# A twinning experience in prototyping a NSDI in Romania

Jandirk Bulens[1], Marcel Schram[2], Gabriela Dragan [3], Daniela Docan [4]
[1]Centre for Geo Information, Wageningen University and Research Centre,
jandirk.bulens@wur.nl
[2]Kadaster, marcel.schram@kadaster.nl
[3] ANCPI, gabriela.dragan@ancpi.ro
[4] ANCPI, daniela.docan@ancpi.ro

**Abstract**

As part of the PHARE Twinning project Geodetic network modernization and spatial data infrastructure framework in 2007-2008 the Romanian National Agency for Cadastre and Land Registration (ANCPI) and the Dutch Kadaster International developed an operational prototype according to the principles of INSPIRE and international spatial standards. The prototype is meant to demonstrate the set up of a Geoportal and it's functioning. There are two Geoportals set up. One will act as a National Geoportal for discovery of spatial information. The other is an organizational Geoportal (data delivery or download portal) to provide information and access to the geo-products of the ANCPI.

For the National Geoportal the selection of the data to be included is defined by trying to describe a real world use case. In cooperation with the Ministry of Regional Development and Housing a collection of data sets was identified in the process of regional planning. The area selected is the municipality Faurei in the Braila county For this area data were available from an earlier project in a digital format. The ANCPI Geoportal is set up as a web shop portal to find, view, display metadata and to create a shopping list ready to be ordered. Since the Geoportal will act as a demonstrator no real order and payment service is included.

To build the portal available Open Source and/or freeware software components were used to show that creating web services is possible without the help of licensed market GIS products. For the client application the Luigi Framework of Alterra - Wageningen UR is used, a customizable freeware software product for front end web applications. Except for the web client all components are easy to configure with the help of manuals available on the Web. Since all data has to be published in catalogue services the proper metadata had to be created and included in the metadata repository used by the metadata server. This process showed to be very helpful to show the relevance of creating metadata. The data and map services are meant to show the use of Geoportals and are neither complete nor quality checked.

An overall conclusion is that Geoportals as a base for the Romanian SDI will work when set up according to the principles the prototype is designed. The little number of datasets included in the prototype indicates there is still a lot of work to do. Especial the transformation of existing data in properly structured digital spatial data sets will take a lot of effort. But there is a lot of ambition to develop a SDI in Romania.

**Keywords:** NSDI, Romania, INSPIRE, Data Delivery Geoportal, Web shop Geoportal, standards, Luigi

## 1 INTRODUCTION

Romania is undergoing rapid changes due to the process towards and the membership of the European Union, among others. Also the geo-information sector in Romania is facing many challenges that are to a major extent related to EU initiatives. One of the most important drivers is the Directive for an INfrastructure for

SPatial InfoRmation in Europe (INSPIRE). INSPIRE will build on the National Spatial Data Infrastructures (NSDI) of the EU Member States.

Cadastres and National Mapping Agencies (NMA) are important stakeholders of a Spatial Data Infrastructure (SDI). Through the PHARE Twinning project Geodetic network modernization and spatial data infrastructure framework the National Agency for Cadastre and Land Registration (ANCPI) initiated the further development of the NSDI of Romania together with its Twinning partner Kadaster International. The main objective was to develop a Strategy and Implementation plan for the NSDI, supported by a first attempt to set up the National Romanian Geoportal (Bulens et al, 2008). For the implementation of the NSDI an organizational structure is proposed based on the experiences of the Netherlands' Kadaster. The chosen organizational structure suits its purpose and consists out of three layers: the political responsibility, the decision making level and the operational and technical layer. It is built on the notion that all the relevant stakeholders have to be involved and the primary responsibility for the NSDI is taken by the national government (Schram et al, 2008).

The Dutch and Romanian Cadastre worked together to raise awareness and commitment for realizing the Romanian NSDI. An inventory had taken place on previous studies on the subject, interviews are taken with the most relevant stakeholders and workshops are organized. One step to be recommended to identify and start with the core data sets, and the development of one national access point for geographic information: the geoportal. A prototype was developed to be able to demonstrate the possible use of such a NSDI (Bulens et al, 2009).

## 2 TECHNICAL ASPECTS OF SDI

Developing an SDI technically is all about interoperability and easy access. Interoperability is achieved by decide to use a common language. Semantic standards and harmonization are the most important in order to fully understand the meaning of the information intended to be shared. But also in the technical sense it is crucial to use common standards in order to build applications being part of the infrastructure. Applying standards will enable access to spatial data. In that way many stakeholders can join in and benefit from the available data in as many ways as possible, though by keeping the existing legacy and legal aspects in mind. ICT is constantly evolving in a way of understanding how this can be achieved as successfully as possible. For SDI the technology itself is not the decisive force, but the architectural model that describes how the technology is implemented.

Currently, the most common way of implementing ICT for SDI is by using the so-called service oriented architecture (SOA). SOA is an application architecture within which all functions are defined as independent services with well-defined evocable interfaces, which can be called in defined sequences to form business processes. The services communicate with each other by passing data from one service to another, or by coordinating an activity between two or more services (www.wikipedia.org). SOA concepts are often seen as built upon, and evolving from older concepts of distributed computing and modular programming. And in future SOA on its turn will evolve into the next generation type of model.

## 3 SERVICE ORIENTED ARCHITECTURE FOR THE GEO-DOMAIN

A Web services framework consists of a publish-find-bind cycle, whereby service providers make data, content or services available to registered service requesters who consume resources by locating and binding to services. Requesting applications tune themselves to Web services using WSDL (Web Services Description

Language), which provides low-level technical information about the service desired, grants applications access to XML Schema information for data encoding, and ensures that the right operations are invoked over the right protocols. These ideas are shown in the Figure 1.

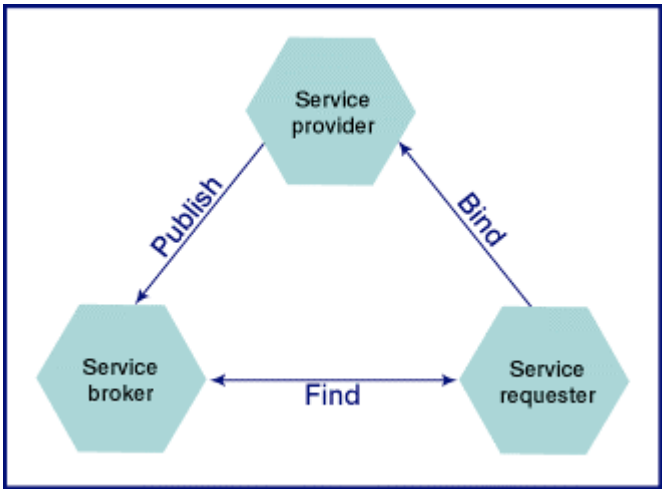


**Figure 1 The Publish- Find- Bind concept**

In the geo domain these operation apply to specific actions. Service providers use Open Geospatial Consortium (OGC) web mapping services (maps: WMS, features: WFS and/or coverages: WCS), to create web services containing spatial data, they use catalogue services for the web (CS-W) to publish their metadata. The consumer will bind the data service found in the catalogue.

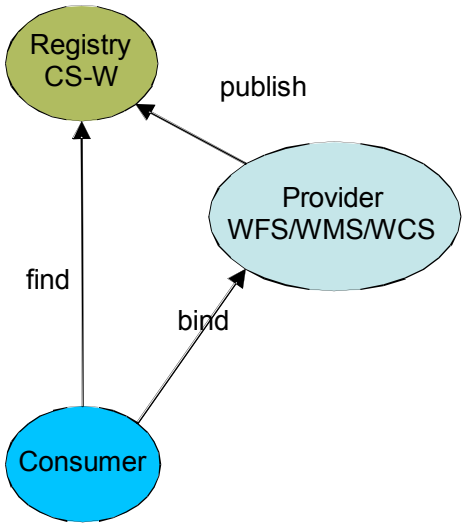


**Figure 2 The Publish- Find- Bind concept applied to geo**

## 4 OGC WEB SERVICES

Underneath is a schematic overview of the different components of a SOA implementation for SDI. The paragraphs thereafter explain the different components. Additional information can be found at the website of the Open Geospatial Consortium (OGC, http://www.opengeospatial.com).

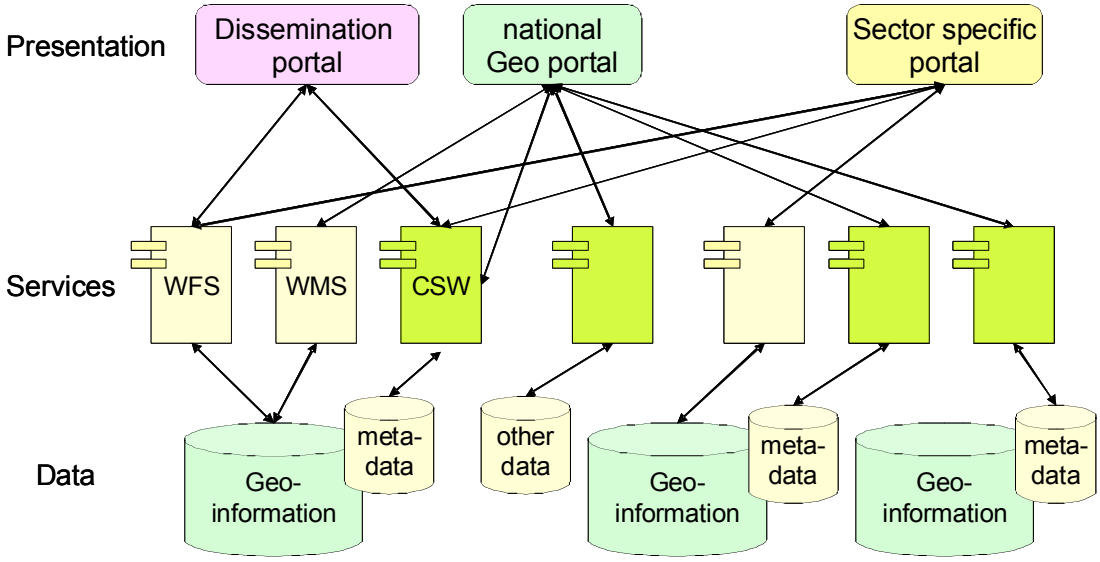


**Figure 3 Service Oriented Architecture components in the geo-domain**

Geo-information is created by manipulating geographic (or spatial) data in a computerized system. Geo-information comes in many different forms, such as maps created with data of ground surveys, but also of images taken from the air or from space, i.e., remote sensing data. To deliver these spatial data there are different services defined to the nature of the data being served.

## 5 GEOPORTALS

The services are available for the user in client applications. For spatial data this will typically be a geoportal. Geoportals are expected to play a prominent role in the efforts of many local and national governments in making their geodata better findable and more accessible to potential users. A geoportal can be defined as a website that presents an entry point to geoproducts on the web. A more precise definition is impossible for two reasons: the gradual scale (what exactly is a geoproduct, how much “geo” must there be in a portal in order for it to be called a geoportal?) and the fact that the term is relatively new. As a consequence of being new, the definition is gradually taking shape as it is being adopted by its users and software producers. In practice though, the term geoportal is used mostly for facilities specialised in geodata. There are geoportals where geoproducts can be directly accessed and there are those which only provide product information plus ordering instructions. Geoportal users can range from members of a single large organization (an intranet geoportal), to members of a specific community, up to users from all over the world. (Oort et al, 2008)

Technically the geoportal is the place where the geo-information can be found on the web. Ideally, all governmental geo-information should be available in this portal. More ideally, it should be accessible through the national governmental website. Currently, there are no official implementation rules or regulations how to implement a portal on the web. In itself this also explains the nature of a geoportal. Any provider of data should be able to publish his or her data on the web. All geoportals together should be seamlessly accessible by their metadata using a mechanism to search (or harvest) the available catalogues forming a real spatial data infrastructure (SDI). The only problem still existing is to find all the different catalogues to find the data in the catalogues. To overcome this within the INSPIRE directive it is proposed to organize this nationally (by setting up national geoportals) and to harvest in Europe in the INSPIRE/JRC European geoportal all the metadata of the national geoportals.

In this paper we consider two types of geoportals, 1) 'discovery geoportals' and 2) 'data delivery geoportals'. The only difference is the accessibility of the real data in the second type geoportal. Be aware that data delivery is not necessarily free of charge and ordering and payment are technical supported by components that are part of the data delivery geoportal (webshop). A data delivery geoportal is setup by the owner of that data. In that sense these geoportals are usually limited to the number of datasets owned by the provider. At the other hand this follows the INSPIRE principle of obtaining and maintaining data at the source.

## 6 DISCOVERY GEOPORTALS

People looking for geoproducts that have no clue where to find those geoproducts are best served with a national geoportal that includes information on all available products across the country. The main function of such a portal is discovery of products and their specifications. Typical functionality within such a portal would be:

- Search and browse for products;
- View search results;
- Refinement of search results;
- View product information: summary or all details;
- Preview product;
- Compare products.

So, a discovery geoportal contains elements of a search engine and a directory and the handling of search results is tailored specifically to geoproducts. Most standard software products for creating a geoportal are of this type. Examples include ESRI's GIS Portal Toolkit (commercial software (ESRI, http://www.esri.com)) and FAO's GeoNetwork (open source software, (FAO: http://www.fao.org/)). Discovery portals should be designed for publishing information on a large number of products, so functionality to drill down efficiently and effectively in the product catalogue is essential. A well-designed discovery portal will likely have functionality to both narrow and widen search results.

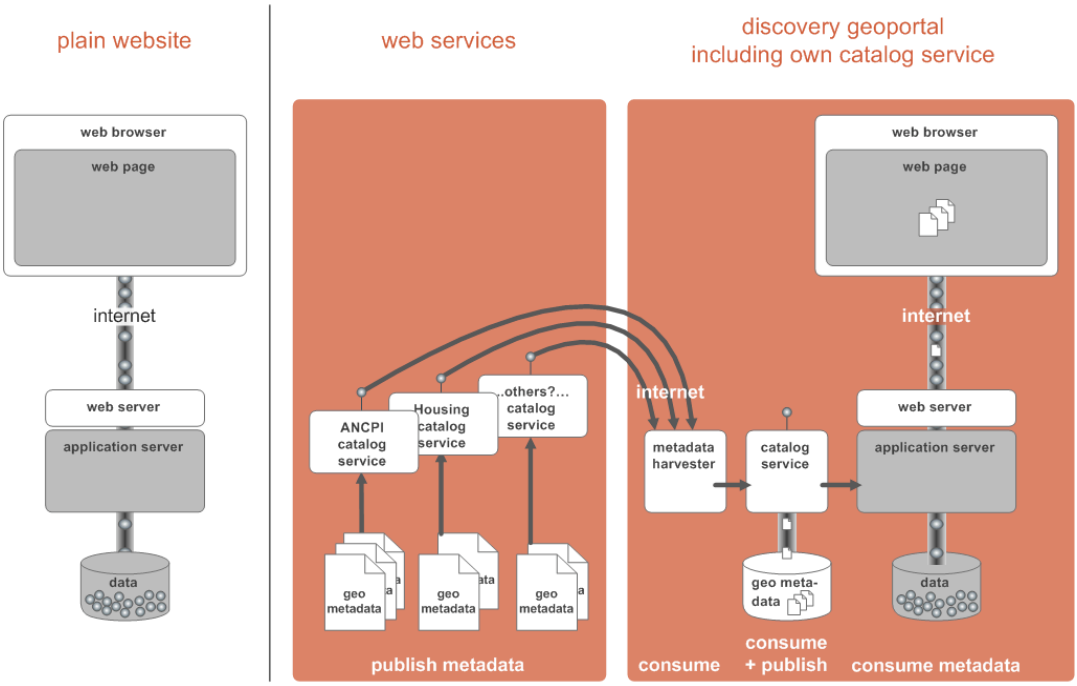


**Figure 4 Architecture of a discovery portal with geo metadata storage by an additional software component: a catalogue web service. This catalogue both consumes and publishes metadata by aggregating metadata of other catalogues and re-publishing it for use by the discovery portal and third parties. For reference purposes the left side of the figure depicts the architecture of a plain website**

## 7 DATA DELIVERY GEOPORTALS

Organizations that sell geoproducts may sell them through the Internet. That means they need a website that serves as a data delivery geoportal or web shop for their geoproducts. Geoproducts sold through the web could be of any kind: digital maps, paper maps, consultancy services, training services, GIS books, etc. Any product or service can be described and offered for sale on a web page, including free products.

Within the Romanian NSDI the geoportal of ANCPI is a typical data delivery geoportal (see Figure 1). A data delivery geoportal includes at least a product catalogue. Organizations that charge money for their products or require that users sign an agreement before they are allowed to use their products will include registration functionality and possibly ordering functionality in their portals. The differences between a data delivery geoportal and a discovery geoportal:

1. Data delivery portals typically contain a small number of products compared to discovery portals;
2. As a consequence of 1) the design could be tailored to showcase the products in an optimal fashion. The software of data delivery geoportals is often custom written;
3. As a consequence of 1) data delivery don't need extensive search functionality to drill down through a large amount of products in the product catalogue;
4. Data delivery portals are often owned by a single geoproduct producer, while a discovery portal is often a joint service of a group of organizations;
5. As a consequence of 4) a data delivery geoportal is often integrated as a sub-site of a corporate website, while a discovery portal is often an entity itself;

When a user wants to obtain a geoproduct a data delivery geoportal will send the user to it's ordering page while a discovery portal will redirect the user to another geoportal: the supplier's geoportal. The supplier can tailor that redirection to a specific product page by publishing the product page's URL in the metadata of his geoproducts.

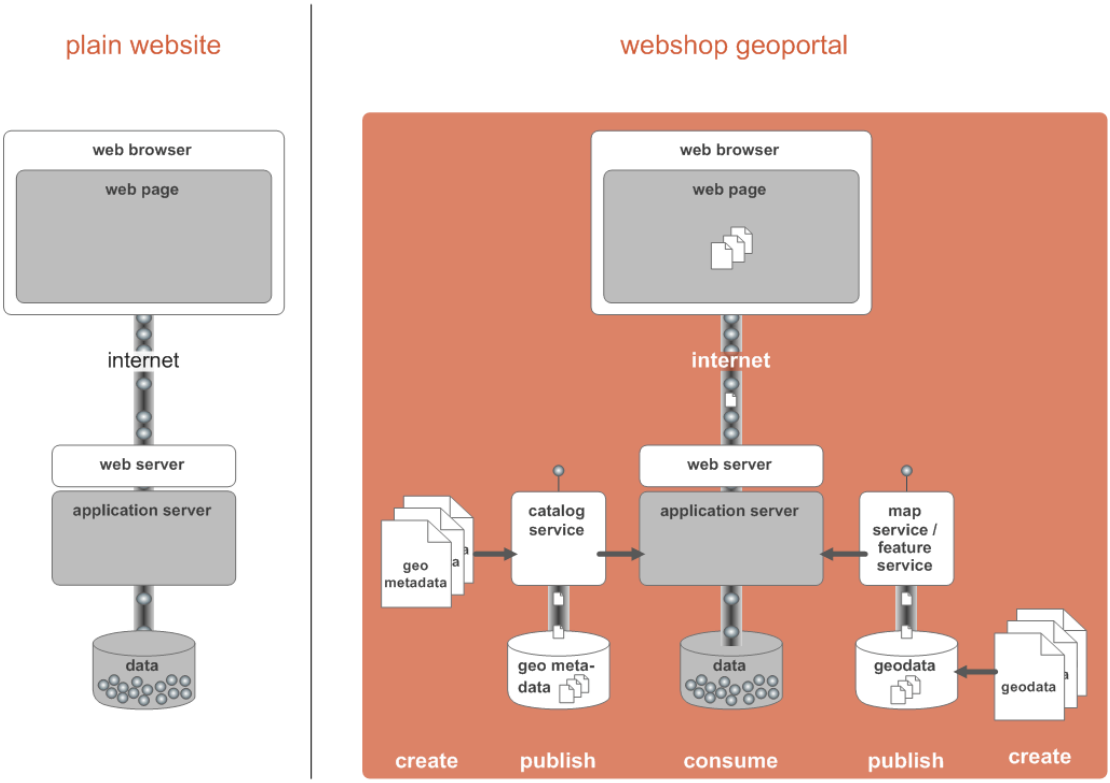


**Figure 5 Architecture of a data delivery geoportal. For reference purposes the left side of the figure depicts the architecture of a plain website**

## 8 INSPIRE NETWORK SERVICES ARCHITECTURE

The INSPIRE network and services architecture is designed according to a Services Oriented Architecture. As a reminder this paragraph contains the most relevant technical related issues mentioned in the directive. The network architecture explicitly uses the following services:

- discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata;
- view services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
- download services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
- transformation services, enabling spatial data sets to be transformed with a view to achieving interoperability;
- services allowing spatial data services to be invoked.

In addition to the service types requested by the INSPIRE directive further services are needed to run an interoperable spatial data infrastructure. There is a need at least for registry services that provide access to resources describing the data in order to allow for a correct processing and interpretation of the data. These registers need to be maintained properly and have to have a clear and well-defined governance model. It is important that all registers keep track of all changes so that data created with reference to an outdated register can still be interpreted completely and correctly; i.e. superseded or retired register items will remain in the register. A key characteristic of a register is that every item in the register is associated with a unique, unambiguous and permanent identifier. In addition all necessary information to specify the meanings that are assigned to the item is described. The number of registers that need to be maintained in the infrastructure can be significant. As a result, a clear and sustainable operational model forms a key part of the setup of the infrastructure.

Registry Services are not explicitly asked for by the directive and therefore will most likely not be in the Implementing Rules. Nevertheless as part of the infrastructure implementation, registry services will be implemented.

## 9 SOFTWARE AND TOOLS

As mentioned before because SOA is relatively new software and tools are scarce. GIS software vendors are starting to market their first products in this field. ESRI for example have the GIS Portal Toolkit to support geoportal development (ESRI, http://www.esri.com)). GeoNetwork is an open source bundle of software with components to create SDI's and its components (FAO http://www.fao.org/). The RGI-project Geoportal Network (Geoloketten) in the Netherlands also bundled there tools and experiences to create SDI components (Zevenbergen et al, 2009). For editing XML documents and modeling in UML there are many products (commercially and open source) available since these techniques do exist for many years now. For editing metadata the University of Zaragoza in Spain developed an open source tool CatMDEdit. The most difficult issue in providing software and tools is that standards are still evolving and new releases do follow each other in e relative short time. Therefore efforts made in developing tools and software components are not paying back. Secondly there is still little experience in working with these standards and implementing rules. This will improve quickly now since organizations start working with it now. Also invoked by developments initiated by INSPIRE.

To demonstrate what is needed for a National Spatial Data Infrastructure, together with the ANCPI a prototype is developed for Romania. The data included in this NSDI are selected based on the use for a specific user group. This user group contains the regional and local administrations dealing with territorial plans. Together with the Ministry of Regional Development and Housing this selection is made. The prototype is build using OGC standards, INSPIRE implementing rules in as far as they are known in 2008 and open source or free available software and tools. The intention of the prototype is not to be the future national geoportal for Romania, but to demonstrate and show the NSDI in a real operational environment. It is hosted by the ANCPI. The prototype is described in the next sections.

## 10 THE ROMANIAN PROTOTYPE

For the prototype we distinguished two types of Geoportals: discovery Geoportals and data delivery or webshop Geoportals, see the following figure:

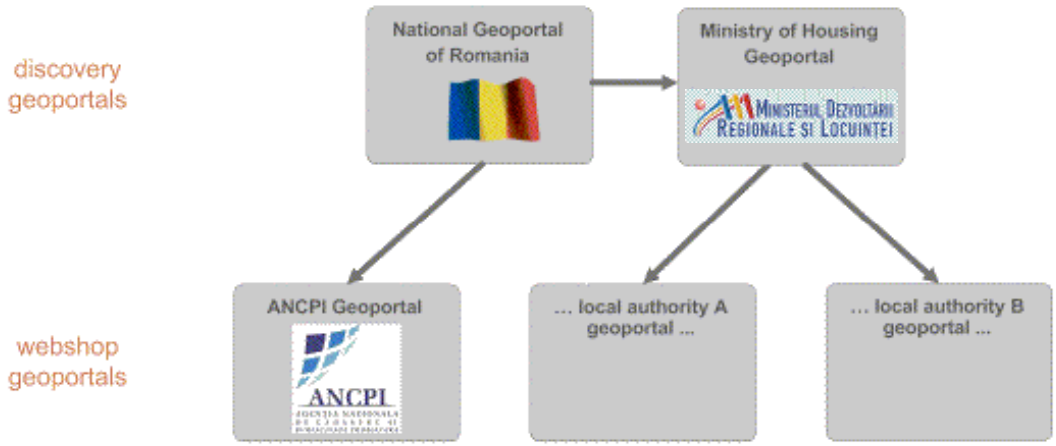


Figure 6 The NSDI consists roughly of two types of Geoportals: a National Geoportal for the discovery of geo-products across Romania and data delivery or webshop Geoportals for organisation specific product catalogues and ordering functionality. The Ministry of Regional Development and Housing does not own geo-products but could aggregate all relevant geo-products of local authorities into a Ministry of Regional Development and Houising.

The goal of the prototype is to evaluate and discuss the required functionality for Romania's National Geoportal (ANCPI, http://www.ancpi.ro). The prototype will only show digital available datasets, being vector data, scans and aerial photographs. The following sections describe the existing situation.

### 10.1 ANCPI Geoportal (Data delivery portal / to be extended)

The current ANCPI Geoportal is part of the ANCPI website. It offers maps and plans (ANCPI, http://www.ancpi.ro) (see the figure for an impression). Static images give an overview of the available geodata and users can order the data through downloadable forms that should be printed and sent to ANCPI by fax, email or mail. Payment is done through conventional money transfer methods. Finally, ordered data will be sent to the customer on CD or DVD.

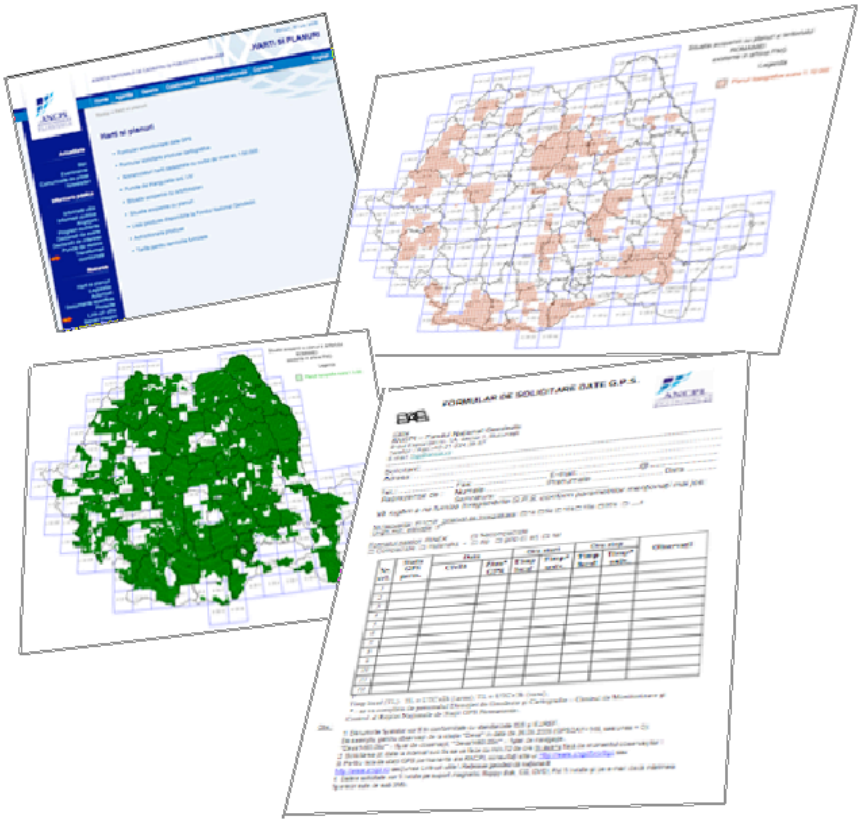

**Figure 7 Screenshots of parts of the ANCPI Geoportal**

In order to become a part of a modern NSDI, the functionality of the Geoportal of ANCPI should be extended to include web services: web map services (for e.g. the orthophotos), web feature services (for e.g. the cadastral parcels) and a web catalogue service.

### 10.2 ANCPI Orthophoto Portal (discovery portal / to be extended)

The current Image service created in the past with the help of Denmark is a good example of an electronic service for delivering data. Because of the size on disk of the images appropriate software is needed to achieve acceptable performance. For this service, commercially available software is selected to do the job. Since no OGC standards are used, the service is only available within this web application. Using the OGC standards at this stage will probably result in low performance. Therefore, this will be no option now. When more experience is gained worldwide with the OGC/ISO standards this could change. Options should be investigated to extent the current service in a way that the data also can be directly obtained using the internet by fully automated electronic means.

## 11 DEFINING THE PROTOTYPE

For the design of the prototype we wanted its use to be well defined. Describing a use case for a major user of spatial data in Romania could do that. The use case involved the design a new neighbourhood in a municipality within the urban planning process. There have been several discussions with the Ministry of Regional Development and Housing how to describe the use of the Geoportals for this use case. This work is usually done by the regional offices and the Ministry plays a coordinating role in these activities. Therefore the use case was described on a more generic level. Important however was the recognition by the ministry of Regional

Development and Housing of the relevance and usefulness of Geoportals in Romania for this purpose.

For the prototype we aimed at the professional user. The information provided to all organisations dealing with spatial data in a professional way. This can be an organisation from many different domains like utilities, environment, industry, public safety, local authorities, academia and so on.

### 11.1 Use of Metadata

Metadata are used to publish the information about data sets on the Internet so that users can find them. Because there are many data providers for spatial data it is good practice to use a standardised format to publish the metadata in. There are several standards in use of which Dublin Core Metadata Initiative (DCMI) is the most well know and used. The standard is most commonly used in the archives domain (libraries and so on). For the spatial domain there are more specific demands and requirements so the OGC and ISO have created standards on this topic. There is a metadata standard for spatial information by ISO in ISO19115. INSPIRE adopted this standard and defined a profile, a subset of all the elements in the standard, as a minimum requirement to publish spatial data in Europe. And there is an implementation specification of metadata provided in ISO19139.

For the prototype we applied these standards as much as possible. The metadata are created and a selected set of the elements are filled out for the National Geoportal. For the ANCPI portal we decided to use a limited number of elements, since a lot of the datasets are not available using web services and sometimes also only available in an analogue format.

The elements used for all metadata descriptions are at least:

| | |
|---|---|
| ID | Metadata file identifier |
| Name | Identification Information.MD_DataIdentification.Citation.CI_Citation.Title |
| Short description | Identification Information.MD_DataIdentification.Abstract |
| Scale | Identification Information.MD_DataIdentification.Spatial resolution |
| Format (vector/grid/scan/analog) | Distribution information.MD_Distribution.Distribution format.MD_Format |
| Owner/publisher/provider | Identification Information.MD_DataIdentification.Point of contact.CI_ResponsibleParty (role) |
| Topic category* | Identification Information.MD_DataIdentification.Topic category |
| Keywords (use GEMET) | Identification Information.MD_DataIdentification.Descriptive keywords |
| Pricing | Identification Information.MD_DataIdentification.Resource constraint.MD_Constraints.Use Limitations |
| Links | Identification Information.MD_DataIdentification.Supplemantal information |

**The element TopicCategory is used to make a division in different type of data sets.*

For editing we used the tool CatMDedit developed by The Advanced Information Systems group of the University of Zaragoza and GeoSpatiumLab S.L. There had to be some modifications (adding values to the used thesauri) to make to tool suited for the Romanian data sets. Metadata is published in catalogues. The catalogues, set up as services, can be access points to search for specific datasets. Also these services are set up by using standards. OGC has defined a standard for catalogue services (CS-W). Once the metadata was created it was stored in a metadata data base of the eXcat, the server component for serving the metadata used for the prototype.

## 11.2 Functional requirements

We have two types of Geoportals represented in the prototype, a discovery Geoportal as the National Geoportal (NSDI), and the data delivery Geoportal for the ANCPI Functionality for finding and viewing spatial information will be identical in both types of Geoportals.

### *11.2.1 National Geoportal*

For the discovery Geoportal the functionality should be:

- Finding spatial information. A search engine must be able to find the correct datasets given certain search criteria. The search will be done on the metadata base and makes use of the information as is recorded by the element of the metadata description
- Showing result of the search. A hit list with the relevant information must be given to give the user an overview of available data sets.
- Previewing the results. Since we deal with spatial information, the user will view maps. A map viewer will show the maps found.
- Combine previewed maps with own or other maps. It should be possible to show the results with own maps or other maps relevant fir the user. Data sets can be added if the comply to the same rules as the data to be found in the catalogue as map or feature services.

The catalogue used by the National Geoportal must contain all information of available data sets of Romania. Therefore metadata harvesting functionality must be present to collect all metadata records in what we can call the National Registry (the harvested metadata in the database of the CS-W of the National Geoportal). For this functionality data providers should offer their catalogue locations (URL's of their CS-W) to the registrar. For this prototype this is not elaborated in the design.

### *11.2.2 ANCPI Geoportal*

Being a data delivery or webshop portal there should be some more functional requirements:

- Viewing a shelf with the products being a product catalogue showing the obtainable geo-products
- Search for specific products based on keywords entered by the client.
- Viewing each product in more detail. The description (metadata) must be consulted and if possible the dataset can be viewed, either being a sample or the real data
- Creating a shopping list with the geo-product to be purchased. The list can be modified by the user based on information given by the product provider.
- A cash register being a way of paying for the products, for the prototype it is not possible to have this functionality operational, but the prototype must give insight how this should work.
- Insight in quality of the product and the right to use the product.
- Delivery service. How to obtain the product that is requested.
- Counter for additional help and/or information or to give feedback to the product owner. A way of contacting the right people, by e-mail, phone and so on.

# 12 TECHNICAL REQUIREMENTS

The prototype does have some technical requirements. The architecture will be based on a Service Oriented Architecture. Basically we can recognise three tiers, a data layer, an application or services layer and a presentation layer as in the previous figure.

The data can be stored in spatial databases or file systems. We distinguish data and metadata to be stored in separate databases. The National Metadata database can be the result of harvesting the distributed metadata databases through a harvesting protocol. In the services layer typically the map and feature services (WMS/WFS) are present in combination with catalogue services (CS-W). In reality there can be a number of other services as well, but these are less relevant for the prototype. The presentation layer contains the web based client application showing the information to the user. It provides the user with interactivity to perform specific tasks carried out by the underlying services. If we look closer we need more components for the generic tasks. To summarise the different components (figure):

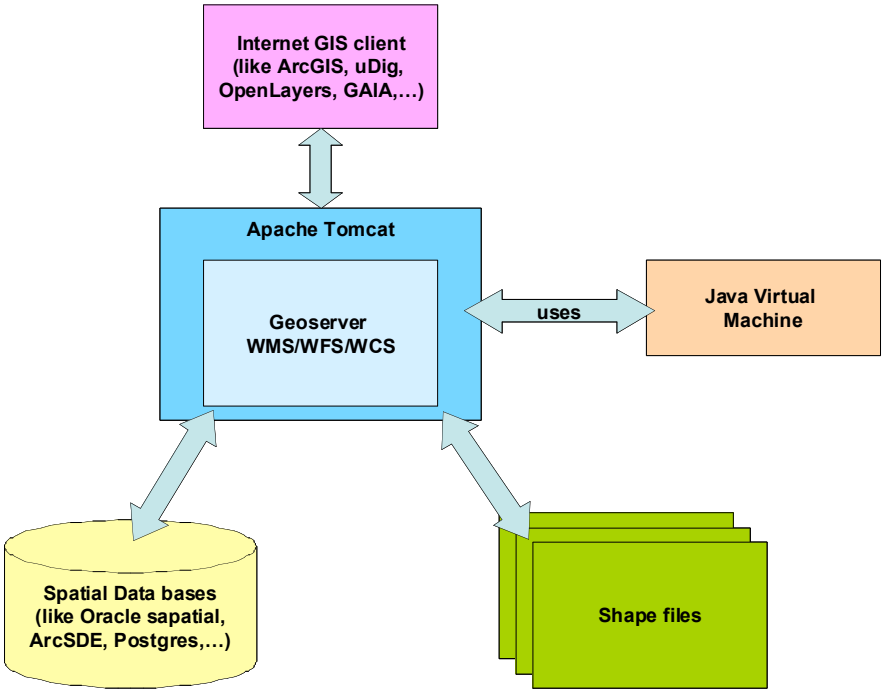


**Figure 8**

- Server with proper Operating system
- Java Virtual Machine
- Internet server (Apache)
- Application server (Apache TomCat)
- Mapserver (Geoserver (FAO http://www.fao.org/geonetwork))
- Spatial data base (Oracle spatial, ArcSDE, PostGIS) or File based data storage (Shape files)
- Services
- WMS/WFS (geoserver (FAO http://www.fao.org/geonetwork))
- CS-W (eXcat)
- Internet GIS Client (ArcGIS, uDig, OpenLayers, Luigi, etc).

## 12.1 Geodata

The data used for the prototype are selected based on the discussions held with the Ministry of Regional Development and Housing. This objective was to have a specified use case in which the data of the ANCPI would be used. Since the actual work is done on the regional and local level it was difficult to define the use case. Nevertheless we had a good overview of possible data to be used (ANCPI, http://www.ancpi.ro). Also these data are usually collected on the regional and local

offices and were not available at the National level. For that reason a specific study area is used for which in an earlier project data were made available. Datasets were selected for Faurei (Town in Braila county in east of Romania).

### *12.1.1 Vector format (example administrative data) (ANCPI, http://www.ancpi.ro)*

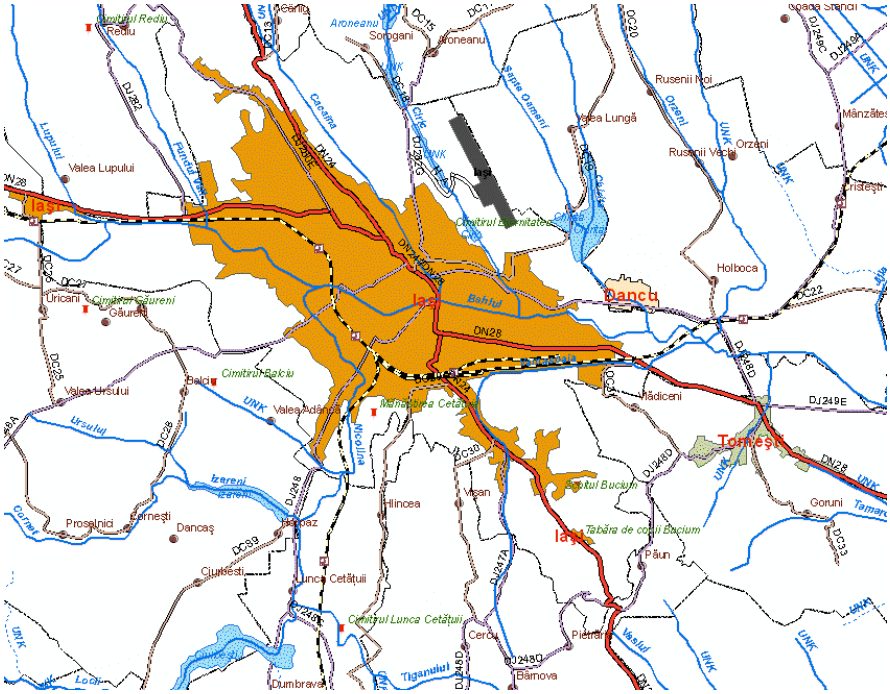


**Figure 9 Map scale 1: 250 000**

### *12.1.2 Raster format*


**Figure 10 scanned maps sample for the 1:5000**

**Figure 11 samples for the orthophoto 1:5000**

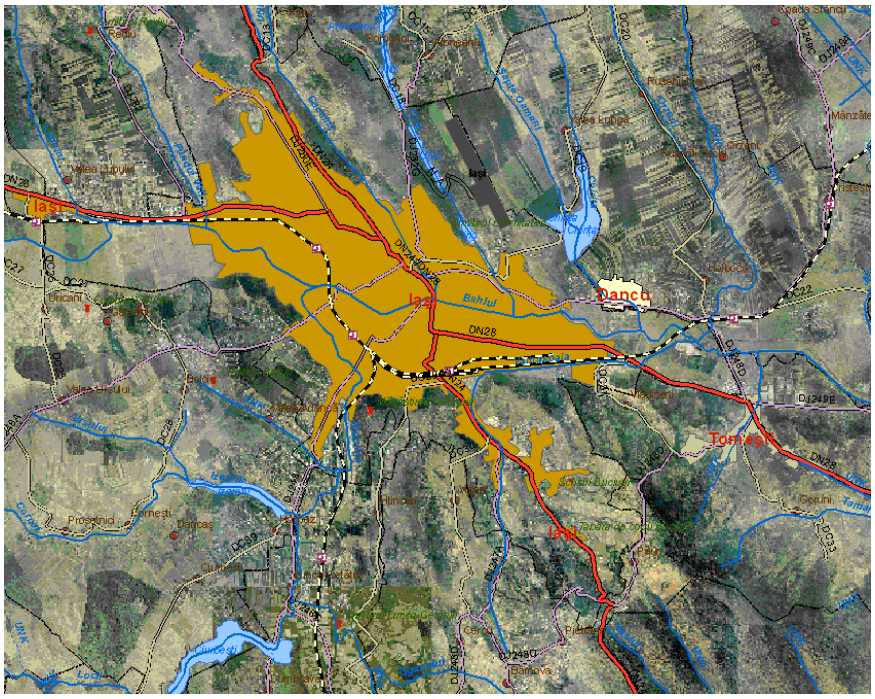


**Figure 12 Sample of a hybrid map with combined data layers**

With these ingredients in a very short period of time a prototype is realized representing the two types of geoportals. Since international standards were used the geoportals were accomplished relatively easily. The biggest effort was to create the interfaces, especially the discovery portals to support the different type of data

sets for the NSDI of Romania. The standard does not really support a user friendly way of representing data in a human understandable way.

## 13 CONCLUSIONS

The prototype is meant for demonstration purposes. The content was prepared and described by the Romanian counterparts and the Dutch developers of the team did the development of the web client. There is still little experience in setting up SDI's in a service oriented architecture (SOA). In using the prototype as a demonstrator more experience is gained and it will provide more insight in how to set up services within a SDI. For the development of the prototype Geoportal we used available products. Also it was decided to use open source and freeware products. They are well documented on the web. The web client component, Luigi, is the only component that had to be modified by programming in order to get the proper layout and the necessary functionality. This component, available as freeware, is built in Flex and Ruby on Rails programming language. For this programmers' skills are needed to modify the client.

For future development it is intended to define how to realise a NSDI for Romania and also, to select the software for set up the services. Whatever choice is made, it is important to stick to the standards used and defined according to the INSPIRE directive.

Research showed us that the success of Geoportals so far could vary enormously. There are factors known why some are successful and others are not. So to identify what Geoportal should be realized one should consider these aspects. (Oort, 2008). It is important that the potential user is known and the content offered is tailored to this user group. Describing real world use cases can do this. For web shop geoportals a clear marketing strategy may help in designing the portal (see www.urisa.org/vanoort or www.Geoportalmarketing.wur.nl).

Finally the use of Geoportals based on a service oriented architecture requires map and data services. OGC services are required to guarantee interoperability. Be aware of the versions of the standard used. And be sure that the selected software components are compliant to the correct versions of the standards.

## REFERENCES


### Articles in journals

Oort, P.A.J. van , M.C. Kuyper, A.K. Bregt, J. Crompvoets (2008) The Added Value of Geoportals: An Internet Marketing Perspective. Authors In: Urban and Regional Information Systems Association (URISA). In prep., submitted July 22, 2008.

### Reports

Bulens, Jandirk; Bas Vanmeulebrouk, Marjolijn Kuyper (2008): Geoportals and geo-products for a Romanian SDI: Report of the Twinning Contract RO 2006/IB/OT-01 PHARE 2006/018-147.02.01.03

Schram, Marcel, Floris de Bree, Jandirk Bulens, Bastiaan van Loenen, Jan Polman, Ko van Raamsdonk, (2008). Strategy and Implementation plan NSDI in Romania. Report of the Twinning Contract RO 2006/IB/OT-01 PHARE 2006/018-147.02.01.03

### Web- based articles and Websites

ANCPI Maps and Plans ordering system: www.ancpi.ro --> Harti si planuri. Date of visit: July 30, 2008

ESRI GIS Portal Toolkit: http://www.esri.com/software/arcgis/gisportal-toolkit. Date of visit: July 30, 2008

FAO GeoNetwork: http://www.fao.org/geonetwork. Date of visit: July 30, 2008.

OGC Open Geospatial Consortium Inc.. http://www.opengeospatial.com. Date of visit: July 30, 2008

**Proceedings**

Zevenbergen,Jaap, Jandirk Bulens, Marjolijn Kuyper, Henk Koerten, Michiel Jellema and Frederika Welle Donker. (2009) Geoportal network - more process catalyst then project.; UDMS 2009 (to be published)