Geo Web Services: An NSDI-Embedded Approach

Christine Najar[1], Christine Giger[1]
Francois Golay[2], Camilla Moreni[2], Marc Riedo[2]
[1]Institute for Geodesy and Photogrammetry – Swiss Institute of Technology Zurich (ETHZ)
8093 Zurich, Switzerland
najar@geod.baug.ethz.ch
[2]GIS research laboratory (LaSIG) – Swiss Institute of Technology Lausanne (EPFL)
1015 Lausanne, Switzerland

SUMMARY

In the development of the Internet and Web Services, the GIS community can profit of experiences and technical progress for creating Spatial Data Infrastructures and Geo Web Services. Yet, the organizational aspects should be strongly considered, too. They are interdependent with technical points and influence the planned steps towards an working infrastructure. Among Geo Web Services, we must distinguish between basic services, which are of common interest and therefore should be offered by a neutral provider and end-user-services that can be administered by private companies or other institutions. We identify the different categories of Geo Web Services and provide case studies for an end-user-service (site-planning tool).

KEYWORDS: *Embedded Geo Web Services, organizational aspects of NSDI, service for location planning, metadata service*

SDI AND GEO WEB SERVICES

Spatial Data Infrastructures (SDIs) assist in discovering, visualizing, evaluating and accessing geo-data (Giger, 2003). In the GIS world, the idea of SDIs and linking the National Spatial Data Infrastructures (NSDIs) to a large, international SDI by means network technology and common standards is revolutionizing the concept of interoperability. Until now, proprietary GIS software was used by experts in an offline manner to solve spatial problems. New technology and solutions for data and service exchange as well as processing will be necessary. Therefore, Geo Web Services are an important item of research.

Today, ever more laymen want to use geo-data. Therefore, there are different requirements for the way geo-data are presented and used in an infrastructure, e.g. there must be some kind of certification of the quality, and the user interface of both portal and services must be adapted to inexperienced users.

Also, laymen often do not know how to use GIS software and are merely asking a spatial question to be answered (e.g. where is the best site to build my house?). Consequently, it would be of great value if there were services to take over the processing of geo-data. It is therefore necessary to build not only a data infrastructure but a flexible service infrastructure (Figure 1).

Obviously, there is a strong requirement for technical and organizational guidelines, which must work closely together in an infrastructure. This will be analyzed in the following chapters.

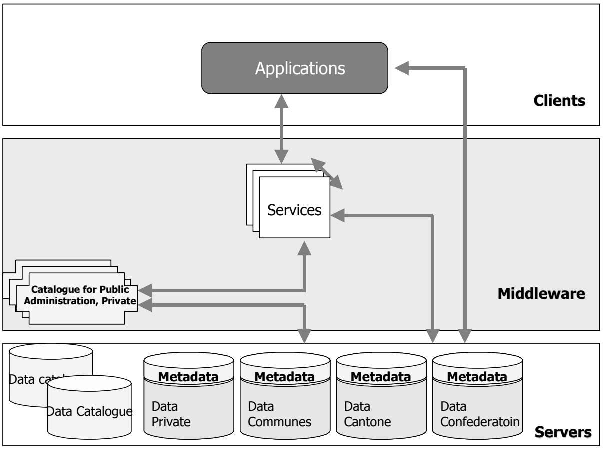

Figure 1: SDI Infrastructure according to (Moreni et al, 2003) and (Smits, 2002)

TECHNICAL ASPECTS OF GEO WEB SERVICES

The main technical challenges of Geo Web Services in an SDI are the following:

Chaining Services

It is interesting to be able to use various services sequentially, e.g. after searching the data in a search engine the user might want to preview (visualization service) them before processing them in a next service.

Therefore, interoperability and flexibility is of major importance in research:

- "The interoperability between operations, often referred to as system interoperability, relies on how well the output data of operation A matches the input data requirements of operation B" (Lemmens, 2003).
- The most flexible possibility to build services is in a granular, component based way so that they may be freely combined (Golay, 2003).

Open Architecture for Services

In terms of architecture, the possibility of chaining services would require that client, middleware and servers are able to work independently from each other (Figure 2).

Metadata for Services

We must be able to find services in an SDI via Clearinghouse and catalogue. This affords having metadata descriptions for services, e.g. according to ISO 19119 and Open GIS Consortium ((ISO, 2002) and (OGC)).

We are striving for a component-based solution, which allows us to combine different functionalities from different tools or services. Yet, even if this is possible on technical level, it will be important to achieve interoperability on semantic level (Lemmens, 2003). Therefore, metadata for services are necessary.

Ontologies for Services

Looking even further into the complex problem of chaining, ontologies for describing the meaning and conduct of services must be created.

ORGANISATIONAL ASPECTS OF SERVICES

Business concept for Service Infrastructures

From an organizational point of view different interest groups must be integrated in the SDI idea. In order to analyse the SDI concept from a different point of view a use-case diagram (Henrich, 2003) was derived.

The four business uses cases show the planned external performance by the system from point of view of the protagonists. It clarifies which requirements the system must meet, but not how it must do so.

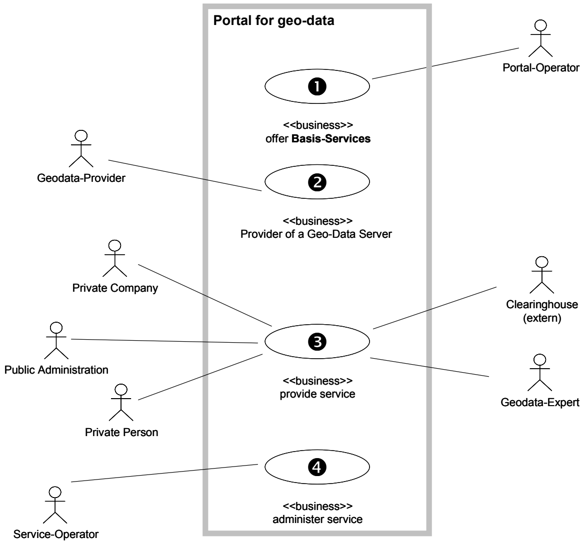

Figure 2: Use-Case Diagram for the system “Portal for Geo-Data” (Henrich, 2003)

“In this paper the business case number three, “provide service” is the most important and will be analyzed in greater detail.

Who is in Charge for which Services, in a NSDI?

In our preliminary study for Switzerland (Moreni et al, 2003) we have suggested the following principles which can be applied easily for other federal structures :

- The services should be offered by those organizations, which are responsible for the missions for which they were developed.
- For efficiency reasons, and especially in order to avoid redundancy, developing a service of common interest should be delegated to a single instance.
- In order to guarantee efficiency of the service infrastructure, the national responsibles (for Switzerland it would be the Confederation) should define standards that allow perfect integration into the service infrastructure.

Furthermore, there is a difference between basic services, of common interest which should be offered by a central, unbiased organisation and end-user services, that may be offered by private companies or organisations. These end-user services may offer the possibilty for revenue where as the basic services should be either for free or for the net cost price.

For Switzerland, we have identified a few basic services (Moreni et al, 2003), e.g. :

Storage and catalogue services
Discovery Service, Catalogue Gateway, Metadatabase Management Service, which should have high priority and Chaining Service for detailed search.

Content repositories
Gazetteer helps the search for geographical locations in a document and is considered medium priority. Where as Geocoding tools, which serve to allocate addresses for an object have low priority.

Portrayal services
Viewer, e.g. according to WMS specifications (OGC) should be considered very important. A Style Management Service is considered low priority.

Aids for modelling and standardizing
Tools like a UML Editor and a tool for checking the models are rated as high priority. They already exist on the KOGIS homepage (group for coordination of geographic information and geographic information systems in Switzerland, www.kogis.ch).

Considering end-user services, there are so many possibilities for services that a list would never be sufficiently comprehensive. Therefore, we would like to offer some classification by comparing two possible attempts:

a) According to a study for Switzerland (Moreni et al, 2003)
Here, the classification goes according to the objective of the services.
  - Services for searching, that permit finding data or services (e.g. clearinghouse)
  - Services for visualization
  - Services for access, that enable sharing of data sets or single objects.
  - Services for processing, transforming or handling geo-data, e.g. coordinate transformation.
  - Catalogue Services or services for maintenance, management and registration.
  - Services for modeling

b) According to OGC OpenGIS Service architecture and ISO 19101 six classes of information technology services are used to categorize geographic services.

Human interaction services : Management of user interfaces, graphics, multimedia and presentation
Model/Information management services : Management of the development, manipulation and storage of metadata, conceptual schemas, and datasets
Workflow/Task services : support specific tasks or work-related activities that may be conducted by different persons.
Processing services : perform large-scale computations involving substantial amounts of data.
Communication services : encode and transfer data across communications networks.
System management services: management of system components, applications, networks, user accounts and access privileges.

CASE STUDIES

Tool for Site Planning

The case study for the service for site planning is an example for a Prototype of an end-user service. The aim of this service is to assist users of an SDI, laymen and experts, in land use planning, e.g. for a golf course. This affords detailed reflection upon the user interface (laymen and experts have different demands in terms of functionalities), the visualization of data and the chaining of extra services (e.g. for payment).

Four main, successive steps have been identified:
- Navigator: rough search for defining the perimeter.
- Selector: choosing the useful geo-data from a list offered by the Navigator

- Inspector: analyzing and processing the geo-data
- Purchaser: shows an overview of the objects and used services.

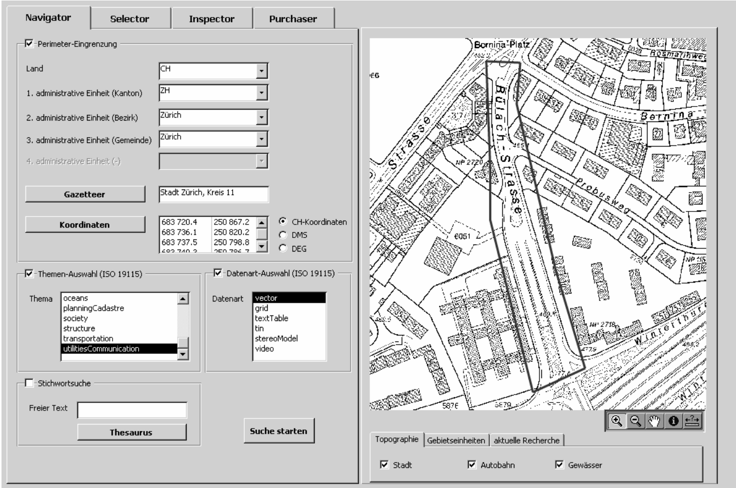

Figure 3: Navigator for the Site-Planning Service

CONCLUSION

Technical and organizational aspects of a SDI are closely and entwined and inseparable. Technically speaking, there are already many possibilities to build services, yet they must be embedded in the organization. We want give evidence for how specific organizational decisions can have direct influence on technical decisions.

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