DEVELOPING GEOSPATIAL DATA SPECIFICATION FOLLOWING INSPIRE WITH TURKEY CASE

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ABSTRACT:

Various Geospatial Information Systems (GIS) projects have been produced by different public institutions in Turkey. But, coordination has not been provided among these public institutions that produce and use geo-data. Technical, Standard, and policy deficiencies result in time and effort losses on data production, management, and sharing. GIS were largely designed to serve specific projects or user communities; the focus is now increasingly shifting to the challenges associated with integrating these systems into a society perspective. This can be explained with Geospatial Data Infrastructure (GDI) concept. Directive 2007/2/EC for establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) entered into force on the 15th May 2007. The INSPIRE Data Specifications Drafting Team has finalized the framework documents for the specification development process and is now preparing application schemas for geo-data themes to determine geographic data standards of European Union countries. Turkey, as a candidate country for entering European Union, should follow the INSPIRE initiative in her geo-data related actions. In this study, to develop a new generation of data model, INSPIRE data specifications and methodology were followed. Data Harmonization Components are determined, including principles, reference model, application schema rules, general feature model, spatial object identifier, spatial object versioning, etc. This model manages and delivers geospatial framework (and other) data in meaningful packets of information, with unique and persistent identifiers that support association and aggregation. More importantly the model help shift the paradigm in terms of data linking, sharing and reuse and assist in the move towards mainstream GI take up. The model should solve application-driven geo-data needs of local governments and support decision making processes through regional and national levels. This domain model is an object-relational model and the starting point to create sector models. Generic Conceptual Model components define rules to harmonize geographic data and to produce data specifications. It is a semantic model because harmonized model provides common domain of interaction and the related information. This interchangeable information in the model should explain objects with properties and relations semantically. That is, a variety of different kinds of organizations can operate in the same geo-information and exchange the data technically. This model is designed with UML class diagrams that are a graphical modeling tool with well defined semantics and underlying computer model in a Model Driven Approach (MDA). Application schemas are produced for data themes such as Administrative Unit, Address, Cadastre/Building, Land Cover/Use, and etc. with Unified Modelling Language enabling semantic interoperability.

1. INTRODUCTION

Geospatial ("geo-" prefix) data provides a powerful decision support and finds optimal solutions in geo-application domain. Geo-information has economic, social, and policy value (Craglia, 2004). The users need to use geo-data collaboratively to provide noteworthy benefits to environmental, social, and economic context. In this way, Information Systems (IS) that support information management in concerned working group have been re-conceptualized as Information Infrastructure (II) concept. In this way, the focus on Geo-Information Systems (GIS) can be explained with Geo-Data Infrastructure (GDI) concept. GDI encompasses policies, technologies, standards for the effective collection, management, and access of geo-information to stimulate better governance, and to foster environmental sustainability by reducing duplication and facilitating integration at different administrative levels. Most countries in developing world are in the process of building GDI at different administrative levels in order to enable effective geo-data management (Mc Laughin and Nichols, 1992, Georgiadau et al., 2005, Rajabifard et al., 2002).

A central component of a GDI is geo-information itself. According to the GDI Cookbook (Nebert, 2004), the development of consistent reusable geo-information sets is recognized as a common ingredient and beginning phase in the building of GDI (Nebert, 2004). In this way, Open Geospatial Concortium (OGC) and ISO/TC211 have developed a variety of standards in this area. For example, in Europe, Infrastructure for Spatial Information in Europe (INSPIRE) directive encourages European countries to manage geo-data corporately for effective decision making (INSPIRE, 2007).

In this study, geo-data use in Turkey was examined. Requirements were determined to develop geo-data specifications following INSPIRE progress as a case study of developing countries.

2. GEOSPATIAL DATA USE IN TURKEY

Turkey is managed by the republican parliamentary democracy. She covers 780.580 km^2 with a population of around 70 million as a bridge between Europe and Asia. Some of her main

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priorities are to meet accession criteria of European Union, to develop public administration, governance including decentralization, and infrastructure services, and to support environmental protection.

Information and Communication Technologies (ICT) started to be used commonly in 1990s. Public Institutions increased investments for ICT hardware and software since 1995s. The importance of GIS has been realized by many public and private organizations within Turkey since 1990s. General Command of Mapping (HGK) pioneered digital map production especially. Standard Topographic Maps smaller than 1:5000 are produced by HGK. Large Scaled Maps, 1:5000 and larger, are produced by Land Registry & Cadastre Directorate (TKGM) and State Provincial Bank. According to Turkey State Planning Organization (TKGM, 2004), coordination has not been provided among public institutions that produce and use geo-data. Technical, standard, and policy deficiencies result in time and effort losses on data production, management, and sharing. A variety of GIS Projects were produced by different public organizations. Public Institutions produce geo-data, depending on their responsibilities and rights legalized by the laws.

Turkey has started to transform into an information society with eTurkey initiative which is almost identical to eEurope+. After 2003, these actions are combined in e- Transformation Turkey Project that aims at fostering the evolution and coordination of information society activities in a participatory manner. With Action-47, current situation to build Turkey National GDI was examined in 2004. With Action-36, Turkey National GDI concept and implementation models were determined in 2005. In 2007, Action 75 aims to build Turkey National GDI portal that is required to share geo-data on different context and scale efficiently.

Geo-data specifications are not defined for using in various GIS applications. Large Scaled Maps are produced, depending on Large Scaled Map Production Regulation (BÖHHBUY). BÖHHBUY was revised and enclosed with feature / attribute catalog in 2006. But, this catalogue was not designed to solve application-driven requirements for various GIS projects. GIS applications of local governments were developed, depending on GIS software and related companies. Therefore, geo-data is not interoperable because public institutions use different conceptual model and feature catalogs (TKGM, 2006).

Local governments need high resolution and large scaled geo-data and maps for applications like zoning plan, real property management, and infrastructure (Yomralıoğlu, 2004). Therefore, a common concept should be developed to manage geo-data corporately from local to national level. Applications Schemas of geo-data themes should support updating National Data Exchange Format (UVDF) compliant with Geographic Markup Language (GML) 3.X (BHIKPK, 2007).

3. DEVELOPING GEOSPATIAL DATA SPECIFICATIONS

As a preliminary work to build GDI, geo-data specifications were designed to make the data enabled for multiple uses in Turkey. By this way, Turkey National Geo-Data Exchange Model with TURKVA:UVDM acronym can be the base and harmonized geo-database model as a new approach on geo-information management. This base model is a starting point to create sector models in different thematic areas. Because all sectors share this base, interoperability between the sectors is greatly enhanced. Basic properties of this model (Aydinoglu, 2009);

- UVDM is a semantic model. Harmonized model provides common domain of interaction and the related information.
- UVDM is an object-relational model that enables the users to store spatial data and their associated attribute data in a single database system.
- UVDM is compliant with ISO/TC 211 standards, the expectations of INSPIRE data specifications, and Turkey National GIS actions.
- UVDM is designed with Unified Modelling Language (UML) class diagrams, an underlying computer model in a model driven approach (MDA).
- A Geography Markup Language (GML) application schema as an exchange format can be automatically derived from the UML model for harmonizing the data model.
- The design of UVDM follows the requirements of application algorithms and use of information in view of INSPIRE methodology.

3.1. Conceptual Model Components

UVDM Conceptual Model specifies the components to determine application schemas of geo-data themes and to harmonize geo-data. These components were defined and divided into two sections, Scope/Application Area and Technical Components are explained in Figure 1. UVDM geo-data themes are Administrative Unit (IB), Address (AD), Land Ownership/Building (MB), Hydrography (HI), Topography (TO), Geodesy (JD), Transportation (UL), Land Cover/Use (AR). The reason for selecting these data themes is that they were determined the most needed by geo-data users according to the field work and accepted as INSPIRE data themes.

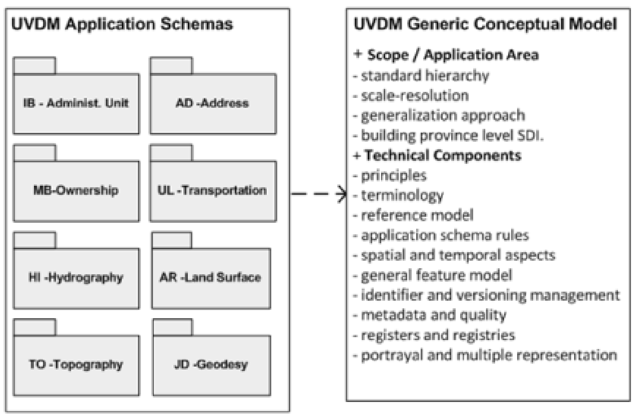

Figure 1. UVDM geo-data themes and conceptual model components

If some conceptual model components are examined;

Scale-Resolution and Generalization Approach: Geo-data should be maintained at a level where the data is managed effectively. In Turkey, province level is the most effective level that produces and uses geo-data in GIS applications. Municipalities and Provincial Administrations are managing the data larger than 1:5000 scales as BOHHBUY defines. Geospatial Hierarchy Approach enables collecting the data at province level, larger than 1:5000 scale and 50 cm resolution once and then re-using at different levels such as Region and Nation with graphic and cartographic generalization (Figure 2).

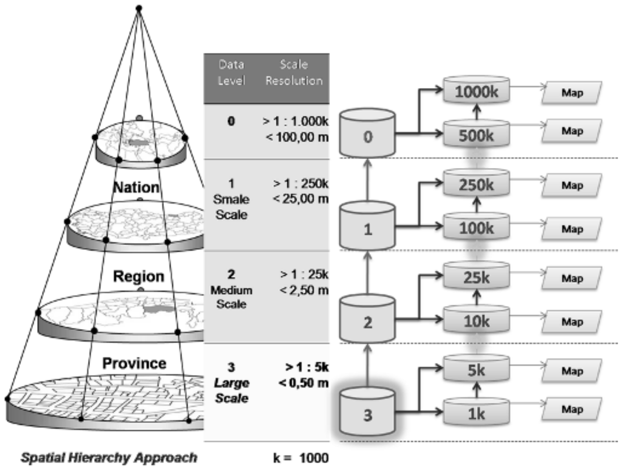

Figure 2. UVDM Scale-Resolution and Generalization

Geo-Object Identification and Versioning: A common framework was determined for the unique identification of geo-objects. These identifiers can be used to ensure interoperability among databases under national systems. This means all geo-objects shall carry a unique identifier property. In order for a unique identifier to remain meaningful, it must persist throughout the lifecycle of the object it refers to. For example, feature types defined on different data themes support data sharing for applications. For example; Numbering data sets (NUMA) in Address Data theme (AD) can be related to Building data sets (YAPI) in Ownership/Building data theme (MU) to support various local applications. Temporal feature class is produced for each feature class to manage the data temporally.

3.2. An example Application Schema: Address (AD)

Application schemas of the data themes include documentation, catalogues, and UML application schemas. The data specification for address data theme (UVDM:AD) is required to facilitate the interoperability of address information from all country. Address reference data not only provide data in its own right, but also has the useful property to link information from other data sets. General properties of these application schema on Figure 3;

- On AD data theme, Numbering (NUMA) feature class define fixed location of properties. Attributes of NUMA feature classes includes position as point, origin, identifier as CNTA, status, object versions, and like this.
- Each NUMA object has an address defined with sub-address components such as Administrative unit name, street name, numbering of gate, post region, and like this. These components are managed in a ADRS table that enables to get point geometry of address with "address locator mechanism".
- Each NUMA object is defined in a post region (POBI) and points the location of Landmarks (ILNO) defining urban functions like shops and touristic buildings.
- Properties of any building are defined in BABO class with sub-address that is related to NUMA object.

The relationships between UVDM themes are modelled by associations;

- A numbering object with address is defined in a District/Village (MAKO) object in IB data theme.
- A numbering object with address represents a Building (YAPI) object or parcel (PARS) in MB data theme.
- In order to be able to express that two sides of a road carry a different name a class called Road Description (YOTA) is included in AD data theme. This association defines which numbering object in AD theme is related to which road in UL data theme.

The relationships to other sector and institutional databases are modelled by associations;

- National Address code (UAKO) of UVDM enables Urban GIS applications to combine with the databases of Ministry of Interior.
- BABO class can be associated with urban utility functions of municipalities and public institutions, such as electricity, water, gas, and like this.

4. CONCLUSION

Geo-database Model called TURKVA:UVDM can provide an effective approach on geo-data management. Common terminology and definitions are key factor for data harmonization. Conceptual model components enable to manage the data in terms of linking, sharing and multiple use. UML data modeling also supports inheritance, aggregation, composition, and association among feature classes. By this way, this common approach enables to balance heterogeneity on geo-data management towards building national GDI.

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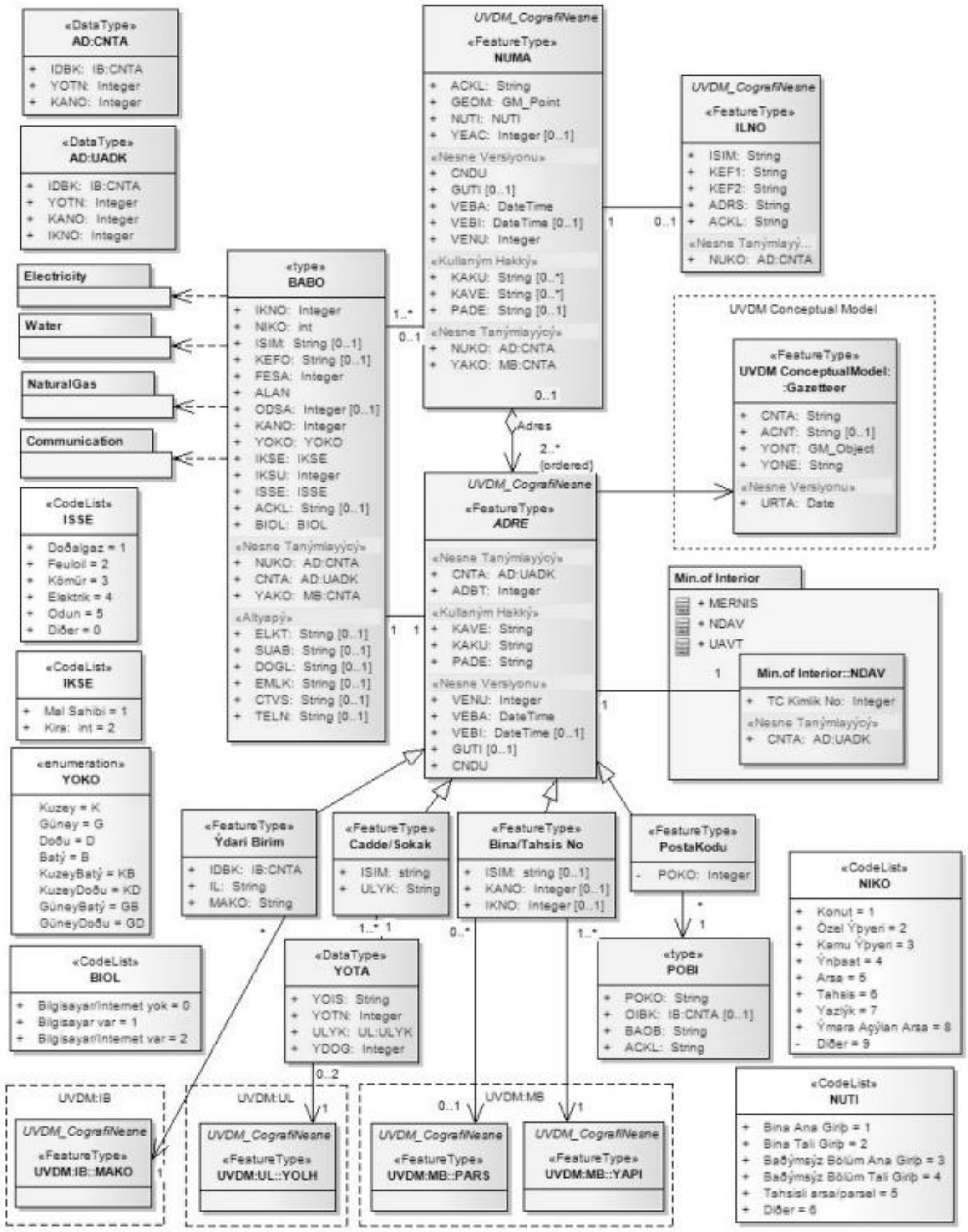

Figure 3. UVDM:AD Address Application Schema