A new concept for creating the basic map

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Abstract: A lot of changes have been made to the legislative regulations associated with geodesy during the implementation of the INSPIRE Directive in Poland (amongst others, the structure of databases). There have also been great changes concerning the basic map and the method of its creation and updating.
A new concept for creating the basic map is presented in this article.

Key words: harmonization, INSPIRE Directive, basic map, UML

1. Introduction

At present, very great changes are happening within the legislative regulations concerning geodesy and cartography in Poland. Those changes were initiated by the INSPIRE Directive of the European Union (INSPIRE, 2007) and the need for changes to the technical standards which have become outdated because of scientific and technological developments.. The decision to change the technical standards was taken in order to follow the INSPIRE Directive recommendations, specifically as follows:

– using conceptual modeling to construct database models and to write these models as UML application schemes (UML – Unified Modeling Language);
– using ISO standards series 19100 in developed application schemes;
– using GML language (Geography Markup Language) as the standard for the exchange of data.

These changes-have had an intense influence on all aspects of geodetic activity, particularly as UML application schemes and GML schemes have been included in the regulations, and have become a part of Polish law.

2. Current and past practice

The basic map in Poland is a cartographic study which covers the entire area of the country at a scale of 1: 500 to 1: 5000, depending on the degree of urban development.

Before the recent changes, the basic map was one of many separate products of geodetic activity such as: cadastre, underground utilities, topographic maps, etc.

After performing measurements in the field, the geodesist used to deliver (and often still delivers) materials from their work to the Centre for Geodetic and Cartographic Data Resources in different forms (and often in analogue as well as paper form). Once the accuracy of these surveyors' work had been checked by the inspector, their work was plotted on the basic map.

This way of working did not depend on the type of map (analogue or digital).

The data from which the map arose was (and still is) given as sets of documents (most often in paper form) or as data saved in a format appropriate to the given application in a data resource.

3. The new concept

During the preparation of the 'geodetic' regulations the conceptual modeling methodology was used to define the database structure of Geodetic and Cartographic Data Resources. Many changes have also been made to that structure. The models thus created have been written as UML application schemes. Based on these schemes standards of data exchange have been created in the form of GML application schemes (as XSD files).

Applying these new changes, the new methodology of modeling and the new language has caused the basic map to be greatly transformed in the direction of the current approach (Regulation, 2013a). According to the new regulations, the data from the Geodetic and Cartographic Data Resources will have to be stored in the form of a dozen or so databases:
– cadastre
– utilities
– DTM database
– Ortho database
– topo10k – topographic data at the level of details 1:10000
– topo500 – topographic data at the level of details basic map
– geographic names
– addresses
    …………

Amongst these databases there is no special database for the basic map. Up to now, the basic map has been a separate product and applications which were drawn up only for the creation and editing of the basic map are still functioning. Elements which are included in the basic map are saved in some of the above-mentioned databases. According to the new concept, the basic map is produced as a graphical report from these databases.

Only part of the information saved in these databases is essential for creating the basic map (such as geometry, type of object and the values of those attributes which should be shown as an object on the map).

The Database is the basic set for saving and working with data. Therefore the basic map is a graphical report from such databases in their exactly-defined content and appearance, and it is used to show the contents of these databases. This view is used for many different aims, such as to control new data before the updating of databases, to mark interesting objects etc. Marked objects can be chosen from the relevant databases and GML files compatible with XSD schemes are being created. (For every database, one GML file is being created).

4. How should these ideas be written in UML?

The path is made up of three stages:

Stage 1: – a UML scheme is presented which includes the set of spatial data as shown in Figure 1, the spatial object which is included in the set, and the reference spatial object which has been derived from it. The data set is described by an identifier (according to the recommendations of the INSPIRE Directive – every element of the infrastructure of spatial information must have its own unique identifier) and by metadata (also according to the recommendations of the Directive). Spatial objects are represented in the UML scheme by the abstract *BT_SpatialObject* (BT is short for: basic type) class which is included in a set of spatial data. From this class another class is derived: *BT_ReferenceSpatialObject*. This is the first step in recording the concept for creating the basic map in UML.
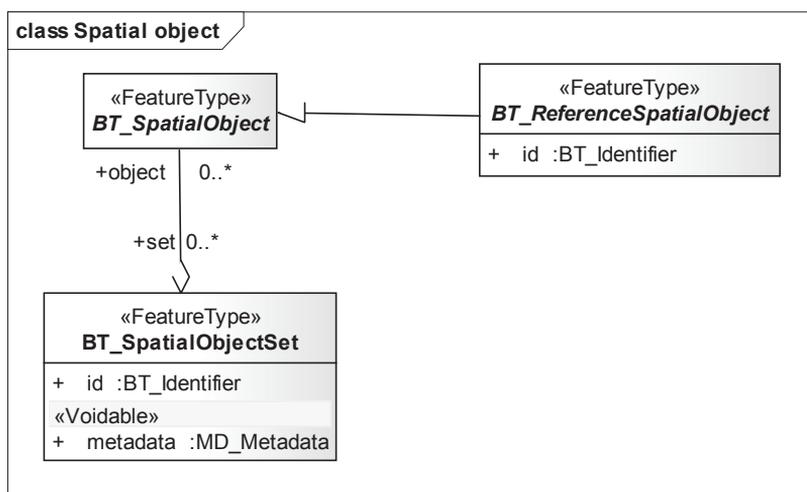

Fig. 1. The set of spatial data and the reference spatial object

Stage 2 – in Figure 2 is shown the mechanism of extracting information from the classes defined in other UML application schemes. The main element of stage 2 is a class with the <<*Union*>> stereotype: *BT_ReferenceToObject*. The <<*Union*>> stereotype is described in the technical specification ISO/TS 19103 (ISO 19103, 2005) which defines the UML language for geographical information. A fragment of the description and the method of defining the stereotype is taken from the specification: '<<*Union*>>, which is a type consisting of one and only one of several alternatives (listed as member attributes).' In the definition it is not stated that this is the only attribute of the class, but it can be one of many options. In our opinion, these attributes were written as an example and it is also possible to make a choice between the attribute of the *BT_ReferenceToObject* class and the relationship joining this class to the *BT_ReferenceSpatialObject* class.

It is possible (using the possibility of the <<Union>> stereotype) to refer to:
– an attribute of the BT_ReferenceToObject class – that is of the identifier;
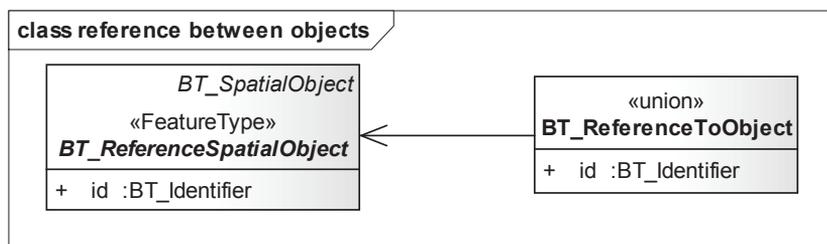– or, by association, to interesting attributes of the reference object.

Fig. 2. UML application scheme for reference

Stage 3 – consists of using stage 1 and 2 in practice. For the basic map, a created UML application scheme shows, in a formalized way, a definition of the new attempt at creating the basic map (Figure 3)

The *BM_GeneralObject* (BM is short for: basic map) class represents any object put on the basic map. Names, types and appropriate attributes of objects which should be placed on the basic map are defined in UML application schemes of relevant databases.

This class is connected by 6 relationships of the class *BT_ReferenceToObject*. The number of relationships corresponds to the number of databases from which the objects should be displayed on the basic map. In Poland, these databases are:
– borders (Regulation, 2012b)
– cadastre (Regulation, 2013b)
– addresses (Regulation, 2012a)
– topo500 (Regulation, 2013a)
– utilities (Regulation, 2013a)
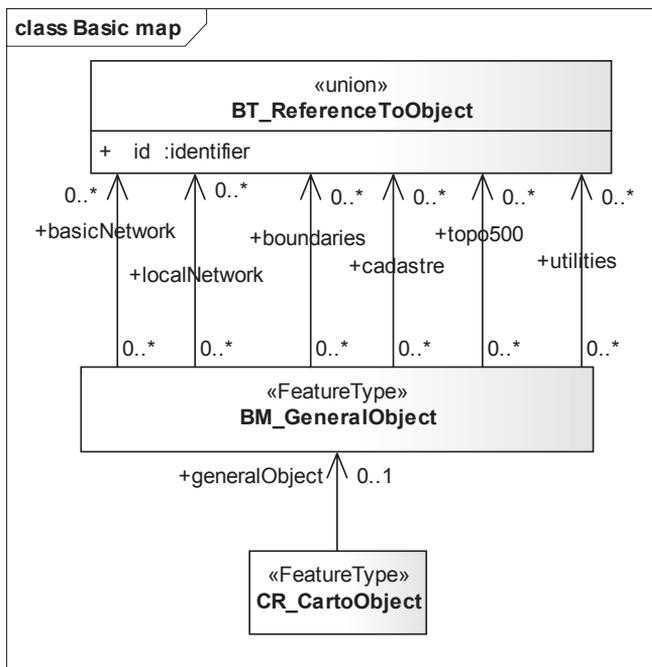– basic network (Regulation, 2012c)
– local network (Regulation, 2012c)

Fig. 3. UML application scheme for basic map

The class called *CR_CartoObject* (CR is short for: cartographic representation) in the model is used to define the structure for a "graphical" database, and this is where classes representing objects, as well as classes describing footnotes, inscriptions etc are stored.

An object catalogue is attached to every application scheme, in which definitions of classes, attributes and relations are placed. Here are also listed all kinds of objects which should be put on the basic map.

GML application schemes have also been developed based on UML schemes which define the data exchange standards. Data will be sent through the internet to Geodetic and Cartographic Data Resources, amongst others, in the form of XSD files which will be used as a base, after technical and formal control and updating of databases has been performed.

The UML application scheme shown in Figure 3 and the XSD application scheme as the standard for the exchange of data in combination with UML application schemes for relevant databases are defining the content of the basic map. There is, a lack of signals from the application producers about the need for additional schemes, for example the method of transforming a UML schema into a GML schema for implementation.

5. Conclusion

Implementing the requirements and recommendations of the INSPIRE Directive in Polish law has caused numerous and deep changes in the current structure and the method of performing some processes. It has brought about some essential changes in the method of compiling the basic map. A new concept has been developed. According to these assumptions, all data which is in Geodetic and Cartographic Data Resources is saved in one of a dozen or so databases. The task of the application is to update the view of the basic map according to the UML application scheme, in harmony with the revised data. The basic map is a graphical report of the contents of the specified databases.

Like any map, a basic map also requires editing. In order to meet the reporting demands, the GML schema that will allow uploading (transferring) of the edited map (with titles, links, etc.) is currently being prepared. There are many problems to solve. One of them is the incompatibility between the UML and the GML languages. Because of this, certain aspects coming from UML diagrams are difficult to save in GML files.

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Nowy pomysł na tworzenie mapy zasadniczej

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Streszczenie

Dokonaliśmy wielu zmian w prawnych regulacjach dotyczących geodezji w trakcie implementacji Dyrektywy INSPIRE w Polsce (m.in. struktury baz danych). Bardzo duże zmiany objęły mapę zasadniczą i procedury jej tworzenia i uaktualniania.

W artykule jest zaprezentowana nowa koncepcja tworzenia mapy zasadniczej.