Dissemination of Environmental Data through the Web – Examples from Norway

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Key words: Web-mapping, Interoperability, GI-standardization, Thematic web-maps.

SUMMARY

Since 1997 the Norwegian government has focused on the GI aspect of environmental information through the Arealis project. The main objective of the project has been to make environmental data and land use information available at national, regional and local level. The project has focused on co-operation, standardization and extensive information activities to achieve the objective. From the very beginning the Arealis project choose the Internet as a strategic information channel.

The Internet related work follow two main tracks. The first is the Arealis web-site, a traditional 'home-page' like site. However, the site now holds a huge amount of information ranging from the latest news to all specifications and data-set definitions. The second track is the development of web-mapping applications. Following both tracks have been very successful.

Several successful web-mapping applications focusing on environment GI has been launched both on national, regional and local level. These have proven to have an effect on politicians on all levels resulting in more funding for environment data capture projects.

The latest development of specifications by OGC and standards by ISO has been implemented by the Arealis sponsored project 'GI on the Internet' project. The project focused on testing interoperability between GI-servers through WMS clients.

The experience from all work and projects is now brought further through the 2003 Arealis initiative, the development of the new Arealis GI-gateway, an Internet portal which aims to become a central part in the Norwegian national spatial data infrastructure.

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1. INTRODUCTION

The framework for environmental data including land use information in Norway is the AREALIS project. AREALIS is a national project initiated by the Norwegian Ministry of Environment in 1997. The main objective of the project is to make environmental data and land use information available at national, regional and local level.

One of the important elements in AREALIS is co-operation. Several activities stimulating increased co-operation between sectors, making their efforts known to each other, in turn often stimulates to further co-operation, has been carried out. Today more than 10 Norwegian ministries and 20 of their agencies are involved in AREALIS, either as data suppliers or as potential users of the information accessable through AREALIS. In addition 100 county agencies and 85 municipalities take part. The Norwegian Mapping Authority is co-ordinating the programme on behalf of the Ministry of Environment.

Another important element in AREALIS is standardization. Large effort has been made in working out specifications of several different environmental data-sets. The specifications have been developed based on the principles of the national de facto standard for geographic information(SOSI). The AREALIS specifications are now a part of the standard. About 150 data-sets have been defined, grouped into 9 main topics.

From the very beginning of the AREALIS project the Internet has been used as the main information channel. The Arealis web-site has grown constantly and now holds a huge amount of information, ranging from latest news to all specifications and dataset definitions as well as simple file-download functionality. An important part of the development on the web has been the increasing number of web-mapping applications. This paper will focus on some of these applications.

2. USING WEB MAPPING TECHNIQUES

2.1 The TITAN project – a regional spatial data infrastructure

One of the very first web-mapping applications running in Norway was launched by the TITAN(Tactical Integration of telematics Applications Access Intelligent Network) project in 1999. The project was organized by the county councellor in Sogn og Fjordane, a county located at the Norwegian west-coast. The project had several stakeholders including different county agencies, NMA(through Arealis), local communities and Vestforsk research institute.

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The main objective of the project was to make it easier to gather information about the Sogn og Fjordane region, and to develop interactive services involving public sector, private sector companies and the citizens by integrating existing and new web services. The timeframe of the project was: 01.01.1998 - 30.06.2000.

The project soon realized that the map was a natural entry point and integrator and thus decided to develop the application with a geographic interface. The application is based on Autodesk Mapguide internet map server and Oracle dbms. A java based client was developed. This approach had the disadvantage requering a plug-in, but on the other hand enables the use of 'intelligent' vector data on the client.

In 1999 the lack of international GI standards was a problem. In Norway we had a de facto national standard(SOSI). The base map was based on the NMA's topographical databases, and the only technical solution regarding storage of data was to store as a local copy on the project server. Developing the base map from the NMA's topographical map databases required a significant amount of work, both regarding converting the GI from standard SOSI format to Mapguide internal format and developing the digital cartography given relatively limited functionality and possibilities(in 1999). However, a remarkable satisfactory result turned out, a scalable base map designed for the scale range 1:5 mill to 1:5000.

Many of the stakeholders had a lot of information already collected and stored in databases(Oracle), a minor part of it was geo-referenced. During the project all the information was geo-referenced using both direct and indirect geo-referencing., but still separating the GI-part of the information from the existing information stored in the DBMS. A servlet integrating the GI stored in Mapguide format and the DBMS was also developed. This turned out to be one of the technical successes of the project.

In addition the Arealis members made a valuable contribution with their data-sets.
A general request was made to local communities to submit their thematic GI to the project organization for implementation in the application. Some, but not many local community GI data-sets were collected this way. The overall result was a collection of 64 GI data-sets generally grouped into three main categories environment, transport and tourism(hotels, point of interest).
The information was made available to the user in two ways. Firstly as a set of predefined thematic maps selectable from a list, and secondly as an option of composing the users own map from a selection of 64 thematic data-sets.
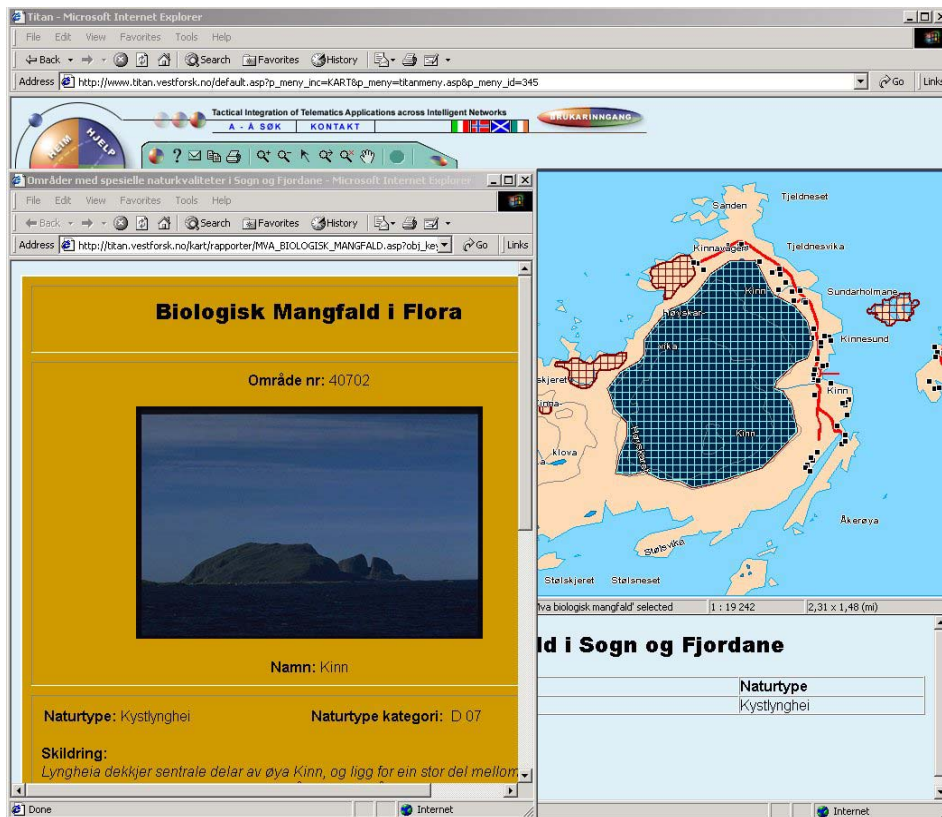
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Figure 1 Screenshot showing connection between thematic information stored in a DBMS and the web-map. Hatched areas on the map are entities in the Arealis dataset 'Nature type of high value' – biodiversity. Black area is the selected one.

The TITAN project may be regarded as an early attempt to establish a Regional Spatial data infrastructure(RSDI). The service has gained much attention both through media, the GI community and at last but not at least by a large amount of visitors.

2.2 Collaboration, a success factor in establishing a local spatial data infrastructure

In Norway, many of the local communities are relatively small and have limited financial and human resources. As mentioned earlier, approx. 80 local communities today participate in the Arealis project. Several of these are small local communities. The local communities struggle to meet the GI challenge(and other challenges). Especially as the number of GI data-sets to obtain and maintain grow by several tenths due to demands from central government in areas such as of sustainable development. To meet the challenge a formalized co-operation between neighboring local communities may be a solution.

An excellent example of co-operation in the GIS field is found in the region of Ryfylke where seven small local communities, all members of Arealis, have joined up in a formalized cooperation on GI matters, organized as a project. The project has defined to main activities. One activity is to join forces in first time data capture/storage, maintenance and distribution

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of Arealis and some other data-sets. The second activity is to develop and run is a common web-mapping application.

Two major benefits achieved from the project is a)shared cost through establishing a common IT/GIS infrastructure and b)access to GI expertise by employing a project manager with long GIS experience.

The web-mapping application has the following characteristics:

Internet map server	Arc_IMS
Client	HTML based with improved printing and search functionality
GI storage format	ESRI .shp format
Total number og GI datasets	72
Number of environmental datasets	17

One of the success factors of the project is the amount of captured GI data-sets over a relatively short period. The data-sets have high accuracy, and is intended for use up to scale 1:500. They also comply to the Arealis specifications which in turn will make them well fit into the upcoming national geospatial data infrastructure.

Further work in the project will be focused on further data capture and technical development towards implementing the OGC Web Map Server specification. In this work the project will be supported with technical expertise from the central Arealis organization.
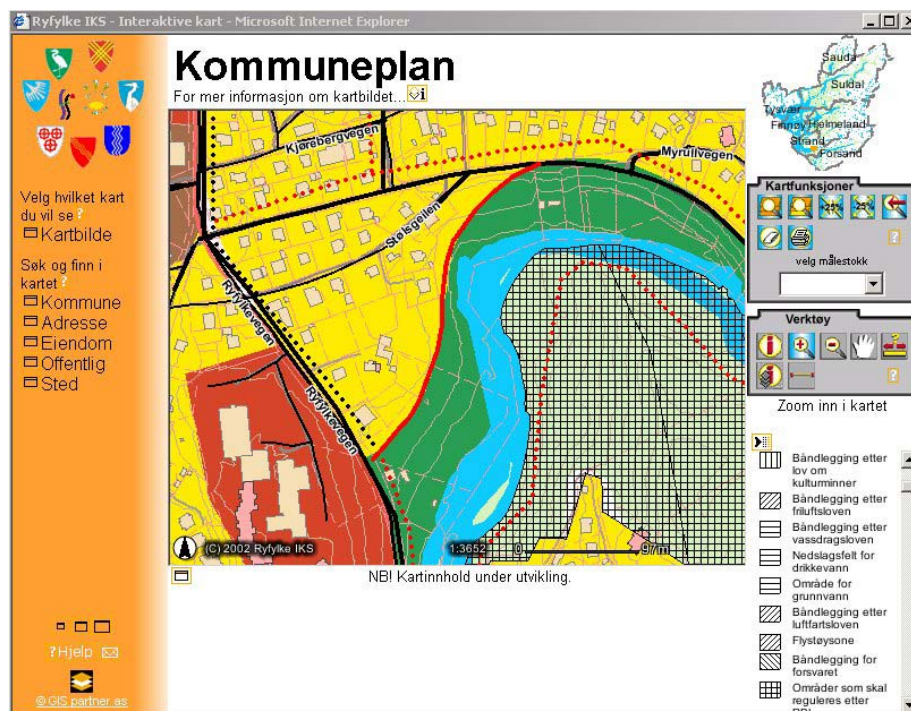

Figure 2 Screenshot showing a local community area plan. Actual scale is approx. 1:1500.

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2.3 Interoperability and web services

The lack of interoperability within Geographic Information Technology(GIT) has been, and still is a serious challenge. However, the technical specifications(GML, WMS and WFS) from OGC and the standards from ISO/TC211 provide a basis for developing interoperable geospatial database services and clients as elements in a National Geospatial Data Infrastructure(NSDI).

To gain experience with, and take advantage of the OGC and ISO work, the project 'GI on the Web' was launched in june 2001. The project terminated in june 2002. The following national agencies participated in the project : Norwegian Mapping Authority(NMA), Norwegian Land Use Mapping Agency (NIJOS), Norwegian Geologic Survey(NGU, Road Authority(SVV) and Directorate of Nature conservation(DN) . In addition the Hedmark county and two local communities participated.

Among several activities the most relevant in this context were: a)Establishing geodataservers, b) add contents – GI - to the geodataservers and c) develop Web Map Server(WMS) clients.

2.3.1   Establishing geodataservers

This activity concentrated on designing and implementing necessary hardware and software structures. Powerful database servers were connected in a high speed communication (2-4 Mbit) network. ArcSDE was implemented as the geodatabase platform for storing and maintaining spatial data in a DBMS(mainly Oracle).

2.3.2   Adding content

The participating agencies had huge amounts of GI stored on different platforms, but mostly ESRI platform, in their respective local GIS-systems. The task was to bring this GI into the geodatabases. A this time, data modeling activities on GI had just started, thus the GI had to be stored in an alternative way – as BLOBS(binary large object). This method proved to be relatively straightforward, and ended up with approx. 2.5 terrabyte of GI in three separate geodatabases.

The GI included all NMA's topographical map databases, several environmental GI data-sets from NIJOS, NGU and DN. Mainly data-sets with national coverage were establish as geodatabases at this stage.

2.3.3   Developing WMS clients

The participating national agencies already used Arc_IMS as Internet map-server. The three servers were easily upgraded to WMS functionality by installing the ESRI WMS extension(servlet). On this platform three WMS-clients were developed.

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A thematic client developed by Norwegian Geologic Survey(NGU, and Directorate of Nature conservation(DN). This client is based on a HTML template provided with Arc_IMS. The client access topographic layers from the NMA server and thematic information from the NGU and DN servers. Thematic information is from the main thematic group nature and include geological data-sets, and conservation of nature data-sets and more.

A thematic client developed by Norwegian Land Use Mapping Agency (NIJOS). This client is also based on a HTML template provided with Arc_IMS. But is heavily modified both regarding functionality and layout. The client access topographic layers from the NMA server and thematic information from the NIJOS server. Thematic information include suitability for crops and soil erosion susceptibility.

A generic client developed by Norwegian Mapping Authority(NMA). This is a relatively thin client. The user must himself compose the map from a list of layers(data-sets) available from the NGU/DN, NIJOS and NMA servers. The number of servers is expandable through the WMS register functionality provided by the client.
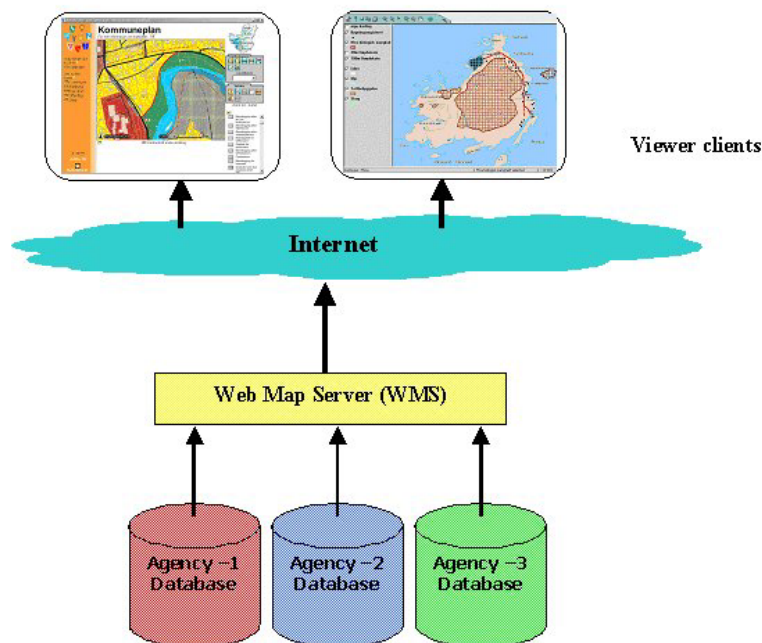

Figure 3 Interoperable Internet Map services, components in the 'GI on the Web project' .

The main success of the project was the contribution of interoperable Geospatial databases as a part of the national geospatial data infrastructure.

2.4 The new AREALIS GI Gateway

Based on the national strategy on GI in the environmental sector and the work in several the projects including the ones mentioned earlier in this paper, Arealis this year will focus on

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developing a new GI gateway – The Arealis Portal. All major national Arealis participants will in some way also participate in this development. The gateway will focus on four main topics :
- GI catalogue/metadataservice
- web mapping, web map server clients
- downloading functionality
- information, specification, standardization

The main objective is to make environmental GI available to local and regional planners, officials and politicians. Needs for environmental decision making and planning will have priority. The Arealis Portal shall also in general serve the government, private sector and citizens with environmental GI on the Internet.
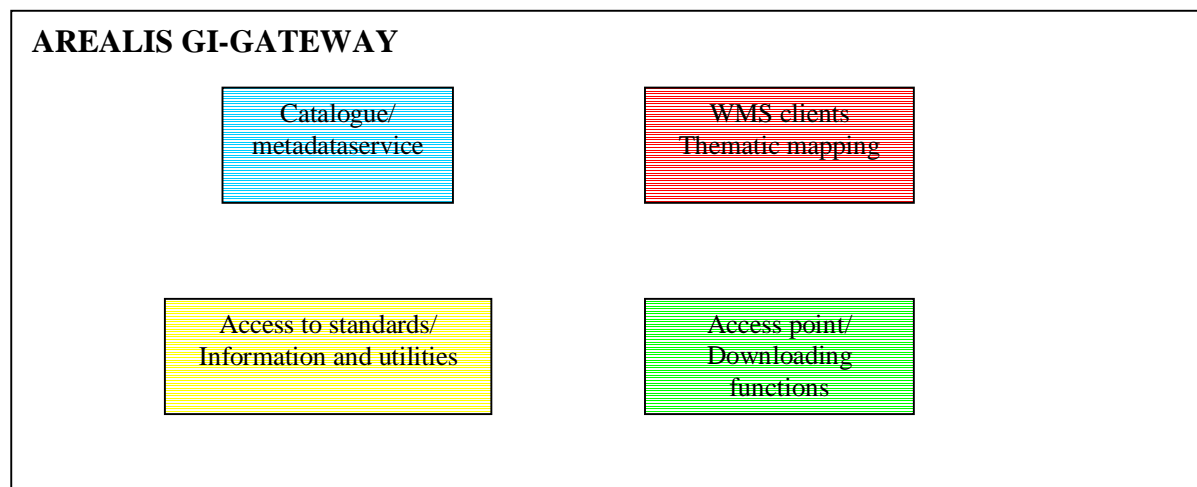
AREALIS GI-GATEWAY

Catalogue/ metadataservice	WMS clients Thematic mapping
Access to standards/ Information and utilities	Access point/ Downloading functions

Figure 4 The four major elements of the new Arealis GI-gateway.

2.4.1   The GI catalogue/metadataservice

The status regarding GI metadataservices in Norway is relatively poor. However, a new metadataservice is to be launched on the 1.april this year. The new metadaservice implements the ISO19115 metadata standard in a DBMS(Oracle). A national adaption complying to the ISO 19115 standard has been worked out. To access de database an application programmers interface(api) has been developed. The api is based on XML(Q), XML and XSL. Use of this approach makes the development of clients to a highly standardized and flexible level.

The metadataservice will have extensive administrator tools and XML, sdv import/export facilities.

The metadataservice will be general i.e. cover all types of GI, but from the Arealis Portal only information on GI contained in the Arealis specifications will be accessable through specific database views and report facilities.

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A geographical interface has been specified, and will be implemented by the end of 2003.

2.4.2 Web mapping applications

A wide range of web-mapping applications are provided by municipalities, counties, national agencies and private sector companies. A major part of them present environmental data-sets in some way. The portal will provide a gateway to all relevant applications. In addition, the Arealis Portal will provide it's own web-mapping application. The specification of this application was completed on the 15 of March this year. The application will provide the following functionality:

– Extensive search functionality including: place-name search, address-point search, search on administrative unit (bounding box, center and adm.center). The search functionality will also be available as generals web services.
– Select predefined thematic maps from list(called map-basic mode)
– Compose your own thematic map from available web-map server sites(we call it advanced mode)
– High quality printing
– Error report functionality
– Standard map-navigation such as zoom, pan.

The thematic information in AREALIS is grouped into 9 main topics with currently about 150 geographical data sets . A major challenge is the development of a digital(web) cartography for all these data-sets. In principle, each of the 150 data-sets will apply to web-presentation and defined as a wms accessable layer. A scheme has been developed to specify the cartographic primitives at different scale spans.
A set of 5 standard base maps from the NMA's topographic databases has been designed aimed to form the proper bases for the thematic data-sets. (made available as wms layers).

In the short term the application will use the ISO 19128 Web map server interface. The application will be based on ESRI's Arc_IMS internet map server and will be hosted at the NMA.

2.4.3 Download functionality, access points

Still many users will need the thematic data-sets for use on their own GIS applications. The Arealis portal will be an access point making environmental data-sets available through a set of download functions.

It will be a distributed solution where some of the national agencies provide 'their' information from their own web-sites. While the Arealis portal will offer the download functionality as service to other data suppliers.
In this context it is interesting to observe the differences regarding copyright and pricing policies. Ranging form full cost recovery and strict licensing regimes to general free access and use.

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2.4.4 Information and stadardization services

An important part of the new Arealis portal is to continue to provide information about relevant GI-standards. This will be achieved by improving current services and provide
− Easy access to online data-set specifications
− Easy access to online cartography recommendations, both digital and analogue versions

In addition a set of utilities will be offered as web-applications. In 2003 two such utilities are planned. These are :
− A web-based GI quality control service. To check the users own GI against the appropriate Arealis specification. A vital service to ensure interoperability in the broadest sense.
− A coordinate transformation service. Still many local communities work in local coordinate systems. The service uses the NMA's national transformation software library. Necessary in cases lacking on-the-fly coordinate transformation.

Finally, as a tool towards interoperability, a WMS connection wizard will be developed. Currently the knowledge of the WMS technology is relative poor. To assist the Norwegian GI community in making their web-mapping applications WMS compatible either stored locally or in a storage service provided by the NMA.

3. CONCLUSION

The AREALIS project has achieved considerable success by using the Internet as a main channel for information and dissemination of environmental GI data-sets. A huge amount of information and data has been captured, collected and made available to the government, private sector companies and the public. The efforts made by AREALIS form a vital part of the Norwegian national spatial data infrastructure. Late work has made several steps towards interoperability. This work continues by the development of the AREALIS GI gateway, a new Internet portal.

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