INSPIRE Infrastructure Build-up in Estonia

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Abstract

This paper concentrates on the methodic of complying with INSPIRE requirements in conditions where the project is under pressure both in terms of time and budget. The goal was to discover and view services for the spatial data and according metadata that is described in INSPIRE directive Appendix 1 and 2 (INSPIRE). Another objective was also to create Estonian GeoPortal with its subpages and administrative tools that could be used to add and maintain spatial data and metadata.

1. Spatial Data Infrastructure for Estonia

According to a directive by the European Commission (INSPIRE directive, 14. 03. 2007) an "infrastructure for spatial information" (SDI) means:

a) metadata, spatial data sets and spatial data services
b) network services and technologies;
c) agreements on sharing, access and use;
d) coordination and monitoring mechanisms, processes and procedures, established, operated or made available [1].

Spatial data infrastructure (SDI) ensures that geographically referenced data held by public authorities, i.e. national spatial data, are available and reliable. In order to achieve availability and reliability, we need data, technologies, legal regulation and mutual agreements. Thus, SDI is much more than simply a database or a geographic information system [2].

There are many national databases in Estonia that contain spatial data: Estonian topographic database (ETAK), Cadastral register, Register of construction works, Register of roads, Environmental register, Addresses data system (ADS), etc [2]. It is extremely important that these spatial data are of high quality, well-described and easily discoverable. In addition to these spatial datasets of national level, there are more than one thousand different spatial data producers in Estonia. Hence, the Estonian SDI must be a common "gateway", through which spatial data that are owned by the Estonian state, local governments and other legal persons governed by public law, can be published and made available [2].

The objective of SDI will be achieved when the interoperability of different spatial data generates a considerable added value. Basically, this means that the provided data and services must conform to certain standards. Spatial data must be unambiguous, i.e. semantically described; they must contain metadata with a common structure [2].

All of the above is regulated with different regulations starting from laws and ending with recommendations, cooperation agreements and guidelines both in the world and also in Estonia. In Estonia, this field is regulated by the Spatial Data Act (17. 02. 2011) [3] and Public Information Act, implementing rules of the INSPIRE directive and different regulations, development plans and framework documents [2].

By these Acts and Laws, the coordinating role in building up the Estonian SDI was given to the Estonian Land Board (ELB). In the year of 2010, the public procurement to create the Estonian SDI was opened under the egis of ELB and the competition was won by AS Regio.

2. Estonian SDI architecture

2.1. Technical Concept

In the second half of 2010, AS Regio began to work out a technical solution to meet the requirements made by the Estonian Land Board for INSPIRE-compliant Estonian Spatial Data Infrastructure (SDI). The following list describes shortly the solution proposed by AS Regio:

a) Using common practices and capabilities of base software as much as possible;
b) Combining common practices and base software with open source components, in order to reduce the license- and maintenance fees and achieve better performance;
c) Taking local customs and traditions into account: by including best GIS and portal creation specialists from the country.

After examining the existing solutions and software on offer, we made our decisions about the core technology for this project.

By creating INSPIRE-compliant infrastructure, ESRI has been — by no doubt — one of the leading component providers, thus the ESRI technology was also chosen as a so-called backbone for the Estonian project. But not all functionality needs licensed products that have high maintenance costs, — for database

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software we used Postgre/PostGIS, and to serve thin clients, we used OpenLayers. For GeoPortal we used the open expansion of ESRI Geoportal Server.

The first version of concept for Estonian SDI, proposed to review in Estonian Land Board at the end of Q3 2010, did not consist ArcGIS for INSPIRE and ConTerra SDI software. Deeper analysis made it clear that by this way, it is hard to meet budgetary and project deadline requirements. After further discussion, we came to the conclusion that the usage of ArcGIS for INSPIRE and ConTerra SDI components should give an advantage in time and money.

2.2. Estonian SDI data system architecture

The initial task from Estonian Land Board set 3 main data sources for Estonian SDI (Fig. 1):

a) Spatial datasets required by INSPIRE Annex 1;
b) Metadata about spatial datasets;
c) Spatial data from different data owners.

ArcGIS for INSPIRE technology from one side and data content prescribed by customer's requirements form other side dictated databases architecture solution.

The key for INSPIRE view service is **repository** (Fig. 1): an ESRI geodatabase. All INSPIRE view services in this project were created by ArcGIS for INSPIRE. The data structure in this geodatabase was created from ready to use XML Workspace template, distributed by ESRI. Initial spatial data from Estonian Land Board databases is automatically uploaded and into repository. Data upload and upgrade mechanism was created by Regio.

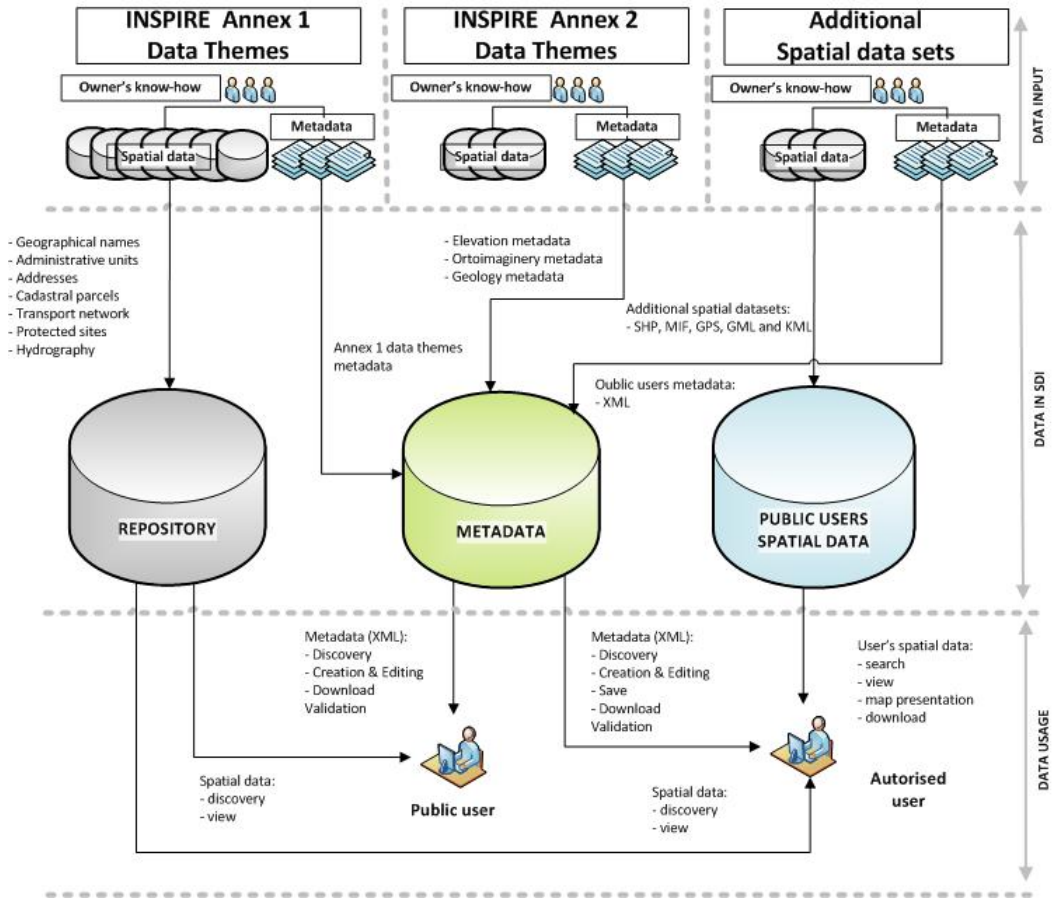

Fig. 1. Dataflow into Estonian SDI

The volume for **metadata** (Fig. 1) is the source for INSPIRE discovery service. Discovery service was created by ArcGIS especially for INSPIRE. The tasks of creating, uploading, validating, editing and sharing metadata were solved on the base of ESRI Geoportal Server. The task of sharing and distributing metadata was managed via ConTerra SDI components and LDAP (Lightweight Directory Access Protocol).

An additional ESRI geodatabase was set for **spatial datasets from authorised users** (Fig. 1). User-specific datasets that do not fall under the INSPIRE Annex 1 spatial data themes are also included in this database. Aforementioned data are available from the geoportal, but are not included to INSPIRE view service. A geodatabase for users' datasets, various geodata services, WMS and webmap applications for Estonian geoportal were developed by AS Regio on the platform of ESRI ArcGIS Server (Estonian GeoPortal).

In addition to the three main volumes for spatial data and metadata content, some other databases were created to store knowledge about content management (CMS), users, user rights and rules.

2.3. SDI schematic architecture

For INSPIRE services, the virtual servers (Fig. 2): **ESRI ArcGIS**, **Geoportal Repository** and **Databases** form the main engine of the SDI. All operation systems run on 64-bit mode.

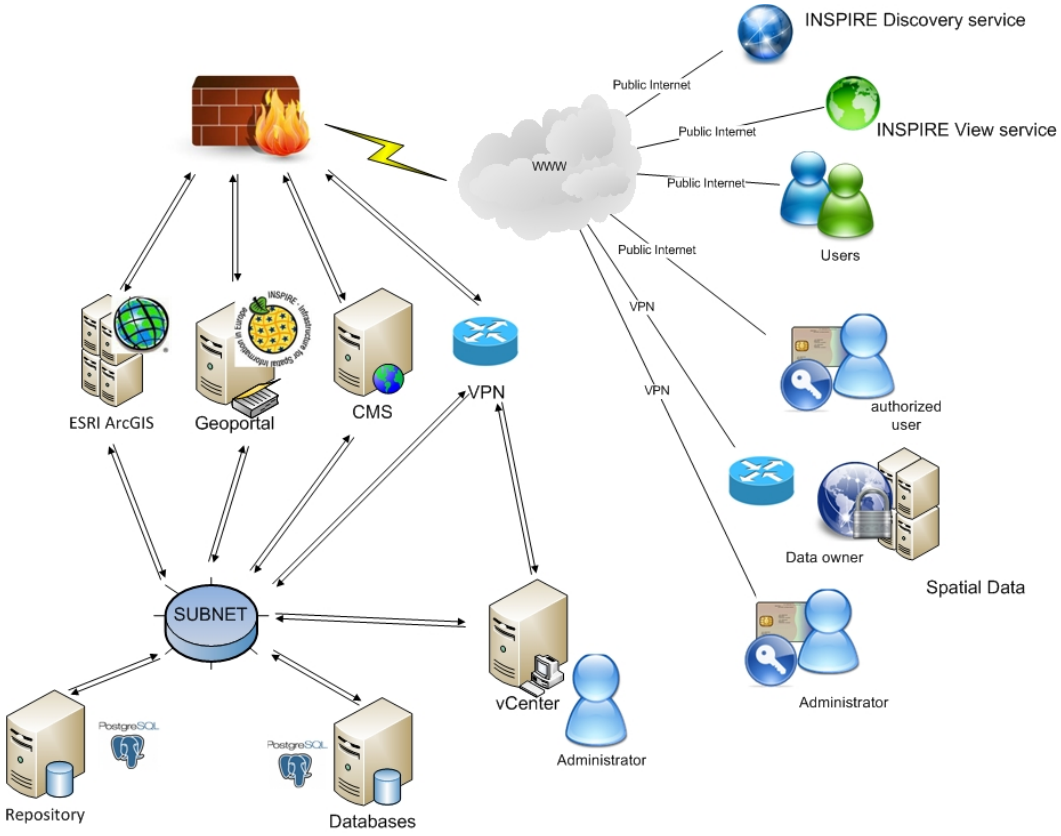

Fig. 2. Estonian SDI architecture

Windows 2008R2 server **ESRI ArcGIS** is the home for ArcGIS Server Standard Enterprise ver 10.0 SP3 (Java), ESRI Data Interoperability and ArcGIS for INSPIRE 1.0 SP2. This server has many important roles in the Estonian SDI:

- all data upload and upgrade mechanisms run in this server (as ArcGIS Server geoprocessings);
- by the ArcGIS for INSPIRE, the INSPIRE view and discovery services were created and served into Geoportal and Internet;
- ArcGIS server generates a map service for webmap application in Geoportal.

Windows 2008R2 server **Geoportal** has installed:

- ESRI Geoportal Server ver 1.2;
- Apache TomCat v. 6.0.33;
- ConTerra SDI suite Service Monitor;
- ConTerra SDI suite Security Monitor;
- Webmap application developed by Regio;
- Geocoding service for webmap, Regio standard product (JGC).

The content of **Repository** and **Databases** are described above (2.2 Estonian SDI data system architecture).

3. Data upload and refresh system

3.1. Initial task for developing data system

The data design and data models currently used in Estonia did not correspond to the INSPIRE specification data models. Thus, the following things were necessary:

a) Detailed analysis of the data.
b) Creating corresponding data structures for INSPIRE-compliant spatial data repository, creating transfer and update mechanisms for data and making them flexible enough to be used in the future.
c) Loading the data into the database with initiating the update mechanisms.
d) Creating the Estonian GeoPortal to access the INSPIRE discovery and view services.

3.2. Technical solution

Under the constant pressure concerning the deadline and budget, we needed a time- and resource-saving method for developing data systems.

The decision to use ready repository data structures from ESRI saved us some time, but still not enough – additional months for developing were still needed. Our project data team had a very heated discussion about the

situation, which resulted in a consensus about the developing process and also the decision to use ESRI ArcGIS ArcModel, ETL-tools and Toolbox in combination with Python scripts. Undoubtedly, the most significant decision we made was doing the data converter developing and data analysis at the same time.

ESRI graphic programming tools provide convenient ways to achieve a self-documenting developing process. A graphical presentation of ESRI tools with comments in human-language is an exhaustive document for describing correspondences between initial datasets and tables and ESRI feature classes in repository. The main advantage of this method is the ability to test the work of converters - the engines for automatic data upload and upgrade mechanisms in Estonian SDI - in every stage of development. After testing in desktop workstations, the ESRI geoprocessing services were created on the base of these converters.

All INSPIRE Annex 1 data themes have their own upload and refreshing mechanisms. Every mechanism consists of two branches: initial upload and regular refreshing. A quick review of data upload or refresh process is given as a convenient RSS feed. A more detailed view can be had when observing the data import reports, these reports are versioned by date and time. It is important to mention that all report files have a backup and are available for a long time.

Below, we describe the converters in detail, using the sample of address theme.

3.3. Addresses and address components renewing mechanism

The toolbox consists of different tools created with ArcModel, ETL and Python (Fig. 3). The naming rule is *<tablename in repository> + process name*.

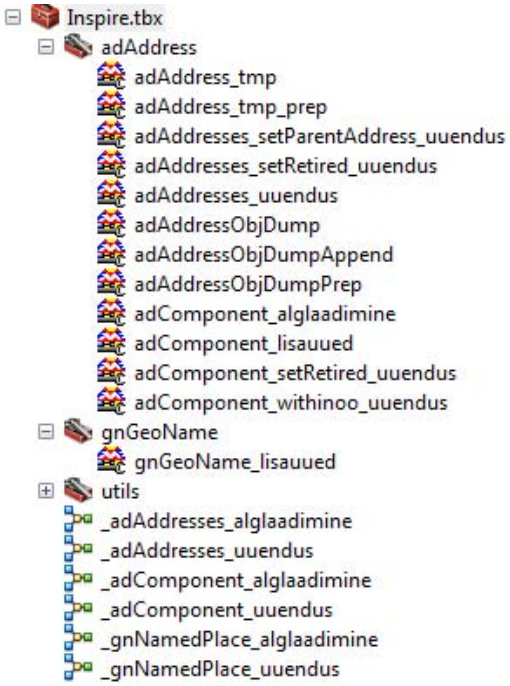

Fig. 3. INSPIRE toolbox for address data

Below, some components are presented in detail. For address data, these two toolsets were developed:

– adAddresses_alglaadimine – for initial upload;
– adAddresses_uuendus – for data refresh.

The initial upload process (Fig. 4) deletes all data in repository address theme tables and uploads full dataset into repository. The data refresh process (Fig. 5) only takes changes from initial databases and refreshes the SDI repository address theme tables.

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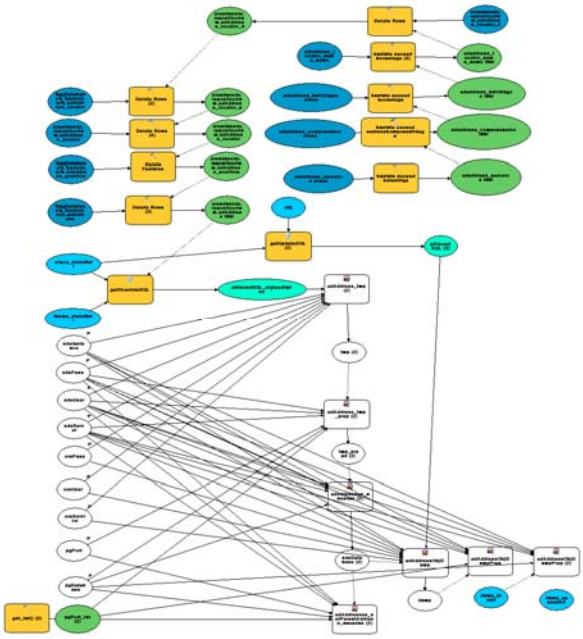

Fig. 4. Address data initial upload process (adAddresses_alglaadimine)

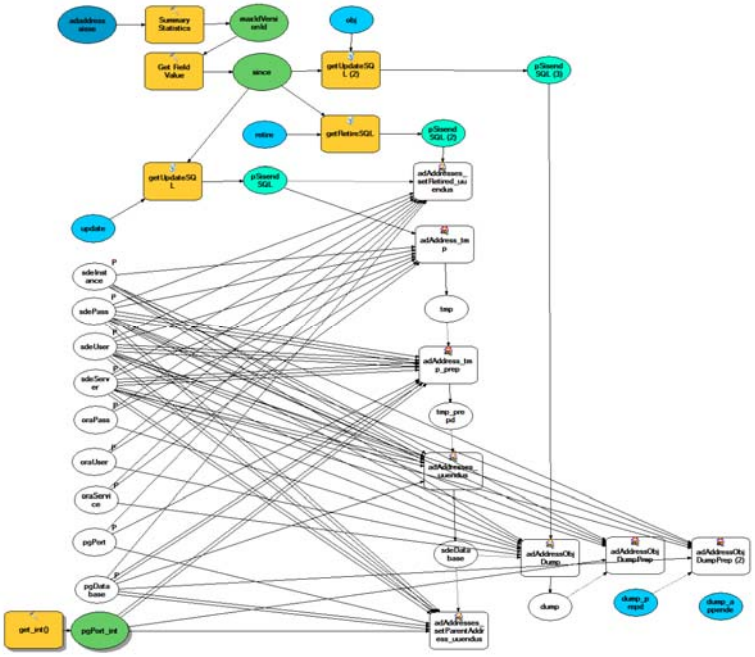

Fig. 5. Address data refresh process (adAddresses_uuendus)

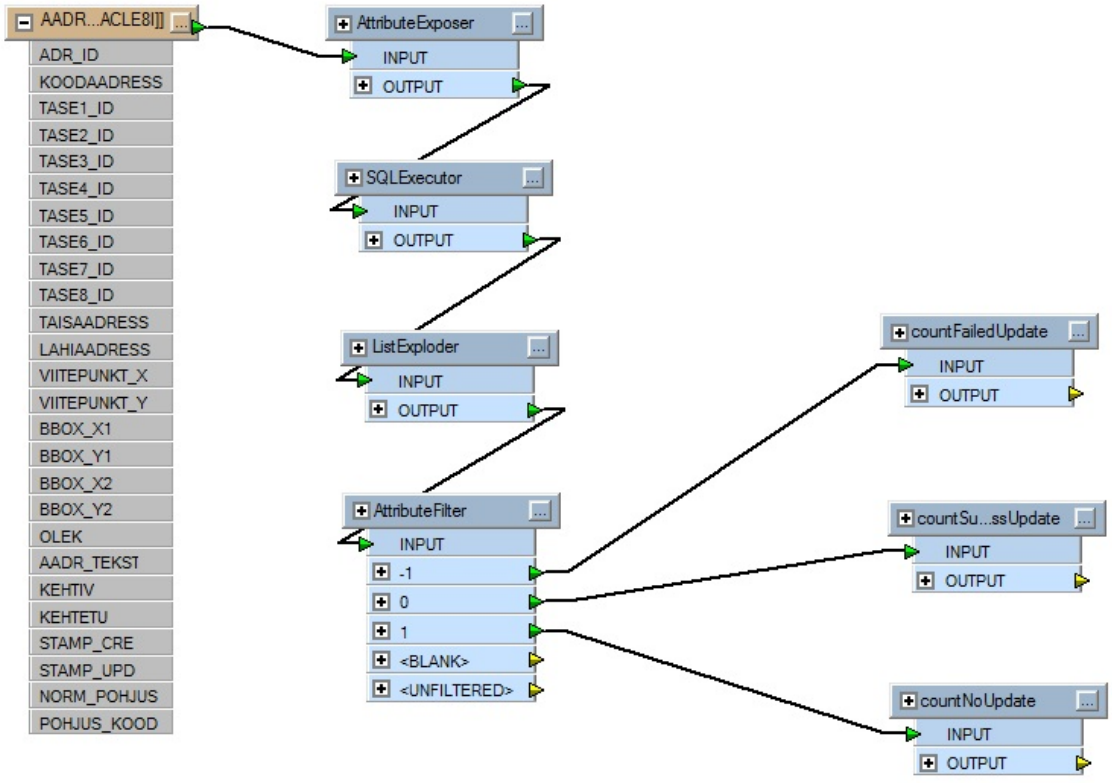

Fig. 6. The process for retried addresses (adAddresses_setRetired_uuendus)

3.4. Estonian SDI data system development team

We, Mati Tee and Tanel Ilves, would also like to use the opportunity to thank our team members once again. The skills, enthusiasm and experience of these talented people were absolutely irreplaceable to make this project happen.

This job was done by AS Regio data specialists:

– Mati Tee, MSc, team leader
– Tanel Ilves, MSc, process analytic
– Priit Madisson, BSc, data specialist
– Tõnis Kärdi, MSc, data analytic
– Aarne Luud, PHD, data analytic
– Kaido Irdt, GIS engineer.

For our team, working on an interesting project such as this one, was essentially a source of valuable experience - we plan to use the skills and knowledge we acquired to be even more efficient in our work in the next stages of INSPIRE-compliant projects.

4. Conclusion

In the end of the first quarter of 2011, our data system development team consisting of experienced specialists in various fields, started working on the Estonian SDI project. As we had predicted, the usage of ready-to-use base software, ArcGIS for INPIRE from ESRI, resulted in a quick success. The functional prototype - with started INSPIRE services and data repository - was ready in a few months. It is worth mentioning that perhaps the hardest task of the entire project was creating the automatic data upload and refresh mechanisms between INSPIRE repository and original datasets. After careful consideration, our team came up with the following solution: the technical part is based on ArcModel and ETL-tools usage. By December 2011, the data upload procedures for INSPIRE directive Annex 1 datasets were fully started. It can be said with great contentment, that by the end of the first quarter of 2012, all developing was finalized, resulting in the Estonian Spatial Data Infrastructure – which, in turn, is now a part of the Infrastructure for Spatial Information in Europe (INSPIRE).

With the above-mentioned process, the first stage of creating INSPIRE-compliant Estonian SDI is finalized: view services and automatic update mechanisms have been created for Annex 1 data, metadata can be found through discover service, also the freely accessible Estonian GeoPortal was created.

Литература

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Инфраструктура пространственных данных Эстонии, созданная в соответствии с директивой INSPIRE

М. Теэ, Т. Ильвес

Статья описывает работы по созданию Эстонской инфраструктуры пространст-венных данных. Целью разработки является достижение доступности по предостав-лению пространственных данных и метаданных, в соответствии требованиями директивы INSPIRE (INSPIRE). А так же процесса создания Геопортала Эстонии, состоящего из различных сервисов и административных инструментов, которые могут быть использованы для введения и редактирования пространственных данных и метаданных.

Общие работы начались в начале 2011 года, и уже в первой половине 2012 года готовая система была передана заказчику.