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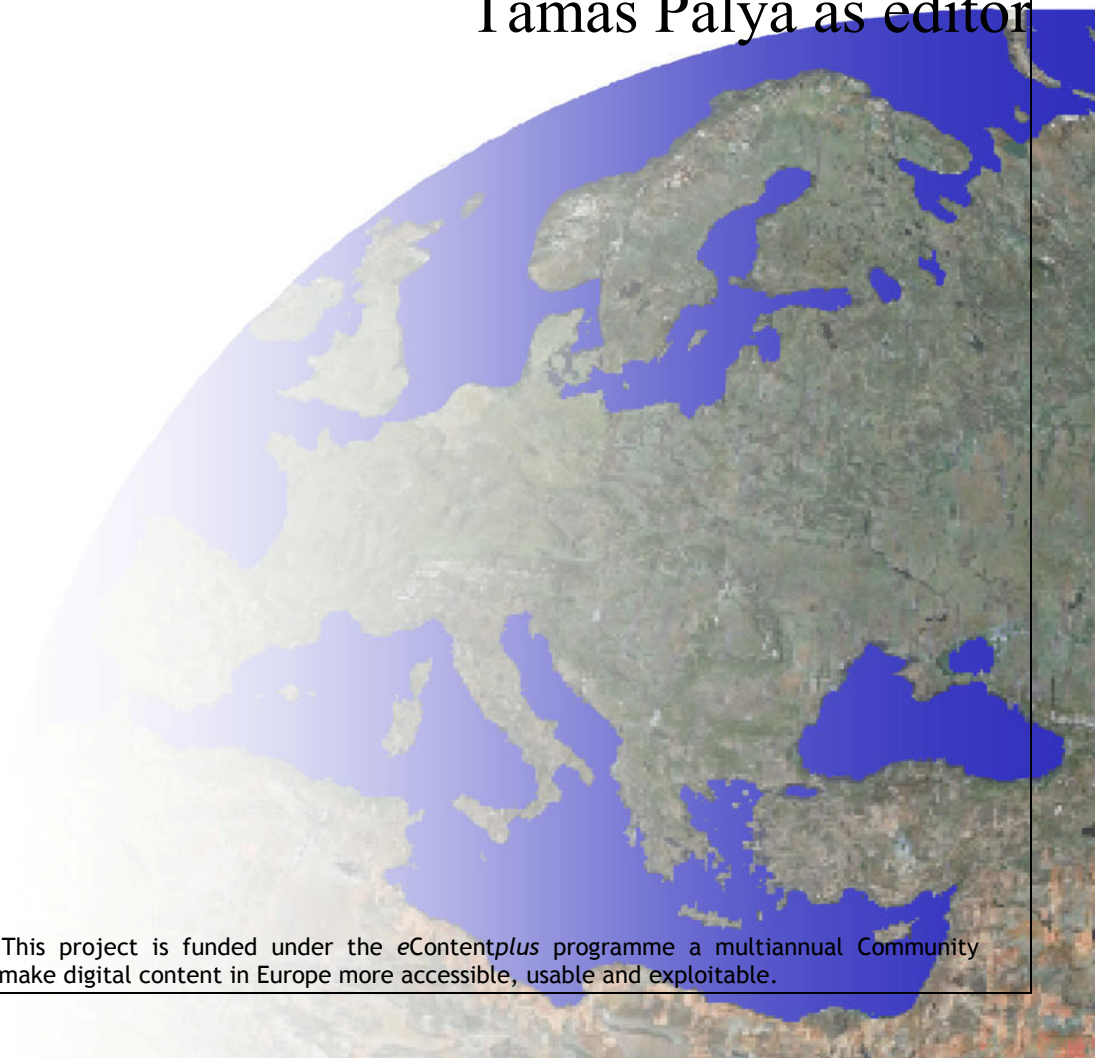
D3.2 Comparison of GIS4EU datasets to INSPIRE Common Data Model -Administrative Units

Tamás Palya as editor



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RESUME

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Table 1-1 - Document classification 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 Administrative Units 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 Administrative Units 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 Administrative Units.

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 Overview of INSPIRE Data Specification "Administrative Units"

4.1 General information

Each national territory is divided into (administrative) units. These units are identified at different levels of national administrative hierarchy, and are separated by administrative boundaries. Administrative boundaries play key role in integration of data coming from national custodians, and are subject to international agreements on best possible spatial resolution for shared geometry.

Administrative units may correspond to the items identified in frame of other territory division systems. The examples of such relationships include, among others, the cadastral parcels, census districts, postal regions, sea regions, statistical units, or sector-specific regions. The administrative division forms an indirect spatial reference system. The reference to an administrative unit provides a spatial dimension to data without using coordinates.

The Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 (INSPIRE, 2007) *establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)*, Annex I, defines the Administrative Units Theme as follows:

"Units of administration, dividing areas where Member States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries. "

This synthetic formal definition was further extended by INSPIRE Drafting Team "Data Specification" with an interpretation of theme content, including the context, informational scope, objectives, and a list of relevant reference material. The overview information, documented in INSPIRE D2.3 *Definition of Annex Themes and Scope* became a starting point to work of INSPIRE Thematic Working Group "Administrative Units", which has resulted in version 1.0 of *INSPIRE Data Specification "Administrative Units"*

The draft INSPIRE *Data Specification "Administrative Units"* [INSPIRE D2.8.1.4/1] does not have formal regulatory meaning, but aims to support definition of Implementing Rules, according to article 7(1) of the INSPIRE Directive. The entire data specification will be published as implementation guidelines accompanying the Implementing Rules.

4.2 Thematic scope of INSPIRE AU theme

The INSPIRE theme 'Administrative units' refers to the official administrative division of areas where Member States have jurisdictional rights. Consequently, cadastral parcels and territorial waters are not considered by European initiative as part of AU theme[1]. The specification does not overlap related systems such as census districts, post office regions and other sector-specific regions. However, the administrative units include direct reference to national statistical units at local level (LAU) and to the Nomenclature of Territorial Units for Statistics (NUTS) in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. Additionally, for the purposes of statistical analyses it can be distinguished between land and water parts of administrative units, and the reference date of the administrative units is included.

The INSPIRE data specification is derived from the *EuroBoundaryMap* specification [EBM, EuroBoundary Map Specification, version 2.0]. This specification has been already used to develop GISCO reference database of European Commission for the Administrative Unit theme, and to publish maps and web services for NUTS, Communes, Sub-communes, Structural Funds, Urban Audit and FADN. The European Environment Agency (EEA) also uses this dataset to relate their environmental information and indicators to the official defined administrative areas in Europe.

[1] in fact, these are the subject to other INSPIRE themes 'Cadastral parcels', 'Hydrography' (Annex I) and/or 'Sea regions' (Annex III).

4.3 Document structure

The draft *INSPIRE Data Specification "Administrative Units"* is structured according to the template for data specifications defined by INSPIRE Data Specification Drafting Team in compliance to ISO 19131:2007 Geographic information – Data product specification. The table of contents refers to the following key sections:

Scope	This section highlights the fact that this specification supports INSPIRE Directive and it refers to the concrete theme (e.g. Administrative Units).
Overview	This statement includes the formal definition of INSPIRE Administrative units theme, the informal description of thematic scope, the information concerning the document creation and maintenance (i.e. metadata about data specification), the list normative references, as well as definition of terms and abbreviations.
Specification scopes	This section provides information on document scope, as defined in ISO 19131. The description might include explanation of scope level, extent and/or coverage. For INSPIRE data specifications, it is recommended that only one general default scope (i.e. "specification scope") is applied.
Data product identification	In this statement it is given the general information on data specification such as the title, list of topic categories, geographic extent of the data, description of spatial resolution, the kind of spatial representation.
Data content and structure	This is the key section of specification containing the application schema requirements according to the Generic Conceptual Model. The schema is presented in a form of UML static diagrams accompanied by the extract from feature catalogue content, and the narrative description. It is also included the requirements for model consistency, managing feature identifiers, and optionally, the requirements for object cross-referencing and geometry and temporality representation.

Reference systems	This statement contains the reference system requirements for data of the theme according to the INSPIRE DS-DT 2.5 Generic Conceptual Model, Clause 12.
Data quality	The optional section provides recommend minimum data quality requirements and the conformity levels to be reported with the metadata of data product.
Metadata	If this optional section is present in data specification, it identifies additional metadata elements, according to the rules described in Clause *18 of INSPIRE DS-DT D2.5 Generic Conceptual Model, v3.0. The theme-specific metadata elements extend the mandatory description of dataset established in* INSPIRE IR for Metadata.
Delivery	This mandatory statement describes allowable data format and transfer medium, in accordance to the draft-implementing rule on download services and the guidelines for the encoding of data (INSPIRE DS-DT 2.7).
Data capture	This optional section describes the selection criteria that data providers shall apply to properly classify various spatial object types as the data serving for the given theme.
Portrayal	If a generally accepted portrayal rule for spatial object types of the themes exists, these should be referenced in this section.

Considering the objectives of GIS4EU Thematic Working Group “Administrative Unit” - Data Model, the sections 4-6 of INSPIRE specification are of particular importance. The summary information on the INSPIRE data structure is given in below.

4.4 Application schema

Section *Document content and structure* of INSPIRE data specification contains the application schema for Administrative Units theme, according to EN-ISO 19109:2006 *Geographic information - Rules for application schema* and the INSPIRE *Generic Conceptual Model* [INSPIRE DS-D2.5]. The application schema specifies requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. All properties have to be reported, if the relevant information is part of the data set.

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema.
featureType	Class	A spatial object type.
dataType	Class	A structured data type without identity.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A flexible enumeration that uses string values for expressing a list of potential values.
voidable	Attribute, association role	A mandatory property of feature that is observed in real world, but may be missing in data set[2]. According to INSPIRE specification, the reason for void value should be provided where possible using a listed value from the VoidValueReason code list i.e. unknown, or unpopulated[3] (see Recommendation 1).
lifeCycleInfo	Attribute, association role	A property considered to be part of the life-cycle information of a spatial object.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

Table 4-1 - Stereotypes used in INSPIRE "Administrative Units" application schema

The INSPIRE application schema is expressed using static diagrams of UML model and constraints expressed in Object Constraint Language, accompanied with narrative description of the schema's content. All the model elements are labelled with stereotype, which can be either <<*applicationSchema*>> (for packages), <<*featureType*>>, <<*dataType*>>, <<*enumeration*>>, or <<*codeList*>>. Other stereotypes present on the diagrams i.e.

[2] Most properties can be reported as "void", if the data set does not include relevant information.
[3] *Unknown* value means that the correct value for the specific spatial object is not known, and not computable by the data provider, e.g. when the "elevation of the water body above the sea level" of a certain lake has not been measured, then the reason for a void value of this property would be 'Unknown'. This value is applied on an object-by-object basis in a spatial data set. The value *Unpopulated* is the same as 'Unknown' with the difference that the property is unknown for all spatial objects of that spatial object type within the spatial data set.

<<*voidable*>>, <<*lifeCycleInfo*>>, and <<*version*>>, support classification and specification of feature properties. The meaning of the stereotypes is shortly explained in Table 4-1. For further information see also Section 5.1 of INSPIRE *Data Specification "Administrative Units"* [INSPIRE D2.8.1.4/1], and the *Generic Conceptual Model* [INSPIRE DS-D2.5].

4.4.1 Schema content

The INSPIRE application schema defines the spatial object type *AdministrativeUnit* as an aggregation of areas covered by an administrative authority. Administrative units may be composed of several different areas like islands, coastal waters and exclaves etc., which are represented by spatial object type *AdministrativeUnitArea*. Administrative units are defined at different levels (number of administrative levels differs from country to country). The spatial object type AdministrativeBoundary defines boundaries of administrative units.

The abstract object type *AdministrativeUnit* is the main type in the diagram and represents administrative units at different levels in the administrative hierarchy. The instantiable specialized spatial object types – *AdministrativeUnitLowestLevel* and AdministrativeUnitUpperLevel - provide the means for describing adminstrative units at lowest level and upper levels of administrative division hierarchy, respectively. Administrative units at higher level aggregate lower level units.

A unit at lowest level consists of one or more administrative areas represented by spatial object type *AdministrativeUnitArea*. If there is only one main area of administrative unit, then the single administrative area object shall be associated to the unit object, and its attribute *administrativeAreaType* shall have value equal to 1, that is "Main area". More area objects can be associated to single unit object in case of complex administrative units having subareas like exclaves, islands, inland water or coastal water.

Each *AdministrativeUnitLowestLevel* can belong to zero or up to three NUTS-regions where a *NUTSregion* is a separate spatial object with a NUTS-code, a label (name), a NUTS level (1,2 or 3) and a country-code. A lowest level administrative unit can then belong to up to 3 NUTS regions of different levels and the NUTS-regions consist of 1 or more lower level administrative units. The spatial extent of a NUTS-region consists therefore of a set of administrative units which is defined in the model as a derived attribute region with spatial type *GM_MultiSurface*. The LAU (code of local administrative unit) is an optional attribute of *AdministrativeUnitLowestLevel*.

AdministrativeUnits make use of common *GeographicalName* type defined in application schema for INSPIRE *Data Specification - Geographical Names* [INSPIRE D2.8.1.3/1] theme, in order to represent the names in different languages and spellings.

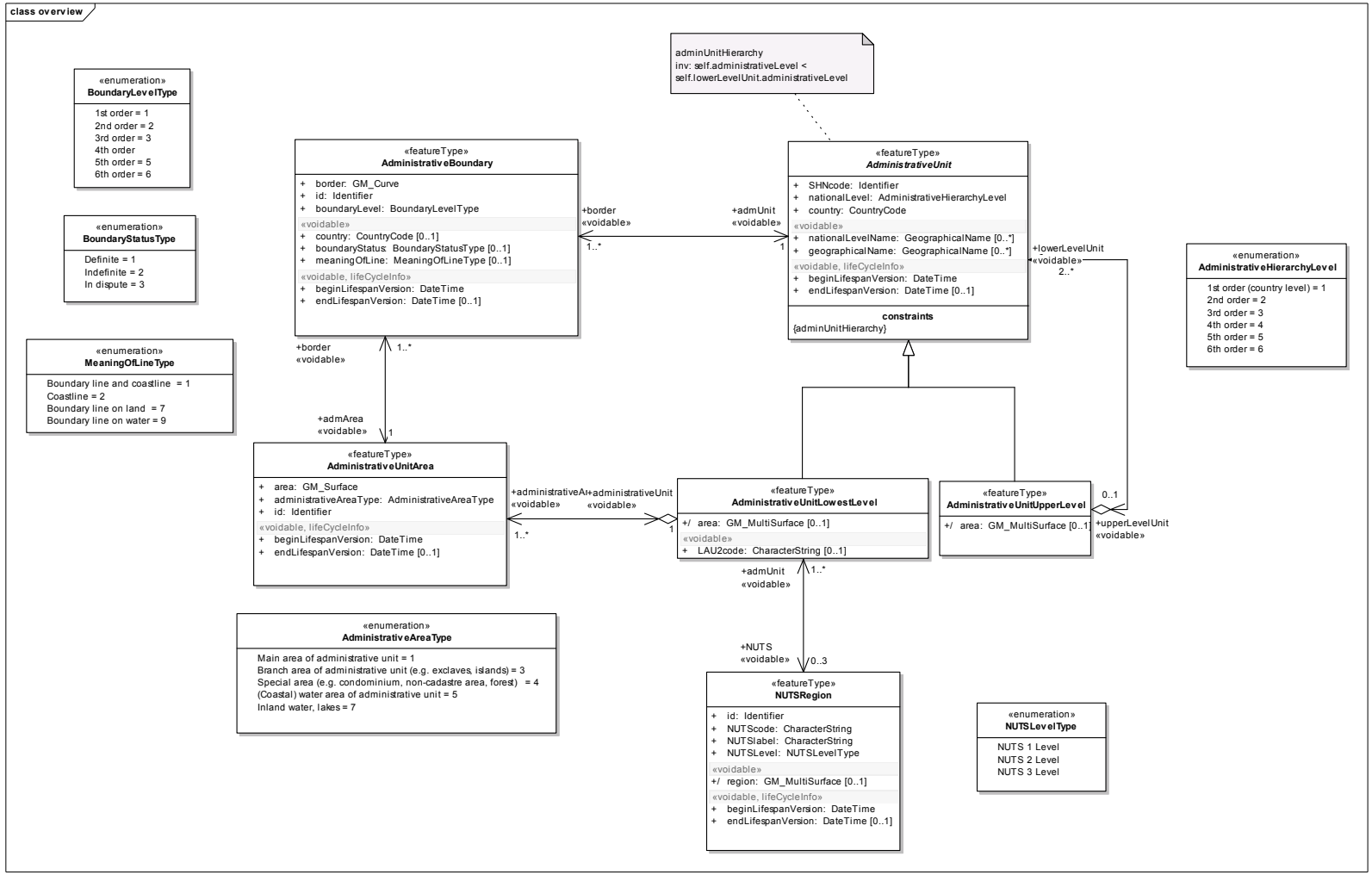


Fig. 1 – Overview of draft INSPIRE Administrative Units application schema

Spatial object type *AdministrativeBoundary* represents boundaries being a part of administrative hierarchy. For each administrative boundary the administrative level, its status and type (meaning) should be stated. The attribute *meaningOfLine* is important in specifying what kind of boundary we are dealing with. Administrative boundaries differ from country to country and the enumeration *MeaningOfLine* describes the different possible kinds of lines that can occur.

4.4.1.1 Spatial representation

According to *Generic Feature Model*, the spatial objects identified in Administrative Units application schema are simple features, as defined in OGC *Simple Feature Access* [OGC document 06-103r3] i.e. their spatial representations are based on 2D geometry with linear interpolation between vertices.

The spatial extent of administrative units is defined by the aggregated geometry of associated *AdministrativeUnitArea* objects (*GM_Surface*). All administrative units have an optional spatial representation, which is derived from the aggregated lower level units or areas (*GM_MultiSurface*).

Considering boundaries, there is no distinction in spatial representation of administrative boundaries and other division (e.g. Coastline) identified between the administrative areas. The *AdministrativeBoundary* is thus any single line (*GM_Curve*) between the administrative areas, which belong to different administrative units.

4.4.1.2 Topological relationships

The spatial objects identified in application schema of *INSPIRE Data Specification "Administrative Units"* do not have topological properties in terms of edges, areas, or solids. Instead, there is defined a set of topological relationships between the administrative units, their areas, and administrative boundaries. The recommended set of relationships for the purposes of data consistency includes:

- The administrative units at the same level of hierarchy must not overlap, i.e. their boundaries must not intersect with boundaries of the same and with other administrative units;
- the gaps between administrative units are in principle not allowed; boundaries of neighbouring administrative units have the same set of coordinates, within the specified resolution;
- the border line that limits the administrative units shall correspond to the geometries representing the boundaries of this administrative unit;

- the area boundaries must not have dangles; boundaries always divide different administrative units;
- the geometry of an administrative unit shall be equivalent to the aggregation of geometries representing administrative areas which belong to this unit;
- the border ring for aggregated administrative areas is equivalent to the boundaries of administrative units to which these areas belong.

4.4.1.3 Temporality representation

The application schema uses the attributes to record the versioning of a spatial object. The attributes *beginLifespanVersion* specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set[4]. The attribute *endLifespanVersion* specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set[5].

According to *INSPIRE Data Specification "Administrative Units"*, if life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "*unknown*".

4.4.1.4 Unique identifiers

According to INSPIRE *D2.5 Generic Feature Model*, each spatial object type has mandatory attribute *identifier* to provide a unique identifier. It is expected that the national or regional authority will allocate this identifier, and it will consists of a namespace and a local id. The pragmatic approach to making it internationally unique is to add a prefix of the Member State identifier[6].

INSPIRE *Data Specification "Administrative Units"* recommends using the European-wide SHN-code for administrative units. The SHN-code is a spatial reference for unambiguous identification of locations established for the purposes of *EuroBoundaryMap*. It was derived from identifiers under national systems and extended with the ISO 3166 country codes for purposes of international uniqueness. The internal structure of SHN identifier follows the belonging relationships between the upper/lower units of national administrative units

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

[5] Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

[6] The maintenance and management of identifiers is out of INSPRE scope, and it might be specific to each Member State.

hierarchy, and allows the same to track from bottom most unit up to its composite top most unit, e.g. municipality Lørenskog (SHN=NO0230) belongs to county Akershus (SHN=NO0200) in Norway (ISO 3166 code=NO).

Additionally it is recommended for Member States to link the national (LAU) codes and the NUTS codes (thematic identifier) for each local administrative unit to ensure interoperability with national and European statistical/thematic information.

4.4.2 Feature catalogue

In section 5.1.2 of draft INSPIRE *data specification* it is provided the draft content of common feature catalogue for Administrative Units theme. The Appendix, Section 10.7 includes the summary of the feature catalogue content, as proposed in INSPIRE document, version 1.0.

4.4.3 Reference systems

INSPIRE *Data Specification "Administrative Units"* follows the requirements and recommendations collected by Coordinate Reference Systems Thematic Working Group. Consequently, for the horizontal component it requires using European Terrestrial Reference System 1989 (ETRS89) for areas linked to the Eurasian tectonic plate. For areas that are not on the stable part of the Eurasian tectonic plate, it requires using the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS. The parameters of the GRS80 ellipsoid shall be used for the computation of latitude and longitude.

For the representation of data in plane coordinates in general applications, it is recommended to use the following projections:

- Lambert Azimuthal Equal Area (ETRS-LAEA) for spatial analysis and display;
- Lambert Conformal Conic (ETRS-LCC) for conformal pan-European mapping at scales smaller or equal to 1:500,000;
- Transverse Mercator (ETRS-TMzn) for conformal pan-European mapping at scales larger than 1:500,000.

For the vertical component, specification requires using of European Vertical Reference System (EVRS). Other vertical reference systems may be used in areas that are outside the geographical scope of EVRS.

In order to deal with temporal aspects, INSPIRE data specification requires Gregorian Calendar for referencing dates and Coordinated Universal Time or local time for referencing time.

4.4.4 Expected applicability

This INSPIRE data specification on Administrative Units theme is to support the following high level use cases:

- Filtering data. A user selects regions (e.g. by clicking or entering a name or code). The geometry of the selected administrative units is used in a query filter when retrieving geographic information (using a download service) or metadata (using a discovery service). This could e.g. be used in verification to identify features located at the border between two administrative units.
- Linking thematic information. To provide users with easy and rapid access to comparable thematic information, data providers link their information to the administrative units.
- Disaster management. The administrative units that are affected by an environmental phenomenon or disaster are selected.
- Boundary based analysis. Verification of data of thematic features located at the boundaries of administrative units. This covers the aspect of edge matching.
- Discovery of unit related data. Search catalogues to discover available data sets with respect to administrative unit geometry or name (or code).

4.5 Development methodology applied

The process of developing INSPIRE data specification followed the "Methodology for the development of data specifications" defined by INSPIRE Data Specification Drafting Team. In general, the methodology identified the following steps:

- 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 accounts the requirements and analysis results.

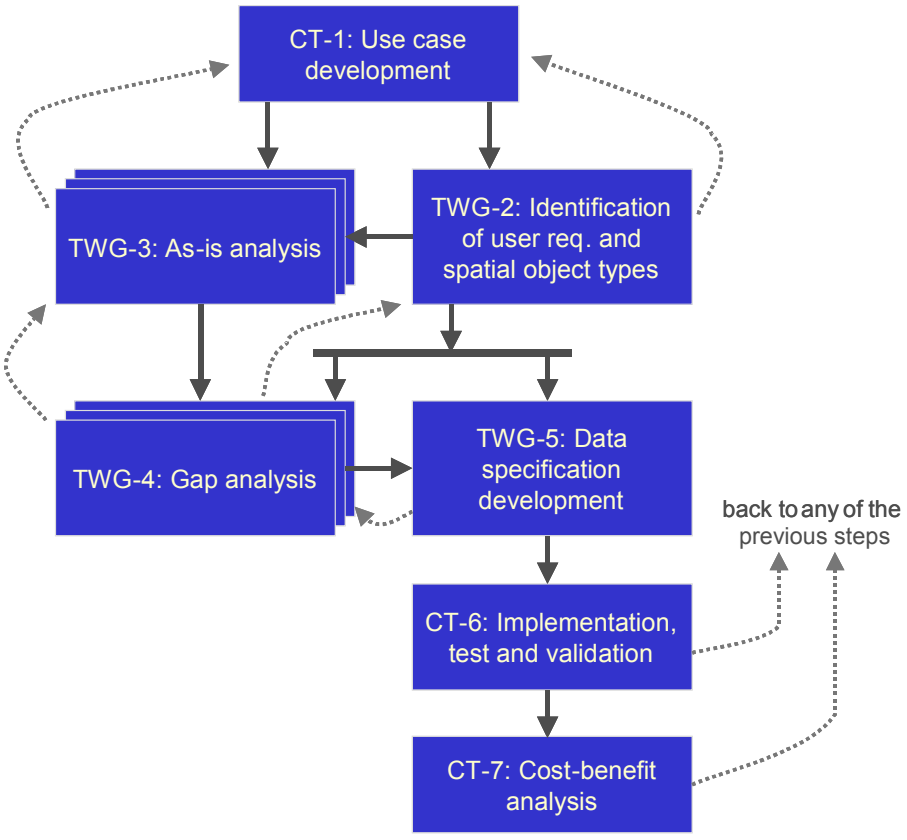


Fig. 2 – Methodology for data specification used in INSPIRE process

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.

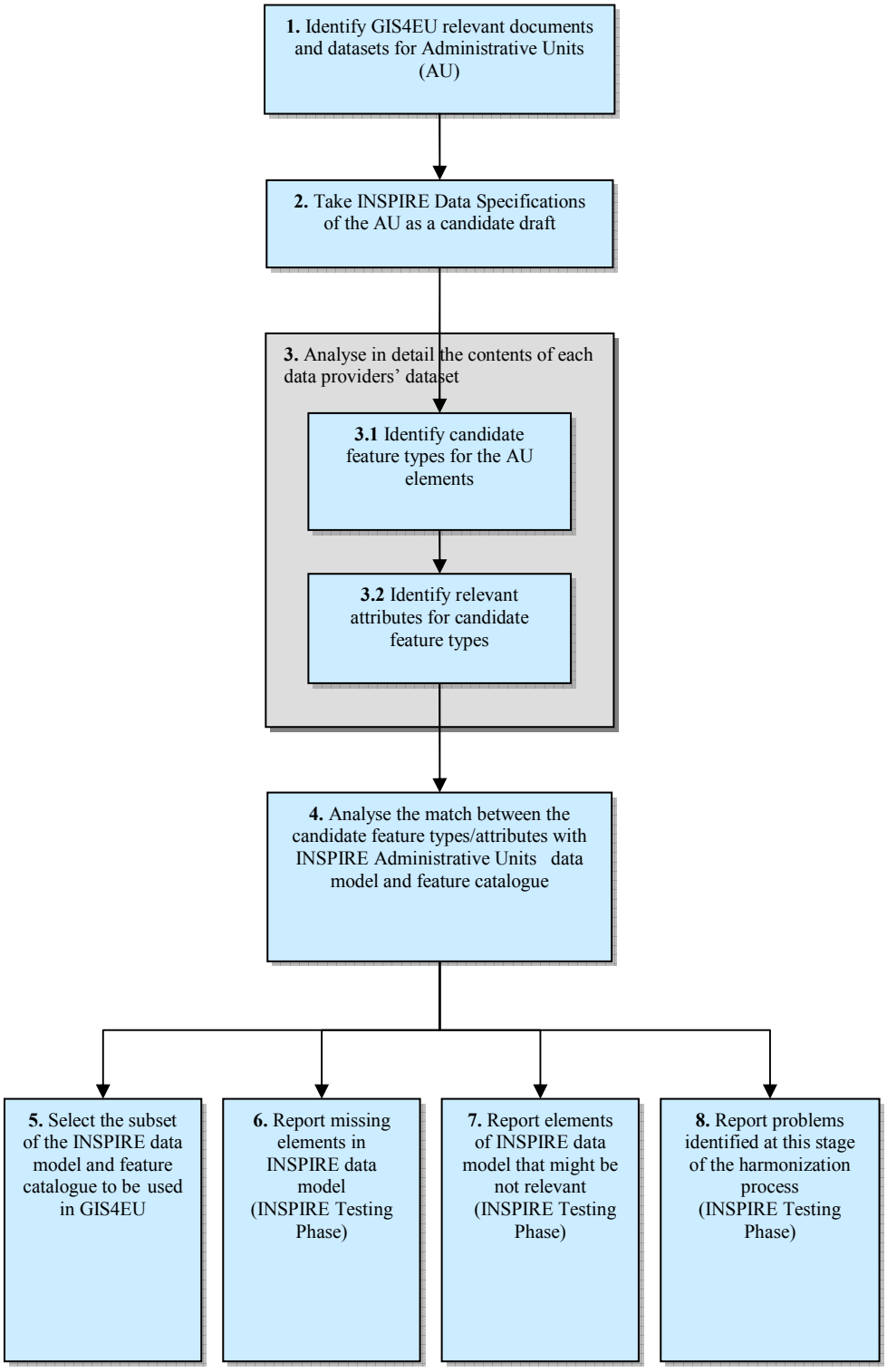


Fig. 3 – Comparative analysis workflow

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 5-1 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 5-1 - 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 Administrative Units 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 4 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 3 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).

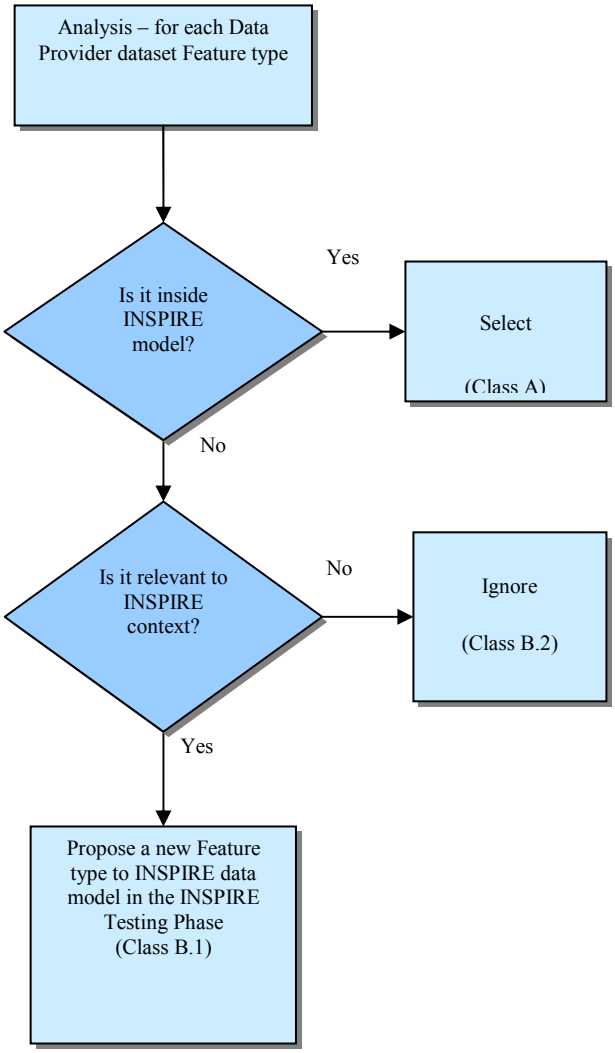


Fig. 4 – Decision flow: Class A and B features and attributes

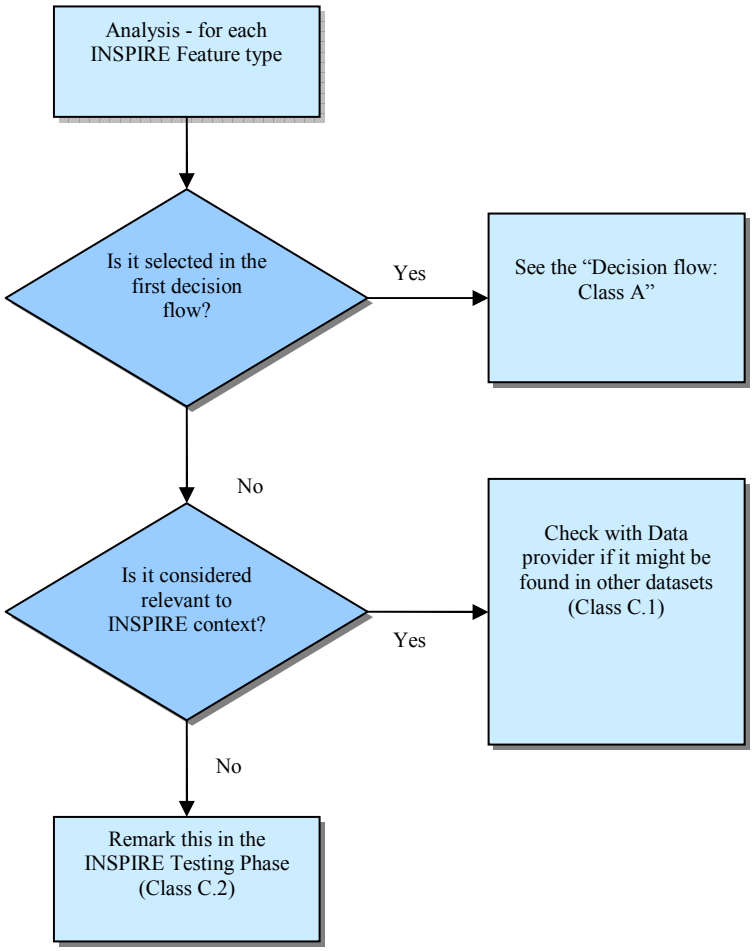


Fig. 5 - Decision flow: Class C features and attributes

6 Comparison of GIS4EU datasets with INSPIRE data model

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.

The GIS4EU available datasets for Administrative Units theme are listed in table 10-1 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. Next, the match between the candidate feature types and attributes with INSPIRE Administrative Units 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. As a summary of the results of the match, the following information is elaborated and presented in this section for each Data provider dataset:

- 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.

Administrative units are regions where member states have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries. An administrative unit is therefore a geographic region within a country and tends to be managed by a local government. Depending on the country, there may be various levels of administrative units for example: municipalities, counties, provinces or states. The GIS4EU data providers and Administrative Units TWG examined descriptions in GIS4EU D2.2 and compared them to the INSPIRE data models. This document provides a report on the comparison.

Spatial extent: The INSPIRE data models cover all countries within the European Union. The GIS4EU datasets cover Italy, Catalonia, Portugal, Hungary and Slovakia.

Data sources: ICC, RLIG, RPIE, FOMI, VUGK, CGE, INSIEL, RVEN and IGP supplied the datasets for analysing. Please see the PARTNER LIST chapter for the full names of project partners.

6.1 Analysis of VUGK Dataset

Critical analysis of the VUGK dataset matching process for Administrative Units

The INSPIRE Administrative units theme is composed by the following feature classes:

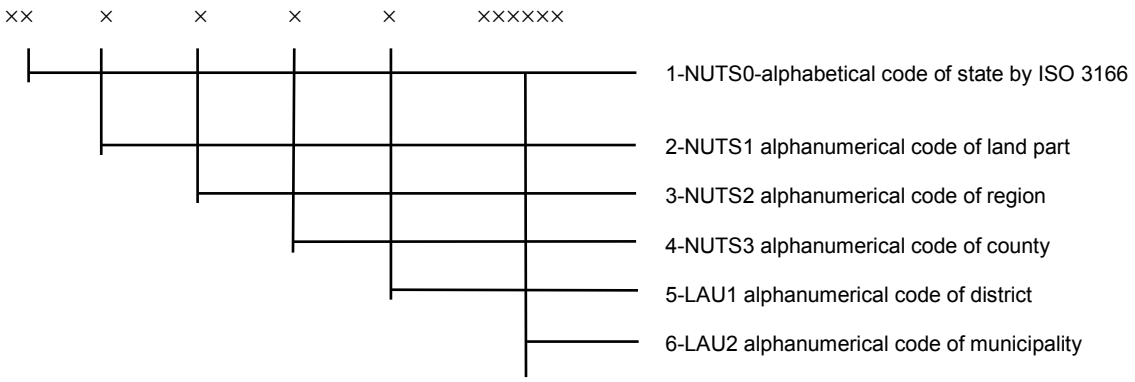
- AdministrativeUnit
- AdministrativeUnitLowestLevel
- AdministrativeUnitUpperLevel
- AdministrativeUnitArea
- AdministrativeBoundary
- NUTSRegion

The VUGK has given to GIS4EU project datasets about Administrative units as SHP, SBX, SBN, PRJ, DBF and XML files:

Stat_Polygon (level 2/NUTS1), Oblast_Polygon (regions - level 3/NUTS2), Kraj_Polygon (counties - level 4/NUTS3), Okres_Polygon (districts - level 5/LAU1/NUTS4), Obec_Polygon (municipalities – the lowest level - level 6/LAU2/NUTS5) and KU_Polygon (Cadastral units – this level is out of scope GIS4EU project, it is only for illustration of area division in Slovak republic – one municipality as the lowest level administrative unit consists of one, in majority cases, but in minority cases of two or more cadastral units, it has historical roots – in merging separate habitations to the bigger ones).

Level 1/NUTS0 is national level – whole area of the country. Because Slovak republic has only one part at level 2/NUTS1, Stat_polygon feature describes both level 1 and level 2 (NUTS0 and NUTS1) – these levels are the same.

We present official NUTS and LAU classification of administrative division in Slovak republic because this is basis for unique SHN coding of administrative units. From structure of this codes results very useful relations and associations.



This max. 12 characters length string is SHN code used in datasets provided by VUGK. As Slovak republic has international code **SK** and only one land part at level 2 with code 0 (NUTS1 level), every code has prefix **"SK0"** follows with 1,2,3 or 9 next characters. SHN's with length 3,4,5,6 and 12 are legal; SHN's with length 7-11 does not exist. Useful relations and associations:

1. if length = 12, **NationalLevel** is 6 and **NationalLevelName** is "Obec" (Municipality).
2. if length = 6, **NationalLevel** is 5, and **NationalLevelName** is "Okres" (District).
3. if length = 5, **NationalLevel** is 4, and **NationalLevelName** is "Kraj" (County).
4. if length = 4, **NationalLevel** is 3, and **NationalLevelName** is "Oblasť" (Region).
5. if length = 3, **NationalLevel** is 2, and **NationalLevelName** is "Územie" (Land).
6. **Country** code is "SK", first 2 characters of SHN.
7. **AdministrativeUnitUpperLeve**l are those, which have SHN length, less or equal to 6.
8. **AdministrativeUnitLowestLeve**l are those which has SHN length equal to 12.
9. **LowerLevelUnits** of any adm. unit at levels 2, 3, 4 are those which have SHN code one character longer and prefix is equal to SHN code of this adm. unit, **LowerLevelUnits** of any adm. unit at level 5 are those which have SHN code length equal to 12 and first six character are equal to SHN code of this adm. unit.
10. **UpperLevelUnit** of any adm. unit at level 3,4,5 is that one which SHN code is equal to SHN of this adm. unit without last character, **UpperLevelUnit** of any adm. unit at level 6 is that which SHN code is equal to SHN code of this adm. unit after cutting last six characters.

These rules were used in matching table and can help in interpretation, derivation and transformation of attributes in provided datasets.

The results of the match with INSPIRE Administrative Units data model are marked with colours in relevant matching table set by VUGK (**Matchingtable_ADMIN_UNITS_VUGK.xls**).

Main differences on the matched features/attributes:

AdministrativeUnit	Not available in VUGK dataset as stand alone class, but data can be derived from provided datasets
AdministrativeUnitLowestLevel	This feature is represented in VUGK dataset with Obec/Municipality (Obec_Polygon.shp). As can be seen in the matching table, some of the attributes can be well matched (class A1), as is the case of *Area, LAU2code, SHNcode* and *GeographicalName*. Some attributes as *UpperLevelUnit, NUTSCode, National Level and Country* can be derived from SHNCode (class A2) and some, for example *AdministrativeBoundary* would need more complex transformation (class A3). Some of INSPIRE data model attributes are not presented in VUGK dataset. Most of them are considered really relevant (class C1). On the other hand, some attributes from VUGK dataset are not presented in INSPIRE data model. Most of them are considered really relevant (class B1).
AdministrativeUnitUpperLevel	This feature is represented in VUGK dataset with Okres/District (Okres_Polygon.shp), Kraj/County (Kraj_Polygon.shp), Oblast/Region (Olast_Polygon.shp) and Stat/Land (Stat_Polygon.shp). As can be seen in the matching table, some of the attributes can be well matched (class A1), as is the case of *Area, SHNcode* and *GeographicalName*. Some attributes as *UpperLevelUnit, NUTSCode, National Level and Country* can be derived from SHNCode (A2) and some, for example *AdministrativeBoundary* would need more complex transformation (A3). Some of INSPIRE data model attributes are not presented in

	VUGK dataset. Most of them are considered really relevant (class C1). On the other hand, some attributes from VUGK dataset are not presented in INSPIRE data model. Most of them are considered really relevant (class B1).
AdministrativeUnitArea	Not available in VUGK dataset as stand alone class, but could be derived from geometry attribute Shape of feature *AdministrativeUnitLowestLevel*
AdministrativeBoundary	Not available in VUGK dataset as stand alone class It could be derived by spatial analysis of shape files because boundary lines between neighbour units have identical points and are integral part of both neighbouring polygons
NUTSRegion	Not available in VUGK dataset as stand alone class. All attributes (both non-geometry and geometry) can be derived from feature *AdministrativeUnitUpperLevel* at level 1, 2, 3, 4 (country, land, region, county) because there is direct relation between NUTS0, NUTS1, NUTS2 and NUTS3 division and administrative division at levels 1, 2, 3 and 4.

After identification and description regarding requirements for the GIS4EU data model we find out that VUGK datasets for Administrative Units theme /see par. 6.1/ are prepared to by include in to the GIS4EU data model and they correspond in structure and content quite well to INSPIRE data model, especially in features:

AdministrativeUnitLowestLevel

AdministrativeUnitUpperLevel

We note the importance of attribute SHNCode, which structure and content allow to derive other attributes – ***nationalLevel***, ***nationalLevelName***, ***country*** and mainly associations among features – ***lower level units***, ***upper unit***.

Also is important to note that provided datasets covered at vertical level all hierarchy levels of administrative unit division and in horizontal level the whole area of Slovak republic.

6.2 Analysis of ICC Dataset

Critical analysis of the ICC dataset matching process for Administrative Units

The INSPIRE Administrative units theme is composed by the following feature classes:

- AdministrativeUnit
- AdministrativeUnitLowestLevel
- AdministrativeUnitUpperLevel
- AdministrativeUnitArea
- AdministrativeBoundary
- NUTSRegion

The ICC has given to GIS4EU project one dataset about Administrative units as SHP files:

bm50mv33lmr09.shp, bm50mv33cmr09.shp, bm50mv33pmr09.shp, bm50mv33pcr09.shp and bm50mv33ppr09.shp.

Main differences on the matched features/attributes:

AdministrativeUnit	Abstract class. Attributes described in subclasses.
AdministrativeUnitLowestLevel	This feature is represented in ICC dataset with Municipalities (bm50mv33pmr09.shp). All the attributes can be matched most of them must be derived performing additional operations. The INSPIRE attribute "upperLevelUnit" only allows to assign one hierarchy; we have chosen the national administration hierarchy in Catalunya.
AdministrativeUnitUpperLevel	3rd order national level. This feature is represented in ICC dataset with Provinces (bm50mv33ppr09.shp). All the attributes can be matched most of them must be derived performing additional operations.

AdministrativeUnitUpperLevel	2nd order national level. The ICC dataset does not have the region that covers Catalunya as a feature. It can be obtained merging the lower level features. It will have only one instance. All the attributes can be matched most of them must be derived performing additional operations.
AdministrativeUnitArea	The ICC dataset does not have the areas components of the municipalities as a feature. They can be obtained decomposing the geometry of the municipalities. All the attributes must be derived performing additional operations.
AdministrativeBoundary	In ICC dataset the boundary lines (bm50mv33lmr09.shp) do not have explicit topology with the administrative units but it can be derived by spatial analysis because the polygons of the administrative units were derived from the geometry of the boundary lines. We assume that the borders must be duplicated between areas at the same or different levels because in the INSPIRE model it is allowed to assign just one area to each boundary. All the attributes must be derived performing additional operations. The INSPIRE attribute “id” is not included in the dataset but it can be build considering GIS4EU requirements.
NUTSRegion	Not available in the ICC dataset. It can be build using Administrative unit upper level. NUTS3 from 3rd order national level and NUTS2 from 2nd order national level. The INSPIRE attribute “id” is not included in the dataset but it can be build considering GIS4EU requirements.

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

- Feature **bm50mv33pcr09** ("Comarques"). In Catalonia there are two administrative units hierarchies.
- Feature **bm50mv33pmr09** / Attribute **SUP_MUNI**. Feature **bm50mv33pcr09** / Attribute **SUP_COMAR**. Feature **bm50mv33ppr09** / Attribute **SUP_PROV**. When it is available we store the "official" surface of the administrative units because it might be different from the calculated from the geometry (precision or resolution of the boundaries, Reference System transformations).
- Feature **AdministrativeUnitUpperLevel** / Attribute cardinality **2-N** of **lowerLevelUnit**. In Spain there are some regions (2nd level) composed of one province (3rd level). So the attribute cardinality might be 1-N.
- Feature **bm50mv33cmr09** (Municipality capitals). Feature **bm50mv33pmr09** / Attribute **CAP_MUNI** and **CAPN_MUNI** and **CAPG_MUNI**. Feature **bm50mv33pcr09 bm50mv33pmr09** / Attribute **CAP_COMAR**. We store the position and name of the capitals of the administrative units.

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

- Feature **bm50mv33pmr09** / Attribute **NOMN_MUNI**. It just facilitates some sorting or searching capabilities.
- Feature **bm50mv33pmr09** / Attribute **NOMG_MUNI**. It just facilitates the graphic representation of the name from this attribute at the nominal scale of the dataset.

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

- Feature **AdministrativeUnitArea**. Feature **AdministrativeBoundary** / Attribute **id**. Feature **NUTSRegion**. Feature **NUTSRegion** / Attribute **id**. They can be built as it has been described.
- Feature **NUTSRegion** / Attribute **NUTSlabel**. Eurostat codelist can be used to match the **NUTScode** with the name.
- Attribute **endLifespanVersion**. Versioning will not be maintained in GIS4EU.

Not relevant features and attributes from INSPIRE data model that are not included in the dataset: None

Major problems found:

- The model allows describing only one hierarchy of administrative units. In Catalonia there are two administrative units hierarchies. One of them is for the national administration (municipality, province, region, country) and the other one is for regional administration (municipality, comarca, region). So that the lowest administrative units have two upper level administrative units.
- Feature **AdministrativeBoundary** / Attribute cardinality **1** of **admArea** and **admUnit**. Where a borderline limits two areas it must be duplicated for each one because it is allowed to assign just one area. The attribute cardinality might be 1-N if the borders might not be duplicated (between areas at the same or different levels).
- Feature **AdministrativeBoundary** / Attribute cardinality **0-1** of **CountryCode**. If the borders were not duplicated on the boundaries between two countries it would not be possible to assign both codes. In this case the attribute cardinality might be 0-2 or any code assigned.

6.3 Analysis of FÖMI Dataset

Critical analysis of the FÖMI dataset matching process for Administrative Units

The INSPIRE Administrative units theme is composed by the following feature classes:

- AdministrativeUnit
- AdministrativeUnitLowestLevel
- AdministrativeUnitUpperLevel
- AdministrativeUnitArea
- AdministrativeBoundary
- NUTSRegion

The FÖMI has given to GIS4EU project 2 dataset about Administrative units as SHP files, which covered 6 km x 4 km territory:

- 52-424_t_region (settlements)
- 52-424_f_region (cadastral units)

This datasets are not suitable for the matching analysis, because it not give a satisfied picture about Administrative system of the whole country.

The results of the match with INSPIRE Administrative Units data model can be found in this file Matchingtable_INSPIRE_ADMIN_UNITS_FOMI.xls.

The following table contents the analysis of the MKH (Hungarian Administrative Boundaries) dataset.

The dataset stands 5 levels of polygons. (It stored in Mapinfo, but we will handle it in ArcGIS next year): A_0.shp, R_0.shp, M_0.shp, K_0.shp, T_0.shp.

Main differences on the matched features/attributes:

AdministrativeUnit	Abstract class. Attributes described in subclasses.
AdministrativeUnitLowestLevel	This feature is represented in FÖMI dataset with Settlements (“Település”) (T_0.shp). All the attributes can be matched most of them must be derived performing additional operations. The SHN code

	derived from Country code (HU) + REGIO_KOD + MEGYE_KOD + KOD + KSH_KOD.
AdministrativeUnitUpperLevel	This feature is represented in FÖMI dataset with Micro regions (“Kistérség”)(K_0.shp). All the attributes can be matched most of them must be derived performing additional operations. The SHN code derived from Country code (HU) + REGIO_KOD + MEGYE_KOD + KOD.
AdministrativeUnitUpperLevel	This feature is represented in FÖMI dataset with Counties (“Megye”) (M_0.shp). All the attributes can be matched most of them must be derived performing additional operations. The SHN code derived from Country code (HU) + REGIO_KOD + MEGYE_KOD.
AdministrativeUnitUpperLevel	This feature is represented in FÖMI dataset with Regions (“Régio”) (R_0.shp). All the attributes can be matched most of them must be derived performing additional operations. The SHN code derived from Country code (HU) + REGIO_KOD.
AdministrativeUnitUpperLevel	This feature is represented in FÖMI dataset with Country (“Ország”) (A_0.shp). All the attributes can be matched most of them must be derived performing additional operations. The SHN code derived from Country code (HU).
AdministrativeUnitArea	Not available in the FÖMI dataset.
AdministrativeBoundary	Not available in the FÖMI dataset.
NUTSRegion	Not available in the FÖMI dataset, but we stored NUTS code, as attribute.

6.4 Analysis of RLIG Dataset

Critical analysis of the RLIG dataset matching process for Administrative Units

The Administrative Unit 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". 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 a 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 INSPIRE Administrative Units theme is composed by the following feature classes:

- AdministrativeUnit
- Administrative Unit lowest level
- Administrative Unit upper level
- Administrative Unit area
- Administrative boundary
- NUTS region

One feature class composes the RLIG Administrative Units theme:

- Comuni_07

The RLIG feature class **"Comuni_07"** matches with INSPIRE feature class **"Administrative Unit area"** (as can be seen in the matching table).

The RLIG field ***ID*** matches with Inspire attributes ***Identifier*****.**

A.2: the RLIG attribute ***TIPO_AREA*** matches with Inspire attributes ***AdministrativeAreaType*** and ***LandCoverType*****.**

TIPO_AREA is an enumeration field and its possible values are:

- Sede Comunale
- Isola Amministrativa

- Zona in Contestazione
- Area partizione in Comunita Montana
- Isola Lacuale o Marina
- Sede Comunale

The values “Sede Comunale, Isola Amministrativa, Zona in Contestazione, Area partizione in Comunita Montana” matches with Inspire attribute ***AdministrativeAreaType***.

The values “ Isola Lacuale o Marina, Sede Comunale” matches with Inspire attribute ***LandCoverType***.

C.1: in the INSPIRE feature are present the attributes ***BeginLifespanVersion*** and ***EndLifespanVersion*** for the multitemporal feature. The RLIG does not implement the multitemporal features, but only monotemporal features, so these attributes aren’t relevant for RLIG dataset.

RLIG manage the multitemporal aspect with different layers and not with attributes.

C.1: the INSPIRE field ***Border*** isn’t present in the RLIG dataset and isn’t relevant for the RLIG Model.

B.2: the RLIG fields ***ORIGINE***, ***NOME***, ***CODICE_ISTAT***, ***CODICE_ISTAT_PROV***, ***CODICE_ISTAT_REG***, ***CODICE_CM*** aren’t present in the Inspire model and aren’t relevant for the Inspire directive.

6.5 Analysis of RPIE Dataset

Critical analysis of the RPIE dataset matching process for Administrative Units

The RPIE datasets for Administrative Units contain a few informations; in fact each dataset has only three features.

All the feature classes present in RPIE datasets are similar in structure and contain the same information.

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

There are two common attributes that are not present in INSPIRE data model (**ISTAT code, SIGLA**):

- the first one (in each case CODICE_IST, PROV and ISTAT) could be relevant for the INSPIRE directive (B1). This attribute is similar of NUTScode "code of statistical region that corresponds to the administrative unit"
- the second one (SIGLA) is considered not to be relevant for the INSPIRE directive (B2) because is only for internal use.

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

The dataset information is, at the moment, enough for the requirements for which it was created.
At this time it is hard to understand if the Inspire feature will can insert into the new dataset.

6.6 Analysis of CGE Dataset

Critical analysis of the CGE dataset matching process for Administrative Units

The area of territorial jurisdiction of CGE contains, obviously, a unit Municipality.

CTC1000/cCTC2000 dataset provided by the Municipality of Genoa (CGE) contain only the Municipal boundaries. Other administrative boundaries refer to sub-municipal administrative areas, which are not relevant in the Inspire context.

As indicated in the matching table, the most important attributes of administrative boundary matched very well with the Inspire model.

6.7 Analysis of IGP Dataset

Critical analysis of the IGP dataset matching process for Administrative Units

The INSPIRE Administrative units theme is composed by the following feature classes:

- AdministrativeUnit
- AdministrativeUnitLowestLevel
- AdministrativeUnitUpperLevel
- AdministrativeUnitArea
- AdministrativeBoundary
- NUTSRegion

Concerning to Portuguese Administrative Boundaries Official Map – CAOP, IGP has given to GIS4EU project a dataset about Administrative units as SHP files:

- Cont_freg_V6_HG73. Shp
- Cont_freg_V6_HGLX. SHP
- arqacores_gcentral_freg.Shp
- arqacores_gocidental_freg.Shp
- arqacores_goriental_freg.Shp
- arqmadeira_freg.Shp

The results of the match with INSPIRE Administrative Units data model are marked with colours in Matchingtable_ADMIN_UNITS_FINAL2.xls.

Main differences on the matched features/attributes:

AdministrativeUnit	Not in the Matching Table
AdministrativeUnitLowestLevel	This feature is represented in IGP dataset with **FREGUESIA**. Some of the attributes can be matched, as is the case of *Area, UpperLevelUnit, SHNcode* and *geographicalName*. Some attributes from INSPIRE data model are not present in IGP dataset and some of them are very important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion. Some attributes from IGP dataset are not present in INSPIRE data model and they are important too, like Fonte2007 (the data source).
AdministrativeUnitUpperLevel	This feature is represented in IGP dataset with **CONCELHO**. As can be seen in the matching table, some of the attributes can be well matched, as is the case of *Area, lowerLevelUnit, SHNcode* and *geographicalName*. Some attributes from INSPIRE data model are not present in IGP dataset and some of them are very important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion. Some attributes from IGP dataset are not present in INSPIRE data model and they are important too, like NUM_FREGUE (number of parishes) or ALT_MAX and ALT_MIN (Maximum and minimum altitude of the municipality).
AdministrativeUnitUpperLevel	This feature is represented in IGP dataset with **DISTRITO**. As can be seen in the matching table, some of the attributes can be well matched, as is the case of *Area, lowerLevelUnit SHNcode* and *geographicalName*. Some attributes from INSPIRE data model are not present in IGP dataset and some of them are very

	important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion. Some attributes from IGP dataset are not present in INSPIRE data model and they are important too, like NUM_FREGUE (number of parishes) or NUM_CONCE (number of municipalities).
AdministrativeUnitUpperLevel	This feature is represented in IGP dataset with **NUT3**. Some of the attributes can be well matched, as is the case of *Area*, *lowerLevelUnit* *SHNcode* and *geographicalName*. Some attributes from INSPIRE data model are not present in IGP dataset and some of them are very important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion. Some attributes from IGP dataset are not present in INSPIRE data model and they are important too, like NUM_FREGUE (number of parishes).
AdministrativeUnitUpperLevel	This feature is represented in IGP dataset with **NUT2**. As can be seen in the matching table, some of the attributes can be well matched, as is the case of *Area*, *lowerLevelUnit* *SHNcode* and *geographicalName*. Some attributes from INSPIRE data model are not present in IGP dataset and some of them are very important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion. Some attributes from IGP dataset are not present in INSPIRE data model and they are important too, like NUM_FREGUE (number of parishes).
AdministrativeUnitUpperLevel	This feature is represented in IGP dataset with **NUT1**. Some of the attributes can be well matched, as is the case of *Area*, *lowerLevelUnit* *SHNcode* and *geographicalName*. Some attributes from INSPIRE data

	model are not present in IGP dataset and some of them are very important like for instance NationalLevelName and beginLifespanVerson or endLifespanVersion.
AdministrativeUnitArea	Not in the Matching Table
AdministrativeBoundary	Not in the Matching Table
NUTSRegion	This feature is in our dataset as attribute in features AdministrativeUnitLowest/UpperLevel.

6.8 Analysis of INSIEL Dataset

Critical analysis of the INSIEL dataset matching process for Administrative Units

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

All the feature class presents in INSIEL datasets are similar, which contain the same information.

There are two common attributes that are not present in INSPIRE data model (PERIM_ml, AREA_mq): these are considered not to be relevant for the INSPIRE directive, as deductible through cartographic operations (B2);

Otherwise, the following ones could be relevant for the INSPIRE directive (B1):

COD_CM: Mountain Community Code for the feature DbPrior_0804_Comunità_montane;

COD_ISTAT: Istat Municipality Code for the feature DbPrior_0802_Provincia

Are similar attributes of NUTScode “code of statistical region that corresponds to the administrative unit” of feature DbPrior_0801_Comune

Analysis of relevant features and attributes from INSPIRE data model dataset that are not included in the dataset: nothing.

6.9 Analysis of RVEN Dataset

Critical analysis of the RVEN dataset matching process for AU

The INSPIRE Administrative Units theme is composed by the following feature classes:

- AdministrativeUnit
- Administrative unit lowest level
- Administrative unit upper level
- Administrative unit area
- Administrative boundary
- NUTS region

The RVEN dataset provided by “Regione del Veneto” corresponds to a simplified database which aim is to provide basic reference data for spatial applications. It contains four feature classes:

Three of these are polygons (Regione, Provincia, Comune)

One is lines (C_Stato).

In the feature classes Regione, Provincia, Comune we don’t consider the border type; the border has the same shape for every feature.

The C_Stato feature is only a line.

Main differences on the matched features/attributes:

AdministrativeUnit	This feature class is not implemented in RVEN data model
AdministrativeUnitLowestLevel	This feature is represented in RVEN dataset with C0104011_Comuni and only matches the Attribute NUTScode, SHNcode and geographicalName with COD_ISTAT, PROVINCIA and NOMCOM. RVEN dataset use also the features PERIMETER and AREA (perimeter and surface) that are not implemented in INSPIRE model, so has been classified as B2 class.
AdministrativeUnitUpperLevel	This feature is represented in RVEN dataset with C0104031_Province and only matches the Attribute SHNcode and geographicalName with PROVINCIA and NOME that match Inspire model in class A1. RVEN dataset use also the features PERIMETER and AREA (perimeter and surface) that are not implemented in INSPIRE model, so has been classified as B2 class and CODISTAT for class B1. RVEN dataset for this feature match inspire model with the feature C0104031_Regione too with the attributes AREA, CODISTAT and NOME, respectively with the INSPIRE model Attributes area, SHNcode and geographicalName all matching in class A1
AdministrativeUnitArea	This feature class is not implemented in RVEN data model.
AdministrativeBoundary	This feature class is implemented RVEN data model with the C0104052_Stato feature with the attributes ID1 and CODICE50 that match in class A1 id and country in the INSPIRE model
NUTSRegion	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.

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.

7 Critical analysis of the matching process at theme level

INSPIRE *Data Specification " Administrative Units"*, version 1.0 identifies five instantiable feature classes: AdministrativeUnitLowestLevel, AdministrativeUnitUpperLevel, AdministrativeUnitArea, AdministrativeBoundary, and NUTSRegion. According to cardinality constraints embedded in the model, the following relationships between the model elements apply:

- each instance of AdministrativeUnitLowestLevel has a border composed of one or more instances of AdministrativeBoundary, and its area is spatially decomposed onto one or more areas (instances of AdministrativeUnitArea);
- the information about lowest level admnistrative unit shall include unit identifier in a form of SHN code, its level in administrative hierarchy, code of the country it is part of, the date it has been established, the reference to its administrative boundary(ies), and the reference to its administrative unit area(s);
- the boundary information shall be at minimum composed of: identifier, geometric linear representation, its level in administrative hierarchy, the date it has been established, the reference to one administrative unit and one unit area it distinguishes from other part of territory;
- the unit area information shall include: identifier, label explaining its type with respect to other areas distinguished within administrative units, geometric area representation, the date it has been established, the reference to one administrative unit it belongs to, and the reference administrative boundary(ies) surrounding it.

Table 7-1 presents the summary information on mandatory and optional elements of INSPIRE draft model. The rows representing mandatory elements are highlighted.

The critical analysis of datasets available in GIS4EU project, in particular – the matching tables – has figured out the degree of adaptability of existing geographic data structures to the AU concepts proposed for INSPIRE initiative. Bellow it is given the summary of GIS4EU matching results. It is highlighted the following issues:

- the elements of INSPIRE model for which it is possible to find correspondence in original dataset structures;
- the significant elements of original dataset structures, which are not covered by INSPIRE data model,

- the elements of INSPIRE data model, which are not represented in GIS4EU datasets;
- other issues noticed in draft INSPIRE Data Specification „Administrative Units" Theme

FEATURE CLASS: AdministrativeUnitLowestLevel		
PROPERTIES	**DOMAIN**	**CARDINALITY**
area	<<DataType>> GM_MultiSurface	Optional [0..1]
LAU2code	<<DataType>> CharacterString	Optional [0..1]
SHNcode	<<DataType>> Identifier	**Mandatory [1]**
nationalLevel	<<Enumeration>>AdministrativeHierarchyLevel	**Mandatory [1]**
nationalLevelName	<<DataType>> GeographicalName	Optional [0..N]
country:	<<Enumeration>> CountryCode	**Mandatory [1]**
geographicalName	<<DataType>> GeographicalName	Optional [0..N]
beginLifespanVersion	<<DataType>> DateTime	**Mandatory [1]**
endLifespanVersion	<<DataType>> DateTime	Optional [0..1]
border	<<FeatureType>> AdministrativeBoundary	**Mandatory [1..N]**
administrativeArea	<<FeatureType>> AdministrativeUnitArea	**Mandatory [1..N]**
upperLevelUnit	<<FeatureType>> AdministrativeUnitUpperLevel	Optional [0..1]
NUTScode	<<FeatureType>> NUTSRegion	Optional [0..3]
FEATURE CLASS: AdministrativeUnitUpperLevel		
PROPERTIES	**DOMAIN**	**CARDINALITY**
area	<<DataType>> GM_MultiSurface	Optional [0..1]
SHNcode	<<DataType>> Identifier	**Mandatory [1]**
nationalLevel	<<Enumeration>> AdministrativeHierarchyLevel	**Mandatory [1]**
nationalLevelName	<<DataType>> GeographicalName	Optional [0..N]
country:	<<Enumeration>> CountryCode	**Mandatory [1]**
geographicalName	<<DataType>> GeographicalName	Optional [0..N]
beginLifespanVersion	<<DataType>> DateTime	**Mandatory [1]**

endLifespanVersion	<<DataType>> DateTime	Optional [0..1]
border	<<FeatureType>> AdministrativeBoundary	**Mandatory [1..N]**
lowerLevelUnit	<<Abstract, FeatureType>> AdministrativeUnit	**Mandatory [2..N]**
upperLevelUnit	<<FeatureType>> AdministrativeUnitUpperLevel	Optional [0..1]
FEATURE CLASS: AdministrativeUnitArea		
PROPERTIES	**DOMAIN**	**CARDINALITY**
area	<<DataType>> GM_Surface	**Mandatory [1]**
administrativeAreaType	<<Enumeration>> AdministrativeAreaType	**Mandatory [1]**
id	<<DataType>> Idenitifier	**Mandatory [1]**
beginLifespanVersion	<<DataType>> DateTime	**Mandatory [1]**
endLifespanVersion	<<DataType>> DateTime	Optional [0..1]
border	<<FeatureType>> AdministrativeBoundary	**Mandatory [1..N]**
administrativeUnit	<<FeatureType>> AdministrativeUnitLowestLevel	**Mandatory [1]**
FEATURE CLASS: AdministrativeBoundary		
PROPERTIES	**DOMAIN**	**CARDINALITY**
border	<<DataType>> GM_Curve	**Mandatory [1]**
id	<<DataType>> Idenitifier	**Mandatory [1]**
country	<<Enumeration>> CountryCode	Optional [0..1]
boundaryLevel	<<Enumeration>> BoundaryLevelType	**Mandatory [1]**
boundaryStatus	<<Enumeration>> BoundaryStatusType	Optional [0..1]
meaningOfLine	<<Enumeration>> MeaningOfLineType	Optional [0..1]
beginLifespanVersion	<<DataType>> DateTime	**Mandatory [1]**
endLifespanVersion	<<DataType>> DateTime	Optional [0..1]
admArea	<<FeatureType>> AdministrativeUnitArea	**Mandatory [1]**
admUnit	<<Abstract, FeatureType>> AdministrativeUnit	**Mandatory [1]**
FEATURE CLASS: NUTSRegion		

PROPERTIES	DOMAIN	CARDINALITY
region	<<DataType>> GM_MultiSurface	Optional [0..1]
id	<<DataType>> Idenitifier	**Mandatory [1]**
NUTScode	<<DataType>> CharacterString	**Mandatory [1]**
NUTSlabel	<<DataType>> CharacterString	**Mandatory [1]**
NUTSLevel	<<Enumeration>> NUTSLevelType	**Mandatory [1]**
beginLifespanVersion	<<DataType>> DateTime	**Mandatory [1]**
endLifespanVersion	<<DataType>> DateTime	Optional [0..1]
admUnit	<<FeatureType>> AdministrativeUnitLowestLevel	**Mandatory [1..N]**

Table 7-1 – Mandatory and optional attributes of INSPIRE feature classes

7.1 Corresponding elements of INSPIRE model

Matching tables prepared by Data Providers show that all datasets include a special structure(s) to store administrative units. These structures basically include geographical name, unique identifier and areal geometric representation of administrative units. However, it is rather rare that the data stored for the units include mandatory information, as considered in INSPIRE Data Specification. In particular, none of datasets identify nationalLevel, countryCode. The begin lifespan version of administrative unit has its explicit correspondence in FOMI dataset. Since it is mandatory attribute of all INSPIRE features, ICC has suggested to use the date of database creation to overcome this specific incompliance problem.

The situation concerning classification of features with respect to hierarchical levels into lowest and upper level units is also not so evident in datasets operated in GIS4EU project. Even all national conceptual models serving for the background of dataset implementations consider levelled organization of territory and differentiate between upper and lower level units, such information is rarely explicitly encoded into the dataset schema. The INTESA based Italian datasets (INSIEL, RPIE, RVEN), as well as ICC; VUGK and FOMI datasets define separate tables to deal with administrative unit data at particular levels of administrative hierarchy. In turn, IGP dataset includes only lowest level units; upper level units can be derived based on hierarchically structured unit codes and spatial merge of lowest level units matching the code based search criteria for particular upper level unit.

However, only the ICC and VUGK databases store attribute-based reference (foreign key) to upper level units, and there is no dataset that includes references from upper level units to lower level units. None of analysed datasets provides explicit reference from administrative units to administrative boundaries and unit areas. Consequently, this information has to be derived based on spatial analyses in order to meet the logical constraints of INSPIRE model.

Draft INSPIRE Data Specification provides separate feature class to represent administrative boundaries. However, for majority of datasets provided in GIS4EU project administrative boundaries are the subjects of spatial analyses rather than individually represented feature. Only two of ten datasets, ICC and RVEN, define separate table for storing boundary information.

Draft INSPIRE *Data Specification "Administrative Units"* provides separate feature class *AdministrativeUnitArea* to represent areas differentiated within administrative unit. Only RLIG has defined direct correspondence between*AdministrativeUnitArea* and its database feature class, and ICC has identified the means for deriving mandatory information on unit areas. In other cases main areas of administrative units will have to be derived based on administrative unit geometry and other non-spatial properties.

Table 7-2 shows the summary representation of INSPIRE features and their attributes in the ten datasets analysed in GIS4EU project: ICC, IGP, INSIEL, RVEN, RPIE, RLIG, VUGK, CGE, and FOMI. Column "PRESENCE" in the table includes the number of datasets with explicitly stated correspondence to INSPIRE feature attributes.

FEATURE CLASS: AdministrativeUnitLowestLevel			
PROPERTIES	**DOMAIN**	**CARDINALITY**	**PRESENCE**
area	<<DataType>> GM_MultiSurface	Optional [0..1]	8/9
LAU2code	<<DataType>> CharacterString	Optional [0..1]	3/9
SHNcode	<<DataType>> Identifier	Mandatory [1]	6/9
nationalLevel	*<<Enumeration>> AdministrativeHierarchyLevel*	*Mandatory [1]*	*0/9*
nationalLevelName	*<<DataType>> GeographicalName*	*Optional [0..N]*	*0/9*
country	*<<Enumeration>> CountryCode*	*Mandatory [1]*	*0/9*
geographicalName	<<DataType>> GeographicalName	Optional [0..N]	7/9
beginLifespanVersion	*<<DataType>> DateTime*	*Mandatory [1]*	*1/9*

endLifespanVersion	*<<DataType>> DateTime*	*Optional [0..1]*	*0/9*
border	*<<FeatureType>> AdministrativeBoundary*	*Mandatory [1..N]*	*0/9*
administrativeArea	*<<FeatureType>> AdministrativeUnitArea*	*Mandatory [1..N]*	*0/9*
upperLevelUnit	<<FeatureType>> AdministrativeUnitUpperLevel	Optional [0..1]	2/9
NUTScode	<<FeatureType>> NUTSRegion	Optional [0..3]	4/9
FEATURE CLASS: AdministrativeUnitLUpperLevel			
PROPERTIES	**DOMAIN**	**CARDINALITY**	**PRESENCE**
area	<<DataType>> GM_MultiSurface	Optional [0..1]	3/9
SHNcode	<<DataType>> Identifier	Mandatory [1]	5/9
nationalLevel	*<<Enumeration>> AdministrativeHierarchyLevel*	*Mandatory [1]*	*0/9*
nationalLevelName	*<<DataType>> GeographicalName*	*Optional [0..N]*	*0/9*
country	*<<Enumeration>> CountryCode*	*Mandatory [1]*	*0/9*
geographicalName	<<DataType>> GeographicalName	Optional [0..N]	6/9
beginLifespanVersion	*<<DataType>> DateTime*	*Mandatory [1]*	*1/9*
endLifespanVersion	*<<DataType>> DateTime*	*Optional [0..1]*	*0/9*
border	*<<FeatureType>> AdministrativeBoundary*	*Mandatory [1..N]*	*0/9*
lowerLevelUnit	*<<Abstract, FeatureType>> AdministrativeUnit*	*Mandatory [2..N]*	*0/9*
upperLevelUnit	*<<FeatureType>> AdministrativeUnitUpperLevel*	*Optional [0..1]*	*0/9*
FEATURE CLASS: AdministrativeUnitArea			
PROPERTIES	**DOMAIN**	**CARDINALITY**	**PRESENCE**
area	<<DataType>> GM_Surface	Mandatory [1]	2/9
administrativeAreaType	<<Enumeration>> AdministrativeAreaType	Mandatory [1]	2/9
id	<<DataType>> Idenitifier	Mandatory [1]	1/9

beginLifespanVersion	*<<DataType>> DateTime*	*Mandatory [1]*	*0/9*
endLifespanVersion	*<<DataType>> DateTime*	*Optional [0..1]*	*0/9*
border	*<<FeatureType>> AdministrativeBoundary*	*Mandatory [1..N]*	*0/9*
administrativeUnit	*<<FeatureType>> AdministrativeUnitLowestLevel*	*Mandatory [1]*	*0/9*
FEATURE CLASS: AdministrativeBoundary			
PROPERTIES	**DOMAIN**	**CARDINALITY**	**PRESENCE**
border	<<DataType>> GM_Curve	Mandatory [1]	2/9
id	<<DataType>> Idenitifier	Mandatory [1]	2/9
country	*<<Enumeration>> CountryCode*	*Optional [0..1]*	*0/9*
boundaryLevel	<<Enumeration>> BoundaryLevelType	Mandatory [1]	1/9
boundaryStatus	*<<Enumeration>> BoundaryStatusType*	*Optional [0..1]*	*0/9*
meaningOfLine	<<Enumeration>> MeaningOfLineType	Optional [0..1]	1/9
beginLifespanVersion	*<<DataType>> DateTime*	*Mandatory [1]*	*0/9*
endLifespanVersion	*<<DataType>> DateTime*	*Optional [0..1]*	*0/9*
admArea	*<<FeatureType>> AdministrativeUnitArea*	*Mandatory [1]*	*0/9*
admUnit	*<<Abstract, FeatureType>> AdministrativeUnit*	*Mandatory [1]*	*0/9*

Table 7-2 – Summary representation of INSPIRE features and feature attributes in GIS4EU collection of analysed datasets

7.2 Report of missing elements in INSPIRE data model

The analysis of data content has evidenced a fact that some Data Providers (ICC, VUGK, RVEN, INSIEL) consider as important to store information about the surface (in square meters) of an administrative units, and/or the boundary lengths. The decision is argumented with a need for providing precise „official" values established at national level, which might be different from the ones derived from geometries.

The ICC dataset includes also information on the capitals of administrative units, thus enhancing searching and localizing of administrative unit authorities.

Table 7-3 provides the summary of elements, which are present in datasets available for GIS4EU project, but not present in INSPIRE model.

7.3 Elements of INSPIRE data model not present in datasets

Based on comparison of analysis results and matching tables provided by Data Providers it can be noticed the following facts:

- none of the dataset structure distinguishes separate feature class corresponding to NUTS Region feature class of INSPIRE model; the information on the region of statistics is eventually represented as an attribute of administrative units (ICC, INSIEL, RPIE, RVEN);
- the mandatory attributes country and national Level of administrative units are not stored in datasets; these have to be completed during remodelling process;
- country code of administrative boundaries is not stored in analysed datasets;
- no dataset includes explicit reference from administrative units to administrative boundaries and the areas identified within the unit. Considering that these references are mandatory in draft INSPIRE model, these relationships have to be defined in remodelling phase.

ICC	CGE	IGP	INSIEL	RLIG	RPIE	RVEN	VUGK	FOMI
AdministrativeUnitLowestLevel								
Name of the municipality standardized with the article in the end, separated by comma (NOMN_MUNI)		Area in hectares (AREA2007HA)	Perimeter in linear meters (PERIM_ml)	CODICE_ISTAT		Perimeter in linear meters (PERIMETER)	Area in square meters (Shape_Area)	Area in hectares (TERULET_HA)
NOM_MUNI with jump of line indicator ("\") to facilitate the graphic representation of the name from this attribute (NOMG_MUNI)			Surface in square meters (AREA_mq)			Surface in square meters (AREA)	Length of boundary in m (Shape_Leng)	Type of Municipality -Main or branch area (JELLEG)
Official name of the capital of the municipality (CAP_MUNI)								Census data
Name of the capital of the municipality standardized with the article in the end, separated by comma (CAPN_MUNI)								Status according by law - approved or not approved. (ÁLLAPOT)
CAP_MUNI with jump of line indicator ("\") to facilitate the graphic representation of the name from this attribute (CAPG_MUNI)								
Surface of the municipality								

(SUP_MUNI)								
Indication the origin of the value of SUP_MUNI (OPSUP_MUNI)								
AdministrativeUnitLUpperLevel								
Location of comarca or province capital (SHPGeometry)			Istat Municipality Code (COD_ISTAT) or Mountain Community Code (COD_CM)	CODICE_ISTAT_PROV	Istat Municipality Code (PROV) or Istat Region Code (CODICE_IST)	Istat Municipality Code (COD_ISTAT)	Area in square meters (Shape_Area)	
Code of comarca (COMARCA) or province (ES_CAP_PR)			Perimeter in linear (PERIM_ml)	CODICE_ISTAT_REG	Abbreviation of Province/Region name (SIGLA)	Perimeter in linear (PERIMETER)	Length of boundary in m (Shape_Leng)	
Code of municipality (bm50mv33cmr09:MUNICIPI)			Surface in square meters (AREA_mq)	CODICE_CM		Surface in square meters (AREA)		
Official name of 'comarca'. (NOM_COMAR)								
Official name of comarca capital (CAP_COMAR) or province capital (MUNICIPI)								
Surface of 'comarca' (SUP_COMAR) or province (SUP_PROV)								

Table 7-3 – Dataset information not represented in INSPIRE model

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

The INSPIRE Data Specification theme aims to serve for data harmonization for the purposes of information exchange in service-oriented environment. Current model follows rather database pattern assuming that several elements can be derived by spatial analyses and merging operations, but are not trivial outside static database or GIS system environment. Considering, that administrative unit is not obliged to include its geometric representation, the question for square area of unit in a worse case would require spatial merge of all geometries of the unit areas related to this unit. However, such calculation is impossible at the pure cascaded web service level assumed in INSPIRE.

INSPIRE Data Specification "Administrative Unit" theme supports description of only one administrative hierarchy tree. In ICC case there are two official administrative hierarchies conducted at regional level. That is, in autonomous region "Catalunya" lowest level units can refer to two kinds of upper level units, each belonging to different of administrative taxonomy. Since the actual situation may not be represented in unified way using INSPIRE model, either decision for constraining the mapping to one hierarchy is required, either two independent mappings have to be defined.

According to draft INSPIRE DS "Administrative unit" Administrative, version 1.0, the AdministrativeBoundary refers to only one administrative unit, while in fact it distinguishes between the two different administrative units. Consequently, following current model it is impossible to identify which administrative units a given boundary separates.
Considering also, that no requirement on cardinality of key feature instances is given explicitly in INSPIRE Data Specification, and the reference to upper level unit is optional, one could hypothetically deduce that minimun content of INSPIRE „AdministrativeUnit" compliant dataset can be composed of one lowest level administrative unit, one administrative unit area overlapping the spatial extent of this unit, and one boundary serving for the border of this unit. In minimum dataset upper level Units and NUTS regions might be ommitted.

8 The GIS4EU Administrative Units subset of the INSPIRE Data Model

Based on the results of critical analysis of draft INSPIRE Data Specification Administrative Units model, in particular the mapping summary given in Appendix, Section 10.4, the GIS4EU model for administrative Units theme shall be an INSPIRE profile consisting four mandatory feature classes:

- AdministrativeUnitsLowestLevel
- AdministrativeUnitsUpperLevel
- AdministrativeBoundary
- AdministrativeArea

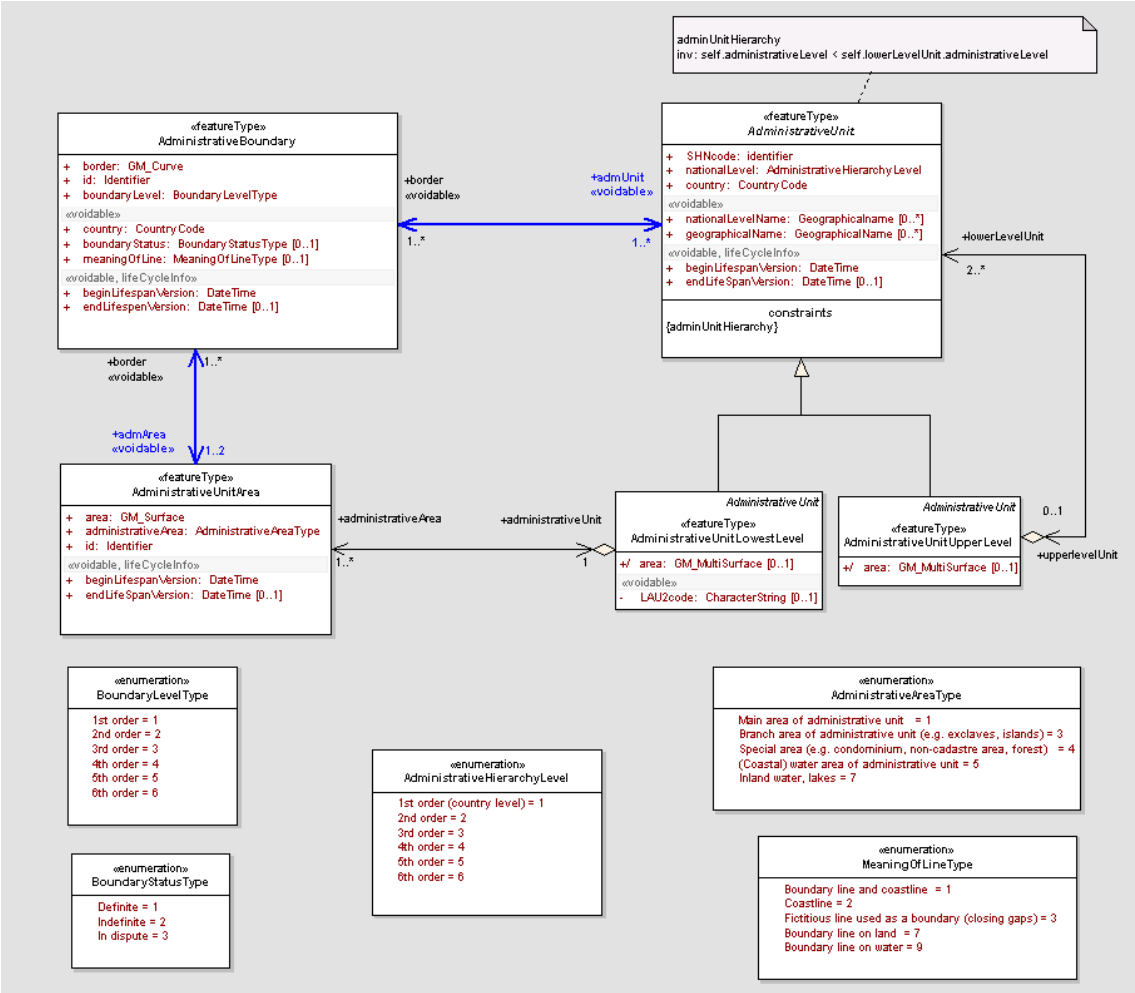


Fig. 6 – Overview of GIS4EU application schema

The subsections below provide the citation of feature characteristics, as defined in INSPIRE draft.

8.1 Administrative Unit

«featureType» AdministrativeUnits::AdministrativeUnit	
Definition:	An administrative unit is an area controlled by an administrative authority
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: SHNcode	
Value type:	Identifier
Multiplicity:	1..1
Definition:	Identifier corresponding to the national administrative codes defined in each country. To ensure that this (SHN) identifier is European-wide unique, it is strictly hierarchical built (according to the number of levels of the administrative hierarchy of the country) and the first two characters are the 2 digit country code
Stereotypes:	
Attribute: nationalLevel	
Value type:	AdministrativeHierarchyLevel
Multiplicity:	1..1
Definition:	Level in national administrative hierarchy
Stereotypes:	
Attribute: nationalLevelName	
Value type:	GeographicalName
Multiplicity:	0..*
Definition:	Name of level in national administrative hierarchy
Stereotypes:	«voidable»
Attribute: country	
Value type:	CountryCode
Multiplicity:	1..1
Definition:	Two-character country code according to ISO 3166.
Stereotypes:	
Attribute: geographicalName	
Value type:	GeographicalName
Multiplicity:	0..*
Definition:	Geographical (official national) name of the administrative unit
Stereotypes:	«voidable»
Attribute: beginLifespanVersion	
Value type:	DateTime
Multiplicity:	1..1
Definition:	Date and time at which this spatial object was inserted or changed in the spatial data set.
Stereotypes:	«voidable»
Attribute: endLifespanVersion	
Value type:	DateTime
Multiplicity:	0..1
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.

Stereotypes:	«voidable»
Association role: lowerLevelUnit	
Value type:	AdministrativeUnits::AdministrativeUnit
Multiplicity:	2..*
Definition:	
Stereotypes:	«voidable»
Association role: upperLevelUnit	
Value type:	AdministrativeUnits::AdministrativeUnitUpperLevel
Multiplicity:	0..1
Definition:	
Stereotypes:	«voidable»
Association role: border	
Value type:	AdministrativeUnits::AdministrativeBoundary
Multiplicity:	1..*
Definition:	
Stereotypes:	«voidable»
Constraint: adminUnitHierarchy	
Type:	OCL
Constraint:	inv: self.administrativeLevel < self.lowerLevelUnit.administrativeLevel

8.2 AdministrativeUnitLowestLevel

«featureType» AdministrativeUnits::AdministrativeUnitLowestLevel	
Definition:	Unit at lowest level in the national administrative hierarchy
Subtype of:	AdministrativeUnit
Status:	Proposed
Stereotypes:	«featureType»
Attribute: area	
Value type:	GM_MultiSurface
Multiplicity:	**0..1**
Definition:	Extent of the administrative unit area
Stereotypes:	
Attribute: LAU2code	
Value type:	CharacterString
Multiplicity:	0..1
Definition:	Statistical code of local administrative units (LAU) as delivered by Eurostat.
Stereotypes:	«voidable»
Association role: administrativeArea	
Value type:	AdministrativeUnits::AdministrativeUnitArea
Multiplicity:	1..*
Definition:	
Stereotypes:	«voidable»

8.3 AdministrativeUnitUpperLevel

«featureType» AdministrativeUnits::AdministrativeUnitUpperLevel	
Definition:	An administrative unit at upper level of national administrative hierarchy is composed of lower level administrative units. The relations between administrative units at upper levels are country specific (see examples in Annex C)
Subtype of:	AdministrativeUnit
Status:	Proposed
Stereotypes:	«featureType»
Attribute: area	
Value type:	GM_MultiSurface
Multiplicity:	**0..1**
Definition:	Extent of the administrative unit area
Stereotypes:	
Association role: lowerLevelUnit	
Value type:	AdministrativeUnits::AdministrativeUnit
Multiplicity:	2..*
Definition:	
Stereotypes:	«voidable»

8.4 AdministrativeUnitArea

«featureType» AdministrativeUnits::AdministrativeUnitArea	
Definition:	An administrative area is the smallest unit of administrative division. Geometrically it is represented by only one face. It can represent all or part of a (lowest level) administrative unit, i.e. an administrative unit is composed of one or more administrative areas
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: area	
Value type:	GM_Surface
Multiplicity:	1..1
Definition:	Extent of the administrative unit area
Stereotypes:	
Attribute: administrativeAreaType	
Value type:	AdministrativeAreaType = „Main area of administratoive unit” (1)
Multiplicity:	1..1
Definition:	Type of administrative area
Stereotypes:	
Attribute: id	
Value type:	Identifier
Multiplicity:	1..1
Definition:	Unique identification of object
Stereotypes:	
Attribute: beginLifespanVersion	
Value type:	DateTime
Multiplicity:	1..1

Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Stereotypes:	«voidable»
Attribute: endLifespanVersion	
Value type:	DateTime
Multiplicity:	0..1
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Stereotypes:	«voidable»
Association role: border	
Value type:	AdministrativeUnits::AdministrativeBoundary
Multiplicity:	1..*
Definition:	
Stereotypes:	«voidable»
Association role: administrativeUnit	
Value type:	AdministrativeUnits::AdministrativeUnitLowestLevel
Multiplicity:	1
Definition:	
Stereotypes:	«voidable»

8.5 AdministrativeBoundary

For GIS4EU purposes the cardinality of admUnit and admArea roles has been changed to better fit the real values of datasets.

«featureType» AdministrativeUnits::AdministrativeBoundary	
Definition:	A line of demarcation between controlled areas (administrative units).
Subtype of:	
Status:	Proposed
Stereotypes:	«featureType»
Attribute: border	
Value type:	GM_Curve
Multiplicity:	1..1
Definition:	Borderline of administrative boundary.
Stereotypes:	
Attribute: id	
Value type:	Identifier
Multiplicity:	1..1
Definition:	Unique identification of object.
Stereotypes:	
Attribute: country	
Value type:	CountryCode
Multiplicity:	0..1
Definition:	Two-character country code according to ISO 3166
Stereotypes:	«voidable»
Attribute: boundaryLevel	
Value type:	BoundaryLevelType
Multiplicity:	1..1

Definition:	Level of administration in the country's hierarchy
Stereotypes:	
Attribute: boundaryStatus	
Value type:	BoundaryStatusType
Multiplicity:	0..1
Definition:	Status of the administrative boundary.
Stereotypes:	«voidable»
Attribute: meaningOfLine	
Value type:	MeaningOfLineType
Multiplicity:	0..1
Definition:	Meaning of the line denoting the administrative boundary.
Stereotypes:	«voidable»
Attribute: beginLifespanVersion	
Value type:	DateTime
Multiplicity:	1..1
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Stereotypes:	«voidable»
Attribute: endLifespanVersion	
Value type:	DateTime
Multiplicity:	0..1
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Stereotypes:	«voidable»
Association role: admArea	
Value type:	AdministrativeUnits::AdministrativeUnitArea
Multiplicity:	**1..2**
Definition:	
Stereotypes:	«voidable»
Association role: admUnit	
Value type:	AdministrativeUnits::AdministrativeUnit
Multiplicity:	1..*
Definition:	
Stereotypes:	«voidable»

8.6 AdministrativeAreaType

«enumeration» AdministrativeUnits::AdministrativeAreaType	
Definition:	Type of the administrative area
Status:	Proposed
Stereotypes:	«enumeration»
Value: Main area of administrative unit	
Code:	1
Definition:	
Value: Branch area of administrative unit (e.g. exclaves, islands)	
Code:	3
Definition:	
Value: Special area (e.g. condominium, non-cadastre area, forest)	
Code:	4
Definition:	Area having a specific function of scope
Value: (Coastal) water area of administrative unit	

Code:	5
Definition:	water area belonging to an administrative unit
Value: Inland water, lakes	
Code:	7
Definition:	Area of water away from large bodies of water, surrounded by land

8.7 AdministrativeHierarchyLevel

«enumeration» AdministrativeUnits::AdministrativeHierarchyLevel	
Definition:	value domain for levels of administration in the national administrative hierarchy
Status:	Proposed
Stereotypes:	«enumeration»
Value: 1st order (country level)	
Code:	1
Definition:	Highest level in the national administrative hierarchy of units
Value: 2nd order	
Code:	2
Definition:	2nd level in the national administrative hierarchy of units
Value: 3rd order	
Code:	3
Definition:	3rd level in the national administrative hierarchy of units
Value: 4th order	
Code:	4
Definition:	4th level in the national administrative hierarchy of units
Value: 5th order	
Code:	5
Definition:	5th level in the national administrative hierarchy of units
Value: 6th order	
Code:	6
Definition:	6th level in the national administrative hierarchy of units

8.8 BoundaryLevelType

«enumeration» AdministrativeUnits::BoundaryLevelType	
Definition:	boundary levels in the national administrative hierarchy
Status:	Proposed
Stereotypes:	«enumeration»
Value: 1st order	
Code:	1
Definition:	Highest boundary level in the national administrative hierarchy
Value: 2nd order	
Code:	2
Definition:	2nd boundary level in the national administrative hierarchy
Value: 3rd order	
Code:	3
Definition:	3rd boundary level in the national administrative hierarchy
Value: 4th order	
Code:	
Definition:	4th boundary level in the national administrative hierarchy

Value: 5th order	
Code:	5
Definition:	5th boundary level in the national administrative hierarchy
Value: 6th order	
Code:	6
Definition:	6th boundary level in the national administrative hierarchy

8.9 BoundaryStatusType

«enumeration» AdministrativeUnits::BoundaryStatusType	
Definition:	types of status for administrative boundaries
Status:	Proposed
Stereotypes:	«enumeration»
Value: Definite	
Code:	1
Definition:	
Value: Indefinite	
Code:	2
Definition:	
Value: In dispute	
Code:	3
Definition:	

8.10 MeaningOfLineType

«enumeration» AdministrativeUnits::MeaningOfLineType	
Definition:	value domain of "meaning of line"
Status:	Proposed
Stereotypes:	«enumeration»
Value: Boundary line and coastline	
Code:	1
Definition:	boundary line following the coastline
Value: Coastline	
Code:	2
Definition:	line dividing land and water administrative areas of an administrative unit
Value: Boundary line on land	
Code:	7
Definition:	A line of demarcation between controlled land areas
Value: Boundary line on water	
Code:	9
Definition:	A line of demarcation between controlled water areas

9 Conclusion

One of the objectives of GIS4EU project is to operationally test INSPIRE draft solutions for harmonization and aggregation of geographic datasets in Europe. Considering the overlays between GIS4EU and INSPIRE thematic scopes, three themes serve for the subject of direct for operational validation, including Administrative Units.

To workout significant measuring results, the INSPIRE-compliant approach for definition of GIS4EU common models has been adopted. It focuses on maximized reuse of INSPIRE methodology and concepts, and profiling INSPIRE application schemas to better reflect the specifics of datasets available within the project.

Here, the version 1.0 of INSPIRE Data Specification "Administrative Unit" has been investigated in terms of its completeness and applicability to geographic data on territorial division being collected and maintained by nine GIS4EU partners: ICC, IGP, FOMI, VUGK, INSIEL, RVEN, RLIG, RPIE, and CGE. The results of work have been summarized in a form of matching tables (Appendix 10.4) and critical analyses (see Section 7) performed by each Data Provider. These analytical materials explicitly show the extent to witch existing datasets fit to INSPIRE concepts. It also highlights the certain drawbacks of current draft INSPIRE models, as identified by Data Providers.

Based on this analysis the INSPIRE profile has been defined and proposed as initial GIS4EU common model for administrative units. It includes mandatory INSPIRE features. The only optional feature (NUTSRegion) of INSPIRE model has been removed from the profile, as it did not find representation in any of analysed datasets.

Beside the cardinalities of AdministrativeBoundary: adminUnit and AdministrativeBoundary: admArea association roles other features and feature properties are remained unmatched. According to draft INSPIRE DS "Administrative unit" Administrative, version 1.0, the AdministrativeBoundary refers to only one administrative unit, while in fact it distinguishes between the two different administrative units. The decision for change has been driven by recent discussion and changes planned to the model by INSPIRE TWG-AU team. It is expected that upcoming INSPIRE Data Specification "Administrative Units" version 2.0 will include modified cardinality for admArea and admUnit roles and thus allows to keep GIS4EU model compliant to INSPIRE model.

For the reasons of compliance to INSPIRE application schema, version 1.0, current GIS4EU "Administrative Units" common model does not resolve the critical issue detected during analysis, - that is a support to multi-hierarchical administrative division of territory. As it has

been explained in Section 7.1, Catalan dataset requires representation of two official administrative hierarchies, and doubled referencing from lowest level units to upper level units, each belonging to different of administrative taxonomy. Since the actual situation may not be represented in unified way in compliance to INSPIRE model, either decision for constraining the mapping to one hierarchy is required, either two independent mappings have to be defined.

This multi-hierarchy issue shall be reported to INSPIRE Data Specification team in terms of official GIS4EU feedback to INSPIRE Data specification Annex I testing phase.

Finally, for the purposes of operational validation of INSPIRE models, the current version of common GIS4EU model for “Administrative Units” theme shall be revised and updated according once the INSPIRE Data Specification team publishes final draft of INSPIRE data specification on “Administrative Units”.

10 Appendix

10.1 List of GIS4EU Datasets involved in the process

Data provider	Data Provider level	Dataset	Administrative Units
03_VUGK	National	Slovak Administrative Boundaries	X
05_ICC	Regional	BM-50M	X
07_FÖMI	National	52-424_t_region	X
08_RLIG	Regional	DBPrior10K	X
09_RPIE/17_CSI	Regional	CTR10.000/Census	X
11_CGE	Local	CTC1000/CTC2000	X
14_IGP	National	CAOP - Administrative Units for Portugal	X
16_INSIEL	Regional	DbPrior10K	X
20_RVEN	Regional	DBPrior10K	X

Table 10-1 - GIS4EU available datasets for Administrative Units

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 10-2.
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 **Source model**	Description of the characteristics defining the logical structure of the GIS4EU dataset model, known here as *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 10-3 – 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 5-1, 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?
- Does the attribute in the GIS4EU dataset include other real world entities different from those that were envisioned in the corresponding data specifications?

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

10.5 Abbreviations

CEN	Comité Européen de Normalisation
CEN/TC287	CEN Technical Committee 287 Geographic Information
CRS	Coordinate Reference System
CSL	Conceptual Schema Language
DCP	Distributed Computing Platform
DIS	Draft International Standard
DNS	Domain Name System
DT	Drafting Team
DT-DS	Drafting Team "Data Specifications"
DT-DS TWG AU	Drafting Team "Data Specifications" Thematic Working Group on Administrative Units
DTI	Draft Implementing Rules
EC	European Commission
ESDI	European Spatial Data Infrastructure
EU	European Union
EUREF	REference Frame sub commission for Europe (IAG Commission I)
FGDC	Federal Geographic Data Committee
GCM	Generic Conceptual Model
GEODRM	Geospatial Digital Rights Management
GI	Geographic Information
GML	Geography Markup Language
GNM	Generic Network Model
ICT	Information and Communication Technology
IRs	Implementing Rules
INSPIRE	INfrastructure for SPatial InfoRmation in Europe
ISO	International Standardization Organisation

ISO/TC211	ISO Technical Committee 211 Geographic information/Geomatics
JRC	European Commission Directorate General Joint Research Centre
LBS	Location Based Services
LMO	Legally Mandate Organisation
LoD	Level of Detail
OCL	Object Constraint Language
OGC	Open Geospatial Consortium
OGP	international association of the Oil & Gas Producers
OSF	Open Software Foundation
OWL	Web Ontology Language
PSI	Public Sector Information
SDI	Spatial Data Infrastructure
SDIC	Spatial Data Interest Communities
SI	International System of Units
SOAP	Simple Object Access Protocol
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Universal Resource Names
UUID	Universally Unique IDentifier
WCS	Web Coverage Service
WFS	Web Feature Service
WMO	World Meterological Organization
WMS	Web Map Service
XML	eXtensible Markup Language

Table 10-4 - Abbreviation list of document content

10.6 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	Set of spatial objects that correspond to the same real world entity, but

SPATIAL OBJECTS	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
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	Detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and

DESCRIPTION	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 system against which time is measured [ISO 19108;2002(E)].

REFERENCE SYSTEMS	
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 10-5 - Table of abbreviation

10.7 Elements of "Administrative Units" model [DS2.8.1.4/1, version 1.0]

TYPE NAME	STEREOTYPE	DEFINITION			PARENT	ABSTRACT
AdministrativeUnit	«featureType»	An administrative unit is an area controlled by an administrative authority			NO	YES
		PROPERTIES				
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		SHNCode	CharacterString	Thematic identifier corresponding to the national administrative codes defined in each country. To ensure that this (SHN) identifier is European-wide unique, it is strictly hierarchical built (according to the number of levels of the administrative hierarchy of the country) and the first two characters have to be the 2 digit country code according to ISO 3166.		1
		nationalLevel	Administrative HierarchyLevel	Level in national administrative hierarchy.		1
		nationalLevelName	GeographicalName	Name of level in national administrative hierarchy.	«voidable»	0..*
		country	CountryCode	Two-character country code according to ISO 3166.		1
		geographicalName	GeographicalName	Geographical (official national) name of the administrative unit.		0..*
		beginLifespanVersion	DateTime	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.	«voidable, lifeCycleInfo»	1

		endLifespanVersion	DateTime	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.	«voidable, lifeCycleInfo»	0..1
		lowerLevelUnit	AdministrativeUnit		«voidable»	2..*
		border (association role)	AdministrativeBoundary		«voidable»	1..*
		upperLevelUnit (association role)	AdministrativeUnit UpperLevel		«voidable»	0..1
		CONSTRAINTS				
		NAME	**RULE**		**OCL**	
		adminUnitHierarchy	A higher level unit (e.g. administrative level of 1) must have a lower value for administrativeLevel than lower level units (e.g. having a administrative level of 2).		inv: self.administrativeLevel < self.lowerLevelUnit.administrativeLevel	
TYPE NAME	**STEREOTYPE**	**DEFINITION**			**PARENT**	**ABSTRACT**
AdministrativeUnitArea	«featureType»	An administrative area is the smallest unit of administrative division. Geometrically it is represented by only one face. It can represent all or part of a (lowest level) administrative unit, i.e. an administrative unit is composed of one or more administrative areas			NO	NO
		PROPERTIES				
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		area	GM_Surface	Extent of the administrative area.		1
		id	Identifier	Unique identification object		1
		administrativeAreaType	AdministrativeAreaType	Type of administrative area		1
		beginLifespanVersion	DateTime	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.	«voidable, lifeCycleInfo»	1
		endLifespanVersion	DateTime	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.	«voidable, lifeCycleInfo»	0..1

		border (association role)	AdministrativeBoundary		«voidable»	1..*
		administrativeUnit (association role)	AdministrativeUnitLowestLevel		«voidable»	1..*
TYPE NAME	**STEREOTYPE**	**DEFINITION**			**PARENT**	**ABSTRACT**
AdministrativeUnitLowestLevel	«featureType»	Unit at lowest level in the national administrative hierarchy[7].			Administrative Unit	NO
		PROPERTIES				
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		area	GM_MultiSurface	Extent of the administrative unit at lowest level.		0..1
		LAU2code	CharacterString	Statistical code of local administrative units (LAU) as defined by the National Statistical Institutes.	«voidable»	0..1
		NUTS (association role)	NUTSRegion		«voidable»	0..3
		administrativeArea (association role)	AdministrativeUnitArea		«voidable»	1..*
TYPE NAME	**STEREOTYPE**	**DEFINITION**			**PARENT**	**ABSTRACT**
AdministrativeUnitUpperLevel	«featureType»	An administrative unit at upper level of national administrative hierarchy is composed of lower level administrative units. The relations between administrative units at upper levels are country specific.			Administrative Unit	NO
		PROPERTIES				
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		area	GM_MultiSurface	Extent of the administrative unit area.		0..1
		lowerLevelUnit (association role)	AdministrativeUnit	Each upper level unit includes 2 or more lower level units (in exceptional cases only one)	«voidable»	2..*

[7] For most of the Member States these units correspond to the Local Administrative Units (LAU) at second level.

TYPE NAME	STEREOTYPE	DEFINITION			PARENT	ABSTRACT
AdministrativeBoundary	«featureType»	A line of demarcation between controlled areas (administrative units).			NO	NO
		PROPERTIES				
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		border	GM_Curve	borderline of administrative boundary.		1
		id	Identifier	unique identification of object		1
		country	CountryCode	Two-character country code according to ISO 3166.		0..1
		boundaryLevel	BoundaryLevelType	Level of administration in the country's hierarchy		1
		boundaryStatus	BoundaryStatus Type	status of the administrative boundary	«voidable»	0..1
		meaningOfLine	MeaningOfLineType	meaning of the line denoting the administrative boundary	«voidable»	0..1
		beginLifespan Version	DateTime	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.	«voidable, lifeCycleInfo»	1
		endLifespanVersion	DateTime	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.	«voidable, lifeCycleInfo»	0..1
		admArea (association role)	AdministrativeUnit Area	Two adjacent administrative areas are separated by an (administrative) boundary line.	«voidable»	1
		admUnit (association role)	AdministrativeUnit		«voidable»	1

TYPE NAME	STEREOTYPE	DEFINITION	PARENT	ABSTRACT

NUTSRegion[8]	«featureType»	Territorial unit for statistics as defined by Eurostat.		NO	NO
		PROPERTIES			
		NAME	**DATA TYPE NAME**	**DEFINITION**	**STEREOTYPE**	**MULTIPL.**
		geometry	GM_MultiSurface	Surface geometry of NUTS-region.	«voidable»	0..1
		id	Identifier			1
		NUTScode	CharacterString	NUTS code of the territorial unit for statistics as delivered by Eurostat		1
		NUTSlabel	CharacterString	Name of the NUTS unit as delivered by Eurostat.		1
		NUTSLevel	NUTSLevelType	Level in NUTS hierarchy.		1
		beginLifespan Version	DateTime	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.	«voidable, lifeCycleInfo»	1
		endLifespanVersion	DateTime	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.	«voidable, lifeCycleInfo»	0..1
		admUnit (association role)	AdministrativeUnit LowestLevel	Each NUTS-region consists of one or more Administrative Units at lowest level.	«voidable»	1..*
TYPE NAME	**STEREOTYPE**	**DEFINITION**			
AdministrativeAreaType	«enumeration»	The type of administrative area describes the property of the area concerning its role within the national administrative structure.			
		VALUES			
		NAME	**MEANING**		**CODE**
		Main area	The main area is the administrative area where the residence of authority is located.		1
		Branch area	Areas which are geometrically separated from the main area (eg. Exclaves).		3

[8] NUTS regions subdivide each Member State into a whole number of territorial units for statistic at NUTS1 level. Each of these is then subdivided into regions at NUTS2 level and these in turn into regions at NUTS3 level.

		Special area	Area having a specific function of scope (e.g. condominium, non-cadastre area, forest).	4
		(Coastal) water area	water area belonging to an administrative unit	5
		Inland water, lakes	Area of water away from large bodies of water, surrounded by land	7
TYPE NAME	**STEREOTYPE**	**DEFINITION**		
AdministrativeHierarchy Level	«enumeration»	Value domain for levels of administration in the national administrative hierarchy.		
		VALUES		
		NAME	**MEANING**	**CODE**
		1st order (country level)	Highest level in the national administrative hierarchy	1
		2nd order	2nd level in the national administrative hierarchy.	2
		3rd order	3rd level in the national administrative hierarchy.	3
		4th order	4th level in the national administrative hierarchy.	4
		5th order	5th level in the national administrative hierarchy.	5
		6th order	6th level in the national administrative hierarchy.	6
TYPE NAME	**STEREOTYPE**	**DEFINITION**		
BoundaryLevelType	«enumeration»	Boundary levels in the national administrative hierarchy.		
		VALUES		
		NAME	**MEANING**	**CODE**
		1st order (country level)	Highest boundary level in the national administrative hierarchy.	1
		2nd order	2nd boundary level in the national administrative hierarchy.	2
		3rd order	3rd boundary level in the national administrative hierarchy.	3
		4th order	4th boundary level in the national administrative hierarchy.	4
		5th order	5th boundary level in the national administrative hierarchy.	5
		6th order	6th boundary level in the national administrative hierarchy.	6
TYPE NAME	**STEREOTYPE**	**DEFINITION**		

BoundaryStatusType	«enumeration»	Types of status for (international) administrative boundaries.		
		VALUES		
		NAME	**MEANING**	**CODE**
		Definite	Edge-matched boundary has been agreed between neighbouring countries and is stable now.	1
		Indefinite	Edge-matched boundary has not yet agreed between neighbouring countries and could be changed.	2
		In dispute	No agreement can be reached on boundary between neighbouring countries, boundary is in dispute.	3
TYPE NAME	**STEREOTYPE**	**DEFINITION**		
MeaningOfLineType	«enumeration»	Classification of a boundary according to the land-water nature of the adjacent areas.		
		VALUES		
		NAME	**MEANING**	**CODE**
		Boundary line between land and water	Boundary line following the coastline.	1
		Coastline	line dividing land and water administrative areas of an administrative unit	2
		Boundary line on land	Boundary line dividing administrative areas on land.	7
		Boundary line on water	Boundary line dividing administrative areas on water.	9
TYPE NAME	**STEREOTYPE**	**DEFINITION**		
NUTSLevelType	«enumeration»	NUTS levels.		
		VALUES		
		NAME	**MEANING**	**CODE**
		NUTS 1 Level	First level of hierarchical NUTS classification	
		NUTS 2 Level	Second level of hierarchical NUTS classification.	
		NUTS 3 Level	Third level of hierarchical NUTS classification	

10.8 References

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- EuroBoundaryMap Specification / User Guide, version 2.0
- ISO 19131:2007 Geographic information -- Data product specifications
- EN-ISO 19109:2006 Geographic information - Rules for application schema

10.9 List of figures

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10.11 Partner list

PARTICIPANT NAME	SHORT NAME	COUNTRY
Consorzio per il coordinamento delle Ricerche sul Sistema Lagunare di Venezia	CORILA	Italy
Intergraph (Deutschland) GmbH	GERIN	Germany
Vyskumny ustav geodezie a kartografie v Bratislave	VUGK	Slovakia
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
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