Name	Feature Definition			Feature Geometry
FerryLine	A waterway to transport passengers and/or vehicles across a body of water, usually linking two or more nodes of a land based transport network. [TWG TN]				Ferry crossing	A route in a body of water where a ferry crosses from one shoreline to another.			Line
Attribute Name	Attribute definition	Attribute type	Attribute cardinality	Possible values	Attribute Name	Attribute definition	Attribute type	Attribute cardinality	Possible values
Comments					Comments	A1			

Table 20 - Features/attributes from the IGP EuroGlobalMapPT Dataset that fit on the INSPIRE Water Network data model

Critical analysis of the IGP EuroGlobalMapPT dataset matching process for Water Network

The feature “FerryLine” defined in the INSPIRE data model is matched with the feature "Ferry crossing" (FC=AQ070) of the dataset under analysis and this feature is the only one in this dataset that can be classified as belonging to the theme Water Network.

6.3.2 Analysis of IGP EuroRegionalMapPT Dataset

Features/attributes from the IGP EuroRegionalMapPT dataset that fit on the INSPIRE Water Network data model

INSPIRE feature catalogue					Data provider IGP (dataset EuroGlobalMapPT) feature catalogue				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
FerryLine	A waterway to transport passengers and/or vehicles across a body of water, usually linking two or more nodes of a land based transport network. [TWG TN]				**Ferry crossing**	A route in a body of water where a ferry crosses from one shoreline to another.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
Comments					**Comments**	A1			

Table 21 - Features/attributes from the IGP EuroRegionalMapPT Dataset that fit on the INSPIRE Water Network data model

Critical analysis of the ICC BT-5M dataset matching process for Water Network

The feature FerryLine defined in the INSPIRE data model is matched with the feature "Ferry crossing" (FC=AQ070) of the dataset under analysis. However the feature "Pier/Wharf/Quay" (FC=BB190) classified in the dataset has a belonging to the transportation theme does not have a correspondence (match) in the INSPIRE data model.

6.3.3 Analysis of MAV GD012RETIIDROLAGL1 Dataset

Features/attributes from the MAV GD012RETIIDROLAGL1 dataset that fit on the INSPIRE Water Network data model

INSPIRE feature catalogue					**Data provider MAV (dataset GD012RETIIDROLAGL1) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
WaterwayNode	Place where one or more WaterwayLinks start or end. [TWG TN]			Point	**Nodi_rete_nav**	Point geometry where one or more WaterwayLinks start or end. [TWG TN]			Point
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		ID	Automatic check of objects, granted by program	Alphanumeric String		
Comments					**Comments**	attribute management			
name	The name for this element	GeographicalName <<dataType>>	voidable - 1		ID_NODO	Value of the node in the network	Integer		
Comments					**Comments**	Refered attribute "STARTPOINT" or "ENDPOINT" in feature "reticolo_rete_nav"			

Feature Name	Feature Definition			Feature Geometry	Feature Name	Feature Definition			Feature Geometry
WatercourseSegment	A segment of a watercourse within a hydrographic network.			Line	**reticolo_rete_nav**	A segment of a watercourse within a hydrographic network.			Line
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
id	The identity of the element	Identifier <<datatype>>	1		ID	Automatic check of objects, granted by program	Autonumber		
Comments					**Comments**	attribute management			
name	The name for this element	GeographicalName <<dataType>>	voidable - 1		Toponomastica	Full name of the ship canal	Alphanumeric String		
Comments					**Comments**				
length	Length of segment	Length <<dataType>>			**LUNGHEZZA_m**	Length of the segment channel	Integer		

Table 22 - Features/attributes from the MAV GD012RETIIDROLAGL1 Dataset that fit on the INSPIRE Water Network data model

Critical analysis of the MAV GD012RETIIDROLAGL1 dataset matching process for Water Network

Nodi_rete_nav of MAV GD012RETIIDROLAGL1Dataset

Analysis of relevant features and attributes from dataset that are not included in the INSPIRE data model

The attribute *intersecanti* give the number of waterwaylinks that pass through the node.

The attributes *pos_gbest* and *pos_gbnord* gives the projected coordinates (east for *pos_gbest* and north for *pos_gbnord*) in the national Italian projection system Gauss Boaga Fuso Est.

Analysis of relevant features and attributes from INSPIRE data model dataset that are not included in the dataset

The attributes *beginLifespanVersion, endLifespanVersion, formOfWaterwayNode, validFrom and validTo* of the INSPIRE dataset are not contemplated in the MAV GD012RETIIDROLAGL1dataset.

Report of the problems

The INSPIRE's attribute *geometry* is equivalent at the MAV GD012RETIIDROLAGL1's hidden attribute *FunctionalAttribute*. The name of this attribute can be change in future: in this case it's the result of a spatial operation but really it's a *geometry*.

And what about the program's hidden features?

reticolo_rete_nav of MAV GD012RETIIDROLAGL1Dataset

Analysis of relevant features and attributes from dataset that are not included in the INSPIRE data model

The following attributes of the MAV GD012RETIIDROLAGL1Dataset are not included in the INSPIRE model.

Cod_CTR	Reference number in the CTR (Carta Tecnica Regionale)
Sottocod_CTR	Sub-reference number in the CTR (Carta Tecnica Regionale)
Operatore	code operator

Uso_canale	Specific use of the canal or tract of canal
Giurisd	Specification of the administrative responsibility
Competenza	Administrative responsibility
velocita	Speed limit (Km/h) with the engine boat
STARTPOINT	Point geometry where one or more WaterwayLinks start
ENDPOINT	Point geometry where one or more Waterway end

Analysis of relevant features and attributes from INSPIRE data model dataset that are not included in the dataset

The following attributes of the INSPIRE Dataset are not include in the MAV GD012RETIIDROLAGL1 model.

centerLineGeometry	The geometry that representes the centerline of the link
beginLifespanVersion	Date and time at which this version of the transport link was inserted or changed in the spatial data set.
endLifespanVersion	Date and time at which this version of the transport link was superseded or retired in the spatial data set.
validFrom	The time when the transport link is started to be in service in the real world.
validTo	The time from which the transport link is no longer in service in the real world.
CrossSection	A series of profiles of the watercourse bed geometry taken along the length of teh watercourse
dischargeRate	Rate of water flow in the segment (units of measure should be a volume rate of flow, e.g. m^3/s)
flowDirection	Direction of water flow in the segment relative to digitisation of segment geometry
flowResistance	Resistance of flow
CEMT-Class	Inland waterway classification according to CEMT (European Conference of Ministers of Transport), standard vessels on which

	classification is based.
ferryUse	Types of transport carried by a ferry.

Report of the problems

The INSPIRE's attribute *centerLineGeometry* is equivalent at the MAV GD012RETIIDROLAGL1's hidden attribute *FunctionalAttribute*. The name of this attribute can be change in future: in this case it's the result of a spatial operation but really it's a *geometry*.

We didn't use an attribute like the INSPIRE's attribute flowDirection , *flowResistance* because the flowdirection depend from the tidal flow and *flowResistance* is very variable.

Why an attribute like roadlink's speedlimit is not contemplating the watersegment or waterlink feature?

Why an attribute like *BasicRoadLink's functionalRoadClass* is not contemplating the watersegment or waterlink feature?

Which's the real difference between watersegment and waterlink. At the beginning we use waterlink, but the definition of watersegment seam better in our case.

6.4 Air Network

6.4.1 Analysis IGP EuroGlobalMapPT Dataset

Features/attributes from IGP EuroGlobalMapPT dataset that fit on the INSPIRE Air Network data model

INSPIRE feature catalogue					**Data provider IGP (dataset EuroGlobalMapPT) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
Airport	Point / Node approximately located at the Aerodrome Reference Point of an airport, which is used to represent it simply. [TWG TN] The Aerodrome Reference Point (ARP) is "the designated geographical location of an aerodrome, located near the initial or planned geometric centre of the aerodrome and normally remaining where originally established". [AICM3.3]				**Airport/Airfield**	A defined area of land or water used for landing, take-off, and movement of aircraft including associated buildings and facilities. [DIGEST]			Point, Area
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
airfieldElevation		Measure	voidable		**ZV3**	Airfield elevation	Integer	1	
iataCode		CharacterString	voidable		**IAT**	IATA 3-letter designator	Coded value (3 char.)	1	

INSPIRE feature catalogue					Data provider IGP (dataset EuroGlobalMapPT) feature catalogue				
Target model					**Source model**				
icaoCode		CharacterString	voidable		**IKO**	ICAO 4-letter designator	Coded value (4 char.)		
name		GeographicalName	voidable		**NAMN1**	Name of feature in first national language	Character		
Comments					Comments	A1			

Table 23 - Features/attributes from the IGP EuroGlobalMapPT Dataset that fit on the INSPIRE Air Network data model

Critical analysis of the IGP EuroGlobalMapPT dataset matching process for Road Network

The feature Airport defined in the INSPIRE data model is matched with the feature "Airport/Airfield" (FC=GB005) of the dataset under analysis and this feature is the only one in this dataset that can be classified as belonging to the theme Air Transport.

6.4.2 Analysis of IGP EuroRegionalMapPT Dataset

Features/attributes from the IGP EuroRegionalMapPT dataset that fit on the INSPIRE Air Network data model

INSPIRE feature catalogue					**Data provider IGP (dataset EuroRegionalMapPT) feature catalogue**				
Target model					**Source model**				
Feature Name	**Feature Definition**			**Feature Geometry**	**Feature Name**	**Feature Definition**			**Feature Geometry**
Airport	Point / Node approximately located at the Aerodrome Reference Point of an airport, which is used to represent it simply. [TWG TN] The Aerodrome Reference Point (ARP) is "the designated geographical location of an aerodrome, located near the initial or planned geometric centre of the aerodrome and normally remaining where originally established". [AICM3.3]				**Airport/Airfield**	A defined area of land or water used for landing, take-off, and movement of aircraft including associated buildings and facilities. [DIGEST]			Point, Area
Attribute Name	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**	**Attribute Name**	**Attribute definition**	**Attribute type**	**Attribute cardinality**	**Possible values**
airfieldElevation		Measure	voidable		**ZV3**	Airfield elevation	Integer	1	
iataCode		CharacterString	voidable		**IAT**	IATA 3-letter designator	Coded value (3 char.)	1	
icaoCode		CharacterString	voidable		**IKO**	ICAO 4-letter designator	Coded value (4 char.)		

INSPIRE feature catalogue					Data provider IGP (dataset EuroRegionalMapPT) feature catalogue				
Target model					**Source model**				
name		GeographicalName	voidable		**NAMN1**	Name of feature in first national language	Character		
Comments					Comments	A1			

Table 24 - Features/attributes from the IGP EuroRegionalMapPT Dataset that fit on the INSPIRE Air Network data model

Critical analysis of the IGP EuroRegionalMapPT dataset matching process for Road Network

The feature “Airport” defined in the INSPIRE data model is matched with the feature "Airport/Airfield" (FC=GB005) of the dataset under analysis.

Despite not present in this dataset the generic data model for EuroRegionalMap also has the features "Heliport" (FC=GB035) and "Control Tower" (FC=AQ060) that can be matched, respectively, with the INSPIRE features "Heliport" and "ControlTowerPlaceholder".

It is impossible to find a match in the INSPIRE data model for the feature "Runway" (FC=GB055).

7 The GIS4EU Transport Networks subset of the INSPIRE Data Model

The purpose of this section is to assess, based on the results of the matching process reported in the tables of section 6, the subset of the INSPIRE features that is possible to find in the datasets analysed in this document.

The features of the INSPIRE data model that were matched with features from the GIS4EU datasets are listed according to the INSPIRE Transport Networks sub-theme to which they can be classified into. The data providers of each dataset did the matching process once they have the best knowledge available of their own data.

For each INSPIRE sub-theme, we begin by presenting a listing of the INSPIRE features and attributes matched for each GIS4EU dataset and afterwards we present a table with the final global result, that is, the INSPIRE features and attributes for which it was possible to find a match in one or more of the datasets.

Finally, the Appendix 10.5 shows (highlighted in yellow colour) the GIS4EU selected subset of features and attributes in top the INSPIRE UML class model for each sub-theme.

7.1 Road Network

For the Road Network sub-theme the matches are:

- ICC BT-5M dataset

  Feature: RoadLink

  Attributes: id, centerLineGeometry, beginLifespanVersion, endLifespanVersion, formOfWay, locationCategory, surfaceCategory

- ICC BT-50M dataset:

  Feature: RoadLink

  Attributes: id, centerLineGeometry, beginLifespanVersion, endLifespanVersion, formOfWay, functionalRoadClass, locationCategory, maintenanceAuthority, ownerAuthority, surfaceCategory, trafficFlowDirection, europeanRoadCode, nationalRoadCode

- RLIG DBPrior 10K dataset:

  Feature: RoadNode

Attributes: id, geometry, formOfNode

Feature: RoadLink

Attributes: id, centerLineGeometry, functionalRoadClass, fictitious, locationCategory, maintenanceAuthority, withCategory

- RPIE Piemonte Est dataset:

  Feature: RoadNode

  Attributes: geometry, formOfNode

  Feature: RoadLink

  Attributes: centerLineGeometry, formOfWay, locationCategory, roadWith, surfaceCategory, withCategory

  Feature: RoadArea

  Attributes: geometry

  Feature: VehicleTrafficArea

  Attributes: geometry

- RPIE DBPrior 10K dataset: RoadNode, RoadLink

  Feature: RoadNode

  Attributes: id, geometry, formOfNode

  Feature: RoadLink

  Attributes: id, centerLineGeometry, formOfWay, maintenanceAuthority

- IGP EuroGlobalMapPT dataset: RoadLink

  Feature: RoadLink

  Attributes: locationCategory, surfaceCategory, europeanRoadCode, nationalRoadCode

- IGP EuroRegionalMapPT dataset: RoadLink

  Feature: RoadLink

  Attributes: locationCategory, surfaceCategory, europeanRoadCode, nationalRoadCode

- INSIEL DBPrior_0503_Strada_Administrativa dataset: RoadLink

Feature: RoadLink

Attributes: name, centerLineGeometry, formOfWay, functionalRoadClass, maintenanceAuthority

- RVEN Veneto dataset: RoadNode, RoadLink

Feature: RoadNode

Attributes: id, geometry, formOfNode

Feature: RoadLink

Attributes: id, name, centerLineGeometry, formOfWay, locationCategory, roadWidth, functionalRoadClass

The INSPIRE features and attributes matched with one or more GIS4EU features and attributes are listed in the next table that intends to summarise the results of the matching process. The columns "Count" contain the number of datasets (of the total count of 9) in which the feature or the attribute has been matched.

Feature	Count	Attribute	Count
RoadNode	3	id	3
		geometry	4
		formOfNode	4
RoadLink	8	id	5
		name	2
		centerLineGeometry	7
		beginLifespanVersion	2
		endLifespanVersion	2
		formOfWay	6
		functionalRoadClass	4
		fictitious	1
		locationCategory	7
		maintenanceAuthority	4
		ownerAuthority	1

		roadWith	2
		surfaceCategory	5
		withCategory	2
		trafficFlowDirection	1
		europeanRoadCode	3
		nationalRoadCode	3
RoadArea	1	geometry	1
VehicleTrafficArea	1	geometry	1

Table 25 – INSPIRE features and attributes matched with GIS4EU datsets' features and attributes for Road Network Transport sub-theme.

In the Appendix 10.5 – "Identification of GIS4EU features and attributes in INSPIRE Transport Networks data model" – is provided the INSPIRE UML Model for the Road Network, with the feature types and attributes selected for the GIS4EU Model, highlighted in yellow colour.

7.2 Rail Network

For the Rail Network sub-theme the matches are:

- ICC BT-5M dataset:

  Feature: RailwayLink

  Attributes: id, centerLineGeometry, beginLifespanVersion, endLifespanVersion, railwayType, locationCategory, railwayPowerMethod

- ICC BT-50M dataset:

  Feature: RailwayLink

  Attributes: id, centerLineGeometry, beginLifespanVersion, endLifespanVersion, numberOfTracks, railwayGauge, railwayGaugeCategory, railwayType, conditionOfFacility, designSpeed, locationCategory, owningAuthority, railwayPowerMethod

- RPIE Piemonte Est dataset:

  Feature: RailwayStationNode

  Attributes: geometry

Feature: SignificantPoint

Attributes: geometry, function

Feature: RailwayLink

Attributes: centerLineGeometry, numberOfTracks, railwayGaugeCategory, railwayType, conditionOfFacility, locationCategory, railwayPowerMethod

Feature: RailwayArea

Attributes: geometry, function

- RPIE DBPrior 10K dataset:

Feature: RailwayStationNode

Attributes: id, geometry

Feature: SignificantPoint

Attributes: geometry, id, function

Feature: RailwayLink

Attributes: centerLineGeometry, id, numberOfTracks, railwayGaugeCategory, railwayType, locationCategory, railwayPowerMethod

- IGP EuroGlobalMapPT dataset:

Feature: BasicRailwayLink

Attributes: railwayGauge, railwayGaugeCategory

- IGP EuroRegionalMapPT dataset:

Feature: RailwayStationNode

Attributes: id, stationName

Feature: BasicRailwayLink

Attributes: id, railwayGauge, railwayGaugeCategory

- INSIEL DBPrior_0513_Tratta_Ferroviaria dataset:

Feature: RailwayLink

Attributes: id, centerLineGeometry, numberOfTracks, railwayGaugeCategory, railwayType, conditionOfFacility, locationCategory, owningAuthority, railwayPowerMethod

- RVEN Veneto dataset:

Feature: RailwayStationNode

Attributes: geometry, stationType

Feature: SignificantPoint

Attributes: geometry, function

Feature: RailwayYardNode

Attributes: id, name, railwayYardOperatingAuthority, railwayYardOwnerAuthority,

Feature: RailwayLink

Attributes: centerLineGeometry, numberOfTracks, railwayGaugeCategory, conditionOfFacility, locationCategory, railwayPowerMethod, id, railwayType, owningAuthority

The INSPIRE features and attributes matched with one or more GIS4EU features and attributes are listed in the next table that intends to summarise the results of the matching process. The columns "Count" contain the number of datasets (of the total count of 8) in which the feature or the attribute has been matched.

Feature	Count	Attribute	Count
RailwayStationNode	4	id	2
		geometry	3
		stationName	1
		stationType	1
SignificantPoint	4	id	1
		geometry	3
		function	3
RailwayYardNode	1	id	1
		name	1
		railwayYardOperatingAuthority	1
		railwayYardOwnerAuthority	1
BasicRailwayLink	2	id	1

		railwayGauge	2
		railwayGaugeCategory	2
RailwayLink	6	id	5
		centerLineGeometry	6
		beginLifespanVersion	2
		endLifespanVersion	2
		railwayGauge	1
		railwayGaugeCategory	5
		railwayType	6
		numberOfTracks	5
		designSpeed	1
		conditionOfFacility	4
		locationCategory	6
		owningAuthority	3
		railwayPowerMethod	6
RailwayArea	1	geometry	1
		function	1

Table 26 – INSPIRE features and attributes matched with GIS4EU datsets' features and attributes for Rail Network Transport sub-theme.

In the Appendix 10.5 – "Identification of GIS4EU features and attributes in INSPIRE Transport Networks data model" – is provided the INSPIRE UML Model for the Rail Network, with the feature types and attributes selected for the GIS4EU Model, highlighted in yellow colour.

7.3 Water Network

For the Water Network sub-theme the matches are:

- IGP EuroGlobalMapPT dataset:

  Feature: FerryLine

  Attributes: - No attributes matching -

- IGP EuroRegionalMapPT dataset:

  Feature: FerryLine

  Attributes: - No attributes matching -

- MAV GD01RETIIDROLAGL1 dataset:

  Feature: WaterwayNode

  Attributes: id, name

  Feature: WatercourseSegment

  Attributes: id, name, length

The INSPIRE features and attributes matched with one or more GIS4EU features and attributes are listed in the next table that intends to summarise the results of the matching process. The columns "Count" contain the number of datasets (of the total count of 3) in which the feature or the attribute has been matched.

Feature	Count	Attribute	Count
FerryLine	2	- No attributes matching -	0
WaterwayNode	1	id	1
		name	1
WatercourseSegment Note: This feature is from INSPIRE TWG Hydrography	1	id	1
		name	1
		length	1

Table 27 – INSPIRE features and attributes matched with GIS4EU datsets' features and attributes for Water Network Transport sub-theme.

In the Appendix 10.5 – "Identification of GIS4EU features and attributes in INSPIRE Transport Networks data model" – is provided the INSPIRE UML Model for the Water Network, with the feature types and attributes selected for the GIS4EU Model, highlighted in yellow colour.

7.4 Air Network

For the Air Network sub-theme the matches are:

- IGP EuroGlobalMapPT dataset:

  Feature: Airport

Attributes: airfieldElevation, iataCode, icaoCode, name

- IGP EuroRegionalMapPT dataset:

  Feature: Airport

  Attributes: airfieldElevation, iataCode, icaoCode, name

The INSPIRE features and attributes matched with one or more GIS4EU features and attributes are listed in the next table that intends to summarise the results of the matching process. The columns "Count" contain the number of datasets (of the total count of 2) in which the feature or the attribute has been matched.

Feature	Count	Attribute	Count
Airport	2	airfieldElevation	2
		iataCode	2
		icaoCode	2
		name	2

Table 28 – INSPIRE features and attributes matched with GIS4EU datsets' features and attributes for Air Network Transport sub-theme.

In the Appendix 10.5 – "Identification of GIS4EU features and attributes in INSPIRE Transport Networks data model" – is provided the INSPIRE UML Model for the Air Network, with the feature types and attributes selected for the GIS4EU Model, highlighted in yellow colour.

8 Critical analysis of the matching process at theme level

8.1 Report of missing elements in INSPIRE data model

As a result of the matching process carried out between the Data providers' datasets and the INSPIRE Transport Networks data models, some features and attributes have been identified as candidates to be added to those data models. The table 29 lists the features and the attributes proposed in the critical analysis section of one data provider at least.

Transport Network sub-theme	Feature	Attribute	Justification
Road	**TurnTable**		Having in mind that one of the use cases selected in the INSPIRE Transport Networks theme requires the navigability of the network, it would be advisable to include in the data model the information concerning the allowed/not allowed turns for each of the pairs of RoadLink instances that come together in a "RoadNode".
Road	RoadLink	**conditionOfFacility**	An attribute describing the status of the road with regard to its usability or completion is present in some of the Data providers' datasets. This attribute is also foreseen in the INPIRE Rail Transport Network data model but not in the Road Network one.
Road	**RoadServiceNode**	The same as RoadServiceArea	The feature RoadServiceArea is not present in some of the Data providers' datasets as a consequence of its level of detail. Provided that in the INSPIRE Rail Network data model the area features RailwayStationArea and RailwayArea have its correspondent point features, the same

Transport Network sub-theme	Feature	Attribute	Justification
			could be done in the Road Transport Network data model, adding a new feature RoadServiceNode.
Road	RoadLink	**lenght**	An attribute describing the real lenght of the link is present in some of the Data providers' datasets. This attribute is also foreseen in the INPIRE Water Transport Network data model but not in the Road Network one.
Rail	RailwayLink	**lenght**	An attribute describing the real lenght of the link is present in some of the Data providers' datasets. This attribute is also foreseen in the INPIRE Water Transport Network data model but not in the Rail Network one.
Water	WaterLink	**speedLimit**	An attribute describing the speed limit of the link is present in some of the Data providers' datasets. This attribute is also foreseen in the INPIRE Road Transport Network data model but not in the Water Network one.
Water	WaterLink	**functionalWaterLinkClass**	An attribute describing the functional classification of the link is present in some of the Data providers' datasets. This attribute is also foreseen in the INPIRE Road Transport Network data model but not in the Water Network one.
All		**spatial resolution / scale of acquisition**	In INSPIRE models there is no indication related to the spatial resolution or the acquisition scale of the data. Maybe some attributes are mandatory in the large

Transport Network sub-theme	Feature	Attribute	Justification
			scale, but not in the small scale. The matching process results are dependent from the scale of the dataset compared with INSPIRE models, because the contents may be differents.
All	**Feature?**	**Attribute?**	Some issues related to the level of detal of the features are not fully considered in the INSPIRE models, such as the road network in level 2 of GDF standard.

Table 29 – List of the additional Transport Network features/attributes that could be relevant in the INSPIRE context

8.2 Report of elements of INSPIRE data model that might be not relevant

There are some features and some attributes from INSPIRE data model not present in the Data Providers dataset. They have been identified in the matching tables of Appendix 10.4 as class C1 (as defined in table 2 and explained in Appendix 10.3). It is mentioned that sometimes these features or attributes exist in other datasets of the same data provider or in a dataset maintained by another organization of the country.

It has been reported in sections 6.1.1 and 6.1.2 that the data type “validityPeriod" related to the “SpeedLimit” attribute of “RoadLink” feature and the attribute “speedLimitSource” could be considered not relevant to INSPIRE context (class C2).

However, as this is an assessment of just one data provider, the global result of the analysis carried out is that all the features and attributes of the INSPIRE data model are considered relevant.

8.3 Report of problems identified at the present stage of the harmonization process

One of the difficulties found in the matching process is related to the features and attributes present in the INSPIRE model and consists in the not complete knowledge of the precise

significance of the INSPIRE data model definitions (sometimes very generic or undefined). With respect to this point, a glossary would be of great help.

Moreover, as is detailed in the critical analysis sections at Data providers' dataset level, there are some INSPIRE features and attributes that need to be clarified (e.g. formOfWay, functionalRoadClass, RoadWithClass of feature RoadLink) and some others for wich a minor change is proposed (e.g. using the more general value "InProtectedSites" for the attribute speedLimit.speedLimit.areaCondition instead of the more specific "InNationalParks") .

A second issue is related with the semantic problems that arise when performing the match at the attribute level. Frequently both attributes deal with the same characteristic of the feature but there is not a direct correspondence between their values. The differences in the classification make it difficult or impossible to establish a good correspondence. It is even possible that the values of an attribute are distributed in several attributes. In this situation, a consecuence of the convergence to a common data model is on the one hand the loss of part of the information available at Data provider dataset level but on the other hand the inclusion of instances different from those that were envisioned in the definitions of the attribute values.

Examples of attributes with semantic matching problems are the attribute "formOfNode" of the feature "RoadNode" or the attributes "formOfay" and "functionalRoadClass", both from the feature "RoadLink".

Finally, it is also important to remark that apart from the already mentioned difficulties found matching the two models depending on the real understanding of the meaning of each INSPIRE attribute, there is an added difficulty derived from the not easy readability of a big spreadsheet like the matching table used.

9 Conclusions

As final output of this deliverable, the following global conclusions could be derived from the matching process and different critical analyses done within the context of GIS4EU TWG-DM TN Group:

- Need for clear semantics of data models to improve the harmonization process

  One of the desirable goals of the harmonization process is to maximize the match of data provider datasets' features, attributes and coded values with the corresponding ones in the INSPIRE data model. In order to achieve this goal and at the same time obtain a high level of temathic accuracy in the matching process (being the exact matching the highest level desired for this quality element), there is a major need for clear and concrete definitions – detailed and accurate semantic descriptions - of features, attributes and coded values in both models matched between (INSPIRE and dataset ones), in such a way that no misunderstanding might be possible.

  As far as it is concerned, a detailed Feature Concept Dictionary and Feature Catalogue is needed for the INSPIRE Model. On the other hand, a sort of semantic glossary of terms used within the context of INSPIRE Data Specification process could help to improve its understanding by the final data providers.

- Relevance and existence of the information

  GIS4EU proposed Data Model helps to determine the information which is really relevant across European countries, since in global terms the elements present in a subset of European datasets are identified.

  Selecting the union of features and attributes existing in these datasets it is possible to derive a global view of the information that is captured and used in the different countries. This relevance is one of the important results of the project which could be very interesting for the Testing Phase of INSPIRE.

  On the other hand, if we analyse the current existence of the information found before (the set of elements forming the mentioned union) in each European dataset, we can state from the results of the project that generally there is an important lack of these information elements in the datasets considered. In other words, if we identify the intersection set of features and attributes present in all the datasets analysed, we obtain a small set as a result.

  Having these in mind, if we look up the final GIS4EU Data Model without reading previously the comments provided in the different critical analysis of each data

provider, we can wrongly draw as conclusion that the current matching with the INSPIRE Model is very good. As remarked before, the critical analyses describe that the real situation is not so optimistic.

As illustration of this problem, practically all the features foreseen in the Water and Air INSPIRE Models are not present in the datasets analysed. However, taking into account the case of a high standarised transport network like Air, the information really exist but in the context of a quite restricted group of organizations (different from the organizations that usually acquire geographic information). This shows the current need for institutional agreements to share different types of geographic data in the Member States.

It is already important to remark that a great number of the attributes matched show some semantic or data capture differences which must be stressed. The above mentioned lack of exact matching might be a more frequent situation than what would be desirable in the harmonization process.

As a conclusion of this situation, a gradual adaptation of current data providers' and Member States's data models could be foreseen in order to fulfil the INSPIRE Data Specification Implementing Rules in the near future.

- Level of detail of the model

  One of the characteristics observed in the INSPIRE Transport Network Model is the possible use of different views for the same object.

  It is - for example - the representation of a road stretch as a centreline feature ("RoadLink" – a simplified view of the road stretch) or as an area ("RoadArea" or "VehicleTrafficArea" – as a view delimiting the real extent of the road stretch).

  Another example of this could be the representation of a railway station as a simplified point feature ("RailwayStationNode") or as an area of influence which delimits all its related facilities ("RailwayStationArea").

  However, the INSPIRE Transport Network Model is not provided with a pragmathic mechanism to specify the level of detail of the information given by a specific data provider. Concretly there is not a quantitative or fuzzy indication of the spatial resolution or scale of acquisition of the data, while quality of the matching and harmonization process clearly depends on it. The information content of INSPIRE models should be slightly different for each level of detail, leading this to a necessary distinction between mandatory and optional features and attributes.

Furthermore, the differences found during GIS4EU matching process highlight the existing heterogeneity in the use of levels of detail for the transport network elements considered within the different INSPIRE sub-models.

In order to illustrate the problems regarding the level of detail of the information in the INSPIRE Model, some examples are provided below:

- Existing models dealing with different levels of detail of the transport network, such as the use of levels 1 and 2 from GDF standard, are not fully considered.
- Some topics, such as speed limits for the RoadLink features, are presented in a very great detail - typical of specific applications - while other attributes or feature classes have much less details (for example, some area feature classes).

- Transversal homogeneity of the INSPIRE models and sub-models

  One of the results of the analysis carried out in GIS4EU project is the identification of several features and attributes that are present in the data providers' datasets and not in the INSPIRE data model.

  The analysis of these elements lead to the conclusion that the INSPIRE Transport Network Data Model is suffering from lack of transversal homogeneity. The problem should be taken into account in future revisions of the INSPIRE Model.

  Most of the missing elements identified during the analysis phase are examples of this heterogeneity, for example:

  - The feature "RoadServiceNode" is lacking in the INSPIRE Road Transport Network Data Model, as proposed in Table 29.
  - The attributes "conditionOfFacility", "length" or "speedLimit" are applicable to most of Transport Networks INSPIRE sub-models but only exist in some of them.

- Methodology used in the GIS4EU Project

  The GIS4EU project is a real scenario of the situation that INSPIRE will face when the Implementing Rules enter into force. As a consequence, the methodology developed in the project could be considered as a starting point for real data providers' dataset harmonisation.

10 Appendix

10.1 List of GIS4EU Datasets involved in the process

Data provider	Data Provider level	Dataset	Scale	Road Network	Rail Network	Water Network	Air Network
05_ICC	Regional	BT-5M	1:5.000	X	X	-	-
		BT-50M	1:50.000	X	X	-	-
08_RLIG	Regional	DBPrior10K	1:10.000	X	-	-	-
09_RPIE/17_CSI	Regional	Piemonte Est	1:10.000	X	X	-	-
		DBPrior10K	1:10.000	X	X	-	-
14_IGP	National	ERM-EuroRegionalMapPT	1:250.000	X	X	X	X
		EGM-EuroGlobalMapPT	1:1.000.000	X	X	X	X
16_INSIEL	Regional	DBPrior10K	1:5.000	X	X	-	-
20_RVEN	Regional	Veneto	1:5.000	X	X	-	-
21_MAV	Local	CD012RETIIDROLAGL1	1:5.000	-	-	X	-

Table 30 - GIS4EU available datasets for Transport Networks sub-themes

10.2 Structure of the matching tables

Column name	Definition
Matching classification	Classification used to categorise each feature / attribute of the GIS4EU dataset regarding the matching with a feature / attribute of the INSPIRE data model.
Matching Class Code	Code assigned to the type of matching regarding the previous classification. Possible values for this code are defined for the different cases identified in Table 30.
INSPIRE feature catalogue **Target model**	Description of the characteristics defining the logical structure of the INSPIRE Consolidated UML Model (INSPIRE Model, 2008), known here as *Target Model*.
Feature Name	Name of a specific feature type in the target model.
Feature code	Code assigned to the feature type in the target model.
Feature definition	Definition of the feature type in the target model.
Feature Geometry	Geometry type defined for the feature type in the target model.
Attribute Name – Data Type Hierarchy	Name of a specific attribute in the target model. Description any complex data type hierarchy followed to arrive to the simple attribute level in the target model.
Attribute code	Code assigned to the attribute in the target model.
Attribute type	Data type defined for the attribute in the target model.
Attribute Cardinality	Number or range of possible instances that could exist for the attribute in the target model.
Possible values	Enumeration of the possible values (names) defined in the domain of the attribute in the target model.
Attribute definition	Definition of the attribute in the target model.
Abstract class	Indicates if it is forbidden instantiate the class / feature type in the target model (yes / not).
Comments	Relevant notes about the feature / attribute of the target model.
Data provider XX (dataset YY) feature catalogue	Description of the characteristics defining the logical structure of the GIS4EU dataset model, known here as *Source Model*.

Source model	
Feature Name	Name of a specific feature type in the source model.
Feature code	Code assigned to the feature type in the source model.
Feature definition	Definition of the feature type in the source model.
Feature Geometry	Geometry type defined for the feature type in the source model.
Attribute Name	Name of a specific attribute in the source model.
Attribute code	Code assigned to the attribute in the source model.
Attribute type	Data type defined for the attribute in the source model.
Possible values	Enumeration of the possible values (names) defined in the domain of the attribute in the source model.
Attribute definition	Definition of the attribute in the source model.
Abstract class	Indicates if it is forbidden instantiate the class / feature type in the source model (yes / not).
Comments	Relevant notes about the matching of a feature / attribute of the source model with a feature / attribute of the target model.

Table 31 – Description of the matching table structure

10.3 Guidelines to provide comments about the matching

The agreed table of contents of deliverables D3.2-4 includes critical analysis sections for the match between each GIS4EU datasets model and the INSPIRE data model, at dataset and also at theme level.

In order to come up with a realistic and practical critical analysis and fulfil the goals of the GIS4EU Project in the INSPIRE Testing Phase, it is crucial the data providers supply detailed information at feature and attribute level by means of clear comments introduced in the matching tables. This will help to evaluate how they match with the INSPIRE Model elements.

The goal of these guidelines is to give an outline that helps to write the comments where they could be necessary, but it does not mean that for every feature and attribute it is mandatory to give some comment.

Specific Comments

Please, for the following cases (A, B and C), based on the classification defined in table 2, consider the recommendations and example questions proposed as guidance below:

A. For the specific features / attributes from the GIS4EU Dataset which somehow match with any INSPIRE feature / attribute.

Describe in which grade they match with the INSPIRE Model, trying to categorise each element in one of the following cases:

A.1 ***Direct match***

Add any comment you consider relevant regarding the matching of these features / attributes.

A.2 ***Match with some semantic or data capture differences which must be stressed***

Add any comment you consider relevant regarding the matching of these features / attributes.

Example questions:

- Do the features matching have important definition differences in both models?
- What data capture differences exist between the GIS4EU dataset feature and the corresponding one in the INSPIRE Model?

- Do the attributes matching have important definition differences in both models?
- Does the feature in the GIS4EU dataset include other real world entities different from those that were envisioned in the corresponding data specifications? (i.e. instances of cog railway and funicular transport elements are included in a "Cog Railway" feature).
- Does the attribute in the GIS4EU dataset include other real world entities different from those that were envisioned in the corresponding data specifications? (i.e. cog railway and funicular entities are included within the same value "Cog Railway" of a "Transport Type" attribute)

A.3 ***Complex match***

The match apparently seems not possible, but features / attributes of the INSPIRE model could be somehow derived from the features / attributes of the GIS4EU dataset by performing additional operations

Add any comment you consider relevant regarding the matching of these features / attributes.

Example of operations:

- Matching is feasible by filtering or grouping (aggregating) features / attributes, or performing more complex alphanumeric operations.

  Example 1 – An INSPIRE attribute match with a dataset attribute, but only for a subset of values. The match is possible by selecting these values with an alphanumeric operation.

  Example 2 – A group of GIS4EU dataset attribute values matches with a INSPIRE feature or attribute value. The match is possible by aggregating these values with an alphanumeric operation.

  Indicate any issues derived from this situation that you could appreciate.

- Matching is feasible by performing complex spatial analyses.

  Example 3 – Extracting the centreline of a road feature (which is the element considered within the INSPIRE "RoadLink" feature) from the road borders captured during the production of the GIS4EU dataset by spatial analysis operations.

B. For the specific features / attributes from the GIS4EU Dataset which do not match with any INSPIRE feature / attribute in any of the previously mentioned ways (A.1, A.2, A3.1, A3.2):

Think about if they could be important in the context of INSPIRE, trying to categorise each element in one of the following cases:

B.1 ***Feature/attribute that could be relevant in the INSPIRE context***

B.2 ***Feature/attribute that could NOT be relevant in the INSPIRE context***

For both cases (Yes/Not), explain why you think this by providing specific reasons.

C. For the specific features / attributes from the INSPIRE Model that do not match with any feature / attribute of the GIS4EU Dataset:

Think about if some of they might be considered not important in the context of INSPIRE, trying to categorise each element in one of the following cases:

C.1 ***Feature/attribute that is considered relevant in the INSPIRE context***

C.2 ***Feature/attribute that might be considered NOT relevant in the INSPIRE context***

For both cases (Yes/Not), explain why you think this by providing specific and clear reasons.

In case of considering a specific feature / attribute as relevant to INSPIRE context, does any Organisation in your country / region produce or maintain it?

General Comments

As a conclusion, write a brief summary of the matching process you have done, explaining the major problems found and giving your personal opinion.

10.4 Matching tables of GIS4EU Datasets

05_ICC Matching table

08_RLIG Matching table

09_RPIE/17_CSI Matching table

14_IGP Matching table

16_INSIEL Matching table

20_RVEN Matching table

21_MAV Matching table

10.5 Identification of GIS4EU features and attributes in INSPIRE Transport Networks data model

Road package

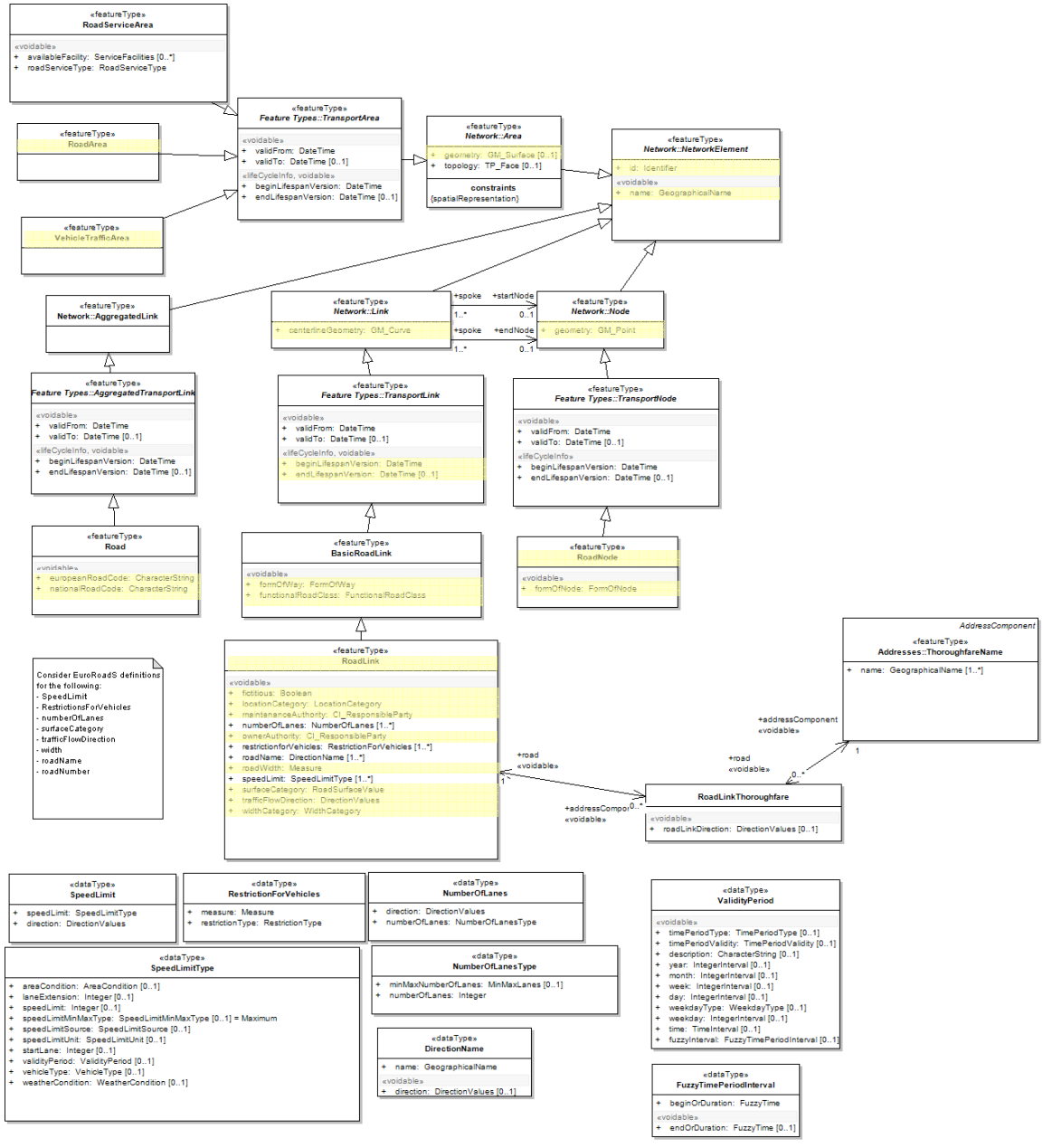

Fig. 12 – Identification of GIS4EU features and attributes in Road package model (INSPIRE Model, 2008)

Rail package

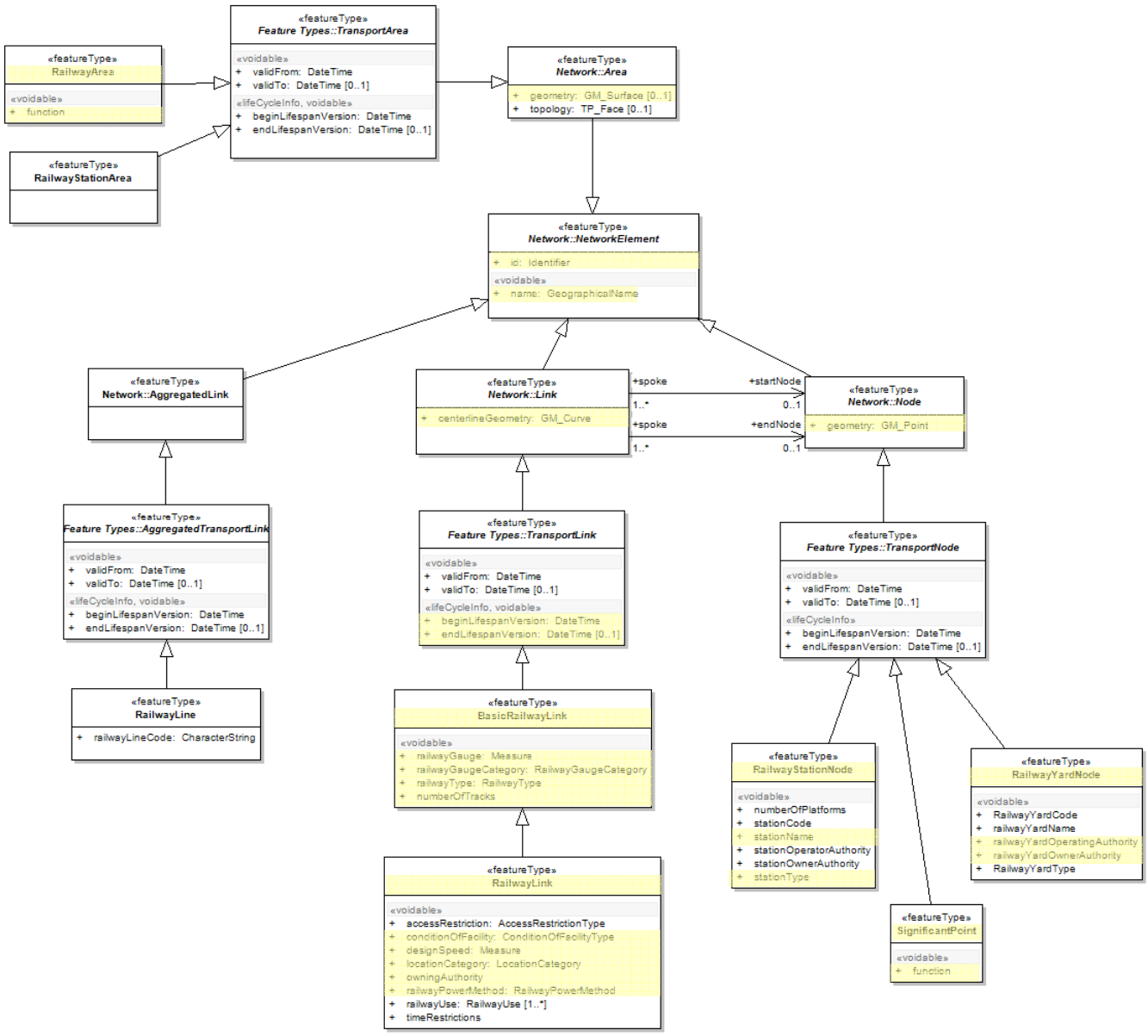

Fig. 13 - Identification of GIS4EU features and attributes in Rail package model (INSPIRE Model, 2008)

Water Package

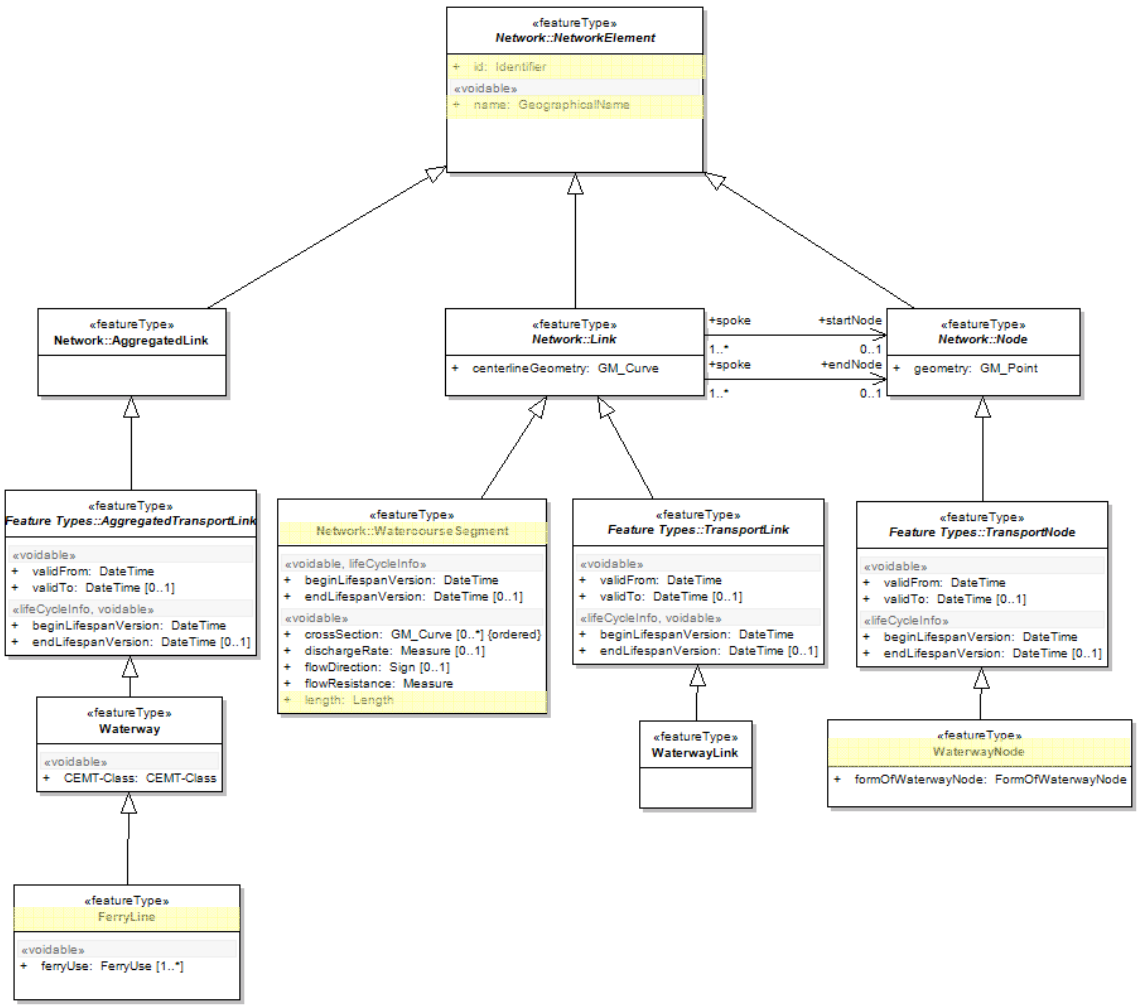

Fig. 14 - Identification of GIS4EU features and attributes in Water package model (INSPIRE Model, 2008)

Air package

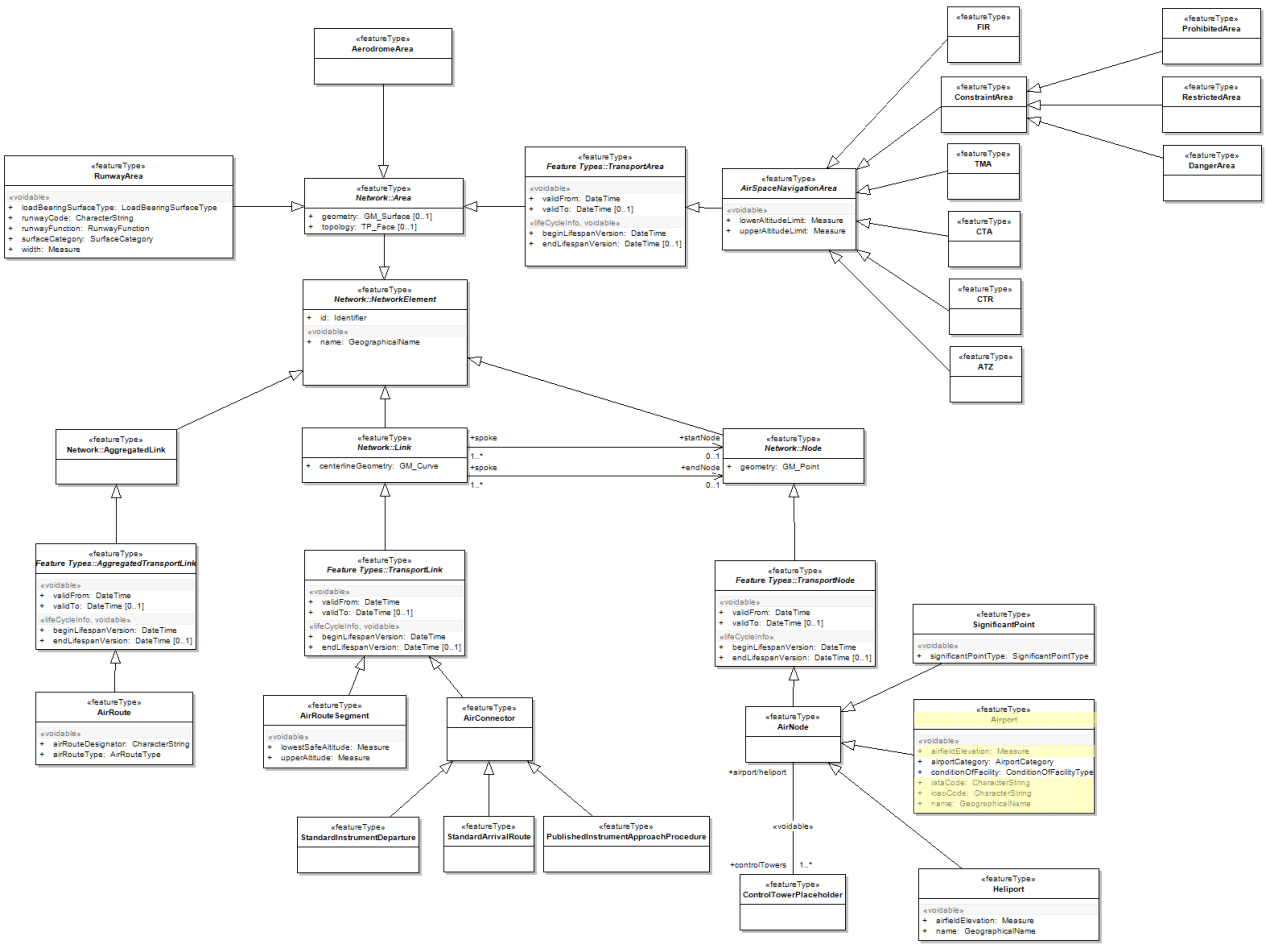

Fig. 15 - Identification of GIS4EU features and attributes in Air package model (INSPIRE Model, 2008)

10.6 Abbreviations

DT-DS	Drafting Team “Data Specifications”
DT-DS TWG TN	Drafting Team “Data Specifications” Thematic Working Group on Transport Networks
EC	European Commission
GCM	Generic Conceptual Model
GNM	Generic Network Model
INSPIRE	INfrastructure for SPatial InfoRmation in Europe
LBS	Location Based Services
LMO	Legally Mandate Organisation
UML	Unified Modelling Language

Table 32 - Abbreviation list of document content

10.7 Glossary

TERM	Definition
APPLICATION DATA	Data in support of user requirements
APPLICATION SCHEMA	Conceptual schema for data required by one or more applications [ISO 19101:2002(E)]
CLASS	Description of a set of objects that share the same attributes, operations, methods, relationships, and semantics [ISO 19107:2003(E)]
CODE LIST	Value domain including a code for each permissible value [N1784]
CONCEPTUAL MODEL	Model that defines concepts of a universe of discourse [ISO 19101:2002(E)]
CONCEPTUAL SCHEMA	Formal description of a conceptual model [ISO 19101:2002(E)] Note: ISO 19107 contains a formal description of geometrical and topological concepts using the conceptual schema language UML.
CONCEPTUAL SCHEMA LANGUAGE	Formal language based on a conceptual formalism for the purpose of representing conceptual schemas [ISO 19101:2002(E)] Notes: UML, EXPRESS, ORM and INTERLIS are examples of conceptual schema language
COORDINATE REFERENCE SYSTEM	Coordinate system that is related to the real world by a datum [ISO 19111:2003(E) – Modified] Note: ISO19111 defines coordinate reference system as coordinate system that is related to the real world by a datum 2: Following ISO19111, temporal reference systems are understood as covered by the term coordinate reference systems as well. Examples are: ETRS89 and any formally defined national coordinate system such as the ITM (Irish Transverse Mercator).
COVERAGE	Spatial objects that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain. [ISO 19123:2005(E) – Modified] Examples are Orthoimage, digital elevation model (as grid or TIN), point grids etc
DATA	Reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing [ISO/IEC 2382-1]. Note 1: Data can be any form of information whether on paper or in electronic form. Data may refer to any electronic file no matter what the format: database data, text, images, audio and video. Everything read and written by the computer can be considered data except for instructions in a program that are executed (software). Note 2: Services can provide things like WMS (a picture of a map), WFS (GML) and WCS (an image). Then there are services where a user supplies a coordinate and the service transforms it to another coordinate, or a user supplies an image and the service transforms or performs image processing. These are all something that can be read and written by the computer and are in accord with note 1 data.
DATA HARMONIZATION	Providing access to data through network services in a representation that allows for combining it with other harmonized data in a coherent way by using a common set of data product specifications this includes agreements about coordinate reference systems, classification systems , application schemas etc.

DATA INTERCHANGE	Delivery, receipt and interpretation of data [ISO 19118].
DATA MODEL	A model that defines in an abstract way how data is represented in an information system or a database management system
DATA PRODUCT SPECIFICATION	Detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO/DOS 19131].
DATA SPECIFICATION	Data product specification that describes datasets of a specific theme in a harmonized way [N1786].
DATA TRANSFER	Movement of data from one point to another over a medium [ISO 19118].
DATASET	Identifiable collection of data [ISO 19115:2003(E)].
DATASET SERIES	Collection of datasets sharing the same product specification [ISO 19115].
DISCOVERY METADATA	The minimum amount of information that needs to be provided to convey to the inquirer the nature and content of the data resource Note: The above definition falls into broad categories which answer the "what, why, when, who, where and how" questions about spatial data.
E-GOVERNMENT	Application of information and communication technology to enhance the effectiveness of a legislature, judiciary or administration, either to improve efficiency or to change the relationship between citizen and government, or both
ENCODING	Conversion of data into a series of codes [ISO 19118].
ENTITY	Real-world phenomenon
ESDI	European Spatial Data Infrastructure as built and based on the INSPIRE framework directive]
EVALUATION	Providing sufficient information to enable an inquirer to ascertain that data fit for a given purpose exists, to evaluate its properties, and to reference some point of contact for more information (adapted from GSDI Cookbook). Note: metadata include those properties required to allow the prospective end user to know whether the data will meet the general requirements of a given problem.
EXCHANGE FORMAT	Structured representation of data in a document for exchange between systems In most cases, a machine readable schema will document the structure of the data in the exchange document. Example: GML encodes the application schema in XML schema
EXONYM	Name used in a specific language for a spatial object situated outside the area where that language is spoken, and differing in its form from the name used in an official or well-established language of that area where the geographical feature is located UNGEGN Glossary of Terminology: http://unstats.un.org/unsd/geoinfo/glossary.pdf - Modified
EXTERNAL [OBJECT] IDENTIFIER	A unique [object] identifier which is published by the responsible body, which may be used by third parties to reference the spatial object
FEATURE	Abstraction of a real-world phenomena. Note: The term "(geographic) feature" as used in the ISO 19100 series of International Standards and in this document is synonymous with spatial object as used in this document. Unfortunately "spatial

	object" is also used in the ISO 19100 series of International Standards, however with a different meaning: a spatial object in the ISO 19100 series is a spatial geometry or topology. [ISO 19101].
FEATURE CATALOGUE	Catalogue(s) containing definitions and descriptions of the feature/object types, their attributes and associated components occurring in one or more spatial data sets, together with any operations that may be applied [ISO 19110:2005(E) – modified].
FEATURE DATA DICTIONARY	Dictionary containing definitions and descriptions of feature concepts and feature-related concepts [ISO/CD 19126].
GAZETTEER	Directory of instances of a class or classes of features containing some information regarding position A gazetteer can be considered as a geographical index or dictionary of spatial objects [ISO 19112].
GENERAL FEATURE MODEL	Metamodel for spatial object types and their property types [ISO 19109]
GEOGRAPHIC FEATURE	Synonymous with spatial object
GEOGRAPHIC IDENTIFIER	Spatial reference in the form of a label or code that identifies a location [ISO 19112:2003(E)]. Example 1: Paris, [river] Rhine, Mont Blanc Example 2: Postal codes: 53115, 01009, SW1, IV19 1PZ
GEOGRAPHICAL GRID SYSTEMS	Harmonized multi-resolution grid with a common point of origin and standardized location and size of grid cells. Note: Geographical grid systems are not limited to rectified grids or grids using cell axes parallel to the meridians
GEOMETRIC PRIMITIVE	Geometric object representing a single connected, homogeneous element of space [ISO 19107].
GLOSSARY	An alphabetical list of words often defined or translated: dictionary, lexicon, vocabulary, wordbook
HOMOLOGOUS SPATIAL OBJECTS	Set of spatial objects that correspond to the same real world entity, but are represented differently according to different levels of details or point of views
INSPIRE APPLICATION SCHEMA	Application schema specified in the INSPIRE implementing rules
INSPIRE DATA SPECIFICATION	Data product specification for a spatial data theme from Annex I, II or III of the INSPIRE Directive
INSPIRE INFORMATION MODEL	A structured collection of components that will be documented to support the interoperability and harmonization of geographic information across Europe. Note: rules for application schema, identifier management, terminology etc are examples of the components.
INTEROPERABILITY	Possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention, in such a way that the result is coherent and the added value of the data sets and services is enhanced.
LINEAR REFERENCE SYSTEM	Reference system that identifies a location by reference to a segment of a linear spatial object and distance along that segment from a given point [ISO 19116:2004(E) – modified]. Example: kilometer markers along a motorway or railway, references along the center line of a river object from the intersection with a bridge object. Note: synonymous with linear referencing system

MATCHING TABLE	Table containing the information items about the matching between feature types and attributes of a source dataset and a target dataset.
METADATA	Information describing spatial data sets and spatial data services and making it possible to discover, inventory and use them [ISO 19115:2003(E)] The more general term as defined by ISO19115 is "data about data"
METADATA ELEMENT	Discrete unit of metadata [ISO 19115]
MULTICULTURAL	Multiplicity in systems of values held by different groups: ethnic, regional, or professional [Hofstede G. 1980. Culture's Consequences, Sage: London - modified].
MULTILINGUAL	In or using several languages
MULTIPLE REPRESENTATION	Representation of the relationship between homologous spatial objects
OBJECT	In this document is synonymous with spatial object
OBJECT IDENTIFIER	A unique identifier associated with a spatial object
OBJECT REFERENCING	A method of referencing thematic or other spatial objects to existing spatial objects describing their location to ensure spatial consistency across the spatial objects associated in this way in this way
PORTRAYAL	Presentation of information to humans [ISO 19117]
PRODUCT DESCRIPTION	Detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO 19113].
PROFILE	Set of one or more base standards, and, where applicable, the identification of chosen clauses, classes, options and parameters of those base standards, that are necessary for accomplishing a particular function. A profile is derived from base standards so that by definition, conformance to a profile is conformance to the base standards from which it is derived [ISO 19106].
REFERENCE DATA	Spatial objects that are used to provide location information in object referencing
REFERENCE MODEL	Architectural framework for a specific context, e.g. an application or an information infrastructure
REGISTER	Set of files containing identifiers assigned to items with descriptions of the associated items [ISO 19135].
RESOURCE	Asset or means that fulfills a requirement Example: dataset, service, document, person or organisation.
SERVICE	Distinct part of the functionality that is provided by an entity through interfaces [ISO 19119].
SPATIAL DATA	Any data with a direct or indirect reference to a specific location or geographic area NOTE The use of the word "spatial" in INSPIRE is unfortunate as in the everyday language its meaning goes beyond the meaning of "geographic" - which is considered by the Drafting Team as the intended scope - and includes subjects

	such as medical images, molecules, or other planets to name a few. However, since the term is used as a synonym for geographic in the draft Directive, this document uses the term “spatial data” as a synonym for the term “geographic information” used by the ISO 19100 series of International Standards.
SPATIAL OBJECT	An abstract representation of a real-world phenomenon related to a specific location or geographical area. NOTE It should be noted that the term has a different meaning in the ISO 19100 series. It is also synonymous with "(geographic) feature" as used in the ISO 19100 series.
SPATIAL OBJECT TYPE	Classification of spatial objects NOTE In the conceptual schema language UML a spatial object type will be described by a class with stereotype <<FeatureType>>.
SPATIAL REFERENCE SYSTEMS	System for identifying position in the real world, which does not necessarily use coordinates [ISO 19112:2003(E) -Modified]. EXAMPLE Geographic coordinates describing positions on the Earth surface (coordinate reference system), linear measurements along a river centreline from the intersection of a bridge (linear reference system), postal codes identifying the extent of postal zones (gazetteer)
SPATIAL SCHEMA	Conceptual schema of spatial geometries and topologies to be used in an application schema
TEMPORAL REFERENCE SYSTEMS	Reference system against which time is measured [ISO 19108;2002(E)].
THEMATIC APPLICATION SCHEMA	INSPIRE application schema for an INSPIRE theme
THEMATIC DATA	Synonymous to application data
THEMATIC IDENTIFIER	A descriptive identifier applied to spatial objects in a defined information theme EXAMPLE an administrative code for administrative area objects in the administrative units theme, a parcel code for parcel objects in the cadastre theme
THEME	Grouping of spatial data according to Annex I, II and III of the INSPIRE Directive
TRANSFER PROTOCOL	Common set of rules for defining interactions between distributed systems [ISO 19118]
UNIQUE OBJECT IDENTIFIER	A piece of data, usually in the form of printable characters, that unequivocally identifies a spatial object
UNITS OF MEASUREMENT	Defined quantity in which dimensioned parameters are expressed [ISO/TC211/N1791].
USE	Information required to access, transfer, load, interpret, and apply the data in the end application where it is exploited (adapted from GSDI Cookbook). Note: This class of metadata often includes the details of a data dictionary, the data organization or schema, projection and geometric characteristics, and other parameters that are useful to human and machine in the proper use of the spatial data.
VERSION	A particular form of something differing in certain respects from other forms of the same type of thing

VERSIONING	Applying a process to ensure that one version of something can be distinguished from another
XML SCHEMA	Means for defining the structure, content and semantics of XML documents

Table 33 - Table of abbreviation

10.8 References

10.8.1 Paper references

No paper documents have been consulted.

10.8.2 Web reference

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10.11 Partner list

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Universitat de Girona	UDG	Spain
Institut Cartogràfic de Catalunya	ICC	Spain
Geographical Information Systems International Group	GISIG	Italy
Földmérési és Távérzékelési Intézet	FÖMI.	Hungary
Regione Liguria	RLIG	Italy
Regione Piemonte	RPIE	Italy
University of Nottingham	UNOTT	United Kingdom
Comune di Genova	CGE	Italy
University Of Rome "La Sapienza"	UNISAP	Italy
Intergraph Polska sp. z o. o.	INGR	Poland
Instituto Geográfico Português	IGP	Portugal
Institut National des Sciences Appliquées de Lyon	INSA	France
INSIEL Informatica per il Sistema degli Enti Locali Spa	INSIEL	Italy
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